

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.

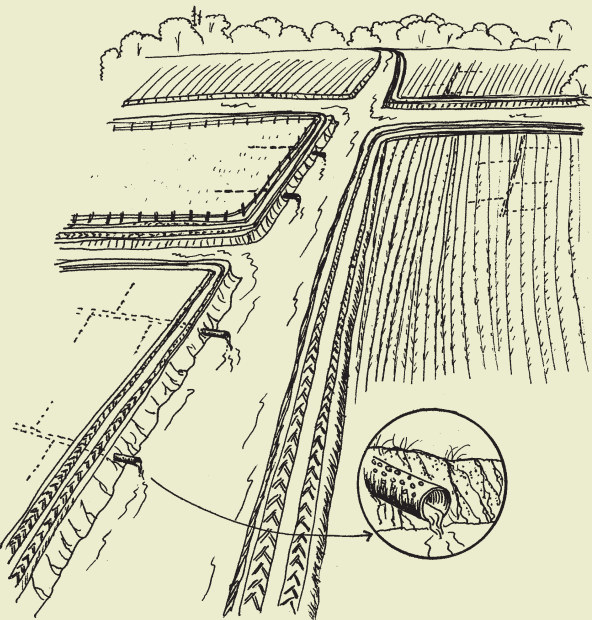


1890
An undisturbed wetland in the 19th Century.

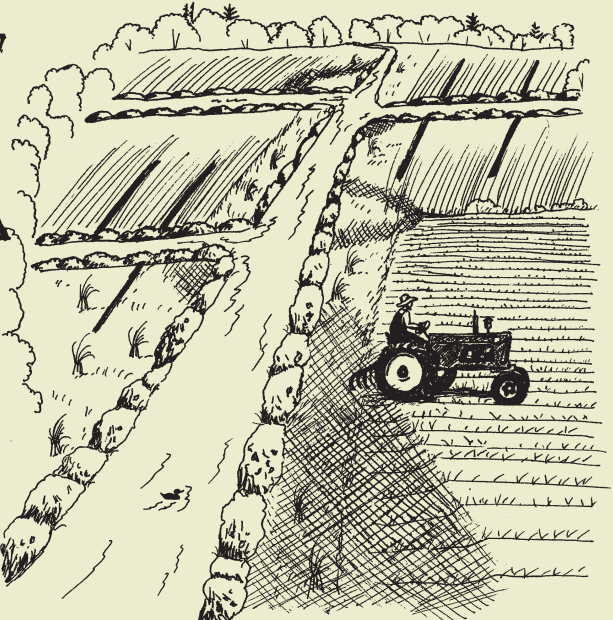


1920
Ditching wetlands began in the early part of the 20th Century.

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

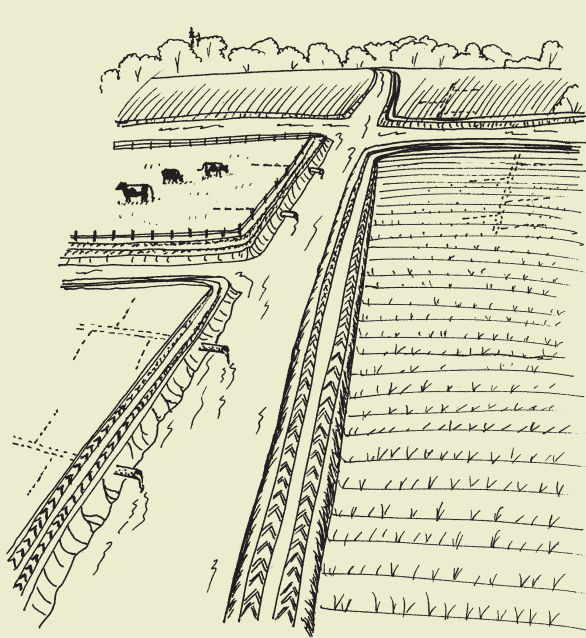


1960
From the 1940s to the 1970s, extensive wetland ditching, drainage (using tiles), and stream channelization for expanded agricultural activities destroyed many of Wisconsin's wetlands.



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.

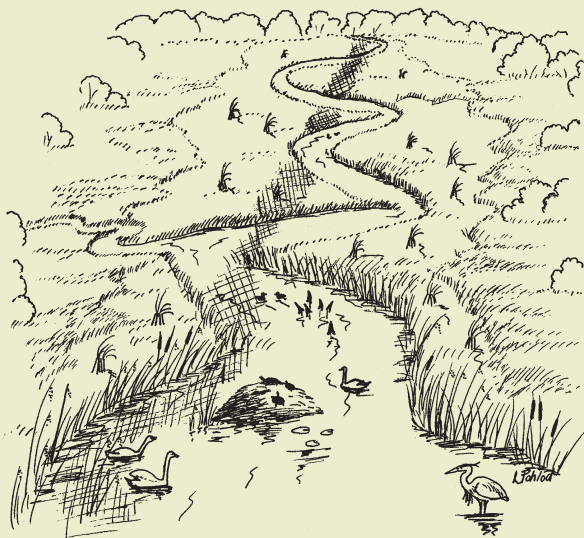


DRAINED, DITCHED, AND CHANNELIZED WETLAND, FORMERLY FARMED, TO BE RESTORED.

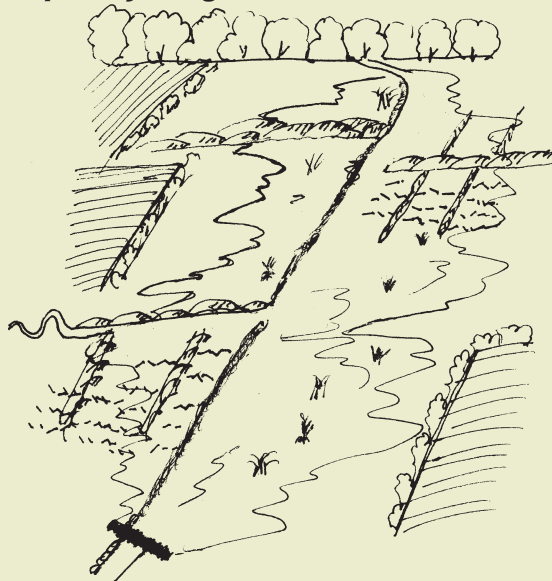


GOAL: MINIMAL RESTORATION.
This, the simplest restoration, entails ditch plugs only.

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

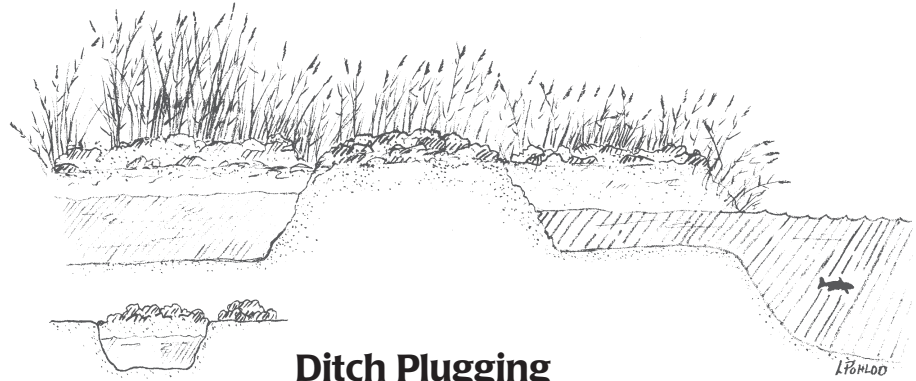


Wetland restorationists have assembled a “bag of tools” over the years and your plan will likely use one or a combination of these tools. Which combination you use will depend on your site, your resources, and your goals.

Side-view of a simple ditch plug.

Cross-section of a simple ditch plug.

Below, ditch plugs.

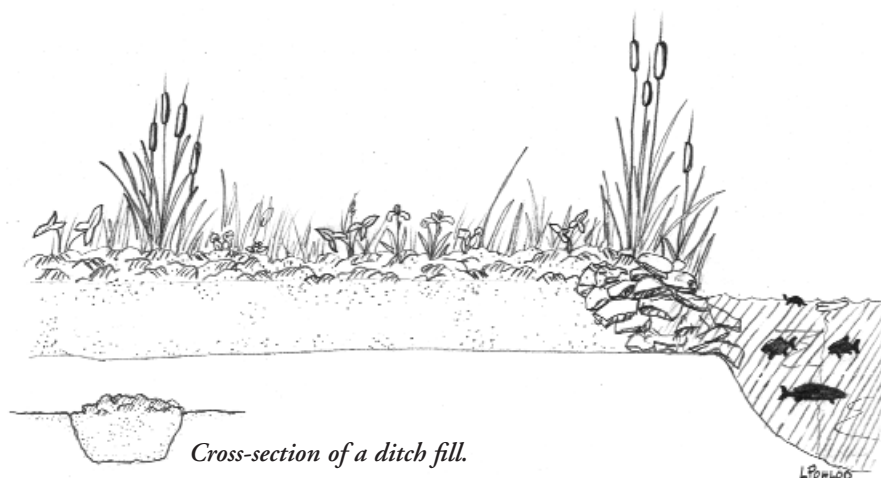


Ditch Plugging

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.



Photos: Art Kitchen



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.

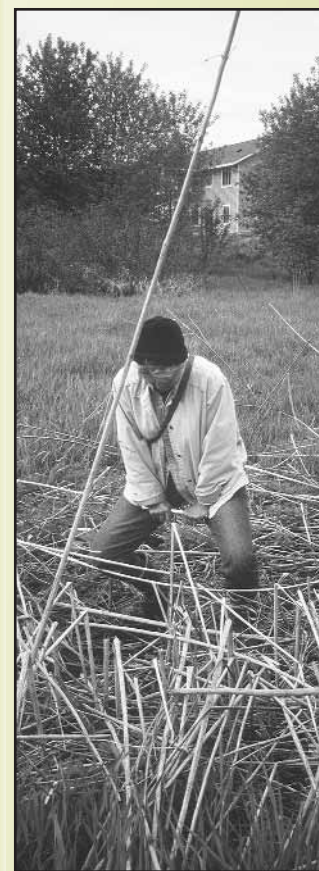
Depending on the size and depth, a ditch may have a negative hydrological impact on the wetland due to its water storage capacity. Ditches may drain water from the adjoining wetland and store the water in a deep, narrow, artificially concentrated basin, effectively lowering the water level in portions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



Alice Thompson

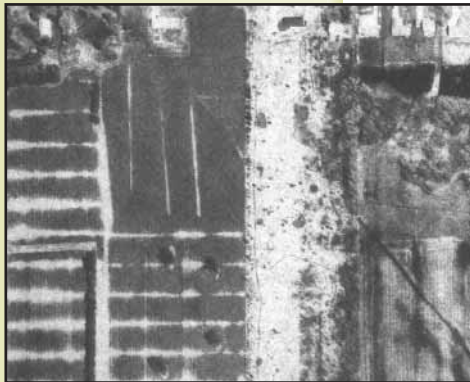
Drain tile.

Disabling 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

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



Alice Thompson

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



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



Alice Thompson

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



Alice Thompson

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.

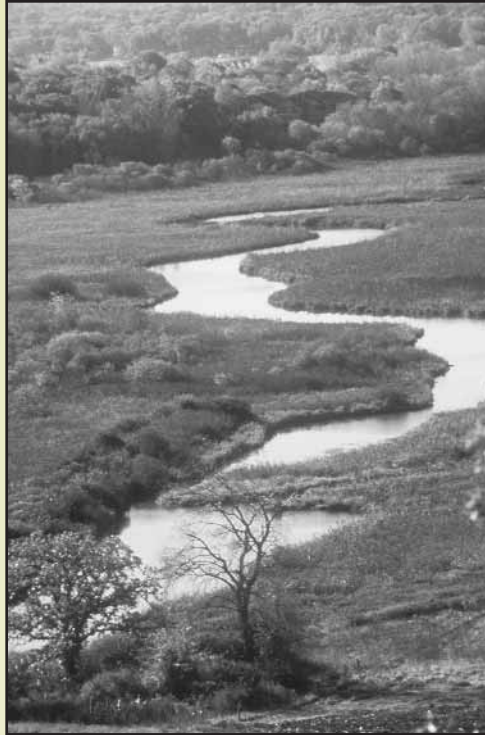
Once the lines are located, remove them and fill the trench. Clay tiles can be crushed and reburied. Most tile lines drain to a ditch so if you fill, re-grade the ditch, and remove or destroy the line, you will double your chances of successfully restoring the original hydrology.

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.



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: Jeff Nania



Left, undisturbed stream meandering through a wetland complex.

Right, creek dredged, straightened, and concrete lined.



Photos: Left, Wisconsin Wetlands Association Right, Alice Thompson

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

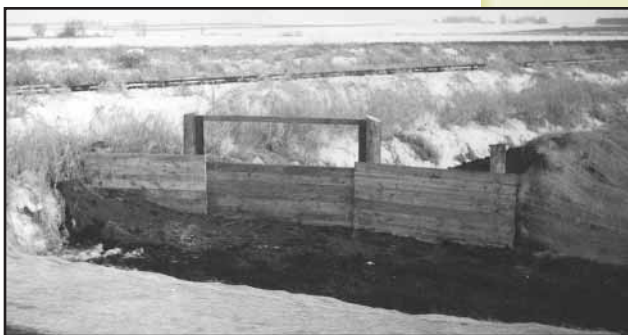
Berms, dams, dikes, and levees are all earthen embankments constructed to contain water. These will be referred to here collectively as berms. These structures must be properly designed to prevent failure due to over-topping, seepage, sloughing, or collapse. Berms often are used to increase water levels 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 Nemia



DNR Archive

A stop-log water control structure in a ditch.

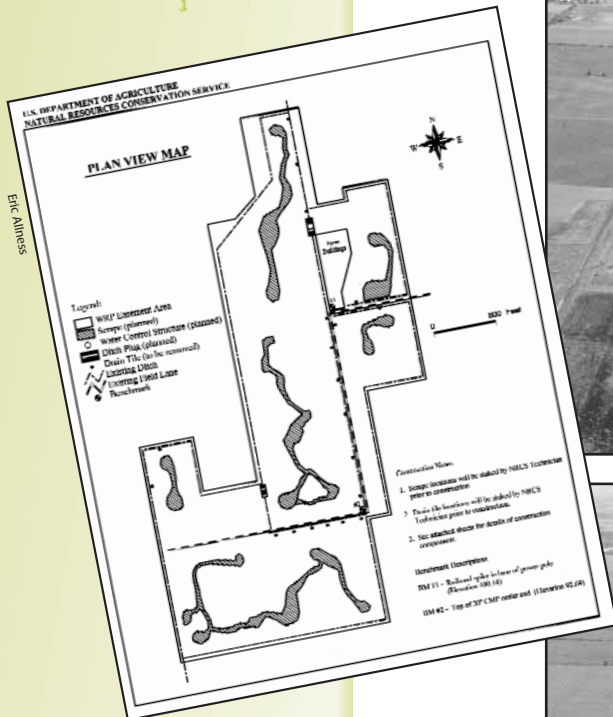
Scrapes

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.



*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.*

Eric Allness

Kevin Halverson, USDA-NRCS



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

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



Tim Ehlinger



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.

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.

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! 