Wisconsin Department of Natural Resources Wetland Assessment Tools

The Wisconsin Department of Natural Resources (WDNR) has developed six tools for assessing potential sites for wetland restoration and protection: 1) a potentially restorable wetlands (PRW) layer identifying areas where wetland restoration is feasible based on existing hydric soils, existing wetlands, and land use data, 2) a water quality index tool that assesses the relative amount of sediment that restored wetlands could capture in each catchment, 3) a habitat quality index that identifies areas where restoration or protection would benefit 13 "umbrella" species based on expert input on the affinity of each species for different land cover types, 4) a flood abatement tool (not yet complete) that evaluates the capacity of wetland restoration or protection to improve flood retention in each subwatershed or catchment, 5) a tool for assessing the relative need for restoration, and 6) a tool for assessing potential opportunities for restoration. According to the WDNR representative, the tools are especially transferable to local entities, which may be able to apply higher resolution data to further extend the tools' usefulness.

OVERVIEW

Lead developer(s): Joanne Kline, Thomas Bernthal, Marsha Burzynski, Kate Barrett and Chris Smith, Wisconsin Department of Natural Resources (WDNR); Gary Casper, (Associate Scientist, University of Wisconsin-Milwaukee).[1,3]

Year developed: 2007.[2]

Geographic area: Milwaukee, Rock River, and Mead Lake river basins, Wisconsin (Fig. 1).[3,4]

Resource types: Wetlands.

Restoration/conservation: Restoration (reestablishment and rehabilitation), enhancement, preservation/protection, and acquisition without preservation/protection.[2]

Stakeholders: Mitigation providers and land trusts.[2]

Figure 1. WDNR has applied its tools to assessments of the Rock River Basin, Milwaukee River Basin, and Mead Lake watersheds. Used with permission of Wisconsin Department of Natural Resources (WDNR). Potentially Restorable Wetlands (PRW v.2.1) have now been mapped for the entire state.

Current status: At the county level, the Ozaukee Land Trust is using the tool to inform selection of preservation sites. In addition, as part of its Emergency Watershed Repair Plan, NRCS combined PRW data with floodplain data to determine which wetland restoration sites would best attenuate flood waters.[2]

PRIORITIZATION ANALYSIS

Landscape prioritization tool(s):

Potentially restorable wetlands (PRWs) tool: This tool identifies restoration opportunities across the landscape and is composed of the combined boundaries of hydric soils, existing wetlands, and land use datasets. PRW version 2.2 is now available for the entire state. WDNR classified areas as potentially restorable if they: 1) contained hydric soils, 2) do not overlap the location of existing wetlands, and 3) are not developed.[1]

Prioritization objectives assessed:

- Feasibility of Restoration

Table 1. Potentially restorable wetlands were determined based on the following factors and data sources.[1]

Factor used in analysis	Data source(s)
Hydric soils	SSURGO soils data (percent hydric field)
Is not within an existing wetland	Digital WWI wetland mapping data;
Land use reflecting opportunity (e.g., agriculture) or lack of opportunity (e.g., urban) for successful wetland restoration	Current statewide update (PRW v.2.2) used 2007 NLCD, and 2011 NASS for cropland data.

NASS = USDA National Agricultural Statistics Service; DWWI = Digital Wisconsin Wetland Inventory; SSURGO = Soil Survey Geographic (database); NLCD = National Land Cover Dataset

Habitat Quality Index (HQI or "Wildlife Tool"): Using expert input, WDNR identified 13 wetland habitat types (e.g., wetlands near woodlands) along with one or two associated umbrella species (e.g., wood frog) for each. In doing so, WDNR could comprehensively evaluate habitat value by analyzing a relatively small number of wildlife species, each of which accounts for the habitat requirements of several species, for each wetland type. For example, wood frog habitat is also critical for blue spotted salamanders, tiger salamanders, American toads, spring peepers, and several other species. An expert group then scored 15 land use types in terms of their importance for each habitat type/umbrella species. In addition, "proximity factors" were used in a GIS analysis to identify locations of potential habitat for each species, which can then be combined with the PRW layer to produce a layer of potentially restorable habitat for each species. By assigning each grid cell for each species a score of '1' (i.e., each grid cell that provides potential habitat for a species is assigned a score of '1') all species layers can be summed to obtain a final HQI.[1]

Prioritization objectives assessed:

- Habitat quality

Table 2. WDNR calculated the HQI using the factors and data sources listed below.[1]

Factor used in analysis	Data source(s)
"Open water wetlands" (black tern, pied-billed grebe)	SEWRPC land cover data augmented by WISCLAND land cover and US Census
"Shallow marsh areas" (American bittern or Sora) with >50% reed canary grass land cover included if within 10m of shallow marshes frequently used by or required habitat of American bittern/Sora	

"Watery wetlands near grassland" (blue-winged teal) that are frequently used by or required habitat of blue-winged teal, larger than 0.5 acres, within 10m of grassland AND associated grassland within 10m of and extending 100m from a watery wetland frequently used by or required habitat of blue-winged teal	TIGER/Line road data; WDNR DWWI wetland mapping data; Other sources of wetland mapping data (e.g., county-level sources, if available)
Wet meadow (sedge wren) with shallow marsh land cover included only if within 10m of other wet meadow frequently used by or required habitat sedge wren AND mesic grassland adjacent to other wet meadow frequently used by or required habitat of sedge wren.	
Wet shrub (Alder, willow flycatcher) including wetland meadow land cover only if within 10m of wetland shrub type	
Wet forest, coniferous or mixed (very, black-and-white warbler) – uplands within 100m of wetlands	
Wet forest, deciduous (American redstart, blue-gray gnatcatcher) – uplands within 100m of wetlands	
Deep marsh and shallow marsh (muskrat)	
Wet meadow/grassland (meadow vole)	
Wet forests (masked shrew)	
Open wetlands near grassland (chorus frog) frequently used by or required habitat of chorus frogs that are larger than 0.5 acres, and within 10m of grassland AND grassland larger than 0.5 acres that extends 300m from open wetlands frequently used by or required of chorus frogs	
Wetlands near woodlands (wood frog) frequently used by or required habitat of wood frogs that are larger than 0.5 acres, and within 10m of upland forest AND upland forest larger than 0.5 acres that extends up to 300m from wetlands frequently used by or required of wood frogs	
Wetland/upland complex (Blanding's turtle): wetlands frequently used by or required habitat of Blanding's turtle that are larger than 0.5 acres, and within 15m of uplands frequently used by or required of wood frogs AND uplands frequently used by or required habitat of Blanding's Turtles that extends from frequently used wetlands within a travel distance of 300m	

Wetland water quality assessment tool: This tool assigns a relative score to each catchment (HUC-14) based on the degree to which its wetlands protect downstream water quality by trapping sediment. The relative amount of sediment trapped by wetlands in each catchment is determined by using a sediment loading grid and P-8 model and the inputs listed in Table 3 to calculate the relative sediment loading in each catchment multiplied by the relative wetland trapping efficiency. Using this tool, planners can estimate the relative increase in sediment trapping that can be gained in a catchment through wetland restoration (Fig. 6).[5]

Prioritization objectives assessed:

- Water quality improvement

Table 3. WDNR calculated relative sediment trapped by wetlands using the factors and data listed below.[1]

Factor used in analysis	Data source(s)
DEMs	SEWRPC + county data
Hydrography	WDNR 24K Hydrolayer
Land use layer	SEWRPC
SCS runoff curve numbers	210-VI-TR-55, Second Ed. (1986); NRCS, WDNR, and SEWRPC (2004)
Unit area pollutant loads	Bannerman et al. (1894)
Wetland area	Digital WWI + SEWRPC land use inventory
Catchment area	8-12 digit HUs ; 14 –digit catchments created for project
Long-term continuous rainfall/snowfall data for the region of interest	Regional dataset compiled by regional partners

SEWRPC = Southeastern Wisconsin Regional Planning Commission; WWI = Wisconsin Wetland Inventory

Flood storage decision support tool: WDNR is currently developing a method for determining which individual subwatersheds (HUC-12s) and catchments (HUC-14s) would benefit most from wetland restoration and protection. The method accomplishes this by quantifying several parameters indicative of the capacity of wetland restoration or protection to improve flood abatement for each subwatershed or catchment (Table 3). These would then be combined to obtain final scores for potential flood abatement benefits for wetland restoration within each subwatershed or catchment.[1]

Prioritization objectives assessed:

- Flood mitigation

Table 4. WDNR's method for prioritizing subwatersheds or catchments for potential flood abatement benefits scores subwatersheds or catchments using the parameters listed below.[1]

Factor used in analysis	Data source(s)
Percent area of remaining wetlands	N/A
Percent of wetlands in headwaters areas	N/A
Percent of wetlands in isolated depressional areas	N/A
Percent of wetlands in floodplain areas	N/A
Percent impervious land cover	N/A
Number of wetland acres lost	N/A
Percent loss of PRWs	N/A

Relative need tool: This tool measures the extent to which wetland restoration has the potential to improve wetland functions (e.g., flood storage, water quality, and habitat) within a subwatershed. The tool applies the equation in Figure 2 (with factors and data sources listed in Table 5) to score HUC-12 watersheds. Watersheds that have lost large amounts of wetland acreage but have few restored or remaining acres and have a large amount of original wetland acreage relative to the total size of the HUC-12 are ranked highest. The tool does not evaluate specific functions, but rather assumes that wetland restoration will produce general functional improvement.[3]

$$\frac{\text{(LOST ACRES - RESTORED ACRES)}}{\text{REMAINING ACRES}} \times \frac{\text{ORIGINAL ACRES}}{\text{SUBWATERSHED ACRES}} \times 100$$

Figure 2. WDNR calculates relative need for wetland restoration in each HUC-12 using the above equation. Used with permission of Wisconsin Department of Natural Resources (WDNR).

Prioritization objectives assessed:

- Historic functional change

Table 5. WDNR assesses relative need for each HUC-12 using the factors and data listed below.[3]

Factors used in analysis	Data source(s)
Lost wetland acres	PRWs
Restored wetland acres through federal, state, and non-profit partnerships.	WRTD
Remaining wetland acres	WWI; WRTD
Original (pre-settlement) wetland acres	WWI
Total wetland acres.	N/A

WRTD = Wetland Restoration Tracking Database

<u>Potential opportunity tool:</u> This tool evaluates the opportunity for wetland functional improvement through restoration across HUC-12 watersheds as indicated by the relative amount of PRWs and the original percentage of wetlands in the watershed. WDNR assesses potential opportunity using the equation in Figure 3.[3]

$$\frac{\text{POTENTIALLY RESTORABLE ACRES}}{\text{REMAINING ACRES}} \times \frac{\text{ORIGINAL ACRES}}{\text{SUBWATERSHED ACRES}} \times 100$$

Figure 3. WDNR calculates the potential opportunity for wetland restoration in each HUC-12 using the above equation. Used with permission of Wisconsin Department of Natural Resources (WDNR). Used with permission of Wisconsin Department of Natural Resources (WDNR).

Prioritization objectives assessed:

- Feasibility of restoration

Table 6. WDNR assesses relative need for each HUC-12 using the factors and data listed below.[3]

Factors used in analysis	Data source(s)
Potentially Restorable Wetland (PRW v.2.1) acres	SSURGO soils data; WWI wetland mapping data; other wetland mapping data (e.g. county-level data); SEWRPC data; WISCLAND data; NASS cropland data.
Remaining wetland acres	WWI
Original (pre-settlement) wetland acres	WWI; PRW
Total wetland acres	N/A

SEWRPC = Southeastern Wisconsin Regional Planning Commission; WISCLAND = Wisconsin Initiative for Statewide Cooperation on Landscape Analysis and Data; NASS = USDA National Agricultural Statistics Service; DWWI = Digital Wisconsin Wetland Inventory.

Input data QA/QC: In developing the PRW v.2.1 layer, WDNR instituted a hierarchical subtraction method starting with hydric soils, subtracting out existing wetlands and then subtracting out areas in urban land use. WDNR also cleaned up slivers and gaps in the final PRW dataset created as a result of overlaying and intersecting base layer feature polygons and eliminated all PRWs less than 0.5 acres in size.[6]

Validation of the landscape prioritization tool(s): For the Milwaukee River Basin assessment, WDNR used random stratified sampling to test for errors of commission and omission in the PRW layer for three watersheds. WDNR staff visited randomly selected points within PRWs and within non-PRWs to assess the accuracy of the PRW layer at each point. WDNR found the accuracy of the tool to be "very acceptable," exceeding 80% in the three watersheds. In addition, WDNR validated this PRW layer by conducting an extensive survey of PRW polygons in five high priority subwatersheds, testing for errors of omission. WDNR recruited county field staff from local conservation agencies with expertise in wetland restoration to adjust boundaries of PRW polygons as necessary and provide an evaluation of the technical feasibility of restoration within each PRW area. These county staff evaluated all possible sites, accessing private property when possible with the permission of landowners.[7]

Results showed that error varied widely among subwatersheds, but the most frequent error was PRW polygons that were actually still wetlands. Reasons for error included land use change, reversion of drained hydric soil back to wetlands, and errors of omission in the version of the Wisconsin Wetland Inventory available to the project. The Wisconsin Wetland Inventory has since been updated twice, based on 2005 aerial photography and 2010 aerial photography for the 7 counties in the SEWRPC planning area.[7]

The Habitat Quality Index tool's output for 3 of the umbrella species in the original Milwaukee River Basin assessment was tested against known occurrences of these species. Results were considered acceptable for 2 of the 3 species.[1] A project is currently underway in the Duck-Pensaukee Watershed to test the validity of the tool output produced for the watershed by the Nature Conservancy in a demonstration of the "watershed approach" for wetland compensatory mitigation.[4]

Prioritization products: WDNR makes prioritization outputs available for download from its website as PDF maps contained in reports (Figs. 4, 5, 6). See: http://dnr.wi.gov/wetlands/reports.html.

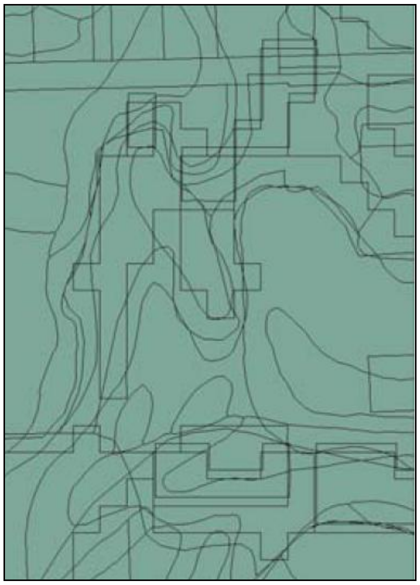

Figure 4. The Potentially Restorable Wetlands layer combines features from hydric soils, mapped wetland, land use, and subwatershed data. The records in this layer can be used to examine the potential for wetland restoration for different areas throughout the landscape.[1] Used with permission of Wisconsin Department of Natural Resources (WDNR).

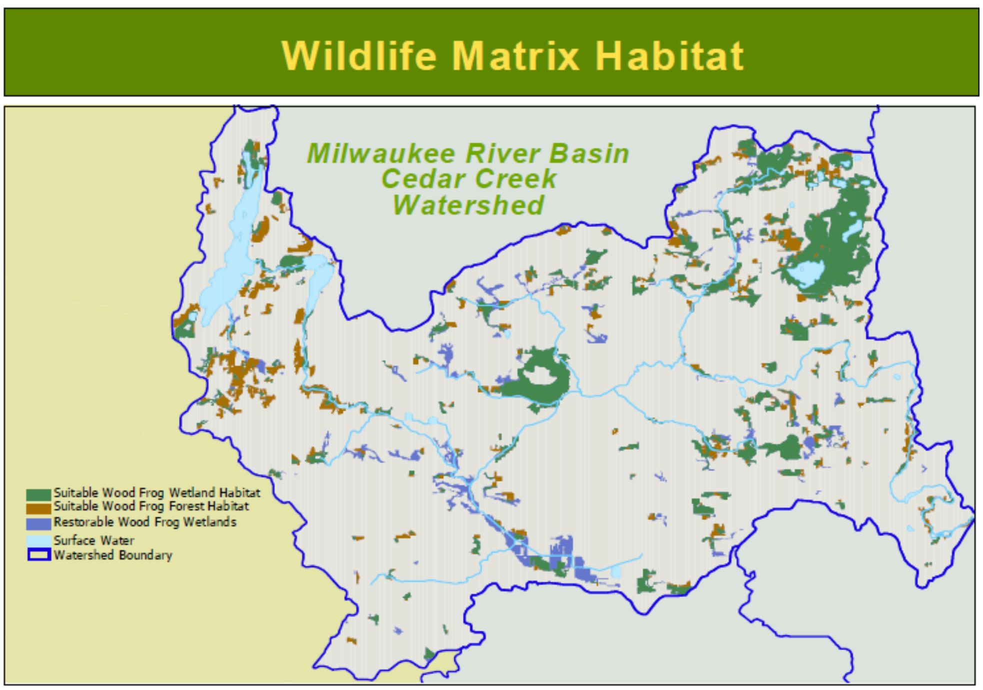

Figure 5. Suitable habitat for wood frogs including wetlands (green) and associated uplands (brown). Only wetlands identified as PRWs, and thus suitable for restoration, are identified here.[1] Used with permission of Wisconsin Department of Natural Resources (WDNR).

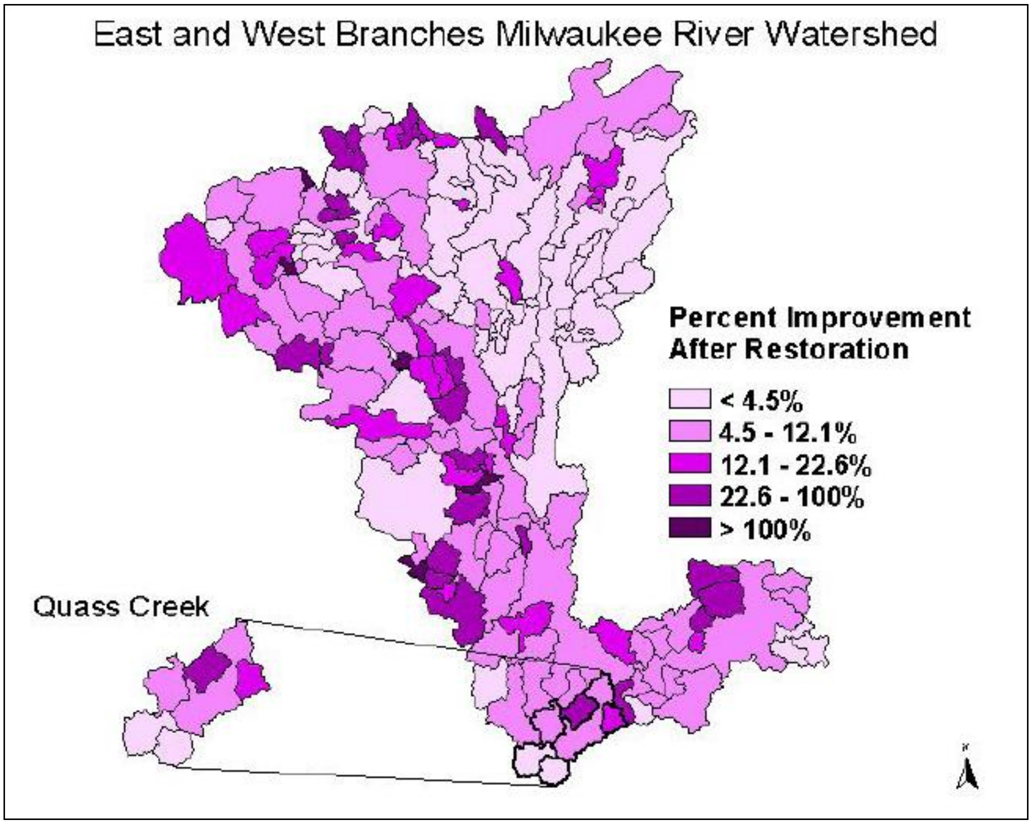

Figure 6. WDNR's water quality tool can be used to determine the percentage improvement in sedimentation trapping following restoration. Used with permission of Wisconsin Department of Natural Resources (WDNR).

IMPLEMENTATION

Regulatory/non-regulatory programs:

- Section 404 compensatory wetland mitigation: Mitigation bankers have used the PRW tool to select areas in which to establish mitigation banks (e.g., areas of high wetland loss at the county level).[2]
- Ozaukee Land Trust uses to tools to inform its selection of preservation sites.[2]
- NRCS Emergency Watershed Repair Plan: NRCS combined PRW data with floodplain data to determine which wetland restoration sites would best attenuate flood waters.[2]

Transferability:

- The tools are easy to conceptualize and use. Combining datasets (e.g., for the PRW layer) can be done by anyone with GIS expertise.[2]
- The tools are especially transferable to local entities (e.g., county-level) because data collected at the local scale are very usefully applied by the tools – adoption of the tools by local communities, in particular, could extend the usefulness of the tools. Where local data are higher resolution than data used by WDNR, local results could be superior to those obtained by WDNR. Transfer of the tools to local communities in other states could also be worthwhile.[2]

Data gaps:

- A lack of accurate forested wetland and agricultural wetland coverage in the DWWI where data are older. However, WDNR expects wetland data to improve as it currently has two full-time staff working on updating the DWWI county by county.[2]
- County floodplain data are not up to date. As part of the WDNR's Map Modernization Project, counties are updating their floodplain data, but many still have not done so. As the Modernization Project proceeds, WDNR expects flood data to continue becoming available.[2]
- A lack of presence data for wildlife species occurrence for the habitat tool, though WDNR is actively coordinating volunteers to obtain these data. WDNR would also like to have absence data, which would be more difficult to obtain.[2]

Barriers:

- Staff time.[2]
- Funding.[2]
- Property rights issues.[2]
- Landowner cooperation varies throughout the state, with landowners in urban areas generally more interested in wetland restoration and preservation than agricultural landowners, who tend to view conversion back to wetlands as an unproductive use of the land.[2]

Future goals:

- Complete development of the flood tool and apply it to more areas throughout the state.[2]
- Most importantly, apply the tools to more on-the-ground projects by building stronger relationships with users of the tools.[2]
- To achieve these goals, WDNR will need:
  - A wetland restoration fund to support outreach efforts aimed at providing information about the tools to different entities. Better advertising of the tools is necessary to build stronger links to users.[2]
  - Staff dedicated to the long-term development of the tools. Progress WDNR has made so far has been supported by grants providing funding over short intervals.[2]
  - Continued public support, which dictates the continued availability of funding. The ongoing development of the tools depends on programs such as the Farm Bill Wetlands Programs and the Great Lakes Restoration Initiative.[2]

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[1] Kline J, Bernthal T, Burzynski M, Barrett K. 2006. Milwaukee River Basin Wetland Assessment Project: Developing Decision Support Tools for Effective Planning.
[2] Interview on 8/18/2011 and 9/6/2011 with Thomas Bernthal, Wisconsin Department of Natural Resources.
[3] Hatch B, Bernthal T. 2008. Mapping Potentially Restorable Wetland in the Rock River Basin.
[4] In addition, the Habitat Quality Index, described in this fact sheet, served as the basis for the "Wildlife Tool" used in Duck – Pensaukee Watershed as part of a watershed approach pilot project completed in 2012 by The Nature Conservancy and the Environmental Law Institute. Documentation for the Wildlife Tool is available at: http://conserveonline.org/library/the-duck-pensaukee-watershed-approach-mapping/@@view.html
[5] Kline et al. (2006), pp. 46-59.
[6] Kline et al. (2006), pp. 73-99.

[7] Bernthal T, Kline J, Burzynski M, Barrett K. 2007. Milwaukee River Basin Wetland Assessment Project: Phase Two: Groundtruthing the Potentially Restorable Wetlands Layer.