Final Report

Region 5 Wetland Management Opportunities and Marketing Plan:

Select Watersheds in the Lower Fox and Des Plaines River Watersheds

By:

TETRA TECH

1468 West 9th Street, Suite 620
Cleveland, OH 44113

and

P.O. Box 14409
1 Park Drive, Suite 200
Research Triangle Park, NC 27709

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Acronyms and Abbreviations

ADID	advanced identification wetlands
CDL	Cropland Data Layer
CMAP	Chicago Metropolitan Agency for Planning
FEMA	Federal Emergency Management Agency
FSA	Farm Service Agency
HOA	home owner association
GIS	geographic information system
GLNPO	Great Lakes National Program Office
IEPA	Illinois Environmental Protection Agency
IDNR	Illinois Department of Natural Resources
IDOT	Illinois Department of Transportation
LCDOT	Lake County Department of Transportation
LCSMC	Lake County Stormwater Management Commission
LLWFA	landscape level wetland functional assessment
LLWW	landscape position, landform, water body type, and water flow path
NWI	National Wetlands Inventory
MDEQ	Michigan Department of Environmental Quality
MWRD	Metropolitan Water Reclamation District of Greater Chicago
NASS	National Agricultural Statistics Service
NHD	National Hydrography Dataset
NLCD	National Land Cover Database
NRCS	Natural Resources Conservation Service
PRW	potentially restorable wetlands
SEWRPC	Southeast Wisconsin Regional Planning Commission
SSURGO	Soil Survey Geographic Database
SWCD	soil and water conservation districts
TMDL	total maximum daily load
TNC	The Nature Conservancy
UIUC	University of Illinois Champaign
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USFWS	United States Fish and Wildlife Service
W-PAWF	Watershed-based Preliminary Assessment of Wetland Functions
WDNR	Wisconsin Department of Natural Resources
WIDOT	Wisconsin Department of Transportation
WWA	Wisconsin Wetlands Association
WWI	Wisconsin Wetlands inventory

1. Introduction

The goal of this analysis is to identify opportunities for wetland management (restoration, enhancement, and creation) in selected watersheds in the Des Plaines River and the Lower Fox River watersheds. The project supports Goal 2: Protecting America's Waters, Objective 2.2: Protect and Restore Watersheds and Aquatic Ecosystems, of the USEPA Strategic Plan (USEPA 2014). The project addresses the strategic measure of increasing wetlands[1] by providing information that targets restoration efforts in priority watersheds, specifically the identification of restoration opportunities to restore, create, and enhance wetlands. Wetland restoration can be instrumental for improving water quality and enhancing ecological integrity throughout the watershed. Integrating wetland planning and restoration work into watershed planning efforts can be an important step to meeting water quality objectives. This analysis is focused in two priority watersheds including the Des Plaines River watershed in Wisconsin and Illinois and the Lower Fox River Watershed in Wisconsin. The analysis is conducted at a HUC-12 scale, with the purpose of informing focused watershed management plans. At this scale, local data when available can be used with regional or statewide datasets to provide the most accurate assessment. Local watershed planning efforts are led by the Lake County Stormwater Management Commission (LCSMC) in the Des Plaines River watershed and by the Wisconsin Department of Natural Resources (WDNR) in the Lower Fox River watershed. Significant wetland loss since presettlement times has occurred in both the Lower Fox River and the Des Plaines River watersheds. Restoring these lost wetlands has the potential to improve water quality and water quantity and re-create important habitat in these watersheds. The project contains both a technical and a social component.

The technical component of the project focuses on providing information that targets management efforts in priority watersheds, specifically the identification of opportunities to restore, create, and enhance wetlands. The technical component details the methods and results of a geographic information system (GIS)-based screening analysis to identify wetland opportunities within the selected HUC-12 watersheds (Figure 1) including Baird Creek and Kankapot Creek in the Lower Fox River watershed (Figure 2 and Figure 3) and North Mill Creek – Dutch Gap Canal, Mill Creek, and Wheeling Drainage Ditch, locally known as Buffalo Creek, in the Des Plaines River watershed (Figure 4 through Figure 6).

The social component of the project focuses on promoting the ecosystem services associated with the wetland management opportunities in each watershed through the development of a wetlands marketing plan applicable to the Lower Fox River and Des Plaines River watersheds.

[1] "By 2018, working with partners, achieve a net increase in wetlands nationwide, with additional focus on coastal wetlands, and biological and functional measures and assessment of wetland condition."

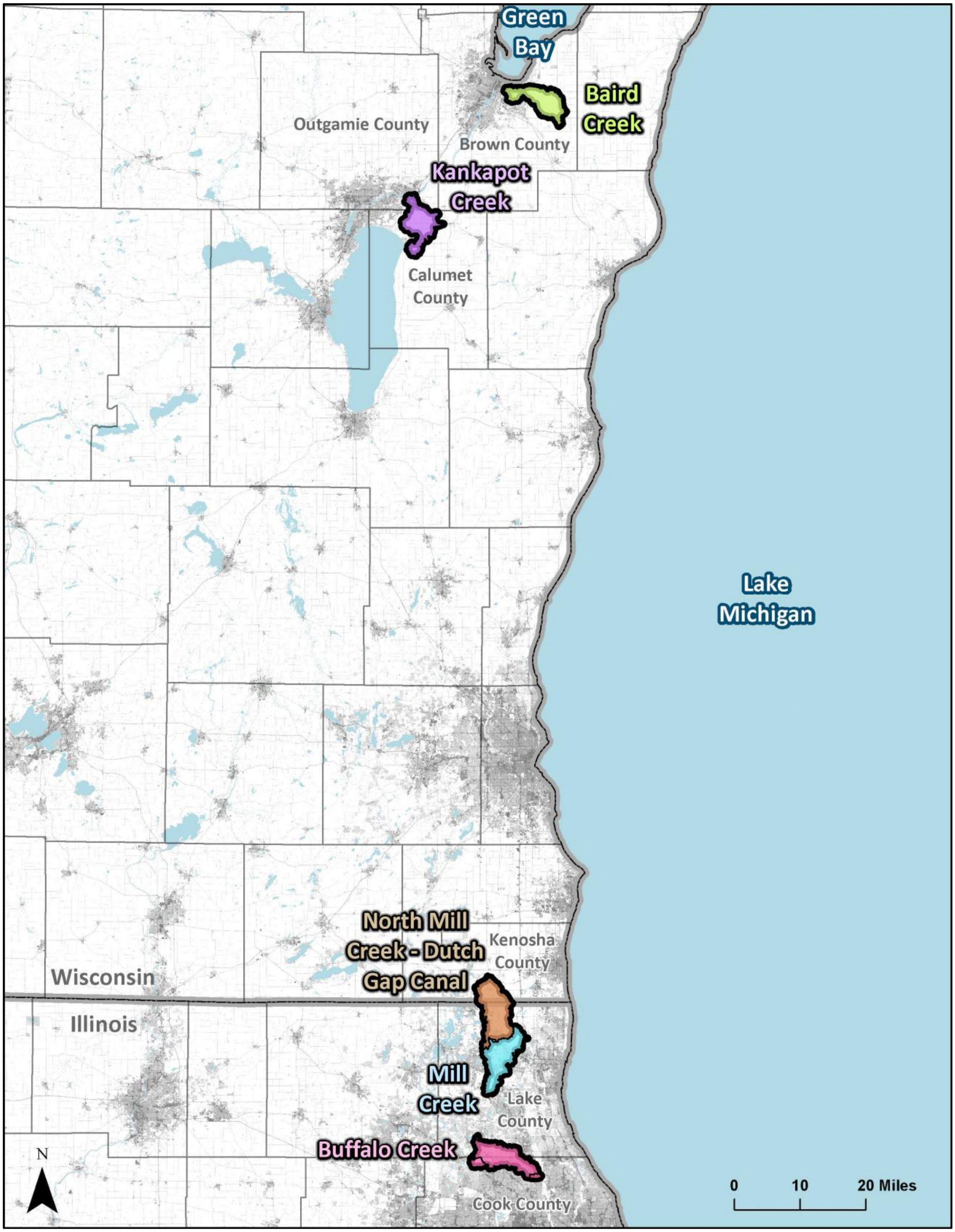


Figure 1. Project watersheds.

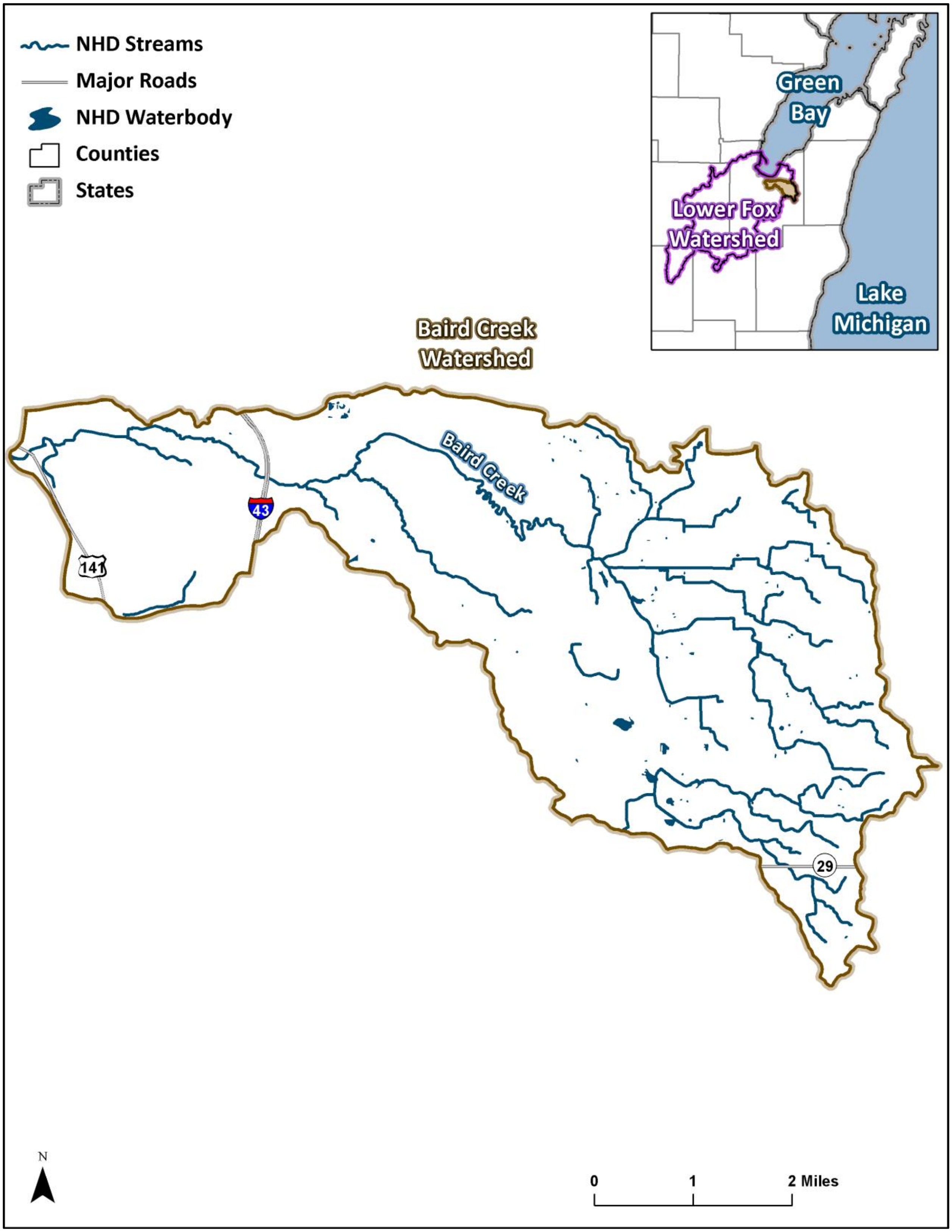


Figure 2. Baird Creek watershed.

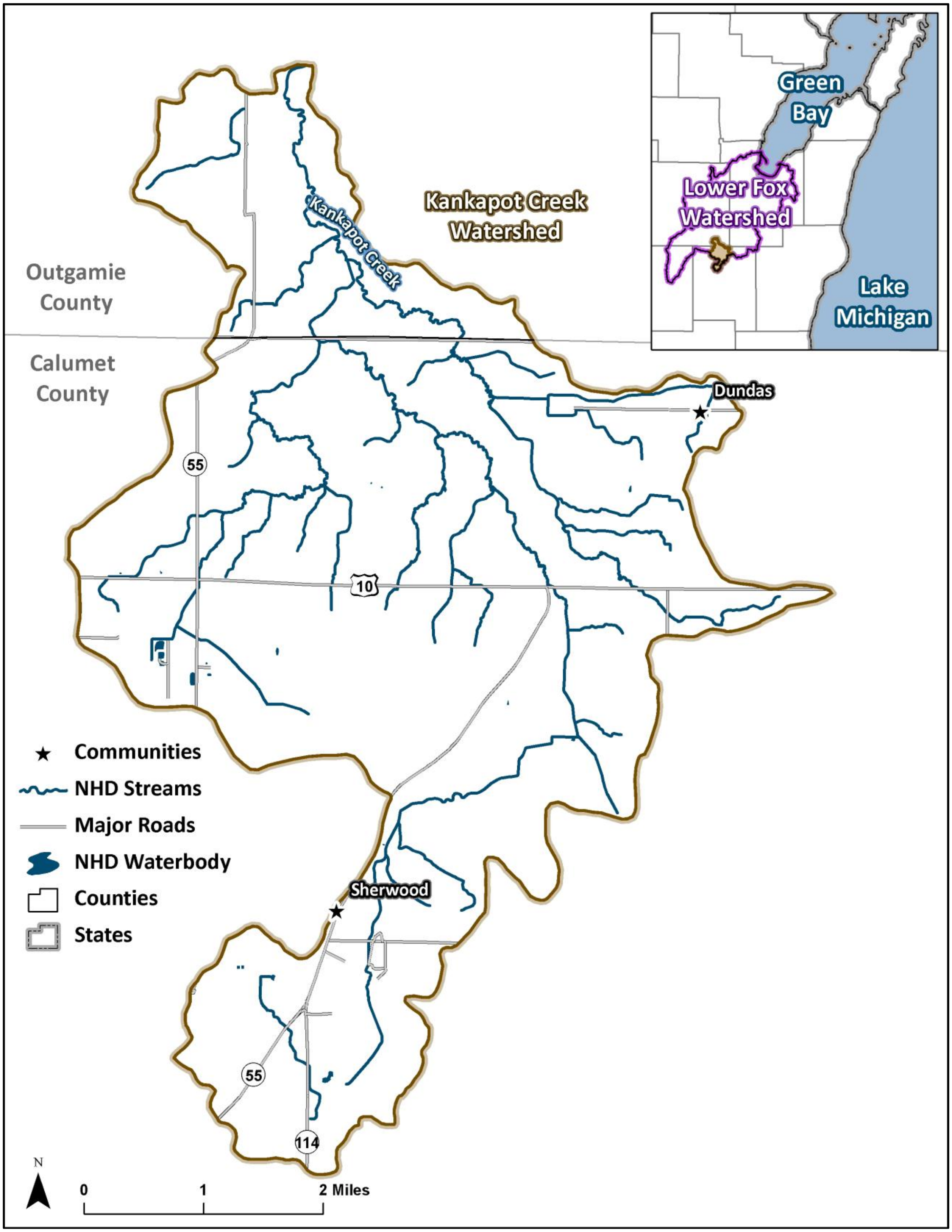


Figure 3. Kankapot Creek watershed.

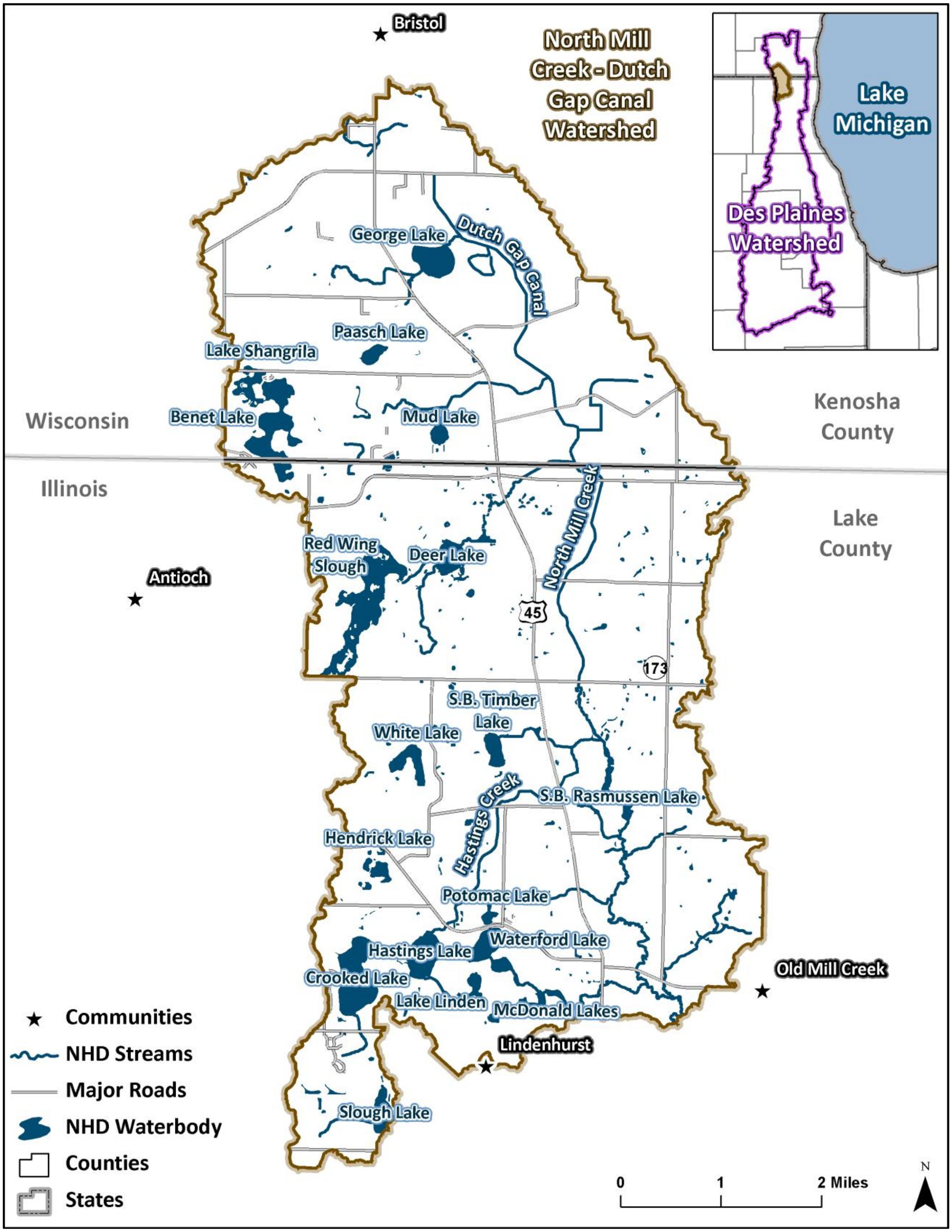


Figure 4. North Mill Creek – Dutch Gap Canal watershed.

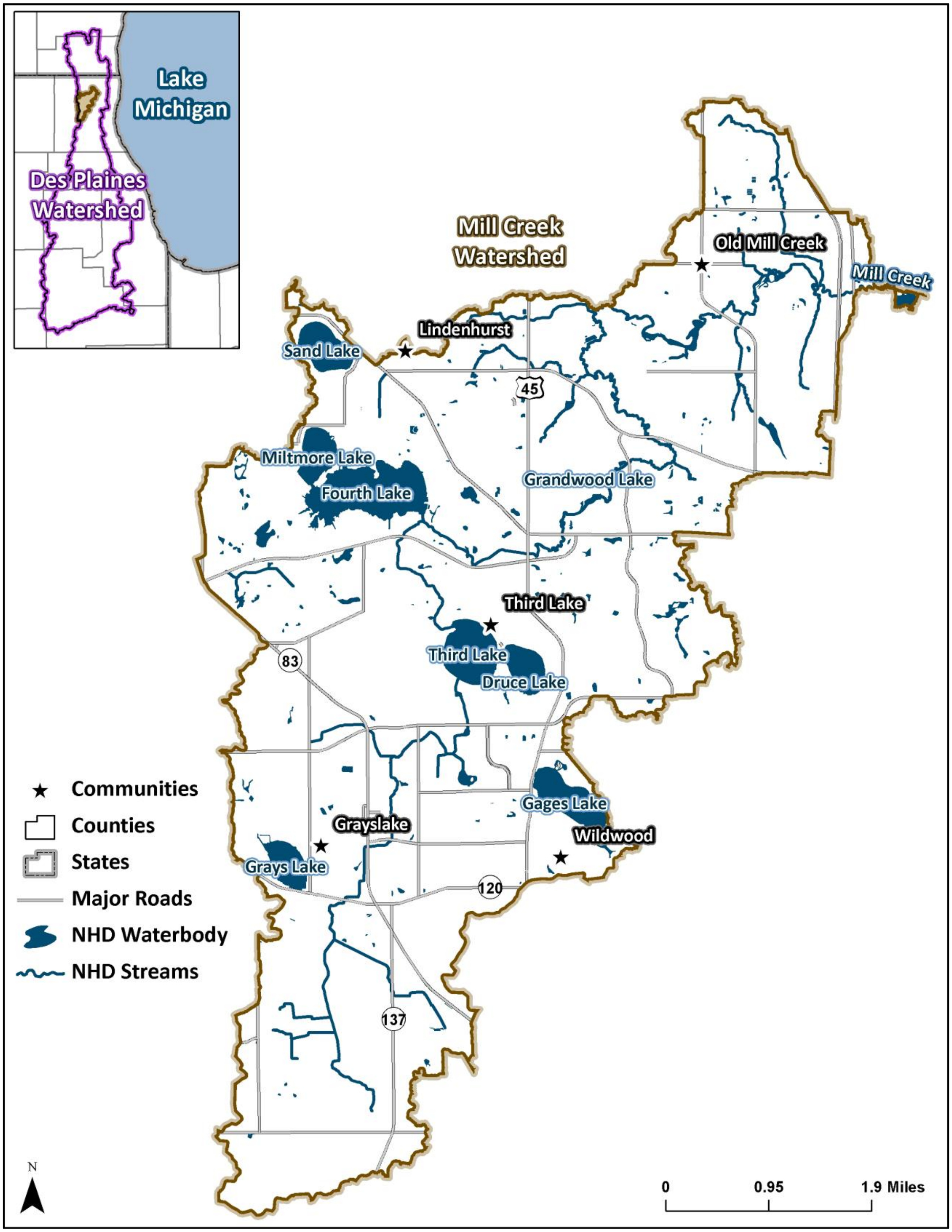


Figure 5. Mill Creek watershed.

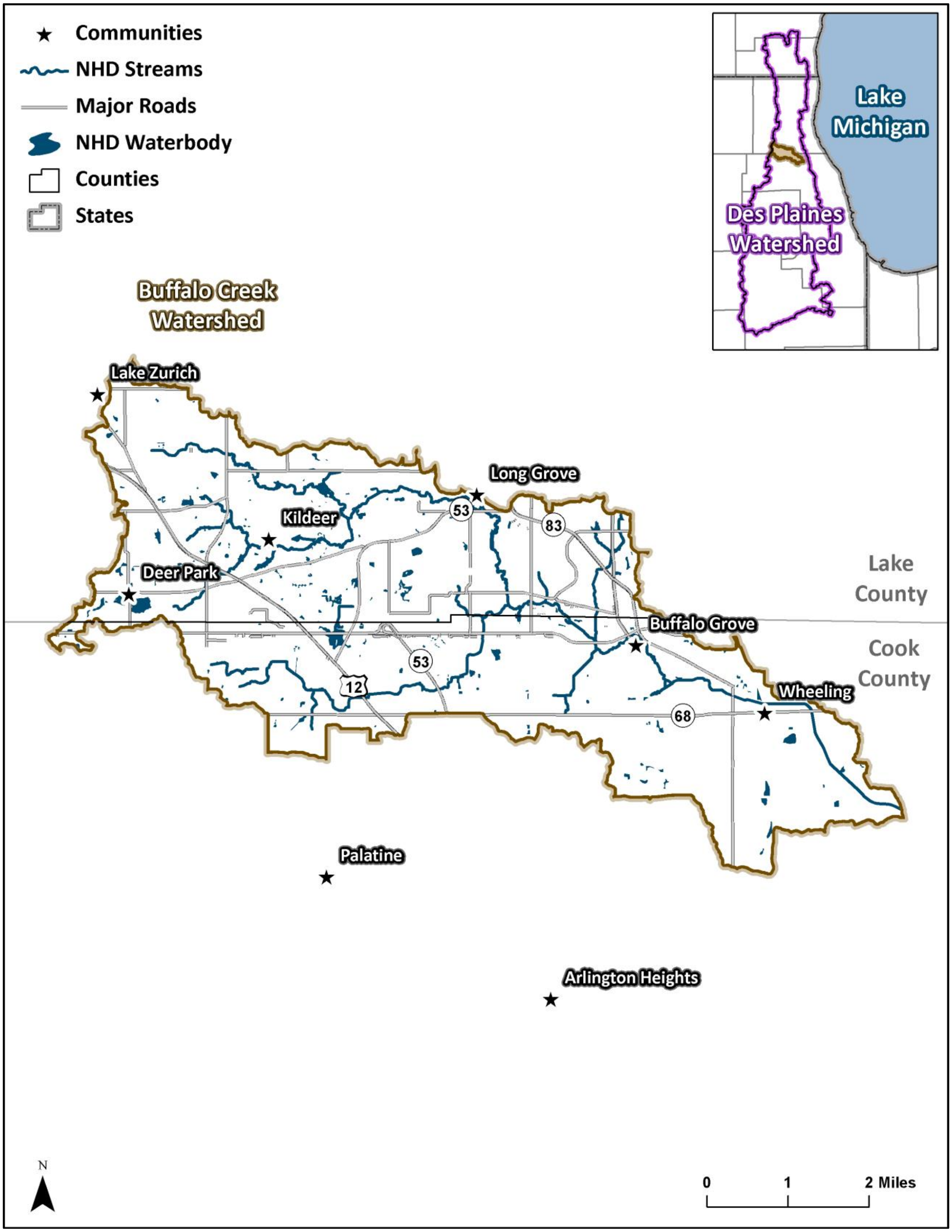


Figure 6. Buffalo Creek watershed.

Lower Fox River Watersheds

The Baird Creek and Kankapot Creek HUC-12 watersheds include tributaries to the Lower Fox River in Outagamie, Brown, and Calumet Counties, Wisconsin, which ultimately drains to Lake Michigan. The size and land cover composition of both Baird Creek and Kankapot Creek watersheds are similar (Table 1). Baird Creek is 16,000 acres in size consisting predominantly of agricultural and developed land uses. The Kankapot Creek watershed is 16,800 acres in size and consists of predominately agricultural land uses. Both watersheds have developed land uses near the outlet of the HUC-12 watersheds.

Planning efforts in the Lower Fox River watershed are being led by WDNR and are being developed primarily based on outcomes of the Lower Fox River TMDL (USEPA et al. 2012). Activities related to wetland planning in the Lower Fox River watersheds include a Potentially Restorable Wetland Analysis. In this case, a potentially restorable wetland is defined by the presence of hydric soils and a compatible land use (i.e., non-urban). Hydric soils in urban areas are not considered restorable wetlands.

Table 1. Land cover in the Baird Creek and Kankapot Creek watersheds

	Baird		Kankapot	
Land Cover	**Acres**	**Percent**	**Acres**	**Percent**
Open Water	6.8	0.0%	20.3	0.1%
Developed, Open Space	1,133.5	7.1%	772.1	4.6%
Developed, Low Intensity	2,062.9	12.8%	1,219.8	7.3%
Developed, Medium Intensity	675.3	4.2%	420.9	2.5%
Developed, High Intensity	249.7	1.6%	63.7	0.4%
Barren Land	5.2	0.0%	48.0	0.3%
Forest	787.6	4.9%	1,297.4	7.7%
Shrub	13.0	0.1%	35.1	0.2%
Herbaceous Grassland	59.0	0.4%	75.3	0.4%
Agriculture	10,767.1	67.0%	12,157.2	72.5%
Wetlands	306.1	1.9%	659.6	3.9%

Note: Land cover data provided by 2011 NLCD; wetland acres do not represent available wetland inventory data used in this report.

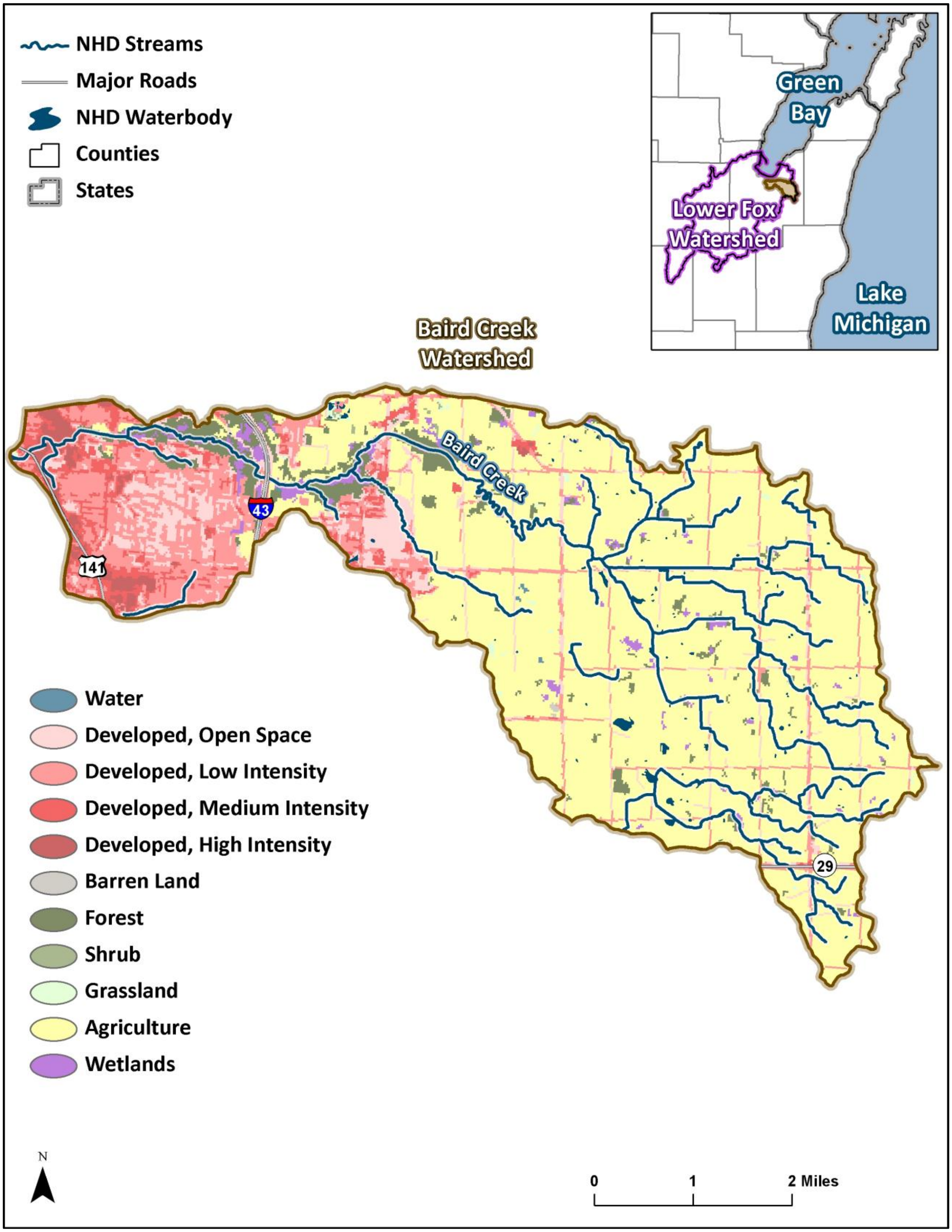


Figure 7. Baird Creek watershed land use.

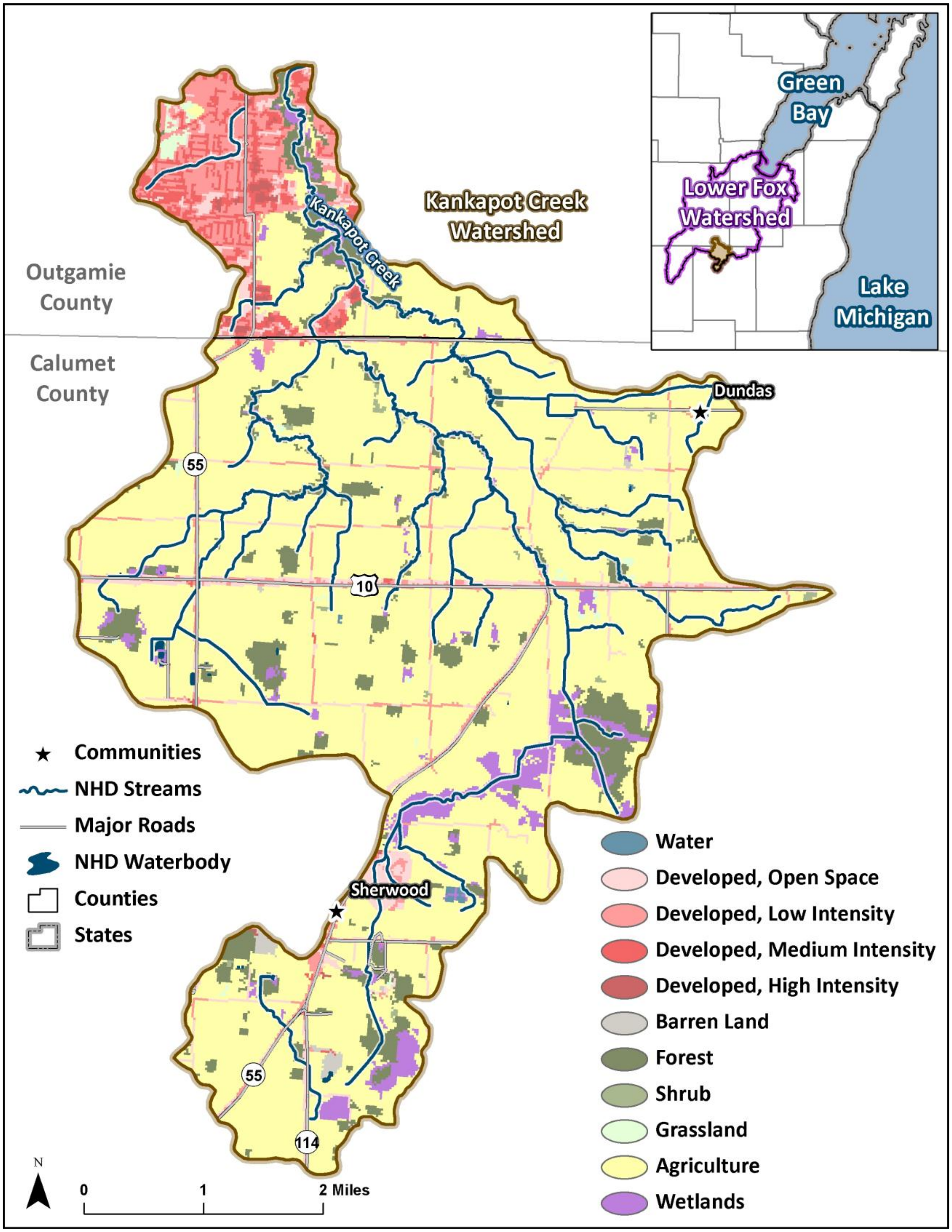


Figure 8. Kankapot Creek watershed land use.

Des Plaines River Watersheds

The North Mill Creek – Dutch Gap Canal, Mill Creek, and Buffalo Creek are tributaries of the Des Plaines River. These watersheds are located mainly in Lake County, Illinois. The Des Plaines River flows to the Illinois River and eventually the Mississippi River. Land cover varies by watershed (Table 2); North Mill Creek watershed is over 50 percent agricultural with over 25 percent in natural cover or water, Mill Creek is almost 50 percent developed, and Buffalo Creek watershed is predominately developed land uses (85 percent). Figure 9 through Figure 11 illustrate the land cover in each watershed.

Table 2. Land cover in the North Mill Creek – Dutch Gap Canal, Mill Creek, and Buffalo Creek watersheds

Land Cover	North Mill Creek – Dutch Gap Canal		Mill Creek		Buffalo Creek	
	Acres	Percent	Acres	Percent	Acres	Percent
Open Water	1,209.3	5.0%	1,153.4	5.7%	162.7	0.9%
Developed, Open Space	1,669.1	6.9%	2,618.1	12.9%	3,307.8	18.6%
Developed, Low Intensity	2,280.3	9.5%	5,021.8	24.8%	7,613.7	42.8%
Developed, Medium Intensity	495.3	2.1%	1,860.6	9.2%	3,096.3	17.4%
Developed, High Intensity	57.8	0.2%	557.4	2.8%	1,106.9	6.2%
Barren Land	33.0	0.1%	37.3	0.2%	5.9	0.0%
Forest	3,081.3	12.8%	1,939.1	9.6%	1,314.1	7.4%
Shrub	156.4	0.6%	64.0	0.3%	23.9	0.1%
Herbaceous Grassland	885.0	3.7%	432.7	2.1%	363.1	2.0%
Agriculture	12,644.1	52.5%	5,341.6	26.4%	367.2	2.1%
Wetlands	1,577.9	6.6%	1,225.1	6.0%	436.8	2.5%

Note: Land cover data provided by 2011 NLCD; wetland acres do not represent available wetland inventory data used in this report.

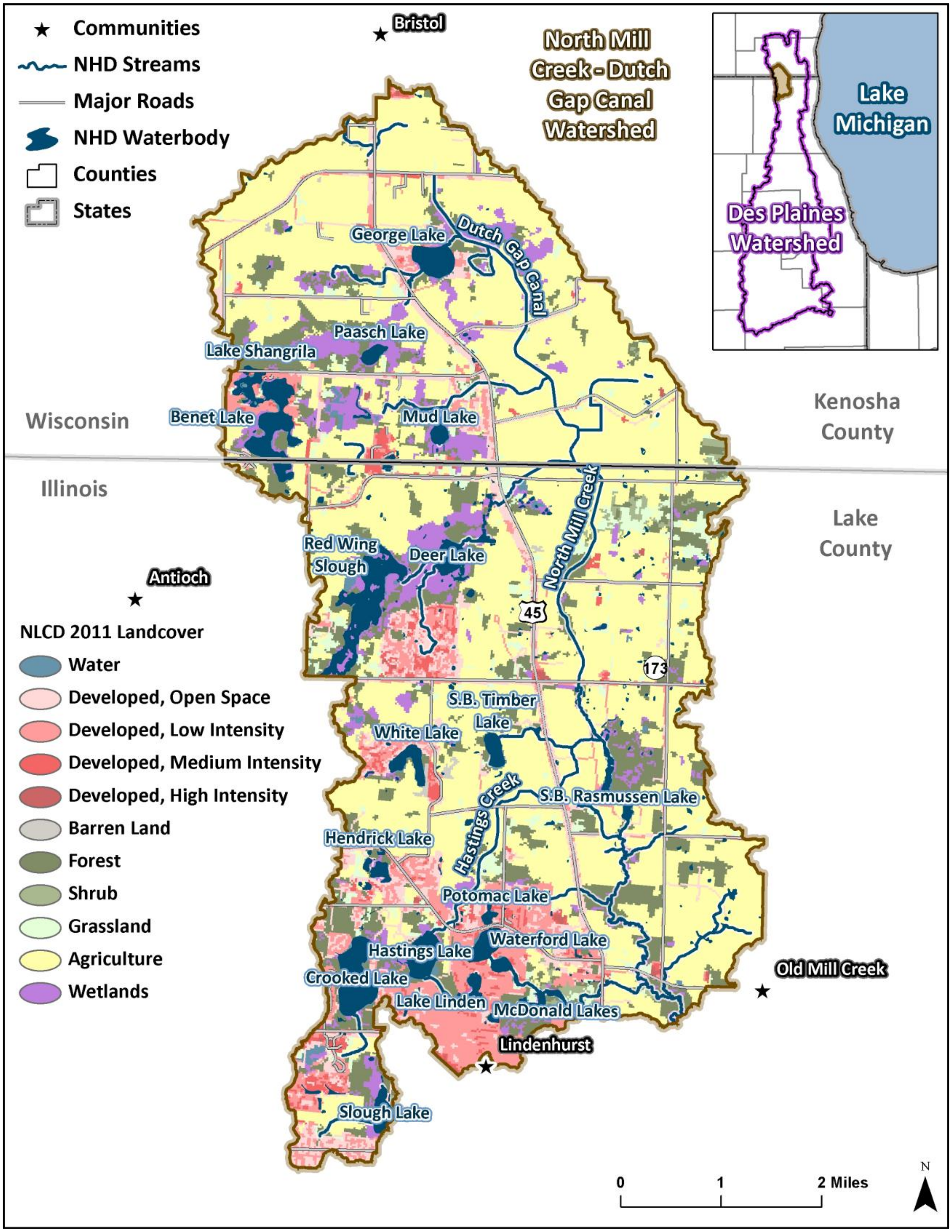


Figure 9. North Mill Creek – Dutch Gap Canal watershed land cover.

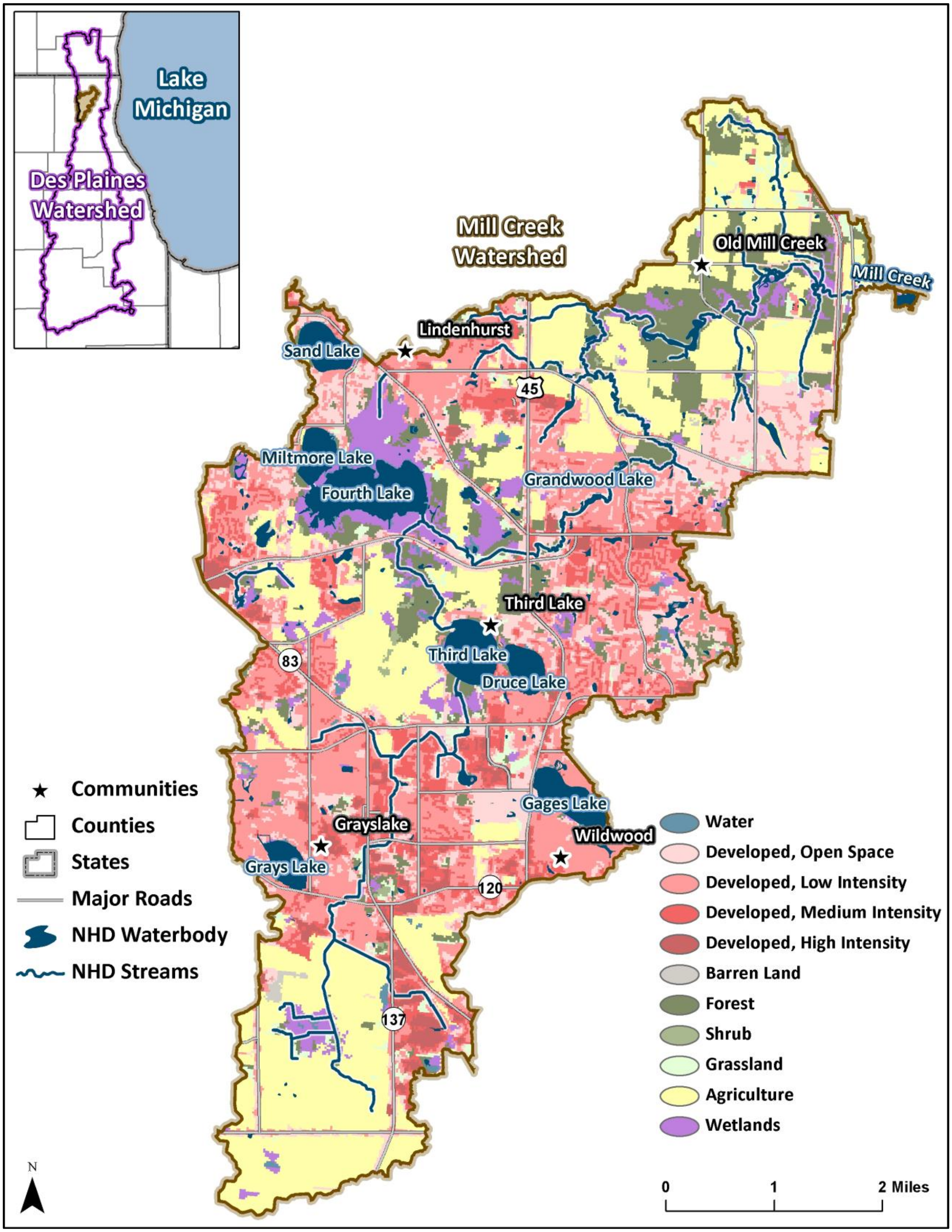


Figure 10. Mill Creek watershed land cover.

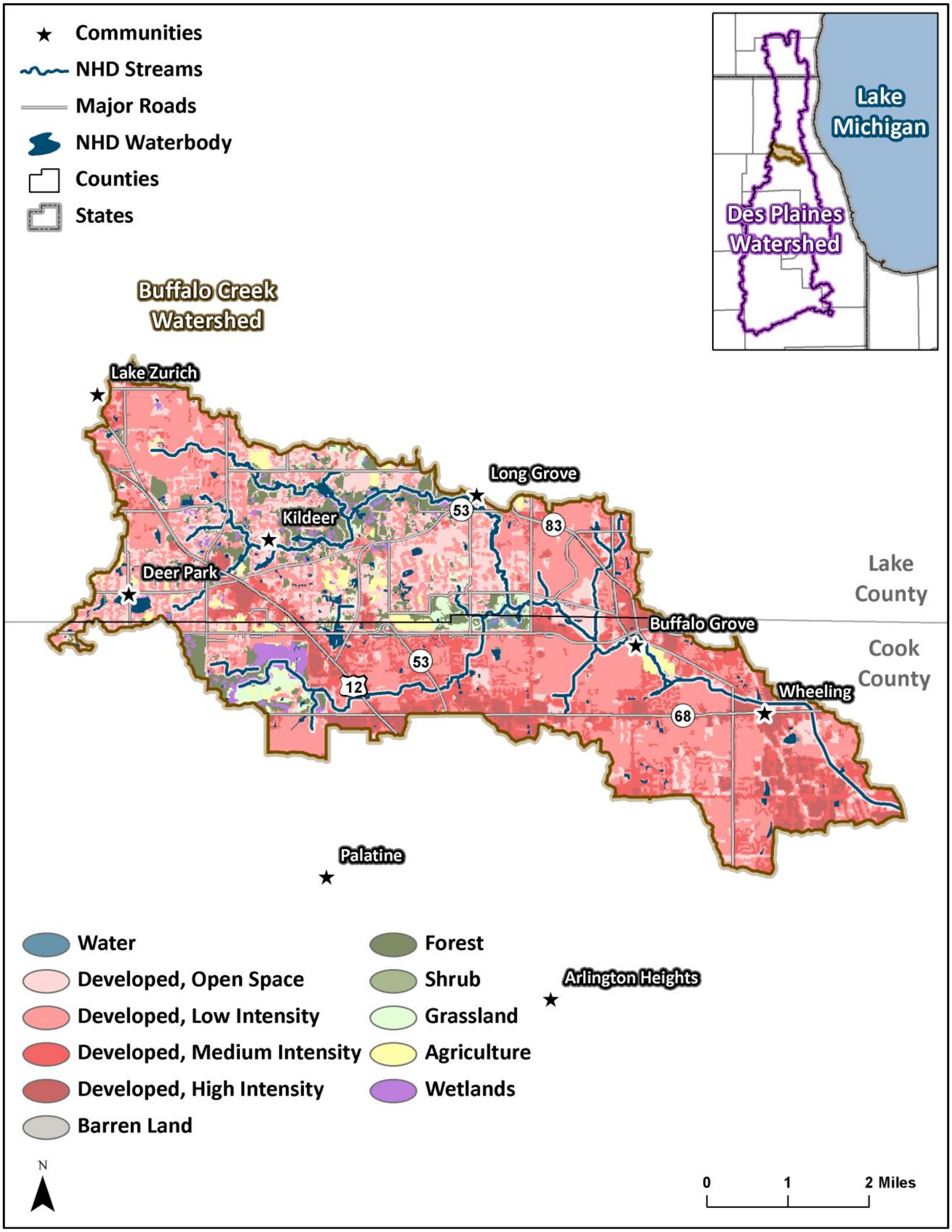


Figure 11. Buffalo Creek watershed land cover.

The LCSMC has developed a watershed plan for Mill Creek and a draft watershed plan for North Mill Creek – Dutch Gap Canal watershed has been completed. A watershed plan is currently underway in the Buffalo Creek watershed. As part of the planning process, wetlands are identified according to the Lake County Wetland Inventory (LCWI) which was updated in 2002 using high resolution aerial photography and enhanced topographic information. The LCWI identifies five different types of wetlands including: wetlands, farmed wetlands, artificial wetlands, converted wetlands, and Advanced Identification wetlands (ADID). The ADID was developed by the USEPA et al. in 1992 and identified high functionality wetlands that should be protected. Three primary functions were used to evaluate wetlands during the ADID process: biological functions (i.e., threatened or endangered species, wildlife habitat, and plant species diversity), hydrologic functions (i.e., stormwater storage), and water quality mitigation functions (i.e., sediment and toxicant retention, shoreline/bank stabilization). ADID wetlands are assessed to determine locations appropriate for preservation, restoration, and management options. Watershed plans typically include wetland restoration and protection opportunities (Figure 12).

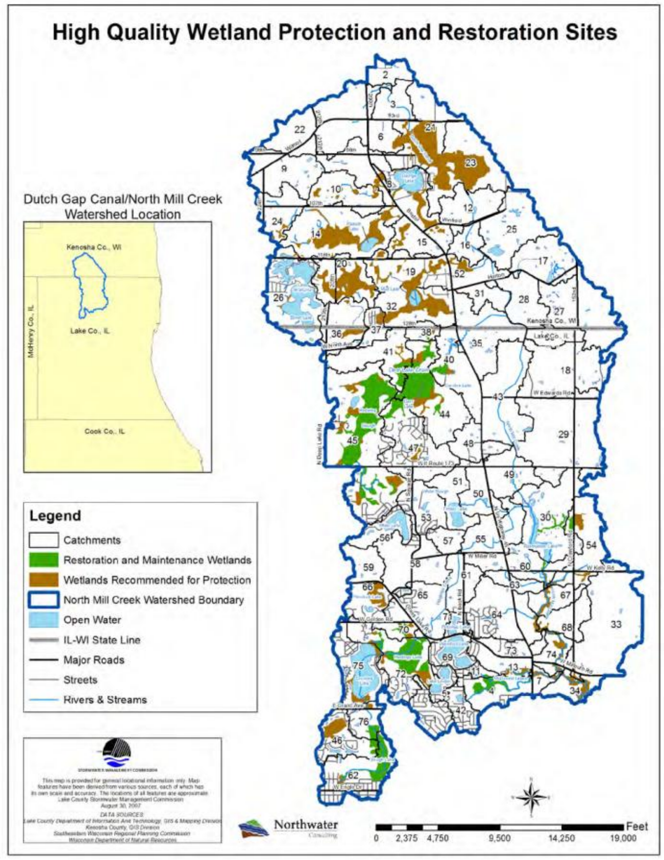


Figure 12. Example of wetland planning work in the North Mill Creek – Dutch Gap Canal watershed.

2. Methods and Results

2.1 Overview

The overall project approach is based on the work of numerous landscape based wetland functional assessment projects/studies/work (Fizzell 2007, Tiner 2003a, 2003b, 2011, and USEPA 2012) and is modeled after the 2011 Michigan Department of Environmental Quality (MDEQ) "Landscape Level Wetland Functional Assessment (LLWFA) Version 1.0, Methodology Report." The 2011 MDEQ's LLWFA is a regional customization and expansion of the landscape position, landform, water body type, and water flow path (LLWW) system of wetland classification, which is primarily based on the methods of Tiner (2003a, 2003b, and 2011). Tiner and other researchers developed an approach to add the hydrology and geomorphology of wetlands to the existing U.S. Fish and Wildlife Service's (USFWS) National Wetlands Inventory (NWI) geospatial database by creating an enhanced digital wetland database (often referred to as NWI Plus, or NWI+). For this project, a similar approach was applied to state and local wetland inventory datasets in the project areas, providing a landscape-level wetland functional analysis that infers wetland function from a wetland's hydrogeomorphic qualities. The analysis presented here closely follows the MDEQ method, with regional adjustments for the Des Plaines River and Lower Fox River watersheds as well as further analysis and dataset refinements based on work recently completed in the Sandusky River watershed, Ohio (PG Environmental 2014).

The approach to identify wetland opportunities also incorporates information from the Region 5 Wetlands Supplement: Incorporating Wetlands into Watershed Planning (USEPA 2012). The approach used in the Paw Paw River watershed (Fizzell 2007) was followed as described in this section, including relevant modifications recently employed for the Sandusky River Watershed Wetland Management Opportunity project (PG Environmental 2014). Both the Paw Paw and Sandusky projects estimated the extent of "historic" wetlands from before European settlement (referred to herein as "presettlement") compared to current conditions, and then identified presettlement and existing wetlands of significance based on wetland functions.

Local efforts related to watershed planning and TMDL implementation were taken into consideration, and existing data and analyses were used where appropriate. The identification of potentially restorable wetlands (PRWs), a subset of presettlement wetlands, by WDNR informed this project and helped to refine the analysis. PRWs are presented along with existing and presettlement wetlands. The purpose of this project is to provide a preliminary assessment of wetland functions in existing wetlands and PRWs, in order to identify opportunities for wetland management (restoration, enhancement, and creation).

The following three main steps were used to identify wetland management opportunities:

1) <u>Wetland inventory and characterization</u>: Identification of presettlement, potentially restorable, and existing wetlands.
2) <u>Hydrogeomorphic classification using LLWW</u>: Hydrogeomorphic characterization of each wetland according to landform, landscape position, water flow path, and water body type; applied to PRWs and existing wetlands.
3) <u>Wetland functional assessment using W-PAWF classification</u>: Assigning functional significance rankings (i.e., high, medium, or low) of 12 wetland functions based on the LLWW hydrogeomorphic characterization. The USFWS refers to this type of analysis, in which hydrogeomorphic characteristics of wetlands are used to predict wetland function, as a Watershed-based Preliminary Assessment of Wetland Functions, or W-PAWF.

This 3-step wetland functional assessment is only an initial screening and does not take into account existing land use practices that may affect wetlands, such as agriculture, stormwater runoff, disturbance in the adjacent upland areas, or the water quality and quantity of adjacent water bodies. Although multiple wetlands may be classified as the same LLWW type, and thus the same estimated level of significance for a wetland function, there can be substantial differences between the predicted and actual wetland functions.

2.2 Existing Datasets

The LCWI and the Wisconsin Wetland Inventory (WWI) formed the basis of the analysis. These datasets define polygons representing existing wetland and are more geographically accurate than national data (i.e., NWI). Supplemental classification characteristics found spatially in the NWI data were appended to these datasets as needed to maximize wetland attribute descriptions. Additional datasets were identified and obtained for this project (Table 3); minimum data requirements are also included.

Table 3. Secondary datasets

Data type	Source	Description	Minimum data requirements
Geography and physical			
Aerial imagery	US Department of Agriculture (USDA), Farm Service Agency, National Agricultural Imagery Program	Color air photos provided by county Air photos, various years 2012-2013	Not required
Elevation	US Geological Survey (USGS)	National Elevation Dataset	10-meter resolution digital elevation model
	Multiple	County light detection and ranging (LiDAR) data	
Land use and land cover	USDA and US Department of Interior	LANDFIRE Existing Vegetation Type Layer, 2008	CDL, LANDFIRE is required if NWI Cowardin classification is unavailable
	USDA, National Agricultural Statistics Service (NASS)	Cropland Data Layer (CDL) – 2013 release	
Soils	NRCS	Soil Survey Geographic database (SSURGO) by county	SSURGO data
Presettlement Vegetation	WDNR, Lake County Forest Preserve District, Illinois Natural History Survey	Digitized presettlement vegetation	Required, varies by state
Hydrology and hydrography			
Streams	WDNR, Cook County, Lake County	National Hydrography Dataset (NHD) medium with designated uses, county mapped streams and waterways	NHD high resolution
	USGS	NHD high resolution	
Water Table Depth	NRCS	SSURGO by county	Not required
Wetlands	WDNR, Illinois NWI (Ducks Unlimited), Lake County	Estimated locations of wetlands, WWI, Wisconsin Potentially Restorable Wetland Inventory (2012), Illinois NWI, LCWI	NWI
	USFWS	NWI	
Floodplain boundaries	Federal Emergency Management Agency (FEMA)	100-year floodplain boundaries (publication dates, 2012 to 2014)	100-year FEMA floodplain boundaries
Constructed Water Bodies	Lake County	LCWI (artificial wetlands)	Not required
Other			
Roads, Municipal Boundaries, watershed boundaries, etc.	2010 Census, USGS, Lake County, and Cook County	Primary and secondary roads, municipal boundaries, watershed boundaries	Not required

2.3 Wetland Inventory and Characterization

An inventory of presettlement and existing wetlands was completed using publicly-available geospatial datasets and analyses performed in a GIS environment (ArcGIS v. 10.1). A subset of presettlement wetlands— those wetlands that no longer exist but appear to be restorable—are identified as PRWs. There are slight differences in the approaches for Wisconsin and Illinois based on regional preferences.

Vegetation type and water regime are then assigned to each existing and PRW. The resulting information is used as the basis for the hydrogeomorphic characterization and functional assessment.

2.3.1 Wetland Inventory

Wisconsin

Existing wetlands within the project areas are provided in the WWI (http://dnr.wi.gov/topic/wetlands/inventory.html). WDNR provided a spatial dataset of PRWs developed in 2012 (Smith 2014). The following steps were taken by WDNR to identify PRWs in Wisconsin:

1. PRWs wetlands are approximated based on existing hydric soils and include SSURGO polygons with greater than 85 percent hydric soils.
2. Areas that are identified as wetland, river or lake were removed.
3. Areas that are less than 0.1 acre were removed from the database.

WDNR includes a flag in the database for PRWs that are less than 0.5 acres in size and PRWs that are located in urban land uses. All PRWs were used in subsequent analysis, regardless of size or land use. WDNR is currently working on a refined approach to identify PRW that incorporates a compound topographic index (CTI); however, this approach was not finalized at the time of this analysis (see sidebar for additional information).

WDNR's 2012 PRW, in combination with the WWI, are used to represent presettlement wetlands for the Wisconsin portion of the project watersheds. Note that Wisconsin PRWs presented in this report do not take into consideration land use, property ownership, or other land-use related limitations to restoration.

Identifying Potentially Restorable Wetlands with Compound Topographic Index

WDNR is developing a more complex GIS-based approach to identify additional potentially restorable wetlands that involves the creation of a Compound Topographic Index (CTI). The CTI is a steady state wetness index which strongly correlates to soil moisture and aims to model soil water content (Moore 1991). It is a measure of the likelihood of water to pond in any given location on the landscape.

The CTI incorporates slope and contributing area using the following equation:

$$CTI = \ln \text{(Contributing Area / Slope)}$$

This approach has been applied in other Wisconsin watersheds, where WDNR found that CTI values between 10 and 17 identify areas with potential for wetland restoration (Smith 2014). CTI values less than 10 are typically too dry to provide for wetland hydrology, and CTI values greater than 17 have been found to be perennial water bodies (Smith 2014). Additional processing steps are required after the CTI is created, and WDNR should be contacted for a full description of the approach to creating a potentially restorable wetlands GIS dataset using this methodology.

Illinois

Existing wetland locations in Illinois are derived from two data sets—the LCWI (https://s3.amazonaws.com/lakecountygis-public/water.html#adid), and the NWI in Cook County, as modified and provided by Ducks Unlimited (2010). Presettlement and PRW wetlands have not been previously identified for the Illinois portion of the project watersheds; therefore methods similar to those used by WDNR's serve as a guide to produce results comparable across state boundaries.

The following steps are taken to identify PRWs in Illinois:

1. PRWs wetland polygons are approximated based on existing hydric soils and include SSURGO polygons with greater than 75 percent hydric soils. Wisconsin noted in their analysis that an appropriate range of hydric soils is between 75 and 85 percent, the Illinois analysis used 75 percent based on this uncertainty and on previous work conducted in Ohio (PG Environmental 2014).
2. If a polygon is less than 75 percent hydric soils but characterized as temporarily flooded in SSURGO, it is also considered to be a PRW in Illinois.
3. Water bodies that were present at the time of the soil survey but have since disappeared are included as PRWs. These areas are identified by selecting polygons that do not have a value for percent hydric soil in SURRGOs.
4. Polygons that are identified as existing water bodies (wetland, river or lake) are removed.
5. Polygons that are isolated and less than 0.1 acre were removed from the database, polygons that are not isolated and less than 0.1 acre were aggregated into its nearest neighboring wetland.

Presettlement wetlands in Illinois are identified for this study as Illinois PRWs plus existing wetlands, rivers or lakes. Note that Illinois PRWs presented in this report do not take into consideration land use, property ownership, or other land-use related limitations to restoration.

2.3.2 Vegetation

NWI Cowardin vegetation classes were assigned to presettlement and existing wetlands to create consistency among the databases. This step is needed to characterize wetlands in preparation for the hydrogeomorphic portion of the analysis.

Presettlement Vegetation

NWI Cowardin vegetation classes (Table 4) were assigned to the presettlement wetlands based on the description of presettlement vegetation. Presettlement vegetation in Wisconsin was derived from WDNR's *Original Vegetation Cover* database (Table 5), and vegetation in Illinois was derived from Lake County Forest Preserve District's presettlement vegetation database (Table 6)and the Illinois Natural History Survey's *Historic Vegetation* database (Table 7). Depending on the available presettlement vegetation layer, different conversions would be needed.

Table 4. NWI Cowardin vegetation classes

System	Subsystem	Class	Subclass
Palustrine (P)		AB - Aquatic Bed	1. Algal
			2. Aquatic moss
			3. Rooted vascular
			4. Floating vascular
			6. Unknown surface
		EM – Emergent	1. Persistent
			2. Non-persistent
		FO – Forested	1. Broad-leaved deciduous
			2. Needle-leaved deciduous
			5. Dead
			6. Deciduous
		OW - Open Water	
		SS - Scrub-Shrub	1. Broad-leaved deciduous
			3. Broad-leaved evergreen
			5. Dead
		UB - Unconsolidated Bottom	
		US - Unconsolidated Shore	2. Sand
Lacustrine (L)	1 –Limnetic	AB - Aquatic Bed	3. Rooted Vascular
			4. Floating Vascular
	2 –Littoral	AB - Aquatic Bed	3. Rooted Vascular
			4. Floating vascular
		EM – Emergent	2. Non-persistent
		OW - Open Water	
		RS - Rocky Shore	
		UB - Unconsolidated Bottom	
		US - Unconsolidated Shore	
Riverine (R)	2 - Lower perennial	AB - Aquatic Bed	4. Floating Vascular
		EM – Emergent	1. Persistent
			2. Non-persistent
		RB - Rock Bottom	1. Bedrock
			2. Rubble
		OW - Open Water	
		SB – Streambed	
		UB - Unconsolidated Bottom	
		US - Unconsolidated Shore	
	3 - Upper perennial	AB - Aquatic Bed	1. Algal
		RB - Rock Bottom	
		UB - Unconsolidated Bottom	

Table 5. Vegetation code conversions from the WDNR's *Original Vegetation Cover* database to NWI Cowardin vegetation class

WNDR Vegetation Code	WNDR Vegetation Description	NWI Cowardin Vegetation Class
9	Sugar maple, basswood, red oak, white oak, black oak	PFO1
4	Sugar maple, yellow birch, white pine, red pine	PFO1
8	Beech, sugar maple, basswood, red oak, white oak, black oak	PFO1
2	Beech, hemlock, sugar maple, yellow birch, white pine, red pine	PFO1
10	Oak -- white oak, black oak, bur oak	PFO1
11	Oak openings -- bur oak, white oak, black oak	PFO1
7	Aspen, white birch, pine	PFO1
13	Brush	PEM1
12	Prairie	PEM1
5	White pine, red pine	PFO4
3	Hemlock, sugar maple, yellow birch, white pine, red pine	PFO4
6	Jack pine, scrub (hill's), oak forest and barrens	PFO4
1	White spruce, balsam fir, tamarack, white cedar, white birch, aspen	PFO4
0	Historic water (Hydrographic area from the USGS 1:250,000-scale Land Use and Land Cover data layer)	L1UBH
14	Swamp conifers -- white cedar, black spruce, tamarack, hemlock	PFO4
15	Lowland hardwoods -- willow, soft maple, box elder, ash, elm, cottonwood, river birch	PFO1
16	Marsh and sedge meadow, wet prairie, lowland shrubs	PSS1/EM1

Table 6. Vegetation code conversions from the Lake County Forest Preserve District's presettlement vegetation database to NWI Cowardin vegetation class

Lake County Forest Preserve District Vegetation Code	Lake County Forest Preserve District Vegetation Description	NWI Cowardin Vegetation Class
9	river/creek	R2UB
2	timber	PFO1
1	prairie	PEM1
5	scattering timber	PFO1
3	barrens (hickory/oaks)	PFO1
8	pond/lake	L1UB
11	wet prairie	PEM1
6	slough	PSS1/EM1
10	swamp	PFO1

Table 7. Vegetation code conversions from the INHS's *Historic Vegetation* database to NWI Cowardin vegetation class

INHS Vegetation Code	INHS Vegetation Name	INHS Vegetation Description	NWI Cowardin Vegetation Class
DMF	Dry mesic upland forest	This community was dominated by White Oak, Red Oak, Burr Oak, and Shagbark Hickory. The canopy was usually more open than in mesic upland forest but more dense than in savannas.	PFO1
LLF	Floodplain forest	Located on the floodplains of streams and rivers, this community was largely confined to the low-lying areas along the Des Plaines River. The dominant trees were Silver Maple, Cottonwood, and American Elm.	PFO1
LMS	Beach-ridge complex	A diverse environment of former lakeshore dunes, with ridges covered by Black Oak and grasses, and intervening swales containing marsh and wet meadow/prairie communities. White Pine and Jack Pine also occurred in the southern half of this area.	PFO1
MAR	Marsh	Areas comprised of water tolerant plants that preferred standing water for prolonged periods during the growing season.	PSS1/EM1
MSF	Mesic upland forest	Distribution of this community was limited to ravines and scattered sand and gravel terraces along the Des Plaines River. Typical species were Sugar Maple, Basswood, and Red Oak.	PFO1
PRA	Prairie	Described by early surveyors as an area devoid of trees, this category indicates regions that are essentially well-drained and not having water tolerant grasses.	PEM1
SVN	Savanna	This extensive natural community was characterized by widely spaced trees with a grassy ground cover. Burr Oak was the principal species, with White Oak, Black Oak, and Shagbark Hickory appearing less frequently.	PEM1
TMF	Forested bog	A relic community of a more northern forest type, limited to poorly drained, acidic depressions scattered in the western half of the county. Eastern Larch was the major species, with associated species of Poison Sumac and Bog Birch.	PSS1
WET	Water	Lakes, rivers, and streams.	R2UB
WPR	Wet meadow / prairie	This community consisted of water tolerant plants in areas devoid of trees. It was characterized by moist to saturated soils but no prolonged standing water.	PEM1

Existing Vegetation

For existing wetlands in Wisconsin, the vegetation information from the WWI was assigned a NWI Cowardin code using the classification schema as found in Table 4. The 'Wetland Class' and 'Wetland Subclass' categories from the inventory were assigned NWI Cowardin codes as described in Table 8.

Table 8. Vegetation code conversions from the WWI to NWI Cowardin vegetation class

WWI Wetland Class	WWI Wetland Subclass	NWI Cowardin Vegetation Class
Forested	Broad-leaved deciduous	PFO1
Emergent/wet meadow	Narrow-leaved persistent	PEM1
Filled/drained wetland, Forested, Scrub/shrub	Broad-leaved deciduous, Broad-leaved deciduous	PFO1/SS1
Forested, Scrub/shrub	Broad-leaved deciduous, Broad-leaved deciduous	PFO1/SS1
Open Water	Subclass unknown	L1UB
Scrub/shrub	Broad-leaved deciduous	PSS1
Scrub/shrub, Emergent/wet meadow	Broad-leaved deciduous, Narrow-leaved persistent	PSS1/EM1
Emergent/wet meadow	Persistent	PEM1
Forested, Emergent/wet meadow	Broad-leaved deciduous, Persistent	PFO1/EM1
Forested, Emergent/wet meadow	Broad-leaved deciduous, Narrow-leaved persistent	PFO1/EM1
Forested, Emergent/wet meadow	Dead, Narrow-leaved persistent	PFO5/EM1
Scrub/shrub, Emergent/wet meadow	Broad-leaved deciduous, Persistent	PSS1/EM1
Forested	Broad-leaved deciduous, Needle-leaved evergreen	PFO1/FO4
Scrub/shrub, Emergent/wet meadow	Needle-leaved evergreen, Persistent	PSS4/EM1
Emergent/wet meadow, Open Water	Persistent, Subclass unknown	PEM1
Forested	Deciduous	PFO1
Forested	Broad-leaved deciduous, Dead	PFO5
Forested	Needle-leaved deciduous	PFO2
Forested	Broad-leaved deciduous, Needle-leaved	PFO1/FO2
Flats/unvegetated wet soil	Subclass unknown	PUB
Filled/drained wetland, Flats/unvegetated wet soil	Subclass unknown	PUB
Filled/drained wetland, Emergent/wet meadow	Persistent	EM1
Aquatic bed	Rooted floating	PAB3/AB4
Emergent/wet meadow, Open Water	Narrow-leaved persistent, Subclass unknown	EM1
Filled/drained wetland, Emergent/wet meadow	Narrow-leaved persistent	EM1
Forested, Open Water	Broad-leaved deciduous, Subclass unknown	PFO1
Filled/drained wetland, Forested	Broad-leaved deciduous	PFO1
Filled/drained wetland, Scrub/shrub, Emergent/wet meadow	Broad-leaved deciduous, Persistent	PSS1/EM1
Deep water lake		L1UB
Aquatic bed	Submergent	PAB

Existing wetland vegetation types in Illinois were derived from multiple sources depending on watershed location (e.g., Lake County, Cook County, or Wisconsin). Because wetland locations in Cook County, Illinois were based on the NWI layer, the NWI vegetation type was taken directly from the NWI database.

The NWI was used in Lake County to assign a Cowardin code to those wetlands for which NWI overlapped with LCWI. In the areas where the Lake County layer did not overlap with NWI, the most recent and publicly-available land cover information was obtained from the 2008 LANDFIRE (http://www.landfire.gov) database and the LANDFIRE existing vegetation type was converted into Cowardin codes (Table 9). LANDFIRE vegetation datasets are created using predictive landscape models based on extensive field-referenced data, satellite imagery and biophysical gradient layers using classification and regression trees. LANDFIRE data provide more detailed vegetation types needed to assign Cowardin vegetation classes.

Table 9. Vegetation code conversions from the LANDFIRE database to NWI Cowardin vegetation class

LANDFIRE Existing Vegetation Type	NWI Cowardin Vegetation Class
Non-vegetated	UB
Mixed evergreen-deciduous open tree canopy	PFO1
Perennial graminoid grassland	EM1
Mixed evergreen-deciduous shrubland	PSS1
Developed	DEV
Annual graminoid/forb	EM2
Deciduous open tree canopy	PFO1
Herbaceous - grassland	EM1
Evergreen open tree canopy	PFO4
Deciduous closed tree canopy	PFO1
Deciduous sparse tree canopy	PFO1
Mixed evergreen-deciduous closed tree canopy	PFO1

2.3.3 Water Regime

For both the Illinois and Wisconsin watersheds, attributes from the SSURGO database were used to classify each wetland's water regime including percent hydric soils, drainage class, flooding frequency, geomorphic description, and taxonomic order attributes. SSURGO soil map units which intersect the PRWs and existing wetlands were categorized according to Table 10 for water regime. Existing wetlands that did not fit into any of the water regime categories in Table 10 were assigned a water regime based on the nearest wetland.

Table 10. Application of SSURGO soil map units to water regime

SSURGO Characteristics					Water Regime	
Hydric Soils Coverage	Drainage Class	Flooding Frequency	Geomorphic Description	Taxonomic Order	Code	Description
< 75%	"Moderately Well Drained" or "Somewhat Poorly Drained"	Any	"Flood Plains" Or "Terraces"	Any	A	Temporarily Flooded
≥ 75%	"Poorly Drained"	"None"	Any	Not "Histosols"	B	Saturated
≥ 75%	"Poorly Drained"	"Rare" Or "Occasional" Or "Frequent"	Any	Not "Histosols"	C	Seasonally Flooded
≥ 75%	"Very Poorly Drained"	"Rare" Or "Occasional" Or "Frequent"	Any	Not "Histosols"	E	Seasonally Flooded/Saturated
≥ 75%	"Very Poorly Drained"	"Rare" Or "Occasional" Or "Frequent"	Any	Any	F	Semi-permanently Flooded
≥ 75%	"Very Poorly Drained"	"None"	Any	Any	G	Intermittently Exposed
NULL [a]	NULL	Any	Any	NULL	H	Permanently Flooded

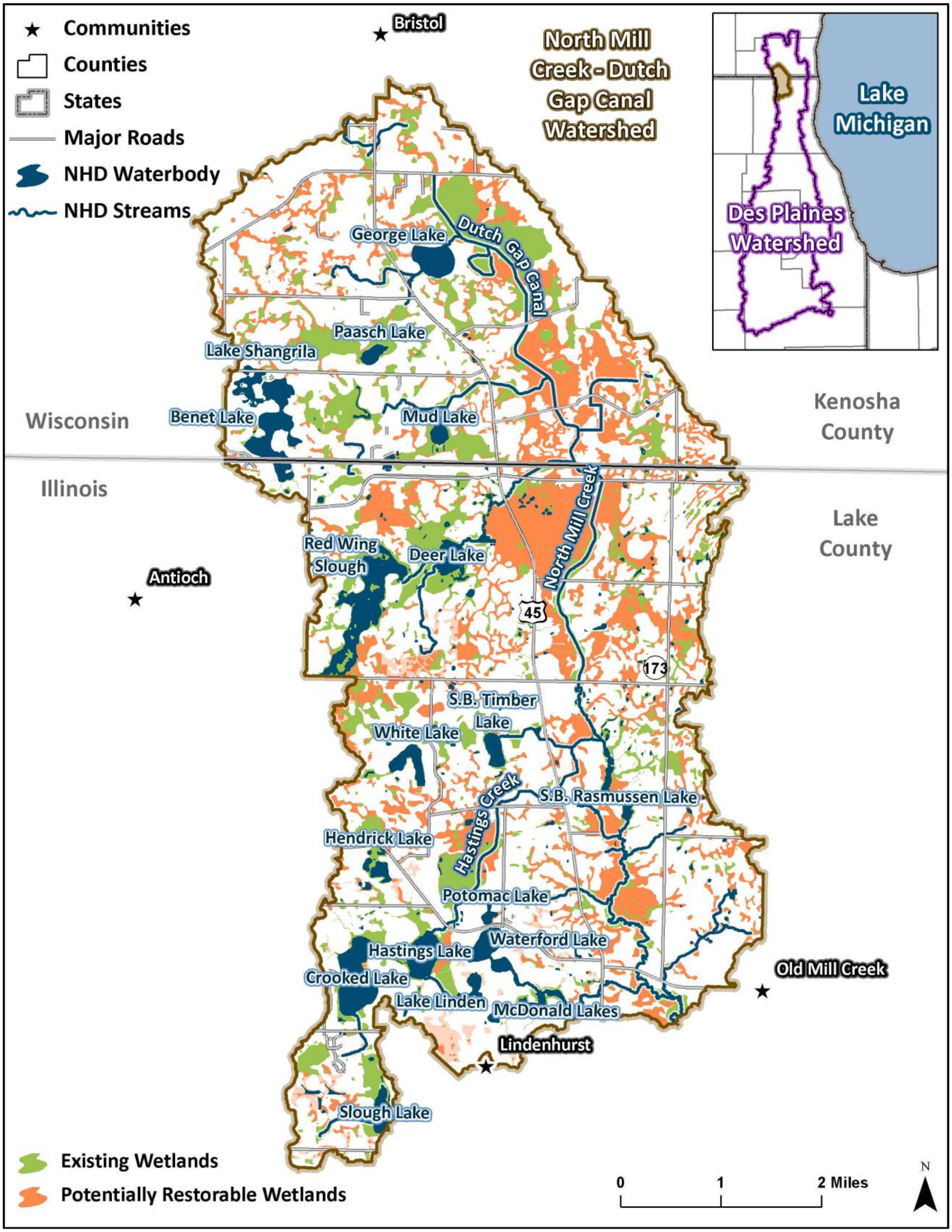
a. Attributes with a null value indicate water bodies present at the time of the soil survey, and the permanently flooded water regime was applied.

2.3.4 Wetland Inventory Results

PRWs and existing wetlands are illustrated on Figure 13 through Figure 17 and in Table 11 for each of the HUC-12 watersheds. Many historic wetlands have been converted to developed land uses; these wetlands are included in the PRW database but are shaded on the figures and further described in Table 11.

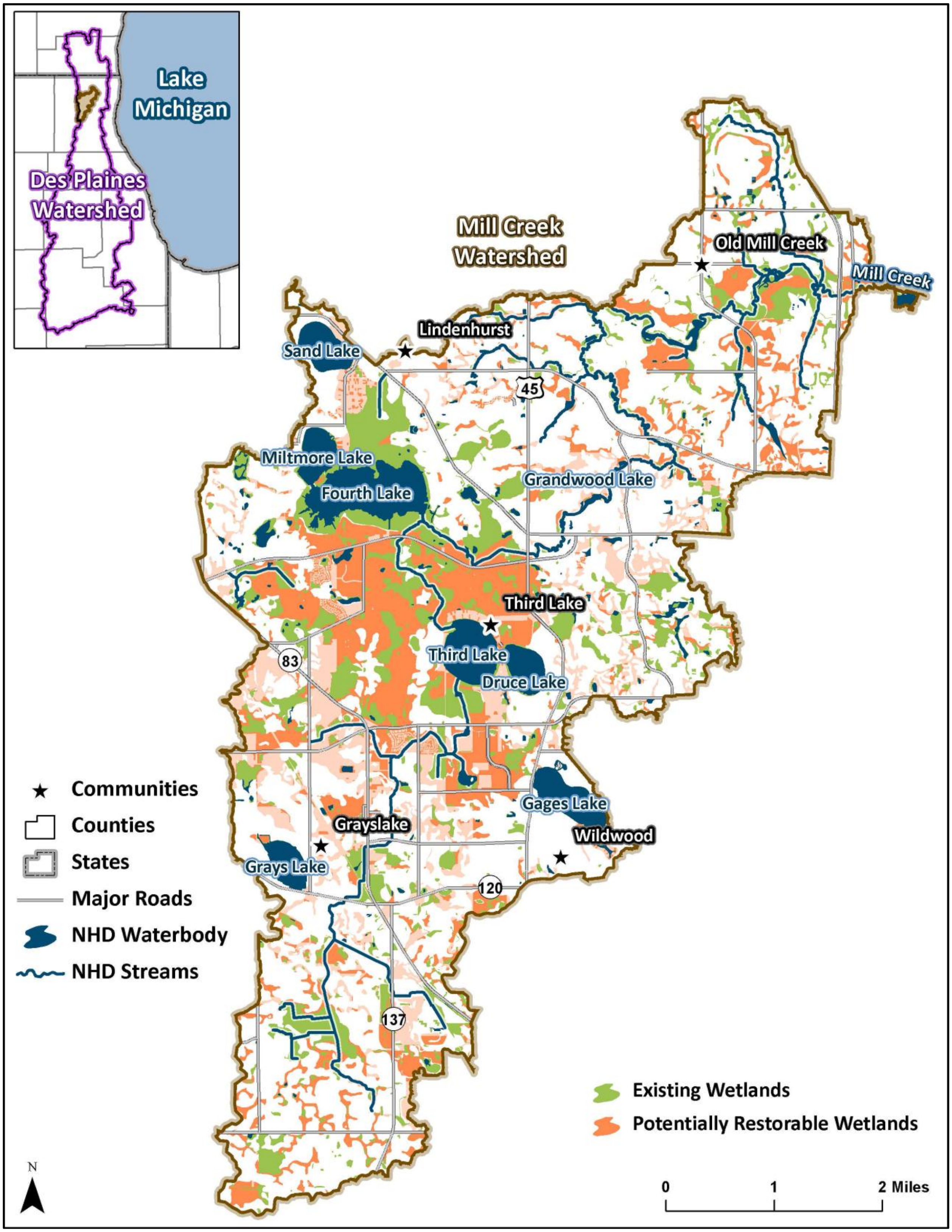
Table 11. Pre-European settlement, existing, and PRWs

Watershed		Wetland Area (acres)		Percent Loss of Area (%)	PRWs		Percent of PRWs that have been converted to developed land uses (%)
		Presettlement	Existing		(total acres)	(total acres on undeveloped land)	
Des Plaines	North Mill Creek-Dutch Canal	9,146	4,353	52%	4,793	4,110	14
	Mill Creek	8,804	3,963	55%	4,841	2,898	40
	Buffalo Creek	5,364	1,576	71%	3,788	1,019	73
Lower Fox	Baird Creek	3,214	1,623	50%	1,592	1,306	18
	Kankapot Creek	1,692	958	43%	734	640	13



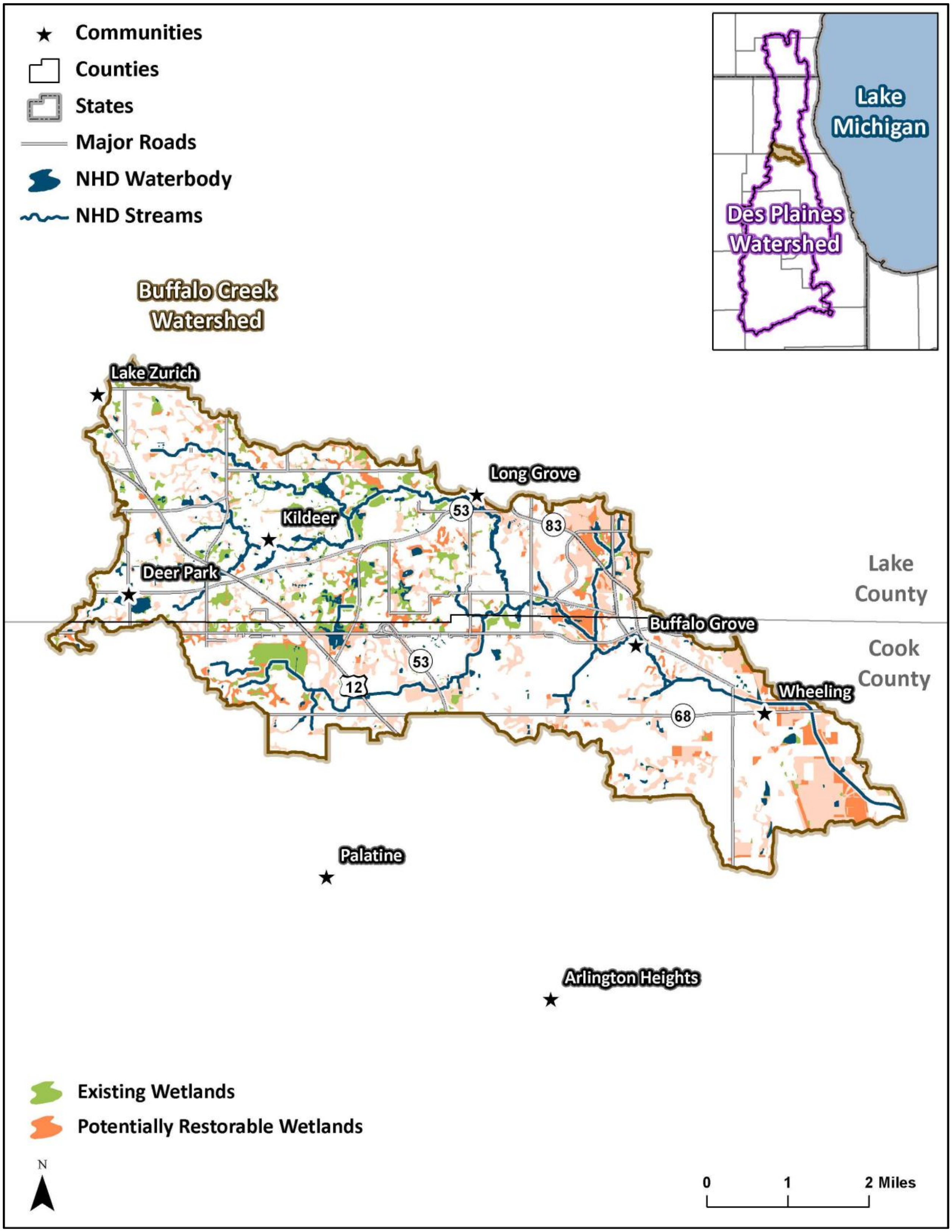
Lighter shaded areas are historic wetlands that have been converted to developed land uses.

Figure 13. Existing and potentially restorable wetlands, North Mill Creek – Dutch Gap Canal watershed.



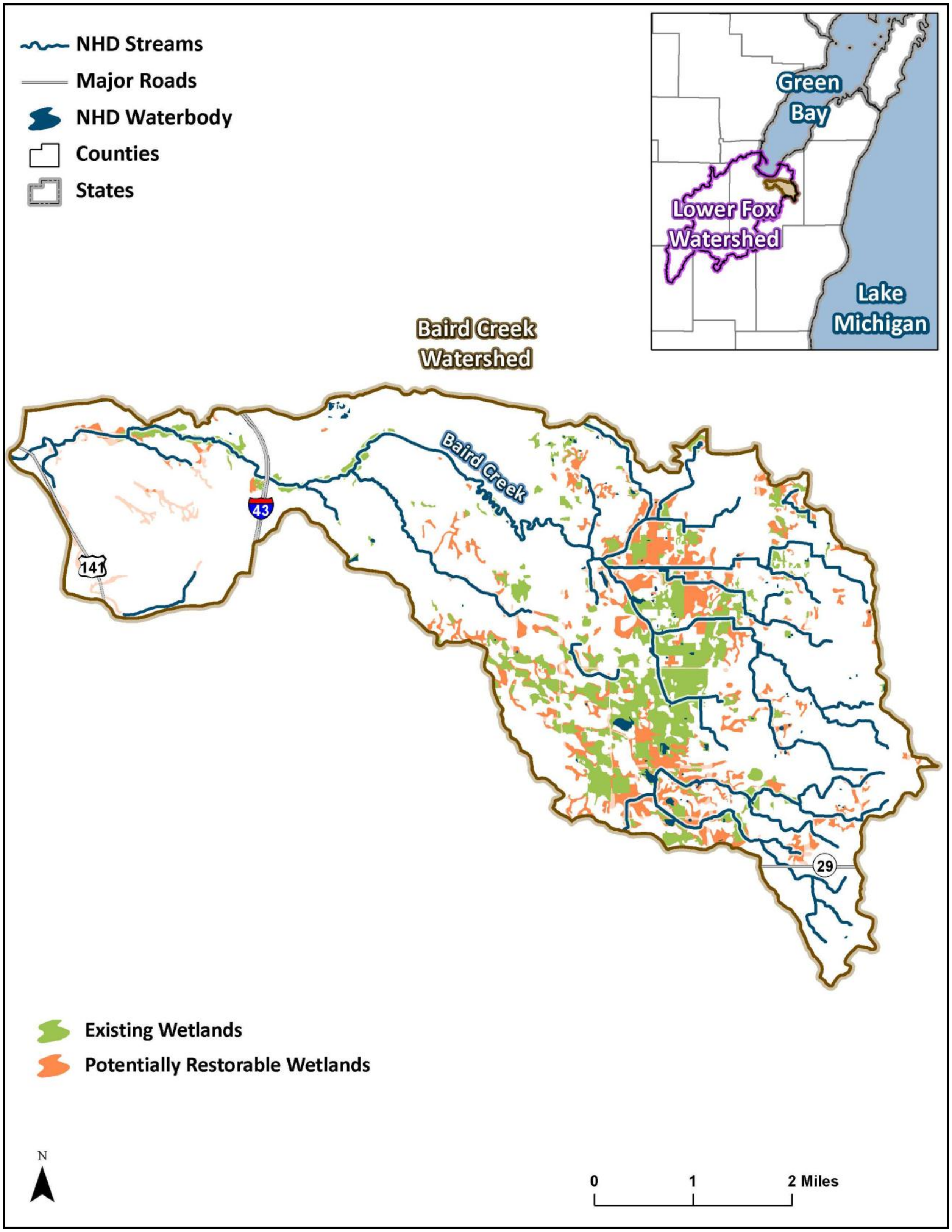
Lighter shaded areas are historic wetlands that have been converted to developed land uses.

Figure 14. Existing and potentially restorable wetlands, Mill Creek watershed.



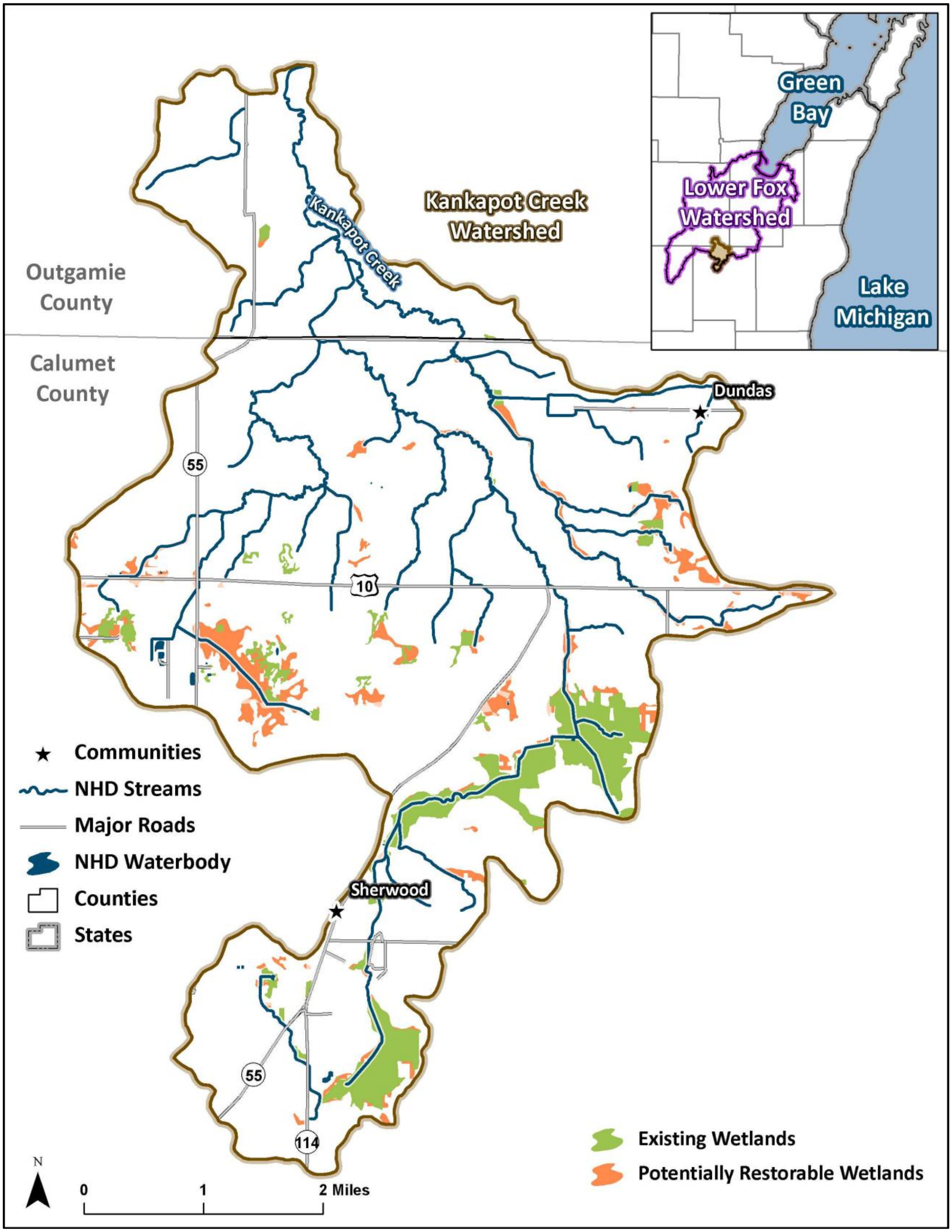
Lighter shaded areas are historic wetlands that have been converted to developed land uses.

Figure 15. Existing and potentially restorable wetlands, Buffalo Creek watershed.



Lighter shaded areas are historic wetlands that have been converted to developed land uses.

Figure 16. Existing and potentially restorable wetlands, Baird Creek watershed.



Lighter shaded areas are historic wetlands that have been converted to developed land uses.

Figure 17. Existing and potentially restorable wetlands, Kankapot Creek watershed.

2.4 Hydrogeomorphic Classification using LLWW

The LLWW system of wetland classification characterizes the hydrogeomorphic qualities of each wetland and is an enhancement to existing wetland classification systems. LLWW applies descriptors based on wetland landform, landscape position, water flow path, and water body type. The LLWW approach used by MDEQ (2011) was closely followed, with refinements based on recent publications by Tiner (2003b, 2011), methods employed in the Sandusky River watershed project (PG Environmental 2014), and other current research. The LLWW characterization was applied to the PRWs and existing wetlands.

The LLWW steps were performed in the order that is most effective for GIS processing: 1) landform, 2) landscape position, 3) water flow path, and 4) water body type. This order also reflects the level of effort required for each step, from highest to lowest.

2.4.1 Landform

Landform describes the physical shape of a wetland or the wetland's location within the landscape. The classification methodology from MDEQ (2011) was expanded to include not only the NWI Cowardin water regime but also other datasets that were used in the Sandusky project including the FEMA 100-year floodplain boundaries. FEMA flood insurance rate maps are available in GIS format (also known as DFIRM datasets) for all project watershed areas. While true ecological connections of each wetland may not be identified using FEMA data, and in some cases can be misidentified as connected when truly not, it is the most consistent data available at the scale of the project watersheds. Additionally, the scale of this project (i.e., landscape, or watershed) could require a significant amount of time and effort to accurately identify only those wetlands connected to rivers and streams using DEMs and hydrologic and hydraulic modeling. In addition to field work, or field based-data, high-resolution DEM data (i.e., LiDAR-derived data) could be used when looking at specific wetlands, or groups of wetlands, to ensure accurate delineation of each wetland's landform type. Each wetland was assigned one of the landform classes (Table 12).

The landform analysis was run in the order of slope, island, fringe, floodplain, basin, and flat, as specified by Tiner (2011). The order of operation is crucial because the landform classes are not mutually exclusive. For example, a wetland polygon could have characteristics that would allow it to be coded as either basin or slope. If the basin analysis were run first, wetlands could be misclassified that should have been coded as slope.

Table 12. Landform classes

Landform Class	Description
Slope (SL)	Wetlands occurring on a slope of 5 percent or greater, as indicated by a slope raster created from highest-resolution available DEM.
Island (IL)	A wetland completely surrounded by water, as indicated by the local water body layers.
Fringe (FR)	Wetland occurs in the shallow water zone of a permanent water body. NWI water regimes F, G, and H.
Floodplain (FP)	Wetland occurs on an active alluvial plain along a river and some streams, as defined through the use of FEMA floodplain data. Modifiers FPba (basin) and FPfl (flat) – see below.
Basin (BA)	Wetland occurs in a distinct depression. NWI water regimes C and E.
Floodplain–basin (FPba)	Wetland occurs in a distinct depression. NWI water regimes C and E; and is already classified as Floodplain (FP).
Flat (FL)	Wetland occurs on a nearly level landform. NWI water regimes A, B, and K.
Floodplain–flat (FPfl)	Wetland occurs on a nearly level landform. NWI water regimes A, B, and K; and is already classified as Floodplain (FP).

A slope raster was created to determine the average percent slope across each wetland. Wetlands with slopes of 5 percent or greater were assigned the landform position class of "slope." The remaining landform class assignments were based primarily on each wetland's water regime classification. Water regimes were assigned to each wetland during previous steps in the analysis. The floodplain class assignment was assigned to wetlands that intersected the FEMA-designated 100-year floodplain areas. An example of this type of wetland and others is available in Figure 18. Table 13 summarizes the landform class results by HUC-12 watershed.

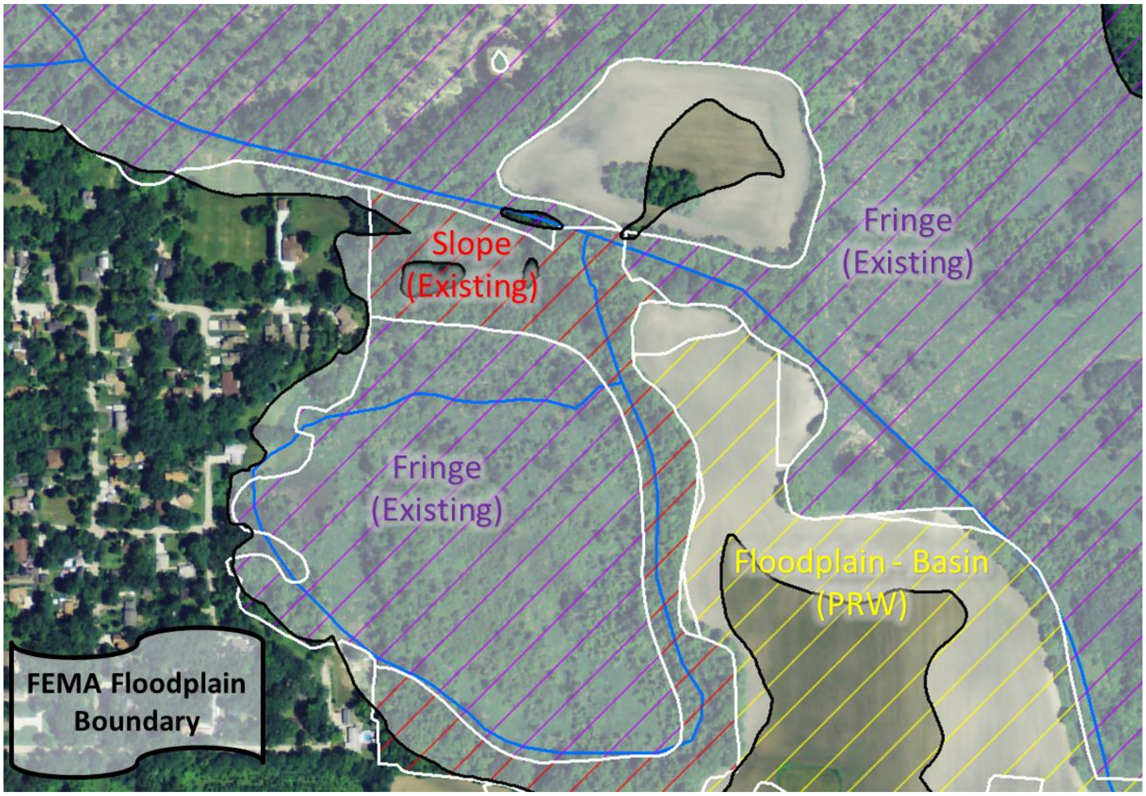


Figure 18. Examples of landform classes.

Table 13. Wetland areas by landform class

Landform Class	Des Plaines						Lower Fox			
	North Mill		Mill		Buffalo		Baird		Kankapot	
	PRW	Existing	PRW	Existing	PRW	Existing	PRW	Existing	PRW	Existing
Percent Wetland Area (%)										
Slope (SL)	9%	14%	26%	15%	32%	36%	-	11%	22%	13%
Island (IL)	-	0.2%	-	1%	-	2%	-	-	-	-
Fringe (FR)	14%	73%	5%	76%	3%	52%	17%	45%	2%	53%
Floodplain (FP)	-	0.01%	-	-	-	-	-	2%	4%	1%
Floodplain - flat (FP(fl))	39%	2%	43%	1%	34%	2%	49%	15%	9%	24%
Floodplain - basin (FP(ba))	6%	1%	0%	1%	0.2%	0.5%	2%	-	-	-
Basin (BA)	0.5%	1%	0.05%	0.02%	-	0%	8%	-	0%	-
Flat (FL)	31%	9%	26%	6%	31%	8%	24%	27%	63%	8%
Wetland Area (acres)										
Total	4,793	4,353	4,841	3,963	3,788	1,576	1,592	1,623	734	958

2.4.2 Landscape Position

Landscape position refers to the location of a wetland with respect to topography and the impact of topography on the wetland's water source(s). Tiner notes that the upstream limit of a lake's influence can typically be approximated by the extent of the lake's basin. However, he advises that assigning the limits of a lake's influence should be based on the physiography and climate of the landscape under analysis.

There are four landscape position classes: lentic, lotic river, lotic stream, and terrene (Table 14 and Figure 19). A lentic wetland is located in or along a lake, or within the part of the lake's upstream drainage area that is affected by rising lake levels. In the Lower Fox River watersheds, a lake is defined as an open water body that is greather than 5 acres in size as used by MDEQ and in the Sandusky River watershed, Ohio (PG Environmental 2014). In the Des Plaines River watersheds, a lake is defined as an open water body that is 2 acres or more in size per the Lake County Watershed Development Ordinance.

A lotic river wetland is associated with a river or its active floodplain. A river is defined as a channel that is mapped as a polygon or a two-lined watercourse on a 1:24,000 U.S. Geological Survey topographic map (Tiner 2011). A lotic stream wetland is associated with a stream or its active floodplain, in this case active floodplain is representred by from FEMA 100-year floodplain. A stream is defined as a linear or single-line watercourse on a 1:24,000 U.S. Geological Survey topographic map. The distinction for this analysis is based on whether the watercourse is defined as a polygon or a linear feature in the GIS (i.e., polyline). Terrene wetlands represent all remaining wetlands.

Table 14. Landscape position classes

Landscape Position Class	Description
Lentic (LE)	Wetland in or along lake (water body ≥ 5 acres in Wisconsin or ≥ 2 acres in Illinois) or within a lake's basin, defined as area contiguous to lake affected by rising lake levels.
Lotic River (LR)	Wetland associated with (directly intersected by) a river or its active floodplain.
Lotic Stream (LS)	Wetland associated with (directly intersected by) a stream or its active floodplain.
Terrene (TE)	All remaining wetlands including those that are: • Located in or border a pond, or wetland is a pond (water body < 5 acres in Wisconsin or < 2 acres in Illinois in size surrounded by upland). • Adjacent to but not affected by a stream or river (located in or along stream/river, but NOT along a periodically flooded stream). • Completely surrounded by upland (non-hydric soils).
Terrene-headwater (TE(hw))	Any of the LE, LR, LS, or TE wetlands that are at the upper terminus of the hydro24k or local water flowline datasets.

As with the Landform Position classification above, FEMA flood insurance rate maps were used to determine the wetlands that are connected and influenced by lakes, rivers, or streams. Watershed boundaries for lakes, rivers, and streams were derived using the highest-resolution DEM dataset available in conjunction with hydrography datasets and were used to characterize floodplain areas as being associated with either a lake, river, or stream.

The lentic (LE) landscape position class was assigned before the other three classes. All of the wetlands within a lake's floodplain were considered lentic, including wetlands near the lake that are bisected by streams (Tiner 2011). For this analysis, a lake is defined as a water body that is 5 acres or greater in Wisconsin or 2 acres or greater in Illinois.

After the lentic wetlands were identified, the lotic river wetlands were identified similarly. The lotic stream wetlands were identified next, after which all remaining wetlands surrounded by upland or those in or adjacent to a pond (a water body less than 5 acres in Wisconsin or less than 2 acres in Illinois) were selected and classified as terrene.

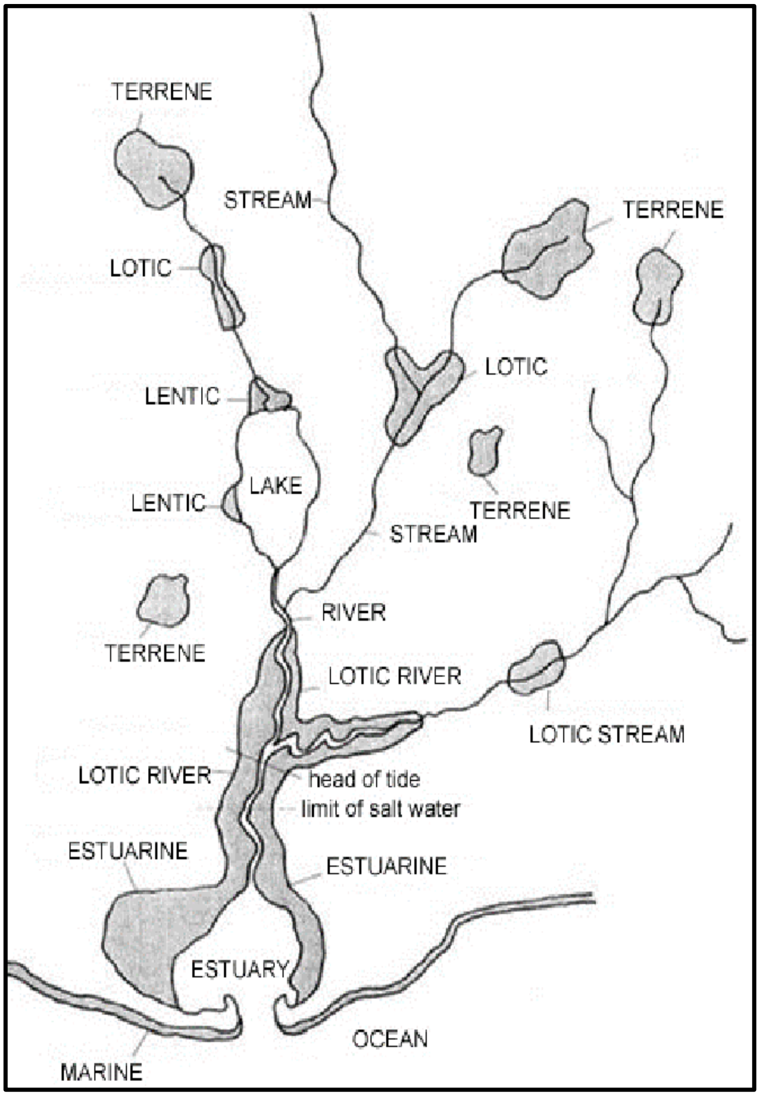


Figure 19. Examples of landscape position classes (Tiner 2011).

Finally, a headwater subclass of terrene wetlands (TE(hw)) was identified. Headwater wetlands are classified where a river or stream does not extend through the wetland, and where the wetland is considered the source of the downstream waterway. The execution of this step occurs after all other LLWW descriptors are assigned, and could reclassify a lotic river (LR) or lotic stream (LS) wetland to be a terrene headwater (TE(hw)) wetland. These terrene headwater wetlands were identified by selecting all wetlands not classified as Lentic (LE) with a Water Flow Path designation of Outflow (OU, OI, or OA). A detailed description of the methods to determine Outflow designation is below under the Water Flow Path assignment methods. An example of this type of wetland and others is available in Figure 20.

Table 15 summarizes the landscape position results by HUC-12 watershed.

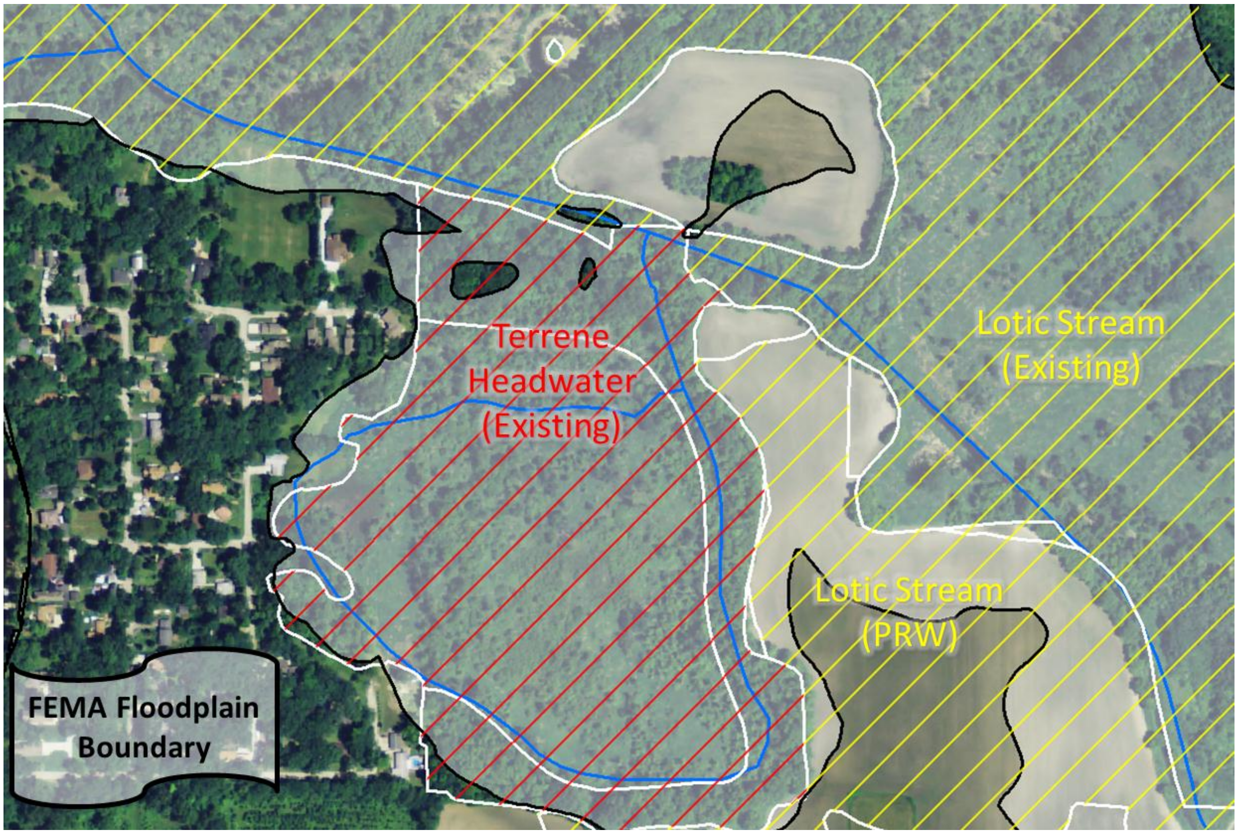


Figure 20. Examples of landscape classes (North Mill Creek – Dutch Gap Canal watershed).

Table 15. Wetland areas by landscape position

Landscape Position	Des Plaines						Lower Fox			
	North Mill		Mill		Buffalo		Baird		Kankapot	
	PRW	Existing	PRW	Existing	PRW	Existing	PRW	Existing	PRW	Existing
Percent Wetland Area (%)										
Lentic (LE)	12%	46%	37%	58%	39%	31%	1%	4%	-	-
Lotic River (LR)	10%	11%	15%	13%	17%	28%	-	-	-	-
Lotic Stream (LS)	53%	24%	30%	16%	12%	17%	64%	55%	31%	48%
Terrene (TE)	21%	13%	14%	12%	27%	22%	32%	35%	31%	20%
Terrene-headwater (TE(hw))	5%	7%	5%	1%	4%	1%	2%	6%	38%	32%
Wetland Area (acres)										
Total	4,793	4,353	4,841	3,963	3,788	1,576	1,592	1,623	734	958

2.4.3 Water Flow Path

Water flow path classification delineates wetlands into five main classes dependent on the wetland's source of water as well as the role of the wetland as a source for downstream waterways (Table 16 and Figure 21). The five classes contain several subclasses that are further subdivided based on whether the body of water is naturally occurring, constructed (e.g., canal or drainage ditch), or with intermittent flow. The water flow path class is sometimes referred to as hydrodynamics (MDEQ 2011).

Table 16. Water flow path classes

Water Flow Path Class	Water Flow Path Subclass	Description
Outflow	Outflow (OU)	Water flows out of the wetland naturally, but does not flow into the wetland from another source.
	Outflow Intermittent (OI)	Water flows out of the wetland intermittently, but does not flow into the wetland from another source.
	Outflow Artificial (OA)	Water flows out of the wetland in a channel that was manipulated or artificially created.
Bidirectional	Bidirectional (BI)	Wetland along a lake and not along a river or stream; its water levels are subjected to the rise and fall of the lake levels. Lentic wetlands with no streams intersecting them.
Throughflow	Throughflow (TH)	Water flows through wetland, often coming from upstream sources (typically wetlands along rivers and streams). Lentic wetlands with streams running through them are classified as throughflow (or throughflow intermittent, if stream is classed as intermittent).
	Throughflow Intermittent (TI)	Water flows through the wetland intermittently, often coming from upstream sources (typically wetlands along streams).
	Throughflow Artificial (TA)	Water flows through the wetland in a channel that was manipulated or artificially created.
Isolated	Isolated (IS)	Wetland is typically surrounded by upland (nonhydric soil); receives precipitation and runoff from adjacent areas with no apparent outflow.
Inflow	Inflow (IN)	Wetland is a sink receiving water from a river, stream, or other surface water source, lacking surface-water outflow.

The general approach for the water flow path class is to identify the intersections between the wetlands and the flowline layers and then classify each wetland based on the type of water body it intersects. For Wisconsin wetlands, the WDNR's hydrography data already contained the required information. In Illinois, the NHD flowlines layer was referenced and the water body type codes were added to the local hydrography data (which lacked this information). The identification of water body types in the NHD flowlines layer uses the dataset's feature codes (FCodes) attributes. Lines were grouped into three types:

1. Perennial (FCode 46006 or "Stream/River–Perennial," and FCode 55800 or "Artificial Path")
2. Intermittent (FCode 46003 or "Stream/River–Intermittent," and FCode 46007 or "Stream/River–Ephemeral")
3. Pipes/Canals/Ditches (FCode 42800 or "Pipeline," FCode 33600 or "Canal/Ditch," and FCode 33400 or "Connector")

The "Artificial Path" classification in the NHD (FCode 55800) does not necessarily indicate a constructed versus a natural waterway. Artificial paths in the NHD flowlines are connectors developed as a part of NHD to complete pathways facilitating hydrologic network modeling; the artificial path feature includes many natural rivers and streams, and they were therefore grouped with the perennial FCode types.

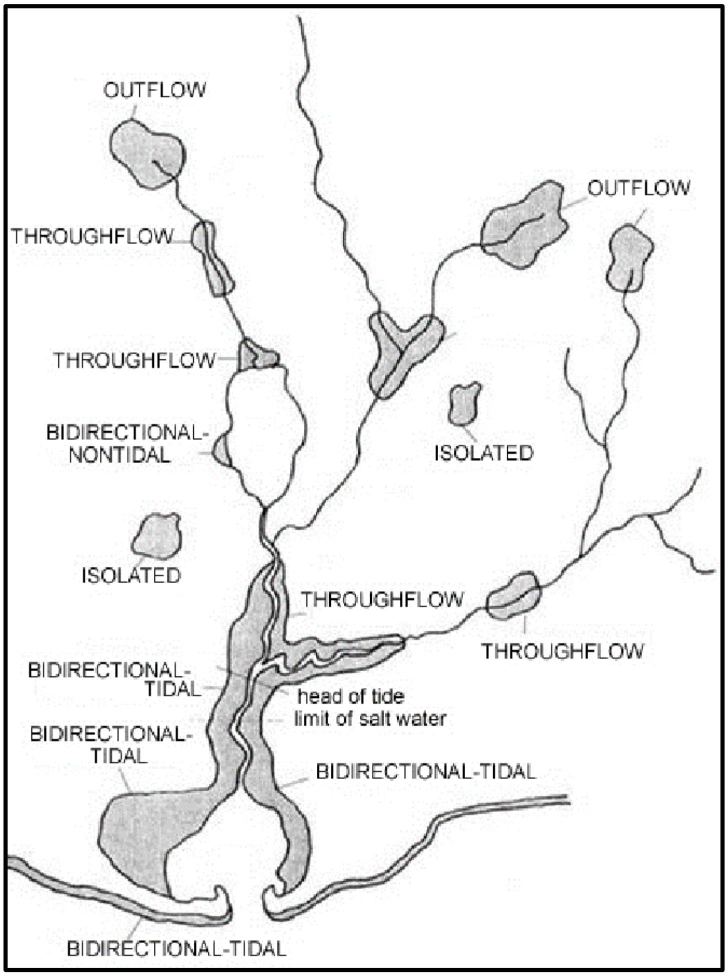


Figure 21. Examples of water flow path classes (Tiner 2011).

Outflow wetlands are considered those within close proximity of the upstream end of streams, creeks, etc. Those wetlands that were within 10 meters of the upstream terminus points of the water flowline network were classified as Outflow. The attributes of those upstream flowlines were used to assign the appropriate Outflow subclass. The 10 meter distance was selected since water flowlines in GIS may not accurately represent the true terminus of a waterway on any given day—stream locations, especially upstream termini, shift in response to different storm events and upstream watershed changes. The distance used for other project areas should be dependent on the resolution of the data used for that specific project area.

Throughflow wetlands receive surface or groundwater from a stream, other water body, or another wetland at a higher elevation, and the surface or groundwater passes through that wetland to another stream or water body (Tiner 2011). To account for groundwater influence, and not just assign the throughflow classification to wetlands directly intersected by flowlines, the criteria were expanded by using a 200-ft buffer created for all flowlines which is consistent with the Sandusky River project (PG Environmental 2014). This also corrects for potential mismatches between the flowlines and the true position of a waterway with respect to a wetland. An example of this type of wetland and others is available in Figure 22.

Table 17 summarizes the water flow path results by HUC-12 watershed.

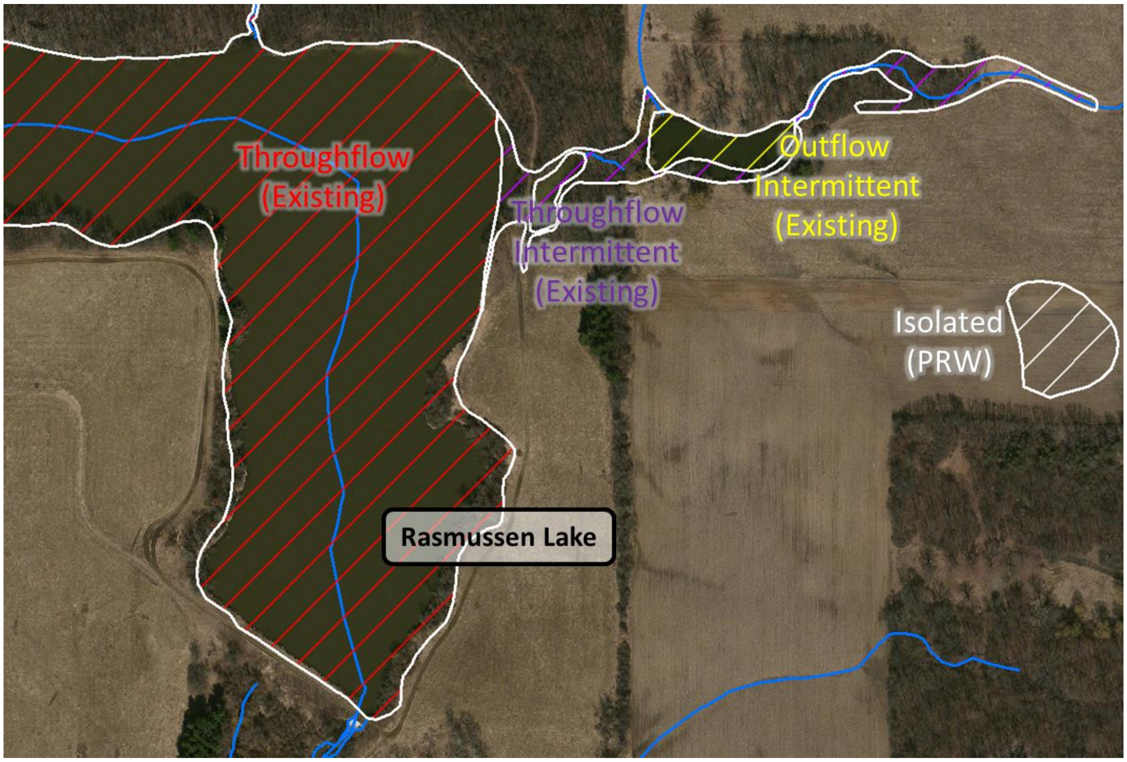


Figure 22. Examples of water flow path classes.

Table 17. Wetland areas by water flow path

Water Flow Path	Des Plaines						Lower Fox			
	North Mill		Mill		Buffalo		Baird		Kankapot	
	PRW	Existing	PRW	Existing	PRW	Existing	PRW	Existing	PRW	Existing
Percent Wetland Area (%)										
Outflow (OU)	1%	4%	-	-	0.3%	0.1%	-	-	4%	20%
Outflow Intermittent (OI)	4%	3%	5%	1%	4%	1%	2%	6%	23%	12%
Outflow Artificial (OA)	-	-	-	0.1%	-	-	-	-	-	-
Bidirectional (BI)	1%	22%	10%	25%	5%	11%	-	4%	-	-
Throughflow (TH)	27%	21%	14%	23%	28%	33%	5%	6%	15%	53%
Throughflow Intermittent (TI)	46%	38%	61%	34%	26%	44%	82%	64%	51%	5%
Throughflow Artificial (TA)	11%	1%	4%	10%	18%	1%	-	-	-	-
Isolated (IS)	11%	11%	7%	7%	18%	9%	12%	20%	7%	9%
Inflow (IN)	-	-	-	-	-	-	-	-	-	-
Wetland Area (acres)										
Total	4,793	4,353	4,841	3,963	3,788	1,576	1,592	1,623	734	958

2.4.4 Water Body Type

The water body type classification defines types of permanent and deep open water habitats, such as ponds, lakes, and rivers. Not all wetlands have a designated water body type. When possible, the water body type of a wetland was determined by the wetland's Cowardin code or other attributes of local wetland inventory datasets. Lake County's and WDNR's hydrography polygon layers were used to code wetlands coinciding with excavated lakes or ponds. Also, in Illinois, modifiers on the updated, state-wide NWI layer were used to isolate lake and pond types (e.g., x = excavated, h = dammed). When these types of attributes were not available, water body type was determined based on water body classifications included in national (e.g., NHD) hydrographic datasets. Both "freshwater pond" and "lake" wetland types were further sorted for the division of lakes versus ponds (Table 18). An example of this type of wetland and others is available in Figure 23. Table 19 summarizes the wetland areas by water body type results for each HUC-12 watershed.

Table 18. Water body types

Water Body Type	Description
Natural Pond (PD1)	A natural pond < 5 acres in Wisconsin or < 2 acres in Illinois.
Dike and/or Impounded Pond (PD2)	A pond that is diked and/or impounded and < 5 acres in Wisconsin or < 2 acres in Illinois.
Excavated Pond (PD3)	A pond that is excavated and < 5 acres in Wisconsin or < 2 acres in Illinois.
Natural Lake (LK1)	A natural lake > 5 acres in Wisconsin or > 2 acres in Illinois.
Dammed River Valley (LK2)	A lake created by damming a river valley and > 5 acres in size in Wisconsin or > 2 acres in Illinois. [a]
Excavated Lake (LK3)	A lake that is excavated and > 5 acres in Wisconsin or > 2 acres in Illinois.
River (RV)	A polygonal feature in the NHD (or state-level hydrography datasets) or wetland datasets.

a. A currently dammed stream in Lake County (locally referred to as Rasmussen) is being restored through dam removal.

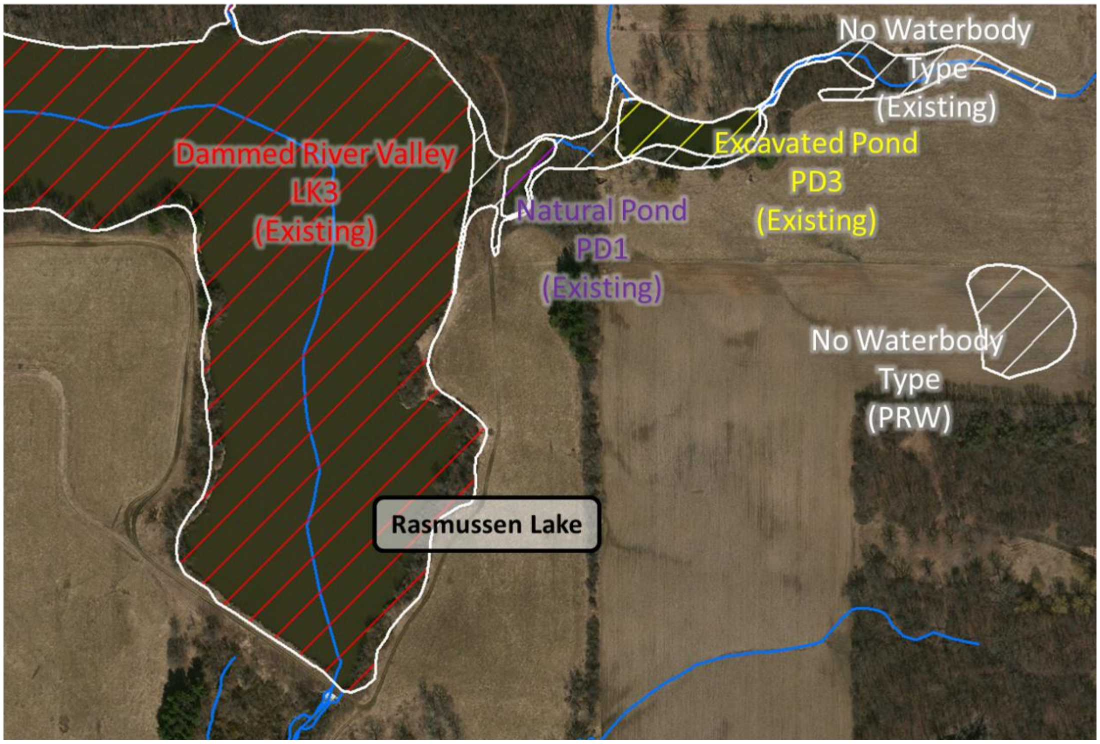


Figure 23. Examples of water body types.

Table 19. Wetland areas by water body type

Water Body Type	Des Plaines						Lower Fox			
	North Mill		Mill		Buffalo		Baird		Kankapot	
	PRW	Existing	PRW	Existing	PRW	Existing	PRW	Existing	PRW	Existing
Percent Wetland Area (%)										
Natural Pond (PD1)	4%	5%	0.1%	4%	0.3%	4%	25%	24%	7%	10%
Dike and/or Impounded Pond (PD2)	-	0.1%	-	0.2%	-	0.03%	-	-	-	-
Excavated Pond (PD3)	0.004%	1%	-	2%	-	10%	-	-	-	-
Natural Lake (LK1)	0.2%	18%	-	24%	1%	5%	-	4%	-	-
Dammed River Valley (LK2)	-	7%	-	1%	-	-	-	-	-	-
Excavated Lake (LK3)	-	5%	-	7%	-	17%	-	-	-	-
River (RV)	0.1%	0.3%	0.3%	1%	0.3%	0.3%	-	-	-	-
Wetland Area (acres)										
Total	4,793	4,353	4,841	3,963	3,788	1,576	1,592	1,623	734	958

2.5 Wetland Functional Assessment using W-PAWF Classification Process

The Watershed-based Preliminary Assessment of Wetland Functions (W-PAWF) is an approach that classifies wetlands based on the significance of their functions (USFWS 2010). A wetland function is a natural, physical, and/or biological process that occurs within the wetland. Wetland function can, to some extent, be linked to physical and biological processes within the waterways and other ecosystems connected to the wetland. Some of the processes sustain the wetland and others are incidental functions provided by the wetland. Examples of wetland functions include sediment retention and the transformation of nutrients.

The W-PAWF analysis uses the LLWW hydrogeomorphic classification descriptors and the Cowardin wetland type designations for vegetation type and water regime (Cowardin et al. 1979). Additional information about the ecology, hydrology, and physiography of the project area is used to supplement the analysis. The W-PAWF uses correlations that have been made between wetland function and wetland hydrogeomorphology, wetland type, and other descriptors. Wetland function is thus inferred from wetland hydrogeomorphology and type. The majority of the functional correlations presented here are from Tiner's "Correlating Enhanced National Wetlands Inventory Data with Wetland Functions for Watershed Assessments: A Rationale for Northeastern U.S. Wetlands" (Tiner 2003b). The MDEQ (2011) report applied Tiner's 2003 work in Michigan, adjusting and adding to the functional correlations originally intended for the northeast region of the United States. MDEQ's efforts resulted in 13 different indicators of wetland functional significance.

The significance of a function refers to the relative level of the function in a wetland compared to other wetlands, and can be described as high, moderate, or low. These rankings are not related to the perceived human value of a wetland function or its benefit to a watershed. For example, wetlands with a high functional significance for nutrient transformation do not necessarily meet a particular standard, but rather they are better at nutrient transformation than other wetlands in the watershed. Functional *significance* is 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.

Twelve of the 13 wetland functions from MDEQ's analysis were completed for this project. Data for the Conservation of Rare Wetlands and Species Indicator were not available and each wetland's significance of that function was not determined (see sidebar for additional information). The 12 functions completed in this analysis were:

1. Flood water storage
2. Streamflow maintenance
3. Nutrient transformation
4. Sediment and other particulate retention
5. Shoreline stabilization
6. Stream shading

Conservation of Rare Wetlands and Species

Wetlands considered rare either globally, on a state-level, or even within a particular area of interest such as a single watershed provide the foundation for this indicator. Wetlands fall into this category if they have a large diversity of flora and fauna and/or habitat that is threatened, endangered, or rare. Designations of such wetlands by state or local agencies are often employed for this indicator. For example, in Lake County, the USACE's Chicago District developed an approach to identify rare wetlands using a coefficient of conservatism or floristic quality index. At the time of this analysis, these data were not comprehensively available but in the future could be added by local entities. Suggested criteria include:

High Functional Significance:
- Wetland has at least one occurrence of a Federal or State-listed threatened or endangered species
- Wetland is identified as locally rare by local assessment work

7. Fish habitat
8. Waterfowl and waterbird habitat
9. Shorebird habitat
10. Interior forest bird habitat
11. Amphibian habitat
12. Influence of groundwater on stream recharge

Given the proximity of Michigan to Wisconsin and Illinois and general similarities in topography, land use, and climate, MDEQ's W-PAWF criteria are considered to be appropriate for this analysis. The approach to each of the 12 functional indicators is presented below.

2.5.1 Flood Water Storage

Tiner (2003b) refers to this function as "surface water detention," but describes it as the ability to stop or delay flooding. MDEQ (2011) emphasizes the flood control benefit and refers to this wetland function as "flood water storage." In this analysis, larger wetlands were assigned a higher functional significance for flood water storage than smaller wetlands. Although the size of a wetland is not an exact estimate of flood water storage capacity, larger wetlands presumably have a higher storage capacity. This approach is limited based on available spatial datasets, however if additional information on the depth of the wetland were available, a better representation of flood water storage could be made. It is possible that the current approach is underestimating the importance of smaller wetlands, especially when those wetlands are part of larger wetland complexes. An alternate approach to determining the significance of this function could be based on landscape position, as was done by MDEQ (2011). For example, MDEQ (2011) identified wetlands that were located along streams and rivers as having high functional significance due to the wetlands ability to accept floodwater from the nearby stream. In addition, site specific data or watershed modeling could be used to further inform this function.

In past applications of the method, the median value of wetland acreage from the entire existing wetland population was used to determine a threshold value in order to delineate wetlands with higher versus medium functional significance (e.g., Sandusky's threshold was found to be 0.59 acres). A similar approach was employed for this project separately for each of the five HUC-12 watersheds. The median-size thresholds for the different project watersheds are:

- North Mill Creek– Dutch Gap Canal 1.00 acre
- Mill Creek 1.39 acres
- Buffalo Creek 1.42 acres
- Baird Creek 1.54 acres
- Kankapot Creek 1.99 acres

Additional selection criteria were used for class assignments of various wetland types and LLWW descriptors (Table 20).

Table 20. Criteria for flood water storage functional significance

Functional Significance	Selection Criteria
High	• Wetlands along streams and rivers (i.e., LR or LS) • Island wetlands • Ponds that are throughflow, throughflow intermittent, bidirectional, or isolated --for all of the above, wetland area equal or greater than median size of historic and existing wetlands determined separately for each HUC-12 watershed.
Moderate	• All of the above in the High category less than watershed-specific threshold • Terrene basin isolated • Outflow or outflow intermittent wetlands classified as Terrene (i.e., TE(hw)) • Terrene wetlands that are associated with ponds • All lake-side (LK) wetlands not already ranked high
Low	• All remaining wetlands

2.5.2 Streamflow Maintenance

Both Tiner (2003b) and MDEQ (2011) associate high functional significance with wetlands that act as sources of groundwater discharge to surface waterways and thus maintain streamflow. Wetlands in the headwaters of a watershed were rated as having a high streamflow maintenance function, along with wetlands that store and release water over long periods of time, such as those rated high for the flood water storage wetland function. Tiner also directly correlates the fish habitat wetland function with wetlands that are rated high for the streamflow maintenance function, as consistent streamflow is critical for fish. Of additional benefit to fish habitat, streamflow maintenance can provide temperature control in water bodies. Reduced temperatures can decrease solubility of many chemicals, decreasing the chance of toxic stress to aquatic organisms (California SWRCB 2012). As with the flood water storage function, the size of particular wetland is used to place it into either a high or medium functional significance class (see previous section for watershed-specific thresholds). Additional class assignment criteria were used (Table 21).

Table 21. Criteria for streamflow maintenance functional significance

Functional Significance	Selection Criteria
High	• All headwater wetlands (hw) that have a wetland area equal or greater than the median size of historic and existing wetlands determined separately for each HUC-12 watershed.
Moderate	• All headwater wetlands (hw) that have a wetland area less than the median size of historic and existing wetlands determined separately for each HUC-12 watershed. • Lotic stream and Lotic river that are fringe wetlands • Lotic stream that are FP(ba) or BA wetlands • Throughflow and outflow ponds and lakes
Low	• All remaining wetlands

2.5.3 Nutrient Transformation

Tiner (2003b) and MDEQ (2011) attribute high nutrient transformation significance to wetlands with characteristics that slow the flow water and encourage settling of particulates. The presence of vegetation slows the flow of water which allows for the precipitation of minerals and settling of particulates, including nutrients sorbed to particulates. Water table fluctuation also increases deposition by creating pockets of water in the landscape which slows surface flows. Other characteristics that increase deposition, such as the reduction of stream flow velocity upon entering a large body of water, also provide a minor functional value. In addition to increasing deposition, water table fluctuations promote nutrient uptake by most wetland vegetation. The frequent wetting and drying of soils caused by water table fluctuations increases the removal of nitrogen through denitrification.

Tiner and MDEQ used the vegetative class and water regime wetland attributes to evaluate nutrient transformation. The flooding frequency attribute from the SSURGO database was also used in this study to incorporate the impact of frequent wetting and drying cycles on nutrient transformation (Table 22).

Table 22. Criteria for nutrient transformation functional significance

Functional Significance	Selection Criteria
High	• Vegetated wetlands P_ (AB, EM, SS, FO, and mixes) with water regime C, E, F, H, G. No open water types; and with SSURGO Flood Frequency of “Frequent” or “Occasional”
Moderate	• Vegetated wetlands P_ (AB, EM, SS, FO, and mixes) with water regime C, E, F, H, G. No open water types; and with SSURGO Flood Frequency of “Rare”, “Very Rare”, or “None” • Seasonally Saturated and Temporarily Flooded Vegetated Wetlands P_ (AB, EM, SS, FO, and mixes) with A, B water regime or lacustrine vegetated wetlands (no open water) – with SSURGO Flood Frequency of “Frequent” or “Occasional”
Low	• All remaining wetlands

2.5.4 Sediment and Other Particulate Retention

A wetland’s sediment retention ability is influenced by the presence of vegetation to reduce the flow of water and drop sediment out of entrainment. Large, open water bodies provide opportunities to reduce water velocity and encourage deposition (Table 23).

When this function’s significance is evaluated based on the presence of ponds, certain types of water bodies should be removed, such as ponds formed in gravel pits, impoundments that are completely surrounded by dikes, and man-made dug-out ponds with little or no surface water inflow, such as stormwater detention ponds (Tiner 2003a). State-level Hydro24k and local (e.g., Lake County) water body GIS data layers were used to identify water body types that should be removed, or ranked low, for this indicator. In addition, the LCWI was used to identify constructed ponds.

Table 23. Criteria for sediment and other particulate retention functional significance

Functional Significance	Selection Criteria
High	• Basin wetlands associated with lakes (i.e., Landscape = "LE") • Fringe and island wetlands associated with lakes (i.e., Landscape = "LE") • Floodplain wetlands • Lotic stream (but only basin, flat, and fringe) wetlands that are throughflow or throughflow intermittent • Lotic river (but only floodplain or fringe) throughflow wetlands • Throughflow or throughflow intermittent ponds • Island wetlands
Moderate	• Terrene basin wetlands that are outflow, outflow intermittent or outflow artificial (i.e., TE(hw) wetlands) • Natural ponds not rated water regime H (Permanently Flooded) • All wetlands associated with a pond • Terrene basin wetlands that are isolated
Low	• All remaining wetlands

2.5.5 Shoreline Stabilization

The shoreline stabilization function evaluates a wetland's ability to provide erosion control by minimizing the effect of wave action or stream cutting on shores and banks. Vegetation along shorelines and banks is the primary characteristic for rating a wetland as highly significant for this function (Table 24).

Using LiDAR to Identify Existing Shoreline Vegetation

To provide a more accurate assessment of shoreline vegetation for existing wetlands, a GIS-based analysis can be conducted using the red-green-blue, or RGB, signature of high-resolution aerial imagery (1-meter). The RGB signature can allow identification of shorelines with well-established vegetated cover.

RGB signatures were not used in this analysis since RGB data are limited to existing wetlands and are not available for those wetlands no longer on the landscape.

Table 24. Criteria for shoreline stabilization functional significance

Functional Significance	Selection Criteria
High	• Vegetated wetlands along water bodies (rivers, lakes, streams)
Moderate	• Terrene vegetated wetlands along ponds • Terrene outflow, outflow-intermittent, outflow-artificial wetlands-i.e.,TE(hw) wetlands
Low	• All remaining wetlands

2.5.6 Stream Shading

High vegetation in wetlands that are forested or scrub-shrub can provide shading, which helps regulate water temperature in nearby streams and waterways. Shaded headwater wetlands are scored with a high functional significance (Table 25). Tiner (2003b) did not evaluate a stream shading function, but it is assessed by MDEQ (2011). Temperature regulation also increases the significance of the fish and amphibian habitat wetland functions. Cooler water temperatures decrease the solubility of many chemicals which decreases the chance of toxic stress to aquatic organisms (California SWRCB 2012).

Table 25. Criteria for stream shading functional significance

Functional Significance	Selection Criteria
High	• Wetlands that are forested and scrub-shrub and within 50 feet of the hydrography network • Wetlands that are palustrine forested and palustrine scrub-shrub and headwater (i.e., TE[hw])
Moderate	• All other wetlands that are not forested and scrub-shrub and within 50 feet of the hydrography network • Lotic stream wetlands that are palustrine forested and palustrine scrub-shrub and not headwater
Low	• All remaining wetlands

2.5.7 Fish Habitat

Tiner (2003b) states that the functional significance criteria identified for fish habitat are specific to the northeastern United States and need to be re-examined for individual watersheds when using the functional assessment in other regions of the country. He suggests that the other functional criteria in his analysis method should be relevant nationwide, but that fish and wildlife habitat are highly watershed-dependent. While Lake Michigan, part of the Great Lakes, does experience water level fluctuations that could affect near-shore wetlands, those changes are primarily driven by meteorological effects such as wind and pressure change. True gravitational effects are limited to less than several inches of height change daily. The Great Lakes can therefore be considered non-tidal, and Tiner's functional significance criteria that involve tidal influence have been left out of the proposed approach for this project, as was done in the 2011 MDEQ LLWFA report and Sandusky River Watershed Project.

Table 26. Criteria for fish habitat functional significance

Functional Significance	Selection Criteria
High	• Lentic wetlands • Stream and river wetlands that are only throughflow (not TA or TI, only TH) • Wetlands associated with a pond (i.e., water body = PDx) connected to the hydrography network • Wetlands within 10 meters of Ponds connected to the hydrography network • Palustrine aquatic bed outflowing wetlands • Natural lakes • All lakes that are throughflow, throughflow intermittent, or throughflow artificial, outflow, outflow intermittent or outflow artificial • Headwater wetlands except artificial types
Moderate	• Wetlands associated with a pond not connected to the hydrography network • Natural ponds that are isolated (moved from MDEQ's assignment of a high classification) • Headwater wetlands that are artificial types • Throughflow ponds
Low	• All remaining wetlands

2.5.8 Waterfowl and Waterbird Habitat

Tiner's (2003b) correlations for significance of waterfowl and waterbird habitat are specific to the northeastern United States. Tiner suggests that wetlands that are consistently wet or that are flooded for long periods of time provide habitat for nesting, reproduction, and feeding and should in general rate high for this function. To tailor the approach for this project area, MDEQ's 2011 methodology for bird habitat was used and supplemented with the addition of SSURGO flooding frequency information (Table 27).

Table 27. Criteria for waterfowl and waterbird habitat functional significance

Functional Significance	Selection Criteria
High	• Frequently flooded (as defined by SSURGO dataset) that are; Palustrine aquatic bed, emergent, and scrub-shrub wetlands that are seasonally flooded (C), seasonally flooded/saturated (E), semi-permanently flooded (F), intermittently exposed (G), and permanently flooded (H). Excludes coniferous vegetation types.
Moderate	• Palustrine forested and (remaining) scrub-shrub wetlands that; are seasonally flooded (C), seasonally flooded/saturated (E), semi-permanently flooded (F), intermittently exposed (G), and permanently flooded (H). Excludes coniferous vegetation types.
Low	• All remaining wetlands

2.5.9 Shorebird Habitat

Wetlands that are rated high for the shorebird habitat function have more open water and less canopy coverage along the shoreline. These characteristics provide habitat for nesting, reproduction, and feeding. MDEQ's approach to evaluating shorebird habitat was supplemented with the addition of SSURGO flooding frequency information (Table 28).

Table 28. Criteria for shorebird habitat functional significance

Functional Significance	Selection Criteria
High	• Frequently flooded (as defined by SSURGO dataset) that are: Palustrine aquatic bed, emergent, and scrub-shrub wetlands not intermittently exposed (G) or permanently flooded (H) • Non-persistent wetlands (PEM2) • Lacustrine unconsolidated shore that is partially flooded
Moderate	• Palustrine emergent, scrub-shrub, and forested wetlands not intermittently exposed (G) or permanently flooded (H)
Low	• All remaining wetlands

2.5.10 Interior Forest Bird Habitat

Large areas of forested land along water bodies offer habitat for interior forest birds for nesting, reproduction, and feeding. MDEQ's approach was supplemented with a recent vegetative cover dataset (2013 Cropland Data Layer) produced by the USDA (Table 29). The Cropland Data Layer has the same natural vegetation types as the National Land Cover Dataset and either dataset could be used in this analysis.

Table 29. Criteria for interior forest bird habitat functional significance

Functional Significance	Selection Criteria
High	• Frequently flooded (as defined by SSURGO dataset) forested or scrub-shrub wetlands with >50% of surrounding areas (within a 1 km buffer) under forest or scrub-shrub coverage (including non-wetland areas) • Palustrine forested wetlands that are along rivers and streams • Palustrine scrub-shrub wetlands and those mixed with other wetlands types • Within an area identified by local entities as a highly functional forested bird habitat (not included in analysis)
Moderate	• Of the remaining wetlands, those frequently flooded (as defined by SSURGO dataset) forested or scrub-shrub wetlands with <50% of surrounding areas (within a 1 km buffer) under forest or scrub-shrub coverage (including non-wetland areas) • Of the remaining wetlands, those palustrine forested wetlands that are not already rated as high
Low	• All remaining wetlands

2.5.11 Amphibian Habitat

The amphibian habitat function was not specifically addressed by Tiner (2003b), but he noted that some of the criteria that he developed for fish and shellfish should be applicable to amphibians and other aquatic-dependent species. The 2011 MDEQ analysis started with Tiner's fish and shellfish criteria and identified more specific wetland characteristics that provide amphibian habitat. Wetland size is a primary factor. Isolated, vegetated wetlands that are less than 5 acres in Wisconsin or less than 2 acres in Illinois that can provide terrestrial habitat for some or all of the year rank high for the amphibian habitat function (Table 30). Other criteria that rank high are wetlands with a natural outflow water flow path, floodplain landform wetlands, lentic landscape position wetlands, wetlands associated with natural ponds, and the ponds themselves. The SSURGO flooding frequency criteria was also added to this indicator.

Table 30. Criteria for amphibian habitat functional significance

Functional Significance	Selection Criteria
High	• Palustrine emergent, scrub-shrub, and forested wetlands along with those mixed types less than 5 acres in size in Wisconsin or less than 2 acres in size in Illinois, isolated, and only seasonally flooded (C), seasonally flooded/saturated (E), or semipermanently flooded (F); and not frequently flooded as defined by SSURGO. • Outflowing wetlands • Palustrine aquatic beds that are isolated and not intermittently exposed (G) or permanently flooded (H); and not frequently flooded as defined by SSURGO • Wetlands adjacent to rivers • Lakeside wetlands • Wetland ponds and any wetlands that are directly adjacent to those wetland ponds
Moderate	• Palustrine emergent, scrub-shrub, and forested wetlands with those mixed types that are less than 5 acres in size in Wisconsin or less than 2 acres in size in Illinois and within 50 feet of the hydrography network and only seasonally flooded (C), seasonally flooded/saturated (E), or semipermanently flooded (F); and not frequently flooded as defined by SSURGO • Palustrine emergent, scrub-shrub, and forested wetlands along with those mixed types that less than 5 acres in size in Wisconsin or less than 2 acres in size in Illinois and outflowing artificially or intermittently and only seasonally flooded (C), seasonally flooded/saturated (E), or semipermanently flooded (F); and not frequently flooded as defined by SSURGO • Palustrine emergent, scrub-shrub, and forested wetlands along with those mixed types that are isolated and only seasonally flooded (C), seasonally flooded/saturated (E), or semipermanently flooded (F); and not frequently flooded as defined by SSURGO • Palustrine aquatic bed isolated wetlands that are permanently flooded • Scrub-shrub and forested wetlands less than less than 5 acres in size in Wisconsin or less than 2 acres in size in Illinois (must be PFO1) • Rivers
Low	• All remaining wetlands

2.5.12 Groundwater Influence on Stream Recharge

Wetlands with groundwater discharge and wetlands that have a zero depth to the annual or seasonally high water table based on SSURGO were identified as groundwater dependent (Table 31). Groundwater dependent wetlands that are outflow or throughflow are labeled as having a high functional significance of groundwater influence on stream recharge. This approach differs from the 2011 MDEQ analysis, which used geospatial output from a model based on Darcy's law with inputs of soil transmissivity and topography to determine the rate of groundwater movement. These data are not available in the project watersheds.

Table 31. Criteria for groundwater influence functional significance

Functional Significance	Selection Criteria
High	• Wetland with a zero depth to the water table (annual or seasonal) and is outflow or throughflow
Moderate	• All remaining wetlands with a zero depth to the water table (annual or seasonal)
Low	• All remaining wetlands

2.5.13 W-PAWF Results

The results of the W-PAWF classification presented in this section are based on equally weighing all twelve indicators (Table 32). Each indicator was assigned a High, Moderate, or Low level of significance as described in Table 20 through Table 31. Equally weighted composite scores for each existing wetland and PRW and detailed W-PAWF scoring for each of the watersheds are provided in the following sections (Figure 24 through Figure 33 and Table 33 through Table 37). Composite scores range from a low of 12 (low functional significance for all indicators) to a high of 36 (high functional significance for all indicators). Within the results, there are scored indicators which do not have any associated wetlands (acres are zero), in these cases additional research may be needed to adjust the approach or thresholds for scoring that indicator. Appendix A includes additional detailed results for flood water storage, streamflow maintenance, nutrient transformation, and sediment and other particulate retention for each of the watersheds.

Table 32. Wetland Scoring

Functional Significance	Numeric Score
High	3
Moderate	2
Low	1

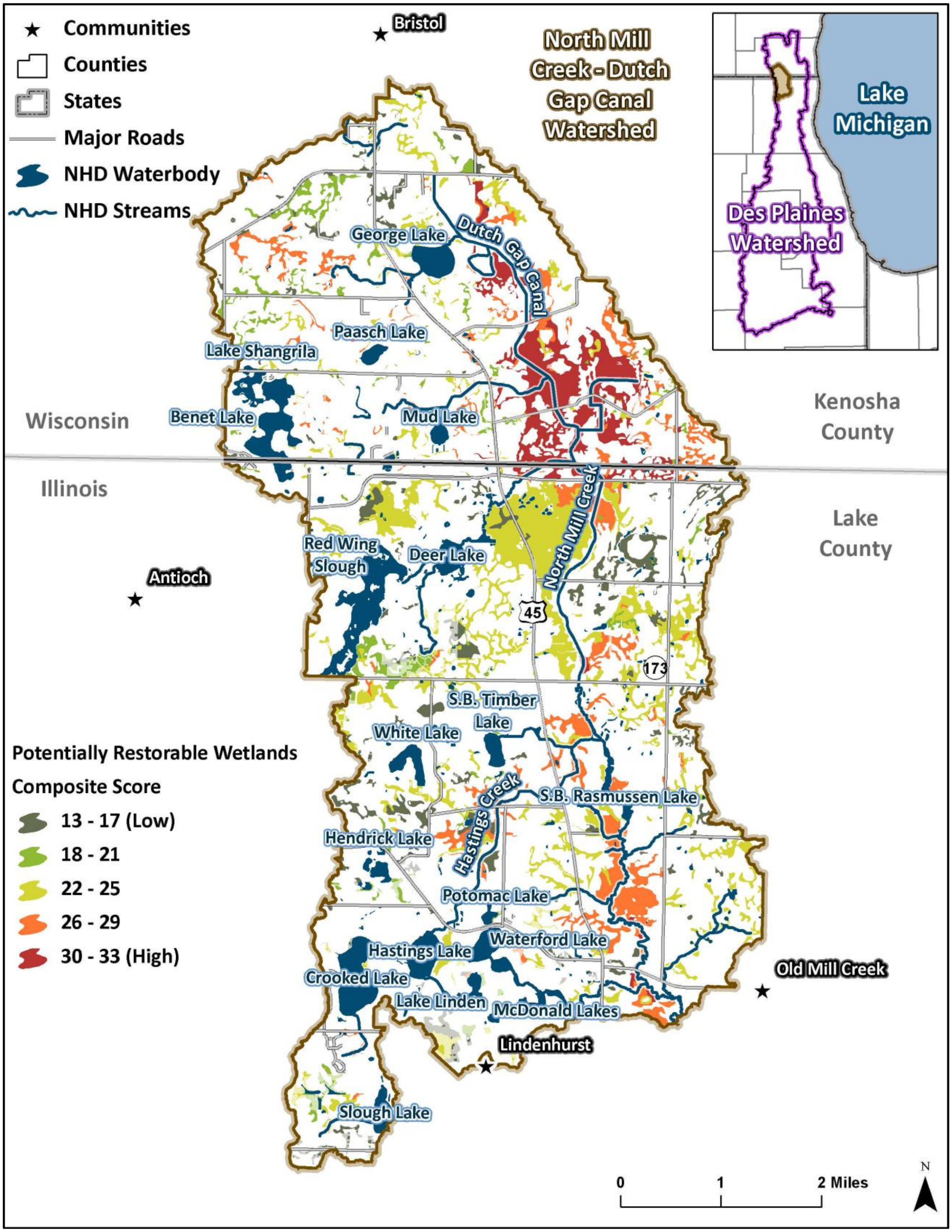
North Mill Creek – Dutch Gap Canal Watershed Results

Table 33. North Mill Creek – Dutch Gap Canal watershed, results

Functional Indicator	Functional Significance (acres)					
	PRW			Existing		
	Low	Medium	High	Low	Medium	High
Flood water storage	1,021	799	2,974	1,026	1,835	1,492
Streamflow maintenance	4,051	908	202	2,908	1,183	262
Nutrient transformation	3,699	1,067	27	2,253	2,100	0
Sediment and other particulate retention	730	505	3,559	555	826	2,972
Shoreline stabilization	5	1,215	3,573	849	668	2,835
Stream shading	1,184	2,763	846	1,004	2,573	775
Fish habitat	2,627	151	2,015	1,209	95	3,049
Waterfowl and waterbird habitat	3,875	46	873	3,200	225	928
Shorebird habitat	8	2,926	1,860	1,248	2,525	579
Interior forest bird habitat	1,193	315	3,285	2,253	162	1,938
Amphibian habitat	3,477	48	1,268	1,532	0	2,821
Influence of groundwater on stream recharge	0	1,812	2,982	0	2,557	1,796

Zeros in the table do not have any associated wetlands acres; the approach can be modified to adjust the scoring.

Fewer acres → Highest number of acres



Lighter shaded areas are historic wetlands that have been converted to developed land uses.

Figure 24. Potentially restorable wetlands composite scores of functional significance, North Mill Creek – Dutch Gap Canal watershed.

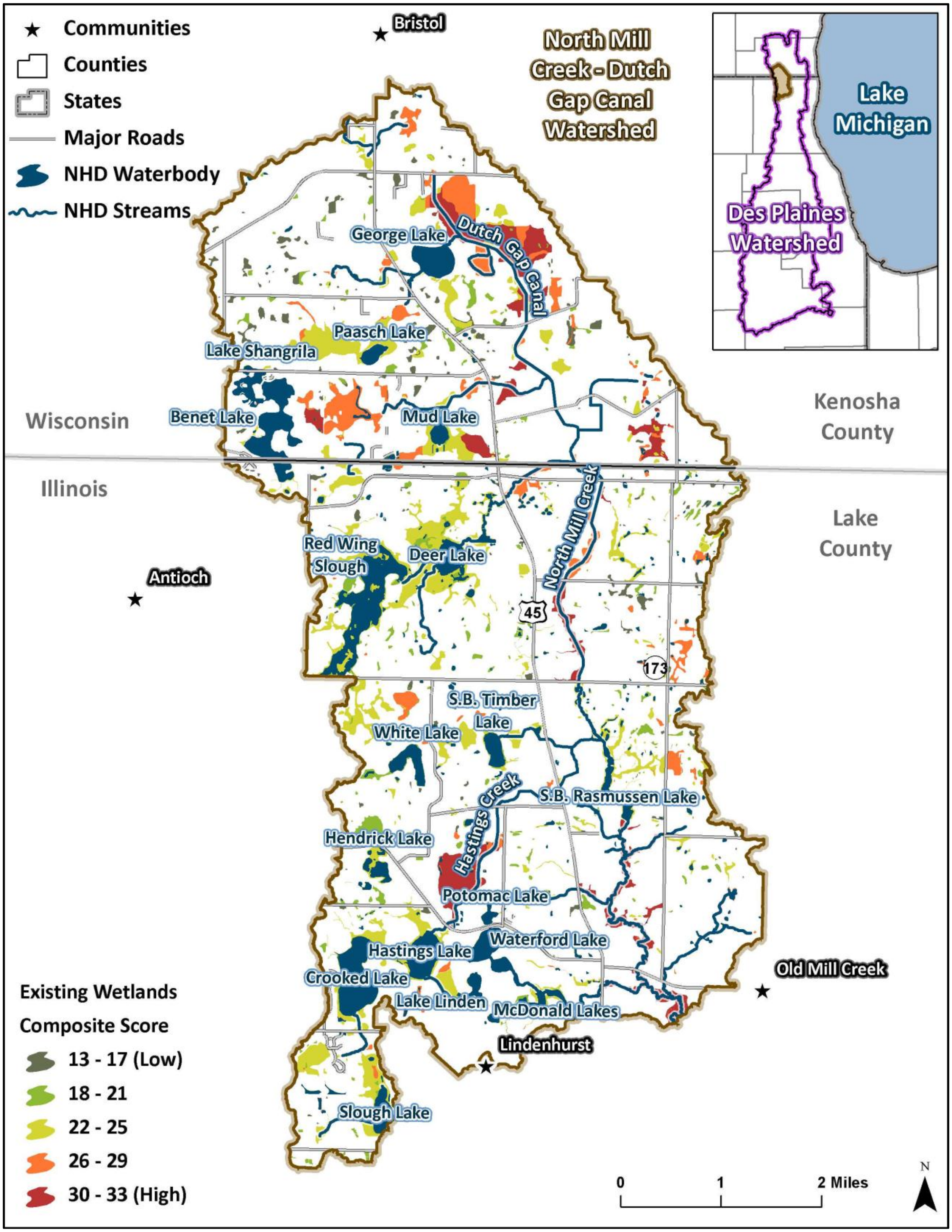


Figure 25. Existing wetlands composite scores of functional significance, North Mill Creek – Dutch Gap Canal watershed.

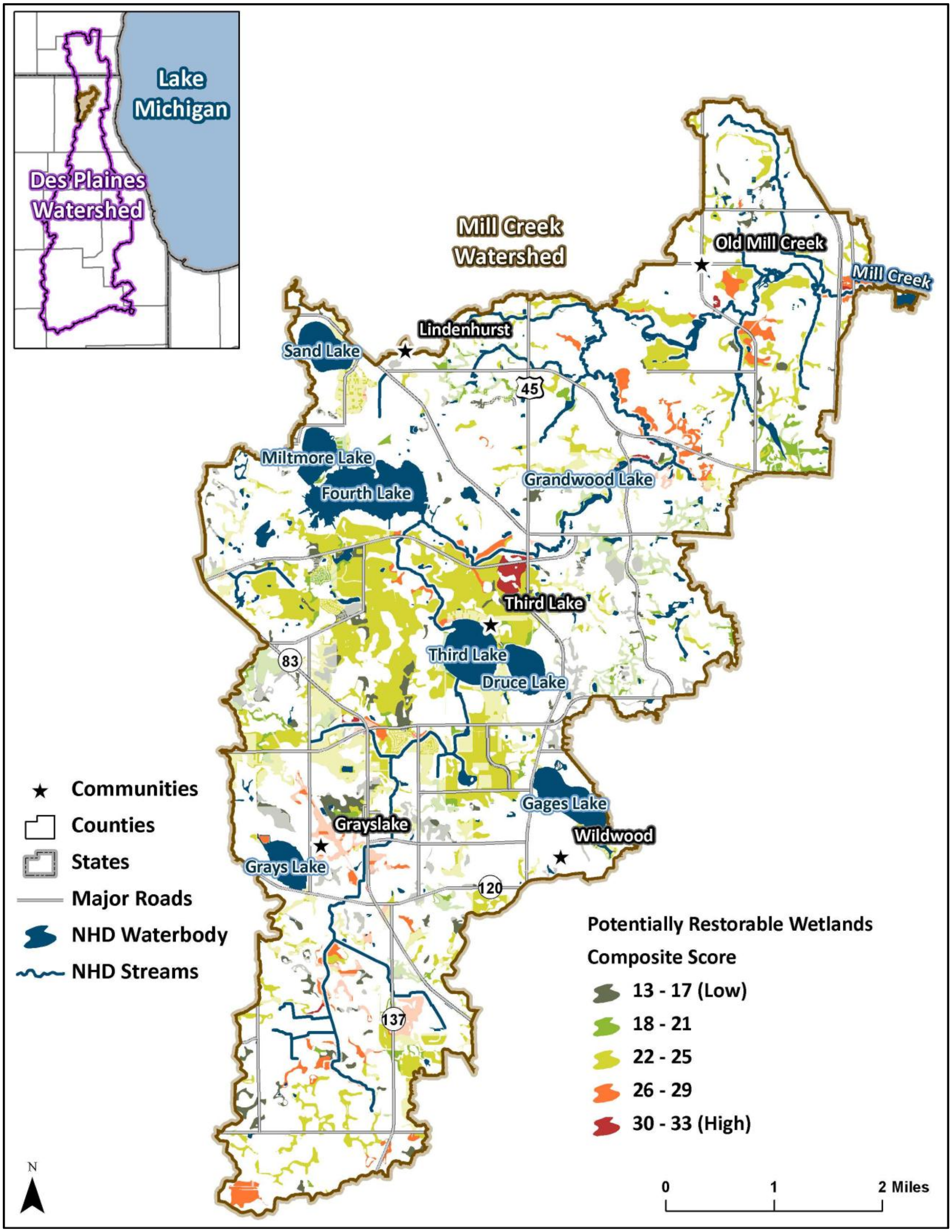
Mill Creek Watershed Results

Table 34. Mill Creek watershed, results

Functional Indicator	Functional Significance (acres)					
	PRW			Existing		
	Low	Medium	High	Low	Medium	High
Flood water storage	2,462	267	2,112	1,353	1,497	1,112
Streamflow maintenance	4,910	189	219	2,966	960	36
Nutrient transformation	12	15	2	1,902	2,060	0
Sediment and other particulate retention	1,470	550	2,822	678	419	2,865
Shoreline stabilization	13	920	3,909	1,013	387	2,563
Stream shading	1,492	3,106	244	802	2,619	542
Fish habitat	2,573	1	2,268	1,059	108	2,796
Waterfowl and waterbird habitat	4,718	96	27	3,046	141	776
Shorebird habitat	18	4,274	550	1,522	2,067	374
Interior forest bird habitat	2,298	8	2,535	2,495	57	1,410
Amphibian habitat	2,362	0	2,480	965	0	2,998
Influence of groundwater on stream recharge	0	1,773	3,069	0	1,730	2,232

Zeros in the table do not have any associated wetlands acres; the approach can be modified to adjust the scoring.

Fewer acres → Highest number of acres



Lighter shaded areas are historic wetlands that have been converted to developed land uses.

Figure 26. Potentially restorable wetlands composite scores of functional significance, Mill Creek watershed.

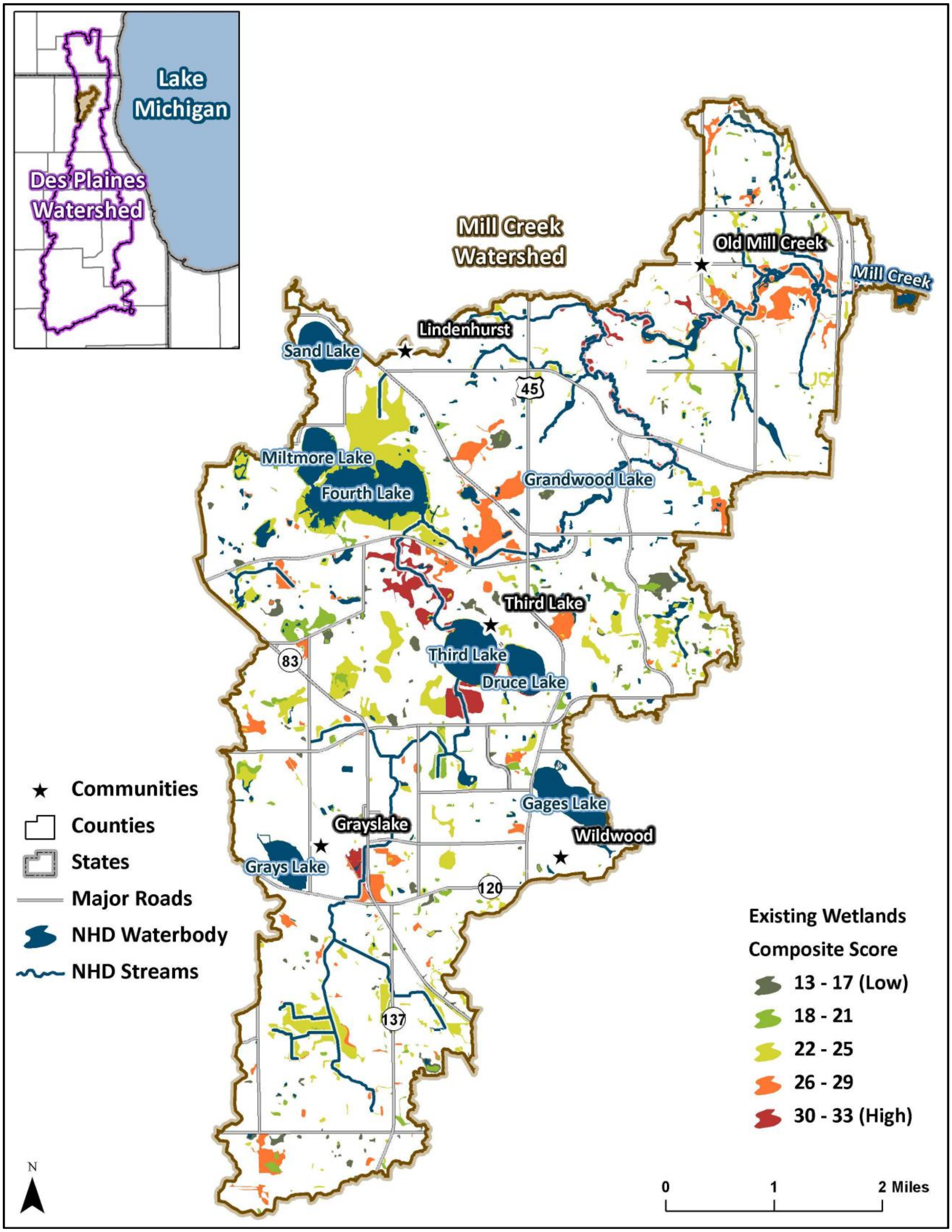


Figure 27. Existing wetlands composite scores of functional significance, Mill Creek watershed.

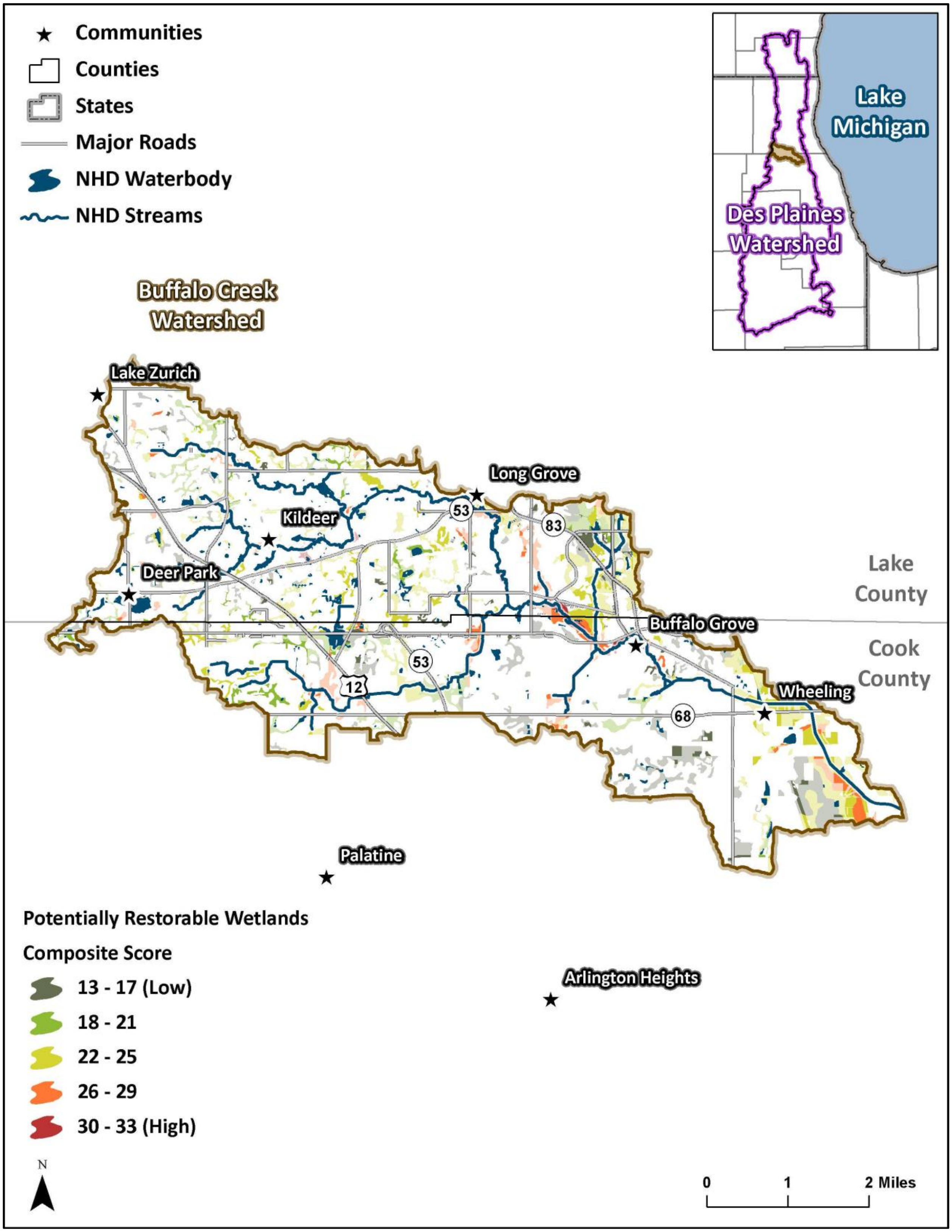
Buffalo Creek Watershed Results

Table 35. Buffalo Creek watershed, results

Functional Indicator	Functional Significance (acres)					
	PRW			Existing		
	Low	Medium	High	Low	Medium	High
Flood water storage	1,780	908	1,099	296	595	685
Streamflow maintenance	3,825	40	159	1,276	285	15
Nutrient transformation	3,367	421	0	837	739	0
Sediment and other particulate retention	1,461	852	1,475	634	225	717
Shoreline stabilization	52	1,166	2,570	96	245	1,236
Stream shading	1,431	2,226	131	279	831	466
Fish habitat	1,741	1	2,045	578	99	899
Waterfowl and waterbird habitat	3,565	66	157	1,205	126	246
Shorebird habitat	59	2,903	826	565	775	236
Interior forest bird habitat	2,431	62	1,295	662	35	880
Amphibian habitat	1,616	0	2,172	446	0	1,130
Influence of groundwater on stream recharge	0	688	3,100	0	563	1,013

Zeros in the table do not have any associated wetlands acres; the approach can be modified to adjust the scoring.

Fewer acres → Highest number of acres



Lighter shaded areas are historic wetlands that have been converted to developed land uses.

Figure 28. Potentially restorable wetlands composite scores of functional significance, Buffalo Creek watershed.

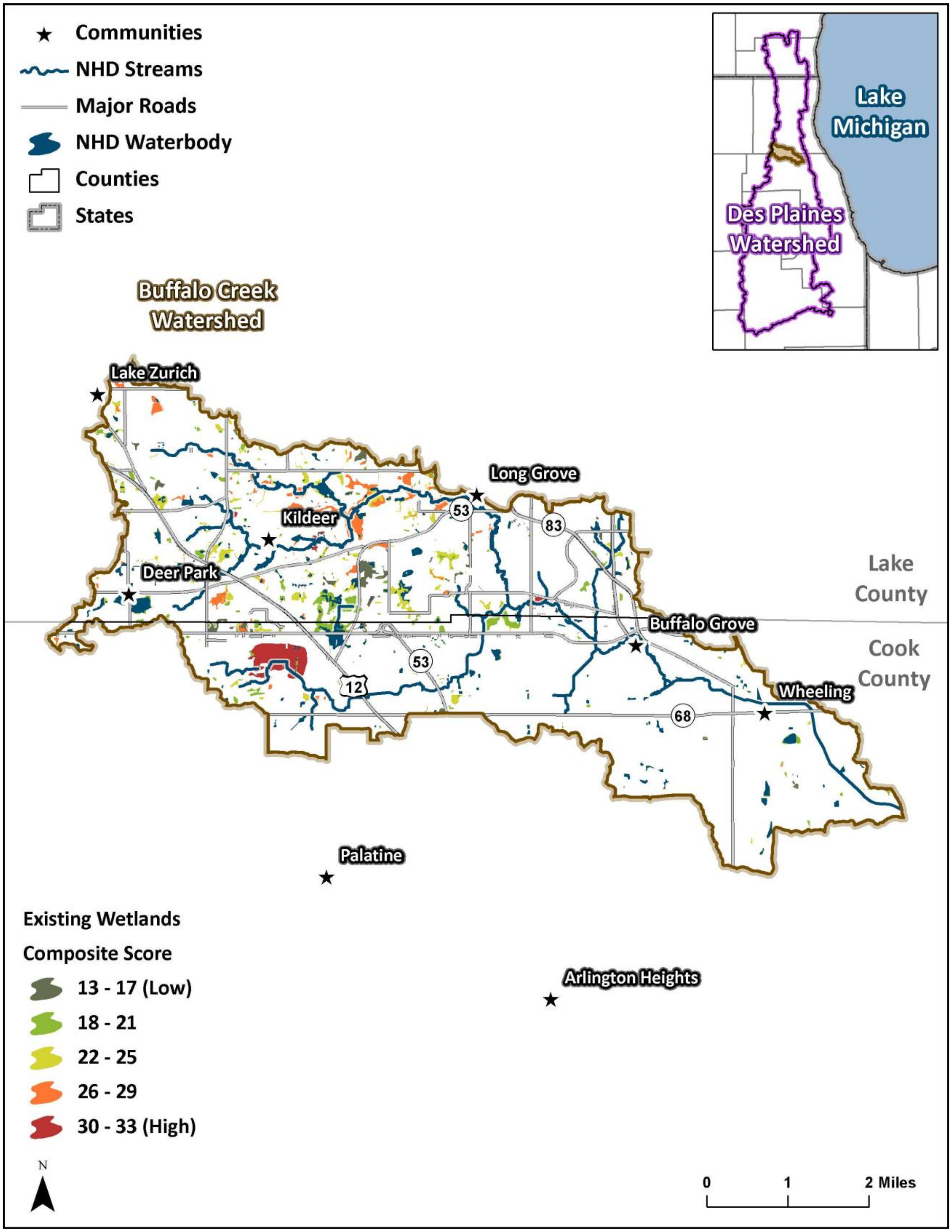


Figure 29. Existing wetlands composite scores of functional significance, Buffalo Creek watershed.

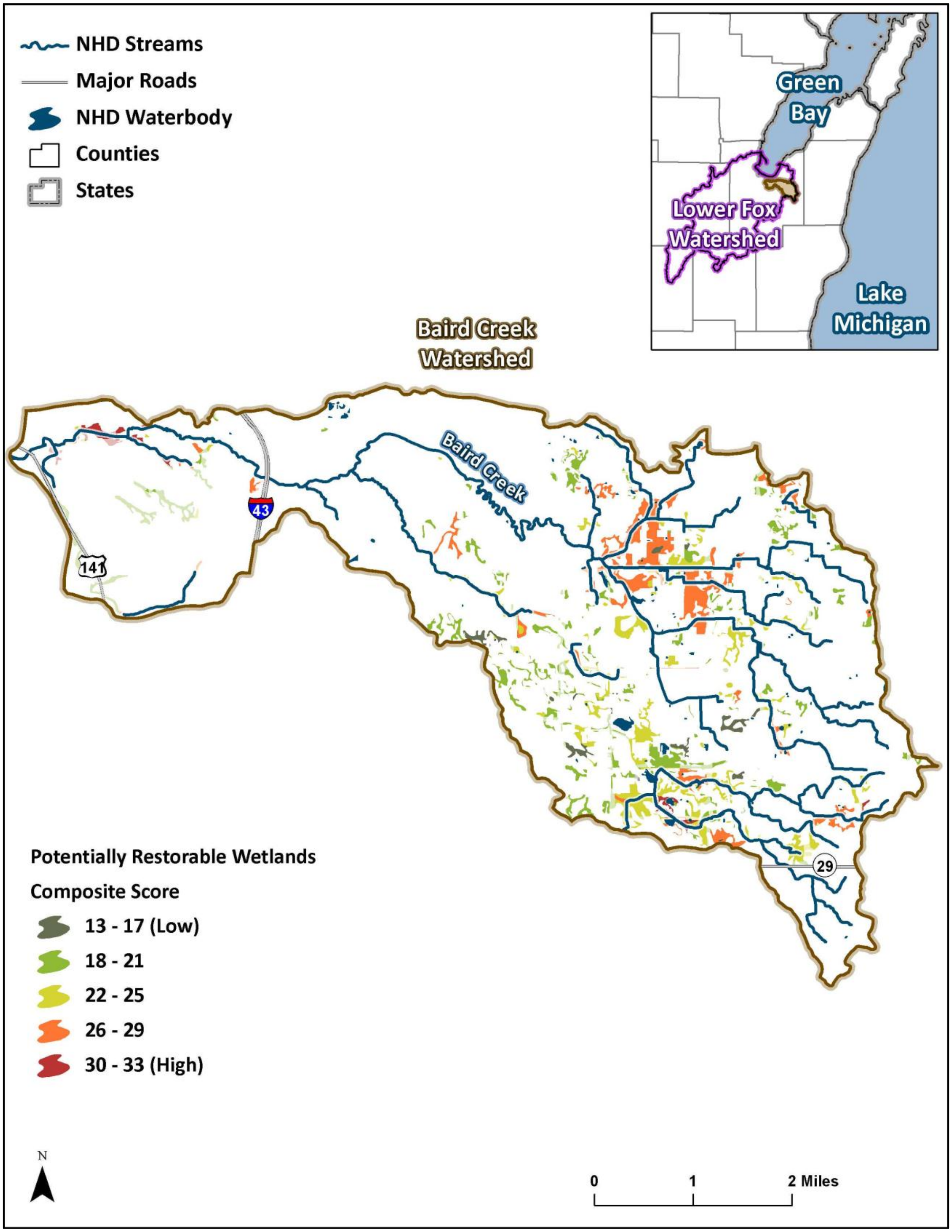
Baird Creek Watershed Results

Table 36. Baird Creek watershed, results

Functional Indicator	Functional Significance (acres)					
	PRW			Existing		
	Low	Medium	High	Low	Medium	High
Flood water storage	117	355	1,120	211	490	922
Streamflow maintenance	980	585	27	687	849	87
Nutrient transformation	473	754	366	467	614	541
Sediment and other particulate retention	71	61	1,460	172	391	1,060
Shoreline stabilization	1,022	39	530	919	125	579
Stream shading	681	0	911	753	341	528
Fish habitat	1,074	15	503	982	145	496
Waterfowl and waterbird habitat	1,164	427	0	1,106	508	8
Shorebird habitat	197	1,395	0	633	982	8
Interior forest bird habitat	0	754	838	642	274	706
Amphibian habitat	692	467	433	544	641	438
Influence of groundwater on stream recharge	0	1,519	73	115	1,403	104

Zeros in the table do not have any associated wetlands acres; the approach can be modified to adjust the scoring.

Fewer acres → Highest number of acres



Lighter shaded areas are historic wetlands that have been converted to developed land uses.

Figure 30. Potentially restorable wetlands composite scores of functional significance, Baird Creek watershed.

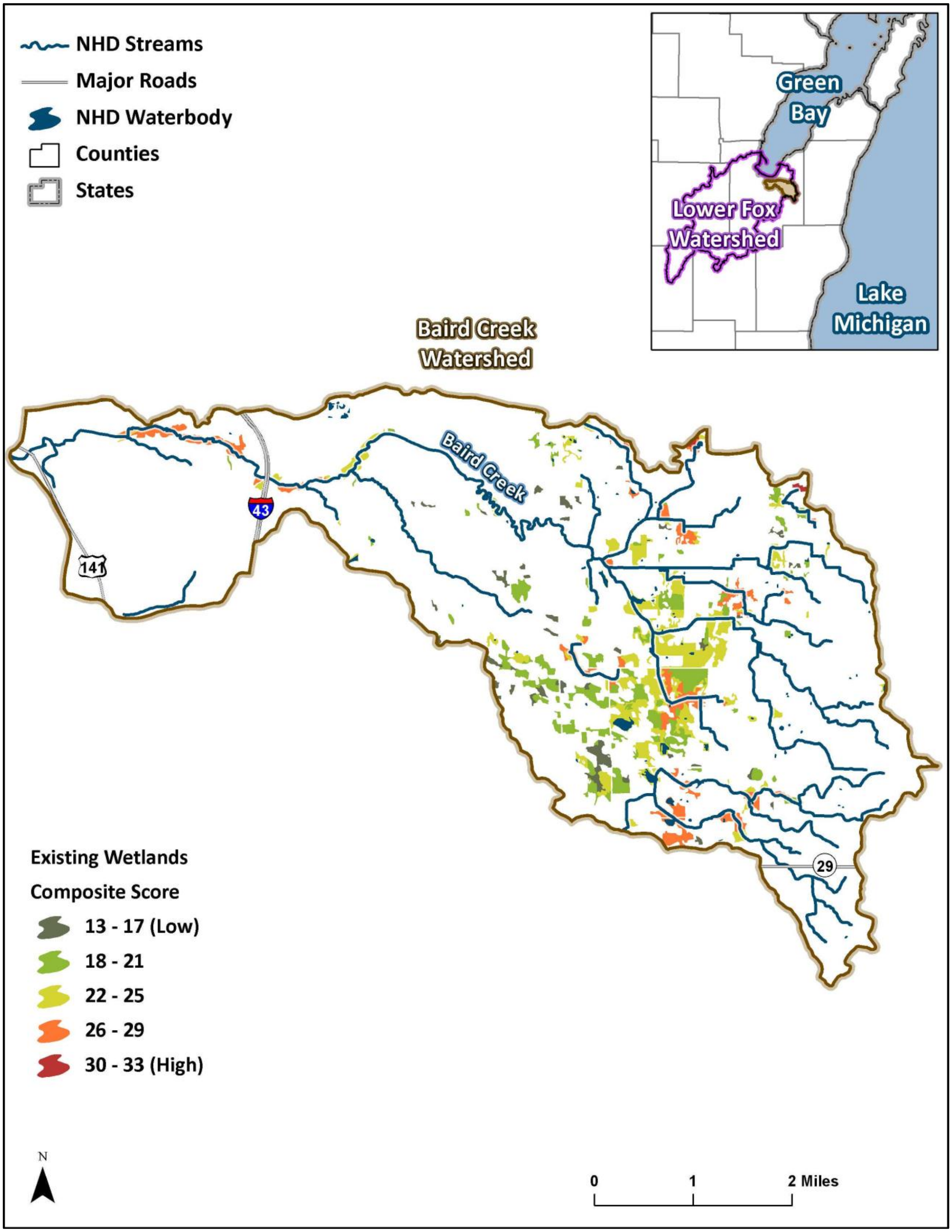


Figure 31. Existing wetlands composite scores of functional significance, Baird Creek watershed.

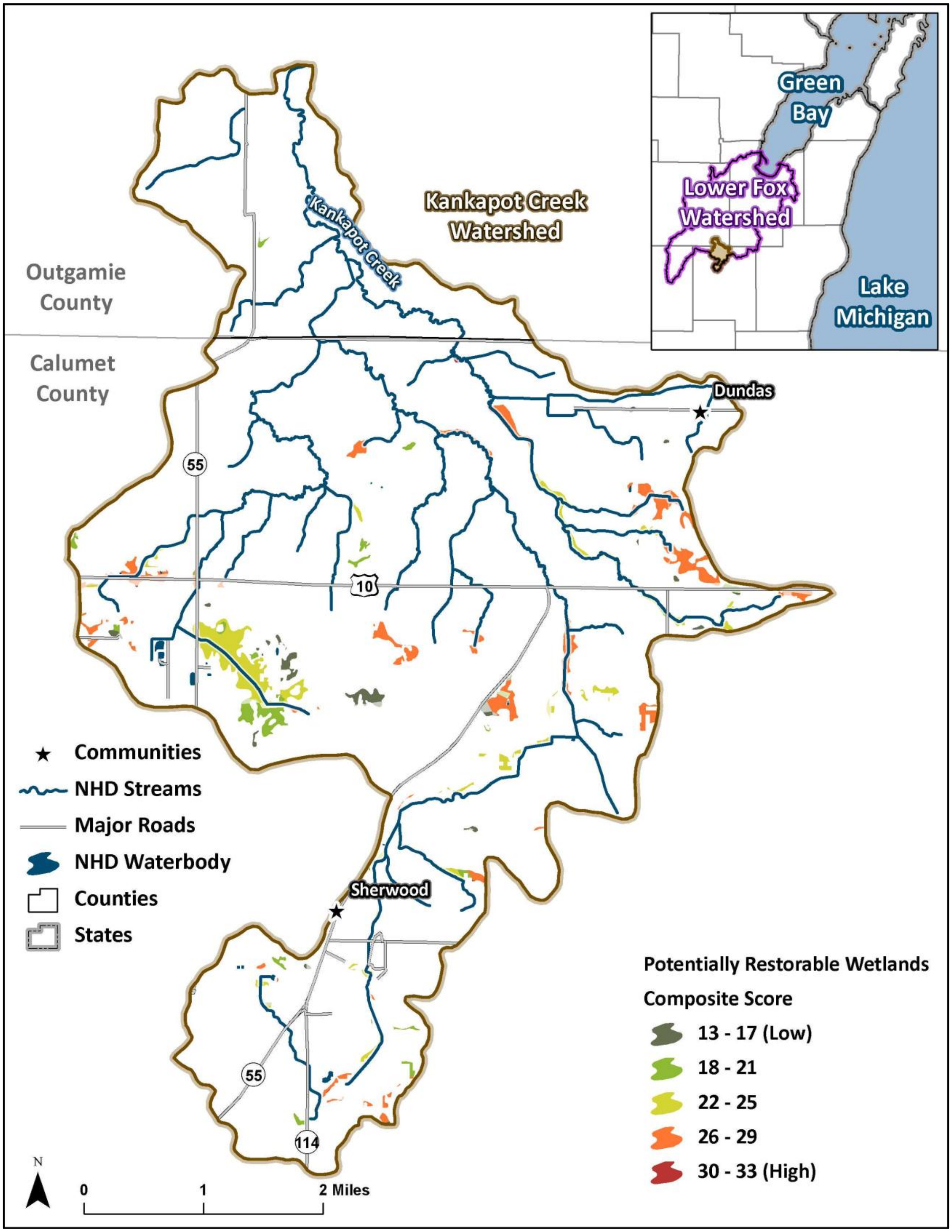
Kankapot Creek Watershed Results

Table 37. Kankapot Creek watershed, results

Functional Indicator	Functional Significance (acres)					
	PRW			Existing		
	Low	Medium	High	Low	Medium	High
Flood water storage	49	251	434	89	302	568
Streamflow maintenance	479	78	211	397	254	307
Nutrient transformation	2	618	114	85	393	480
Sediment and other particulate retention	245	184	305	186	279	493
Shoreline stabilization	182	119	433	309	210	440
Stream shading	212	322	199	155	647	157
Fish habitat	380	0	353	204	0	755
Waterfowl and waterbird habitat	616	118	0	395	157	406
Shorebird habitat	2	731	0	29	929	0
Interior forest bird habitat	0	364	370	382	329	247
Amphibian habitat	438	45	251	543	21	395
Influence of groundwater on stream recharge	0	598	136	27	236	696

Zeros in the table do not have any associated wetlands acres; the approach can be modified to adjust the scoring.

Fewer acres → Highest number of acres



Lighter shaded areas are historic wetlands that have been converted to developed land uses.

Figure 32. Potentially restorable wetlands composite scores of functional significance, Kankapot Creek watershed.

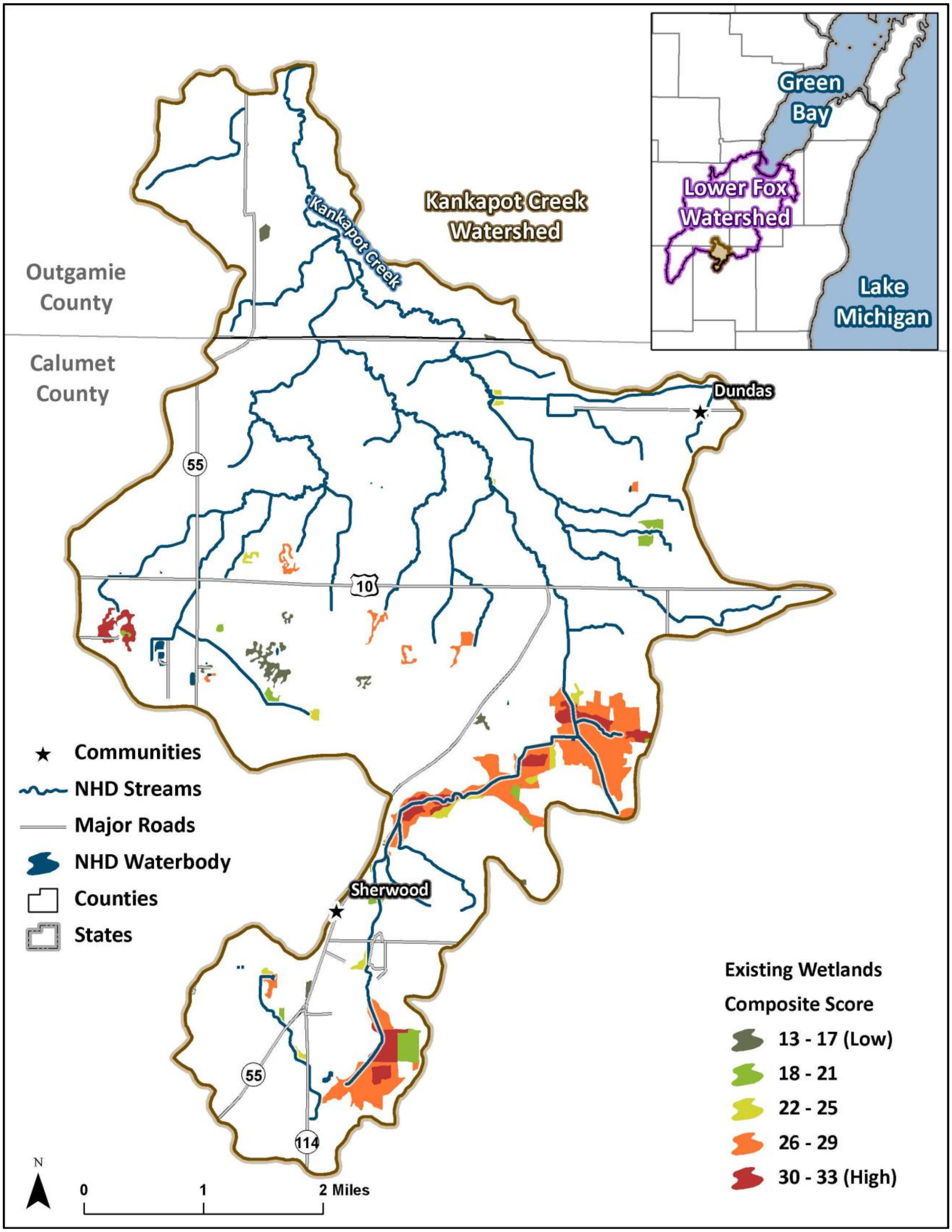


Figure 33. Existing wetlands composite scores of functional significance, Kankapot Creek watershed.

3. Marketing Plan

The goal of the wetland marketing plan is to identify the benefits of wetland functions for specific key audiences and develop tailored messages to first increase awareness about the location of potentially restorable wetlands and the associated benefits, then generate interest in and a desire to implement wetland management activities. Ultimately, the goal of the marketing plan is to motivate key audiences to participate in wetland management activities, whether that is conducting wetland restoration on their property or making policy decisions that will motivate landowners to do so. Providing information on targeted wetlands management opportunities, as described in the previous sections, is the first step in motivating key stakeholders, such as agricultural landowners, to take action.

This document is intended for use by agencies, non-governmental organizations, and other conservation partners working in the Des Plaines River watershed and the Lower Fox River watershed with an interest in educating property owners and other decision-makers about the ecosystem services of local wetlands, as identified in previous sections, and promoting wetland management activities. In the Des Plaines River watershed, potential users of this document include the LCSMC, the Lake County Forest Preserve District, and the McHenry-Lake County soil and water conservation district (SWCD), lake managers, watershed groups, and the Des Plaines River Watershed Workgroup. In the Lower Fox River watershed, potential users include county land conservation departments and watershed organizations.

3.1 Market Analysis

Changing behavior through marketing efforts requires an understanding of key audiences' existing behaviors, perceptions, attitudes, and motivations. A market analysis helps to gain this understanding through two components: an inventory of key target audiences and a key target audience characterization. These components will help to determine the most meaningful product/service that the identified wetland management opportunities can provide for each audience. This section presents a preliminary inventory of key target audiences by watershed and a corresponding preliminary key target audience characterization.

3.1.1 Inventory of Key Target Audiences by Watershed

Creating an inventory of key audiences linked to the Wetlands Management Opportunities analysis focuses on determining (1) who owns the lands where potentially restorable wetlands and existing wetlands are located in each watershed and (2) who has the capacity to help motivate behavior changes of these landowners. Sources of information used to compile an inventory of key target audiences included landownership data and existing watershed management plans, as well as input from key local stakeholders.

Land Ownership in the North Mill Creek - Dutch Gap Canal and Mill Creek Watersheds

For this project, identifying the landowners of the parcels with PRWs on open space as identified in the Wetlands Management Opportunities analysis in the North Mill Creek - Dutch Gap Canal and the Mill Creek watersheds in the Des Plaines River watershed was possible due to the availability of the landownership information.

In the North Mill Creek - Dutch Gap Canal watershed, there are 4,110 acres of PRWs located on open space. Figure 34 shows the location of the PRWs located on public open space in the North Mill Creek watershed. Table 38 provides a breakdown of the PRW acreage located on open space in each composite score category by landowner type for the North Mill Creek - Dutch Gap Canal watershed. According to Table 38, approximately 75 percent of the PRW acreage on open space in the North Mill Creek - Dutch Gap Canal watershed is located on privately-owned land. The other landowners within this watershed with PRWs on open space include the Forest Preserve District (18 percent), State (3 percent), and religious institutions (3 percent). Other public or quasi-public landowners with less than 3 percent of the PRW acreage on open space include home owner/business association, park district, school district, municipality, private club, hospital, Kenosha County. This indicates that based on land ownership only, wetland marketing in the North Mill Creek - Dutch Gap Canal watershed should predominantly focus on private landowners. Further stratification of these landowners to determine what percentage is agriculture, residential, and commercial, as well as identifying the potential restoration opportunities on PRWs held by existing government (e.g., Forest Preserve, State), would help to refine marketing messages and approaches. Other important indicators that could be evaluated include interest and willingness of landowners and goals in each watershed (e.g., nutrient reduction).

Table 38. Landowners with a minimum of 1 acre of PRWs on open space in the North Mill Creek - Dutch Gap Canal and Mill Creek watersheds

Landowner Type	PRW (acres)	
	North Mill Creek - Dutch Gap Canal	Mill Creek
Private	3,073	1,392
Forest Preserve	750	781
State	113	5
Religious Institution	107	74
Home Owner/Business Association	28	128
Park District	15	154
School District/	13	74
Junior College District	--	129
Municipality/Village/Township	4	28
Private Club	3	--
Hospital	3	--
Landfill	--	59
Utility	--	33
County	1	12
Conservation Group	--	17
Unknown	--	6
Library District	--	2
Association Other	--	4
Total	**4,110**	**2,898**

In the Mill Creek watershed, there are 2,898 acres of PRWs located on open space. Figure 35 shows the location of the PRWs located on public open space in the Mill Creek watershed. Table 38 provides a breakdown of the PRW acreage located on open space in each composite score category by landowner type for the Mill Creek watershed. According to Table 38, approximately 48 percent of the PRW acreage on open space in the Mill Creek watershed is located on privately-owned land. The other landowners within this watershed with PRWs on open space include the Forest Preserve District (27 percent), Park District (5 percent), homeowner/business association (4 percent), junior college district (4 percent), religious institutions (3 percent), and school districts (3 percent). Other public or quasi-public landowners with less than 3 percent of the PRW acreage on open space include landfill, utility, village, conservation group, county, state, library, or township. Like the North Mill Creek - Dutch Gap Canal, this indicates that wetland marketing in the Mill Creek watershed should predominantly focus on private landowners. Further stratification of these landowners to determine what percentage is agriculture, residential, and commercial, as well as identifying the potential restoration opportunities on PRWs held by existing government (e.g., Forest Preserve, Park District), would help to refine marketing messages and approaches. Again, other important indicators that could be evaluated include interest and willingness of landowners and goals in each watershed (e.g., nutrient reduction). The ranked significance of select wetland functions is provided in Appendix A.

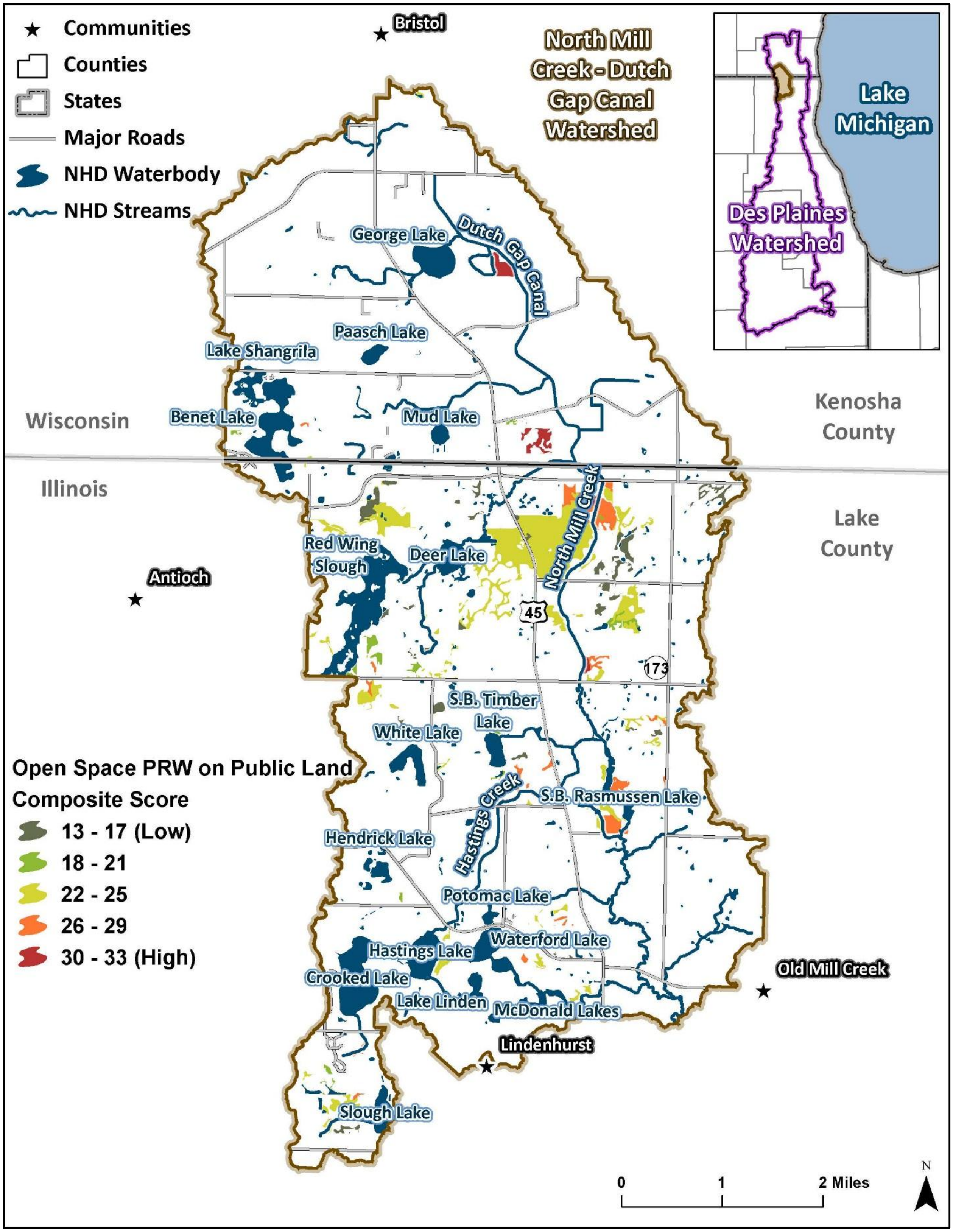


Figure 34. PRWs on public open space in the North Mill Creek - Dutch Gap Canal watershed (Des Plaines River watershed), ranked by composite score for functional significance.

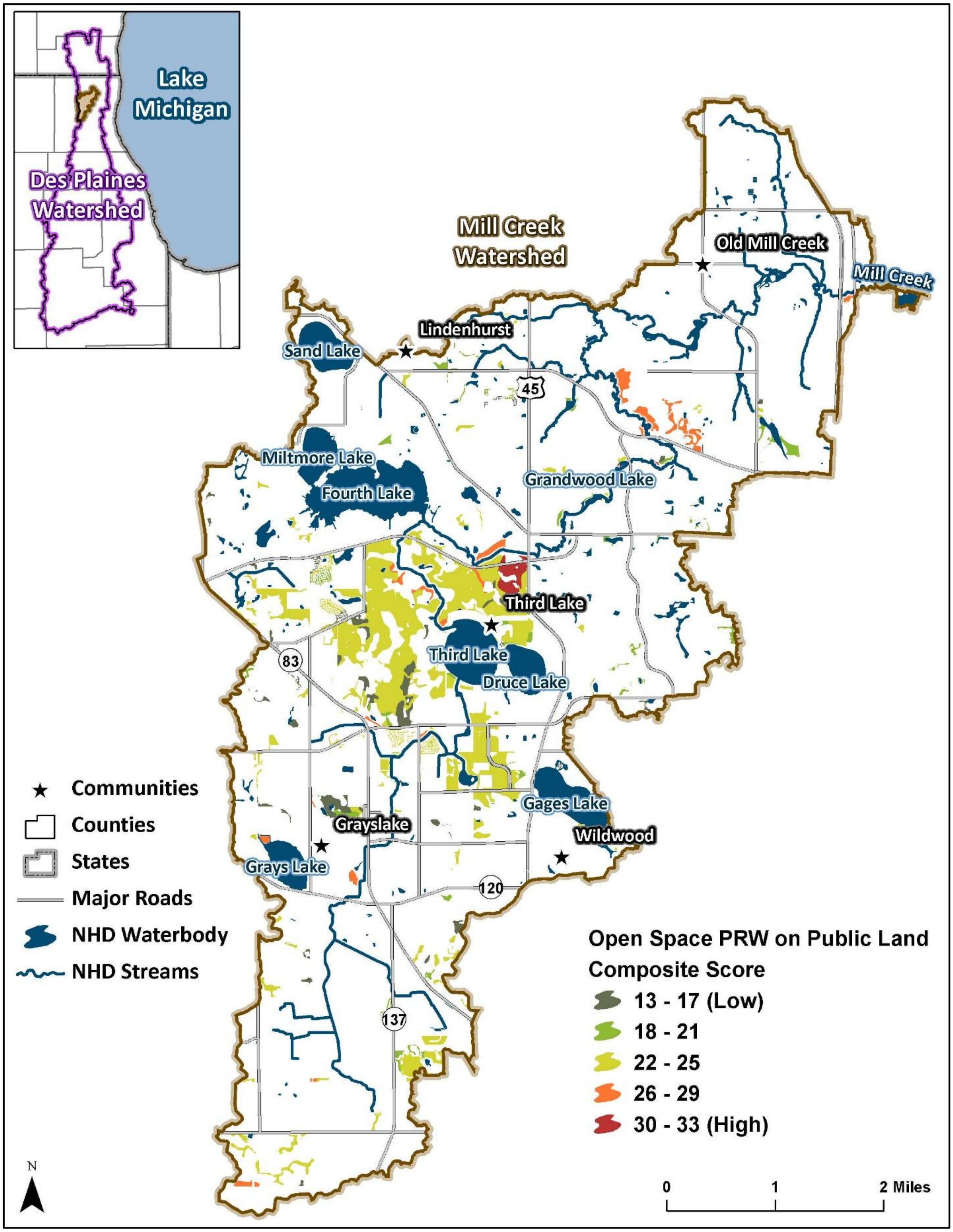


Figure 35. PRWs on public open space in the Mill Creek watershed (Des Plaines River watershed), ranked by composite score for functional significance.

Key Audiences from Existing Watershed Management Plans

Due to limited information on landownership, existing watershed and watershed management plans also served as a source of information for identifying key audiences. Watershed management plans often identify key stakeholders and can even provide insights into potentially effective outreach strategies and messages tailored to the unique characteristics of each watershed's key target audiences. In addition to identifying stakeholders from existing plans to craft a list of key target audiences, the list was further refined using local knowledge from project points of contact at LCSMC and WDNR.

The categories of key target audiences for each watershed are generally the same, but the specific organizations and entities will vary. Categories of potential key target audiences include:

- Private Landowners
- Land and Resource Managers
- Development Community
- Land Use Decision-Makers
- Funders / Project Partners
- Regulators
- Educators

Table 39 presents an inventory of key target audiences by watershed for the Lower Fox River watershed and Table 40 presents an inventory of key target audiences by watershed for the Des Plaines River watershed. Some key target audiences might transcend more than one category. For example some organizations that fall under the Land and Resource Manager category might also fall under the Educator category, and some agencies that fall under the Regulator category might also fall under both the Educator and Funder categories. For purposes of the wetland marketing plan, audiences have been placed into categories that best represent the role they will likely play in promoting and implementing wetland protection and restoration activities in each watershed.

Table 39. Key target audiences in the Lower Fox River watershed

Watershed	Key Target Audiences by Category						
	Private Landowners	**Land and Resource Managers**	**Development Community**	**Land Use Decision-Makers**	**Regulators**	**Funders/ Project Partners**	**Educators**
Baird Creek (BC) and Kankapot Creek (KC)	• Residential developments/ homeowners (e.g., The Ponds at Baird Creek) • Businesses • Agricultural landowners (approx. 187 farms; dairies; other in Outagamie County portion of KC watershed)	• Baird Creek Preservation Foundation (BC) • School districts • Humboldt, Eaton, Brown Counties (BC) • Municipalities • WI DOT • Outgamie and Calumet Counties (KC)	• Home Builders Association • Commercial development interests • Wisconsin Realtors Association	• City of Green Bay (BC) • Humboldt, Eaton, Brown Counties (BC) • Municipalities and towns • Outagamie and Calumet Counties (KC)	• WDNR • USACE • USFWS • Brown County (BC) • Outagamie and Brown Counties (KC)	• Ducks Unlimited • U.S. EPA GLNPO • NRCS • FSA • WWA • TNC • NE WI Land Trust	UW-Green Bay

Table 40. Key target audiences in the Des Plaines River watershed

Watersheds	Key Target Audiences by Category						
	Private Landowners	Land and Resource Managers	Development Community	Land Use Decision-Makers	Regulators	Funders/ Project Partners	Educators
North Mill Creek-Dutch Gap Canal (NM), Mill Creek (MC), and Buffalo Creek (BC)	• Homeowner and lake management associations • Cropland farmers • Agricultural landowners • Equestrian facilities (NM) • Plant nurseries (NM) • Commercial landowners	• Grubb School Drainage District (NM) • IDOT, LCDOT • WIDOT (NM) • Metra Tollway Authority • Lake County • Municipalities and townships • Lake County Forest Preserve District • Lindenhurst Park District (NM) • Avon-Fremont Drainage District (MC) • Grandwood, Grayslake Community, Gurnee, Lindenhurst, Round Lake Area, and Wildwood Park Districts (MC) • Buffalo Creek Forest Preserve (BC) • Buffalo Grove, Arlington Heights, Wheeling Park Districts (BC) • Cook County Forest Preserve District (BC)	• Homebuilders association • Lake County Partners • Consulting engineers • Development corporations • Chamber of Commerce • Lake County Municipal League • Hamilton Partners (BC)	• Lake County ✓ Lake County Board of Commissioners • Cook County (BC) • Kenosha County (NM) • Municipalities and townships	• USACE (Chicago District) • IL EPA • LCSMC • Counties • Municipalities • MWRD (BC)	• FEMA • U.S. EPA/ GLNPO • U.S. Fish and Wildlife Service • USACE (Chicago District) • NRCS • IEPA • IDNR • WDNR (NM) • Kenosha County (NM) • McHenry/Lake County SWCD • Des Plaines River Watershed Work Group • Buffalo Clean Water Partnership • MWRD • North Cook SWCD • CMAP • SEWRPC • Ducks Unlimited • Liberty Prairie Conservancy (MC)	• College of Lake County (NM, BC) • Lake County Audubon • Lake County Farm Bureau • Lake County Extension (UIUC) • Sierra Club (“Woods and Wetlands” Northeastern Illinois) • Conserve Lake County (MC, BC) • Des Plaines River Watershed Workgroup (BC) • UIUC • Barrington Area Conservation Trust (BC) • Citizens for Conservation

3.1.2 Key Target Audience Characterization

In addition to creating an inventory of key audiences for each watershed, it is important to characterize these audiences to support the development of meaningful and effective messaging. Characterizing target audiences means compiling information about priorities, concerns, perceptions, and values. This information will help to determine the types of wetland benefits that will align and resonate with specific key target audiences.

Table 41 summarizes characteristics of specific key target audiences. Some of this characterization information is available through existing reports. For example, the 2004 Baird Creek Watershed Stewardship Assessment addresses some of the development pressures that landowners in Humbolt and Eaton face from development in eastern Green Bay and how those pressures could affect various stakeholders' concern. It is important not to assume that every key target audience under each category has the same set of values, perceptions, priorities, and concerns. These characteristics are likely to vary from watershed to watershed and even watershed to watershed. For example, a 2008 agricultural survey in the Lower Fox River watershed conducted by the University of Wisconsin Extension to support the TMDL development process illustrates watershed differences in attitudes. The findings of this survey stated that surveyed dairy farmers in the "Plum and Kankapot Creek watersheds were significantly more likely to have attitudes more protective of water quality than other subwatersheds (Genskow and Smail 2009)." The Alliance for the Great Lakes conducted a 2014 survey of agricultural landowners in the Lower Fox River Watershed via interview and questionnaire administered by county land and water conservation departments and local agronomists. Findings of this updated survey demonstrated that agricultural landowners in Kankapot Creek place high value on natural resources, specifically on soil and land. Other sources of characterization information include articles, results from community visioning exercises, and inference from local policies. This type of information helps to characterize audiences and align these audiences with wetland benefits/ecosystem services to highlight in promotional messaging.

Where characterization information is not readily available, local project partners familiar with the watersheds (e.g., Baird Creek Preservation Foundation, Buffalo Creek Partnership, Lake County Forest Preserve District, LCSMC) were asked to share their opinions about the values, perceptions, and concerns of key target audiences based on their work in the watersheds. Discussions with these local watershed partners highlighted an interest in conducting more social surveying work to compliment watershed management planning efforts. Future social surveys should include questions related to wetlands restoration and preservation designed to capture information about existing wetland management activities, perceptions, priorities, and incentives. This type of social survey information to further characterize specific key audiences that own property with PRWs and existing wetlands will assist in not only crafting effective wetland marketing messages and approaches, but also identify other needed tools to motivate behavior changes (e.g., financial incentives).

Table 41. Summary of key target audience characteristics by category

Watershed	Characteristics of Key Target Audiences by Category						
	Landowners	Land and Resource Managers	Development Community	Land Use Decision-Makers	Regulators	Funders/ Project Partners	Educators
Lower Fox River watershed							
Baird Creek	Humbolt and Eaton landowners receiving inflated offers to sell land due to development pressures; From Lower Fox TMDL stakeholder involvement process: "Smaller farms are struggling economically....saving them money is an instant buy"; From local organization: landowners can be resistant to change and often don't trust government; many enjoy hunting; need to demonstrate why they should care; 75% of surveyed agricultural landowners responded yes or maybe to entering into contracts with wastewater treatment plants or industry (implications for possible nutrient farming through water quality trading in Lower Fox River watershed); Property tax consequences for wetland restoration	Limited budgets and competing land management priorities	Want agricultural land in Humbolt and Eaton as eastern Green Bay develops; Maximize the developable area of a site; Concerned about burdensome and expensive wetland regulatory requirements; Looking for mitigation banking opportunities	Concerns over balancing development with wetland preservation; Concerns about the cost of wastewater treatment and upgrades	Compliance with state and federal wetland management regulations, including wetlands mitigation banking requirements	Use of funding toward projects that meet eligibility criteria and maximize benefits	Want to effectively educate landowners on conservation and restoration options, particularly where land has potential for development
Kankapot Creek	Dairy operators surveyed in 2008 indicated attitudes protective of water quality; 2014 survey showed that participating agricultural landowners place high value on natural resources, specifically on soil and land; low familiarity with conservation practices; From Lower Fox TMDL stakeholder involvement process: "Smaller farms are struggling economically....saving them money is an instant buy"; From local partner organization: wetlands management will likely be challenging to sell because landowners don't want to take land out of production;	Limited budgets and competing land management priorities	Maximize the developable area of a site; Concerned about burdensome and expensive wetland regulatory requirements; Looking for mitigation banking opportunities	Concerns over balancing development with wetland preservation	Compliance with state and federal wetland management regulations	Use of funding toward projects that meet eligibility criteria and maximize benefits	Want to effectively educate landowners on wetland management, particularly where land is under development

Watershed	Characteristics of Key Target Audiences by Category						
	Landowners	Land and Resource Managers	Development Community	Land Use Decision-Makers	Regulators	Funders/ Project Partners	Educators
Lower Fox River watershed							
Kankapot Creek	55% of surveyed agricultural landowners responded yes or maybe to entering into contracts with wastewater treatment plants or industry (implications for possible nutrient farming through water quality trading in Lower Fox River watershed); Community survey for the Town of Buchanan indicated that 70% of respondents feel that wetland/marsh features in and around Buchanan are important or very important; Property tax consequences for wetland restoration						
Des Plaines River watershed							
North Mill Creek-Dutch Gap Canal	Ag producers are stewards, but need to make money off their land; Pharmaceutical corporation responsible for protecting 394 acres of forest and wetlands during expansion project 20 years ago; commercial land may be managed by a contractor or division of a large commercial owner; HOAs don’t have expertise or money to adequately manage the stormwater facilities and wetlands they are charged with managing, but many are beginning to understand that those areas need to be managed	Forest Preserve Districts support wetland restoration, but need funding to support projects; Limited budgets and competing land management priorities; Drainage Districts are typically concerned with maintaining drainage, not wetlands or water quality	Maximize the developable area of a site	Most local officials want to maximize development potential of their jurisdiction; many in Lake County appear to value open space and environmental quality as well	Concerned about compliance with state and federal wetland management regulations		

Watershed	Characteristics of Key Target Audiences by Category						
	Landowners	Land and Resource Managers	Development Community	Land Use Decision-Makers	Regulators	Funders/ Project Partners	Educators
Des Plaines River watershed							
Mill Creek	Ag producers are stewards, but need to make money off their land; Agricultural operators on forest preserve land follow forest preserve districts' farm license agreements and conservation plan requirements; HOAs don't have expertise or money to adequately manage the stormwater facilities and wetlands they are charged with managing, but many are beginning to understand that those areas need to be managed	Limited budgets and competing land management priorities; Drainage Districts are typically concerned with maintaining drainage, not wetland or water quality	Maximize the developable area of a site	Most local officials want to maximize development potential; many in Lake County appear to value open space and environmental quality; Village of Old Mill Creek wants to preserve country feel and avoid sprawl by placing 1,500 acres in a scenic and conservational green belt in new village plan	Concerned about compliance with state and federal wetland management regulations		
Buffalo Creek	Differing attitudes about wetland management and environmental issues among communities in the watershed due to variations nature-based recreational opportunities and socio-economics among communities	Limited budgets and competing land management priorities; Maximize recreational opportunities at low cost; Drainage Districts are typically concerned with maintaining drainage, not wetland or water quality; Wetland management might be more reactionary due to residential complaints	Metra tollway authority wants to develop proposed tollway with limited controversy; Maximize the developable area of a site	Most local officials want to maximize development potential of their jurisdiction; many in Lake County appear to value open space and environmental quality as well	Concerned about compliance with state and federal wetland management regulations		

3.2 Tailored Promotional Messaging

Using the characterization information for the inventoried key target audiences in Table 41, it is possible to better understand the possible relationship between key audiences' concerns and beneficial wetland functions. The objective is to tie concerns and benefits together to craft messages that will help to raise awareness about the location and benefits of PRWs and existing wetlands, increase interest in playing a role in wetland restoration and preservation, and eventually motivate behavior change to participate in wetland management activities. To meet the goal and objectives of the wetland marketing plan, messages should attempt to break any existing barriers (e.g., misperceptions, attitudes) and gradually motivate behavior change by highlighting meaningful benefits that align with a landowner's concerns, values, or needs.

A range of wetlands benefits can tie into messaging, depending on the characteristics of the target audience. For this effort, there are three broad categories of wetland benefits: water quality, water quantity, and ancillary. The benefits under the first two categories, water quality and water quantity, are described in previous sections. The third category, ancillary benefits, reflect other types of benefits that wetlands can provide that are indirectly related to water quality and water quantity. Habitat benefits, such as fish, waterfowl and waterbird, shorebird, interior forest bird, and amphibian habitat, are also addressed in previous sections. Other potential social and economic benefits, such as recreation, possible increased property values, and increased economic opportunities (e.g., fee hunting), are not reflected in the wetlands management opportunity prioritization process and are described below.

These types of benefits are highly variable from watershed to watershed, depending on the unique political, development, and economic conditions. It is important to keep in mind that the importance and applicability of potential wetland benefits emphasized in the marketing strategy will vary from audience to audience in each watershed, based on an audience's specific characteristics (e.g., concerns, values, perceptions, needs).

Water Quality

- **Reduced pollutant loadings (nutrients and sediment).** Wetlands with characteristics that slow the flow water and encourage settling of particulates. Wetlands can filter 70-90 percent of nitrogen, 45 percent of phosphorous, and retain more than 70 percent of sediment (TCF 2014).

- **Shoreline stabilization.** A wetland's ability to provide erosion control by minimizing the effect of wave action or stream cutting on shores and banks.

- **Decreasing water temperature to support cold water fisheries (stream shading).** High vegetation in wetlands that are forested or scrub-shrub can provide shading, which helps regulate water temperature in nearby streams and waterways.

Water Quantity

- **Decreased downstream flooding (increased flood water storage).** Wetlands that have the ability to stop or delay flooding. The Conservation Foundation compiled information on ecosystems services valuation as part of Chicago Wilderness Green Infrastructure Vision for the CMAP region. Research compiled through this effort shows that an acre of wetlands can typically store 1-1.5 million gallons of floodwater and, in Wisconsin, watersheds with 30 percent wetland or lake area had flood peaks 60-80 percent lower than watersheds with no wetland or lake area (Conservation Fund 2014). Estimates show a potential total benefit of $87/acre from annual reduction in crop subsidies and annual reduction in crop damages from flooding (TWI undated).

- **Streamflow maintenance.** Wetlands that act as sources of groundwater discharge to surface waterways and thus maintain streamflow.

- **Influence of groundwater recharge.** Wetlands often contribute to groundwater and can be important in recharging aquifers. Forested wetlands overlying permeable soil can release up to 100,000 gallons per acre per day into groundwater (Conservation Fund 2014).

Ancillary Benefits

- **Improved/restored wildlife habitat.** This includes fish, waterfowl and waterbird, shorebird, interior forest bird, amphibian habitat. Biological diversity and genetic information are not easy to translate into dollar terms, but a number of studies have quantified the economic value of habitat, with wetlands having a value up to $14,800 per acre per year ($2014) (Conservation Fund 2014).

- **Improved recreational opportunities.** Improved wildlife habitat and lead to increased hunting and birdwatching opportunities, as well as enjoyment of open space.

- **Improved aesthetics.** Developers and communities that maintain wetlands can market the appeal of preserved and restored natural areas to residents and tourists.

- **Increased property value.** Studies have shown that in urban areas, proximity to certain types of wetlands can increase property values. A 1991 American Housing Survey conducted by the Department of Housing and Urban Development and the Department of Commerce also concurs that "when all else is equal, the price of a home located within 300 feet from a body of water increases by up to 27.8%" (InterNACHI undated).

- **Educational opportunities.** Wetlands can provide significant hands-on learning opportunities for schools and residents within a community. Nature centers can design programs around wetland exploration and education, providing educational (and possibly revenue generating) opportunities.

- **Increased economic opportunity.** For property owners, increased economic opportunities can include leasing or selling hunting or birdwatching rights or potential wetland mitigation banking. For communities, wetlands can spur ecotourism through migratory birdwatching and educational programming. Total estimated benefit t is $97/acre, based on the average annual nonflood-related benefits of wetlands, including fishing, hunting, and recreation (TWI undated).Where nutrient credit markets exist, agricultural producers can engage in nutrient farming and sell nutrient removal credits to regulated sources. Water quality trading markets are being developed in the Lower Fox River watershed, providing potential markets for nutrient removal from wetlands. The Wisconsin Wetlands Association (WWA) states that "communities that maintain healthy wetlands on public and private lands can realize a greater portion of the $3.8 billion dollars in annual retail sales and the 72,000 jobs associated with Wisconsin's hunting and outdoor recreation economy (WWA undated).

- **Cost savings.** For agricultural landowners, taking hard-to-farm land out of production for wetlands creation can result in reduced materials and labor, generating a potential cost savings (CTIC 2008). Potential cost savings for communities through reduced need for wastewater treatment plant upgrades to decrease nutrient loads. Wisconsin's current property tax law that calls for some wetlands, namely those classified as "undeveloped lands," to be assessed at 50 percent of fair market value (WWA 2012). The cost of restoring and operating wetlands to remove nitrogen and phosphorus can be 50-70 percent less than the cost of constructing and operating engineered wastewater treatment systems (Conservation Fund 2014). The average wastewater treatment costs using conventional methods are $4.36 per 1,000 gallons, but through wetlands construction, the cost is only $0.63/1,000 gallons ($2014) (Conservation Fund 2014).

It is important to note that the exact type of benefits potentially afforded by a wetland depends on the type of wetland and its location – not every wetland will perform the same and offer the same type of benefits. For example, the size, shape, location, and soil type of a wetland determines its capacity to reduce local and downstream flooding. Understanding a wetland's influence on groundwater recharge requires an understanding of which wetlands are connected to groundwater systems. As a result, aligning specific wetland locations, wetland types, and the specific expected wetland benefits to assist in crafting very specific messages for existing wetlands and PRWs in each watershed is beyond the scope of this project. However, it is highly recommended that local partners undertake this effort as it will be potentially important for raising awareness about the location of PRWs and existing wetlands. If landowners and decision-makers aren't educated about the wetland assets and specific expected wetland benefits associated with private and public land, a solid foundation for motivating behavior change won't exist.

Effective messaging is the result of aligning target audience characterization information with benefits that reflect the audience's values, concerns, attitudes, and perceptions. In addition to crafting messages based on "who cares about what and why," messaging needs to also take into account the words that hold meaning with different target audiences. Audience characteristics will also influence messaging word choice. Table 42 provides preliminary messages for key target audiences in both the Lower Fox River and Des Plaines River watersheds. The messages reflect audience characterization information and the wetland benefits that are likely to be the most valued by the target audience. Where there are watershed specific characteristics that influence messaging, those unique factors are identified and messages reflect those variations.

Table 42. Most valued wetland benefits and preliminary messaging for key target audiences

Key Target Audience and Characteristics	Most Valued Wetland Benefits	Preliminary Messaging
Landowners		
Baird Creek agricultural landowners: resistant to change; concern about economics; many enjoy hunting	• Increased economic opportunity • Cost savings • Increased flood water storage • Improved recreational opportunities • Improved/restored wildlife habitat	• A wetland on your property can help prevent soil erosion, provide flood storage, and keep local water healthy and clean. • If you protect or restore a wetland on your property, the wetland can protect against soil losses and restore local water quality. • There are programs and funding available to help you restore and protect wetlands on your property. • You might be eligible for funding if you restore and protect wetlands on your property.
Kankapot Creek agricultural landowners: high value on natural resources, particularly soil and land; limited knowledge of available programs	• Improved/restored wildlife habitat • Reduced pollutant loadings (nutrients and sediment). • Increased economic opportunity • Cost savings • Increased flood water storage • Improved recreational opportunities	
Private agricultural landowners (non-forest preserve land) in North Mill/Mill Creek/Buffalo Creek: want to keep their soils, be acknowledged for the good work they're already doing	• Increased economic opportunity • Cost savings • Increased flood water storage • Improved recreational opportunities	
Land and Resource Managers		
Limited budgets and competing land management priorities; Regulatory compliance.	• Increased economic opportunity • Cost savings • Increased flood water storage	• Wetlands can purify water for less money. • Wetlands can save your community money by eliminating or reducing the need for costly upgrades to your community's water management systems. • Protecting wetlands at the outset of a project can save you time and money down the road. • Strategic wetland protection and restoration can help reduce flood peaks and damage, protect human health and safety, and reduce the need for expensive projects such as levees, detention ponds, and the reconstruction of flood-damaged roads. • Communities that maintain healthy wetlands on public and private lands can realize a greater portion of the dollars in annual retail sales and jobs associated with hunting and outdoor recreation economy.

Key Target Audience and Characteristics	Most Valued Wetland Benefits	Preliminary Messaging
Development Community		
Residential and commercial developers: Maximize the developable area of a site; regulatory requirements	• Improved recreational opportunities. • Improved aesthetics. • Increased property value. • Increased flood water storage	• Developers can charge premiums (extra charges) for property with water views, views of wooded land, or desirable types of wetlands.
Construction contractors: regulatory requirements	• Cost savings	• Protecting wetlands during the project planning phase can save you time and money.
Land Use Decision Makers		
Municipalities: Concerns over balancing development with wetland preservation; Concerns about the cost of wastewater treatment and upgrades	• Reduced pollutant loadings (nutrients and sediment) • Cost savings • Increased flood water storage • Improved aesthetics • Increased property value • Increased economic opportunity	• Wetlands can purify water for less money. • Property values increase as water quality improves, so preserving wetlands can help increase your community's tax base. • Wetlands can save your community money by eliminating or reducing the need for costly upgrades to your community's water management systems. • Strategic wetland protection and restoration can help reduce flood peaks and damage, protect human health and safety, and reduce the need for expensive projects such as levees, detention ponds, and the reconstruction of flood-damaged roads. • Communities that maintain healthy wetlands on public and private lands can realize a greater portion of the dollars in annual retail sales and jobs associated with hunting and outdoor recreation economy. • Communities that make a commitment to identify and acquire PRWs may be able to leverage state funds such as Wisconsin Coastal Management Grants or WDNR Lake Protection and River Planning Grants.
Regulators		
Concerns about permit compliance and wetland mitigation to replace lost function and value, as well as avoiding unauthorized activities that could affect wetlands; also concerns about effective targeting of limited program resources to achieve regulatory program goals	• Reduced pollutant loadings (nutrients and sediment) • Increased flood water storage • Cost savings	• Target technical assistance and compliance attention to these assessed wetlands in each watersheds to promote cost-effective use of limited programmatic resources that will produce ecological benefits.

Key Target Audience and Characteristics	Most Valued Wetland Benefits	Preliminary Messaging
Funders/Project Partners		
Local, state and federal funders: use of funding toward projects that meet eligibility criteria and maximize beneficial outcomes; encourage funding program participation	• Reduced pollutant loadings (nutrients and sediment) • Cost savings • Increased flood water storage • Improved aesthetics • Increased property value • Increased economic opportunity • Improved/restored wildlife habitat	• Targeted funding to identified and assessed potentially restorable wetlands and existing wetlands in these watersheds can help to incentivize conservation on private lands while reducing water quality impacts, flooding, and improving habitat. • Invest funding in wetland restoration and protection opportunities that already have strong data to support the investment. • Consider working one-on-one with landowners that have these wetlands on their properties to make data-driven conservation and restoration investments. • Consider priority funding to restore and protect the valuable wetland acreage identified and assessed in this watershed.
Local, state, and federal project partners: targeting investment of time and resources in projects that will produce multiple benefits	• Reduced pollutant loadings (nutrients and sediment) • Cost savings • Increased flood water storage • Improved aesthetics • Increased property value • Increased economic opportunity • Improved/restored wildlife habitat • Educational opportunities	• Invest time and resources in wetland restoration and protection opportunities that have strong data to support the investment and project. • Work one-on-one with landowners that have these wetlands on their properties to develop and pursue wetland protection and restoration projects that can benefit landowners, the community, and the watershed.
Educators		
Raise awareness about opportunities to restore and protect wetlands, promote behavior change, demonstrate wetland restoration and protection benefits	• Reduced pollutant loadings (nutrients and sediment) • Increased flood water storage • Improved/restored wildlife habitat • Educational opportunities	• The data and information provided through the Wetland Management Opportunities analysis will allow you to raise landowner awareness about the valuable natural resources on their property and help craft incentives to promote conservation behaviors. • Use your education expertise and the data about wetland restoration and protection opportunities to encourage landowners to make conservation decisions that will benefit them, their community, and their watershed.

3.3 Marketing Formats and Communication Channels/Distribution

Formatting and distributing the messages crafted to promote wetland management are also key components of the marketing plan. Formats for conveying key messages can range from printed materials (e.g., fact sheets, newsletters, brochures) to in-person, hands-on activities (e.g., workshops, demonstrations, presentations). Communication channels and distribution mechanisms can also vary, ranging from traditional media (e.g., newspaper, radio, television), electronic and social media, and one-on-one communication with trusted information sources. While values and perceptions vary among key target audiences help to drive messaging, the communication preferences among these audiences drive formatting and distribution choices. Not only do the messages have to resonate with the target audience, but they also need to be delivered by an individual, organization, or forum that the audience trusts in a format that aligns with the audience's communication preferences. As a result, it is important to understand and apply these communication preferences. This section presents communication information relevant to the key target audiences in each major watershed and, where available, watersheds. More social survey work is recommended to assess the communication preferences among key target audiences to allow for refinement of marketing formats and trusted communication channels.

3.3.1 Communication Preferences in the Lower Fox River Watershed

The Alliance for the Great Lakes 2014 survey of agricultural landowners in the Lower Fox River Watershed contained a number questions designed to develop a better understanding of the communication preferences of agricultural landowners, including the most trusted organizations for information and how they prefer to receive/exchange information. The findings have implications for both Baird Creek and Kankapot Creek watersheds.

The preferred methods of communication were: newsletters, on farm demonstrations/field days, one on one hands on demonstrations, and magazines (based on responses from the entire Lower Fox River watershed). In terms of trusted sources of information, agricultural landowners go to similar organizations for both farming advice and water quality information (% indicates the percentage of respondents who named this organization as important).

- For agronomic information in Kankapot Creek, trusted sources include: local farm cooperatives/crop consultants (92%); FSA (58%) and county land and water conservation department (58%); other farmers (50%) and Fox Valley Tech Ag Program (50%).
- For water quality information in Kankapot Creek, trusted sources include; local farm cooperatives/crop consultants (73%); county land and water conservation department (73%); FSA (55%); NRCS (45%).
- For agronomic information in Baird Creek, trusted sources include: local farm cooperatives/crop consultants (74%); other Farmers (68%); FSA (42%) and NRCS (42%).
- For water quality information in Baird Creek, trusted sources include: local farm cooperatives/crop consultants (88%); county land and water conservation department (69%); NRCS (63%).

This information demonstrates that agricultural landowners in Baird Creek and Kankapot Creek are more likely to trust information on wetland benefits if the information comes from local farm cooperatives/crop consultants. This information would most likely be delivered in a one-on-one format, but could also be distributed in other preferred communication channels such as newsletters and on-farm demonstrations/field days.

Survey information about communication preferences for other key audiences in the Baird Creek and Kankapot Creek watersheds was not readily available for use in the development of the marketing plan. This is a potential area for future research and analysis. Key audiences to target for future survey efforts should depend on the link between landownership and location of PRWs and existing wetlands.

3.3.2 Communication Preferences in the Des Plaines River Watershed

Stakeholders participating in this project provided some insights about trusted messengers. For example, in Lake County, stakeholders stated that Conserve Lake County, the University of Illinois Extension, and SWCDs are trusted messengers among the agricultural community in the Des Plaines River watershed. The LCSMC is also a trusted messenger among homeowner associations, developers, and some communities in Lake County, but would not be considered a trusted messenger in the agricultural community.

3.4 Wetland Marketing Case Studies and Existing Materials

There are several approaches to wetlands marketing that local partners can consider, including an overarching wetland marketing campaign at the county or watershed levels and a project-by-project marketing approach. An overarching wetland marketing campaign for a watershed could focus on all landowners with PRWs and existing wetland acreage, as well as the general public, to learn more the types, locations, and potential benefits associated with wetlands. Then, as local partners (e.g., watershed organizations, SWCDs) target specific wetland management opportunities, a project-specific marketing and outreach effort would occur that focuses on the specific and unique benefits of a particular wetland in a particular location for the directly affected stakeholders.

Although local partners should tailor approaches to wetland marketing for specific key audiences and wetland management opportunities, examining the experience of other wetland outreach projects can provide ideas and lessons learned. Local partners involved in the development of the technical analysis and the marketing report requested case study information on other wetland marketing efforts. While there are numerous wetland conservation plans that identify wetland outreach as an important need, few examples of post-implementation wetland marketing programs are readily available on the Internet. Presented below are descriptions of case study information on wetland marketing efforts, as well as projects related to wetland outreach (e.g., surveys for use in developing wetland marketing materials.).

3.4.1 Case Studies

Using Wetland Functional Assessment Data to Conduct Targeted Outreach: Friends of the St. Joe River (Michigan and Indiana) Wetland Partnership Project

This was a three year project involving 15 counties in the St. Joe River Watershed that conducted a Landscape Level Wetland Functional Assessment for the entire watershed. Using the results of the assessment, the project sought to "educate decision-makers and landowners about wetland functions, their importance for quality of life, and their value to the local economy." The educational component of the project included landowner outreach and municipal outreach. The project website includes an Outreach Toolbox, with a variety of resources available, including presentations, checklists, guides, and sample wetland protection ordinance language. For landowners, the project developed and distributed a comprehensive list of available incentives/programs for wetland restoration/protection, including USDA - Wetland Reserve Program, USDA –Conservation Reserve Program, U.S. Fish and Wildlife Service-Partners for Fish and Wildlife Program, Michigan Department of Natural Resources and Environment - Landowner Incentive Program, Ducks Unlimited, and Land Conservancies. In addition, the project developed and distributed outreach materials about wetland protection and restoration for landowners. Outreach targeting municipal officials included a range of materials and formats, such as:

- Model master plan language about the value of wetlands and the options for protection and restoration
- Model zoning ordinance language options (local wetland ordinances, setbacks from wetlands, etc.)
- Custom maps for high priority municipalities showcasing functions of wetlands
- Workshops for municipal planning officials to present planning and zoning tools

The presentation on local wetland options targets local land use decision makers and emphasizes the relationship between wetland management and master planning, including percent wetland loss by county, as well as wetland values and benefits. More information on this project is available at http://www.fotsjr.org/AboutWetlandPartnership.

Understanding A Key Target Audience to Conduct Conservation Marketing: Innovating Outreach to Great Lakes Basin Absentee Landowner Project

Although wetlands were not the focus of this project, the lessons learned from this outreach effort have applicability to wetland marketing due to the demonstration of conducting a survey and a multi-pronged targeted outreach approach intending to change behavior. The three-year project had two primary goals: (1) Reduce the amount of nutrients and sediment that enters the Great Lakes through installation of vegetative filter strips; and (2) Improve the ability of conservation organizations in the Great Lakes Basin to market conservation practices to absentee landowners. The project partners conducted a mail survey of absentee landowners in three Great Lakes counties (Michigan, Wisconsin, and New York). The survey results helped to characterize absentee landowners' demographics, behaviors, values, and importance of sources when making decisions about their land. Using the survey data results, the project partners developed an outreach strategy with the initial goal of raising absentee landowners' awareness of conservation practice benefits and the availability of technical and financial assistance programs. The initial outreach activities included direct mail, telephone calls to invite landowners to participate in a one-on-one meeting at a local coffee shop with NRCS representative. Some meetings in other counties paired local and state conservation staff with landowners to discuss conservation options and opportunities. According to project partners, the multicontact outreach strategies were successful in engaging 30-40 percent of the absentee landowners requesting additional information (Petrzelka et al. 2009). More information is available at http://www.uvm.edu/farmlasts/conferenceoutline/03LandUseConservationAndStewardship/02meetinglandlordandtenantconservationinterests/bumanpresentation.pdf.

Sustainable Shoreview Wetlands: Fostering Community Involvement through Education and Communication (Minnesota)

This report provides a wetland outreach and education roadmap for residents of the City of Shoreview, a built-out second-ring suburb of the Twin Cities Metropolitan area in Minnesota. The wetland outreach and communication recommendations are based on a review of secondary survey sources not specifically related to the wetland outreach project, as well as expert interviews to inventory existing programs, levels of resident awareness, and interest in wetlands conservation. Recommendations developed through this effort included a thematic approach to wetlands communication using a branded outreach campaign, increasing online wetlands information, conducting a wetland walking tour, providing residential wetland workshops, and leveraging existing volunteer organizations. More information on the survey findings and wetlands communication recommendations is available at http://www.shoreviewmn.gov/home/showdocument?id=1722

3.4.2 Existing Wetland Marketing Materials and Surveys

There are existing wetland outreach efforts taking place at the national, state, and watershed scales that target one or more of the key audiences identified in this marketing plan. Some of these existing efforts focus on specific wetland restoration and conservation projects while others focus on wetland conservation as a broad issue. While the outreach materials produced through these efforts don't specifically address the wetlands inventoried in the analysis, the messages and formats of educational materials could be adapted for marketing in a specific watershed. A few of the organizations and associated wetland outreach and marketing offerings are described below.

The **Wisconsin Wetland Association** has a wide variety of wetland marketing materials available on their website, including brochures and fact sheets that highlight the benefits of wetlands. Materials targeting local decision makers are available at http://wisconsinwetlands.org/localgovs.htm. This organization also has a Private Wetland Landowner Outreach Program that offers a compilation of outreach materials intended to promote the protection, restoration and management of privately owned wetlands.

The **Conservation Technology and Innovation Center** has a few resources that describe wetland benefits for agricultural producers. The publication *Wetlands: A More Profitable Alternative?* contains 10 case studies about the economic and environmental benefits generated by wetlands on agricultural property. This document is available at http://www.ctic.purdue.edu/media/pdf/WetlandRestorationSuccessLOW.pdf. Another CTIC publication, *Wetlands: A Component of an Integrated Farming Operation*, describes how agricultural property owners can generate economic benefits from wetlands. This document is available at http://www.ctic.purdue.edu/media/users/lvollmer/pdf/CTIC_Wetlands.pdf

The Wetlands Initiative focuses on wetlands management in the Midwest and offers a number of publications with useful wetland economic benefits information in easy-to-read format, such as one-page fact sheets, that could be shared with local government officials. These materials are available at http://www.wetlands-initiative.org/why-wetlands/publications.html.

3.5 Recommendations for Future Wetland Marketing Efforts

The analysis of existing wetland-related information for the watersheds in the Des Plaines River and Lower Fox River watersheds, as well as discussions with local watershed partners, highlighted information gaps that could benefit future wetland marketing efforts.

Recommendation 1: Identify Landownership Associated with All PRWS and Existing Wetlands

This project was able to make some correlation between landownership and the location of PRWs and existing wetlands. However, landownership information was only available for two of the five watersheds analyzed for this project. As demonstrated in the Mackinaw River watershed case study, broad outreach can generate participation in conservation activities, but high intensity outreach results in more significant participation. Information on specific landownership, therefore, would allow for a more high-intensity approach to wetland marketing. It is recommended that local partners work to obtain landownership data for all watersheds to support the development of tailored wetland marketing materials and activities.

Recommendation 2: Conduct Social Surveys of Key Audiences to Characterize Wetland Awareness and Behaviors

In the Des Plaines River watershed, there are some secondary sources of information on key target audiences' perspectives on sustainability and quality of life. For example, the Lake County Strategic Planning visioning process addressed the importance of environmental sustainability. Conducting wetland conservation specific social surveys to better characterize the awareness, perceptions, values, behaviors, and motivating factors of key audiences. Surveys could be prioritized to the landowners of PRWs and existing wetlands that have the highest value according to the technical wetlands assessment. While social survey work has been done in the Lower Fox River watershed, the survey focused on agricultural landowners and did not specifically address wetland conservation behaviors. Both watersheds could benefit from additional social surveys with a wetland-focus to help craft targeted, intensive wetland marketing messages and approaches that address key audiences' characteristics.

Recommendation 3: Couple Marketing About Wetland Benefits with Other Incentives

While communicating the functional benefits of wetlands to key audiences is essential for effective marketing, it is also important to look at marketing as one component of an overall approach for changing behavior. Increasing awareness and understanding of wetland management opportunities and benefits may not be sufficient enough to move landowners from interest and desire to actual behavior change. Financial incentives are also a critical component and wetlands marketing efforts should promote the development of these incentives to state and local officials.

Recommendation 4: Inventory and Leverage Existing Wetland Outreach Resources and Partners

As described above, there are several state and regional partners currently working on wetlands communication and outreach. It is important to review these existing materials to determine which documents could be adapted and distributed to key audiences in the targeted watersheds. One option to determine effectiveness of these materials before broad distribution is to conduct a focus group with members of key audiences and modify the materials based on feedback.

4. Integrating Results into Watershed Planning Efforts

A functional assessment can be used to prioritize wetland protection and restoration activities as part of on-going and anticipated watershed planning efforts. Opportunities to integrate the results of this work include an expanded TMDL Implementation Plan for the Lower Fox River TMDL (USEPA et al. 2012) and prioritizing wetland restoration opportunities in watershed plans being developed in Lake County.

Different scenarios can be evaluated which can focus on a single indicator, such as Flood Water Storage, or several indicators. Weighing the various indicators can also be used to evaluate different scenarios. Scenarios should be watershed-specific, for example, a scenario could be based on identifying nutrient TMDL implementation priorities. In this example, key indicators could include Nutrient Transformation, Sediment and Other Particulate Retention, and Shoreline Stabilization. These indicators could be evaluated alone or they could be weighted in an analysis of all indicators. Scenario development will require the database developed as part of this project (see Table 43 for an excerpt from the database). The database which has been provided to both LCSMC and WDNR and is available from USEPA and can be modified in Excel, Access, or in a GIS by selecting the indicators and adjusting the scores in the W-PAWF columns. Wetlands located in specific areas of interest can also be selected in a GIS and then sorted based on indicator score. The results of this work can be incorporated into watershed plans as priority implementation areas specific to planning goals and objectives.

When developing scenarios using the results and database from this project, a user has to consider how the data were analyzed, the limitations of the data, and specific user and watershed needs. Key considerations include:

- PRWs in this analysis do not take into account landowner willingness or the availability of funding mechanisms. Both of these important factors should be defined in a watershed plan.

- Wetland site evaluations are a critical component of effective management. Site evaluations can be used to verify assigned classifications and identify other factors not considered as part of this analysis such as adjacent land uses and errors in spatial datasets.

- An important distinction in the database is the inability to acknowledge the condition of existing wetlands. Existing wetlands may or may not be good candidates for enhancement or restoration. This information is most often determined through site evaluations and field surveys. For example, a wetland which contains reed canary grass or phragmites is considered to be lower quality than a wetland that contains bog vegetation. The reed canary grass wetland would be a potential candidate for restoration or enhancement while the bog would not likely require any improvement, but instead can be considered for protection.

- The functional assessment presented in this report does not take into account watershed-specific planning goals and objectives but rather weighs all of the indicators equally. The database and ranking is flexible such that various W-PAWF indicators can be included or excluded and weighed different depending on local water planning objectives.

- For this project, the best available data with coverage over the project area in each respective state (Wisconsin or Illinois) was used to determine outputs. It is important to recognize the limits to using GIS-based datasets. The accuracy and precision of different data needs to be considered when viewing the results of one particular wetland, or groups of wetland. For example, the majority of the land use and land cover data used in this project was 30-meter resolution, satellite-derived data. The large extent of each grid cell relative to the size of any particular wetland need to be considered in an appropriate context. Additionally, SSURGO soils data is a polygon-based data set derived from field work of soil scientists who often extrapolated soil attributes to areas they may not have field visited. Therefore SSURGO soils data has unknown inaccuracies.

The following recommendations can also be used to further inform watershed planning efforts. These recommendations were developed as part of marketing plan:

- **Recommendation 1: Identify land ownership associated with all PRWS and existing wetlands**
  Initial work on land ownership was conducted in the Lake County, Illinois portion of the watershed. In the North Mill Creek – Dutch Gap Canal watershed, 75 percent of the PRWs are located on open private land, therefore a focus on private entities is important for implementation planning. In the Mill Creek watershed, 52 percent of the PRWs are on open public or quasi-public land. A combined effort on both public and private lands is needed in this watershed.

- **Recommendation 2: Conduct social surveys of key audiences to characterize wetland awareness and behaviors**
  Additional information is needed to better characterize the awareness, perceptions, values, behaviors, and motivating factors of key audiences.

- **Recommendation 3: Couple marketing about wetland benefits with other incentives**
  A multi-faceted approach which includes financial incentives is needed to move landowners from interest in wetland restoration to behavior change.

- **Recommendation 4: Inventory and leverage existing wetland outreach resources and partners**
  There are many entities that are currently promoting wetland restoration. A strong and consistent message is important, and leveraging existing resources through partnerships can be a cost-effective approach to implementation.

Table 43. Example database entries

	LLWW				W-PAWF														
	Landscape	Landform	Waterbody	W_FlowPath	Flood_Stor	Streamflow	Nutr_Trans	Sed_Retent	Shore_Stab	Strm_Shade	Fish_Habit	Waterfowl	Shorebird	IntForBird	Amphibian	Rare_Speci	Groundwatr	Composite Score	Area (acres)
Wetland 1	TE	FR	PD1	TI	2	1	1	3	3	1	2	1	1	1	3	0	3	22	0.3
Wetland 2	TE	FR	PD1	TI	2	1	1	3	3	2	3	1	1	1	3	0	3	24	1.3
Wetland 3	TE	FR	PD1	TI	2	1	1	3	3	2	2	1	1	1	3	0	3	23	0.8
Wetland 4	TE	FR	PD1	TI	2	1	1	3	3	1	2	1	1	1	3	0	3	22	0.5
Wetland 5	TE	FR	PD1	TI	2	1	1	3	3	2	3	1	1	1	3	0	2	23	0.8
Wetland 6	TE	FR	PD2	IS	2	1	1	2	3	1	2	1	1	1	3	0	3	21	0.28
Wetland 7	TE	FR	PD2	IS	2	1	1	2	3	1	2	1	1	1	3	0	2	20	1.3
Wetland 8	TE	FR	PD2	IS	2	1	1	2	3	1	2	1	1	1	3	0	2	20	1.3
Wetland 9	TE	FR	PD2	IS	3	1	1	2	3	1	2	1	1	1	3	0	2	21	1.7
Wetland 10	TE	FR	PD2	IS	2	1	1	2	3	1	2	1	1	1	3	0	3	21	0.7

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Appendix A – Functional Significance

- Streamflow maintenance
- Flood water storage
- Nutrient transformation
- Sediment and other particulate retention

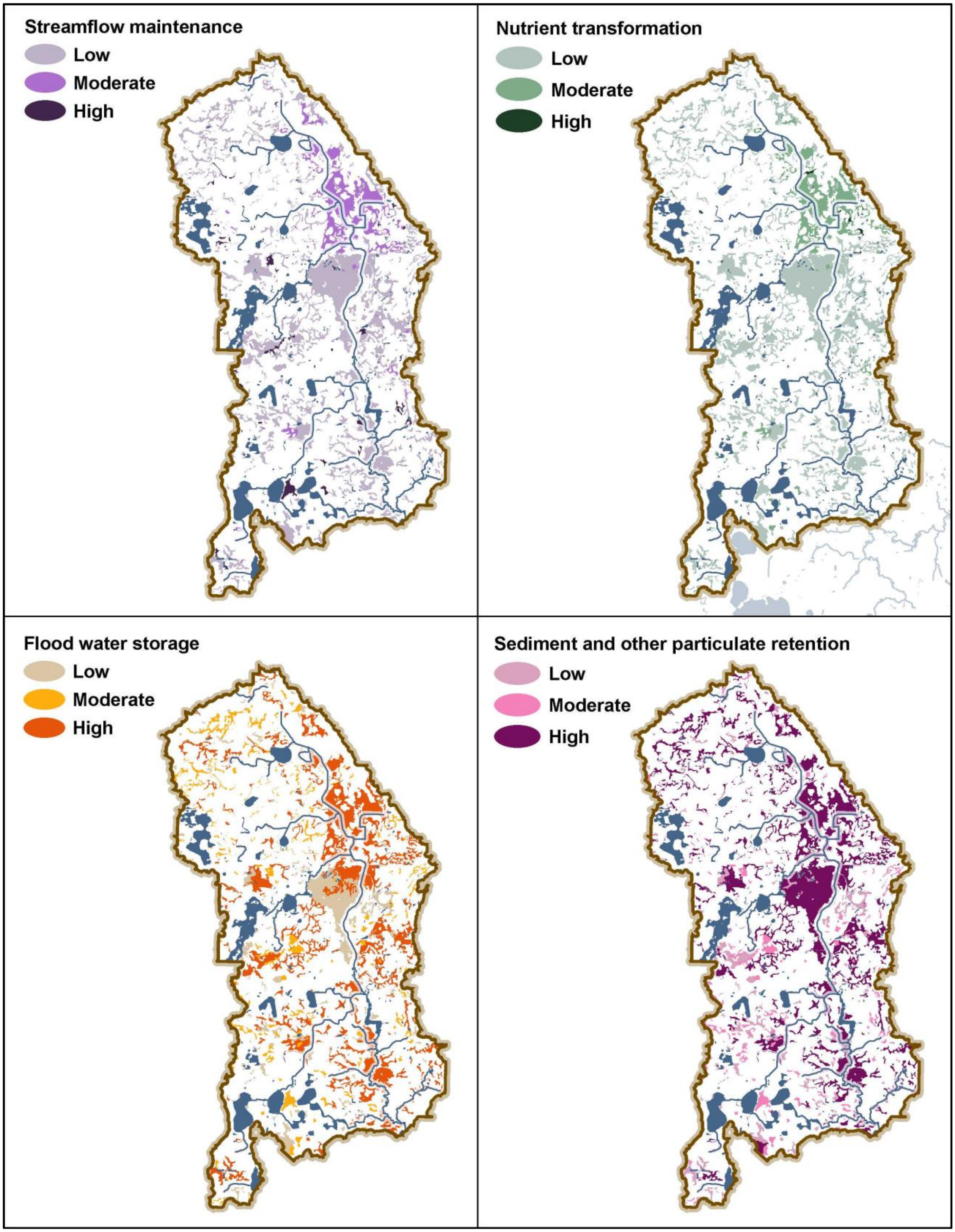

Figure 36. Significance for select wetland functions, North Mill Creek - Dutch Gap Canal watershed.

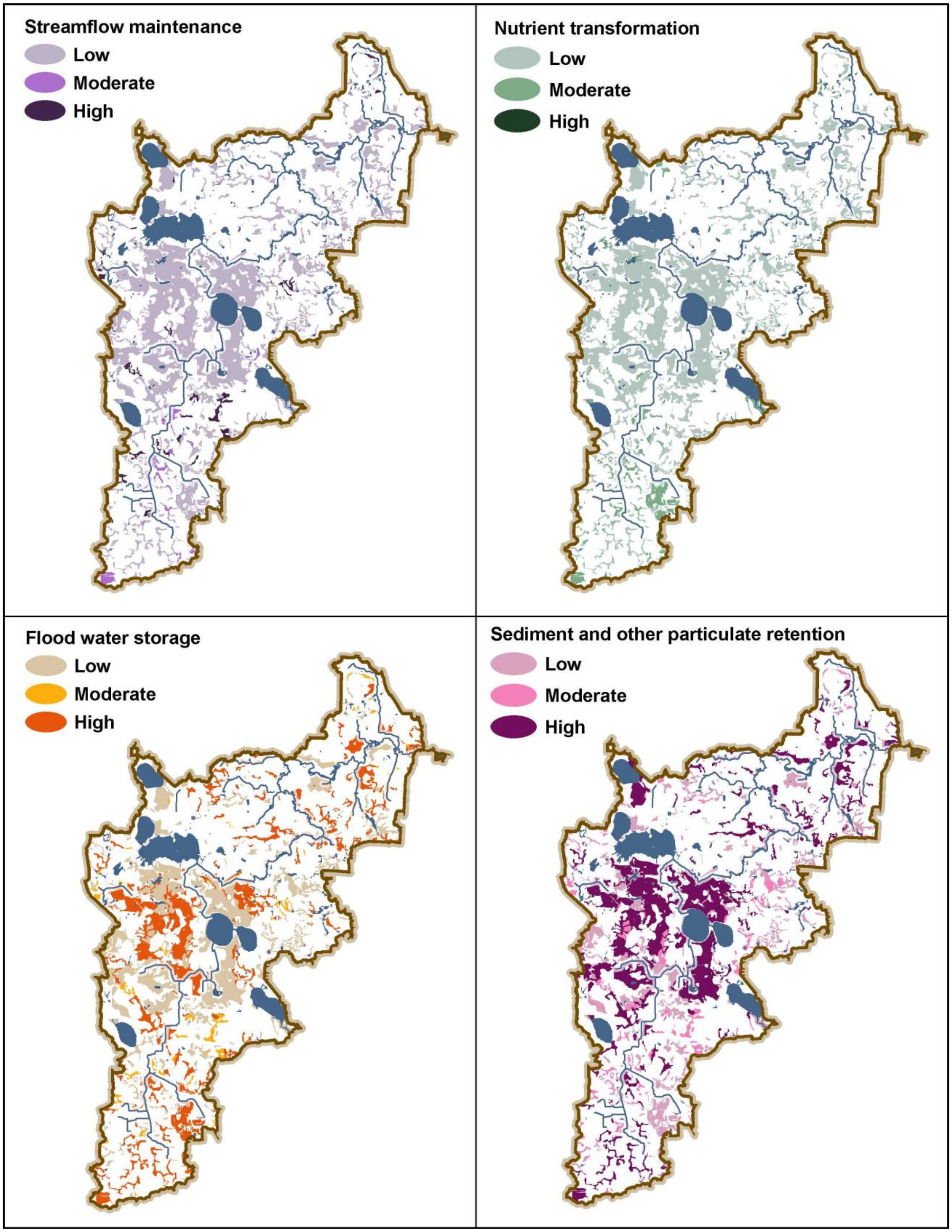

Figure 37. Significance for select wetland functions, Mill Creek watershed.

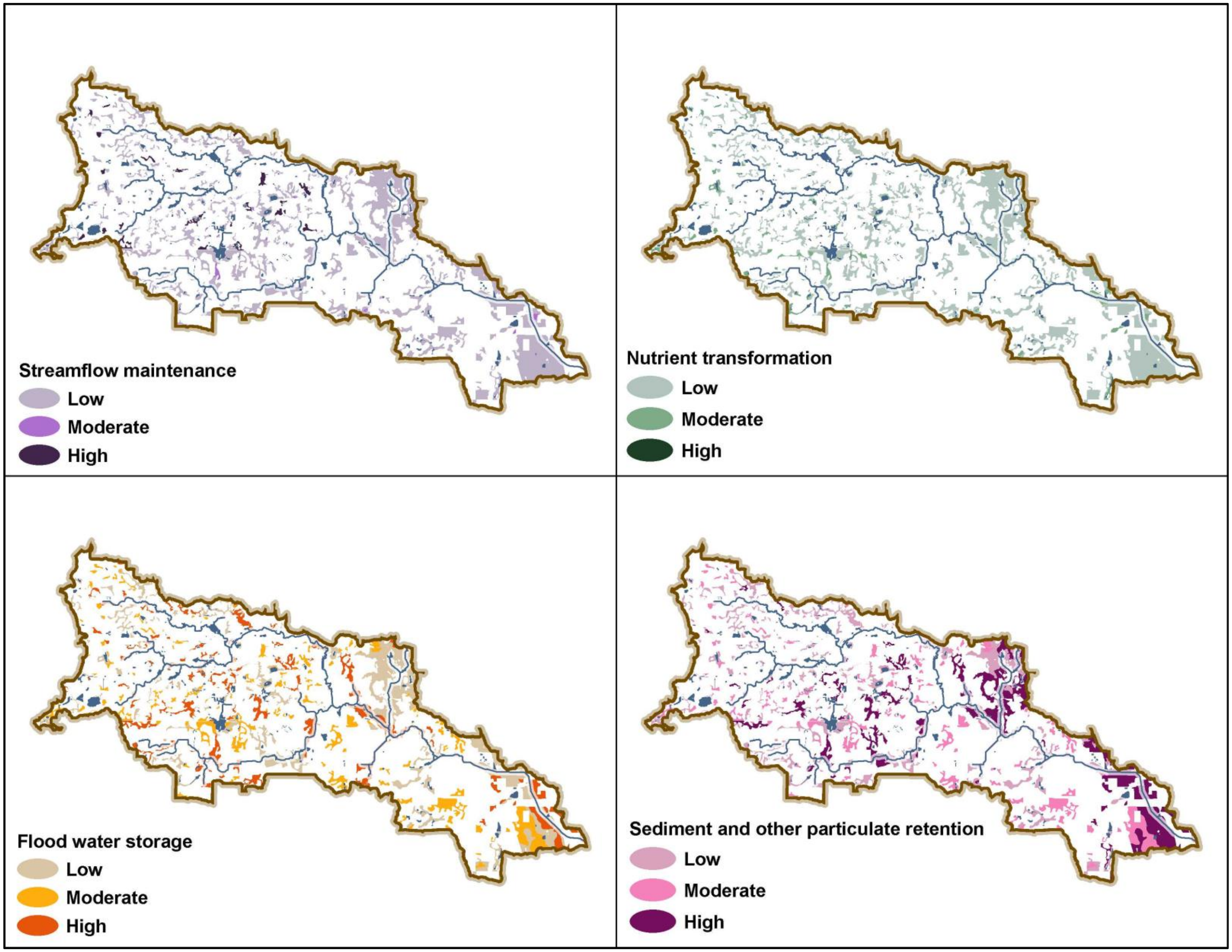

Figure 38. Significance for select wetland functions, Buffalo Creek watershed.

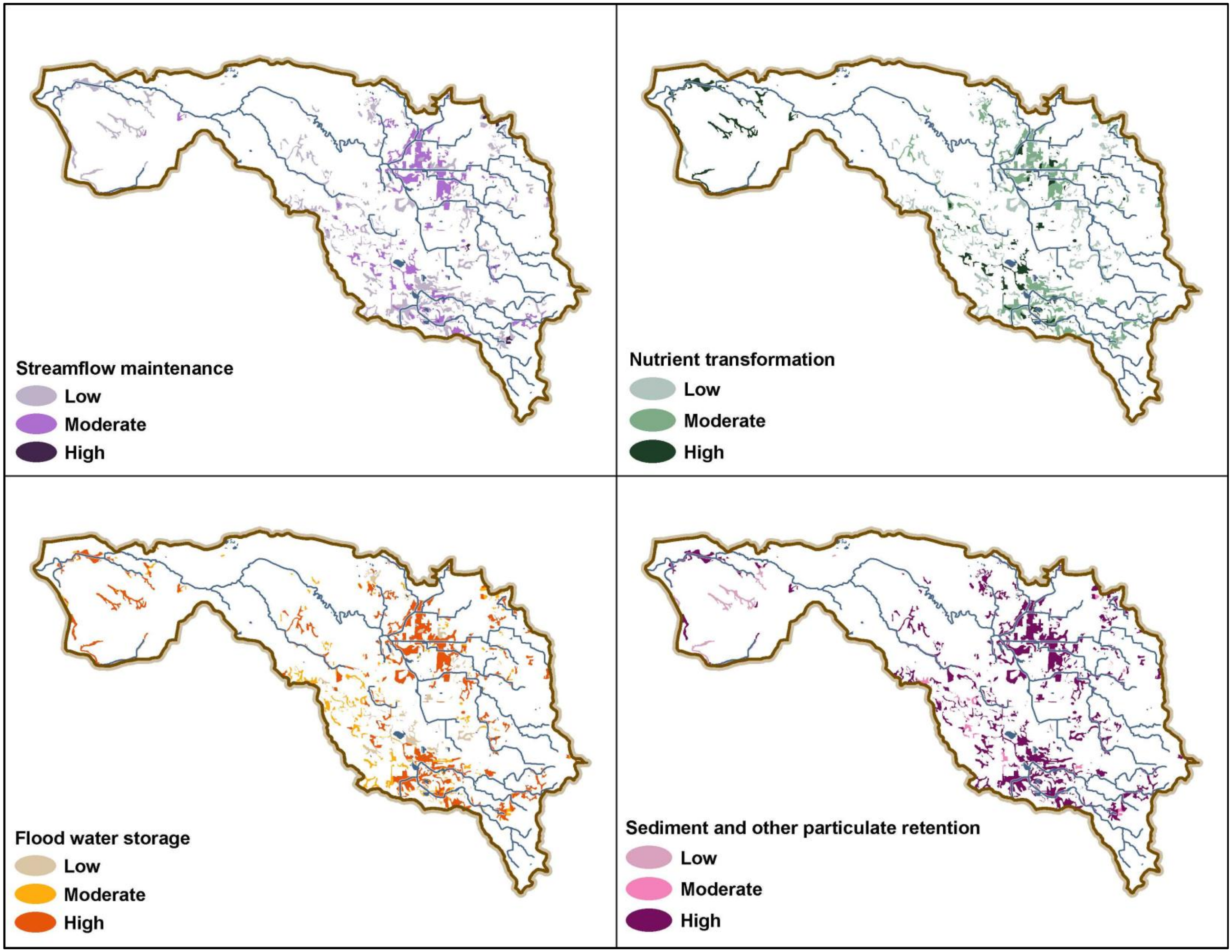

Figure 39. Significance for select wetland functions, Baird Creek watershed

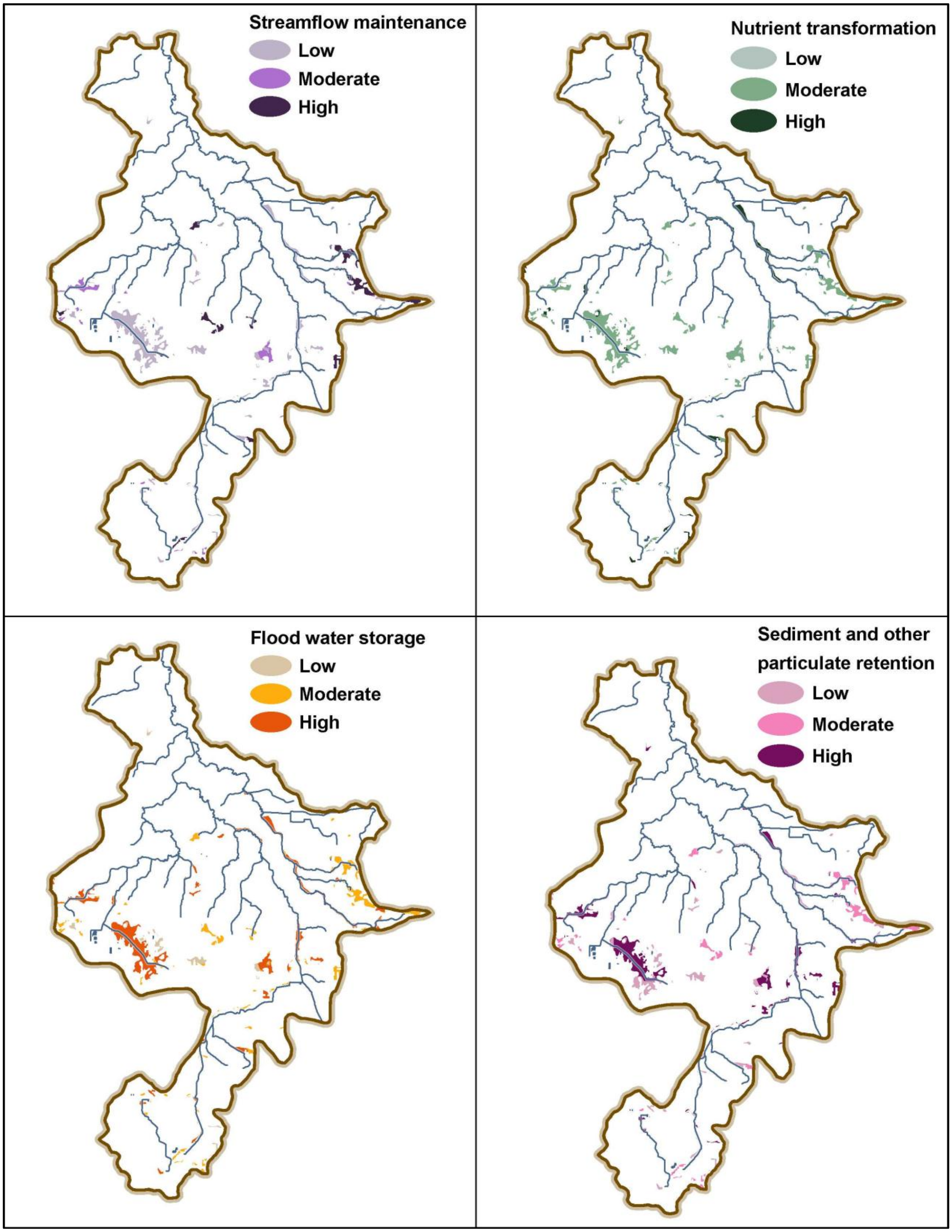

Figure 40. Significance for select wetland functions, Kankapot Creek watershed.