

Upper East River Habitat Conservation Plan

*A plan to improve the fish and wildlife habitat condition in the Upper East River
Watershed of Northeast Wisconsin.*



A. Hudak, Wisconsin DNR

**Prepared by The Nature Conservancy in cooperation
with the U.S. Fish and Wildlife Service
February 2020**

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Land Acknowledgement

The Upper East River Watershed planning team respectfully acknowledges the First Nations People of Wisconsin and the original inhabitants of the Green Bay watershed, including the Upper East River Watershed as the original custodians of the land and water on which we rely and operate, and we pay our respects to Elders past, present and future. We acknowledge the continued cultural, social and spiritual connections of the watershed's inhabitants from the earliest post-glacial inhabitants and the people known as the Oneota through the more recent indigenous peoples known to live in the East Central region of Wisconsin; including the Menominee, Potawatomi, Ho-Chunk, Miami and Sioux. We recognize and value the essential and continuing contribution of the First Nations people to the region. We apologize if any indigenous or First Nations peoples have been omitted from this land acknowledgement.

Finally, we most respectfully acknowledge the lives and actions of the native biota of the watershed in providing the peoples of the watershed with the resources we have used to support our societies, culture and livelihoods in this region.

Acknowledgements

Funding for the development of the Upper East River Watershed Habitat Plan was provided by the U. S. Fish & Wildlife Service. The Nature Conservancy, working cooperatively with the U.S. Fish & Wildlife Service, authored the Upper East River Watershed Habitat Plan. Thank you to the following individuals and organizations that have attended meetings, provided input or data used in the planning process, and contributed to the writing on this plan:

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Nicole Van Helden; The Nature Conservancy
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Additional knowledge and guidance provided by the following individuals:

Professor Nelson Ham, Saint Norbert College, De Pere, Wisconsin
Michael Mushinski, Brown County Land and Water Conservation Department

Literature Citation

The Nature Conservancy. 2020. Upper East River Conservation Plan. A plan to improve the fish and wildlife habitat condition in the Upper East River Watershed of Northeast Wisconsin. The Nature Conservancy, Northeast Wisconsin Office. Sturgeon Bay, WI.

Disclaimer

The information in this plan is specific to the Upper East River Watershed and believed to be current and accurate as of the writing of this document. All conservation or other actions undertaken as a result of consultation of this plan should rely on the most current knowledge of the site involved and the best conservation knowledge, management methods and philosophies current at the time of implementation. The methodology and methods of planning have been provided within this plan for those desiring to replicate the process in other watersheds.

Contents

Land Acknowledgement	2
Acknowledgements	2
Literature Citation	3
Disclaimer.....	3
Executive Summary	5
Introduction	6
Purposes for the Upper East River Conservation Plan	6
Methodology and Methods of Planning	6
Activities and Schedule of the UERW Planning Team:	7
Watershed Status and Conservation Goals	9
Upper East River Watershed Overview:	9
Problem definition.....	17
Vision	17
Watershed Goals	17
Conservation Targets.....	18
Aquatic Target Group Descriptions	19
Community Target Group Descriptions	21
Individual Species Target Group Descriptions.....	23
Strategies and Actions to Reach Conservation Goals and Improve Status of Targets:	25
Relevant Stakeholders & Conservation Partners:	34
Appendices.....	35
Appendix A: Guidance for Two–Stage Ditches.....	36
Appendix B: Guidance for Aquatic Organism Passage.....	38
Appendix C: Guidance for Non-Wooded Riparian Corridors	39
Appendix D: Guidance for Wooded Riparian Corridor Management.....	42
Appendix E: Creation, restoration and management of wetlands for wildlife benefits.....	46
Appendix E: Template Conservation Action Profile	50
Appendix F: References & Resources	51

Executive Summary

The Upper East River originates from intermittent surface flows along with an unknown input of ground water from the uplands in the south east corner of Brown County and flows north and northeast through the lower East River landscape to the Lower Fox River (watershed HUC 04030204) near the mouth of the Fox River in northeast Wisconsin. Ultimately the waters of the East River flow to the southern end of Green Bay and on to Lake Michigan. The watershed of the Upper East River drains approximately 22,992 acres. Row crop dairy agriculture dominates land use and cover in the watershed and several large CAFOs control much of the arable acreage.

As defined by planning team, the Upper East River and its tributaries lack the necessary and sufficient hydrologic quality and quantity and bio-physical conditions to support a fish and wildlife assemblage that could occur in a system with higher landscape quality conditions in the same geographic setting. Put simply; the Upper East River watershed does not support the fish and wildlife it could if the surrounding landscape were of higher quality.

To identify strategies to mitigate the problems degrading fish and wildlife habitat in the Upper East River, The Nature Conservancy's "site conservation planning" methods were adopted for use in this project. These methods resulted in a vision, a set of goals and a set of strategies that address the threats limiting the conservation entities of interest (i.e., conservation targets) by the planning team, took a systems view of the planning geography, and developed trust and buy-in from the conservation partners who will ultimately be primary enactors of the strategies developed through the planning process. Site specific strategies and non-site-specific guidance documents were developed to address both threats and opportunities for conservation projects in the watershed.

Introduction

Purposes for the Upper East River Conservation Plan

The Upper East River plan was initiated to satisfy two goals of the U.S. Fish and Wildlife Service's Ecological Services Field Office in New Franken, WI. The first goal was to develop a document that would serve to guide conservation partners as they implement fish and wildlife focused projects in the watershed alone, or in conjunction with projects aimed at improving water-quality as directed by the existing Nine Key Element Plan or similar plans for the watershed. The second goal of this planning exercise was to document the development of the plan in order to use this process as a model for future fish and wildlife planning projects in the sub-watersheds in the Lower Fox River watershed, or possibly elsewhere.

Streams, tributaries and their associated habitats are vital to the health and productivity of the Green Bay watershed. The hydrology, and sediment and nutrient delivery of the sub-watersheds of the Lower Fox River watershed impact the morphology and biological potential of the lower Fox River and the near shore ecological communities of lower Green Bay. The tributaries originating in these sub-watersheds also provide spawning and rearing habitat for many fish, which occupy the lower Fox River for part of their life cycle. Unfortunately, impediments to aquatic organism movement, loss of keystone species such as beaver, loss and fragmentation or reduction of in-stream and riparian habitat, presence of invasive species, degraded water quality, and alteration of natural hydrology has collectively compromised the health of these systems. The goal of this project was to identify conservation strategies for the streams, wetlands and associated upland habitats of the Upper East River watershed with the primary focus of improving conditions for resident and migratory fish. However, additional trust resources (e.g., migratory birds, threatened and endangered species), other wildlife species and groups, water quality and ecological processes felt by the planning team to be important to the ecological character or functioning of this sub-watershed were also included as planning foci for this plan.

The term 'conservation strategy' noted above is meant to include practices that would improve conditions for the natural resources of interest in the plan. Such strategies could include actions to enhance, create, or revitalize degraded or lost habitat.

Methodology and Methods of Planning

The Nature Conservancy's "site conservation planning" methods were adopted for use in this project. These methods were selected as they are replicable, result in a set of strategies that address the threats limiting the conservation entities of interest by the planning team, take a systems view of the planning geography that could include all levels of biological diversity as well as other physical properties of the system that are critical for ecological health and resilience and the relationships between the biological diversity and physical processes of the system, and develops trust and buy-in from the conservation partnership that will ultimately be primary enactors of the strategies developed through the planning process.

Components of this approach that were used in developing this conservation plan included:

1. Creation of a planning team;
2. Delineation and development of a common basic biophysical understanding of the planning unit (i.e., a geography of interest – here the Upper East River Watershed);

3. Characterization the relevant ecological, hydrologic, climatic conditions of the planning unit and description of the ecological patterns (habitats), flows, functions and processes of the planning unit;
4. Description of the biodiversity of interest;
5. Creation of a vision and broad goal statements for the planning unit and ecological condition of the unit;
6. Selection biophysical targets (e.g., species, habitats, controlling biophysical processes (e.g., hydrology)), of interest for the plan, and identify other biodiversity of interest 'nested' under the protection of the selected targets;
7. Definition of the current status of the set of attributes that support the targets and the defining of desired status or condition of the attributes and targets;
8. Definition of the relationship of these attributes to the hydrologic and ecologic patterns (habitats), flows, functions and processes of the planning unit;
9. A review the targets selected for planning to make sure attributes that support the targets also support other important biodiversity or biophysical processes of importance in the planning unit:
10. An Identification of threats to these attributes, i.e., current or possibly future conditions and drivers of those conditions that negatively impact the attributes;
11. The development of strategies to mitigate or eliminate the threats;
12. An articulation of the logic for why, how, when, by whom the proposed actions will change the condition of the attributes and targets to the desired conditions and meet the goals of the plan;
13. The definition of measures of success and the monitoring and evaluation plan.

Activities and Schedule of the UERW Planning Team:

The UERW Planning Project began in 2018 with an effort by the Northeast Wisconsin Ecological Field Office of the U.S. Fish & Wildlife Service to select one of the 13 sub-watersheds of the Lower Fox River in Northeastern Wisconsin for a planning effort that would result in a fish and wildlife habitat conservation plan for that sub-watershed. The decision to initiate conservation planning for the UERW was made by a team of regional conservation professionals from several agencies and non-profit groups. This group included members from the US Fish & Wildlife Service, Wisconsin Department of Natural Resources (WDNR), Brown County Land and Water Conservation Department (BCLCD), The Nature Conservancy (TNC), and the Outagamie Land Conservation Department. The group used existing GIS and land use information to guide the selection process. Watersheds where there was a high level of restoration activity were not included in the selection process to avoid overlap or duplication of efforts. The goal of this team was to select a sub-watershed of the Lower Fox River for this planning process that had:

- Reasonable ecological and biological value in habitat conditions with reasonable potential for maintenance, creation, revitalization, enhancement and/or improvement;
- Favorable land cover and landowner composition that would facilitate implementation of the strategies;
- Conservation interest or ongoing conservation work from conservation agencies or non-profits; and
- Adequate baseline planning data on the ecological conditions and fish and wildlife resources of the sub-watershed.

Once the Upper East River was selected as the planning unit, a planning team was formed from individuals with a strong understanding of the natural resources of the region. This core planning team consisted of staff from the U.S. Fish & Wildlife Service, WDNR, BCLCD, TNC, and the Outagamie Land Conservation Department.

Planning was initiated with a tour of the Upper East River Watershed by the planning team in late fall of 2018 to gain familiarity with the geography, land cover, land use, and general ecological conditions of the watershed. From there the planning team met as a group every month to two months to work through steps 3 – 13 of the planning sequence noted in the previous section on planning methods. When needed, information was gathered from outside experts on important biophysical or social issues related to the planning process.

After the planning document was drafted it was reviewed by the core planning team and outside reviewers.

This plan is intended to be used in conjunction with other plans and planning materials. Specifically, this plan is meant to be used in conjunction with those non-point source water quality plans (e.g., Nonpoint Source Implementation Plan for the Upper East River Watershed; county conservation plans etc.) that recommend management practices including reduced tillage methods, cover crops, vegetated buffers, wetland restoration, grassed waterways, improved nutrient management, streambank stabilization for water quality. This plan is intended to bolster restoration of fish and wildlife habitat within the watershed as a compliment to existing compatible plans.

Watershed Status and Conservation Goals

Upper East River Watershed Overview:

The Upper East River originates from intermittent surface flows with an unknown quantity of ground water discharge from the uplands in the south east corner of Brown County. The Upper East River Watershed is sub-watershed of the Lower Fox River Basin (*Figure 1*). While its watershed is primarily confined to Brown County it also drains small portions of Calumet and Manitowoc Counties. Two unincorporated communities; Greenleaf and Askeaton, lie within the watershed's boundaries. The Upper East River watershed (UERW) drains approximately 22,992 acres. More than 15 miles of the East River run through the watershed along with more than 26 miles of large, unnamed tributaries to the East and numerous small, intermittent streams (*Figure 2*).

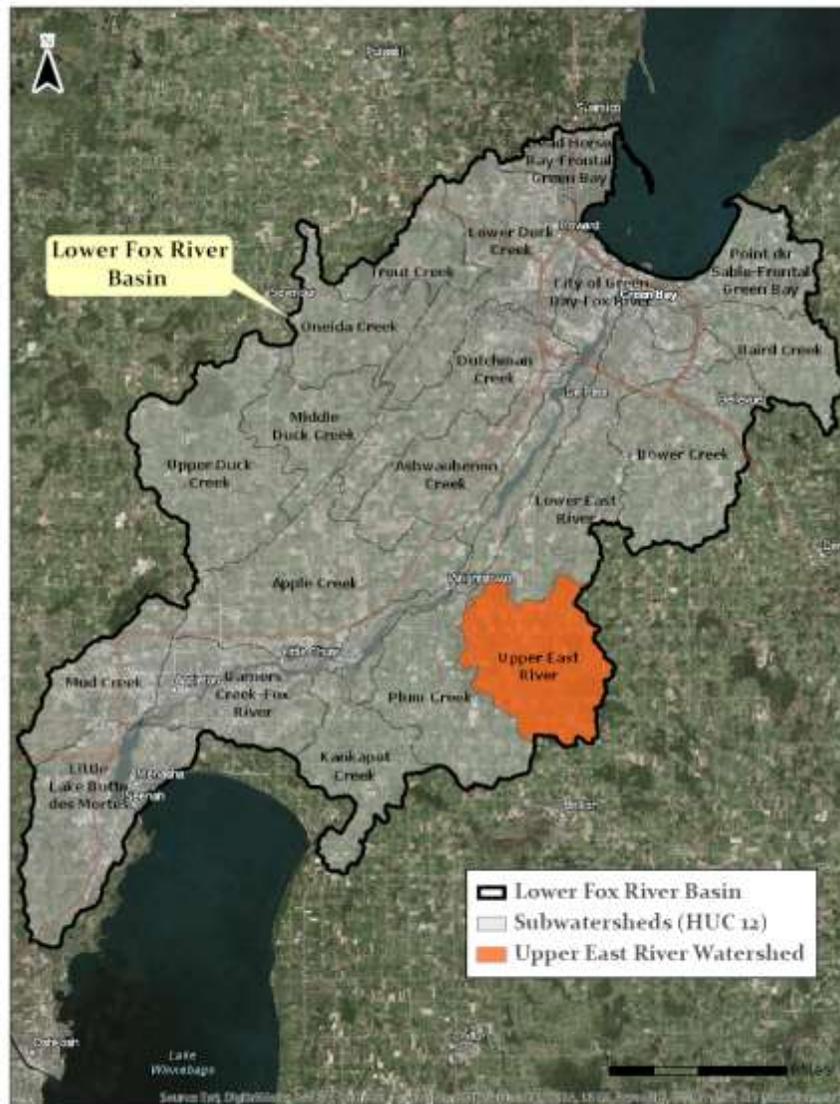


Figure 1: Location of the Upper East River Watershed with the Lower Fox River Basin, and in relation to the Bay of Green Bay to the north and Lake Winnebago to the south. Map courtesy of Outagamie County LCD.

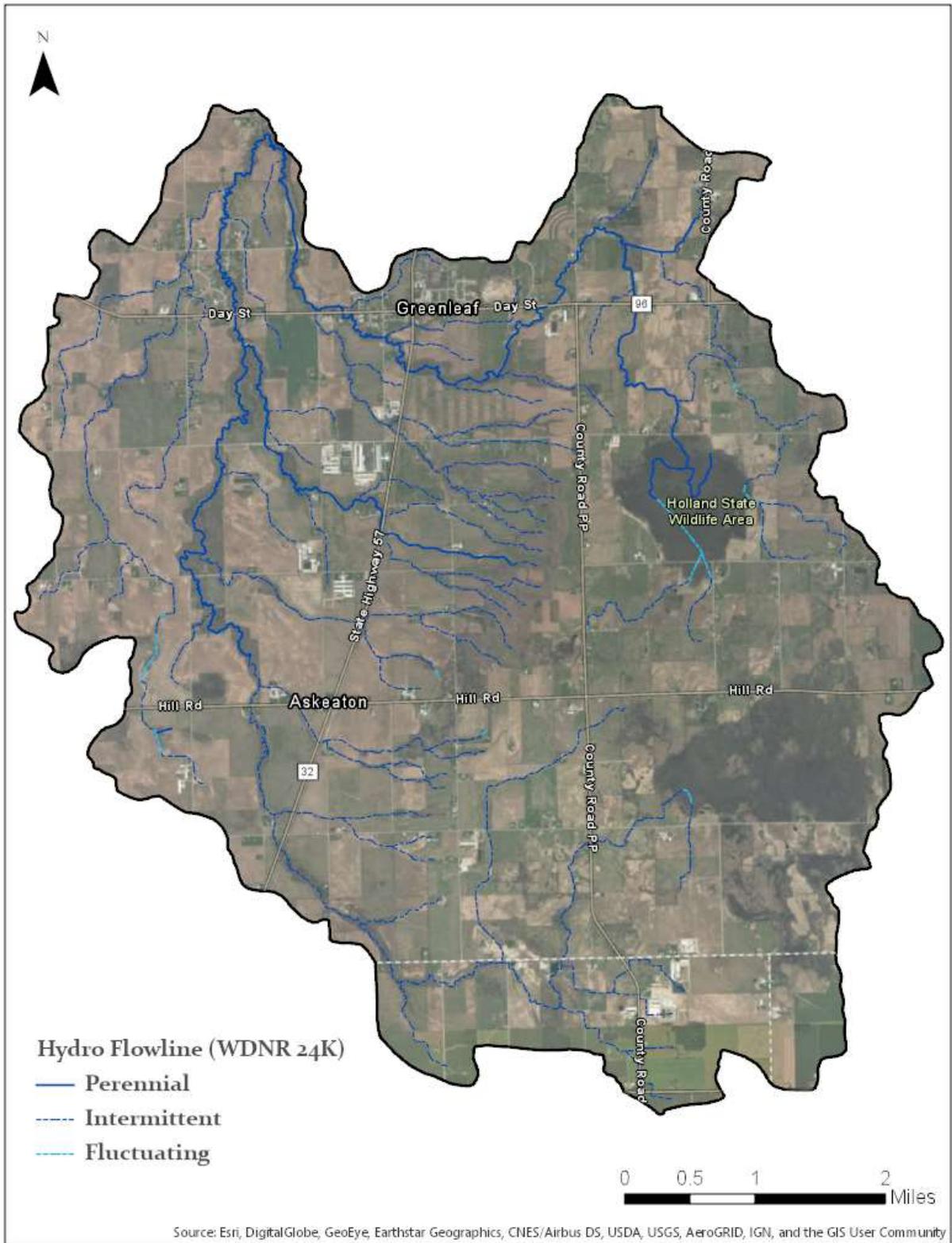


Figure 2: Waterways within the Upper East River watershed include more than 15 miles of the East River and more than 26 miles of perennial, intermittent, and fluctuating waterways. Map courtesy of Outagamie County LCD.

The highest point in the watershed, located in the southeast portion, is 1,020 above sea level. The lowest point in the watershed is 638 feet above sea level in the northwest corner with a total change in elevation of about 382 feet. Surface water leaving this watershed flows north and northeast through the lower East River landscape to the Lower Fox River (watershed HUC 04030204) near the mouth of the Fox River in northeast Wisconsin. Ultimately the waters of the East River flow to the freshwater estuary of Green Bay and Lake Michigan.

The high ground in the southeast corner of Brown County is formed by the Niagara Escarpment and a significant glacial moraine that holds the largest blocks of existing forested wetlands in the watershed, the headwaters of a few streams that flow to the East River and several small scattered insular or poorly connected basins of poor drainage. Many small intermittent to perennial streams of high gradient that form the upper East River begin on the west to northwest facing slope of this escarpment and moraine 'plateau'. These streams have a high gradient and flow through deeply down-cut channels lined by narrow bands of riparian forest. Small patches of upland forest and agricultural land mix with dispersed rural residential homes to constitute the land cover on this sloping ground. Slow meandering, lower gradient streams with incised channels cross the broad terrace of lacustrine clays and silty clays below the slope. These three zones of the UERW are depicted in Figure 3.

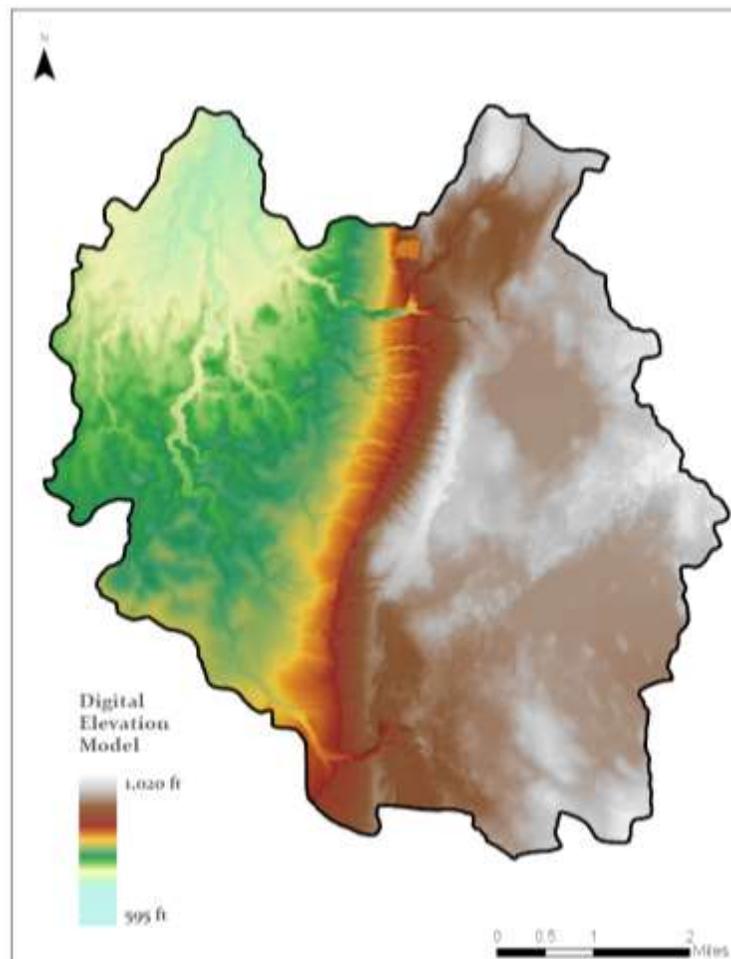


Figure 3: Digital Elevation Model (DEM) showing the three distinct topographic zones of the Upper East River watershed - from west to east - the plateau terrace, the plateau slope, and the headwaters. Map courtesy of Outagamie County LCD.

Dairy farm agriculture is the dominant land use in the UERW and is supported by fields of soybean, corn, and alfalfa. The UERW lies in an area having some of the highest dairy farm and concentrated animal feeding operations (CAFO) in Wisconsin, shown in Figure 4, and the UERW is considered a major contributor to poor water quality in the lower Fox River and Green Bay (Cadmus, 2012). Agricultural land use has been estimated to be responsible for 83% of the sediment and 94% of the phosphorus loading in the Lower Fox River watershed (Outagamie County Land Conservation Department & Brown County Land and Water Conservation Department, 2016). It is one of the highest contributing sub-watersheds of phosphorus and sediment to the lower Fox River and the bay of Green Bay.

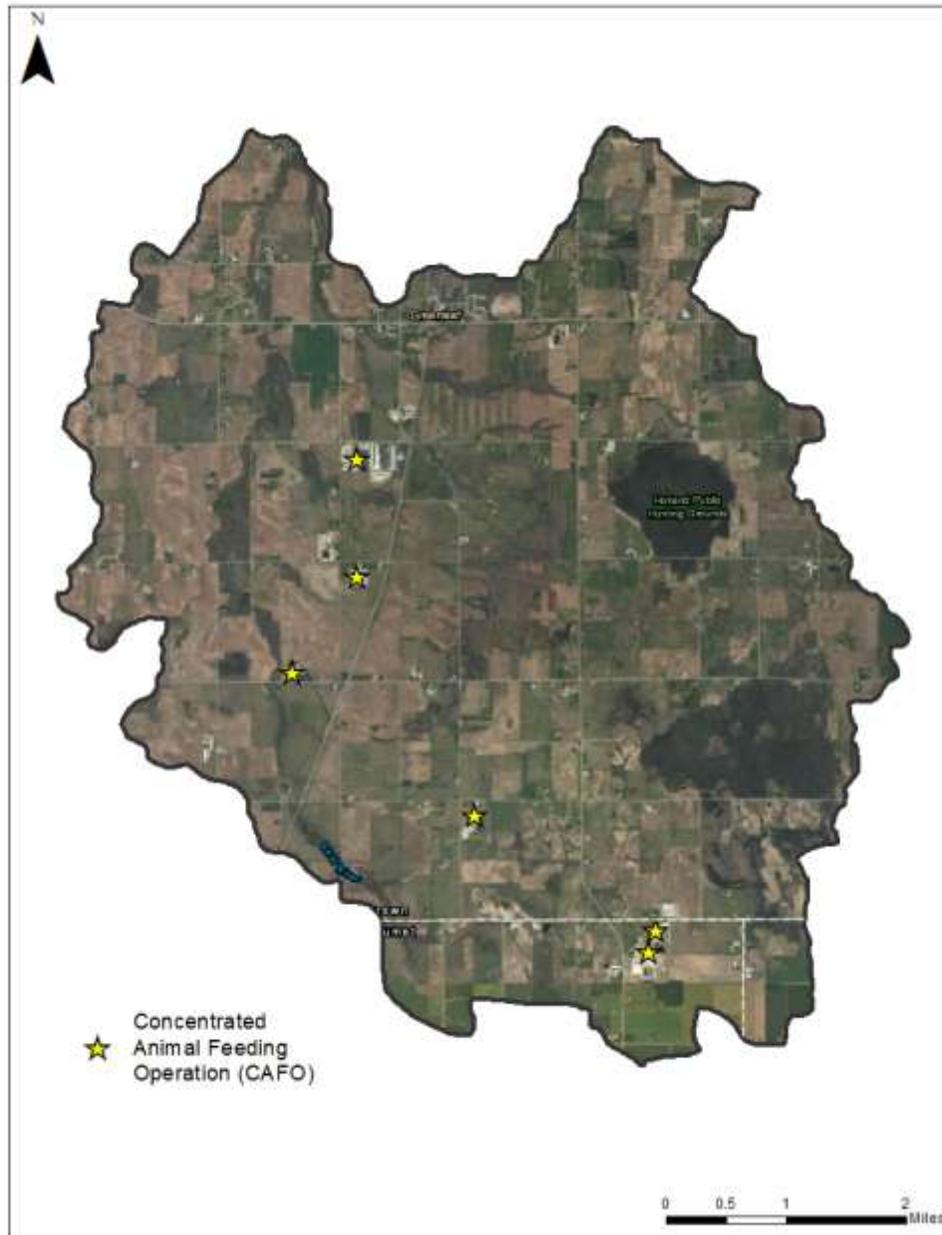


Figure 4: Locations of Concentrated Animal Feeding Operations (CAFOs) within the Upper East River watershed. Map courtesy of Outagamie County LCD.

Agriculture and the clearing of the pre-settlement forests in the watershed began in the early and mid-1800's. However, impacts to the hydrology of the watershed from non-indigenous cultures began in the late 1600's and through the 1700's with intense trapping of beaver for the commercial fur trade by French and later English trappers/traders along with members of indigenous tribes. Forest clearing along with trapping likely contributed to the severe decline and possible extirpation of the beaver from the watershed as agriculture began to dominate the landscape. The introduction of row crop agriculture to the area also saw the drainage of wetlands and conversion of those acres to arable lands. Models indicate that approximately 42% of the pre-settlement wetlands of the UERW have been converted to agriculture or other land uses (i.e., "potentially restorable wetlands") as shown in Figure 5 on the following page (Miller, et al., 2017).

The UERW lies completely within the Central Lake Michigan Coastal Ecological Landscape of Wisconsin, holding portions of three Land Type Associations (Wisconsin Department of Natural Resources, 2015). These three Land Type Associations (LTAs) correspond to the three geographic regions of the UERW mentioned above. The headwater area of the UERW lies within the Wayside Moraines LTA (212Zc08) characterized as an undulating moraine landform with both upland and lowland settings. Two large hardwood swamps with loamy – mucky soils (Carbondale, Cathro series) occupy the low, poorly drained basins of this LTA. The northern swamp is almost entirely owned by the WDNR and managed as the 536-acre Holland Wildlife Area, which contains the Holland Red Maple Swamp State Natural Area. The southern swamp is privately owned by several landowners. The west facing slope of this upland area lies within a portion of the Chapel Ridge LTA (212Zc10), a landform of steep slopes and deep cut small stream valleys. The soils are predominately well drained silt loams over calcareous clay till or dolomite bedrock. The undulating plain dominated by row crop / dairy agriculture below and to the west of the Chapel Ridge LTA is part of the Holland Plains LTA and is characterized by deep v-shaped stream valleys and well drained silt loam soils.

While not dramatic in topographic relief the bedrock controlled and overlying glacially derived landforms of the UERW such as ground moraines, outwash areas, and lake plain deposits create a landscape occupied by several wildlife habitat types, though moderately to severely reduced in size, quality and connectivity. An inventory of the wildlife habitats and natural communities present in the watershed has not been conducted, but based on other resource inventories completed in the watershed, aerial photo and other digital data interpretation, resource planning documents and general knowledge of the watershed by team members, Table 1 describes natural communities and habitats that do occur or are likely to occur in the watershed.

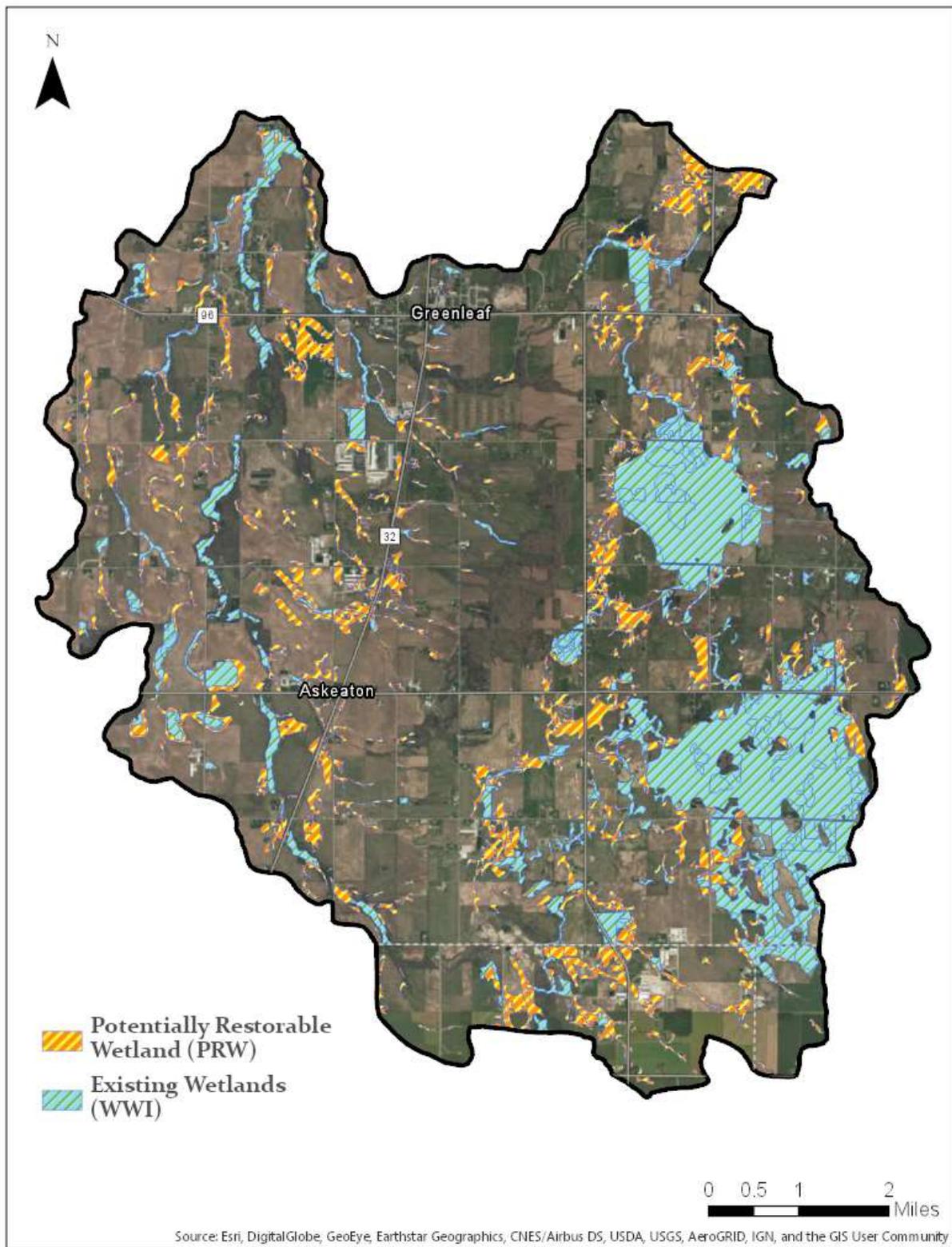


Figure 5: Existing and potentially restorable wetlands of the Upper East River watershed. Map courtesy of Outagamie County LCD.

Table 1: Land use and habitat types within the Upper East River Watershed. Habitat types in italics indicate that that type is possible within the UER watershed but has not been confirmed. Percentage next to land cover indicate the percentage of the watershed that is currently in that type (based on Wiscland 2.0 data from the Wisconsin Department of Natural Resources).

Land Cover	Habitat Types	Occurrence in the UER Watershed
Agriculture - 61%		
Grassland - 17%		
Wetlands (11%)	Emergent marsh	Limited examples present in detention basins or edging lowland hardwood swamp habitat
	Ephemeral ponds	Many seasonally flooded depressions occur within hardwood swamps of upper watershed.
	Northern hardwood swamp	The Holland Red Maple Swamp within the Holland Wildlife Area (HWA) contains this habitat type. Little is known about the larger block of lowland forest to the south of HWA.
	<i>Southern hardwood swamp</i>	Species associated with this habitat are present in the hardwood swamps of the watershed.
	Northern sedge meadow	Small, linear, low diversity patches may occur in the stream buffer/riparian areas or bordering hardwood swamps.
	<i>Southern sedge meadow</i>	Occurs in the Central Lake Michigan Coastal Ecological Landscape; no examples are currently known to this watershed.
	<i>Forested seep</i>	Possible within the hardwood swamps of the UERW.
Forest (7%)	Floodplain forest	Patches of limited extent and poor quality along the East River
	Northern mesic forest	Small patches may exist on the slopes west of the plateau region of the watershed.
	Northern wet-mesic forest	A portion of the HWA consists of northern wet-mesic forest habitat. Little is known about the larger block of lowland forest south of HWA.
	<i>Southern mesic forest</i>	Occurs in the Central Lake Michigan Coastal Ecological Landscape; no examples are currently known to this watershed.
	<i>Southern dry-mesic forest</i>	Occurs in the Central Lake Michigan Coastal Ecological Landscape; no examples are currently known to this watershed.
	<i>Eastern red-cedar thicket</i>	Known to occur on the edge of the Niagara escarpment north of the UERW, unknown if species occurs in UERW in numbers.
	Conifer plantation	Likely small examples scattered on drier sites.
Urban/Developed (3%)		
Barren (<0.1%)		
Open Water (<0.1%)		
Other (does not fall under Wiscland 2.0 cover categories)	Dry or moist cliff and caves	Associated with outcrops of the Niagara escarpment in northeastern portion of UERW.
	Shrub carr	May occur in riparian areas of the East River or its tributaries, likely dominated by willow species.
	<i>Springs and spring runs (hard)</i>	Springs and spring runs issue from the talus of the Niagara escarpment, just north of the UERW. Unknown if similiar conditions exist in the UERW.

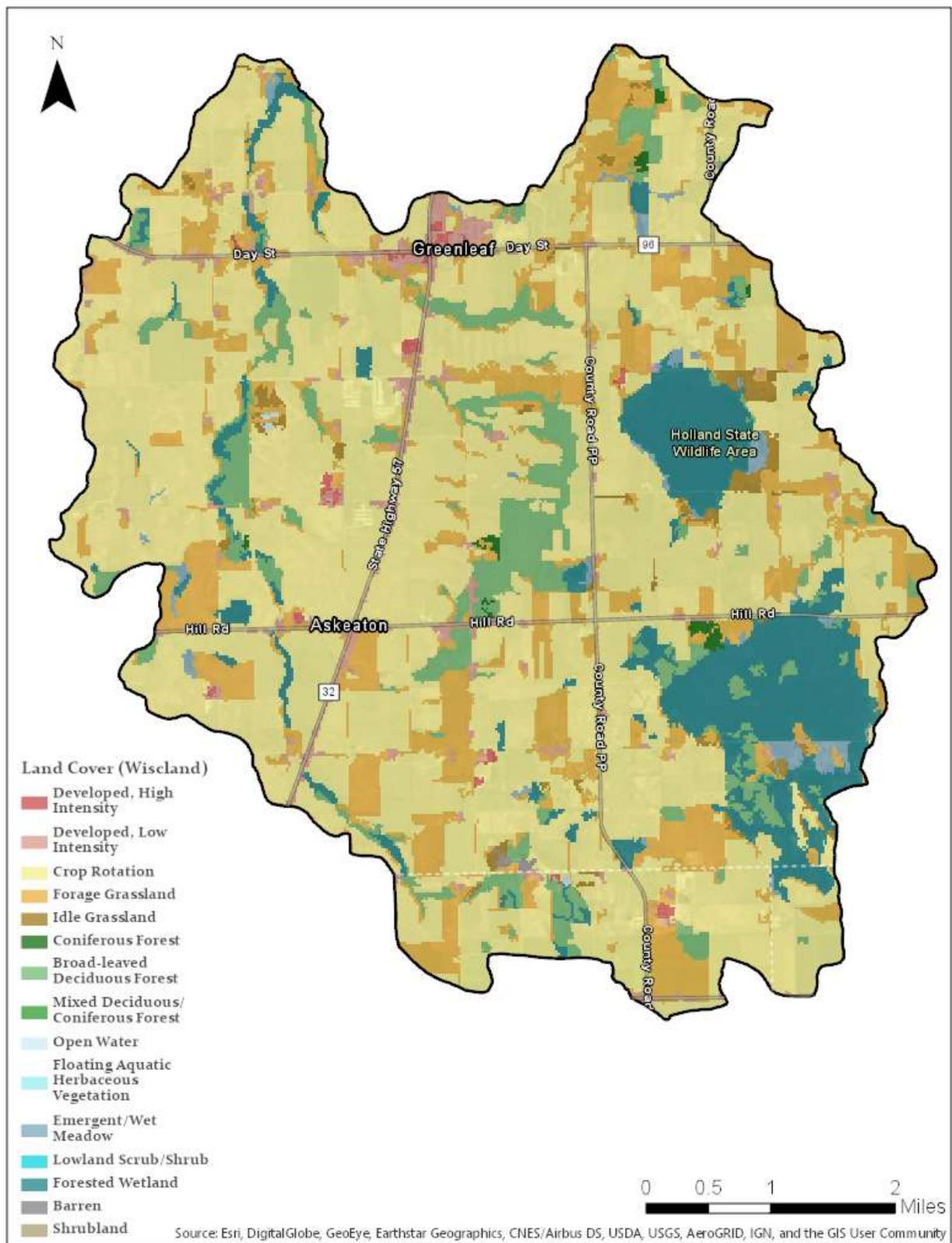


Figure 6: Land use within the Upper East River watershed from the Wisland 2.0 dataset. Map courtesy of Outagamie County LCD.

Watershed Status and Conservation Goals

Problem definition

The Upper East River (UER), its tributaries and watershed land cover lack the necessary and sufficient hydrologic quality and quantity attributes and bio-physical conditions to support the fish and wildlife assemblage potential in a system with higher landscape quality conditions in the same geographic setting. Put simply; the upper East River watershed does not support the fish and wildlife it could if the surrounding landscape were of higher quality.

Vision

The landscape of the UER and its tributaries supports the diversity, abundance and reproductive success of fish and macroinvertebrate species expected in a stream system of higher bio-physical quality in the same region. The landscape of the UER also supports upland and wetland wildlife habitat in a kind and pattern that is compatible with and supported by the farming community of the watershed.

Watershed Goals

- Base and surface flows to streams of the UER are such that fish and invertebrates have access to and reproductive success at, high quality spawning reaches on the watershed network;
- Aquatic organisms are not impeded in movement throughout the watershed by barriers such as road/stream crossings or low water quality;
- High quality instream spawning, resting, and feeding habitat and morphology is distributed in the stream network to adequately sustain and/or grow target species populations;
- Riparian upland (forest and herbaceous cover), connected wetland vegetation and stream banks are managed to promote and protect water quality and provide habitat for target species;
- Upland land cover and farming practices continually improve the quality and hydroperiod of water flowing to the UER system; and
- Upland land cover and farming practices continually improve habitat conditions (size, quality and connectivity) for other upland target species (e.g., grassland and forest migratory and breeding birds, insect pollinators, herps, and other target species).
- Increase wetland acreage by restoring potentially restorable wetland sites; evaluate current condition of wetlands within the watershed and potentially improve quality of existing wetlands within the watershed
- Invasive species, if present, are at a level at which they are not negatively impacting the ability to achieve other conservation goals for the Upper East River watershed.

Conservation Targets

Conservation targets were identified by the planning team to serve as tools to develop the strategies needed to meet the goals the team had noted. The function of conservation targets is to focus planning efforts on a select set of species, natural communities, species assemblages or ecological processes which are essential to conserve in order to support the functionality and all other essential biodiversity of the site. A single restoration or protection project that can hit on multiple targets may be evaluated as a higher priority than a project that only includes a single target.

The conservation targets created for this planning effort included:

1. Resident and migratory fish native to the region
2. Macroinvertebrates
3. Mussels
4. Ground water base flow
5. Riparian plant communities
6. Lowland forests and wetlands
7. Upland Forests
8. Migratory birds
9. Bats
10. Pollinators
11. Turtles and amphibians
12. Raptors

The targets are grouped into three broader categories: aquatic target group, community target group, and the individual species target group. Many of the strategies generated for one target within a group will advance the goal(s) for other targets also within that group. For each target/group, the threats to that target and the current status of the target were assessed. It should be noted that while gains may be made through restoration efforts, those efforts could be negated by new or emerging threats that are not currently present on the landscape or not manageable at the scale of this planning effort (e.g. climate change). In addition to threats specific to each group, there was a common threat identified in a lack of landowner and public buy-in for conservation practices.

Aquatic Target Group Descriptions

Native Resident and Migratory Fish

This target includes species native to the region that would typically be found in warm transitional streams ranging in size from small to medium sized streams with low to moderate gradient. The target includes fish that utilize these streams on either a resident or seasonal basis and have been observed in recent surveys or have been captured in historic surveys. Fish species identified as specific targets include Northern Pike, Smallmouth Bass, Redside Dace, Pearl Dace, Brassy Minnow, Golden Redhorse, and Burbot among others. A diverse fish community assemblage is also a critical link to improve mussel distribution within the watershed.

Macroinvertebrates

This target covers macroinvertebrates as the base of the food web for fish and wildlife along the riparian corridor within the watershed. Macroinvertebrate communities reflect instream habitat conditions and nutrient concentrations. Currently macroinvertebrate communities within streams of the watershed are in poor to fair condition.

Mussels

Many native freshwater mussels are state- and federally-listed species and mussel species as a whole have experienced nationwide declines. Mussel populations within the streams of the UERW are unknown but it is suspected that suitable habitat can recover in the mainstem of the East of River.

Groundwater Base Flow

This target was identified to protect and enhance the connection of groundwater to surface water and maximize the potential for streams to support diverse habitats with sustained flows. Presence and duration of water highly influences other species targets.

Threats to Aquatic Target Group:

- Degradation or elimination of instream habitat features (runs, pools, riffles)
- Sedimentation and turbidity
- Tile lines
- High capacity wells and increased pumping of groundwater for agriculture or development
- Degraded groundwater quality (WWPT discharges to groundwater)
- High water use crops
- Gravel and sand pits
- Lack of adjacent connected and accessible wetlands
- Disturbance producing high flows and lack of adequate base flows
- Ammonia and chloride discharges from point sources
- Bank instability and erosion
- Impacts of neonicotinoids and other pesticides on invertebrate populations
- Lack of founder populations for fishery
- Increased flows off impermeable surfaces (houses, parking lots, roads)

Table 2: Habitat, spatial needs, and health of targets found within the aquatic target group.

Aquatic Target	Habitat or spatial needs	Nested Targets	Health of target
Resident and migratory fish native to the region	Needs include runs, riffles and pools; stable vegetated banks, connected & functional floodplains, 100-foot buffers of appropriate habitat type for specific area, and access to adjacent wetlands. Habitat could be protected and/or improved through conservation easements or deed restrictions along waterways, management incentives for landowners, enforcement of buffer ordinances, cover crops, and other soil health practices.	Most other targets listed but especially mussels, aquatic macroinvertebrates, pollinators and insect communities. Also important to humans as a source of recreation.	Migratory fish - POOR. Resident fish - FAIR OR MIXED based on specific stream. Absence of intolerant species and diverse community assemblage. Need a stronger balance of specialist and generalist species.
Macroinvertebrates	Needs include adequate pools and riffles, vegetated banks, woody substrate, appropriate buffers, access to healthy wetlands, and adjacent connected floodplains. Habitat can be improved by utilization of cover crops, BMPS, and other soil health practices.	Birds, bats, mussels, insects, fish, humans.	FAIR TO LOW based on data available from the Wisconsin DNR.
Mussels	Species-specific driven needs may include clean, rocky with cobble and gravel substrate, adequate riffle to pool ratios and summer flows, stable vegetated banks, and improved woody debris and in-stream habitat.	Aquatic macroinvertebrates, fish, and fur-bearers.	UNKNOWN – need assessment of mussel populations. Likely imperiled or stressed.
Groundwater base flow	Need connected and functional floodplains, infiltration, good upland soil health, healthy headwater wetlands, and adequate pools in upper reaches.	All targets: humans, mammals, wetlands, streams, etc.	IMPACTED – need for more information on base flow and groundwater in the UER.

Community Target Group Descriptions

Riparian Plan Communities

This target covers natural communities that occur along stream edges of the UER. These communities include herbaceous, shrub or tree dominated plant assemblages and are usually a mix of native and non-native species, vary in width along the stream edges, and may or may not form contiguous borders along the streams. They comprise both upland and wet soils with agricultural lands bordering these riparian settings in most cases. Functions include stabilizing stream banks, filtering fine sediment from overland flow, providing areas for flood storage in high water, providing woody and herbaceous debris for food and cover for aquatic species and providing habitat for terrestrial or amphibious species.

Lowland Forests and Wetlands

The major blocks of lowland forest occur in the headwaters region of the watershed and include the 560-acre block encompassing Holland Wildlife Area and an 800-acre block of private lands to the south. These swamps are in somewhat confined basins on deep glacial moraine deposits with Carbondale or Cathro muck soils and form the headwaters of several branches of the UER. The Holland swamp drains to the north via small streams while the drainage of the southern block of lowland forest is unclear and parts of that swamp may drain through another watershed. According to the WDNR (<https://dnr.wi.gov/topic/Lands/naturalareas/index.asp?SNA=380>) the Holland swamp holds both a northern hardwood swamp and a northern wet-mesic forest. The hardwood swamp is dominated by red maple, green ash, and black ash with occasional swamp white oak and tamarack while white cedar dominates the wet-mesic forest. Little is known about the larger block of lowland forest to the south. In the lower reaches of the watershed this target occurs in floodplain areas along the stream edges, but many of the acres have been lost. Forested wetlands provide flood storage, fish spawning and nursery habitat, and sediment and nutrient capture functions.

Non-forested wetlands within the UER watershed include emergent marsh and northern sedge meadow habitats. Limited examples of emergent marsh may be present within detention basins and stream buffers or edging lowland hardwood swamps. Sedge meadow also exists in small, linear, low-diversity patches within riparian areas and bordering hardwood swamps. There is opportunity within the watershed to improve the diversity of existing non-forested wetlands and increase the number of these wetlands on the landscape.

Upland Forests

This forest type is defined as occurring outside of the floodplain. Most examples of this target occur on the steeper sections of the upper plateau's west slope as linear patches bordering incised streams, or as scattered small disconnected patches where agricultural practices were discontinued. Historically dominant tree species present include beech, sugar maple, basswood, red oak, white oak, and black oak.

Threats to Community Target Group:

- Aggressive agricultural practices
- Non-native invasive plants
- Poor or inadequate forest management practices
- Encroaching development
- Tilling and/or ditching

- Lack of forest regeneration
- Non-native forest pests (e.g. Emerald Ash Borer)
- Loss of wetland habitat and quality
- Fragmentation

Table 3: Habitat, spatial needs, and health of targets found within the community target group.

Community Target	Habitat or spatial needs	Nested Targets	Health of target
Lowland forests and wetlands	Needs include sustained hydrologic patterns to maintain community composition and structure, adequate community size to mitigate edge effects on flora and fauna. Large forest blocks are of adequate size to be resilient against storm damage or large enough to harbor area sensitive forest species. Historic logging may have damaged the age structure and composition of the forests.	Migratory and nesting bird species, including raptors. Mammals, as well as regionally common herps and invertebrates.	GOOD condition on upper escarpment due to large size of forested wetland blocks, and protected status of Holland Wildlife Area. UNKNOWN on private lands in this area. Below the escarpment the condition is POOR due to lack of acreage and poor quality.
Riparian plant communities	This target is found along the edges of the perennial and intermittent stretches of the branches of the UER. To be effective for water quality goals widths of riparian vegetation have been set at 50' to 100' from the stream edge.	Pollinators, turtles, amphibians, migratory birds, river & stream associated breeding birds (e.g. belted kingfisher, green heron, wood duck), small mammals, and other terrestrial invertebrates.	POOR - small extent of riparian cover is in good condition especially in lower reaches; riparian cover present often narrow in extent; wooded stretches often poorly managed with heavy shade and low-quality trees/non-native species (e.g. buckthorn).
Upland forests		Migratory and breeding birds (non-area sensitive species), woodlot animals and insects. The woodlot edges could provide good pollinator habitat.	POOR throughout the watershed due to historic loss of acreage to agriculture; effects of poor historic management (high grading), current small patch size and prevalence of invasive species.

Individual Species Target Group Descriptions

Migratory Birds

Several species groups are contained within the migratory bird target including waterfowl, songbirds, and marsh birds. The focus of this target is as much on conserving appropriate habitat (plant communities, hydrology, etc.) for these species' assemblages than on individual species themselves. This target is defined to include generally forest habitats but includes non-forest habitat as well that provides rest, food, and protection from predation for migratory land birds (e.g., warblers, finches, vireos, tanagers, orioles). Proximity to water is an important criterion that defines this target.

Bats

This target focuses on the Northern Long-eared Bat (*Myotis septentrionalis*), a state- and federally-threatened species, as a surrogate for more common bat species like the little brown bat (*Myotis lucifagus*) within the watershed. The northern long-eared utilizes caves and mines for hibernation. In the summer, they commonly roost in trees under bark close to the tree trunk. They prefer to roost in tall trees with dynamic forest structure. Northern long-eared bats commonly forage within the forest and below the canopy mainly in upland forests with hillsides and ridges, but have also been noted to forage along paths, ponds, streams and at forest edges.

Pollinators

The focus of this target is on pollinator habitat containing diverse assemblages of native plants. Pollinators play a key role in natural and agricultural systems. Globally, an estimated 87% of flowering plants rely on animals – mostly insects – for pollination (Ollerton, et al. 2011). Specific species of interest include the monarch butterfly (*Danaus plexippus*) and federally endangered rusty patched bumblebee (*Bombus affinis*).

Turtles and Amphibians

Species included in this target include painted and possibly snapping turtle, green, leopard, wood, and tree frogs, spring peepers, American toad, red-backed, spotted and blue-spotted salamanders. This group utilizes wetlands and downed wood in the forest and riparian corridors to survive.

Raptors

Raptors of interest include the red-tailed hawk, screech owl, great-horned owl, broad-winged hawk, cooper's hawk, sharp-shinned hawk, barred owls and bald eagle. This group uses the edge habitat and small openings in the woods to find food.

Threats to Individual Species Target Group:

- Loss of habitat
- Habitat fragmentation
- Invasive species
- Pesticides and Neonicotinoids

Table 4: Habitat, spatial needs, and health of targets found within the individual species target group.

Individual Species Target Group	Habitat or spatial needs	Nested Targets	Health of target
Turtles and amphibians	Species need upland forage areas and wetland breeding sites that area adjacent, some species need riparian habitat	Ephemeral riparian and isolated wetlands, riparian natural cover,	POOR in lower portion of the watershed due to lack of suitable habitat, FAIR to GOOD in the upper portions due to presence of large wetland blocks.
Migratory birds	Varies by species assemblage; need intact habitat blocks with diverse native plant species assemblage; Waterfowl: open water, food sources; Songbirds: quick food sources (native plants); marsh birds: wetland complexes.	Other wildlife groups: bats, pollinators, Raptors; habitat groups: riparian plant communities, forests and wetlands	Not applicable as their status would be assessed on a range wide basis.
Bats	Non-hibernating roosting and nesting habitat, large trees/ and forests with old growth characteristics (snags); open feeding areas. May be roosting and hibernacula along an open rock faces of the Niagara Escarpment. Possible caves on escarpment just north of the watershed boundary.	Pollinators, macroinvertebrates (for diet); riparian plant communities, lowland forests and wetland (feeding), upland forests	POOR - though lack of data. WNS in the region implies a general concern for bat populations.
Pollinators	Heterogeneous habitats between habitat types; Native plant communities (both herbaceous and woody) with range of phenology; habitat having downed wood/grass communities (overwintering habitat); diverse assemblage of pollen and nectar plants	Upland and lowland forest communities; Wetland complexes/habitat, riparian habitats; bats, migratory birds	POOR - lack of high-quality habitat, impact from ag chemicals and low diversity fields; presence of invasive plants driving decline in native nectar and pollen sources; insects worldwide are on the decline
Raptors	Grassland/open, edges and perching areas/trees; some species depend on more forested habitats; wooded areas for nesting and roosting; healthy prey populations	Upland and lowland forest communities; riparian plant communities; migratory birds.	Not applicable as their status would be assessed on a range wide basis.

Strategies and Actions to Reach Conservation Goals and Improve Status of Targets:

To achieve the overarching goals for the Upper East River Watershed, strategies and specific actions were developed by the planning team. A strategy is a planned activity or set of activities that would, when implemented, mitigate, eliminate, or reduce the level of stress on a conservation target or multiple targets. Nested under each broad strategy are actions necessary to advance conservation to achieve the goal(s) outline. Included with these strategies are guidance for several of the prescribed practices that can accompany established best management practices (BMP's) found in other UER Watershed plans. For each of our action items, monitoring and evaluation will be a required component utilizing standard adaptive management principals. Include comment: look at appendices for action x goal table.

To facilitate the implementation of this plan and advance conservation goals for the watershed, a suite of demonstration projects has been proposed to Brown County on lands under their ownership (Figure 7). Through the planning process the potential for restoration work on these lands emerged as a significant opportunity that should be pursued immediately. The work proposed on Brown County lands includes implementation of several strategies outlined below including in-stream habitat restoration, buffer improvement, and bank stabilization among others. Project outlines have been provided to a sub-committee of the core planning team for advancement.

Goal 1: Base and surface flows to streams of the UER are such that fish and invertebrates have access to and reproductive success at, high quality spawning reaches on the watershed network;

- **Strategy: Further Research & Assessment**
 - Action 1: Build a better understanding of hydrology and base flow within the Upper East River watershed, especially within streams emerging from the escarpment face and a major glacial moraine found within the watershed. Determine if there are actions that can be taken to maintain or improve base flow within this system and the role those actions would play in the overall implementation of this plan.

To address several goals, including the above goal of improved base and surface flows to streams, the Upper East River planning team has provided guidelines for the creation of two-stage ditches within agricultural areas of the UER watershed (Appendix A).

Goal 2: Aquatic organisms are not impeded in movement throughout the watershed by barriers such as road/stream crossings or low water quality;

- **Strategy: Further Assessment**
 - Action 1: Assess species condition, and when necessary species assemblages, within the watershed for fish, mussels and invertebrates.
 - Action 2: Further research on the seasonal use of streams and waterways by migratory fish species.

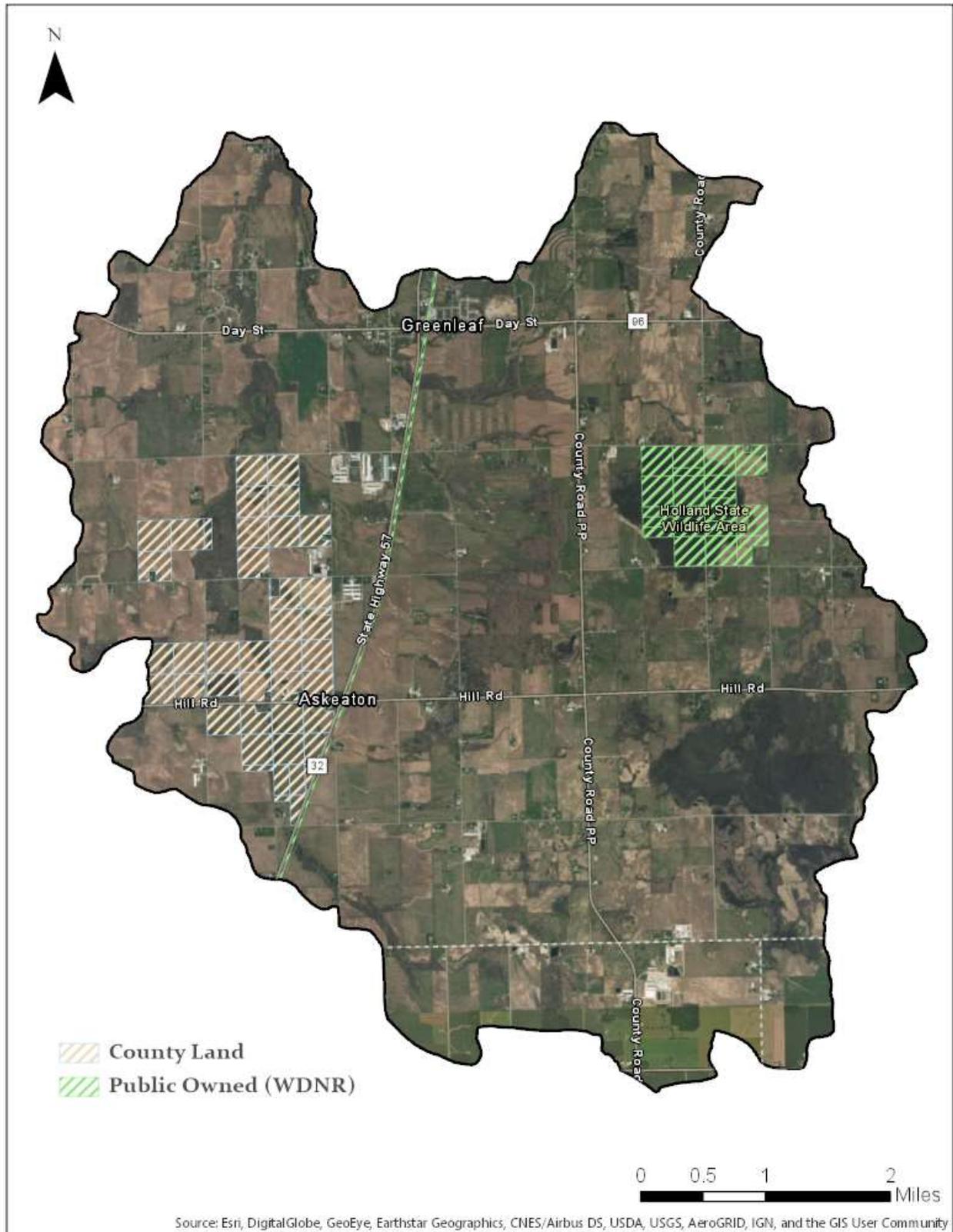


Figure 7: Brown County and Wisconsin Department of Natural Resources ownership within the Upper East River watershed. WDR-owned lands comprise the Holland State Wildlife Area. Map courtesy of Outagamie County LCD.

- **Strategy: Aquatic Connectivity**

- Action 1: Identify priority fish passage barriers on private lands that may limit fish passage.
- Action 2: Conduct a larger study to assess floodplain connectivity and flood-flow stages of streams. Identify critical areas within watershed to focus floodplain and connected wetland strategies.
- Action 3: Reconnection of floodplain through stream restoration; restoration of stream meanders and natural features within critical areas.
- Action 4: Restore stream function through improved width-to-depth ratio of streams in the watershed.

Goal 3: High quality instream spawning, resting, and feeding habitat and morphology is distributed in the stream network to adequately sustain and/or grow target species populations;

- **Strategy: In-stream Habitat**

- Action 1: Complete an assessment of in-stream habitat within the watershed including a ranking of habitat complexity. Identify priority areas for restoration.
- Action 2: Increase abundance of in-stream fish habitat within priority areas including overhanging vegetation, coarse woody debris, boulders, and emergent and submergent vegetation. Target is 20m of woody habitat present per 100m stretch (20%).
- Action 3: Where possible, restore natural stream morphology and decrease average distance between riffles, runs, pools, and bends.

- **Strategy: Bank Stabilization**

- Action 1: Complete full assessment of bank condition within the watershed.
- Action 2: Develop holistic watershed-scale bank stabilization and habitat plan that establishes a three-stepped approach to bank stabilization: 1) riparian buffer condition management, 2) bank stabilization treatments, and 3) instream habitat component
- Action 3: Prioritize severely eroding bank areas with specific BMPs that may include: log vanes/barbs, grading, brush bundles, rip-rap, soil lifts, etc.

In addition to the strategies outlined above, the Upper East River planning team has also developed guidance for streambank restoration and stabilization, as well as instream habitat recommendations (Appendix B).



*Figure 8: Eroded streambank along the East River within the Upper East River Watershed.
Photo courtesy of Andrew Hudak, Wisconsin DNR.*

Goal 4: Riparian upland (forest and herbaceous cover), connected wetland vegetation and stream banks are managed to promote and protect water quality and provide habitat for target species;

- **Strategy: Timber stand improvement**
 - Action 1: Conduct outreach to further appropriate management of the 35-meter corridor on either stream bank to promote water quality and habitat benefits. Appropriate management will promote infiltration, slow the rate of flow across bare soil areas and sequestering sediment in the overbank areas to allow for rapid revegetation (based on frequency) and soil retention.
 - Action 2: Develop timber stand improvement (TSI) plan for existing forested, undeveloped, and non-production areas within the stream corridors (see Forest Management Strategy under Goal #5).
 - Action 3: Identify and promote native shrub species, such as ninebark or dogwoods, that could be utilized as a riparian habitat component.

- **Strategy: Improved management of riparian plant communities**
 - Action 1: Riparian vegetation surveys should be conducted within priority areas of the watershed.
 - Action 2: Invasive species inventory and assessment with management on public and private lands as necessary.
 - Action 3: Potential demo sites or landowner workshops demonstrating desired management of the riparian corridor.
 - Action 4: Explore limited access rotational grazing within the riparian corridor to reduce encroachment of woody vegetation and invasive species.

In addition to the strategies above, the Upper East River planning team also developed guidelines for improving existing riparian buffers and creating adequate new buffers, including management of non-wooded riparian corridors (Appendix C) and wooded riparian corridors (Appendix D).

Goal 5: Upland land cover and farming practices continually improve the quality and hydroperiod of water flowing to the UER system; and upland land cover and farming practices continually improve habitat conditions (size, quality and connectivity) for other upland target species (e.g., grassland and forest migratory and breeding birds, insect pollinators, herps, and other target species).

- **Strategy: Field Buffers**
 - Action 1: Survey and geolocate existing areas needing buffers.
 - Action 2: Increase agricultural buffers in headwater areas.
 - Action 3: Promote and increase buffer widths, locations, and extent along headwater streams and roadside ditches. Improve the habitat condition of existing buffers. Use recommendations found in the Appendices, and the analysis of recommended buffer widths (*Figure 8*) on the following page, to guide planning and on-the-ground action.

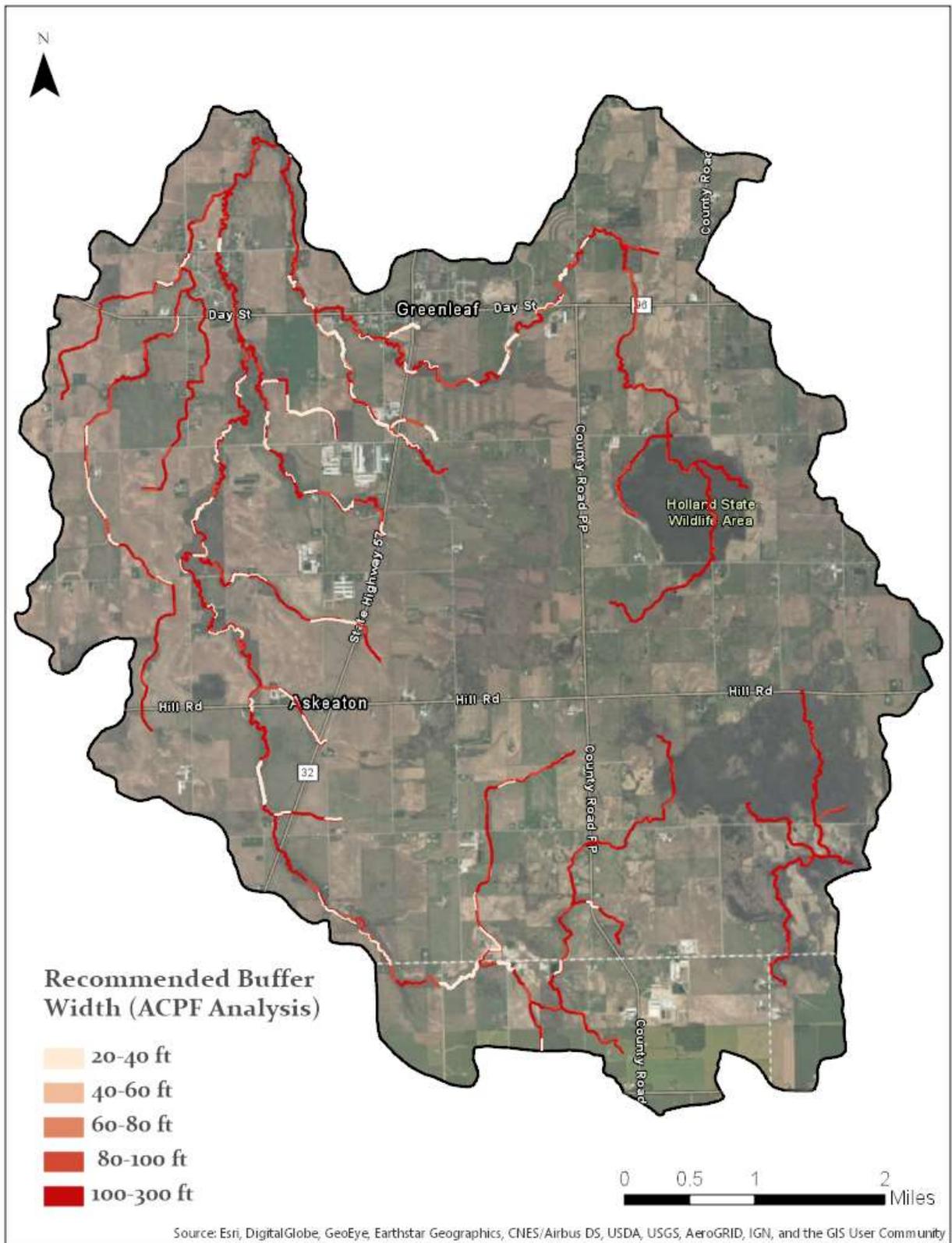


Figure 9: Recommended buffer widths for waterways within the Upper East River Watershed based on Agricultural Conservation Planning Framework analysis. Map courtesy of Outagamie County LCD.

- **Strategy: Sediment and Nutrient Reduction**
 - Action 1: Improve agricultural infiltration capacity of the soils (soil health).
 - Action 2: Develop roadside ditch protection plan to reduce transport of sediment and nutrients.
 - Action 3: Advance strategies and actions identified in Goal #6 to increase wetland acres within the watershed as an important method for nutrient and sediment reduction. Consider prioritizing wetland restoration projects based in part on their potential to reduce nutrients/sediments.

- **Strategy: Building Habitat into Agricultural Practices**
 - Action 1: Promote use of diverse cover crop mix that would provide grassland bird and wildlife habitat.
 - Action 2: Promote or encourage rotational grazing practices within grassland areas to provide further habitat for grassland birds and wildlife in upland areas.
 - Action 3: Encourage landowners and farmers to plant diverse, native cover within buffer areas and marginal lands that will provide food and forage for migratory birds and wildlife. Investigate what incentives are available for these plantings.

- **Strategy: Forest Management**
 - Action 1: Landowner education on existing programs (e.g. MFL) and tax incentives available to increase the number of people actively managing forest properties.
 - Action 2: Identify properties already enrolled in MFL or other forestry programs/practices and conduct outreach asking landowners to consider additional management actions to improve habitat and water quality. Explore feasibility of amending existing MFL contracts to include new actions that aren't in conflict with the overall goal/plan.
 - Action 3: Identify priority areas where Deer Management Assistance Program (DMAP) cooperatives could help achieve forest management objectives on private lands. Establish cooperatives and encourage certified forest managers to include additional habitat improvement actions within their prescriptions for DMAP cooperatives.
 - Action 4: Enhancement or restoration of currently protected forest habitat (i.e. control of invasive species).
 - Action 5: Assess watershed for opportunities for reconnection of the forest corridor through reforestation.

Goal 6: Increase wetland acreage by restoring potentially restorable wetland sites; evaluate current condition of wetlands within the watershed and potentially improve quality of existing wetlands within the watershed

- **Strategy: Protection of existing wetland habitat and quality of that habitat**
 - Action 1: Identify stakeholders that could do land protection through purchase or conservation easements.

- Action 2: Wetland condition assessment for remaining wetlands within the watershed to determine enhancement or restoration needs.
- Action 3: Invasive species management on protected lands; potential use of protected/public lands to demonstrate habitat enhancement techniques to landowners within watershed. Identify partners that can work with private landowners on invasive species and provide outreach.
- **Strategy: Wetland restoration**
 - Action 1: Identification and ranking of potentially restorable wetlands. Ground-truthing of these wetlands as necessary.
- **Strategy: Lowland forest protection and restoration**
 - Action 1: Assess and rank current invasive species within protected lowland forest habitat. Reach out to private landowners in target blocks. Provide funding and assistance.
 - Action 2: Protect current lowland forest through conservation easements or land protection. Identify partners who may be able to do this work within the watershed.
 - Action 3: Connect large blocks in the upper plateau. Explore incentives to convert marginal lands to forest. Provide information on existing programs that could fund lowland forest restoration and partners that could provide assistance (i.e. USFWS Partners Program).

In addition to the strategies outlined above, the Upper East River planning team has also developed guidelines for wetland enhancement and creation for wildlife within the UER watershed (*Appendix E*).

Goal 7: Invasive species, if present, are at a level at which they are not negatively impacting the ability to achieve other conservation goals for the Upper East River watershed. *Note: While invasive species actions are identified under other strategies within this plan, additional actions were identified that led the planning team to include an overall invasive species goal for the watershed. This plan defines invasive species as those listed under Wisconsin’s Chapter NR-40 Invasive Species Rule. We recognize that other non-native plants may be established within the watershed, or that there may exist aggressive native plants, however whether these species are managed will depend on project specific goals.

- **Strategy: Monitoring, Management and Outreach**
 - Action 1: Assess and prioritize invasive species occurrences within the watershed with an emphasis on early detection species that are not yet widely established (e.g. those listed as *prohibited* under NR-40, see *Figure 10 below*).
 - Action 2: Initiate an aquatic invasive species (AIS) monitoring program for the Upper East River watershed. Consider existing programs such as Project RED (Riverine Early Detectors), AIS snapshot day, and the Citizen Lake Monitoring Network (CLMN) as possibilities to engage stakeholders and landowners in AIS monitoring within the UER.
 - Action 3: Consider invasive species prevention, monitoring and management in all habitat restoration projects. This includes, for example, requiring researchers, practitioners and contractors to clean their clothing and equipment before and after their work in the Upper East River watershed.

- Action 4: Use outreach around the Emerald Ash Borer (EAB) or other emerging forest pests within the watershed to engage landowners around the broader topic of invasive species. Assess the potential impact of forest pests on existing habitat within the Upper East River watershed.

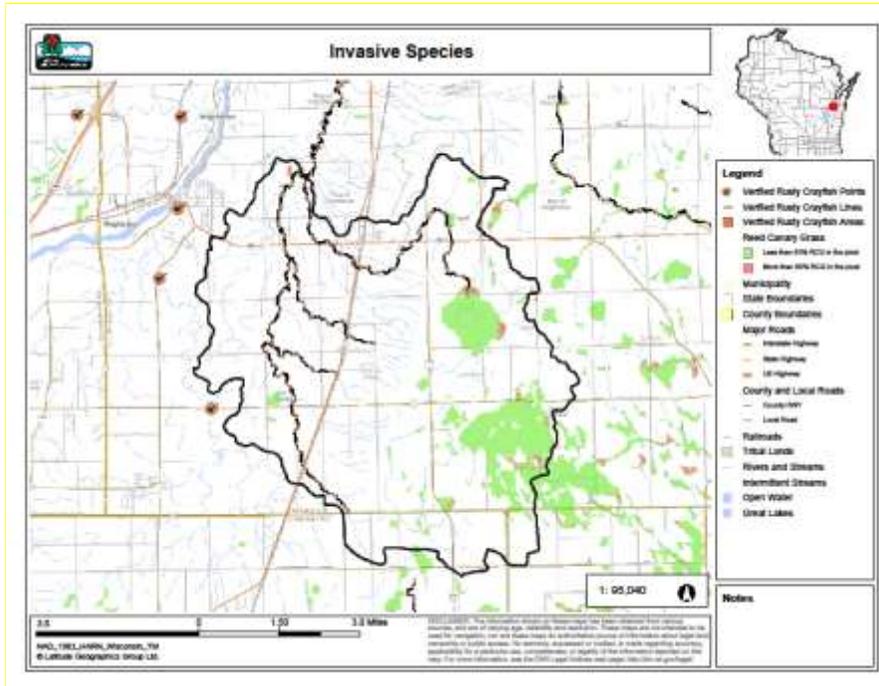


Figure 10: Currently mapped invasive species within the Upper East River Watershed through the Lakes & AIS Mapping Tool of the Wisconsin DNR. Map courtesy of Outagamie County LCD.

Additional watershed-wide strategies that touch on all goals of this plan:

- **Strategy: Land-use Planning**
 - Action 1: Assess existing township land-use plans, comprehensive plans, public property master plans, or zoning ordinances for opportunities to employ conservation practices, enhance environmental corridors and restore natural communities.
 - Action 2: As future town or county comprehensive plans are being developed make sure that conservation actions noted in this plan are included in planning process.
- **Strategy: Outreach**
 - Action 1: Creation of a private landowner outreach strategy and a communications plan on how this document and the goals, strategies and actions outlined will be communicated with stakeholders and landowners within the watershed.
 - Action 2: Continued work with NRCS and other agencies to disseminate BMPs for agriculture.
 - Action 3: Initial conservation projects in this watershed will serve as demonstration projects in order to generate landowner interest and buy-in for habitat improvement.

- **Strategy: Outcomes and Monitoring**
 - Action 1: Further work to define measures of success and monitoring and evaluation plans. The planning team recognized that each individual habitat project that is developed from these strategies will require its own suite of outcomes and monitoring needs. These components are included for consideration in a Conservation Action Profile template, designed for project planning and found in Appendix E of this plan.

Relevant Stakeholders & Conservation Partners:

Strong partnerships are needed to accomplish conservation goals for the Upper East River watershed. The level of a partner's involvement would be based on their expertise and their current work within the watershed or northeastern Wisconsin. Partners may advance this plan through land acquisition, research, grant writing/administration, habitat restoration, or landowner outreach as examples.

Potential partners and stakeholders that could help advance the strategies and actions identified within the Upper East River watershed include:

- Izaak Walton League
- Southern Brown County Conservation Alliance
- Brown County Conservation Alliance
- Northeastern Wisconsin Land Trust
- Brown County Port & Resource Recovery
- Wisconsin Department of Natural Resources (Property managers, NHC, Foresters, etc.)
- Brown County LCD
- Natural Resources Conservation Service (NRCS)
- University of Wisconsin – Green Bay
- University of Wisconsin – Extension
- Brown County Zoning Department
- Town of Brillion
- Town of Wrightstown
- Town of Maple Grove
- Town of Holland
- Brown County Parks Department (Fox River Trail)
- Friends of the Fox River Trail
- Fox-Wolf Watershed Alliance
- Niagara Escarpment Resource Network (NERN)
- Bay Lake Regional Planning
- Fox Demo Farms
- Glacierland RC&D
- Golden Sands RC&D
- Wisconsin Woodland Owners Association
- Wisconsin Certified Tree Farmers
- Hunting and Fishing Clubs (QDM for whitetails, TU, etc.)
- Confined Animal Feeding Operations (CAFOs) and renting farmers
- Permitting agencies

Appendices

Appendix A: Guidance for Two-Stage Ditches

Appendix B: Guidance for Aquatic Organism Passage

Appendix C: Guidance for Management Non-wooded Riparian Corridors

Appendix D: Guidance for Management of Wooded Riparian Corridors

Appendix E: Creation, Restoration and Management of Wetlands for Wildlife Benefits

Appendix F: Conservation Action Profile Template

Appendix G: References & Resources

Appendix A: Guidance for Two-Stage Ditches

Two-stage ditches are drainage ditches that have been modified by adding benches that serve as floodplains within the overall channel. Benefits of a two-stage ditch over the typical agricultural ditch include both improved drainage function and ecological function. The two-stage design improves ditch stability by slowing down water flow and reducing the need for maintenance, saving both labor and money. At low flows the water is concentrated to provide habitat for aquatic organisms such as fish or frogs. At higher flows the channel has the capacity to move the water downstream. Figure 11 is an example of a traditional drainage ditch, a two-stage ditch with flood plain benches and an enhanced two stage design.

A traditional ditch would have the potential for the sides to be undercut and causing slumping of the banks. This can add to the erosion problems of a stream. A floodplain bench decreases the scour by decreasing the head pressure and allowing vegetation to help hold the soil. A more in-depth review of the design and construction of the two-stage ditch and other alternative drainage systems can be found in Karmer, et al. 2019, available at <https://medcraveonline.com/IJH/IJH-03-00188.pdf>.

A simple modification that increases the channel capacity and adds habitat complexity is by lowering the elevation on alternating sides of the channel by 6 to 12 inches. This change in elevation will allow different wetland plants to thrive and increase the complexity of the wetland communities. Figure 12 is an example of alternating a two-stage drainage every 5 to 7 channel widths to increase the meander length at higher flows and increase the diversity of wetland plants. The side to side movement of water dissipates energy and mimics a natural stream pattern.

When considering working on a single stage drainage ditch look at the benefits of a two-stage ditch and the minimal time it will take to enhance your project. Like many conservation practices, a two-stage design is better suited in certain locations. Consulting a knowledgeable professional such as your county engineer, local Soil and Water Conservation District, and/or a professional engineering company is a must before any earthwork is performed.

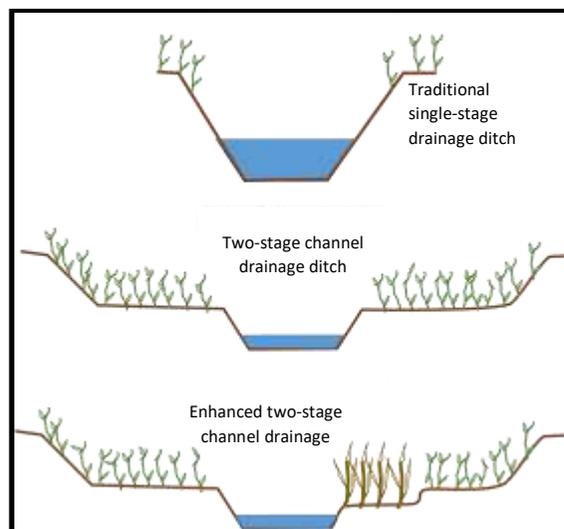


Figure 11: Examples of a single-stage drainage ditch, a two-stage channel and an enhanced two-stage channel design (diagram not to scale).

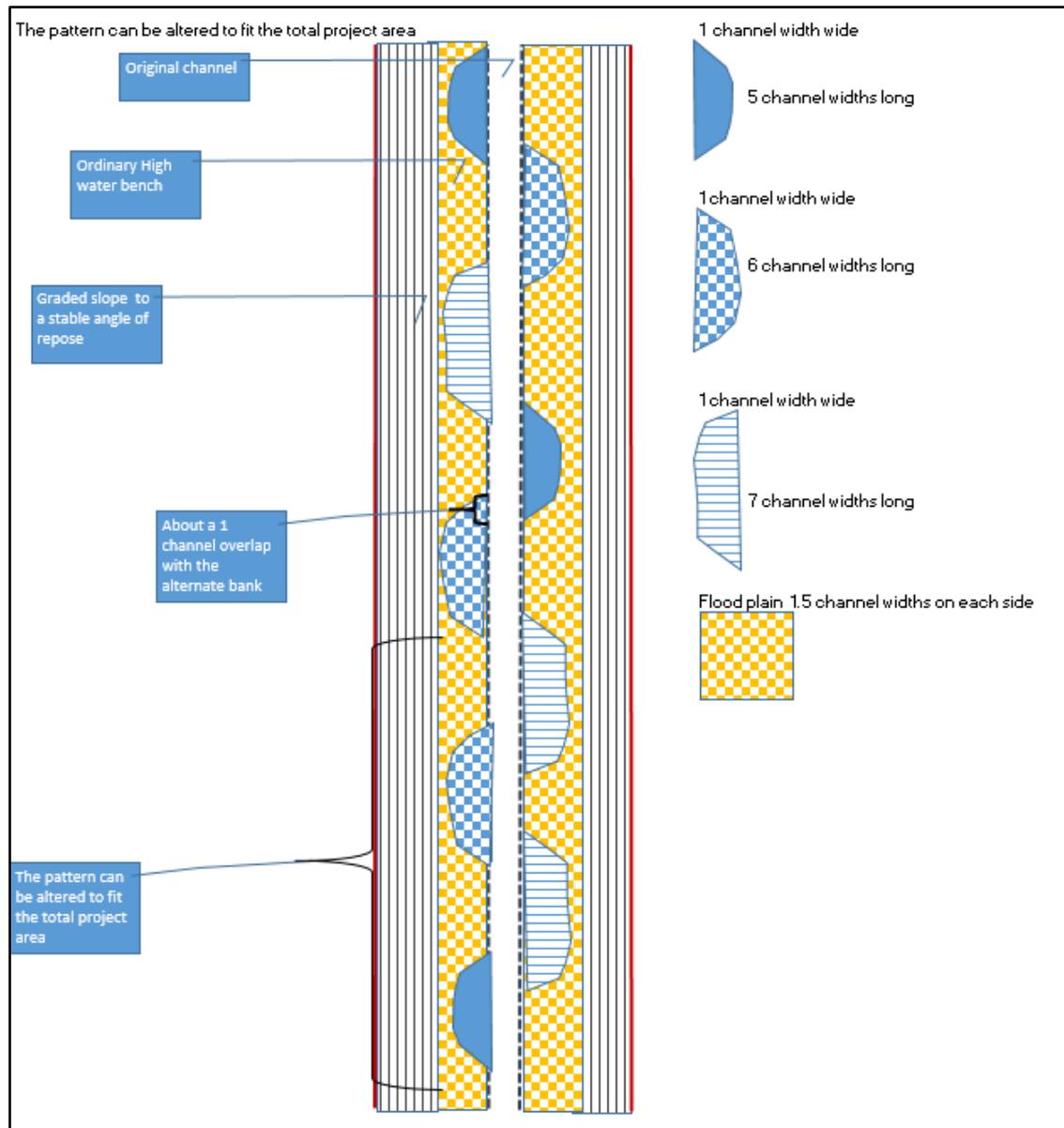


Figure 12: An overhead view of an enhanced two-stage channel where there are alternating pull backs to enhance the habitat values and mimic a natural channel.

Appendix B: Guidance for Aquatic Organism Passage

Fish, turtles, macroinvertebrates, freshwater mussels, and other aquatic organisms need connected waterways to migrate, find food, and complete their life cycle. Passage barriers include anything that inhibits an organism from moving between areas needed for survival, including access for reproduction, foraging, and refuge habitats. A barrier may be a physical structure, like a culvert, dam, or levee, or it may be an abiotic feature like sediment, water temperature, water flow, or water quality. If an aquatic organism cannot move between habitats due to barriers, they may not likely survive. Providing aquatic organism passage includes the removal or replacement of barriers so that organisms are no longer inhibited in movement and can freely access the range of habitat needs necessary for them to successfully complete their lifecycle and contribute to ecosystem function.

Optimizing aquatic organism passage in the watershed involves multiple stages including a barrier inventory, determining biological targets (e.g., species or population goals) to guide decision-making, and identifying priority barriers where removal or replacement will provide the greatest return on investment (i.e., maximize habitat connectivity, connect integral populations, benefit multiple species, low cost of barrier removal/replacement, etc.). The first step for optimizing aquatic organism passage is to conduct a barrier inventory across the watershed that assesses potential barriers and the degree in which they inhibit passage (e.g., full barrier, partial barrier, seasonal barrier, species-specific, etc.). The barrier inventory will also serve to identify any data gaps and direct field assessments to collect missing information. The [Great Lakes Road Stream Crossing Inventory](#) survey protocol provides a comprehensive assessment tool developed by state and federal agencies and conservation organizations in Wisconsin and Michigan to identify barriers and estimate replacement costs. The Great Lakes Road Stream Crossing protocol tool, in conjunction with abiotic monitoring, developing stream profiles, hydrologic analysis, and species richness surveys, will help identify aquatic organism passage barriers across the watershed.

Setting measurable biological targets will help estimate success of reestablish aquatic organism passage. Biological targets can be a range of goals that start broad and nonspecific for species (e.g., increasing biodiversity and species richness surveys, or increasing an index of biotic integrity score), or the presence of a species that was not previously documented when the barrier was in place, or may be specifically quantified by a species population assessment (e.g., increase the population of a species by 150% or increase recruitment of a species by a set number).

Once a barrier inventory is complete and biological targets are set to achieve goals for population recruitment or habitat use, a plan of action can be created to prioritize barrier removal or replacement to achieve aquatic organism passage. Objectives for maximizing the return on investment for a barrier removal or replacement may consider the length of stream miles opened for access, the number of wetland acres restored, the size of meta-populations connected through barrier removal, the number of the species that will benefit from each passage project, or other considerations. Prioritizing barrier removal to achieve aquatic organism passage will help direct conservation actions to achieve the greatest ecological uplift within the watershed.

Appendix C: Guidance for Non-Wooded Riparian Corridors

The purpose of non-wooded corridor management is to focus efforts on habitat management along existing non-wooded buffers of the Upper East River and its tributaries. Buffers in non-wooded corridors can vary greatly in size and quality. In some locations adequate buffer widths exist but are dominated by monotypic stands of reed canary grass or narrow-leaved cattail. Others are undersized and of varying quality, while other buffers are located within and may serve a roll in an agricultural production. An over-arching goal of this recommendation is establishing a minimum distance that should be established as a vegetative buffer and recommendations for management within non-production areas to benefit instream habitat, wildlife habitat and water quality conditions.

Generally non-wooded stream corridors in the Upper East River watershed contain a mix of herbaceous species but may often be dominated by lower quality species such as reed canary grass, narrow-leaved cattail, or phragmites. A few scattered trees of cottonwood, boxelder, willow, or ash may be present, but the community is largely in an herbaceous setting. Bank erosion is most often not a significant concern since the dense herbaceous vegetation has provided stable conditions. Fish habitat within these stream reaches may occur as undercut banks or overhanging vegetation. Focus for these areas should be on improving conditions for use as wildlife habitat and minimizing sediment and nutrient inputs into the streams protecting other habitat.

The overarching goal of the non-wooded riparian buffer enhancement objective is to increase buffer width and quality.

Goals of guidance for non-wooded riparian corridors:

- 1) Continue to provide stable bank conditions
- 2) Improve bank vegetation as overhanging cover for fish and wildlife habitat
- 3) Increase stream buffer widths
 - a. Min 35m (on each side) on East River
 - b. Min 10m on all other streams
- 4) Increase stream buffer vegetation quality in non-agricultural buffers
 - a. Target herbaceous species diversity
 - b. Target areas to alter cover type- multi-species, layering of vegetation-Trees, Shrubs, Herbaceous

General Target Areas – Non-Woody Riparian Corridors



Visual Representation of Desired Outcomes of Target Implementation – Non-woody Corridors



Appendix D: Guidance for Wooded Riparian Corridor Management

The purpose of wooded corridor management is to focus efforts on habitat management along existing wooded buffers of the Upper East River and its tributaries. It has been identified that areas of adequate buffers currently exist between agricultural lands and the streams in the watershed, however conditions within these buffers often provide limited benefits to instream habitat and water quality conditions.

Generally riparian forests in the Upper East River watershed contain a mix of tree species including ash, boxelder, basswood, elm, cottonwood, hard maple, and oaks. The understory can be sparsely to moderately vegetated with species such as common buckthorn, prickly ash, barberry, gooseberry, and honey suckle. The goal of the wooded riparian buffer enhancement objective is to reduce canopy cover of un-desirable or lower quality tree species to promote establishment of a robust shrub and/or herbaceous layer to aid in bank stabilization and in-stream habitat improvements. One challenge to this approach is the establishment of a quality herbaceous layer along the banks, protection of high-quality trees for wildlife and fish habitat, and the removal/management of invasive or undesirable tree/shrub species.

Goals:

- 1) Provide stable bank conditions
- 2) Increase bank vegetation as overhanging cover for fish and wildlife
- 3) Increase instream woody habitat structure
- 4) Increase stream buffer width and quality

General Considerations:

- 1) Stream bank focus areas are within 0-10m of OHWM, but wooded corridor management should extend to a minimum 35m of the OHWM.
- 2) No heavy equipment should be operated within 3m of stream unless bank grading or structural practices are proposed for bank stabilization or instream habitat enhancements.
 - a. Areas of structural bank stabilization should be identified on a project or reach basis to determine the most appropriate approach to provide adequate bank stability. Methods may include grading, rock rip or large wood placement other bank stabilization focused methods.
- 3) Selective thinning - Remove box elder, ash, elm and select for oak spp., hard maple, to less than 30 percent crown closure to promote establishment of dense herbaceous vegetation within 10m of the OHWM. Crown closure within the remaining wooded buffer area should be on a case by case basis to promote stand improvement and other management objectives.
- 4) Planting of supplemental desirable species including swamp white oak, white pine, maple species, white cedar, basswood, burr oak, tamarack, and hemlock.
- 5) Significant snag or instream habitat trees should be identified and protected during the planning phase.
- 6) Trees selected for thinning within 10m should be considered for woody instream habitat placement.
 - a. Woody Habitat Target is minimum 20m of habitat within 100m stretches, or in other words, roughly greater than 20% of the area of the stream should contain cover for fish that provides protection from the current or visual isolation.

- b. Woody habitat target includes large pieces or aggregations of smaller pieces located in or in contact with water that is 0.2m deep.
- c. Within a wooded corridor project, additional bank stabilization measures may be required to correct significant bank alterations
- d. Comprised of log vanes, brush bundles, tree drops, root wads, etc.
- e. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_025097.pdf

Tree tops following any harvest or management should be left within wooded corridor zone to provide roughness and woody debris recruitment

- a. Surface seeding of a floodplain native seed mix on exposed soils should be considered where low to moderate density of existing herbaceous vegetation exists. For successful implementation of this practice, seed mixes should include such species as Common Water Plantain, Marsh Milkweed, New England Aster, Red-Stemmed Aster, Spotted Joe Pye Weed, Boneset, Sneezeweed, Saw-Tooth Sunflower, Marsh Blazing Star, Cardinal Flower, Great Blue Lobelia, Mountain Mint, Wild Golden Glow, Cupplant, Riddell's Goldenrod, Blue Vervain, Ironweed, Golden Alexanders Fringed Brome, Brown Fox Sedge, River Bank Wild Rye, Virginia Wild Rye, Reed Manna Grass, Rice Cut Grass, Dark-Green Bulrush, Wool Grass, River Bulrush, Soft-Stem Bulrush, Prairie Cord Grass. On drier slopes species mixes including Partridge Pea, Lance-Leaf Coreopsis, Purple Coneflower, Early Sunflower, Wild Bergamot, Yellow Coneflower, Black-Eyed Susan, Sweet Black-Eyed Susan, Big Bluestem, Side Oats Grama, Canada Wild Rye, Slender Wheatgrass, Virginia Wild Rye, Switchgrass, Little Bluestem, and Indian grass should be considered

Upper East Wooded Riparian Habitat Recommendations (Figure 12)

Zone 1- Minimum 3m- Hand removal of undesirable tree/shrub species and manage for high value tree shrubs only and establish dense herbaceous vegetation through reduced canopy and seeding.

Zone 2- Minimum 29m Managed Forest w/ feathered edges

Zone 3- 3m Field side buffer Management Zone



Figure 13: Visual representation of Upper East River wooded riparian habitat recommendations.

General Target Areas – Wooded Riparian Corridors



**Visual Representations of Desired Outcome of Target Implementation –
Wooded Riparian Corridors**



Appendix E: Creation, restoration and management of wetlands for wildlife benefits

Wetlands once covered approximately 13% of the Lower Fox River watershed. Of historical wetlands it is estimated that 42% have now been lost within the basin (Cadmus, 2012). The benefits of wetlands to hydrologic control, fish and wildlife habitat, water quality and recreation are well known. This section will offer guidelines to maximize the benefit of wetland creation, restoration or improvement for the fish and wildlife native to this watershed. Specifically, this section will address wetland conservation actions that will benefit the species, species groups, and habitat types related to wetlands and identified by the Upper East River Planning Team as important conservation targets for the watershed. These species, species groups, and habitat types include:

- resident and migratory fish native to the region;
- macroinvertebrates;
- riparian plant communities;
- lowland forests and wetlands;
- ground water base flow;
- migratory birds;
- bats;
- pollinators;
- turtles and amphibians.

The planning team also developed broad watershed goals. Those relevant to wetland conservation include:

- Base and surface flows to streams of the UER are such that fish and inverts have access to and reproductive success at, high quality spawning reaches on the watershed network;
- Riparian upland (forest and herbaceous cover), connected wetland vegetation and stream banks are managed to promote and protect water quality and provide habitat for target species;
- Upland land cover and farming practices continually improve the quality and hydroperiod of water flowing to the UER system;
- Increase wetland acreage by restoring potentially restorable wetland sites; evaluate current condition of wetlands within the watershed and potentially improve quality of existing wetlands within the watershed
- Control invasive species

To achieve these goals and address the conservation needs of the priority target species and species groups an approach for wetland conservation should include:

- Identifying the highest priority existing wetlands for protection and conservation management and identifying those prior converted wetlands of highest value if restored. The Wisconsin “*Wetland by Design*” software tool (<https://maps.freshwaternetwork.org/wisconsin/#>) was designed to assist with this ranking task (Figures 13 & 14).

In addition to identifying wetlands with high value for wildlife, water quality and hydrologic management, watershed wetland conservation planning and implementation should also consider the following principles:

- Whenever possible begin wetland conservation work in the headwater reaches of the watershed and work downstream;
- Consider landscape context of the existing wetland or proposed wetland recreation. Important attributes of landscape context would include the adjacent land cover and use – present and possible future use; the location and distance of other wetlands or supportive habitat types; the habitat connectivity between the wetland and nearest other supportive habitat types; the landcover of the watershed of the wetland and the connectivity, hydrologic regime, and quality of the upstream water source for the wetland.
- Wetland conservation on a watershed scale should be thought of as preserving or developing a complex of connected wetland types, with different types and many successional stages and hydroperiods represented in close proximity. Wisconsin has over 30 different types of wetland communities of which many would be inappropriate and difficult if not impossible to recreate in the Upper East river watershed (e.g., bogs, ridge and swale wetlands). However, assessing the current diversity of wetland types in the watershed and nearby watersheds with similar soils and hydrology could offer guidance to the types of target wetlands to protect and recreate.
- Wetland types that are known to provide critical habitat (nesting, foraging, denning, etc.) for Species of Greatest Conservation Need (SGCN) <https://dnr.wi.gov/topic/wildlifehabitat/actionplan.html> are identified in the Wisconsin Wildlife Action Plan. Preservation, enhancement or recreation of habitats that support SGCN populations should be ranked highly in watershed planning.
- Size and internal habitat heterogeneity are important drivers of the numbers and diversity of species utilizing a habitat patch. The goal should be to try to protect or recreate the largest wetland habitat patches available.

Management, maintenance and operation of wetland sites should be included in any protection or recreation program. According to the NRCS components of an operation and management plan should include:

- Monitoring and management of habitat structure and vegetation;
- For sites that will utilize water depth management for habitat or unwanted vegetation control (e.g., reed canary grass) the water depth, duration and periodicity needs to be specified and monitored;
- if haying or livestock grazing is used as a habitat management tool, the conditions of grazing intensity, location and rotation should be developed to facilitate the establishment, development and management of wetland and buffering upland vegetation for the intended wetland and/or wildlife purpose.
- Biological control of undesirable plant species and pests (e.g., using predator or parasitic species) shall be implemented where available and feasible.

Sources of information for wetland management include:

Management of wetlands for wildlife by: Matthew J. Gray, Heath M. Hagy, J. Andrew Nyman, and Joshua D. Stafford. https://doi.org/10.1007/978-94-007-6907-6_4 . This can be found in: Anderson J., Davis C. (eds) *Wetland Techniques*. Springer, Dordrecht

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<https://content.govdelivery.com/accounts/USDANRCS/bulletins/26cbe68> and https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026455.pdf .

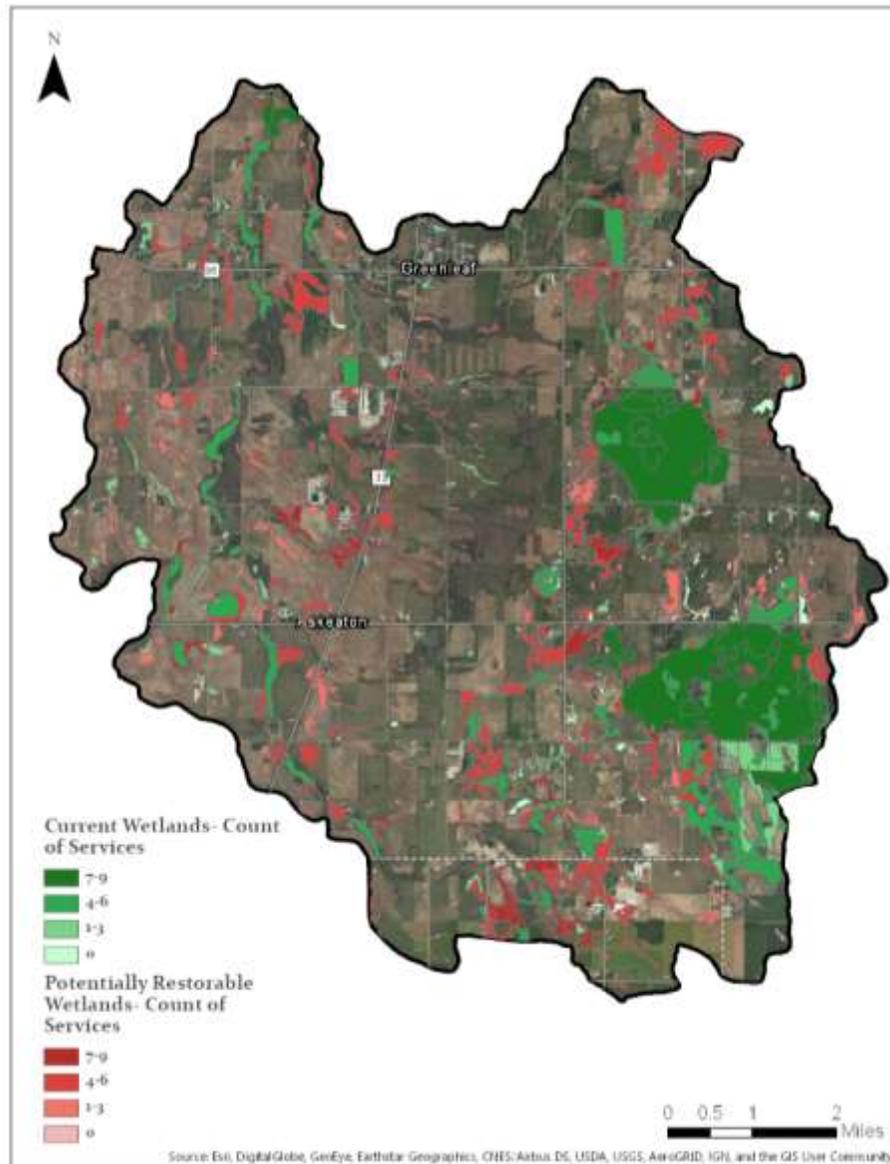


Figure 14: Current and potentially restorable wetlands ranked by the number of ecosystem services they are providing or have the potential to provide once restored. Services assessed include flood abatement, sediment retention, phosphorus retention, nitrogen reduction, shoreline protection, surface water supply, carbon storage, fish and aquatic habitat, and floristic integrity. Wetlands that provide or could provide the greatest number of services should be prioritized for protection and/or restoration. Map courtesy of Outagamie County LCD.

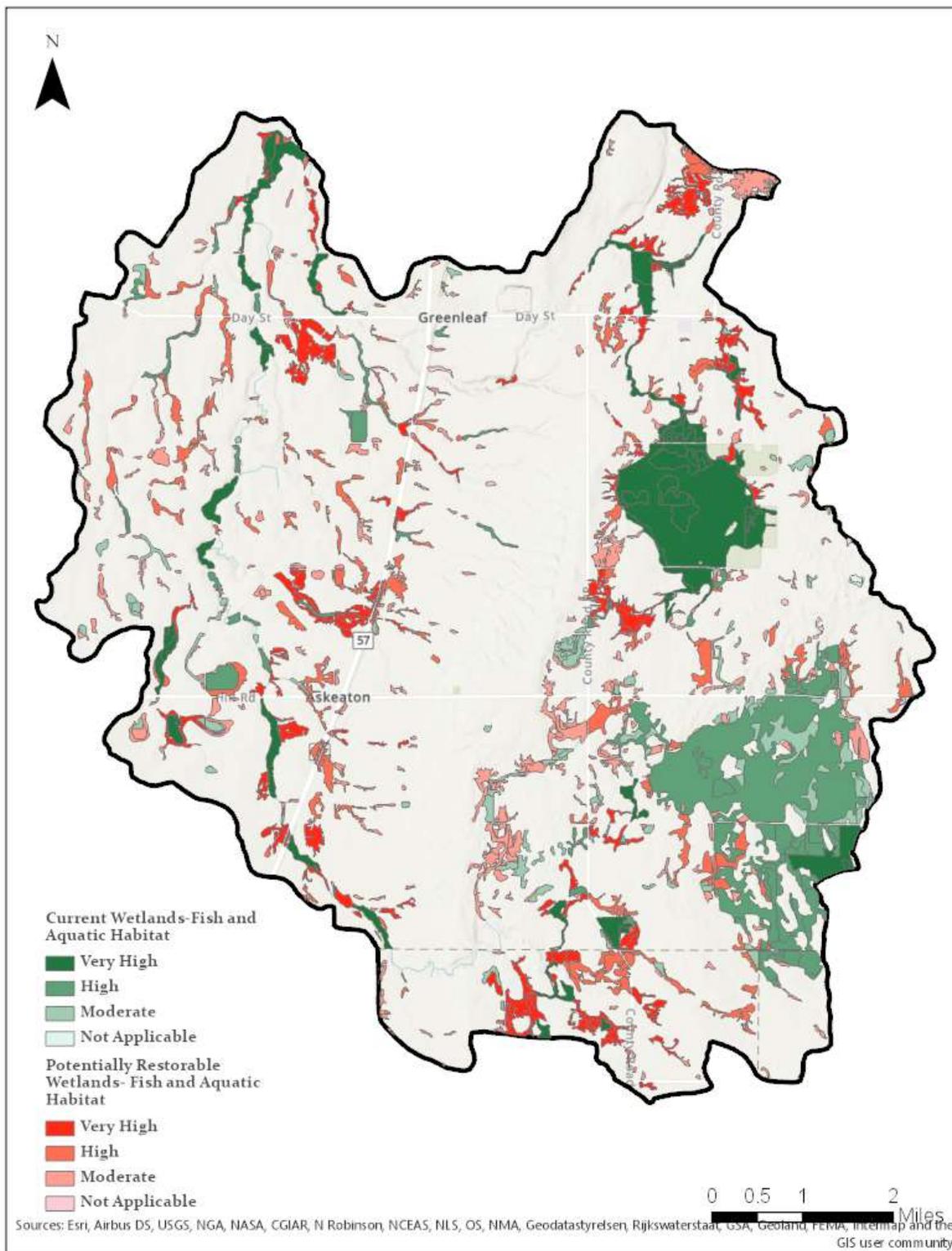


Figure 15: Current and potentially restorable wetlands categorized by their current/potential value for fish and aquatic habitat within the Upper East River Watershed. Wetlands of highest value should be prioritized for protection and/or restoration. Map courtesy of Outagamie County LCD.

Appendix E: Conservation Action Profile Template for the Upper East River Watershed. Potential projects within the Upper East River watershed can be assessed using this template and considered against other potential projects/management actions.

**UPPER EAST RIVER
Conservation Action Profile**

Action	
Priority level	
Goal	
Strategy	
Action priority and sequencing comments	<i>e.g., this is a highly ranked action and should be considered for implementation before other stream bank or in-stream habitat management actions</i>
Measures of Success	
Location(s) and comments on functional ecological connectivity	
Management Activities	
Monitoring	
Species or species groups to benefit	
Habitat types to benefit	
Potential challenges or barriers	
Project partners	
Estimated budget	
Potential funding sources/leveraging opportunities	
Questions or knowledge gaps	
Research needs or opportunities	
Comments on resilience to climate change or change in surrounding land use	

Appendix F: References & Resources

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