WETLAND RESTORATION HANDBOOK

for Wisconsin Landowners

2nd Edition
2nd Printing 2010

Alice L. Thompson and Charles S. Luthin

Financial assistance for the **first edition** of this book was provided by the Coastal Zone Management Act of 1972, as amended, and administered by the Office of Ocean and Coastal Resource Management, National Oceanic and Atmospheric Administration pursuant to Grant #NA870Z0255 and the **Wisconsin Coastal Management Program**.

The **Wisconsin Coastal Management Program**, part of the Wisconsin Department of Administration, and overseen by the **Wisconsin Coastal Management Council**, was established in 1978 to preserve, protect and manage the resources of the Lake Michigan and Lake Superior coastline for this and future generations.

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The first edition of the *Wetland Restoration Handbook for Wisconsin Landowners* was awarded the "Wisconsin's Distinguished Document Award" by the Wisconsin Library Association's Government Documents Roundtable in 2000.

Comments about the first edition of the *Wetland Restoration Handbook*:

"Stewardship of our natural resources by private landowners is essential to the health of Wisconsin's environment. This handbook provides an excellent tool to help landowners achieve their conservation goals."
Jim Ruwaldt, Private Lands Coordinator • United States Fish and Wildlife Service

"The *Wetland Restoration Handbook* is a valuable resource for citizens in protecting and restoring wetlands. The book has already become a well-used resource in Wisconsin and across the Great Lakes Basin. Citizens in our network have found the document to be thorough, informative and beautifully written and illustrated."
Jill Ryan, Director • Great Lakes Aquatic Habitat Network and Fund

"The *Handbook* has been a great resource for our landowner education programs. It provides workshop participants an easy to use reference and helps to reinforce the concepts that they've seen and discussed in class."
Rob Nelson, Education Coordinator • Aldo Leopold Foundation

"As wetland and natural resources consultants, Cedarburg Science uses the *Wetland Restoration Handbook* frequently as a reference guide and as a tool to provide background for educating landowners. It has a logical layout, and it provides technical information in a very readable format, which is important in our outreach efforts with developers and landowners."
Ginny Plumeau, President • Cedarburg Science

"For landowners and land managers who want to mend our damaged wetlands, the *Wetland Restoration Handbook* is simply indispensable. This is a practical and user-friendly guide, chock full of essential information, attractively presented. It is a book meant to be put to work; use it, and help bring health, diversity and beauty back to our landscapes."
Curt Meine, Director of Conservation Programs • Wisconsin Academy of Sciences, Arts and Letters

Wetland Restoration Handbook for Wisconsin Landowners

Comments for a Changing Landscape, 2010 Printing

By Alice Thompson

This Handbook was written to facilitate the protection and restoration of Wisconsin's wetlands. As we print the third run of this book, we are mindful of the rapid changes in our society since the first edition was published in 2000. A wealth of land information is now available on the internet. Maps and resources that once required a visit to a local office are now a mouse-click away. A new chapter on how to access this information would quickly become obsolete as web sites continually change addresses and develop new and more productive ways of providing information. While we have tried to provide you with updated web addresses and other contact info in this *errata*, most of this updated information can also be found through a web search using Google or another internet search engine (just enter the name of the person or resource you are trying to find).

Most counties now have recent aerial photography on a web site (include the terms "GIS" or "Interactive Mapping" along with the name of the county in the search engine to locate). Although each county's web site is unique, overlays of topography, soils, wetlands, floodplains, and property lines are common. Some counties are in the process of scanning in historic photos so that you can view decades of change as you scroll from one map to another. Recent aerial photos are also found on Google Maps and Bing Maps (At the time of this printing, Bing has close-up "bird's eye view" aerial photos for some portions of the state of Wisconsin, primarily urban areas). The Wisconsin Department of Natural Resources has a Surface Water Data Viewer on its web site, with detailed maps of wetlands and potential wetlands. The Natural Resources Conservation Service has a "Web Soil Survey" for soil maps, and you can click on various links for soil descriptions. All of the 1800's land survey field notes are on the web (Wisconsin Public Land Survey Records at **http://digicoll.library.wisc.edu/SurveyNotes/**). These are just a few of the additional resources now available on-line, and more resources will undoubtedly be available in the future.

There is a Big Unknown shadowing our current work that simultaneously creates great urgency as well as uncertainty. As global climate change effects unfold, the need to foster resiliency in wetland ecosystems is ever more critical. The Wisconsin Initiative on Climate Change Impacts (**www.wicci.wisc.edu**) has resources and strategies listed and maps that predict temperature and precipitation changes in our state. To understand our wetland ecosystems, we currently look back at the retreat of the last Wisconsin ice age that created the geological underpinnings, kettles, old lake basins, and stream beds that wetlands inhabit. We read settlers notes and survey records to understand pre-settlement vegetation and plant communities in order to restore native wetlands on the landscape. And yet, we see an ever widening gap between what we once had and what may remain on our altered landscape. Dr. Joy B. Zedler, Aldo Leopold Chair of Restoration Ecology, University of Wisconsin-Madison states: "*Although it is difficult to test, I contend that sustaining biodiversity is the key to sustaining resilience in ecosystems, especially wetlands, which are disproportionately vulnerable to effects of climate change.*" We have to continue asking hard questions and working diligently to sustain biodiversity.

Wetland restoration is a relatively young practice and science. There are ever evolving methods, but this handbook lays out an unchanged strategy to evaluate your land, and plan its restoration. We offer this handbook in a spirit of hope and adventure. Experiment, try new techniques, let us know what is working and what is not. **Above all enjoy the wetland you restore!**

Errata/update information is on the next page.

2010 Errata/Updates

Chapter 1

- To learn more about Wisconsin's plan for wetlands and how you can help, please visit the Wisconsin Department of Natural Resources web site at **http://dnr.wi.gov/wetlands/strategy.html**.
- To learn more about Wisconsin's Wetland Gems please visit the Wisconsin Wetlands Association web site at **www.wisconsinwetlands.org/gems.htm**.

Chapter 3

Page 27 The Wisconsin Wetland Inventory Maps web site is now **http://dnr.wi.gov/wetlands/mapping.html**.

The Wisconsin Catalog of Aerial Photography web site is now **http://www.sco.wisc.edu/apcat/**.

Chapter 5

Page 52 The current list of native plant nurseries is at **http://dnr.wi.gov/org/land/er/plants/nurseries.htm**.

Chapter 6

Page 59 The Invasive Plants Association of Wisconsin (IPAW) web site is now **http://www.ipaw.org/**.

Page 66 The current list of native plant nurseries is at **http://dnr.wi.gov/org/land/er/plants/nurseries.htm**.

Page 68 The purple loosestrife fact sheet is at **http://dnr.wi.gov/invasives/fact/loosestrife.htm**.

Page 69 The Wisconsin Wetlands Association (WWA) website is now **http://www.wisconsinwetlands.org**.

Chapter 7

Page 78 State Regulations for Wetlands can now be found at **http://dnr.wi.gov/wetlands/programs.html**. Regulations also are summarized on the Wisconsin Wetlands Association web site at **http://www.wisconsinwetlands.org/protectingregulations.htm**.

Page 82 The complete text of NR 353, Wis. Adm. Code, is available at **http://www.legis.state.wi.us/rsb/code/nr/nr353.pdf**.

Page 85 The mitigation banking web site is now **http://dnr.wi.gov/wetlands/mitigation/**.

Page 91 Ricky Lien is the Wisconsin DNR Wetland Habitat Specialist. His phone number is 920-892-8756, ext.3045. His email address is **Ricky.Lien@Wisconsin.gov**. His mailing address is Wisconsin Dept. of Natural Resources, 1155 Pilgrim Road, Plymouth, WI 53073.

Page 92 Wisconsin Waterfowl Association's address has changed to P.O. Box 427, Wales, WI 53183-0427. The phone number has changed to (262) 968-1722 (The toll free number remains the same).

Ducks Unlimited's GLARO office address has changed to 1220 Eisenhower Place, Ann Arbor, MI 48108. The phone number remains the same.

Page 93 Wings Over Wisconsin, Inc.'s phone number has changed to (920) 387-5198. The organization's web site is **www.wingsoverwisconsin.org/**.

Kevin Wallenfang is the Regional Biologist for Pheasants Forever in Wisconsin. His phone number is (608) 798-2466. His email address is **kwallenfang@pheasantsforever.org**. Pheasants Forever's web site is **www.pheasantsforever.org/**.

Page 94 The current list of native plant nurseries is at **http://dnr.wi.gov/org/land/er/plants/nurseries.htm**.

Appendix A – World Wide Web Resources

Page 139: Wisconsin Web Sites

The Wisconsin Coastal Management Program web site is now **http://www.doa.state.wi.us/section.asp?linkid=65&locid=9**.

The Wisconsin Department of Natural Resources web site is now **http://www.dnr.wi.gov**.

The Waterway and Wetland Permits web site is now **http://dnr.wi.gov/waterways/shoreline_habitat/wetlands.html**.

The Wetlands Strategy web site is now **http://dnr.wi.gov/wetlands/strategy.html**.

The Invasive Plants web site is now **http://dnr.wi.gov/invasives/**.

The Wisconsin Wetlands Association web site is now **http://www.wisconsinwetlands.org**.

The Invasive Plant Association of Wisconsin (IPAW) web site is now **http://www.ipaw.org/**.

The Great Lakes Indian Fish and Wildlife Commission (GLIFWC) web site is now **http://www.glifwc.org/**.

Page 140: Non-Wisconsin Web Sites

The National Wetlands Inventory web site is now **http://www.fws.gov/wetlands/**.

The University of Minnesota's Horticultural Science Department published *Restoration and Reclamation Review* between 1996 and 2003. This student produced journal includes several excellent articles, including some that pertain to shoreland and wetland restoration. The articles are archived at **http://conservancy.umn.edu/handle/55448**.

The Wetlands Reserve Program web site is now **http://www.nrcs.usda.gov/programs/wrp/**.

Appendix B – Contacts for Wisconsin Wetland Information

It is possible that some of the addresses or phone numbers listed in Appendix B have changed since this book's printing. If you find an out-of-date listing, we recommend using an internet search to identify the updated contact information: include the county name and the agency name in your search terms.

Inside Back Cover

The Wisconsin Wetlands Association web site is now **http://www.wisconsinwetlands.org** and the email contact is now **wetlands@wisconsinwetlands.org**.

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for Wisconsin Landowners

2nd Edition
2nd Printing 2010

Alice L. Thompson and Charles S. Luthin
Wisconsin Wetlands Association

Edited by:
Martin P.A. Griffin and Dreux J. Watermolen

Designed by:
Michelle E. Voss

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Preface

Wisconsin's wetlands serve many important functions. They provide economic and aesthetic benefits to their owners and to society in general. They create habitat for a diversity of wildlife, help alleviate flooding, reduce soil erosion, cleanse dirty and polluted waters, and contribute to regular water flow in streams and rivers throughout the year. It follows then, that healthy wetlands translate into a healthy environment. This handbook was produced based on the assumption that healthy wetlands benefit our communities.

This handbook contains general guidance for landowners interested in improving the health of their wetlands. It discusses conservation, management, and restoration techniques that will improve drained, ditched, or otherwise degraded wetlands, and provides a range of activities that can greatly improve the values and functions of our wetland resources.

A landowner does not need to manage or restore his or her wetland alone. This handbook provides an extensive list of federal and state agencies, conservation organizations, and private entities that can offer financial or technical assistance with private restoration projects. Various published references are also mentioned, and landowners are encouraged to turn to them for assistance.

Purpose

The objective of this handbook is to encourage the responsible and effective restoration of wetland habitats. Each wetland has its own unique characteristics, and restoration efforts should attempt to recreate, to the degree possible, the original structure, hydrology (how water interacts with the land and circulates) and plant communities that existed at the site prior to its destruction or degradation. To accomplish this requires an initial working knowledge of the history, hydrology, and ecology of the site. Moreover, attempting to recreate historic conditions ensures that the wetland is a good "fit" into the landscape, and increases the chance of restoring a site that will be self-sustaining into the future. Simply stated, historic restoration requires reversing the impacts to a wetland that initially caused its degradation.

We do not advocate the creation of wetlands where they did not exist before, nor do we encourage establishing a wetland type different from the original. For example, creating a pond or shallow pool of extensive open water by impounding water, such as with a dam, in an area that was once sedge meadow does not constitute a true restoration. Indeed, many of the original wetland functions of the sedge meadow would be lost.

Restoration ecology is a science in its infancy. Wetlands are very complex systems that have interdependent water, soils, and vegetation. No simple recipe or prescription exists for restoring what took nature the 12,000 years since the retreat of the last glacier in Wisconsin to create. The recommendations in this handbook, however, represent the "state of the science" in wetland restoration that should provide guidance for restoring private wetlands.

In December 2000, the Wisconsin DNR released an important planning document called *Reversing the Loss: A Strategy for Protecting and Restoring Wetlands in Wisconsin*. The goal of this document is to guide wetland conservation and restoration throughout the state. The vision statement from this document reads,

U. of Florida, Center for Aquatic Plants (Gainesville)

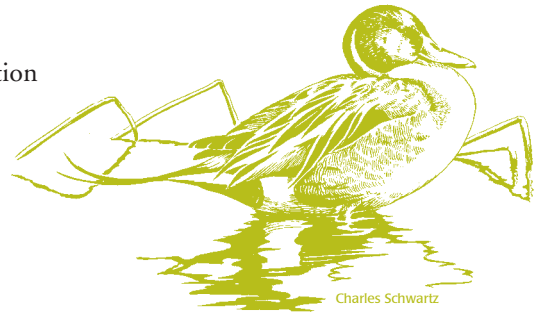
"We promote, restore, enhance, and preserve the quantity, quality, and diversity of Wisconsin's wetlands as a critical component of ecosystems essential to the health and quality of life of our state's diverse citizenry, plants, animals, and landscapes." The strategy is available at the Wisconsin DNR's web site at: **www.dnr.wi.gov/org/water/fhp/wetlands/.**

In the *Reversing the Loss* strategy, the Wisconsin DNR gives high priority to wetland restoration. Cooperation between private landowners and public agencies to restore degraded and destroyed wetlands could help reverse the trend of wetland losses over the past century. It is possible to envision thousands of acres of Wisconsin's degraded wetlands restored over the next decade, restoring the lost functions these wet landscapes offer to humans and wildlife alike. This would serve as a lasting legacy for future generations.

This revised edition of the *Wetland Restoration Handbook* provides considerably more information to landowners interested in wetland restoration than the first edition. We have expanded the chapters that explain restoration techniques, describe control strategies for invasive plants in-depth, and have included a new chapter on post-restoration site management. Where available, we have incorporated new ideas and techniques that have surfaced since the first edition was written. Several chapters have been rearranged to provide information in a more logical sequence. Furthermore, we have updated the lists of agency contacts for regulatory needs and restoration assistance and added new web sites with pertinent wetland information. Since the first edition of the handbook was published, Wisconsin Wetlands Association has produced the *Wetland Resource Directory*, an extensive list of scientists, agency personnel, private consultants, nurseries, and other individuals involved in wetland conservation, science, restoration, or management. This directory is available at the Wisconsin Wetlands Association web site (**www.wiscwetlands.org**). We encourage you to visit this directory if you are in need of any contacts on wetland-related issues.

The opportunities for wetland restoration in Wisconsin and throughout the country are better than ever before in the history of our nation. In the 2002 Farm Bill, the United States Congress allocated significant funding to support various farm conservation programs. This includes the very popular and successful Wetland Reserve Program (WRP) described in Chapter 8 of this handbook. The funds available to the Natural Resources Conservation Service for wetland restoration in Wisconsin under the WRP are four to five times more than in previous years. With any luck, this popular program will be continued for many years. The WRP, in combination with other state and federal conservation programs, will help increase the number of wetland acres restored in Wisconsin. We encourage landowners to take advantage of the very favorable financial terms of these conservation programs while the opportunity exists.

Wisconsin Wetlands Association
December 2003



Charles Schwartz

Foreword

Joy B. Zedler, Aldo Leopold Chair in Restoration Ecology, University of Wisconsin-Madison

Individual landowners can make a difference in restoring wetland habitat. In fact, private property owners are the hope for reversing the trend of declining "ecosystem services," that is, processes that wetlands carry out that benefit society as well as individual landowners. Your restoration of wetlands will help abate flooding, improve water quality, and support biodiversity!

Many readers will already know that over half of the wetland acreage in the contiguous United States has been lost over the past 200 years. The United States Fish and Wildlife Service compared historical maps with recent census data on wetland area to give us a quantitative measure of loss. But no one has a good measure of the cumulative loss of wetland biodiversity-how many of the native wetland species have declined, and over what portion of their historical range? In one small fen at the University of Wisconsin-Madison Arboretum, more than half of the historical 50 plus species are missing, perhaps as a result of groundwater drawdown and crowding by invasive species. If native species are being lost in protected areas, such as the Arboretum, biodiversity is sure to be declining in unprotected areas, wherever hydrological regimes have been altered and wherever invasive species are becoming dominant.

Driving across Wisconsin, I am reassured by the knowledge that about half of our historical wetland acreage is still intact, while at the same time deeply concerned by the degraded condition of many wetland remnants. Invasive plants such as reed canary grass, purple loosestrife, and hybrid cattails are extremely widespread and often dominant. It is clear that the expansion of invasive species has caused the decline of many natives.

How can we halt and reverse such trends? Three positive actions can be taken. We can: 1) protect the region's best wetland sites and manage them to sustain biodiversity, 2) improve conditions at wetlands that are losing biodiversity, perhaps by learning why species are being lost so we can correct the problems and reintroduce species, and 3) restore former wetlands to expand acreage and foster the growth of native species. As individuals, we can participate by contributing to organizations that do this work. As landowners, a privileged few of us can participate directly in all three activities.

My wetland has a dense stand of reed canary grass that appears to be marching across the sedge meadow. My students and other researchers have learned a great deal about this pest plant, and we are continually looking for new methods to control this invasive species without damaging other plants and sensitive animals. We don't have prescriptions yet, but we know that it is easier to remove the plant as it establishes in remnant wetlands than to wait and attempt to control dense stands without damaging the native plants.

Where former wetlands have been filled or drained, most of the native species died out when the water supplies were eliminated. Replenishing the water and watching the vegetation and invertebrate fauna develop would be like uncovering a great ecological treasure chest. Perhaps there is a species-rich seed bank that

would display its bounty as soon as the soil is wet enough to stimulate germination. If not, the wind and inflowing water would surely bring in seeds from other wetlands. The newly restored wetland would then grow plants that would attract birds and other animals which, in turn, would bring in more seeds and more species. Over time, it might accumulate dozens of native species.

But, even then, the gems of the wetland treasure trove would be vulnerable to attack by unwanted invaders—"marauding species" that could reduce the wetland's rich vegetation to a single invasive plant. In that event, it would be critical to be on the lookout for the earliest arrivals, so that they could be hand-pulled before they spread.

Obviously, wetland restoration has multiple responsibilities, involving both the renewal of wetland environmental conditions and the protection of the native inhabitants. Fortunately for landowners, this guidebook offers sound advice for accomplishing both objectives. Alice Thompson and Charlie Luthin have ably pulled together a wealth of information. If you put it to use in your degraded wetland, you *will* make a difference. Your contribution toward the restoration of lost wetland acreage *will* benefit native wetland species. If enough landowners participate in wetland restoration, the collective efforts will also enhance floodwater absorption and improve water quality. I'm sure you will find the advice you need to help sustain its diverse and valuable wetland resources.

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Basic Steps Toward Restoring Your Wetland

This handbook will help guide you through a process that has many steps and sometimes tangents. The basic process more or less follows the seven steps listed here, but those steps sometimes require looking ahead in the handbook, or referring back to sections you may have already read, scanned, or skipped.

Get Familiar With Your Site

- ❑ Understand what wetlands are, and which types of wetlands exist in Wisconsin [Chapter 1].
- ❑ Begin a wetland journal and track seasonal information about plants, animals, water levels, and signs of disturbance in your wetland for at least a year to help you determine which type of wetland exists on the site now [Chapter 2].
- ❑ Determine whether your wetland needs simple conservation and/or management activities rather than restoration which can be more complicated [Chapter 3].
- ❑ Gain a sense of what wetland restoration is all about [Chapter 13].

Gather Information for a Restoration Plan

- ❑ Make a simple, hand-drawn map of the site to be restored that includes landscape features, plants, and boundaries [Chapter 3].
- ❑ Contact local, state, and federal agencies and resources to collect information about the site and its history including: a legal description and plat map, soils and wetland maps, topographic maps, aerial photos, prior drainage, and cultivation/grazing information [Chapter 3].
- ❑ Contact former landowner(s), neighbors, and other knowledgeable parties about the history of your chosen site [Chapter 3].
- ❑ Become familiar with potential permits necessary to conduct work in your wetland and the schedule for obtaining them [Chapter 7].

Pull it All Together

- ❑ Once you've collected photos of your wetland [Chapter 2], determined the level of disturbance on the site [Chapter 3], and gathered historic information, you can update your map [Chapter 4].
- ❑ You may wish to have a surveyor do a thorough survey of the site to determine its restorability [Chapters 3 & 4].
- ❑ Gather information on federal, state, and private wetland restoration programs to determine if you are eligible for technical or financial assistance [Chapter 8].

Plan Your Restoration

Take adequate time to plan your restoration project properly! This is a very important phase of your project.

- ❑ Establish realistic restoration goals for your wetland [Chapter 4].
- ❑ Recruit help from private or government agencies in planning and designing your restoration project [Chapter 8].
- ❑ Develop a site plan and "vision" map or illustration, complete with goals, designs, any engineering needs, etc. [Chapter 4].

PLEASE NOTE:
Technical terms are defined in the glossary.

- ❑ Determine which "restoration tools," such as filling or plugging ditches, are most appropriate for restoring the hydrology of your wetland [Chapter 4].
- ❑ Plan and apply for appropriate permits [Chapter 7].
- ❑ Determine if there is a viable "seed bank," or if you will need to reintroduce native wetland (and upland) plant species [Chapter 5].

Implement Your Restoration

- ❑ Establish a timetable for your project and follow it closely to prevent seasonal delays [Chapter 9].
- ❑ Be certain to have all permits in place before starting any work [Chapter 7].
- ❑ Evaluate and choose a contractor(s) for any "earth-moving" activities, engineering, or native vegetation restoration. Check their references [Chapter 9]!
- ❑ Locate sources of native seed or rootstock and acquire necessary plant materials prior to construction, for planting into the wetland soil once the site has been prepared [Chapter 5].
- ❑ Review your goals, objectives, and site plan with the contractor(s) before the contractor begins work and before the contractor leaves the site, to be certain your plan is understood, carefully followed, and that the desired result has been achieved [Chapter 9].
- ❑ Work closely with the contractor to plan specific details of the restoration project and be on-site daily to coordinate construction details with the work crew [Chapter 9].
- ❑ Break tile lines and fill any ditches in a sequence that doesn't place the project or the equipment in jeopardy [Chapter 9].

Evaluate and Monitor Your Restoration Project

- ❑ Monitor the site immediately after construction to look for potential problems [Chapter 10].
- ❑ Document changes in your wetland by continuing to keep your wetland journal [Chapters 2, 10, & 11].
- ❑ Take reference photographs regularly, noting changes in plant and animal life, water levels, etc., over the seasons and years [Chapter 11].
- ❑ Monitor and control invasive plant species that tend to become established in newly disturbed sites [Chapters 6 & 11].
- ❑ Inspect any plantings of native plants to watch for germination and establishment [Chapter 5].
- ❑ Regularly revisit your project goals to determine if the restoration is achieving what you intended at the outset [Chapters 4, 10, & 11].
- ❑ Practice "adaptive management" by continually evaluating the condition of your wetland and addressing needs as they arise [Chapters 6 & 11].

Plan for the Future

- ❑ Be alert to potential problems within your watershed, such as land use activities, that could harm your wetland. Work toward resolving threats [Chapter 11].
- ❑ Seek long-term protection or perpetual management options for your wetland and surrounding upland habitats [Chapter 11].

"The next morning we proceeded up the Fox River, which was very serpentine. We came to a shallow lake where we could not see water except in the canoe track. The wild rice was so thick that the Indians could hardly get one of their small canoes into the rice to gather it. Vast numbers of wild ducks fatten there on the Wild Rice every fall. When they rise, they make a noise like thunder."

—Peter Pond, fur trader, 1773-1775

DNR Archive Photo

CHAPTER 1. WISCONSIN'S WETLANDS

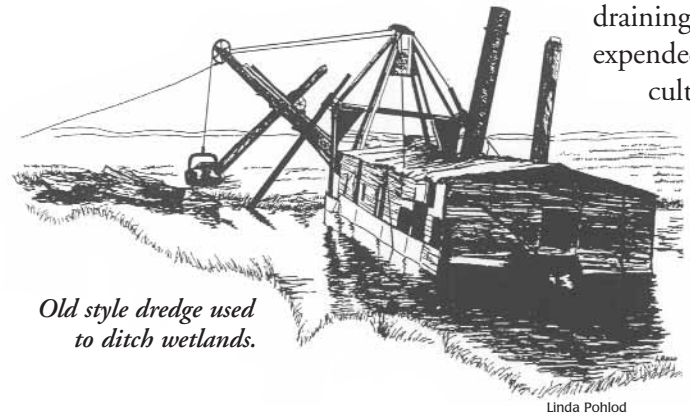
Wetland Losses...and Hope for the Future

"If there is any fact which may be supposed to be known by everybody and therefore by the courts, it is that swamps and stagnant waters are the cause of malaria and malignant fevers, and that public power is never more legitimately exercised than in removing such nuisances."

—The Swamp Land Act of 1850, United States Supreme Court

The influence of Aldo Leopold and other early conservationists made Wisconsin a pioneer in the preservation and restoration of wetlands. In the 1930s and 1940s, the prevailing practices of over-hunting waterfowl, clearing swamp forests of timber, and draining marshes for conversion into cropland were reversed at Horicon Marsh in the southeast, and Crex Meadows in the northwest, when a few far-sighted conservationists saw that we were losing something precious. These important wetland resources were revitalized as drained farmland was restored.

For most of Wisconsin's history, our predecessors looked at wetlands as areas of little importance, as "wastelands" that became valuable after they were drained or filled. Their intrinsic value to wildlife and society went unrecognized. Until the early 1970s, federal policy promoted draining wetlands, and many federal and state programs expended large sums to bring vast areas of wetland under cultivation. Ditching drained the water from these soggy areas, while rivers and streams were deepened and straightened to speed drainage after a rainfall. Later, farmers used extensive drain tile systems under wetlands to remove water more efficiently from cropland. Loggers cleared forested swamps of trees for timber. Those in urban areas filled wetlands to create land for houses, roads, or commercial buildings. As a



Old style dredge used to ditch wetlands.

Linda Pohlod

result, half of Wisconsin's original 10 million acres of wetlands were lost and many of our remaining wetlands are degraded.

United States Fish and Wildlife Service

The federal Clean Water Act of 1972 has subsequently provided some, albeit still inadequate, protection to the nation's wetlands. Over the past three decades the vital role wetlands play in maintaining the overall health of our environment has become clearer. Yet, even as we begin to recognize the complexity and importance of wetland ecosystems and establish state and national measures to protect them, small wetlands statewide continue to be filled for development or drained for agricultural activities. Indirect impacts due to urban runoff, rural development, and invasion by exotic species further degrade wetlands. The cumulative statewide loss is considerable, not only in quantity, but also in wetland quality. Many of our remaining original wetlands, about five million acres, are seriously impacted. Because the majority of Wisconsin's wetlands are privately owned, individual landowners -you! - are crucial to protecting what wetland resources remain and restoring them to their original condition. Even if you don't own property with wetlands, your advocacy role is equally important.

The picture isn't entirely bleak. Increasingly, we are recognizing the need for stronger protective measures for remaining wetlands. Federal and state initiatives and private efforts to restore wetlands have accelerated. Private landowners like you are extremely important in this effort since most of the state's wetlands or potentially restorable sites are on private land.

This handbook is a ***starting point*** for landowners interested in restoring wetlands on their property. It is not a "recipe book" with a specific "formula" because wetland restoration is not a simple task and each wetland is different and will require its own unique process that should be chosen based on the particular characteristics of the site. This handbook demonstrates how you can assess your wetland site, introduces the basic tools needed for you to consider a restoration project, and provides recommendations for planning.

You need not undertake wetland restoration alone! Chapter 8 outlines a variety of government agencies and non-profit organizations that have considerable experience in wetland restoration. They can provide technical assistance, help evaluate the site, plan restoration, and sometimes offer financial assistance for the implementation of your project.

Read this handbook first for suggestions, perhaps to spark your interest in a restoration project, and to see why you should consider the many aspects of your individual wetland project ***prior*** to starting restoration work. Planning is a huge part of the project; 50 percent to 70 percent of a restoration project involves gathering necessary background information, conferring with experts, and designing the restoration. The more effort you put into planning, the more likely your project will achieve its goals. It took nature thousands of years to create a wetland ecosystem, and the degradation in many cases may have

"Swamps and wetlands are a necessary part of the ecological creation. ...An owner of land has no absolute and unlimited right to change the essential natural character of his land so as to use it for a purpose for which it was unsuited in its natural state and which injures the rights of others."

—Justice Hallows,
Wisconsin Supreme Court,
Just vs. Marinette County, 1972

"For millennia, water lay over the land. Untold generations of water plants, birds, animals, insects, lived, shed bits of themselves, and died. I used to like to imagine how it all drifted down, lazily, in the warm, soupy water-leaves, seeds, feathers, scales, flesh, bones, petals, pollen-then mixed with the saturated soil below and became, itself, soil. I used to like to imagine the millions of birds darkening the sunset, settling the sloughs for a night, or a breeding season, the riot of their cries and chirps, the rushing *hough-shhh* of twice millions of wings, the swish of their twiglike legs of paddling feet in the water, sounds barely audible until amplified by millions."

— Jane Smiley, *A Thousand Acres,* 1991

taken 100 years, thus your project requires a long-term view. Patience and perseverance through the hours of planning and years until diversity and health are restored to the wetland bear gratifying rewards.

With rehabilitation and restoration we will begin to add more acres to our treasury of wetland resources. These restored wetlands will contribute to the health and well being of our cultural and ecological future.

What is a Wetland?

Wetlands are wonderful wet, muddy, soggy, boggy places. They are places that suck your boots off, trip you on logs or hummocks, and tip you on your back. They are habitat for waterfowl and frogs, home to lady slipper orchids and the elusive Virginia rail. They are places of beauty and diversity, where odd-shaped pitcher plants capture insects for nutrients, tiny sundews trap gnats on sticky hairs, and the call of the sandhill crane echoes in the spring.

Wetlands are ecosystems typically found where land meets water on the landscape, a transitional place between dry upland and aquatic environments. Wetlands may form at the edges of lakes, rivers, and streams, in low isolated spots on the landscape, where groundwater comes to the surface via springs and seeps, or where rainwater collects and the underlying impermeable soils or bedrock trap the water.

Wetland plants are uniquely adapted to seasonal or year-round saturated soils, with specialized root and stem structures designed to capture and transport oxygen that is limited in a wet environment. How much water is present for how long and the specific soil conditions determine which plants are suited to the site. Saturated conditions also slow the decomposition of organic material such as dead leaves and plants, thereby tying up nutrients and creating organic soils such as peat.

Although a cattail marsh is among the most recognizable wetlands, many different kinds of wetlands exist in Wisconsin, including wet prairies, sedge meadows, sphagnum bogs, tamarack swamps, floodplain forests, and alder thickets. Despite the wide variety of wetland types, three features are common to all:

- The presence of water at or just below the surface of the land for at least a portion of the year (wetland hydrology),
- Specific types of soils that develop under saturated (wet) conditions (hydric soils), and
- Distinctive plants adapted to wet conditions (hydrophytes).

For regulatory purposes, the State of Wisconsin defines a wetland as:

> ***An area where water is at, near, or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation and which has soils indicative of wet conditions.*** **—Wisconsin Statutes *23.32(1)***

In very general terms, the term *marsh* or meadow applies to a wetland dominated by grass-like plants—sedges, reeds, grasses, and cattails—and wildflowers, and *swamps* are wetlands with considerable shrub or tree cover.

WISCONSIN'S 14 WETLAND COMMUNITIES

- SHALLOW, OPEN WATER
- DEEP MARSH
- SHALLOW MARSH
- SEDGE MEADOW
- WET MEADOW
- WET PRAIRIE
- CALCAREOUS FEN
- SHRUB CARR
- ALDER THICKET
- HARDWOOD SWAMP
- CONIFEROUS SWAMP
- FLOODPLAIN FOREST
- OPEN BOG
- CONIFEROUS BOG

WISCONSIN WETLAND COMMUNITIES

SHALLOW, OPEN WATER WETLANDS occur where there is 6 feet or less of standing water. They differ from marshes in that the water is seldom, if ever, drawn down. The aquatic plants in these communities occur at or below the surface and are known as submergent vegetation. Submergent plants are rooted, or attached to the bottom, and may have leaves that float at the surface such as water lilies. Because these communities almost always have deep water, they will not support most emergent vegetation—those plants that rise out of the water such as reeds and cattails—except for wild rice, an emergent that may grow in deeper waters. Typical open water plants include pondweed, water lily, coontail, and the floating duckweeds.

Yellow Pondlily

MARSHES contain deep to shallow standing water.

- **Deep marshes**, with more than 6 inches of standing water, may contain both submergent and emergent plants.
- **Shallow marshes**, with 6 inches or less of standing water, generally contain only emergent plants.

Deep and shallow marshes often occur adjacent one another on a gradient. They may exist along pond edges, quiet lakeshores and bays or on gently sloping stream banks that are not prone to strong winds or fast-flowing water. Common marsh plants include cattail, bulrush, bur reed, and pickerel weed. The water level of marshes, especially shallow marshes, may vary considerably from year to year. Shallow marshes may become dry during drought periods.

Pickerel Weed

INLAND FRESH MEADOWS characterize saturated soils with little to no standing water. They contain a mixture of grasses, sedges, and wildflowers, known as forbs. In Wisconsin, four types of inland fresh meadows occur: **sedge meadows**, **wet meadows**, **wet (low) prairies**, and **calcareous fens**.

Tussock Sedge

- Sedges, grass-like plants generally in the genus *Carex*, dominate the **sedge meadow**. "Sedges have edges" is a mnemonic device you can use to help identify these sharp-leaved, triangular-stemmed plants. Several characteristic wetland sedges grow in hummocks. Grasses and forbs may be present, but are not as abundant as sedges. Sedge meadows often occur on peat or muck soils.
- Grasses dominate the **wet meadows,** and generally a large variety of forbs, such as goldenrod and aster, are present. The invasive and very aggressive reed canary grass often thrives in wet meadows that have been disturbed by drainage or plowing (see Chapter 3).
- While **wet (or low) prairies** are similar to wet meadows, they are somewhat drier. Usually found in the southern part of the state, grasses such as prairie cord grass and particular species of wildflowers characterize this wetland community, which has grown scarce due to extensive conversion for agriculture.

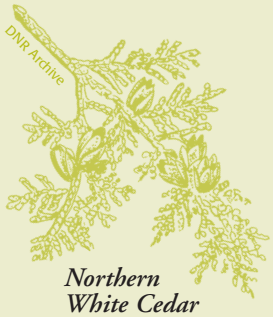
White Ladyslipper Orchid

Calcareous fens generally occur south of the tension zone in places where springs or seeps bring calcium-rich groundwater to the surface, turning both soil and water somewhat alkaline. Often, white deposits appear on the surface where minerals have precipitated out of the water. Characteristic plants in this community tolerate the harsh growing conditions. Among the rarest of the state's wetland communities, calcareous fens contain some of the most threatened or rare plant species, such as white ladyslipper orchid, false asphodel, Ohio goldenrod, and lesser fringed gentian.

SHRUB SWAMPS are dominated by shrubs and woody plants less than 20 feet tall. Wisconsin supports two basic types of shrub swamp: alder thickets and shrub-carrs.

- **Alder thickets** frequently grow along stream banks in northern and central Wisconsin. The tall multi-stemmed speckled alder dominates this community, and its dense overhanging branches help keep streams cool.
- **Shrub-carrs** grow on saturated soils throughout the state and are home to red osier dogwood and a number of willow species. The shrub-carr community may encroach on sedge meadows that become drier as a result of drainage or disturbance. The absence of fire also allows shrubs to invade sedge meadows.

WOODED SWAMP refers to forested wetlands often associated with ancient lake basins and old river channels.



Northern White Cedar

- **Coniferous swamps** occur on saturated peat soils generally within or north of the tension zone. Mixed stands of tamarack and black spruce characterize the northern coniferous swamp. Northern white cedar and tamarack are found in cedar swamps, which occur on soils that are pH neutral or even slightly alkaline.
- Lowland **hardwood swamps** occur predominantly south of the tension zone and contain hardwood tree species such as black ash, red maple, and yellow birch. Water often inundates these swamps regularly, such as in spring, and they occur on saturated soils.

FLOODPLAIN FORESTS are forested wetlands associated with seasonally flooded river floodplains and old river channels (oxbows). This community may experience extremes in depth and duration of flooding, occasionally having standing water in deeper zones well into the growing season. The floodplain forest typically becomes very dry late in the growing season and may resemble an upland community to an untrained observer. Characteristic tree species include silver maple, river birch, eastern cottonwood, black willow, American elm, and swamp white oak.

OPEN BOGS contain distinctive plants associated with saturated, nutrient-poor, acidic soils in northern, central, and southeast Wisconsin. Most bogs occur in depressions where sphagnum moss forms a thick mat. Over time the sphagnum slowly builds thick organic peat soils. Since groundwater or streams that would normally "flush" a wetland rarely flow into or through bogs, the soil becomes very acidic. Plants that live in bogs must be adapted to the extremes in acidity. Remarkably, sphagnum moss not only survives in acid conditions but also contributes further to a bog's acidity. Typical bog plants include members of the blueberry (heath) family, such as the native cranberry, leatherleaf, bog rosemary, and Labrador tea. Other characteristic species include pitcher plants, sedges, sundews, and various orchids.

- **Coniferous bogs** are sphagnum bogs that contain tamarack and/ or black spruce trees.

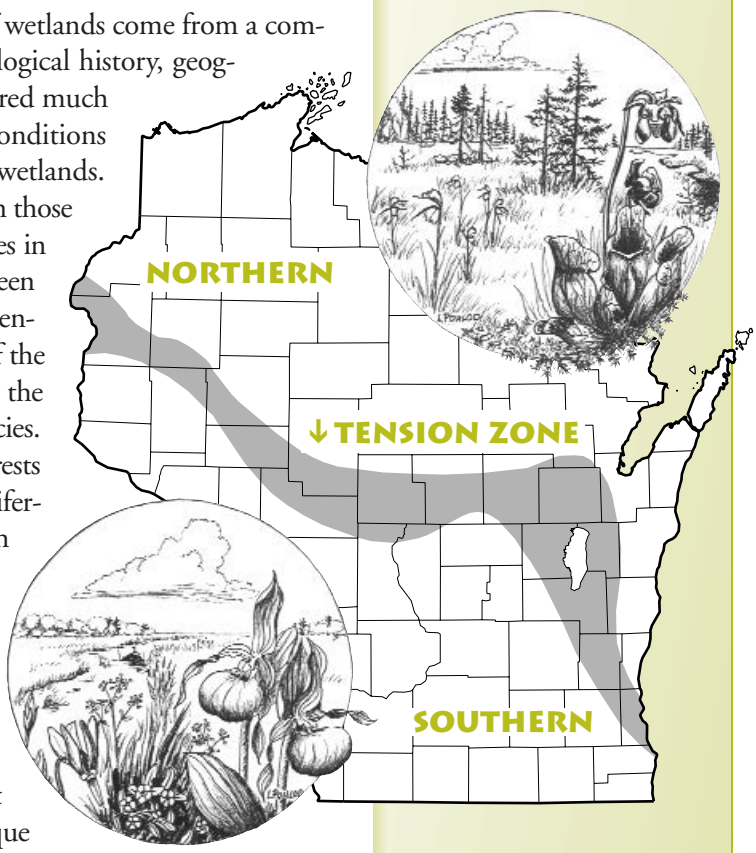
Northern Bog

Our Wetland Heritage

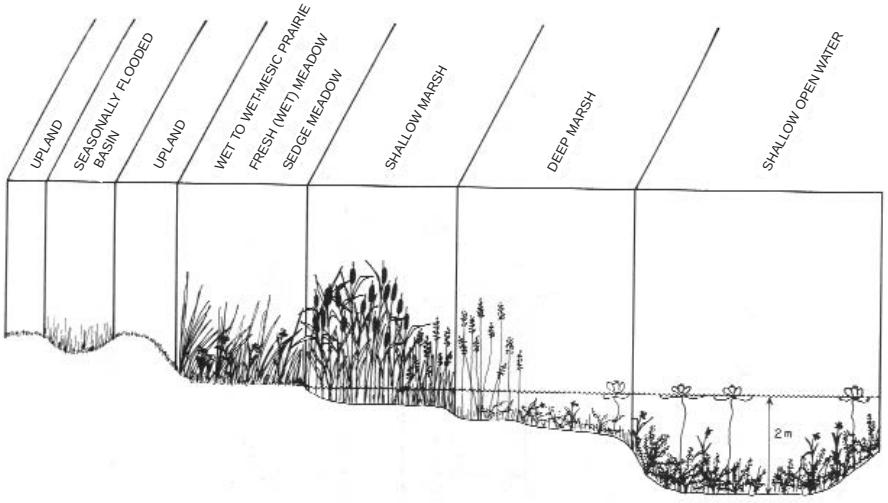
Wisconsin's large variety and abundance of wetlands come from a combination of factors that include our geological history, geography, and climate. When the glaciers that covered much of the state receded about 12,000 years ago, conditions existed that favored the formation of extensive wetlands.

Northern wetlands may differ markedly from those in the southern half of the state due to differences in climate and soils. The transitional area between northern and southern plant communities, the tension zone, runs diagonally through the middle of the state from northwest to southeast and represents the range limits of a large number of plant species. Communities such as prairies and hardwood forests exist south of the tension zone and mixed conifer-hardwood forests dominate the ecosystems north of the zone. Within the tension zone, northern and southern vegetation mix, harboring diverse habitats. Wetlands in the hilly western "driftless area" of the state, an area missed by the last glacial advance, are generally confined to the floodplains of rivers and streams.

Wisconsin's wetlands fall into 14 different community classifications defined by a unique combination of plants, soil types and water levels. In many places, several kinds of wetlands occur together to form a mosaic on the landscape. Wetlands also may change as they transition from very wet to drier habitats, such as from marsh to sedge meadow to shrub swamp. *Wetland Plants and Plant Communities of Minnesota and Wisconsin* (1997, United States Army Corps of Engineers, St. Paul) by Steve Eggers and Don Reed has many photos of different wetland plants and communities.



Wetland vegetation often differs from northern to southern Wisconsin, with a mixing of the two in the tension zone.



Generalized cross section of a meadow-marsh-open water complex.

Wetlands, Watersheds, and the Water Cycle . . .

Water moves from the atmosphere to the land and back again in a complex hydrologic cycle. This cycle has flux; annual and seasonal variations in hydrologic patterns are natural phenomena in wetlands. Many factors affect the water available to your site, including rainfall, groundwater levels, temperature, evaporation rates, how much water is taken up by plants, climactic changes, and especially land and water use in your watershed.

What is a Watershed?

A watershed (also called a drainage basin) is the topographic area that drains to a single water body. Water always flows downhill following the topography of the land, from high to low elevations. Landforms such as hills will determine the direction and speed of water movement. If a hill separates two watersheds, a raindrop may end up in a different watershed, depending on which side of the divide it falls on. The slope of the hill collects and funnels water towards a channel at its base, which in turn will follow land elevations down slope, eventually creating a natural feature such as a stream, river, lake or wetland. You can locate the watershed of your site on a detailed topographic map. The highest elevation point on all sides of your site is the divide that defines the watershed of your site.

Your wetland plays the role of a "stabilizer" of local hydrology within its watershed. During rainfall or snowmelt, the wetland slows water movement, storing it in its absorbent, sponge-like wetland soils. This ability to retain (or retard) storm and meltwater runoff can reduce the frequency and severity of downstream flooding. Reduced water velocity in turn allows sediment particles to settle out. Wetlands can, therefore, effectively reduce the amount of sediments carried downstream into streams and lakes.

"A watershed is a gatherer—a living place that draws the sun and rain together. Its surface of soils, rocks, and plant life forms a "commons" for this intermingling of sun, water, and nutrient."

– Peter Warshall, River Voices

Linda Pohlod

Fluctuations in a Wetland

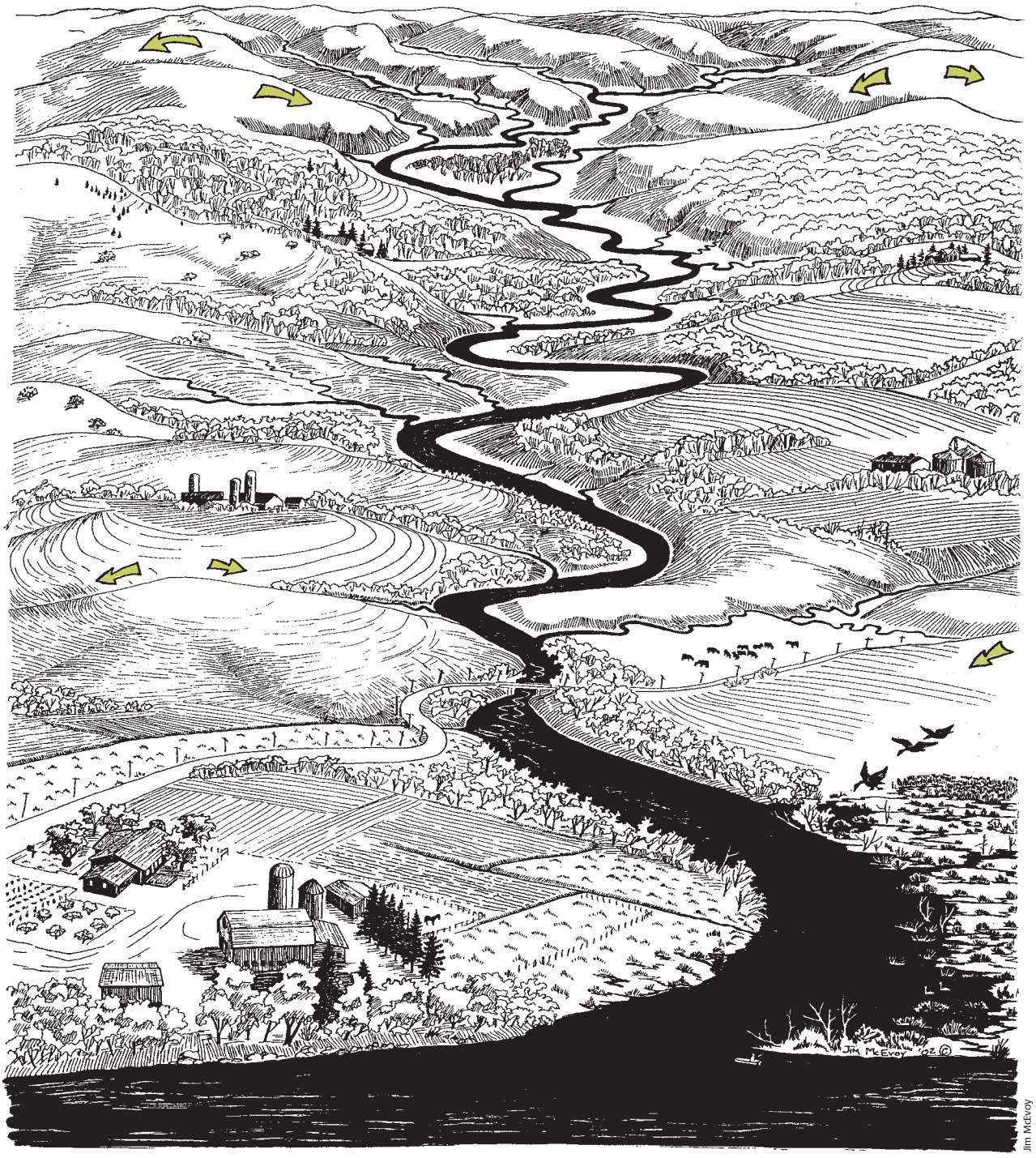
Rainfall varies seasonally and may be abundant during major climatic events. When snow melts before the ground thaws in spring, a maximum surge of water often occurs in a watershed. Another surge generally arrives with heavy spring rainfall. Both can raise wetland water levels. With the drier and hotter weather of summer, water levels drop as evaporation increases. Growing plants take in water through their roots and release it to the atmosphere through their leaves in a process called transpiration. By late summer water levels may be at their lowest, but the cool of autumn reduces evaporation and with plants dying back transpiration decreases. Fall rains can contribute new water to the wetland. Water levels rise again and the cycle starts over, varying in magnitude depending on the type of wetland, such as marsh or riverine forest, and its source of water.

You should anticipate this normal seasonal cycle of water levels. Furthermore, annual cycles may vary from year to year or even decade to decade based on larger climate changes. Physical changes in the watershed can also cause water level changes in your wetland. Beavers are a natural

change agent as they build dams across streams that block water. Beaver activity may increase the water level in a wetland.

Human changes may be more permanent and less benign. Constructed stormwater facilities upstream, or lack of them, affect the amount, quality, and temperature of water flowing downstream. Upstream agricultural or municipal use of water may alter your wetland as well. In urban or suburban areas, new roads, parking lots, and other impermeable surfaces can cause increased water runoff into wetlands and waterways.

A typical watershed includes all drainages within a basin (below).



Jim McEvoy

RESTORATION OF WATERSHEDS: A CASE STUDY

Whittlesey Creek Wildlife Refuge, Bayfield County

Whittlesey Creek near Ashland in Bayfield County owes its name to Asaph Whittlesey, the first member of the Wisconsin Legislature to represent the Lake Superior area. He was so determined to serve northern Wisconsin at the legislative session in Madison in January 1860, he donned buckskin and goggles to fend off snow blindness, and with his tin drinking cup strapped to his waist, snowshoed 240 miles to the nearest train in Sparta.

The wetlands restored on private lands in the Whittlesey Creek watershed are an example of restoration goals that are set at a watershed level. The creek, which empties to Lake Superior, is part of the state's priority watershed program, singled out for its unique water and habitat potential, and for the controllable problems threatening the stream's water quality. Historically the 12,000-acre watershed, 5,000 acres of which are within the Chequamegon National Forest, provided important spawning habitat for coaster brook trout, a large fish native to Lake Superior. With deforestation caused by logging and conversion to farmland in the late 1800s and early 1900s, and with the loss of wetlands, these native trout disappeared from the watershed and the Wisconsin shores of Lake Superior.

The deforestation led to more rapid snow melt and increased surface water runoff in upper regions of the watershed, causing large quantities of sandy sediments to be deposited downstream. In the lower stretch of the watershed, farmers graded wetlands that were adjacent the creek to drain runoff more efficiently. The highly erodible red clay soils in the lower watershed were then no longer trapped by wetlands. Fine sediment filled in the cobbled streambed once attractive to coaster brook trout. As a result, the fish are unable to spawn in the creek where sediment has covered the beds and the mouth of the stream has become too shallow for fish to enter.

Streambank stabilization within the Whittlesey Creek Watershed.

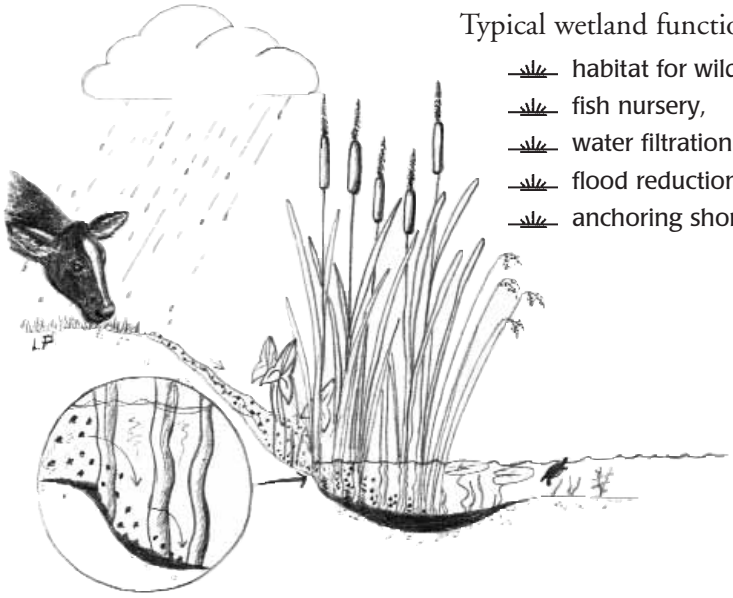
United States Fish and Wildlife Service

The lost wetlands and forest no longer slow runoff, leading to floods much higher than historically recorded levels and more likely to damage stream banks and associated habitats.

Recently the United States Fish and Wildlife Service created a national refuge to protect the creek. Upstream farms have been encouraged to restore wetlands through financial help from Partners for Wildlife, Ducks Unlimited, and The Whittlesey Creek Priority Watershed Project. Typically, wetland restorations consist of berms and shallow scrapes (see Case Study #1, Chapter 13) designed to retain water and slow the rate of runoff, though they also attract waterfowl and shorebirds. Multiple scrapes, each about a tenth of an acre, are being excavated on private property. The wildlife refuge has begun stream monitoring to track the success of the project. As the stream recovers, native coaster brook trout eventually will be released to return to spawn in these waters.

Wetlands... What Are They Good For?

Scientists investigating wetland ecosystems have found that wetlands have many functions and provide numerous benefits to the environment and to us. These benefits vary from wetland to wetland, and depend on the type of wetland, its size, its proximity to other wetlands and natural ecosystems, and the degree of disturbance, among other factors.



Typical wetland functions include:

- habitat for wildlife and plants,
- fish nursery,
- water filtration and cleansing,
- flood reduction, and
- anchoring shorelines.

Many values are associated with these wetland functions. Hunting, fishing, canoeing, bird watching, and aesthetic enjoyment are direct wetland values that offer us obvious and immediate benefits. In addition, wetland functions such as water filtration, flood control, and reduced soil erosion may provide direct or indirect benefits to society and to the environment in general. Some wetland values are subtle and understanding their importance requires a good working knowledge of land, soils, and hydrology.

The primary wetland values include ecological, aesthetic, recreational, economic, and environmental "services."

Ecological Values

Wetlands are our most biologically productive ecosystems, providing habitat for a rich diversity of plant and animal species. Nationally, more than one third of endangered species are associated with wetlands even though wetlands cover only 5 percent of the landscape. Wetlands serve as spawning grounds for many of the state's game fish, nesting grounds for abundant waterfowl, and year-round habitat for deer, mink, beaver, and other fur-bearers. Bald eagles and osprey generally nest in tall trees along lakeshores and in floodplain forests along rivers. A variety of insects, frogs, salamanders, snakes, turtles, and other organisms that play valuable roles in the ecological web of life live in wetlands. The sensitivity of a wetland's frogs to environmental contaminants makes them potential indicators of environmental pollution.

Wetlands slow the rate that sediments flow into waterways.

A GOOD REFERENCE:

BASIC GUIDE TO WISCONSIN'S WETLANDS AND THEIR BOUNDARIES

Wisconsin Dept. of Administration, Coastal Management Program (1995)

Publ-WZ-029-94,

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Wetland values include many recreational activities.

Aesthetic and Recreational Values

You may enjoy fishing, hunting, and other recreational uses on your privately owned wetlands. The state's national wildlife refuges, state parks, and state natural areas contain extensive wetland areas attractive to visitors. Annually, millions of individuals seek out public lands for bird watching, hiking, camping, skiing, fishing, and hunting, among other recreational uses. Some of Wisconsin's most striking wild spots contain marshes, coastal wetlands, bogs, and other wetlands, with spectacular scenic opportunities like a sunset silhouetting a flock of cranes coming to roost in Crex Meadows.

Economic Values

Intact wetlands often provide direct economic benefits to all of us. They may serve as a source of natural "products" or crops such as hay for cattle, wildlife such as fish, waterfowl, and furbearers, fruits, timber, and other valuable commodities such as wild rice. Private properties with wetlands are increasingly in demand as home sites, with property values increasing significantly due to the value of the open space. Communities with nearby healthy and protected wetlands often gain from tourism dollars spent by visitors attracted to the area for recreation. The "environmental services" provided by wetlands (see below) have tremendous economic value.

Environmental Services

Wetlands help reduce the frequency and intensity of floods, cleanse the excess nutrients and chemical pollutants from storm runoff, and reduce the impact of soil erosion by trapping sediments coming from upland areas. Furthermore, wetlands protect stream banks and shorelines from erosion and serve as a source of fresh water to maintain base flows in streams and rivers. Although these environmental values are hard to quantify, wetlands save millions of dollars each year in flood protection alone.

What Are Wetlands Bad For?

Wetlands are *not* good places for development. High water tables, the potential for flooding, and soils that seasonally shrink and swell can pose severe problems when a home, commercial enterprise, or road is built in a former wetland. Development in wetlands exacerbates flooding and runoff problems.

The best thing for a wetland to be is what it was naturally meant to be.

FISH AND WETLANDS

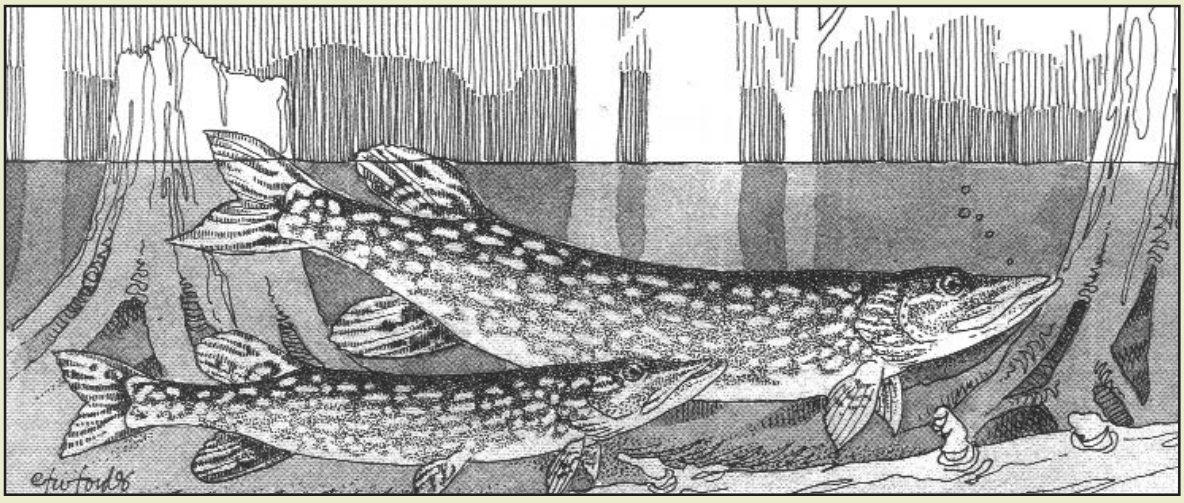
Healthy, functioning wetlands benefit our fisheries. Many sport and forage fish rely on wetlands for some part of their life cycle. Healthy wetlands filter water to remove excess nutrients and sediments and help maintain good water quality in streams, rivers, and lakes. Restored wetlands may also provide a continuous source of groundwater to streams. Native wetland vegetation—including sedges, grasses, and shrubs—provides shade and a substrate, or home base, for insects that are an important food source for fish and other stream life. In riparian zones—areas beside a waterway—wetlands serve as a refuge during flooding, providing shelter from the fast-moving water in the main channel.

Some wetlands provide critical nursery habitat for many fish. For example, northern pike deposit eggs on dense mats of aquatic vegetation-such as wetland grasses, sedges, rushes, and other shallow-water plants found in wetlands that occur along lake fringes and stream headwaters. After hatching, the fry attach themselves to wetland vegetation that provides protection and food. Other species such as walleye, muskellunge, bass, perch, bluegill, and various minnow species also use quality wetlands as nursery habitats. Sloughs in floodplain forests that are seasonally flooded provide important foraging and breeding areas for sport fish.

When lake-edge wetlands are destroyed and shorelines become heavily developed, fish populations suffer. For example, in the last 40 years, populations of northern pike in 16 southeastern Wisconsin lakes have declined 72 percent.

Wetland restoration is vital to the maintenance and enhancement of fish habitat. When your restoration project targets wetlands where fisheries were historically important—near streams, rivers, and lakes—you should consider attempting to reestablish the historical conditions and habitat favorable to the fish.

Isolated wetlands, those not connected with natural water bodies, typically are not good candidates for establishing fish populations, though they are important for reptiles and amphibians. In these wetlands, introduced fish may reduce or eliminate vulnerable frog and salamander populations by consuming the available food sources or preying on tadpoles. Fish also run the risk of winter kill, where ice depths or low oxygen levels kill the fish. Aerating such wetlands to provide oxygen is most often expensive and impractical.



Sandhill cranes inhabit many Wisconsin wetlands.

CHAPTER 2. GETTING TO KNOW YOUR WETLAND

It is important to know as much about your wetland as possible so you can make informed decisions about its future. This chapter will assist you in getting acquainted with your land. You will find the background information you gather to be invaluable in developing your restoration plan or making management decisions. The discussion on site assessment in Chapter 3 will help you gather further detail about your wetland for restoration purposes.

This discussion is for landowners with wetlands that are only moderately disturbed or degraded and still have recognizable wetland features. If your site has been badly degraded and retains virtually no wetland characteristics, you may wish to skip to Chapter 3 to begin assessing the site for its restoration potential.

"We can be ethical only in relation to something we can see, feel, understand, love, or otherwise have faith in."

– Aldo Leopold, *A Sand County Almanac*, 1949

Getting Acquainted

The simplest way to learn about a wetland is to spend time there at different times of the day and under different conditions throughout the year. The same wetland may offer a very different impression from sunrise to mid-day, from spring to fall, and from sunny to drizzly to snowy days. Try to spend time in the wetland during all the seasons and under as many different weather conditions as you can to see the cycles, patterns, and diversity of life that your wetland has to offer.

Exploring a wetland community is an opportunity to "open your senses." Besides visual observations, feeling, smelling, and hearing different components of the wetland may heighten your awareness of the site. Wetlands offer a unique complement of sights, sounds, smells, and sensations found in no other natural environment. Our minds register many impressions, and by opening ourselves up to these sensations we contribute to our understanding of our natural environment.

Don't forget to dress for discovery. Wet, cold feet or not dressing warmly enough for the cooler wetland landscape could make your experience less enjoyable.

Here are a few questions that you might want to answer to help you understand your wetland better:

- ☑ What are some of the unique attributes or features of the wetland?
- ☑ What plants and animals live in or use the wetland?
- ☑ What degree of disturbance has the wetland experienced?
- ☑ In Chapter 1 we mentioned the different kinds of wetlands found in Wisconsin. Does this wetland fit into any of these categories?
- ☑ Does standing water occur for any or all of the growing season?
- ☑ Is the wetland in a basin or depression, on a flat low plain, or adjacent to a river, stream, or lake?
- ☑ Is the wetland isolated, or is it part of a larger wetland ecosystem?
- ☑ What animals or signs of animals do you notice?

Keep a Wetland Journal: Record Keeping

It is a good idea to keep a journal of observations and your impressions with each visit to your wetland. Day to day, season to season, year to year, you will begin to amass a collection of observations and important information about the area. This information will be very important as you plan conservation, management, or restoration activities for the wetland.

Good record keeping is an acquired skill. It takes practice to remember to record even simple events and observations, such as time of day, weather conditions like temperature, wind direction, speed, cloud cover, etc., and other basic details of that day's visit. You also may wish to note recent weather events such as when and how much rain or snow fell, the duration of a drought, etc.

Note which plants and animals are blooming, calling, mating, or simply

SENSING EXERCISE

Since we often rely almost exclusively on our sense of sight to characterize a place, one fun exercise to "tune in" to your wetland and "turn on" your various senses is to sit quietly near—or even in!—your wetland, close your eyes, and focus on the sensory stimuli that surround you. Focus a few moments on the sounds, then focus on the smells. Grab a handful of soil and take a sniff. Break a few leaves from nearby plants and smell them. The more time you take, the more you will discover. Approaching this exercise with a curious and open "mind of a scientist" will lead to countless discoveries about the unique characteristics of your wetland. Once you tune into the rhythms and cycles of your wetland, your future observations will be more informed, more thorough, and more interesting.

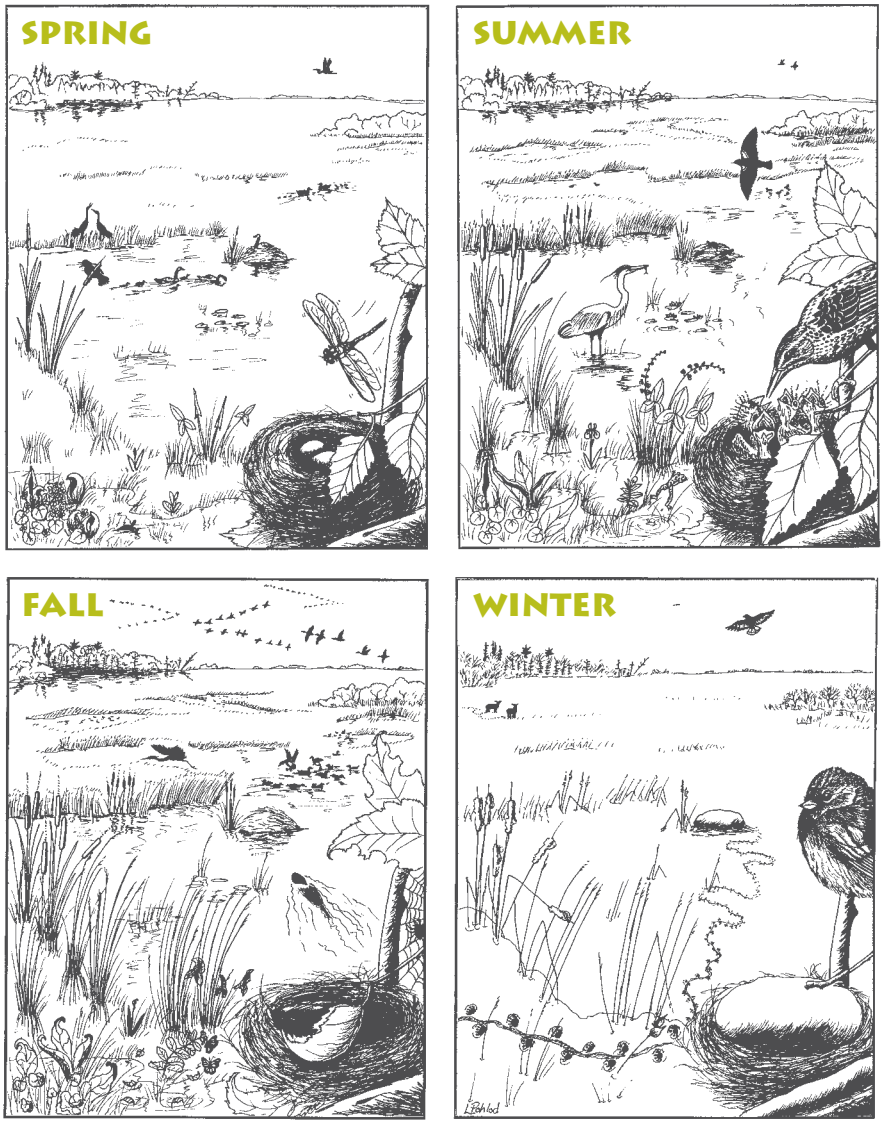
FIELD OBSERVATION CHECKLIST

- ❑ SPIRAL OR BOUND NOTEBOOK (JOURNAL)
- ❑ PENCIL OR WATER PROOF PEN
- ❑ THERMOMETER
- ❑ COMPASS
- ❑ RULER OR TAPE MEASURE
- ❑ BINOCULARS
- ❑ FIELD GUIDES
- ❑ MAGNIFYING LENS OR LOUPE (8X OR 10X)
- ❑ BACKPACK OR FANNY PACK
- ❑ RAIN GEAR
- ❑ BUG SPRAY
- ❑ WATER BOTTLE
- ❑ HAT
- ❑ SHOVEL
- ❑ CAMERA

observed. Where are these plants or animals found in your wetland? Were they found on dry or wet soils? Typically wetland plants live under specific conditions; for example, cattails often grow in shallow standing water, whereas some wetland grasses and wildflowers will be found only on drier portions of a site. If you make good observations and take notes of unknown animals or plants, or sketch or photograph them, you can try to identify them later with the help of field guides.

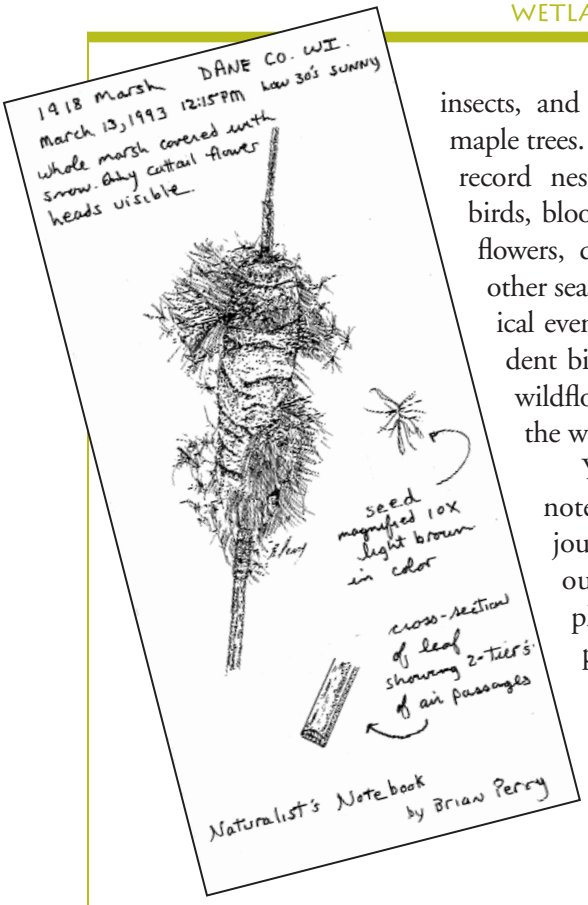
Repeated visits over the seasons will help you better understand your site and build lasting memories. Changes can be dramatic from day to day and week to week, especially in spring when migrating birds return to the wetland, plants bloom, and insects hatch.

The study of the seasonal occurrence of natural phenomena is called phenology. An intriguing way to explore your wetland is to maintain phenological records of natural events that you observe. Examples would include the date red-winged blackbirds or great blue herons return in the spring, the first bloom dates of wildflowers, first calls of frogs, the first hatch of different



"A sense of time lies thick and heavy on such a place. Yearly since the ice age it has awakened each spring to the clangor of cranes. The peat layers that comprise the bog are laid down in the basin of an ancient lake. The cranes stand, as it were, upon the sodden pages of their own history. These peats are the compressed remains of the mosses that clogged the pools, of the tamaracks that spread over the moss, of the cranes that bugled over the tamaracks since the retreat of the ice sheet. An endless caravan of generations has built of its own bones this bridge into the future, this habitat where the oncoming host again may live and breed and die.
To what end? Out on the bog a crane, gulping some luckless frog, springs his ungainly hulk into the air and flails the morning sun with mighty wings. The tamaracks re-echo with his bugled certitude.
He seems to know."

— Aldo Leopold,
A Sand County Almanac, 1949



insects, and first leaves of tamarack or silver maple trees. As the season progresses you might record nesting, hatching, and fledgling of birds, bloom and senescence (dying back) of flowers, drying cycles in your wetland, or other seasonal events. Late season phenological events could include departure of resident birds, last date of blooming autumn wildflowers, and first frost or freezing in the wetland.

You may wish to transfer your field notes into a more permanent wetland journal back home, where more thorough observations, impressions, photographs, drawings, and even poetry can be included.

Excerpt from a wetland notebook.

"April 26, 1838. A crow's voice filled all the miles of air with sound. A bird's voice, even a piping frog, enlivens a solitude and makes world enough for us. At night I went out into the dark and saw a glimmering star and heard a frog, and Nature seemed to say, Well do not these suffice?"

—Ralph Waldo Emerson, *The Heart of Emerson's Journals*, 1926

Wetland Indicators: Plants and Animals

The best way to determine what kind of wetland you have is to look for characteristic wetland plants found there. Plants that typically occur together comprise a wetland community as described in Chapter 1. Many plants, because of the specific conditions they require or tolerate for growth, are wetland indicators.

As early as February, there may be plants blooming in your wetland, such as skunk cabbage, marsh marigold, willows, and silver maple. Many wetland plants bloom in early or late summer. Some plants will bloom long after a frost, including asters, gentians, and goldenrods. A number of good field guides exist to help you identify wetland plants (see Appendix A). As you begin to identify different species of plants, ask yourself, is the plant rare or common in your wetland? Is it a native plant or a non-native, exotic plant? By answering these questions you gain an understanding of the plant community in your wetland.

Wetlands may be rich in their diversity of wildlife species. A wide variety of animals—including insects, frogs, snakes, fish, birds, and mammals—depend on wetlands for part of most of their lives. Different kinds of wetlands serve as habitat for different species of animals, providing food, shelter, and breeding areas. Some animals may be permanent residents in your wetland, such as spiders, frogs, snails, fishes, and aquatic insects, while others will be seasonal visitors, such as insects, migratory

WETLAND PLANTS AND PLANT COMMUNITIES OF MINNESOTA AND WISCONSIN

STEVE EGGERS AND DONALD REED, 1997

This 263-page book includes photographs of 15 wetland types and 144 representative plant species. Brief descriptions of each plant species include taxonomic characteristics, habitat, and notes on wildlife use and economic values.

Price is $13 per book with book-rate shipping and $15 per book with 1st Class shipping.

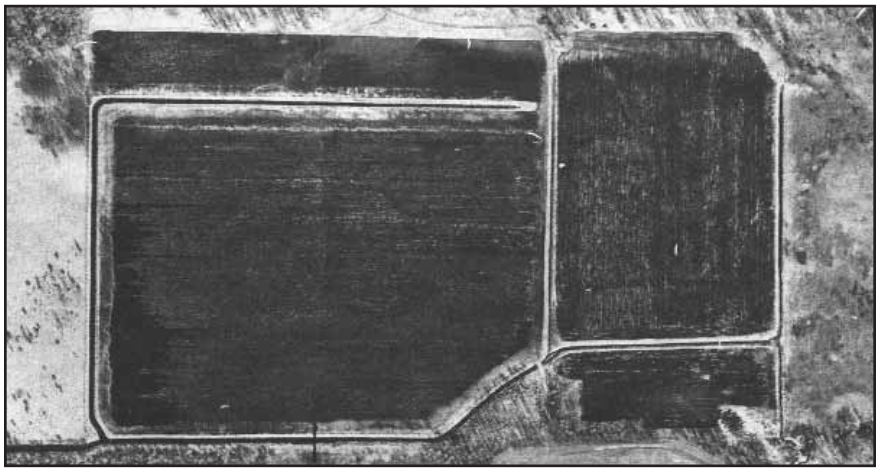
Order from St. Paul District, United States Army Corps of Engineers,

Attn.: CENCS
Library/Sales Agent
190- 5th Street East
St. Paul, MN 55101-1638

(651) 290-5680

birds, and wandering mammals. Look for signs of wildlife throughout the seasons. For example, when leaves drop in the fall you may be able to find once hidden bird nests in shrubs and trees. Winter is a great time to find tracks of animals that you can't see during the summer season.

Signs of Wetland Disturbance



Southeastern Wisconsin Regional Planning Commission

Aerial photo of a typical drained wetland. Ditches were cut into muck soils.

Unfortunately many, if not most, of Wisconsin's wetlands have been harmed by some form of human activity over the past 100 to 150 years. It is hard to find a wetland that does not have signs of disturbance, especially in urban areas of the state. Some disturbances are historic and the wetland has begun to recover. In other situations historic disturbances did long-term harm to the wetland. Where disturbance occurred recently, degradation is quite obvious.

You need to know the signs of disturbance to understand the degree to which your wetland has been affected. ***Knowing how, and to what extent, your wetland is degraded is critical for determining how best to restore it to its original condition.*** In general, if the amount and flow of water—at the surface or under the ground—and the duration of soil saturation in a wetland are changed, the wetland plant and animal communities will likely change. Once wetland hydrology is altered, the factors that influence a wetland's plant and animal make up will be different.

The primary disturbance to wetland hydrology throughout rural Wisconsin is artificial drainage. Past ditching or buried drain tiles that remove surface and groundwater for the land to be used for cultivation alter the wetland's hydrology and can have significant long-term negative impacts on the entire wetland.

In urban areas the addition of stormwater runoff from streets and parking lots, yards, and roofs may degrade a water body or wetland. Storm sewers often drain directly into lakes, rivers, or wetlands, unloading excess water, chemicals, fertilizers, and other hazardous substances into these ecosystems.

Alice Thompson

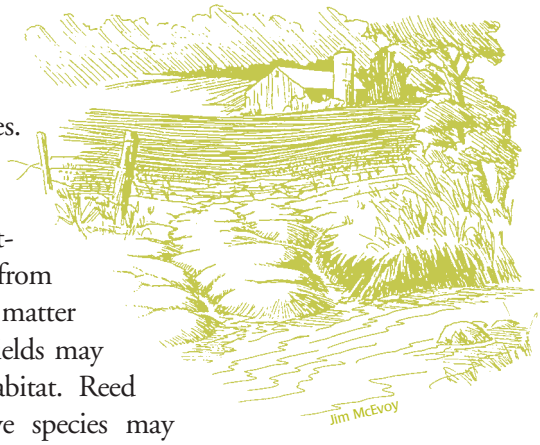
Ditch in Waukesha County wetland.

If a wetland soil is extensively disturbed, an opportunity exists for aggressive invasive species to establish themselves. Impacts to wetland soils that affect vegetation may include:

- cultivation,
- subsidence or erosion of muck soils,
- soil compaction due to cattle grazing or driving heavy machinery over a wetland, and
- placing telephone poles, pipeline, sewer lines, or underground cables.

Once the wetland sod has been broken, invasive species can get a foothold and may eventually outcompete the less aggressive native plants.

Siltation, or the accumulation of sediments, causes serious damage to wetland quality, especially in agricultural landscapes. Agricultural activities can cause soil erosion from fields to dump directly into adjacent wetlands. The increase in nutrients from manure, fertilizers, and plant matter entering the wetland from the fields may alter vegetation and wildlife habitat. Reed canary grass and other invasive species may encroach on a wetland that has trapped silt from adjoining farm fields.



Jim McEvoy

Wisconsin Wetlands Association

Many wetlands were filled historically.

Fill material such as soil, rocks, cement, and gravel brought into a wetland can have adverse direct and indirect impacts. The consequences of filling are usually quite obvious. The fill material may contain seeds of undesirable species that can

invade wetland areas. Filling one portion of a wetland may result in a shift in hydrology, increasing or decreasing water input into other areas of the wetland. For example, water pooling behind a dike or road will cause a shift in wetland vegetation to adapt to the changed water depth. A wetland that has been completely filled may not even be recognized as a former wetland!

Typical Disturbance Indicator Plants

Robert Queen

All the disturbances mentioned previously tend to reduce, modify, or change the quality of a wetland and its functional values, not to mention its aesthetic appeal. The biological diversity, or richness of plant and animal species in an area, can be seriously reduced through disturbance. A good wetland restoration project attempts to restore the original hydrology, plants, and animals to the site. Further discussions of wetland disturbance are found in Chapters 3 and 6.

Disturbed wetlands lose plant diversity and are typically dominated by only a few species. Several plant species frequently occur in the majority of Wisconsin's disturbed wetlands. Becoming familiar with these species will help you determine the extent of disturbance.

Purple loosestrife, reed canary grass, giant reed grass, and even cattails are extremely aggressive invasive plants that can grow under a number of conditions, ranging from wetlands with considerable seasonal inundation to relatively dry upland sites. Their presence indicates that some disturbance in the distant or recent past allowed the plants to gain entry. A more extensive discussion of these invasive species is covered in Chapter 6.

In many open wetlands in the southern areas of the state—shallow marshes, sedge meadows, wet meadows, and wet prairies—where the water table has been lowered and where fire has been suppressed, native and non-native shrubs and trees begin to invade. Glossy and common buckthorns are typical aggressive non-native shrubs that establish themselves. Native shrubs and trees that invade disturbed wetlands include red osier dogwood, gray dogwood, willows, prickly ash, quaking aspen, and box elder.

Linda Pohlod

WETLAND INSECTS

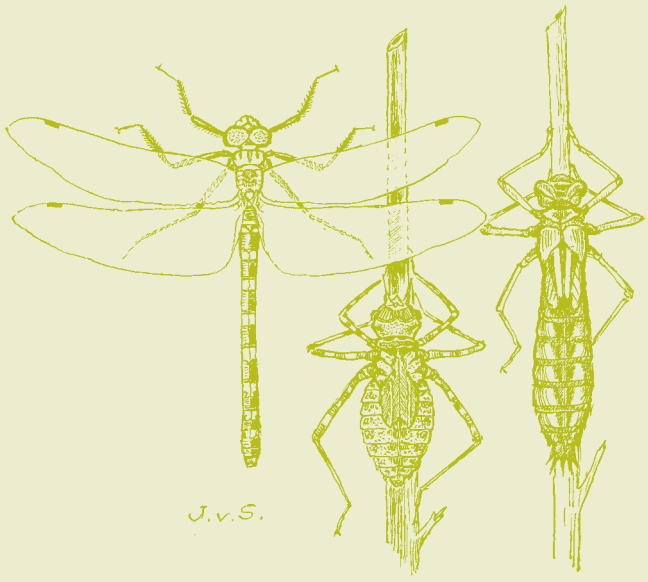
By Lesley Zuehls
University of Illinois

Wisconsin Wetlands Association

The mention of insects within a wetland typically conjures up thoughts of mosquitoes and other biting flies buzzing in our ears. However, there is a wide variety of insect diversity that depends on wetlands for survival. A healthy wetland will support an abundance of insects, creating a natural balance between predators and prey. This diversity ranges from aquatic to semi-aquatic to terrestrial. Some insects, such as dragonflies, damselflies, caddisflies, and mayflies, develop as larvae within the wetland before they emerge as adults into the terrestrial habitat. A number of insects never live within the waters of the wetland but depend on it for their survival. Butterflies, such as swallowtails, viceroys, coppers, skippers, and blues, frequent wetland plants as they forage and deposit their eggs. Extensive arrays of insects are found within wetlands, including beetles, true bugs, grasshoppers, leafhoppers, and many others.

Insects are critical for wetland function. The food webs within wetlands can be quite intricate. Insects shred plant material and graze on algae, breaking down and recycling nutrients within the system. Predators eat many of these insects and often each other as the larvae grow within the wetland's waters. Most aquatic insects emerge from the wetlands and are transformed into the terrestrial adult insects most of us are familiar with. As adults, these insects continue to play an important role within the wetland community. For example, dragonflies dart through the air, capturing and eating biting flies and other small prey along the way.

Restored wetlands carry out many of the same functions as natural wetlands and contain many of the same species. However, the effects on insect diversity within restored wetlands are not well understood. Initially, insect diversity will be low, but as insects colonize the wetland, this diversity will increase. The rate at which insects colonize depends on the distance between the restored and nearby wetlands and on insect type. Some species, such as dragonflies, are strong fliers and can colonize a new wetland rather quickly. The design of the restored wetland can encourage insect diversity. As the diversity of plant species increases, so will the diversity of insects. Plants provide habitat for insects both below and above the water's surface. Certain species of plants will encourage specific types of insects. Wetlands designed to mimic natural hydroperiods, basin heterogeneity, and native plant species will help to create a healthy system where a wide variety of insects thrive.



Dragon fly adult and nymphs.

CHAPTER 3.

ASSESSING YOUR WETLAND'S POTENTIAL FOR RESTORATION

"A properly restored wetland blends beautifully into its surroundings. An altered system just never finds its place in the landscape."

– Jeff Nania, Wisconsin Waterfowl Association

This chapter describes wetland restoration and leads you through the assessment of your land for its restoration potential. The information you gather on the site's soils, topography, drainage, and plant communities will be used in Chapter 4 to plan the restoration.

Remember that at any point you can seek help from the agencies and organizations described in Chapter 8. Restoration projects need considerable planning and may require local, state, and federal permits. Unless you are willing to pay for the restoration costs yourself, you may want to seek other sources of funding for your project. What may seem like obstacles early in the process can be overcome with careful planning, patience, and diligence. Remember that it took thousands of years for your wetland to evolve, decades or centuries to degrade it, and if it takes you a few years to see progress on your restoration, it is time well spent!

Restoration, Enhancement, and Creation . . .

Various terms are used in reference to wetland restoration. Definitions follow for several key terms that are used in this handbook. Check the glossary for other terms related to wetlands.

Wetland restoration is defined as the reestablishment of wetland conditions similar to the original condition in an area where wetlands were altered by past human activities.

Many of the state's former wetlands are significantly disturbed and have been altered by such activities as ditching, drain tile installation, stream channelization, and sedimentation. These areas generally have hydric soils typical of wetlands, and may have some wetland plants growing among weeds or crops. The key to wetland restoration of these sites is reestablishing the area's original hydrology and topography, and restoring natural processes including the original native plant cover.

Wetland enhancement is defined as the maintenance and management of existing wetlands for a particular function or value, sometimes at the expense of other functions or values. Degrees of enhancement activity range from simple measures to more complex activities. Generally, wetland enhancement activities are used to restore severely degraded wetlands to higher quality sites.

Art Kitchen

An example of an historic wetland "enhancement" where a pond was excavated from a sedge meadow wetland. The spoil piles are dominated by reed canary grass, an undesirable invasive species.

Enhancement includes management activities that affect wildlife habitat and vegetation. These activities compensate for natural processes that no longer exist. Examples include using prescribed burns, controlling invasive species, planting upland buffer zones, and providing nest boxes for wildlife (see Chapters 6 & 11).

Wetland enhancement can change the physical characteristics of a functioning wetland. Examples include impounding water behind a dike or dam at higher levels than historically present or dredging a pond in a relatively undisturbed wetland. These activities usually require permits and result in enhancing one wetland function at the expense of others. As we learn more about wetland diversity and functions, some practices undertaken with good intentions years ago, such as dynamiting ponds in wooded wetlands or sedge meadows, or planting reed canary grass, today are seen as unfortunate mistakes. Enhancement techniques should be evaluated carefully, because one generation's enhancement could create unintended problems for the next generation.

Wetland creation is the establishment of a wetland in an area where a wetland *never* existed historically. We create artificial wetlands by

impounding water behind a dike or dam or excavating surface soils in upland areas to create a depression. These efforts are costly and labor-intensive and the resulting "wetland" may not fit into the landscape and may never function as a natural wetland. Wetland creation requires a higher level of science than presently available.

The first problem encountered in creating wetlands is establishing suitable wetland hydrology. Even if that is accomplished, hydric soils appear to be critical to establishing a healthy wetland plant community. It is difficult to create the soil conditions that were formed by natural processes over thousands of years.

What Kind of Restoration Has the Best Track Record?

Based on the hundreds of wetland restorations and wetland enhancements and alterations that have been made across the state during the last 50 years, we are beginning to learn what works and what doesn't. ***The most ecologically sound and most cost-efficient approach to wetland restoration is to restore degraded, formerly drained wetlands by systematically undoing the activities that were done to alter them.***

Gathering Information on Your Wetland

You may have already begun exploring and documenting the features and ecology of your site as described in Chapter 2. To actually plan a restoration project, a more thorough site analysis is needed requiring information from diverse sources, including county and federal agencies.

Mapping the Site

Start your planning by sketching a rough map of your site based on simple field techniques. You will add detail as you locate additional information from diverse sources. The map you create will be the framework of your restoration plan.

For your mapping project, be sure to bring everything you need into the field (see checklist).

THINGS TO BRING:

- ☑ Notepad
- ☑ Pencil (to prevent ink smears)
- ☑ Camera
- ☑ Plant identification book
- ☑ Compass
- ☑ Bright-colored surveyor's tape or scraps of cloth torn into strips
- ☑ Recent aerial photo of the site (discussed later in this chapter)

You also need to measure your "pace." Most people have a pace, or stride, between 2.5 and 3 feet long. Your pace will be shorter in rough or wet terrain and on slopes. Measure an average stride against a marked flat surface (or take 5-10 strides, measure the distance, and divide by the number of steps taken) before heading into the field.

Your map helps create a general picture of your land with any special or unique features identified on it. Find a

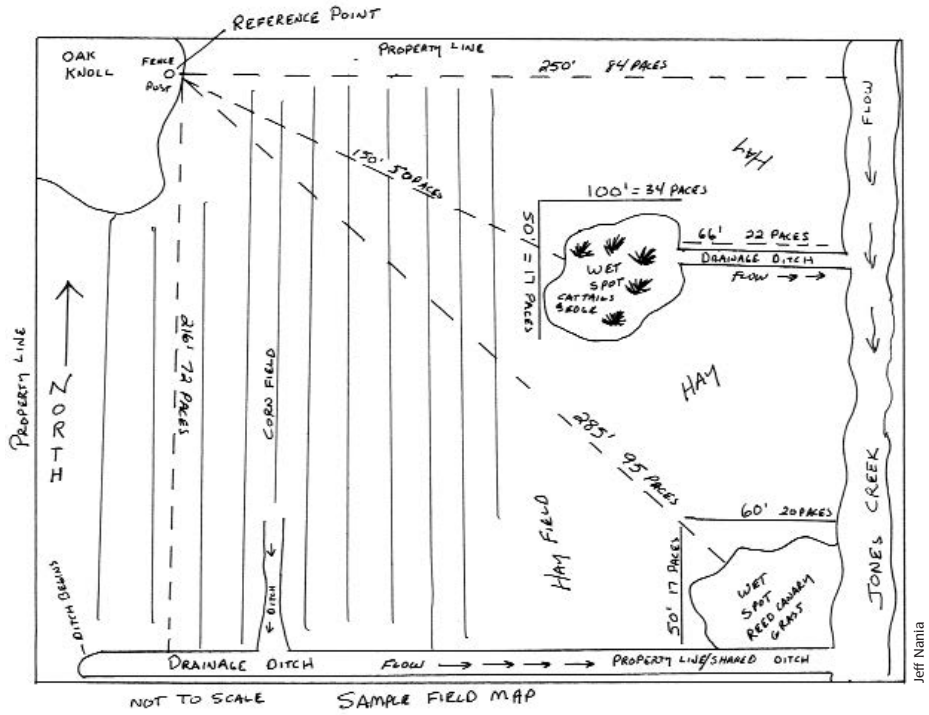
good reference point to start from, selecting a spot that offers a good view of the whole property, such as an oak knoll or the edge of a road. Note the location of your reference point on your notepad, for example: "standing on an oak knoll, next to a small oak tree, facing west." Mark your reference point with a piece of surveyor's tape or cloth.

Standing at your reference point, make a sketch map of your site. As you look across the site, note on the map the approximate locations of special features such as:

- ☑ Lakes, streams, or rivers nearby (including name if known).
- ☑ Topography of property (flat or hilly, note any large hills).
- ☑ Ditches.
- ☑ Drain tile outlets.
- ☑ Springs.
- ☑ Potential sources of water.
- ☑ Standing water.
- ☑ Cropland.
- ☑ Roads/culverts.
- ☑ Noticeable change in the types of plants.
- ☑ Mature trees or shrubs.
- ☑ Waterfowl or muskrat using the waterways.
- ☑ Any other clues of wildlife use.

Take a few pictures from your reference point by facing in different compass directions. Try to shoot overlapping images so they can be placed side to side when you review them at home.

Continue mapping your wetland by pacing distances from your reference point to any special features. Note distances and compass direction on your map. Document abrupt changes in vegetation, ditches, culverts, signs of disturbance, etc. When you get to a special feature, take a picture and make a



Jeff Nania

A hand-drawn field map will provide useful information for planning your restoration.

note of it. In this way you will build an archive of information and photos about the site. If you are working alone or with a technical consultant on your restoration plan, the more detailed information you can gather about the specific conditions and features of the area, the more complete will be the plan.

What Plants Occur on the Site?

You don't have to be an expert botanist to gather valuable information. Learning to identify the few invasive plants described in Chapter 6 is an important starting point. Use your field guide to identify the most common wetland plants at your site. It is easiest to identify plants when they are in bloom. Many wetland flowers begin blooming as early as April, although the majority will bloom in mid- to late summer.

You can be as specific as you like with your plant inventory, but if you are a novice at this try to get a general sense of what is found on the site. If you look at a wetland area and find no, or very few, invasive plants and many different types of plants, you are probably observing a good-quality community. Conversely, if you only see one or several different kinds of plants and one or more of them is an invasive plant described in Chapter 6, then you are likely in a lower quality plant community. Take a photo of the area, and of flowers and leaves of unknown plants if you need to confirm your identifications later.

Locate and note the most common plants on your map, and indicate the approximate size of the area. If the area of special interest is too large to measure easily by pacing, make a note of that and determine its size later by using the aerial photographs you will be obtaining for the planning process. Use the same technique for all the wet areas and any upland areas included in your project boundaries.

Where wetland plants occur is important because it denotes an area where some degree of wetland hydrology remains, and native plants may exist that you want to protect and promote during restoration. Areas with invasive weeds need control measures as part of the restoration process.

If you need help with plant identification contact the agencies or organizations listed in Chapter 8, find a friend who knows plants, ask for help at a nature center or local biology department of a college or university, or hire a plant ecologist to assist you.

Unraveling the Past

An investigation into the history of the wetland is important when planning how to restore the land. With perseverance you can find old maps and aerial photos, drainage plans and tile lines, historic crop yields, former owners or other kinds of details that piece together your property's history. At a minimum, you need to know the legal description—the *county, township, range, and section*—of the site. If you don't have this on a survey map of your property, the easiest way to find it is in a county plat book. Many government offices such as the county clerk or assessor's offices, libraries, and even real estate companies have plat books. Get a copy of the correct plat page and highlight the property location.

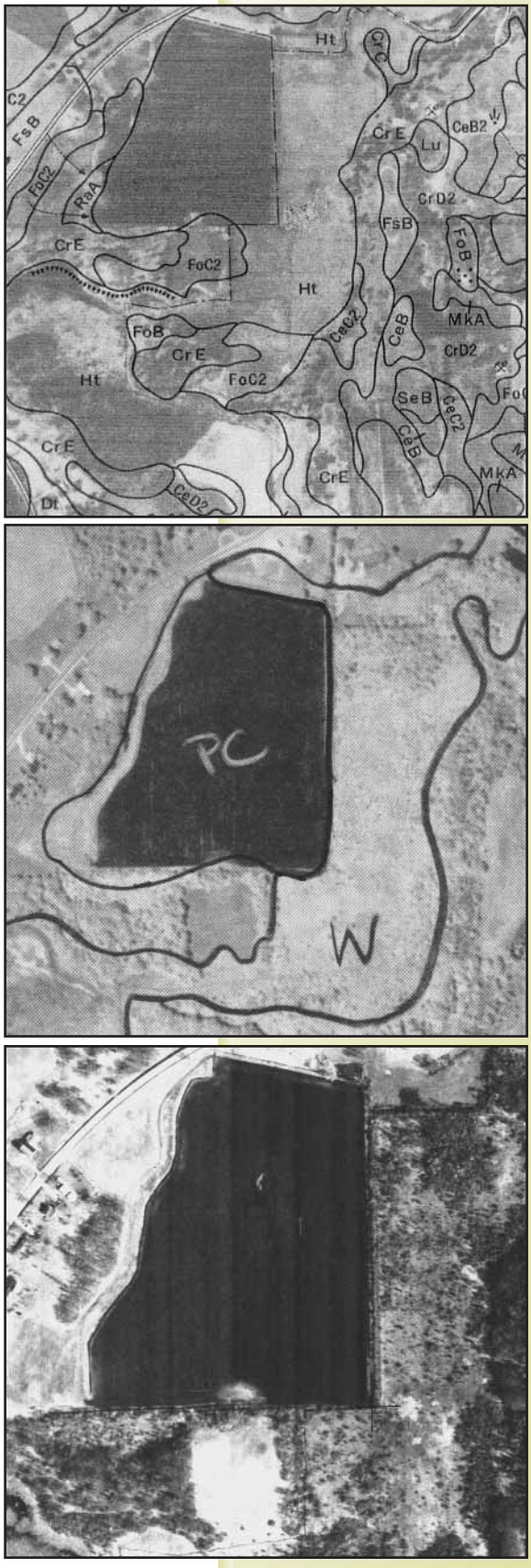
Visit the NRCS

Contact the Natural Resources Conservation Service (NRCS) office (formerly known as the Soil Conservation Service) or County Land Conservation office in the county in which your site is located. Make an appointment to obtain soil information about your property. You need to know what wetland soils you have on your site and where they occur. These hydric soil areas are where you can begin to restore wetland hydrology.

Bring all of the site information you gathered, including a copy of the page from the plat map, to your appointment. The agent will show you soil maps and can help you interpret them. The soil maps are aerial photos overlain with black lines and abbreviations of the mapped soil units, such as Ht for Houghton, Pa for Palms and VwA for Virgil, all of which are wetland soils, and PnC2 for Plano, an upland soil type (see map at top right).

Ask for a copy of the soil map and descriptions of the soil types on your site. Ask whether or not these are wetland soils. During your meeting, take notes about the soils and ask the NRCS staff if they have other information on the drainage of your site, such as maps of drain tile lines.

You should also ask if Farm Service Agency (FSA) aerial photographs exist for your site (see photo at bottom right). NRCS offices also have wetland inventory maps on aerial photographs, some with wetland soils already mapped (see photo at middle right). This soil mapping is a little different because it combines some current site



Top, the NRCS soil map of a drained, ditched and farmed wetland (dark area, upper left) shows the type of wetland (hydric) soil. Here, Houghton muck (Ht), a typical peat soil, occurs on the site. The land to the east of the drained site is an undisturbed wetland. A channelized stream flows on the east side of the drained field, and ditches have been dug on the other three sides.

Middle, the NRCS wetland inventory map of the same site labels the drained wetland as "PC", for "prior-converted" and the intact healthy wetland as "W." The site may be a good candidate for restoration, as the adjoining wetland could be a natural source of seeds and wetland wildlife that will reinhabit a restored wetland.

Bottom, the recent aerial photo is of the same site. Note how the intact wetland is considerably more brushy than what appears in the wetland map, which was based on an earlier aerial photo, perhaps due to a change in hydrology from the extensive ditching and channelization of the original wetland and stream.

Top and Middle Photos: Natural Resources Conservation Service, Bottom Photo: Southeastern Wisconsin Regional Planning Commission

WISCONSIN WETLAND INVENTORY MAPS
available from:
Wisconsin Wetland Inventory
Wisconsin Department of Natural Resources, FH/3
P.O. Box 7921
Madison, WI 53707
(608) 266-8852
www.dnr.wi.gov/org/water/fhp/wetlands/mapping.shtml

The Wisconsin State Cartographers office maintains the **WISCONSIN CATALOG OF AERIAL PHOTOGRAPHY** on-line that provides a comprehensive listing of aerial photography acquired by federal, state and local agencies, and other groups. Photos listed in this catalog span the period from 1936-2000. You can search for a photograph by county or area. The information will include what kind of photo it is, the year it was taken, the scale, where you can view the photo, and where you can purchase it. The on-line catalog is found at:
www.geography.wisc.edu/sco/aerial_sat/apsi.html
or call the State Cartographers office at: (608) 262-3065

The **ROBINSON MAP LIBRARY**, located on the University of Wisconsin campus has a worldwide collection of maps and an extensive collection of aerial photography of Wisconsin. The library is located in the Science Hall, 3rd Floor, 550 N. Park, Madison, WI.
Call for hours: (608) 262-1471 or visit their web site at:
www.geography.wisc.edu/map_lib.htm.

UNITED STATES GEOLOGICAL SURVEY TOPOGRAPHIC MAPS
available from:
Wisconsin Geological and Natural History Survey
3817 Mineral Point Road
Madison, WI 53705
(608) 263-7389
www.uwex.edu/wgnhs/

conditions and crop histories with the hydric soil types and can indicate what type of cropping or drainage history your site has. The abbreviations on the NRCS Wetland Inventory maps are:

PC for **PRIOR CONVERTED**, referring to a former wetland that has been drained to the point that it can be farmed most of the time.

FW for **FARMED WETLAND**, lands that were partially altered but because of wetness can't be farmed every year.

W for **WETLAND**, areas that are essentially unaltered or non-cropped that have been altered but still retain wetland characteristics. Many of these areas in parts of the state were timbered and possibly farmed in the past.

NW for **NON-WETLAND** can refer to upland or to non-cropped wetland areas that are so well drained that they no longer have any wetland characteristics.

NI means **NOT INVENTORIED**. The lack of any symbol also indicates NRCS personnel have not evaluated the site.

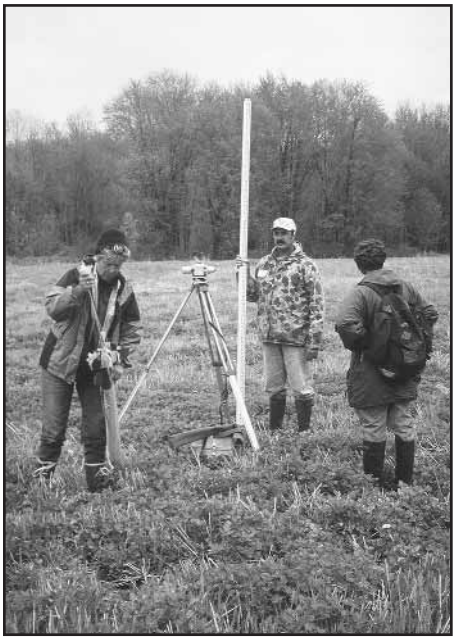
You can request this evaluation of your site at no charge, if you wish. Although these terms are used for farm program purposes and are not absolute determinations of wetland conditions, they are very useful for wetland restoration.

Obtain Other Maps

The Wisconsin Wetland Inventory has mapped known wetlands of two or five acres or larger in each town on aerial photographs. These maps are continually updated. Revised maps may show wetlands smaller than 2 acres. Maps of your town can be requested from the Wisconsin DNR office in Madison (see side bar). These maps provide a general idea of vegetation and hydrology on your site or adjacent wetland areas. Even if your site is not mapped, nearby wetlands may give you a clue about how best to restore your site.

Your county offices may know of other aerial photos by a public agency, such as the Southeast Wisconsin Regional Planning Commission (SEWRPC), which takes aerial photographs of its region every five years. If photos exist, order one for each year flown to determine changes to your site and adjacent properties over time. Aerial photos from the late 1930's to early 1940's are available for most areas of the state. Visit the state cartographers web site for more information (see side bar).

United States Geological Survey (USGS) topographical ("topo") maps can be obtained from the Wisconsin Geological and Natural History Survey in Madison. Topo maps will show the general direction of water flow. If a stream meanders it is less altered than a straightened stream. Because the topographic contour interval, which indicates elevation changes, is 10 feet, the maps may lack detail on your site. They do, however, provide an overview of how your site fits into the larger landscape. Your county may have more accurate topo maps with 2-foot contours; ask at the county or regional planning office.


Alice Thompson

Surveying a wetland restoration project.


DNR Archive

Topographic Survey

The most useful survey for wetland restoration is a 1-foot contour map. However, the 2-foot interval map may be enough to plan your restoration with some additional site information provided by a surveyor. If you hire a professional survey team, discuss the restoration objectives and site plans with them. For all ditches on site that you plan to fill or plug you need the width and height of the spoil bank on the side of the ditch, and the depth, width, and length of the ditch so that you can estimate the quantities of soil you will need during construction to fill the ditch. You will want the elevation of the bottom of the ditch as it enters and leaves the property as well.

Have the surveyor take a survey line across the width and length of the site, mapping low spots and high points to understand how water will flow or collect. You need to know the elevation of all low areas on neighboring properties to determine if restoring your site will flood them. The impact of increased water on neighboring property owners could be higher than the expected level of surface water and may extend 2-3 feet above that water level, depending on the soils and sources of water. You may need technical assistance to help you determine if your project will flood your neighbor's land if you do not own the entire wetland basin.

Interview the "Elders"

It is very helpful to speak with previous landowners that farmed or altered the site to find out how it changed. You may be able to track down previous owners through the county register of deeds or tax office. Another source of information is a neighboring landowner or town historian. Set up a visit, bring your maps and questions and start making a valuable friend. Questions to ask include:

- ☑ What did the land look like before it was drained?
- ☑ Was it shallow marsh, wet meadow, willow brush, or forested?
- ☑ When was the site farmed and was it farmed every year or only during dry seasons?
- ☑ When was it ditched?
- ☑ Does it have drain tiles, and if so are they clay, concrete or plastic? Is there a drain tile map for the field?

All of this information will contribute to your restoration plan.

If you cannot find the landowner, the NRCS or the County Land Conservation Department may have historic records of the property. In order to restore hydrology you need to find out what was done to the site. If you can locate this information, you have saved yourself many hours of hard work!

Putting It All Together

Now you'll need to compare all your maps. Refine your hand-drawn site map using the new information and correlate your photographs, air photos, soils map, and hand-drawn map. The FSA air photo, for example, is at a scale of 660 feet on the ground to 1 inch on the map; use this along with your pace to estimate the distances on your map. Your map should show the drainage features, wetland soils, remnant wetland plants, and upland areas. The map you produce will be the framework for your wetland restoration project. Giving adequate attention to map-making is well worth the effort.

What can you conclude about the history of your site? By examining aerial photos and talking to others, you will know crop history, past forest cover, when it was drained, and if it was ditched or tiled. Knowing the past helps you plan for the future.

Is There an Undisturbed Wetland Nearby to Study?

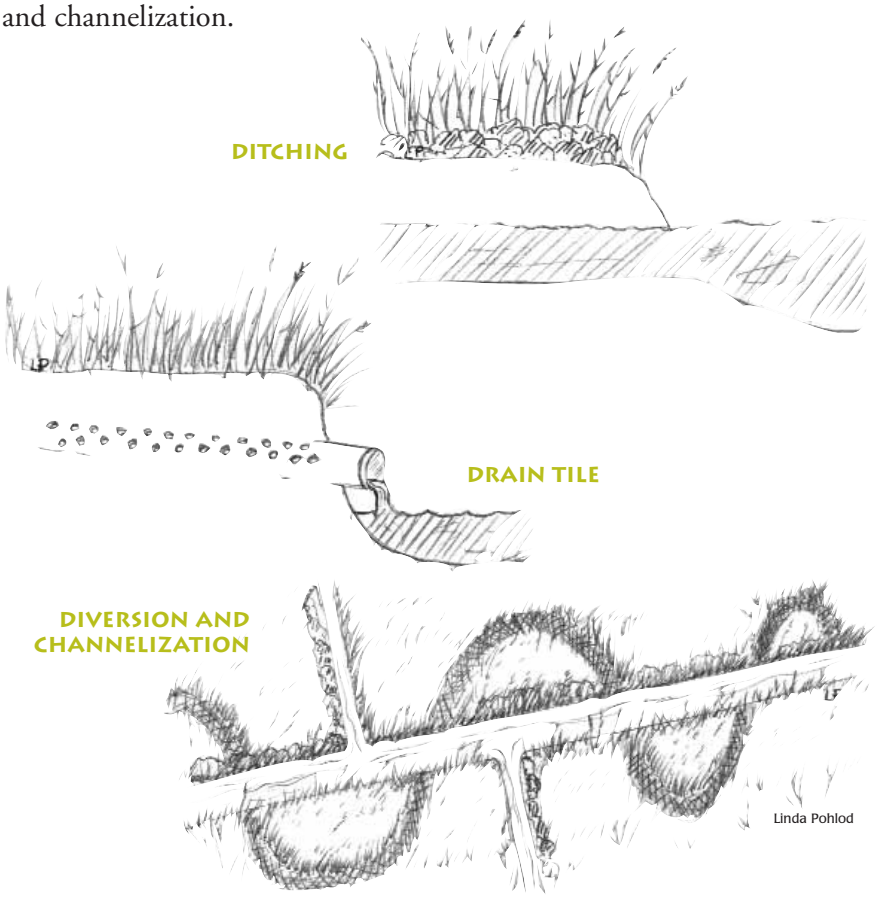
Once you determine the wetland soils on your site, check all the references you have gathered: the NRCS soil survey, USGS topography map, and the FSA aerial photograph to find areas nearby with the same soil types as yours. Can you find areas that haven't been as severely altered, perhaps unditched sites or public lands nearby? Either visit the publicly owned wetland, or ask a landowner's permission to study a nearby property. What is the vegetation there? Is it forested, shrub-dominated, or a grass or sedge wetland? How deep is the water? If possible, study the area over several seasons, to see how the hydrology changes. Take photos to document the site. If the site is in relatively good condition, you may want to use it as a model for your restoration efforts.


Linda Pohlod


Jessie Hewitt

Where Did the Water Go?

To determine if your site is restorable you need to discover if, when, and how it was drained. If your site was drained, you need to know by what means to help determine how to reestablish hydrologic conditions. The most common hydrologic alterations are ditching, drain tile, diversions, and channelization.



Most sites have experienced a combination of several modifications; for example, rows of drain tile running to a ditch. If there are no obvious drainage features on the landscape, you may need some assistance to determine whether the land has been drained.

DITCHING is the most common alteration technique. Dug in the wetland, the ditch usually begins at the wetland's lowest point, and it lowers the water table and channels the water from the wetland.

USING DRAIN TILE involves placing underground perforated drainage tubes made of plastic, concrete, or clay at regular intervals across the wetland at depths from 2 to 5 feet. Slots in the tubes collect water from below the surface and channel it to a ditch or stream.

DIVERSION or **CHANNELIZATION** alters a stream that once ran though a wetland. The stream is blocked and a channel dug to straighten the stream and divert the water away from the wetland to another ditch or stream.

How about the Soil Conditions?

Another significant disturbance on many sites is sedimentation, or siltation, caused by eroded soils transported in runoff following rain or rapid snow melt. The impact of sedimentation on wetlands is so pervasive it is common to find sediment deposits completely burying original wetland soils. This is often found in wetlands downslope of cultivated agricultural fields or in floodplains. Even if an upland field is now fallow, erosion and deposition of sediments onto the wetland may have occurred years ago when early settlers cut down


Art Kitchen

Light-colored silt eroded from upland areas has accumulated over the darker wetland (hydric) soils.

"Soil is the hidden, secret friend, which is the root domain of lively darkness and silence"

– Francis D. Hole

upland forests and farmed the land. Eroded soils are carried to the lowest point in the landscape, generally wetlands. Floodwaters of rivers and streams continually deposit sediment in adjacent wetlands over time.

There are few wetlands in hilly agricultural settings that have not been impacted by sedimentation. In the "driftless" unglaciated southwest region of the state, sediment accumulation is so deep that entire river valleys are now 8 to 10 feet higher than they were historically, and it is impossible to reverse the impact.

If you suspect that sedimentation has occurred on your restoration site, you need the following tools to assess the site: a spade (a narrow bladed "sharpshooter" works well), a post hole digger or soil probe, and strips of lath or wooden wedges to mark the edge of the sediment layer.

If your wetland is adjacent an upland farm field, dig a series of holes from the interior of the wetland where you think there is no sediment towards the upland slope where you suspect there is sediment. The original edge of some wetlands is considerably farther "up slope" from where it is now, buried by sediment. Look, as you dig, for a change in color and texture between the soil layers or profile. The sediment tends to be brown with fine loose particles, horizontally stratified (as if deposited in layers), and has no sands or gravels. The buried wetland soil should be a characteristic black or very dark gray color. Peats or muck soils will be very black, spongy, and once water is squeezed out, very light in weight. Buried wetland mineral soils will be black to very dark gray in color. Depending on the soil types, there may be a very visible line where this change takes place, for example a distinct color change at thirteen inches below the soil surface where a brown silt overlays a black muck wetland soil.

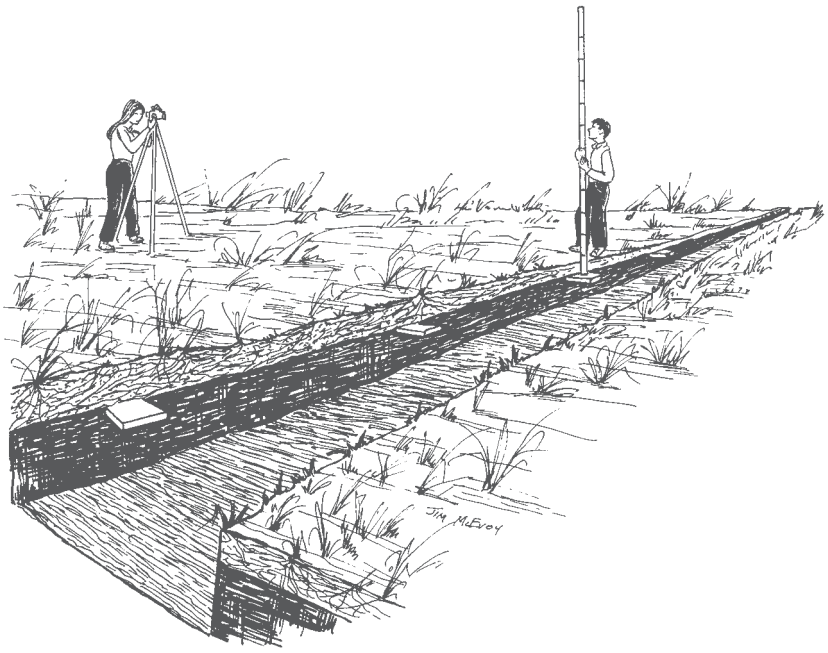
Several inches of non-wetland soils in soil pit are visible above the wooden shim that marks the darker hydric soil.

Photos: Alice Thompson

Push a wedge or wood strip "shim" into the side of the pit at the boundary between soil layers (see photo at left), and measure and record the depth to the boundary. Flag your pits so you can locate them again. Dig several lines of pits to determine the depth of sediment across the site. If the sediment is deeper than you are able to reach by hand digging, you can try to determine the depth of wetland soil using a soil probe at the bottom of the pit (A typical soil probe can be purchased for less than $100.00 in environmental supply catalogs and has a reach of 3 feet. Large diameter tubes (1¼″) collect samples much better in wetland soils than narrow probe tubes). Again, as you probe deep, look for the change in texture and color and measure the distance from the soil surface. In sites with very thick sediment accumulations, or in very large sites, a backhoe for digging a trench may be the only feasible way to find the original wetland soil level. If the sediment is too thick, it may not be possible to remove it at all because of the cost of equipment time or the lack of available upland space for the removed material.

While you are investigating the soils, you may want to take soil samples and test them for the presence of viable wetland seeds. Carefully remove a sample of the original wetland soil from within the soil pit and place it in a plastic bag marked with the location of where the sample was taken. See the discussion in Chapter 5 on how to conduct a seed bank test.

You need to keep careful notes of the position of each pit and the depth of sediment. To accurately determine the former topography of the



Surveying for original topography by taking elevations on the original hydric soil layer and the current ground surface.

wetland before the sediment was deposited, you need to have your site surveyed. The surveyor needs to take two elevations at the soil pit: the elevation of the existing ground surface next to your hole, and the elevation of the original soil, which is where you placed the shim. Using these elevations you can draw two cross-sections for your site- one that shows the existing grade and one that shows the original grade. The difference between them is an estimate of how much soil needs to be removed if you want to restore the original basin.

Do You Have a Restorable Wetland?

The aim of all the research thus far is to determine your site's condition, if and how it has been significantly altered and drained, and what the site may have looked like before the alterations took place. You will use this information in deciding what steps to take in management or restoration. Generally there are three possibilities:

1. **Wetland needs conservation and management.**
   You may have discovered that your wetland is relatively diverse and not significantly altered. If it supports a native plant community, you have something of great value worth preserving and protecting for native wetland plants, mammals, amphibians, reptiles, and birds. The site may require some management and little else. The use of fire, brush cutting, mowing or other management activities may improve the wetland's condition. Your restoration efforts may best be focused on an upland buffer planted with native species to increase wildlife habitat and use surrounding your wetland (see Chapter 11).

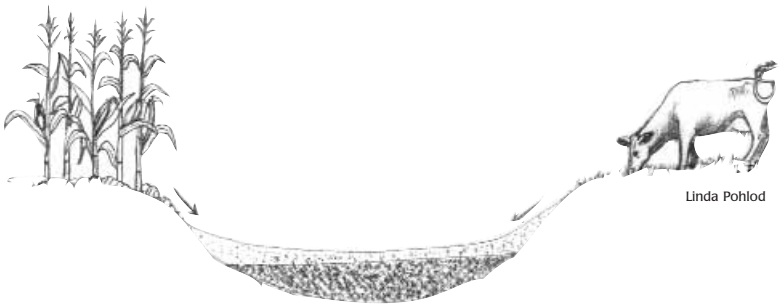
2. **Wetland is very degraded and can be restored.**

   The site may have undergone significant changes due to draining and/or cultivation, and supports little to no native wetland vegetation. In the process of researching your site, you have uncovered the artificial drainage features and now have enough information to plan the restoration. You may need a survey to determine that neighboring lands will not be affected when you restore the hydrology to original conditions. This book is for you!

3. **Wetland is very degraded but cannot be readily restored.**

   If your site lacks drainage features such as ditches or tile lines, there may be nothing you can do to restore the hydrology, short of massive excavation. This may be the case where a small shallow wetland has been filled with sediments and no longer supports wetland vegetation. Excavation may be fruitless if the water table has been drawn down on the site.

   Often, your restoration activities could cause problems for your neighbors, especially if it alters the movement of water on their land. You may own only a part of the entire original wetland, and need to join in partnership with your neighbors to restore a larger site to ensure that the hydrology is adequately restored. Another option is to wait for neighboring land to come up for sale. At this point you may want to consult with an expert to help determine what options are available to you.



Linda Pohlod

Agricultural activities may lead to soil erosion, which leads to sedimentation of lowland areas, including wetlands.

U. of Florida, Center for Aquatic Plants (Gainesville)

What to Look for If You Are Purchasing a Wetland to Restore

This chapter was intended for those who own land and want to find out if it can be restored. Many landowners, however, seek properties to purchase and restore. To make a wise investment you will want to evaluate potential for wetland restoration of a site very carefully. The strategies outlined in this chapter can help you assess whether the property you plan to purchase can be effectively restored to a self-maintaining wetland system. Case Study #2 in Chapter 13 is an example of a wetland restoration that included an exhaustive site search. Much of the success of that site comes from finding a great site to restore.

Occasionally wetland enthusiasts purchase an existing wetland assuming they can flood it or dredge it to alter its function, only to find they are unable to obtain the needed Wisconsin DNR permit. Typically, the Wisconsin DNR determines, for good reason, that the existing wetland should remain intact and not be changed. Impounding water on a healthy sedge meadow or swamp forest, or dredging a healthy wetland, can destroy most of the natural plant

and animal diversity these wetlands support. While the open water created in such a project may attract waterfowl initially, once wetlands are altered, they become prone to invasion by non-native plants, and their habitat value diminishes over time. They are often very expensive to maintain.

Purchasing drained cropland with wetland soils, and restoring the hydrology and vegetation is more cost-effective and ecologically sound. Following are characteristics to look for in a potential wetland site to restore. The characteristics listed and terms used were discussed earlier in this chapter. Before you purchase land for restoration you may need a survey crew to determine if neighboring lands would be affected.

Look for the following features in a potential wetland restoration site:

- ☑ Not mapped as wetland in the Wisconsin Wetland Inventory.
- ☑ NRCS mapped as "prior converted" (PC) wetland or "farmed wetlands" (FW).
- ☑ NRCS mapped soils are wetland soils.
- ☑ Site has functioning drainage features: drain tiles, ditches, diversions, pumps.
- ☑ Topography allows restoration of hydrology without affecting neighboring land, which may require a topographic survey to determine.
- ☑ If actively cropped, wetland plants are found in edges or between cropped plants.
- ☑ Buffer areas can be incorporated into the site to lessen pollution impacts and sedimentation from roads, lawns, farms, etc.

If you purchase prior converted cropland that has great restoration potential, continue to have the site farmed and maintained until you are ready to construct the wetland. Farming the site will keep invasive wetland weeds from taking over while you finalize permits and plans and will make the construction phase more feasible.

Deanne D. Wilde

CHAPTER 4. PLANNING YOUR WETLAND RESTORATION

Using the site information you gathered in Chapter 3, you are now ready to begin planning your restoration project. Planning a wetland restoration is not a simple task. ***This important process is critical to the outcome of your project.*** The planning process should comprise fully 50 percent or more of the time and energy you put into the project. Each project will have an individualized goal and plan based on its unique characteristics. We encourage you to work with wetland consultants and restoration professionals during the planning stage. Some assistance may be available from the agencies and organizations listed in Chapter 8, or from federal and state agencies listed in Appendix B.

"The first rule of restoration is to have a goal. I can't stress this enough. You have to know where you're headed in order to know how to get there, and when you've arrived."

– Jeff Nania, Wisconsin Waterfowl Association

Set Project Goals

What is the goal of your restoration project? Based on your understanding of the site, you have a picture of how it may have looked originally. An ecologically sound goal is to reverse the historical impacts and restore the site to its original features. Some examples of restoration goals are described on the following pages and illustrated in the case studies in Chapter 13.

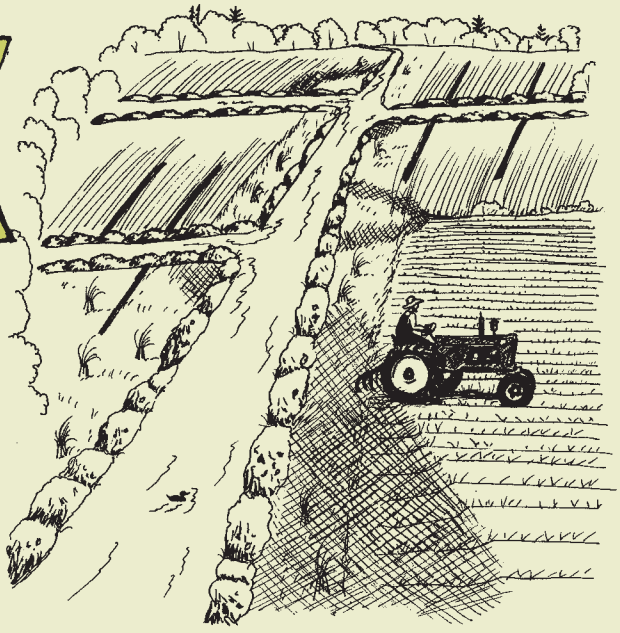
WETLAND DESTRUCTION

About 50 percent of Wisconsin's wetlands were destroyed over the past 100 years due to ditching, tiling, filling, and stream channelization. As agricultural activities intensified, more wetland acreage was lost.

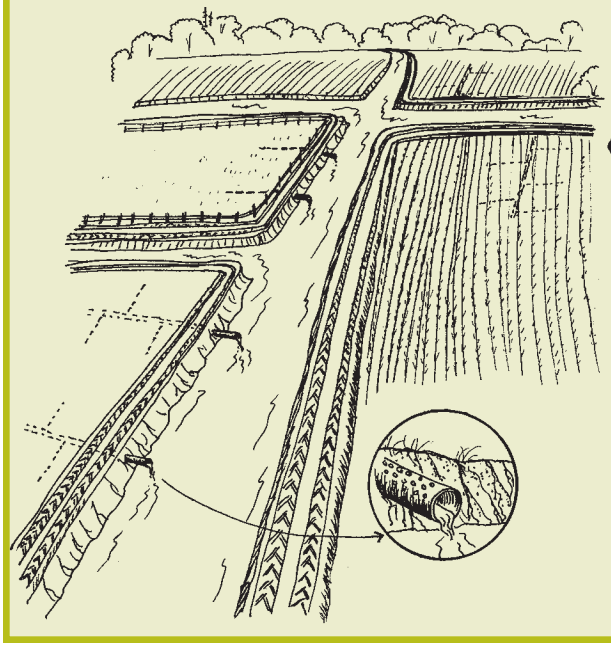
1890
An undisturbed wetland in the 19th Century.

1920
Ditching wetlands began in the early part of the 20th Century.

1960
From the 1940s to the 1970s, extensive wetland ditching, drainage (using tiles), and stream channelization for expanded agricultural activities destroyed many of Wisconsin's wetlands.

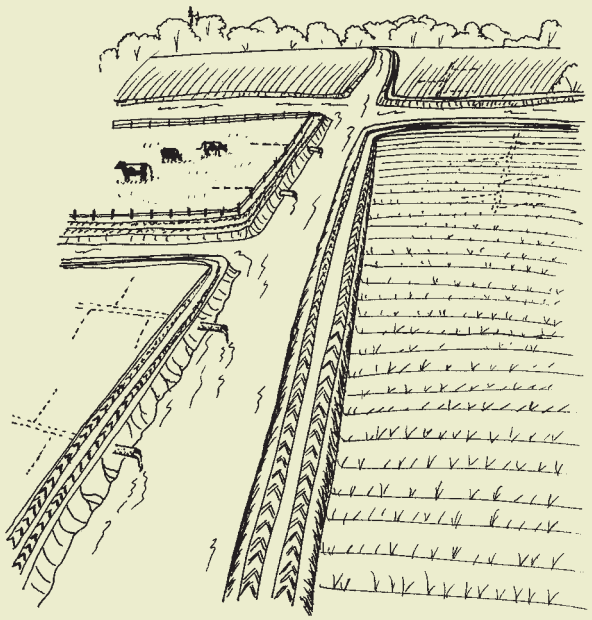


PRESENT
With intensive farm practices, many fields that border drainage ditches have no buffer whatsoever.



WETLAND RESTORATION

It is important to establish your wetland restoration goal at the outset of the restoration process. Once partial restoration has been initiated, it is almost impossible to return to the site for more complete restoration.

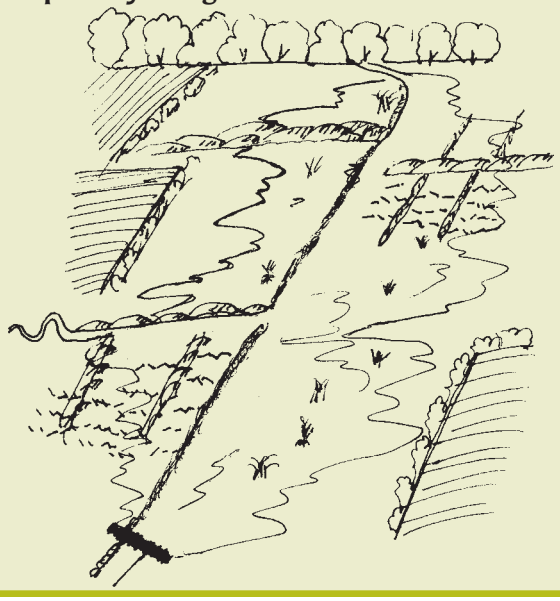


DRAINED, DITCHED, AND CHANNELIZED WETLAND, FORMERLY FARMED, TO BE RESTORED.

GOAL: MINIMAL RESTORATION.
This, the simplest restoration, entails ditch plugs only.

GOAL:
COMPLETE HISTORIC RESTORATION.
All historic changes are reversed: drain tiles are disabled and both the lateral and main ditches are filled, allowing the stream to reestablish its original channel.

GOAL: PARTIAL RESTORATION.
In this scenario, ditches are filled, drain tiles disabled, and the main ditch plugged to the height of the surrounding topography to allow almost complete hydrologic restoration of the site.



Setting Project Goals, Continued

1. Historic Restoration

Returning the site to a close approximation of original topography and wetland hydrology are goals of historic restoration. You use the information you gathered to reverse each site impact. In the end, you want to create a self-sustaining site and let natural processes restore the wetland. A variety of techniques, specific to each site, are often used to reach this goal (see Case Study #2, Chapter 13).

2. Restoration Within Limits

Not all sites can be restored to their historic state. Often, you may own only a part of the original wetland and some ditches must be retained to avoid flooding neighboring lots. If your neighbors will not join in with you, it may still be worthwhile to create the best restoration you can within the confines of your circumstances. The goal of the project is then to create a self-sustaining system within limitations by using as many tools as you can.

3. Small Shallow Marsh Scrapes

Creating a series of shallow water bodies that attract wetland wildlife, including waterfowl, in lands formerly converted to cropland from wetland is a goal of shallow scrape projects. Many of these sites are constructed as small potholes in cropped fields, often using drain tile breaks, scrapes, and berms to trap water. Usually successful at attracting waterfowl, these projects do require berm maintenance and may not be self-sustaining wetlands in the long term. This approach is not recommended for functional native wetlands. The case study in Chapter 1 and Case Study #1 in Chapter 13 feature such scrapes.

4. Management/Enhancement of Wetland

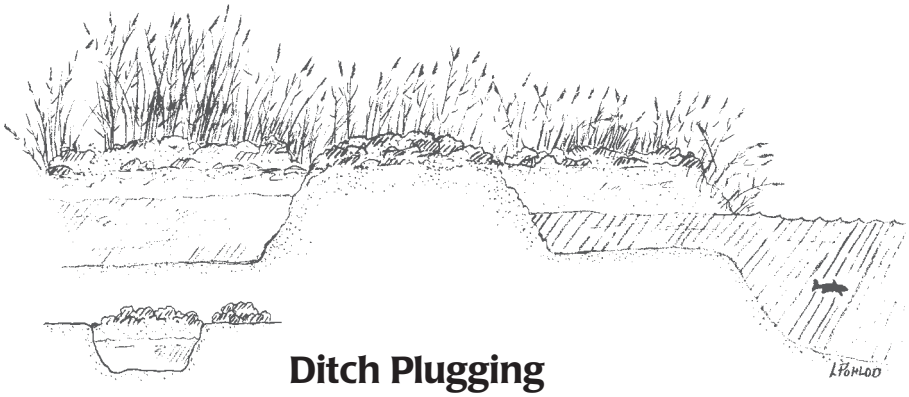
These projects aim to increase the overall plant and animal diversity on your site via active management. Many sites are severely degraded by invasive plants. An example of a management/enhancement plan would be to initiate a prescribed burn, eliminate the invasive plant species, and plant a buffer zone of native prairie grasses to encourage wildlife habitat and nesting areas. On many sites in northern Wisconsin, a special case of wetland enhancement involves restoring the native wild rice community, where appropriate (see Chapter 12).

Enhancement should not entail bulldozing a pond in the middle of a wetland and heaping up spoil piles around the perimeter of the pond. The perceived value of open water to waterfowl will be at the expense of many other species. The barren, drier spoil piles are, unfortunately, an ideal site for reed canary grass to become established. The water flowing into the pond may drain the wetland surrounding the pond, increasing the likelihood of reed canary grass thriving. Once this invasive grass takes hold, the pond has very limited wildlife use. All other native plants are shaded out. Frogs, toads, salamanders, and turtles cannot navigate through the combined obstacle of spoil piles and reed canary grass thatch. The overall diversity of the site is ultimately diminished.

Linda Pohlod

Use Your Restoration Toolbox

Wetland restorationists have assembled a "bag of tools" over the years and your plan will likely use one or a combination of these tools. Which combination you use will depend on your site, your resources, and your goals.



Side-view of a simple ditch plug.

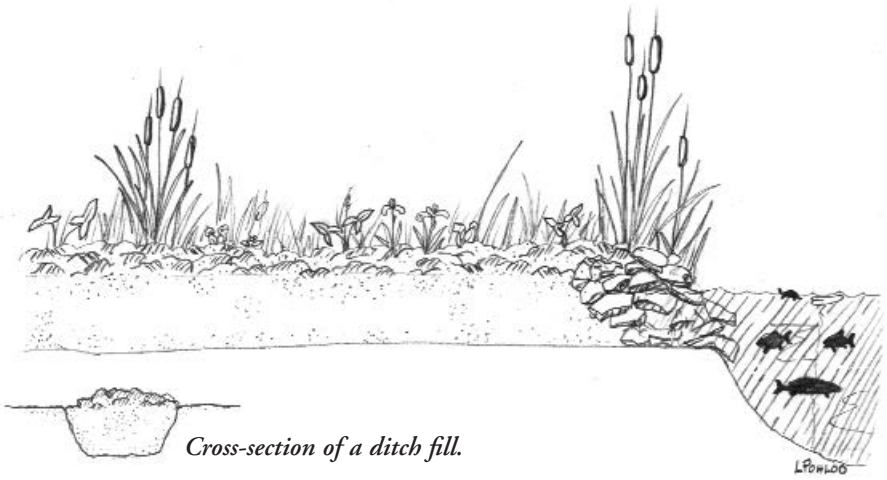
Cross-section of a simple ditch plug.

Ditch Plugging

Many wetland sites have a ditch or several ditches that drain the wetland. The quickest and least expensive option for reversing the harmful effect of the ditch is to plug it at the lowest point. By pushing an earthen plug into the ditch, the drainage stops and water backs up in the wetland. Current recommendations are to plug at least 150 feet of ditch if the soils are organic and 100 feet if soils are mineral. The plug should rise 33 percent above grade for organic soils and 20 percent above grade for mineral soils to allow for soil settling. A gentle slope with at least an 8:1 ratio, where for every 8 feet of width the level goes up a foot, is best. In some instances ditch plugs require periodic extensive maintenance to ensure that they remain functional.

Below, ditch plugs.

Photos: Art Kitchen



Cross-section of a ditch fill.

Side-view of a ditch fill.

Filling Ditches and Recontouring

Back filling the entire ditch is an alternative to a plug. In most cases filling may result in a more effective and permanent restoration of site topography and hydrology than simply plugging the ditch. Typically, ditches are rimmed by soil berms, called spoil banks (or spoils), made up of the earth excavated when the land was ditched. Spoils can be on one or both sides of the ditch and create an unnatural rise in topography that serves as a barrier to water flowing across the site. The spoil piles can harbor invasive plants such as glossy buckthorn, reed canary grass, or other upland weeds, and are a conduit for predators to readily enter and traverse the wetland.

Depending on the size and depth, a ditch may have a negative hydrological impact on the wetland due to its water storage capacity. Ditches may drain water from the adjoining wetland and store the water in a deep, narrow, artificially concentrated basin, effectively lowering the water level in portions of the wetland and making it vulnerable to invasive species.

To return the site to its historic topography, ditches are filled with the spoils from the sides of the ditch. The land is recontoured to approximate the original topography of the site. Practitioners of this method make sure the spoil is compacted in the ditch, and then build the spoils up about 10 percent over the level of the ground to allow for settling.

The spoils may have decomposed since excavation, requiring additional on-site materials for fill or expensive off-site soil that must be trucked in. The on-site material typically comes from removing topsoil in a relatively small area and scraping the subsoil to a depth of 1-3 feet in a shallow pond configuration, then regrading the topsoil over the borrow site. An alternative method is to scrape soils to 6 inches over a larger area to use as fill for the ditch. Such a scrape would be ideal where a reed canary grass monoculture exists.

Ditch filling is perceived as more costly than using a plug. The actual cost per acre is less, however, because more wetland can be restored using a ditch fill than with a ditch plug alone. Once completed the filled ditch does not usually require further maintenance, as may a ditch plug.

Probing for a tile line in an abandoned farm field.

Alice Thompson

Disabling Drain Tile

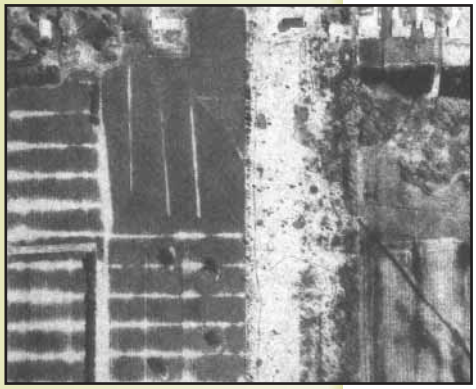
Alice Thompson

Drain tile.

Drain tiles are perforated, hollow tubes buried underground, usually in an array of parallel tile lines 2 to 5 or more feet deep. As water infiltrates into the soil, it collects in the tile and drains off site to a ditch or stream. As long as drain tiles function, they are very efficient at water removal. Tiles were first made of wood, then clay (1900-1970) and concrete (1940-1970). Since 1970, plastic has become the preferred tile material. Several kinds of tile may occur in the field, depending on when they were installed. Multiple layers of tile may have been laid in your farmed wetland by several generations of farmers.

If your site contains drain tiles you need to locate and disable them. The original farmer, NRCS, county land conservation office, or excavation firm that placed the tiles may have a tile map for the site. Aerial photos of your site occasionally reveal tile locations if they were shot in the spring, because frost heave can show outlines of the drain tile lines in a bare field (see photo, below). Once the land is plowed or vegetated they are not visible.

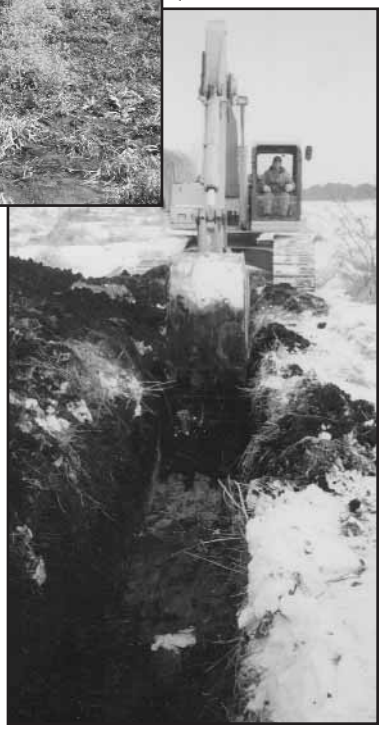
If no tile map exists, search the ditches for outlet pipes. If you find no outlet, there may be tile lines—maybe as long as several miles—passing through several properties before reaching an outlet. Once you find an outlet you can locate tile lines in the field with a tile probe, flagging stakes, and patience. A tile probe can be purchased from a forestry or natural



Southeastern Wisconsin Regional Planning Commission

Alice Thompson

Alice Thompson



Alice Thompson

Top left, aerial photo reveals locations of drain tiles as whitish straight lines caused by frost heaves on unplowed fields.

Top right, low spot in field indicating tile line below.

Right, plastic drain tile line exiting farm field into ditch.

Far right, tile lines being broken in a farmed wetland.

resources catalog. You can search the worldwide web under the key words "forestry suppliers" for companies that sell natural resources equipment. A section of rebar is a cheap and useful tile probe.

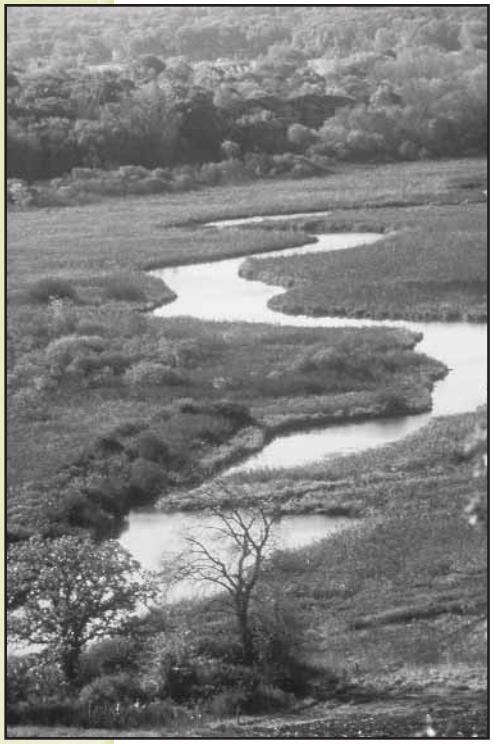
Probe the soil close to the outlet until you locate the tile line, which generally is buried from 2 to 5 feet below the soil surface. Hand dug lines installed many years ago may be closer to the surface, at 1.5 feet. Place a flag where you find a tile. Move several feet away, and again probe until you find the line, and place another flag. Now using the 2 flags as points on a straight line, go some distance and again relocate and flag the line. Continue until you have mapped that line. Likely, the next line lies parallel to the first. In heavier mineral or clay soils the lines are 40 to 80 feet apart. In sands or muck the lines are commonly 80 to 100 feet apart, though some lines could be up to 150 feet apart.

Once the lines are located, remove them and fill the trench. Clay tiles can be crushed and reburied. Most tile lines drain to a ditch so if you fill, re-grade the ditch, and remove or destroy the line, you will double your chances of successfully restoring the original hydrology.

It is equally important to disable the "soil conduit," the space created by compacted soil surrounding the tile lines that forms a distinct channel. Water can flow out this channel as efficiently as through the tile line itself and must be filled in and compacted after the tile is removed or crushed.

Photos: Jeff Nania

Beginning at the top, these three photos show the wetland six days, two weeks, and one and a half months after the tiles were broken.



Photos: Left, Wisconsin Wetlands Association Right, Alice Thompson

Left, undisturbed stream meandering through a wetland complex.

Right, creek dredged, straightened, and concrete lined.

Stream Channelization and Realignment

Most sites that feature stream channelization and realignments included other drainage techniques. A meandering stream may have been realigned and its channel straightened, widened and deepened, as well as tiled or ditched. In such sites you may be able to restructure and restore the original waterway using old aerial photos and the topography of the site as guides. Spoils are put back into the ditch and the site re-graded as close as possible to the historic grades of the original meandering stream channel.

Due to changes in upstream drainage, the amount of flow in the stream may be greater than what existed historically. Returning the stream to its original course requires care; simply filling the ditch and diverting the stream could lead to a wash out and reversion to the old ditch channel. Instead, when filling the ditch and grading, return the original base material to the ditch first. Thus, the last soil removed from the ditch becomes the first soil put back in. It should be compacted as hard as it can be with equipment as it is added. On some sites it may require compaction for every 6 to 7 inches of material. The very last step is to remove the diversion and direct the water down its original path.

Reconfiguring a stream requires experienced assistance. Any stream work will require Wisconsin DNR permits. Your local Wisconsin DNR water management specialist can guide you through the permit process. Extensive erosion-control practices will be required to ensure that sediments washing in do not become a problem. Work may be done in the winter when the ground is frozen and water is tied up as ice to minimize erosion. A variety of devices exist for trapping soils and sediment before they reach the waterway, including silt fencing, silt booms, and biodegradable fiber matting.

Berms, Dams, Dikes, and Levees

Berms, dams, dikes, and levees are all earthen embankments constructed to contain water. These will be referred to here collectively as berms. These structures must be properly designed to prevent failure due to over-topping, seepage, sloughing, or collapse. Berms often are used to increase water levels in a wetland above historic levels to create open water. They also can protect a neighboring property from flooding.

Berms require maintenance to control muskrat damage and to guard against erosion caused by heavy rains. Another issue with berms comes from elevated water levels inhibiting the germination of native vegetation where the seed bank is adapted to shallower water. A spillway must be properly engineered if included in the berm design to establish a maximum water level. You will undoubtedly need a Wisconsin DNR permit to construct a berm.

Water Control Structures

Water control structures control flows into and out of a wetland. Such structures include spillways, pipes with drop inlets, and stoplog water controls. A spillway, a low point in a berm, provides an escape for excess water above the designed level. The scrapes described in Case Study #1 in Chapter 13 are an example of the use of a spillway. Stoplog and drop inlet water control structures also control water levels on the site, but give the owner/manager of the property more control over filling or draining the area.

Berms in conjunction with water control structures can be used temporarily to control invasive species and to manage for a native plant community. Such structures were employed in Case Study #2 in Chapter 13 to flood reed canary grass during the restoration project, and to manage wild rice habitat (Chapter 12). Long-term reliance on water control structures as the sole alteration of hydrology is cost-prohibitive and does not restore self-sustaining wetland systems.

Jeff Nania

A stop-log water control structure in a ditch.

Scrapes

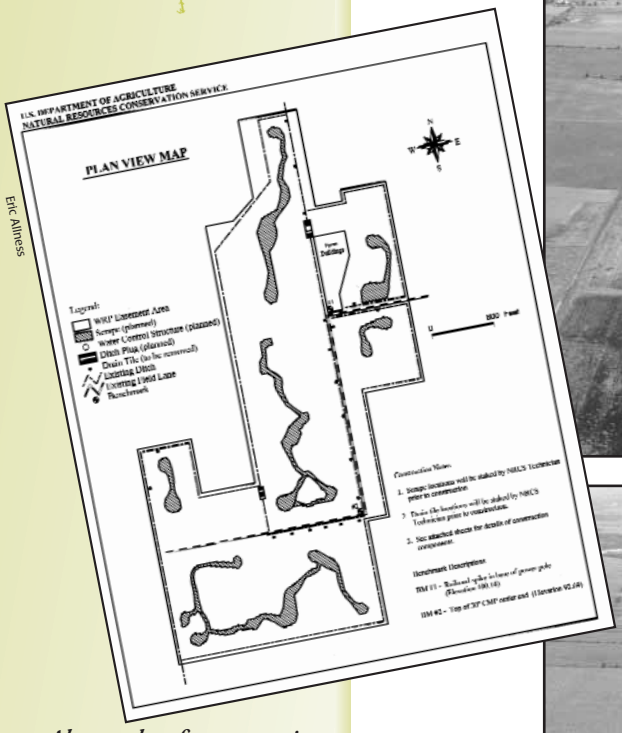
Many small "pothole" or scrape wetlands are being constructed, often in clusters, in croplands across the state (see Case Study #1 in Chapter 13). On suitable sites, topsoil is stripped away to expose sub-surface soils, which are removed to create a berm. Then the topsoil, comprised of wetland soils and the seed bank, is redistributed over the surface of the newly formed basin. On some sites, eroded topsoil deposited in a former wetland depression in the field can be scraped out, uncovering the original wetland soils. On other sites wetland soils or wetland seed banks may be nonexistent.

These pothole wetlands often create suitable wetland habitat for waterfowl and amphibians. Researchers monitoring these sites for bird and animal use find that sites with the highest wildlife usage have a 50-percent-open-water to 50-percent-vegetation ratio. Because no single design can fit all wildlife habitat requirements, where appropriate, clusters of scrapes should vary in size, shape and depth to create habitat diversity. Very small scrapes, as little as 0.03 acres in one study, tend to dry down before waterfowl and some amphibians have a chance to breed. A deeper area of at least 3 to 4 feet within the scrape inhibits cattail or reed canary grass growth and provides muskrat habitat. Muskrats will control cattails and create open water, but they can also burrow into and even destroy a berm.

If there are few seeds in the soil, wind-borne seeds of prolific wetland plants, such as cattails and willows can dominate the plant community (see Case Study #1 in Chapter 13). Purple loosestrife and reed canary grasses commonly move into these sites after a few years.

Scrapes provide an appropriate remedy in some situations, but in the long term they may not become self-sustaining wetlands. A small scrape constructed within an area that could support a much larger restoration does not realize the full potential of the site.

Jessie Hewitt



Eric Allness

Eric Allness

Kevin Halvorson, USDA-NRCS

Above, plan for restoration for wetlands shown in photos at right.

Top right, disturbed wetland, 5 months after restoration.

Bottom right, wetland complex 1 year after restoration outlined in plan above.

Consider Water: Quality and Quantity

Your restoration design needs to take advantage of water that is available on your site and capture water that presently leaves your site through artificial features such as ditches, drain tiles, culverts, and swales. Initially you will probably be concerned whether you have enough water on your site. There can be many impacts to water movement off site that can influence how much water is available to you: roads or railroad beds that block natural water flow or segment the wetland from another water source such as a stream, ditches on neighboring properties that divert flow away from your site, straightened or deepened waterways, and various other changes that may be impossible to reverse. You will want to be choosy about your sources of water. Too *much* water that is high in sediment and nutrients can be as bad as too *little* water for your restoration.

Alice Thompson

A culvert empties stormwater loaded with sediment into a wetland.

In areas of the state with urban development, the amount and quality of water entering the wetland has likely changed from what entered the site historically. As more buildings, roads, and parking lots are built in the watershed, the amount of area for rainwater to seep into the ground is reduced. Stormwater is typically routed to wetlands or directly into lakes and rivers. This water carries contaminants including sediment, nutrients, chemicals, and road salts. Stormwater delivered by sheet flow, swales, culverts, or pipes onto your site may be much higher in volume than the historic water flow onto your site. It may also be delivered in unnatural rapid pulses, causing excessively high water volumes after storms and abnormally low water volumes between storms.

In a rural site, a neighbor's cattle feedlot or livestock pasture, if untreated, may deliver runoff water loaded with nutrients to your wetland. Fertilizers, pesticides, and herbicides may contaminate water flowing from cultivated lands onto your wetland. Nutrients and chemicals will degrade your site, and will make it difficult to establish native vegetation. Excessive nutrient and sediment laden water stimulates the growth and expansion of reed canary grass, narrow-leaved cattail, and other rapidly-invading species to the exclusion of a variety of native plants.

"The government tells us we need flood control and comes to straighten the creek in our pasture. The engineer on the job tells us the creek is now able to carry off more floodwater, but in the process we have lost our old willows where the owl hooted on a winter night…. We lost the little marshy spot where our fringed gentians bloomed."

Aldo Leopold,
The Round River, 1953

Tim Ehlinger

A sediment pond traps nutrients before water reaches a nearby trout stream.

Treating Stormwater

Identify where and how much surface or stormwater is entering your wetland. If the overall amount of water delivered to your site is too high compared to what was historically present, you may want to set a spillway at an elevation to divert excessive water off the site. You may also want to treat stormwater or agricultural runoff entering your site. One way is to construct a shallow basin at the exit of the culvert or inlet onto your land that will collect water and slow it down long enough to drop sediment and nutrients. The size of this basin will depend on the amount and quality of water entering your site. A broad spillway allows water to enter the wetland after it has settled, or the water can flow as a sheet over the entire flat edge of the basin. This basin may need to be dredged out as sediment collects over time.

Eight landowners located on the floodplain of the Baraboo River cooperated on a large-scale restoration project. Three landowners actively restored their drained wetlands by filling in large ditches that emptied into the Baraboo. The other adjacent landowners were impacted somewhat by the return of historic wetland hydrology and cooperatively agreed to the project. Had the neighbors chosen not to collaborate, the project would have been impossible.

Flooding Your Neighbor

You need to pay attention to and understand how restored water levels on your property will impact adjacent land. Many former wetlands were extensively ditched and drained and your property may be only a fraction of the much larger historic wetland basin. To get a sense of the original basin, look carefully at the NRCS soils map for your land as was described in Chapter 3. Use a highlighter to mark all the wetland soils on your property and continue to highlight them off of your property. All areas where wetland soils have been highlighted that extend beyond your property boundary need to be evaluated during the design process.

If one or several neighbors' land will be impacted by your restoration work, the most obvious solution is to expand the scope of your restoration by working with your neighbors to jointly restore all of the original wetland. If they are interested and willing to collaborate, this will solve many potential problems. This may take the form of both properties being restored at once, or if your neighbors do not want to actively restore their affected properties, but do not mind if you restore your property and make their wetlands wetter, a good approach is to ask them to be a co-applicant on the permit. By being a co-applicant they are signing on to the project and they understand and accept the effect of increased hydrology on their property.

You may have to design your restoration project to avoid impacting your neighbor's land all together. This may include creating a low berm at the property line to retain water on your land and to avoid flooding adjoining properties. A spillway can be designed at a set elevation to allow water to flow off site before it backs up high enough to impact the neighbor. Ditches on property lines may have to be left unaltered if the neighbors do not want additional water on their site. Some sites are virtually unrestorable without neighboring landowners' participation and cooperation.

Develop the Plan

Before you pull together all the information you've gathered so far be sure to read Chapter 5 "Seeding and Planting Considerations" and Chapter 6 "Invasive Species and Wetland Management." Then, incorporate all that you have learned about your site into the final restoration plan. You will want to figure out each stage of your project to accomplish your restoration goal. At this point begin contacting the United States Army Corps of Engineers and Wisconsin DNR about permitting issues (see Chapter 7). Consult with other professionals as well. The more variety in perspectives you can incorporate into your final plan, the better it likely will be.

Your final plan should consist of the following:

- ☑ A summary of current site conditions.
- ☑ A set of restoration goals.
- ☑ A "vision" map of what the site could look like when restored.
- ☑ Actual construction plans or plans for contracting professional services to draw them.
- ☑ An estimate of the time required for each activity.
- ☑ A budget for each step.
- ☑ A long-term management plan.

If you plan to use native seeds or plants, identify the sources of plant material you want to use. Nurseries should be contacted in advance to be certain stock is on hand. Applications for permits must be submitted in a timely manner. Allow plenty of time for the planning process; don't rush it!

CHAPTER 5. SEEDING AND PLANTING CONSIDERATIONS

"Where native wetlands are often composed of a mix of grasses, sedges, forbs, and sometimes shrubs, this diversity of plant material produces a "micro-edge" effect in the lower reaches of the stands. These edges provide dense areas for nest concealment and paths for wildlife movement within the stands between the dense growth. Reed canary grass invasion causes a loss of plant diversity. Monotypic (one species) stands lose the "micro-edge" effect and overall structure that provides for dense nesting cover, movement lanes, singing perches, and nesting sites."

—William K. Volkert,
Wildlife Educator/ Naturalist,
DNR-Horicon Marsh

In Chapter 3, we suggested that you draw a sketch of your site and determine what vegetation already exists. Chances are one of the reasons you are interested in restoring your site is to change existing vegetation dominated by invasive or weedy agricultural plants to native species beneficial to wildlife. This chapter and the following chapter on invasive species will guide you in the restoration of native vegetation.

The Hippocratic Oath's admonition to "first do no harm" also applies to wetland vegetation. You may find many non-native plants listed as wildlife cover in various guides. Reed canary grass, giant reed grass (*Phragmites* sp.), crown vetch, and other undesirable non-native plant species are sold for erosion control and wildlife habitat. Native plants that have evolved and adapted to this region often lose out against aggressive imports that are less valuable to native wildlife. Many invasive species are extremely difficult to control once established. Native species may need to be reintroduced or encouraged to maintain a healthy and diverse wetland.

A functioning wetland needs a rich mix of native vegetation. Wetland vegetation provides food, cover, and habitat for wildlife in addition to aesthetic beauty. The assemblage of plants that colonize a site can indicate the heath and diversity of a successful restoration.

Reintroducing native vegetation on a wetland site can be accomplished in a number of ways. What works on your site will depend on many factors, including its history, disturbance, the condition of the natural seed bank, soil and water factors, light levels, and the presence of invasive plants. Invasive wetland plant species and their management are discussed in Chapter 6.

Stick With Natives

Art Kitchen

Native plant community avoided during earthwork.

How Do I Work Around Native Plants on Site?

In most cases small patches of native plants remain on your site. You will want to treat them carefully and take great care to work around them. Remnant areas of native plants are an indication of the original wetland plant community and may expand and re-establish within your site once your restoration is complete. Identify these areas for protection and avoid planning earthwork (e.g., scrapes) in them. Point them out to your contractor, flag the areas with bright colored surveyors tape, and keep construction equipment away from these areas if possible. Upland areas with intact native vegetation should also be treated with respect, as their integrity will increase the value of the site to wildlife. Avoid using heavy equipment and stockpiling soils on native upland communities.

Ditch at Summerton Bog with original spoil bank that was on the right now in ditch and native sedges placed on top of ditch fill.

Alice Thompson

WETLAND PLANTS AND PLANT COMMUNITIES OF MINNESOTA AND WISCONSIN

STEVE EGGERS AND DONALD REED, 1997

This 263-page book includes photographs of 15 wetland types and 144 representative plant species. Brief descriptions of each plant species include taxonomic characteristics, habitat, and notes on wildlife use and economic values.

Price is $13 per book with book-rate shipping and $15 per book with 1st Class shipping.

Order from St. Paul District, United States Army Corps of Engineers,

Attn.: CENCS
Library/Sales Agent
190- 5th Street East
St. Paul, MN 55101-1638

(651) 290-5680

At The Nature Conservancy's SUMMERTON BOG property in central Wisconsin, the RESTORATION of a large sedge meadow - swamp forest wetland complex called for miles of ditches to be filled. Native sedges surrounded the ditch and spoil piles in one section of the site, and sedges were growing at the bottom of the ditch. The construction contractor kept his backhoe on the spoil pile and methodically scraped the sedge mat out of the ditch, placed it on the side, filled the ditch with the soil from the spoil pile, and then replaced the sedge clumps on the top of the ditch as he backed out, minimizing impact to the native community.

"One of the penalties of an ecological education is that one lives alone in a world of wounds."

Aldo Leopold,
The Round River, 1953

A mnemonic that can help as you try to identify seedlings is "SEDGES HAVE EDGES". Sedges will look triangular at the base of the seedling, as compared to a round grass stem. The invasive reed canary grass has a round stem and can be readily identified by its long white membranous distinctive ligule you can see as you gently pull a leaf blade back from the stem (see Chapter 6 on reed canary grass).

How Can I Find Out What Wetland Seeds Are Still Present and Viable?

For thousands of years wetland plants have produced and dropped seeds into the soil of your wetland. Sometimes, under the right conditions, recent seeds buried in wetland soils or under sediment may be viable (living) but dormant, even if the site has been cultivated for decades. Seeds have been know to be dormant for up to 80 or more years. These living but dormant seeds comprise what is called the seed bank.

By removing sediment overburden or restoring the original hydrology, you may provide the right conditions for dormant seeds to germinate. The seed bank may have a better chance to establish itself if the site is well drained up to the point that restoration takes place. If the site became wetter over time as drainage failed causing the dormant seeds to sprout, the young plants may have been plowed under before re-seeding. Failed drainage may result in dormant seeds responding to the wetter conditions by sprouting but failing to mature. If this happens the seed bank may be exhausted before the restoration begins. Therefore, to avoid giving the seed bank a "false start", ***it is important to maintain drainage*** using pumps and maintained ditches right up until the time you begin your construction.

Does your site have dormant seeds ready to sprout once you have restored the site? The more living seeds you have, and the closer the site is to other diverse wetland sites that can serve as a source of new seed, the fewer new seeds or plants you will need to introduce into your restoration project. The viability of seed banks vary from site to site reflecting factors we do not yet fully understand. You can't always predict what kind of results you will get.

To determine if you have viable seed in your seed bank take plugs of soil just below the litter layer to test for germination. If you are planning to strip off sediment during restoration, take the plugs from the wetland soil layer that will be exposed. Take a number of samples from across your entire site. Use clean implements for collecting the soil from across your site so that you do not contaminate the samples. Take the samples home or to a reliable nursery for help. Spread the sample thinly, less than ¼ inch deep, over sterile potting soil and water regularly so that the flats are kept moist. Make sure the flats are exposed to light. You may require some help identifying what seedlings come up, but even if you don't know the species name, just knowing that sedges, rushes, and wildflowers are germinating as opposed to reed canary grass will be of great use as you proceed with your plans.

Left, in a seed bank study, wetland (hydric) soil samples are allowed to germinate at a greenhouse to determine whether dormant wetland species remain in the soil.

Right, seed bank study in greenhouse.

Photos: Left, Jeff Nania Right, Joanne Kline

Can I Rely on Plants Colonizing from Other Wetlands?

Seeds travel on water, wind, duck feathers, animal fur, and in bird and animal droppings. If your wetland has a poor seed bank, seeds blown or carried in can eventually colonize the site. The closer a natural diverse wetland is to your site, the more likely it is for this to occur. Of course, the seeds of ubiquitous species like wind-blown cattail, willow seeds, and water-borne reed canary grass can also arrive quickly in many areas of the state and establish dominance that prevents the establishment of other, less aggressive native seeds (see Case Study #1 in Chapter 13). The bottom line is, if there is no native seed bank on the site, relying on passive re-colonization in a restored wetland may prove disappointing.

How Long Should I Wait for the Vegetation to Respond?

In many cases you will want to give your site a year to respond after restoration before you seed it with purchased or gathered seed. One situation where you may want to seed immediately with native seed stock is if you are faced with encroachment of reed canary grass or another undesirable invasive plant, and are unsure of the viability of the seed bank.

You may want to plant the emergent zone immediately where cattail will come in quickly on its own as its seeds are windblown and widespread. For unknown reasons other desirable emergents such as arrowhead, giant burreed, etc. are less likely to germinate from the seed bank. Planting live plants in the spring will boost the plant diversity in this zone.

What Plant Species Do I Decide On?

Plant a diversity of native species that are found in your area. Higher diversity will protect your site from colonization by invasive plants. The greater the number of plant species the more hardy your vegetation will be to droughts, floods, and pathogens. Plan to plant a mixture of fast growing, pioneer (early successional) species and slower growing mid-successional species. Include species that will tolerate a variety of moisture conditions, and differing light conditions (if your site has such variation). The plants will sort themselves on the site according to their own requirements for water, light, and soil.

Seeds for your wetland can be hand collected from wetland sites or purchased at Wisconsin native seed suppliers. If you hand-collect seed, be certain to seek permission from landowners, avoid state lands, and always leave at least half the seed behind for natural regeneration. If you intend to purchase seeds, work with a local supplier who grows or collects local native plant stock, rather than buying seed from other states or regions that may not be adapted to Wisconsin and that could be less successful. Seed gathered from a source as close to your site as possible will be most appropriate for your site as plants have genetic variation that allows them to adapt to local conditions. Be wary of prepared seed mixes from commercial sources. A seed mixture should be carefully considered and prepared separately for each site.

NATIVE PLANT GENETICS

It is very important to use seeds collected from local Wisconsin plants in restoration. Plants have evolved adaptations to many factors, including a region's soils and climate, which determine the season when plants germinate, bloom, set seed, and go dormant. Genetically determined blooming dates may reflect the time when natural pollinators are present or when the danger of frost ends. In addition, plants imported from other regions of the country can contaminate the local "gene pool" and damage local stock if cross-pollination results in offspring no longer adapted to local conditions. This is particularly grave if the local plant is rare, threatened, or endangered.

The Department of Natural Resources maintains a CURRENT LIST OF NATIVE PLANT NURSERIES located throughout the state. You may contact the DNR for a copy.

www.dnr.wi.gov/org/land/er/invasive/info/nurseries.htm

Native Plant Conservation Program Manager
Bureau of Endangered Resources
P.O. Box 7921
101 S. Webster Street
Madison, WI 53707
(608) 267-5066

The WWA "WETLAND RESOURCE DIRECTORY" available on the WWA web site lists many native plant nurseries and private consultants in Wisconsin and the region.

Photos: Alice Thompson

*Top, Jewelweed (***Impatens capensis***).*

*Bottom, Sneezeweed (***Helenium autumnale***).*

Your planting will depend on the area of the state that you are in, the soil type and water level of your wetland, the competing vegetation on site, and how you will manage the site. For example, if you are going to manage an open marsh and meadow and use prescribed burns to maintain your site, you need to use plants tolerant to burns, such as wet meadow, sedge meadow, marsh, or prairie species. However, tree plantings such as white cedar or tamarack will not be compatible with burning. You need to make a choice whether to keep a site open with burning or other methods, or to shade the wetland over the long term with shrub or tree plantings.

If you are concerned about reed canary grass already on the site or invading the site, you have many considerations. Refer to Chapter 6 for more details on native plantings as a strategy to control invasive or unwanted species.

There are a number of good references that list some of the common wetland species in the state (see Chapter 1 and Appendix A). Furthermore, you can contact a native plant nursery for more detailed listings and for recommendations on your site. Consult with a private wetland ecologist, a Wisconsin DNR wetland specialist, or an ecologist at a local college or university for ideas on wetland plantings. Visit WWA's *Wetland Resource Directory* on-line at **www.wiscwetlands.org** for access to a list of area nurseries, agency staff, wetland professionals, and college or university faculty.

What about Buffer Zones?

Planting a high quality upland buffer is well worth your time and resources. The edge of a wetland gradually merges with uplands, and wetland species such as ducks, cranes, turtles, snakes, and amphibians use uplands for nesting, feeding, and shelter. If disconnected from quality upland habitat the wetland will never be as useful to wildlife species as a wetland-upland complex. Current recommendations are for a minimum of a 100-foot wide upland buffer, with an optimum width of 300 feet or more. The vegetation you plant or manage should depend on where the site is located in the state (i.e. prairie vs. forest), the site's specific features, and how you can manage it. Because prairie and oak uplands are so scarce on our landscape compared to pre-settlement times, planted and managed prairie and savanna buffers are an ecologically sound option that provide excellent wildlife habitat in those parts of the state that were once prairie. Be certain that you can ideally manage the site with prescribed burns before you spend money on prairie seed.

Left, vegetated buffer surrounds wetland restoration.

Right, vegetated buffer surrounds wetland restoration. Native prairie plantings are in the foreground.

Photos: Art Kitchen

Photos: Alice Thompson

Left, planting shrubs and trees in a disturbed stream corridor.

Right, white cedar planted in disturbed reed canary grass alongside a stream.

What about Trees and Shrubs?

In many regions of the state forested wetlands were once common. They included black spruce and tamarack bogs, tamarack and white cedar swamps, floodplain forests, and hardwood swamps. Historical aerial photos of your site can reveal wooded wetlands. However, in many cases the wetlands were drained and logged long before the earliest photos were taken. Native shrubs can provide important transitional zones to uplands in many wetlands. Tree and shrub plantings as a management tool to shade reed canary grass are discussed in more detail in Chapter 6. Your local Wisconsin DNR forester frequently works with landowners on forest management and plantings. Contact him or her for information on tree and shrub stock, prices, and availability. Local county land conservation departments may also sell native trees and shrubs at a very reasonable cost. Typically plant orders are placed in winter and picked up in the spring.

Managing and expanding remnant upland woodlands can also provide important wildlife habitat. Try to determine the types of uplands that were once on your site. The NRCS soils book described in Chapter 3 discusses the type of vegetation each soil unit on your site was formed under, and may provide insight into what types of vegetation were once there.

Manage Your Soil

Do I Need a Cover Crop?

Planting a cover crop on the upland buffers of adjacent wetlands will hold disturbed soil in place after construction. Because wetlands are flat and not subject to severe erosion, wetland cover crops are generally not used. If wetlands are seeded, "pioneer" (i.e. fast establishing) species should be intermixed with more conservative (i.e. slower growing or establishing) wetland species. This way the native pioneer plants will occupy space quickly while the conservative species establish themselves.

Troy Weldy, New York Natural Heritage Program

Pitcher plants (the mouth shown here) trap insects to utilize nutrients in a low nutrient bog.

To establish a cover crop on upland buffer sites, plant seed oats, as they are cheap and easily spread. Oats or annual rye are generally used in spring and early summer (e.g., April 15 to June 15). In the fall or winter, winter wheat can be planted in mineral soil and annual rye in mineral or peat soils (e.g., September 10 to October 15). Do not use excessive amounts of annual rye as it is slightly allelopathic (it produces a chemical to discourage other plant growth). Cover crops are usually added to the native prairie upland seed mix so that the total mix is at least 30 pounds per acre.

What about Erosion?

Earthwork in former wetland areas does not create a serious erosion problem because the disturbed ground is flat. However, slopes that exceed a 4:1 ratio in steepness or areas close to streams may need some erosion control before they are vegetated. Biodegradable straw erosion matting (e.g., Curlex® biomatting; see construction terms on page 99) can be unrolled and pinned onto freshly seeded surfaces. It can be purchased at any type of construction supply store. You can also use weed-free mulch or straw to cover 90% of the soil, especially on shallow slopes.

Do I Need to Add Topsoil?

Do **not** add topsoil if you have original hydric soil on the final surface in the restored wetland. If you are constructing a scrape in an area of shallow topsoil with clay underneath, you need to make sure you first strip off and stockpile the top organic soil layers, excavate the clay only, and finally cover the exposed clay basin with the stockpiled organic soil.

Alice Thompson

Lack of topsoil on the border of a scrape creates bare areas fifteen years after construction.

Do I Need Fertilizer?

No, the wetland plants you want to encourage are competitive against weedy invasive plants in low nutrient soil. As discussed previously, controlling fertilizer runoff onto the site is very important. Do not add to your problem by fertilizing any seeding or plantings.

DO HIGH NUTRIENTS MEAN LOW DIVERSITY?

It may seem counter-intuitive, but high nutrient conditions produce lower plant diversity. Think of it this way: for hundreds of years in a low nutrient wetland the plants have adapted in creative ways to survive. Some plants such as pitcher plants trap insects that decompose and provide nutrients, some plants coexist with nitrogen-fixing bacteria on their roots and utilize nitrogen from the atmosphere, while other plants recycle nutrients or hold on to leaves to avoid nutrient loss. Each of the adaptations a plant species evolves is different and drives diversity. No strategy is perfect; there are trade-offs, and many plants can co-exist using different strategies. Now take this diverse plant community and add nutrients. All of a sudden, the conditions are ripe for a fast growing, highly productive bulky species to out-compete and tower over the diverse, slow growing low nutrient adapted plants. This results in the highly diverse wetland plants being crowded out by the invader, reducing the overall diversity on the site.

Get Your Vegetation Started

When Should I Plant?

The timing of planting is important to maximize the chances that seeds or plants will survive. Seeds are usually planted in spring or fall. The spring planting season varies from year to year but is generally from April 15 to June 15 in southern Wisconsin. Seeds can be planted once the frost is out of the ground but before the heat of summer. The fall planting typically occurs after a hard frost and before a heavy snow falls—generally from October 15 to December 1. Seeds planted in the fall will lie dormant through the winter and germinate in the spring.

The "window" for planting rootstock is between May 1 and June 15, after the danger of frost has passed, but early enough to establish strong roots before fall. You may be able to plant until late July if the wetland has stable water levels. Do not plant live plant material in the fall because plants are vulnerable to frost heave and wildlife predation.

Do I Need to Pre-treat Seeds?

If you plant in the fall the seed will overwinter and the combination of moisture and cool weather will prepare the seeds for sprouting in spring. If you plant in spring the seeds of many species will lie dormant unless they are pre-treated to mimic overwintering. To break seed dormancy, either ask the supplier to pre-treat the seeds or do it yourself. Your supplier can give you specific directions on how to pre-treat the seed. One treatment method is to mix the seeds with moist vermiculite, sand, or soil, and store the mixture in a refrigerator for several weeks.

How Do I Plant the Seeds?

There are several ways to seed wetland soils. If the site has been freshly graded, the seed can be spread by hand and lightly raked into the soil. Large areas can be planted using a seed broadcaster mounted on a vehicle that can traverse the bare soil. But be aware that some native seeds can have debris or rough surfaces that may jam and get caught in mechanical seeders.

Upland areas need to be prepared and then seeded by hand and raked, or the seed can be broadcast with a mounted seeder on a vehicle and then lightly raked with a drag. The site can also be seeded with a brillion or no-till drill that pushes the seed into the soil. A description of different types of seeders can be found in Chapter 9. Prairie nurseries can give great advice on how to plant your site if you purchase seed from them.

Alice Thompson

*Joe Pye weed (***Eupatorium maculatum***) is common in sedge meadows.*

Alice Thompson

Seeds of native plants are collected or purchased for sowing into the restoration site.

Jeff Nania

Tractor pulling brillion seeder used for native prairie seeding.

Sedge clump in forested wetland.

Alice Thompson

What about Rootstock or Plants?

As mentioned earlier, selective planting of live plants may be very useful for increasing diversity in your wetland, particularly in the emergent plant zone. Planting live plants or rootstock is usually done by hand and is labor and time intensive. Plant stock can be costly as well. If you decide to plant live plants or rootstock make sure you are planting at an appropriate depth. You may need to construct enclosures around new plantings to prevent muskrats, geese, and other wildlife from devouring your rootstock before it becomes established. One technique for giving your roots and tubers a head start is to grow them in buckets before planting them outside. Take 5-gallon buckets and fill them first with a layer of sand and then with a layer of soil from your site. Plant the tubers, add water until it saturates the soil to the surface, and keep them watered and in the sun. Transfer them to your site once the plants have grown 6 inches or higher and the plant and soil/root ball easily pulls off the sand layer.

Do I Just Plant and Wait?

No, aggressive follow-up and control measures are critical in the first three years. You may need to hand pull weeds, use spot herbicide, or use combinations of water level fluctuation, mowing, or burning to control undesirable plants. Refer to Chapter 6 for more invasive plant management advice and Chapter 10 on post-restoration management considerations.

Conclusion

The vegetation that develops in your wetland is the cornerstone to the diversity of wildlife your site will attract. All the effort you put into understanding your site and its original vegetation is time well spent. Be sure to read Chapters 6 and 11 to plan long-term management on your site and to deal with invasive plants that will invariably find their way into your restored wetland.

William Radke, USFWS

CHAPTER 6. INVASIVE SPECIES AND WETLAND MANAGEMENT

"Noxious weeds are like a biological wildfire, raging beyond control."

– Max Peterson, USDA Forest Service (formerly).

More details on the biology and control of invasive species can be found in the Wisconsin DNR publication, WISCONSIN MANUAL OF CONTROL RECOMMENDATIONS FOR ECOLOGICALLY INVASIVE SPECIES (see Appendix A). The Invasive Plant Association of Wisconsin (IPAW) maintains a web site on invasive species at: www.uwex.edu/ces/ipaw/.

Plant diversity is an important goal of many wetland restoration projects and invasive plants are a serious threat to diversity. This chapter includes ideas for planning your site restoration to address invasive plants. It also touches upon specific control and management recommendations for the most common invasive plants: reed canary grass, purple loosestrife, giant (or common) reed, and glossy and common buckthorn.

The cumulative loss of habitat from invasive species cannot be overstated. Besides the most common wetland invaders mentioned above, other invasive plants beginning to spread into various regions in the state include cut-leaved teasel (*Dipsacus laciniatus*), Japanese knotweed (*Polygonum cuspidatum*), and European alder (*Alnus glutinosa*). These and other species may present greater problems in the future.

Planning for Invasive Species Control

To maintain or increase species diversity you will need to address the existing invasive species in your wetland and anticipate that others may colonize the site at a future time. During the mapping of your site (Chapter 3) it is important that you note the presence of invasive plant species. If they are

on your site, prepare plans to deal with them. If your project site adjoins invasive species on a neighboring property, it might be wise to contact your neighbor during planning. Perhaps you can jointly tackle the problem. Trying to control invasive species on your site that is already surrounded by invasive species on adjacent land, especially problem woody species (e.g., glossy buckthorn or box elder) is difficult. Areas on your site that flood need to be monitored yearly for seeds that will float in and re-invade from upstream colonies of invasive plants such as reed canary grass or purple loosestrife.

There is no better opportunity for invasive plants to establish themselves than on newly disturbed soil following construction and restoration. To avoid inadvertently bringing in invasive species, it is important that the tracks or tires of all excavator equipment be washed before entering your site. If there are invasive species in your construction area do not spread the excavated soils in a way that will contribute to the problem. Soils contaminated by invasive species belong in the bottom of a ditch or on adjacent upland cropland; do not leave them in a newly excavated wetland area.

Invasive plant control is difficult. Since sites vary, it is difficult to make general statements on how to set your particular site up for vegetation management. However, the best long-term technique for control of invasive species is to establish site circumstances where a desirable native plant community will outcompete the invaders. In order for this to be successful, it is important that you have a plan to take care of invasive plant species while they are still manageable. Aggressive treatment of small patches of invasive plants after restoration is extremely important. Careful attention to remnant native plants on site is equally important. Be sure to refer to Chapter 5 for seeding and planting considerations.

If you have a known invasive plant problem on your site (e.g., a meadow of reed canary grass) you need to plan in advance how you will control the plants during and after the restoration process. Maximum damage should be done to the existing invasive plants before and during construction. For example, you could use combinations of mowing, discing, burning, and herbiciding while the site is dry before construction begins. Construction equipment can be used to scrape monocultures of invasive plants or remove sediment layers that are harboring them. Finally, restoring hydrology to the site will further stress the invasive plants.

If you plan to actively manipulate water levels following construction, a control device must be incorporated into the design with enough height to flood the problem area. If you plan to burn following restoration, you may be able to better facilitate safe burning by adding some design features including burn units and fire breaks. Note prevailing wind directions, locations of hazards (i.e. roads, structures, and utility lines), and any other landscape features that might affect a burn. Think ahead about how to exit the site if a fire were to escape. Dry peat soils can ignite and burn under the surface causing extensive fires that are difficult to control. Check if this could be a problem on your site.

If mowing is part of your plan, determine how you will be able to access the area to be mowed and what kind of equipment can enter the site after


DNR Archive

construction. Widespread use of herbicides after construction could be counter-productive if you are trying to establish a desirable plant community from a remnant seed bank. You may want to apply herbicides very selectively, so we encourage you to plan where and how herbicide will be applied.

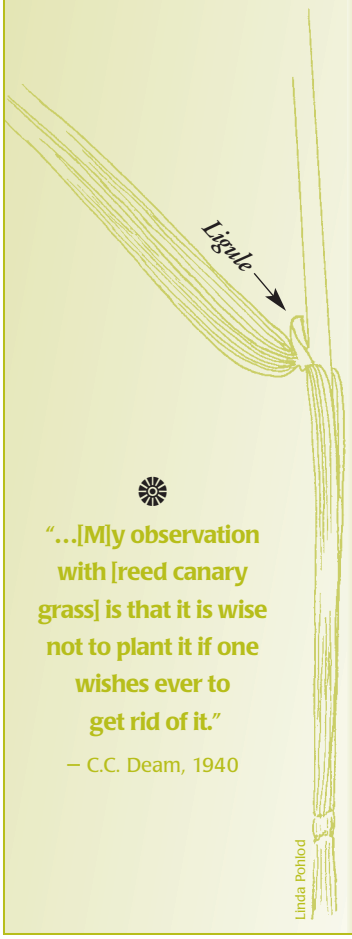
Plantings, if used, should be planned in advance. Please see the recommendations in this chapter dealing with problem invasive species and refer to Chapter 5 for more assistance.

As mentioned earlier, you should design adequate upland buffers to protect your restored wetland from stormwater or agricultural runoff. You may also want to incorporate features for pre-treating water coming onto the site. These design elements should be addressed during the restoration planning process, as nutrients and chemicals will exacerbate a problem with invasive species. Ideally you should integrate upland buffer and wetland areas management into your entire site plan. Take a map of your site and outline areas that you anticipate managing and write down the techniques you may use. Include this management plan with your permit applications to gain approval for these activities.

Current Recommendations for Control of Specific Invasive Plants

Reed Canary Grass (*Phalaris arundinacea*)

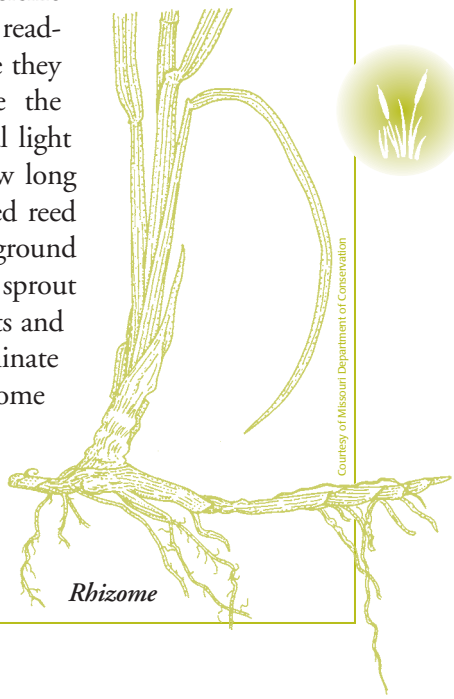
Reed canary grass can grow up to 6 feet tall and is common in farmed and urban wetlands and waterways. The grass has abundant leaves along hollow stems. If you gently pull the leaf away from the stem you will see a distinctive white membrane on the leaf called a "ligule" at the junction of the stem and leaf. In Wisconsin, the plant produces an open flowering head above the leafy canopy in June and sets seed by early July. The flowering head, or "spike", eventually contracts into a straight or sickle shape. The species reproduces from seed quite readily, as seeds need only a week of wetting before they will germinate. Seeds germinate best where the nearby vegetation is low and allows substantial light penetration to the ground. It is unknown how long viable seeds persist in the soil. Once established reed canary grass expands readily through underground stems called "rhizomes". Rhizomes are able to sprout new plants where the canopy is open. The roots and rhizomes of reed canary grass are dense and dominate the soil below the surface. Stems and rhizome growth increases when nutrients are abundant. Reed canary grass is a "cool season" grass and has a long growing season. It is one of the first plants to green up in spring and the last to die back each fall.



Linda Pohlod

"…[M]y observation with [reed canary grass] is that it is wise not to plant it if one wishes ever to get rid of it."

– C.C. Deam, 1940

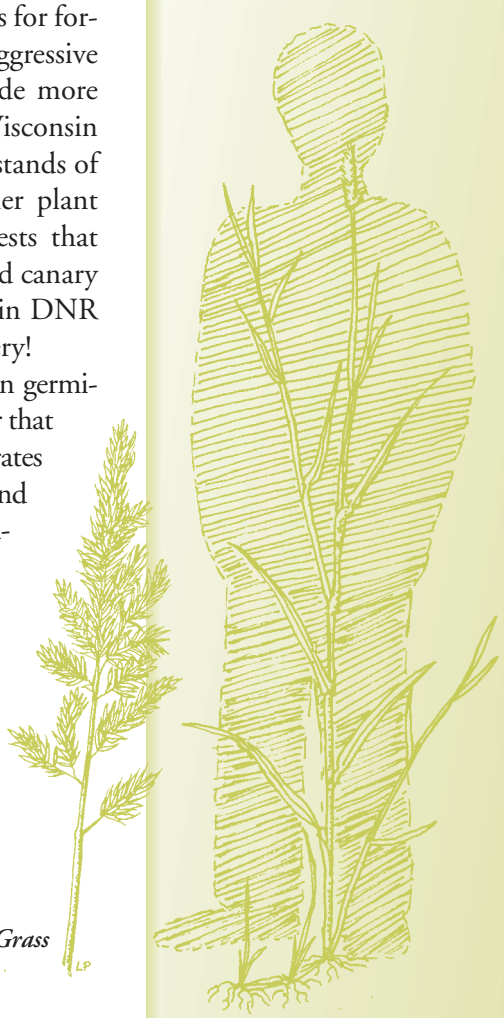


Courtesy of Missouri Department of Conservation

Beginning in the 1800s, farmers intentionally planted European and cultivated strains of reed canary grass throughout the United States for forage. To date, some agencies still encourage the planting of this aggressive grass. Additional cultivated strains are being produced to provide more nutritional forage for cattle. Today, many disturbed wetlands in Wisconsin support large monotypic stands of reed canary grass. These large stands of grass may entirely dominate vast acres to the exclusion of other plant species. This is especially becoming a problem in lowland forests that result in reduced tree regeneration. Large monotypic stands of reed canary grass have become so widespread in Wisconsin that the Wisconsin DNR is able to map its occurrence and abundance using satellite imagery!

Reed canary grass produces enormous quantities of seed that can germinate in disturbed soil, where the plant crowds out other vegetation, or that float downstream to colonize stream banks. Although the grass tolerates a wide variety of soils and moisture regimes, including drought and standing water, it can be set back or killed with at least 1 foot of standing water or through repetitive flooding for a duration of 3-6 months. Reed canary grass is intolerant of dense shade and can be shaded out by trees and shrubs. While a number of control techniques have been attempted, there is no simple solution for eliminating the species.

Before you attempt to control reed canary grass, you will need to assess the disturbances and impacts to your site (see Chapter 3). Large-scale problems including nutrient inputs, historic sedimentation, or drainage of the wetland may need to be addressed in conjunction with reed canary grass control and subsequent replacement by native species.



Reed Canary Grass

Reed Canary Grass Control

Controlling reed canary grass involves using a variety of techniques continuously over a number of years. Techniques vary depending on the size of the stand and the adjacent or underlying plant community that could compete with reed canary grass. Control of nutrients and sediment entering the wetland is very important. The best time to eradicate reed canary grass is before it takes over the site. Unfortunately this time has already passed for most wetlands. The best way to control reed canary grass is to combine several techniques that significantly and repeatedly stress the plant. For example, you could combine burning and spraying, mowing and spraying, or scraping away the root zone and flooding.

Although many ideas are presented below, there is no sure cure known at this time. Repeated control efforts over several growing seasons may be necessary for reducing or eliminating reed canary grass infestations. Be persistent! Research and experimentation on control techniques are ongoing.

Alice Thompson

Situation 1: Reed canary grass is limited to small patches or mixed among high quality native vegetation.

Right, control method for small, isolated clumps of reed canary grass.

Herbicide Use. Application of 6% glyphosate (i.e. commercial products Roundup® or Rodeo®) can be used to reduce growth of reed canary grass. Keep in mind that this is a general herbicide (i.e. it kills all vegetation) and is recommended only for solid monotypic stands of reed canary grass. Rodeo® is formulated for use over water. The herbicide should be sprayed directly onto the grass. Care must be taken to avoid herbicide contact to adjacent vegetation. Recent research on the timing of herbicide application indicates that the maximum effect on the grass is late summer and fall (August and September). It is this time of year when the grass is sending sugars down to its roots and can carry the herbicide to the roots as well. Unfortunately this is when the grass is at its maximum height, making application difficult. Pairing a preliminary burn or mowing and then spraying herbicide on the re-sprouts may prove more effective that using a single control method.

Another herbicide application technique for killing isolated reed canary grass clumps is to tie stems together in mid to late summer, cut and bag the flower heads, and apply 33% glyphosate to the leaves of the remaining plants with a hand-held spray bottle or wick applicator found at garden stores. Tying the plant eases herbicide application and reduces the impact to desirable plants nearby.

Vantage® and Poast® are reportedly grass specific herbicides that do not kill non-grass plants. One study of Vantage® use on reed canary grass indicated that sedges were not killed. Vantage® is being researched to selectively control reed canary grass; however, Vantage® cannot be used over standing water. Consequently this herbicide would be most useful in summer when many wetland sites are dry.

Read the instructions carefully on any herbicide that you intend to use to ensure proper application. Be careful that the spray does not come in contact with water or areas with native vegetation. Keep in mind that some herbicides require a permit for application.

Reed canary grass in bloom.

Alice Thompson

Controlled Burning. A late summer or early to mid-fall burn increases the potential for frost damage to the plants, which discourages growth. You may want to repeat summer burning each year or as the amount of burnable vegetation allows. Early spring burns may initially stimulate growth (by reducing litter and increasing the amount of light that reaches new sprouts), but spring burning might have some value over the long term if repeated annually or combined with

late summer herbicide application and mowing. A late spring burn may slow plant growth and the setting of seed for that season. Burning can work as the exclusive control technique where continued disturbances (including nutrient additions) are at a minimum and where there is a significant native plant community that can re-establish itself and outcompete reed canary grass for light and resources. Be aware that burning and the resulting increase of sunlight to the ground can stimulate the germination of any reed canary grass seeds that are present.

Planting Shrubs and Trees. Reed canary grass cannot form dense monoculture stands in wetlands that have an abundant cover of trees or shrubs. Only when forested wetlands are cut for timber or farming can large open stands of reed canary grass become dominant. Tree and shrub seedlings grow very slowly under a canopy of reed canary grass and are unable to re-populate the site. Planting of trees or shrubs to control reed canary grass is a possible long-term solution in areas of the state where wetlands were originally forested. Trees native to wetlands such as tamarack, white cedar, green ash, and American elm have been planted into very small stands of reed canary grass with some success. After several years of management by cutting the reed canary grass around saplings to allow light penetration, trees will often grow well. Do not undertake a larger planting than you can manage or maintain. Large scale planting of trees is discussed in detail further below.

Alice Thompson

Planting shrubs in a reed canary grass meadow.

Situation 2: Reed canary grass has become a monoculture.

Cutting or Mowing. Mowing reed canary grass will lower seed production but can stimulate a denser regrowth of stems. Used alone, mowing has questionable results, but can be useful in combination with other methods.

Mowing prior to herbicide treatment to stress the plant and shorten the sprouts to a manageable height is useful. This can reduce the amount of herbicide needed and allows better herbicide contact with the whole plant. Mowing before flooding can be another useful paired technique. Allowing mowed reed canary grass to dry and then burning the mown areas in mid-summer can produce a hotter fire that may damage the roots and the unwanted seed bank.

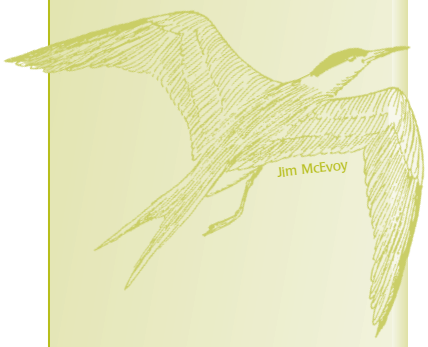
Controlled burn of a reed canary grass meadow after herbicide application.

Herbicide Use. It can be beneficial to use burning or mowing to reduce the litter and height of the grass prior to herbicide application. Apply 6% glyphosate to re-sprouting reed canary grass that is at least 6 inches tall. Current research indicates that mid-summer appears to be the most effective time to apply herbicide. Consider repeated applications of herbicide treatment over several years, and pair herbicide use with other control techniques.

Alice Thompson

Another technique is to apply herbicide in summer, disc the roots in the fall or spring, and apply a second herbicide application to the re-sprouts. Even after there is a native plant response, it will be necessary to continue to control reed canary grass. Consider using Vantage® or Poast®, both of which are grass-specific herbicides that purportedly do not harm sedges and other desirable native plants on sites with no standing water.

Discing. Using a disc to cultivate the sod as the grass comes into flower will stress the plants at a time when nutrient reserves in their roots are at a low level. Discing breaks up the dense root/rhizome mat and may allow other seeds physical space to germinate. If the seed bank only contains reed canary grass, however, the light will stimulate reed canary grass germination and disced plant fragments may re-sprout. As discussed earlier, discing may be most useful paired with other control techniques. For example, discing after herbicide treatment and followed by further herbicide application to re-sprouts has proven effective on some sites.



Flooding. You can use high water as a control tool where reed canary grass is the dominant species and where native plants are few and expendable. Cut or burn the site prior to flooding. Increase the amount of water on the site with the use of a temporary water control device to allow accumulation of 8-18 inches of water for a minimum of three months during the growing season. Drain the site, burn or cut again in the fall or spring, submerge again during the next growing season and then drain. Stressed reed canary grass will begin to clump. It may take several seasons to impact the reed canary grass. The site will eventually contain interspersed patches of native vegetation and open water. Once the reed canary grass has been eliminated or significantly reduced, regular restoration practices can commence.


Jeff Nania


Art Kitchen

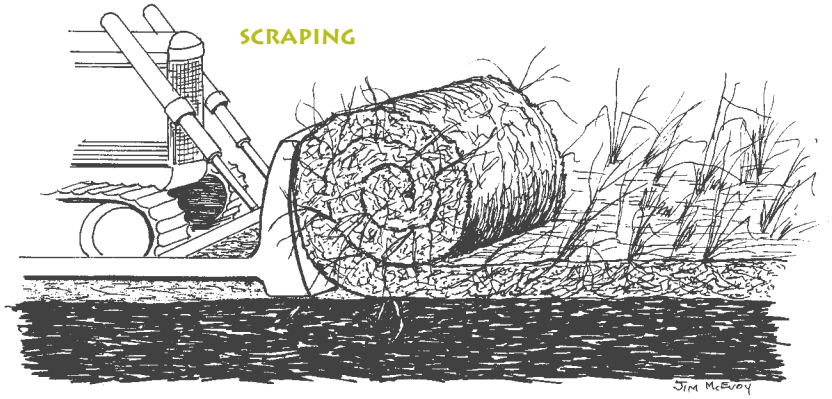
Top, water control structure used to flood reed canary grass meadow.

Bottom, reed canary grass is stressed and clumping under inundation; post restoration.

Excavating. When mechanically removing reed canary grass sod with a bulldozer you should scrape approximately 6-12 inches of sod in order to include the extensive rhizomes. This is sometimes a useful technique for eliminating a monoculture of reed canary grass. The reed canary sod can be "rolled up" and deposited into a ditch where the plants will drown. Even though this may not completely eliminate the invasive species, at least the reed canary grass propagules (seeds and rhizomes) will be depleted. If the site has upland sediment over original wetland soils, try to remove the sediment to expose the original wetland soil layer, thereby uncovering any residual seed bank of native plants. This technique has had success in southern Wisconsin where a wide diversity of native species re-established themselves once reed canary grass was mechanically removed from the original hydric soils (see Case Study #2 in Chapter 13).

Original wetland (darker) soils revealed under sediment.

Art Kitchen



Scraping is a useful technique for eliminating reed canary grass sod.

Planting Native Seeds or Live Plants. You may want to investigate the seed bank (reservoir of viable, ungerminated seeds in the soil) on your site before you begin management of reed canary grass. Instructions on how to do a seed bank study are found in Chapter 5. If you have few native seeds on site, then you need to introduce native seed or plants so they can get a head start in occupying the site and compete with reed canary grass, which will likely re-colonize the site if a native plant population is not well established. To determine appropriate native species to introduce to the site, visit the more diverse wetlands in your area that have similar soil and water conditions, or look at any remnant patches of native wetland vegetation on your site. Discuss your site with a local Wisconsin native plant nursery. Some plants that appear to compete with reed canary grass include native wetland grasses such as prairie cord grass (*Spartina pectinata*), rice cut grass (*Leersia oryzoides*), Canada blue-joint grass

The Department of Natural Resources maintains A CURRENT LIST OF NATIVE PLANT NURSERIES around the state. You may contact the DNR for a copy.

www.dnr.wi.gov/org/land/er/invasive/info/nurseries.htm

Native Plant Conservation Program Manager
Bureau of Endangered Resources
P.O. Box 7921
101 S. Webster Street
Madison, WI 53707
(608) 267-5066

The WWA "WETLAND RESOURCE DIRECTORY" available on the WWA web site lists many native plant nurseries and private consultants in Wisconsin and the region.

(*Calamagrostis canadensis*), and fowl manna grass (*Glyceria striata).* Any *Glyceria* spp. may be useful in areas with low light. In wet situations consider planting lake sedge (*Carex lacustris*), wool-grass (*Scirpus cyperinus*), river bulrush (*Scirpus fluviatilis*), and soft-stem bulrush (*Scirpus validus*).

Prairie grasses planted on the upland edge of a reed canary grass patch are also very competitive over time. One strategy is to prepare a mixture of seed that can tolerate a wide range of water conditions. Spread the seed over the site where you have bare ground and let the plants establish themselves wherever they will do best. Current research suggests that dense stands of species-rich vegetation are more resistant to invasion by reed canary grass than stands of low species diversity with open canopies that allow light penetration. Most undisturbed wetlands are very rich in the number of plant species they contain. You should attempt to plant seeds of a large diversity of native species to simulate what might have once been found on the site. A variety of plants will attract more diverse wildlife.

White oak in spring.

Alice Thompson

Planting Trees or Shrubs. As discussed earlier, a long-term management tool for the control of reed canary grass involves planting trees and shrubs native to wetlands on the site to shade out the grass. Common native trees and shrubs can be purchased from your county land management or Wisconsin DNR office. They are usually ordered in the winter for spring planting. This strategy is still experimental and the long-term results are uncertain. We do not recommend planting a large number of trees or shrubs without planning for their management. Without management small saplings will wither under the dense shade and impenetrable root zone of reed canary grass. In addition, reed canary grass provides habitat for small mammals that may girdle planted trees. Even with the best intentions to manage your site, randomly planted tree saplings may be impossible to locate unless they are somehow tagged or marked. If you do decide to plant trees, they should be planted in pre-treated reed canary grass, using a combination of herbicide application, mowing, discing, or burning as previously described. State foresters recommend planting trees in rows so herbicide or mowing treatments can be performed between the rows. Plan the width of the rows to accommodate the width of your equipment. Randomly spaced trees look more natural, but time and resources will be invested best if the trees can be managed until they are well established. Only after trees emerge above the reed canary grass canopy can you selectively thin individuals to achieve a less patterned distribution. Furthermore, once reed canary grass has been controlled and there is a shady canopy, additional native shade-tolerant herbaceous plants can be seeded or planted under the trees or shrubs.

Purple Loosestrife (*Lythrum salicaria*)

Purple loosestrife arrived from Europe in the early 1800s as an imported garden perennial. It also inadvertently arrived as seeds carried in the ballast water of ships. The species has spread to all 50 states and is replacing native wetland vegetation in some areas. Purple loosestrife is an erect plant from 3 to 9 feet tall with characteristic four to six-sided stems that die back each year. The leaves are paired opposites that hug the stem. The bright purple flower spikes are visible from July to September. A mature purple loosestrife plant can produce anywhere from 100,000 to 2,500,000 seeds annually. The plant invades marshes, stream margins, alluvial flood plains, sedge meadows, and wet prairies. Once established in a wetland purple loosestrife may outcompete and often displace native vegetation. Although attractive, it is little used by wildlife.

Several methods can be used to remove purple loosestrife from your site. If there are relatively few small plants in loose soils, they can be pulled by hand before they set seed. The removal of the entire plant is important. Dispose of the plants by bagging them and sending them to a landfill, or dry and burn them in an upland area so that the seeds will not ripen and spread. If purple loosestrife is cut and then completely submerged for one year, the plants will die. Be careful not to inadvertently kill desirable native plants!

Herbicides can be effective against purple loosestrife if they are applied to the leaves in mid-summer before the plants flower. Spraying the leaves with glyphosate (e.g., Rodeo®) should only be attempted if there is a dense stand of purple loosestrife and few native plants nearby that could be killed by the herbicide. A weak solution of 1% glyphosate applied to 25% of the leaf surface has been demonstrated to kill purple loosestrife. Another control method is to cut the plant stems low (knee high) and apply glyphosate herbicide to the cut stems with a drip bottle. The plant tops should be placed in a plastic bag and carried off site. It is important to cut the stems before flowering or early in the flowering season as late flowers may have mature seed. Herbicides applied to stems should contain 20%-40% active ingredient. You will need to apply for a permit to use herbicides over water. Contact your Wisconsin DNR aquatic plant management coordinator for more details.

If your site has large stands of purple loosestrife that cannot be controlled by the methods described above you may want to consider biological control. Several insects native to Europe that feed on purple loosestrife are being released to control this exotic plant species. Two small beetles, *Galerucella calmariensis* and *Galerucella pusilla*, eat purple loosestrife leaves exclusively and have been the most successful control insects. In Europe it is difficult to find large healthy robust stands of purple loosestrife because of persistent insect damage by these beetles and other insects. The ecology and feeding preferences of *Galerucella calmariensis* and *Galerucella pusilla* have been extensively researched to make sure that other native and agricultural plants are not damaged by their release.

Daniel Q. Thompson

Purple loosestrife in bloom.

For details about the PURPLE LOOSESTRIFE BIOLOGICAL CONTROL PROGRAM, access the Wisconsin DNR's web site at:

www.dnr.wi.gov/org/land/er/invasive/factsheets/loose.htm

For further information about the program, call your Wisconsin DNR regional aquatic plant manager or contact Brock Woods, the state biological control coordinator, at:

Brock.Woods@dnr.state.wi.us or at:

Wisconsin DNR
Biological Control Program
1350 Femrite Drive
Monona, WI 53716
(608) 221-6349

Wisconsin Wetlands Association coordinated a region-wide purple loosestrife volunteer survey for coastal counties of Wisconsin in 2002 with a grant from the Wisconsin Coastal Management Program. The data on over 600 loosestrife infestations from this preliminary survey have been entered into a statewide database and map of the distribution of the species. The survey was continued and expanded to many other counties in 2003. The **PURPLE LOOSESTRIFE DATABASE** is maintained by the Great Lakes Indian Fish and Wildlife Commission (GLIFWC).

Access their web site and loosestrife distribution information at:

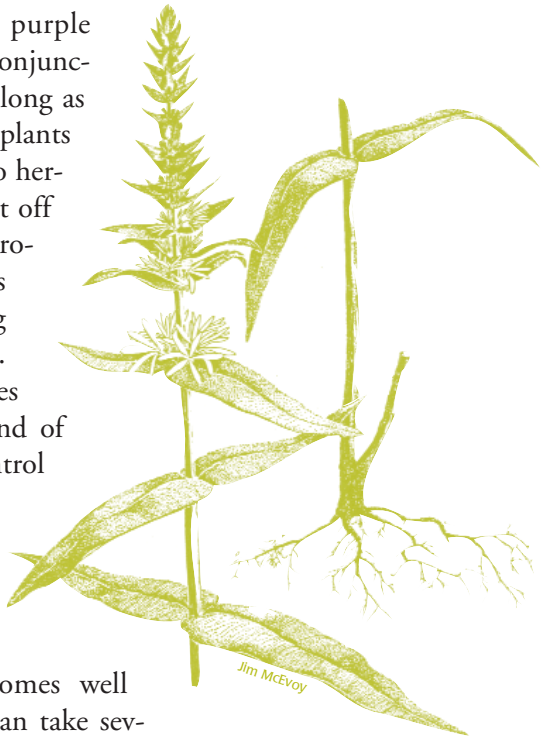
www.glifwc-maps.org

In conjunction with the state purple loosestrife biological control coordinator and a group of educators from throughout the state, Wisconsin Wetlands Association has produced a set of **TEACHER ACTIVITIES ON WETLANDS AND THE BIOLOGICAL CONTROL OF PURPLE LOOSESTRIFE** that meet Wisconsin teaching standards for science and environmental education. This manual of activities can be viewed at the WWA web site:

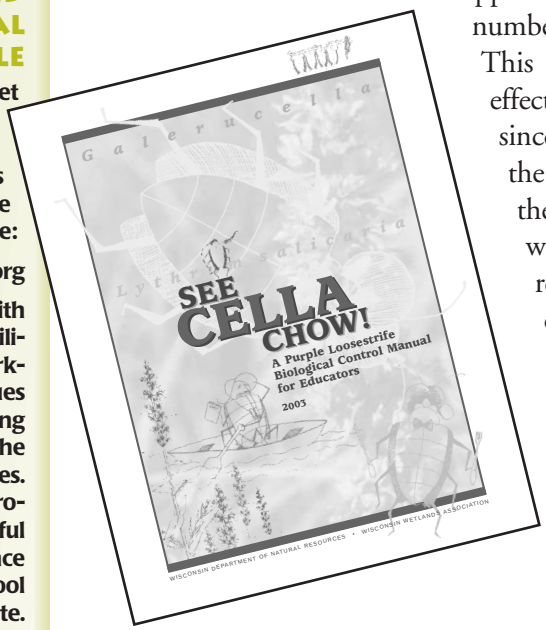
www.wiscwetlands.org

WWA is collaborating with the Wisconsin DNR to facilitate teacher training workshops on the techniques of rearing and releasing *Galerucella* beetles and the use of the teacher activities. The biological control program provides a wonderful hands-on learning experience for middle and high school students around the state.

Biological control of purple loosestrife may be used in conjunction with other methods as long as the introduced insects have plants to eat and are not exposed to herbicide. One strategy is to cut off the flowers to prevent seed production, but allow the leaves to remain for the developing beetle population to feed on. You can also introduce beetles at the center of a large stand of purple loosestrife and control the plants at the periphery by using other methods to avoid further spread. Using beetles for control can become self-sustaining as the insect population becomes well established. However, this can take several years and may require multiple releases. Keep in mind that some sites with summer flooding may be unsuitable for beetles.


Jim McEvoy

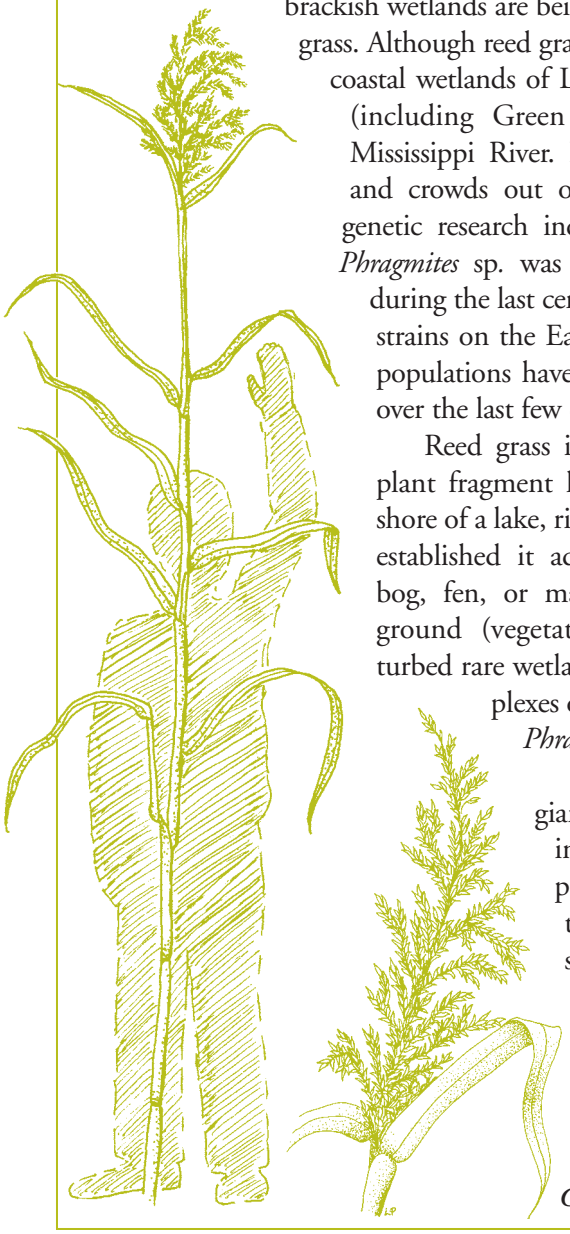
You can establish a local population of *Galerucella calmariensis* or *Galerucella pusilla* by raising your own beetles from propagation stock for $200 or less. To raise beetles you can receive instructions, netting (free if you agree to rear beetles for 3 years or more), and "starter beetles" ($25.00) from the Wisconsin DNR. The rest of the cost is for purchasing supplies. If you start with 100 beetles in early spring you can expect to release up to 10,000 beetles in June or July. If you are unable to raise your own beetles—for example, if you do not have a convenient place to keep the beetle rearing apparatus—then you can purchase a large number of beetles for immediate release. This is a very expensive and likely less effective than raising your own beetles, since it is best if the beetles are adapted to the local environment. Please note that the release of these exotic beetles comes with a small risk since research is currently on-going and all possible outcomes have not been tested. Nonetheless, the risk of a future problem with the release insects is considered very small relative to the risk of further damage to Wisconsin's wetlands by invasion with purple loosestrife.



Giant or Common Reed Grass (*Phragmites australis*)

Common reed grass (*Phragmites australis*) is the tallest wetland grass in Wisconsin. The grass can grow upwards of 14 feet, towering over all other wetland vegetation. It is a warm season grass with a round stem, long, wide leaves, and a prominent plume-like seed head that is whitish to purplish in color. The grass is tolerant of salt (i.e. brackish conditions) and thrives in roadside ditches. Since only a small percentage of the seed it produces is fertile, common reed grass spreads mostly by its rhizomes (underground stems).

In Europe this grass has a long history of being used as material for thatching roofs. In fact, some Europeans are concerned that historic reed beds are declining. Reed grass is found in marshes, wet shores, ditches and swales, tamarack bogs, and is reported in open water up to 6 feet deep. Some North Americans are concerned that many rare native plants in freshwater and brackish wetlands are being outcompeted by stands of reed grass. Although reed grass is a native species, it is invading coastal wetlands of Lake Superior and Lake Michigan (including Green Bay), and floodplains of the Mississippi River. It frequently forms dense stands and crowds out other plant communities. Recent genetic research indicates that a Eurasian strain of *Phragmites* sp. was introduced into North America during the last century and has swamped out native strains on the East Coast the Midwest. Aggressive populations have only been noticed in Wisconsin over the last few decades.



Giant Reed Grass

Reed grass is able to establish itself when a plant fragment lands in available habitat on the shore of a lake, river, or wetland. Once reed grass is established it advances quickly into adjourning bog, fen, or marsh habitat through its underground (vegetative) rhizomes. Pristine, undisturbed rare wetlands such as ridge and swale complexes or fens are currently threatened by *Phragmites* invasion.

Early and effective control of giant reed grass is necessary before an invading patch becomes a serious problem. Rather than inhibiting this grass, prescribed burns in the spring or fall will actually *encourage* its growth. However, burning in summer (mid-June to August) when the soil is dry can damage the rhizomes. Reed grass appears to be more vulnerable to

Top,* Phragmites *invading a Door County sedge meadow from roadside ditch.

Middle,* Phragmites *used for thatch in Europe.

Bottom,* Phragmites *invading a fen with orchids.

Alice Thompson

Daniel Q. Thompson

Steve Eggers

burning at this time because the plant is sending carbohydrates (sugars) to the rhizomes. A mid-summer burn may trigger the plant to sprout from buds that would normally overwinter in an unburned stand. These young shoots are then susceptible to frost kill the following winter.

Herbicide control with Rodeo®, a glyphosate herbicide, has had some success. However, Rodeo® is not specific to reed grass and a broad application of this herbicide can also kill the vegetation you are trying to protect. Other grass specific herbicides have not been tested but may be suitable in non-aquatic situations. Application is recommended when plants are at mid- to full bloom from late July through October. In a calcareous fen in Minnesota, a prescribed burn followed by hand-wicking Rodeo® on the re-sprouting shoots achieved 99% control in the first 2 years and 70% control after 4 years. The Nature Conservancy in Massachusetts reports cutting reed grass and individually spraying Rodeo® (at 20-30% strength) into each cut stem with a hand held squirt bottle avoiding adjacent native plants. This may be a time consuming method but can be useful for small or localized reed grass infestations in a high quality wetland.

Common Buckthorn

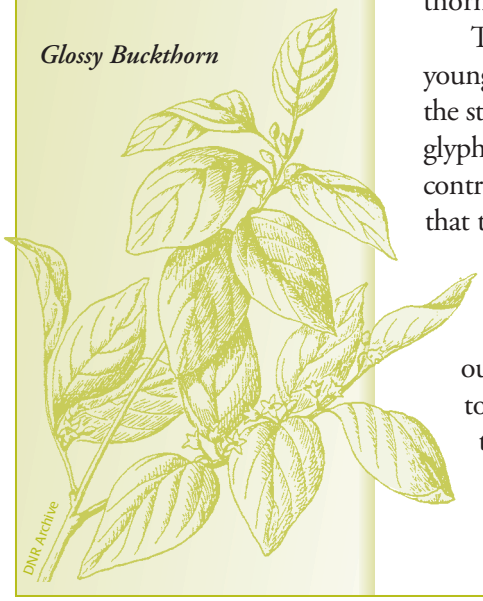
Courtesy of Missouri Department of Conservation

Glossy Buckthorn (*Rhamnus frangula*) and Common Buckthorn (*Rhamnus cathartica*)

Glossy buckthorn is a small tree or tall shrub native to European wetlands. Currently it is invading wetlands in Wisconsin and consequently shading out native vegetation. Common buckthorn is a related upland species that can invade disturbed wetlands, particularly along the drier borders. While common buckthorn has long thorns on the ends of the twigs, glossy buckthorn has no thorns.

Both species are spread when birds or other animals eat the berries and disperse the seeds in their droppings. Wetlands are susceptible to invasion by glossy buckthorn regardless of how disturbed they are. This aggressive shrub can invade virtually any type of wetland including bog, fen, sedge meadow, and swamp forest. Ironically, the only wetlands that glossy buckthorn cannot readily invade are wetlands dominated by reed canary grass!

Glossy Buckthorn



DNR Archive

The best method of control for *Rhamnus* spp. is to physically pull out young seedlings. If the seedling has become too large to pull you should cut the stem close to the ground and paint the cut surface with a solution of 50% glyphosate herbicide. The herbicide must be applied immediately; chemical control is ineffective if you wait more than a few hours for treatment. Be aware that the shrub will re-sprout vigorously if cut and left untreated.

A good time to locate and treat the shrubs is in the fall, as the species holds its leaves longer than most native wetland trees and shrubs. Another time to control buckthorn is in spring, as the shrub leafs out earlier than native shrubs. If you have a large infestation, give priority to treating the largest fruit-producing trees first. Then focus on mid-sized trees, and finally seedlings. If possible, cut and remove the fruit-bearing trees to an off site location. Keep in mind that once *Rhamnus* spp. invades, only routine ongoing removal will keep these species in check.

CATTAILS AND DISTURBANCE

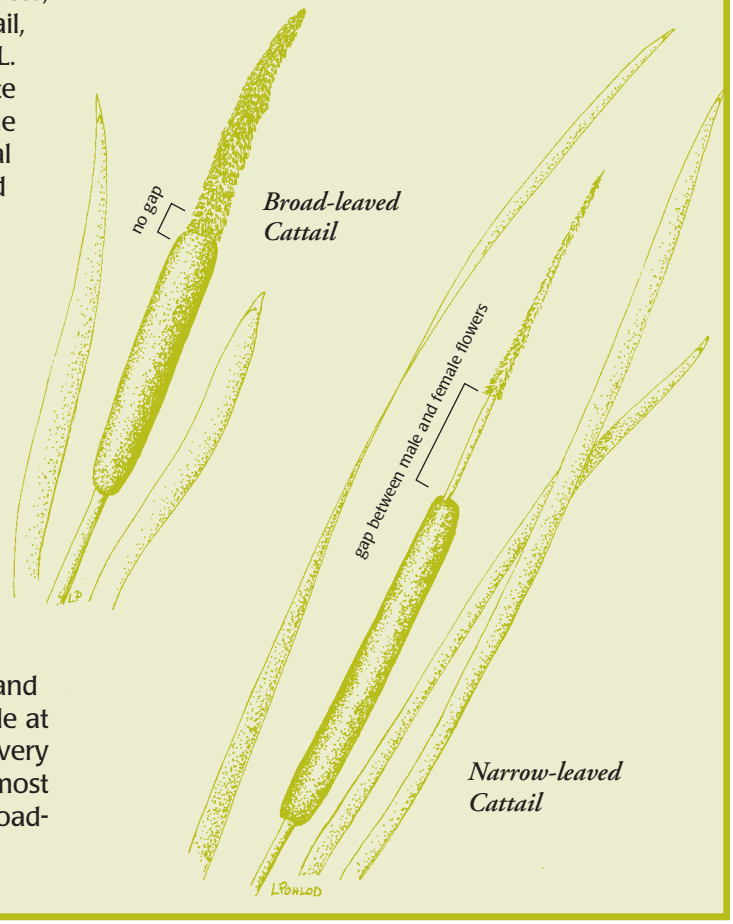
By S. Galen Smith, Professor Emeritus
Department of Biology, University of Wisconsin-Whitewater

Cattails are well known, characteristic wetland plants found throughout most of the world. Species found in Wisconsin are broad-leaved cattail, (*Typha latifolia)* and narrow-leaved cattail, (*T. angustifolia).* Although common, cattails in a wetland may indicate a disturbance problem.

In recent decades many naturalists in Wisconsin and other parts of North America have become alarmed to find species-rich natural plant communities replaced by nearly pure stands of cattails. In Wisconsin the concern is mainly with narrow-leaved cattail and "hybrid cattail," a cross of narrow- and broad-leaved cattail (*T.* × *glauca*) which have been markedly increasing in range and abundance. Broad-leaved cattail is native to North America, where it is ecologically important in many nutrient-rich marshes, sedge meadows, fens, springy places, and shores. In contrast, narrow-leaved cattail, according to data gathered by Ronald L. Stuckey and D. P. Salamon at Ohio State University, may have been introduced to the Atlantic Coast of North America in colonial times and has been migrating westward ever since.

The spread of narrow-leaved cattail in recent years, especially since World War II, may be partly due to increased eutrophication, or nutrient enrichment, of wetlands and increased use of road salt. Narrow-leaved cattail is especially abundant in slightly saline places such as near tidewater along the Atlantic Coast, and in eutrophic places such as rich agricultural lands. It is absent or rare in nutrient-poor habitats such as bogs and in regions with mineral-poor geological substrates. Where it becomes established in sedge meadows and fens in southeastern Wisconsin, for example at Lulu Lake in Walworth Co., it often forms very dense stands that appear to exclude most native species. In contrast, our native broad-leaved cattail forms less dense stands.

The main ecological effect of narrow-leaved cattail in North America, however, may be through hybridization with broad-leaved cattail to form the sterile "hybrid" cattail. This hybrid is remarkably successful ecologically because it spreads by means of rhizomes to form very large clones. It often out-competes the parent species, especially in eutrophic, disturbed habitats with unstable water levels. In Wisconsin, "hybrid" cattail now dominates many wetlands; two notable examples are large areas of the Horicon Marsh and the Yahara River marshes along the Highway 12 & 18 Beltline southeast of Madison. It has also invaded and seriously reduced the biodiversity of numerous prairie pothole wetlands. Further research is badly needed to document the effects of the spread of the narrow-leaved and hybrid cattails.



Managing Your Restored Wetland

Using Fire

Natural and human-caused fires influenced wetlands historically associated with the prairie/oak savanna ecosystem. Prairie fires also swept through sedge meadows and low prairies, often killing or setting back the encroaching shrubs and trees. Wetland systems today can benefit from prescribed burns that remove thatch and expose the soil to light. This allows sedges and forbs to germinate. However, not all wetland systems depend upon fire, especially those in the northern part of the state. For example, tamarack trees are very sensitive and will not survive a burn.

Do not attempt a controlled burn without experienced assistance! Small, controlled fires can quickly rage out of control, causing extensive damage. Dry peat soils can ignite during a controlled burn, swiftly burrowing underground and burning uncontrolled for weeks or more. Always, without exception when using fire, err on the side of caution. Check with your local Wisconsin DNR warden for information on burning permits and be sure to discuss the burn with your local fire department. Further information on managing wetlands with controlled burns is referenced in Appendix A.

Mowing/Removing Brush

In situations where burning is not an option, mowing or brush removal can be just as effective in controlling encroaching brush on an open wetland. When the ground is frozen, mow vegetation about 6 to 8 inches tall in order to effectively remove brush without damaging the dormant vegetation. Do not mow during the nesting season!

Attracting Wildlife

Wildlife will be attracted to wetlands managed with the techniques mentioned earlier, including invasive plant control, buffer zones planted with native species, and doing prescribed burns where appropriate. If installed properly, nest boxes with predator guards can increase nesting success. Bird species that nest in cavities include: wood ducks, hooded mergansers, blue birds, tree swallows, house wrens, prothonotary warblers, and screech owls. In general, the best way to attract wildlife is to restore the landscape as closely as possible to how it existed prior to human interference. A diversity of habitats and plant species will attract more diverse wildlife to your wetland.

Alice Thompson

Art Kitchen

Top, wetlands may need an occasional controlled burn to discourage invasion by shrubs and invasive species.

Bottom, wetland with vegetated buffer.

Ongoing Management . . .

Ongoing adaptive management may be critical to reaching your project goal. Although you should plan for a self-sustaining wetland, management practices exist that will enhance your project. We caution against planning management projects that are unrealistic or unachievable. Prioritize the activities and start with those that add the greatest value to wetland habitat and species diversity.

Prescribed burns, brush control, tree plantings, berm or plug repair, maintenance of upland buffer areas, and controlling invasive plants are all important management activities but will vary in importance depending on your site. You can spend a lot of time building nesting platforms and boxes, but the most worthwhile activities should focus on providing wildlife habitat by establishing varied native vegetation. Many publications, agencies and organizations can help you achieve your management objectives; a few of these are listed in Appendix A.

CHAPTER 7. WHAT ABOUT REGULATIONS?


Thomas W. Ford

When proposing a wetland restoration project there are various federal and state laws, along with municipal and county ordinances, that have to be followed. Without these regulations in place to protect wetlands, many acres of wetlands in Wisconsin would have been filled. Regulation of wetlands also extends to their restoration. Permits are required for most wetland restoration activities, especially those that alter or impact a wetland or waterway including removing drainage features, diverting water, changing topography, moving soil, or other significant changes to the site.

The first step in navigating regulations is to determine which regulations apply to your situation. Once you have assessed your site and have some thoughts on your plan, contact the United States Army Corps of Engineers (USACE) staff and the Wisconsin DNR water management specialist in your county (see Appendix B). They will be able to determine which federal and state permits will be required for your project. They might also have suggestions on the design of your project that may limit the number of permits that are required. Be sure to find out how long the permit process will take and apply for all necessary permits at once. Visit your county and town offices to determine if they have additional permit requirements. Keep in mind that the more urban your county, the more likely you may need to apply for a permit that will involve a public hearing.

There are some ways you can streamline the permit process. For example, if your project is located in an agricultural setting it might qualify for one or more government wetland restoration programs such as the Conservation Reserve Program (CRP), Wetland Reserve Program (WRP), or Partners for Wildlife. In addition, private organizations like the Wisconsin Waterfowl Association or Ducks Unlimited may have wetland restoration efforts in your area that you may qualify for. Please see Chapter 8 for a discussion of these different programs. If you are accepted into any of these programs part of the technical assistance you will get with your project will include facilitation with acquiring necessary permits.

Later in this chapter you will find a section on the Wisconsin administrative code entitled NR 353 "Wetland Conservation Activities". This rule was developed to specifically streamline the regulatory process for wetland restoration activities. Consequently, if you do all you can to fit within the conditions of NR 353, the permit process for your project will be simpler and faster. If your project only involves maintenance of an existing project, you may find that your site can be managed under the "grandfather" provisions of NR 353. If you proceed in restoring your wetland *before* securing the necessary permits, you might be found to be in violation of wetland regulations. The consequences of illegal wetland activities could be severe, possibly including fines or restoration of the site to pre-disturbance conditions.

United States Army Corps of Engineers

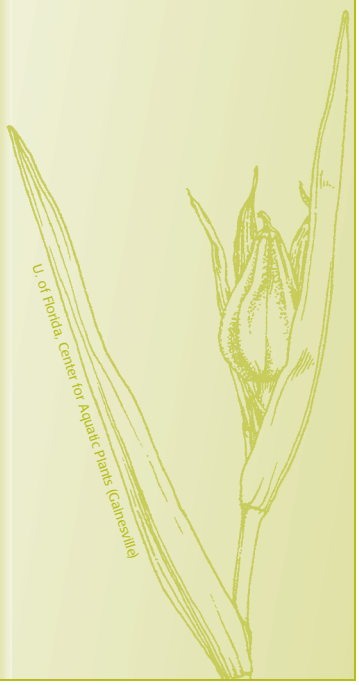
Section 404 of the Clean Water Act

The Section 404 permitting program is the primary federal program governing activities in wetlands. This program aims at minimizing adverse impacts to waters of the United States (including wetlands) and regulates filling, grading, and other land disturbing activities in those areas. The USACE is the sole federal agency responsible for administering the Section 404 permit process under the Clean Water Act.

If your restoration is in an existing wetland you will need to contact the USACE and the Wisconsin DNR since both agencies have regulatory oversight of wetland activities (see the flow chart at the end of this chapter). A USACE permit is not valid without water quality certification from the Wisconsin DNR.

Some of the factors the USACE will consider during the permitting process include:

- ☑ How disturbed or altered is the site?
- ☑ Will any soil/fill be placed in a drainage ditch, creek, or wetland? If so, how much?
- ☑ Where will excavated soil be placed? Will it be used as a ditch plug or spread on an adjacent upland?
- ☑ What techniques are you using to promote vegetation and to control invasive plants?
- ☑ What is the timing of your project?



The regional office of the USACE recently reorganized the permit process for Wisconsin by eliminating 30 to 40 nationwide permits and developing a simplified version called the General Permit/Letter of Permission (GP/LOP-98-WI). There are currently four types of general federal permits and letters of permission categories.

Two types of general permits are applicable to wetland restoration projects. The first is a "non-reporting provision" of GP/LOP-98-WI that applies to wetland and riparian (e.g., stream or river) restoration projects sponsored by federal or state agencies. There is no individual Wisconsin DNR water quality certification required and no reporting of activities under this particular permit. Since GP/LOP-98-WI only applies to projects sponsored by federal or state agencies, if you have a privately funded restoration you can ask an agency to consider co-sponsoring your project. Even if you are supplying all of the financial support, the interested agency can review the project and agree to sponsor it. This will allow you to use the non- reporting GP/LOP-98-WI. Keep in mind, you will need to enter into a binding agreement with the agency which may include conditions you must uphold for the permit to be valid.

The second type of general permit for wetland projects the USACE may authorize is GP/1-WI. GP/1-WI regulates waterfowl habitat and wildlife ponds for private projects. This permit is only valid if your project requires a Wisconsin DNR permit under Chapters 30 or 31. The conditions of GP/1-WI require that the restoration have 1) irregular shorelines, 2) shallow slopes with a minimum of an 8:1 ratio, 3) average water depths no more that 2-3 feet, and 4) only 25% of the surface area can have a maximum depth of 5 feet. Please note, however, to get the corresponding Wisconsin DNR permit, your design must contain less than 4 feet of water. In addition, the goal of your project must include wildlife or waterfowl habitat improvement.

It is important to remember that before you file for any permit, discuss the site and your plans with your local USACE wetland staff (see Appendix B). The USACE will review your site and may ask to see final restoration plans before issuing or denying a permit. If your site cannot be permitted under the two general permits discussed above, your project may require the more involved *individual* permit process.

Wisconsin Department of Natural Resources

State waterway and wetland laws regulate activities in Wisconsin's wetlands and in adjacent navigable waters. Wisconsin has some of the best wetland regulations in the country. The primary wetland protection mechanism is a set of administrative rules, NR103, which outline water quality standards for wetlands. Rather than second-guessing what state regulations may apply to your site, it is best to involve Wisconsin DNR staff early in the planning phase of your project to determine if permits are required. Wisconsin DNR staff comments and initial review may assist you in preparing your plan to comply with state laws and rules. The Wisconsin DNR water management specialists are listed by county in Appendix B.

The Wetland Conservation Permit under NR 353

Recognizing that wetland restoration is in the public interest, the Wisconsin DNR has given wetland restoration special regulatory consideration under new administrative rules, NR 353. These rules are meant to encourage and facilitate ecologically sound wetland restoration through a streamlined permitting process. Your project will have faster application review and permit approval if the site and restoration practices meet specific conditions. It is wise to make every effort to design your site to meet the criteria outlined in NR 353. If you do, you will have a more ecologically friendly project and the permit may be issued quicker. ***Please note: If the purpose of the project is to convert a wetland into a pond or a stormwater system, NR 353 criteria will not apply.***

In order for your project to be permitted under the streamlined NR 353, your site needs to meet a number of eligibility requirements. The language of NR 353 can be found on the Wisconsin DNR web site at: **www.dnr.wi.gov/org/water/fhp/wetlands/whatsnew.shtml**. A discussion of the main eligibility requirements and how your site may fit these requirements are listed below. It is difficult to simplify these regulations since there are legal nuances that may be important. Please be advised that this discussion is not exhaustive and is only intended to help you understand how the Wisconsin DNR may view your site.

Your restoration project may be eligible for the NR 353 permit if: (Wisconsin DNR rule language is in **bold**)

1. **The project purpose is wetland conservation.** For example, projects with other purposes such as stormwater retention, flood control, or fish ponds cannot be permitted by NR 353.
2. **The project proponent has demonstrated that site conditions exhibit impacts to topography, soils, native vegetation, or hydrology that have degraded a wetland and are potentially**

STATE REGULATIONS FOR WETLANDS can be found at the Wisconsin DNR web site:

www.dnr.wi.gov/org/water/fhp/wetlands/programs.shtml

A **SUMMARY OF WETLAND REGULATIONS** is also found at the Wisconsin Wetlands Association web site:

www.wiscwetlands.org/regulation.htm

WHAT IS NAVIGABILITY?

A navigable waterway is a ditch or stream with a defined bed and bank, a direction of flow, and at some point in a normal year, you can float a canoe on it. For example, even if a ditch is bone-dry in July but during spring runoff a small canoe could navigate the waterway (with allowances for portaging around obstructions) it is considered *navigable*. Navigable waters often are depicted with a blue line on a topographic map. Even though streams are identified on maps as intermittent (meaning they may not have a year-round flow), they are nonetheless usually categorized as navigable. Laws associated with the state's navigable waters protect public rights, including the public use of water, fish, aquatic life, and wildlife. Make sure to check with the Wisconsin DNR water management specialist for your area to determine if a waterway is navigable.

reversible. A site with any combination of ditches, drain tiles, wetland fill, deposition or sediment, and dominant invasive plants will easily meet these criteria. If there are no reversible impacts on your site, chances are the wetland is in a natural state and should not be disturbed.

3. The project uses the listed wetland conservation activities as explained in the next section, including drain tile removal, ditch plug or fill, certain berms, sediment removal, etc.

4. **The project does not involve any activities in navigable waters with prior stream history, or is otherwise determined to not cause significant adverse impacts to those waters.** The permit is applicable to fill or plug ditches that were dug to drain a wetland, were not originally a stream, and therefore do **not** have stream history (see accompanying explanation of navigability and stream history). If you want to restore a stream or a ditch that **has** a stream history (i.e. historically was a stream) you will need to apply for a more involved Chapter 30 permit.

5. **The project does not cause significant adverse impacts to a cold water community as defined in s. NR 102.04(3)(a) or cause significant obstruction of fish passage to existing spawning areas.** If your project is adjacent to a cold water stream, it needs to be designed to avoid seriously impacting these waters. For example, trout habitat could be negatively affected if pooled, sun-warmed water from your restoration site drained into the cold water stream. The permit would not be issued unless you could work out the design with the Wisconsin DNR to eliminate warm water drainage or other problems. In addition, there are areas in the state where streams have been so radically altered that ditches are the only available way for fish to access existing spawning areas. If your project blocks fish access in one of these ditches the permit may not apply.

6. **The project will not cause significant adverse impacts to state threatened or endangered resources…** or… **historic or cultural resources…** The Wisconsin DNR will determine if there are state threatened or endangered species or historic and cultural resources on your site when they review the permit application. Most threatened or endangered wetland species are aided by wetland restoration. However, if threatened or endangered species are identified by the Wisconsin DNR as a concern on the site, the project needs to be specifically designed to benefit those species. As a result, an additional review may be needed. Similarly, they will determine if a restoration plan needs to be modified in order to protect an historic or cultural resource.

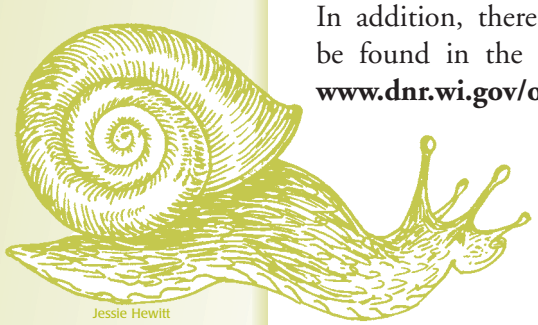
7. **The project does not involve the planned introduction of non-native or invasive wetland plants.** Only native plants may be seeded or planted on your project.

In addition, there are several other eligibility requirements which can be found in the NR 353 text on the Wisconsin DNR web site at: **www.dnr.wi.gov/org/water/fhp/wetlands/whatsnew.shtml.**

DNR Archive

WHAT IS STREAM HISTORY?

The Wisconsin DNR may check to see if a ditch has a stream history. Often ditches were dug into existing streams, and former streams have been filled, straightened, or channeled. Ditches were frequently dug much wider and deeper than the original stream and often relocated to property boundaries. Old aerial photos, maps, or pre-settlement land survey records can be viewed to determine if a natural stream once existed in the vicinity of the current ditch. Any ditch that was once a stream is considered to have a stream history.



Jessie Hewitt

The NR 353 permit applies to the following wetland restoration practices and the sites on which these practices are appropriate:

Tile Breaks. Drain tile may be removed or disabled in the project area provided the activity does not impact adjacent landowners or drain tile is not part of a legal drainage system.


Alice Thompson

Ditch Plugs and Ditch Fills. Ditches may be plugged or completely filled as long as they do not have stream history and are not part of a legal drainage system. If the ditch is located in a floodplain, you will need to supply top, cross-sectional, and side view plans of the project.


Art Kitchen

Dikes, Embankments, or Low Berms. For proposed new dikes, embankments, or low berms there are several considerations under the conservation permit process. These structures are allowed under the conservation permit as long as the site is cropped, or is dominated by invasive wetland species or pioneer wetland plants. A berm cannot be built to flood an existing wetland community or negatively impact an adjacent wetland. For example, if the berm would isolate an adjacent wetland from its water source or cause its water levels to rise, then the permit would not apply.

In addition, the berm can be no more than 6 feet high from the ground and create less than 50 "acre-feet" of water storage. The berm must be designed by a professional engineer or be submitted by a county, state, or federal agency (e.g., NRCS, Wisconsin DNR, or USFWS). The requirement for a professional engineer to design the berm is waived if the berm is no more than 2 feet high and creates less than 50 "acre-feet" of water storage.

Excavation. Excavation includes the removal of soil and vegetation; the creation of micro-topography including shallow scrapes, channels, submerged islands, and interconnected open water areas, or the removal of post-European settlement deposition that has accumulated over historic wetland soils. These techniques are allowed under the conservation permit as long as the site is cropped or is dominated by invasive wetland species or pioneer wetland plants. The practices cannot harm an undisturbed wetland on or adjacent the site. For example, the scrape or soil removal is permitted in an area dominated by reed canary grass but not in an alder thicket or sedge meadow. Additionally, excess soil not used as a component of the restoration design to plug or fill a ditch will need to be deposited on adjacent uplands or trucked to an off-site disposal location.


Alice Thompson

Water Level Manipulation. Activities that are allowable include adding or removing pumps, breaching dikes, re-routing ditches or other artificial water features, or installing and manipulating a water control structure. These techniques are allowed as long as the site is cropped or is dominated by invasive wetland and pioneer plant species. The practices cannot harm an undisturbed wetland on or adjacent the site. For example, water control may be used as a management tool to flood a meadow of reed canary grass or narrow-leaved cattail, but not to flood out a higher quality wetland community.


Alice Thompson

Alice Thompson

Vegetation Management. Vegetation management is allowed under NR 353. Introducing native wetland plants, controlling invasive plants by cutting or removal, introducing USDA approved biological control agents (e.g., purple loosestrife beetles), manipulating water levels, burning, or using US EPA registered herbicides are acceptable management techniques under NR 353. The project, however, cannot involve the planned introduction of non-native or invasive wetland plants.

Water Monitoring Devices. Staff gauges, water level recording devices, water quality testing, and small weirs and flumes to measure and record scientific data are permitted.

Further descriptions of these practices can be found in Chapter 4.

To apply for a NR 353 general wetland conservation permit contact your Wisconsin DNR water management specialist for the correct form. A list of these specialists is available at **www.dnr.wi.gov/org/water/fhp/waterway/watermanagementspecialists.shtml** and in Appendix B.

Some of the materials you need to put together for your permit include:

- ☑ The location of the site on a USGS quad map.
- ☑ A general description of the site and any adjacent wetland areas, including aerial photographs of the proposed restoration area.
- ☑ A description of the existing site conditions including soils, hydrology, and the current land use and plant communities present.
- ☑ A narrative description of the planned project and how it meets the eligibility requirements.
- ☑ A sketch of the project with dimensions (additional information is required for proposed dike, embankment, or berm projects).
- ☑ Sufficient information to demonstrate that the project will not flood any neighboring lands or obstruct ditches in drainage districts.
- ☑ The goals and objectives for your site, including long-term management.

U. of Florida, Center for Aquatic Plants (Gainesville)

It is very important to include your **management plans** with the permit application because maintenance that is described and included in your proposal will not require Wisconsin DNR permits in the future. For example, if your management plan includes maintenance of a ditch plug you will be allowed to repair the plug to original specifications at a later date without a permit. Burns, herbicide use, vegetation control, and any future maintenance should be included if you want to practice them in the future without further Wisconsin DNR permitting. Keep in mind that you may still need future federal or local permits.

Timing

Every effort should be made to submit a complete application to the Wisconsin DNR. You can speed up the review by having the local Wisconsin DNR water management specialist visit your project site in

advance while you are developing your restoration plan. Make sure you thoroughly communicate your site conditions and how your project fits the permit criteria. For projects that meet the NR 353 eligibility requirements, the Wisconsin DNR has 30 days to request any additional information from you and an additional 30 days from the receipt of this additional information to either issue a permit or deny the plans.

Special Case for Previously Completed Wetland Projects

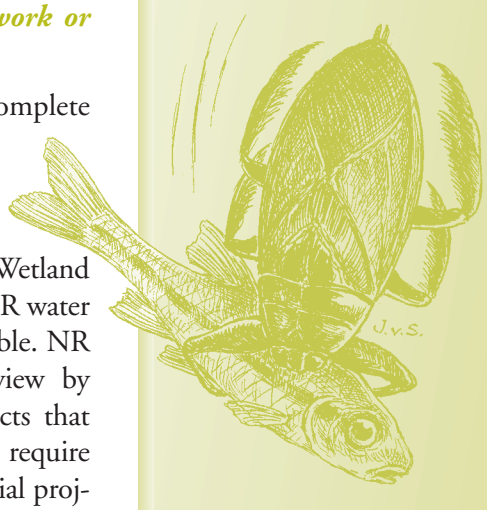
If you own land with a wetland project that was constructed prior to August 1, 1991, you may maintain your project under the NR 353 rules. The project maintenance provisions of NR 353 were developed for landowners who have structures (such as berms) that were constructed prior to when the existing wetland protection laws came into effect. It is intended to allow you to rebuild and maintain original water control structures on your site without additional permit requirements.

In order for your project to be considered under NR 353 without further permit requirements, you need to provide a description and a diagram of existing site conditions including: the location of the project, hydrologic characteristics of the site, existing plant communities on the site, the location and condition of existing project infrastructures (e.g., dikes, ditches, nesting islands, water level control structures and pumps, etc.), current land use for the site, and past management and maintenance activities that may have occurred on the site.

The application should include a plan that describes the proposed maintenance activities including areas to be excavated and cross-sections of proposed enhancements to existing dikes and nesting islands. A hydrologic/hydraulic analysis by an engineer licensed in the state of Wisconsin may be required if the proposed project includes alteration to the height or cross-section of the original dike.

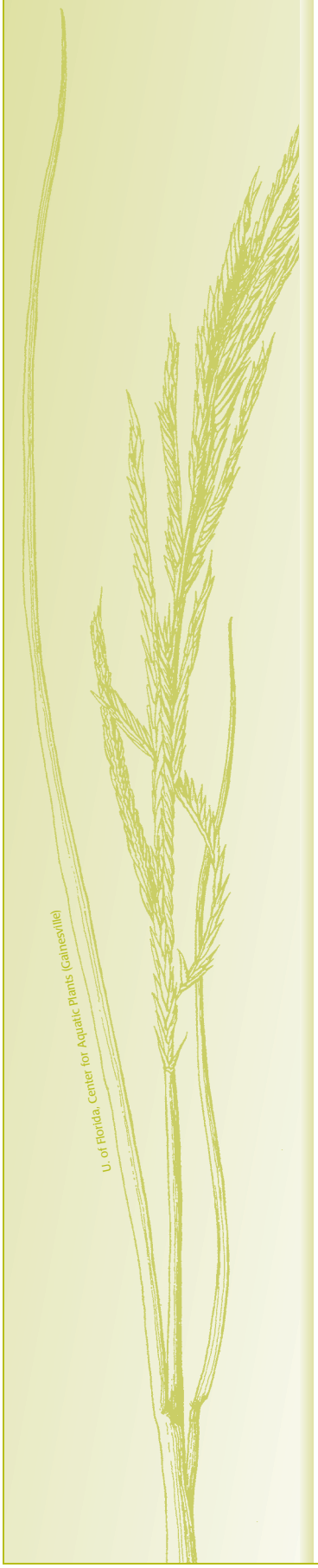
The Wisconsin DNR may wish to meet with you to review the project in the field and to discuss any modifications to your maintenance plan. Only after approval of the plan can you conduct the maintenance activities described in the plan as long as Wisconsin DNR employees have access to make inspections of the site. ***Note, any new project work or expansion of created wetlands would require a new permit!***

Please visit **www.legis.state.wi.us/rsb/code/index.html** for the complete text of NR 353.



Other Wisconsin DNR Permits

If your restoration project cannot be permitted under the NR 353 Wetland Conservation Permit, you need to discuss with your Wisconsin DNR water management specialist what other permit options, if any, are available. NR 353 is designed to expedite projects that involve minimal review by Wisconsin DNR staff. Very large and involved restoration projects that require extensive environmental review or public notice will either require additional permits or may not be able to be permitted at all. Potential project situations where other permits may be needed include bridges or culverts


U. of Florida, Center for Aquatic Plants (Gainesville)

in navigable waters, stream restoration projects (or projects impacting ditches with stream history), dams, grading adjacent navigable waters that cannot be permitted under NR 353, and ponds connected to or within 500 feet of navigable waters.

Vegetation Management: Possible Permit Concerns

If you confine your restoration plan to vegetation management activities alone, generally you will not need permits. However, you may need to call your local fire department to obtain a town-issued agricultural burn permit before undertaking a prescribed burn. If you live in an ozone non-attainment area of the state (including Washington, Ozaukee, Milwaukee, Waukesha, Racine, and Kenosha counties) you need to call the Wisconsin DNR air management program to obtain approval before burning. Planting native stock and brush cutting usually do not require permits. Counties may regulate the cutting of vegetation in a shoreland zone and a county permit may be required to clear brush. When in doubt, check all potential local (municipal, county, etc.) permit requirements.

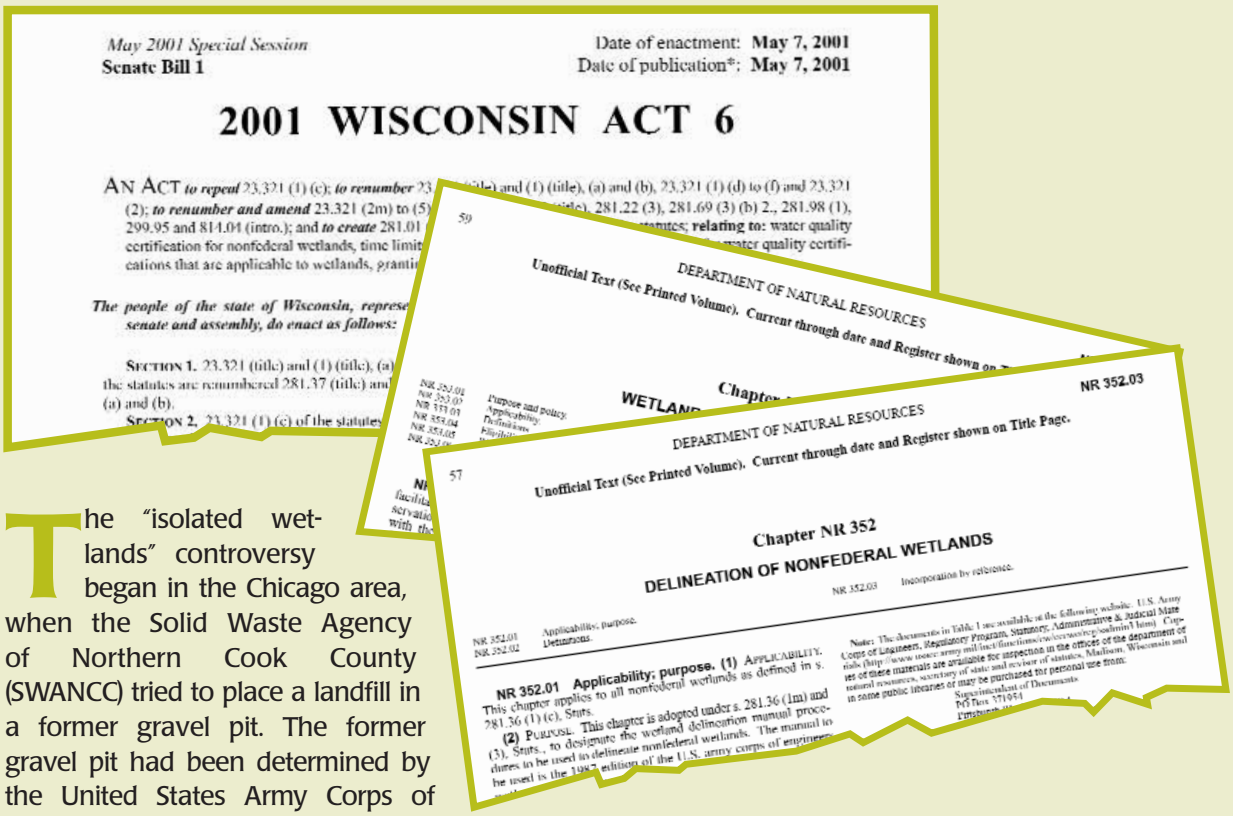
If your management activities include controlling aquatic plants (i.e. plants in water, including wetlands) by the use of chemicals, manual or mechanical removal, or by using biological control agents, you may need a valid aquatic plant management permit under state administrative rules NR 107 or NR 109, or a NR 353 permit described above. Contact the aquatic plant manager at your local or regional Wisconsin DNR office for details on obtaining permits (see Appendix B). ***Some herbicides are not suitable for use over or near water.*** If herbicide use is planned, it is very important to carefully read the label before purchasing and applying any chemical.

"Isolated" Wetlands

In January 2001, the United States Supreme Court decided that wetland sites that are "isolated" from navigable waterbodies are excluded from USACE jurisdiction. Isolated wetlands typically have no detectable connection to streams, rivers, or lakes and are surrounded by uplands. Examples of isolated wetlands include ephemeral ponds, prairie potholes, depressional basins, and kettle bogs.

The USACE makes the determination whether a site is isolated or not. If they determine that the wetland is isolated, the USACE has no further authority to review or permit activities on that site. The Wisconsin Legislature passed a law in 2001 that gives regulatory authority over these "non-federal" isolated wetlands to the Wisconsin DNR. ***Therefore, all proposed wetland fill or dredge activities in isolated wetlands need to be permitted with water quality certification by the Wisconsin DNR.***

"ISOLATED WETLANDS" CONTROVERSY



May 2001 Special Session
Senate Bill 1

Date of enactment: **May 7, 2001**
Date of publication*: **May 7, 2001**

2001 WISCONSIN ACT 6

AN ACT *to repeal* 23.321 (1) (c); *to renumber* 23. ...title) and (1) (title), (a) and (b), 23.321 (1) (d) to (f) and 23.321 (2); *to renumber and amend* 23.321 (2m) to (5) ...title), 281.22 (3), 281.69 (3) (b) 2., 281.98 (1), 299.95 and 814.01 (intro.); and *to create* 281.01 ...statutes; **relating to:** water quality certification for nonfederal wetlands, time limit... water quality certifications that are applicable to wetlands, granti...

The people of the state of Wisconsin, represe... senate and assembly, do enact as follows:

SECTION 1. 23.321 (title) and (1) (title), (a) ... the statutes are renumbered 281.37 (title) and ... (a) and (b).

SECTION 2. 23.321 (1) (c) of the statutes...

59

DEPARTMENT OF NATURAL RESOURCES

Unofficial Text (See Printed Volume). Current through date and Register shown on ...

WETLAND...

Chapter...

57

DEPARTMENT OF NATURAL RESOURCES

NR 352.03

Unofficial Text (See Printed Volume). Current through date and Register shown on Title Page.

Chapter NR 352

DELINEATION OF NONFEDERAL WETLANDS

NR 352.01 Applicability; purpose.
NR 352.02 Definitions.
NR 352.03 Incorporation by reference.

NR 352.01 Applicability; purpose. (1) APPLICABILITY. This chapter applies to all nonfederal wetlands as defined in s. 281.36 (1) (c), Stats.

(2) PURPOSE. This chapter is adopted under s. 281.36 (1m) and (3), Stats., to designate the wetland delineation manual procedures to be used to delineate nonfederal wetlands. The manual to be used is the 1987 edition of the U.S. army corps of engineer...

Note: The documents in Table 1 are available at the following website: U.S. Army Corps of Engineers, Regulatory Program, Statutory, Administrative & Judicial Mate... rials (http://www.usace.army.mil/inet/functions/cw/cecwo/reg/wetlnk1.htm). Copies of these materials are available for inspection in the offices of the department of natural resources, secretary of state and revisor of statutes, Madison, Wisconsin and in some public libraries or may be purchased for personal use from:

Superintendent of Documents
PO Box 371954
Pittsburgh...

The "isolated wetlands" controversy began in the Chicago area, when the Solid Waste Agency of Northern Cook County (SWANCC) tried to place a landfill in a former gravel pit. The former gravel pit had been determined by the United States Army Corps of Engineers (USACE) to be a wetland and as a result, the USACE refused to issue a permit. When the resulting lawsuit landed in the lap of the United States Supreme Court, the Court declared in January 2001 that this gravel pit was not a wetland under federal definitions. This decision had the far-reaching and unexpected effect of eliminating federal jurisdiction over all isolated wetlands in the country. Because Wisconsin's state wetland protection regulations were linked to federal jurisdiction, this meant that an estimated one million acres of isolated wetlands were instantly vulnerable to development. Within a few months, isolated wetlands began to be filled in the state, and citizen alarm mounted. The Wisconsin Wetlands Association (WWA) worked closely with key legislators, the Wisconsin DNR, other environmental groups, and the Governor's office to find a way to quickly resolve the isolated wetland crisis. WWA helped create an impressive coalition of over 70 organizations representing more than 330,000 conservationists, hunters, and anglers in the state that worked diligently to urge lawmakers to protect our vulnerable wetlands. By April 30, 2001, the new wetlands protection bill passed the State Senate and Assembly *unanimously* and the Governor signed the law on May 7, thereby restoring protection to all of Wisconsin's wetlands. Wisconsin was the first state in the country to swiftly fill the regulatory gap created by the Supreme Court's decision. Sadly, as of 2003, very few states have yet taken action to protect their isolated wetlands.

Isolated wetland in Milwaukee county. Forested depression protected from development.

Alice Thompson

WHAT IS A MITIGATION BANK?

A mitigation bank is a system of accounting for wetland loss and compensation that includes one or more sites where wetlands are restored, enhanced, or created to provide transferable credits to be subsequently applied to compensate for adverse impacts to wetlands. Banks are established through a formal legal agreement between a bank sponsor and several regulatory agencies including the United States Army Corps of Engineers, the Wisconsin DNR, the United States Fish and Wildlife Service, and the Environmental Protection Agency. The process for establishing a bank is quite rigorous. It involves a coordinated review by agencies, developing a bank document, establishing a credit accounting and reporting process, establishing maintenance and monitoring plans, and protecting the site in perpetuity. Once the bank is approved, the owners can sell "mitigation credits" to anyone who has an approved permit to fill a wetland that includes mitigation and for whom local mitigation has been ruled-out. The details on how banking works and what is required can be found in the document *Guidelines for Wetland Compensatory Mitigation in Wisconsin*, available from the Wisconsin DNR web site at :

www.dnr.wi.gov/org/water/fhp/wetlands/mitigation/

Wetland Mitigation

Under the federal "no net loss" wetland policy, many federal wetland permits have been issued with the requirement to "mitigate" or offset the unavoidable wetland losses that result from a fill activity. Many states have adopted wetland mitigation policies that accept wetland creation, enhancement, or restoration activities on other sites to compensate for lost wetland acres. New state rules for Wisconsin that allow the use of wetland mitigation became effective in 2002. The Wisconsin DNR permitting process, under NR 103, requires avoidance of any wetland fill activity. If wetlands are impacted, the impact must be minimized. The new law allows for flexibility in the permitting process and, in certain situations where wetlands would be impacted, an applicant for a wetland fill permit can include a proposal to mitigate the fill by restoring wetlands to compensate for those destroyed.

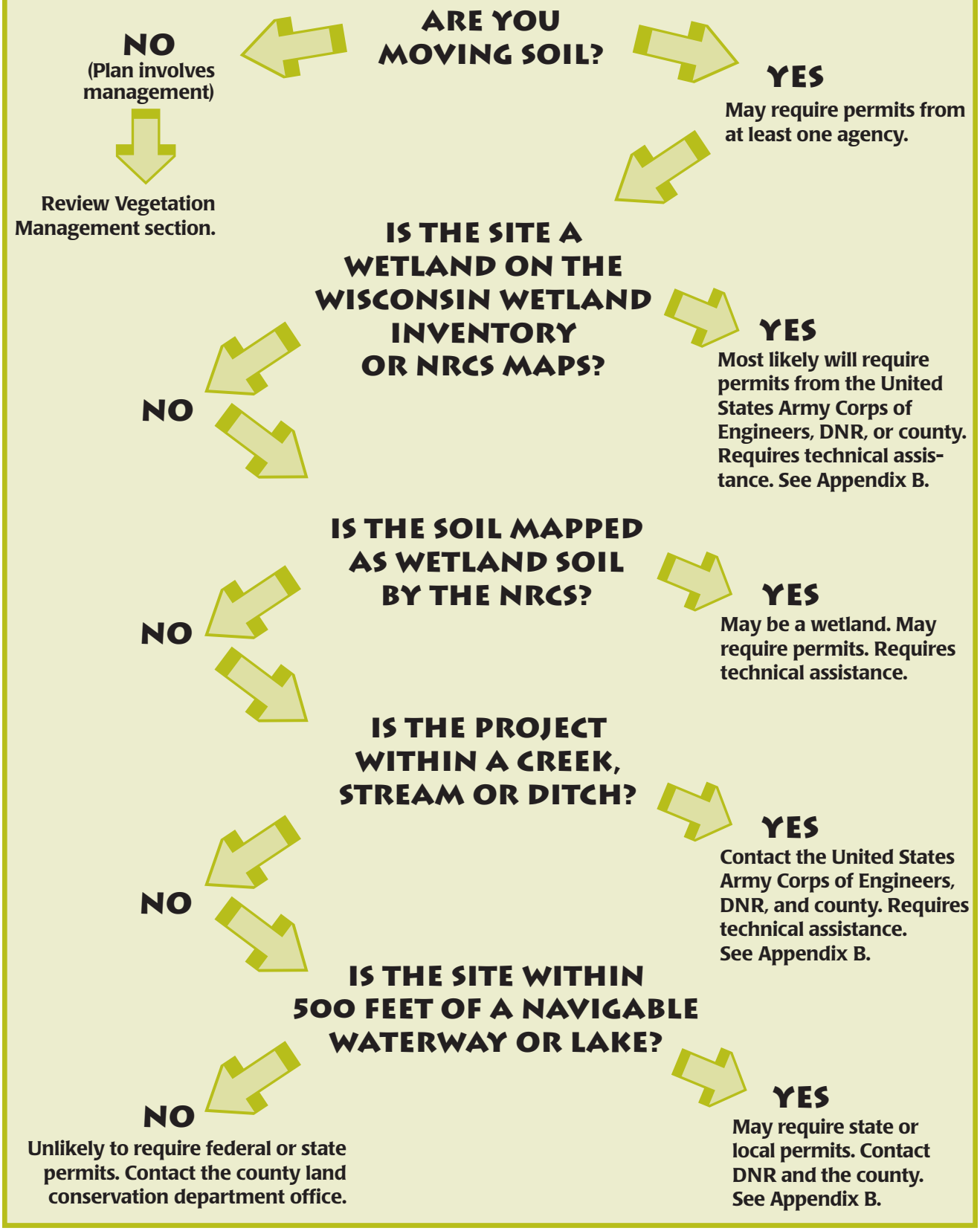
The new rules favor mitigation projects that are restorations, as opposed to creations or enhancements, on original wetland soils. In general, the replacement ratio requires providing 1.5 acres of restored wetland for each acre of wetland lost. The first area to search for mitigation is on the site within ½ mile of the impacted area. If there are no suitable areas on-site then look at restoration sites within the Geographic Management Unit, within the county of impact, within a 20 mile radius from the project site, or purchase credits from an approved "mitigation bank". The Wisconsin DNR maintains a list of approved mitigation bank sites and their service areas on a registry that is found on the Wisconsin DNR web site at: **www.dnr.wi.gov/org/water/fhp/wetlands/mitigation/mitigationbanks.shtml**.

The purpose of mitigation is to allow a flexible permit process that allows restored wetlands to replace other wetlands that are permitted to be filled. When mitigation is part of the approved project proposal, the regulatory agencies have a high interest in the success of the mitigation project. Projects should be designed to restore wetlands on the landscape using restoration methods that have low maintenance requirements. In addition, the restored wetland must be protected in perpetuity. Projects should favor ecologically sound restoration to original site conditions with good upland buffers, such as the ones described in this handbook. The ***Guidelines for Wetland Compensatory Mitigation in Wisconsin*** are available from the Wisconsin DNR web site at: **www.dnr.wi.gov/org/es/science/wetmit.htm**. If the mitigation is being mandated by the USACE, your project must also be in accordance with the USACE Section 404 mitigation policy. We encourage you to speak with your USACE agency staff early in the planning process (see Appendix B).

County and Town Ordinances

Local town and county governments vary statewide in their regulation of wetlands and floodplain shorelands through zoning ordinances. Check with your local government county zoning or land conservation office early in the process to see which ordinances may apply to your project (see Appendix B).

DECISION CHART FOR WETLAND RESTORATION REGULATION



CHAPTER 8. WHO CAN HELP FACILITATE MY RESTORATION WORK?

Since wetlands are widely deemed valuable, many federal, state, and private programs exist to assist landowners in protecting, restoring, and enhancing wetlands and associated uplands. Experienced wetland specialists are available throughout the state to assist you. Evaluate each program carefully to determine which, if any, suits the goals of your site. These programs offer landowners technical assistance and advice, help with the regulatory process, and can sometimes provide funding. Appendix B lists the major federal and state agency contacts in Wisconsin.

Federal Programs

If you want to know how your project will look when it's complete, visit a few wetlands restored under the state or federal program you're interested in.

At no time in history have the incentives for wetland restoration been so attractive. As a result of the 2002 Farm Bill passed by Congress, considerable sums of money are now available to landowners as payment for enrolling in various wetland restoration programs. We provide descriptions of the major Farm Bill programs, however, keep in mind that there are other programs that include wetlands as a component of more comprehensive farm conservation programs that are not described in this handbook. We encourage you to contact the Natural Resources Conservation Service (NRCS) and Farm Service Agency (FSA) offices in your county for current and more detailed information about wetland and wildlife conservation incentive programs, as **these programs change often!**

Most applicable federal programs help fund wetland restoration activities that restore hydrology using methods such as ditch plugs, drain tile breaks, scrapes, and berms. Generally, the programs rely on an existing seed bank or colonization of plants from neighboring wetlands and do not feature seeding or planting of wetland vegetation. Some programs, however, do include warm-season (native prairie) plantings in upland buffer zones.

Although the financial incentives under federal conservation programs have never been better, it should be noted that your property taxes may rise as a result of enrolling in one of these federal programs, especially WRP and possibly other programs, due to Wisconsin's agricultural "use value" taxation system. We encourage you to ask the appropriate agency staff about this before you enroll your property in any program.

Conservation Reserve Program

The **Conservation Reserve Program (CRP)** is one of the primary and popular conservation programs authorized under the Federal Farm Bill. CRP provides incentives for farmers to take highly erodable cropland, cropped wetlands, or land contributing to a serious water quality problem out of crop production for periods of 10 to 15 years. The CRP program was re-authorized through 2007 in the 2002 Farm Bill.

Local officers of the Farm Service Agency (FSA) administer the CRP program in Wisconsin. To enroll in the program, your project site must meet various requirements. Key criteria include:

- ☑ A commodity crop has been grown on the site in at least 4 of the 6 year period, 1996-2001. If hay was planted on the site during this period, it is considered a commodity crop and is likely eligible for CRP.
- ☑ You have owned the land for the last 12 months.

Applications are accepted on a continuous basis. The program provides landowners with technical assistance in designing, obtaining permits for, and constructing a restored wetland. In addition, landowners receive an annual rental payment while the land is in the reserve program, though the landowner is required to share up to 50 percent of the costs of restoration. Other incentives are permitted.

Congress created a new program under CRP called the **Farmable Wetland Pilot Program (FWP)** that is now available in Wisconsin. This cost-share program, created in 2001, was authorized for all states following passage of the 2002 Farm Bill. This program targets small farmed wetland acreage (5-10 acres) with a cropping history of 3 out of the past 10 years. A buffer, limited to three times the wetland acreage enrolled or 150 feet wide (whichever is greater) is allowable under FWP. Contact your USDA Service Center for more information on this program.

The **Conservation Reserve Enhancement Program (CREP)** is a state-sponsored special provision of the USDA Conservation Reserve Program (CRP). CREP is a partnership of the Farm Services Agency (FSA), Natural

"The wetland restoration project was land that I was farming, but it was a wet area and hard to plant and harvest some years. I just decided that given the opportunity and cost-sharing from the [Farm Service Administration] I would revert it back for wildlife. There are ducks and killdeer wandering around all over. Next year I hope to place 100 acres into the Wetland Reserve Program."

—Steve Querin-Schultz, Dane County farmer who restored 3.5 acres of wetland.

Resources Conservation Service (NRCS), Department of Agriculture, Trade and Consumer Protection (DATCP), and local land conservation departments (LCD). Landowners receive incentive and cost share payments for installing specific long-term conservation practices. Wetland restoration is one of the targeted practices eligible under CREP. Restorable sites must be located within the designated Statewide CREP Priority Areas. Eligible sites are manipulated wetlands where all man-made alterations can be reversed. The wetland to be restored must be a cropped wetland and must be hydrologically connected to a permanent water body, stream, or located in a field which will be restored to grassland in the special "Grassland Priority Areas". A "filter strip" buffer is required along waterways under CREP. The maximum acreage allowed for enrollment in CREP is 40 acres, which includes the restored wetland and adjacent buffer. Fifteen-year contracts or permanent easements are available, with greater financial incentives being offered for permanent easements. Contact your local USDA Service Center for further information on this program.

Wetland Reserve Program

U.S. Department of Agriculture NRCS Natural Resources Conservation Service

The **Wetland Reserve Program (WRP)**, a voluntary program offering landowners a chance to receive payments for restoring wetlands, is administered by the local office of the Natural Resources Conservation Service (NRCS). Participation occurs at three levels, but all require:

- ☑ that the parcel must be restorable, and
- ☑ that the wetland has been altered by ditches, drain tiles, or some other change in hydrology.

Landowner, Sandy Quayle, with drain tile probe.

Art Kitchen

Most WRP projects are larger than 40 acres in size. If accepted into the program, NRCS staff will provide technical assistance to design and construct the restoration on your property. The permitting process is simpler for these types of sponsored restorations. The levels of involvement vary in the number of years enrolled, the amount of cost sharing or cash payments involved, and the restrictions on your property. Please contact your local NRCS staff for the most current information on this program (see Appendix B for contact information).

10-Year WRP Agreement

This is a very competitive program and funded projects tend to be small sites (less than 10 acres). The NRCS will pay at least 75 percent of project costs, with the landowner responsible for up to 25 percent. On some projects, other federal agencies or the Wisconsin DNR may help fund your share of the costs.

Beyond cost-sharing, you would receive no additional financial incentives and would be obligated to maintain the wetland restoration for the term of the contract. Backing out early likely would require reimbursement of construction costs to the NRCS.

"We are more than satisfied with our wetland restoration. We worked out the finances and went ahead. Now it's Nature's turn and we're going along with that. There has been such a great increase in wildlife; amphibians, toads, and snakes are everywhere."

—Sandy Quayle and Joyce Brehm, Dane County landowners who restored 100 acres.

30-Year WRP Easement

If you sign up for the 30-year WRP, you receive the same cost-sharing and technical assistance as the 10-year program, plus a lump sum payment immediately, or in installments, for 75 percent of the lesser amount of the appraised agricultural value of the land. The wetland must remain undisturbed for the duration of the 30 years.

Permanent WRP Easement

Enrolling your land in a permanent easement increases your financial incentives. The NRCS will pay for 100 percent of the restoration, and you would receive a lump sum payment of 100 percent of the appraised agricultural value of the land. In exchange, the deed for the property reflects a permanent conservation easement for the restored wetland restricting how you or future landowners can use the restored land. Even with the easement in place, you still own the land.

Partners for Wildlife Program

In addition to the federal WRP cost sharing programs, the United States Fish and Wildlife Service (USFWS) sponsors the **Partners for Wildlife program (PFW)** to assist private landowners with wetland and associated upland habitat restoration. Although this program is more flexible than the various WRPs, there are no payments for the use of the land. The only eligibility requirement is that the site be considered restorable and that the landowner has written consent from neighbors in case water backs up on adjacent land. The program requires a minimum commitment of 10 years to the restoration. However, you can enroll longer to receive additional funding. Since its inception, the PFW program in Wisconsin has restored 4,500 sites on 11,770 acres. Wisconsin's PFW program is the third largest in the nation behind North Dakota and Minnesota.

USFWS will pay up to 100 percent of restoration costs, depending on the quality of the site and the nature of work. A majority of the funding usually goes toward the restoration of wetland hydrology for projects such as ditch plugs or drain tile breaks. If a landowner is interested in additional activities, such as removal of sediment, the PFW program may provide some cost sharing.

In addition, the PFW has landowner assistance available for upland buffer areas associated with wetlands or with projects protecting a threatened or endangered species. As of 2001, the PFW program had restored native prairie grasses and forbs to 905 sites in Wisconsin on 10,245 acres. In addition, the PFW program funds restoration of the endangered Karner blue butterfly habitat since the butterfly larvae feed on lupine, a prairie legume.

NRCS Natural Resources Conservation Service

Each county has an NRCS OFFICE; consult your telephone directory for the appropriate location and phone number, or see Appendix B.

Contact the STATE WRP COORDINATOR for any further questions:

Wetland Reserve Program Coordinator

Natural Resources Conservation Service

6515 Watts Road
Madison, WI 53719

(608) 276-8732

"It's pretty neat to see the wildlife. The ducks and geese stop in spring. The United States Fish and Wildlife staff did everything for me and took care of all the hassles. They made it a trouble-free restoration from the landowner point of view."

– Tim Mielcarek,
Dane County landowner who restored 25 acres of wetland.

CONTACT:

United States Fish and Wildlife Service Wisconsin Private Lands Office

4511 Helgesen Drive
Madison, WI 53718

(608) 221-1206

State Programs

The Wisconsin Department of Natural Resources (Wisconsin DNR) has funding available for wetland restoration in priority areas of the state, which are identified in the *Upper Mississippi River and Great Lakes Region Joint Venture of the North American Waterfowl Management Plan*. In general, these areas are in the southeast and northwest quarters of the state where restored wetlands are known to be the most productive for waterfowl.

Funding for wetland restoration efforts on private lands in these areas is generated by the sale of waterfowl hunting licenses and from the solicitation of federal funds from various grant sources. In portions of the state where funding may not be available, Wisconsin DNR wildlife biologists can, at a minimum, assist landowners with technical advice about how to best design a wetland restoration to maximize wildlife benefits.

Wisconsin Forest Landowner Grant Program (WFLGP)

This state program targets current and future forest landowners. Funds go to protect and enhance forest, prairie, wetland, and water bodies and may reimburse up to 65 percent of the cost to qualified landowners.

Applicants must demonstrate an interest in good stewardship of their natural resources *and* own at least 10 (but no more than 500) contiguous acres of non-industrial private forest in Wisconsin. The program defines a forest as an area being restored, or already planted with trees. Applicants should also have, or be in the process of applying for, a forest stewardship plan. A variety of projects or practices are funded by WFLGP, including:

- forest stewardship plan development,
- tree planting,
- forest improvement,
- soil and water protection or improvement,
- wetland protection, restoration, and enhancement,
- stream and stream bank protection,
- wildlife habitat creation or improvement, and
- the protection of rare natural communities and species.

Applications can be picked up at your county forester's office, from a private forestry consultant, or from the Wisconsin DNR Service Center in your area (see Appendix B).

CONTACT:
Tim Grunewald
Wetland Habitat Specialist
Wisconsin DNR
101 S. Webster St.
P.O. Box 7921
Madison, WI 53707-7921
(608) 264-6137
(606) 267-3579 (fax)
Tim.Grunewald@dnr.state.wi.us

"I thought I had a pretty good natural area, but I was surprised by how much it could be improved. My land had been drained in the 30s so we filled the ditches and took down dikes. I'm eagerly awaiting spring to see what will happen."

—Peg Whiteside, Columbia County landowner who restored 70 acres on the Baraboo River.

Photos: Jeff Nania

Above, Peg Whiteside's Columbia County ditch being prepared for fill.

Right, the ditch after being filled.

Non-Governmental Assistance

A number of private non-profit organizations dedicated to wetland restoration can provide additional assistance. Services available range from direct assistance and funding, to raising funds matched by federal and state programs.

Wisconsin Waterfowl Association

Since 1983, the Wisconsin Waterfowl Association, a non-profit conservation organization dedicated to waterfowl and wetland resources, has helped individuals and public agencies with wildlife habitat enhancement and restoration. The organization provides technical assistance and funding through cooperatives and other partnerships.

Project applications are available from the organization for anyone interested in a collaborative project. The organization requires upland components in accepted wetland restoration projects. A successful wetland restoration by Wisconsin Waterfowl Association is highlighted in Case Study #2 in Chapter 13.

CONTACT:

Wisconsin Waterfowl Association

614 W. Capitol Drive
Hartland, WI 53029

(262) 369-6309
or (800) 524-8460

(262) 369-7813 (fax)

www.wisducks.org

Ducks Unlimited, Inc.

This national non-profit conservation organization addresses the needs of North American waterfowl by protecting, restoring, enhancing, and managing wetlands and associated uplands. Through its "Private Lands" program, Ducks Unlimited provides free technical assistance for managing land as wildlife habitat. Cost-sharing assistance, engineering services, and on-site surveys may be available for wetland restoration and grassland establishment in certain focus areas. Ducks Unlimited may also provide pipe or water control structures for suitable wetland restoration or enhancement projects. The organization gives priority to projects within targeted regions of the state.

A portion of all funds raised by Ducks Unlimited are retained for wetland habitat projects in the state. The funds are administered through the MARSH program. This program is a national initiative for the organization, and in this state is operated cooperatively with the Wisconsin DNR. The program provides matching funds to public or private conservation groups for projects that significantly benefit waterfowl and lead to the permanent protection or restoration of important waterfowl habitat. The MARSH program often provides cost sharing for wetland restoration on private land and through programs administered by the Wisconsin DNR, United States Fish and Wildlife Service, and local county land conservation departments.

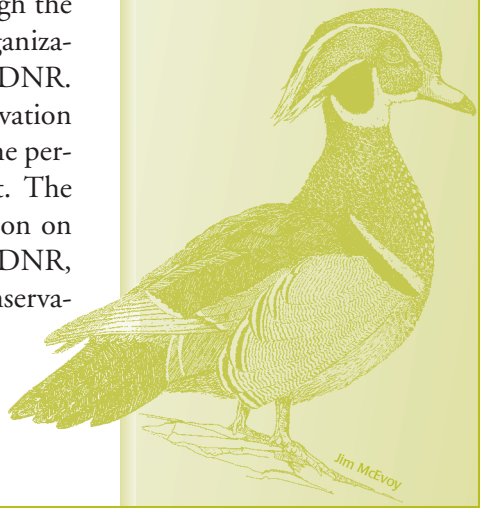
CONTACT:

Ducks Unlimited, Inc.
GLARO

331 Metty Drive, Suite 4
Ann Arbor, MI 48103

(734) 623-2000

www.ducks.org



Wings Over Wisconsin, Inc.

This organization targets natural resource restoration and preservation, as well as, environmental education for communities. Funds raised go to local chapters that focus on particular habitat areas when providing landowners technical assistance and cost sharing for restoration projects. The organization initially worked to increase upland habitat for pheasants, but now actively promotes grassland, woodland, and wetland restorations.

CONTACT:

Rick Stel
Wildlife Project Coordinator
Wings Over Wisconsin, Inc.

8 South Main St.
P.O. Box 202
Mayville, WI 53050

(920) 387-5298

Waterfowl USA

This national organization concerned with the dwindling waterfowl populations in America has a southern Wisconsin chapter that can provide technical assistance and wood duck houses to wetland projects in Dane, Jefferson, and Rock counties.

CONTACT:

Dr. John Wilke
7329 Territorial Rd.
Evansville, WI 53536

(608) 882-4146

Pheasants Forever

Pheasants Forever coordinates a cost-share program to support a variety of habitat enhancement projects for ring-necked pheasants and other game and non-game species in counties with Pheasants Forever chapters. The organization provides cost-share funds for wetland restoration projects, prairie plantings, and seed drills. They review projects to develop long-term nesting, winter roosting, feeding, and brood-rearing habitats for pheasants and other species on private lands.

Some counties are more active than others and local chapters determine which activities to fund. For projects funded by Pheasants Forever, you must plan to maintain wetland restorations for at least 10 years. Food plots and nesting cover cannot be mowed or harvested before August 1 of each year and woody cover must remain for a minimum of 10 years.

CONTACT:

Jeff Gaska
Regional Biologist
Pheasants Forever

W9947 Ghost Hill Rd.
Beaver Dam, WI 53916

(920) 927-3579

Private Consultants

There may be situations where you need more assistance than what is available from state and federal programs or private organizations. Many private wetland consultants exist in Wisconsin and provide services for a fee.

The United States Army Corps of Engineers keeps updated lists of wetland consultants (see Appendix B). The Wisconsin DNR and WWA's *Wetland Resource Directory* maintain a list of consultants. The listings are not endorsements of the consultants. In addition, your local phone directory generally lists consultants under "Ecological and Environmental Firms." You may also wish to contact other individuals or associations with wetland restoration experience and ask their advice.

As with any profession, consultants fall within a range of skills and expertise. Depending on your needs, you may want to select a consultant who can help you identify and assess your wetland and serve as your agent in the permitting process. A wetland consultant experienced in wetland restoration can provide site planning, help avoid and minimize adverse wetland impacts, and assist with planting and site management, activities that may be outside the range of what some of the governmental programs can offer.

"I know what cattails are but I wouldn't know a sedge if I tripped over it. And I have a life that doesn't include understanding all the regulations. Find someone who can explain wetland restoration to you and who really knows what they are doing."

—Peg Whiteside, Columbia County landowner who restored 70 acres along the Baraboo River with Wisconsin Waterfowl Association assistance.

Evaluate the consultant's qualifications, experience, and quality of service. Ask for three to five references from former wetland clients and ask these contacts about the quality of service they received, including their professionalism, working relationship with the consultant, the client and regulatory agencies, and their fees and timeliness.

Native Plant Nurseries

Numerous private native plant nurseries operate around the state. The quality of advice and plant stock may vary so check references and ask questions to ensure they provide viable seed of local stock and to evaluate the price and availability of seed. If you plan a spring planting, you could request that the seed be cold stratified. The nursery may also mix the seed with vermiculite or other similar material for hand seeding. The Wisconsin DNR and WWA's *Wetland Resource Directory* updates a list of Wisconsin native plant nurseries that carry wetland species annually (see side box). The listings are not endorsements of the nurseries.

Nature Centers

Local nature centers may offer diverse and useful resources for your restoration project. You may find there:

- ☑ plant and animal identification books,
- ☑ naturalists who can assist with species identification or management,
- ☑ plans for duck and bluebird nest boxes or the boxes themselves,
- ☑ seed and live plant materials,
- ☑ a restored wetland or prairie on site, and
- ☑ staff experienced in restoration.

The Department of Natural Resources maintains A CURRENT LIST OF NATIVE PLANT NURSERIES around the state. You may contact the DNR for a copy.

Native Plant Conservation Program Manager
Bureau of Endangered Resources
P.O. Box 7921
101 S. Webster Street
Madison, WI 53707
(608) 267-5066

www.dnr.wi.gov/org/land/er/invasive/info/nurseries.htm

The WWA "WETLAND RESOURCE DIRECTORY" available on the WWA web site lists many native plant nurseries and private consultants in Wisconsin and the region.

USEFUL LITERATURE AND WEB SITES

Appendix A in this handbook contains a bibliography of general wetland references, plant and animal guides, and commonly used web sites. Many books can be located through the public or university library systems. Ever-increasing resources are available through the Internet; the web sites we provide may also provide links to other useful sites.

CHAPTER 9. IMPLEMENTING THE RESTORATION

While each restoration project is unique and has a very specific plan, this chapter outlines some general recommendations and pitfalls to beware of when implementing your wetland restoration. If you choose to hire a contractor, the one you select will be crucial to your restoration's outcome. Poor planning and poor construction are the two most common reasons wetland restoration projects fail, and repairing a poorly constructed project is usually difficult and sometimes impossible.

Timetables

The permitting process, project size, the kind of work you plan to do, and when contractors can schedule the work will influence your project's timetable. You may easily spend up to a year planning the project and obtaining appropriate permits. An experienced contractor may not want to look at your site until you have your permits in hand; some contractors, however, may be helpful during the design phase.

Earth moving under wet conditions is difficult and time consuming. A good contractor will set the project up in sequence, with all the "dry work" of site preparation and planning conducted first. Once you start restoring water levels you can't turn back.

Construction schedules depend on weather and site conditions. Some wetland soil types can only be worked on during the driest time of the

year, while others are worked in winter when frozen ground can support heavy equipment. You may be able to avoid the cost of using large construction mats for the equipment to rest on (see "Construction Terms" on page 99) if work is done during the right season.

Planting and seeding have timetables as well. Plantings occur in October and November before the ground freezes, or in April and May, after the thaw but before temperatures are high. If a spring planting is planned, seeds need to be "cold stratified" by the supplier. Avoid planting after May since small sprouted seedlings or transplanted plants become stressed or can dry up in summer heat before developing a good root system.

Be prepared to plan around annual variations in local weather. Exceedingly dry years ease construction, but limit prescribed burns, while a wet year or warm winter can delay construction.

How to Evaluate the Contractor

Perhaps the greatest potential for problems comes from the failure of the contractor to follow the plans. Before hiring anybody, carefully evaluate the contractor's ability to meet your project's needs. Seek recommendations of a company or individual from a local Wisconsin DNR or United States Fish and Wildlife Service office, or from a private conservation group with restoration experience. If few wetland projects have been constructed near you, check on firms that do engineering and earth moving for farmers. You should contact several contractors, tell them about your project and have them walk your site with you. Suggested questions include:

1. **Do they have experience doing wetland restoration work?** What types of projects have they completed? Have they worked with ponds, scrapes, ditch plugs, ditch recontours, drain tile removal, berms, control structures, etc.?

2. **What kind of equipment do they have?** Most contractors who do wetland work have low ground pressure (LGP) equipment (see Construction Terms on page 99). This "tracked" equipment (usually a backhoe and bulldozer with a wider than normal track) is less likely to compact the soil and can move in wet areas that would mire other equipment. Find out what type of support equipment the contractor uses. Dump trucks, graders, scrapers, and other equipment may be needed during a wetland restoration depending on the site. Each job is unique; some require several pieces of equipment, others require just one.

3. **Is the equipment big enough to do the job?** You will want equipment large enough to move earth quickly and efficiently. The less time spent during construction the better, especially during restoration of water levels. A contractor may claim that the hourly cost of a smaller machine is less expensive, however, a big machine may quickly prove a financial advantage by being able to work faster and more efficiently.

Top, low ground pressure backhoes have wide tracks that distribute weight on wetland soils.

Bottom, a harrow or drag is attached to an ATV to smooth freshly seeded soil.

Photos: Jeff Nania

4. **Can the contractor provide at least three references?**
   Contact those references. If a contractor doesn't give references, be cautious. There are plenty of others who are more than willing to offer references.

5. **Can the contractor provide a firm price?**
   Get it in writing. If the cost exceeds your budget, seek additional bids. Find out if you can save money doing some of the work yourself. Ask the contractor to suggest ways the project could be modified to meet your goals, save equipment time, and cost less. Some contractors may only bid wetland projects on a time-and-material basis (the longer it takes, the more it costs). You may be able to request a clause in your contract that caps costs at a given amount. This establishes the budget for your project and tells the contractor that he must keep track of time and not exceed the set price without your consent.

6. **Will the contractor stay on your site until the job is done?**
   You may be able to include a clause in the contract that the contractor must remain on site unless weather conditions require work to stop, or at the written request of the client. Some contractors have been known to drop a wetland job for a larger and more lucrative job, and as a result, it may take up to a year to complete the work.

Silt fencing contains sediments during wetland restoration.

Jeff Nania

7. **Does the contractor use erosion and siltation control and earth stabilization methods?**
   Find out what steps the contractor intends to take to prevent erosion and sedimentation, and how disturbed soils, especially slopes, will be stabilized.

8. **Can the contractor steam clean the equipment before coming on site?**
   If your site is relatively free of invasive species (e.g., reed canary grass or purple loosestrife) you want to ensure the equipment carries no unwanted invasive plant seeds into your wetland.

It is important that you communicate your ideas to your contractor so that you are working toward the same goals and carry the same mental picture of the project. Be open to learning from the contractor's experience. A knowledgeable wetland contractor may have construction and design suggestions that benefit the project and save money.

Make sure your contractor understands the conditions of your permits and has a basic familiarity with water and water law. Violations can result in unnecessary problems and even expensive fines.

Pre-Construction

Once you have chosen your contractor, reviewed and agreed on your plan, timetable and permit conditions, the following points should be discussed (if applicable to your plan).

- ☑ Discuss what equipment will be used and check into the availability of pumps. Ask that equipment is well maintained to minimize leaking oil, etc., and steam cleaned before entering your wetland.
- ☑ Decide who will be responsible for contacting "Diggers Hotline" at least three days prior to excavation to locate and mark any underground utility lines or cables in the area.
- ☑ Agree on routes that the equipment will take to and within the site.
- ☑ If pumps are used, discuss where the water will be disposed. If pumping is necessary, it may need to be included in the Wisconsin DNR permit.
- ☑ Point out those areas you want to remain undisturbed, such as young trees, remnant wetland plant areas, prairie plantings, or landscape features. Staking or flagging these areas with survey-or ribbon beforehand will help the contractor avoid them.
- ☑ Point out and flag property boundaries.
- ☑ Indicate areas that can be used to deposit and grade excavated material if needed.
- ☑ Discuss how the project will be staged to avoid damaging completed portions and dealing with water backing up on the site.
- ☑ Review erosion control measures and discuss how the contractor will remove the devices when they are no longer needed.
- ☑ Indicate that you or another designated person will inspect the construction work daily.
- ☑ Agree on terms for payment. Do not pay the entire amount until you are satisfied with the job.

General Construction Recommendations

You should visit the site daily and talk regularly with the contractor. An experienced person must closely monitor all phases of construction daily. On the first day, arrive before construction begins. Review the plan with the contractor again to make sure you are in agreement about how to begin. Visually inspect the equipment. Look for obvious fluid leaks or other problems that can contaminate your site. Ask what the progression of the construction will be and what the contractor expects to accomplish each day.

Be a part of the construction. There is always plenty to do, so ask the contractor if you can help. You might be able to make changes while construction is in progress that is impossible once the contractor is gone.

U. of Florida, Center for Aquatic Plants (Gainesville)

CONSTRUCTION TERMS AND SEEDING EQUIPMENT

Construction Terms

Backhoe-excavator–A large piece of equipment on steel tracks. An excavation bucket is mounted at the end of a hydraulic arm. Backhoes with tires instead of tracks are rarely used in wetland work.

Bio-matting–A biodegradable woven mat that comes in various lengths. It is rolled in place and then staked to help stabilize slopes.

Jeff Nania

Biodegradable bio-matting helps control soil erosion and allows desired vegetation to become established.

Bucket–This is the actual excavator at the end of the hydraulic arm of the backhoe. Buckets come in all shapes and sizes. Some have large teeth on the edge of the bucket, others are smooth. The teeth rip through tough material, but a smooth-edged bucket usually works much better for wetland work.

Dos-R valve–Water control device used to connect with drain tile lines to raise the water level in lateral lines while allowing the main line to drain. Used for situations when it is impossible to disable tile lines without affecting other areas.

Dozer or bulldozer–This tracked earth mover scrapes earth with a front-mounted, hydraulically controlled blade. This and the backhoe are the two most common pieces of equipment used on wetland projects.

Dragline–A dragline is a large machine that operates like a crane. It has a large boom that allows a "clamshell" to be cast far into the site to excavate soils. Draglines are generally not efficient for wetland work and increasingly less available.

Low ground pressure (LGP)–This refers to any kind of equipment with wider than normal tracks. Wide tracks distribute the weight of the machine over a larger area. This keeps the machine from sinking into soft or wet soil. Low ground pressure tracks are used most on backhoes and dozers. LGP equipment is preferred for wetland work.

Mats–Mats are 12-inch by 12-inch or larger, 20-foot-long timbers connected together with chain or cable. Used in very wet conditions, a machine will sit on the mat to prevent it from sinking. A backhoe will use two or more sets of mats at one time. Experienced wetland contractors often will have these mats on site just in case they are needed.

Jeff Nania

Pump dewaters a wetland site under construction.

Pumps–Pumps are usually self-contained units to which large hoses are attached. The pumps dewater sites during the construction process, keeping the work area as dry as possible. A contractor should have access to pumps.

Scraper–This is an excavator often used when spoil must be moved off site. This large machine with front and rear engines has an area in the middle for collecting earth.

Silt fence–Silt fence is tightly woven plastic strung between wooden stakes that comes in long rolls. Silt fence is often used across waterways to prevent downstream siltation. It is also used to surround disturbed soil areas in order to curb erosion.

Spoil–The soil that has been excavated and deposited in a pile on the soil surface.

Transit/level and grade pole–These two pieces are often used on wetland restoration sites. The transit/level is mounted on a tripod; you look through the transit at the grade pole, which is like a big ruler with numbers. Those numbers are used to determine ground elevation and contours.

Seeding Equipment

Brillion seeder–The brillion has a box seeder mounted on the front that distributes grass seed in a random pattern, not in rows, with brushes inside the hopper. The seeder is mounted on a culti-packer that immediately presses seed into the soil. Seeds are planted at a shallow depth. Usually soil is well worked and disced before seeding.

Disc–An agricultural device pulled by a tractor and used to stir and level soil before planting.

Hand-broadcast seed–Seed may be mixed with damp sand, vermiculite or sawdust and tossed by hand on the site.

No-till seed drill–Special seeder that drops seed into a small trench and covers it. It is especially useful for upland prairie plantings, and may eliminate the need to disc soil before seeding.

Seeder–Seeders can be hand held or mounted onto a tractor or ATV. Seed may be mixed with damp sand, vermiculite or sawdust.

For example, it is very difficult to regrade muck soil at a later time; it has to be done to your satisfaction while the equipment and crew are present.

An experienced contractor will have a plan of how to deal with water on the site. As you begin to plug and fill ditches, break tile, or move soil, the water may quickly return to the site. This is exactly what you want to happen, but your contractor needs to work fast to keep ahead of the water. You are better off letting the water continue to drain from the site during construction, with the last step closing off the lowest point where water drains. The contractor may pump water while the construction proceeds. When filling ditches, the contractor should make sure the site can drain and prevent flooding of areas still under construction. If plans call for topsoil to be stockpiled for re-spreading after scraping the subsoil, make sure that the last step of re-spreading topsoil really happens. Commonly a contractor pulls out of the job before re-spreading the topsoil adequately, especially if the site is now under water. Not only are you left with an unnatural looking pile, but also this topsoil is what some plants need to thrive and often contains the seed bank needed to re-vegetate your site.

Jeff Nania

Mats like these on a flatbed truck are used to keep equipment from sinking into wetland soils.

If a berm or ditch plug is included in your plans, be careful that the topsoil of organic soils and root masses are not used in the core or foundation of these structures. If topsoil is used in the core of a berm, decomposition of the plant materials over time can cause berm failure. The core of any feature containing water needs to be made up of compacted mineral soil.

Use adequate erosion control on all wetland work to ensure that sediment does not wash into local streams or lakes. All exposed surfaces need to be seeded quickly or utilize erosion matting to keep them from eroding. In general, prevent environmental damage to other resources while you construct the restoration site.

When the contractor completes the job and *before* equipment is removed, do a walk-through with the plan in hand. Make sure everything conforms to expectations. If any work remaining requires the contractor to come back, find out when, and make final payment only after everything is to your satisfaction.

Conclusion

Implementing your plan is an exciting phase of your project. If you have made sound decisions, you have given your wetland a great boost on the road back to ecological health. Pay great attention to detail at the time of construction and visit the site at least daily. You will find the time spent on site during this critical phase of the project rewarding.

DNR Archive

Deanne D. Wilde

CHAPTER 10. IMMEDIATE POST-RESTORATION MANAGEMENT

This chapter discusses management of your site after construction. Further long-term management is discussed in Chapter 6 and Chapter 11.

The post-construction monitoring of your site should begin immediately after the project is completed. Your first efforts should be to watch for and identify potential problems. If you planned your restoration project well, made necessary mid-course corrections during the restoration process, and paid attention to the nuances of your site, much of the information that follows may not concern you and your project. If you are concerned, you should have a pretty good idea of the specific areas on your site that need the most watching. Early identification and management of post-construction site problems will help prevent "a trickle from turning into a torrent". Most construction failures are a result of poor design, faulty construction, improper erosion control, or because you have failed to properly assess the site. The rest of the failures may be beyond your control. Some failures will require long term care and planning, others short term immediate fixes, but addressing these problems is important to the overall success of your site.

DNR Archive

Immediate Post-Construction Failures

Most wetland restoration construction failures occur where excess water is being held back or where water is flowing over newly disturbed ground with sufficient force to cause erosion. The power of water and its ability to cause damage should never be underestimated.

The degree to which these types of problems occur may be directly correlated to the type of restoration project. Generally, the greater the amount of water and the more complex the project, the higher the probability of post-construction problems. For example, if your site involves a shallow, gently sloped excavation in the middle of a 40-acre field, the potential for problems is less than if you built an above-ground berm to impound water. The good news about post-construction problems is that as time goes by the site heals. Bare soil becomes re-vegetated and water flow becomes somewhat predictable. As the site stabilizes, the chance for problems on a well-constructed site diminishes by the day. However, poor construction or a poor site plan can result in a project that becomes a source of never ending problems.

What Happens When Water Meets Soil?

Sloped, disturbed ground is especially susceptible to erosion. If you have stabilized all disturbed soil areas on a slope during construction, erosion should not be a problem. You have a legal responsibility to control erosion on your site, especially if it could contaminate a waterway. Standard soil stabilization methods that are very useful include planting a fast growing cover crop overlain with mulch, and use of straw erosion-control matting (for more detail see planting techniques highlighted in Chapter 5 and "Construction Terms" in Chapter 9). Be attentive to areas where water has begun to erode soil. If you spot an erosion channel forming, determine whether it is occurring in a designed discharge feature (e.g., a spillway), or if it is occurring where water is not supposed to flow.

If erosion is occurring in a designed feature, it usually means that the ground around this area was not properly stabilized prior to introducing water, or you have underestimated the amount of flow in your site. If erosion is occurring where there shouldn't be any water flowing, it may require more work to stabilize the area. Act as quickly as possible to stabilize the area of concern. There are several methods you can use to quickly prevent further damage. The key to all these methods, regardless of the exact problem, is to cause the water to lose energy and flow over stabilized soils.

If the problem is an eroding spillway and the water is flowing slowly and still controllable, you can place straw bales between the flowing water and the erosion channel. If bales are placed properly, water will hit them and seep through and underneath the straw slowly before entering the channel. If the water is flowing quickly in the eroded area, drive wooden stakes through the bales to hold them

Seeding of dike to immediately stabilize fresh soil surfaces.

Photos: Art Kitchen

Art Kitchen

Stabilizing freshly seeded slopes with erosion control matting.

in place. Another technique is to place the straw bales in two rows, one behind the other, with the second row offset by half a bale to ensure overlap with the seams of the first row. The bales can be staked, or weighed down with large rocks, sandbags, or other heavy objects. Adding a small section of silt fence in front or behind the bales will further slow water.

Once the flow has dissipated, you can begin to stabilize the eroded area. In most cases, it will probably be too late to plant a fast growing seed and expect success. The simplest way to deal with the problem area is to create a spillway using geo-textile fabric and stone. Decide what the final elevation of the spillway should be, take into account the diameter of the stone you will lay on top, and excavate the area to a slightly lower depth to end up at your intended elevation. Lay the fabric at least 2 feet wider on both sides of the channel. Use a shovel to dig a blade width trench along the front edge of the fabric. Pack the edge of the fabric into the trench and tap the soil back into place. The goal is to make sure water does not get around or under the fabric. Finally, cover the exposed fabric with stone. Any type of stone will work as long as it is large enough to remain in place against flowing water and small enough that you can place it by hand if need be. Leave the straw bales in place and let them decompose as the site stabilizes.

"Hey, I Didn't Think Water Was Supposed to Go There!"

DNR Archive

A potentially serious post-construction problem occurs when water appears where it was not supposed to be. For example, you may have constructed an above-ground berm that was built to hold back water but is leaking, or you may have constructed a ditch plug but it is not holding back what appears to be flowing water. These are the kinds of problems that will almost never resolve themselves without some corrective measure. Left alone, what starts as a small controllable problem can quickly turn into a disaster.

If you have a problem like this, don't panic! A call to your contractor telling them that your site is falling apart and that water is flowing everywhere will get an instant and expensive response in the form of a semi-truck and a big piece of equipment. Instead, assess the problem carefully and ask yourself these 4 questions:

- ☑ Where is the water coming from?
- ☑ Where is it going?
- ☑ Is it a torrent or a trickle?
- ☑ What will be the likely result of continued flow?

Identify the source of water by following the flow back to where it originates. Walk the entire length of the flow on the site. Do not assume that two areas of flow are connected. Once you find the source, flag it. Follow the channel or water back to where it is leaking and flag that area. Is it a meandering channel or a straight cut? The source of the water may be very evident, but more often than not it will take some investigation.

Assess what the water is doing. Is it running over disturbed ground causing erosion channels, or is it flowing over a vegetated surface? If the flow is allowed to continue unabated, is the outcome detrimental to your site? Flowing water does not always indicate a disaster. In some cases it is very desirable. If water is running over bare soil, the potential for damage is higher than if it is flowing over vegetation. It is not uncommon in a restoration site for water to seek out and find an old stream channel that was not noticed during the site survey. A historic stream bed will have a meandering channel while a straight channel indicates it is something man-made. Whether it is a historic, man-made, or erosion cut channel, if the water flow is discharging at a point that is threatening the integrity of the construction or impacting a neighbor off your site, it needs to be dealt with.

If the water is running someplace unplanned, you need to understand why. While the cause may be elusive, there is always a "why". For example, maybe your site design included a rock spillway to handle the overflow. You notice that the water is not going through the spillway, but is discharging somewhere else. In this case, there is a good chance that either the elevation on the spillway was set too high or the area with the unplanned flow is too low. To get the water to discharge over the stable spillway, either lower the spillway or fill in the low spot.

Water running down the edge or center of a ditch plug can result in real problems. If you observe this happening on your site it is likely the result of a construction problem and you will need to call your contractor. The ditch plug should have been constructed to encourage water to take a path other than across your newly constructed plug. A solution in this situation is to divert the water away from the ditch plug or fill as close to the source as possible. You need to create a circumstance where the water's path of least resistance is somewhere other than through your ditch plug. Once the water is properly diverted, determine if the damage to the plug or fill is significant. If it is, you need to repair, compact, and stabilize the damaged area. Monitor the diversion for any new changes.

If the problem is occurring in an above-ground structure (e.g., a berm), there can be many causes. If it is determined that it is not a design problem, then you have to suspect it may be a construction problem. First assure yourself that the spillway is functioning properly and that there are no inadvertent mistakes (e.g., a low spot in the berm or a small, unfinished area). Berm failures can occur for a variety of reasons. For example, the soil used to construct the berm may not be suitable or the soil may not have been thoroughly compacted. The structure may have been built on top of existing vegetation instead of bare soil, thereby causing leakage, or the berm may not have been constructed to the designed height or width. If it appears that you have a berm failure your contractor and other qualified professionals should evaluate it. There is really no easy cure for poor planning and construction; a berm made out of substandard material may be in constant need of repair.

Saturated Soil

Some projects involve the excavation of very wet, saturated soil. When saturated soil is graded or mounded on a site, water will drain from it. This can look deceptively like a water flow problem but in most cases the excess water will drain away fairly rapidly. If it is discharging enough water that it is causing other problems, the stabilization techniques previously mentioned should be used.

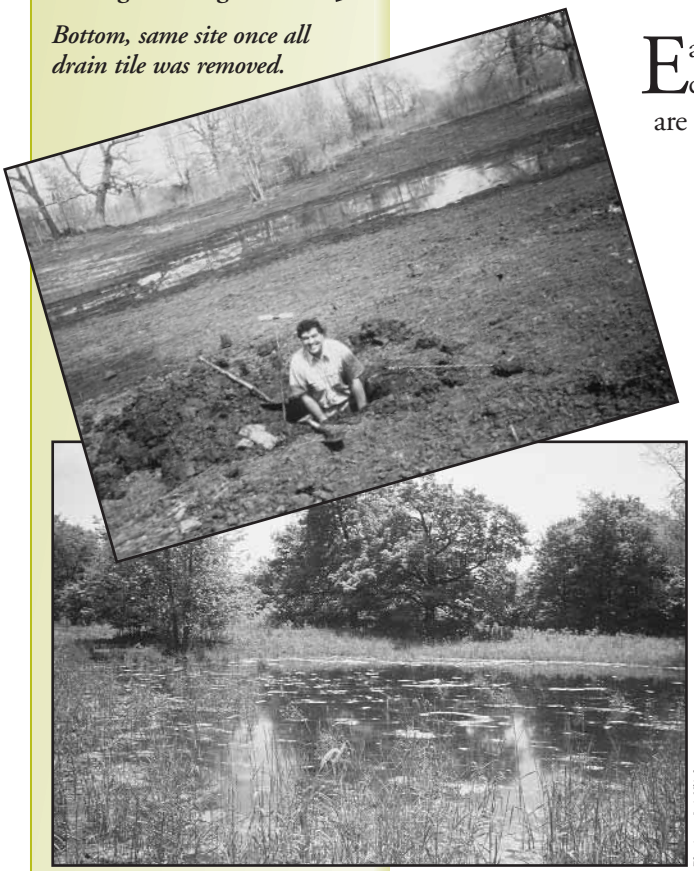
Algae

Some sites will have a noticeable algae bloom a short time after the project is complete. As soils are disturbed and nutrients are released during construction, algal growth is triggered. One way of dealing with algae blooms is the use of specific aquatic herbicides. However, the application of herbicides is not recommended if you are interested in encouraging emergent plants. As the site stabilizes the algae bloom will likely dissipate unless there is an ongoing problem with high nutrients on your site. If you want to try a technique that has worked well on some sites, acquire bales of barley straw. Set the bales in the water so just the bottom inch of the bale is wet. Let them decompose; in some cases the algae bloom is reduced.

Site Mysteries

Top, Stephan Gonzales locating a missing tile line.

Bottom, same site once all drain tile was removed.



Photos: Art Kitchen

Each restoration project has its own unique set of circumstances, problems, and occasional mysteries! Here are a few typical issues that may occur on you site:

- you have water flowing within your site and cannot find its source,
- everything appears to be as planned but the site is not holding water, or
- water is bubbling up in the middle of your ditch plug or elsewhere on your site.

Each site is different, but if your site is experiencing any of these problems it may be that during planning or construction an underground drain tile was left intact. A single tile line can disrupt your restoration and drain your site. It is easy to overlook an old tile line, since some sites have several layers of tile due to generations of farmers improving the drainage. Sometimes a tile line that was not draining and lay unnoticed because it was located above the water level, will start working as soon as groundwater is raised to its level. You should thoroughly search for any intact tile lines and disable or remove them to the extent possible.

The HoChunk Nation has recently completed a significant wetland restoration northwest of Wisconsin Dells, aided by Wisconsin Waterfowl Association and various agencies.

HoChunk President Troy Swallow (left) greets State Senator Dale Schultz (next to Pres. Swallow) at the site. Jeff Nania, project director for Wisconsin Waterfowl Association (far right) facilitated the restoration.

Charlie Luthin

If you observe water bubbling up in the site, it may be an indication of groundwater discharge (water flowing from an underground source). A landscape setting for this can be a wetland located at the base of a hill. Groundwater is advantageous to your site, as it will give you a steady source of clean, low nutrient water. Anything you can do to allow this water to flow freely over the site will contribute to the success of your project. Attempting to block or stop groundwater flow is not only counter-productive but will likely be impossible.

I Should Have Thought of That!

Hindsight is always "20/20" and this is certainly true for wetland restoration projects. You can easily look out on your site, after the construction is done, and say "I should have excavated soil just a little deeper", or "I should have set the spillway a little higher", or " I should have filled the whole ditch", etc.

If you have taken the time to develop and implement a good plan, stick with it. Give the site a chance to stabilize after you are done with the construction. Deviating from the plan or second guessing your site shortly after restoration is not recommended. This is not to say that you should be hesitant. As the restoration unfolds, it is okay to make corrections as needed to improve the quality of the project. But when you are done with construction, give the site time to become established.

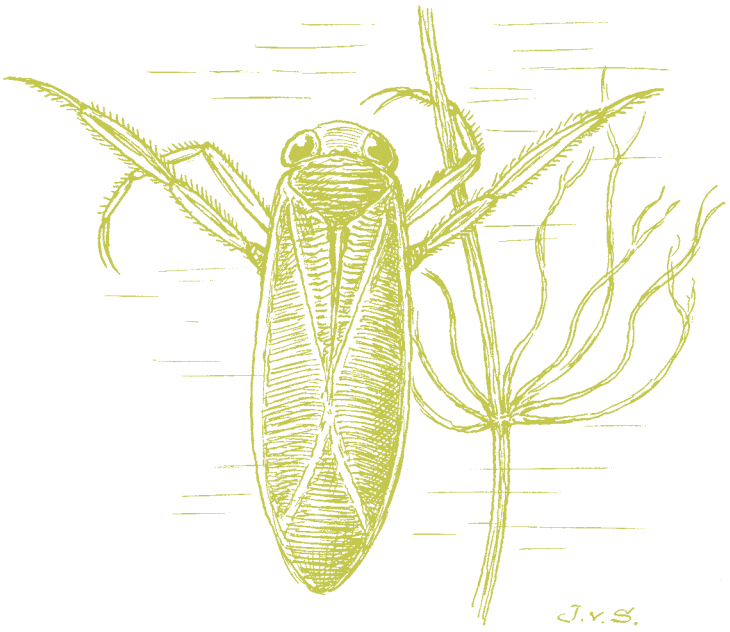
If you are plagued with "I shouldas", evaluate each concern in the context of the entire restoration project. For example, a missed tile line can really cause problems on the site, but a deeper excavation rarely improves the restoration. When you evaluate your post-restoration site, be clear as to what benefits you will gain later in the process. If the desired change is important to the site, make the correction as soon as possible before the site settles. If it is not, use the money saved to buy a lawn chair and a pair of binoculars and enjoy your restored wetland!

CASE STUDY: HO CHUNK NATION-HURLEY PROPERTY, JUNEAU COUNTY.

The Ho Chunk Nation and Wisconsin Waterfowl Association (with support from United States Fish and Wildlife) planned the restoration of an apparently dry site with a large drainage ditch cut through the middle of the property. Prior to restoration the ditch averaged 40 feet in width and 4 feet in depth but was bone dry. The assumption was that the site, when restored, would support seasonal wetlands. After approximately 250 feet of the ditch was filled, the contractor hit what appeared to be an underground water discharge point. Water began to flow slowly in the old ditch, but within two hours the flow was 15 feet wide and 4 inches deep. Within twenty-four hours the force of the water had cut a channel through the entire ditch plug.

The solution, in this case, was to divert the water away from freshly disturbed ground in the ditch by excavating a small channel to what turned out to be a heavily impacted, but natural stream course that was overlooked during the initial site review. With the water diverted elsewhere, the contractor was able to complete filling the ditch and stabilize the site. This unknown and unplanned source of groundwater became a real asset to the site; there are areas of soil saturated with water at an elevation 8 feet upslope of the elevation of the top of the ditch! The resulting wetland is considerably more extensive than originally planned.

The lesson that was learned here is that there is no such thing as farmers practicing recreational ditch digging! The width and depth of the ditch or extent of the drainage usually correlates to the amount of water present at the time it was dug. Impressive ditches that are dry should alert you to be on the lookout for less obvious sources of water.



CHAPTER 11. NOW WHAT? MONITORING AND CONSERVATION ACTIVITIES

This chapter discusses simple ways to measure the progress of your wetland restoration using monitoring resources available to you. We also include suggestions for simple conservation activities and long-term protection of your wetland.

Evaluating Your Project


Jens von Sivers

The speed at which the plant community establishes itself in your wetland will be the most important change to evaluate. The plants that colonize the site can be used as a measure of progress toward achieving restoration goals. Primary objectives include restoring historic hydrology at the site and colonization by a high number of native plant species. As water levels stabilize and the plants become established, birds, amphibians, and mammals will make greater use of the wetland. The variety of wildlife using the wetland will depend on the location and size of your site and the habitats restored. You can monitor your wetland through a variety of activities. At a minimum, take photographs regularly and always watch for invasive species.

Linda Pohlod

Taking photos throughout the year is a good way to monitor changes in the restored wetland.

Take Photos

If you haven't already done so in the planning phase of your project, set up one or several permanent photo points on your site where you can view a large portion of the wetland. Use of a landmark or stake can help you maintain photo consistency. Take photos before restoration, immediately after restoration and, at a minimum, annually thereafter in the same season. For more detail, take a photo from each point each season. Carefully label the photos with the date and exact location. A notebook of photos is very useful information for documenting changes in your wetland over time.

Look for Invasive Plants

Monitoring for the invasive plants discussed in Chapter 6 is critical to the health of your wetland. In particular, look for reed canary grass and purple loosestrife. Both plant species aggressively invade a wetland after a disturbance. Using the methods discussed in Chapter 6, immediately remove any invasive plants before they become a larger problem. These plants can be effectively eliminated if discovered and treated early in the restoration process.

Revisit Your Project Goals and Objectives

Refer to your original goals and "vision" plan occasionally to evaluate your restoration. Many sites take several years before beginning to achieve the vision. Upon project completion, and for subsequent years, review the site map you drew before construction. Draw a new map outlining major plant community types, areas dominated by open water, cattails, sedges, grasses, shrubs, or trees. Compare this to your project goal and use it over time to plan additional site management activities.

Inspect the Plantings

Keep close watch over any plantings. This is particularly critical in the first year when plants are growing root systems and are under stress. Wilting plants may need mulch or water. You can expect a certain percentage of

loss, and may want to fill in gaps where plants or rootstock did not survive. Rapidly growing "colonizer" plant species may quickly dominate a site and overwhelm your plantings. Mowing 6 to 8 inches high after plants begin to grow may discourage unwanted species.

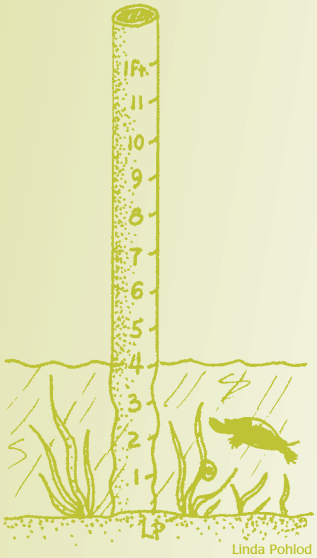
Notice Bare Ground

In the first year of restoration you may notice spots with little vegetative cover. These should fill in by the second year. If these areas remain without vegetation for several years, especially if they are not flooded, then it may indicate poor soil in that area. You may need to bring in organic topsoil from elsewhere on your site and re-seed the area with appropriate species.

Measure Water Depths

During site construction drive several lengths of hollow and uncapped PVC piping, marked with permanent markings at 1-foot intervals, into the ground at several points in the wetland. Three pipes set in a line over an area anticipated to be covered with water provides a good range. At different times over the years, this will allow you to record the depth of the water at each point following construction. Read the marks with binoculars or, if accessible, measure with a ruler from the ground surface to the height of the water.

If you have the time and interest, take a reading every other week during the spring, summer, and early fall. Even infrequent data collection can be important. Be aware that frost heaving can raise and lower pipes affecting year-to-year comparisons of data. You may observe seasonal or annual fluctuations that are normal to wetlands, or you may document that your site has a hydrologic problem. You may need to discuss your water level information with a wetland specialist. Consult Chapter 1 for more information on normal water level fluctuations.



Linda Pohlod

Water gauges put into the wetland during the restoration process will provide opportunities to monitor water level changes seasonally and annually.

Maintain a Wetland Journal

In Chapter 2, we recommended keeping a journal for assessing your wetland. You can expand that journal once your restoration is under way. Each time you visit the site record the date, time, weather conditions, and recent precipitation that may have influenced your wetland. List observations of animals, birds, insects, and plants, starting with what interests you most. What you notice can be seasonal. Remember that winter is an excellent time to find tracks of animals that are otherwise secretive. Spring is ideal for hearing frogs and migratory birds. In the summer you can watch for plants, butterflies, and birds, and when trees drop their leaves in fall you can observe bird nests.

Charles W. Schwartz

Assistance With Monitoring

Marsh Monitoring Program

The Marsh Monitoring Program (MMP) provides training materials to assist you in monitoring frog, toad, and bird species in a wetland. There is no fee required to join the MMP, and volunteers can choose to conduct annual surveys for birds or amphibians. The program involves compiling useful baseline information on the population status of Great Lakes marsh birds and amphibians that can be identified by their calls.

The yearly program begins in spring when volunteers count frog and toad songs. The MMP will send you tapes of the calls and a guide for counting them. You are responsible for sending in your data at the end of the season. Because there are only 12 frog and toad calls to learn in Wisconsin, this program can be easily mastered by an amateur.

The MMP also seeks volunteers to identify by sight and sound at least 50 marsh birds. Standardized training materials are provided that guide volunteers and help them polish their bird identification abilities. These programs provide everyone—from amateur naturalists to professional biologists—a unique and rewarding opportunity to learn about and conserve Great Lakes amphibians and marsh birds and their threatened habitats.

CONTACT:

Aquatic Surveys Officer
Marsh Monitoring Program
Bird Studies Canada

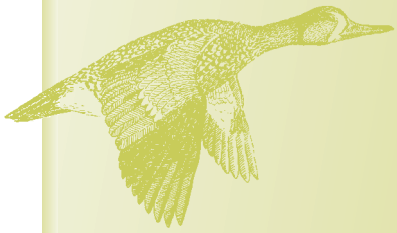
P.O. Box 160
Port Rowan, ON
Canada N0E 1M0

(888) 448-2473 or
(519) 586-3531
(519) 586-3532 (fax)

aqsurvey@bsc-eoc.org
www.bsc-eoc.org

Local Scientists

By contacting local scientists about your project, you may interest someone in helping monitor your wetland. Because the science of wetland restoration is in its infancy, monitoring and evaluating wetland restorations are important ways to learn about restoration. Possible places to find a local scientist include: the biology departments at local colleges or universities, local naturalists or volunteers at nature centers or environmental organizations, the biology teacher at the closest high school, or wetland specialists at your local NRCS or Wisconsin DNR office. Local chapters of the National Audubon Society, various regional or statewide conservation organizations, and the Wisconsin Society for Ornithology may have competent wetland specialists as members. The WWA Wetland Resource Directory lists many wetland specialists in Wisconsin and can be found at **www.wiscwetlands.org/**.



Simple Conservation Activities

A variety of relatively inexpensive and simple conservation activities may improve the health of your wetland. You need to be aware of which factors contribute to the degradation of a wetland in order to help correct them. The following conservation and management recommendations target the negative effects of past and present disturbance to your wetland.

Develop a Buffer Area

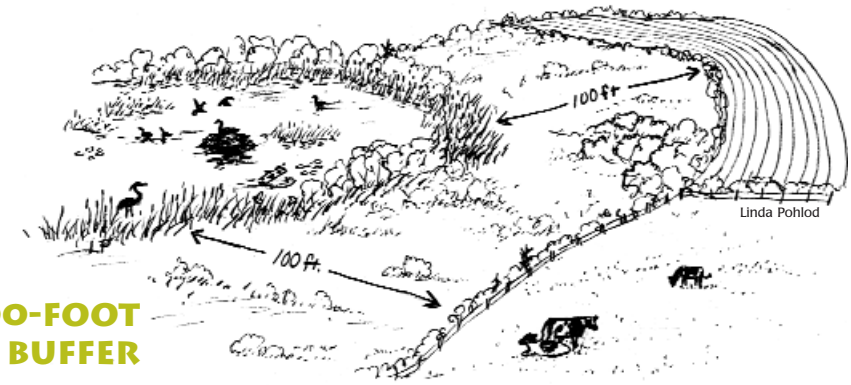
Before human activities altered the landscape, a continual expanse of uninterrupted vegetation linked uplands and wetlands. Historically, land use practices have tended to alter or develop upland areas, creating abrupt boundaries between upland and wetland at the wetland edge. By establishing a buffer zone, you can recreate the vegetation continuum and minimize the abrupt boundary between cultivated or grazed lands and wetlands. A buffer area can protect wetlands from siltation, excess nutrients, and pollution from chemicals such as pesticides and herbicides applied to neighboring agricultural fields. We recommend that you establish an unmowed swath of vegetation at least 100 feet wide around your wetland. If you cannot maintain 100 feet, a narrower buffer is better than none at all. Further suggestions are found in Chapter 5. If reed canary grass occurs or becomes established in the buffer area, this may pose a management problem that may require a mowing schedule to manage the stand (see discussion on invasive species in Chapter 6).

Landscape the Buffer with Native Plants

High quality uplands can provide important habitat for many wetland wildlife species. Planting a buffer around your restored wetland is also an important way to protect it from the impact of nutrients and sediments over time. Developing and maintaining diverse upland plant communities will increase the health and diversity of your wetland. Planting a variety of native warm season species (e.g., prairie grasses and prairie wildflowers) in your upland buffer zone may be appropriate depending on your area of the state. Planting native shrubs and trees provides important nesting habitat, food, and shelter. Consult with a native plant nursery in your area to select the best plantings for your site. Further suggestions are found in Chapter 5.

A vegetated buffer protects wetlands from the impacts of siltation, pollution, excessive nutrients, and livestock damage.

NO BUFFER



100-FOOT BUFFER

Avoid Mowing to the Edges of Lakes or Streams

The vegetated wetland edge of a lake or stream is important habitat for fish, reptiles, amphibians, songbirds, waterfowl, and mammals. The shoreline of all waterbodies should not be disturbed or mowed. Native plants along the shoreline will buffer wave action and help cool shallow water, while their roots bind the soil to resist erosion. This unmowed shoreline edge also protects water quality by filtering and slowing runoff from the upland areas.

Delay Mowing until after the Nesting Season

Many species of birds and butterflies depend upon tall grassy areas for feeding and breeding. If the adjacent land must be mowed for hay or brush removal, we suggest that you wait to mow until after the grassland-bird nesting season. Blue-winged teal and mallards nest in grassy uplands near ponds and wetlands and can suffer tremendous nest failure and mortality when fields are mowed before eggs hatch. As a general rule, do not mow before mid-July. If possible, hold off mowing until early August to allow fledging of young birds.

Fence Out Livestock

If cattle, horses, or other livestock graze in or near the wetland, fence them out 100 or more feet from the wetland's edge. If a pond or the wetland serves as drinking water for livestock, find an alternative water source. Cattle trampling can destroy sensitive wetland plants and break wetland sod, providing an opportunity for invasive species to become established. Additionally, invasive plant seeds can hitchhike into the area by clinging to the hooves of livestock. Some species of wetland grasses and wildflowers are favorite food items of grazing livestock and quickly disappear under grazing pressure. Manure can quickly become a source of excess nutrients and unwanted seeds. Undesirable plants, like reed canary grass, often establish themselves in grazed wetlands and along their edges.

Use Silt Fencing in All Construction Projects

Any construction activity at a higher elevation than the wetland can lead to erosion of the exposed soil into the wetland. Use properly installed and maintained silt fencing below areas with bare soil to protect your wetland from silt and sediment. Inspect the fencing after each rainfall to make sure it is trapping silt, and have it reinstalled if necessary. Keep the fencing

Ron Gatti

SELECTED BIRD NESTING SEASONS FROM THE WISCONSIN BREEDING BIRD ATLAS

Blue-winged teal
April 30-July 12

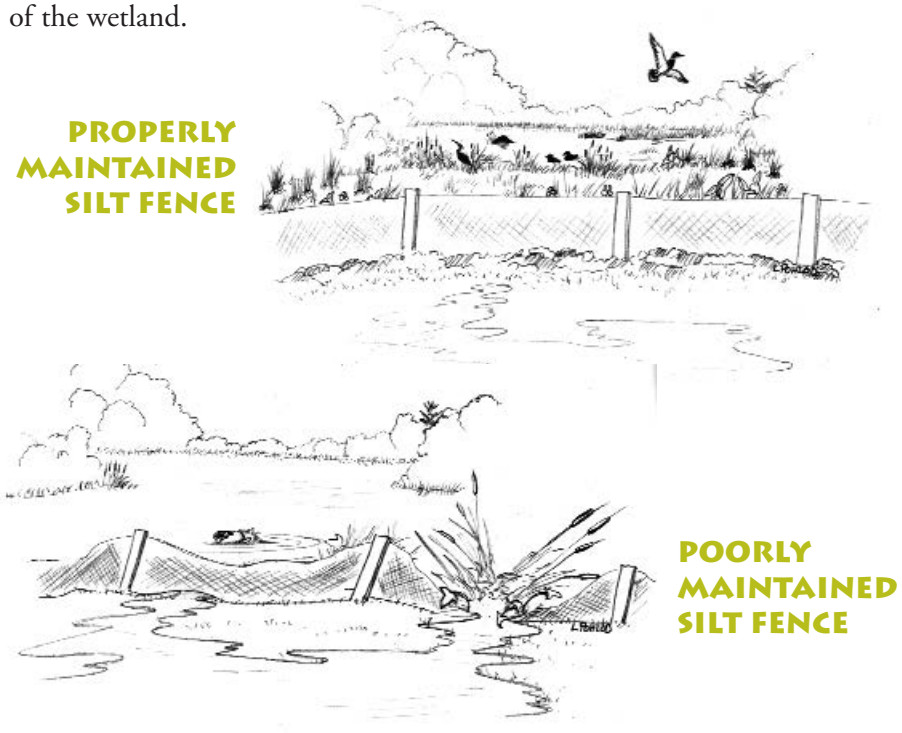
Mallard
April 2-August 19

Ring-necked pheasant
April 2- June 15

Bobolink
May 12-July 13

Meadowlarks
May 1-July 16

in place until vegetation is restored, but remove it after it is no longer needed, as the fence can block the movement of small animals in and out of the wetland.



Construction sites near wetlands should have well-maintained silt fences to keep runoff rich in sediments from entering wetlands.

Control Sources of Chemical Pollution

Agricultural activities, yard maintenance, septic systems, and storm drains can divert excess nutrients and undesirable substances into wetlands. Because wetlands, streams, rivers, and lakes are "downhill" from most inhabited areas, they can act as a "sink" for many chemicals that are transported in water. Look to reduce chemical use in and near your wetland, including the adjoining yard, garden, and agricultural fields. Talk with neighbors about their use of fertilizers and pesticides to minimize impacts on your wetland. Maintain your septic system so it functions properly.

Control Sources of Excess Water Entering the Wetland

Drain pipes, culverts, and ditches are intended to drain upland sites of excess water. They often empty into wetlands, inundating important lowland communities. Although wetlands are water-dependent, excessive water can damage the integrity of a wetland. For example, excess water in urban areas may flood a sedge meadow causing native plants to be replaced by non-natives or by cattails.

Upland runoff may carry large amounts of nutrients like manure or commercial fertilizer, petroleum products, salt, or other compounds (e.g., pesticides, herbicides, fungicides, etc.). These pollutants may stress and even kill sensitive wetland plants and animals. If possible, divert runoff to other areas or spread the water evenly over the landscape so that it slowly filters into the wetland. As an alternative, excess stormwater can be

diverted into a buffer zone to slow its velocity and allow sediment and nutrients to settle before the water drains into your wetland.

If you have a wetland that is being negatively impacted by a significant change in stormwater coming from a neighboring landowner, common law provides recourse and you can file suit in civil court. However, bear in mind that you will need more than anecdotal evidence to win your case. Photos, stormwater studies, and other evidence will be required to substantiate your arguments. You will undoubtedly want to seek legal and technical help for a problem of this nature.

To be proactive and to protect your wetland from changes in hydrology you need to be involved at the local level if nearby development is proposed that might impact your property. Discuss your concerns with local government officials and at public meetings. If the development is being permitted by the Wisconsin DNR, go directly to the Wisconsin DNR to raise your concerns.


Alice Thompson

Control Water Outlets

Many wetlands have historically been drained through ditching, dredging, and underground drain tiles. Look for signs of past drainage attempts such as a ditch, an outflow conduit or pipe. All that may be required to restore the hydrology of your wetland is to plug a ditch or drain conduit. However, undoing drainage systems on your wetland may be a complicated endeavor. Further suggestions are outlined in Chapters 3 and 4.

Use Heavy Equipment for Logging or Other Activities Only During the Winter

Avoid logging or taking heavy equipment into your wetland until the ground is frozen to avoid damaging the soil surface and plant community. Construction matting may help alleviate compacting the soil. Carefully consider the impacts before cutting trees in swamp forests. Forested wetlands were severely degraded by logging in the late 1800s to early 1900s, and in some parts of the state the open wetlands that resulted have not yet recovered. Be aware that county zoning ordinances may regulate the removal of trees and vegetation in shoreland zones.

My Wetland's Future: Is it Secure?

Long-term Protection Options for Landowners

A well-restored wetland should last forever, therefore long-term security of your wetland should be considered. A variety of long-term protection options are described below and can include donation of your land to a private or public agency, conservation easements, or deed restrictions that follow the land in perpetuity. The time, energy, and expense of restoring your wetland can be for naught if the next landowner does not care for the site or if it is not permanently protected.

GATHERING WATERS is a statewide clearinghouse for land trust organizations you can contact for more information on how land trusts can protect your land.

Gathering Waters Conservancy
211 S. Patterson, Suite 180
Madison, WI 53703

(608) 251-9131

elkin@ gatheringwaters.org
www.gatheringwaters.org

David Koplitzke

DNR Archive Photo

Donation

Donation of land is an effective and simple way to protect it. A donor can give land to a qualified charitable organization or governmental agency for conservation purposes. The gift is tax-deductible with variations depending on the particular situation. A tax attorney or accountant should be consulted to analyze the tax advantages of your case.

Before you donate your wetland, find an organization or agency that shares your philosophical view of your land. It is important to discuss how the property might be used and managed. If the organization wants to reserve the right to sell the property in the future, you may want to consider granting a conservation easement to a third party to ensure that the land will be protected by future owners or arrange for permanent deed restrictions on the property. There are non-profit land trusts developing across the state dedicated to preserving open space and natural lands. For more information on a land trust that serves your area, contact Gathering Waters Conservancy (see left).

Conservation Easements

A conservation easement is a voluntary agreement used to transfer certain rights of use to a qualified non-profit organization, governmental body, or other legal entity without transferring title of the land. Conservation easements contain permanent restrictions that run with the land for a set period of time. An easement is a flexible and effective means of protecting the property while you still own it and does not grant public access unless you specifically allow it.

To be eligible for a tax deduction, conservation easements must be granted in perpetuity by the landowner. Contact a tax advisor for tax information before drawing up a conservation easement, perhaps with the assistance of an attorney familiar with conservation easements. Discussions with a local assessor are also advisable. The various federal programs described in Chapter 8 often require your restored site to be placed under easement.

Deed Restrictions and Covenants

Deed restrictions are clauses placed in deeds restricting the future use of land. When property containing a wetland is transferred, deed restrictions can prohibit uses or activities by the current and subsequent owners that would destroy, damage, or modify wetlands. A deed restriction should be developed with the aid of an attorney. Unlike a conservation easement, which provides long-term protection because of third-party monitoring, the enforcement of deed restrictions is less reliable and a future landowner can petition the court to vacate the deed restriction or just ignore it. In deed restrictions, the loss in market value due to the restriction may not be claimed as a charitable deduction on income tax returns.

Sale

Sometimes landowners must sell their land containing wetlands for financial or other reasons. If you must sell your wetland but are concerned about its future protection, you can consider using some of the tools described above to protect your wetland from future activities.

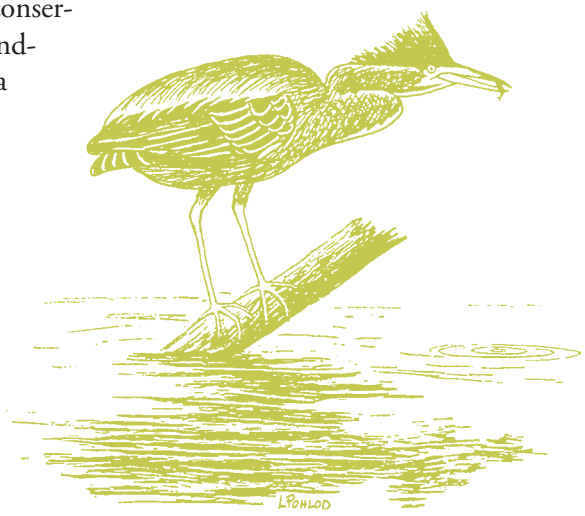
You can also seek a purchaser who shares your values and goals for the wetland's protection and management. Consider advertising in publications that target people who share your values such as environmental, sporting, hunting, and fishing publications. Try not to limit your search for a buyer to individuals. Nonprofit organizations (such as The Nature Conservancy), local land conservancies, hunting clubs, and land trusts may be interested in your property. In addition, state and federal government agencies or local units of government may be interested in your property for the purpose of preserving community open space and passive recreation areas, especially if your property lies adjacent a public area or in a planned environmental corridor.

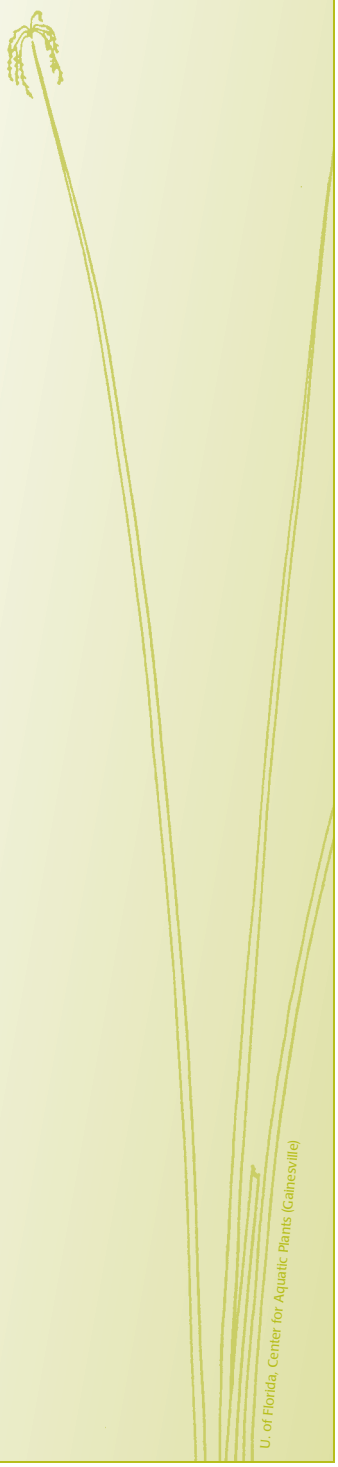
What Is Right for Me?

The options listed above can be pursued individually or in combination with one another. What works for you depends on a variety of factors, and you need to consider each option carefully before acting. You can use the following list of questions as a guide in helping to make your decision.

- ☑ Do you want to continue to own your wetland?
- ☑ Do you want to manage the property exclusively?
- ☑ Do you want compensation for the property?
- ☑ Do you want to restrict future use of the wetland when property title is transferred?
- ☑ Do you want tax breaks for your property?

Voluntary protection efforts have increased in recent years due to income and property tax reductions as an incentive. However, the greater driving force may be the conservation sentiment of the landowner. Landowners with a strong sense of stewardship continue to seek ways to protect their land in the long term, allowing future generations to enjoy the beauty of wetlands.





U. of Florida, Center for Aquatic Plants (Gainesville)

U. of Florida, Center for Aquatic Plants (Gainesville)

CHAPTER 12. WILD RICE COMMUNITY RESTORATION

Reintroduction of the native plant community is an important component of wetland restoration. This chapter explores the restoration of the wild rice plant community and highlights a restoration at Crex Meadows Wildlife Area because this plant community: 1) has historically occurred statewide, 2) has sustained extensive habitat loss, and 3) is often requested by landowners. Wild rice can be restored when reintroduced into its former habitat; however, it has particular habitat requirements and will not grow if these requirements are not met on a site.

"Wild rice has always been regarded by the Ojibwa as the sacred gift of their chosen ground. Wild rice has always been generous to those who gather and use her in a respectful way."

– Edward Benton-Banai, *The Mishomis Book.*

Jim McEvoy

Historically, wild rice provided an important food and cultural component for Native American tribes including the Dakota, Menomonee, and Ojibwa. Early Wisconsin explorers described abundant wild rice beds that hindered their travel on many waterways. Wild rice is also a source of nutrition to various mammals and bird species. Besides nutritious food, the rice beds provide roosting and loafing areas to adult birds and essential brood cover for their young. Declines in historic wild rice beds have occurred statewide due to many factors, including dams, pollution, large boat wakes, and invasive plant species. Renewed interest in the wild rice community has led to large-scale restoration efforts to reintroduce wild rice in Wisconsin's landscape.

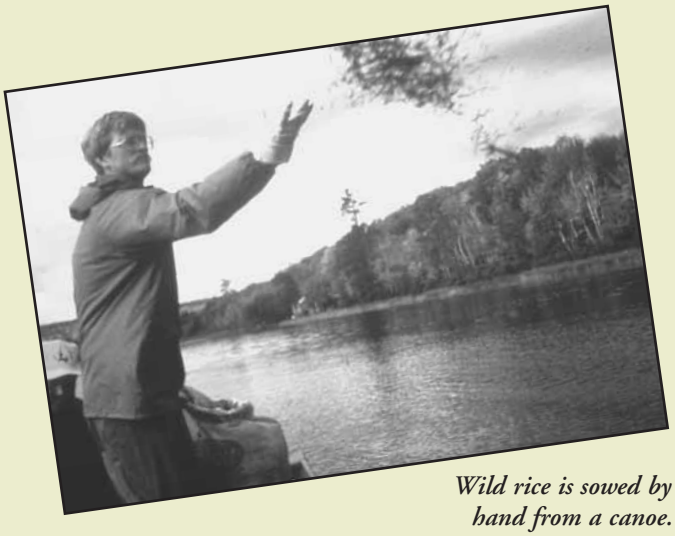
RESTORATION OF WILD RICE: A CASE STUDY

Crex Meadows Wildlife Area, Burnett County

Crex Meadows Wildlife Area, originally part of 1,500 square miles of shallow sedge marsh and gently rolling sand plain, was intensively drained in the 1890s for farming. In 1912 the Crex Carpet Company purchased the property and harvested native sedges to weave into grass rugs. Restoration efforts began in 1945 after the state purchased several thousand acres. Acquisitions are ongoing and 26,000 of the targeted 30,000 acres are now protected as public land.

The construction of two water control structures and a 1.5-mile-long dike in 1952 created Phantom Flowage. "Flowage" describes the water gathered, or impounded, behind a dike or dam with structures that control water levels. While constructing a flowage is not feasible for a private landowner, it serves as an example to guide you in evaluating your site for the suitability of wild rice restoration.

Wild rice restoration began on Phantom Flowage in 1991 when 100 pounds of rice seed was sowed using canoes. The Great Lakes Indian Fish and Wildlife Commission and the State of Wisconsin shared the costs. In the photo taken the first summer after seeding (middle right), the planted rice bed appears in bands. After two additional years of seeding 200 pounds each year, the photo shows successful reintroduction of rice. Once established wild rice will reseed itself annually and form dense beds. The best results for wild rice germination and growth have been when water is between 1 to 2 feet deep, allowing sunlight to reach the underwater emerging plants.



Wild rice is sowed by hand from a canoe.

Photos: Peter David

Phantom Flowage at Crex Meadows. Center, the first year of wild rice restoration. Note bands of sown rice. Bottom, four years after successful restoration of wild rice.

Did Your Site Historically Support Wild Rice?

"The first Nation that we came to was That of the folle avoine . . .The wild oat [wild rice], whose name they bear because it is found in their country, is a sort of grass, which grows naturally in the small Rivers with muddy bottoms, and in Swampy Places."

– Father Marquette's Journal, 1673-1675

The Anishinabe (also known as Ojibwa or Chippewa) who traveled from the eastern seaboard to this region ended their journey when the words of their prophets were fulfilled with the finding of Manoomin–"the food that grows on water" –wild rice.

Mary Hollinger, NOAA

In Wisconsin wild rice has historically ranged from the mouth of the Menomonee River in Southeastern Wisconsin, to Ashland on the shore of Lake Superior, and west to the Mississippi River.

Determining whether or not wild rice has historically existed on your site can be very difficult. The existence of remnant plants is a positive sign. You may want to ask historians or long-time residents who may be able to point to its occurrence. Local colleges or universities may also have wild rice specimens listing the location where the plants were collected. You may be able to collect a sediment core sample and search for old seeds, which can persist for a long time under the right conditions.

Wild rice seed may remain viable in the sediment for five years or more. You should not seed wild rice if the historic stand has been absent *less* than five years or if remnant stands still exist. Instead, use the existing seed from the site to replenish the remnant stands or ask for help in figuring out why the wild rice is not expanding and work to control those factors. The most common problems affecting wild rice stands are changes in water levels or turbidity (suspended sediment in the water). High turbidity can prevent light from reaching the plants under the water.

Will Your Site Support Wild Rice?

If you do not know whether wild rice occurred historically on your site, you need to be certain that present site conditions can support rice. To thrive and become established, wild rice has specific requirements. These requirements are listed in the following sections.

Water Flow

Wild rice seems to require the presence of flowing water. Rivers, sloughs, shallow lakes, wetlands with inlets and outlets, and flowages may provide optimal habitat. Some success may also be possible on ponds with seasonal flow. Generally, the less flow through a wetland, the more the crop will vary from year to year. Getting a poor crop on occasion should be no cause for concern since having good and bad years is natural for annual plants that seed each year. In most cases the rice should come back on its own if the rice bed was previously well established.

Water Depth

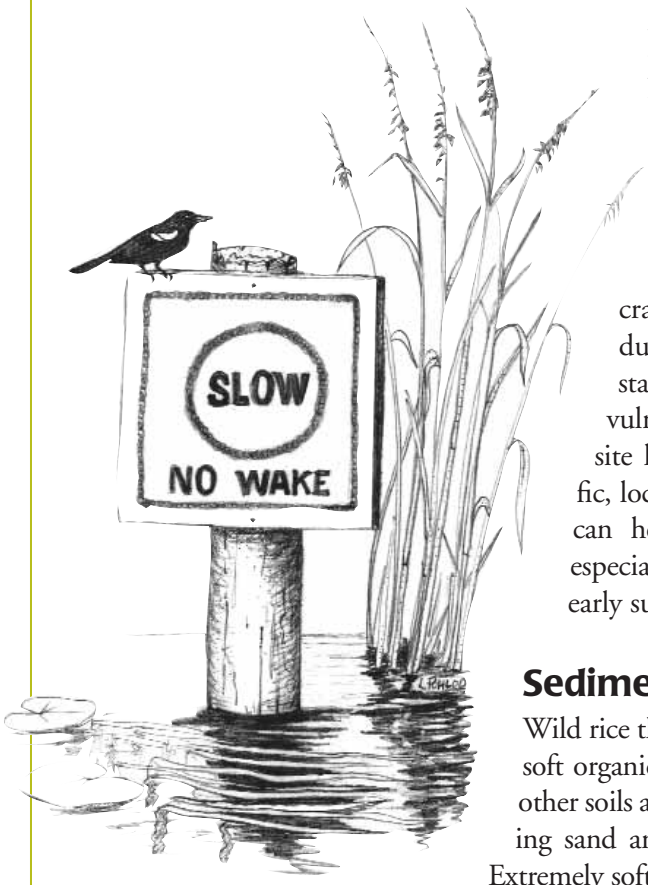
This is perhaps the most critical element. Rice grows in depths of a half-foot to 3 feet, with 1 foot to 2 feet being optimal.

Water Clarity and Color

Wild rice prefers clear water since very dark or turbid water will not allow sunlight to reach the young plant. Rice beds can grow in moderately stained waters, particularly where water depths are limited to 2 feet or less.

Water Fluctuations

Generally, wild rice prefers minimal annual fluctuations in water level and stable or gradually receding water levels during the growing season. Plants are most susceptible to damage during the stage in early summer when the leaves float like ribbons on the surface of the water. Some natural fluctuations in water level are important to keep perennial plants from taking over, even if it means an occasional bad year for rice.



Boats

Boat wakes are a serious contributor to the decline of wild rice. Seeded areas subject to high wave action from boats or personal watercraft may fail, especially during the floating leaf stage when the plant is very vulnerable. If the restoration site has significant boat traffic, local "no wake" regulations can help protect these beds, especially in the late spring and early summer.

Sediment Type

Wild rice thrives in several inches of soft organic muck, but will tolerate other soils and bottom types, including sand and gravel in some cases. Extremely soft bottoms may be unsuitable, but moderately soft or flocculent sites are a preferred habitat.

Competing Vegetation

If dense vegetation already exists, wild rice may have difficulty establishing itself. Heavier than normal seeding rates may help in these instances.

"Ricing gets in your blood. It's the hunter-gatherer instinct. I freeze venison and harvest wild rice; it's deeply satisfying to collect something from the land to feed your family."

–Paul Kooiker, Wildlife Biologist, Wisconsin DNR, Grantsburg

We left this bay [Green Bay] to enter the river [Fox River] that discharges into it; it is very beautiful at its Mouth, and flows gently; it is full Of bustards, Ducks, Teal and other birds, attracted thither by the wild oats of which they are very fond."

Father Marquette's Journal, 1673-1675

Sandy Engel

Muskrat damage to wild rice plants.

Negative Wildlife Impacts

Well-established rice beds can survive being eaten by various wildlife species; small, sparse beds may not. Large goose or muskrat populations may pose significant challenges to wild rice. Temporary control of these species may be beneficial. Carp can also cause problems by uprooting plants and increasing water turbidity that limits early plant development.

How to Obtain Seed

There are a number of options for obtaining native wild rice seed. For all approaches, keep in mind that plants in the wild have good and bad years, and seed can vary in its germination rate from year to year.

- ☑ Get a permit and go harvest it! Hand harvesting seed means fresher seed from a known location, and the experience will expand your knowledge of the plant and perhaps provide a little extra for the pantry. The Great Lakes Indian Fish and Wildlife Commission (GLIFWC) or the local Wisconsin DNR office may have information on harvest techniques and locations. GLIFWC may help you obtain seed and generally will cost share the price of seed for projects that occur on public lands within the ceded territory (those lands upon which Wisconsin tribes have hunting and gathering rights). If you are interested, please contact GLIFWC by June of the year of collection.
- ☑ Go to a harvest site and purchase the seed directly from a harvester. You will be assured of fresh seed from a known source.
- ☑ Purchase it from a Wisconsin-based commercial wild seed nursery. Contact the Wisconsin DNR or local nurseries to determine which nurseries sell wild rice. Try to purchase the seed from as local a source as possible.

WHERE TO GET MORE HELP:

The Great Lakes Indian Fish and Wildlife Commission (GLIFWC) has information available on restoring wild rice and can be of assistance for private projects.

CONTACT:

Great Lakes Indian Fish and Wildlife Commission
Wildlife Biologist

P.O. Box 9
Odanah, WI 54861

(715) 682-6619

www.glifwc.org

How to Plant the Rice Seed

Seeding wild rice is a simple matter of dispersing seed by hand in the fall. Although some references say to pack the seed in mud balls, it is unnecessary and extra work. More extensive seeding recommendations are available from GLIFWC. The following are general guidelines.

- ☑ Begin with a test seeding of three to four acres, at a rate of 40 to 50 pounds per acre.
- ☑ Use locally harvested seed, if possible, and match growing conditions. For example, plant seed collected from a river into a river wetland, or seed from a shallow lake or wetland habitat into a similar community.

Planting the Rice Seed, Continued

- ☑ Obtain freshly harvested seed, and seed it as soon as possible. The harvest season generally begins in late August and runs through September. If you are unable to sow the seed within two to three days from harvest, store the seed wet or cold to ensure that the seed does not heat up, dry up, and spoil. One easy way to do this is to soak the seed bags in a stream. While soaked rice rapidly develops a strong odor; it does not alter viability.

- ☑ Monitor progress several times during the growing season. This is important in helping evaluate detrimental impacts from water levels or wildlife eating the plants.

- ☑ If you get poor results, do not give up on the site, but try again. Although some seedlings will show immediate response, it may take three to five years to determine if a population can be established. No results during the first year could mean poor seed or poor environmental conditions during the critical spring growth period. The lack of first year response does not mean the site is unsuitable.

- ☑ As some positive results are observed, seeding can be expanded. Because seed generally does not disperse far from the mother plant, even well established beds may not spread to a significant degree without additional planting. The objective of all seeding sites should ultimately be to establish self-sustaining populations.

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CHAPTER 13. LEARNING FROM PAST EXPERIENCES:

Case Studies from Wisconsin

The case studies outlined in this chapter illustrate some of the issues raised in this handbook. Case Study #1 highlights two wetlands in Ozaukee County that are typical of the many small wetlands constructed to mimic prairie potholes across the state. Case Study #2 highlights a larger, more costly and ambitious wetland project in Columbia County. Your wetland restoration project may fall somewhere between the extremes of the small cattail basin described in Case Study #1 and the large diverse site described in Case Study #2. For additional project examples refer to the Whittlesey Creek study outlined in Chapter 1 and the Phantom Flowage project in Chapter 12.

Ecologically, small restorations are just as important as large ones. Many small, isolated wetlands provide critical habitat for reptiles and amphibians. Isolated wetlands are used nationwide by 450 species of migratory birds, 25 of which are listed as federally endangered species. Because breeding ducks are territorial and need isolation to produce young, ten 1-acre wetland restorations with associated upland habitat or in a large wetland complex may provide more habitat for nesting ducks than an isolated 10-acre wetland. Small wetlands are often filled and lost at a greater rate than large conspicuous wetlands with more protection or obstacles to development. When done well, small wetland restoration projects are positive additions to our landscape.

Case Study #1: Ozaukee County

The pre-settlement vegetation of Ozaukee County, which borders Lake Michigan just north of Milwaukee County, consisted largely of forested uplands and lowlands. Early surveyors described this area as swamp forests of tamarack and white cedar. Today, the landscape is open, rolling ground, with farmland being replaced by residential areas as more homes are built north of Milwaukee.

More than 300 small wetlands were created or restored in Ozaukee County between 1988 and 1999. Most of these wetlands, built on private land, were created as part of the Conservation Reserve Program (CRP). The Natural Resource Conservation Service (NRCS), United States Fish and Wildlife Service, and the Wisconsin DNR cooperated to design, build, and fund these projects consisting of a series of pothole wetlands clustered in recently farmed fields. A subset of these wetlands have been monitored and researched by Dr. James A. Reinartz and his students at the University of Wisconsin-Milwaukee. Some of these wetland restorations are more than 10 years old and are able to provide us with a look at what has worked and what has not.

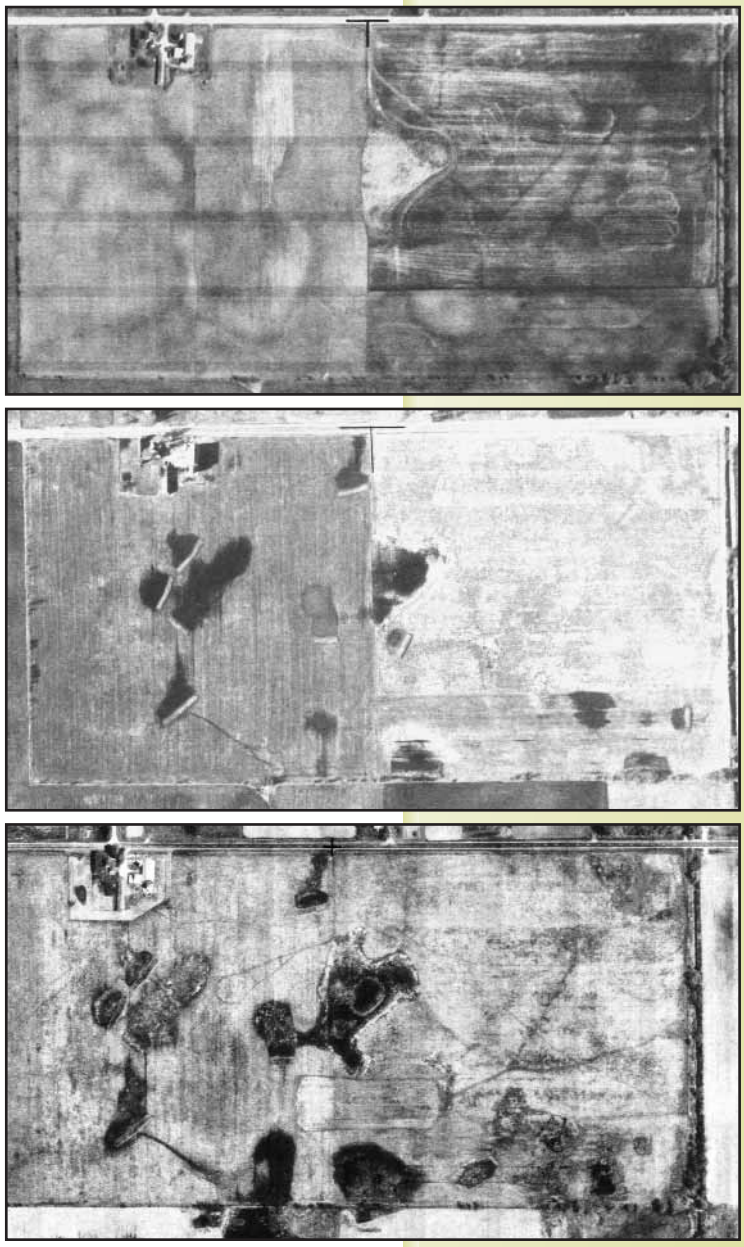
Restoration Goal

The lowlands where these wetland restorations occur were once drainage ways through pre-settlement forests or ephemeral wetlands. After settlement the forests were cut and the land was drained for crops. Wetland areas became depressions or swales in farm fields. Many of the wetland restoration projects took advantage of these low spots on the landscape to block drainage by taking soil from the high sides of the basin and creating a berm on the low side to impound water. Drain tiles, if present, were broken. Historic conditions could not be recreated exactly, due to the extensive deforestation and agricultural use of the land, but the depressions that were once wetlands are natural places to concentrate restoration efforts on today's altered landscape.

Top, aerial photo of "1989" restoration site prior to establishment.

Middle, aerial photo of "1989" restoration site one year following restoration work. Note clusters of berm and scrape wetlands within farm field.

Bottom, aerial photo of "1989" restoration site five years after restoration.



Photos: Southeastern Wisconsin Regional Planning Commission

Construction

Two wetlands are highlighted, a 1.5-acre wetland that was created in 1989 and a half acre wetland that was created in 1990. Each wetland was part of a cluster of four additional wetlands created on the properties and formed by using scrapes and berms. Prior to wetland construction, the land was used for agriculture. The sites have silty, clay loam soils classified as having low permeability. During the construction, topsoil was scraped off and stockpiled. The underlying clay subsoil was scraped and pushed up to create a berm with a spillway on each end to establish a maximum water level in the impoundment. The stockpiled topsoil was then replaced over the constructed basin and berm. Both sites were seeded with a mixture of oats, timothy, brome grass, and alfalfa. Hydrology was restored at the site constructed in 1989 by breaking 30 feet of tile in addition to the scrape and berm.

Native Wetland Seeding- Is it Beneficial?

Native wetland seed was not used in the wetland constructed in 1989. As part of a University of Wisconsin-Milwaukee project led by Dr. Reinartz, the site constructed in 1990 became one of five wetlands seeded with a mixture of 22 native wetland species. The seeds were collected locally on private land and stored outdoors in a metal can for winter stratification (to break dormancy). They were then hand scattered around the edge of the wetland in the spring of 1991, with half the seed cast in the shallow water at the wetland edge and half just above the water line. The development of vegetation and wildlife usage was monitored on these sites and 28 other

Top left, "1989" restoration one year after restoration.

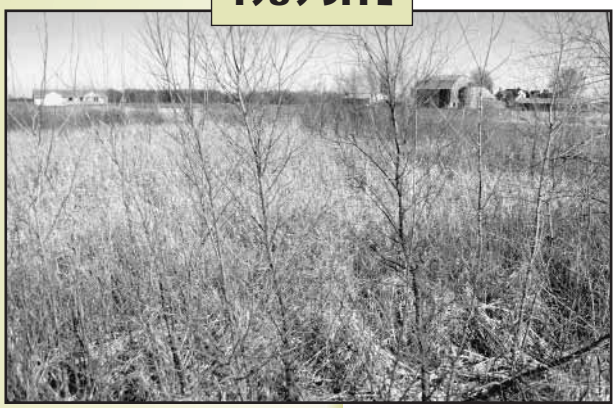
Bottom left, "1989" site ten years after restoration. Open water has been replaced by cattails in the basin and willows on the berm.

Top right, "1990" site during first growing season.

Bottom right, "1990" site nine years later. Open water and a diversity of native plants support wildlife use, including waterfowl and muskrats.

1989 SITE

1990 SITE



Top photos: Jim Reinartz

Bottom photos: Alice Thompson

wetlands. Two to three years after construction, the seeded wetlands as a group had a higher number of native plant species and a lower area covered by cattails.

Viewing both wetlands 10 years after construction, the difference between these similarly constructed wetlands is remarkable. About half of the 1990 restoration area is open water with a diverse native and non-native plant community surrounding the open water. The shallow water edges are colonized by spike rushes (*Eleocharis* spp.) and coontail, a submerged aquatic. Very few cattails are present. In contrast, the 1989 site has a dense thicket of cattails with no open water, and by early summer no standing water. On the drier perimeter, the cattails give way to an equally dense willow fringe. After 10 years, all five of the seeded wetlands had higher diversity than the unseeded wetlands. These studies suggest that early seeding with native plants can "jump-start" the colonization of the site by natives and give the natives the establishment advantage. Cattail seed is light and wind blown and can quickly seed in from nearby wetlands. If cattail is the only plant in the wetland, it can rapidly spread. Once it is dominant it will exclude any other plants from gaining a foothold.

A closer comparison of the sites reveals some important distinctions between these two wetlands. The wetland constructed in 1989 appears to rely solely on surface water to supply the hydrology. This surface water drains agricultural land, with nearby cattle and sheep. As a result, the nutrient-rich animal waste drains directly to the wetland. In contrast, the wetland constructed in 1990 shows signs of groundwater input for its hydrology. Groundwater provides a stable, year-round water source that is lower in nutrients that favor invasive plants. Additionally, in the wetland constructed in 1990, the year-round supply of water made conditions favorable for a resident population of muskrats. The muskrats continually clip and chew wetland plants, including cattails. All of these differences illustrate the complexity in evaluating the results of wetland restoration.

"It is crucial that we continue to monitor wetland creations and restorations to learn more about those factors that lead to successes and failures. Success can only be measured relative to the goals of the project. It is important that landowners not only allow, but engage in or encourage monitoring of projects on their land."

—Dr. James A. Reinartz, Director of the University of Wisconsin-Milwaukee Field Station

Case Study #2: Walker Site, Columbia County . . .

Following an extensive search for a suitable Columbia County site, a consortium of owners, including the Wisconsin Waterfowl Association, purchased 155 acres of cropland as a wetland restoration site, about 90 acres of which were restorable wetlands. The Walker family dairy farm operated on the property for 75 years. The site's lowland soils included muck, and higher slopes were mapped as hydric mineral soils grading to upland soils. When purchased for restora-

Jeff Nania

Determining the depth at which wetland (hydric) soils still occur is important in planning a wetland restoration.

tion, the entire basin affected by any change in hydrology was acquired so that there would be no limitations on how the land was to be restored.

The goal of the Walker Site restoration was to return drained cropland to its historic wetland condition. To accomplish this, restorers identified each site alteration that occurred over the years and determined as much as possible its impact on the wetland. The plan was to reverse each artificial impact in order to restore the original hydrology and topography to the site. The restoration's success hinged not only on the plan and construction, but also the initial evaluation of site potential (see Chapter 3). The presence of groundwater, remnant native plants, and a rich native seed bank, were important to the restoration.

Site Features

The restoration site is a 90-acre basin, crisscrossed by a series of drainage ditches constructed from the 1930s to the 1960s, with 60 acres of uplands surrounding it. The main drainage ditch ranged from 10 to 15 feet deep and 20 to 30 feet wide with a year-round flow. A series of lateral ditches fed the main ditch, but no drain tile had been used.

The Walker dairy farm also grew corn, and they planted low areas with reed canary grass to be cut for animal bedding. The entire site was plowed in drier years throughout its crop history, and only portions were plowed in wet years. This indicated that the soils could not be effectively drained despite extensive ditching. An on-site seed bank study sampling soil layers at 6-inch intervals produced viable, native wetland seed. However, there was no viable seed found in the prairie upland fringe.

A water control structure is used to control water levels during restoration, creating a regime of high water and drawdown to stress reed canary grass.

Alice Thompson

The reed canary grass stands (planted for animal bedding) had become monocultures with over 95 percent dominance (see Chapter 6 for a discussion of this invasive species). Nonetheless, many of these areas showed strong remnant seed banks. Since the goals of the restoration were to return the site to historic water levels and establish native plant communities, much of the plan hinged on eradication of the reed canary grass.

By comparing the site to nearby undisturbed wetlands, planners determined that shallow marsh and sedge meadow/shrub carr were the historic wetland types on the organic soil. The mineral soils had supported wet and mesic prairie (see Chapter 1 for definitions of wetland types) and upland areas had remnant woods consisting of shagbark hickory and red and black oak.

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Restoration

In the summer of 1996, a temporary water control structure was installed at the drainage outlet to manage water levels during construction. A series of water level manipulations were planned, alternating with prescribed burns, to eradicate the reed canary grass. During the first summer, water levels were set

2 feet higher than the estimated historic levels in order to flood the reed canary grass. The water levels were then drawn down in winter. A prescribed burn in the spring preceded another water level elevation for the next summer. Four cycles of flooding/drawdown/burn resulted in eliminating about 80 percent of the reed canary grass in the basin. The reed canary that persisted occurred on the upper reaches of the site where it could not be flooded.

Beginning in 1996, the most critical portions of the ditches were filled over a four-year period. By the end of the first season, about a quarter of the ditches were filled. Water levels rose with the combination of ditch filling and the use of a water control structure. To fill the main ditch, a low pressure bulldozer skimmed 4 to 8 inches of remaining reed canary grass sod that was on a spoil pile and rolled it into the ditch. The remainder of the ditch was filled with spoils still intact from the original ditching. Ditched areas and slopes were graded to approximate the original elevations. Areas that had received erosional deposition from uplands were bulldozed to the original soil layer. In three successive years most of the ditches were filled, and the rising water levels affected more areas each year. The 60-acre upland area was planted with native prairie seed collected on nearby private land. The prairie was seeded over a three-year period, as seed became available.

Jeff Nania

Reed canary grass is scraped from a restoration site and used to fill an existing ditch.

Results

Water levels began to stabilize three years after construction. By the fourth year, even areas considerably upslope from the basin had wetland vegetation. Water levels will be allowed to stabilize without manipulation, unless reed canary grass areas increase in size. Eventually the water control structure will be abandoned to create a self-sustaining natural system.

The restored wetland now contains a diverse native community. Marsh areas are now covered with open water. Flooded trees and shrubs provide structure for waterfowl and other wetland animals. Beds of lake sedge (*Carex lacustris*) and tussock sedge (*Carex stricta*) have flourished in areas with saturated soils. A total of 140 plant species have been recorded at the site. However, continued management of reed canary grass, including prescribed burns, is necessary to protect the native vegetation

The upland prairie has responded slower. Typically prairie plants take several years for root development before becoming large enough to be noticed above ground. In the most recent season, however, prairie plants were beginning to cover the uplands. A remnant prairie patch of less than an acre responded to repeated burns and a colony of state-threatened lesser yellow lady's slipper rebounded under management.

Bob Hay

The response of wildlife to the diversity of native vegetation was immediate. Before the restoration, at most half-a-dozen ducks, mainly mallards or blue-winged teal, would be flushed from the ditches. By the end of the second season of restoration, birds counted during fall migration averaged 1,000 birds per night, peaking at 1,400! By 1999, more than 2,000 waterfowl per day utilized the wetland complex. Wood ducks, mallards, blue-winged teal, tundra swans, Canada geese, sandhill cranes, green herons, soras, yellow-headed blackbirds, black terns, great blue herons, and double-crested cormorants were observed. More than 25 state threatened great egrets were sighted using the wetland throughout the spring. Besides painted turtle and snapping turtle, the state threatened Blanding's turtle occurs on the site. The goal of restoring the hydrology and native vegetation on site has attracted a great variety of wildlife.

Wetland vegetation returns to the restored Walker site from the dormant seed bank.

Wetland hydrology returns to the historic level at the Walker site following the filling of ditches that have a high water storage capacity.

It is important to continue monitoring your wetland restoration for many years to determine what species become established and to detect any invasive plant problems.

Photos: Jeff Nania

Alice Thompson

GLOSSARY

Acidic–Solutions (including soil moisture and water vapor) that have a pH value less than 7.

Acre–A land unit containing 43,560 square feet.

Aerial photo–A black and white photo of land taken from an airplane.

Alkaline (basic)–Solutions (including soil moisture and water vapor) that have a pH value greater than 7.

Annual–A plant that completes its life cycle in one growing season and then dies.

Artificial drainage–Use of ditches, drain tiles, pumps, and/or channelization to lower the water table and drain land.

Berm–A mound or wall of earth that acts like a dike or levee to impound water

Biological control–The use of a living organism as a predator or competitor of an undesirable organism.

Biodiversity/biological diversity–The abundance and mix of different plant and animal species in an area.

Bog–A wetland with peat soil, which is isolated from ground or surface water (only significant water inputs are from rain) and dominated by mosses (*Sphagnum* spp.), sedges, shrubs, and evergreen trees such as black spruce and tamarack.

Buffer zone–An area of vegetation maintained around the shoreline or edge of a stream or wetland. The buffer zone reduces impacts to water, vegetation, and wildlife from adjacent upland activities.

Calcareous–Containing calcium carbonate, calcium or lime, which typically causes an alkaline condition.

Channelization–The straightening and widening or deepening of a stream to speed drainage.

Cool season plants–Plants that actively grow in cool weather: spring and fall (includes many Eurasian grasses).

Cold stratified–Seeds are stored in a cool place over winter to encourage germination.

Community–See "plant community."

Controlled burn–Using fire as a management tool.

Disturbance–Any physical force, such as fire, wind, flood, or extreme cold and disease epidemics. Some natural disturbances were historical forces acting on an ecosystem. Human disturbances were more recent.

Ditching–Excavating a channel in a wetland to drain water.

Ditch plug–A particular amount of fill in a ditch at its lowest point.

Diversion–See "channelization."

Diversity–Variety, see "biological diversity."

Drainage–See "artificial drainage."

Drain tile–Perforated plastic, clay, or concrete pipes that are buried under the surface of the ground to facilitate drainage.

Drawdown–A seasonally cyclic natural or artificial removal of water from a wetland system.

Driftless area–A portion of south-central Wisconsin that was spared from the last advance of glaciers

Ecological–Involving a relationship between living organisms and their environment.

Ecosystem–A community of plants and animals and the physical environment they inhabit, e.g. wetlands, rivers, uplands. The ecosystem reflects the interaction among soil, climate, vegetation, and animal life.

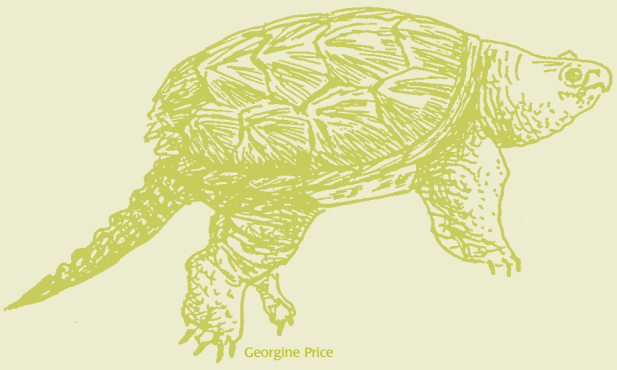
Emergent–A plant that is rooted in the ground and rises out of water such as cattails or rushes.

Erosion–The movement of soil by wind and/or water.

Eutrophication–An aging process by which a water body becomes highly productive either due to natural causes or excessive inputs of pollution rich in dissolved nutrients (e.g., fertilizers).

Evaporation–Conversion of liquid water to vapor.

Exotic species–A plant or animal that evolved in another region or on another continent and is therefore not native to the area in question. Also called "non-native species."



Georgine Price

Farmed wetlands–An NRCS term for land that is partially altered but because of wetness, can't be farmed every year.

Fen–A type of wetland that receives mineral-rich inputs of groundwater and is dominated by sedges and other grass-like vegetation.

Fill–Soil, rocks, concrete, cement, gravel, etc. deposited over wetlands.

Forb–A non-woody plant that is not a grass. This includes annual, biennial, and perennial flowers.

Groundwater–Water that seeps below the surface of the ground and fills interconnected pores in soil and cracks in rocks. Generally lower in nutrients than surface water.

Habitat–The environment in which the requirements of a specific plant or animal are met, including food, water, cover, and space.

Herbicide–A chemical used to kill plants.

Hummocks–Tussocks or raised knobs of organic soil with a clump of sedges on the top. Hummocks are created by some species of sedges, e.g., *Carex stricta*. The tussock height can be from a few inches to a few feet tall. Tussocks are arranged in a regular pattern.

Hybrid–An offspring resulting from a cross between genetically different parents (different breeds, varieties, species, or genera) .

Hydric soil–A soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic (no oxygen) conditions in the root zone.

Hydrology–The study of water sources and flows. The term used to describe particular water conditions in a wetland: where water comes from, how much water exists, and how long it stays on site.

Hydrophyte or **hydrophytic vegetation**–Literally, water-loving vegetation. Any plant that grows in water, or on a base surface that is at least periodically deficient in oxygen as a result of excessive water content; plants typically found in wetlands and other aquatic habitats.

Impoundment–A body of water that is collected or confined, as behind a dam or dike.

Invasive species–A species that can aggressively spread and may not be native.

Marsh–A wetland characterized by grass-like plants (sedges, reeds, grasses, cattails) and wildflowers.

Mineral soil–Any soil consisting primarily of mineral (sand, silt, and clay) material, rather than organic matter.

Monoculture/monotypic–Characterized by a large area occupied by a single species.

Muck–Dark-colored, finely textured, well-decomposed organic soil material where most plant fibers are not recognizable.

Native plant–A plant species that originally occurred in an area.

Navigable waterway–A ditch or stream that has a defined bed and bank, a direction of flow, and at some point in a normal year, you can float a canoe on it.

Non-hydric soil–An area that has sufficiently dry conditions that hydrophytic vegetation, hydric soils, and/or wetland hydrology are lacking (synonymous with upland).

Non-native species–A plant or animal that evolved in another region or on another continent and that is therefore not native to the area in question. Also called "exotic species."

Nutrient–Any mineral, compound, or element that promotes biological growth or development.

Organic soils–Soils composed of partially decomposed plant parts, e.g., mucks and peats. Typically very black in color.

Oxbows–A curving channel of a river.

pH–A chemical measure of the degree of acidity or alkalinity on a scale of 0 to 14. A typical Wisconsin bog has pH values of 4-5 (acidic), while fens and shallow marshes may be 6-8 (neutral or slightly alkaline).

Peat–A low-density, slightly decomposed fibrous organic soil composed largely of plant material that can still be identified.

Permeability–The quality of the soil that enables water to move downward through the profile, measured as the number of inches per hour that water moves downward through the saturated soil.

Pesticide–A chemical used to control pests such as insects.

Phenology–The study of the seasonal changes in plant or animal life and the relationship of these changes to weather and climate.

Plant community–The various plant species that share a single habitat.

Prescribed burn–See "controlled burn."

Pre-settlement–Before European and Euro-American settlement.

Prior-converted–An NRCS term for a former wetland that has been drained to the point that it can be farmed most of the time.

Restoration–See "wetland restoration."

Rhizome–Underground, swollen, horizontal stems from which new plants can develop.

Riparian–The area along the banks of a water course or lake.

Rootstock–An underground stem with erect stems or leaves at intervals.

Saturated–A condition in which virtually all pores between soil particles are temporarily or permanently filled with water.

Scrape–A slight excavation in a wetland that allows for open water ponding.

Sedges–A group of plants that typically have triangular solid stems and occur in wetlands.

Sedimentation–The settling of soil particles and pollutants on the soil surface.

Seed bank–A reservoir of ungerminated seeds within the soil.

Seed drill–A device, usually pulled behind a tractor, used to plant crops or native seeds.

Senescence–Dying off of plant material.

Shoreland zone–The area immediately adjacent a lake or waterway, generally excluded from certain types of development by local or state laws.

Shrub–Woody vegetation usually greater than 3 feet but less than 20 feet tall, including multi-stemmed, bushy shrubs and small trees and saplings.

Siltation–See "sedimentation."

Soil compaction–Alteration in soil structure as it is pressed and the soil loses pore spaces.

Spillway–An overflow area constructed on a berm or dike to allow water to flow out at a set elevation.

Spoils–The soil that has been excavated and deposited in a pile adjacent the evacuation.

Steward/stewardship–To care for and manage natural land in a way that maintains its ecological integrity for the benefit of present and future generations.

Stratify/stratification–See "cold stratified."

Submergent–Plant that is rooted in the ground and is either below the water surface or has floating leaves, e.g., water lily.

Subsidence–Soil that is compressed and loses structure, or organic soil that decomposes and is lower in elevation than originally.

Substrate–The base, usually soil, upon which a plant grows.

Sustainable site–Implies that the site will be self-maintaining over a long period of time.

Surface water–Water that runs off the ground.

Swamp–A forested wetland.

Tension zone–A zone of climatic change that roughly divides the state of Wisconsin into two regions running in a band from the southeast to northwest.

Topography/topographic map–The configuration of the surface, including its relief and the position of its natural and human-made features. When this information is depicted, it creates topographic maps.

Transpiration–The process in plants by which water is released into the atmosphere through the leaves.

Tree–A woody plant 5 inches or greater in diameter at breast height and 20 feet or taller.

Upland–Any area that does not qualify as a wetland because the associated hydrologic regime is not sufficiently wet to elicit development of vegetation, soil, and/or hydrologic characteristics associated with wetlands.

Warm season–Plants (including prairie grasses) that are most actively growing in the warmth of the summer.

Water quality–A wetland function referring to a wetland's capacity to retain and process dissolved or particulate materials to the benefit of downstream water quality.

Watershed–The surrounding land area that drains into a lake, river, river system, or wetland.

Water table–The point at which the ground becomes completely saturated with water.

Wetland–An area that is inundated or saturated to the surface for a sufficient time to foster the growth of hydrophytic plants and/or the development of hydric soils.

Wetland creation–The establishment of a wetland in an area where a wetland never existed historically.

Wetland enhancement–Maintenance or management of existing wetlands for a particular function or value, sometimes at the expense of other functions or values.

Wetland hydrology–See "hydrology."

Wetland indicators–Plants that are adapted to wetland conditions. Their presence indicates the area may be a wetland.

Wetland management–Activities that do not involve changes in soils or hydrology, but may affect wildlife habitat and vegetation.

Wetland restoration–The reestablishment of a wetland of the same type in the landscape where a wetland existed historically.

Alice Thompson

APPENDIX A.
Useful Literature and World Wide Web Resources

WETLAND GUIDES

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- *Restoration Ecology*. Journal of the Society for Ecological Restoration. **www.ser.org** or **www.blackwellpublishing.com/journals/REC/**
- *Natural Areas Journal*. Natural Areas Association. **www.naturalarea.org**

WORLD WIDE WEB RESOURCES

The following are a few of the many wetland web sites available on-line.

Wisconsin Web Sites

- Wisconsin Coastal Management Program, a voluntary program to award annual grants to support coastal conservation and management programs: **www.doa.state.wi.us/pagesubtext_detail.asp?linksubcatid=249&linkcatid=108&linkid=**
- Wisconsin Department of Natural Resources: **www.dnr.wi.gov**
  - Waterway and Wetland Permits: **www.dnr.wi.gov/org/water/fhp/waterway/**
  - Wetlands Strategy: **www.dnr.wi.gov/org/water/fhp/wetlands/index.htm**
  - Invasive Plants: **www.dnr.wi.gov/org/land/er/invasive/**
- U.S. Army Corps of Engineers: St. Paul District covers the state of Wisconsin, waterway permits and information, and order form for Eggers and Reed's wetland book: **www.mvp.usace.army.mil**
- Wisconsin Waterfowl Association: **www.wisducks.org**
- Wisconsin Wetlands Association: **www.wiscwetlands.org**
- Invasive Plant Association of Wisconsin (IPAW): **www.uwex.edu/ces/ipaw/**
- Great Lakes Indian Fish and Wildlife Commission (GLIFWC): **www.glifwc.org/epicenter/**

Non-Wisconsin Web Sites

- Association of State Wetland Managers (Berne, NY): **www.aswm.org**
- Bird Conservation Partners: **www.partnersinflight.org**
- Biodiversity Project: **www.biodiversityproject.org**
- Ducks Unlimited: **www.ducks.org**
- Environmental Protection Agency, Wetland Home Page. Includes wetland information hotline, restoration information, etc.: **www.epa.gov/owow/wetlands/**
- Green Acres: Green Landscaping with Native Plants, native plant site, handbook, frequently asked questions and other resources: **www.epa.gov/greenacres/**
- Isaak Walton League of America: **www.iwla.org**

(Continued on next page)

- League of Woman Voters Wetland Web Walk contains information to encourage activism and community problem solving: **www.lwv.org/where/protecting/webwalk/**
- National Audubon Society: **www.audubon.org**
- National Wetland Inventory, U.S. Fish and Wildlife Service, characteristics, extent and status of Nation's wetlands. Maps can be downloaded, ask "Dr. Wetland" questions on wetland issues: **www.nwi.fws.gov**
- Natural Resources Conservation Service (NRCS): **www.nrcs.usda.gov**
- Northern Prairie Wildlife Research Center: **www.npwrc.usgs.gov**
- Prairie Enthusiasts: **www.theprairieenthusiasts.org**
- Society of Wetland Scientists web site includes "Discussion Forum" with information exchanged with wetland professionals: **www.sws.org**
- Society for Ecological Restoration, Northwest Chapter; Reed Canary Grass workgroup: **www.sernw.org**
- The Nature Conservancy: **nature.org**

  Invasives: **nature.org/initiatives/invasivespecies/about/index.html**
- University of Minnesota's Horticultural Science Department has an excellent collection of articles on restoration and reclamation, some pertain to shoreland and wetland restoration: **www.hort.agri.umn.edu/h5015/rrr.htm**
- U.S. Fish and Wildlife Service: **www.fws.gov**
- U.S. Geological Survey: **www.usgs.gov**
- Wetland Reserve Program: **www.wl.fb-net.org**

APPENDIX B.
Contacts for Wisconsin Wetland Information

County	County Zoning	DNR	Corps of Engineers	NRCS	USFWS
Adams	Zoning Administrator Adams Co. Courthouse P.O. Box 187 Friendship, WI 53934 (608) 339-4222	DNR 473 Griffith Ave. Wisconsin Rapids, WI 54494 (715) 421-7815	USACOE 1314 Contractor's Blvd. Plover, WI 54467 (715) 345-7911 ext. 4	District Conservationist Agricultural Service Center 220 La Crosse St. Mauston, WI 53948-2101 (608) 847-7221	Necedah National Wildlife Refuge W7996 20th Street West Necedah, WI 54646-7531 (608) 565-2551
Ashland	Zoning Administrator Ashland Co. Courthouse 201 W. Main St., Rm. 109 Ashland, WI 54806-1652 (715) 682-7014	DNR 2501 Golf Course Rd. Ashland, WI 54806 (715) 685-2923	USACOE 1568 Highway 2, Rm. 107/112 Two Harbors, MN 55616 (218) 834-6630	District Conservationist 315 Sanborn Ave., Suite 100 P.O. Box 267 Ashland, WI 54806-1032 (715) 682-9117	Fisheries Assistance Office 2800 Lake Shore Drive East Ashland, WI 54806 (715) 682-6185
Barron	Zoning Administrator Agricultural Building 330 E. La Salle Ave. Barron, WI 54812 715) 537-6375	DNR 1341 2nd Ave. P.O. Box 397 Cumberland, WI 54829 (715) 822-5421 ext. 108	USACOE- St. Paul District Attention: CO-R 190 Fifth Street East St. Paul, MN 55101-1638 651) 290-5357	District Conservationist Agricultural Service Center 330 E. La Salle Ave. Barron, WI 54812-1540 (715) 537-5645	St. Croix Wetland Mgt. District 1764 95th St. New Richmond, WI 54017 (715) 246-7784
Bayfield	Zoning Administrator 117 E. 6th St. P.O. Box 58 Washburn, WI 54891 (715) 373-6138	DNR 2501 Golf Course Rd. Ashland, WI 54806 (715) 685-2923	USACOE 1568 Highway 2, Rm. 107/112 Two Harbors, MN 55616 (218) 834-6630	District Conservationist 315 Sanborn Ave., Suite 100 P.O. Box 267 Ashland, WI 54806-1032 (715) 682-9117	Fisheries Assistance Office 2800 Lake Shore Drive East Ashland, WI 54806 (715) 682-6185
Brown	Zoning Administrator 305 E. Walnut St., Rm. 320 P.O. Box 23600 Green Bay, WI 54305-3600 (920) 448-4490	DNR 801 E. Walnut St. Green Bay, WI 54301 (920) 448-5166	USACOE Suite 211, Old Fort Square 211 North Broadway Green Bay, WI 54303 (920) 448-2824	District Conservationist Agricultural Service Center 3071 C Voyager Dr. Green Bay, WI 54311 (920) 884-3910	Ecological Services Office 2661 Scott Tower Dr. New Franken, WI 54229 (920) 866-1717
Buffalo	Zoning Administrator 407 2nd St. P.O. Box 492 Alma, WI 54610-0492 (608) 685-6218	DNR 910 Highway 54 East Black River Falls, WI 54615 (715) 284-1424	USACOE Attention: CO-R 1114 South Oak St. La Crescent, MN 55947-1338 (507) 895-8059	District Conservationist Buffalo County Courthouse 407 S. 2nd St., P.O. Box 88 Alma, WI 54610-0088 (608) 685-4454	Trempealeau National Wildlife Refuge W28488 Refuge Rd. Trempealeau, WI 54661 (608) 539-2311

County	County Zoning	DNR	Corps of Engineers	NRCS	USFWS
Buffalo-Mississippi R.	Zoning Administrator 407 2nd St. P.O. Box 492 Alma, WI 54610-0492 (608) 685-6218	DNR 3550 Mormon Coulee Rd. Room 104 La Crosse, WI 54601 (608) 785- 9010	USACOE Attention: CO-R 1114 South Oak St. La Crescent, MN 55947-1338 (507) 895-8059	District Conservationist Buffalo County Courthouse 407 2nd St., P.O. Box 88 Alma, WI 54610-0088 (608) 685-4454	Trempealeau National Wildlife Refuge W28488 Refuge Rd. Trempealeau, WI 54661 (608) 539-2311
Burnett	Zoning Administrator County Government Center 7410 CTH K, #102 Siren, WI 54872 (715) 349-2138	DNR 810 W. Maple St. Spooner, WI 54801 (715) 635-4097	USACOE 1568 Highway 2, Rm.107/112 Two Harbors, MN 55616 (218) 834-6630	District Conservationist Siren Service Center 7410 County Road K, #109 Siren, WI 54872-9043 (715) 349-2185	St. Croix Wetland Mgt. Office 1764 95th St. New Richmond, WI 54017 (715) 246-7784
Calumet	Zoning Administrator Calumet Co. Courthouse 206 Court St. Chilton, WI 53014-1198 (920) 849-1442/2361	DNR 2220 East CTH V Mishicot, WI 54228 (920) 755-4942	USACOE Suite 211, Old Fort Square 211 North Broadway Green Bay, WI 54303 (920) 448-2824	District Conservationist Courthouse 206 Court St. Chilton, WI 53014-1127 (920) 849-1444	Ecological Services Office 2661 Scott Tower Dr. New Franken, WI 54229 (920) 866-1717
Calumet-Lake Winnebago & tributaries	Zoning Administrator Calumet Co. Courthouse 206 Court St. Chilton, WI 53014-1198 (920) 849-1442/2361	DNR 625 E. County Road Y Suite 700 Oshkosh, WI 54901-9731 (920) 424-7885	USACOE Suite 211, Old Fort Square 211 North Broadway Green Bay, WI 54303 (920) 448-2824	District Conservationist Courthouse 206 Court St. Chilton, WI 53014-1127 (920) 849-1444	Ecological Services Office 2661 Scott Tower Dr. New Franken, WI 54229 (920) 866-1717
Chippewa	Zoning Administrator Chippewa Co. Courthouse 711 N. Bridge St. Chippewa Falls, WI 54729-1876 (715) 726-7940	DNR 1300 W. Clairemont Ave. P.O. Box 4001 Eau Claire, WI 54702-4001 (715) 839-3769	USACOE - St. Paul District Attention: CO- R 190 Fifth Street East St. Paul, MN 55101-1638 (651) 290-5263	District Conservationist USDA Service Center 1160 Weatheridge Chippewa Falls, WI 54729 (715) 720-9083	Necedah National Wildlife Refuge W7996 20th Street West Necedah, WI 54646-7531 (608) 565-2551
Clark	Zoning Administrator Clark Co. Courthouse 517 Court St., Rm. 204A Neillsville, WI 54456 (715) 743-5130/5131	DNR 910 Highway 54 East Black River Falls, WI 54615 (715) 284-1424	USACOE - St. Paul District Attention: CO-R 190 Fifth Street East St. Paul, MN 55101-1638 (651) 290-5263	District Conservationist Agricultural Service Center 517 Court St. Neillsville, WI 54456-1971 (715) 743-3164	Necedah National Wildlife Refuge W7996 20th Street West Necedah, WI 54646-7531 (608) 565-2551
Columbia	Zoning Administrator 400 De Witt St. PO Box 177 Portage, WI 53901 (608) 742-9660	DNR 3911 Fish Hatchery Rd. Fitchburg, WI 53711 (608) 275-3228	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-1876	District Conservationist USDA Service Center 2912 Red Fox Run Rd. Portage, WI 53901-3400 (608) 742-5361	Leopold Wetland Mgt. Office. W10040 Cascade Mountain Rd. Portage, WI 53901 (608) 742-7100 ext. 14 or 15

County	County Zoning	DNR	Corps of Engineers	NRCS	USFWS
Crawford	Zoning Administrator 111 W. Dunn St. Prairie du Chien, WI 53821 (608) 326-0294	DNR 3550 Mormon Coulee Rd. La Crosse, WI 54601 (608) 785-9010	USACOE, Attention CO-R 1114 South Oak St. La Crescent MN 55947-1338 (507) 895-8059	District Conservationist USDA Service Center 37500 U.S Hwy. 18 Prairie du Chien, WI 53821 (608) 326-7179	Upper Mississippi River Refuge District P. O. Box 460 McGregor, IA 52157 (563) 873-3423
Dane	Zoning Administrator City County Building, Rm. 116 210 M. L. King Jr. Blvd Madison, WI 53709 (608) 266-9083/4266	DNR 3911 Fish Hatchery Rd. Fitchburg, WI 53711 (608) 275-3208	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-1876	District Conservationist Madison Service Center 1 Fen Oak Court, Room 208 Madison, WI 53718-8812 (608) 224-3750	Wisconsin Private Lands Office 4511 Helgesen Dr. Madison, WI 53718-6747 (608) 221-1206 ext. 14
Dodge	Zoning Administrator County Admin. Building 127 E. Oak St. Juneau, WI 53039 (920) 386-3700	DNR N7725 State Highway 28 Horicon, WI 53032 (920) 387-7878	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-4071	District Conservationist USDA Service Center 451 West North St. Juneau, WI 53039-1120 (920) 386-9999	Leopold Wetland Mgt. Office W10040 Cascade Mountain Rd. Portage, WI 53901 (608) 742-7100 ext. 14 or 15
Door	Zoning Administrator Door County Courthouse 421 Nebraska St. Sturgeon Bay, WI 54235-0670 (920) 746-2323	DNR 110 S. Neenah Ave. Sturgeon Bay, WI 54235-2718 (920) 746-2873	USACOE Suite 211, Old Fort Square 211 North Broadway Green Bay, WI 54303 (920) 448-2824	District Conservationist USDA Service Center 926 Marquette Dr. Kewaunee, WI 54216-1772 (920) 388-2792	Ecological Services Office 2661 Scott Tower Dr. New Franken, WI 54229 (920) 866-1717
Douglas	Zoning Administrator Douglas Co. Courthouse 1313 Belknap St., Rm. 206 Superior, WI 54880 (715) 395-1380	DNR 1401 Tower Ave. Superior, WI 54880 (715) 392-0803	USACOE 1568 Highway 2, Rm. 107/112 Two Harbors, MN 55616 (218) 834-6630	District Conservationist 315 Sanborn Ave., Suite 100 PO Box 267 Ashland, WI 54806-1032 (715) 682-9117	Fisheries Assistance Office 2800 Lake Shore Drive East Ashland, WI 54806 (715) 682-6185
Dunn	Zoning Administrator 800 Wilson Ave. Menomonie, WI 54751 (715) 232-1401	DNR 1300 W. Clairemont Ave. P.O. Box 4001 Eau Claire, WI 54702-4001 (715) 839-3769	USACOE - St. Paul District Attention: CO-R 190 Fifth Street East St. Paul, MN 55101-1638 (651) 290-5263	District Conservationist Agricultural Service Center 390 Red Cedar St., Suite. C Menomonie, WI 54751-2265 (715) 232-2614	St. Croix Wetland Mgt. District 1764 95th St. New Richmond, WI 54017 (715) 246-7784
Eau Claire	Zoning Administrator Eau Claire Co. Courthouse 721 Oxford Ave., Rm. 1510 Eau Claire, WI 54703 (715) 839-2979/4743	DNR 1300 W. Clairemont Ave. P.O. Box 4001 Eau Claire, WI 54702-4001 (715) 839-3769	USACOE - St. Paul District Attention: CO-R 190 Fifth Street East St. Paul, MN 55101-1638 (651) 290-5263	District Conservationist Altoona Service Center 227 First Street West Altoona, WI 54720-1601 (715) 839-4786	Necedah National Wildlife Refuge W7996 20th Street West Necedah, WI 54646-7531 (608) 565-2551

County	County Zoning	DNR	Corps of Engineers	NRCS	USFWS
Florence	Zoning Administrator Florence Co. Courthouse 501 Lake Ave., P.O. Box 627 Florence, WI 54121 (715) 528-3206	DNR 8770 Highway J Woodruff, WI 54568 715-358-9214	USACOE 1314 Contractor's Blvd. Plover, WI 54467 715-345-7911 ext. 2	District Conservationist Agricultural Service Center 639 West Kemp St. Rhinelander, WI 54501-3879 (715) 362-5941	Ecological Services Office 2661 Scott Tower Dr. New Franken, WI 54229 (920) 866-1717
Fond du Lac	Zoning Administrator City-County Govt. Center 160 S. Macy St. Fond du Lac, WI 54935 (920) 929-3139	DNR 625 E. County Road Y Suite 700 Oshkosh, WI 54901-9731 (920) 424-7885	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-4171	District Conservationist Agricultural Service Center W6529 Forest Ave. Fond du Lac, WI 54937 (920) 923-3033	Leopold Wetland Mgt. Office W10040 Cascade Mountain Rd. Portage, WI 53901 (608) 742-7100 ext. 14 or 15
Forest	Zoning Administrator 200 E. Madison St. Crandon, WI 54520 (715) 478-3893	DNR 107 Sutliff Ave. Rhinelander, WI 54501 (715) 365-8991	USACOE 1314 Contractor's Blvd. Plover, WI 54467 (715) 345-7911 ext. 2	District Conservationist Agricultural Service Center 639 West Kemp St. Rhinelander, WI 54501-3879 (715) 362-5941	Ecological Services Office 2661 Scott Tower Dr. New Franken, WI 54229 (920) 866-1717
Grant	Zoning Administrator 111 South Jefferson St. Lancaster, WI 53813 (608) 723-2848/4394	DNR 1500 N. Johns St. Dodgeville, WI 53533-2116 (608) 935-1920	USACOE Attention: CO-R 1114 South Oak St. La Crescent, MN 55947-1338 (507) 895-8059	District Conservationist Lancaster Service Center 150 W. Alona Lane Lancaster, WI 53813-2197 (608) 723-6377	Upper Mississippi River Refuge McGregor District P. O. Box 460 McGregor, IA 52157 (563) 873-3423
Green	Zoning Administrator Pleasant View Complex N3150 Hwy. 81, P.O. Box 358 Monroe, WI 53566 (608) 328-9423	DNR 1500 N. Johns St. Dodgeville, WI 53533-2116 (608) 935-1920	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-1876	District Conservationist Agriculture Building 2841 6th Street, Box 497 Monroe, WI 53566-1902 (608) 325-4195	Wisconsin Private Lands Office 4511 Helgesen Dr. Madison, WI 53718-6467 (608) 221-1206 ext. 14
Green Lake	Zoning Administrator Green Lake Co. Courthouse 492 Hill St. Green Lake, WI 54941 (920) 294-4026/4027	DNR 427 E. Tower Drive, Suite 100 Wautoma, WI 54982-6927 (920) 787-4686 ext. 3016	USACOE 1314 Contractor's Blvd. Plover, WI 54467 (715) 345-7911 ext. 4	District Conservationist USDA Service Center 630 East South St. Green Lake, WI 54941-9496 (920) 294-6140	Leopold Wetland Mgt. Office W10040 Cascade Mountain Rd. Portage, WI 53901 (608) 742-7100 ext. 14 or 15
Iowa	Zoning Administrator Iowa Co. Courthouse 222 N. Iowa St. Dodgeville, WI 53533 (608) 935-0398	DNR 1500 N. Johns St. Dodgeville, WI 53533-2116 (608) 935-1920	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-1876	District Conservationist Dodgeville Service Center 138 S. Iowa St., Suite 3 Dodgeville, WI 53533-1543 (608) 935-2791	Wisconsin Private Lands Office 4511 Helgesen Dr. Madison, WI 53718-6747 (608) 221-1206 ext. 14

County	County Zoning	DNR	Corps of Engineers	NRCS	USFWS
Iron	Zoning Administrator Iron Co. Courthouse 300 Taconite St. Hurley, WI 54534 (715) 561-5414	DNR 875 S. 4th Avenue P.O. Box 220 Park Falls, WI 54552 (715) 762-4684 ext. 102	USACOE 1568 Highway 2, Rm. 107/112 Two Harbors, MN 55616 (218) 834-6630	District Conservationist 315 Sanborn Ave., Suite 100 P.O. Box 267 Ashland, WI 54806-1032 (715) 682-9117	Fisheries Assistance Office 2800 Lake Shore Drive East Ashland, WI 54806 (715) 682-6185
Jackson	Zoning Administrator Jackson Co. Courthouse 307 Main St. Black River Falls, WI 54615 (715) 284-0220/0206	DNR 910 Highway 54 East Black River Falls, WI 54615 (715) 284-1424	USACOE, Attention: CO-R 1114 South Oak St. La Crescent, MN 55947-1338 (507) 895-8059	District Conservationist Black River Falls Service Center 311 County Road A Black River Falls, WI 54615 (715) 284-4515	Necedah National Wildlife Refuge W7996 20th Street West Necedah, WI 54646-7531 (608) 565-2551
Jefferson North. of I-94	Zoning Administrator Jefferson Co. Courthouse 320 S. Main St., Rm. 201 Jefferson, WI 53549 (920) 674-7130	DNR N7725 State Highway 28 Horicon, WI 53032 (920) 387-7878	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-1876	District Conservationist USDA Service Center 134 W. Rockwell, Rm. 120 Jefferson, WI 53549-2089 (920) 674-2020	Wisconsin Private Lands Office 4511 Helgesen Dr. Madison, WI 53718-6747 (608) 221-1206 ext. 14
Jefferson South of I-94	Zoning Administrator Jefferson Co. Courthouse 320 S. Main St., Rm. 201 Jefferson, WI 53549 (920) 674-7130	DNR 2514 Morse St. Janesville, WI 53545-0249 (608) 743-4820	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-1876	District Conservationist USDA Service Center 134 W. Rockwell, Rm. 120 Jefferson, WI 53549-2089 (920) 674-2020	Wisconsin Private Lands Office 4511 Helgesen Dr. Madison, WI 53718-6747 (608) 221-1206 ext. 14
Juneau	Zoning Administrator 650 Prairie St. Mauston, WI 53948 (608) 847-9391	DNR 473 Griffith Ave. Wisconsin Rapids ,WI 54494 (715) 421-7815	USACOE 1314 Contractor's Blvd. Plover, WI 54467 (715) 345-7911 ext. 3	District Conservationist Agricultural Service Center 220 LaCrosse St. Mauston, WI 53948-2101 (608) 847-7221	Necedah National Wildlife Refuge W7996 20th Street West Necedah, WI 54646-7531 (608) 565-2551
Kenosha	Zoning Administrator Kenosha County Center 19600 75th St., P.O. Box 520 Bristol, WI 53104-0520 (262) 857-1895	DNR 9531 Rayne Road, Suite 4 Sturtevant, WI 53177 (262) 884-2355	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-0868	District Conservationist Union Grove Service Center 826 Main St. Union Grove, WI 53182 (262) 878-1243	Wisconsin Private Lands Office 4511 Helgesen Dr. Madison, WI 53718-6747 (608) 221-1206 ext. 14
Kewaunee	Zoning Administrator Kewaunee Co. Courthouse 613 Dodge St. Kewaunee, WI 54216 (920) 388-7192	DNR 2220 East CTH V Mishicot, WI 54228 (920) 755-4942	USACOE Suite 211, Old Fort Square 211 North Broadway Green Bay, WI 54303 (920) 448-2824	District Conservationist USDA Service Center 925 Marquette Dr. Kewaunee, WI 54216-1772 (920) 388-2792	Ecological Services Office 2661 Scott Tower Dr. New Franken, WI 54229 (920) 866-1717

County	County Zoning	DNR	Corps of Engineers	NRCS	USFWS
La Crosse	Zoning Administrator La Crosse Co. Courthouse 400 4th Street N., Rm. 105 La Crosse, WI 54601-3200 (608) 785-9722	DNR 3550 Mormon Coulee Road Rm. 104 La Crosse, WI 54601 (608) 785- 9010	USACOE Attention: CO-R 1114 South Oak St. La Crescent, MN 55947-1338 (507) 895-8059	District Conservationist USDA Service Center 1107 Riders Club Rd. Onalaska, WI 54650-2079 (608) 782-0180	Upper Mississippi River Refuge La Crosse District 555 Lester Ave. Onalaska, WI 54650 (608) 783-8405
Lafayette	Zoning Administrator Agricultural Center 627 Washington St. Darlington, WI 53530 (608) 776-4830	DNR 1500 N. Johns St. Dodgeville, WI 53533-2116 (608) 935-1920	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-1876	District Conservationist USDA Service Center 1845 Center Dr. Darlington, WI 53530-9210 (608) 776-4028	Wisconsin Private Lands Office 4511 Helgesen Dr. Madison, WI 53718-6747 (608) 221-1206 ext. 14
Langlade	Zoning Administrator Resource Center 837 Clermont St. P.O. Box 505 Antigo, WI 54409-0505 (715) 627-6206	DNR 223 E. Steinfest Rd. Antigo, WI 54409 (715) 623-4190 ext. 3111	USACOE 1314 Contractor's Blvd. Plover, WI 54467 (715) 345-7911 ext. 2	District Conservationist N1545 County Road W Merrill, WI 54452-1100 (715) 536-6003	Ecological Services Office 2661 Scott Tower Dr. New Franken, WI 54229 (920) 866-1717
Lincoln	Zoning Administrator Lincoln Co. Courthouse 1106 East Eighth St. Merrill, WI 54452-2554 (715) 536-0333	DNR 223 E. Steinfest Rd. Antigo, WI 54409 (715) 623-4190 ext. 3111	USACOE 1314 Contractor's Blvd. Plover, WI 54467 (715) 345-7911 ext. 2	District Conservationist N1545 County Road W Merrill, WI 54452-1113 (715) 536-6003	Ecological Services Office 2661 Scott Tower Dr. New Franken, WI 54229 (920) 866-1717
Manitowoc	Zoning Administrator 4319 Expo Dr., P.O. Box 610 Manitowoc, WI 54221-0610 (920) 683-4185/4187	DNR 2220 East CTH V Mishicot, WI 54228 (920) 755-4942	USACOE Suite 211, Old Fort Square 211 North Broadway Green Bay, WI 54303 (920) 448-2824	District Conservationist Manitowoc Service Center 4319 Expo Dr., P.O. Box 758 Manitowoc, WI 54221-0758 (920) 683-5119	Ecological Services Office 2661 Scott Tower Dr. New Franken, WI 54229 (920) 866-1717
Marathon	Zoning Administrator 210 River Dr. Wausau, WI 54403-5449 (715) 261-6020/6021	DNR 5301 Rib Mountain Dr. Wausau, WI 54401-7599 (715) 241-7502	USACOE 1314 Contractor's Blvd. Plover, WI 54467 (715) 345-7911 ext. 3	District Conservationist Wausau Service Center 326 River Dr. Wausau, WI 54403-5451 (715) 848-2330	Ecological Services Office 2661 Scott Tower Dr. New Franken, WI 54229 (920) 866-1717
Marinette	Zoning Administrator Marinette Co. Courthouse 1926 Hall Ave. Marinette, WI 54143-1717 (715) 732-7535	DNR 101 N. Ogden Rd. P.O. Box 208 Peshtigo, WI 54157 (715) 582-5041	USACOE Suite 211, Old Fort Square 211 North Broadway Green Bay, WI 54303 (920) 448-2824	District Conservationist USDA Service Center 700 Owena St. Marinette, WI 54143-1938 (715) 735-5680	Ecological Services Office 2661 Scott Tower Dr. New Franken, WI 54229 (920) 866-1717

County	County Zoning	DNR	Corps of Engineers	NRCS	USFWS
Marquette	Zoning Administrator Marquette Co. Courthouse P.O. Box 21 Montello, WI 53949 (608) 297-9136 ext. 259	DNR 427 E. Tower Drive, Suite 100 Wautoma, WI 54982-6927 (920) 787-4686 ext. 3016	USACOE 1314 Contractor's Blvd. Plover, WI 54467 (715) 345-7911 ext. 4	USDA, NRCS 480 Underwood Ave. P.O. Box 217 Montello, WI 53949-9248 (608) 297-9165	Leopold Wetland Mgt. Office W10040 Cascade Mountain Rd. Portage, WI 53901 (608) 742-7100 ext. 14 or 15
Menominee	Zoning Administrator Menominee Co. Courthouse P.O. Box 279 Keshena, WI 54135 (715) 799-3001	DNR 647 Lakeland Rd. Shawano, WI 54166-3843 (715) 526-4232	USACOE Suite 211, Old Fort Square 211 North Broadway Green Bay, WI 54303 (920) 448-2824	Tribal Liaison MTE Forestry Division P.O. Box 670, Hwy. 47 North Keshena, WI 54135 (715) 799-3896	Ecological Services Office 2661 Scott Tower Dr. New Franken, WI 54229 (920) 866-1717
Milwaukee	Not Available	DNR 2300 N. M. L. King Jr. Dr. Milwaukee, WI 53212 (414) 263-8522	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-4171	District Conservationist Waukesha Service Center 1320 Pewaukee Rd. Waukesha, WI 53188-3878 (262) 547-3754	Wisconsin Private Lands Office 4511 Helgesen Dr. Madison, WI 53718-6747 (608) 221-1206 ext. 14
Monroe	Zoning Administrator Community Service Center 14307 County Hwy. B (C-21A) Sparta, WI 54656-4509 (608) 269-8737/8738	DNR 3550 Mormon Coulee Road Rm. 104 La Crosse, WI 54601 (608) 785-9013	USACOE Attention: CO-R 1114 South Oak St. La Crescent, MN 55947-1338 (507) 895-8059	District Conservationist USDA Service Center 820 Industrial Drive, Suite 3 Sparta, WI 54656-4215 (608) 269-8136	Necedah National Wildlife Refuge W7996 20th Street West Necedah, WI 54646-7531 (608) 565-2551
Oconto	Zoning Administrator Oconto Co. Courthouse 301 Washington St. Oconto, WI 54153-1621 (920) 834-6827	DNR 101 N. Ogden Rd. P.O. Box 208 Peshtigo, WI 54157 (715) 582-5041	USACOE Suite 211, Old Fort Square 211 North Broadway Green Bay, WI 54303 (920) 448-2824	District Conservationist Oconto Service Center 111 Arbutus Ave., P.O. Box 15 Oconto, WI 54153-1626 (920) 834-5688	Ecological Services Office 2661 Scott Tower Dr. New Franken, WI 54229 (920) 866-1717
Oneida	Zoning Administrator Oneida Co. Courthouse 1 Courthouse Square Rhinelander, WI 54501-0400 (715) 369-6130	DNR 107 Sutliff Ave. Rhinelander, WI 54501 (715) 365-8991	USACOE 1314 Contractor's Blvd. Plover, WI 54467 (715) 345-7911 ext. 2	District Conservationist Rhinelander Service Center 639 West Kemp Street Rhinelander, WI 54501-3879 (715) 362-5941	Fisheries Assistance Office 2800 Lake Shore Drive East Ashland, WI 54806 (715) 682-6185
Outagamie	Zoning Administrator 410 South Walnut Street Appleton, WI 54911 (920) 832-5255	DNR 801 E. Walnut Avenue Green Bay, WI 54301 (920) 448-5166	USACOE Suite 211, Old Fort Square 211 North Broadway Green Bay, WI 54303 (920) 448-2824	District Conservationist Appleton Service Center 3369 West Brewster St. Appleton, WI 54914-1602 (920) 733-1575	Ecological Services Office 2661 Scott Tower Drive New Franken, WI 54229 (920) 866-1717

County	County Zoning	DNR	Corps of Engineers	NRCS	USFWS
Ozaukee-N of. Cedar Sauk Rd	Zoning Administrator Ozaukee Co. Admin. Center 121 W. Main, P.O. Box 994 Port Washington, WI 53074 (262) 284-8313	DNR 5750 Woodchuck Lane P. O. Box 408 Plymouth, WI 53073-0408 (920) 892-8756 ext. 3031	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-4171	District Conservationist Administration Building 121 W. Main, P.O. Box 994 Port Washington, WI 53074 (262) 284-8273	Leopold Wetland Mgt. Office W10040 Cascade Mountain Rd. Portage, WI 53901 (608) 742-7100 ext. 14 or 15
Ozaukee-S of . Cedar Sauk Rd	Zoning Administrator Ozaukee Co. Admin. Center 121 W. Main, P.O. Box 994 Port Washington, WI 53074 (262) 284-8313	DNR 2300 N. M. L. King Jr. Dr. Milwaukee, WI 53212 (414) 263-8601	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-4171	District Conservationist Administration Building 121 W. Main, P.O. Box 994 Port Washington, WI 53074 (262) 284-8273	Leopold Wetland Mgt. Office W10040 Cascade Mountain Rd. Portage, WI 53901 (608) 742-7100 ext. 14 or 15
Pepin	Zoning Administrator Pepin Co. Courthouse 740 7th Ave. W., P.O. Box 39 Durand, WI 54736 (715) 672-8897	DNR 1300 W. Clairemont Ave. P.O. Box 4001 Eau Claire, WI 54702-4001 (715) 839-3769	USACOE - St. Paul District Attention: CO-R 190 Fifth Street East St. Paul, MN 55101-1638 (651) 290-5263	District Conservationist Pepin Co. Govt. Center 740 7th Ave. W., P.O. Box 39 Durand, WI 54736-1628 (715) 672-8663	St. Croix Wetland Mgt. District 1764 95th St. New Richmond, WI 54017 (715) 246-7784
Pierce	Zoning Administrator 414 W. Main St., P.O. Box 647 Ellsworth, WI 54011 (715) 273-6747/6746	DNR 990 Hillcrest Street, Suite 104 Baldwin, WI 54002-9263 (715) 684-2914	USACOE - St. Paul District Attention: CO-R 190 Fifth Street East St. Paul, MN 55101-1638 (651) 290-5263	District Conservationist Ellsworth Service Center 412 W. Kinne St., P.O. Box 67 Ellsworth, WI 54011-0067 (715) 273-6763	St. Croix Wetland Mgt. District 1764 95th St. New Richmond, WI 54017 (715) 246-7784
Polk	Zoning Administrator 100 Polk County Plaza Suite 130 Balsam Lake, WI 54810 (715) 485-9248/9279	DNR 1341 2nd Ave P.O. Box 397 Cumberland, WI 54829 (715) 822-5421 ext. 108	USACOE - St. Paul District Attention: CO-R 190 Fifth Street East St. Paul, MN 55101-1638 (651) 290-5357	District Conservationist Balsam Lake Service Center 941 Mallard Lane, Rm.103 Balsam Lake, WI 54810 (715) 485-3138	St. Croix Wetland Mgt. District 1764 95th St. New Richmond, WI 54017 (715) 246-7784
Portage-Northern	Zoning Administrator County-City Building 1462 Strongs Ave. Stevens Point, WI 54481 (715) 346-1334	DNR 5301 Rib Mountain Dr. Wausau, WI 54401-7599 (715) 241-7502	USACOE 1314 Contractor's Blvd. Plover, WI 54467 (715) 345-7911 ext. 3	District Conservationist Stevens Point Service Center 1462 Strongs Ave. Stevens Point, WI 54481 (715) 346-1325	Ecological Services Office 2661 Scott Tower Dr. New Franken, WI 54229 (920) 866-1717
Portage	Zoning Administrator County-City Building 1462 Strongs Ave. Stevens Point, WI 54481 (715) 346-1334	DNR 473 Griffith Ave. Wisconsin Rapids, WI 54494 (715) 421-7815	USACOE 1314 Contractor's Blvd. Plover, WI 54467 (715) 345-7911 ext. 3	District Conservationist Stevens Point Service Center 1462 Strongs Ave. Stevens Point, WI 54481 (715) 346-1325	Ecological Services Office 2661 Scott Tower Dr. New Franken, WI 54229 (920) 866-1717

County	County Zoning	DNR	Corps of Engineers	NRCS	USFWS
Price	Zoning Administrator Normal Building, Rm. 205 104 S. Eyder Ave. Philips, WI 54555-1342 (715) 339-3272	DNR 875 S. 4th Ave. P.O. Box 220 Park Falls, WI 54552 (715) 762-4684 ext. 102	USACOE - St. Paul District Attention: CO-R 190 Fifth Street East St. Paul, MN 55101-1638 (651) 290-5357	District Conservationist USDA Service Center 920 Donald St., Rm. 102 Medford, WI 54451-2096 (715) 748-4121	Fisheries Assistance Office 2800 Lake Shore Drive East Ashland, WI 54806 (715) 682-6185
Racine	Zoning Administrator 14200 Washington Ave. Sturtevant, WI 53177 (262) 886-8475	DNR 9531 Rayne Rd., Suite 4 Sturtevant, WI 53177 (262) 884-2356	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-0868	District Conservationist Union Grove Service Center 826 Main St. Union Grove, WI 53182 (262) 878-1243	Wisconsin Private Lands Office 4511 Helgesen Dr. Madison, WI 53718-6747 (608) 221-1206 ext. 14
Richland	Zoning Administrator 181 W. Seminary St., Rm. 204 Richland Center, WI 53581 (608) 647-2447	DNR 1500 Johns St. Dodgeville, WI 53533-2116 (608) 935-1926	USACOE Attention: CO-R 1114 South Oak St. La Crescent, MN 55947-1338 (507) 895-8059	District Conservationist Richland Center Service Center 1850 Bohman Drive, Suite F Richland Center, WI 53581 (608) 647-8874	Wisconsin Private Lands Office 4511 Helgesen Dr. Madison, WI 53718-6747 (608) 221-1206 ext. 14
Rock	Zoning Administrator Rock Co. Courthouse 51 South Main St. Janesville, WI 53545 (608) 757-5587	DNR 2514 Morse St. Janesville, WI 53545-0249 (608) 743-4820	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-1876	District Conservationist Janesville Service Center 440 North Highway 14 Janesville, WI 53546-9708 (608) 754-6617	Wisconsin Private Lands Office 4511 Helgesen Dr. Madison, WI 53718-6747 (608) 221-1206 ext. 14
Rusk	Zoning Administrator Rusk Co. Courthouse 311 Miner Ave. East Ste. N110 Ladysmith, WI 54848 (715) 532-2156	DNR N4103 State Highway 27 Ladysmith, WI 54848 (715) 532-4367	USACOE - St. Paul District Attention: CO-R 190 Fifth Street East St. Paul, MN 55101-1638 (651) 290-5357	District Conservationist USDA Service Center 1120 W. Lake Ave., P.O. Box 222 Ladysmith, WI 54848 (715) 532-7629	Necedah National Wildlife Refuge W7996 20th Street West Necedah, WI 54646-7531 (608) 565-2551
St. Croix	Zoning Administrator St. Croix Co. Govt. Center 1101 Carmichael Rd. Hudson, WI 54016-7710 (715) 386-4680	DNR 990 Hillcrest St., Suite 104 Baldwin, WI 54002-9263 (715) 684-2914	USACOE - St. Paul District Attention: CO-R 190 Fifth Street East St. Paul, MN 55101-1638 (651) 290-5263	District Conservationist Baldwin Service Center 1960 8th Ave., Suite 141 Baldwin, WI 54002-5159 (715) 684-2874	St. Croix Wetland Mgt. District 1764 95th St. New Richmond, WI 54017 (715) 246-7784
Sauk-E of Hwys 22-23	Zoning Administrator Sauk Co. West Square Bldg. 505 Broadway Baraboo, WI 53913 (608) 355-3285	DNR 3911 Fish Hatchery Rd. Fitchburg, WI 53711 (608) 275-3228	USACOE Attention: CO-R 1114 South Oak St. La Crescent, MN 55947-1338 (507) 895-8059	District Conservationist Baraboo Service Center 505 Broadway, Suite 232 Baraboo, WI 53913-2183 (608) 355-4420	Wisconsin Private Lands Office 4511 Helgesen Dr. Madison, WI 53718-6747 (608) 221-1206 ext. 14

County	County Zoning	DNR	Corps of Engineers	NRCS	USFWS
Sauk-W of Hwys 22-23	Zoning Administrator Sauk Co. West Square Bldg. 505 Broadway Baraboo, WI 53913 (608) 355-3285	DNR 1500 Johns St. Dodgeville, WI 53533-2116 (608) 935-1926	USACOE, Attention: CO-R 1114 South Oak St. La Crescent, MN 55947-1338 (507) 895-8059	District Conservationist Baraboo Service Center 505 Broadway, Suite 232 Baraboo, WI 53913-2183 (608) 355-4420	Wisconsin Private Lands Office 4511 Helgesen Dr. Madison, WI 53718-6747 (608) 221-1206 ext. 14
Sawyer	Zoning Administrator 10610 Main St. Hayward, WI 54843-0668 (715) 634-8288	DNR 10220 N. State Hwy. 27 S Hayward, WI 54843 (715) 634-9658	USACOE 1568 Highway 2, Rm. 107/112 Two Harbors, MN 55616 (218) 834-6630	District Conservationist USDA Service Center 1120 W. Lake Ave., P.O. Box 222 Ladysmith, WI 54848 (715) 532-7629	Fisheries Assistance Center 2800 Lake Shore Drive East Ashland, WI 54806 (715) 682-6185
Shawano	Zoning Administrator Shawano Co. Courthouse 311 N. Main St. Shawano, WI 54166 (715) 526-6766	DNR 647 Lakeland Rd. Shawano, WI 54166-3843 (715) 526-4232	USACOE Suite 211, Old Fort Square 211 North Broadway Green Bay, WI 54303 (920) 448-2824	District Conservationist USDA Service Center 603C Lakeland Rd. Shawano, WI 54166-3843 (715) 524-8520	Ecological Services Office 2661 Scott Tower Dr. New Franken, WI 54229 (920) 866-1717
Sheboygan	Zoning Administrator Sheboygan Co. Courthouse 508 New York Ave. Sheboygan, WI 53081 (920) 459-3060	DNR 5750 Woodchuck Lane P. O. Box 408 Plymouth, WI 53073-0408 (920) 892-8756 ext. 3031	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-4171	District Conservationist USDA Service Center 650 Forest Ave. Sheboygan Falls, WI 53085 (920) 467-9917	Leopold Wetland Mgt. Office W10040 Cascade Mountain Rd. Portage, WI 53901 (608) 742-7100 ext. 14 or 15
Taylor	Zoning Administrator 224 South Second St. Medford, WI 54451 (715) 748-1485	DNR N4103 State Highway 27 Ladysmith, WI 54848 (715) 532-4367	USACOE - St. Paul District Attention: CO-R 190 Fifth Street East St. Paul, MN 55101-1638 (651) 290-5263	District Conservationist USDA Service Center 925 Donald Street, Rm. 102 Medford, WI 54451-2099 (715) 748-4121	Necedah National Wildlife Refuge W7996 20th Street West Necedah, WI 54646-7531 (608) 565-2551
Trempealeau	Zoning Administrator Trempealeau Co. Courthouse 1720 Main St., P.O. Box 67 Whitehall, WI 54773 (715) 538-2311 ext. 222/223	DNR 910 Highway 54 East Black River Falls, WI 54615 (715) 284-1424	USACOE Attention: CO-R 1114 South Oak St. La Crescent, MN 55947-1338 (507) 895-8059	District Conservationist USDA Service Center 19225 Dewey St., P.O. Box 645 Whitehall, WI 54773-7604 (715) 538-4396	Trempealeau National Wildlife Refuge W28488 Refuge Rd. Trempealeau, WI 54661 (608) 539-2311
Vernon	Zoning Administrator P.O. Box 306 Viroqua, WI 54665 (608) 637-5271	DNR 3550 Mormon Coulee Rd. Rm. 104 La Crosse, WI 54601 (608) 785-9010	USACOE Attention: CO-R 1114 South Oak St. La Crescent, MN 55947-1338 (507) 895-8059	District Conservationist Agricultural Service Center 220 Airport Rd. Viroqua, WI 54665-1157 (608) 637-8321	Upper Mississippi River Refuge La Crosse District 555 Lester Ave. Onalaska, WI 54650 (608) 783-8405

County	County Zoning	DNR	Corps of Engineers	NRCS	USFWS
Vilas	Zoning Administrator Vilas Co. Courthouse 330 Court St. Eagle River, WI 54521 (715) 479-3620	DNR 8770 Highway J Woodruff, WI 54568 (715) 358-9214	USACOE 1314 Contractor's Blvd. Plover, WI 54467 (715) 345-7911 ext. 2	District Conservationist Rhinelander Service Center 639 West Kemp St. Rhinelander, WI 54501-3879 (715) 362-5941	Fisheries Assistance Office 2800 Lake Shore Drive East Ashland, WI 54806 (715) 682-6185
Walworth	Zoning Administrator Courthouse Annex W3929 County NN Elkhorn, WI 53121-4362 (262) 741-3394	DNR Waukesha Service Center 141 NW Barstow St., Rm. 180 Waukesha, WI 53188 (262) 574-2136	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-1876	District Conservationist USDA Service Center 225 O'Connor Dr. Elkhorn, WI 53121-4269 (262) 723-3216	Wisconsin Private Lands Office 4511 Helgesen Dr. Madison, WI 53718-6747 (608) 221-1206 ext. 14
Washburn	Zoning Administrator Washburn Co. Courthouse 110 W. 4th Ave., P.O. Box 506 Shell Lake, WI 54871-0506 (715) 468-4690	DNR 10220 N. State Hwy. 27 S Hayward, WI 54843 (715) 634-9658	USACOE 1568 Highway 2, Rm. 107/112 Two Harbors, MN 55616 (218) 834-6630	District Conservationist USDA Service Center 206 Vine St. Spooner, WI 54801-1456 (715) 635-8228	St. Croix Wetland Mgt. District 1764 95th St. New Richmond, WI 54017 (715) 246-7784
Washington	Zoning Administrator Public Agency Center 333 E. Washington St., Suite 2300 West Bend, WI 53095-2585 (262) 335-4445	DNR 2300 N. M. L. King Jr. Dr. P.O. Box 12436 Milwaukee, WI 53212 (414) 263-8498	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-4171	District Conservationist West Bend Service Center 333 E. Washington St., Suite 3200 West Bend, WI 53095-2003 (262) 335-4801	Leopold Wetland Mgt. Office W10040 Cascade Mountain Rd. Portage, WI 53901 (608) 742-7100 ext. 14 or 15
Waukesha N of Hwy. 18	Zoning Administrator 1320 Pewaukee Rd. Waukesha, WI 53188-3868 (262) 548-7790	DNR Waukesha Service Center 141 NW Barstow St., Rm. 180 Waukesha, WI 53188 (262) 574-2137	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-0868	District Conservationist Waukesha Service Center 1320 Pewaukee Rd. Waukesha, WI 53188-3878 (262) 547-3754	Wisconsin Private Lands Office 4511 Helgesen Dr. Madison, WI 53718-6747 (608) 221-1206 ext. 14
Waukesha S of Hwy. 18	Zoning Administrator 1320 Pewaukee Rd. Waukesha, WI 53188-3868 (262) 548-7790	DNR Waukesha Service Center 141 NW Barstow St., Rm. 180 Waukesha, WI 53188 (262) 574-2136	USACOE First Federal Savings Bank Bld. 1617 E. Racine Ave., Rm. 101 Waukesha, WI 53186 (262) 547-0868	District Conservationist Waukesha Service Center 1320 Pewaukee Rd. Waukesha, WI 53188-3878 (262) 547-3754	Wisconsin Private Lands Office 4511 Helgesen Dr. Madison, WI 53718-6747 (608) 221-1206 ext. 14
Waupaca	Zoning Administrator Waupaca Co. Courthouse 811 Harding St. Waupaca, WI 54981 (715) 258-6255	DNR 647 Lakeland Rd. Shawano, WI 54166-3843 (715) 526-4232	USACOE 1314 Contractor's Blvd. Plover, WI 54467 (715) 345-7911 ext. 4	District Conservationist Waupaca Service Center 1337C Royalton St. Waupaca, WI 54981-1608 (715) 258-8380	Ecological Services Office 2661 Scott Tower Dr. New Franken, WI 54229 (920) 866-1717

County	County Zoning	DNR	Corps of Engineers	NRCS	USFWS
Waushara	Zoning Administrator Waushara Co. Courthouse 209 South St. Wautoma, WI 54982-0149 (920) 787-0453	DNR 427 E. Tower Dr., Suite 100 Wautoma, WI 54982-6927 (920) 787-4686 ext. 3016	USACOE 1314 Contractor's Blvd. Plover, WI 54467 (715) 345-7911 ext. 4	District Conservationist USDA Service Center 201 S. 16th Ct., P.O. Box 649 Wautoma, WI 54982-0649 (920) 787-2116	Leopold Wetland Mgt. Office W10040 Cascade Mountain Rd. Portage, WI 53901 (608) 742-7100 ext. 14 or 15
Winnebago	Zoning Administrator 448 Algoma Blvd., P.O. Box 2808 Oshkosh, WI 54903-2808 (920) 236-4840/4841	DNR 625 E. County Road Y Suite 700 Oshkosh, WI 54901-9731 (920) 424-7885	USACOE Suite 211, Old Fort Square 211 North Broadway Green Bay, WI 54303 (920) 448-2824	District Conservationist Oshkosh Service Center 625 E. County Rd. Y, Ste. 403 Oshkosh, WI 54901-9731 (920) 424-0329	Leopold Wetland Mgt. Office W10040 Cascade Mountain Rd. Portage, WI 53901 (608) 742-7100 ext. 14 or 15
Wood	Zoning Administrator Wood Co. Courthouse 400 Market St., P.O. Box 8095 Wisconsin Rapids, WI 54495 (715) 421-8466	DNR 473 Griffith Ave. Wisconsin Rapids, WI 54494 (715) 421-7815	USACOE 1314 Contractor's Blvd. Plover, WI 54467 (715) 345-7911 ext. 3	District Conservationist USDA Service Center 360 First Street North Wisconsin Rapids, WI 54494 (715) 423-3610	Necedah National Wildlife Refuge W7996 20th Street West Necedah, WI 54646-7531 (608) 565-2551

NOTES

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U. of Florida, Center for Aquatic Plants (Gainesville)

About the Authors

Alice Thompson is a wetland ecologist and owner of Thompson and Associates Wetland Services based in South Milwaukee. She holds a masters degree from the University of Wisconsin-Milwaukee, where she conducted research on reed canary grass. Alice is a Professional Wetland Scientist certified by the Society of Wetland Scientists. She serves as a board member (currently the Board Chair) for the Wisconsin Wetlands Association. Alice is active in wetland delineation, restoration, mitigation, and invasive species control, and consults on wetland-related issues and projects throughout the state. She also teaches field ecology and wetland restoration workshops for the Wisconsin Wetlands Association and the Morton Arboretum in Lisle, Illinois. Alice dedicates this book to the memory of her father, Daniel Q. Thompson, who taught her to love wetlands and the wild.

> *"The part about restoration that haunts me the most are the buried seeds waiting patiently in the soil for us. I think these buried seed banks are a treasure for our generation that will be lost if we do not respond quickly. Unlike the birds or mammals, they are motionless, trapped, invisible, soundless, out of mind, waiting for us to do the right thing."*

Charlie Luthin is a conservation biologist who has worked on wetland conservation programs and issues for more than 20 years. He has been affiliated with several state, national, and international nonprofit conservation organizations and has worked extensively in Asia, Mexico, Central America, and North America. Charlie has designed and undertaken programs in wildlife research, endangered species management, protected areas planning, restoration ecology, conservation education, and citizen activism. He has coordinated or co-coordinated five international conferences on wetlands and wildlife conservation and has helped found two local grassroots organizations. Charlie served as the first executive director of the Aldo Leopold Foundation in 1995 (Baraboo, Wisconsin) and was the executive director of the Wisconsin Wetlands Association from 1998 to 2003. He serves currently as executive director of the Natural Resources Foundation of Wisconsin, a statewide organization that raises funds to support conservation of rare plants, animals, and ecosystems. Charlie holds a bachelors degree in biology from the University of Wisconsin-Stevens Point and a masters degree in zoology from the University of Wisconsin-Madison.

About Wisconsin Wetlands Association

Wisconsin Wetlands Association (WWA) is a statewide, nonprofit, science-based educational and advocacy organization dedicated to the protection, restoration, and enjoyment of Wisconsin's wetlands. WWA focuses attention on key wetland/aquatic issues that face the state. The organization trains citizens in wetland protection, and has developed a "Wetland Watch Network" comprised of a growing number of citizen activists throughout Wisconsin. Each year WWA hosts a statewide Wetland Scientists Forum.

Members are invited to participate in field trips and programs and receive a quarterly newsletter. Activists can receive periodic email updates and alerts about current wetland issues, legislation, and projects.

For more information contact:

Wisconsin Wetlands Association
222 South Hamilton St., Suite #1
Madison, WI 53703
(608) 250-9971
wetlands@wiscwetlands.org
www.wiscwetlands.org

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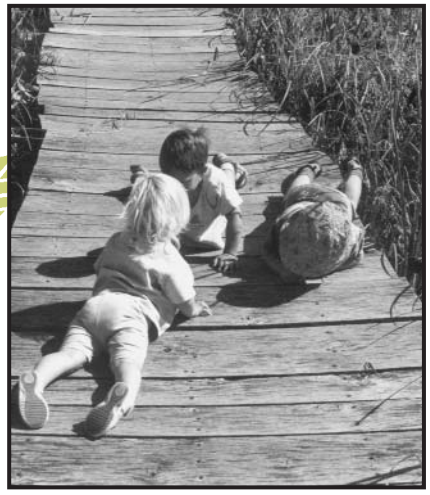

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