

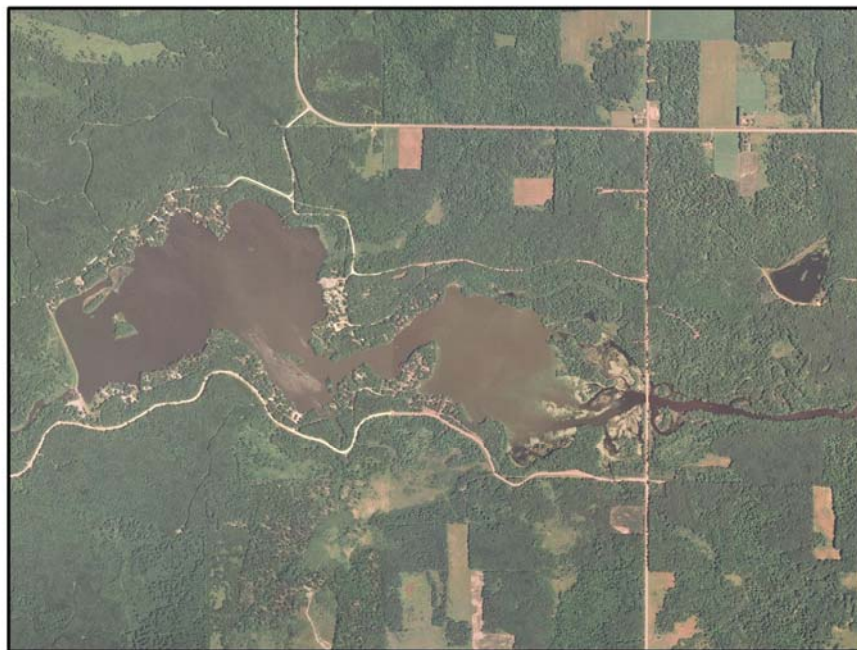
MEAD LAKE WATERSHED WETLAND ASSESSMENT PROJECT

DEVELOPING WETLAND LANDSCAPE METRICS
FOR EFFECTIVE PLANNING
AND
ADAPTING THE MILWAUKEE RIVER BASIN APPROACH
FOR A SMALL AGRICULTURAL WATERSHED

Final Report to the U.S. Environmental Protection Agency,
Region V

Wetland Grant # CD 96511801

March 2007



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Author:

Karen Voss

Contributors:

Kate Barrett

Tom Bernthal

Marsha Burzynski

Ted Johnson

Joanne Kline

Ken Schreiber

Tom Simmons

Pat Oldenburg

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Contact for Further Information

Thomas W. Bernthal
Bureau of Watershed Management
Wisconsin Department of Natural Resources
101 S. Webster Street
P.O. Box 7921
Madison, WI 53707-7921
Phone: (608) 266-3033
Email: thomas.bernthal@dnr.state.wi.us

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Executive Summary

Background: It is often said that Wisconsin has lost nearly 50 percent of its original 10 million acres of wetlands. Because state wetland data lags far behind that of other surface water resources, there is no single authoritative source of information on where wetland loss has occurred, or the functional impact of wetland loss. Landscape scale wetland assessment processes, along with a variety of GIS-based resource information provide opportunities to better understand wetland functions, and to develop realistic protection and restoration goals and management plans on a watershed or basin scale.

The Mead Lake Wetlands Assessment Project follows a similar project in the Milwaukee River Basin (MRB), and provides a means of adapting and testing the wetlands assessment methods developed in southeastern Wisconsin for broader use in another region of the state.

Mead Lake Watershed: The Mead Lake Watershed encompasses 103 square miles within the Lower Chippewa Basin, in Clark County WI (Figure 1). About half the land is in agricultural row crops and forage and the remaining land uses include forest, grassland and wetland. Agriculture predominates in the northern portion of the watershed, while forested land is most prevalent in the southern portion of the watershed.

Mead Lake is a 320-acre impoundment on the South Fork Eau Claire River, and is on the WDNR 303d impaired waters list (WDNR 2006). Pollutants of concern are phosphorus and sediments from nonpoint sources. The state is developing a Total Maximum Daily Load (TMDL) Plan that identifies the amount of a pollutant the lake can tolerate and still achieve acceptable water quality standards. As a part of the TMDL development, modeling scenarios that include restoration of wetlands in each subwatershed will allow evaluation of the potential role of wetland restoration in meeting water quality goals for Mead Lake.

The Project: The core of the Mead Lake Wetlands Assessment Project involved utilizing landscape scale GIS-based data layers to identify existing, original, lost and potentially restorable wetland areas. Base and custom data layers included soils, land uses, mapped wetlands, hydrography, drainage ditches and watershed and subwatershed boundaries. Data processes that were developed for the MRB Project were customized for the Mead Lake Project. Potentially restorable wetland (PRW) areas were identified where hydric soils are present, land uses are compatible, and there is not currently an existing wetland.

PRWs were mapped and overlaid on digital air photos. PRW field inspections were completed on 20 PRWs that were accessible from roadways. Initial verification revealed that linear wetlands along streams or ditches, particularly road ditches, have low restoration potential due to locally steep topography and lack of side ditches that might be plugged. For this subset of PRWs, the PRW identification protocol seemed to correctly identify the presence of PRWs but they were generally smaller than mapped, often due to the deeply incised nature of the road ditches. Restoration is largely incompatible with the road drainage system.

Wetland Loss Analysis: Analysis of the GIS data indicates that the Mead Lake watershed was originally about 23 to 27 percent wetlands, predominantly along streams and intermittent waterways. Original wetlands predominated in the headwaters area (48 percent) and in the lower four subwatersheds (30 to 34 percent). Overall, the Mead Lake watershed has lost about 20 to 26 percent of its original wetland acres. Wetland loss has been greatest in the lowest two subwatersheds (8 and 9), where 30 to 40 percent of the original wetland acres are estimated to have been lost.

Restoration Need: The relationships between the amount of lost and remaining wetlands and the proportion of the subwatershed that was originally wetland were used to assess relative

need for wetland restoration for each of the nine subwatersheds. Where need is identified as relatively high, restoration is most likely to improve ecosystem functions, including water quality and hydrologic stability.

Restoration Opportunity: In addition to need, opportunity is an important consideration in setting realistic wetland restoration goals. Restoration opportunity may be lost to incompatible land uses (urban or forestry), hydrologic changes that can't be readily reversed (road ditches), or lack of appropriate incentives to motivate landowner interest. Mennonite and Amish farmers make up 45 to 70 percent of the farming community in the watershed, and identifying conservation practices (including wetland restoration) that are compatible with their farming styles will be crucial to improving water quality in the Mead Lake Watershed.

Limitations:

- The MLPRW project is a 'first step' in wetland planning. Its products are intended for landscape level analysis. Where this analysis leads to specific sites, decisions to develop further plans at those sites will require on-the-ground assessment.
- MLPRW project products are intended to be used in conjunction with other planning tools to help meet wetland and water quality related goals of State and local governments, public and private conservation organizations and individual landowners.
- The MLPRW project data is not intended for regulatory use. Wetland boundaries are based on the best available data as of 2005. The least accurate data is at a scale of 1:24000, so site-specific projects will require a field evaluation to determine actual boundary locations.
- The MLPRW project assumes that all wetlands have value and deserve protection. Site-specific factors will cause actual wetlands and potential restoration sites to vary in the type and degree of functions they provide.
- Existing and restored wetlands are not a substitute for other best management practices used to control flooding and to maintain water quality and wildlife habitat.

Chapter I: Introduction

Developing Landscape Scale Wetlands Assessment Processes

In 2000, the Wisconsin Department of Natural Resources (WDNR) Wetland Team produced a document, *Reversing the Loss: A Strategy for Protecting & Restoring Wetlands in Wisconsin*. While the Department had many programs with wetland responsibilities and goals, until the Wetlands Team undertook this effort, there was no “big picture” strategy for wetlands. Unfortunately, state wetland data lags far behind that of other surface water resources. The Wisconsin Wetlands Inventory identifies existing wetlands, yet nearly 50% of Wisconsin’s wetlands have been lost since pre-settlement times. There is no single authoritative source of information on exactly where these wetlands have been lost, or the functions they served. This project uses the best available data to estimate the relative amount of original wetland and wetland loss among the subwatersheds of the Mead Lake Watershed.

Developing processes for watershed scale wetland assessment, along with a variety of landscape inventory information are essential to understanding wetland function and importance. Realistic wetland protection and restoration goals and management plans can then be developed on a watershed or basin scale. The “big picture” information that is produced can help agencies and governments focus their restoration and protection efforts where the most can be accomplished with available resources.

Beginning in 2001, the Milwaukee River Basin (MRB) Wetlands Assessment Project developed tools and methods to support a better understanding of the roles wetlands play in the southeastern Wisconsin landscape. As the MRB project got underway, we recognized that its value would be greatly enhanced if its methodology could be adapted for broad use throughout the state. While regional variations in ecology and resource data abound, the general watershed scale wetlands assessment process will consistently include (a) gathering initial data and other information, (b) data customization, (c) developing map layers of estimated original wetland extent, current wetland pattern and relationship to topography, land uses and other surface water, and (d) using the information for planning, restoration and protection efforts. The accomplishments of the Mead Lake project are closely tied to and built upon the MRB project efforts.

The Mead Lake Watershed was identified as a priority location for adapting and applying the MRB wetlands assessment methodology because of local interest, ongoing efforts to improve land use practices, the apparent presence of potentially restorable wetlands, and the “manageable” size of the watershed, for pilot project purposes.

The Mead Lake Watershed

This watershed is located in the upper half of the South Fork Eau Claire River Watershed (LC16) of the Lower Chippewa Basin, in Clark County WI (Figure 1).

The land that drains to Mead Lake encompasses 103 square miles, and is a mosaic of agricultural row crops, forage, forest, grassland and wetland. About half the land is used for agricultural row crops and forage and the remaining land uses include forest, grassland and wetland. Agriculture predominates in the northern portion of the watershed, while forested land is most prevalent in the southern portion of the watershed. About 18 percent of the watershed is identified as wetland. Dendritic wetlands along streams and intermittent waterways predominate in the Mead Lake drainage area.

Mead Lake is an impoundment on the South Fork Eau Claire River. A dam constructed in 1951 created the 320-acre lake, which has two county-owned day use parks and a campground, and is heavily used for recreation. This eutrophic lake has water quality problems including excessive nutrient and sediment loading and excessively high pH values, as well as a fish consumption advisory for mercury.

The Farming Community

The Mead Lake watershed contains roughly 80 farms. The watershed includes a strong and growing Mennonite farming community. Mennonite farmers typically have dairy operations of 50 to 100 cattle. Farming practices can vary by Mennonite sect, however many utilize iron-wheeled tractors, which are difficult to use on snow-covered ground. As a result manure storage is common in the watershed, although not universal. Cash-grain makes up about a third of the farmland in the watershed (Freihoefer 2006). Successfully promoting wetland protection and restoration, as well as other farming practices to improve water quality, will require an understanding and sensitivity to practices and incentives that are accepted by Mennonite farmers.

Watershed Monitoring and Modeling

Clark County has a strong interest in identifying and remedying the land uses in the watershed that contribute to the impaired water quality in Mead Lake, and has worked to build public awareness of the lake water quality and land use concerns, through meetings with town boards and the Mead Lake Association, and with individual interviews of landowners.

In 2001 the Clark County Land Conservation Committee received a Lakes Protection Grant from the DNR to conduct water quality monitoring and lake and watershed modeling activities.

A two year study in 2002-2003 of Mead Lake's water quality was conducted by the Army Corps of Engineers (ACOE) (James 2005). The study focused on external loading (suspended sediments and nutrients from the South Fork Eau Claire River), internal phosphorus fluxes from aquatic sediment and in-lake water quality measurements. The study found that on average 83 percent of the phosphorus load came from tributaries of Mead Lake.

The next task was to construct a river basin computer model, the Soil and Water Assessment Tool (SWAT), to better understand the relationship between land use and sediment and nutrient flows from the watershed and individual stream reaches to Mead Lake.

The setup portion of the SWAT model was completed in August 2006 (Freihoefer 2006). During the winter and spring of 2007, the calibrated model will be used to predict water quality outcomes of various land use scenarios.

TMDL Development

Mead Lake is identified as a high priority on the WDNR 303d impaired waters list (WDNR 2006). Impaired waters are defined in Section 303d of the federal Clean Water Act as not meeting the state's water quality standards or use designations. Pollutants of concern for Mead Lake are phosphorus and sediments from nonpoint sources.

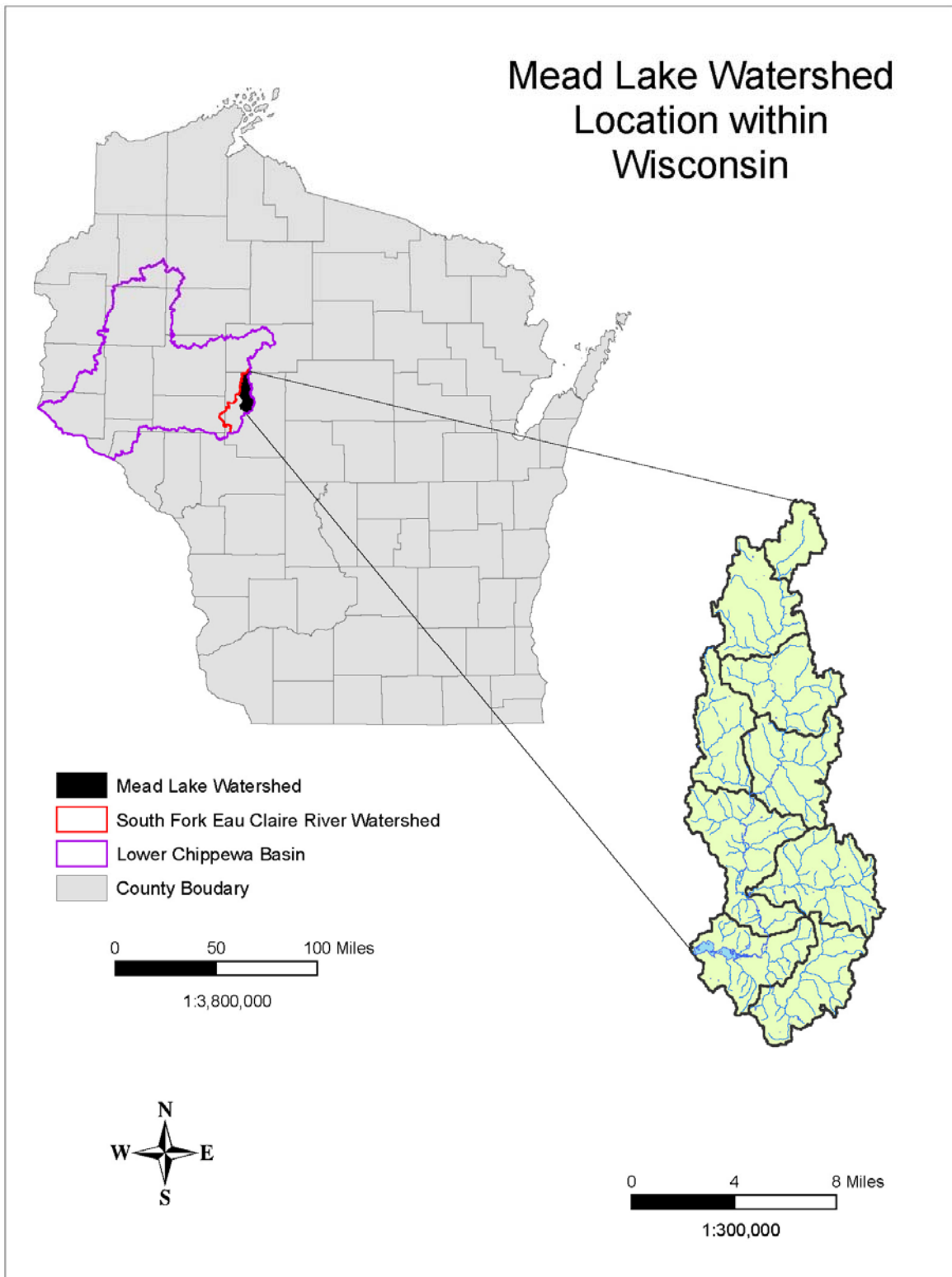
To address the water quality problems of Mead Lake, the state is developing a Total Maximum Daily Load (TMDL) Plan that identifies the amount of a pollutant the lake can tolerate and still meet water quality standards. The plan, including an implementation strategy, will be developed collaboratively by the WDNR, Clark County Land and Water Conservation Department (LWCD), the Mead Lake Rehabilitation District and a citizen advisory group.

How Wetlands Assessment Can Be Used in Watershed Planning

The availability of geographic information system (GIS) data on wetland location, size and vegetation, soils, land cover, and surface water opens the door to watershed scale wetland analysis. We can tease out where wetlands provide important functions, or where restoration could best meet an ecological need.

The wetlands metrics and methodology developed through this project can help with making wetland protection and restoration decisions. Priority areas for wetland restoration or protection can be identified, and the relative impacts of cumulative wetland loss or restoration in subwatershed areas can be predicted. Wetlands assessment data can be utilized in SWAT modeling scenarios to analyze the relative benefits to down-stream water resources of wetland restoration.

Figure 1. Mead Lake Watershed



Chapter II: The Big Picture - Potentially Restorable Wetlands (PRW)

In the last few decades, scientists have confirmed the critical role wetlands play in providing habitat to a wide diversity of valuable plants and animals, reducing flooding and protecting surface water quality. Wisconsin has lost over half of its wetlands in the last 200 years. Understanding the impacts of these losses is important in efforts to protect the remaining wetlands across the state. It is equally important to understand the role that restored wetlands may play in improving water quality or wildlife habitats. Knowing where the best opportunities are in the basin can be a powerful tool for local planners and resource managers who support restoration activities.

Identifying Potentially Restorable Wetlands

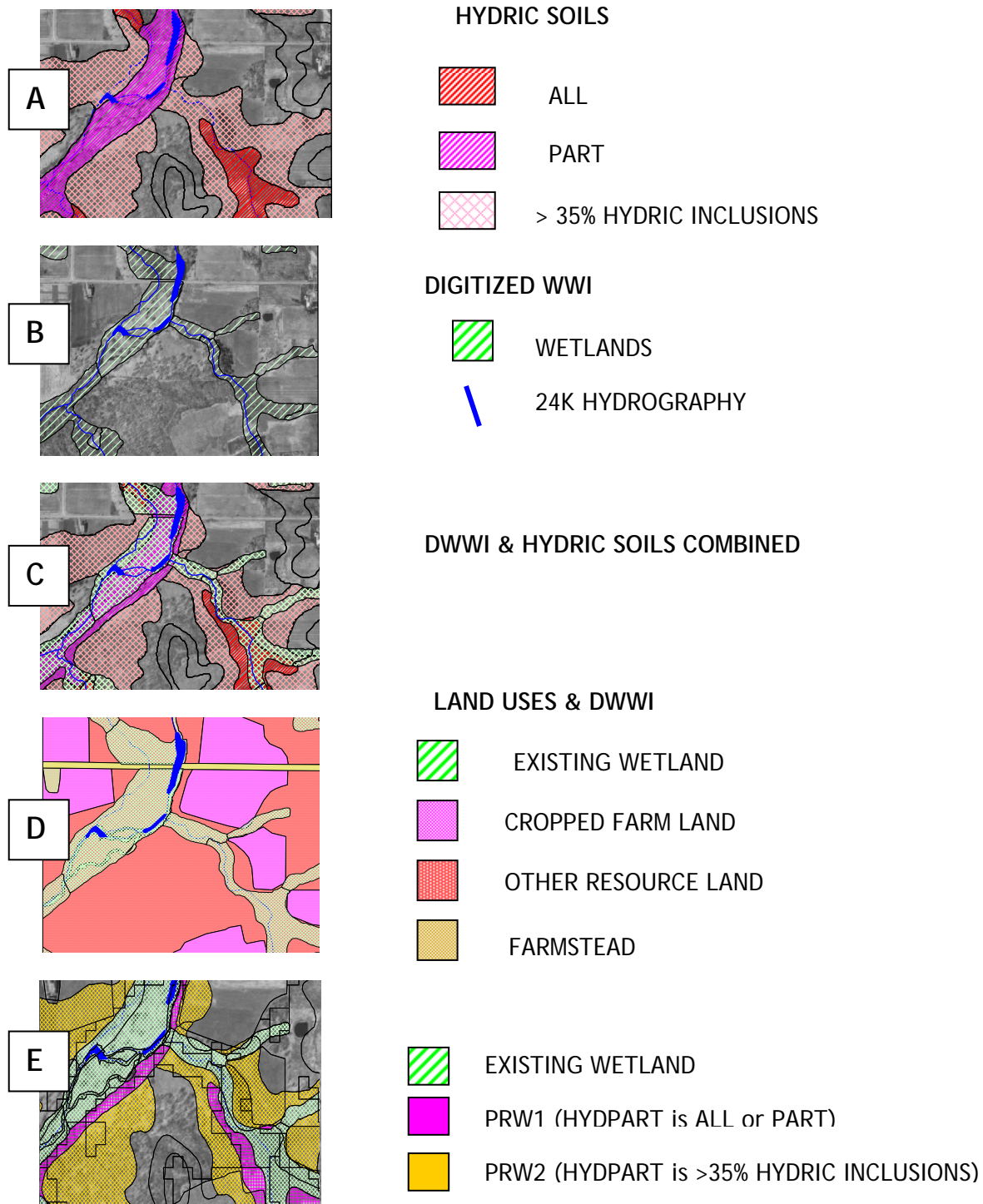
The Milwaukee River Basin (MRB) project began by evaluating the role of existing wetlands in improving water quality, flood control, or wildlife habitat, and then focused on identifying where restored wetlands would have the greatest ecological impact. The concept of a potentially restorable wetland (PRW) emerged, and is based on three criteria:

- there had to be favorable soil conditions to support a wetland (hydric soils);
- the site could not currently be mapped as a wetland (if so, it would be a candidate for an enhancement or rehabilitation project rather than a restoration);
- there had to be opportunities for restoring a site to a functioning wetland. Opportunity can be defined as both having a compatible land use and a willing land owner.

These key concepts were the core elements of the MRB project that were applied to the Mead Lake Wetlands Assessment Project. Figure 2 below illustrates in simplified fashion, how GIS data sets (discussed in Chapter III) were utilized to develop the potentially restorable wetland (PRW) layer. Appendix A - Subwatershed Maps of Wetlands and Potentially Restorable Wetlands contains the PRW maps for each of the nine subwatersheds. Within Figure 2:

- **A:** Hydric soils were sorted into groups including ALL hydric, PART hydric or with greater than 35% hydric INCLUSIONS.
- **B:** An updated Digital Wisconsin Wetland Inventory (DWWI) GIS layer was created for this project.
- **C:** The hydric soils and DWWI layers were superimposed, and the existing wetlands (DWWI) were “subtracted” from the hydric soils layer for a first approximation of PRWs.
- **D:** Land uses were digitized based on a combination of the WISCLAND land cover layer and Clark County’s Land Use data layer and overlaid on the initial PRW layer to exclude areas with land use very likely to be incompatible with restoration (urban, roads, forest, residential).
- **E:** Potentially Restorable Wetlands (PRWs) emerge as areas that have favorable soil conditions, compatible land uses, and are not existing wetlands. PRW1 soils are most likely potentially restorable. PRW2 soils were retained in the data layers to indicate where soils have greater than 35 percent wetland inclusions, and on a site-by-site basis, may have some restoration potential.

Figure 2. Using GIS Layers to Create the PRW Layer



The GIS data layers available for the Mead Lake Basin were similar to, but not always identical to those utilized for the MRB. The groundwork done by the MRB project in selecting

and using data layers facilitated the identification and use of GIS layers for Mead Lake. The data utilized for Mead Lake are discussed in more detail in the next chapter.

Limitations

The scope of this study is limited to a landscape level of analysis, which cannot replace on-site investigation for any individual restoration project. The data allow for relative comparisons between subwatersheds in relation to the needs and opportunities for wetland restoration. However, the feasibility of any individual wetland restoration requires much more detailed site analysis than this study provides. For instance, land owners must be willing, and the ability to complete a wetland restoration without adversely affecting neighbors' properties must be ascertained before a restoration can be feasible.

The ability to use GIS layers for predicting, on a landscape scale, where wetland restoration may be feasible is a powerful tool - but how reliable is it? We drew upon the knowledge of experts in making decisions about the suitability of various soils and land uses in the study area, but remember that the process of classifying soils and land uses is a "lumping" process. Other experts could reasonably make different choices about soil and land use suitability for wetland restoration.

Making the best use of these wetland assessment tools requires a thorough understanding of the source data layers, and how they were used in this Project.

Chapter III: DATA

DATA PROCESSING

Data Processing Environment

The major processing steps were performed in Environmental Systems Research Institute's (ESRI) workstation Arc/Info ver.8.3, which is the WDNR's standard GIS software. The processing steps included a series of overlay commands that combine the major themes (soils, wetlands and land use), building and restoring topology, and populating the attributes. This processing environment was chosen both for maintaining topological structure, better quality control routines, and for processing speed. ESRI's ArcMap ver 9.1 was used to generate summary tables and graphics. ArcView ver.3.2a was used for the initial stages of joining tables, generating new shapefiles, and generating summary tables and graphics.

Data Format

Data for the project were originally provided in both shapefile and coverage formats. The coverage is ArcInfo's primary method for storing point, line and area geographic features, while the shapefile uses a very simple data storage model for feature coordinates. Both have advantages and disadvantages. We chose ArcInfo coverages for creating base layers.

Most of the data used in the project were provided through the Clark County Land Information Office in both shapefile and coverage format. Shapefiles were converted to the coverage format to project the data from Clark County Coordinate System projection to WDNR's standard project, Wisconsin Transverse Mercator based on the North American Datum (NAD) 83/91.

DATA LAYERS

This section outlines the data sources and data processing steps we used to create the Potentially Restorable Wetland base layer and the custom layers used in the project. These layers in turn become the sources for creating the wetland landscape metrics used for assessment.

Input Layer: HYDRIC SOILS

For a site to have potential for wetland restoration it must have soils capable of supporting a wetland. We assumed that the presence of hydric soils where there currently wasn't a mapped wetland was evidence that there had once been a functioning wetland on that site. The definition of a hydric soil is a soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part (59 Fed.Reg.35680, 7/13/94).

We used the USDA Natural Resource Conservation Service (NRCS) Soil Survey Geographic database (SSURGO) soils data layer and associated soil properties tables. Field mapping methods using national standards are used to construct the SSURGO soil maps database, the most detailed level of soil mapping done by the NRCS. This level of mapping is designed for use by landowners, townships, and county natural resource planning and management. Digitization is on-going by NRCS; currently all counties in Wisconsin have digitized SSURGO soils maps. Information on the SSURGO soils maps can be found at:

<http://www.ncgc.nrcs.usda.gov/products/datasets/ssurgo/description.html>

The Clark County USDA Soil Survey maps, soil data, & descriptions were also utilized, and can be found at: <ftp://ftp-fc.sc.egov.usda.gov/WI/Soil/surveys/clark/clark.pdf>.

It is essential to have local knowledge of wetlands and hydric soils, to make decisions about how to classify soil types for likelihood of supporting wetland restoration. We consulted Ted Johnson, who is the Agronomist for WDNR in the West Central Region, and very knowledgeable about area wetland soils. He assisted in determining how soils were categorized for determining wetland restoration potential (see Appendix C - Clark County Soils and PRW Grouping).

Input Layer: MAPPED WETLANDS

An up-to-date digitized wetland layer is essential to the PRW identification process. By definition, a PRW site cannot currently be functioning as a wetland. The WDNR is charged with maintaining a statewide inventory of wetlands for the purpose of obtaining an accurate record of wetlands across the state. The geo-spatial version of the data is called the Digital Wisconsin Wetland Inventory (DWWI). At the start of this project, the DWWI data for Clark County was based on aerial photography from 1979. A comparison of the 1979 DWWI layer for Clark County with more recent (1994) paper WWI maps revealed that the old digitized layer was significantly out of date, and under represented existing wetlands.

The Department is in the process of creating new digital orthography base maps, and new digitized wetlands maps for the state. For this project, with EPA funding, the WDNR was able to digitize the 1994-update of WWI maps for Clark County and several townships in Taylor County and add these to the DWWI to cover the entire Mead Lake Basin. This new DWWI layer was utilized for this project.

Input Layer: LAND USE

Wetland restoration opportunity is based on the assumption that present land uses are favorable for restoring the site as a functioning wetland. Land uses that we defined as favorable for restoration included cropped fields, other farmed land (pasture, forage crops, fallow fields), tree farms, and barren land. Examples of land uses that were not considered favorable for wetland restoration include roadways, county forest, residential, commercial, existing wetlands, and any forest lands that are not tree farms.

Clark County Land Information Office provided a digital Land use layer based on 2001 aerial photography and represents the most up to date land use data available for the project area.

Custom Layer: SUBWATERSHEDS

A watershed is an area of land that drains to a lake, river or stream. Watersheds can be defined on scales ranging from very small to huge. As one moves upstream, each smaller tributary drains successively smaller areas.

In the case of Mead Lake, the Mead Lake "watershed" is the upper half of the South Fork Eau Claire River Watershed (LC16). LC16 is just one of 334 watersheds that are formally delineated in the State of Wisconsin. "LC" stands for the Lower Chippewa Basin, which contains 24 watersheds that ultimately drain to the Lower Chippewa River.

For this study, the Mead Lake watershed was subdivided into nine subwatersheds, which drain via smaller tributaries to the South Fork Eau Claire River above Mead Lake, or to Mead Lake itself.

The perimeter boundary of the Mead Lake watershed is defined by the boundary established for LC16. The interior boundaries separating the subwatersheds were established during the

process of setting up the Soil and Water Assessment Tool (SWAT) modeling tool, as described later in this report.

Custom Layer: Drainage Ditches

Ditches represent alterations to the hydrology that can have an enormous impact on surface waters and wetlands. Understanding where hydrology had been altered is a key piece of the puzzle for wetlands restoration.

A drainage ditch layer was created for the Mead Lake Basin. Ditches that were in the WDNR's 24K Hydrography layer were selected out and used to generate the start of the layer. Air photos of the basin were examined to identify apparent additional ditching. The resolution of the available air photos (1:24,000) led to some difficulty in distinguishing ditches from trails and fence lines. In general, most ditches were identified in the upper reaches of the watershed. Our ability to ground-truth the drainage ditch layer was limited by lack of permission to access private land.

Base layer: Potentially Restorable Wetlands (PRW)

The base layer represents the geometric intersection of hydric soils, mapped wetlands, land use, and subwatersheds. These geo-spatial layers form the foundation for identifying a potential restoration site and understanding the watershed and landscape functions of wetlands. Combined they give an estimate of present conditions in order to conduct a "first cut" identification of wetland restoration opportunity and feasibility. The subwatershed layer was added to facilitate generating metrics. The result is a rich yet dense layer that contains information from all input layers. This allows users to determine at any point on the ground conditions such as what soil type is present, if there is a mapped wetland, and/or what land use is practiced. The base layer for the Mead Lake Basin was developed following the processes that were developed for the Milwaukee River Basin.

One of the major advantages of the base layer is that the user has access to all the attributes from the input layers at his/her disposal. The disadvantage is that the user will need to thoroughly understand the sources and how the layer was generated to take full advantage of the information. We spent a fair amount of time reconciling differences when the attributes from the input layers conflicted with each other.

Appendix B - PRW and Water Quality Decision Documentation includes background information on how the PRW base layer was developed from land use, wetland and soils layers. Appendices B1 and B2 are the Data Dictionary and an explanation of the Data Dictionary Logic used to identify PRW areas. Appendix B3 is a matrix showing how the land use layers were utilized.

Table 1: Data Sets Used for the Mead Lake Basin Wetlands Assessment

BASE DATA LAYERS			
<i>Name</i>	<i>Source</i>	<i>Source Scale</i>	<i>Description</i>
Basins and Watersheds	WiDNR	1:24,000	Watersheds are the smallest geographic unit and through aggregation, comprise basins and major drainage basins in the state. Both hydrologic units are represented in one layer based on aggregation and are maintained within WDNR's GIS Library layer.
Rivers and Lakes	WiDNR	1:24,000	WDNR's 1:24,000 Hydrography layer. Includes rivers, streams, ditches, and lakes as well as other features needed for flow modeling. The ditches were selected out and used to generate the first version of the drainage ditch layer. The layer was also useful for digitizing drainage ditches and generating cartographic products.
CUSTOM DATA LAYERS			
<i>Name</i>	<i>Source</i>	<i>Source Scale</i>	<i>Description</i>
Drainage Ditches	Digital Orthophotos from the counties	=>1:24,000	The WDNR 1:24,000 Hydrography data layer had only limited representations of drainage ditches for this area and there was no one source where we could obtain similar data. We captured drainage ditches for the Mead Lake Basin using Digital Ortho Photography (DOPs) for the area and digitizing features on screen. We were unable to ground truth most ditches, due to lack of access to private land.
Base Layer: i.e. Potentially Restorable Wetlands	WiDNR: input sources vary. Refer to Processing Appendices for more details.	Varies	This is the final product from the project and contains features and attributes from four input layers: hydric soils, surface water (rivers and lakes), wetlands and land use. Combining these three data sources provides the basis for determining potential sites for wetland restoration.
Sub-watersheds	USGS WiDNR	1:24,000 1:24,000	The Soil and Water Assessment Tool (SWAT) model defined nine subwatersheds for the Mead Lake drainage area, based on topography, the stream network and the sampling site location. The WDNR statewide 7.5 minute 30-meter grid based DEM was used.
INPUT DATA LAYERS			
<i>Input</i>	<i>Source</i>	<i>Source Scale</i>	<i>Description</i>
Hydric Soils	NRCS	1:1,000	SSURGO depicts information about the kinds and distribution of soils on the landscape. The soil map and data used in the SSURGO product were prepared by soil scientists as part of the National Cooperative Soil Survey. The data set consists of geo-referenced digital map data and computerized attribute data.

INPUT DATA LAYERS			
<i>Input</i>	<i>Source</i>	<i>Source Scale</i>	<i>Description</i>
Mapped Wetlands	Digital Wisconsin Wetland Inventory	1:24000	The wetland layer includes a series of polygon coverages and point coverages that are digitized from 1:24,000 scale Wisconsin Wetland Inventory (WWI) maps. The point coverage includes information for wetlands smaller than 2 or 5 acres, depending on the county. The DNR Bureau of Watershed Management is the custodian and currently the sole distributor for this layer.
Land use	WISCLAND + Clark County Land Use Layer	1:40,000 1:100,000	<p>WISCLAND landcover data is maintained within the DNR's GIS library and was used to fill areas where the Clark County land use was classified as "Other Resource Land". The land cover data product was derived by classification of LANDSAT Thematic Mapper™ satellite imagery acquired from fly-overs in August, 1991; May, July, September, and October, 1992; and May, 1993.</p> <p>Clark County Landuse geometry is based on 1997 aerial photography but attributes are current as of August 2002.</p>

Chapter IV: Subwatershed Metrics

Ecological Indicators and Wetland Planning

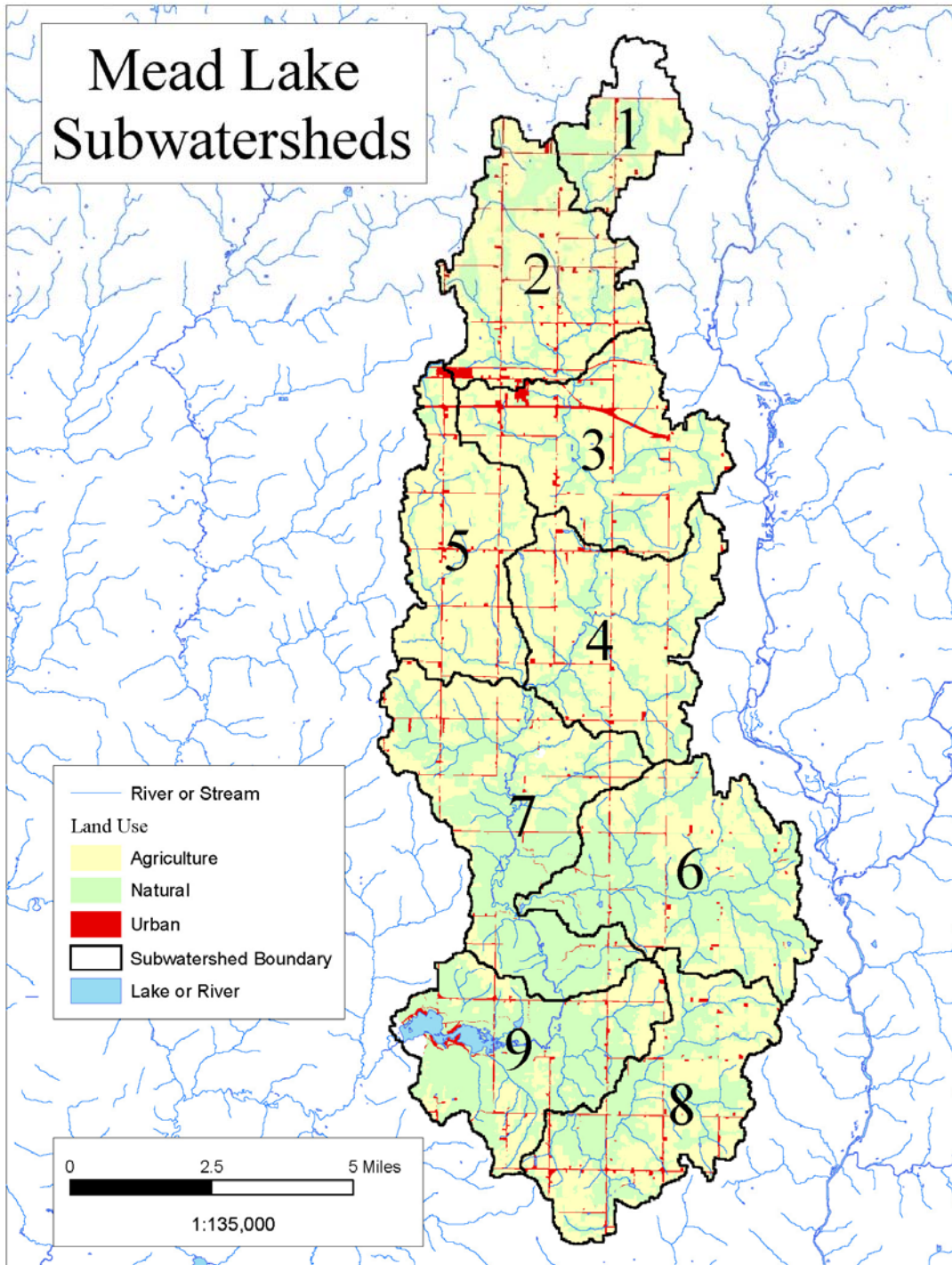
Traditional indicators of ecological health or condition have been site-specific and expensive measures, such as water chemistry sampling, bacteria counts, habitat surveys and other biotic indices that require time on the ground or in the laboratory. Over the last decade, researchers have examined relationships between these traditional indicators of ecological health and patterns in the surrounding landscape. For example, what land use features correlate best with measured water quality? When there is a reliable relationship between landscape patterns and actual ecological conditions, the landscape pattern becomes a surrogate ecological indicator. Remote sensing and GIS analysis can provide rapid and cost effective ecological assessment.

Wetland planning and management decisions are usually made on a site-by-site basis, and are the result of an individual regulatory decision, or a landowner's voluntary restoration of a wetland. Yet ecological problems and community needs (for improved lake water quality, for example) are seldom adequately addressed by land use changes on a single property. Poor water quality or lack of base flow is generally a result of land use patterns over much larger upstream areas. The cumulative effects only become measurable when the impact over a larger area reaches a certain level.

The benefit of a larger picture is that priorities can be set so limited resources may better be applied to address watershed-scale concerns. Landscape level factors influencing wetland management decisions may include the extent of wetlands relative to historic levels, the need for flood storage, or the abundance of specific habitat types within an ecological unit.

The goal of this section is to apply landscape level ecological indicators to the Mead Lake Watershed data to show how these indicators can inform wetland management decisions. Figure 3 shows the Mead Lake subwatersheds upon which the metrics tables are based.

Figure 3. Mead Lake Subwatersheds and Land Cover



Subwatershed Metrics Tables

The Metrics Tables contain the data by subwatershed that were used for developing potential ecological indicators. Each subwatershed metric was developed from the Base and Custom Data Layers described in Chapter III and based on several data criteria:

- ✓ Metric coverage is available for most, if not all, of the Mead Lake Watershed
- ✓ Metric accuracy is appropriate to the subwatershed scale
- ✓ Metric date is a historic baseline or is periodically updated
- ✓ Metric is related to a landscape level ecological indicator

Individual metrics are described below along with several example tables showing how they can be used. The dbf file associated with the PRW Base Data Layer was converted to an Excel worksheet, and summary metrics were then calculated.

Using any of the metrics requires an understanding of the Base and Custom Data Layers and the conditions under which a metric is a useful indicator. Metrics at the subwatershed scale are not intended to, and CANNOT replace site-specific field based methods where more detail is needed.

Table 2. Metrics for Wetlands Restoration Need

Sub-watershed ID	Sub-watershed Acres	Original Wetland Acres	% Original	Lost Wetland Acres	% Lost	Remaining Wetland Acres	% Remaining	PRW Acres	% PRW	Sub-watershed NEED
1	2,040	986	48%	114	6%	872	43%	69	3%	6
2	6,908	1,747	25%	459	7%	1,287	19%	333	5%	9
3	7,099	995	14%	239	3%	757	11%	162	2%	4
4	7,194	1,041	14%	119	2%	922	13%	71	1%	2
5	5,742	770	13%	218	4%	552	10%	191	3%	5
6	8,299	2,459	30%	448	5%	2,011	24%	117	1%	7
7	9,460	3,219	34%	735	8%	2,483	26%	170	2%	10
8	6,993	2,283	33%	976	14%	1,307	19%	650	9%	24
9	6,696	2,268	34%	799	12%	1,469	22%	224	3%	18
Total	60,431	15,767		4,107		11,660		1,988		
Avg.	6,715	1,752	27%	456	7%	1,296	21%	221	3%	9.6

Metrics Definitions

Subwatershed ID

A unique number assigned to each of the nine subwatersheds. Subwatersheds are the same as those used for the SWAT modeling effort.

Subwatershed Acres

Area in acres within each subwatershed. Subwatershed acres can be used to convert other metrics to a 'per unit area' basis for comparison among subwatersheds of different size.

Original Wetland Acres

Acres of subwatershed area that were originally (pre-settlement) wetland. Original wetland acres are estimated as the area of hydric soils, plus areas of known filled or drained wetland, plus the area that is mapped wetland but which occurs over non-hydric soils types.

Percent Original Wetland Acres

Original wetland acres expressed as a percentage of the subwatershed area. This is a measure of the prevalence of wetlands in the pre-settlement landscape.

Lost Wetland Acres

Original wetland acres within each subwatershed that are no longer wetland. They are estimated as the area of hydric soil that is not mapped as wetland plus areas of known filled wetland on the WWI.

Percent Lost Wetland Acres

Lost wetland acres expressed as a percentage of the subwatershed area.

Remaining Wetland Acres

Remaining Wetland Acres are the total wetland acres in each subwatershed based on the Digital Wisconsin Wetland Inventory (DWWI).

Percent Remaining Wetland Acres

Remaining wetland acres expressed as a percentage of the subwatershed area. Studies indicate that streams in subwatersheds with less than six percent of the area in wetlands suffer from frequent flooding and insufficient base flow (Hey and Wickincamp 1998).

Potentially Restorable Wetlands (PRWs)

PRWs are areas with hydric soils that are no longer mapped wetland and are in agricultural use, indicating land uses compatible with potential wetland restoration.

Agricultural use:

Two data sources were utilized: WISCLAND and Clark County land use layers. The Clark County land use layer consists of 26 named land use classes, and was updated as of December 2002. This is the preferred land use information because it is detailed and relatively up to date, especially for agricultural land uses. However, one of the land use categories "Other Resource Land" (ORL) for the Clark County data, lumps woodlands, wetlands and other primarily non-agricultural uses. For the ORL land use areas, the WISCLAND land cover layer was used to "subtract" forested land cover from the ORL layer, which otherwise includes land uses considered favorable for restoration, such as grassland, barren, forage crops and some row crops.

If an area was identified as ORL in the Clark County land use layer, then the WISCLAND land cover was utilized. If WISCLAND identified it as woodland, it was excluded from PRW consideration. If WISCLAND identified it as an agricultural land area, it was included. If WISCLAND identified it as wetland, but it was not on the DWWI, it was included. Any land area identified as wetland on the DWWI was excluded. Appendix B 3. Matrix for DIS_AGRIC, LU_CLASS AND WISCLAND GRID_CODE Combinations shows how the Clark County land use classes and WISCLAND were used to identify land uses that may be suitable for wetland restoration.

Hydric soils: The hydric soils needed to estimate Original Wetland Acres are interpreted from the Natural Resource Conservation Service (NRCS) SSURGO soils data layer and associated soil properties tables. As was true with the MRB project, we needed to determine if soils that were part hydric (HYDPART is "PART") or with hydric inclusions (HYDPART is "INCL") should be considered as an indicator of a potential restoration site. Wetlands can occur on soils that are not entirely hydric due to their position in the landscape. Ted Johnson, DNR Agronomist for the WCR had local knowledge of which soils would most likely be hydric in depressions and provided us with a list of the map unit symbols (MUSYM) that we could link to the geo-spatial layer.

After displaying these hydric soil categories on a map, and field checking areas from roadways in the basin, we decided that including only the all-hydric soils (HYDPART is "ALL") in the primary PRW layer limited the restoration possibilities too much, so we included all-hydric soils and part-hydric soils (HYDPART is "ALL" or "PART") in the highest priority category (PRW1) for PRW purposes (see Appendix C - Clark County Soils and PRW Grouping).

Soils that are 35 percent or more hydric inclusions (HYDPART is "INCL") were identified in a second category (PRW2). For the purposes of this study, both PRW1 and PRW2 soils are considered to have been original wetlands and to have restoration potential, if land use is suitable.

Soils with hydric inclusions making up less than 35 percent of the soils were identified in a third category (PRW3). Soils in the PRW3 category were not identified as original wetland soils, and were not included in the PRW acreage in the base layer. However, because of their spatial locations (often adjacent to wetlands, PRWs or streams) and the presence of some hydric inclusions, they were kept in our GIS database for future reference, as they may also offer opportunities for habitat adjacent to specific restoration sites.

Appendix C 4. PRW99 Soils includes non-hydric soils considered unsuitable for wetland restoration.

Percent Potentially Restorable Wetlands

Potentially restorable wetland acres are expressed as a percentage of the subwatershed area.

Original, Lost and Potentially Restorable Wetland acres are all landscape scale approximations of the actual acres in each class. *Soils that are classified as part hydric may contain areas that are not suitable for wetland restoration. On the other hand, somewhat poorly drained soils that NRCS does not classify as hydric also may support wetlands in areas with hydric inclusions.* Users of this report who have detailed knowledge of area soils may want to consider a different PRW classification for soil types with hydric inclusions in their own analysis.

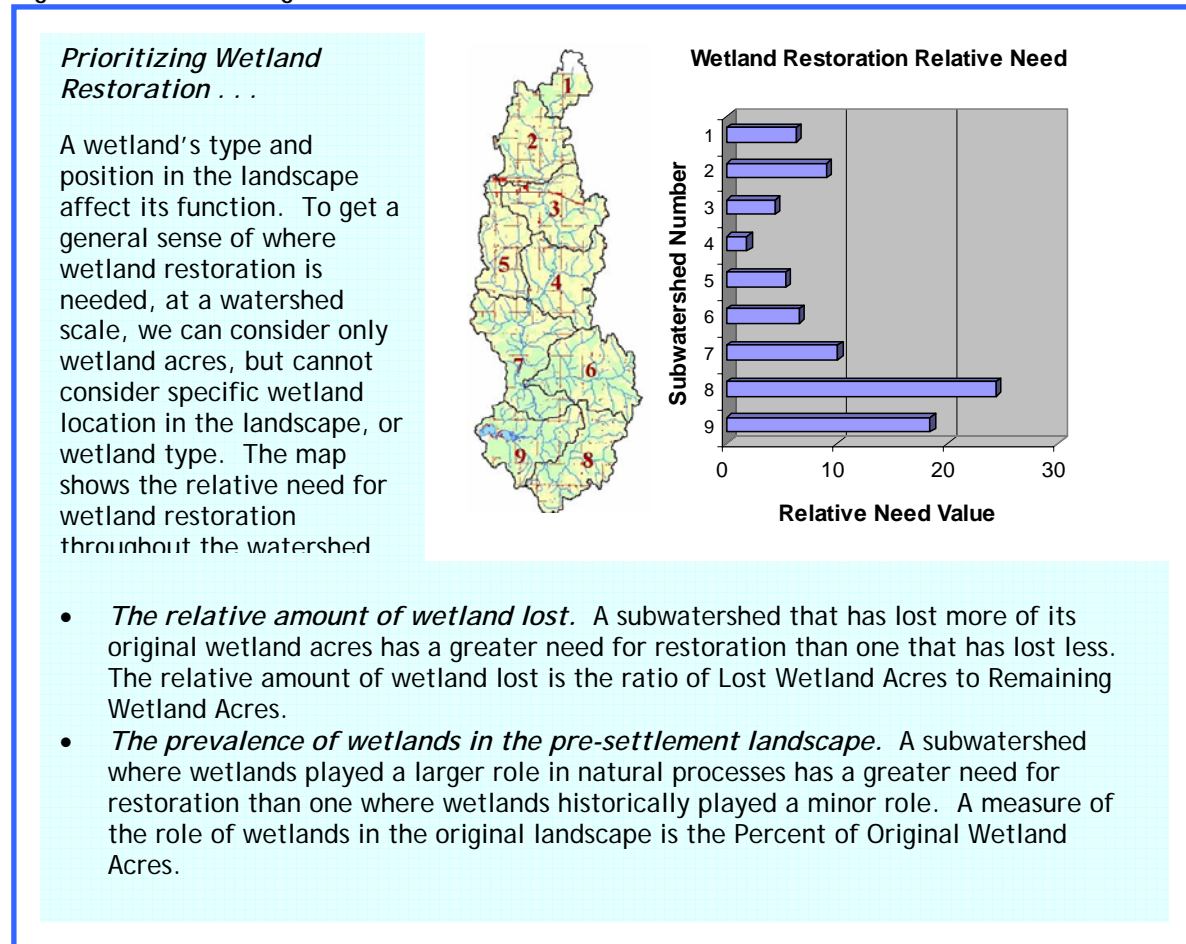
Need

Need is a landscape scale relative measure of the degree to which wetland restoration in a subwatershed has the potential to make an improvement in water quality and habitat. Need reflects both the relative amount of wetlands lost and the prevalence of original (pre-settlement) wetlands. Need is expressed as the ratio of lost wetland acres to remaining wetland acres, multiplied by the percent of original wetland acres in the subwatershed $[(LOST_ACRES / REMAIN_ACRES) \times PERC_ORIG]$. The resulting NEED value does not have units associated with it, and is primarily useful in assessing the relative need of the subwatersheds within the Mead Lake watershed.

This analysis does NOT consider factors that may be very important in analyzing site-specific restoration conditions. Such factors might include the position of the site in relation to

headwaters, connectivity to floodplains and other wetlands, and drainage systems through the site.

Figure 4. Prioritizing Wetland Restoration Need



Metrics for Water Quality

Land Use

Land use categories were established using two data sources: the Clark County Land Use data and WISCLAND land cover. Land uses are grouped into broad land use classes as a percentage of each subwatershed area to simplify analyses.

Table 3. Metrics for Land Use

Sub water shed ID	SWSHED ACRES	Agri-cultural Acres	% Agri-cultural	Natural/ Open Acres	% Natural/ Open	Urban/ Developed Acres	% Urban/ Developed
1	2,040	906	44%	1,084	53%	49	2%
2	6,908	4,567	66%	1,980	29%	361	5%
3	7,099	4,871	69%	1,833	26%	395	6%
4	7,194	4,960	69%	2,058	29%	175	2%
5	5,742	4,623	81%	877	15%	243	4%
6	8,299	2,962	36%	5,223	63%	114	1%
7	9,460	3,296	35%	5,950	63%	214	2%
8	6,993	3,665	52%	3,115	45%	213	3%
9	6,696	1,662	25%	4,806	72%	228	3%
Total	60,431	31,512		26,927		1,992	
Average	6,715	3,501	52%	2,992	45%	221	3%

Table 3 includes the following classes:

Agricultural Acres and Percent Agricultural

The process for delineating agricultural acres utilizing the data source layers was described earlier in the PRW metric discussion, and includes uses such as grassland, barren, forage crops and row crops. Percent Agricultural land use is expressed as a percent of the subwatershed land area.

Natural/Open Acres and Percent Natural/Open

As was true for development of the agricultural acres, the Clark County land use data layer and Wisconsin Wetlands Inventory was used to identify lands that can be classified as natural or open. Examples include County Forest Land, Public and Private Outdoor Recreation, Managed Forest Law land, wetlands and open water. Where the Clark County land use was identified as "Other Resource Land", WISCLAND was utilized because the "ORL" category included both agricultural and natural/open land uses. All WISCLAND woodland codes were included in Natural/Open space acres. Percent Natural/Open Space land use is expressed as a percent of the subwatershed land area.

Urban/Developed Acres and Percent Urban/Developed

The Clark County Land Use layer was used to identify all Urban/Developed land uses. These included uses such as Government Services, Institutional, Manufacturing, Public Roads, Railroads, Residential and Transportation/Communication/Utilities. Percent Urban/Developed land use is expressed as a percent of the subwatershed land area. Appendix B 4. Matrix for Agricultural, Open/Wooded and Urban Land Uses shows how Clark County Land Use Classes and Wiscland Grid Codes were used to classify Agricultural, Natural/Open and Urban/Developed land cover.

Chapter V: Water Quality and Land Use in the Mead Lake Watershed

Many studies have demonstrated quantitatively the relationship between various land use factors and water quality. Some of the factors related to water quality are amount of urban and agricultural land, agricultural practices, roads, population density, types of drainage, soil type and slope, the amount of forest cover, turf, buffers, presence of wetlands, and historical land use.

The many factors that affect water quality make it difficult to tease out simple, consistently reliable relationships. Studies that covered a variety of major land uses indicate that within major land use types some patterns emerge.

Urban Lands

In urban areas impervious cover (IC) is a reliable predictor of how severely stream quality changes in response to different levels of watershed development. Where impervious cover is less than 10 percent, IC is not a reliable indicator of water quality since it is swamped by other factors that play a greater role. Less than 5 percent of the Mead Lake watershed is in urban land uses, and none of the subwatersheds in the Mead Lake Watershed exceed 6 percent urban land uses. The impervious area is only a fraction of the urban land use area; consequently urban lands were not used as an indicator of water quality.

Agricultural Lands

The relationship between the agricultural land uses and water quality at the subwatershed level depends on many variables and their interactions, such as the type of crop, soil, slope, buffers, fertilizer rates and other farming practices. Booth (1991) found that water quality in the Pacific Northwest began to decline if more than 25 percent of forest cover was converted to agricultural land. Wang et al. (1997) found declining habitat quality and reduced species diversity only when agricultural land use exceeded 50 percent. In general, the land use/land cover thresholds for water quality damage are not sharp breakpoints, only averages from many studies under different conditions.

Figure 5. Graphical Representation of Water Quality Thresholds and Agricultural Land Use

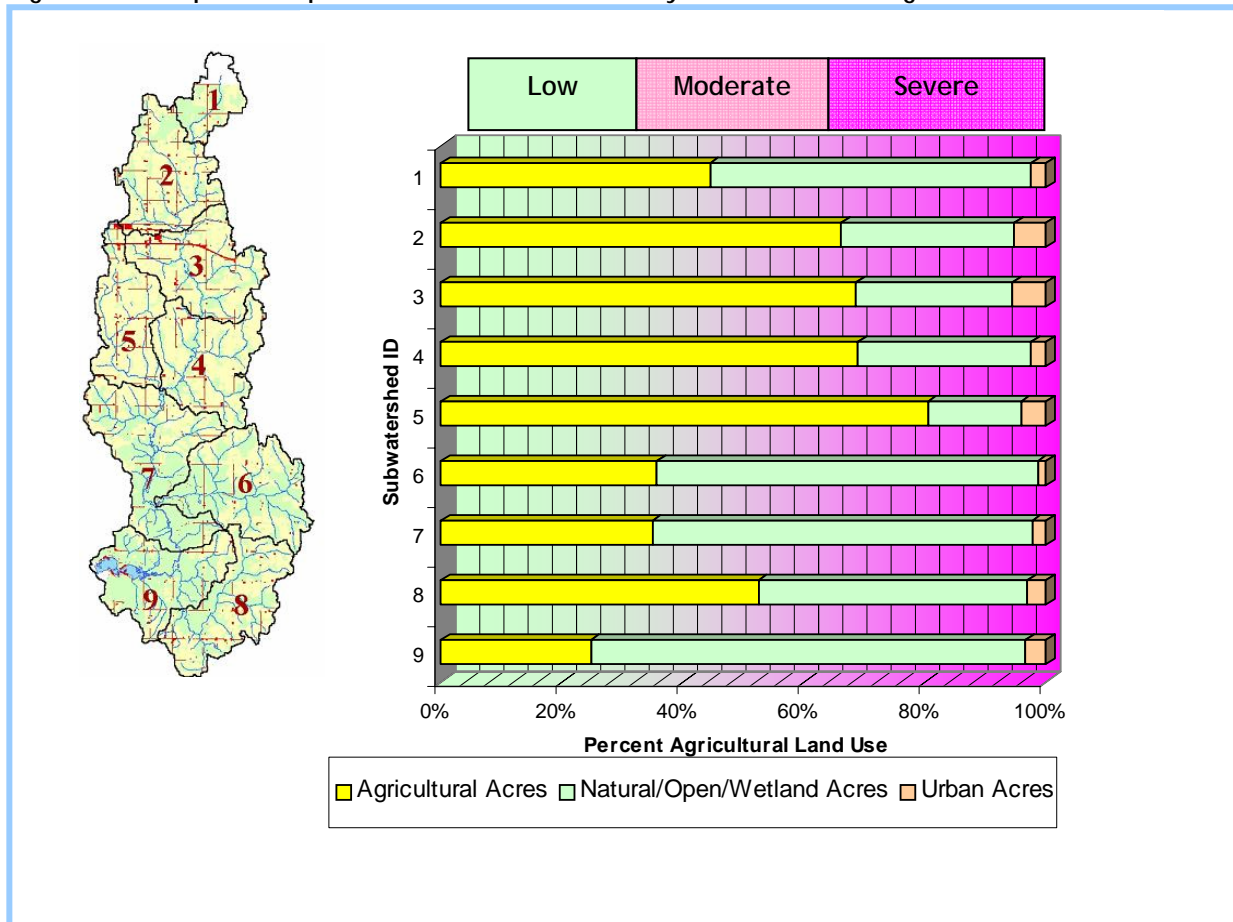


Figure 5 illustrates how increasing levels of agricultural land use is likely to impact water quality. In five of the Mead Lake subwatersheds, agricultural land uses exceed 50 percent of the subwatershed area, as illustrated above. It is important to note that the type of agricultural land use greatly affects impacts on water quality. Important factors include nutrient applications, presence or absence of soil conservation practices, crops and crop rotations, soils and slope.

TMDL Development and SWAT Modeling for Mead Lake

Mead Lake is identified as a high priority on the WDNR 303d impaired waters list (WDNR 2006). Impaired waters are defined in Section 303d of the federal Clean Water Act as not meeting the state's water quality standards or use designations. Pollutants of concern for Mead Lake are phosphorus and sediments from nonpoint sources.

A two year study was conducted by the Army Corps of Engineers (ACOE) to assess sediment and phosphorus loads to Mead Lake (James 2005). The study found that on average, 83 percent of the phosphorus load comes from tributaries to Mead Lake, which overwhelmingly contribute to poor water quality conditions.

To address the water quality problems of Mead Lake, the state will develop a Total Maximum Daily Load (TMDL) Plan that identifies the amount of a pollutant the lake can tolerate and still meet water quality standards. The plan, including an implementation strategy, will be

developed collaboratively by the WDNR, Clark County LWCD, Mead Lake Rehabilitation District, and a citizen advisory group.

SWAT Modeling

The first step in developing a TMDL is to gain a clear understanding of the sources of nutrients and sediment reaching Mead Lake. The Soil and Water Assessment Tool (SWAT) model was developed to predict the effects of alternative land management decisions on water flow, sediment and pollutant loads with reasonable accuracy in rural basins. The SWAT model is a physically based, continuous time, geographic information system (GIS) model developed by the U.S. Department of Agriculture - Agriculture Research Service (USDA-ARS). Components of the model include hydrology, weather, sedimentation, crop growth, nutrients, pesticides, groundwater and lateral flow and agricultural management.

The model must first be set up to closely reflect existing "baseline" conditions in the watershed. Model inputs include topography, soils, land coverage and hydrology data layers. Water quality and continuous flow data were collected for two years from a monitoring location just upstream of Mead Lake. Detailed land management and farming practice information was collected through a survey of farmers in 2002. The SWAT model setup for the Mead Lake Watershed was completed in August 2006 (Freihoefer 2006).

Modeling Alternative Land Management Scenarios

The predominant sources of pollutants and sediment to Mead Lake are from agricultural practices. Improving water quality in Mead Lake will largely depend on identifying realistic alternative farming practices that reduce sediment and nutrient (phosphorus) loads.

Information collected from farm surveys and Clark and Taylor County Land Conservationists indicate that 53 percent of the cropped land is in a dairy rotation of corn-corn/soybeans-oats-alfalfa-alfalfa-alfalfa (C-C/S-O-A-A-A) with manure storage. This rotation predominates in five subwatersheds (2, 3, 4, 5 and 7). Approximately 30 percent of the cropped acres in the watershed are in a cash-crop rotation of corn-corn/soybeans-oats-alfalfa-alfalfa-alfalfa (C-C/S-O-A-A-A) with no manure applied. This rotation predominates in two subwatersheds (1 and 6). These are primarily rented lands that are too far away from the dairy operation to make manure spreading feasible. Subwatershed 8 is unique in that the predominant rotation (60 percent of cropland) is a dairy rotation of corn-oats-alfalfa-alfalfa-alfalfa (C-O-A-A-A), with no manure storage. Subwatershed 9 has cropping practices fairly evenly split between the three described above.

There are many aspects of the cropping practices that can be adjusted in various scenarios. For planning purposes, it is anticipated that the impact of implementing various best management practices will be evaluated such as conservation tillage, nutrient management, an increased adoption of rotational grazing.

Incorporating Wetland Restoration into SWAT scenarios

Wetlands may benefit water quality by slowing runoff and removing sediments and nutrients before they reach lakes and streams.

Wetlands can be modeled in several ways in SWAT. The choice of how to model wetlands is based on how wetlands generally function in a given modeled subwatershed.

- One option models wetlands as a land cover category with their own plant growth, nutrient transformation, and hydraulic (runoff and infiltration) routines which then contribute to a stream network.

- The second option for modeling wetlands in SWAT is by treating them essentially as detention ponds. In this case the wetlands receive inflow from a fraction of the subwatershed area. Hydrology and sediment and nutrient removal are modeled in the wetlands. No nutrient transformations are simulated in wetlands and nutrient removal is limited to settling based on a user defined apparent settling velocity. The apparent settling velocity can be adjusted by season to account for seasonal differences in nutrient uptake and release in wetlands.

One way to estimate the effects of restoring wetlands on sediment and nutrient loading and flows to Mead Lake is to model the PRW areas as if they were all wetlands.

Chapter VI: Wetland Restoration Need and Opportunities

Wetlands in the landscape naturally slow water flow and may remove the sediment and nutrients in runoff before they reach lakes and streams. The extent to which wetland restoration has a positive effect on water quality depends on both site specific and landscape-scale factors. Vegetation type, position in the watershed and proximity to streams or lakes are examples of site specific factors. Landscape-scale factors include the amount of erosion that results from land uses in the watershed, which is an indicator of the sediment loads that wetlands may receive, and the acres of wetlands available or potentially available to “treat” sediment and nutrient pollutant loads.

Comprehensive Land Use and PRW Metrics

The more comprehensive land use and PRW metrics table (Table 4 below) was assembled from the base layer to allow a more detailed assessment, on a subwatershed basis, of the predominance of various lost wetland categories, as well as a more detailed look at the extent of possible restoration opportunities.

Table 4. Comprehensive Land Use and PRW Metrics

Sub-watershed ID	Sub-watershed Acres	Remaining Wetland Acres	TOTAL LOST Wetland Acres	Lost, PRW1 Acres	Lost, PRW2 Acres	Lost, Not Restorable Wooded	Lost, Not Restorable Urban	Total Ag but not PRW acres	Ag Wet Inclusions PRW3	Ag Upland PRW 99	Open/Wooded Upland	Urban Upland
1	2,040	872	114	69	0	36	8	837	398	439	176	42
2	6,908	1,287	459	333	0	71	32	4234	1212	3022	622	329
3	7,099	757	239	162	0	66	10	4709	900	3809	1010	385
4	7,194	922	119	71	0	38	9	4889	597	4292	1097	166
5	5,742	552	218	191	0	7	18	4432	689	3743	318	225
6	8,299	2,011	448	57	60	324	7	2845	326	2519	2888	106
7	9,460	2,483	735	71	100	550	16	3126	372	2754	2917	198
8	6,993	1,307	976	174	476	301	25	3015	232	2783	1507	188
9	6,696	1,469	799	69	156	557	17	1437	82	1355	2780	211
Total	60,431	11,660	4,107	1,197	791	1,951	142	29,525	4,809	24,716	13,315	1,850
Average	6,715	1,296	456	133	88	217	16	3,281	534	2,746	1,479	206

Note:
 Remaining Wetland Acres
 + Total Lost Wetland Acres
 + Total Ag but not PRW Acres
 + Open/Wooded Upland
 + Urban Upland
 = Subwatershed Acres

Note:
 Lost, PRW1 acres
 + Lost, PRW2 Acres
 + Lost, Not Restorable Wooded Acres
 + Lost, Not Restorable Urban Acres
 = Total Lost Wetland Acres

Note:
 Ag Wet Inclusions PRW3
 + Ag Upland PRW99
 = Total Ag but not PRW Acres

Metrics Definitions

Remaining Wetland Acres and Total Lost Wetland Acres were described earlier in the section discussing metrics for wetland restoration need. The following metrics were derived from the PRW base layer, and by utilizing the Matrix for Agricultural, Urban and Natural Land Cover, found in Appendix B 4. Matrix for Agricultural, Open/Wooded and Urban Land Uses.

Lost, PRW1 and PRW2

PRWs are areas with hydric soils that are no longer mapped wetland and are in agricultural use, indicating land uses compatible with potential wetland restoration. For PRW2 areas, the soils are classified as having greater than 35 percent hydric inclusions. These areas are considered generally to be less suitable for restoration than for PRW1 areas, where soils are ALL or PART hydric.

Lost, Not Restorable Wooded

These are areas where hydric soils indicate wetlands were once present, but the current wooded land cover precludes restoration.

Lost, Not Restorable Urban

These are areas where hydric soils indicate wetlands were once present, but the current urban land use precludes restoration.

Total Agricultural but Not PRW

Agricultural acres were delineated as described earlier in the PRW metrics section, but the PRW1 and PRW2 areas are subtracted.

Agricultural - Wet inclusions PRW3

Agricultural lands that are not PRW can be further subdivided, based on soils category. The PRW3 category includes soils with less than 35 percent hydric inclusions.

Agricultural Upland PRW99

These are agricultural lands that have soils where HYDPART is "NONE". These are considered to be all upland soils.

Open/Wooded Upland

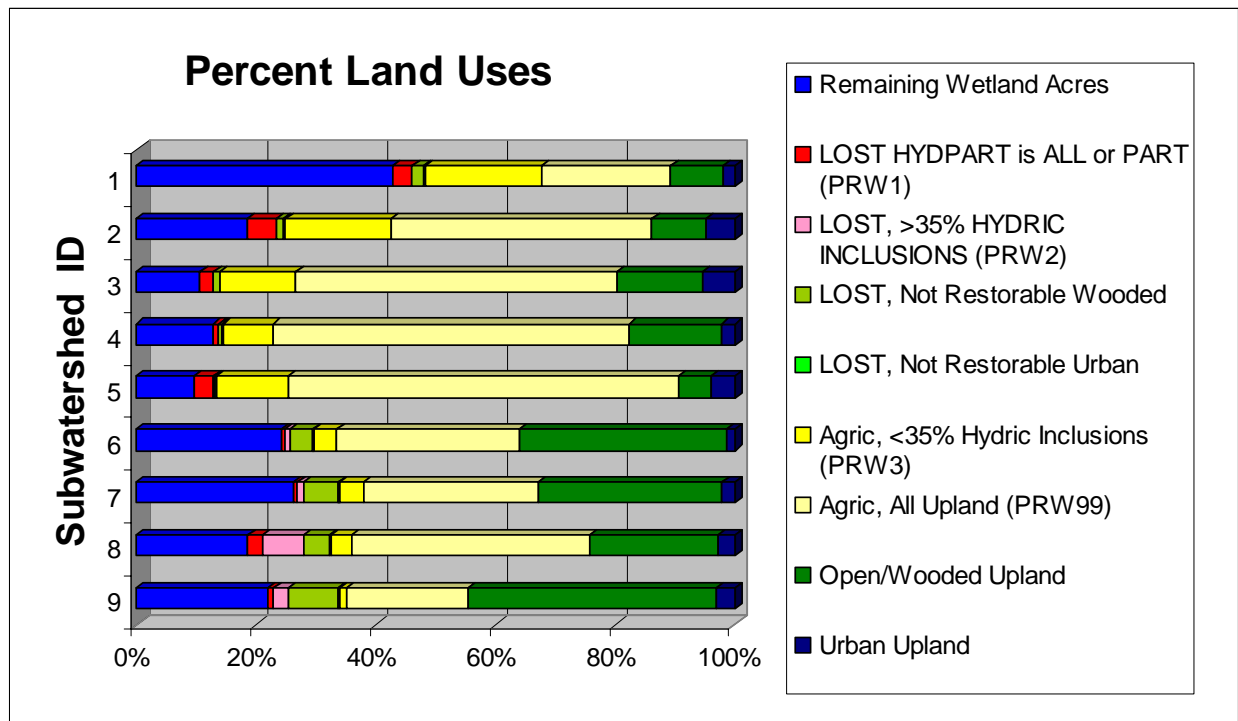
These are non-agricultural, non-urban lands that were not identified as originally wetlands.

Urban Upland

These are areas where the Clark County land uses were classified as "Urban" and were not identified as originally wetlands.

Figure 6 below shows a graphical representation of this comprehensive land use metrics table for the subwatersheds.

Figure 6. Percent Detailed Land Cover and Uses by Subwatershed



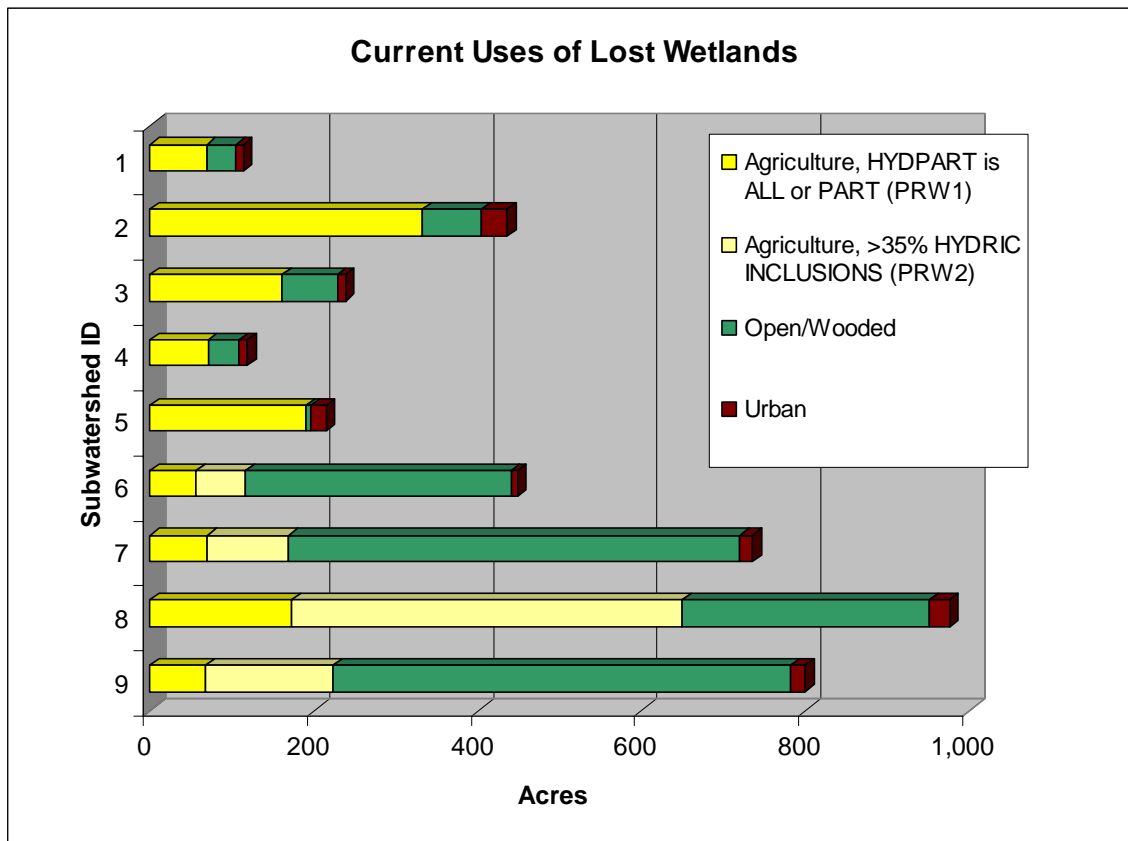
While Figure 6 is somewhat complex, several general observations can be made.

- It is easy to see that agriculture (bright and pale yellow bars) predominate in the upper portion of the watershed, especially subwatersheds 2-5.
- Wooded land cover (pale and dark green bars) predominates in the lower portion of the watershed, especially subwatersheds 6-9.
- Lost but not restorable lands that are wooded (pale green bars) are found almost exclusively in the lower portion of the watershed (subwatersheds 6-9).
- While Lost but not restorable urban lands were graphed, they are so insignificant that they are not visible.
- PRW areas where soils are all or part hydric (red bars), which represent the highest likelihood of restorability, make up only a small portion of any subwatershed.
- PRW areas where soils have greater than 35 percent hydric inclusions are absent in the upper portion of the watershed, but are present in subwatersheds 7-9.
- Agricultural lands with soils that have less than 35 percent hydric inclusions (PRW3) make up a substantial part of the land that is in agriculture in the upper portion of the watershed, particularly subwatershed 1 and 2, and also are present in subwatersheds 3-5. While we did not classify these soils as hydric, the extent of these soils in agriculture may mean that there are some restoration possibilities, especially where they are adjacent to PRW1 or PRW2 soils.

A Closer Look at “Lost” Wetlands

“Lost” Wetland Land Uses

Figure 7. Current Uses of Lost Wetlands



The current land uses for areas that are identified as lost wetlands are grouped as agriculture, open/wooded or urban, as defined earlier in this chapter. Figure 7 illustrates how these lost wetland land uses are distributed in the Mead Lake watershed. Urban land uses (brown) make up only a very small portion of the lost wetland areas.

Open/wooded land cover (green) predominates in the southern portion of the watersheds (subwatersheds 6 - 9). By definition, these land uses are not considered “restorable”. Lost wetlands that are in agricultural use (yellow bars) are by definition, potentially restorable. The agricultural land use on PRW1 (dark yellow) areas have soils most likely to be restorable. The agricultural land use on PRW2 (light yellow) areas have soils that have lower potential for restoration.

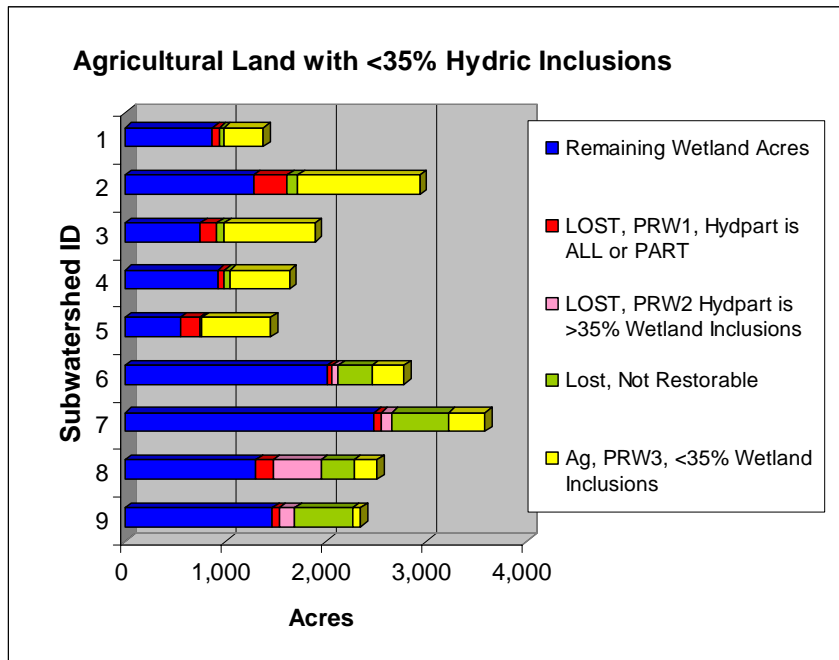
Restoration Opportunity

In addition to identifying the need, it is useful to look at the “opportunity” on a landscape scale. While the restoration need is greatest in subwatersheds 8, 9 and 7 respectively, these subwatersheds appear to have much more limited restoration opportunity. A large portion of the lost wetlands in these subwatersheds are “not restorable” because they are wooded lands, a land use that was not considered compatible with restoration. The PRW2 (greater than 35 percent hydic inclusions) areas, which also predominate in these subwatersheds offer

more limited restoration opportunities than the PRW1 (all or part hydric), which predominate in the upper part of the watershed. If the opportunity arises to conduct further field investigations, a closer look at these PRW2 areas would greatly enhance our understanding of the actual restoration opportunities that may exist.

Agricultural Land with Less Than 35 Percent Hydric Inclusions

Figure 8. Agricultural Land with Less Than 35% Hydric Inclusions



We did not include soils with less than 35 percent hydric inclusions among our “original wetlands” soils (yellow bars). It is felt that the scattered and limited amount of hydric soil inclusions would not present suitable restoration opportunities. Nevertheless, in the upper portion of the watershed, these lands make up a substantial amount of the land in agricultural use (subwatersheds 1-5). If the opportunity arises to conduct further field investigations, a closer look at these areas would greatly enhance our understanding of the actual restoration opportunities in these PRW3 areas.

A Closer Look at Lost, Not Restorable Wetlands

As Illustrated in Figure 7, “Lost, Not Restorable” wetlands appear to predominate in Subwatersheds 6, 7, 8 and 9. These are also subwatersheds where woodland predominates and nearly all of the “Lost, Not Restorable” acres are woodland.

Figure 9 below is a representative woodland area of mapped wetlands and “lost” wetlands. One generally thinks of ditching activities or filling activities as being responsible for wetland loss. It seems unlikely that there is enough ditching or filling in these areas to account for the extent of “lost” wetlands, based on knowledge of similar Clark County public hunting lands (P. Oldenburg, personal communication, January 16, 2007).

Several factors may play into a probable overestimation of lost wetlands, which is most obvious in woodland areas.

One explanation is that some areas that are actually wetlands were not mapped due to the difficulties of photo interpretation for wooded areas. A second explanation is that the areas

mapped as "original" wetland soils may not all be capable of supporting wetland. Very likely, both factors have some influence on the estimated lost wetland acreage. The first underestimates the existing wetlands and the second overestimates the amount of land that was originally wetland.

Original wetland soils include those considered "ALL" hydric, "PART" hydric or soils with hydric "INCLUSIONS" making up more than 35% of the soil area. By definition, portions of the areas covered by these soils are not wetland soils. Table 5 shows the percent wetland ranges for the hydric classification of soils in Clark County (USDA 2003).

Table 5. Range of percent of wetland soils in hydric soils groups.

Hydric Classification	Maximum % wetland	Minimum % wetland
Hydpart is ALL	90%	60%
Hydpart is PART	80%	40%
Hydpart is INCL (>35%)	50%	36%

Figure 9 below is a good illustration of the uncertainties in estimating original and lost wetland acres. It shows that the underlying soils for much of the "lost" wetland in this wooded area is PART hydric or with hydric inclusions making up greater than 35 percent of the soil. These are clearly fringe areas between delineated wetlands and upland soils. They may be soggy upland or they may be "not very wet" wetland, and likely, a combination of both.

Figure 9. Mapped and "Lost" Wetlands in Wooded Area of Mead Lake Watershed

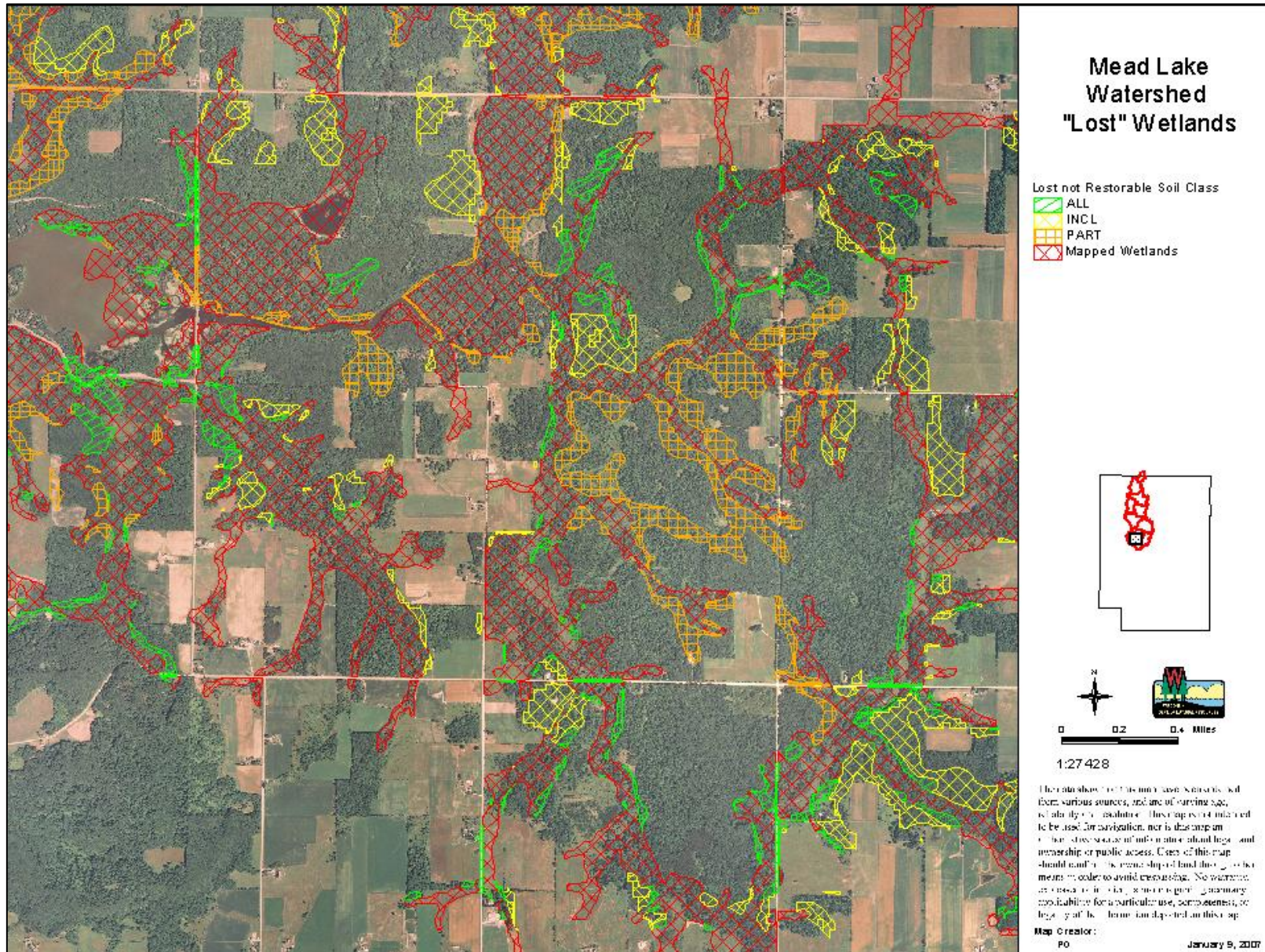


Figure 10. Mapped vs. Estimated Lost, Not Restorable Wooded Acres

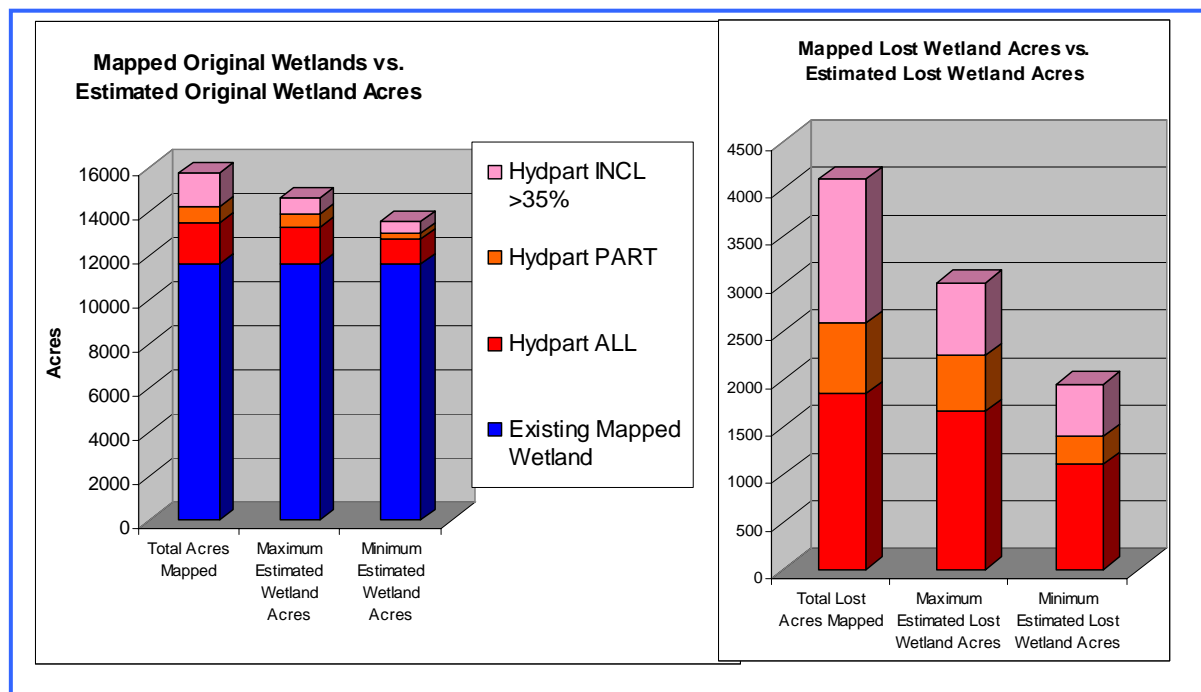
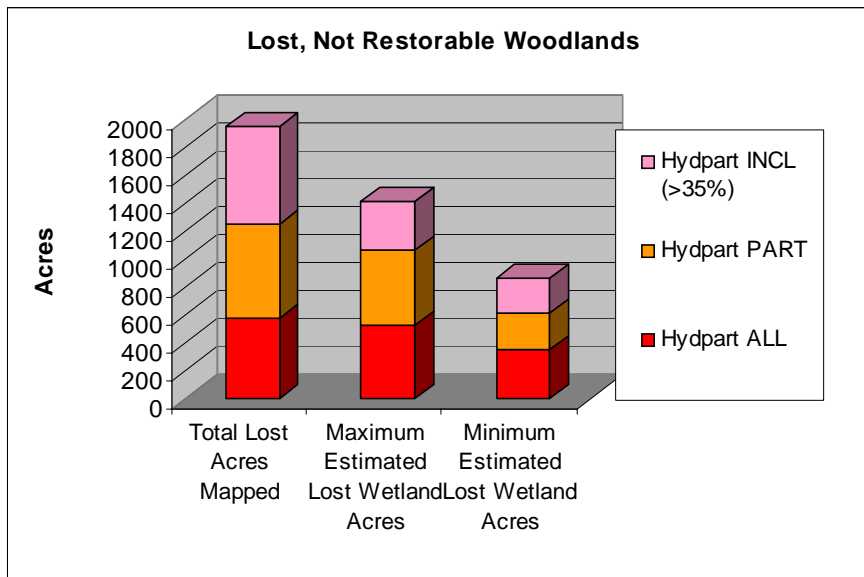


Figure 10 illustrates the degree to which the mapped original and lost wetland acres may overestimate the actual original and lost wetland acres, based on the range of percent wetlands shown in Table 5 above. In Figure 10 the “Total Acres Mapped” and “Total Lost Acres Mapped” bars are the total acres of land that are covered by the indicated Hydpart groups. The “Maximum Estimated Wetland Acres” and “Maximum Estimated Lost Wetland Acres” are the result of multiplying the “Total” acreages by the percentages for the Hydpart groups shown in the “Maximum Percent Wetland” column of Table 5, above. Similarly, the “Minimum Estimated Wetland Acres” and “Minimum Estimated Lost Wetland Acres” are the result of multiplying the “Total” acreages by the percentages for the Hydpart groups shown in the “Minimum Percent Wetland” column of Table 5, above.

Similarly, Figure 11 illustrates the degree to which the mapped “Lost, Not Restorable” wooded acres may overestimate the actual “Lost, Not Restorable” wooded acres.

Although our knowledge of the watershed leads us to believe that original and lost wetland acreage is probably overestimated, as discussed above, there are areas where original and lost wetland acres may also be underestimated. Likely some of the PRW3 areas are in fact original wetland (see [Figure 8. Agricultural Land with Less Than 35% Hydric Inclusions](#)). Some soils identified as not hydric include wetland components.

Figure 11 Mapped vs. Estimated Lost, Not Restorable Wooded Acres



PRW Mapping and Field Verification

PRWs were mapped and overlaid on digital air photos. A subset of 20 PRWs was selected for initial PRW field inspections based on size and accessibility from roadways. Initial verification, using the protocol developed for the Milwaukee River Basin, revealed that linear wetlands along streams or ditches, particularly road ditches, have low restoration potential, due to locally steep topography and lack of side ditches that might be plugged. For this subset of PRWs, the PRW identification protocol seemed to correctly identify the presence of PRWs but they were generally smaller than mapped, often due to the deeply incised nature of the road ditches. Restoration is largely incompatible with the road drainage system.

The PRW layer was then dissolved to identify larger contiguous PRW lands, revealing about 60 PRWs greater than 5 acres in size. We surmised that larger PRWs farther from roadways might have greater restoration potential.

The County's parcel data was incorporated into the GIS data base, and land ownership identified. County LWCD staff contacted landowners to seek permission for field verification visits. The ground survey was intended to provide a qualitative accuracy estimate for the PRW mapping process, and an opportunity to identify high priority sites and provide an initial assessment of landowner willingness to pursue wetland restoration and other conservation projects. Unfortunately, Clark LWCD staffs were unsuccessful in obtaining permission for field verification visits. Landowner reluctance to participate is almost certainly tied to social factors discussed in the next chapter - factors we had not expected or fully understood at the outset of the Mead Lake project.

Chapter VII: Social Factors in Implementing Wetland Restoration and Other Best Management Practices

To be successful, any strategy for implementing changes in land use practices must be sensitive to the social, economic and political factors that are important to the citizens who live and work within the watershed. Mead Lake's designation as an Impaired Water highlights the need for land management change. Social factors discussed in this chapter came to light during this study. Although they do not specifically or exclusively pertain to wetland restoration they are important considerations for TMDL planning and implementation.

Amish and Mennonite Farming Communities

Amish Farming Practices in the Watershed

Amish farms are generally very small operations, with a maximum of 20 cows and less than 20 acres of corn/year. They do not use manure storage, but their small herds are bedded with long straw, and consequently they don't have the liquid manure that is common in larger operations.

Amish farming predominates in subwatershed 8 and portions of subwatershed 9, in the southeastern part of the Mead Lake watershed. In addition, there are other Amish farmers scattered throughout the watershed. The Amish community in subwatersheds 8 and 9 appear to be stable and fairly permanent. Individually, these farms have a low impact on natural resources, although where concentrated (such as subwatershed 8), there may be a cumulative impact.

Mennonite Farming Practices in the Watershed

Nearly all the Mennonite farmers have 6-12 months of manure storage and nutrient management plans (which are required for manure storage). The use of steel-wheeled or non-modern equipment by Mennonites makes winter spreading difficult. Mennonite farmers have herds of about 50 to 60 cows, and farm 120 to 200 acres.

The highest concentration of Mennonite farmers are in the predominantly agricultural middle and northern portions of the project area. Subwatershed 2 has the highest concentration, about 65 to 70 percent Mennonite. Subwatersheds 3, 4 and 5 are about 45 percent Mennonite farmers. The "English" farmers, a term used by Mennonites to refer to non-Mennonites, use similar farming practices (G. Stangl, personal communication, December 15, 2006).

Mennonite farmers are expanding in the watershed, primarily because sons of current farmers' are establishing their own farms. It is likely that the entire watershed will eventually be predominantly Mennonite. *It is essential that land conservationists adapt implementation strategies to the Mennonite and Amish farming culture.*

Amish and Mennonite Community Structure

In general, each church district includes about 30 to 35 families and is led by a bishop, with assistance from ministers and deacons. Accepted farming practices can vary from district to district, since these decisions are generally made by the bishop. For instance, some bishops allow photovoltaic cells for electric fences, while others do not. When working with the Mennonite farming community, contact needs to be initiated through the bishop for the area. Conservation practices are best introduced through personal contact (M. Anderson, personal communication, December 6, 2006.).

Considerations for Promoting Conservation Practices in the Mead Lake Watershed

Rotational/Intensive Grazing

Rotational/intensive grazing is expanding in Marathon County (adjacent to Clark County), where Mennonite farmers who have recently immigrated from Ohio and Pennsylvania have brought the practice with them (P. Daigle, personal communication, December 6, 2006). In contrast, the Mennonite farmers in the Mead Lake area have been here for a decade or more, and rotational/intensive grazing is less common.

About 10 percent of the farmers are now rotational grazers, and they are both English and Mennonite farmers. The obstacles to switching to rotational grazing are similar for both. While it may be more profitable per pound of milk production (as demonstrated in Marathon County), rotational grazing may still result in an overall loss of production, which is a “hard sell” for farmers that have conventional dairy operations (G. Stangl, personal communication, December 15, 2006).

Nevertheless, this practice has proven to be effective in achieving pollutant load reductions, and is recommended for promotion in the Mead Lake watershed. *Opportunities may exist on both PRW areas and upland farmland.*

Cost Share and Tax Based Incentives

Amish and Mennonite farmers traditionally do not participate in government incentive programs. They avoid programs which involve management contracts, cost-share agreements or easements. For these reasons, Federal Farm Bill programs (e.g., Conservation Reserve Program, Conservation Reserve Enhancement Program and Wetlands Reserve Program) are poorly received.

Programs that provide tax benefits for wetlands may be more successful. However, even with recently enacted Wisconsin tax breaks calling for undeveloped lands to be assessed at 50 percent of fair market value, in many tax districts the average tax per acre of undeveloped land can be 5-10 times greater than on agricultural lands and may also preclude landowners from holding or restoring wetlands. *Additional tax incentives that more effectively favor wetland and other conservation land uses need to be found for all agricultural landowners, and may be one of the few tools that are acceptable in Amish or Mennonite farming communities.*

Currently about half the farmers in the project area are “English”, or non-Amish and non-Mennonite. Government programs and cost-sharing are much more accepted by them. *Working with “English” farmers, utilizing cost-sharing programs in targeted areas of the Mead Lake watershed may be the most effective way to achieve reductions in pollutant loading for the immediate future.*

Chapter VIII - Summary

Lessons Learned

Applying the Milwaukee River Basin PRW Identification Processes

The Mead Lake Project followed on the heels of the Milwaukee River Basin project and was a simpler project with respect to basin size and land use complexity, and focused primarily on use of metrics to set restoration priorities, rather than use of the decision support tools developed for the MRB. The PRW layer itself will be a useful input to the SWAT modeling process to identify the role wetland restoration can play in reducing water quality impacts of land uses.

We were able to apply many of the lessons learned in developing the MRB project, streamlining the data processing. One MRB lesson we benefited from was management of file size. The whole range of attributes that come from the input layers need to be maintained and are critical for testing out hypotheses as well as facilitating simple quality control procedures. Based on what was learned, we kept the original attributes and original values of the input layers. The result is a very dense, highly complex data layer which may prove unwieldy for most users. However, the PRW Base Layer, along with the Data Dictionary, allows the interested individual to ask and answer data questions.

Watershed Hydraulic Suitability Factors

Key factors in choosing the Mead Lake watershed for testing out the MRB PRW processes included local interest in improving water quality and hydrology for Mead Lake, and the fact that Mead Lake is identified as a 303d Impaired Water. Also, Clark County had already completed a detailed land use inventory and field soil testing, in preparation for utilizing the SWAT model to look at nutrient and sediment load and hydrologic regimes for each subwatershed. Thus, it seemed a great deal of groundwork had already been completed, and the PRW identification process would dovetail nicely into SWAT modeling. In addition, a very preliminary comparison of the hydric soils layer and mapped wetland layer indicated ample opportunity for wetland restoration.

In hindsight, it would have been advisable to have a wetland ecologist out in the field to provide critical insight into the wetland restoration potential for this area in advance of completing the PRW test area selection. We knew that wetlands and hydric soils had a very dendritic appearance on the maps, following streams and tributaries, but we did not realize the degree to which streams had been incised and thus hydrologically separated from surrounding wetlands.

Later, when field-checking mapped PRWs, it became apparent that due to road ditching, many of the streams and tributaries had become fairly deeply incised, and slopes adjacent to streams were steeper than expected. This “narrowed up” the possible restoration areas much more than was apparent on the maps, and many of these PRW areas are hydraulically linked to road ditches. Restoration of wetland hydrology would require the plugging of road ditches, a clearly unacceptable option.

Sociological Factors

Mead Lake has an active Lake Association. Members of the Association and Clark County lake users are eager to improve water quality in Mead Lake for aesthetic and recreational purposes. Much of the Mead Lake watershed is either Clark County Forest land or in

agricultural land use. In recent years, the Mennonite farming community has grown significantly in the watershed.

Of greatest significance, Mennonite farmers traditionally have chosen to not participate in government incentive programs, which are sources of cost-sharing for wetland restoration. In addition, Clark County Land Conservation Department staffs were unable to secure permission from any landowners for access to field-check mapped PRWs. We were entirely limited to roadside surveys and review of air photos.

While we understood some of these sociological issues at the outset, we did not anticipate that we would be unable to field check any PRW sites that were not along roadways. Based on our roadside checks, it appears that we were successful in correctly identifying the location of PRW lands, but that the extent of PRW acres tended to not be the same as mapped. Most often, the PRW lands were less extensive than mapped, due to the incision of streams and sloped topography.

Had we been able to field check sites away from roadways, we may have had quite different observations.

Using Mead Lake Watershed PRW Information

Before using any of the products of the MLPRW project, the User needs to become familiar with the scope and limitations of the PRW process and with the assumptions that underlie the base data layers, the custom data layers and the decision tools. Some general considerations include:

- The MLPRW project is a 'first step' in wetland planning. Its products are intended for landscape level analysis. Where this analysis leads to specific sites, decisions to develop further plans at those sites will require on-the-ground assessment.
- MLPRW project products are intended to be used in conjunction with other planning tools to help meet wetland and water quality related goals of State and local governments, public and private conservation organizations and individual landowners.
- The MLPRW project data is not intended for regulatory use. Wetland boundaries are based on the best available data as of 2005. The least accurate data is at a scale of 1:24000, so site-specific projects will require a field evaluation to determine actual boundary locations.
- The MLPRW project assumes that all wetlands have value and deserve protection. Site-specific factors will cause actual wetlands and potential restoration sites to vary in the type and degree of functions they provide.
- Existing and restored wetlands are not a substitute for other best management practices used to control flooding and to maintain water quality and wildlife habitat.

Voluntary Wetland Restoration

Efforts to restore and rehabilitate wetlands rely on locating potential project sites. Searches for potential wetland restoration sites require time-consuming map reviews and screening before any planning can begin. The identified PRW locations reduce the site search effort. By combining PRW sites with the subwatershed metrics that show which areas have the most restorable wetlands, and where historical wetland loss has had the greatest cumulative effect, we can promote restorations that address ecological needs beyond their project boundaries.

Improved Basin Planning

The MLPRW project demonstrates that a watershed or basin scale PRW layer can be built with a reasonable amount of expertise and effort, utilizing generally available GIS data layers. The result is far more useful information about the regional status of wetlands and impacts of wetland loss than has ever been available before.

State wetland data lags far behind that of other surface water resources. A broader expansion of the MLPRW project would allow planners a more meaningful view of wetland resources and past wetland impacts and could greatly improve Wisconsin's "State of the Basin" reporting for wetlands.

The Biggest Picture

For many decades, it has been commonly quoted that 'Wisconsin has lost about half of its original 10 million acres of wetlands'. Yet, even now, we do not have ready access on a statewide scale, to crucial information about where and how these losses have occurred (WDNR 2000). As digitization of the Wisconsin Wetland Inventory maps progresses and with increasingly more detailed GIS soils and land use information becoming available, there are growing opportunities to track wetland restoration, loss, preservation and management.

The Milwaukee River Basin and the Mead Lake Watershed Wetland Assessment projects have helped to shed light on how we can use GIS-based information to better understand Wisconsin's wetlands. It is our hope that similar wetland assessment projects can be undertaken on broader scales, and eventually, such valuable information can be readily available statewide.

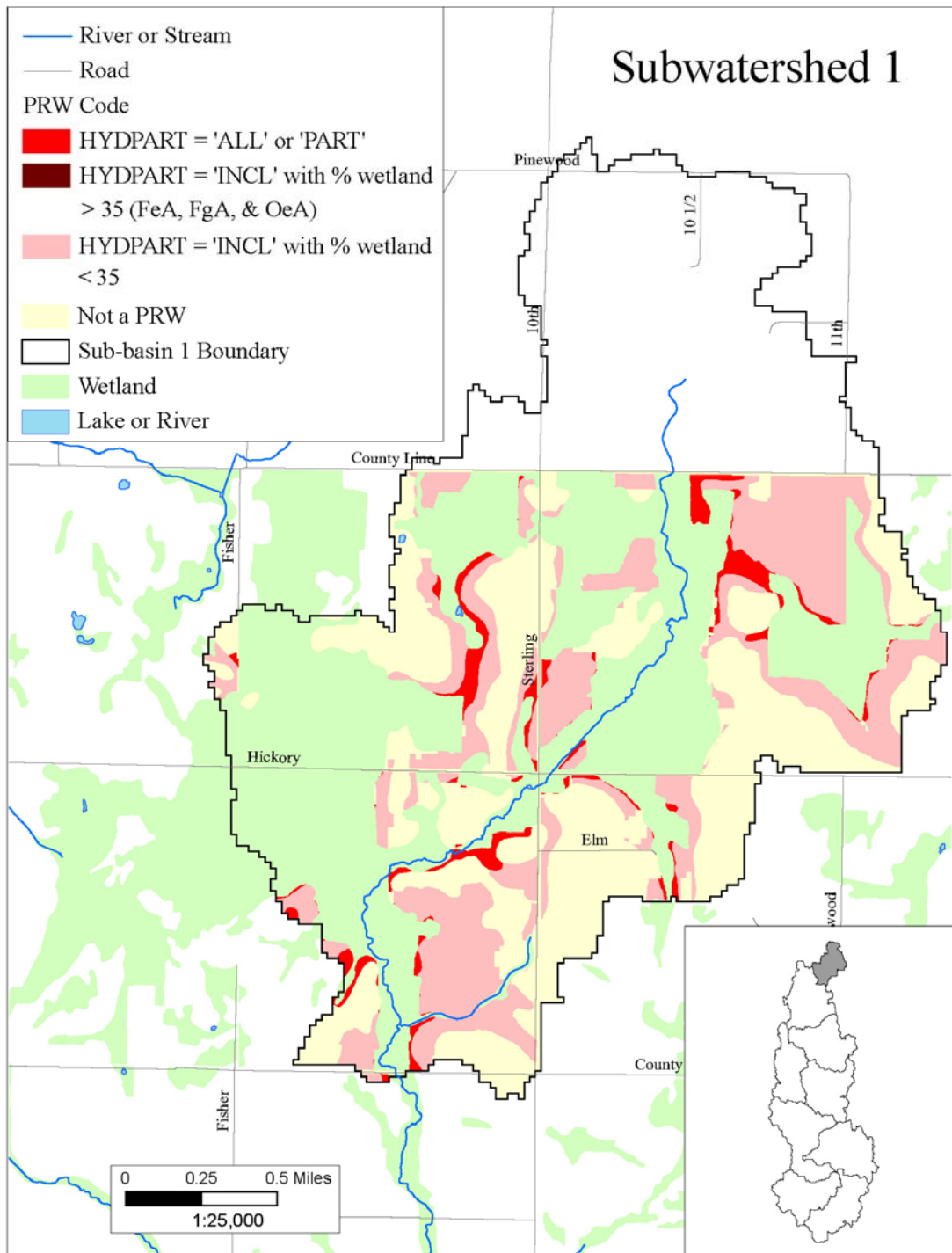
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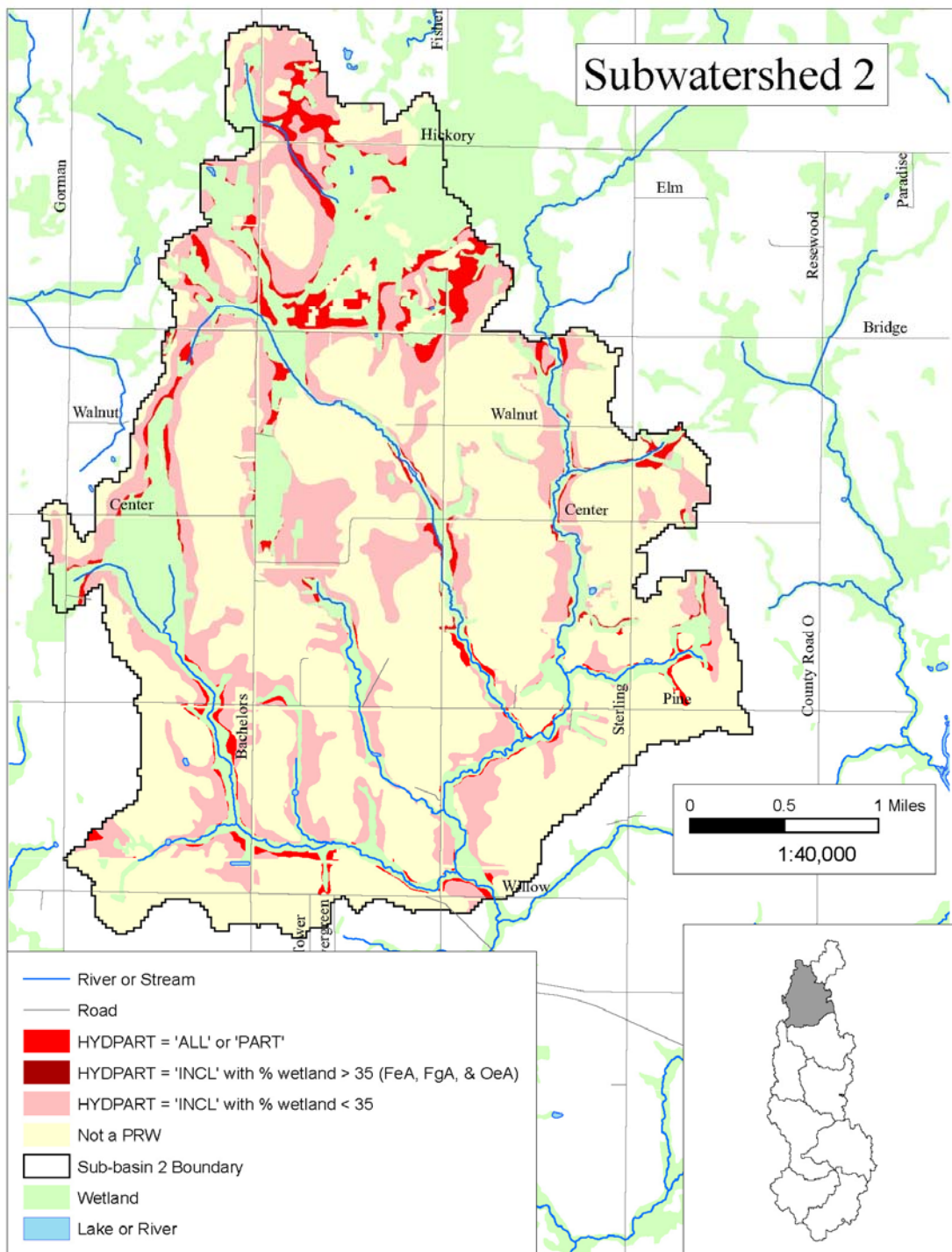
Appendices

Appendix A - Subwatershed Maps of Wetlands and Potentially Restorable Wetlands

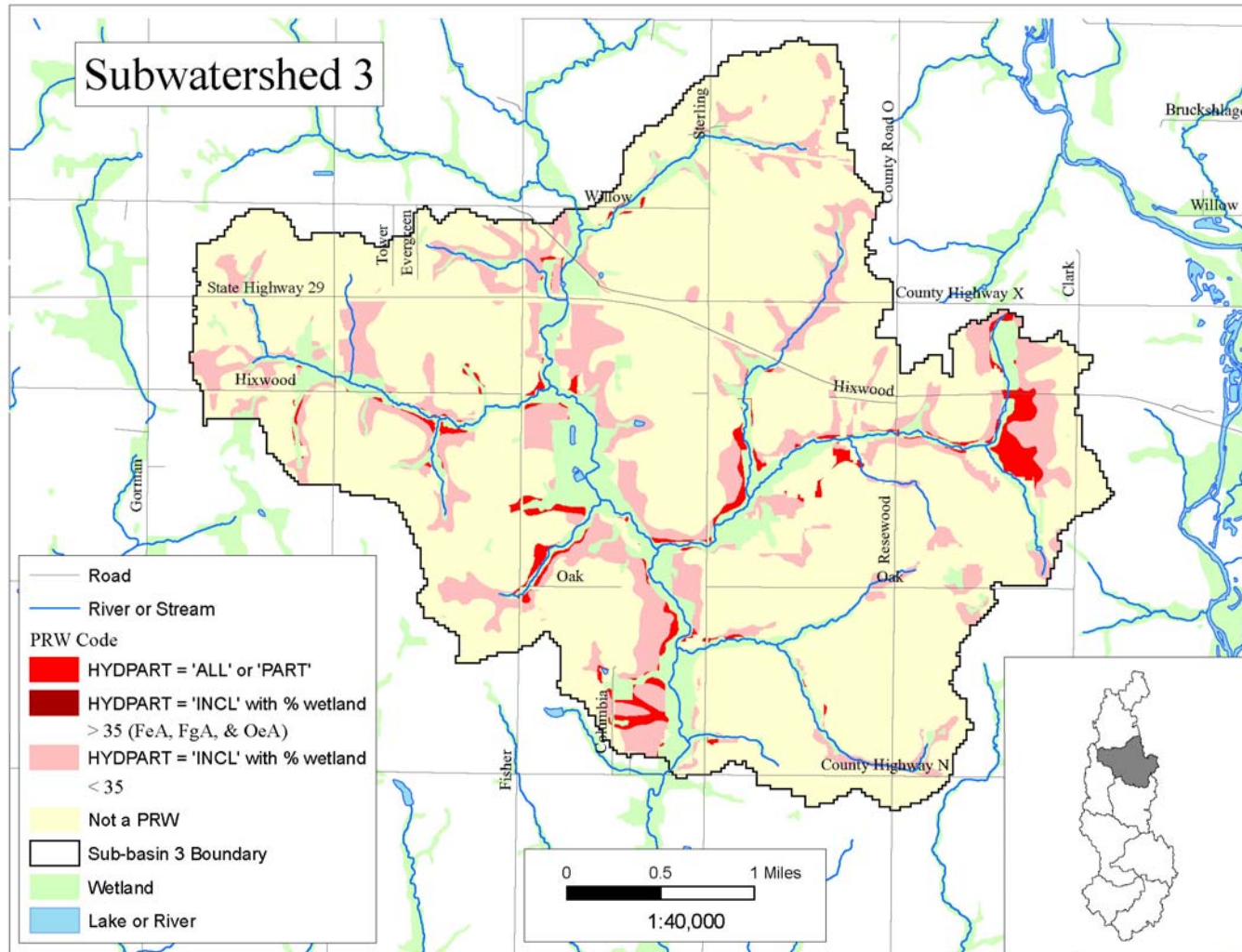
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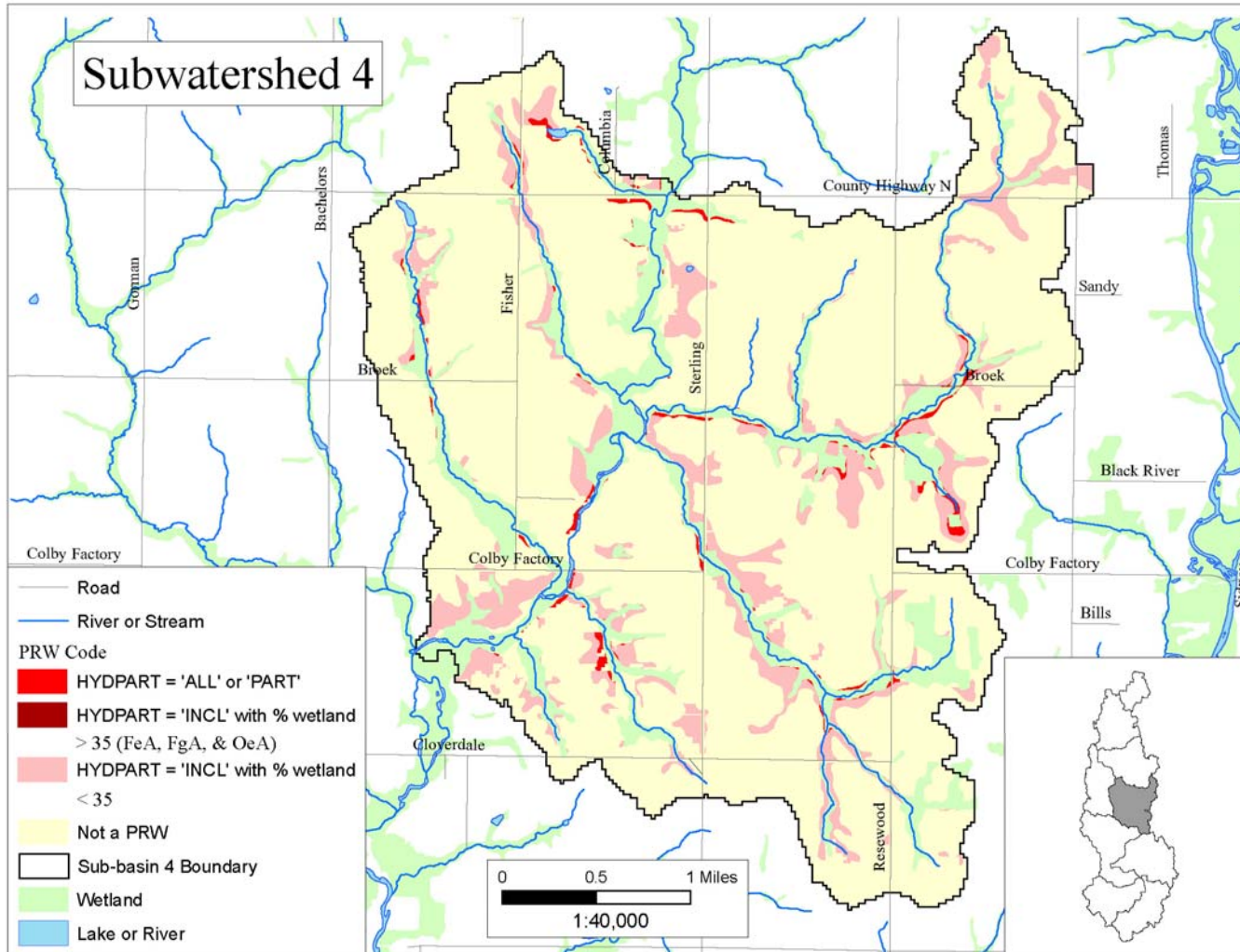
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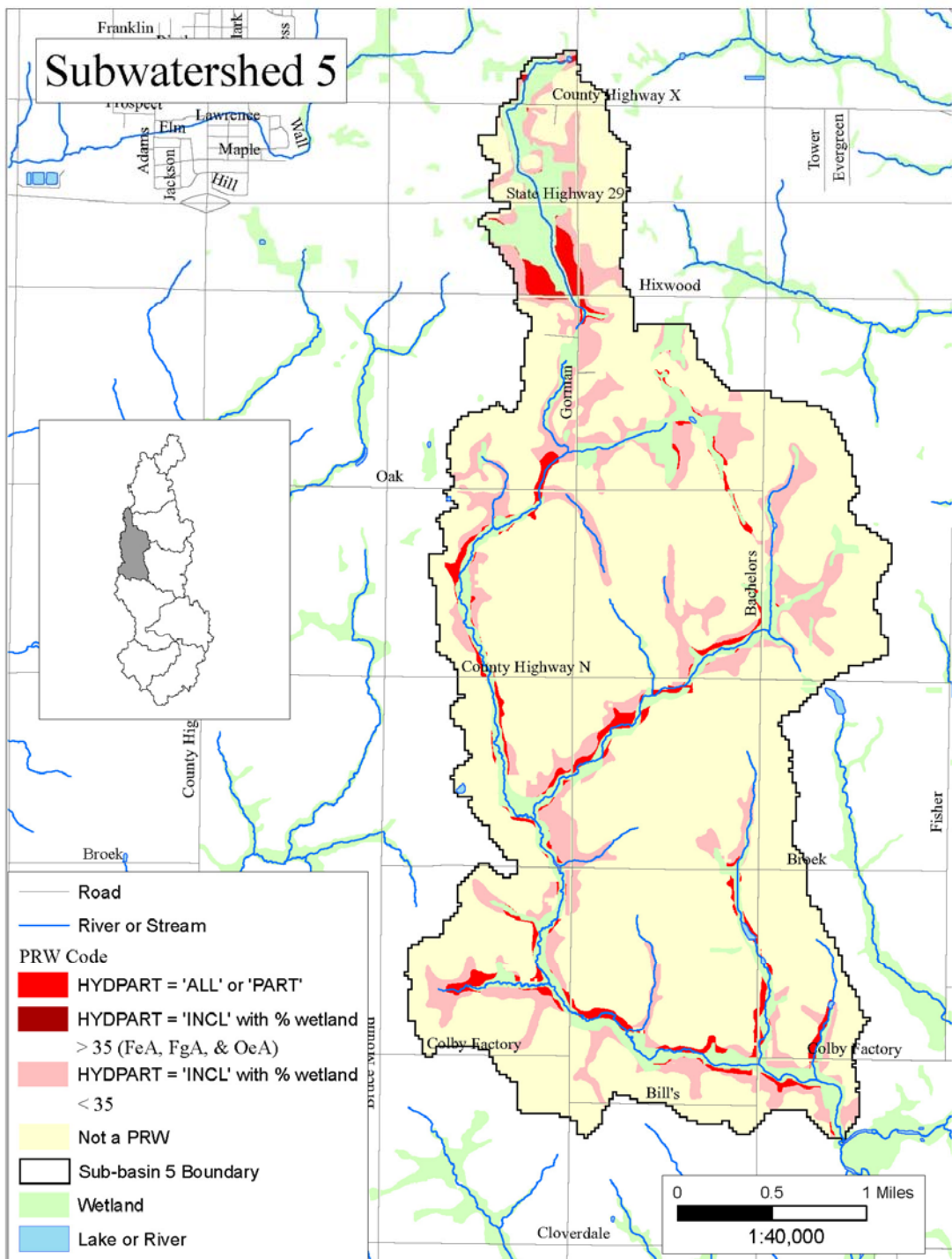
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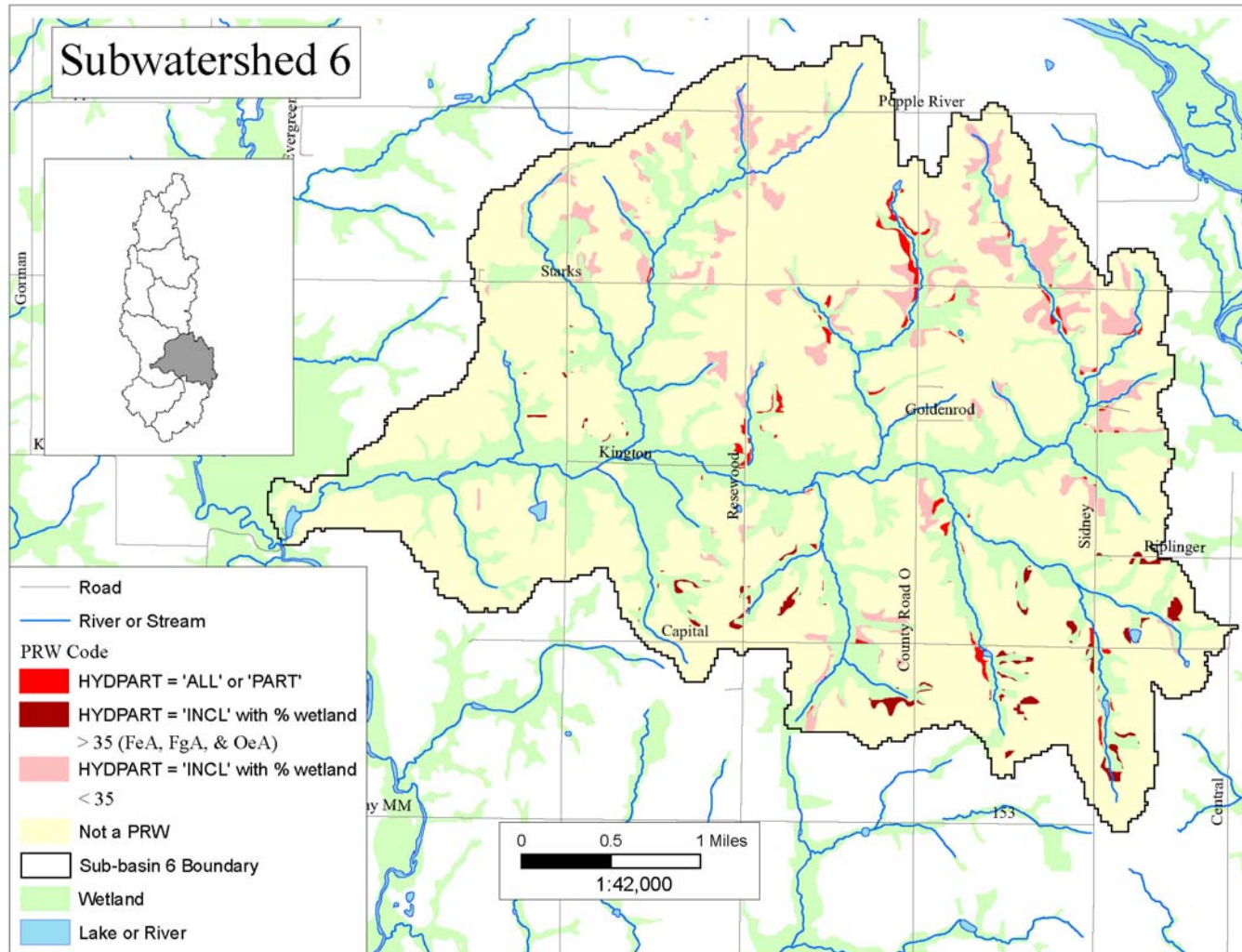
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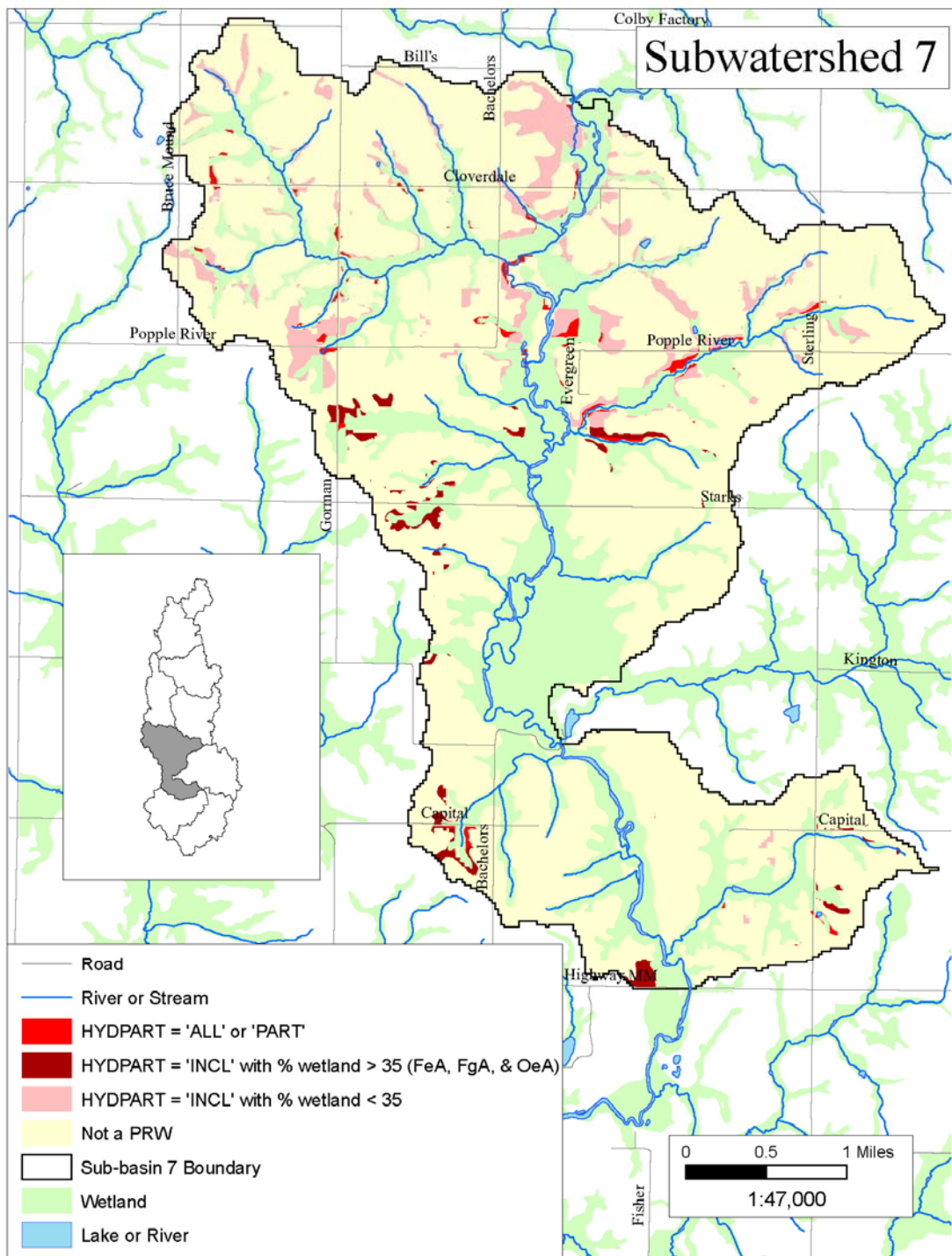
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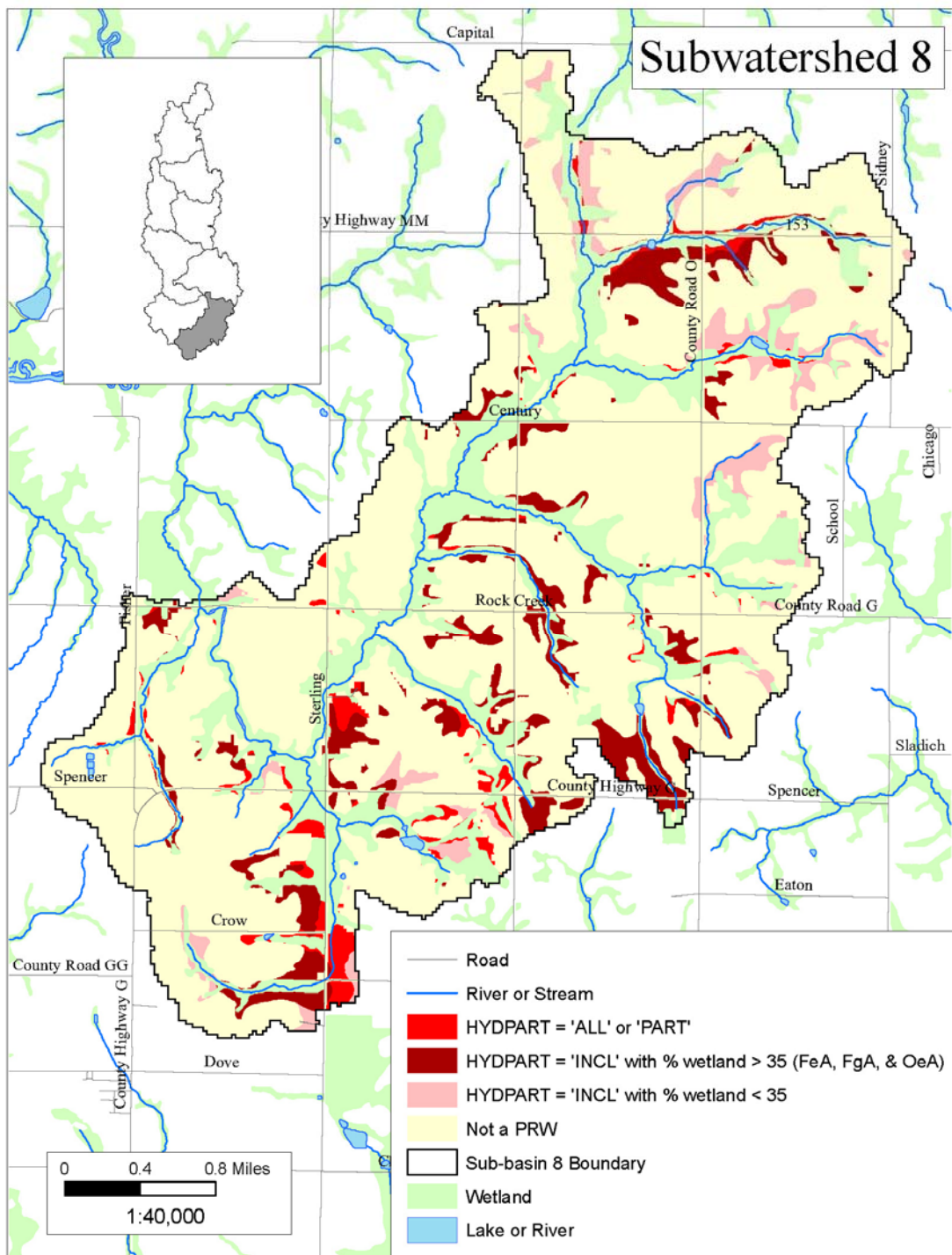
Subwatershed 6



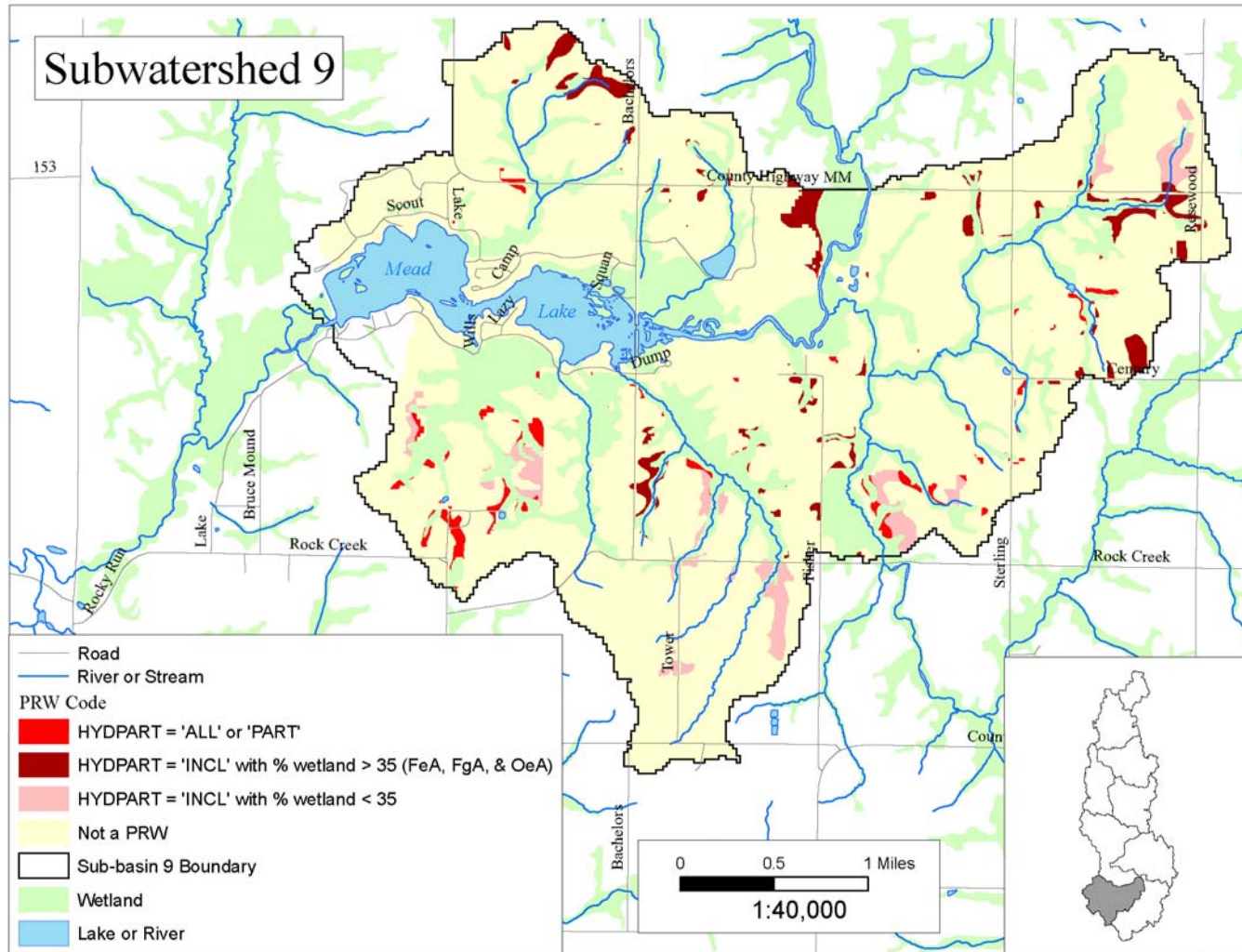
Subwatershed 7



Subwatershed 8



Subwatershed 9



Appendix B - PRW and Water Quality Decision Documentation

Appendix B 1. Data Dictionary for Potentially Restorable Wetlands

PURPOSE:

Develop a GIS data layer, which represents areas of potential wetland restoration. The theory is that if an area can be identified as an historic wetland but is not currently mapped as a wetland and if the area is in agricultural production then it may represent a potential site for wetland restoration.

DATA SOURCES:

Hydric Soils

- ◆ NRCS SSURGO Soils - Clark County

Wetlands

- ◆ Digital Wisconsin Wetland Inventory, updated to 1994 for Clark County

Agricultural Lands

- ◆ Clark County Land Use
- ◆ WISCLAND Land Cover. Used where Clark County land use was classified as "Other Resource Land", to identify and exclude land cover (primarily forested) determined to be not potentially restorable.

Item Definition and Description (Based on mlprw_part2.dbf)

Name	Type	Width	Decimal
AREA	Num	10	3
PERIMETER	Num	8	3
LUSE_CODE	Char	3	
ACRES	Num	10	2
LU_CLASS	Char	50	
GRID_CODE	Num	3	
DIS_AGRIC	Char	2	
WETCODE	Char	8	
MUSYM	Char	8	
HYDPART	Char	4	
HYDGP	Char	5	
DIS_WETL	Char	2	
WETLAND CLASS	Char	50	
ORIGINAL	Char	3	
REMAINING	Char	3	
LOST	Char	3	
PRW_CODE	Num	2	
SUBBASIN	Num	1	0

AREA: (num, 10, 3 dec) Area of polygon in sq. meters

PERIMETER: (num, 8, 3 dec) Length of polygon perimeter in meters

LUSE_CODE: (char, 1-3) Two - three letter codes that refer to Clark Co. land use categories.

Format: Characters Domain:

Land Use Code	Land Use Class
aq	Active Quarry
cmt	Cemetery
c	Commercial
cfl	County Forest Land
crl	County Resource Land
fc	Cropped Farm
pf	Farmsteads
gs	Government Services
im	Industrial/Manufacturing
i	Institutional
mfl	Managed Forest Land
mmh	Manufactured Housing
of	Other Farms
orl	Other Resource Land
pvr	Private Outdoor Recreation
pbr	Public Outdoor Recreation
pr	Public Roads
rr	Railroads
rmf	Residential-Multi-Family
rsf	Residential Single-Family
ss	Seasonal Structures
snr	Structure with No Residence
w	Surface Water
tcu	Transportation, Communications, and Utilities
tfh	Tree Farming/Horticulture
ud	Undeveloped

ACRES: (num, 6, 3 dec) Area of polygon in acres. Number of acres for each feature. Calculated using (AREA * 0.0002471044)

LU_CLASS: (char, 45) 26 named land use classes, as identified for Clark County.
 Format: Characters
 Domain: See list above.

GRID_CODE: (num, 3) Contains the numeric class values from the WISCLAND land cover.

Note: Although Clark Co. land use is being used, these codes are needed to subtract forested land from the ORL(Other Resource Land) category to identify PRW lands. Codes with "*" are considered feasible for PRW designation.

Format: numbers, no decimal

Domain:

Agriculture (coded 110 - 128)

- ◆ 112* Row Crops
- ◆ 113* Corn
- ◆ 118* Other Row Crops
- ◆ 124* Forage Crops (includes hay and hay mix)

Grassland (coded 150; includes timothy, rye, pasture, idle, CRP, grass and volunteer)

- ◆ 150* Grassland
Forest (coded 160 - 190)
- ◆ 162 Jack Pine
- ◆ 163 Red Pine
- ◆ 173 Mixed/Other Coniferous
- ◆ 176 Aspen
- ◆ 177 Oak
- ◆ 187 Mix/Other Broad-leaved Deciduous
- ◆ 190 Mixed Deciduous/Coniferous
- Open Water
- ◆ 200 Open Water
- Wetland (coded 210 - 234)
- ◆ 211* Emergent/Wet Meadow
- ◆ 217 Lowland Shrub
- ◆ 223 Forested, Broad-leaved Deciduous
- ◆ 229 Forested, Coniferous
- ◆ 234 Forested, Mixed Deciduous/Coniferous
- Barren (Limited ability to support life, less than 33% has vegetation or other cover.)
- ◆ 240* Barren

DIS_AGRIC: (char, 8). Designates land cover/land use as being agricultural or non-agricultural, based on Clark County land uses (A and X) and, within the Clark County "Other Resource Land" category, agricultural or non-agricultural designation is based on WISCLAND cover (AO and XO). "A" and "AO" designations indicate land uses that should not preclude wetland restoration.

Format: (Character, 1-2)

Domain:

- ◆ **A** Clark County land use class is Cropped Farm, Other Farm or Tree farm/horticulture. These are the primarily agricultural uses that have been classified as feasible for PRW designation.
- ◆ **X** Clark County Land uses NOT listed as "A" (above) and also NOT identified as "Other Resource Lands" (ORL). These are the primarily non-agricultural land uses that are not considered feasible for PRW designation.
- ◆ **AO:** Used exclusively for the Clark County "Other Resource Land" (ORL) Land Use Class. Includes land uses identified in WISCLAND that are considered to be suitable for PRWs. These are: Agriculture, Grassland, Wetlands that are Emergent/Wet meadow and Barren lands (see GRID_CODES with marked with an asterisk, above). EXCLUDES all lands identified as wetland on the WWI maps (DIS_WETL = X).
- ◆ **XO:** Used exclusively for the Clark County "Other Resource Land" (ORL) Land Use Class. Includes land uses identified in WISCLAND that are considered to be NOT suitable for PRWs. These are Forest and Forested and Lowland Shrub. INCLUDES all lands that are identified on the WWI maps (DIS_WETL = W).

WETCODE: (char, 26) Contains the vegetative mapping unit classifications from the Wisconsin Wetland Inventory data. Please refer to the [Wisconsin Wetland Inventory: Classification Guide](#) for a full listing of classification codes. In some cases the WETCODE may contradict the Wetland CLASS code due to varying resolution in source data or due to one data source being

more up-to-date than another. When these occur, users should rely on the Wetland CLASS codes for determining what's on the ground.

Format: char, mixed case

Domain: (too numerous to list)

MUSYM: (char, 8) Map Unit Symbol (soil types) used by the Natural Resource Conservation service.

Format: characters, mixed alphanumeric

Domain: (too numerous to list)

HYDPART: (char, 4) Hydric soil indicator as developed using the National Hydric Soils Criteria.

Format: char, All Capitals

Domain:

- ◆ ALL entire mapping unit is considered a hydric soil
- ◆ PART mapping units have parts that are hydric soils.
- ◆ INCL mapping unit contains hydric inclusions
- ◆ NONE non-hydric soil
- ◆ UN feature is not considered a soil (i.e. Gravel pit, open water)

HYDGP: (char, 5) The hydrologic group (infiltration/runoff) for a soil as defined by the Natural Resource Conservation Service (NRCS). HYDGR with a slash indicate conditions when that soil type is drained.

Format: char, all capitals with some forward slash symbols

Domain: *Domain can be a combination of these characters, such as C-A/D, C-B, or C-A/D.*

- ◆ **A** Class -A: high infiltration rates. Soils are deep, well drained to excessively drained sands and gravels
- ◆ **A/D** Class-A/D: Drained/undrained hydrology class of soils that can be drained and are classified.
- ◆ **B** Class-B: Moderate infiltration rates. Deep and moderately deep, moderately well and well drained soils that have moderately coarse textures.
- ◆ **B/D** Class-B/D: Drained/undrained hydrology class of soils that can be drained and re classified.
- ◆ **C** Class-C: Slow infiltration rates. Soils with layers impeding downward movement of water or soils that have moderately fine or fine textures.
- ◆ **C/D** Class-C/D: Drained/undrained hydrology class of soils that can be drained and are classified.
- ◆ **D** Class-D: Very slow infiltration rates. Soils are clayey, have a high water table, or are shallow to an impervious layer.
- ◆ **UN** Undetermined: typically assigned to a feature that is not classified as a soil

DIS_WETL: (char, 2) Indicates whether a feature is considered a wetland or non-wetland based on the WWI. This field was used to dissolve the WWI layer to produce another layer that was a thematic representation of wetlands. The field also provides an efficient way to query the data for a "wetland". Refer to Appendix __ for a full description of the various codes that went into defining a wetland for this project.

Format: single character

Domain:

- ◆ W - Wetland as identified on the WWI layer.
- ◆ X - Not a Wetland on the WWI layer.

WETLAND CLASS: (50, char) Provides a text description of the wetland classifications as found in the Wisconsin Wetland Inventory wetland data.

Format: text, mixed case

Domain:

- ◆ Emergent/wet meadow
- ◆ Filled/drained wetland
- ◆ Forested
- ◆ Open water
- ◆ Scrub/shrub
- ◆ Upland

ORIGINAL: (char, 3) indicates whether the feature is considered an original wetland. For this project, an "original" wetland:

- is mapped as a wetland or is mapped as a filled or drained wetland in WWI, **OR**
- is defined as having soils indicative of wetland history (HYD_PART=ALL, PART or specified INCL soils with \geq 35% wet (FeA, FgA and OeA)).

Format: char, all capitals

Domain:

- ◆ YES Fulfills the definition of an original wetland (DIS_WETL=W, **OR** WET CLASS=filled or drained **OR** HYD-PART=ALL or PART or specified INCL soils)
- ◆ NO Does not fulfill the definition of an original wetland (DIS_WETL=X **OR** HYD_PART= NONE or INCL < 35% wet).
- ◆ NA Just 6 polygons (1.4 acres) where DIS_WETL=X and HYD_PART is blank. It is not currently a wetland, **AND** hydric soil information is absent.

REMAINING: (char, 3) indicates features mapped as wetlands on the WWI, and therefore considered to currently exist.

Format: char, all capitals

Domain:

- ◆ YES Is mapped as wetlands on the WWI (DIS_WETL = W).
- ◆ NO Is not mapped as wetlands on the WWI (DIS_WETL = X).

LOST: (char, 3) indicates that a feature was historically a wetland (ORIGINAL = YES) but no longer is classified as a wetland (REMAINING = NO).

Format:

Domain:

- ◆ YES Was originally a wetland (ORIGINAL=YES) **AND** is not now a wetland (REMAINING=NO).
- ◆ NO Was originally and still is a wetland (ORIGINAL and REMAINING are YES).
- ◆ NA Was never considered an Original wetland for this project (ORIGINAL=NO or NA).

PRW_CODE: (num, 2) Indicates whether a feature fulfills the definition of a potentially restorable wetland (PRW). For this project, a potential site is one that

- is in agricultural production (DIS_AGRIC=A or AO), **AND**
- is not currently mapped as a wetland (DIS_WETL=X, REMAINING=NO), **AND**
- has soils indicative of a wetland history (ORIGINAL=YES).

Where HYDPART = 'INCL' and all other criteria for PRW are met, the PRW_CODE = 2 or 3. This is done to show 'adjacency opportunities' for PRWs. Where the hydric soils make up 35% or more of the inclusion, PRW_CODE =2. Where they make up less than 35%, PRW_CODE = 3.

Format: numbers, no decimal

Domain:

- ◆ 1 HYDPART = 'ALL' or 'PART' **AND** other criteria for PRW are met.
- ◆ 2 HYDPART = 'INCL' and the musym is one of the three soils that have a wetland percentage above 35% (FeA, FgA, and OeA) **AND** other criteria for PRW are met.
- ◆ 3 HYDPART = 'INCL' and the musym is a soil type with a wetland percentage below 35% **AND** other criteria for PRW are met, EXCEPT that in this case, ORIGINAL=NO.
- ◆ 99 Is not a potential site. HYDPART=NONE.

SUBBASIN: (num, 1-9) Identifies each of 9 separate delineated subwatershed. Subwatershed numbering is the same as that used for the SWAT modeling process.

Appendix B 2. Data Dictionary Logic

DIS_AGRIC

- A: LU_CLASS = Cropped Farm, Other Farm or Tree farm/horticulture
- X: LU_CLASS = all others EXCEPT ORL
- AO: LU_CLASS = ORL **AND** WISCLAND codes (GRID_CODE) suitable for PRW
- XO: LU_CLASS = ORL **AND NOT** WISCLAND codes suitable for PRW

DIS_WETL

- W: All polygons identified as wetlands on WWI (dissolve of WWI wet codes)
- X: All polygons NOT identified as wetlands on WWI

ORIGINAL (wetlands):

- YES: DIS_WETL = W **OR** HYD_PART = (ALL or PART or specified INCL >35% - FeA, FgA, and OeA) **OR** WETL CLASS = filled or drained
- NO: DIS_WETL = X **AND** HYD_PART = (NONE or specified INCL <35% wetland)
- NA: (1.4 acres of Public Roads where DIS_WETL = X **AND** HYD_PART = Blank. 6 polygons.

REMAINING (wetlands):

- YES: DIS_WETL = W
- NO: DIS_WETL = X
-

LOST (wetlands):

- YES: ORIGINAL = YES **AND** REMAINING = NO (DIS_WETL=NO)
- NO: ORIGINAL = YES **AND** REMAINING = YES (DIS_WETL=YES)
- NA: ORIGINAL = NO or NA (if ORIGINAL ≠ YES, then LOST is not applicable)

PRW_CODE: DIS_AGRIC = A or AO **AND** DIS_WETL = X **AND** ORIGINAL = YES,

- 1: HYDPART = ALL or PART
- 2: HYDPART = specified INCL >35% wetland

DIS_AGRIC = A or AO **AND** DIS_WETL = X **AND** ORIGINAL = NO,

- 3: HYDPART = specified INCL <35% (coded separately for adjacency information)
- 99: HYDPART = NONE

Appendix B 3. Matrix for DIS_AGRIC, LU_CLASS AND WISCLAND GRID_CODE Combinations

DIS_AGRIC	LU_CLASS	WISCLAND GRID_CODE
A	Cropped Farm	NA
A	Other Farm	NA
A	Tree farm/horticulture	NA
X	Active Quarry	NA
X	Cemetery	NA
X	Commercial	NA
X	County Forest Land	NA
X	County Resource Land	NA
X	Farmsteads	NA
X	Government Services	NA
X	Industrial/Manufacturing	NA
X	Institutional	NA
X	Managed Forest Law	NA
X	Manufactured Housing	NA
X	Other Resource Land	NA
X	Private Outdoor Recreation	NA
X	Public Outdoor Recreation	NA
X	Public Roads	NA
X	Railroads	NA
X	Residential-Multi-Family	NA
X	Residential Single-Family	NA
X	Seasonal Structures	NA
X	Structure with No Residence	NA
X	Surface Water	NA
X	Transportation and Utilities	NA
X	Undeveloped	NA
AO	Other Resource Land	<u>112*</u> Row Crops
AO	Other Resource Land	<u>113*</u> Corn
AO	Other Resource Land	<u>118*</u> Other Row Crops
AO	Other Resource Land	<u>124*</u> Forage Crops (includes hay and hay mix)
AO	Other Resource Land	<u>150*</u> Grassland
AO	Other Resource Land	<u>211*</u> Emergent/Wet Meadow
AO	Other Resource Land	<u>240*</u> Barren
XO	Other Resource Land	<u>162</u> Jack Pine
XO	Other Resource Land	<u>163</u> Red Pine
XO	Other Resource Land	<u>173</u> Mixed/Other Coniferous
XO	Other Resource Land	<u>176</u> Aspen
XO	Other Resource Land	<u>177</u> Oak
XO	Other Resource Land	<u>187</u> Mix/Other Broad-leaved Deciduous
XO	Other Resource Land	<u>190</u> Mixed Deciduous/Coniferous
XO	Other Resource Land	<u>200</u> Open Water
XO	Other Resource Land	<u>217</u> Lowland Shrub
XO	Other Resource Land	<u>223</u> Forested, Broad-leaved Deciduous
XO	Other Resource Land	<u>229</u> Forested, Coniferous
XO	Other Resource Land	<u>234</u> Forested, Mixed Deciduous/Coniferous

Appendix B 4. Matrix for Agricultural, Open/Wooded and Urban Land Uses

Matrix for DIS_AGRIC, DIS_NAT, DIS_URB, LU_CLASS AND WISCLAND GRID_CODE combinations

DIS_AGRIC	DIS_AG_LU	DIS_NAT	DIS_URB	Clark Co. LU_CLASS	WISCLAND GRID_CODE
A	A	X	X	Cropped Farm	NA
A	A	X	X	Other Farm	NA
A	A	X	X	Tree farm/horticulture	NA
X	X	X	X	Active Quarry	NA
X	X	X	U	Cemetery	NA
X	X	X	U	Commercial	NA
X	X	N	X	County Forest Land	NA
X	X	N	X	County Resource Land	NA
X	X	N	X	Farmsteads	NA
X	X	X	U	Government Services	NA
X	X	X	U	Industrial/Manufacturing	NA
X	X	X	U	Institutional	NA
X	X	N	X	Managed Forest Land	NA
X	X	X	U	Manufactured Housing	NA
X	X	N	X	Other Resource Land	NA
X	X	N	X	Private Outdoor Recreation	NA
X	X	N	X	Public Outdoor Recreation	NA
X	X	X	U	Public Roads	NA
X	X	X	U	Railroads	NA
X	X	X	U	Residential-Multi-Family	NA
X	X	X	U	Residential Single-Family	NA
X	X	X	U	Seasonal Structures	NA
X	X	X	U	Structure with No Residence	NA
X	X	N	X	Surface Water	NA
X	X	X	U	Transportation and Utilities	NA
X	X	N	X	Undeveloped	NA
AO	AO	XO	XO	Other Resource Land	<u>112*</u> Row Crops
AO	AO	XO	XO	Other Resource Land	<u>113*</u> Corn
AO	AO	XO	XO	Other Resource Land	<u>118*</u> Other Row Crops
AO	AO	XO	XO	Other Resource Land	<u>124*</u> Forage Crops (incl hay and hay mix)
AO	XO	NO	XO	Other Resource Land	<u>150*</u> Grassland
AO	XO	NO	XO	Other Resource Land	<u>211*</u> Emergent/Wet Meadow
AO	XO	NO	XO	Other Resource Land	<u>240*</u> Barren
XO		NO	XO	Other Resource Land	<u>162</u> Jack Pine
XO		NO	XO	Other Resource Land	<u>163</u> Red Pine
XO		NO	XO	Other Resource Land	<u>173</u> Mixed/Other Coniferous
XO		NO	XO	Other Resource Land	<u>176</u> Aspen
XO		NO	XO	Other Resource Land	<u>177</u> Oak
XO		NO	XO	Other Resource Land	<u>187</u> Mix/Other Broad-leaved Deciduous
XO		NO	XO	Other Resource Land	<u>190</u> Mixed Deciduous/Coniferous
XO		NO	XO	Other Resource Land	<u>200</u> Open Water
XO		NO	XO	Other Resource Land	<u>217</u> Lowland Shrub
XO		NO	XO	Other Resource Land	<u>223</u> Forested, Broad-leaved Deciduous
XO		NO	XO	Other Resource Land	<u>229</u> Forested, Coniferous
XO		NO	XO	Other Resource Land	<u>234</u> Forested, Mixed Deciduous/Coniferous

Appendix C - Clark County Soils and PRW Grouping

This appendix shows the soils data tables for the four PRW soils categories:

- PRW1 - Soils are classified as ALL or PART hydric.
- PRW2 - Soils are classified as INCL and are one of three soils having a wetland inclusion percentage above 35 percent (FeA, FgA and OeA).
- PRW3 - Soils are classified as INCL but the soils have a wetland inclusion percentage less than 35 percent.
- PRW99 - Soils are classified as not hydric.

Appendix C 1. PRW1 Soils

Soil Type	Hyd part	# Acres Mapped as Wetland	Total # of Acres	% Wet land	On Clark Hyd Soils List?*	Soil Legend from "Index to Maps Sheet", Clark Co. WI**	Soil Classification (from Table 20)**	Wetland Plants**	Shallow Water Areas**	Wetland Wildlife**
Au	All	1330.8	2131.3	62%	Y	Auburndale silt loam 0-2%	Auburndale Fine-silty, mixed, frigid Mollic Epiaqualfs	Good	Good	Good
Ba	All	375.3	507.5	74%	Y	Barronett silt loam 0-2%	Barronett Fine-silty, mixed, frigid Mollic Endoaqualfs	Good	Good	Good
Ca	All	2599.1	3550.7	73%	Y	Capitola-Marshfield-Veedum complex 0-2%	Capitola Coarse-loamy, mixed, frigid Mollic Epiaqualfs Marshfield Fine-loamy, mixed, frigid Mollic Epiaqualfs Veedum Fine-loamy, mixed, acid, frigid Humic Epiaquepts	Good	Good	Good
Cd	All	27.7	41.1	67%	Y	Citypoint mucky peat 0-1%	Citypoint Dysic Typic Borosaprists	Poor	Good	Fair
Fm	All	521.6	692.7	75%	Y	Fordum silt loam 0-2%	Fordum Coarse-loamy, mixed, nonacid, frigid Mollic Fluvaquents	Good	Good	Good
Lm	All	606.7	792.9	77%	Y	Loxley, Beseman, Dawson peats, 0-1%	Loxley Dysic Typic Borosaprists Beseman Loamy, mixed, dysic Terric Borosaprists Dawson Sandy or sandy-skeletal, mixed, dysic Terric Borosaprists	Good	Good	Good
Me	All	760.5	983.3	77%	Y	Markey-Newson mucks, 0-2%	Markey Sandy or sandy-skeletal, mixed, euic Terric Borosaprists Newson Mixed, frigid Humaqueptic Psammaquents	Good	Good	Good
Mf	All	238.9	405.9	59%	Y	Marshfield silt loam 0-2%	Marshfield Fine-loamy, mixed, frigid Mollic Epiaqualfs	Good	Good	Good
Pv	All	246.9	323.7	76%	Y	Ponycreek-Dawsil complex 0-2%	Ponycreek Siliceous, frigid Humaqueptic Psammaquents Dawsil Sandy or sandy-skeletal, siliceous, dysic Terric Borosaprists	Good/ Poor	Good/ Good	Good/ Fair
Rb	All	205.9	247.1	83%	Y	Rib silt loam 0-2%	Rib Fine-silty over sandy or sandy-skeletal, mixed, nonacid, frigid Mollic Endoaquepts	Good	Good	Good

Soil Type	Hyd part	# Acres Mapped as Wetland	Total # of Acres	% Wet land	On Clark Hyd Soils List?*	Soil Legend from "Index to Maps Sheet", Clark Co. WI**	Soil Classification (from Table 20)**	Wetland Plants**	Shallow Water Areas**	Wetland Wildlife**
Ve	All	220.5	311.1	71%	Y	Veedum silt loam	Veedum Fine-loamy, mixed, acid, frigid Humic Epiaquepts	Good	Good	Good
Vs	All	564.4	759.1	74%	Y	Veedum-Elm Lake mucks 0-2%	Veedum Fine-loamy, mixed, acid, frigid Humic Epiaquepts Elm Lake Sandy over loamy, siliceous, acid, frigid Humaqueptic Epiaquepts	Good	Good	Good

** Taken from Clark County Published Soils Survey Maps, Soil Data & Descriptions 2002

<ftp://ftp-fc.sc.egov.usda.gov/WI/Soil/surveys/clark/clark.pdf>

Appendix C 2. PRW2 Soils

Soil Type	Hyd part	# Acres Mapped as Wet land	Total # of Acres	% Wet land	On Clark Hyd Soils List?*	Soil Legend from "Index to Maps Sheet", Clark Co. WI	Soil Classification (from Table 20)	**Wet land Plants	Shallow Water Areas**	**Wet land Wildlife
PRW = 2 Soils										
FeA	Incl	1157.7	2868.6	40%	Y	Fairchild-Elm Lake complex 0-3%	Elm Lake Sandy over loamy, siliceous, acid, frigid Humaqueptic Epiaquents Fairchild Sandy over loamy, siliceous, frigid Ultic Epiaquods	Fair/ Poor	Fair/ Good	Fair/ Fair
FgA	Incl	1805.3	5054.0	36%	Y	Fallcreek-Merrillan complex 0-3%	Fallcreek Coarse-loamy, mixed Aquic Glossoboralfs Merrillan Coarse-loamy over clayey, mixed, frigid Ultic Epiaquods	Fair	Fair	Fair
OeA	Incl	82.9	166.4	50%	Y	Oesterle loam 0-3%	Oesterle Coarse-loamy, mixed Aquic Glossoboralfs	Poor	Poor	Poor

** Taken from Clark County Published Soils Survey Maps, Soil Data & Descriptions 2002

<ftp://ftp-fc.sc.egov.usda.gov/WI/Soil/surveys/clark/clark.pdf>

Appendix C 3. PRW3 Soils

Soil Type	Hyd part	# Acres Mapped as Wetland	Total # of Acres	% Wet land	On Clark Hyd Soils List?*	Soil Legend from "Index to Maps Sheet", Clark Co. WI	Soil Classification from Table 20. Classification of Soils	Wet land Plants	Shallow Water Areas	Wetland Wildlife
PRW = 3 Soils										
AgA	Incl	533.4	3690.8	14%	Y	Almena silt loam 0-3%	Almena Fine-silty, mixed Aquic Glossoboralfs	Fair	Fair	Fair
CmA	Incl	11.4	63.4	18%	Y	Comstock silt loam 0-3%	Comstock Fine-silty, mixed Aquic Glossoboralfs	Fair	Fair	Fair
FfA	Incl	326.0	1320.7	25%	Y	Fallcreek loam 0-3%	Fallcreek Coarse-loamy, mixed Aquic Glossoboralfs	Fair	Fair	Fair
HxB	Incl	23.0	578.1	4%	Y	Humbird-Merrillan fine sandy loams 0-6%	Humbird Coarse-loamy over clayey, mixed, frigid Oxyaquic Haplorthods Merrillan Coarse-loamy over clayey, mixed, frigid Ultic Epiquods	Poor/ Fair	V. Poor/ Fair	Poor/ Fair
KeA	Incl	207.7	703.5	30%	Y	Kert silt loam 0-3%	Kert Fine-loamy, mixed Aquic Glossoboralfs	Fair	Fair	Fair
LxB	Incl	37.3	741.8	5%	Y	Ludington-Fairchild sands, 0-6%	Ludington Sandy over loamy, siliceous, frigid Oxyaquic Haplorthods Fairchild Sandy over loamy, siliceous, frigid Ultic Epiquods	Poor	V. Poor	V. Poor
MaB	Incl	71.6	253.8	28%	Y	Magnor silt loam 0-4%	Magnor Coarse-loamy, mixed Aquic Glossoboralfs	Poor	Poor	Poor
McA	Incl	201.7	636.6	32%	Y	Maplehurst silt loam 0-3%	Maplehurst Fine-silty, mixed Aquic Glossoboralfs	Fair	Fair	Fair
MpA	Incl	350.0	1189.6	29%	Y	Merrillan fine sandy loam 0-3%	Merrillan Coarse-loamy over clayey, mixed, frigid Ultic Epiquods	Fair	Fair	Fair
WeA	Incl	363.6	2483.9	15%	Y	Withee silt loam 0-3%	Withee Fine-loamy, mixed Aquic Glossoboralfs	Poor	Poor	Poor
WkA	Incl	296.6	873.9	34%	Y	Withee-Kert silt-loams 0-3%	Withee Fine-loamy, mixed Aquic Glossoboralfs Kert Fine-loamy, mixed Aquic Glossoboralfs	Poor/ Fair	Poor/ Fair	Poor/ Fair

Appendix C 4. PRW99 Soils

Soil Type	Hyd part	# Acres Mapped as Wet land	Total # of Acres	% Wet land	On Clark Hyd Soils List?*	Soil Legend from "Index to Maps Sheet", Clark Co. WI	Soil Classification (from Table 20)	Wet land Plants	Shal low Water Areas	Wet land Wildlife
BrA	None	11.7	70.8	17%	N	Brander silt loam 0-3%	Brander Fine-silty over sandy or sandy-skeletal, mixed Oxyaquic Glossoboralfs	Poor	Poor	Poor
EaB	None	25.8	1134.3	2%	N	Eauclaire loamy sand, 1 to 6%	Eauclair Sandy, mixed, frigid Oxyaquic Haplorthods	V. Poor	V. Poor	V. Poor
FhB	None	89.4	7365.7	1%	N	Flambeau loam, 1 to 6%	Flambeau Fine-loamy, mixed Oxyaquic Glossoboralfs	Poor	V. Poor	V. Poor
FhC	None	2.6	331.3	1%	N	Flambeau loam, 6 to 12%	Flambeau Fine-loamy, mixed Oxyaquic Glossoboralfs	V. Poor	V. Poor	V. Poor
FkB	None	44.0	2738.9	2%	N	Flambeau sandy loam, 1-6%	Flambeau Fine-loamy, mixed Oxyaquic Glossoboralfs	Poor	V. Poor	V. Poor
FIB	None	91.8	1886.4	5%	N	Flambeau-Humbird complex 1-6%	Flambeau Fine-loamy, mixed Oxyaquic Glossoboralfs Humbird Coarse-loamy over clayey, mixed, frigid Oxyaquic Haplorthods	Poor	V. Poor	V. Poor - Poor
FIC	None	57.3	2635.6	2%	N	Flambeau-Humbird sandy loams 6-12%	Flambeau Fine-loamy, mixed Oxyaquic Gossoboralfs Humbird Coarse-loamy over clayey, mixed, frigid Oxyaquic Haplorthods	V. Poor - Poor	V. Poor	V. Poor - Poor
FnB	None	8.1	437.1	2%	N	Freeon silt loam, 2-6%	Freeon Coarse-loamy, mixed Oxyaquic Glossoboralfs	V. Poor	V. Poor	V. Poor
HeB	None	24.7	589.7	4%	N	Hiles silt loam, 1 -6%	Hiles Fine-loamy, mixed Oxyaquic Glossoboralfs	Poor	V. Poor	V. Poor
HuB	None	70.6	2399.2	3%	N	Humbird fine sandy loam, 1-6%	Humbird Coarse-loamy over clayey, mixed, frigid Oxyaquic Haplorthods	Poor	V. Poor	V. Poor
HuC	None	55.4	1371.4	4%	N	Humbird fine sandy loam, 6-12%	Humbird Coarse-loamy over clayey, mixed, frigid Oxyaquic Haplorthods	Poor	V. Poor	V. Poor
LoB	None	130.7	16081.7	1%	N	Loyal silt loam, 1-6%	Loyal Fine-loamy, mixed Oxyaquic Glossoboralfs	Poor	V. Poor	V. Poor
LoC	None	4.7	1115.7	0%	N	Loyal silt loam, 6-12%	Loyal Fine-loamy, mixed Oxyaquic Glossoboralfs	Poor	V. Poor	V. Poor
LsB	None	12.5	528.4	2%	N	Loyal-Hiles silt loams, 1 -6%	Loyal Fine-loamy, mixed Oxyaquic Glossoboralfs Hiles Fine-loamy, mixed Oxyaquic Glossoboralfs	Poor	V. Poor	V. Poor
LsC	None	8.8	788.4	1%	N	Loyal-Hiles silt loams, 6-12%	Loyal Fine-loamy, mixed Oxyaquic Glossoboralfs Hiles Fine-loamy, mixed Oxyaquic Glossoboralfs	Poor	V. Poor	V. Poor
LuB	None	64.1	926.5	7%	N	Ludington sand, 1-6%	Ludington Sandy over loamy, siliceous, frigid Oxyaquic Haplorthods	Poor	V. Poor	V. Poor

Mead Lake Watershed Wetland Assessment Project

Soil Type	Hyd part	# Acres Mapped as Wet land	Total # of Acres	% Wet land	On Clark Hyd Soils List? *	Soil Legend from "Index to Maps Sheet", Clark Co. WI	Soil Classification (from Table 20)**	**Wet land Plants	**Shal low Water Areas	**Wet land Wildlife
LuC	None	25.3	792.1	3%	N	Ludington sand,6-12%	Ludington Sandy over loamy, siliceous, frigid Oxyaquic Haplorthods	V. Poor	V. Poor	V. Poor
MgB	None	11.2	164.7	7%	N	Menahga loamy sand, 0-6%	Menahga Mixed, frigid Typic Udipsamments	V. Poor	V. Poor	V. Poor
NeB	None	8.5	15.8	54%	N	Newood sandy loam 2-6% v. stony	Newood Coarse-loamy, mixed, frigid Oxyaquic Haplorthods	Poor	V. Poor	V. Poor
NoC	None	5.6	258.2	2%	N	Northmound flaggy silt loam, 6-15%	Northmound Loamy-skeletal, mixed Typic Glossoboralfs	V. Poor	V. Poor	V. Poor
NrF	None	1.1	531.5	0%	N	Northmound-Rock outcrop complex 15-50%	Northmound Loamy-skeletal, mixed Typic Glossoboralfs	V. Poor	V. Poor	V. Poor
Pg	None	6.4	62.9	10%	N	Pits	Pits	V. Poor	V. Poor	V. Poor
RkA	None	152.1	526.7	29%	N	Rockdam sand 0-3%	Rockdam Sandy, siliceous, frigid Entic Haplorthods	Poor	V. Poor	V. Poor
RzB	None	1.0	17.7	6%	N	Rozellville silt loam, 2-6%	Rozellville Fine-loamy, mixed Typic Glossoboralfs	Poor	V. Poor	V. Poor
RzC	None	5.8	33.5	17%	N	Rozefille silt loam6-12%	Rozellville Fine-loamy, mixed Typic Glossoboralfs	Poor	V. Poor	V. Poor
ScA	None	1.4	12.8	11%	N	Simescreek sand 0-3%	Simescreek Frigid, uncoated Typic Quartzipsamments	V. Poor	V. Poor	V. Poor
SrB	None	20.3	2563.7	1%	N	Spencer silt loam, 2-6%	Spencer Fine-silty, mixed Oxyaquic Glossoboralfs	Poor	V. Poor	V. Poor

** Taken from Clark County Published Soils Survey Maps, Soil Data & Descriptions 2002

<ftp://ftp-fc.sc.egov.usda.gov/WI/Soil/surveys/clark/clark.pdf>

Appendix D - Processing Documentation

Appendix D 1. Processing Documentation for Potentially Restorable Wetland Layer

Mead Lake Wetland Project Processing the Potentially Restorable Wetland Layer Using Agricultural Lands

OBJECTIVE: Create a GIS data layer that represents areas of potential wetland restoration sites using hydric soils, wetlands, and agricultural lands as the base layers. The theory is that if an area can be identified as likely to be historic wetland, but is not currently mapped as a wetland and if the area is in agricultural production, then it may represent a potential site for wetland restoration.

PURPOSE: This datalayer is designed for landscape level analysis. Existing data sets were used as the base layers. No attempt was made to resolve inconsistencies in different classification systems, nor in the geometry of the features.

PROCESSING ENVIRONMENT: ArcView version 3.2a on a Windows NT desktop, ArcGis v.8.2, ArcInfo workstation v.8.3

A. DATA SOURCES:

A.1 Hydric Soils

NRCS SSURGO Soils - Clark, Eau Claire, and Taylor Counties

A.2 Wetlands

Digital Wisconsin Wetland Inventory, updated to 1994 for Clark County

A.3 Agricultural Lands

WISCLAND Land Cover (for Eau Claire and Taylor Counties)

Clark County Land Use

B. DATA PROCESSING - HYDRIC SOILS

B1. NRCS Soils

- a) The source data for all three counties (Clark, Eau Claire, and Taylor) was provided in a county-wide data layer. Clark County data was processed slightly different than Eau Claire and Taylor Counties. These two counties had two different tables with the necessary data without a common item to do the join. A more detailed documentation of the soils processing is in C:\data\meadlake\GIS\doc.
- b) The Clark County soils shapefile was joined with the data table using the common item MUSYM. The Taylor and Eau Claire County soils data had to be joined using the soils tool that sits on ArcView. Any new soils data coming from NRCS will be in this format.
- c) The county soils layers were clipped to the LC16 basin boundary using ArcView Geoprocessing Wizard.
- d) The 3 shape files were converted to Arc coverages using ArcTool. This was done because the edge matching and other editing is easier and faster in ArcEdit.
- e) The county soils data was not consistent in the item names and the item definitions. The PAT was edited so that all of the item names and definitions were identical. The HYDPART items were not consistent, for example Clark had a

definition of 'All' while in Eau Claire and Taylor this was coded as 'All Hydric'. The values for the HYDPART item were changed to be consistent in all the coverages.

- f) The coverages were appended using the ArcTool Append Wizard, which is essentially the same as using the Geoprocessing Wizard in ArcView to append shapefiles.
- g) The appended soils coverage for the LC16 watershed had a number of sliver polygons between county boundaries that had to be eliminated.
- h) The coverage is converted into a shapefile.

C. DATA PROCESSING - WETLANDS

C.1 Wisconsin Wetlands Inventory

- a) The source data was the Digital Wisconsin Wetland Inventory, updated to 1994 for Clark County.
- b) Coverage was dissolved on WETCODE.

D. DATA PROCESSING - AGRICULTURAL LANDS

D1. WISCLAND Land Cover

- a) The original WISCLAND data was clipped using a buffered coverage of LC16 watershed. The clip coverage was buffered to 100 meters to prevent the stair step appearance of the grid data along the watershed boundary.
- b) The clipped grid is converted to polygon coverage with GRIDPOLY in Arc.
- c) The following items are added to the polygon coverage; LUSE_CODE, ACRES, LU_CLASS, GRID-CODE, and DIS_AGRIC.
- d) In ArcEdit the agricultural lands were selected, GRID-CODE = 112, 113, 118, 124. No other agriculture classes were present in the WISCLAND data for this watershed.
- e) The polygon coverage (lcbuf_wisc) was then clipped to the areas of Eau Claire and Taylor County that fall within the LC16 watershed. The land cover data for Clark County is a different source provided by the County.

D2. Clark County Land Use

- a) The shapefile of Clark County land use was converted to Arc coverage.
- b) Unnecessary items were dropped from the Clark County Land Use coverage so that the items would match the items and definitions found in the Taylor and Eau Claire County land cover coverages.

D3. Merge Data Sources

- a) Combine the land use and land cover data for the 3 counties. Using Append Wizard in ArcToolbox to append the 3 coverages in to one. This works the same way as the append in the Geoprocessing Wizard in ArcView or ArcMap.
- b) The appended coverage had a number of sliver polygons and some missing arcs at the watershed boundary where Eau Claire and Clark Counties meet. After using ELIMINATE to get rid of many of the sliver, the remainder were fixed in ArcEdit.



Wisconsin Department of Natural Resources
P.O. Box 7921, Madison, WI 53707 • (608) 267-7694
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