WETLAND RESTORATION AND PRESERVATION PLAN

For Lake County, Illinois

ADOPTED
MONTH 2020

LAKE COUNTY
STORMWATER MANAGEMENT COMMISSION

VOLUME 1: TECHNICAL REPORT & USER GUIDE

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WETLAND RESTORATION AND PRESERVATION PLAN

FOR LAKE COUNTY, ILLINOIS

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Adopted: Month 2020

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LIST OF ACRONYMS

ADID	Advanced Identification of wetlands in Lake County, Illinois (1992 study)
DST	Decision Support Tool
ESRI	Environmental Systems Research Institute
GIS	Geographic Information System
FEMA	Federal Emergency Management Agency
EWI-LC	Existing Wetland Inventory - Lake County (enhanced existing polygons)
HWI-LC	Historic Wetland Inventory - Lake County (enhanced historic polygons)
INAI	Illinois Natural Areas Inventory
LCWI	Lake County Wetland Inventory
LLWW	Landscape position, landform, water flow path and water body type hydrogeomorphic classification scheme developed by the USFWS (R. Tiner)
NRCS	Natural Resources Conservation Service (formerly SCS)
NWI	National Wetlands Inventory
PRW	Potentially Restorable Wetlands
SCS	Soil Conservation Service (former name of NRCS)
SMC	Stormwater Management Commission
TAG	Technical Advisory Group
TMDL	Total Maximum Daily Load
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
W-PAWF	Watershed-based Preliminary Assessment of Wetland Functions
WRAPP	Wetland Restoration and Preservation Plan

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EXECUTIVE SUMMARY

Wetlands and water bodies provide important functions (services) that help maintain health and well-being for people and wildlife. Alteration and loss of wetlands/water bodies affects the level to which they provide these functions. In addition to quantifying wetland loss, the U.S. Environmental Protection Agency has made a strong push for understanding functional loss on a landscape level and incorporating that information into a watershed management context. Lake County has adopted a "no net loss" wetland policy and established an objective of a "net gain" of wetland function. This *Wetlands Restoration and Preservation Plan* (WRAPP) is intended to guide the selection of wetland sites for restoration and/or preservation in a non-regulatory context.

The Lake County Stormwater Management Commission (SMC) followed a six-step process to develop this WRAPP. *Step 1* involved collecting and integrating geographic information system (GIS) data sets. For *Step 2*, SMC enhanced the county's existing GIS database for wetlands and water bodies and constructed a database of those features in the pre-settlement era. For *Step 3*, SMC characterized the wetland and water bodies in each data set by applying biotic and abiotic codes developed by the U.S. Fish and Wildlife Service (e.g., plant community, water flow path, etc.). *Step 4* involved working closely with a technical advisory group (TAG) of local biologists, ecologists, and other specialists to perform a preliminary assessement of 13 wetland and water body functions: flood water storage, stream baseflow maintenance, nutrient transformation (phosphorus focus), sediment and other particulate retention, shoreline/stream bank stabilization, carbon sequestration, native fish habitat, waterfowl habitat, other wetland-dependent bird habitat, woodland amphibian habitat, unique wetland resources, stream shading, and wildlife movement corridors. This task also included assigning qualitative performance levels (high, moderate, low, n/a) to each function. For *Step 5*, SMC performed a desktop GIS-based preliminary assessment of wetland/water body functions. Lastly (*Step 6*), SMC and members of the TAG conducted Level 2 field studies on a sample population of 48 wetlands and water bodies throughout the county to refine the preliminary functional assessment. The refined data sets enabled prediction of 13 functions for wetlands and water bodies in Lake County and the relative level to which each function is provided.

Based on the GIS analysis, approximately 55 percent of Lake County's wetlands have been drained, filled, or converted to open water since the pre-settlement era. Using the two data sets from Step 2, SMC produced a data layer showing locations of potentially restorable wetlands (PRW). These areas identify restoration opportunities within Lake County, while the existing wetland data set identifies opportunities for wetland preservation and enhancement.

The key component of the WRAPP is an online decision-support tool (DST), which is designed to provide a wide-audience of end users with information and guidance to identify and prioritize opportunities for wetland restoration or preservation, based on site-specific goals.

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1.0 INTRODUCTION

1.1 Why are We Doing This?

Past studies suggest that Lake County, Illinois, has lost approximately 40 to 69 percent of the wetlands that existed prior to European settlement, primarily due to drainage for agriculture and conversion to urban land uses (Havera 1985 as referenced in Suloway and Hubbell 1994). The loss of wetlands and the important functions they provide have resulted in a higher risk of flooding, surface water quality degradation, and wildlife habitat deterioration. Recognizing these losses, Lake County has adopted a "no net loss" wetland policy and established an objective of a "net gain" of wetland function (SMC 2015, as amended, §102.10).

So, how do we decide where the best places are to restore or preserve wetlands as a means toward achieving the "no-net-loss" policy and objective of a "net gain" of wetland function? And what exactly are "wetland functions?" This plan is a *countywide planning effort* to help answers those questions by identifying and assessing the functional significance of existing, pre-settlement, and potentially restorable wetlands in Lake County. ***The goal of the plan is to provide a wide audience of end-users with the decision-making support to help prioritize wetland restoration and preservation efforts using an on-line decision support tool (DST).*** Landowners interested in implementing such practices can avail themselves of public- and private-sector expertise.

DEFINITIONS

Wetlands = Land that is flooded or saturated often enough and long enough to support plants adapted to living in saturated soil conditions.

Restoration = Reestablishment of wetlands where they previously existed.

Preservation = Actions taken to maintain the size and function of an existing wetland.

Enhancement = Actions taken to improve one or more functions of an existing wetland.

For the purposes of this document, *restoration* refers to the re-establishment of wetlands in areas where they previously existed and were altered by drainage activities or landscape modifications. *Preservation* and *Enhancement*, as used in this document, refer to actions taken to maintain or enhance (improve) the size and functions of an existing wetland or water body. *Potentially restorable wetlands* (PRW) refer to areas with predominantly wet (hydric) soils that

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The goal of the plan is to provide a wide audience of end-users with the decision-making support to help prioritize wetland restoration and preservation efforts

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are not mapped as wetlands on the Lake County Wetland Inventory (LCWI, updated 2002) and have not been converted to urban land use. They also include farmed wetlands. Most of the county's PRWs occur on land drained by subsurface tiles or surface ditches for agricultural purposes.

1.2 The Role of Wetland Restoration and Preservation

The SMC does not advocate preserving every remaining wetland or restoring wetlands to return to pre-settlement conditions. Wetlands are, however, like lakes, streams, meadows and forests, an important component of ecosystem integrity, which supports community and economic resilience. Voluntary wetland restoration and preservation, within the context of local planning, is a sound approach to balance the needs of communities and environmental quality.

Wetlands also aren't the solution to all flooding, water quality and wildlife habitat problems. Land use, agricultural practices, stormwater management and other engineered solutions work best when they are partnered with the natural features in the landscape.

1.3 Appropriate Use of This Report

The WRAPP is a *planning tool* designed to educate end-users on the various types and functions (services) of wetlands and water resources in Lake County and allow the users to make informed decisions on wetland restoration and preservation efforts, based on desired functions. The WRAPP is not intended to be prescriptive.

The WRAPP does not create any additional regulations or natural resource protections, replace the need for site-specific wetland delineations or jurisdictional determinations, or recommend land acquisition or zoning changes. Whether a PRW identified by the WRAPP is viable or not will depend on site-specific characteristics, landowner interest and ability, agency funding/priorities, and other factors.

Some examples of anticipated stakeholder interest and appropriate uses of the WRAPP may include the following:

- SMC incorporating WRAPP information into its watershed-based plans to identify PRWs and existing wetlands that could be considered for preservation based on stormwater storage, water quality or other high functional services. This would better position SMC for developing design plans and cost estimates for grant requests to direct limited funds to identified high priority wetland restoration projects.
- Community officials seeking to reduce flood risk by restoring wetlands to benefit flood-prone areas of their community.

- Private property owners near Lake Michigan desiring to preserve a unique ravine wetland.
- Homeowner associations and other community citizen groups seeking to protect or improve neighborhood assets.

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- Municipal and County land use planners using the WRAPP to identify high priority locations to protect/restore wetlands as green infrastructure to provide ecosystem services such as water quality improvement, stormwater storage to reduce flooding risk, and aquatic and terrestrial habitat by incorporating high priority restoration and preservation sites into updated land use/zoning plans.

- Forest Preserve ecologists striving to restore critical wetland habitat for important rare, threatened or endangered species.

- Wetland mitigation bankers seeking potential large-scale wetland restoration and enhancement opportunities.

- Natural resource/conservation agencies and organizations seeking to acquire and preserve unique/high quality aquatic resources.

- Private landowners desiring to protect natural resources, stormwater management, or other conservation values, or potentially realize a financial benefit by legally dedicating high priority wetland restoration-preservation sites on their property in perpetuity under a conservation easement.

- Land developers attempting to avoid high-quality wetlands and identify potential restoration wetlands to mitigate for unavoidable wetland impacts.

1.4 Limitations of the WRAPP

The WRAPP is a *countywide* plan that provides a basic wetland characterization, preliminary assessment of wetland functions, and remotely-sensed assessment of wetlands and water bodies in Lake County. As such, it is useful as an *initial screening tool* for prioritizing wetland restoration and preservation efforts and as an educational resource to help the user better understand the relationships between wetland characteristics and performance of individual functions. However, the WRAPP *does not* eliminate the need for site-specific assessments prior to developing actual restoration or preservation plans.

Any mapping effort relying on secondary data sources (including aerial photography and LiDAR), as this was, will inherently include limitations. For example, the 2002 LCWI that we used as the base for this plan may have omitted certain wetlands and water bodies due to scale and map complexity issues. For example, a 0.5-acre pocket of scrub-shrub or forested wetland may be "included" within a 3-acre wetland classified as emergent. Changes also could have occurred after SMC performed mapping enhancements for the existing conditions Geographic Information System (GIS) polygon layer. Examples include land use changes (e.g., conversion of agricultural land to developed areas with impermeable surfaces) and updated flood hazard mapping based on increased frequency and intensity of precipitation events (Angel and Markus 2020). Addtionally, new sources of data have become available that were not used for this project, including geological and hydrological map products as well as more recent aerial photography. These can be consulted by users as further resources.

Despite our best attempts at quality control, some errors of interpretation and classification are likely due to the sheer number of wetland and water body polygons in the Lake County GIS database. Finally, the WRAPP assumes that all wetlands and water bodies have value and uses generally accepted methods to compare broad levels of functionality. However, site-specific factors can produce variations in the type and degree of functions a wetland or water body provides (Kline et al. 2006).

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2.0 SETTING

Lake County is situated in the northeast corner of Illinois. The county is bordered by Cook County on the south; McHenry County on the west; Kenosha County, Wisconsin, on the north; and Lake Michigan on the east. The county comprises an area of 301,435 acres, or about 471 square miles (not including Lake Michigan water surface area) (Calsyn 2005). Geographically, Lake County drains via four major watersheds (**Figure 1**).

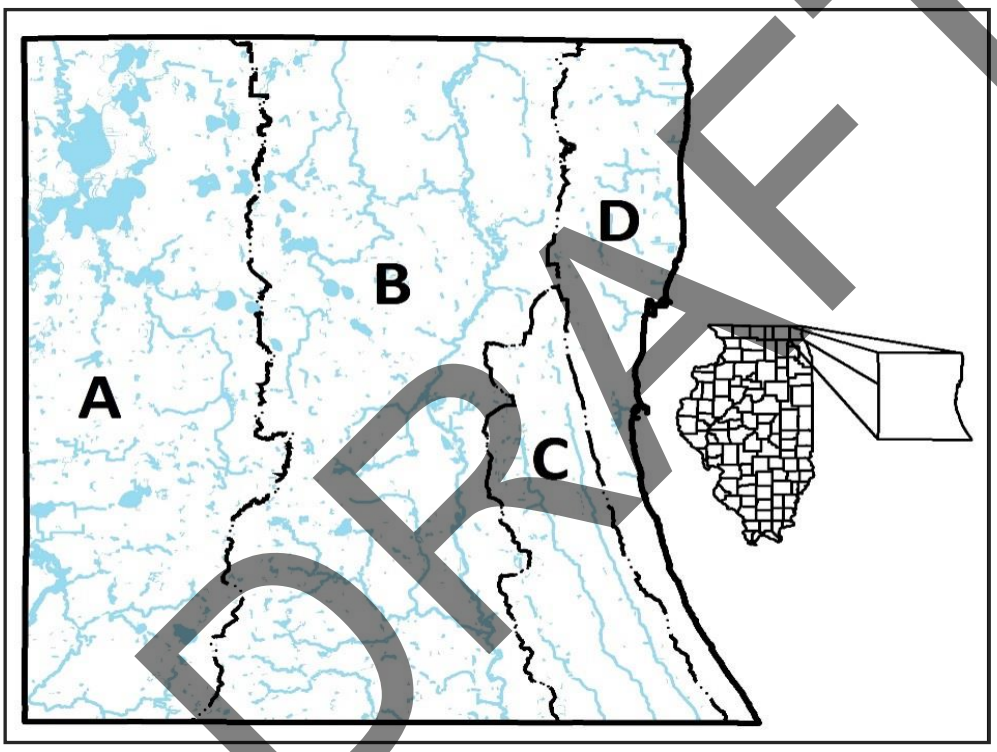

Figure 1. Major Watersheds in Lake County, Illinois. (A) Fox River. (B) Des Plaines River. (C) North Branch Chicago River. (D) Lake Michigan.

Topography (relief) in the county was caused by differences in the thickness of deposits deposited during the most recent glacial period. Generally, the land surface slopes gradually across the county from the highest point of 957 feet above mean sea level (MSL) on Gander Mountain in the northwest corner to the lowest point of 580 feet above MSL at the Lake Michigan shoreline near Waukegan.

The County was historically rich in wetlands, left behind when the last glaciers retreated about 10,000 years ago. Gently sloping land and poorly drained, clay-enriched soils derived from glacial drift combined to form slow, meandering stream systems with extensive associated wetland complexes. A study by the Illinois Natural History Survey (Havera 1985 as cited in Suloway and Hubbell 1994) estimated that 40 to 61 percent of the county was wetlands prior to European settlement in the early 1800s, based on the large extent of mapped hydric soils.

According to Lake County GIS data, approximately 74,700 acres are presently wetlands and water bodies, representing about 25 percent of the County's landscape. Thus, the word "Lake" in the county's name remains very appropriate. The Advanced Identification Study (ADID) for Lake County, Illinois (Dreher et al. 1992) identified 203 high-quality wetland sites and commented that "[t]he diverse ecosystems within wetlands offer necessary habitat for wildlife and plant communities, including many threatened and endangered species. Wetlands in the county are critical in controlling flooding, and in protecting hydrologic cycle functions such as groundwater recharge, flow attenuation, and maintenance of baseflows."

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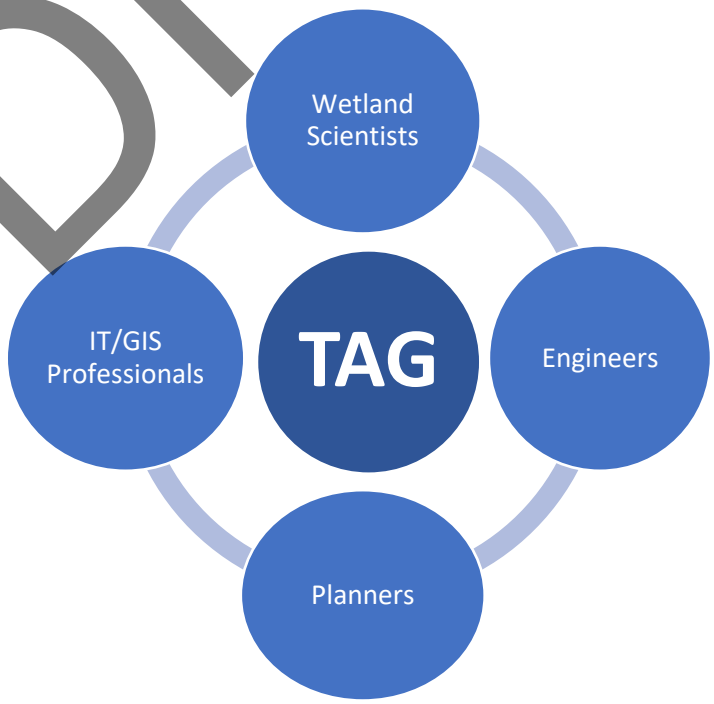
3.0 TECHNICAL ADVISORY GROUP (TAG)

To increase the accuracy and relevance of the WRAPP, SMC assembled a 13-member Technical Advisory Group (TAG) comprised of local and regional experts (e.g., Illinois-based specialists in the fields of wetland science, hydrology, water quality, soil science, biology/ecology, and information technology/GIS) who voluntarily provided advice and technical guidance during all phases of the WRAPP planning effort. The TAG members, along with other voluntary participants and supporters of this planning effort, are listed in the Acknowledgements section at the front of this report (page i).

The TAG involvement included, but was not limited to, the following tasks achieved through a series of office meetings and participation in field studies:

- Identification of potential end users of the WRAPP and guidance on plan development to meet user needs;
- Input on wetland/water body classification using descriptors from the Hydrogeomorphic Classification Method and System for Wetlands and National Wetlands Inventory (NWI) attributes;
- Selection of wetland/water body functions to be assessed;
- Review and refinement of correlations for functional assessment criteria and associated significance ratings to local conditions in Lake County (for efficiency in this task, the TAG was divided into three working groups based on their expertise and preferences);
- Selection of representative wetland and water body types (e.g., emergent, forested, lake, stream, etc.) for field study;
- Input on the field methodology developed specifically for assessment of various functions in the selected representative wetlands;
- Input on design and implementation of the on-line decision support tool; and
- Peer review of this report.



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4.0 METHODS

Because a major objective of the WRAPP is to predict wetland and water body functionality, various supporting characteristics needed to be added to the County's existing wetland and water body database. SMC performed a watershed-based preliminary assessment of wetland and water body functions (W-PAWF) using a six-step process. **Figure 2** shows the W-PAWF process flow chart for the WRAPP.

4.1 COLLECT AND INTEGRATE GIS DATA SETS

Early in the process, SMC decided to use the best available Geographic Information System (GIS) data for the WRAPP, as this would be important when evaluating the functional capabilities of wetlands and water bodies. Factors used to determine the data sets included the following:

Availability

- Data needed to be available at low or no costs. We evaluated applicable local sources, as well as statewide and national data sets.

Completeness

- Data needed to cover the entire county for consistency sake. We relied on County resources for wetland mapping primarily because that information was more comprehensive than national wetland mapping efforts and more complete than site-development-based delineation data.

Current Data

- We enhanced existing polygons from the Lake County Wetland Inventory (LCWI 2002) to reflect current land use conditions using 2015 aerial phtoography (the most recent aerial photography at the time of this plan), as this made the data more useful for determining potentially restorable wetlands.

Exportability

- Data needed to be in a geo-spatial format supported by Environmental Systems Research Institute (ESRI) products (ArcGIS).

Table 1 lists the GIS data sources SMC used for the WRAPP.

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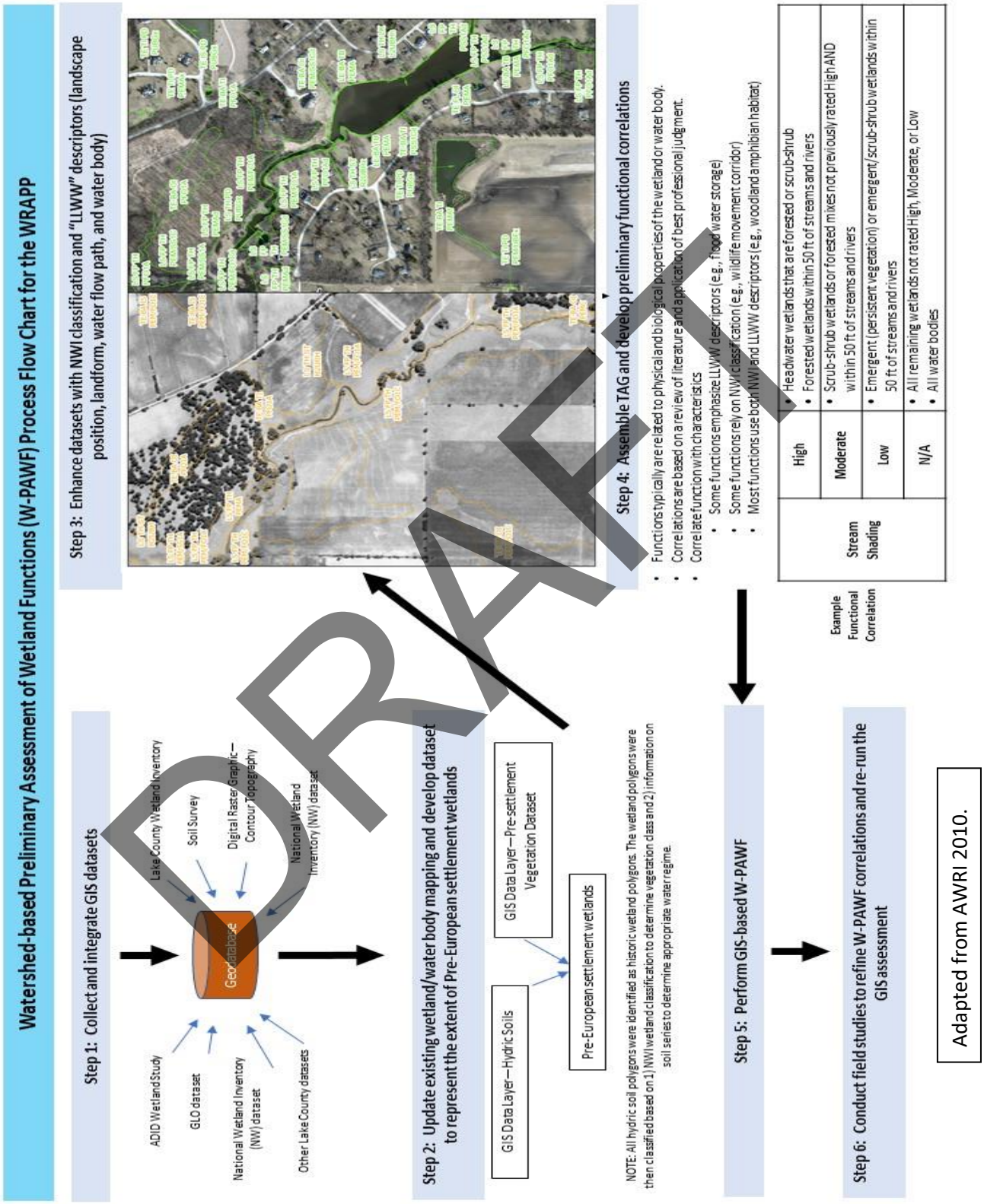

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Figure 2. W-PAWF Process Flow Chart for WRAPP.

Table 1. GIS Data Sources Used for the WRAPP.

Data Source	Source Date
Advance Identification (ADID) Study, Lake County, Illinois	1992
Aerial Photography (Georectified)	1939, 1946, 1961, 1974, 1980, 1993, 1997, 2000, 2002 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2014, 2015
Chiwaukee-Illinois Beach Plain RAMSAR Wetland Boundary	2017
Digital Terrain Model (DTM) (LiDAR-derived)	2007
Digitized Federal Township Plats	1840
Digitized Field Tiles	2001
Digitized Historic County Atlases	1861, 1885
Drainage Areas and Flowlines from 2007 Digital Terrain Model	2014
FEMA Flood Insurance Rate Maps for Lake County	2013-2016
Illinois Biologically Significant Streams	2014
Illinois Department of Natural Resources Natural Heritage database	2016
Lake County Breaklines (Roads and Water Bodies) from 2007 LiDAR	2007
Lake County Forest Preserves	2017
Lake County Hydrology	2002
Lake County Planimetric Data (Building footprints and Edge of Pavement)	2010, 2011
Lake County Pre-Settlement (General Land Office) Vegetation	1832-1840
Lake County Pre-Settlement (General Land Office) Vegetation, augmented with soils data	1832-1840, 1970
Lake County Drainage Tile	Varies, updated 2017
Lake County Stormsewer Atlas	Varies, updated 2017
Lake County Topography, 1-foot contours from 2007 LiDAR	2007
Lake County Transportation (roads, trails, railroads, parking lots)	2013-2017
Lake County Wetland Inventory (LCWI)	2002/2009
Lake County Health Department Lakes Management Unit Lake Bathymetry	2015
Lake County Health Department Lakes Management Unit Lotus Bed Mapping	2015
Lake County Land Use	2005, 2010
SCS/NRCS Soil Surveys of Lake County	1970, 2005
SMC Base Flood Elevations	2004-2017
SMC Watersheds & Sub-Watersheds	1986-2017
State Parks	2014
U.S. Army Corps of Engineers Wetland Mitigation Bank Sites	2017
USFWS National Wetlands Inventory (NWI) Maps, digital	1996
USGS Flood of Record Quadrangle Maps	1963, 1964, 1965, 1966, 1967
USGS Topographic Quadrangle Maps (Historic)	1908-1960

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4.2 ENHANCE EXISTING MAPPING & DEVELOP PRE-SETTLEMENT DATA SET

4.2.1 Existing Wetlands and Water Bodies

For the WRAPP, SMC generated a countywide GIS mapping of existing wetlands and water bodies, termed the Existing Wetland Inventory for Lake County (EWI-LC). We based the EWI-LC off the LCWI, which was developed in 1992 and updated in 2002 and maps wetlands and water bodies within the county in greater detail than the National Wetlands Inventory (NWI) mapping (i.e., LCWI at map scale 1:12,000 vs. NWI at 1:24,000). The impetus for the original LCWI was the under-representation of Lake County wetlands in the NWI. By way of comparison, the LCWI contains roughly twice the number of wetland and water body polygons as the NWI mapping.

Using the LCWI as a base, SMC captured additional changes in wetland and water body coverage from 2002 through 2015. This primarily involved removing developed wetland areas (e.g., roads, urban, commercial, residential land uses) and adding areas that may support wetlands. We overlaid the 2002 LCWI polygon "base" layer with the Lake County "buildings" and "edge of pavement" planimetric layers. Areas of intersection were used to flag potential areas for wetland polygon enhancement for the EWI-LC. For a limited number of sites where existing data were unclear or uncertain, we conducted visual field inspections to confirm wetland presence. **Figure 3** depicts a representative sequence of the wetland polygon mapping and enhancement process, while **Appendix A.1** contains more information on the GIS process used by SMC to refine enhance the LCWI polygons.

While the EWI-LC provides an outstanding countywide base layer for the WRAPP, it is not a comprehensive wetland mapping effort and should not be construed as a substitute for site-specific wetland delineations required for site development and regulatory permitting purposes.

4.2.2 Historic (Pre-European Settlement) Wetlands

SMC also mapped historic wetlands, or those estimated to be present prior to European settlement of the county, termed the HWI-LC. We developed the historic wetlands layer using several data sources with a range of usefulness and accuracy. As such, the HWI-LC data set reflects a best-approximation of wetland presence and extent in pre-settlement times.

SMC derived the location and condition of historic wetlands from three major sources: 1) soil survey data from the U.S. Department of Agriculture - Natural Resources Conservation Service (NRCS, formerly the Soil Conser-vation Service or SCS), 2) mapping of historic vegetation derived from General Land Office Survey maps created between 1832 and 1840 (Bowles and McBride 2005, LCGIS 2003, Moran 1978, Westerman 2006), and 3) historic aerial photography. The soils data were relied upon more heavily, with the land survey maps used to address gaps in the classification of wetland type. We used historic aerial photography to gather additional geographic detail related to hydrological signatures evident on the land surface prior to urban development as well as historical vegetation patterns. **Appendix A.2** contains more detail on the GIS process used by SMC to map pre-settlement wetlands and water bodies.

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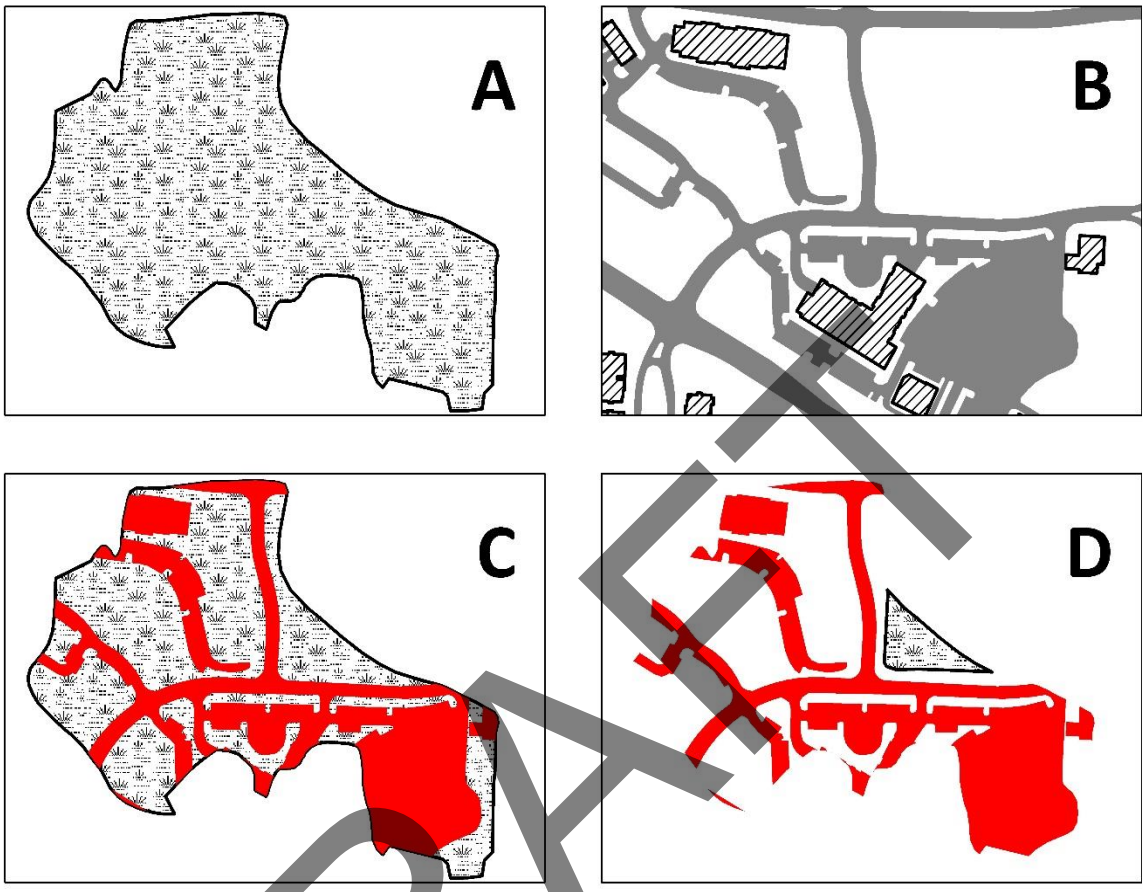

Figure 3. Polygon Mapping and Enhancement Process. (A) Base wetland layer (2002 LCWI mapping). (B) Planimetric layer. (C) Overlay of planimetric layer (red) on base wetland layer. (D) EWI-LC wetland mapping reflecting wetlands remaining post-development.

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4.3 WETLAND AND WATER BODY CHARACTERIZATION

The 2002 LCWI reflects coarse distinctions between wetland types: artificial wetlands, farmed wetlands, and wetland (**Figure 4**). The LCWI data set provides no information on the class, hydrogeomorphology, or function of each wetland polygon. To incorporate such information required enhancement of the EWI-LC and HWI-LC data sets with NWI classification codes and LLWW descriptors from the hydrogeomorphic classification system, as described in the following sections.

4.3.1 National Wetland Inventory (NWI) Classification System

Each historic and existing wetland (or water body) polygon was coded according to the U.S. Fish & Wildlife Service's (USFWS) official national wetland inventory (NWI) classification system for wetlands and deepwater habitats (FGDC 2013, adapted from Cowardin et al. 1979). This system describes a wetland or water body based on plant community type and water regime. Deepwater habitats are permanently flooded areas below the wetland boundary (>2m depth); wetlands are transitional areas between the aquatic environment and uplands.

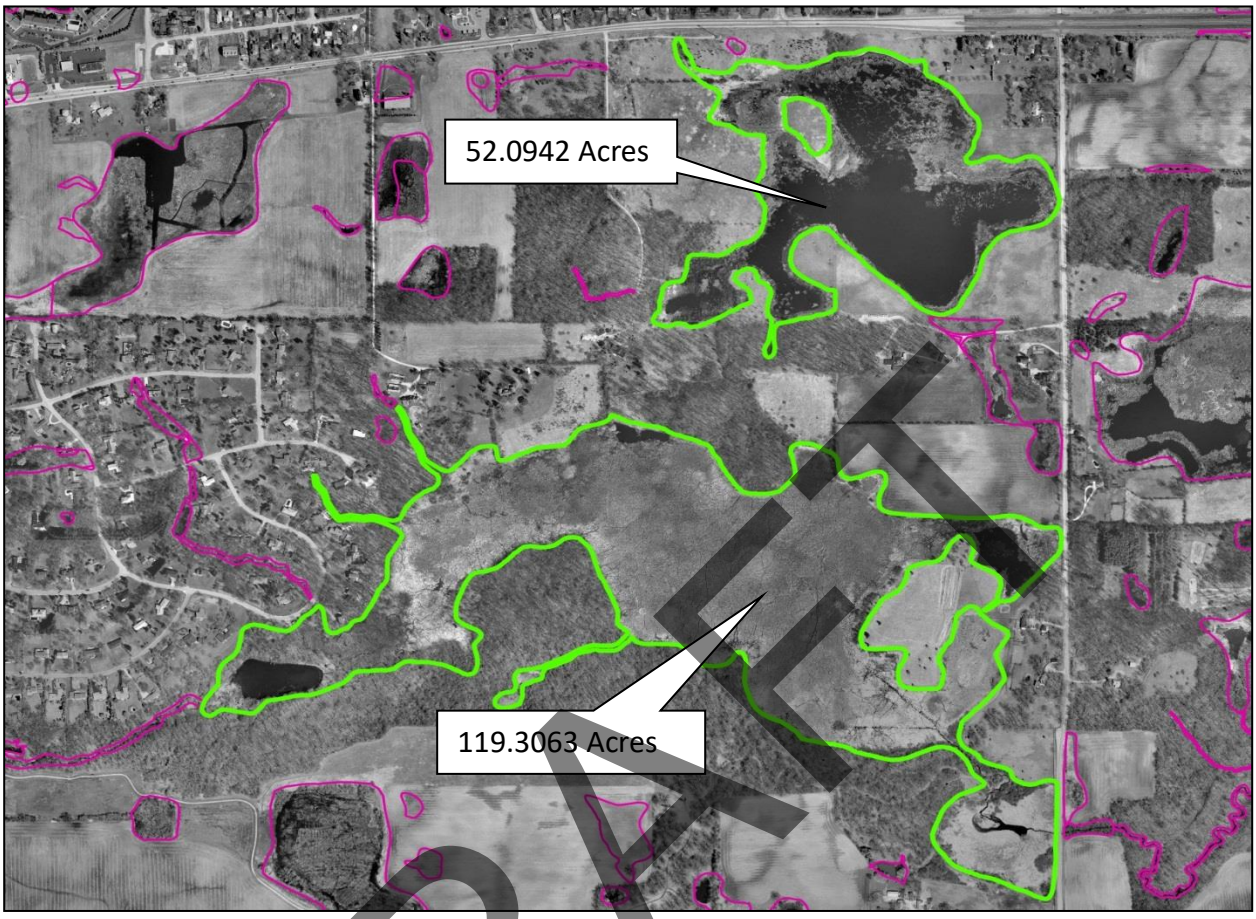

Figure 4. Example of Wetlands from the 2002 Lake County Wetland Inventory. The two polygons outlined in green are clearly different, with each being mapped in hydric soils based on soil survey data (Paschke and Alexander 1970 and Calsyn 2005). However, the LCWI data set only reflects a size difference. Looking at the aerial, one sees distinct physical differences between the two polygons. Most notably, the lower polygon has more vegetation coverage than the upper polygon, which has a greater component of open water.

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Table 2 shows the NWI classification codes we used for the existing and historic wetland and water body polygons in Lake County. For existing wetland/water body polygons that already contained an NWI classification code, based on digital NWI mapping (1996), we reviewed recent Lake County aerial photography (2007 to 2015) to confirm or update the plant community type, as necessary. For example, a polyon labeled as Palustine, Emergent, Seasonally Flooded (PEMC) on the NWI map would have been updated on the EWI-LC data set to Palustine, Forested, Broad-Leaved Deciduous, Seasonally Flooded (PFO1C) if the 2015 aerial photograph clearly showed a mature woodland plant community in this polygon location. Many of the existing wetland/water body polygons on the EWI-LC data set were not included in the NWI mapping, mainly due to small size. For these polygons, SMC assigned the plant community type based on 2015 aerial photograph intepretation. We correlated the water regime for these polygons using SCS/NRCS hydric soil unit mapping and associated drainage class information (see **Table 3**) as well as the similarity of the vegetation and hydrogeomorphic

Table 2. NWI Map Codes for Lake County Wetlands and Water Bodies.

System	Subsystem	Class
Riverine (R)	2 - Lower Perennial	AB - Aquatic Bed
		EM - Emergent
		RB - Rock Bottom
		OW - Open Water
		SB - Streambed
		UB - Unconsolidated Bottom
	3 - Upper Perennial	AB - Aquatic Bed
		RB - Rock Bottom
		UB - Unconsolidated Bottom
	4 - Intermittent	SB - Streambed
Lacustrine (L)	1 - Limnetic	AB - Aquatic Bed
	2 - Littoral	AB - Aquatic Bed
		EM - Emergent
		OW - Open Water
		RS - Rocky Shore
		UB - Unconsolidated Bottom
		US - Unconsolidated Shore
Palustrine (P)		AB - Aquatic Bed
		EM - Emergent
		FO - Forested
		OW - Open Water
		SS - Scrub-Shrub
		UB - Unconsolidated Bottom
		US - Unconsolidated Shore
Water Regime		**Special Modifiers**
A – Temporarily Flooded B – Seasonally Saturated C – Seasonally Flooded D – Continuously Saturated E – Seasonally Flooded/Saturated F – Semipermanently Flooded G – Intermittently Exposed H – Permanently Flooded J – Intermittently Flooded K – Artificially Flooded		b – Beaver d – Partly Drained/Ditched f – Farmed h – Diked/Impounded x - Excavated

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characteristics of the polygon to others with the same water regime classification. Also, we used Lake County topographic mapping (2007) to evaluate the general landscape setting of the polygons (e.g., floodplain, swale, closed depression, etc.).

For NWI coding of the historic wetland polygons, SMC mainly referenced the General Land Office plat maps (years 1832 and 1840) for vegetation information to assign the plant community type and the water regime was estimated primarily based based on the SCS soil mapping and drainage class data (Paschke and Alexander 1970, Caslyn 2005, see **Table 3**). We attributed the existing wetland classification to historic wetland polygons that significantly overlapped unless there was compelling evidence for a different map code (e.g., historic mapping or aerial photography depicted a different vegetation class or the existing wetland polygon was significantly anthropogenic).

Table 3. NWI Code Water Regime Correlations for WRAPP GIS Mapping.

Map Unit	Name	Est. Water Regime*	Organic?	Landscape Setting	NRCS Drainage Class**
67A	Harpster Silty Clay Loam	C	No	Shallow depressions	PD
103A	Houghton Muck	C	Yes	Large closed depressions	VPD
153A	Pella Silty Clay Loam	C	No	Deep swales	PD
232A	Ashkum Silty Clay Loam	C	No	Shallow swales	PD
330A	Peotone Silty Clay Loam	C	No	Large closed depressions	VPD
465A	Montgomery Silty Clay Loam	C	No	Riverine floodplains	PD
488A	Hooppole Loam	C	No	Floodplains/Stream terraces	PD
513A	Granby Fine Sandy Loam	C	No	Lake Michigan dune swales	PD
523A	Dunham Silty Clay Loam	C	No	Floodplains/Stream terraces	PD
626A	Kish Loam	C	No	Floodplains/Stream terraces	PD
1082A	Millington Silt Loam, undrained, occasionally flooded	A	No	Floodplains	PD
1103A	Houghton Muck, undrained	F	Yes	Large closed depressions & bogs (Volo Bog, etc.)	VPD
1107A	Sawmill Silty Clay Loam, undrained	C	No	Riverine floodplains	PD
1153A	Pella Silty Clay Loam, undrained	C	No	Deep swales	PD
1330A	Peotone Silty Clay Loam, undrained	F	No	Large closed depressions	VPD
1210A	Lena Muck, undrained	F	Yes	Closed depressions	VPD
1529A	Selmass Loam, undrained	C	No	Floodplains/Stream terraces	PD
3107A	Sawmill Silty Clay Loam, frequently flooded	F	No	Riverine floodplains	PD
4103A	Houghton muck, ponded	F	Yes	Large closed depressions	VPD
4777A	Adrian Muck, ponded	F	Yes	Lake Michigan dune swales	VPD
8082A	Millington Silt Loam, occasionally flooded	A	No	Floodplains	PD
W	Water	H	No	Permanent water bodies	-

* NWI Water Regimes: A - Temporarily Flooded; C - Seasonally Flooded; F - Semipermanently Flooded; H - Permanently Flooded
** Natural Resource Conservation Service (NRCS) Drainage Classes: PD – Poorly Drained; VPD – Very Poorly Drained

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4.3.2 Hydrogeomorphic Classification Using LLWW Descriptors

For each historic and existing wetland (or water body) polygon, SMC expanded on the NWI classification by adding the hydrogeomorphic classification system descriptors: landscape position, landform, water flow path, and water body type (LLWW; see **Figure 5)**. These descriptors focus on abiotic properties that are key to predicting wetland functions.

Table 4 shows the possible combinations for each landscape position type for Lake County.

To develop these descriptors, we interpreted available map information, consulted aerial photographs, and in some cases conducted field checks. We assigned the LLWW descriptors following the "Dichotomous Keys and Mapping Codes for Wetland Landscape Position, Landform, Water Flow Path , and Waterbody Type Descriptors" (Tiner 2003a, 2011, 2014) and included other modifiers for features such as headwater, drainage-divide, and human-impacted wetlands. **Appendix A.4** contains

details on the GIS process used by SMC to assign the LLWW descriptors.

As indicated by Tetra Tech (2015), Lake Michigan experiences water level fluctuations that can affect near-shore wetlands. Those changes, however, primarily derive from wind and pressure change, not gravitational effects (i.e., not true tides). Therefore, SMC viewed Lake Michigan as a non-tidal system and did not include Tiner's keys for wetlands and water bodies affected by tidal influence.

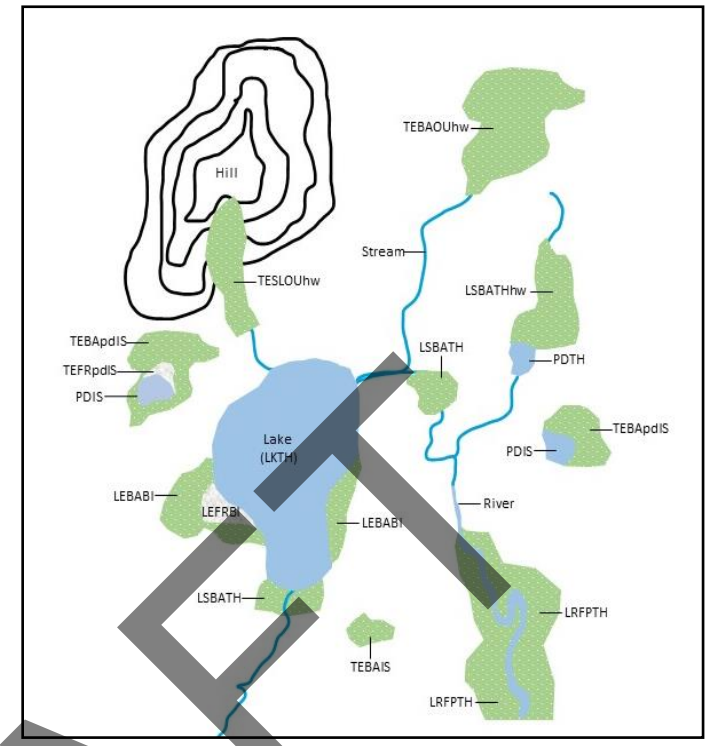

Figure 5. Non-Tidal Wetlands Classified by LLWW (adapted from Tiner 2011).

Landscape position is the broadest LLWW descriptor and refers to the topographic setting of a wetland. For the WRAPP, four landscape positions were possible:

1) *Lentic*, referring to features positioned along lakes and reservoirs;
2) *Lotic River,* referring to features positioned along rivers, as defined below under "Water Body Type," and on their active floodplains (all lotic river wetlands are in contact with rivers and periodically inundated by overflow);

Table 4. LLWW Descriptors for Lake County, IL.

Landscape Position	Landform	Water Flow Path	Water Body Type
Lotic River (LR) Lotic Stream (LS)	Floodplain (FP) Basin (BA) Flat (FL) Fringe (FR) Island (IL) Slope (SL)	Throughflow (TH) Throughflow-artificial (TA) Throughflow-intermittent (TI) Bidirectional-throughflow (TB)	River (RV) Stream (ST) Pond (PD) Lake (LK)
Lentic (LE)	Fringe (FR) Basin (BA) Island (IL)	Bidirectional-nontidal (BI) Bidirectional-throughflow (TB) Throughflow (TH) Throughflow-intermittent (TI)	Pond (PD)
Terrene (TE)	Fringe (FR) Basin (BA) Flat (FL) Fringe (FR) Island (pond) (IL) Slope (SL)	Outflow (OU) Outflow-artificial (OA) Inflow (IN) Throughflow (TH) Throughflow-artificial (TA) Throughflow-intermittent (TI) Isolated (IS) Bidirectional-nontidal (BI) Bidirectional-throughflow (TB)	Lake (LK) Pond (PD)

Note: More detailed categorizations and additional modifiers are possible (see **Appendix A.4**).

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3) *Lotic Stream*, referring to features positioned along streams and on their active floodplains (all lotic stream wetlands are in contact with streams and periodically inundated by overflow); and

4) *Terrene*, referring to features typically surrounded by upland (non-hydric soils) and not within a floodplain or lake basin but also including headwater wetlands that serve as sources of streams.

Landform describes the large-scale distinctive topographic features that affect the physical shape of a wetland or water feature. We recognized six types in Lake County: 1) basin, 2) flat, 3) slope, 4) floodplain, 5) island, and 6) fringe. The *basin* landform (BA) occurs in a distinct depression, including depressions that contain lakes and ponds. *Flat* landforms (FL) occur on more level topography and typically have a seasonally saturated, temporarily flooded, or seasonally flooded water regime. *Slope* landforms (SL), as the term connotes, occur on hillsides, and *island* landforms (IL) are surrounded by water. We restricted the *floodplain* landform (FP) to areas bordering streams and rivers that receive periodic inundation from overflow, while the *fringe* landform (FR) is associated with semi-permanently flooded vegetated wetlands elsewhere (e.g., a permanent water body, within the banks of a river).

Water Flow Path descriptors characterize the direction of water flow, with five general patterns recognized in Lake County: 1) throughflow, 2) outflow, 3) inflow, 4) isolated, and 5) bidirectional (i.e., influenced by an adjacent water body). These general patterns are further divided based on flow regime: perennial, intermittent, and artificial. Flow path type is defined by apparent flow relative to other wetlands and water bodies. A polygon has *throughflow* (TH) if water from another wetland or water body appears to run both into the polygon and out of the polygon to another wetland or water body during high-water periods. River- and stream-side wetlands are throughflow wetlands, as are lakeshore wetlands associated with streams. Polygons that exihibit flow in and out only during a portion of the year are classified throughflow-intermittent (TI) and account for the most acreage countywide of any flow path type. If an area is the source of a stream or a seep, it has an *outflow* (OU) water flow path; such areas typically lack an inflow source and have water leaving them throughout the year. Many wetlands have intermittent outflow and are classified outflow intermittent (OI). *Inflow* areas (IN) are sinks where no outlet exists, yet water enters from another wetland or water body. Some areas have no apparent flow, either in or out. In such areas, water levels rise and fall in response to rainfall, snow melt, local runoff, evapotranspiration, and/or groundwater recharge and are considered *isolated* (IS). In the case of isolated complexes, individual polygons may be assigned isolated-outflow, isolated-throughflow, and isolated-inflow flow paths based on their position relative to one another. Throughflow artificial (TA) and outflow artificial (OA) were applied to polygons with ditched or otherwise artificial flow paths (not including subsurface drain tiles).

We designated wetlands located along lakes, reservoirs, and ponds as having *bidirectional-nontidal* (BI) flow because fluctuating lake or reservoir water levels appeared to be the primary surface water source affecting their hydrology. For bidirectional polygons, the flow path of the adjacent water body (i.e., the source of bidirectional flow) is typically included, resulting in bidirectional (BI), bidirectional-outflow (BO, water body is outflow type), and bidirectional-throughflow (TB, water body is throughflow type) designations.

Water Body Type is the most easily understood LLWW descriptor and includes lakes, ponds, streams, and rivers. We separated *lakes* (LK) and *ponds* (PD) based

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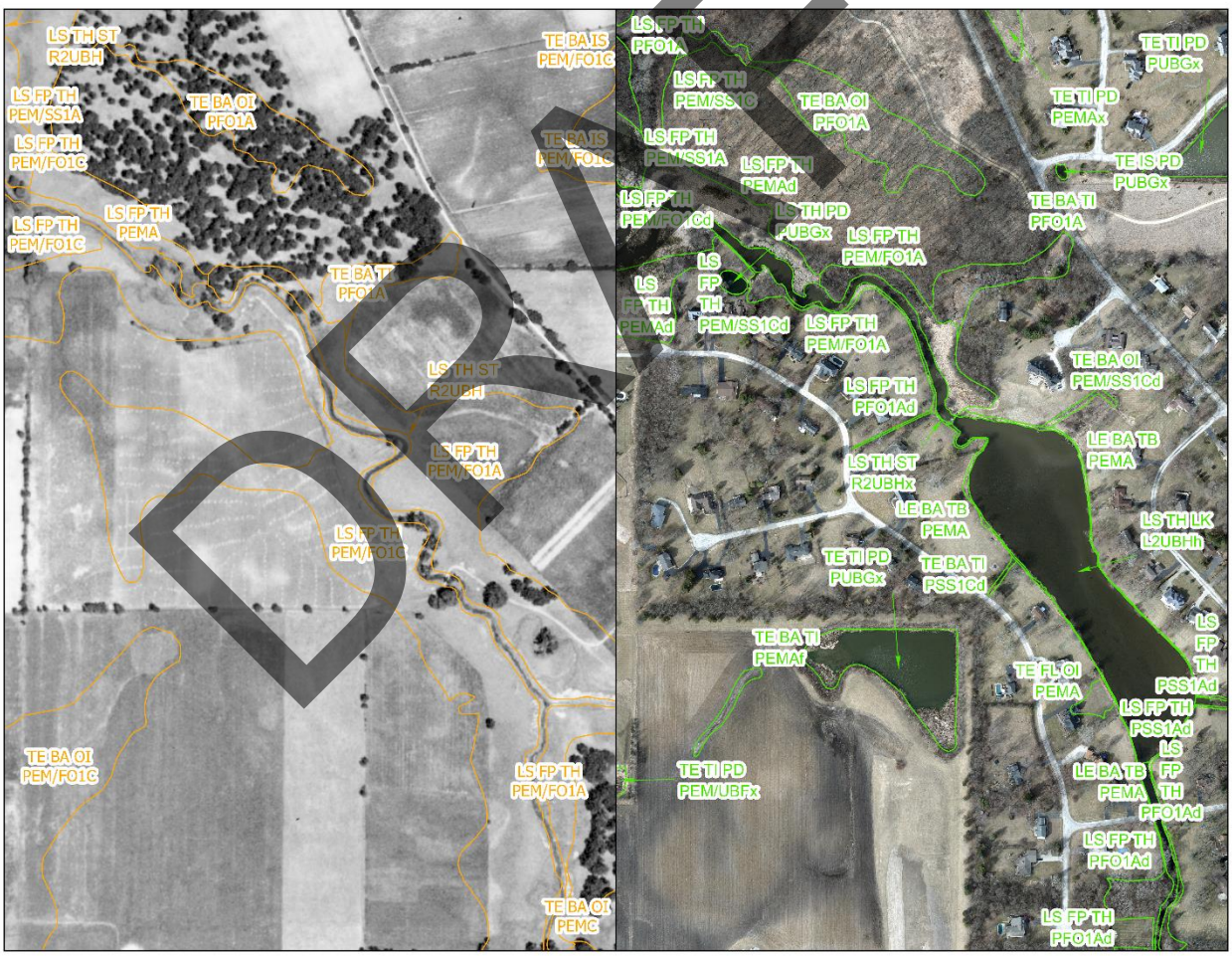
on a 6-acre size threshold established by the WRAPP TAG, with all open-water polygons less than or equal to 6 acres classified as ponds and water bodies exceeding 6 acres being classified as lakes. Watercourses mapped as linear (single-line) features on NWI maps and U.S. Geological Survey topographic maps (1:24,000 scale) were designated as *streams* (LS), whereas two-lined channels (polygonal features on these maps) were classified as *rivers* (LR) and are limited in Lake County to Squaw Creek downstream of Long Lake and the Dead, Des Plaines, and Fox Rivers.

In addition to the main LLWW descriptors above, SMC applied ***other hydrogeomorphic modifiers*** as applicable. For example, we applied a headwater descriptor (hw) to wetlands along intermittent streams or first-order perennial streams as well as to terrene wetlands that are the sources of these streams. Any wetland in contact with a pond received a pond modifier (pd), regardless of whether the pond exerts influence on the wetland vegetation (e.g., an artificially excavated area within a vegetated wetland may have little or no influence on the wetland).

Figure 6 provides an example of the enhanced GIS data sets, including both the NWI map codes and LLWW descriptors for various existing (EWI-LC) and historic (HWI-LC) wetland and water body types common in Lake County, Illinois.



HWI-LC EWI-LC

Figure 6. Example Wetland Data Sets Enhanced with NWI Codes and LLWW Classifications (EWI-LC = existing wetland inventory – Lake County; HWI-L = Historic Wetland Inventory – Lake County).

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4.4 PRELIMINARY ASSESSMENT OF WETLAND FUNCTIONS (W-PAWF)

The WRAPP employs an approach called the *Watershed-Based Preliminary Assessment of Wetland Functions* or "W-PAWF." This is a desktop exercise based on best professional judgement. Tiner (2003a) developed the method to predict wetland functions for large geographic areas (e.g., states, counties, watersheds) from NWI data. At its foundation, the W-PAWF presumes you can use existing information on physical or biological properties (or a combination of the two) to predict the degree to which a wetland or water body performs various functions.

Functions are properties that a wetland or water body provides naturally and typically relate to a physical and/or biological process. Sometimes, functions are linked to physical and biological processes within other habitats connected to the wetland or water body. Examples of wetland functions include sediment retention and the transformation of nutrients. Not all wetlands and water bodies perform all functions, nor do they perform all functions equally well.

SMC and the TAG cast a broad net when considering what functions to include in the WRAPP. We began with the typical suite of functions used in other studies across the United States and expanded on or modified those after careful deliberation. In the end, we selected 13 functions that fall into three general categories as reflected in **Table 5**. In alphabetical order, the 13 functions are 1) carbon sequestration, 2) flood water storage, 3) native fish habitat, 4) nutrient transformation (with a phosphorus focus), 5) sediment and other particulate retention, 6) shoreline/stream bank stabilization, 7) stream baseflow maintenance, 8) stream shading, 9) unique wetland resources,10) waterfowl habitat, 11) wetland-dependent bird habitat (other), 12) wildlife movement corridors, and 13) woodland amphibian habitat. Arguably, some functions may fall under more than one general category (e.g., stream shading).

Assessments of wetland functions are best done in the field on a case-by-case basis, with actual measurement of functional performance and comparison to reference standards. However, that level of effort is not well suited for initial planning purposes, for which a more generalized assessment is beneficial, especially for functions that correlate with landscape position and vegetation community type. For example, wetlands along streams protect the shoreline from erosion, whereas isolated pocket wetlands do not. Headwater wetlands are important for maintaining stream base flow while riverine wetlands are not. Ultimately, the W-PAWF can provide a profile that highlights sites of potential significance for various functions. To do so, the approach simplifies the relationships between the wetland (or water body) and various functions into a set of practical criteria or observable characteristics.

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Table 5. Functions Evaluated for the WRAPP.

Hydrologic Functions	Biodiversity Functions	Water Quality Functions
Flood Water Storage	Native Fish Habitat	Carbon Sequestration
Stream Baseflow Maintenance	Unique Wetland Resources	Nutrient Transformation (P-focus)
	Stream Shading	Sediment and Other Particulate Retention
	Waterfowl Habitat	Shoreline/Stream Bank Stabilization
	Wetland-dependent Bird Habitat (Other)	
	Wildlife Movement Corridors	
	Woodland Amphibian Habitat	

The W-PAWF reflects a wetland or water body's *relative potential* to provide a function. The W-PAWF does not consider the *opportunity* a site may have to provide a function. What does this mean? Consider two wetlands of the same size, hydrologic regime, and similar vegetation, each having the same capacity to retain sediment. If one is downstream of a land-clearing operation that has generated considerable sediment and the other is in an undisturbed forest preserve, the first wetland has more opportunity than the other. Both wetlands physically can retain sediment and particulates to the same degree, but their opportunity to do so differs greatly.

Herein, functional rating or *significance* refers to the relative degree to which a wetland/water body polygon performs the indicated function compared to other mapped polygons. The level of significance is qualitative, described as high, moderate, low, or not applicable. As stated by Tetra Tech (2015), "[t]hese rankings are not related to the perceived human value of a wetland function or its benefit to the watershed…. [they are] only meant as a method to classify and rank wetlands for their ability to perform natural processes. The human *value* of the wetland function and the ecological services that it provides is determined by the goals of regulators and watershed planners." For example, a site with high functional significance for flood water storage does not necessarily meet a standard, but it is more suited to storing flood waters than other wetlands. End-users should collaborate to determine which ecological services are most important, based on project-specific goals and consideration of long-term benefits to the watershed.

DEFINITIONS

Significance = Relative degree to which a wetland or water body polygon performs the indicated function compared to other mapped polygons.

Criteria used to assign the level of significance for each function were based on nationally-accepted methods developed from a growing number of similar studies around the region. Studies influential to WRAPP development included *Correlating Enhanced Wetlands Inventory Data with Wetland Functions for Watershed Assessments: A Rationale for Northeastern U.S. Wetlands* (Tiner 2003a), *Assessing Cumulative Loss of Wetland Functions in the Paw Paw River Watershed Using Enhanced National Wetlands Inventory Data* (Fizzell 2007), *Landscape Level Wetland Functional Assessment Methodology Report, Version 1.0* (MDEQ 2011), *Methods and Results for a Geographic Information System Landscape Model of Wetland Functions in the Sandusky Subbasin* (OH) (PGE 2014), *The Duck-Pensaukee Watershed Approach* (Miller et al. 2012), *Wetlands of Pennsylvania's Lake Erie Watershed: Status, Characterization, Landscape-level Functional Assessment, and Potential Restoration Sites* (Tiner et al. 2014), and *Final Report for Region 5 Wetland Management Opportunities* (Tetra Tech 2015). The TAG subsequently reviewed and modified the draft criteria based on local knowledge and expertise.

The W-PAWF assessment does not eliminate the need for detailed site assessments of the various functions. Rather, the desktop analysis serves as a starting point for more rigorous, site-specific assessments.

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4.4.1 Carbon Sequestration

The carbon sequestration function relates to a site's ability to store carbon and help reduce greenhouse gases, buffering against climate change. All wetlands store carbon to some degree. However, sites with deep organic soils (so long as they are not ditched, drained, or farmed) support this function at a high level, as do areas of aquatic bed. Woody wetlands (e.g., forested, scrub-shrub, and mixes of those) that are flooded or saturated seasonally or longer also have high functionality because woody plants can store carbon above-ground. Volo Bog and the forested wetland at DP-06 (see **Appendix B.3**) are examples of wetlands in Lake County with high carbon sequestration function.

Ditched and drained wetlands with organic soils have moderate functionality for carbon sequestration, as do many vegetated wetlands on mineral soils (so long as they are seasonally flooded or wetter). Vernal pools and wetlands that have been placed into agriculture rate low, as do ephemeral and intermittent streams.

Carbon Sequestration	High	• Vegetated wetlands on organic soils that have not been drained/ditched (excluding vernal pools and farmed wetlands) • Palustrine forested, scrub-shrub or mixes of those wetlands on mineral soils that are seasonally flooded, seasonally flooded/saturated, semi-permanently flooded, permanently flooded, or artificially flooded (excluding vernal pools) • Aquatic beds (Lacustrine and Palustrine) and their mixes with other vegetated wetland classes (e.g., emergent, forested, and scrub-shrub)
	Moderate	• Vegetated wetlands on ditched/drained organic soils • Other vegetated wetlands on mineral soils that are seasonally flooded, seasonally flooded/saturated, semi-permanently flooded, permanently flooded, or artificially flooded (excluding vernal pools and farmed wetlands) • Palustrine forested, scrub-shrub or mixes of those wetlands on mineral soils that are temporarily flooded, saturated, intermittently exposed, or intermittently flooded
	Low	• All remaining wetlands • Ephemeral and intermittent streams
	N/A	• All remaining water bodies

4.4.2 Flood Water Storage

The flood water storage function (often called 'surface water detention' or 'flood abatement' in other studies) relates to a site's ability to delay downstream flooding and/or lower flood heights (which helps minimize flood-related injury and property damage). Polygon size is not a relevant factor in a site's *ability* to perform this function (although it certainly influences the *capacity* to do so). Except for slope wetlands located outside of mapped flood hazard areas (e.g., seeps/springs on ravines), most wetlands perform this function to some degree. By their very nature, wetlands located within a mapped special flood hazard zone have high functionality. Such areas typically occur along streams and rivers. For an example of this in Lake County, see representative field site DP-07 in **Appendix B.3**, a forested/emergent streamside wetland. Pocket or bowl-shaped wetlands within uplands that store at least 0.75 acre-feet of runoff (based on the Lake County Watershed Development Ordinance definition of a regulatory depressional floodplain) also perform this function at a high level. High functionality also occurs in throughflow and intermittent ponds and their associated basin, fringe, and island wetlands; and polygons identified as stormwater basins.

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Wetlands and water bodies performing this function at a moderate level (provided they don't already rate as high) include those that intersect the U.S. Geological Survey's flood of record; those sites associated with streams, rivers, and lakes where there is no mapped FEMA floodplain or fall outside of the mapped floodplain; flat wetlands; all remaining ponds, all remaining fringe and island wetlands, as well as all remaining lentic and lotic wetlands, and all remaining basin wetlands that are isolated or impounded (so long as they are not on a slope or are not slough wetlands). However, slope wetlands within the FEMA-mapped floodplain rate low. This function does not apply to slope wetlands that are outside of FEMA 100/500 zones (e.g., seeps/springs on ravines).

Flood Water Storage	High	• Wetlands & water bodies associated with a mapped special flood hazard area, excluding Slope wetlands • Terrene basins with > 0.75 acre-feet of storage • Throughflow & Throughflow-Intermittent ponds and associated basin, fringe, and island wetlands, as well as lakes (> 6 acres) not rated High per previous bullets • Polygons identified as stormwater basins
	Moderate	• Wetlands & water bodies that intersect the USGS flood of record not rated High, excluding Slope wetlands • Wetlands & water bodies associated with rivers, streams, and lakes with no mapped FEMA floodplain or outside of the mapped floodplain and not already rated High • Flat wetlands outside of mapped floodplains • All remaining Ponds not already rated High or Moderate • Remaining fringe and island wetlands and remaining Lentic and Lotic wetlands • Remaining Basin wetlands that are isolated or impounded and not slough wetlands
	Low	• Remaining wetlands that are not Slope wetlands, including slough wetlands • Slope wetlands within the FEMA 100 or 500 yr floodplains
	N/A	• All remaining Slope wetlands

4.4.3 Native Fish Habitat

The TAG refined the "Fish Habitat," "Fish and Aquatic Invertebrate Habitat" and "Fish and Shellfish Habitat" functions used in other studies to focus on native fish as a significant function for wetlands and water bodies in Lake County. This was done because the shellfish function primarily relates to estuarine and tidal wetlands (of which none occur in Lake County) and because data suitable for performing a countywide assessment of functional significance for aquatic macroinvertebrates (including mussels) in Lake County are lacking.

Wetlands and water bodies in this category are predicted to provide spawning, nursery, foraging, refuge and/or cover habitat for some portion or all the fishes' life cycle during most or all years. Sites with high functionality include non-channelized rivers and natural lakes (even if modified with dams, channels or spillways) and non-channelized perennial streams (provided they have a barrier-free connection to a river or natural lake). High functionality also occurs in wetlands and natural ponds contiguous to the above water bodies, so long as the wetlands and ponds are flooded semi-permanently or longer. Lastly, wetlands or water bodies where recent occurrences of an Illinois or Federal threatened/ endangered fish species have been documented also have high functionality, as do most headwater wetlands. The lake at FX-12 (see **Appendix B.3**) is an example of a site with high functionality for native fish habitat in Lake County.

Among the wetlands and water bodies that provide habitat at a moderate level are artificially created lakes (by impoundment or excavation), channelized perennial rivers, and intermittent streams (non-channelized and barrier-free), wetlands that are intermittently connected to other surface water, seasonally flooded emergent wetlands that are NOT contiguous to open water polygons, and

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artificial outflow headwater wetlands. Ephemeral streams provide this function at a low level, as do basin wetlands flooded seasonally or for longer duration.

Native Fish Habitat	High	• Rivers and natural lakes, including those modified with spillways, dams or channels • Perennial, non-channelized streams with barrier-free connection to a river or natural lake • Wetlands contiguous to water bodies in above bullets AND flooded semi-permanently or longer • Wetlands and water bodies with recent documented occurrence of Illinois or Federal T/E fish species (i.e., within past 10 years using Illinois Department of Natural Resources Natural Heritage database June 2016 geographic information layer) • Headwater wetlands, except artificial outflow types • Natural ponds and wetlands flooded or inundated semi-permanently or longer (includes fringe ponds and pond islands) within polygons that satisfy above bullets
	Moderate	• Artificial Lakes created by impoundment or excavation • Perennial unchannelized streams upstream of 1st dam above mouth at river, glacial lake, or Lake Michigan • Perennial channelized streams with natural or permanent, barrier-free connection to river, natural lake, or Lake Michigan • Intermittent unchannelized, undammed streams with barrier-free connection to a natural lake or river • Wetlands contiguous to water bodies defined under above bullets AND flooded or inundated semi-permanently or longer • Remaining ponds contiguous to polygons rated High or identified in above bullets, including excavated/impounded online ponds that are semi-permanently flooded or wetter • All remaining permanently flooded natural ponds (e.g., isolated ponds) • Fringe and Island wetlands flooded or inundated semi-permanently or longer AND contiguous to ponds rated Moderate • Artificial outflow type (e.g., ditched) headwater wetlands • Wetlands flooded seasonally or longer AND contiguous to polygons rated High, excluding those connected by ditches • All remaining Lotic River Floodplain Basin Wetlands
	Low	• All remaining water bodies (lakes, rivers, streams, ponds), excluding dry detention basins coded as ponds and artificially flooded ponds • All remaining wetlands contiguous to water bodies, excluding ephemeral streams and dry detention basins • All remaining wetlands flooded temporarily AND contiguous to polygons rated High • Basin wetlands flooded seasonally or longer • All remaining floodplain wetlands flooded seasonally or longer AND not farmed • All remaining outflow and throughflow wetlands flooded seasonally or longer AND contiguous to polygons rated High or Moderate, excluding farmed wetlands
	N/A	• All remaining wetlands and water bodies

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4.4.4 Nutrient Transformation (Phosphorus focus)

Nutrient transformation relates to a wetland or water body's ability to remove nutrients from the water and improve local water quality. Previous studies focused on nutrient transformation without distinction of the type of nutrient or focused on nitrogen. For the WRAPP, the TAG refined this function to focus on retention of phosphorus (P), as that was determined the limiting nutrient for many water quality concerns within Lake County. All wetlands perform this function to some degree, and size is not a factor in the *ability* to perform the function. However, it is a factor in the degree, as larger wetlands typically have greater capacity. Vegetative growth and hydrologic regime play important roles in P uptake and release (Phillips 2001, Aldous et al. 2005, Gazzetti 2012, Kadlec and Wallace 2009). Short-term P retention occurs via plant uptake, and attachment to soil particles and sedimentation contribute to long-term P retention (Cronk and Fennessey 2001, Gazetti

2012). For the WRAPP functional correlation, we generalized phosphorus relationships, which can be highly complex. Floodplains, riparian wetlands, and other wetlands and water bodies that trap sediment have a high capacity for P capture (Gambrell 1994, Walbridge and Struthers 1993, Bruland and Richardson 2004, Wright et al. 2006). However, low oxygen conditions in the soil caused by prolonged flooding can result in phosphorus release (Aldous et al. 2005, Phillips 2001).

Most isolated wetlands function at a high level. In Lake County, a scrub-shrub pocket (e.g., NB-02 in **Appendix B.3**) provides an example wetland with High function in P retention. Wetlands with drier water regimes (e.g., seasonally flooded or saturated) tend to have moderate functionality. Slope wetlands, vernal pools, water bodies, and other wetlands not rated as high or moderate have low functionality. Ditching or cultivation for farming reduces functionality one level (e.g., high becomes moderate, moderate becomes low).

Nutrient Transformation (Phosphorus-focus)	High	• Isolated wetlands (excluding vernal pools and farmed wetlands)
	Moderate	• Throughflow and outflow-type riparian wetlands that are seasonally saturated or seasonally flooded (excluding ditched wetlands and farmed wetlands) • Isolated farmed wetlands that are Terrene Basin or Terrene Flat
	Low	• All remaining wetlands (e.g., slope wetlands, vernal pools, remaining ditched wetlands) and water bodies (e.g., open water portions of lakes, ponds, and rivers and intermittent streams)
	N/A	--

4.4.5 Sediment and Other Particulate Retention

The sediment/other particulate retention function relates to a wetland or water body's ability to retain sediment that would otherwise move downstream and accumulate in rivers, streams, lakes, or ponds. This function supports improved water quality by capturing sediment particles and any nutrients or heavy metals bonded to them. All wetlands perform this function to some degree. In general, however, vegetation is a key factor to higher functionality because plants slow the water down, which allows sediment to settle out. Water depth is also a key factor because wind energy will re-suspend sediments and prevent deposition in shallow water bodies. Therefore, areas with high function include basin, fringe and island wetlands that are associated with lakes, floodplain wetlands (excluding unconsolidated shore types), basin wetlands that are surrounded by uplands, and areas with water more than 6.6 feet (2 meters) deep. As an example in Lake County, the island wetland at FX-03 (see **Appendix B.3**) has high function for sediment/other particulate retention.

Sediment and Other Particulate Retention	High	• Basin, Fringe, and Island wetlands associated with lakes (excluding unconsolidated shore types) • Floodplain wetlands (excluding unconsolidated shore types) • Terrene Basin Isolated wetlands • Lacustrine Limnetic systems (depth > 2m)
	Moderate	• Island wetlands (other than those associated with lakes) • Throughflow or Throughflow-Intermittent Lotic Stream Basin, Flat, and Fringe wetlands • Lotic River Basin, Flat and Fringe Throughflow wetlands • Throughflow or Throughflow-Intermittent Ponds • Throughflow-Intermittent, Outflow, Outflow-Intermittent, or Outflow Artificial Terrene Basin wetlands • Lacustrine Littoral systems (excluding unconsolidated shore types) • All wetlands associated with a pond
	Low	• All remaining wetlands and water bodies
	N/A	--

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The type and level of connection can shift functionality higher or lower. For example, wetlands where water flows through them (including intermittently) and basin wetlands with outflow (including intermittent) typically rate moderate, as do all wetlands associated with ponds. Unlike in TetraTech (2015), SMC did not exclude certain types of water bodies from this function.

4.4.6 Shoreline/Stream Bank Stabilization

Various studies refer to this function as "Shoreline Stabilization." As some TAG members felt shoreline stabilization focused on wave-related erosion, SMC modified the name of this function to better reflect the role of protecting the shoreline from erosion by wave action and cutting by stream currents. Vegetation and width of the flanking wetland are primary characteristics for a high rating, as is the size of a water body. Shoreline vegetation is an important characteristic for areas with high functionality, but only if the wetland is located along a lake, stream, or river such as the emergent/forested wetland at DP-14 (see **Appendix B.3**). Wider bands of vegetation provide more protection than narrower bands. Minimum widths establish the cutoff separating high functionality from moderate.

Ponds (because of their smaller size compared to lakes) and their associated wetlands offer moderate functionality, as do wetlands that are too narrow to provide a high functional level. Likewise, wetlands that emphasize outflow (e.g., headwater-position wetlands) provide this function at a moderate level. Island wetlands provide low functionality, as do ephemeral and intermittent streams. If a wetland is not associated with flowing water or open water areas, this function does not apply.

Shoreline/ Stream Bank Stabilization	High	• Vegetated wetlands along water bodies (excluding ponds and island wetlands) where: ○ ≥ 20 ft width of vegetated palustrine wetland adjacent to open water in lake ○ ≥ 10 ft feet of vegetated palustrine wetland along open water of stream or river
	Moderate	• Vegetated wetlands along water bodies (excluding island wetlands) where: ○ ≥ 10 ft width (but <20 ft) of vegetated palustrine wetland adjacent to open water in lake ○ < 10 ft of vegetated palustrine wetland along open water of stream or river • Vegetated wetlands along ponds (excluding island, farmed, and turfgrass wetlands) • Headwater-position wetlands that are Terrene Outflow, Outflow Intermittent, and Outflow Artificial
	Low	• Island wetlands • Remaining wetlands along water bodies • Ephemeral and intermittent streams
	N/A	• All remaining wetlands and water bodies

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4.4.7 Stream Baseflow Maintenance

Stream baseflow maintenance relates to the ability of a wetland or water body to source water that sustains base flow levels in streams. This function is especially critical during dry periods and is an important aspect in supporting aquatic life. As such, this function correlates with the native fish habitat function. As with the flood water storage function, the size is not relevant to an area's ability to provide this function, only its capacity. Headwater wetlands and other wetlands that discharge ground water rate high for this function so long as they have not been modified by ditching, channelization, or drainage. Slope wetlands within 50 feet of rivers (e.g., LM-07 in **Appendix B.3**) or streams and streamside wetlands that are flooded seasonally or longer also function at a high level, as do throughflow

(or outflow) lakes that have a permanent hydrologic connection to perennial streams.

Slope wetlands within 100 feet of streams or rivers function at a moderate level, as do ditched or drained headwater wetlands, streamside wetlands with drier water regimes, and ponds connected to a perennial stream.

Riverine wetlands function at a low level because river flow is not dominated by baseflow from those wetlands. Rivers and streams themselves do not provide this function, as they cannot support themselves. Isolated wetlands, by their very nature, also do not provide this function.

Stream Baseflow Maintenance	High	• Headwater wetlands, excluding ditched/drained wetlands • Slope wetlands within 50 feet of rivers/streams or Lotic wetlands • Lotic stream wetlands flooded seasonally or for longer durations • Throughflow & Outflow lakes with permanent hydrologic connection to perennial stream (excluding Great Lakes coastal types, e.g., Lake Michigan)
	Moderate	• Ditched/drained headwater wetlands • Drier Lotic stream wetlands • Throughflow & Outflow ponds with permanent hydrologic connection to perennial stream • Slope wetlands within 100 feet of rivers/streams or lotic wetlands and not rated High
	Low	• Lotic River wetlands • Outflow & Throughflow lakes, ponds, and wetlands (excluding headwater wetlands) connected naturally or via stormsewer piping to a stream system, including intermittent types • Remaining wetlands contiguous to streams
	N/A	• Rivers, streams, and remaining water bodies and wetlands, including all isolated wetlands

4.4.8 Stream Shading

Tiner's analyses included stream shading as a subcomponent of Fish and Shellfish Habitat. High vegetation along streams and rivers can provide shading, which helps regulate the water temperature. Cooler water temperatures decrease the solubility of many chemicals, which reduces the toxic stress on aquatic organisms. Temperature regulation also increases the significance of the fish and amphibian habitat wetland functions. Forested or scrub-shrub headwater wetlands and forested wetlands within 50 feet of streams or rivers (e.g., DP-98 in **Appendix B.3**) provide this function at the highest level.

Emergent/forested mixes within 50 feet of streams are predicted to function at a moderate level because of lesser canopy coverage. Emergent or emergent/scrub-shrub mixes within 50 feet of streams function at a low level. Water bodies themselves do not provide this function (i.e., they cannot shade themselves). This function does not apply to sites more than 50 feet from streams.

Stream Shading	High	• Forested or scrub-shrub headwater wetlands • Forested wetlands within 50 feet of streams and rivers
	Moderate	• Scrub-shrub wetlands or Forested mixes not rated High AND within 50 feet of streams and rivers
	Low	• Emergent (persistent vegetation) or Emergent/Scrub-shrub wetlands within 50 feet of streams and rivers
	N/A	• All remaining wetlands and water bodies

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4.4.9 Unique Wetland Resources

The wetlands and water bodies identified in this category are considered unique on a global, state or local level. Other studies addressed this functional category under categories such as "Unique, Uncommon, or Highly Diverse Wetland Plant Communities" (Tiner, various) or "Conservation of Rare and Imperiled Wetland Species" (MDEQ 2011, Koches et al. 2010). For the WRAPP, Unique Wetland Resources are those that perform biological and/or stormwater management functions at an exceptional level. Many of these wetlands contain a wide variety of fauna and flora, including threatened or endangered species in some locations. Bogs, ephemeral (vernal) pools, hillside seeps/fens associated with ravine features, Ramsar-designated wetlands of international importance (e.g., Chiwaukee Prairie), the Lake Michigan coastal wetlands (e.g., dune-swale complexes and beach habitat areas such as LM-98 and LM-99 in **Appendix B.3**), ADID sites (Dreher et al. 1992), and designated Illinois Natural Area Inventory sites are all unique wetland resources. The fen at FX-09 (see **Appendix B.3**) is another example. Constructed wetland mitigation bank sites that have been permitted by the U.S. Army Corps of Engineers (USACE) or SMC are also rated high for this category based on their design to meet high quality performance standards.

This rating does not apply to any wetland or water body that does not meet one or more of the criteria to rate as high.

Unique Wetland Resources	High	• Wetlands of international importance (Ramsar designation – e.g., Chiwaukee Prairie) • Wetlands/water bodies with significant biological and/or stormwater management functions per ADID study (Dreher et al. 1992), excluding detention basins • Wetlands in designated Illinois Natural Area Inventory Sites • Bogs • Ephemeral (vernal) pools • Hillside seeps/fens associated with ravine features (slope wetlands) • Lake Michigan coastal wetlands, including dune-swale complex and beach habitat • Constructed wetland mitigation bank sites (permitted by Army Corps or SMC)
	Moderate	--
	Low	--
	N/A	• All wetlands and water bodies not rated High

4.4.10 Waterfowl Habitat

Other studies combined waterfowl and waterbird habitat functionality. For the WRAPP, this function relates to a site's ability to provide habitat for waterfowl (e.g., ducks, geese, swans). Wetlands designated as important for waterfowl are generally those used for nesting, feeding or reproduction. The Northeastern Illinois Planning Commission's basin marsh model (NIPC 2005) assigned highest scores to palustrine aquatic bed/emergent wetlands. The WRAPP's emphasis also is on wetlands and water bodies that are frequently flooded for long periods, such as areas of aquatic bed (e.g., FX-13 in **Appendix B.3**). Emergent wetlands contiguous with open water areas are predicted to have high functionality based on use by a wide diversity of waterfowl species. Open water zones of lakes and ponds and larger streams and rivers also rate high because they provide landing/rafting areas and habitat for diving species. Forested and scrub-shrub wetlands are predicted to rate moderate due to less waterfowl diversity (e.g., emphasis on wood duck habitat).

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Emergent wetlands that are seasonally flooded or drier also rate as moderate, as do all artificial lakes and ponds and all perennial and intermittent streams. Ephemeral streams rate low. The waterfowl habitat function does not apply to slope wetlands that are not seasonally flooded or wetter.

Waterfowl Habitat	High	• Aquatic beds, excluding detention basins • Emergent wetlands flooded semi-permanently or permanently, or intermittently exposed (excluding farmed wetlands) • Emergent wetlands seasonally flooded AND contiguous to a water body (excluding farmed wetlands) • Island wetlands with emergent vegetation • Natural lakes and ponds (open water zone) • Rivers (open water zone)
	Moderate	• Forested and scrub-shrub wetlands seasonally, semi-permanently, intermittently or permanently flooded, or intermittently exposed (excluding terrene flat areas outside the floodplain and farmed wetlands) • Emergent wetlands seasonally flooded, continuously saturated, seasonally flooded/saturated, or intermittently flooded (excluding farmed wetlands) • Artificial lakes and ponds • Perennial and Intermittent streams (open water zone) • Temporarily flooded emergent wetlands within the FEMA 100 yr floodplain
	Low	• All remaining wetlands except Slope wetlands • Ephemeral streams
	N/A	• Slope wetlands not already rated High or Moderate

4.4.11 Wetland-dependent Bird Habitat (Other)

This function attempts to capture the wetland types and water bodies that provide desired habitat for a variety of wading birds, shorebirds and songbirds (e.g., herons, bitterns, plovers, sandpipers, red-winged and yellow-headed blackbirds). Other studies assessed this aspect under various categories, including "Other Wildlife Habitat," "Wetland-associated Birds," "Shore Bird Habitat," or "Interior Forest Bird Habitat." Aquatic beds, island wetlands, and emergent and scrub-shrub wetlands that are seasonally to semi-permanently flooded or are intermittently exposed provide this function at a high level for a wide diversity of bird species that nest, feed and reproduce in these wetland types. Natural ponds that are intermittently exposed and unconsolidated shorelines along natural lakes, ponds and streams/rivers likewise provide this function at a high level for many shorebirds. Almond Marsh is an example of a site with high functionality for other wetland- dependent bird habitat. Coastal wetlands along Lake Michigan (e.g., LM-98 in **Appendix B.3**) also rate high for this function as they provide valuable habitat for a wide diversity of wading birds, shorebirds and songbirds.

Wetlands and water bodies with moderate functionality include most temporarily flooded emergent and scrub-shrub wetlands, artificial ponds that are intermittently exposed, and areas of unconsolidated shore if associated with an artificial lake, pond, or channelized stream. Ephemeral and intermittent streams also have moderate functionality. In contrast, forested wetlands provide more limited habitat for the array of wetland-dependent birds considered and therefore have low significance for this function. Areas that do not provide this function include open water zones of lakes, ponds, rivers, and perennial streams as well as any remaining (i.e., not previously rated) open water wetland types.

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Wetland-dependent Bird Habitat (Other)	High	• Seasonally, intermittently or semi-permanently flooded, or intermittently exposed/flooded or continuously saturated emergent and scrub-shrub wetlands (excluding farmed wetlands) • Island wetlands • Intermittently exposed natural ponds • Unconsolidated shorelines of natural lakes, ponds or streams/rivers • Lake Michigan coastal wetlands, including dune-swale complex
	Moderate	• Temporarily flooded emergent and scrub-shrub wetlands (excluding farmed wetlands) • Intermittently exposed artificial ponds • Unconsolidated shorelines associated with artificial lakes and ponds and channelized streams
	Low	• All remaining wetlands • All polygons classified as "ponds" that did not rate High or Moderate (e.g., detention basins and bermed impoundments) • Ephemeral and intermittent streams • All remaining aquatic beds areas, including mixes
	N/A	• Open water zone of lakes, ponds, rivers, and perennial streams; and open water wetlands (aquatic bed and unconsolidated bottom types) not rated High, Moderate, or Low

4.4.12 Wildlife Movement Corridors

No prior studies reviewed for this effort addressed this functional catetory. For the WRAPP, the Wildlife Movement Corridors function emphasizes connectivity that enables movement of mammals, birds, reptiles, amphians, and insects between wetland environments, so accessibility and proximity are key. Vegetated corridors increase a wetland's ability to provide habitat because a larger pool of species can access and use the wetland. Such corridors include upland connections that can provide refuge, food, and migration for various species as well as artificial connections such as excavated ditches. Disconnects more than 30 feet in length 'break' the corridor; disconnects of 30 feet or less create 'interruptions.' The SMC considered a naturalized upland area "large" if there were 25+ contiguous acres, excluding manicured or agricultural land. All wetlands offer movement opportunities for wildlife to some degree; however, wetlands (excluding aquatic bed areas) interlinked to other wetlands or to sizeable undisturbed upland habitats via broad, relatively uninterrupted vegetated corridors rate highest. Within the County, the wide floodplain wetland at Middlefork Savanna Forest Preserve (NB-05 in **Appendix B.3**) is an example area with high functionality for wildlife movement.

Areas that rate moderate include most aquatic bed sites, wetlands with narrower or more interrupted connections, wetlands that lack a physical corridor connection but have other aquatic resources or a sizeable upland habitat nearby, and intermittent and ephemeral streams with less than five interruptions. Island wetlands rate low for this function.

Wildlife Movement Corridors	High	• Vegetated wetlands (except aquatic bed) connected to other wetlands via a broad, relatively unbroken vegetated corridor • Vegetated wetlands (except aquatic bed) connected to large, naturalized upland area via a broad, relatively unbroken vegetated corridor
	Moderate	• Aquatic beds connected to other wetlands via a broad, relatively unbroken vegetated corridor • Vegetated wetlands connected to other wetlands or large, naturalized uplands via a narrower and/or interrupted vegetated corridor AND not rated High • Vegetated wetlands and aquatic beds connected to other vegetated wetlands or aquatic beds by a non-vegetated wetland or water body • Vegetated wetlands and aquatic beds lacking connections but located near other aquatic resources or sizeable naturalized upland • Intermittent and ephemeral streams
	Low	• All Island wetlands • All remaining wetlands and water bodies, including Lakes, Rivers, and remaining streams
	N/A	--

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4.4.13 Woodland Amphibian Habitat

This function assesses a wetland's suitability to provide breeding habitat specifically for woodland amphibians (e.g., spotted salamanders, wood frog). In general, ratings are based on wetland size (2-acre threshold), wetland type, presence/absence of predators, and proximity to other wetlands on the local landscape. None of the previous functional assessment studies addressed this specific function, although some (Hruby et al. 1999, Tetra Tech 2015, MDEQ 2011, PGE 2014) consider "Amphibian Habitat" in a broad sense, and Tiner (2003b) notes that various criteria used for fish and shellfish habitat should apply to various amphibians and other aquatic-dependent species. For the WRAPP, this function does not focus on the importance of a wetland to a specific species (including threatened or endangered species) nor does it predict habitat suitability accurately for every woodland amphibian species. Areas with high functionality for woodland amphibian habitat include wooded vernal pools (e.g., DP-18 in **Appendix B.3**) and other small wooded ponds that lack fish and have other wetlands nearby. Flatwoods with seasonal to semi-permanent flooding also rate high for this function, if they lack fish habitat. In contrast, this function does not apply for any wetland or water body with high predicted fish habitat function.

Areas with moderate function include sites that would qualify for high rating except for failing the size threshold or because they have moderate predicted fish habitat. Moderate function also occurs for intermittent streams that are contiguous to polygons that rate high or moderate for woodland amphibian habitat. Areas of low functionality include all remaining wooded wetlands and all remaining woodland ponds that are not rated as high for fish habitat.

Woodland Amphibian Habitat	High	• Woodland vernal pools < 2 acres that lack fish habitat AND occur within 500 feet of other wetlands or water bodies • Seasonally to semi-permanently flooded flatwoods that lack fish habitat • Ponds < 2 acres that lack fish habitat AND occur within 500 feet of other wetlands associated with woodlands
	Moderate	• Woodland vernal pools ≥ 2 acres located within 500 feet of other wetlands AND lack good fish habitat • Woodland vernal pools < 2 acres located more than 500 feet from other wetlands AND lack good fish habitat • Seasonally to semi-permanently flooded flatwoods with Moderate fish habitat • Seasonally to semi-permanently flooded ponds associated with woodlands AND have Moderate fish habitat • Wetlands not rated High for fish AND contiguous to wetlands and water bodies rated High for amphibians • Intermittent woodland streams contiguous to polygons rated High or Moderate for amphibians
	Low	• All remaining forested and scrub-shrub wetlands and mixes with forested or scrub-shrub AND not rated High for fish • All remaining woodland ponds not rated High for fish
	N/A	• Any polygon rated High for fish • All remaining wetlands and water bodies

4.5 PERFORM GIS-BASED W-PAWF

The GIS-based W-PAWF is the process SMC used to assign functional ratings to each wetland/water body polygon in the geographic database. The process relies on geographic information system (GIS) software to analyze and select specific polygons from the entire data set that satisfy the criteria outlined in **Section 4.4** above. For the initial

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run prior to the field study and refinement of the W-PAWF, SMC only subjected the EWI-LC data set (existing wetland and water body polygons) to the W-PAWF process. Following the field study and refinement of the W-PAWF functional selection criteria, we subjected all three data sets (i.e., the EWI-LC, HWI-LC, and PRW) to the W-PAWF process.

Generally, the W-PAWF followed the same process for all data sets. Using the narrative criteria identified in **Section 4.4**, specific selection attributes were identified within the geographic data set that would allow for selection of polygons that satisfy the narrative selection criterion. These selection attributes were identified for each narrative criterion under all functions. Next, all polygons in each geographic data set (EWI-LC, HWI-LC, or PRW) were analyzed for each criterion. Polygons were identified in the geodatabase attribute table as satisfying or not satisfying each criterion. This information was then used to determine the functional rating assigned to each polygon for each wetland function. The process was the same for each data set, although not all criteria apply to all data sets (see **Appendix A.5**). For instance, the PRW data set includes wetlands only and therefore criteria that apply only to water bodies are not applicable to the PRW data set.

See **Appendix A.5** for the geographic data attributes SMC used to select polygons for each criterion.

4.6 Field Studies and Refinement of W-PAWF

To calibrate and refine the desktop functional assessment, SMC, accompanied by various TAG members as their time allowed, performed limited Level 2 (rapid assessment) field studies. SMC worked with the TAG to develop a Wetland Field Data Check Form and Wetland Field Check Protocol (see **Appendices B.1** and **B.2**) specifically for the WRAPP. We performed stratified random sampling of representative wetland and water body study sites throughout the county and entered the data for each field-checked site into a metrics table (**Appendix B.4**).

Assessed sites included a cross-section of wetland/water body types, with emphasis placed on the types with the highest percentage of occurrence in each of the four major watersheds based on the GIS analysis. We selected sites mostly on publicly owned land to allow for easier site access and because of the higher potential for such sites to be in a more natural, undisturbed condition than sites on privately owned lands. Each field review had a minimum of two assessors, with at least one person on the team able to identify dominant plant species, understand common wetland plant communities, and basic hydrologic processes affecting wetlands and water bodies in the Midwest, and be acquainted with biological aspects of the aquatic environment (i.e., wildlife habitat).

We reviewed 48 field sites (**Figure 7**) during the growing season (typically May through October). The number of field sites per major watershed was roughly proportional to the total number of mapped wetland/water body polygons in each watershed: Lake Michigan (7), North Branch Chicago River (6), Fox River (14), and Des Plaines River (21).

The field check data form (see **Appendix B.1**.) addresses two main objectives for the WRAPP: 1) to ground-truth the mapped wetland polygon boundaries and classification codes (NWI and LLWW) and 2) to review and refine the preliminary wetland functional assessment criteria developed by TAG for each of the 13 selected functions. Prior to conducting fieldwork, general site information was added to Section 1 of the form. Section 2 involves mapping review and verification of the GIS polygon and NWI and LLWW data enhancements.

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Section 3 covers field observations related to hydrology, wildlife habitat features, vegetation features, and site alterations. Section 4 is a table used to identify functions associated with the wetland/water body or watershed services relevant to the inventory or mapping effort and includes a section dedicated to recommended changes to the preliminary functional assessment based on field observations. At least one photograph was taken of each study site depicting typical features. The field process ranged from 30 minutes to 2 hours per site.

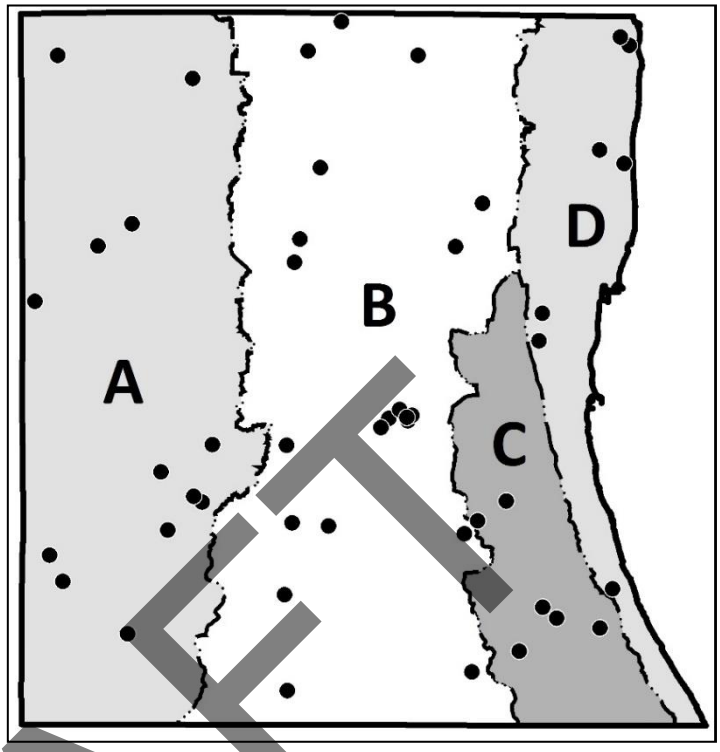

Figure 7. Lake County WRAPP Field Site Locations.

SMC refined the functional assessment criteria based on comments in Section 4 of the field form, as warranted. Most of the refinements fell into two types of non-substantive changes: 1) changes to the narrative criteria for clarification and consistency and 2) changes to the "Classification Codes" column to ensure selection of polygons in the GIS mirrors the narrative criteria. For example, the following NWI water regimes were added, where appropriate, throughout the selection criteria based on field comments related to the presence of these regimes: "B" seasonally saturated, "D" continuously saturated, and "E" seasonally flooded/saturated. Previous studies did not consider these water regimes in their selection criteria; however, they are present in the Lake County NWI and therefore must be considered. These regimes apply primarily to slope (seep), bog, and fen types and are not common among the population of wetland polygons in the LCWI. Using the refined criteria, SMC re-ran the GIS analysis to assign functional assessment ratings to each existing and pre-settlement wetland and water body.

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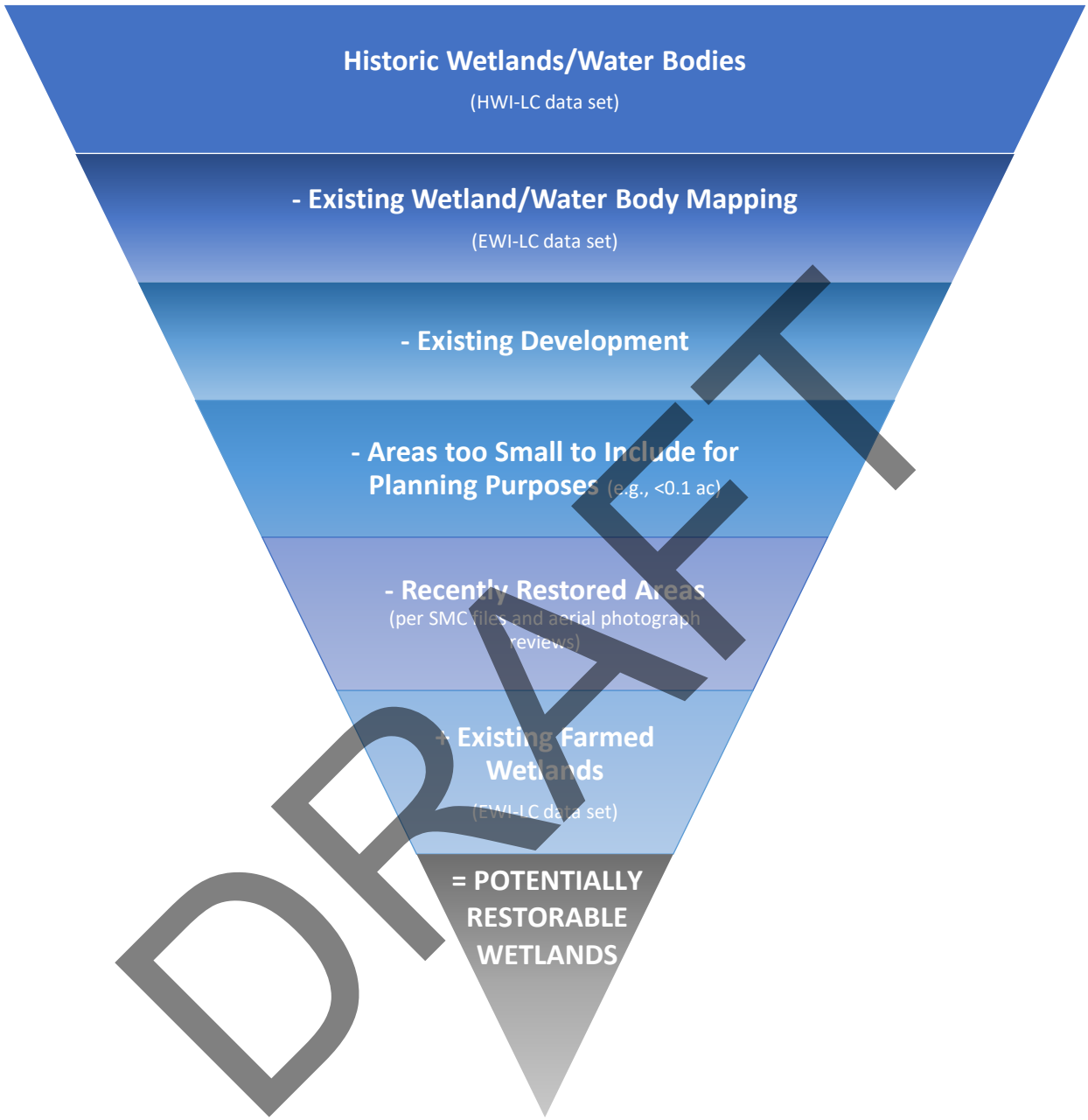
4.7 Identification of Potentially Restorable Wetlands

Efforts to restore wetlands rely on locating potential project sites. The search for a potential restoration site can be time-consuming, involving map reviews and screening. The WRAPP is designed to help focus and reduce the site search effort.

For this plan, PRWs generally refer to areas with predominantly wet (hydric) soils that are not currently mapped as wetlands, have not recently been restored, and have not been converted to permanent urban land use. PRWs also include polygons identified as farmed wetlands with the rationale that farmed wetlands have a high potential for functional gain if restored and that farmed wetland polygons are often surrounded by non-wetland hydric soils mapped as PRWs, so it is logical to include the farmed wetlands with the surrounding PRW polygon.

SMC identified PRW sites countywide using two GIS data sets: existing mapping (EWI-LC) and historic mapping (HWI-LC). In its simplest form, the equation for deriving PRW is as follows:



Appendix A.6 contains more information on PRW coding for the WRAPP. PRWs mapped in this manner typically include drained hydric soils that are in agricultural use, filled wetlands (e.g., dumps and dredge material disposal sites), and former wetlands that are now deepwater habitats (TNC-ELI 2014). They do not, however, reflect wetlands that were lost prior to soil mapping efforts.

4.8 Decision Support Tool development

The culmination of WRAPP data set development and enhancement is a geospatially-based decision support tool (DST) that works at a variety of scales, from as small as a specific property to as large as the entire county. The program includes various mapping and prioritization tools that the user can select for a defined Area of Interest (see **Section 6.1**). Using the DST, one can prioritize each PRW identified within a selected area based on project-specific goals and objectives (see **Section 6.1.2**).

The DST uses ESRI base maps and makes extensive use of functional correlations between site characteristics and wetland/water body functions. **Appendix C** provides details on the DST development. As with all GIS-based efforts, the outcome depends on the quality and currency of the data inputs, and any result generated by the WRAPP's online DST should be "ground-truthed" and interpreted with common sense.

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5.0 RESULTS

This section presents the WRAPP results of existing and historic wetlands and water bodies on a countywide basis (see **Section 5.1**) and a watershed basis (see **Section 5.2**). See **Section 5.3** for results related to potentially restorable wetlands (PRW). The acreages listed below do not include the open water area of Lake Michigan. We have, however, included acreages associated with four harbors (North Point, Waukegan commercial, Waukegan recreational, and Great Lakes) as well as one industrial use intake/return channel for the Waukegan generation plant.

5.1 COUNTYWIDE RESULTS

5.1.1 Overview of Countywide Wetland/Water Body Changes

Table 6 estimates the acreage of historic and existing wetlands and water bodies (i.e., lakes, ponds, rivers, streams) in Lake County, Illinois, based on the results of the geographic information system (GIS) analysis. Combined, historic wetlands and water bodies covered an estimated 32 percent (96,697 acres) of the county's land surface, with wetlands accounting for 28 percent alone. Existing wetlands and water bodies are estimated to cover 20 percent of the county's land surface (59,731 acres), with wetlands alone comprising about 13 percent. These results reflect a mid-range percentage of wetland loss (i.e., 55 percent) compared to the State's estimated 40 to 69 percent loss (Havera 1985 as cited by Suloway and Hubbell 1994). The gain in water body area is somewhat deceptive, however, as a portion of that increase is due to wetland conversion. Other wetland losses are mainly associated with agricultural drainage over many years and conversion to urban land uses in more recent times.

Table 6. Historic (Pre-Settlement) vs. Existing Wetlands and Water Bodies in Lake County, IL.

Wetland Area (acres)		Loss of Wetland Area (%)	Water Body Area* (acres)		Gain in Water Body Area (%)
Historic	Existing		Historic	Existing	
84,899	37,825	47,074 ac (55%)	11,798	21,906	10,108 ac (85%)

* Excludes Lake Michigan open water but includes North Point, Waukegan commercial, Waukegan Recreational, and Great Lakes harbors and one industrial use intake/return channel for the Waukegan generation plant.

5.1.2 Countywide Wetlands/Water Bodies by NWI Codes

Of Lake County's 59,731 acres of wetlands and water bodies (**Table 6**), emergent (e.g., marshes and wet meadows) is the most abundant class **(Table 7)**, followed by forested wetlands. Scrub-shrub, aquatic bed, unconsolidated bottom, and unconsolidated shore wetland types each comprise a minimal percentage of the total wetland acreage in Lake County. Compared to pre-settlement conditions, the county has experienced the sharpest reduction in the emergent type of wetland (59% reduction). This summary likely under-represents some classes, particularly forested and scrub-shrub wetlands, due to their inclusion in mixed classes and the difficulty of mapping their extent using existing data. For example, if forested mixes are included (e.g., EM/FO classes), the existing area increases to 12,182 acres. The same rationale is true for estimates of historic wetland coverage and may result in a concomitant overestimation of historic and existing emergent class acreage in this summary.

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Table 7. Countywide Wetland and Water Body Acreage by NWI System and Class Codes.

System	Subsystem	Class	Existing (ac)	% of Existing	Historic (ac)	% of Historic
Riverine (R)	2 - Lower Perennial	AB - Aquatic Bed	22	<1	--	--
		RS - Rocky Shore	<1	<1	--	--
		UB - Unconsolidated Bottom	1,687	3	1,423	2
		US - Unconsolidated Shore	<1	<1	--	--
	4 - Intermittent	SB - Streambed	191	<1	111	<1
		Riverine Subtotal	***1,900***	***3***	***1,534***	***2***
Lacustrine (L)	1 - Limnetic	AB - Aquatic Bed	642	1	163	<1
		UB - Unconsolidated Bottom	4,395	7	2,741	3
	2 - Littoral	AB - Aquatic Bed	2,149	4	2,352	2
		EM - Emergent	8	<1	--	--
		RS - Rocky Shore	1	<1	--	--
		UB - Unconsolidated Bottom	7,903	13	4,874	5
		US - Unconsolidated Shore	150	<1	<1	<1
		Lacustrine Subtotal	***15,248***	***26***	***10,130***	***10***
Palustrine (P)		AB - Aquatic Bed	721	1	520	1
		EM - Emergent	29,096	49	75,722	77
		FO - Forested	7,798	13	8,022	8
		RB - Rock Bottom	1	<1	--	--
		SS - Scrub-Shrub	864	1	497	1
		UB - Unconsolidated Bottom	4,103	7	270	<1
		Palustrine Subtotal	***42,583***	***71***	***85,031***	***88***
Totals			**59,731**	**100**	**96,695***	**100**

* Rounding error results in a slightly different total than in **Table 6**.

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The acreage of the riverine (R) system in **Table 7** has increased under existing conditions, largely from the creation of ditches and the impoundment of the Fox River mainstem below the Chain O' Lakes. Other differences, such as the smaller acreage for lacustrine (L) aquatic bed in the historic data set, likely reflect the difficulty in mapping historic AB polygons. The decision to not map Lake Michigan beaches resulted in lower historic acreage for unconsolidated lake shoreline. We postulate that the higher historic acreage for palustrine (P) emergent systems derives from difficulties in mapping forested wetlands. Also, sites that were partially wooded (e.g., EM/FO) were counted as emergent. Underestimation also applies to scrub-shrub wetlands, as historic land cover maps often do not clearly identify areas of scrub-shrub vegetation.

Human alterations have impacted the County's wetlands. GIS analysis reflected that 40 percent of the existing wetlands are partly drained, ditched, or otherwise excavated. Only 808 acres of farmed wetlands were identified, while many acres of former wetland (hydric soil areas) are in active agricultural use. Other human alterations are evident in the results, such as the significant increase of the unconsolidated bottom (UB) class. This primarily relates to the construction of lakes and ponds, some of which were converted from other wetland types (e.g., aquatic bed areas). The effect of other human activities on wetlands, such as well construction, was not evaluated.

From a hydrologic standpoint, most wetlands in Lake County are seasonally flooded, accounting for 50 percent of all wetland acres (**Table 8**). Such wetlands have shallow surface

water for extended periods, and most of these areas have high water tables extending into summer. Thirty-one (31) percent of wetlands are semi-permanently flooded and typically have surface water throughout the growing season. Temporarily flooded wetlands, which are inundated for brief periods, amount to 17 percent of Lake County's wetlands. Wetlands defined by saturated soil conditions rather than surface inundation only make up about 1 percent of the county's wetlands but include unique features such as seeps and bogs.

Table 8. Countywide Acreage of Wetlands Classified by NWI Water Regime Code.

NWI Water Regime	Existing (ac)	% of Existing	Historic (ac)	% of Historic
A – Temporarily Flooded	6,322	17	11,135	13
B – Seasonally Saturated	307	<1	327	<1
C – Seasonally Flooded	19,017	50	52,052	61
D – Continuously Saturated	102	<1	112	<1
E – Seasonally Flooded/Saturated	5	<1	-	--
F – Semipermanently Flooded	11,680	31	21,110	25
G – Intermittently Exposed	130	<1	154	<1
H – Permanently Flooded	20	<1	7	<1
J – Intermittently Flooded	152	<1	1	<1
K – Artificially Flooded	-	--	-	--
Totals	37,735*	100	84,898*	100

* Rounding error results in a slightly different total than in **Table 6**.

5.1.3 Countywide Wetlands by LLWW Categories

Table 9 summarizes Lake County wetland acreage based on LLWW descriptors. For simplicity, SMC classified all ponds and lakes as water bodies under the LLWW system. Some water bodies in the 10- to 20-acre size range are considered lakes for LLWW coding. This likely results in the inclusion of some shallow, open water wetlands in the pond or lake categories.

Landscape Position

Terrene wetlands (those primarily surrounded by uplands or not significantly influenced by rivers, streams, or lakes) are the most common landscape position type of wetland, totaling 48 percent of the wetland acreage in Lake County. Thirty-seven (37) percent of the county's wetland acreage is associated with rivers and streams (lotic), with 15 percent associated with lakes (lentic).

Terrene wetlands have experienced a higher rate of loss than other landscape types, reduced by 65 percent, or 33,191 acres, from the pre-settlement estimate. Lotic stream and river wetlands have been reduced by 44 percent since pre-European times, a reduction of approximately 10,844 acres. Lentic wetlands have been reduced by 35 percent, with estimated loss offset somewhat by the creation of lakes through impoundment and/or excavation. Similarly, the mean terrene wetland size also has decreased from more than 6 acres to less than 2 acres, while mean size of lotic river and stream wetlands has decreased from more than 10 acres to less than 3 acres.

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Table 9. Countywide Wetlands Classified by LLWW Descriptors.

Landscape Position	Landform	Existing (ac)	Historic (ac)	Water Flow Path	Existing (ac)	Historic (ac)
Lentic (LE)	Basin	1,268	2,348	Bidirectional	29	151
	Flat	N/A	174	Bidirectional-outflow	158	67
	Fringe	3,924	6,069	Bidirectional-throughflow	5,067	6,743
	Island	380	19	Outflow-perennial	248	578
	Subtotal	***5,572***	***8,611***	Outflow-intermittent	3	4
				Throughflow-perennial	54	1,030
				Throughflow-intermittent	13	39
				Subtotal	***5,572***	***8,612****
Lotic River (LR)	Basin	130	12	Throughflow-perennial	3,671	4,745
	Floodplain	3,520	4,695	Bidirectional-throughflow	2	N/A
	Fringe	20	36	***Subtotal***	***3,673***	***4,745***
	Island	4	2			
	Subtotal	***3,673***	***4,745***			
Lotic Stream (LS)	Basin	4,407	8,524	Bidirectional-throughflow	156	N/A
	Flat	145	200	Outflow-perennial	26	N/A
	Floodplain	5,773	11,402	Outflow-intermittent	13	6
	Fringe	22	4	Throughflow-perennial	7,340	16,427
	Island	12	7	Throughflow-intermittent	2,243	3,711
	Slope	12	7	Throughflow-artificial	594	N/A
	Subtotal	***10,372***	***20,144***	***Subtotal***	***10,372***	***20,144***
Terrene (TE)	Basin	16,972	47,818	Bidirectional	11	1
	Flat	1,063	3,365	Bidirectional-outflow	19	4
	Fringe	57	5	Bidirectional-throughflow	125	10
	Island	14	N/A	Bidirectional-isolated	2	N/A
	Slope	102	212	Outflow- perennial	134	244
	Subtotal	***18,208***	***51,399***	Outflow-intermittent	3,813	18,027
				Outflow-artificial	258	N/A
				Throughflow-perennial	686	1,067
				Throughflow-intermittent	10,519	26,980
				Throughflow-artificial	426	N/A
				Isolated	1,482	3,646
				Isolated-outflow	64	256
				Isolated-throughflow	81	120
				Isolated-inflow	220	260
				Inflow	368	786
				Subtotal	***18,208***	***51,401****
	Totals	**37,825**	**84,899**	**Totals**	**37,825**	**84,902****

* Rounding error results in a slightly different totals than landform acreage.

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Landform

Basin wetlands are most common landform type, accounting for 60 percent of the wetland acreage. Floodplain wetlands rank second, comprising 25 percent of the acreage. Fringe wetlands make up 11 percent of wetland acreage, while flats make up 3 percent of the wetland acreage by landform. Island wetlands account for 1 percent of wetland acres while slope wetlands comprise less than 1 percent of acreage countywide (although this wetland type is almost certainly under-represented due to difficulty in remote identification and mapping of slope wetlands).

The most common landforms in each landscape position (e.g., lentic basin and fringe, lotic river floodplain, lotic stream basin and floodplain, terrene basin and flat) are estimated to have experienced the greatest reductions in area. Lentic fringe and lotic river floodplain wetlands have been reduced at a lower pace than the countywide average, perhaps due to the comparative difficulty in successfully draining or filling these areas. Lentic basin, lotic stream basin and lotic stream floodplain wetlands have been reduced by 40 to 50 percent of their estimated historical extent, only slighty below the overall countywide average. Terrene basin and flat wetlands have been reduced by more than 60 percent of their estimated historic extent, perhaps related to the relative ease with which they were drained or filled.

Water Flow Path

Throughflow types (i.e., perennial, intermittent, or artificial) comprise 68 percent of existing wetland acres. Outflow types account for 12 percent of the acreage and isolated and inflow types comprise only 6 percent of all wetland acres. Fifteen percent (15%) of the acreage has bidirectional flow (associated with lakes/reservoirs).

Compared to the pre-settlement estimate, there have been reductions of 53 percent and 56 percent of wetland acres for throughflow and isolated/inflow types, respectively. These percentages are similar to the countywide estimate for the reduction in overall wetland acreage (i.e., 55%). Outflow wetland types have been reduced by 76 percent while bidirectional flow types have only experienced a 20 percent reduction that can be partly attributed to the construction of lakes (lentic wetlands are typically bidirectional flow types). Since pre-settlement times, wetlands in an apparent headwaters position (those with perennial stream outflow but not perennial inflow) have been reduced from 2,272 to 1,274 acres, or a reduction of 44 percent.

Water Body Type

Water body types in Lake County include rivers, streams (both perennial and intermittent), lakes and ponds. The County has approximately 1,196 acres of water bodies classified as rivers using the LLWW methodology. Under the same classification system, streams (including ditches) account for 704 acres. Lakes comprise 15,096 acres, which includes Lake Michigan harbors, but not the open waters of the lake. Lakes include all polygons classified in the NWI “lacustrine” and “littoral” systems, with the exception of those identified as unconsolidated shorelines.

Ponds comprise 4,910 acres and include dry and wetland-bottom stormwater basins. A variety of pond types occur in the County, most of which were created or altered (6% impounded and 91% excavated), with only 3 percent of natural origin.

5.1.4 Countywide Wetlands by Functional Categories

The enhanced data sets enabled prediction of 13 functions for wetlands in Lake County and the relative level to which each function is provided. The countywide results for each function are given in **Table 10**. Summary sheets in **Appendix D** illustrate the existing and presettlement functional loss on a countywide basis.

Countywide, more than half of the functional significance categories (e.g., High, Moderate, Low, or Not Applicable) for all functions experienced areal reductions of 40 to 70 percent from the estimated historic extent to the present, in line with the overall estimate of 55 percent loss of wetland coverage shown in **Table 6**. Some exceptions and/or trends identified within specific functions are discussed below. Additional watershed-based discussion is included in **Section 5.2.4**.

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Table 10. Countywide Wetland Results for WRAPP Functional Analysis.

Function and Rating		Existing Wetland Acreage (est.)	Presettlement Acreage (est.)	Change Acres (%)
Carbon Sequestration	High	15,169	43,857	-28,688 (-65%)
	Mod	18,388	32,489	-14,101 (-43%)
	Low	4,268	8,554	-4,286 (-50%)
	N/A*	--	--	--
Flood Water Storage	High	33,944	76,985	-43,041 (-56%)
	Mod	1,790	3,992	-2,202 (-55%)
	Low	2,061	3,831	-1,770 (-46)
	N/A	30	92	-62 (-67%)
Native Fish Habitat	High	5,697	13,598	-7,901 (-58%)
	Mod	5,205	19,649	-14,444 (-74%)
	Low	23,305	43,101	-19,796 (-46%)
	N/A	3,618	8,551	-4,933 (-58%)
Nutrient Transformation (P)	High	1,943	5,039	-3,096 (-61%)
	Mod	9,564	48,303	-38,739 (-80%)
	Low	26,318	31,557	-5,239 (-17%)
Sediment/Other Particulate Retention	High	16,899	29,467	-12,568 (-43%)
	Mod	18,456	50,592	-32,136 (-64%)
	Low	2,470	4,841	-2,371 (-49%)
Shoreline/Stream Bank Stabilization**	High	15,060	33,154	-18,094 (-55%)
	Mod	4,607	395	*4,212 (1,066%)*
	Low	2,259	52	*2,207 (4,244%)*
	N/A	15,899	51,299	-35,400 (-69%)
Stream Baseflow Maintenance**	High	8,030	20,168	-12,138 (-60%)
	Mod	3,234	1,822	*1,412 (77%)*
	Low	6,822	48,639	-41,817 (-86%)
	N/A	19,739	14,270	5,469 (38%)
Stream Shading**	High	4,048	3,568	*480 (13%)*
	Mod	2,448	5,390	-2,942 (-55%)
	Low	9,460	23,652	-14,192 (-60%)
	N/A	21,869	52,290	-30,421 (-58%)
Unique Wetland Resources**	High	18,081	3,318	*14,763 (445%)*
	N/A	19,744	81,581	-61,837 (-76%)
Waterfowl Habitat	High	16,133	31,925	-15,792 (-49%)
	Mod	8,508	25,763	-17,255 (-67%)
	Low	13,085	27,136	-14,051 (-52%)
	N/A	99	76	23 (30%)
Wetland-dependent Bird Habitat (Other)	High	22,211	55,578	-33,367 (-60%)
	Mod	1,648	3,446	-1,798 (-52%)
	Low	13,966	25,875	-11,909 (-46%)
	N/A*	--	--	--
Wildlife Movement Corridors**	High	33,582	83,326	-49,744 (-60%)
	Mod	2,476	670	*1,806 (270%)*
	Low	1,767	903	*864 (96%)*
Woodland Amphibian Habitat	High	714	805	-91 (-11%)
	Mod	420	1,571	-1151 (-73%)
	Low	14,761	26,539	-11778 (-44%)
	N/A	21,929	55,984	-34,055 (-61%)

*Does not apply to wetland polygons, only to water bodies.
***Italicized text*: See narrative for explanation of positive change in acreage.

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For the Nutrient Transformation function, the loss of moderate significance wetlands was greater (80%) than overall wetland loss (55%), a result of ditching and farming of throughflow and outflow-type wetlands.

Moderate and low functionality for Shoreline/Streambank Stabilization increased due to the construction of lakes, ponds, ditches, and islands, which resulted in additional shoreline and streambank area. High significance wetlands for this function declined at the same rate as overall wetland loss (55%).

Moderate functionality wetlands for Stream Baseflow Maintenance also increased from historic estimates. The ditching of headwater-position wetlands reduces functional significance from high to moderate and filling or ditching/drainage of floodplain wetlands also reduces functional significance, resulting in the increase in this particular category.

A marginal gain in high functionality wetlands for Stream Shading is the result of two factors: 1) afforestation of wetlands along rivers, streams, and ditches and 2) mapped loss of forested wetlands was much less than the loss of other wetland vegetation classes in Lake County. The combination of these two factors resulted in a small gain in mapped acres of high functionality (forested) riparian wetlands.

Unique Wetland Resources include criteria based on designations assigned by wetland managers and others and not necessarily based only on ecological or hydrogeomorphic factors. These designations, including Wetlands of International Importance (under the Ramsar Convention), designation as an Illinois Natural Area Inventory site, or inclusion in the Lake County Advanced Identification Study, do not apply to historic wetland coverage. In other words, this reflects a scarcity that didn't exist historically for certain wetland characteristics. Therefore, wetlands satisfying these criteria result in a large apparent gain in Unique Wetland Resources extent, but that gain is simply an artefact of geographic designations applied in the recent past.

High functionality wetlands in the Wildlife Movement Corridors function have been reduced at a slightly greater pace (60%) than overall wetland loss in Lake County (55%). Relatively small gains in acreage of moderate and low significance wetlands in this function result from the fragmentation of intact corridors and reduction in functionality of former high significance wetlands.

5.2 WATERSHED-BASED RESULTS

5.2.1 Overview of Wetland and Water Body Losses

Estimates of historic (pre-settlement) wetland coverage appear related to total watershed area for the Des Plaines and Fox River watersheds (see **Table 11**), where wetlands accounted for 28 and 29 percent of total watershed area, respectively. These estimates are consistent with the estimate of historic wetland coverage for Lake County (see **Section 5.1.1**). We estimated that historic wetland acreage covered a larger percentage of the North Branch Chicago River watershed (34 percent) and a much smaller portion of the Lake Michigan watershed (20 percent). While underlying hydrogeomorphic differences may contribute to the lower acreage in the Lake Michigan watershed, we attribute it primarily to the (relatively) early urban development of that watershed and the relative lack of good pre-development wetland and soil data for much of that watershed.

Existing wetland coverage more closely relates to watershed size, with estimates of existing wetland acreage comprising similar percentages of total watershed area in the Des Plaines River (12%), North Branch Chicago River (9%) and Lake Michigan (10%) watersheds. Existing wetlands account for a slightly larger proportion

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Table 11. Historic (Pre-Settlement) vs. Existing Wetlands and Water Bodies by Major Watershed in Lake County, IL.

Watershed	Wetland Area (ac)		% Change	Water Bodies Area (ac)		% Change
	Historic	Existing		Historic	Existing	
Des Plaines River	37,100	15,051	-59%	2,294	6,836	+298%
Fox River	30,060	16,300	-46%	9,330	13,508	+45%
North Branch – Chicago River	10,869	2,998	-72%	79	906	+1,047%
Lake Michigan	6,869	3,476	-49%	95*	655**	+589%

* Does not include open water of Lake Michigan.
** Includes harbors and process/cooling ponds directly connected to open waters of Lake Michgan.

of the Fox River watershed (16%). This difference from the other major watersheds could be a result of later wide-scale urban development relative to the other watersheds or an artefact of the underlying physical geography (i.e., the type, size, or location of wetlands in the Fox River watershed reduces the effect of factors that would otherwise contribute to wetland loss).

Overall the Fox River Watershed had the lowest percentage (46%) wetland loss, followed closely by the Lake Michigan watershed (49%) (see **Table 11**). In these watersheds, the presence of large wetland/water body complexes (associated with the Chain O' Lakes in the Fox and the Illinois Beach plain in the Lake Michigan) dampened the percentage of loss. Lower historic levels of urban/suburban development may contribute to the lower loss percentage in the Fox watershed as well. Historic wetland resources are more difficult to identify in the Lake Michigan watershed relative to the other watersheds due to the older age of urban development and that may contribute to the relatively low rate of wetland loss. The North Branch Chicago River watershed exhibits the highest percentage loss (72%), a result of the ditching and drainage of the inter-morainal wetland systems once present along all three forks of the North Branch of the Chicago River as well as a longer history of urban/suburban development. Among the four major watersheds, percentage of wetland loss in the Des Plaines River watershed (59%) is closest to the overall estimated wetland loss percentage for Lake County (55%).

5.2.2 Wetlands and Water Bodies by NWI Code

Tables 12 and **13** reflect existing and historic wetland and water body acreages for each watershed based on NWI attributes, respectively. Discussion is in addition to **Section 5.1.2** and therefore only reflects watershed-based trends, not those that mirror the countywide results.

Des Plaines River Watershed

The Des Plaines River watershed is the largest (by area) of the four major watersheds in Lake County. Watershed-based results largely reflect the countywide trends with a few minor exceptions. The area of forested and scrub-shrub polygons has increased slightly for two reasons: 1) these wetland types are difficult to map remotely and historically and 2) afforestation has likely occurred in some wetlands.

Fox River Watershed

The Fox River watershed exhibits trends similar to the Des Plaines River watershed, except that the area of lacustrine (L) aquatic bed (AB) has been reduced over time, a result of conversion to unconsolidated bottom types

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Table 12. Estimated Acreage of Existing Wetlands and Water Bodies by NWI Codes and Major Watershed.

System	Subsystem	Class	Existing Acreage by Major Watershed				
			Des Plaines	Fox	North Branch	Lake Michigan	TOTAL
Riverine (R)	2 – Lower Perennial	AB - Aquatic Bed	--	22	--	--	22
		RS - Rocky Shore	--	--	<1	--	<1
		UB – Unconsolidated Bottom	740	808	84	55	1,687
		US - Unconsolidated Shore	--	<1	--	<1	<1
	4 - Intermittent	SB - Streambed	86	31	20	54	191
Lacustrine (L)	1 - Limnetic	AB - Aquatic Bed	215	96	38	292	642
		UB - Unconsolidated Bottom	1,319	2,986	52	38	4,395
	2 - Littoral	AB - Aquatic Bed	962	1,187	--	--	2,149
		EM - Emergent	8	--	--	--	8
		RS - Rocky Shore	--	--	--	1	1
		UB - Unconsolidated Bottom	1,135	6,691	77	--	7,903
		US - Unconsolidated Shore	7	6	--	138	150
Palustrine (P)		AB - Aquatic Bed	252	372	33	64	721
		EM - Emergent	10,786	13,987	1,659	2,666	29,097
		FO - Forested	4,160	1,648	1,372	617	7,798
		RB – Rock Bottom	--	--	1	--	1
		SS - Scrub-Shrub	250	503	30	80	864
		UB – Unconsolidated Bottom	1,968	1,471	538	126	4,103

Table 13. Estimated Acreage of Historic Wetlands and Water Bodies by NWI Code and Major Watershed.

System	Subsystem	Class	Historic Acreage by Major Watershed				
			Des Plaines	Fox	North Branch	Lake Michigan	TOTAL
Riverine (R)	2 - Lower Perennial	UB – Unconsolidated Bottom	706	590	73	53	1,423
	4 - Intermittent	SB - Streambed	56	18	1	35	111
Lacustrine (L)	1 - Limnetic	AB - Aquatic Bed	90	74	--	--	163
		UB - Unconsolidated Bottom	382	2,358	--	--	2,741
	2 - Littoral	AB - Aquatic Bed	723	1,629	--	--	2,352
		UB – Unconsolidated Bottom	301	4,574	--	--	4,874
		US – Unconsolidated Shore	--	<1	--	--	<1
Palustrine (P)		AB - Aquatic Bed	164	312	24	20	520
		EM - Emergent	32,897	28,201	8,878	5,745	75,722
		FO - Forested	3,839	1,259	1,863	1,061	8,022
		SS - Scrub-Shrub	168	179	102	48	497
		UB – Unconsolidated Bottom	68	195	5	3	270

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within the Chain O' Lakes. Additionally, the loss of emergent wetlands has occurred at a lower rate than the other watersheds in Lake County, with about half of the estimated pre-settlement acreage lost.

North Branch Chicago River Watershed
The North Branch Chicago River watershed did not have any lakes identified in the historic wetland inventory, so all gains in the lacustrine system are the result of lake construction via impoundment or excavation. Emergent wetlands that comprised a significant part of the intermorainal lowland sloughs along the three forks of the North Branch Chicago River have been reduced at a greater rate than in other watersheds and currently cover only 19 percent of the estimated pre-settlement extent. Along with the Lake Michigan watershed, most of the estimated forested wetland loss in Lake County is accounted for in the North Branch Chicago River watershed.

Lake Michigan Watershed
The Lake Michigan watershed did not have any lakes identified in the historic wetland inventory (aside from Lake Michigan), so all gains in the lacustrine system are the result of lake construction via impoundment or excavation. Along with the North Branch Chicago River watershed, most of the estimated forested wetland loss in Lake County is accounted for in the Lake Michigan watershed.

5.2.3 Wetlands by LLWW Categories

Tables 14 and **15** reflect wetland acreages for each watershed based on LLWW attributes. Discussion is in addition to **Section 5.1.3** and therefore only reflects watershed-based trends, not those that mirror the countywide results.

Des Plaines River Watershed
Lentic wetlands in the Des Plaines River watershed have experienced marginal loss overall, although some acreage loss of wetlands associated with natural lakes has been "offset" by the acreage gained through wetlands associated with constructed lakes. Some of this lake construction has occurred in historic wetland areas, meaning that some wetland areas now considered lentic would have been classified as lotic or terrene under historic conditions. The addition of wetland acres associated with constructed lakes is also evident in the increase in lentic bidirectional flowpath type wetlands. Loss of lotic river wetland acres is greatest in the Des Plaines River watershed, largely because the Des Plaines River does not meander in and out of Lake County between its entry and exit points (in contrast to the Fox River). That said, the loss of wetlands associated with the Des Plaines River has occurred at a lower rate (28%) than the overall rate of wetland loss in Lake County (55%). This may be due to the hydrological complications associated with conversion of these wetlands to another land cover type but is also largely due to the ownership of large areas of the Des Plaines River floodplain by the Lake County Forest Preserve District. Terrene wetland loss has a occurred at a rate (71%), only exceeded in the North Branch Chicago River watershed (75%). The Des Plaines River watershed has the largest acreage of flat wetlands of the four major watersheds in Lake County and has also lost the greatest amount of flat wetlands (>1,000 acres). Existing and historic flat wetlands occur primarily east of the Des Plaines River in the southern half of the watershed.

Fox River Watershed
As identified in **Section 5.2.1**, the Fox River watershed has the lowest watershed-wide rate of wetland loss (46%) of the four major watersheds in Lake County. This is due to a large historic and existing acreage of lentic wetlands, which tend to be reduced at a lower rate than other landscape positions (e.g., lotic, terrene) and a lower rate of terrene wetland loss (53%) relative to the Des Plaines and North Branch Chicago River watersheds. However, because the Fox River watershed has vastly

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Table 14. Wetlands in Major Watersheds Classified by Landscape Position and Landform.

Landscape Position	Landform	Watershed Acreage							
		Des Plaines		Fox		North Branch		Lake Michigan	
		Existing	Historic	Existing	Historic	Existing	Historic	Existing	Historic
Lentic	Basin	174	224	1,065	2,124	12	--	17	--
	Flat	--	--	--	174	--	--	--	--
	Fringe	816	978	2,969	5,091	--	--	139	--
	Island	21	<1	359	19	<1	--	--	--
	Total	***1,010***	***1,202***	***4,393***	***7,409***	***12***	***--***	***157***	***--***
Lotic River	Basin	2	--	--	12	--	--	128	--
	Floodplain	2,760	3,816	746	866	--	--	13	13
	Fringe	--	--	20	36	--	--	--	--
	Island	2	2	2	--	--	--	--	--
	Total	***2,764***	***3,818***	***768***	***914***	***--***	***--***	***141***	***13***
Lotic Stream	Basin	1,367	2,956	1,558	2,549	220	287	1,262	2,732
	Flat	133	192	--	--	12	--	--	8
	Floodplain	2,572	4,387	1,883	2,846	1,058	3,805	260	363
	Fringe	22	2	--	2	<1	--	<1	--
	Island	9	7	2	<1	<1	--	<1	<1
	Slope	--	--	12	7	--	--	--	--
	Total	***4,104***	***7,544***	***3,455***	***5,404***	***1,290***	***4,093***	***1,523***	***3,102***
Terrene	Basin	6,522	22,863	7,489	15,951	1,431	5,840	1,530	3,163
	Flat	581	1,600	112	247	264	936	107	582
	Fringe	43	--	13	5	--	--	--	--
	Island	2	--	11	--	<1	--	<1	--
	Slope	24	72	59	130	<1	<1	19	9
	Total	***7,172***	***24,535***	***7,684***	***16,334***	***1,696***	***6,777***	***1,656***	***3,754***

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more lentic wetlands than the other major watersheds, it has experienced the greatest reduction of lentic wetland acreage. In particular, the reduction in lentic fringe wetlands (those that are directly along the shores of a lake) in the Fox River watershed accounts for most of the fringe wetland loss in Lake County. Lotic river wetlands are associated with the Fox River and Squaw Creek below Long Lake, both of which meet Tiner's (2011) criteria for "lotic river" classification.

North Branch Chicago River Watershed

Tiner's (2011) scheme classifies the three forks of the North Branch of the Chicago River as "lotic streams;" therefore, no lotic river wetlands are recorded in the historic or existing wetland inventories for this watershed. Lotic stream wetlands, particularly those along perennial streams (classified as lotic stream, throughflow-perennial), have been reduced by a greater percentage (73%) than in the other watersheds in Lake County (45-62%). Terrene wetlands have also been reduced by a greater percentage in the North

Table 15. Wetlands in Major Watersheds Classified by Landscape Position and Water Flow Path Type.

Landscape Position	Water Flow Path	Watershed Acreage							
		Des Plaines		Fox		North Branch		Lake Michigan	
		Existing	Historic	Existing	Historic	Existing	Historic	Existing	Historic
Lentic	Bidirectional	17	13	12	139	<1	--	--	--
	Bidirectional-outflow	146	11	11	55	<1	--	--	--
	Bidirectional-throughflow	640	486	4,271	6,257	11	--	144	--
	Outflow-perennial	205	219	44	358	--	--	--	--
	Outflow-intermittent	--	--	3	4	--	--	--	--
	Throughflow-perennial	2	468	52	561	--	--	--	--
	Throughflow-intermittent	<1	4	--	35	--	--	12	--
	Total	***1,010***	***1,202***	***4,393***	***7,409***	***12***	***--***	***157***	***--***
Lotic River	Throughflow-perennial	2,762	3,818	768	914	--	--	141	13
	Bidirectional-throughflow	2	--	--	--	--	--	--	--
	Total	***2,764***	***3,818***	***768***	***914***	***--***	***--***	***141***	***13***
Lotic Stream	Bidirectional-throughflow	56	--	92	--	6	--	2	--
	Outflow-perennial	--	--	26	--	--	--	--	--
	Outflow-intermittent	<1	2	--	--	--	--	13	4
	Throughflow-perennial	2,878	5,442	2,456	4,471	1,071	4,025	935	2,488
	Throughflow-intermittent	1,028	2,100	673	932	28	68	520	611
	Throughflow-artificial	148	--	208	--	185	--	53	--
	Total	***4,104***	***7,544***	***3,455***	***5,404***	***1,290***	***4,093***	***1,523***	***3,102***
Terrene	Bidirectional	4	<1	8	<1	<1	--	<1	--
	Bidirectional-outflow	10	3	7	<1	1	--	--	--
	Bidirectional-throughflow	37	5	83	5	2	--	3	--
	Bidirectional-isolated	1	--	<1	--	<1	--	--	--
	Outflow-perennial	36	31	97	146.	--	67	<1	--
	Outflow-intermittent	1,648	8,812	1,302	4,748	420	2,927	443	1,543
	Outflow-artificial	131	--	87	--	6	--	34	--
	Throughflow-perennial	191	258	464	532	24	232	7	45
	Throughflow-intermittent	4,053	13,030	4,279	8,638	1,172	3,459	1,015	1,852
	Throughflow-artificial	220	--	182	--	16	--	7	--
	Isolated	587	1,792	696	1,477	54	93	145	284
	Isolated-outflow	34	128	31	116	--	--	--	12
	Isolated-throughflow	67	100	14	20	--	--	--	--
	Isolated-inflow	97	92	122	149	--	--	1	18
	Inflow	56	282	312	502	<1	<1	--	1
	Total	***7,172***	***24,535***	***7,684***	***16,334***	***1,696***	***6,777***	***1,656***	***3,754***

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Branch Chicago River watershed (75%) than in other watersheds (53-71%).

Lake Michigan Watershed

The Lake Michigan watershed has not experienced the same rate of wetland loss as the Des Plaines or North Branch Chicago River watersheds, and nearly two-thirds of the extant wetland acreage is considered "Great Lakes Coastal," meaning it is located along Lake Michigan or within a coastal landform such as the dune and swale systems between Waukegan and Winthrop Harbor. Because numerous streams drain to the Lake Michigan beach plain and because wetlands elsewhere in the watershed have been reduced, lotic stream wetlands account for a larger proportion of wetland acres than in the other watersheds in Lake County. The rate of terrene wetland loss (56%) is similar to the overall countywide rate of all wetland loss (55%) and is much lower than the rate of terrene wetland loss in the Des Plaines River (71%) and North Branch Chicago River (75%) watersheds.

5.2.4 Wetlands by Functional Categories

The enhanced data sets enabled prediction of 13 functions for wetlands in each major watershed and the relative level to which each function is provided. Summary sheets in **Appendix D** illustrate the existing and presettlement functional loss on a watershed basis. As discussed previously in **Section 5.1.4**, wetland acreage reductions of 40 to 70 percent from the estimated historic extent to the present are assumed to trend consistently with the overall estimate of 55 percent loss of wetland coverage shown previously in **Table 6**. Watershed-based exceptions and/or trends identified within specific functions are discussed below.

Des Plaines River Watershed

Table 16 shows the existing and historic acreages of wetlands as well as acreage and percent change for each functional significance category (High, Moderate, Low, Not Applicable) within the Des Plaines River watershed. Functional significance loss/gain trends generally follow countywide trends for wetland loss and functionality change. Wetlands with high functionality for Nutrient Transformation exhibit a higher rate of loss (70%) in the Des Plaines River watershed relative to other Lake County watersheds (54%) due to a greater reduction in isolated flowpath-type wetlands, which are predicted to have higher significance for nutrient transformation. Wetlands of moderate functional significance for Waterfowl Habitat have been reduced at a higher rate than other significance levels due to the loss of emergent seasonally-flooded wetlands, which has outpaced the loss of other wetland types. The Des Plaines River watershed contains most of the wetland acreage in Lake County predicted to function at a high level of significance for Woodland Amphibian Habitat as a result of numerous flatwood and woodland vernal pool wetlands.

Fox River Watershed

Table 17 shows the existing and historic acreages of wetlands as well as acreage and percent change by functional significance category (High, Moderate, Low, Not Applicable) within the Fox River watershed. Generally, the pace of wetland loss within the functional significance levels tends to be slightly lower in the Fox River watershed relative to Lake County as whole, which is consistent with the overall lower rate of wetland loss in the watershed (discussed in **Section 5.2.1**).Wetlands with predicted high functional significance for Carbon Sequestration have been reduced at a greater pace (62%) than the overall rate of wetland loss in the Fox River watershed (46%) as a result of the reduction of wetland acreage on organic hydric soils as well as ditching, draining, and farming of those wetlands. Acreage of wetlands predicted to have moderate significance for this function has increased as a result of these modifications, particularly in larger wetland complexes in the sub-watersheds of Squaw Creek, Mutton Creek, and Slocum Lake Drain. Wetlands of moderate functional significance for Waterfowl Habitat have been

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Table 16. WRAPP Functional Analysis Results for Wetlands in the Des Plaines River Watershed.

Function and Rating		Existing Wetland Acreage (est.)	Presettlement Acreage (est.)	Change Acres (%)
Carbon Sequestration	High	4,944	13,428	-8,484 (-63%)
	Mod	8,105	19,148	-11,043 (-58%)
	Low	2,002	4,524	-2,522 (-56%)
	N/A*	--	--	--
Flood Water Storage	High	13,077	32,539	-19,462 (-60%)
	Mod	976	2,358	-1,382 (-59%)
	Low	986	2,179	-1,193 (-55%)
	N/A	12	23	-11 (-48%)
Native Fish Habitat	High	1,457	3,026	-1,569 (-52%)
	Mod	2,624	7,924	-5,300 (-67%)
	Low	9,212	22,118	-12,906 (-58%)
	N/A	1,757	4,033	-2,276 (-56%)
Nutrient Transformation (P)	High	721	2,382	-1,661 (-70%)
	Mod	4,709	23,279	-18,570 (-80%)
	Low	9,621	11,439	-1,818 (-16%)
Sediment/Other Particulate Retention	High	7,169	11,747	-4,578 (-39%)
	Mod	6,816	23,415	-16,599 (-71%)
	Low	1,065	1,937	-872 (-45%)
Shoreline/Stream Bank Stabilization**	High	6,321	12,488	-6,167 (-49%)
	Mod	1,609	145	*+1,464 (+1,010%)*
	Low	672	10	*+662 (+6,620%)*
	N/A	6,449	24,456	-18,007 (-74%)
Stream Baseflow Maintenance**	High	3,001	7,500	-4,499 (-60%)
	Mod	1,532	946	*+586 (+62%)*
	Low	3,408	22,169	-18,761 (-85%)
	N/A	7,109	6,484	+625 (+10%)
Stream Shading	High	2,501	2,647	-146 (-6%)
	Mod	1,340	2,966	-1,626 (-55%)
	Low	3,289	8,668	-5,379 (-62%)
	N/A	7,921	22,818	-14,897 (-65%)
Unique Wetland Resources**	High	5,561	52	*+5,509 (+10,594%)*
	N/A	9,488	37,048	-27,560 (-74%)
Waterfowl Habitat	High	5,021	10,445	-5,424 (-52%)
	Mod	3,858	14,032	-10,174 (-73%)
	Low	6,148	12,583	-6,435 (-51%)
	N/A	23	39	-16 (-41%)
Wetland-dependent Bird Habitat (Other)	High	7,115	23,015	-15,900 (-69%)
	Mod	815	1,829	-1,014 (-55%)
	Low	7,121	12,256	-5,135 (-42%)
	N/A*	--	--	--
Wildlife Movement Corridors**	High	13,738	36,412	-22,674 (-62%)
	Mod	925	261	*+664 (+254%)*
	Low	388	426	-38 (-9%)
Woodland Amphibian Habitat	High	555	710	-155 (-22%)
	Mod	210	622	-412 (-66%)
	Low	6,784	11,765	-4,981 (-42%)
	N/A	7,502	24,003	-16,501 (-69%)

*Does not apply to wetland polygons, only to water bodies.
***Italicized text*: See Section 5.1.4 for explanation of positive acreage change.

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Table 17. WRAPP Functional Analysis Results for Wetlands in the Fox River Watershed.

Function and Rating		Existing Wetland Acreage (est.)	Presettlement Acreage (est.)	Change Acres (%)
Carbon Sequestration	High	8,494	22,594	-14,100 (-62%)
	Mod	6,665	6,236	+429 (+7%)
	Low	1,140	1,230	-90 (-7%)
	N/A*	--	--	--
Flood Water Storage	High	15,447	28,480	-13,033 (-60%)
	Mod	332	631	-299 (-47%)
	Low	510	890	-380 (-43%)
	N/A	11	60	-49 (-82%)
Native Fish Habitat	High	3,879	6,579	-2,700 (-41%)
	Mod	2,019	7,180	-5,161 (-72%)
	Low	9,416	15,151	-5,735 (-38%)
	N/A	986	1,150	-164 (-14%)
Nutrient Transformation (P)	High	1,041	2,260	-1,219 (-54%)
	Mod	3,708	16,271	-12,563 (-77%)
	Low	11,551	11,529	+22 (+ <1%)
Sediment/Other Particulate Retention	High	8,173	13,141	-4,968 (-38%)
	Mod	7,438	15,823	-8,385 (-53%)
	Low	688	1,096	-408 (-37%)
Shoreline/Stream Bank Stabilization**	High	6,528	13,056	-6,528 (-50%)
	Mod	2,510	153	*+2,357 (+1,541%)*
	Low	1,335	42	*+1,293 (+3,079%)*
	N/A	5,927	16,809	-10,882 (-65%)
Stream Baseflow Maintenance**	High	3,035	5,390	-2,355 (-44%)
	Mod	778	510	*+268 (+53%)*
	Low	2,874	17,571	-14,697 (-84%)
	N/A	9,612	6,589	+3,023 (+46%)
Stream Shading**	High	551	295	*+256 (+87%)*
	Mod	710	1,288	-578 (-45%)
	Low	4,647	8,690	-4,043 (-47%)
	N/A	10,391	19,787	-9,396 (-47%)
Unique Wetland Resources**	High	8,850	321	*+8,529 (+2,657%)*
	N/A	7,452	29,739	-22,287 (-75%)
Waterfowl Habitat	High	9,016	14,899	-5,873 (-39%)
	Mod	2,993	8,515	-5,522 (-65%)
	Low	4,235	6,619	-2,384 (-36%)
	N/A	56	28	+28 (+100%)
Wetland-dependent Bird Habitat (Other)	High	11,781	23,168	-11,387 (-49%)
	Mod	495	321	+174 (+54%)
	Low	4,023	6,571	-2548 (-39%)
	N/A*	--	--	--
Wildlife Movement Corridors**	High	14,086	29,266	-15,180 (-52%)
	Mod	1,009	362	*+647 (+179%)*
	Low	1,205	432	*+773 (+179%)*
Woodland Amphibian Habitat	High	10	9	+1 (+10%)
	Mod	74	74	--
	Low	4,901	7,061	-2,160 (-31%)
	N/A	11,314	22,916	-11,602 (-51%)

*Does not apply to wetland polygons, only to water bodies.
***Italicized text*: See Section 5.1.4. or corresponding watershed narrative for explanation of positive acreage change.

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reduced at a higher rate than other significance levels due to the loss of emergent seasonally-flooded wetlands, which has outpaced the loss of other wetland types. Wetlands of moderate functional significance for Wetland-dependent Bird Habitat (Other) have increased in acreage as ditching and channelization have resulted in wetlands with frequent inundation becoming drier.

North Branch Chicago River Watershed

Table 18 shows the existing and historic acreages of wetlands as well as acreage and percent change by functional significance category (High, Moderate, Low, Not Applicable) within the North Branch Chicago River watershed. Generally, the pace of wetland loss within functional significance levels tends to be higher in the North Branch Chicago River watershed relative to Lake County as a whole, which is consistent with the overall higher rate of wetland loss in the watershed (discussed in **Section 5.2.1**). Wetlands with predicted high and moderate functional significance for Native Fish Habitat have been reduced at a greater pace (93% and 95%, respectively) than the overall rate of wetland loss in the watershed (72%) and the countywide rate for those functional significance levels (58% and 74%, respectively). This large percentage reduction is the result of a predicted reduction in functional significance for streams that have been channelized as well as for wetlands associated with those streams. Likewise, wetland acreage predicted to have high functional significance for Waterfowl Habitat has been reduced at a pace (91%) greater than both the overall rate of wetland loss in the watershed and the countywide rate of loss for this functional significance level (49%). This is due to the loss of of emergent wetlands that are either seasonally flooded and associated with open water or that are flooded semi-permantently or more frequently. Again, this is likely a result of the historic drainage of large marshlands that existed along the three forks of the North Branch of the Chicago River. The gain of 62 acres of high functionality for woodland amphibian habitat largely corresponds to reductions in native fish habitat function.

Lake Michigan Watershed

Table 19 shows the existing and historic acreages of wetlands as well as acreage and percent change by functional significance category (High, Moderate, Low, Not Applicable) within the Lake Michigan watershed. Wetlands with predicted high functional significance for Carbon Sequestration have been reduced at a greater pace (76%) than the overall rate of wetland loss in the Lake Michigan watershed (49%) as a result of the reduction of wetland acreage on organic hydric soils as well as ditching, draining, and farming of those wetlands. Acreage of wetlands predicted to have moderate significance for this function increased as a result of these modifications. Wetlands with predicted high functional significance for Native Fish Habitat have also been reduced at a greater pace (89%) than the overall rate of wetland loss in the watershed while wetlands predicted to have low functional significance increased as a result of channelization, ditching, and fragmentation of the Lake Michigan coastal plain. The Lake Michigan watershed is the only major watershed where wetland acres predicted to have high functional significance for Stream Shading were reduced by more than 10 percent, with 38 percent of acres lost. This corresponds to the loss of forested wetland coverage in this watershed relative to other watersheds discussed in **Section 5.2.2**.

5.3 Potentially Restorable Wetlands

This section discusses countywide and watershed-based results for potentially restorable wetlands (PRWs) based on acreage, NWI codes, and LLWW classification.

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Table 18. WRAPP Functional Analysis Results for Wetlands in the North Branch Chicago River Watershed.

Function and Rating		Existing Wetland Acreage (est.)	Presettlement Acreage (est.)	Change Acres (%)
Carbon Sequestration	High	715	3,681	-2,966 (-81%)
	Mod	1,798	5,345	-3,547 (-66%)
	Low	485	1,844	-1,359 (-74%)
	N/A*	--	--	--
Flood Water Storage	High	2,434	9,938	-7,504 (-76%)
	Mod	225	494	-269 (-54%)
	Low	338	437	-99 (-23%)
	N/A	<1	<1	--
Native Fish Habitat	High	128	1,855	-1,727 (-93%)
	Mod	169	3,353	-3,184 (-95%)
	Low	2,135	3,561	-1,426 (-40%)
	N/A	566	2,101	-1,535 (-73%)
Nutrient Transformation (P)	High	39	85	-46 (-54%)
	Mod	727	6,648	-5,921 (-89%)
	Low	2,231	4,136	-1,905 (-46%)
Sediment/Other Particulate Retention	High	1,120	3,898	-2,778 (-71%)
	Mod	1,496	5,802	-4,306 (-74%)
	Low	382	1,168	-786 (-67%)
Shoreline/Stream Bank Stabilization**	High	929	4,020	-3,091 (-77%)
	Mod	246	90	*+156 (+173%)*
	Low	78	--	*+78 (+Inf.%)*
	N/A	1,745	6,760	-10,882 (-65%)
Stream Baseflow Maintenance**	High	764	4,383	-3,619 (-83%)
	Mod	623	51	*+572 (+1,122%)*
	Low	217	5,997	-5,780 (-96%)
	N/A	1395	437	+958 (+219%)
Stream Shading**	High	645	55	*+590 (+1,073%)*
	Mod	293	736	-443 (-60%)
	Low	338	3,326	-2,988 (-90%)
	N/A	1,722	6,752	-5,030 (-74%)
Unique Wetland Resources**	High	1,142	--	*+1,142 (+Inf.%)*
	N/A	1,856	10,707	-8,851 (-83%)
Waterfowl Habitat	High	318	3,468	-3,150 (-91%)
	Mod	1,064	2,019	-955 (-47%)
	Low	1,615	5,382	-3,767 (-70%)
	N/A	<1	<1	--
Wetland-dependent Bird Habitat (Other)	High	767	5,060	-4,293 (-85%)
	Mod	198	713	-515 (-72%)
	Low	2,033	5,097	-3,064 (-60%)
	N/A*	--	--	--
Wildlife Movement Corridors**	High	2,652	10,795	-8,143 (-75%)
	Mod	326	32	*+294 (+919%)*
	Low	20	42	-22 (-52%)
Woodland Amphibian Habitat**	High	131	69	*+62 (+90%)*
	Mod	136	756	-620 (-82%)
	Low	1,840	5,249	-3,409 (-65%)
	N/A	890	4,796	-3,906 (-81%)

*Does not apply to wetland polygons, only to water bodies.
***Italicized text*: See Section 5.1.4. or corresponding watershed narrative for explanation of positive acreage change.

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Table 19. WRAPP Functional Analysis Results for Wetlands in the Lake Michigan Watershed.

Function and Rating		Existing Wetland Acreage (est.)	Presettlement Acreage (est.)	Change Acres (%)
Carbon Sequestration**	High	1,016	4,154	-3,138 (-76%)
	Mod	1,820	1,759	*+61 (+3%)*
	Low	641	957	-316 (-33%)
	N/A*	--	--	--
Flood Water Storage	High	2,985	6,027	-3,042 (-50%)
	Mod	257	509	-252 (-50%)
	Low	227	325	-98 (-30%)
	N/A	7	8	-1 (-1%)
Native Fish Habitat**	High	233	2,139	-1,906 (-89%)
	Mod	393	1,192	-799 (-67%)
	Low	2,542	2,272	*+270 (+12%)*
	N/A	309	1,267	-958 (-76%)
Nutrient Transformation (P)	High	142	312	-170 (-54%)
	Mod	419	2,106	-1,687 (-80%)
	Low	2,915	4,452	-1,537 (-35%)
Sediment/Other Particulate Retention	High	436	679	-243 (-36%)
	Mod	2,706	5,551	-2,845 (-51%)
	Low	334	639	-305 (-48%)
Shoreline/Stream Bank Stabilization**	High	1,282	3,589	-2,307 (-64%)
	Mod	241	6	*+235 (+3,920%)*
	Low	174	<1	*+174 (+174%)*
	N/A	1,780	3,274	-1,494 (-46%)
Stream Baseflow Maintenance	High	1,230	2,894	-1,664 (-57%)
	Mod	301	314	-13 (-4%)
	Low	323	2,902	-2,579 (-89%)
	N/A	1,622	760	+862 (+113%)
Stream Shading	High	352	570	-218 (-38%)
	Mod	104	399	-295 (-74%)
	Low	1,186	2,966	-1,780 (-60%)
	N/A	1,834	2,934	-1,100 (-37%)
Unique Wetland Resources	High	2,528	2,783	-255 (-9%)
	N/A	948	4,087	-3,139 (-77%)
Waterfowl Habitat	High	1,778	3,112	-1,334 (-43%)
	Mod	592	1,197	-605 (-51%)
	Low	1,088	2,552	-1,464 (-57%)
	N/A	19	9	+10 (+111%)
Wetland-dependent Bird Habitat (Other)	High	2,549	4,334	-1,785 (-41%)
	Mod	140	583	-443 (-76%)
	Low	788	1,952	-1,164 (-60%)
	N/A*	--	--	--
Wildlife Movement Corridors**	High	3,106	6,852	-3,746 (-55%)
	Mod	216	15	*+201 (+1,340%)*
	Low	154	3	*+151 (+5,033%)*
Woodland Amphibian Habitat	High	18	18	--
	Mod	--	119	-119 (-Inf.%)
	Low	1,236	2,464	-1,228 (-50%)
	N/A	2,223	4,268	-2,045 (-48%)

*Does not apply to wetland polygons, only to water bodies.
***Italicized text*: See Section 5.1.4. or corresponding watershed narrative for explanation of positive acreage change.

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5.3.1 Countywide PRW Results

Potentially Restorable Wetlands by Acreage
Using the approach described in **Section 4.7** and as generally depicted in **Figure 8**, there are approximately 14,966 acres of PRWs in Lake County. The PRW acreage represents approximately 32 percent of the estimated historical wetland loss of 47,074 acres and about 5 percent of the total area of Lake County.

As shown in **Figure 9**, the open space/park land category, which includes forest preserves, parks and golf courses, makes up just over a third of land cover for PRW acreage in Lake County, followed by the agricultural and meadow/pasture land categories. As noted previously, landowner interest and ability and other limiting factors will ultimately determine whether a particular site is suitable for wetland restoration.

Potentially Restorable Wetlands by NWI Codes
SMC classified PRWs according to the scheme used in the NWI ("Cowardin Classification system") based on the classification of adjacent existing wetland polygons and classification of estimated historical wetland polygons corresponding to the location of the PRW. All PRW acres in Lake County are in the "palustrine (P)" system based on correlation with the mapping conventions of the NWI maps for the area (see **Figure 10**). Most PRWs belong to the "emergent (EM)" class, followed by the "forested (FO)" class. As with existing and historic wetland estimates (see **Sections 5.1.2** and **5.2.2**), "forested (FO)" and "scrub/shrub (SS)" classes are likely under-represented due to the limitations of identifying these types of wetlands and the classification system accounting. These are lands that are estimated to have historically contained forested wetlands and now exhibit a different land cover. GIS analysis indicated about a quarter of PRWs classified as "forested" are associated with floodplains of rivers and streams while the majority are basins (depressions) or flats in a terrene landscape position (i.e., surrounded by uplands).

Potentially Restorable Wetlands by LLWW Categories
Similar to the above discussion, PRWs are classified into LLWW categories based on the classification of adjacent existing wetland polygons (if restoration would expand the existing wetland within the same hydrogeomorphic feature) and classification of estimated historical wetland polygons corresponding to the location of the PRW. **Section 4.3.2** provides a description of the LLWW categories. Nearly three-quarters of PRWs in Lake County (11,116 acres) occur in the terrene landscape position, or largely surrounded by uplands (see **Table 20**). PRWs in a lotic stream landscape position, associated with smaller streams, make up a significant portion (3,068 acres) of the remaining PRW acreage. PRWs ascribed the lentic (lake-associated) and lotic river landscape positions comprise less than 800 acres in Lake County.

Basins are the most common landform type among PRWs, accounting for 11,766 acres or 79 percent of all PRW acres throughout the county. These include all PRWs associated with bowl-shaped topographic depressions as well as swales or drainageways that form linear topographic depressions. Most of the basin PRWs are terrene (more than 10,000 acres); however, more than 900 acres are associated with streams (lotic stream) and nearly 300 acres are associated with lakes (lentic). PRWs in floodplain landforms cover more than 2,400 acres. PRWs classified as flats (525 acres) and fringe (210 acres) have lower but perhaps locally-significant countywide acreage, while PRWs associated with slope (54 acres) and island (2 acres) landforms are relatively scarce. Nevertheless, opportunities for restoration may exist for these low-acreage types.

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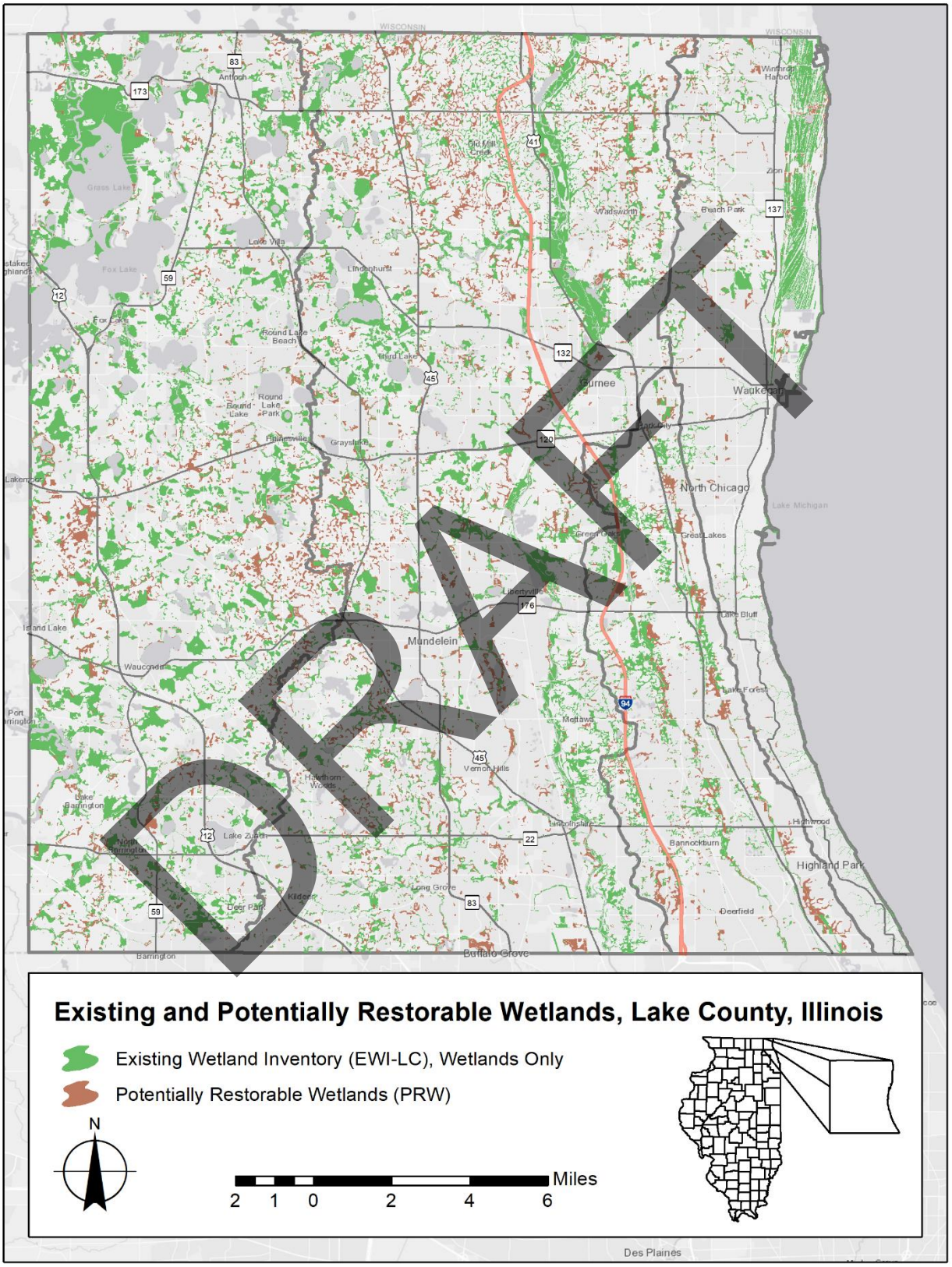

Figure 8. GIS-determined PRWs within Lake County, Illinois.

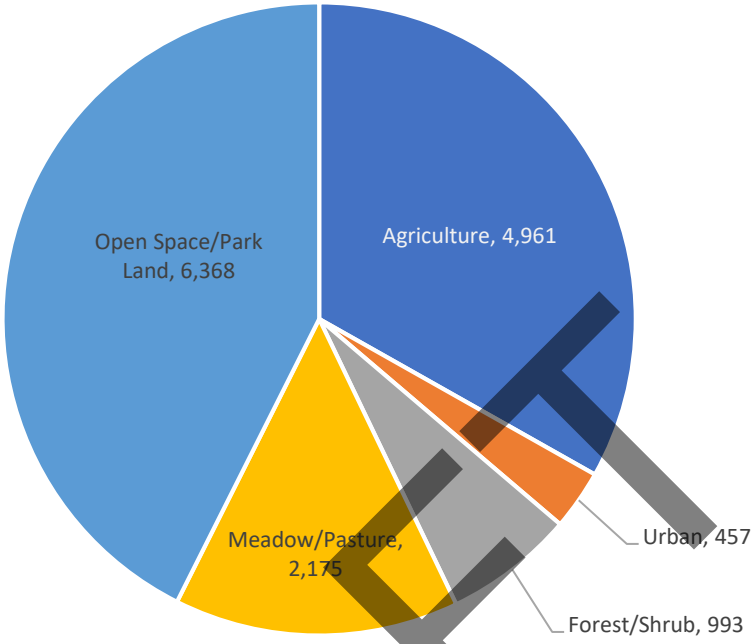

Figure 9. Estimated Countywide PRW Acreage by Land Cover Class.

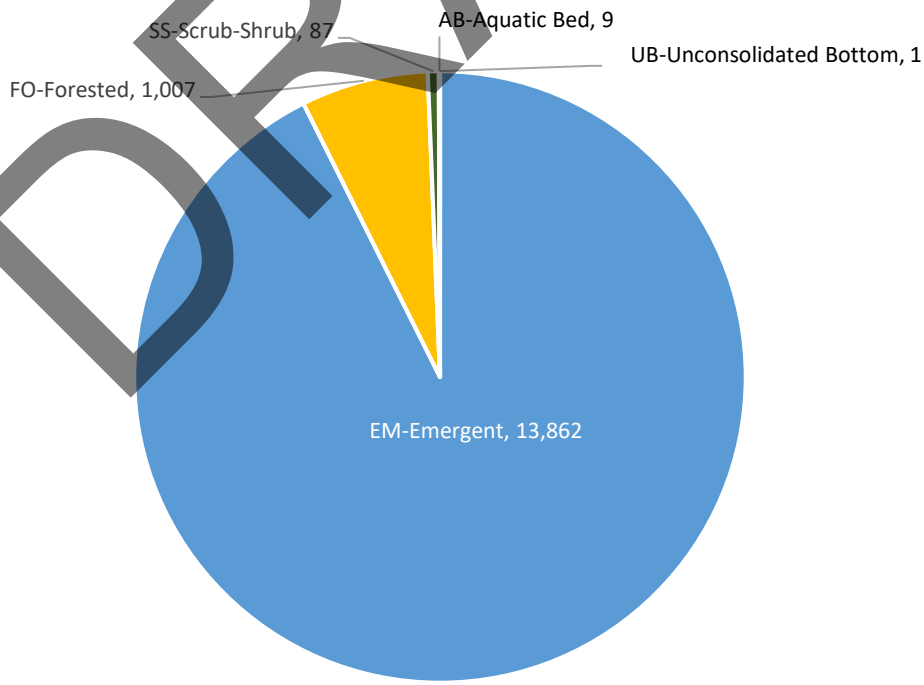

Figure 10. Estimated Countywide PRW Acreage by NWI Code.

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Table 20. PRWs Estimated Countywide by Landscape Position and Landform.

Landscape Position	Landform	Countywide Totals
Lentic	Basin	296
	Flat	3
	Fringe	210
	Island	2
	Total	***511***
Lotic River	Basin	<1
	Floodplain	271
	Total	***272***
Lotic Stream	Basin	912
	Flat	19
	Floodplain	2,137
	Fringe	<1
	Total	***3,068***
Terrene	Basin	10,558
	Flat	503
	Fringe	<1
	Slope	54
	Total	***11,116***

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Acreage of PRWs classified by water flow path (see **Table 21**) is consistent with landscape position and landform types. For example, lotic river PRWs consist almost entirely of the throughflow-perennial flow path classification. PRWs associated with rivers and their floodplains have this type of flow path.

Likewise, lentic PRWs of all landform types are dominated by bi-directional flow paths, which correspond to rising and falling water levels of lakes. Lotic stream PRWs are predominantly classified as throughflow-perennial; however, significant acreages are classified as throughflow-intermittent (400 acres), associated with intermittent streams, and throughflow-artificial (319 acres), associated with constructed stream channels such as ditches. The predominant water flow path classifications of terrene PRWs are throughflow-intermittent (4,939 acres) and outflow-intermittent (4,500 acres). These flow paths indicate the potential for surface water flow into and out of PRWs but not on a consistent or perennial basis. Isolated and inflow waterflow path types also comprise a significant portion of terrene PRWs (more than 1,500 acres).

5.3.2 Watershed-based PRW Results

SMC determined PRW locations by mapping the estimated extent of existing and historic wetland resources, then using existing land cover, and planimetric data (e.g., existing buildings, roads, and large parking lots) to remove areas with little or no viability for restoration. Note, however, that factors such as landowner interest, ability, and limiting hydrologic impacts to neighboring properties (Hatch and Bernthal 2008) likely will lower the feasible acreage of wetland restoration.

Table 21. PRWs Estimated PRW Acreage in Lake County by Landscape Position and Water Flow Path.

Landscape Position	Water Flow Path	Countywide Totals
Lentic	Bidirectional	17
	Bidirectional-outflow	7
	Bidirectional-throughflow	435
	Outflow-perennial	6
	Outflow-intermittent	<1
	Throughflow-perennial	39
	Throughflow-intermittent	5
	Total	***511***
Lotic River	Throughflow-perennial	271
	Throughflow-intermittent	<1
	Bidirectional-throughflow	<1
	Total	***272***
Lotic Stream	Bidirectional-throughflow	2
	Outflow-intermittent	<1
	Outflow-artificial	58
	Throughflow-perennial	2,289
	Throughflow-intermittent	400
	Throughflow-artificial	319
	Total	***3,068***
Terrene	Bidirectional	1
	Bidirectional-outflow	2
	Bidirectional-throughflow	12
	Bidirectional-isolated	<1
	Outflow-perennial	22
	Outflow-intermittent	4,500
	Outflow-artificial	16
	Throughflow-perennial	99
	Throughflow-intermittent	4,939
	Throughflow-artificial	3
	Isolated	1,157
	Isolated-outflow	167
	Isolated-throughflow	34
	Isolated-inflow	41
	Inflow	123
	Total	***11,116***

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Potentially Restorable Wetlands by Acreage

Distribution of PRW acreage (**Figure 11**) across major watersheds is generally related to watershed size, with the Des Plaines River watershed having the most acres of PRWs, followed by the Fox and North Branch Chicago River watersheds, and the Lake Michigan watershed having the fewest acres of PRWs. PRWs account for 4.5 to 6 percent of total watershed acreage in the Des Plaines, Fox, and North Branch Chicago River watersheds, but only account for about 2 percent of the total area of the Lake Michigan watershed. This difference in distribution rate of PRWs in the Lake Michigan watershed can be attributed, in part, to the extent of urban development relative to the other watersheds in the County, which precludes many historic wetland areas from being considered "restorable."

Total acreage of PRWs in a sub-watershed tends to correlate with overall sub-watershed size (i.e., larger sub-watersheds tend to have more PRW acres). GIS analysis indicates that sub-watersheds with the greatest estimated amount of PRW acres are Squaw Creek (1,636 acres), North Mill Creek (1,620 acres) and the Upper Des Plaines River (1,611 acres). Density of PRW acres (PRW acres:sub-watershed acres) weakly associates with both PRW acreage and sub-watershed size and is more dependent upon existing land uses in the sub-watershed. In most sub-watersheds in Lake County (22 of 26), estimated PRWs account for between 2 and 7 percent of total area.

Des Plaines River Watershed

The Des Plaines River watershed occupies about 43 percent of the total area of Lake County and contains about half of the County's PRW acreage (7,544 acres). PRW acreage in the Des Plaines River watershed (**Figure 12**) is predominantly in agricultural lands within the northern part of the County. PRWs are also found in open spaces (e.g., forest preserves, parks and golf courses), particularly along stream systems throughout the watershed.

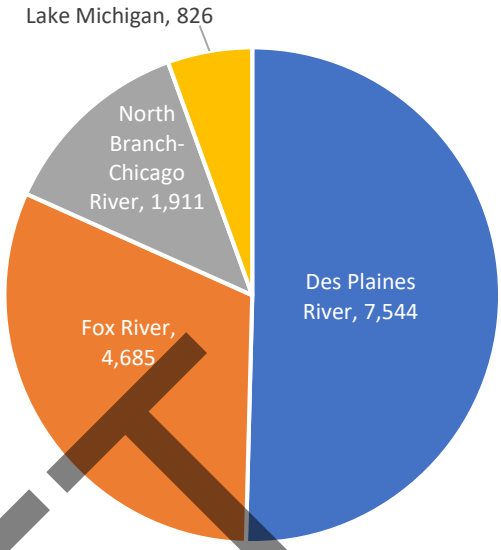

Figure 11. PRW Acreage by Watershed.

Agricultural land PRWs particularly occur in the Newport Drainage Ditch and North Mill Creek sub-watersheds. These sub-watersheds comprise only about 15 percent of the total area of the Des Plaines River watershed but contain about 29 percent of PRW acres in the watershed. In fact, these two sub-watersheds have the greatest density of PRW acres in Lake County, with PRWs comprising more than 10 percent of the total area of each. This relatively high density of PRW acres can be attributed to the rural character and large areas of agricultural land remaining in the North Mill Creek and Newport Drainage Ditch sub-watersheds. The Indian Creek, Mill Creek, North Mill Creek and the Upper Des Plaines River sub-watersheds each contain more than 1,000 acres of PRWs.

Fox River Watershed

The Fox River watershed (**Figure 13**) accounts for approximately 35 percent of the total area of Lake County and contains about 31 percent of the County's PRW acreage (4,685 acres). The Squaw Creek sub-watershed contains more than twice the PRW acreage (1,636) of any other Fox River sub-watershed in Lake County. Agricultural land contains a significant proportion of PRW acres in the Fox River watershed, but more PRW acres are located in land uses classified as "open space." PRW

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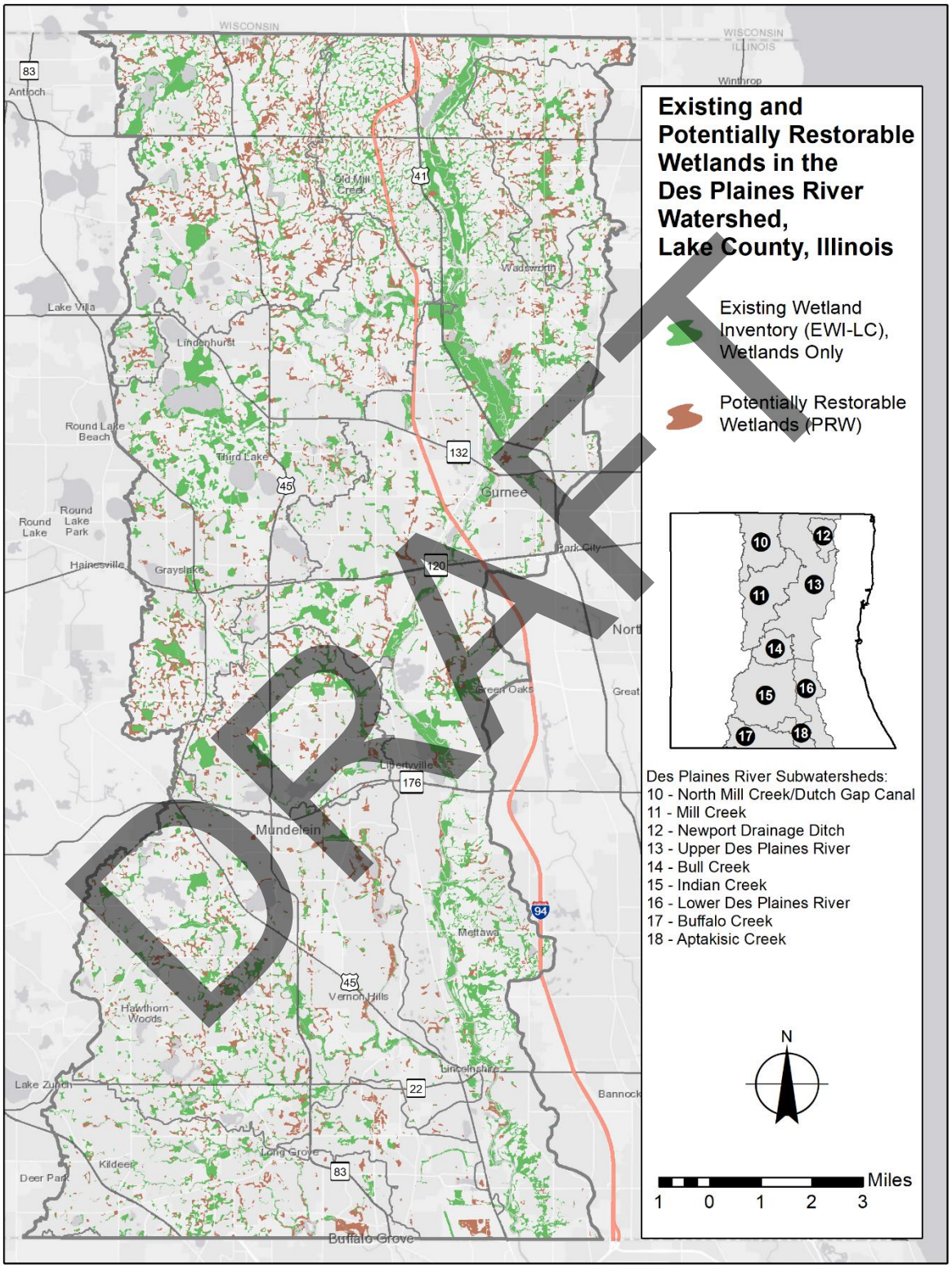

Figure 12. GIS-determined PRW Locations within the Des Plaines River Watershed.

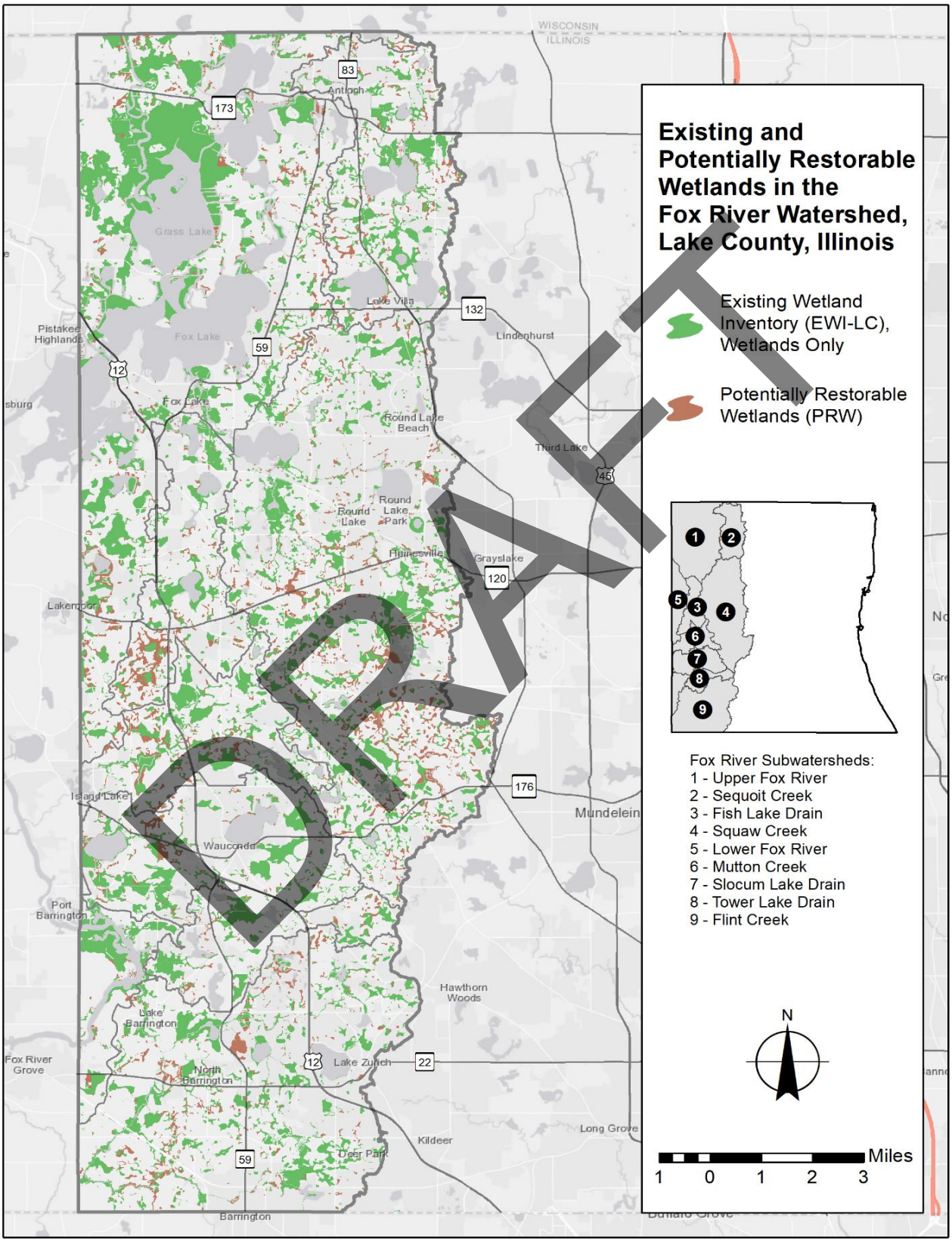

Figure 13. **GIS-determined PRW Locations within the Fox River Watershed.**

density is greatest in the Fish Lake Drain and Squaw Creek sub-watersheds and is particularly concentrated in the southern half of the Fish Lake Drain watershed. The expanse of water bodies and wetlands in the Chain O'Lakes area results in the Upper Fox River watershed having a relatively low density of PRW acres.

North Branch Chicago River Watershed

The North Branch Chicago River watershed (**Figure 14**) comprises about 11 percent of Lake County and contains approximately 13 percent of the County's estimated PRW acreage (1,911 acres). Unlike the other major watersheds, a significant proportion (63%) of PRWs in the North Branch Chicago River watershed are located on "programmed" open space such as golf courses, parks, and residential or commercial open space set asides. The *North Branch Chicago River Watershed-Based Plan* also identified such "recreational" open space as a major component of the watershed open space land use structure (SMC 2008).

PRWs are distributed fairly evenly among the sub-watersheds of the three forks of the North Branch Chicago River, with total PRW acreage generally related to sub-watershed size. The density of PRWs is greatest in the Skokie River sub-watershed (where PRWs account for 6.6 percent of total sub-watershed area) and lowest in the Middle Fork sub-watershed (where PRWs comprise 5.1 percent of total sub-watershed area). The pattern of PRW distribution in the Skokie River and Middle Fork sub-watersheds follows the the stream systems and relates to the locations of recreational open spaces along the streams. PRWs on agricultural and undeveloped open space lands comprise a correspondingly lower proportion of PRW acres in the North Branch Chicago River watershed relative to other Lake County watersheds.

Lake Michigan Watershed

The Lake Michigan watershed (**Figure 15**) accounts for approximately 11 percent of Lake County and contains about 6 percent of the County's PRW acres (826 acres). By comparison, the Lake Michigan watershed is slightly larger than the North Branch Chicago River watershed and contains less than half the acreage of PRWs. The watershed has older and more dense urban development relative to the other watersheds and lower PRW density, with PRW acreage not exceeding 5 percent of total area for any sub-watershed. PRWs are found in the northern end of the Lake Michigan watershed on "programmed" and undeveloped open space as well as sites that previously contained residential, industrial, or other urban land uses (largely along Lake Michigan). Agricultural lands do not comprise a large proportion of of the watershed and therefore are a relatively small component of total PRW acreage (although PRWs are found on agricultural land where it exists).

PRWs are scarce in the Pettibone Creek and Bluff/Ravine sub-watersheds and are largely absent from the eastern third of the Waukegan River sub-watershed, owing to the density of urban development in these areas. These three sub-watersheds have the lowest PRW densities in Lake County, with PRWs comprising less than 1 percent of the Pettibone Creek and Bluff/Ravine sub-watersheds. PRWs are more common in the Dead River and Kellogg Creek sub-watersheds, where there is slightly less urban development, though their distribution is limited relative to other watersheds in Lake County.

Potentially Restorable Wetlands By NWI Codes

As shown in **Table 22**, the "emergent (EM)" class has by far the greatest PRW acreage for each of the four major watersheds. The North Branch Chicago River and Lake Michigan watersheds have a greater density of PRWs classified as "forested" than the countywide average largely because the pre-settlement vegetation maps of Lake County identify more forested land east of the Des Plaines River (Bowles and McBride 2005, Westerman not dated).

Potentially Restorable Wetlands by LLWW Categories

The distribution of terrene PRWs in the major watersheds (**Table 23**) follows the same general

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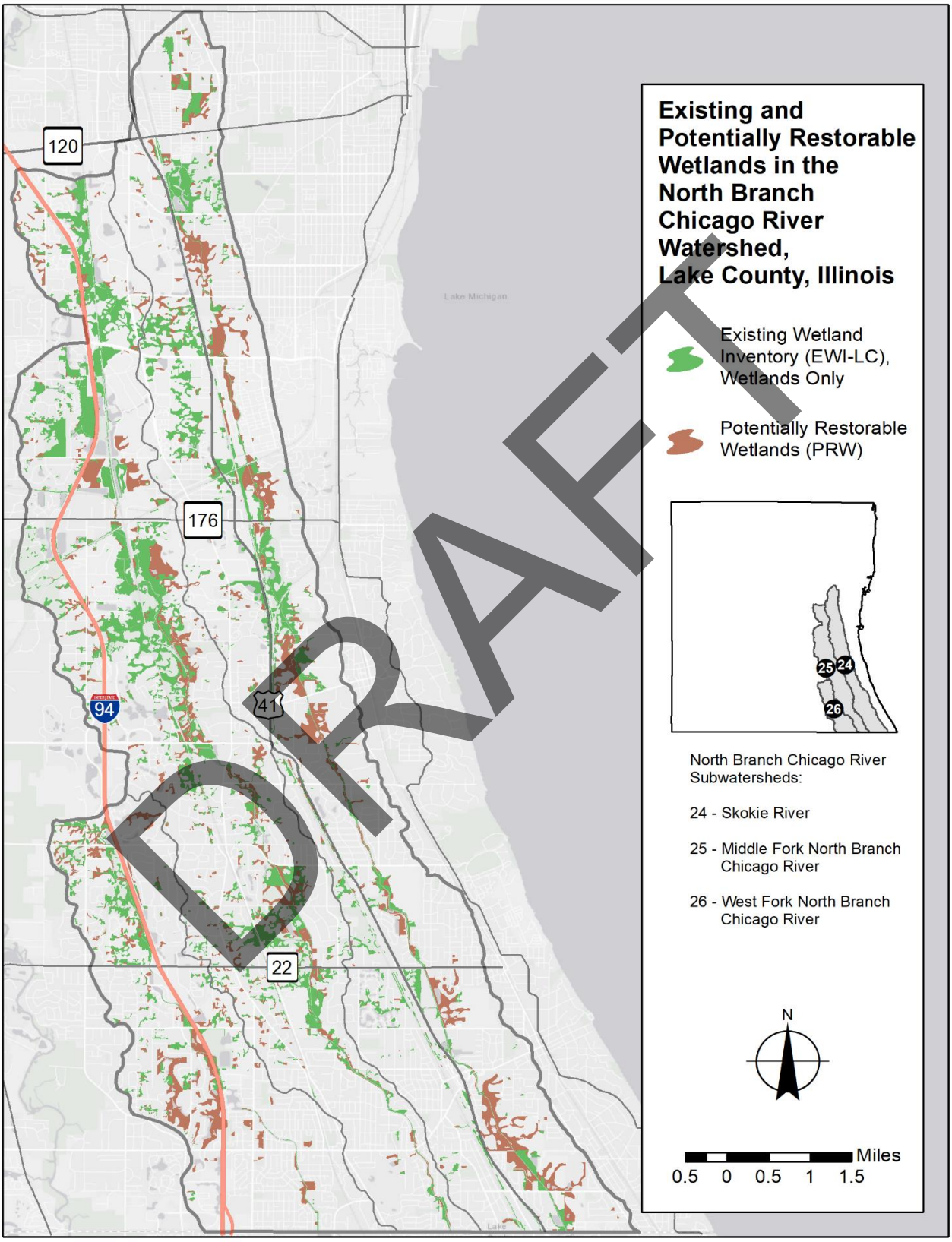

Figure 14. GIS-determined PRW Locations within the North Branch Chicago River Watershed.

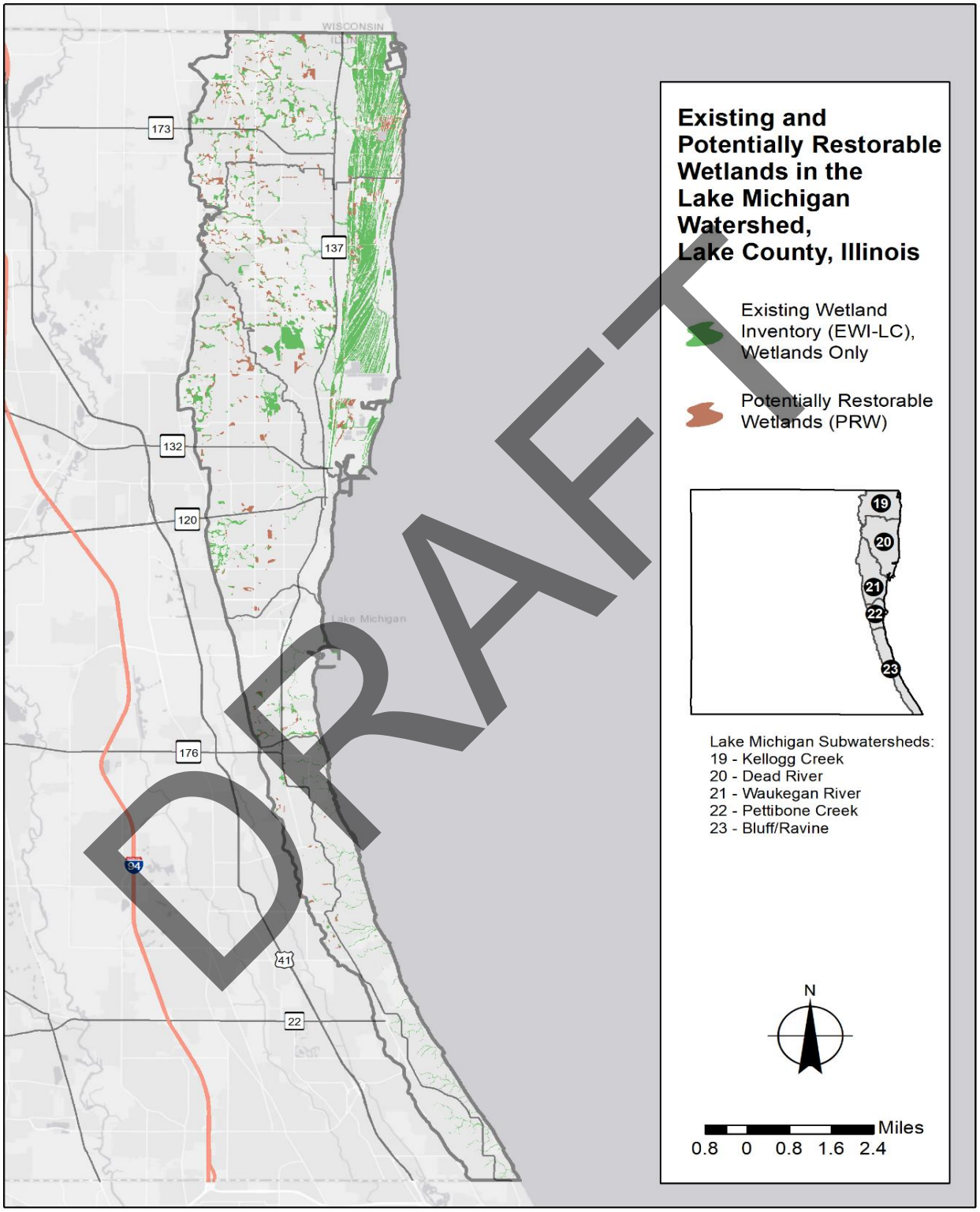

Figure 15. GIS-determined PRW Locations within the Lake Michigan Watershed.

Table 22. Estimated PRW Acreage by Major Watershed per NWI Codes.

System	Class	Existing Acreage by Major Watershed			
		Des Plaines	Fox	North Branch	Lake Michigan
Palustrine (P)	AB - Aquatic Bed	--	7	<1	2
	EM - Emergent	7,162	4,485	1,529	685
	FO - Forested	334	171	375	127
	SS - Scrub-Shrub	47	22	6	12
	UB – Unconsolidated Bottom	<1	<1	--	--

pattern of PRW distribution countywide. PRWs with the lotic stream attribution are most common in the Des Plaines River watershed (1,120 acres) followed by the North Branch Chicago River watershed (931 acres). Recall that the three forks of the North Branch Chicago River are considered "streams" under the LLWW classification scheme. The majority of lentic PRWs are located in the lake-rich Fox River watershed (401 acres) while most PRWs associated with lotic rivers are along the Des Plaines River (225 acres), which has the longest course of any major river within Lake County.

Across all watersheds, the terrene landscape position has the greatest PRW acreage, followed by lotic stream position (see **Table 23**). Basins are the most common landform in the lentic and terrene landscape positions. These include all PRWs associated with bowl-shaped topographic

Table 23. Estimated PRW Acreage by Major Watershed per Landscape Position and Landform.

Landscape Position	Landform	Watershed Acreage			
		Des Plaines	Fox	North Branch	Lake Michigan
Lentic	Basin	81	211	1	3
	Flat	--	3	--	--
	Fringe	24	185	--	--
	Island	1	1	--	--
	Total	***106***	***401***	***1***	***3***
Lotic River	Basin	<1	<1	--	<1
	Floodplain	224	46	--	--
	Total	***225***	***47***	***--***	***<1***
Lotic Stream	Basin	405	326	62	119
	Flat	8	--	7	3
	Floodplain	706	512	861	57
	Fringe	<1	--	--	--
	Total	***1,120***	***838***	***931***	***179***
Terrene	Basin	5,830	3,263	894	571
	Flat	238	108	85	72
	Fringe	<1	--	--	--
	Slope	25	29	--	<1
	Total	***6,093***	***3,400***	***979***	***644***

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depressions as well as swales or drainageways that form linear topographic depressions. The Floodplain landform has the most PRW acreage in the lotic stream and river landscape positions, with the largest amount along the forks of the North Branch Chicago River.

Similar to PRWs with the terrene landscape position, PRWs associated with basin landforms are spread across Lake County watersheds following the general distribution pattern for all PRWs and are the most common landform type for PRWs in each major watershed. Most basin PRWs are therefore located in the Des Plaines River watershed. Five sub-watersheds, including four in the Des Plaines River watershed, contain more than half of all basin PRW acres: North Mill Creek (1,449 acres), Upper Des Plaines River (1,336 acres), Squaw Creek (1,306 acres), Mill Creek (1,078 acres), and Indian Creek (948 acres). Basin PRWs in the terrene landscape position comprise the vast majority of all basin PRWs and are similarly distributed with the same five sub-watersheds containing more than half of all terrene basin PRW acres. Basin (and terrene basin) PRW density is highest and similar in the North Mill Creek and Newport Drainage Ditch sub-watersheds. Basin (and terrene basin) PRW density in the Fish Lake Drain sub-watershed is also considerably higher than the remaining sub-watersheds in Lake County.

PRWs on floodplains number in the hundreds of acres in all watersheds except Lake Michigan, and nearly equal the acreage of basin PRWs in the North Branch Chicago River watershed (see **Table 23**). Far more floodplain PRW acreage occurs along streams and smaller rivers than along the Fox River (46 acres) or Des Plaines River (224 acres). Based on the GIS analysis, the Skokie River sub-watershed contains an estimated 590 acres of PRWs in floodplains, more than twice the acreage of any other sub-watershed in Lake County, largely associated with the open space along the river. The Skokie River sub-watershed also has twice the density of floodplain PRW acres of any other Lake County watershed. The Squaw Creek, Middle Fork North Branch of the Chicago River, and Indian Creek sub-watersheds all contain more than 200 acres of PRWs associated with lotic stream floodplains.

Acreage of PRWs classified by water flow path is consistent with landscape position and landform types (see **Table 24**). For example, lotic river PRWs consist nearly entirely of the throughflow-perennial flow path classification. PRWs associated with rivers and their floodplains have this type of flow path. Likewise, lentic PRWs of all landform types are dominated by bi-directional flow paths, which correspond to rising and falling water levels of lakes. Lotic stream PRWs are, predominantly classified as throughflow-perennial; however, significant acreages are classified as throughflow-intermittent (400 acres), associated with intermittent streams and throughflow-artificial (319 acres), associated with constructed stream channels such as ditches. The predominant water flow path classifications of terrene PRWs are throughflow-intermittent (4,939 acres) and outflow-intermittent (4,500 acres). These flow paths indicate the potential for surface water flow into and out of PRWs but not on a consistent or perennial basis. Isolated and inflow waterflow path types also comprise a significant portion of terrene PRWs (more than 1,500 acres) and are primarily in the Des Plaines River and Fox River watersheds.

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Table 24. PRWs by Major Watershed per Landscape Position and Water Flow Path Type.

Landscape Position	Water Flow Path	Watershed Acreage (est.)				LAKE COUNTY TOTAL
		Des Plaines	Fox	North Branch	Lake Michigan	
Lentic	Bidirectional	4	10	--	2	17
	Bidirectional-outflow	1	6	--	--	7
	Bidirectional-throughflow	91	343	1	--	435
	Outflow-perennial	3	3	--	--	6
	Outflow-intermittent	--	<1	--	--	<1
	Throughflow-perennial	6	33	--	--	39
	Throughflow-intermittent	--	4	--	<1	5
	Total	***106***	***401***	***1***	***3***	***511***
Lotic River	Throughflow-perennial	224	46	--	<1	271
	Throughflow-intermittent	--	<1	--	--	<1
	Bidirectional-throughflow	<1	--	--	--	<1
	Total	***225***	***47***	***--***	***<1***	***272***
Lotic Stream	Bidirectional-throughflow	<1	<1	<1	--	2
	Outflow-intermittent	--	--	--	<1	<1
	Outflow-artificial	39	14	2	3	58
	Throughflow-perennial	724	572	880	112	2,289
	Throughflow-intermittent	210	148	7	35	400
	Throughflow-artificial	145	103	42	29	319
	Total	***1,120***	***838***	***931***	***179***	***3,068***
Terrene	Bidirectional	<1	<1	--	--	1
	Bidirectional-outflow	2	<1	--	--	2
	Bidirectional-throughflow	5	5	2	<1	12
	Bidirectional-isolated	<1	--	--	--	<1
	Outflow-perennial	<1	5	17	--	22
	Outflow-intermittent	2,390	1,357	512	242	4,500
	Outflow-artificial	14	<1	--	1	16
	Throughflow-perennial	15	51	16	17	99
	Throughflow-intermittent	2,878	1,334	405	323	4,939
	Throughflow-artificial	1	<1	<1	<1	3
	Isolated	620	453	26	58	1,157
	Isolated-outflow	92	73	--	1	167
	Isolated-throughflow	28	5	--	--	34
	Isolated-inflow	8	31	--	2	41
	Inflow	39	84	--	--	123
	Total	***6,093***	***3,400***	***979***	***644***	***11,116***

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5.3.3 Potentially Restorable Wetlands by Functional Categories

Table 25 summarizes predicted significance levels for each selected function by PRW acreage in each major watershed and for Lake County. Predicted functional significance for PRWs in Lake County is highly variable and depends on specific wetland function and location in the County. For example, a few wetland functions evaluated in this project (e.g., Carbon Sequestration, Nutrient Transformation, and Waterfowl Habitat) had most acres predicted to have moderate significance with fewer but still large numbers of acres predicted to have high or low significance.

Functions such as Native Fish Habitat, Stream Shading, and Woodland Amphibian Habitat had few acreages of PRWs with predicted high functional significance, a result that may be an artefact of the analysis methods or influence of the surrounding environmental characteristics. High predicted functional significance for Shorline/Streambank Stabilization, Stream Baseflow Maintenance, and Unique Wetland Resources is limited by proximity of a PRW to another feature, in these cases streams, lakes, or other unique wetland resources. The number of PRW acres with high predicted functional significance is correspondingly limited. Finally, most PRWs are predicted to have high significance for the Flood Water Storage, Wildlife Movement Corridors, and Wetland-dependent Bird Habitat functions. Wetlands and PRWs are likely "predisposed" to have high significance for these functions, given the hydrogeomorphic character of wetlands in general. A discussion organized by wetland function follows.

Carbon Sequestration

More than half of the County's PRWs (8,902 acres) are predicted to have moderate functional significance for Carbon Sequestration, a result of the acreage of PRWs on mineral soils that are seasonally flooded (C) or wetter. PRWs predicted to have high functional significance account for approximately 25 percent of all PRW acreage, the bulk of which is located in the Des Plaines and Fox River watersheds. PRWs predicted to have high functional significance are found on hydric soils with relatively high amounts of organic matter (histosols). **Figure 16** is a general depiction of Carbon Sequestration function for PRWs throughout Lake County.

The Fox River watershed has the greatest acreage of PRWs predicted to have high functional significance for carbon sequestration (1,950 acres) among the four major watersheds in Lake County and the Squaw Creek watershed has the greatest acreage of the same among all sub-watersheds in the County (576 acres). PRWs with high predicted functional significance are concentrated in the central Fox River watershed, with Fish Lake Drain, Mutton Creek, the Lower Fox River, and Squaw Creek having four of the five highest sub-watershed densities of such PRW acres.

The Des Plaines River watershed follows the Fox in acres of PRWs with predicted high functional significance (1,398 acres). North Mill Creek contains the second-most acreage (405 acres) and third-greatest density of such PRWs relative to other sub-watersheds in Lake County.

The North Branch Chicago River and Lake Michigan watersheds, combined, contain approximately 10 percent of PRW acres predicted to have high functional significance for Carbon Sequestration. The Lake Michigan watershed in particular has very low overall acreage and density of such PRWs. The Middle Fork sub-watershed has the greatest, albeit limited, acreage of such PRWs in the North Branch Chicago River watershed (110 acres).

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Table 25. Potentially Restorable Wetland Functional Analysis Results for Lake County, by Watershed.

Function		Des Plaines Acreage (est.)	Fox Acreage (est.)	North Branch Acreage (est.)	Lake Michigan Acreage (est.)	Lake County Acreage (Est.)
Carbon Sequestration	High	1,398	1,950	236	112	3,697
	Mod	4,741	2,336	1,397	428	8,902
	Low	1,405	400	277	286	2,367
	N/A*	--	--	--	--	--
Flood Water Storage	High	5,086	3,608	1,571	450	10,716
	Mod	759	320	84	157	1,320
	Low	1,676	736	255	217	2,886
	N/A	22	22	--	<1	45
Native Fish Habitat	High	147	181	16	14	358
	Mod	211	238	63	10	522
	Low	5,944	3,947	1,522	559	11,972
	N/A	1,241	320	310	243	2,114
Nutrient Transformation (P)	High	787	646	26	61	1,521
	Mod	4,888	3,144	1,257	357	9,646
	Low	1,868	896	628	408	3,800
Sediment/Other Particulate Retention	High	1,812	1,580	878	118	4,389
	Mod	5,368	2,858	929	602	9,757
	Low	363	248	103	106	820
Shoreline/Stream Bank Stabilization	High	1,263	1,070	829	169	3,331
	Mod	1,235	731	310	90	2,366
	Low	217	123	38	25	404
	N/A	4,828	2,762	734	541	8,865
Stream Baseflow Maintenance	High	1,128	727	852	169	2,875
	Mod	124	120	94	23	361
	Low	591	195	120	123	1,029
	N/A	5,701	3,644	845	511	10,701
Stream Shading	High	123	28	99	29	279
	Mod	417	290	80	61	848
	Low	1,050	573	710	126	2,458
	N/A	5,954	3,796	1,021	610	11,381
Unique Wetland Resources	High	547	533	194	221	1,494
	N/A	6,999	4,158	1,712	604	13,473
Waterfowl Habitat	High	1,467	1,122	526	214	3,328
	Mod	3,222	2,112	490	219	6,043
	Low	2,844	1,446	895	392	5,577
	N/A	11	6	--	<1	17
Wetland-dependent Bird Habitat (Other)	High	4,465	3,262	982	444	9,152
	Mod	555	81	126	83	845
	Low	2,524	1,343	804	299	4,970
	N/A*	--	--	--	--	--
Wildlife Movement Corridors	High	6,852	4,102	1,694	593	13,241
	Mod	228	294	108	85	714
	Low	464	291	109	148	1,011
Woodland Amphibian Habitat	High	39	<1	16	3	58
	Mod	46	21	70	7	144
	Low	2,657	1,526	991	392	5,567
	N/A	4,802	3,138	833	424	9,197

* Does not apply to wetland polygons, only to water bodies.

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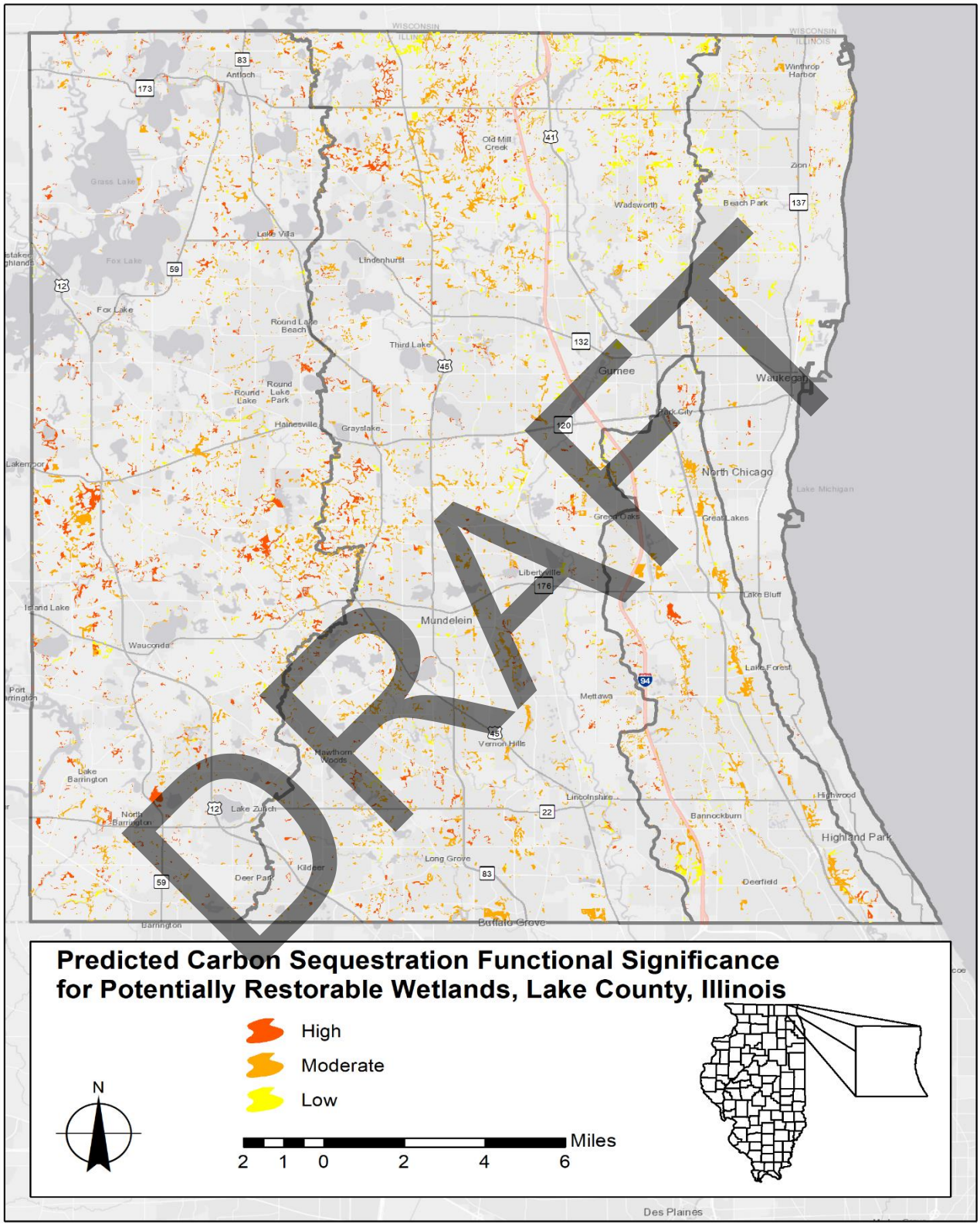

Figure 16. Carbon Sequestration Functionality for PRWs.

Flood Water Storage

Similar to the Existing Wetland Inventory (see **Section 5.1.4**), most PRW acres (10,716 acres) are predicted to have high functional significance for Flood Water Storage due to their hydrogeomorphic characteristics and their association with current or former wetlands. PRWs located in floodplains or topographic basins with significant storage potential (or both) comprise the majority of such PRW acres (10,350 acres). Predicted high-functionality PRWs are well-distributed throughout the County except in the Lake Michigan watershed. **Figure 17** is a general depiction of Flood Water Storage function for PRWs throughout Lake County.

The Des Plaines River watershed contains nearly half of all PRW acres predicted to have high functional significance. The Upper Des Plaines River, North Mill Creek, Indian Creek, and Mill Creek sub-watersheds each contain more than 800 acres of such PRWs. These PRWs cover more than 6 percent of the Newport Drainage Ditch and North Mill Creek sub-watersheds, about twice the County average density. Over 200 acres of PRWs with predicted high functional significance are located along the Des Plaines River mainstem. The Fox River watershed contains more than one-third of all PRW acres (3,608 acres) predicted to have high functional significance for Flood Water Storage. The Squaw Creek sub-watershed has the most acreage of such PRWs (1,233 acres) of any sub-watershed in Lake County. The greatest density of such PRWs is in the Fish Lake Drain sub-watershed, where, like the Squaw Creek sub-watershed, these PRWs are concentrated in the southern half. About 315 acres of PRWs predicted to have high Flood Water Storage functional significance are located along the Chain O'Lakes and Fox River mainstem. In the North Branch Chicago River watershed, more than half of the PRWs predicted to have high functional significance are located in the Skokie River sub-watershed (822 acres), where they account for nearly 6 percent of sub-watershed area. About 77 percent of such PRWs in the Skokie River sub-watershed, or 636 acres, are associated with the Skokie River and its floodplain. Overall, more than half of all PRWs in the North Branch Chicago River watershed with predicted high Flood Water Storage significance are associated with streams (rather than topographic depressions). The Lake Michigan watershed has the fewest acres of PRWs predicted to have high functionality (450 acres); the other major watersheds contain at least one sub-watershed with more than 500 acres of such PRWs. The density of PRW acres for high Flood Water Storage functionality is below the County median in all Lake Michigan sub-watersheds, so there is not a "concentration" of such PRWs in the watershed.

Native Fish Habitat

PRWs predicted to have high functional significance for Native Fish Habitat have very limited distribution and acreage in Lake County. PRWs either 1) are not generally located in areas that would be conducive to exceptional fish habitat or 2) are adjacent to water bodies that require improvement of other factors in order for restored wetlands to provide this function in a significant way. Of the limited PRW acres with predicted high functional significance, most are either headwaters or associated with natural lakes in the Fox River watershed. **Figure 18** is a general depiction of Native Fish Habitat function for PRWs throughout Lake County.

Nutrient Transformation (P-focus)

Predicted high functional significance for Nutrient Transformation (P-focus) is limited to PRWs with an isolated water flow path type. Consequently, watersheds and sub-watersheds with larger acreages and densities of PRWs classified as isolated flow path types will have larger acreages and densities of PRWs predicted to have high functionality. Such PRWs comprise a small proportion (10%) of all PRWs in Lake County, at 1,521 acres. PRWs predicted to have moderate significance for this function occupy a much larger footprint in Lake County (9,646 acres) and are distributed in the same general pattern as overall PRWs. **Figure 19** is a general depiction of Nutrient Transformation (P-focus) function for PRWs throughout Lake County.

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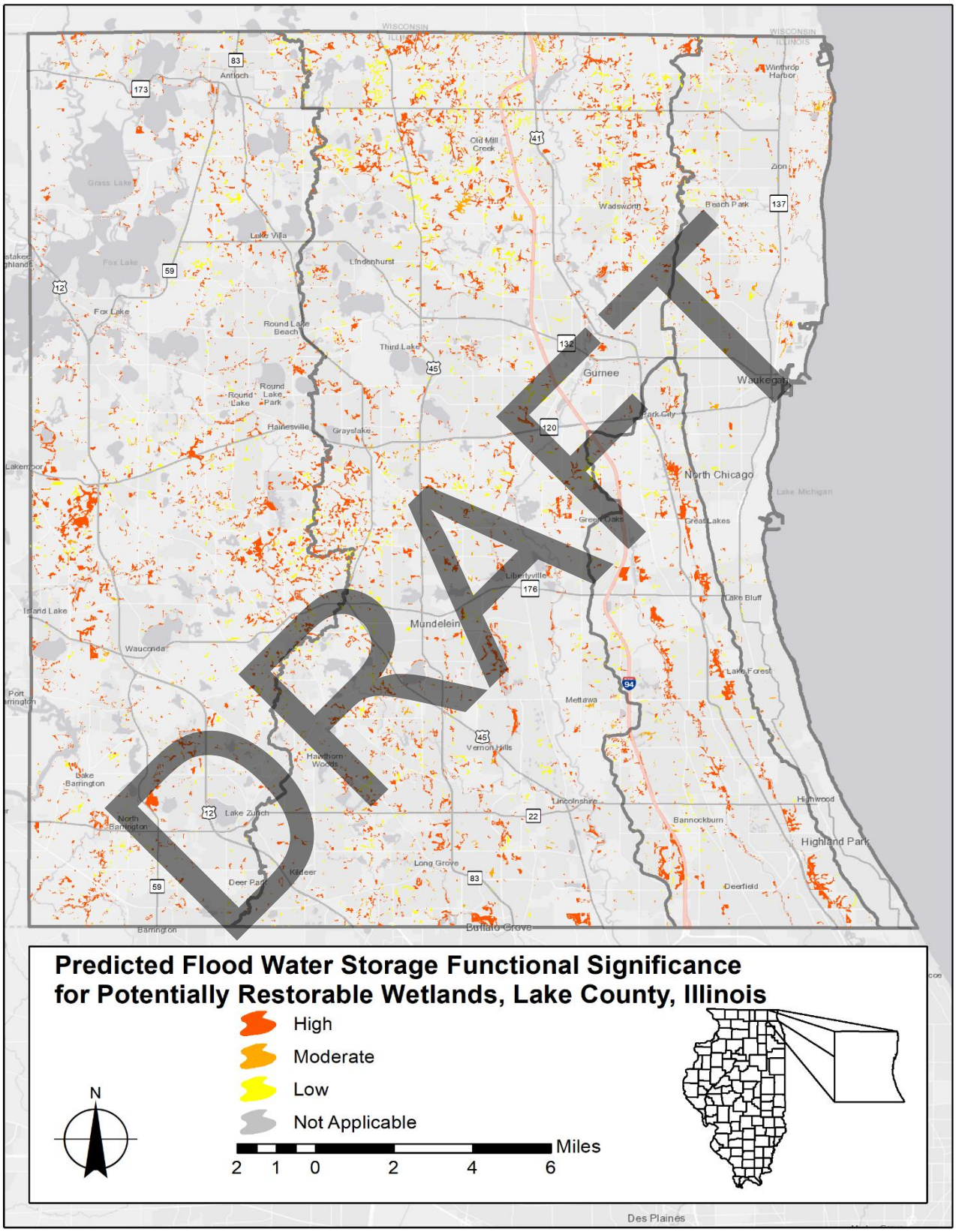

Figure 17. Flood Water Storage Functionality for PRWs.

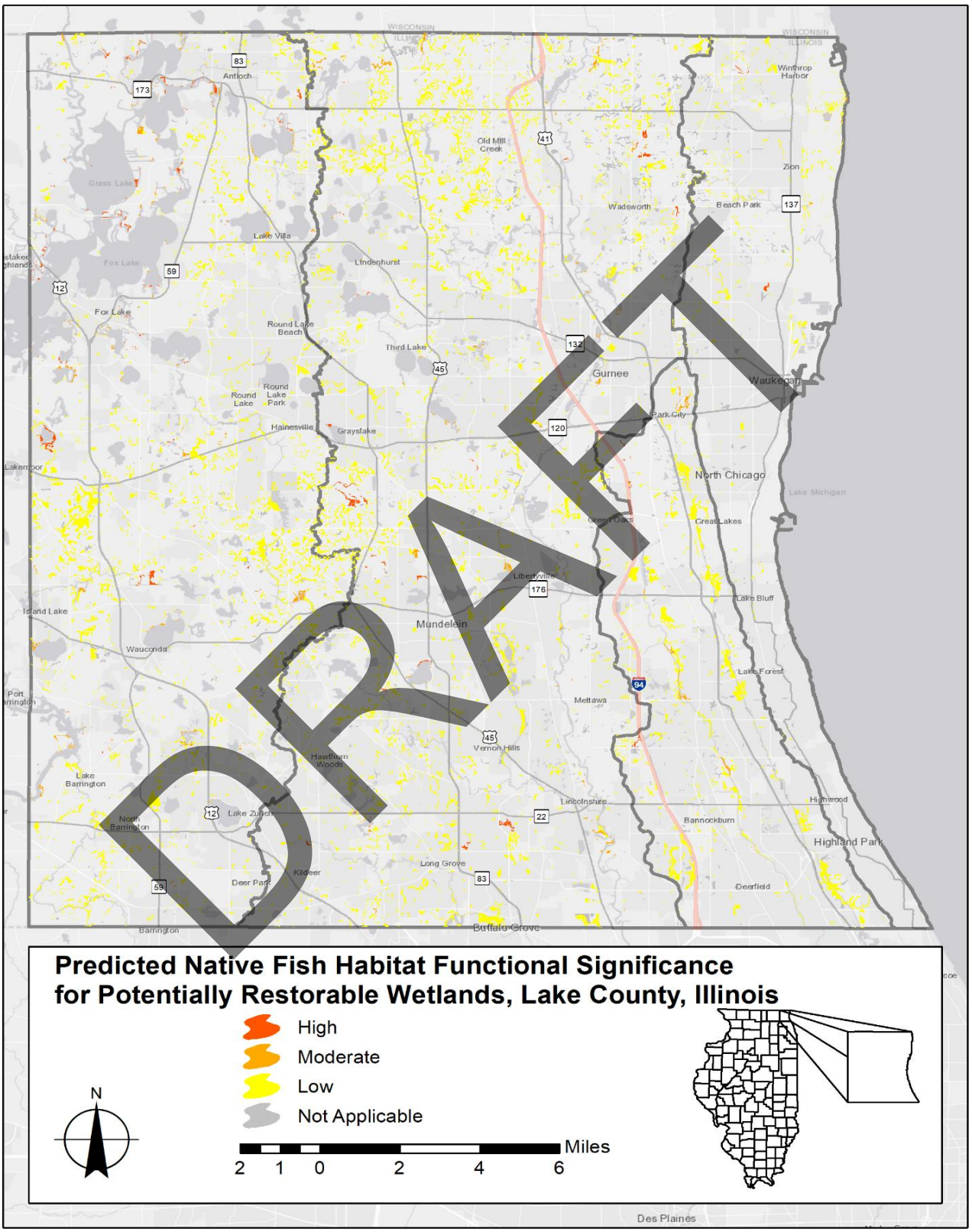

Figure 18. Flood Water Storage Functionality for PRWs.

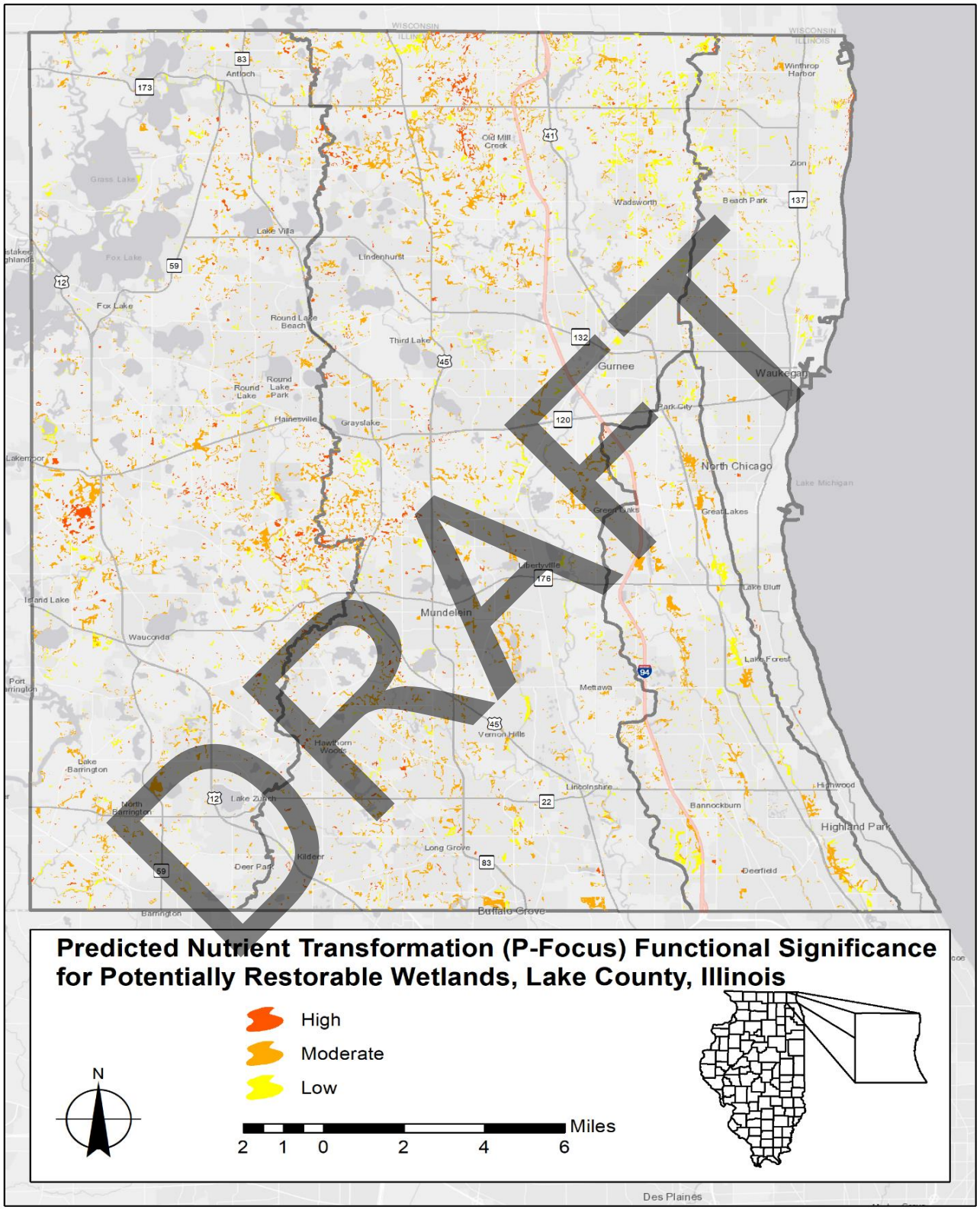

Figure 19. Nutrient Transformation (P-focus) Functionality for PRWs.

Relative to the other major watersheds in Lake County, the Des Plaines River watershed contains the greatest acreage of PRWs predicted to have either high (787 acres) or moderate (4,888 acres) functional significance for Nutrient Transformation. The North Mill Creek sub-watershed contains more acres of PRWs predicted to have high functional significance (304 acres) than any other sub-watershed in the County. It also is the only area in the Des Plaines watershed with a notable concentration of such PRWs. The Mill Creek, Indian Creek, and Upper Des Plaines River sub-watersheds all contain more than 100 acres of PRWs predicted to have high significance for this function. The Fox River watershed contains the second-most acres of PRWs predicted to have either high (646 acres) or moderate (3,144 acres) functional significance for Nutrient Transformation. The Squaw Creek (260 acres) and Fish Lake Drain (150 acres) sub-watersheds contain the greatest amount of PRWs predicted to have high functional significance. The Fish Lake Drain sub-watershed contains the greatest density of such PRWs in Lake County. The North Branch Chicago River and Lake Michigan watersheds each contain less than 100 acres of PRWs predicted to have high functional significance for Nutrient Transformation due to the limited number of PRWs classified as isolated flow path types.

Sediment/Other Particulate Retention

PRWs associated with lakes and floodplains or having an isolated flow path type have high predicted functional significance for Sediment/Other Particulate Retention. These areas comprise about 29 percent of all PRWs in Lake County (4,389 acres). More than half of such PRWs are associated with floodplains, mostly along the forks of the North Branch Chicago River and tributary stream systems rather than large mainstem rivers. **Figure 20** is a general depiction of Sediment/Other Particulate Retention function for PRWs throughout Lake County.

In the Des Plaines River watershed, PRWs with high predicted functional significance are primarily found along streams and in isolated topographic depressions, although 224 acres of such PRWs are located along the Des Plaines River. The North Mill Creek sub-watershed contains the third-most acreage (458 acres) and the third-highest density of such PRWs of Lake County sub-watersheds. In the Fox River watershed, PRWs with high predicted functional significance for Sediment/Other Particulate Retention are found in isolated topographic depressions and along streams and lakes. The Squaw Creek sub-watershed contains the second-most acreage (522 acres) of such PRWs of all sub-watersheds while the Fish Lake Drain sub-watershed has the second-greatest density of such PRWs in Lake County. Twenty (20) percent of PRWs with high predicted functional significance occur in the North Branch Chicago River watershed (878 acres), which contains only 12 percent of all PRWs countywide. The majority of such PRWs in the watershed occur in the Skokie River sub-watershed (596 acres), which has more acres and a higher density of these PRWs than any sub-watershed in the County. PRWs with predicted high significance for this function are almost entirely associated with floodplains and other riparian areas in the North Branch Chicago River watershed. The Lake Michigan watershed contains only 118 acres of PRWs predicted to have high functional significance for Sediment/Other Particulate Retention, more than 80 percent of which are located in the Kellogg Creek and Dead River sub-watersheds.

Shoreline/Stream Bank Stabilization

Approximately 22 percent of all PRWs in Lake County are predicted to have high functional significance for Shoreline/Stream Bank Stabilization. These PRWs are located adjacent to rivers, lakes and streams, with the vast majority of acres located along tributary streams and the forks of the North Branch of the Chicago River. In general, such PRWs are distributed evenly throughout Lake County according to sub-watershed size, with only a couple notable concentrations (Skokie River and Newport Drainage Ditch). **Figure 21** is a general

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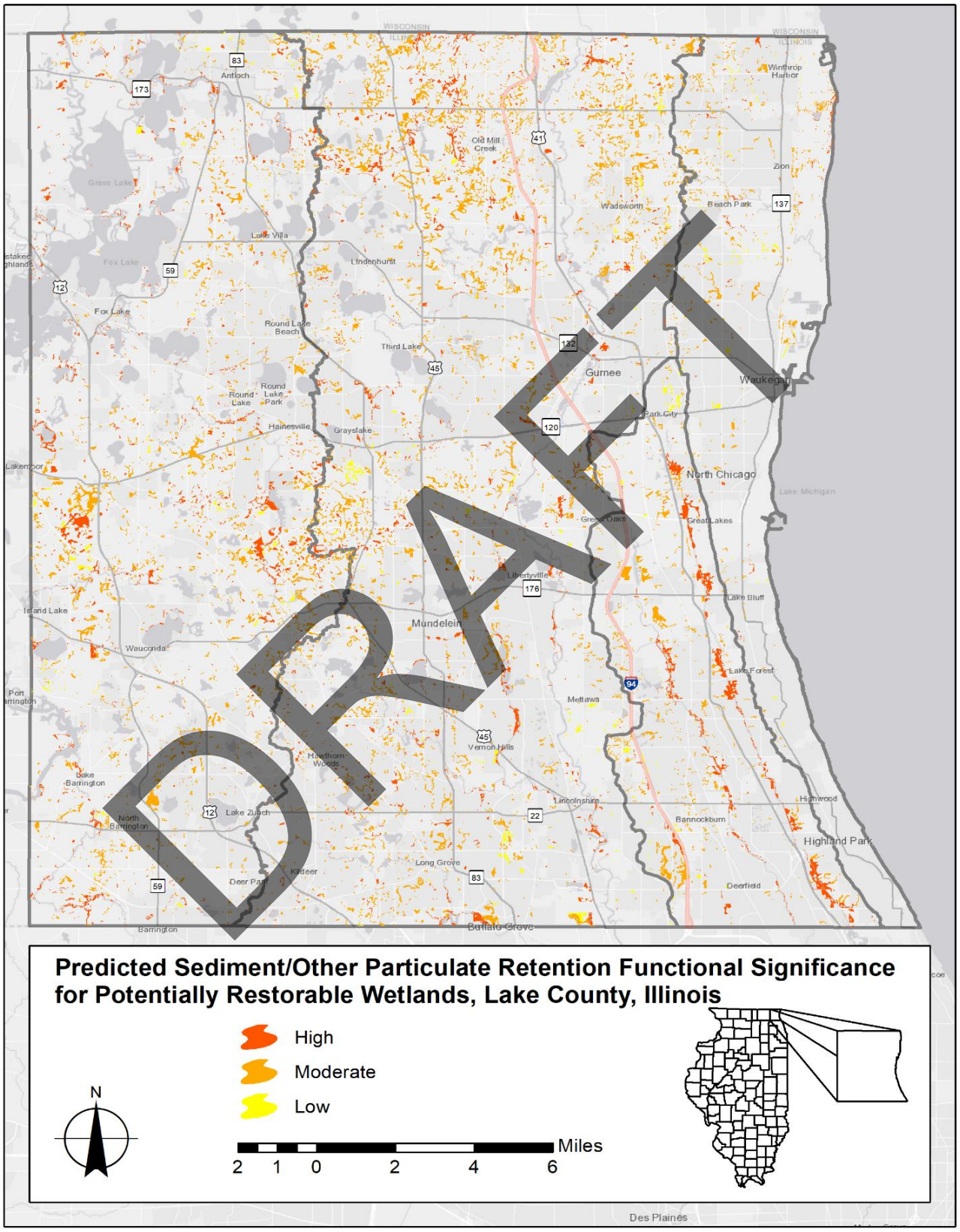

Figure 20. Sediment/Other Particulate Retention Functionality for PRWs.

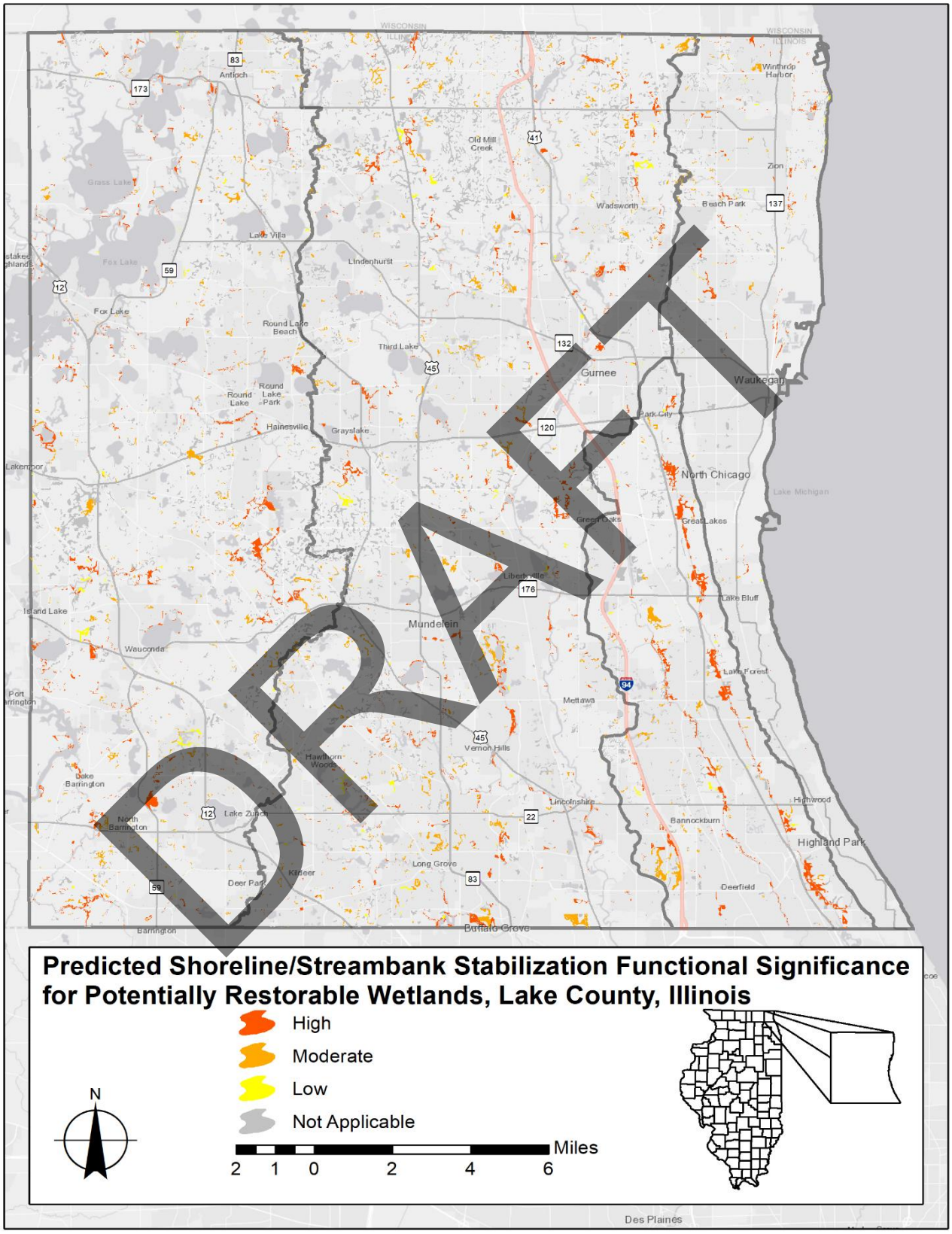

Figure 21. Shoreline/Stream Bank Stabilization Functionality for PRWs.

depiction of Shoreline/Stream Bank Stabilization function for PRWs throughout Lake County.

In the Des Plaines River watershed, the Upper Des Plaines River and Indian Creek sub-watersheds have substantially more acreage of PRWs predicted to have high functional significance relative to other sub-watersheds in Lake County (297 and 252 acres, respectively). The Newport Drainage Ditch sub-watershed contains the second-highest density of such PRWs, per acre, of all sub-watersheds in Lake County. The Fox River watershed contains three-quarters of all PRWs predicted to have high functional significance for Shoreline/ Stream Bank Stabilization that are specifically associated with lakes (303 acres). Overall, the Squaw Creek sub-watershed contains the second-most PRW acres (333 acres) predicted to have high significance relative to other sub-watersheds in Lake County. The North Branch Chicago River watershed contains about 12 percent of all PRW acres in Lake County but contains 25 percent of PRW acres predicted to have high functional significance for Shoreline/ Stream Bank Stabilization (829 acres). These PRWs are largely located in the Skokie River sub-watershed, which contains both the greatest amount (584 acres) and highest density of such PRWs in Lake County, where they occur at about twice the frequency of the next highest concentration. These PRWs are mostly located in open space areas along the Skokie River. The Lake Michigan watershed contains 169 acres of PRWs predicted to have high functional significance for Shoreline/Streambank Stabilization, where they occur in relatively low density.

Stream Baseflow Maintenance

PRWs predicted to have high functional significance for Stream Baseflow Maintenance account for 19 percent of all PRW acres in Lake County (2,875 acres). The vast majority of these are PRWs associated with streams and the forks of the North Branch Chicago River that are predicted to be flooded seasonally or for longer periods during the year. Of note for this function, about 200 acres of headwater PRWs (i.e., those giving rise to a perennial stream) were identified in Lake County. **Figure 22** generally depicts the Stream Baseflow Maintenance function.

In the Des Plaines River watershed, PRWs predicted to have high functional significance are distributed evenly throughout stream systems. Higher concentrations of such PRWs occur in the Aptakisic Creek and Newport Drainage Ditch sub-watersheds. Within the Fox River watershed, the Squaw Creek sub-watershed contains 46 percent of all PRW acreage predicted to have high functional significance (333 acres). This is a result of sub-watershed size, as no sub-watersheds in the Fox River basin have notable densities relative to other locations in the County. The North Branch Chicago River watershed contains about 12 percent of all PRW acres in Lake County but contains 30 percent of PRW acres predicted to have high functional significance for Stream Baseflow Maintenance (852 acres). These PRWs are largely located in the Skokie River sub-watershed, which contains both the greatest amount (546 acres) and highest density of such PRWs in Lake County. These PRWs are mostly located in open space areas along the Skokie River. PRWs predicted to have high functional significance occur in relatively low densities across the Lake Michigan watershed, where the greatest acreage is found in the Dead River and Kellogg Creek sub-watersheds.

Stream Shading

PRWs predicted to have high functional significance for Stream Shading account for only 2 percent of all PRWs in Lake County. The "forested" vegetation classification is a key factor in predicting high significance for this function, in addition to proximity to a stream. Only about 7 percent of all PRWs are classified as forested and many are not adjacent to streams. This function is identified as "not applicable" (N/A) for more than three quarters of the PRW acres in the County. **Figure 23** generally depicts Stream Shading function.

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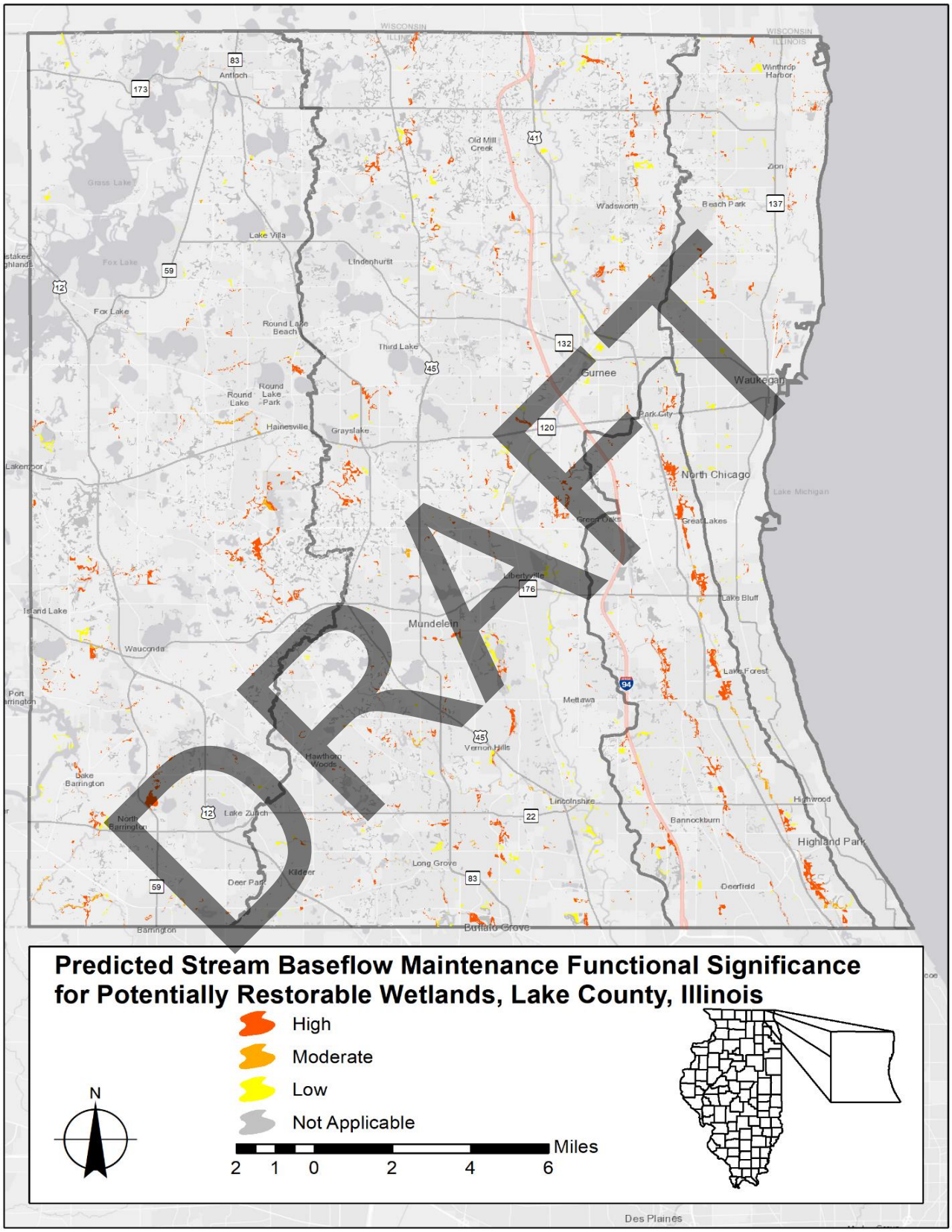

Figure 22. Stream Baseflow Maintenance Functionality for PRWs.

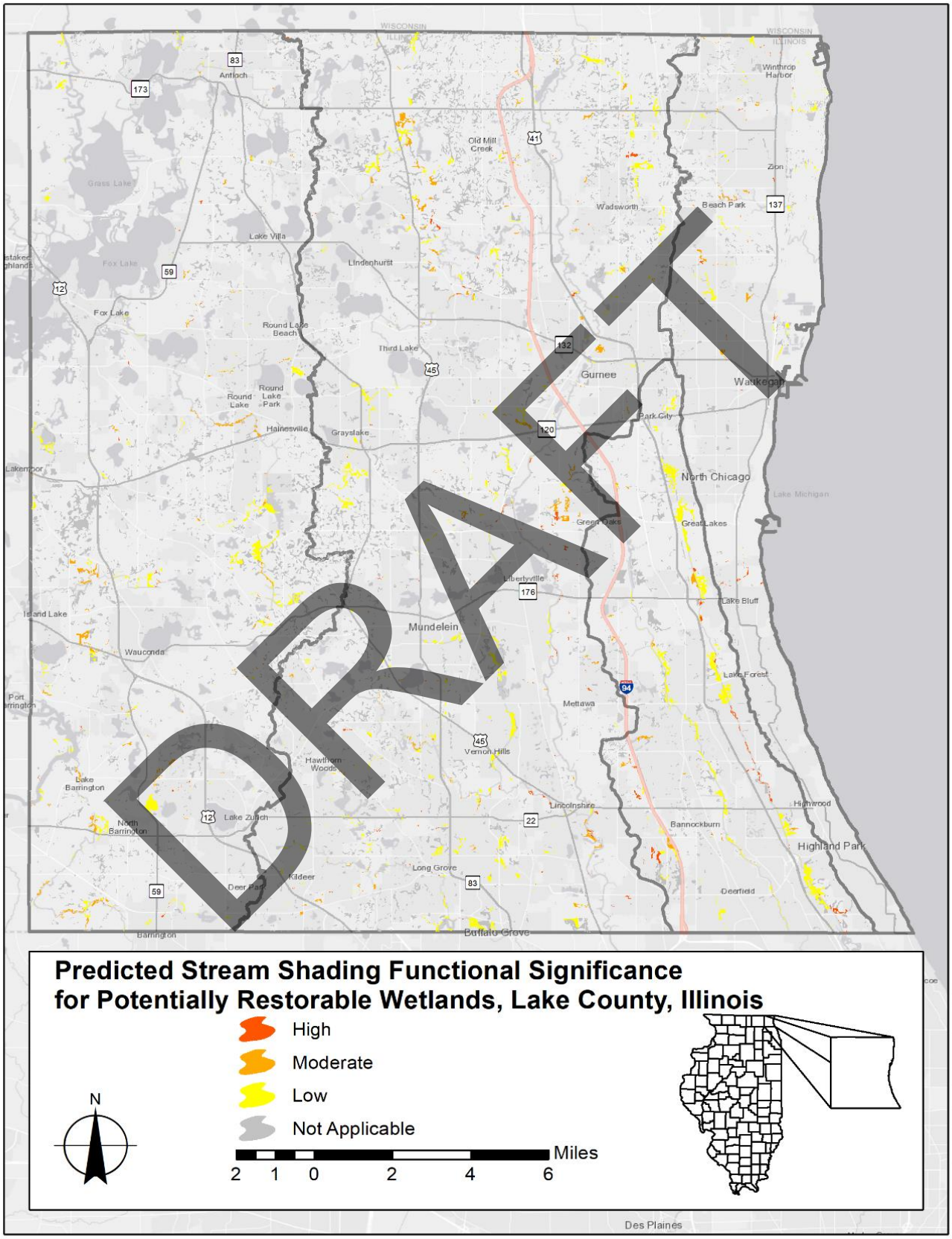

Figure 23. Stream Shading Functionality for PRWs.

Unique Wetland Resources

PRWs predicted to have high functional significance for Unique Wetland Resources are those that are contiguous to and would expand existing wetlands with high predicted functional significance, primarily those identified in the Advanced Identification (ADID) study (1,263 acres). Such PRWs may also be located on the Lake Michigan coastal plain, where restoration would create additional acres of coastal wetlands. Distribution of PRWs throughout the major watersheds and sub-watersheds is related to the amount of existing Unique Wetland Resources and proximity of PRWs to Lake Michigan. For this reason, the Kellogg and Dead River sub-watersheds (Lake Michigan watershed) have a disproportionate share of such PRWs given their overall size. **Figure 24** is a general depiction of Unique Wetland Resources function for PRWs throughout the County.

Waterfowl Habitat

High predicted functional significance for Waterfowl Habitat is attributed to PRWs also predicted to have emergent vegetation and frequent inundation or adjacency to open water. These areas comprise about 22 percent of all PRWs in Lake County (3,328 acres) and follow the countywide distribution pattern of PRWs in general. Three-quarters of such PRWs are associated with existing bodies of water. **Figure 25** is a general depiction of Watefowl Habitat function for PRWs throughout the County.

Within the Des Plaines River watershed, the Indian Creek sub-watershed contains the most acreage of PRWs predicted to have high functional significance for Waterfowl Habitat (403 acres). Concentrations of such PRWs occur in the Aptakisic Creek, Buffalo Creek, and Newport Drainage Ditch sub-watersheds. In the Fox River watershed, PRWs predicted to have high functional significance are distributed somewhat evenly and, accordingly, the Squaw Creek sub-watershed contains the greatest acreage (322 acres). The majority of PRWs in the North Branch Chicago River watershed predicted to have high functional significance occur in the Skokie River sub-watershed (408 acres), which has the most acres and highest density of such PRWs of any sub-watershed in Lake County. The Lake Michigan watershed contains the lowest acreage of PRWs predicted to have high functional significance for Waterfowl Habitat of the major watersheds in Lake County (214 acres). Where they occur, such PRWs tend to be located in the northern end of the watershed and on the Lake Michigan coastal plain.

Wetland-dependent Bird Habitat (Other)

PRWs predicted to have high functional significance for Wetland-dependent Bird Habitat occur throughout Lake County and comprise 9,152 acres, more than 60 percent of all PRW acreage. Such PRWs are predicted to be emergent wetlands that are seasonally flooded or wetter. **Figure 26** is a general depiction of Wetland-dependent Bird Habitat (Other) function for PRWs throughout the County.

The Des Plaines River watershed contains 4,465 acres of PRWs predicted to have high functional significance for Wetland-dependent Bird Habitat (Other). Fifty nine (59) percent of this acreage is within three sub-watersheds: Indian Creek (1,001 acres), Mill Creek (880 acres) and North Mill Creek (768 acres). Within Lake County and the Fox River watershed, the Squaw Creek sub-watershed contains the greatest acreage (1,225 acres) of PRWs predicted to have high functional significance. Additionally, the Fish Lake Drain sub-watershed contains the greatest density of such PRWs in the County. The distribution of PRWs predicted to have high functional significance in the North Branch Chicago River watershed is similar to the distribution of PRWs in general. The Skokie River sub-watershed contains the greatest acreage (611 acres) and density of such PRWs within the watershed. The Lake Michigan watershed contains the least acreage of PRWs predicted to have high functional significance for Wetland-dependent Bird Habitat (Other) of the major watersheds in Lake County (444 acres). However, a significant proportion of these PRWs are classified as coastal (184 acres)

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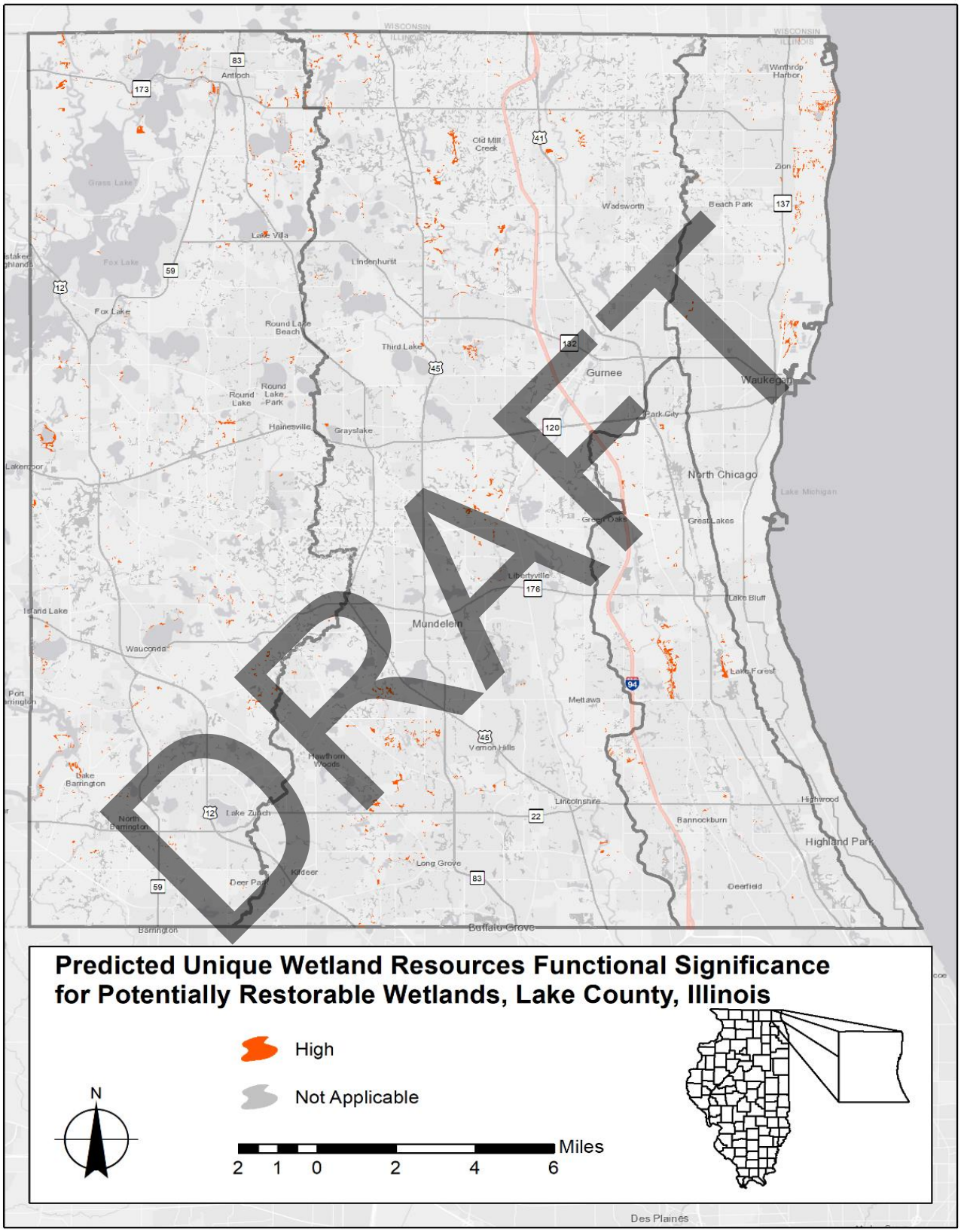

Figure 24. Unique Wetland Resources Functionality for PRWs.

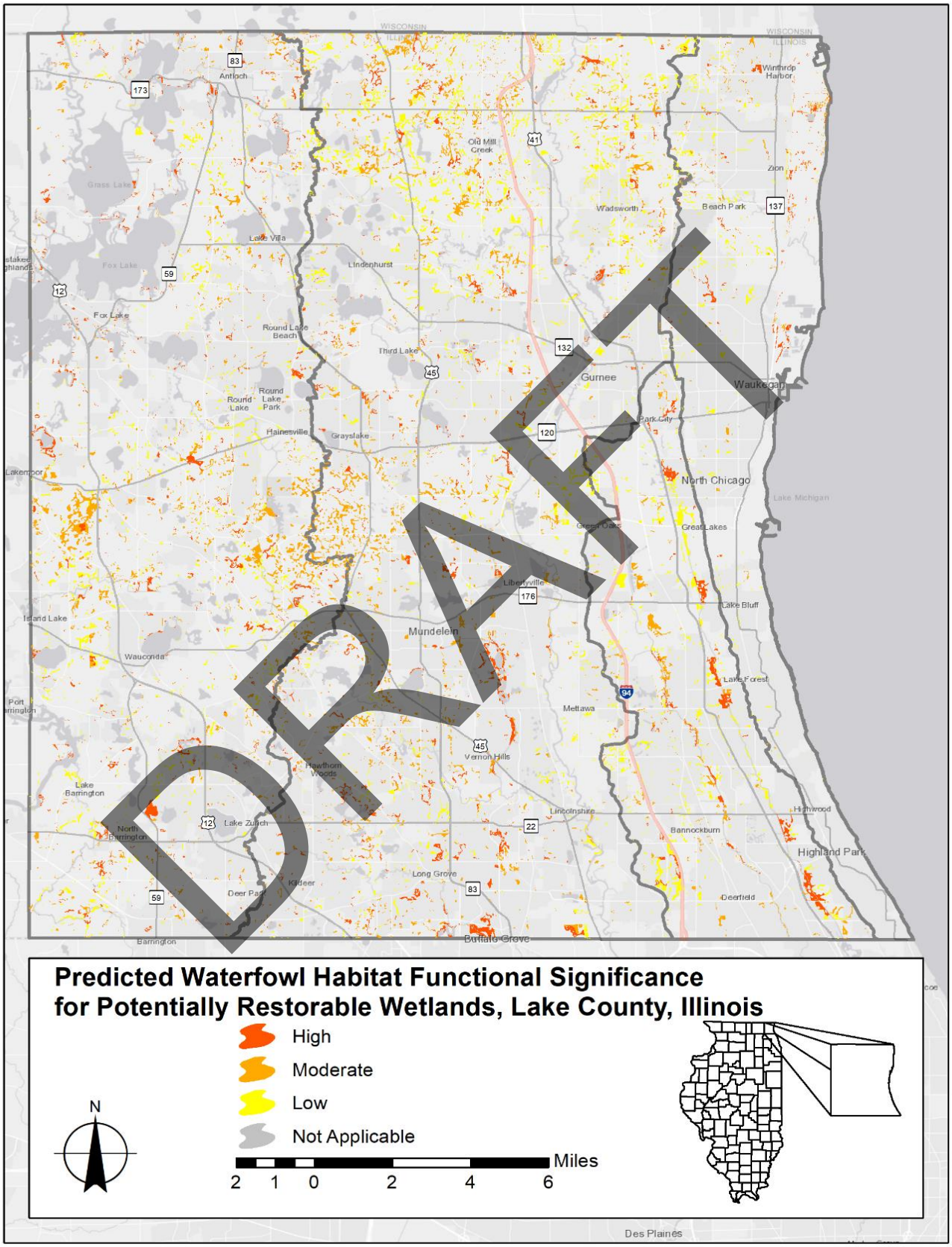

Figure 25. Wildlife Shading Functionality for PRWs.

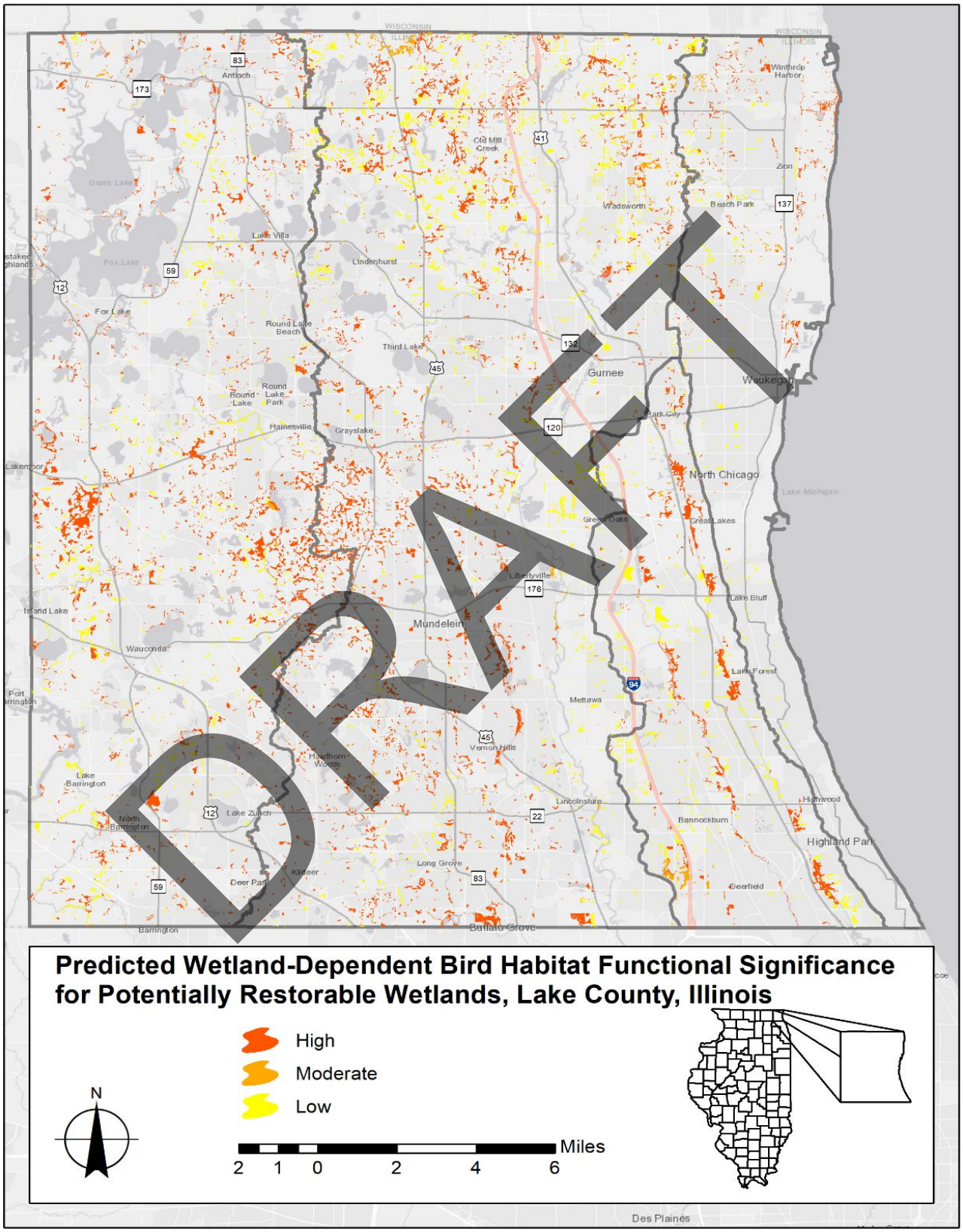

Figure 26. Wetland-dependent Bird Wildlife Habitat (Other) Functionality for PRWs.

and therefore could provide a unique opportunity for restoration.

Wildlife Movement Corridors

More PRW acres are predicted to have high functional significance as a Wildlife Movement Corridors (13,241 acres) than for any other function that was evaluated in this study, about 88 percent of all PRWs. This is attributable to the location of PRWs on relatively undeveloped lands throughout the County. Distribution and concentration across the County tends to follow the pattern(s) for PRWs in general, with larger sub-watersheds containing more acres of such PRWs and smaller and rural sub-watersheds containing high densities of such PRWs. **Figure 27** is a general depiction of Wildlife Movement Corridors function for PRWs throughout the county.

In the Des Plaines River watershed, the North Mill Creek, Upper Des Plaines River, Mill Creek, and Indian Creek sub-watersheds each contain more than 1,000 acres of PRWs predicted to have high significance for this function. The North Mill Creek and Newport Drainage Ditch sub-watersheds have the highest densities of such PRWs in Lake County. In the Fox River watershed, more than one-quarter of PRW acres predicted to have high functional significance are located in the Squaw Creek sub-watershed (1,464 acres). The Fish Lake Drain sub-watershed contains the highest density of such PRWs in the watershed. PRWs predicted to have high functional significance as Wildlife Movement Corridors are distributed in the North Branch Chicago River and Lake Michigan watersheds similar to the distribution of PRWs in general. Such PRWs are most common in the Skokie River watershed, which has contiguous open areas along the Skokie River. In the Lake Michigan watershed, the distribution of these PRWs is more limited relative to other locations in Lake County (i.e., few opportunities south of Waukegan Harbor).

Woodland Amphibian Habitat

PRWs predicted to have high functional significance for Woodland Amphibian Habitat account for less than 0.5 percent of all PRWs in Lake County. The “forested” vegetation classification is a key factor in predicting high significance for this function, in addition to a limiting set of hydrologic, geomorphic and geographic characteristics. Only about 7 percent of all PRWs have a “forested” classification. The relatively low number of PRWs classified as “forested” and the difficulty of predicting the other hydrogeomorphic characteristics associated with high significance for this function limits the mapping of such PRWs. As such, PRWs with the potential to provide a high level of functionality likely are under-represented in this study. **Figure 28** is a general depiction of Woodland Amphibian Habitat function for PRWs throughout the county.

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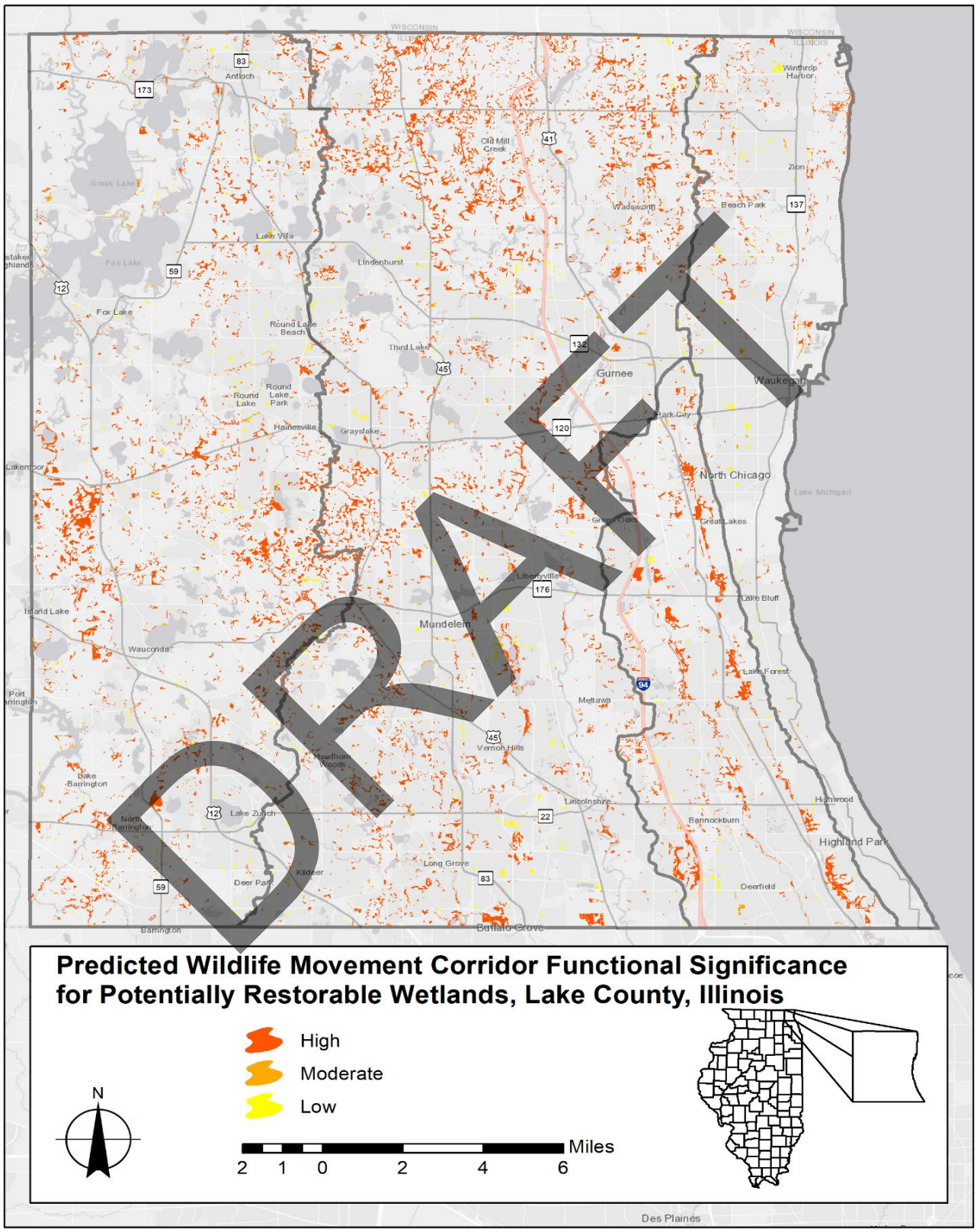

Figure 27. Wildlife Movement Corridors Functionality for PRWs.

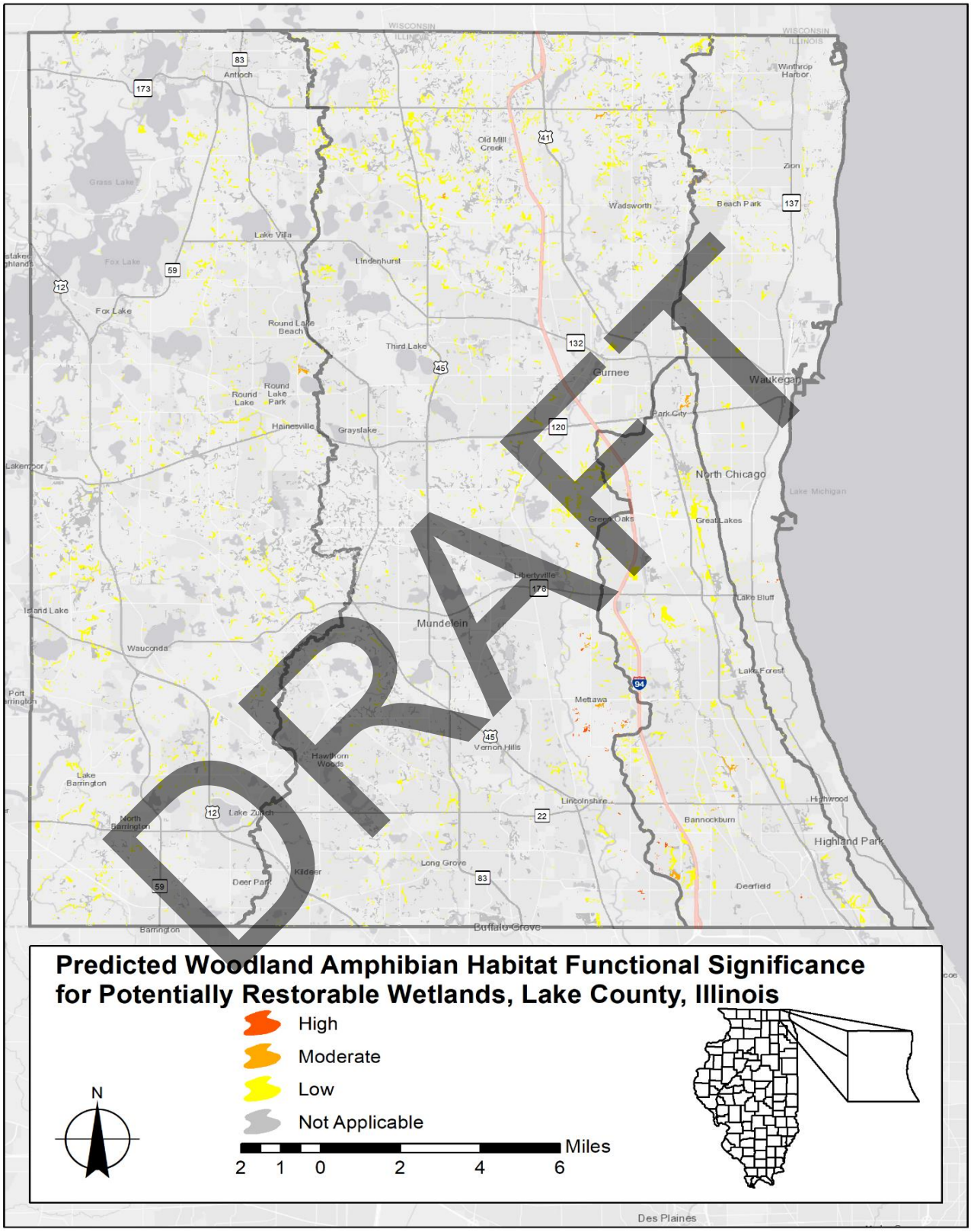

Figure 28. Woodland Amphibian Habitat Functionality for PRWs.

6.0 DECISION SUPPORT TOOL (DST)

Where does one begin to identify and prioritize sites for wetland and water body protection and restoration? The WRAPP does not make decisions for you. It *informs your decisions* once you establish your protection and restoration goals. Depending on your area of concern, flood water storage may be what's most important to you, or shoreline stabilization, or waterfowl habitat, or possibly a suite of functions so you can compare several potential sites. Regardless of the scale of your project area, a larger perspective helps define the issues and identify where restoration and preservation can contribute to solutions.

Be aware that a gain in one function (service) at a wetland may affect other services. For example, restoring an urban wetland to enhance sediment removal potentially could result in a dominance of weedy, invasive plants, which may reduce wildlife habitat functionality. This outcome may be acceptable if water quality improvement is the primary restoration goal, but it may be less acceptable if multiple objectives are desired, including wildlife diversity.

6.1 HOW TO USE THE DST

6.1.1 Wetland Mapping Application

To open the online Decision Support Tool, click here. This displays the title page, which briefly describes the tool and covers ***Limitations*** regarding its content and use (**Figure 29**). The ***Disclaimer*** advises the user that the WRAPP-DST is not intended to be prescriptive. Rather, it is a planning tool to help the user identify and prioritize wetland restoration and preservation efforts based on his or her specific goals and objectives. The user must check the box in the lower left of the title page screen to acknowledge having read the ***Limitations and Disclaimer***, upon which the START button in the bottom right will illuminate. Clicking the Start button now launches the mapping application.

The mapping application landing page displays the boundary of Lake County on a general topographic base image (**Figure 30**). The tool bar in the upper right includes several standard application icons, including the information layers list, basemap gallery, measurement, filter, draw, bookmark, print, and contact us.

The search box in the upper left allows the user to type in a known Area of Interest by full address, tax parcel identification number (PIN) or nearest road intersection using the format of "road name & road name." Alternately, the drop-down menu lets the user choose from a variety of pre-selected areas (e.g., watersheds, townships, municipalities, forest preserves, etc.).

Under the search box are three main operational buttons:

- The ***i*** button automatically pops up and provides a tutorial on how to search for a desired Area of Interest. It also provides basic instructions on using the other two operational buttons, as well as a description of the function of each application icon in the tool bar (**Figure 30**).

- With the **W** button, the user can display existing wetland inventory (EWI) sites and potentially restorable wetlands (PRW) within the Area of Interest. Existing wetlands are **green** and existing water bodies are **blue.** PRWs have purple shading based on polygon size (**purple** = >5-290 ac, **lilac** = 1-5 ac, and **pale lavender** = <1 ac) (**Figure 31**). Clicking on the "**…**" to the right of the operational layers lets the user adjust polygon transparency.

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Figure 29. WRAPP-DST Title Page.

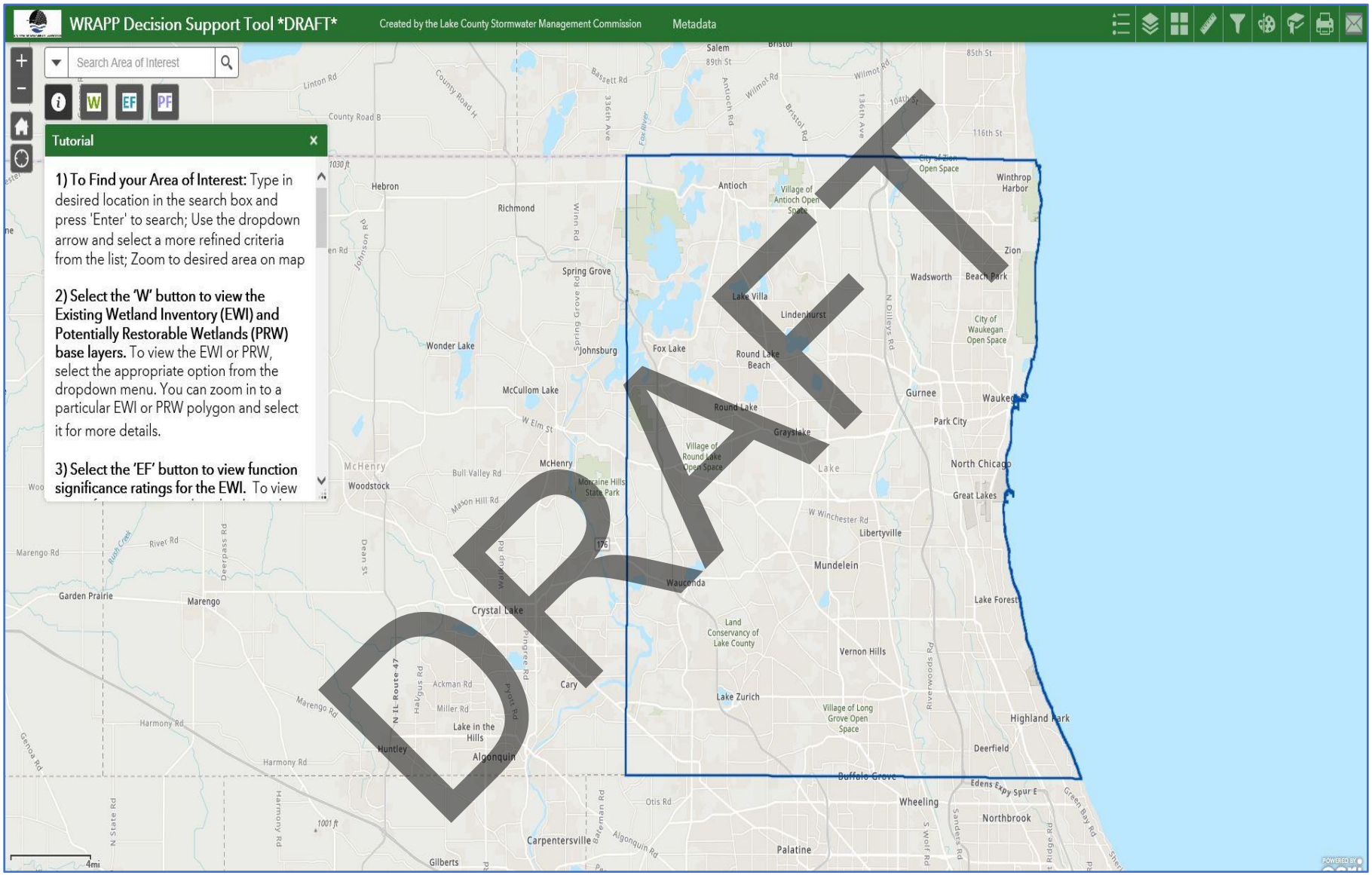

Figure 30. WRAPP-DST Mapping Tool Landing Page.

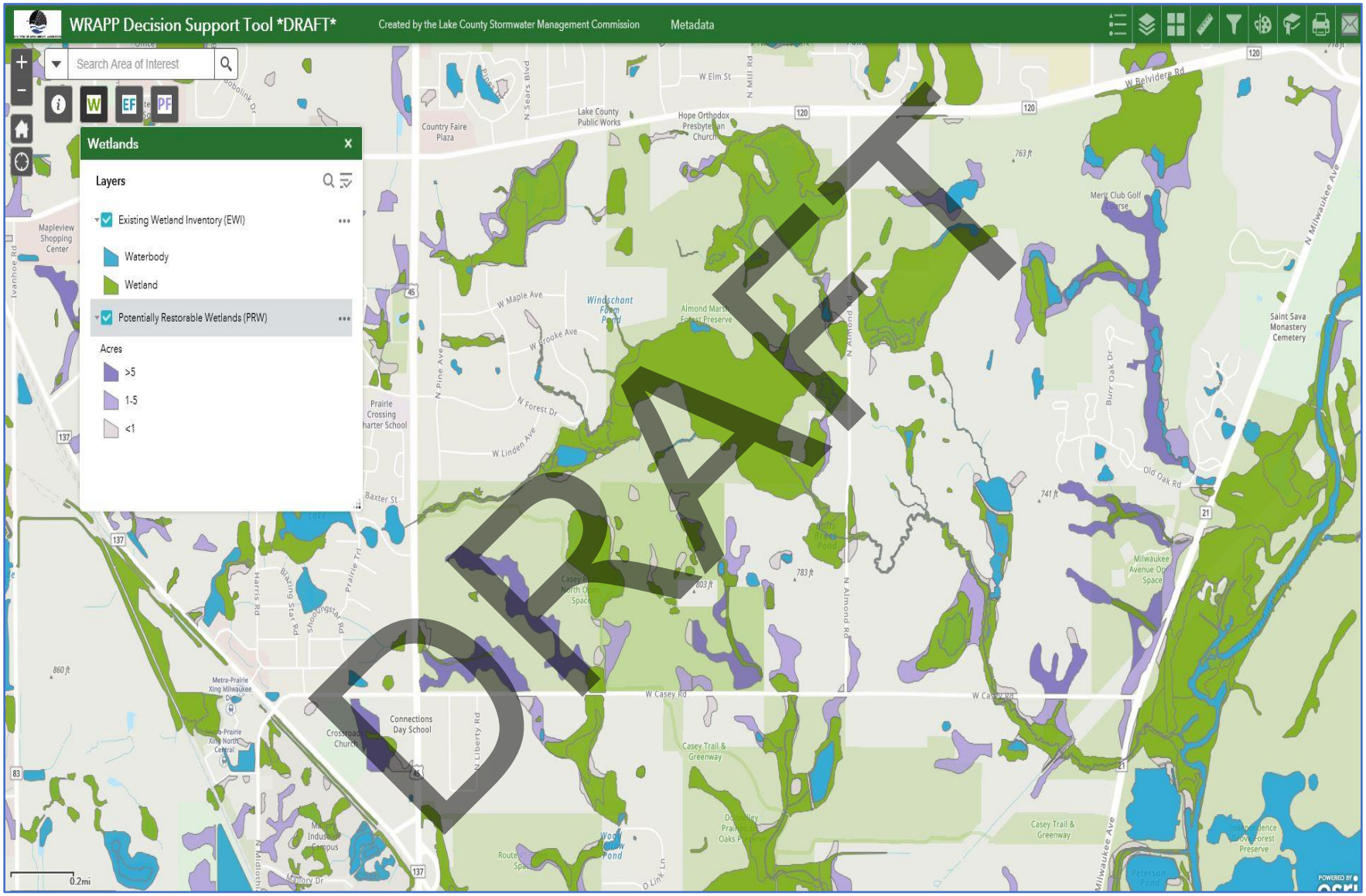

Figure 31. WRAPP-DST Wetland Layers with EWI and PRW by Acreage Category (green = existing wetlands, teal = water bodies, purple = >5 acres, lavender = 1-5 acres, pale lilac = < 1 acre).

In the mapping tool itself, the user can click on a particular polygon for additional details such as size (ac.), type/classification, etc. (**Figure 32**). At this location, selecting the "**…**" symbol provides a link for viewing that feature's information in the Attribute Table at the bottom of the screen. Hide the Attribute Table by selecting the down arrow in the tab at the top center of the table pop-up.

- The **EF** button lets the user select any one of the 13 functions and view the significance ratings for existing wetland and water body polygons *for that function* based on color code: **red** = High, **orange** = Moderate, yellow = Low, and gray = Not Applicable (**Figure 33**). *Important*: If the user selects more than one function at the same time, the color code display only reflects significance ratings for the top function. Clicking on the "**…**" symbol allows the user to adjust the transparency of the functional significance layer.

- The **PF** button allows the user to select any one of the 13 functions and view the significance ratings for PRW polygons in the AOI *for that function* based on color code: **red** = High, **orange** = Moderate, yellow = Low, and gray = Not Applicable (**Figure 34**). *Important*: If the user selects more than one function at the same time, the color code display only reflects significance ratings for the top function. Clicking on the "**…**" symbol allows the user to adjust the transparency of the functional significance layer.

6.1.2 Prioritization Tools

Once the user has identified the PRW or potential wetland preservation site in their Area of Interest using the **W** button, the first step to evaluate and prioritize these sites is to select the desired functions in the drop-down menu of the **PF** button for PRW or **EF** button for existing wetlands and water bodies. Then, the user can overlay various ***Base Maps*** by clicking on the "4-Square" icon (3rd from left in the green tool bar in the upper right of the page) and ***Information Layers*** by clicking on the "Map Stack" icon (2nd from left in the green tool bar in the upper right of the page) to further assess the potential feasibility of the site.

Figure 35 provides an example of the prioritization process for potential wetland preservation site(s) focusing on the Flood Water Storage function. In this example, the selected Area of Interest consists of parcels with agricultural land shown on a 2017 aerial photograph base map and identifies several existing wetlands rated as having mostly high flood water storage functionality. The ***Hydrology-Linear Connections*** and ***Topography-1ft Contours*** layers are also included in this example image, which would help the user gain a better understanding of the local landscape and area drainage patterns.

As the user toggles the various ***Information Layers*** on/off, they can get a better sense of possible site constraints and opportunities. For example, a PRW may appear to have physical constraints (e.g., steep slope, uncertain source of water, access limitations, etc.). A more opportune PRW may have physical attributes such as proximity to existing wetlands or water bodies, situated within floodplain, restorable hydric soils, etc. A potential wetland or water body preservation site may, for example, contain identified threatened or endangered species (click on ***Unique Wetland Resources*** layer) or be located on publicly-owned land (e.g., municipal park, forest preserve, etc.) and have high ratings for desired functions such as flood water storage, nutrient transformation, waterfowl habitat, etc. (click **EF** button, then select desired function from drop-down menu to view rating).

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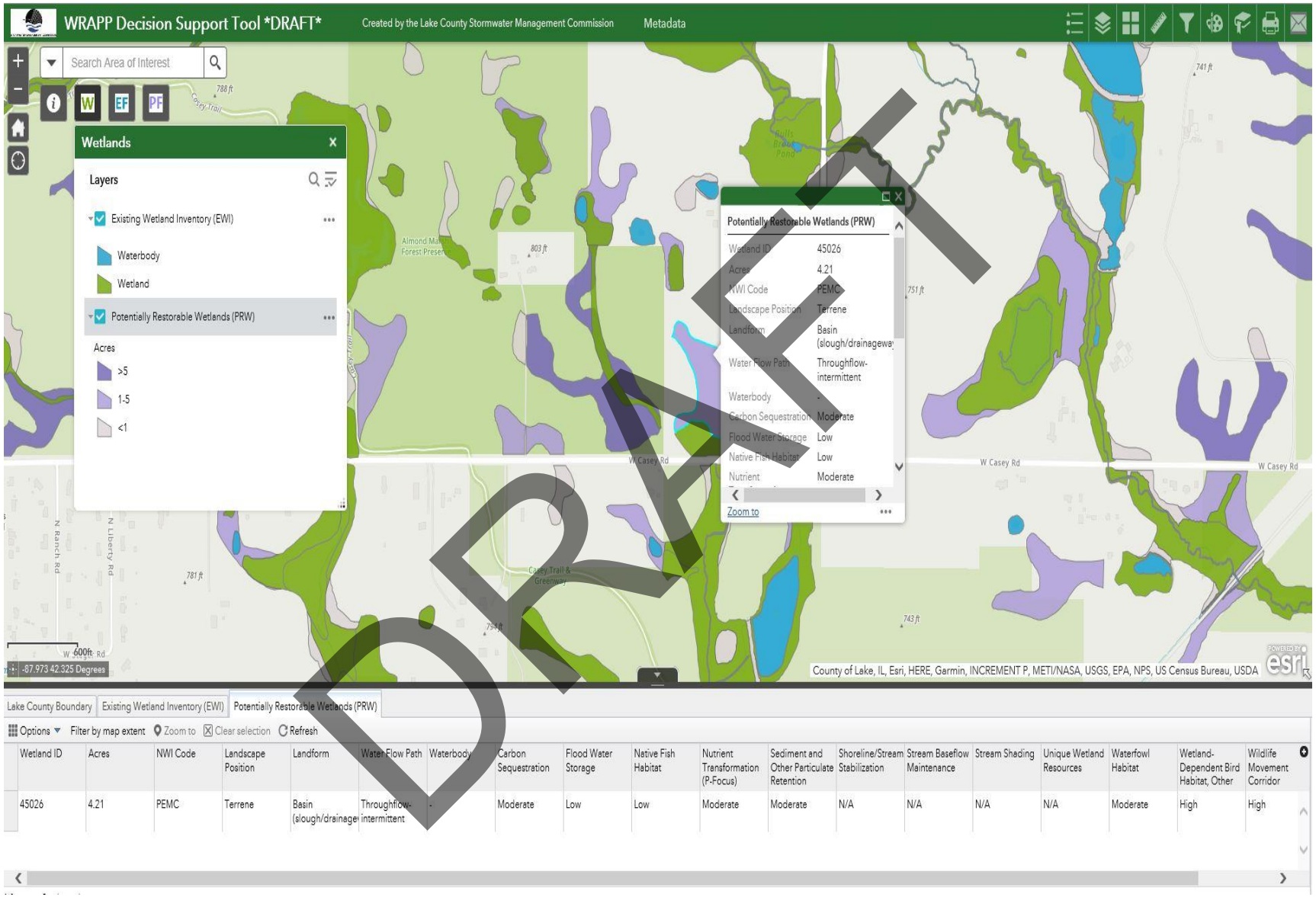

Figure 32. Example of Additional Attribute Details for Selected Polygon.

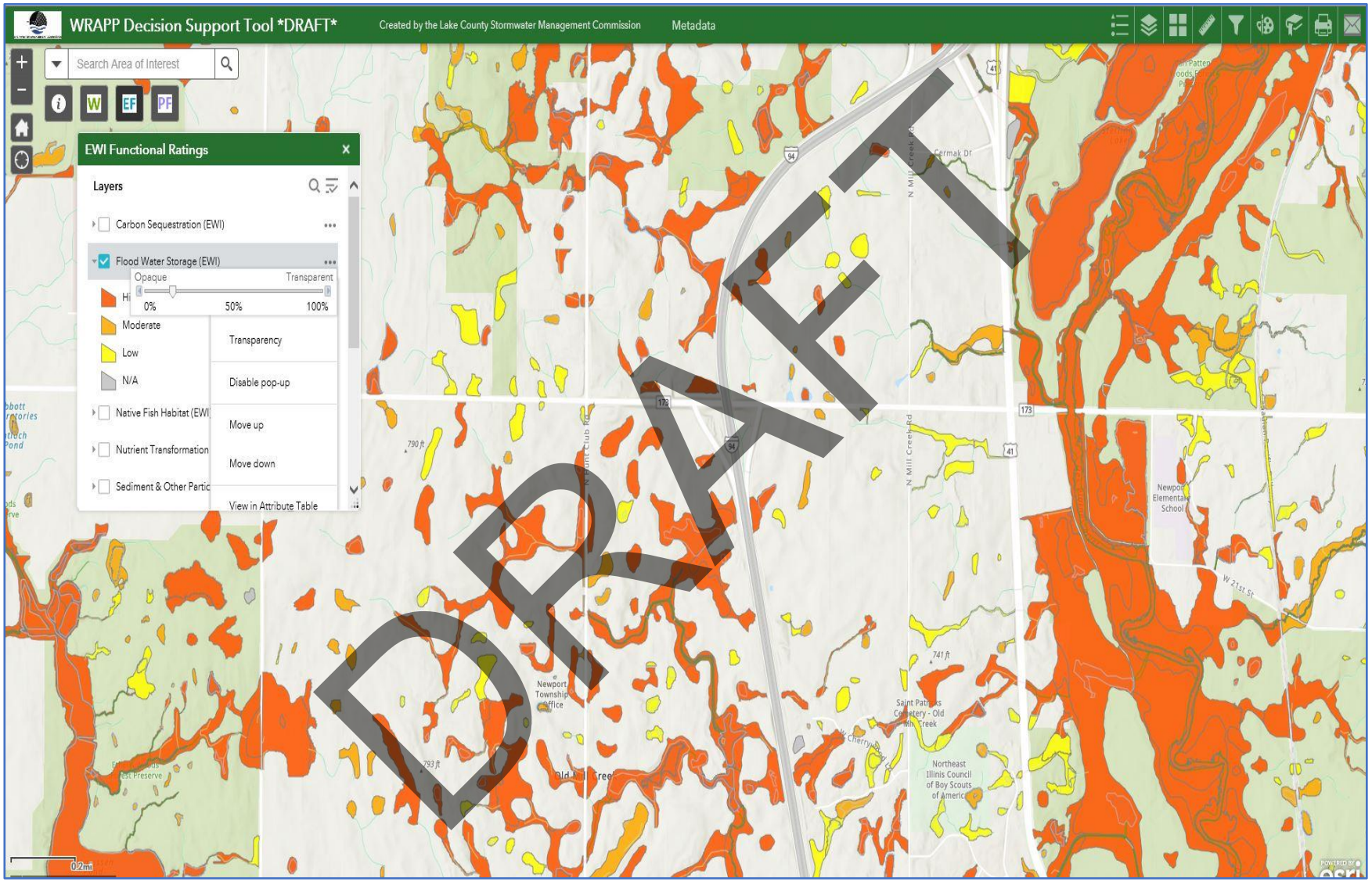

Figure 33. EWI Flood Storage Function and "..." View Options Feature (pale green = forest preserve, flood water storage function: red = high, orange = moderate, yellow = low, gray = n/a).

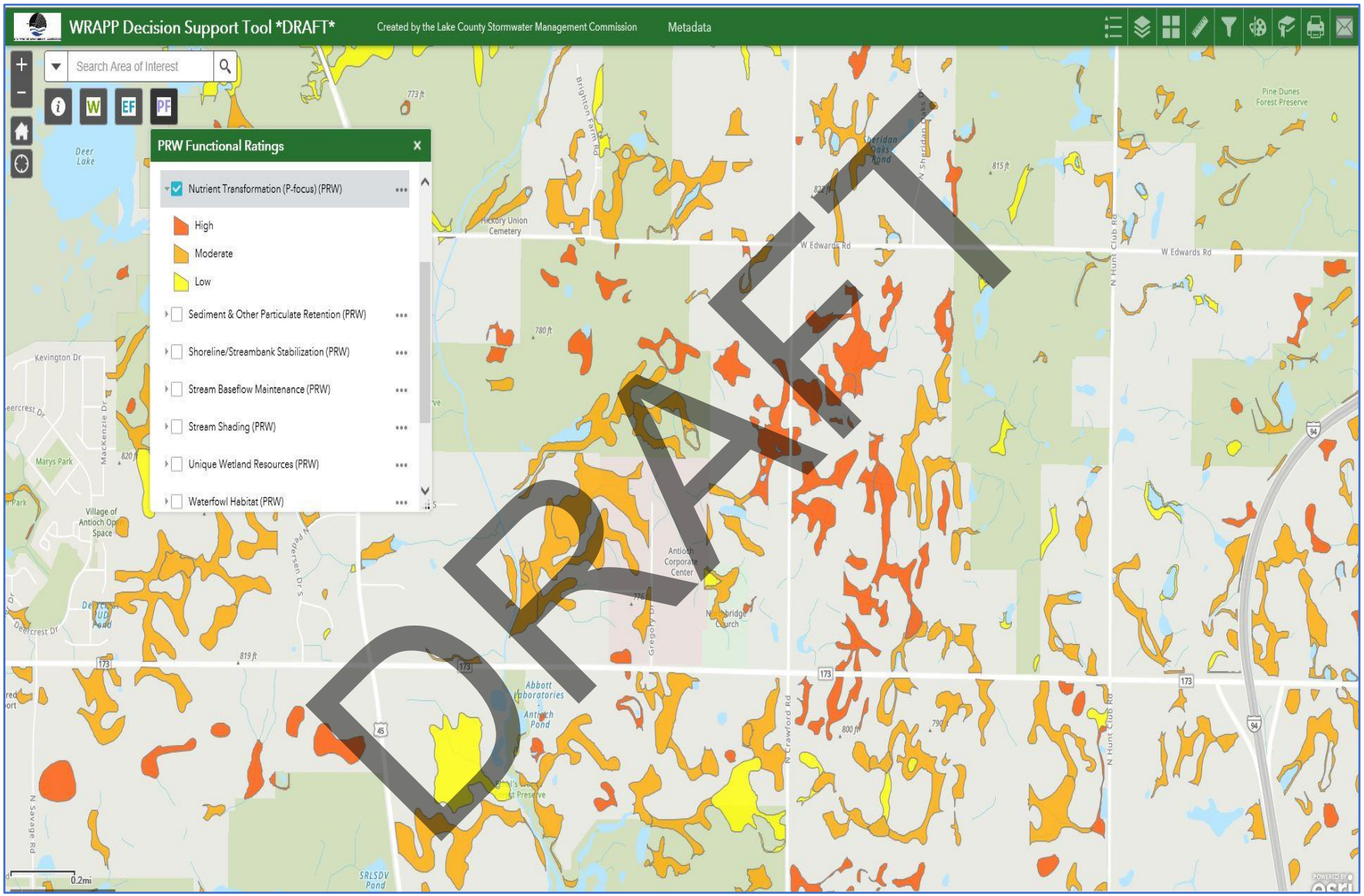

Figure 34. PRW Nutrient Transformation (P-focus) Function (pale blue = water body, pale green = forest preserve, flood water storage function: red = high, orange = moderate, yellow = low, gray = n/a).

Figure 35. EWI Prioritization Example for Flood Water Storage Function (red = high, orange = moderate, yellow = low, gray = n/a).

6.2 Wetland Restoration Example

The following example shows how the WRAPP-DST can be used to inform and support decisions related to watershed plan development and implementation.

Objective: Incorporate information generated by the WRAPP in the *Des Plaines River Watershed-Based Plan* (SMC 2018) to identify PRWs that can provide desired functions to help address two key goals identified by the watershed stakeholders:

- Flood Damage Reduction
- Water Quality Improvement

Using the **W** button in the DST, an initial screening identified numerous PRW throughout the Des Plaines River watershed. The 2nd step used the **PF** button to refine the PRW search according to their significance ratings for the Flood Water Storage and Nutrient Transformation (P-focus) functions. Additional filtering was then performed to specifically target PRW on publicly-owned property, using the "Boundary - Parks and Open Space" layer under the main ***Information Layers*** menu superimposed on a 2017 aerial photograph base map.

This process identified a number of high potential PRW sites, one of which was the Casey Road Open Space property owned by Libertyville Township near Grayslake, Illinois (**Figure 36**). This particular site, located within the Liberty Prairie Reserve, was awarded a 319 water quality grant from the U.S. Environmental Protection Agency and Illinois Environmental Protection Agency in 2018 for wetland restoration, with the goals of improving surface water quality (nutrient transformation function) and reducing flood risk (flood water storage function) in the watershed.

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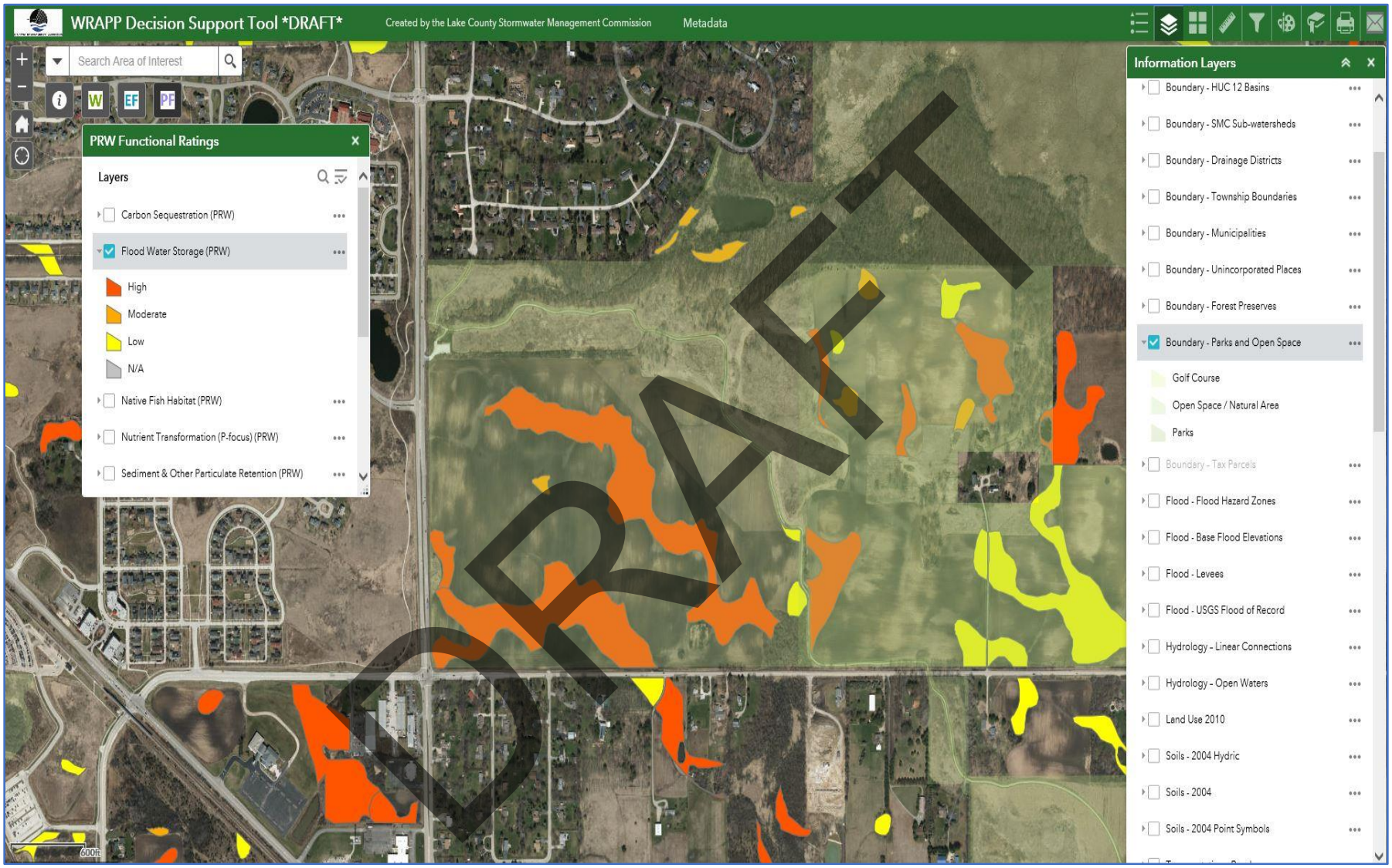

Figure 36. Example for Watershed-based Planning to Target PRWs for Restoring Flood Water Storage Functionality (public ownership = pale green overlay, red = High, orange = moderate, yellow = low).

7.0 ACTION STRATEGIES

A plan is only of value if set into motion and its benefits are recognized. For the Wetland Restoration and Preservation Plan (WRAPP), this means the information provided in this report and the on-line decision support tool (DST) must lead to an increase in actual in-the-ground wetland restoration projects and generate more support for wetland preservation throughout Lake County, Illinois. Only in this way can we attempt to offset, at least partially, the loss of wetland acreage in the county (about 55% countywide since pre-settlement times) and recover the important functions (services) that wetlands and water bodies provide. Below are some suggested strategies to launch the WRAPP into action.

A. SMC should conduct a public outreach program for the WRAPP, initially to disseminate the report and DST into the public domain, followed by ongoing education (e.g., seminars, workshops, webinars, etc.) focused on helping users understand and easily navigate through the DST.

B. SMC should assist willing partners in seeking funding to implement priority wetland restoration projects. Over the years, SMC has become well-acquainted with various grant programs and adept at navigating the application process on behalf of our partners to obtain funding for numerous projects throughout the county, primarily focused on water quality improvement and flood damage reduction.

C. The WRAPP identified over 10,000 acres of *potentially restorable wetlands* (PRWs) and more than 13,000 acres of existing wetlands and water bodies throughout the county that rate "High" for the flood water storage function. These sites represent a significant opportunity for reducing the risk of flooding, which is the number one natural hazard in Lake County, Illinois. This is particularly important in light of the increases in frequency and intensity of precipitation events (Angel and Markus 2020) and impermeable surfaces created by urbanization throughout the county, leading to more stormwater runoff and higher flood risk.

   1) Development is likely to expand within the Des Plaines River watershed, including upstream of Lake County. Stakeholders interested in reducing flood damage should consider restoration of PRWs along streams and in floodplains. This is consistent with sound floodplain management principles. There are more than 2,000 acres of floodplain PRWs countywide, including more than 900 acres in the Des Plaines River watershed.

   2) The North Branch Chicago River watershed has a far greater density and proportion of PRWs in the floodplain than any other watershed. The PRWs are concentrated along the three forks of the North Branch Chicago River. Stakeholders should prioritize restoration of floodplain wetlands as a component of flood damage reduction efforts along the forks, which is consistent with sound floodplain management principles.

D. SMC and other stakeholders have prepared many watershed-based plans for Lake County that include site-specific recommendations for wetland restoration and protection (see current list of plans at: http://il-lakecounty.civicplus.com/2437/Watershed-Management-Plans). The WRAPP can help stakeholders prioritize the recommended actions in their watershed plans by targeting wetland restoration and preservation sites that will best meet their specific goals and objectives.

   1) There are widespread opportunities throughout the county to regain "High" functionality in the Flood Water Storage, Wetland-Dependent Bird Habitat (Other), and Wildlife Movement Corridors functions through wetland restoration.

   2) Additional opportunities exist throught the county to restore wetlands with "Moderate"

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to "High" functionality for Carbon Sequestration, Nutrient Transformation, Sediment/Other Particulate Retention, Stream Baseflow Maintenance (where applicable), Shoreline/Stream Bank Stabilization (where applicable), and Waterfowl Habitat.

3) While opportunities exist to restore wetlands with the objectives of increasing the Native Fish Habitat, Stream Shading and Woodland Amphibian Habitat functions, the acreage of PRWs throughout the county is geographically limited.

4) The efforts of watershed workgroups are acknowledged, particularly their goal to increase indices of biotic integrity to meet MS4 and treatment plant requirements (water quality standards). The WRAPP can be used as a planning tool to achieve this goal.

E. The Lake Michigan watershed has the lowest acreage and density of PRWs and therefore a more limited number of restoration opportunities.

1) Stakeholders interested in pursuing wetland restoration might consider making landowner interest and site suitability, along with cost, the main prioritization factors for wetland restoration sites in the Lake Michigan watershed.

2) The Chiwaukee-Illinois Beach Plain, a designated wetland of international importance, is located in the Lake Michigan watershed. Stakeholders should make efforts to restore wetland functions within and in the vicinity of this unique resource.

F. The WRAPP Geographic Information System (GIS) analysis indicates about a quarter of PRWs classified as "forested" are associated with floodplains of rivers and streams. Efforts should be made to restore the forested wetland community type on floodplains to increase functionality, particularly for Carbon Sequestration, Sediment/Other Particulate Retention, and Flood Water Storage functions.

G. A number of wetland mititgation banks have been developed in the Des Plaines River and Fox River watersheds in Lake County, and some credits (acres) are usually available for sale at one or more of these banks. The North Branch Chicago River Watershed, however, has only had one mitigation bank, which has sold out of credits, and the Lake Michigan Watershed has had no mitigation banks to date. SMC should work with the mitigation bankers to apply the information in the WRAPP along with the DST to locate potential new mitigation banks in the county, with particular emphasis on the North Branch Chicago River and Lake Michigan watersheds.

H. The WRAPP should continue to provide the best available information to meet the plan goal of providing a wide audience of end-users with the decision-making support to help prioritize wetland restoration and preservation efforts using the DST.

1) SMC should include periodic updates of the WRAPP data sets, DST and this report in its annual work program.

2) SMC should maintain a database of wetland restoration and preservation projects, to the extent practical, specifically with respect to gains in wetland acreage and functions.

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8.0 FUTURE STEPS

The practice of watershed planning is ever-evolving, as is our knowledge of wetland science. Therefore, the WRAPP should be viewed as a "living document" that will undoubedtly require modifications and updates in the future as newer, more accurate data sets are generated and additional research provides greater insights into wetland and water body functionality.

8.1 ADDITIONS AND REFINEMENTS OF WETLAND FUNCTIONS

SMC and the TAG selected the 13 wetland/water body functions based on their importance and applicablity to the Lake County WRAPP (see **Section 4.4**). Other functions assessed in various studies across the United States−some more general and some more specific−could be included in future updates of the WRAPP. Examples include but are not limited to the following: groundwater influence on stream recharge, nutrient transformation (Nitrogen-focus), fish habitat (all species), amphibian habitat (all species), riparian habitat, and wildlife habitat for specific species (e.g., Blanding's Turtle, a State-listed endangered species).

Refinements of the assessment criteria and significance ratings assigned to the 13 wetland/water body functions also should be considered in future updates of the WRAPP, as warranted by new research findings and/or field testing results in Lake County. SMC encourages WRAPP users to suggest refinements to the functional criteria and significance ratings, along with data or supporting information. See hyperlink below.

8.2 FIELD STUDIES

SMC and TAG performed field studies of 48 representative wetlands/water bodies for the WRAPP on a limited Level 2 basis. This means the information collected was mostly qualitative, based on visual observations and interpretations (see **Section 4.6** and **Appendix B**). To test and further refine the wetland/water body functional assessement criteria and significance ratings presented in this plan, long-term monitoring and/or more detailed studies of the 48 representative sites (e.g., Level 3, quantitative) could be conducted. Examples of Level 3 studies might include surface and groundwater hydrology monitoring, bird surveys, and vegetation inventories (floristic quality assessments). Expanding the sample size beyond the relatively small number of field sites reviewed for the WRAPP would greatly enhance the data set needed to validate or refine the wetland/water body functional assessement criteria and significance presented in this plan. Ideally, this would include additional study sites located on both publicly-owned and privately-owned land, if access authorization can be obtained.

8.3 OTHER TYPES OF STUDIES

The information generated by this plan will serve as a springboard for a variety of other studies. Possibilities include, but are not limited to, the following:

- ***Economic Valuation:*** There is an ongoing movement toward assigning economic values to "ecosystem services." An example of this is found in *Valuing Nature's Benefits: An Ecological Assessment of Iowa's Middle Cedar Watershed* (Kocian et al. 2012) in which the service benefit of wetlands for flood risk mitigation was estimated at $2,544 to

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3,651/acre/year. The wetland/water body functions (services) identified in the WRAPP could potentially be evaluated in a similar manner to help land-use planners, communities, landowners, and others prioritize wetland restoration and preservation efforts. For instance, a community seeking to reduce annual flood damage costs could perform an economic analysis to compare the cost of restoring wetlands with high flood water storage functionality (e.g., floodplain wetlands) versus constructing a regional stormwater retention facility.

- ***Water Pollution Reduction:*** The functional assessment information in the WRAPP potentially can be integrated into watershed-based action plans for reducing pollutant loading and helping achieve established Total Maximum Daily Load (TMDL) levels for impaired water bodies in the county. For example, existing wetlands and water bodies rated high for nutrient transformation (P-focus) and sediment and other particulate retention may be targeted for preservation and PRW rated high for these functions can be prioritized as a best management practice for reducing non-point pollution on a watershed/sub-watershed level. More detailed studies (e.g., field measurements) of representative wetlands/water bodies rated high for the functions above would provide valuable data to support estimated reductions in specific pollutant loading.

- ***Greenhouse Gas Reduction:*** Wetlands are highly efficient in processing atmospheric carbon dioxide (CO_2) by photosynthesis and storing (sequestering) organic carbon, both in their biomass and soils. Thus, wetlands play a vital role globally in offsetting greenhouse gas emissions—particulary CO_2, which have been linked to climate change. We included Carbon Sequestration in the WRAPP functional assessment list to inform users of the importance of this function and encourage decision-makers to consider preservation and restoration of wetlands in Lake County as at least one small step toward reducing carbon dioxide emissions and mitigating the effects of climate change. More detailed studies, including field measurement and modeling, could be performed to quantify the volume of carbon sequestered in the various types of wetlands in Lake County. This information would allow decision-makers to prioritize wetland preservation and restoration sites on a local basis (e.g., watershed, community) as a means toward obtaining maximum benefit from the carbon sequestration function.

- ***Engineered Wetlands:*** The WRAPP focused primarily on naturally occurring wetlands and water bodies and PRW in the county; therefore, an assessment of constructed stormwater management features was beyond the scope of this plan. While the primary purpose of these man-made features is to control surface runoff (reduce flood risk), there are other functions provided by these features such as nutrient transformation (N and P), sediment retention, and wildlife habitat (general or species-specific) that could be the subject of future studies. The GIS data set developed for the WRAPP (EWI-LC) includes the shape files for the majority of the constructed stormwater features in the county, thus providing a baseline for spatial analysis of these features on a countywide or watershed-based level and a foundation for more detailed studies (e.g., functional assessments) on a localized basis.

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8.4 Plan and Decision Support Tool Updates

The WRAPP is a *dynamic planning effort*. As such, the plan will require periodic updates (perhaps every 10 years) as new data sets are generated and additional research and field testing warrant further refinements of the wetland/water body functional criteria and significance ratings. Enhancements to the online DST will be implemented on a more regular basis (e.g., annually) based on user feedback, availability of new data, and improvements in online technology.

SMC seeks ***your*** input on the usefulness of this plan. For example, are the criteria we used for rating the significance of various wetland/water body functions accurate and understandable? Is the on-line decision support tool easy to navigate to identify and prioritize restoration or preservation sites in your Area of Interest? Have you have implemented any projects on the restoration or preservation sites identified in this plan and, if so, have the results met the desired outcomes, with respect to specific wetland/water body functions (e.g., reduce flood risk, improved water quality, etc.)? Your answers to these questions, along with feedback on other elements of the plan – *pros and cons*, will be vital to maintaining the WRAPP as accurate and up-to-date as possible. You may provide comments to StormWater@lakecountyil.gov.

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