



Rapid Ecological Assessment for the Eastern Lake Winnebago Wildlife Areas

**A Rapid Ecological Assessment Focusing on Rare Plants, Selected Rare Animals, and
High-quality Natural Communities**

Properties included in this report are:

- Brillion Wildlife Area
- Eldorado Wildlife Area
- Collins Marsh Wildlife Area
- Killsnake Wildlife Area

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Cover Photo: Emergent marsh complex with active osprey nesting platform at Brillion Wildlife Area.
Photo by: Andy Clark

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The Eastern Lake Winnebago Wildlife Areas At a Glance

Exceptional Characteristics of the Study Area

- **Rare Animals and Plants.** The diverse habitats of the Eastern Lake Winnebago Wildlife Areas (ELWWA) support numerous rare species. Thirty-nine rare animal species are known from the ELWWA, including four State Endangered, four State Threatened, and 31 Special Concern species. One Special Concern plant species is known from the ELWWA.
- **Migratory Bird Stopover Habitat.** The ELWWA provides stopover habitat to shorebirds, waterbirds, waterfowl, and landbirds. Excellent diversity and high species richness from various bird groups accumulate here during migration because the properties offer important resources to migrating birds including food, water, and shelter.
- **Large Wetlands.** Large wetland types are common natural communities throughout the ELWWA and include emergent marsh, southern sedge meadow, shrub-carr, and southern hardwood swamp. A large proportion of the rare animals of the ELWWA are breeding birds utilizing the emergent marsh, shrub-carr, and impoundment habitats found on these properties.

Site Specific Opportunities for Biodiversity Conservation

Two ecologically important sites were identified on the ELWWA. These “Primary Sites” were delineated because they generally encompass the best examples of 1) representative and rare natural communities, 2) documented occurrences of rare species populations, and/or 3) opportunities for ecological restoration or connections. These sites warrant high protection and/or restoration consideration during the development of the property master plan.

- **Collins Hardwood Swamp.** This Primary Site is an extensive, good-quality southern hardwood swamp, representing an uncommon forest type within an otherwise largely un-forested landscape.
- **Dyke Road Flowage and Marsh.** This Primary Site supports exceptionally high numbers of breeding, foraging, and migrating waterfowl, shorebirds, colonial waterbirds and marshbirds.

Introduction

Purpose and Objectives

This report is intended to be used as a source of information for developing a new master plan for the Wildlife Areas of the Eastern Lake Winnebago Wildlife Areas Planning Group (ELWWA; Figure 1). The regional ecological context for the ELWWA is also provided to assist in developing the Regional and Property Analysis that is part of the master plan. Properties included in this assessment are:

- Brillion Wildlife Area
- Collins Marsh Wildlife Area
- Eldorado Wildlife Area
- Killsnake Wildlife Area

The primary objectives of this project were to collect biological inventory information relevant to the development of a Master Plan for the ELWWA and to analyze, synthesize and interpret this information for use by the master planning team. This effort focused on assessing areas of documented or potential habitat for rare species and identifying natural community management opportunities.

Survey efforts for the ELWWA were limited to a “rapid ecological assessment” for 1) identifying and evaluating ecologically important areas, 2) documenting rare species occurrences, and 3) documenting occurrences of high-quality natural communities. This report can serve as the “Biotic Inventory” document used for master planning, although inventory efforts were reduced compared to similar projects conducted on much larger properties, such as state forests. This report provides much of the same information as in “Biotic Inventory” reports, although, the inventory was limited to a “rapid ecological assessment.” There will, undoubtedly be gaps in our knowledge of the biota of this property, especially for certain taxon groups; these groups have been identified as representing either opportunities or needs for future work.

Overview of Methods

The Wisconsin Natural Heritage Inventory (NHI) program is part of the Wisconsin DNR’s Bureau of Endangered Resources and a member of an international network of Natural Heritage programs representing all 50 states, as well as portions of Canada, Latin America, and the Caribbean. These programs share certain standardized methods for collecting, processing, and managing data for rare species and natural communities. NatureServe, an international non-profit organization (see www.NatureServe.org for more information), coordinates the network.

Natural Heritage programs track certain *elements* of biological diversity: rare plants, rare animals, high-quality examples of natural communities, and other selected natural features. The NHI Working List contains the elements tracked in Wisconsin; they include endangered, threatened, and special concern plants and animals, as well as the natural community types recognized by NHI. The NHI Working List is periodically updated to reflect new information about the rarity and distribution of the state’s plants, animals, and natural communities. The most recent Working List is available from the Wisconsin DNR web site (*Wisconsin Natural Heritage Working List*).

The Wisconsin NHI program uses standard methods for biotic inventory to support master planning (Appendix A). Our general approach involves collecting relevant background information, planning and conducting surveys, compiling and analyzing data, mapping rare species and high-quality natural

community locations into the NHI database, identifying ecologically important areas, and providing interpretation of the findings through reports and other means.

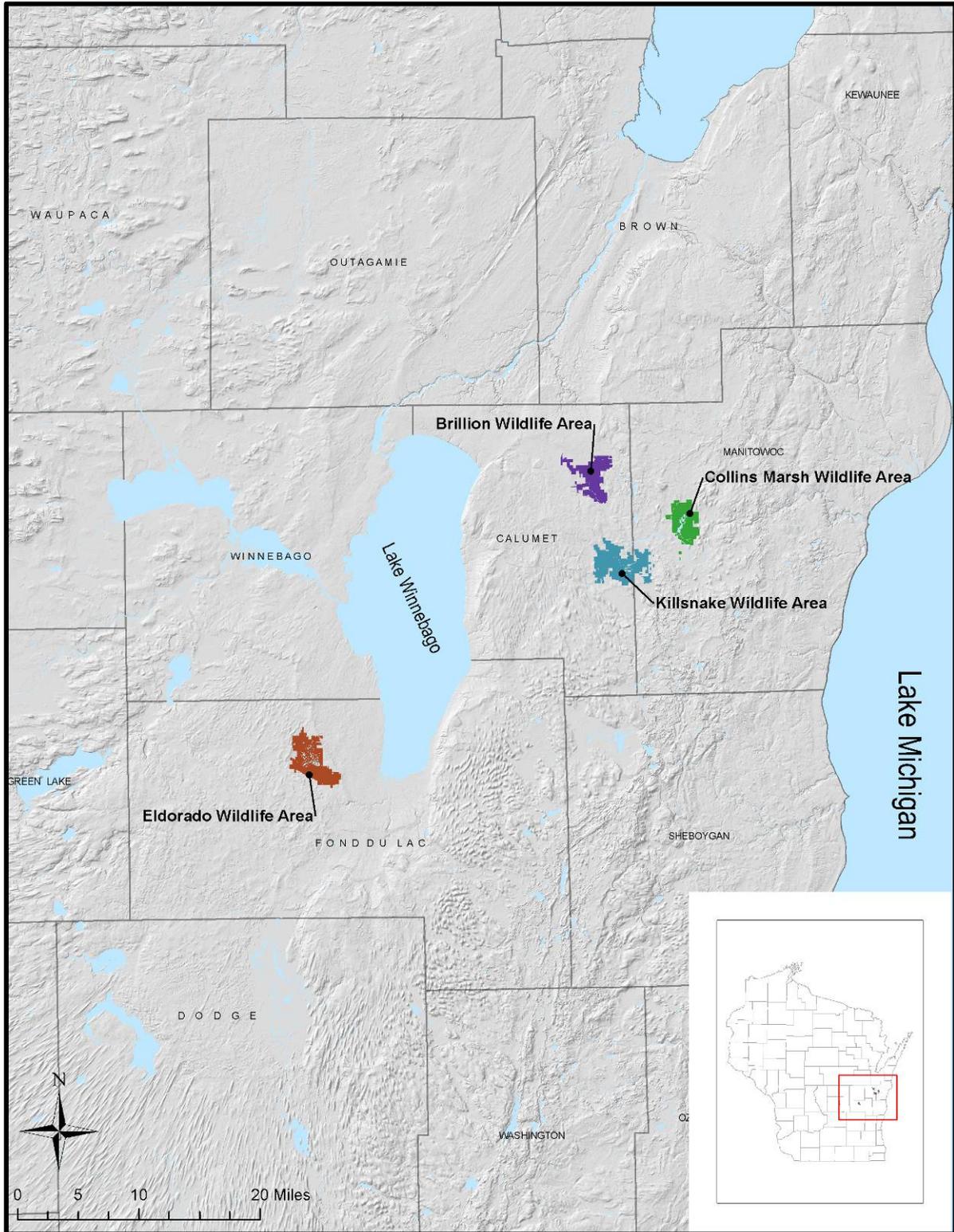
Existing NHI data are often the starting point for conducting a biotic inventory to support master planning. Prior to this project, NHI data for the ELWWA were limited to: 1) the Statewide Natural Area Inventory, a county-by-county effort conducted by WDNR's Bureaus of Research and Endangered Resources between 1969 and 1984 that focused on natural communities but include some surveys for rare plants and animals, 2) volunteer-based bird surveys that primarily focused on marshbirds, 3) WDNR's eagle and osprey aerial surveys, 4) surveys conducted for the *Biodiversity in Selected Natural Communities Related to Global Climate Change* (a.k.a., Peatlands Project; Anderson et al. 2008), and 5) other taxa-specific surveys.

The most recent taxa-specific field surveys for the study area were conducted during 2009. Surveys were limited in scope and focused on documenting high-quality natural communities, rare plants, breeding birds, and rare butterflies, including the swamp metalmark butterfly (*Calephelis muticum*). The collective results from all of these surveys were used, along with other information, to identify ecologically important areas (Primary Sites) on the ELWWA.

Survey locations were identified using recent aerial photos, USGS 7.5' topographic maps, various Geographic Information System (GIS) sources, information from past survey efforts, discussions with property managers, and the expertise of several biologists familiar with the properties or with similar habitats in the region. Based on the location and ecological setting of properties within the ELWWA, key inventory considerations included the identification of high-quality open wetland types including southern sedge meadow and calcareous fen, along with ecologically significant stands of hardwood swamp, bird communities of emergent marsh and open water areas, prairie or surrogate grasslands and the location of additional habitats that had the potential to support rare species. Private lands surrounding the ELWWA were not surveyed.

Scientific names for all species mentioned in the text are included in a list on page 34.

Figure 1: Location of Properties within the Eastern Lake Winnebago Wildlife Areas Planning Group



Background on Past Efforts

Various large-scale research and planning efforts have identified a number of locations within the ELWWA as being ecologically significant. The following are examples of such projects and the significant features identified.

The **Land Legacy Report** (WDNR 2006a) was designed to identify Wisconsin's most important conservation and recreation needs for the next 50 years. The report identifies this region as particularly important for the large wetlands at Brillion, Collins, and Killsnake Wildlife Areas protecting the headwaters of the Manitowoc River. These large marshes and headwater areas provide critical feeding, nesting, and resting habitat for waterfowl, waterbirds, marshbirds, and passerine birds, maintaining the ecological connection of this area should be a priority.

The **NHI Peatlands Project** (Anderson et al. 2008) was a five-year statewide study conducted by the Bureau of Endangered Resources. The primary goals of the project were 1) to obtain baseline data on the presence / absence, abundance, and distribution of species in multiple taxon groups associated with peatland communities in Wisconsin, and 2) to document selected biotic and abiotic variables that could potentially influence the organisms being studied. The surveys were designed to be replicated in 5-10 years and used to detect changes in biota related to climate change. The project included sites at two of the Wildlife Areas (Eldorado and Killsnake) within the ELWWA. All sites were evaluated in the field for inclusion to the Peatlands Project, but neither of the two potential sites contained within this study area met the criteria for the project, meaning they were either too small or consisted of muck soils rather than peat.

Managing Habitat for Grassland Birds: A Guide for Wisconsin listed Brillion / Killsnake Grasslands as a priority landscape for grassland bird management in the surrogate grasslands and southern sedge meadows. Sample and Mossman (1997) noted that there is potential for further prairie restoration and surrogate grassland expansion, including between the two wildlife areas.

Forest Certification is established on all DNR-managed lands, including state parks, wildlife and fishery areas, and natural areas. Certified forests are recognized by the Forest Stewardship Council and the Sustainable Forestry Initiative as being responsibly managed (WDNR 2009). This certification emphasizes the state's commitment to responsibly managing and conserving forestlands, supporting economic activities, protecting wildlife habitat, and providing recreational opportunities.

Special Management Designations

Glacial Habitat Restoration Area (GHRA) is a WDNR program which takes a regional approach to wildlife management by restoring, creating and maintaining habitat for waterfowl, wild pheasants, and non-game passerine birds. The program's focus is the creation of a patchwork of restored grasslands and wetlands amid the established croplands of Columbia, Dodge, Fond du Lac and Winnebago counties, thereby maximizing wildlife habitat. In an era of increasing rural development and disappearing farmland and wetland, these areas are critical to the nesting, feeding, and overall survival of birds and other wildlife populations. Through the purchase of land and the establishment of perpetual conservation easements, the GHRA is working towards its goal of restoring and conserving 38,600 acres of permanent grassland nesting cover and 11,000 acres of wetlands in the 24-township area. Eldorado Wildlife Area is located within the GHRA.

Regional Ecological Context

This section is largely reproduced from the Ecological Landscapes of Wisconsin Handbook (WDNR In Prep.). This handbook was developed by the WDNR Ecosystem Management Planning Team (EMPT) and identifies the best areas of the state to manage for natural communities, key habitats, aquatic features, native plants, and native animals from an ecological perspective.

The WDNR has mapped the state into areas of similar ecological potential and geography called Ecological Landscapes. The Ecological Landscapes are based on aggregations of smaller ecoregional units (Subsections) from a national system of delineated ecoregions known as the National Hierarchical Framework of Ecological Units (NHFEU) (Cleland et al. 1997). These ecoregional classification systems delineate landscapes of similar ecological pattern and potential for use by resource administrators, planners, and managers.

Central Lake Michigan Coastal Ecological Landscape

Brillion, Collins Marsh, and Killsnake Wildlife Areas are located within the Central Lake Michigan Coastal Ecological Landscape (WDNR in Prep.) (Figure 2). The Central Lake Michigan Coastal Ecological Landscape stretches from southern Door County west across Green Bay to the Wolf River drainage, then southward in a narrowing strip along the Lake Michigan shore to central Milwaukee County. Owing to the influence of Lake Michigan in the eastern part of this landscape, summers are cooler, winters warmer, and precipitation levels greater than at locations farther inland. Dolomites and shales underlie the glacial deposits that blanket virtually all of the Central Lake Michigan Coastal Ecological Landscape. The dolomite Niagara Escarpment is the major bedrock feature, running across the entire landscape from northeast to southwest. Series of dolomite cliffs provide critical habitat for rare terrestrial snails, bats, and specialized plants. The primary glacial landforms are ground moraine, outwash, and lakeplain. The topography is generally rolling where the surface is underlain by ground moraine, variable over areas of outwash, and nearly level where lacustrine deposits are present. Important soils include clays, loams, sands, and gravels.

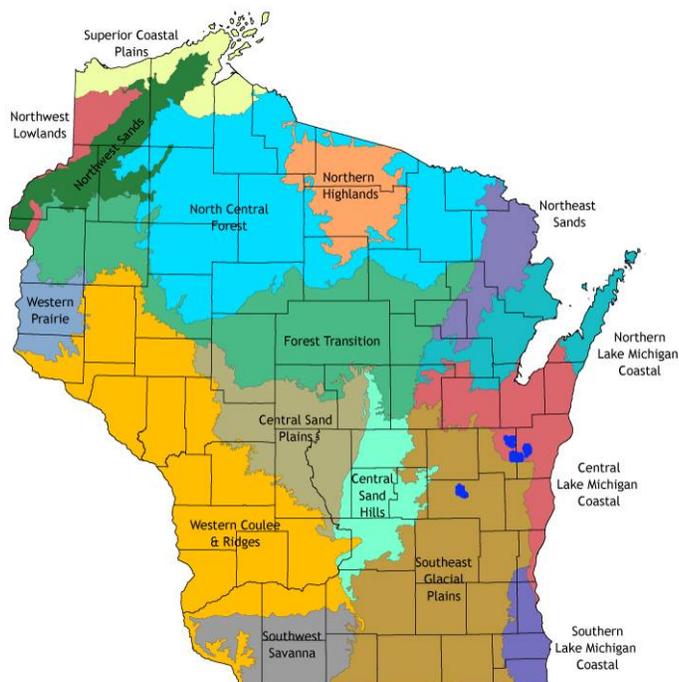


Figure 2: Ecological Landscapes of Wisconsin and the Study Area

Historically, most of this landscape was vegetated with mesic hardwood forest composed primarily of sugar maple (*Acer saccharum*), basswood (*Tilia americana*), and American beech (*Fagus grandifolia*). Eastern hemlock (*Tsuga canadensis*) and white pine (*Pinus strobus*) were locally important, but hemlock was generally restricted to cool moist sites near Lake Michigan. Areas of poorly drained glacial lakeplain supported wet forests of tamarack (*Larix laricina*), northern white-cedar (*Thuja occidentalis*), black ash (*Fraxinus nigra*), red maple (*Acer rubrum*), and elm (*Ulmus* spp.), while the Wolf and Embarrass Rivers flowed through extensive floodplain forests of silver maple (*Acer saccharinum*), green ash (*Fraxinus*

pennsylvanica), and swamp white oak (*Quercus bicolor*). Emergent marshes and wet meadows were common in and adjacent to lower Green Bay, while Lake Michigan shoreline areas featured beaches, dunes, interdunal wetlands, marshes, and highly diverse ridge and swale vegetation. Small patches of prairie and oak savanna were present in the southwestern portion of this landscape.

The biota is especially noteworthy for the rare regional endemic plants and animals associated with Lake Michigan shoreline habitats, and the highly specialized animals inhabiting the Niagara Escarpment. The coastal areas annually host significant concentrations of migratory birds, especially during the spring migration period. The waters of Lake Michigan and Green Bay, and the Wolf-Embarrass River corridors, provide seasonally critical habitat for numerous animals. Lakes are uncommon and most of them have been at least partially developed. Fragmentation of upland habitats is severe throughout this landscape. Most of the upland forest has been removed over the past 150 years as the land was converted to agricultural, residential, and industrial uses. Today approximately 84% of this Ecological Landscape is non-forested. The remaining forest consists mainly of mesic maple-basswood or maple-beech types or lowland hardwoods composed of soft maples, ashes, and elms. Invasive species have become a major concern in both terrestrial and aquatic habitats. Reed canary grass (*Phalaris arundinacea*), common reed grass (*Phragmites australis*), purple loosestrife (*Lythrum salicaria*), garlic mustard (*Alliaria petiolata*), Eurasian buckthorns (*Rhamnus* spp.) and honeysuckles (*Lonicera* spp.), and carp are especially troublesome. Significant wetlands are still present, but most have been affected to some degree by hydrologic disruption, pollution, sedimentation, and the encroachment of invasive species. Large acreages of marsh in Lower Green Bay have been filled to accommodate urban development.

Southeast Glacial Plains Ecological Landscape

Eldorado State Wildlife Area is located in the Southeast Glacial Plains Ecological Landscape (WDNR In Prep.) (Figure 2). The Southeast Glacial Plains Ecological Landscape borders the Illinois state line and covers a large area of southeastern Wisconsin. This ecological landscape is home to some of the world's best examples of continental glacial activity. Drumlins, eskers, kettle lakes, kames, ground and end moraines, and other glacial features are evident throughout the entire area (WDNR 2006a). Most of this Ecological Landscape is composed of glacial materials deposited during the Wisconsin Ice Age (WDNR In Prep.).

Historically, vegetation in the Southeast Glacial Plains Ecological Landscape consisted of a mix of prairie, oak forests and savanna, and maple-basswood forests. Wet-mesic prairies, southern sedge meadows, emergent marshes, calcareous fens, and tamarack swamps were found in poorly drained, wetter portions of the Landscape. The Southeast Glacial Plains has the highest aquatic productivity for plants, insects, invertebrates, and fish of any Ecological Landscape in the state. Significant river systems include the Mukwonago, Bark, Wolf, Sheboygan, Milwaukee, Rock, Sugar, and Fox. Most riparian zones have been degraded through forest clearing, urban development, and intensive agricultural practices.

The Ecological Landscape contains several large lakes, including those in the Madison area and in the Lake Winnebago Pool system. These lakes are important to many aquatic species including the lake sturgeon.

In addition to Horicon Marsh, this Ecological Landscape contains other important marshes, as well as fens, tamarack swamps, wet and wet-mesic prairies, many of which support rare plants and animals. Wetlands are abundant in the Southeast Glacial Plains with more than 713,500 acres of wetlands found here according to the Wisconsin Wetlands Inventory. However, many wetlands have experienced ditching, tiling, grazing, and infestation by invasive plants. Wetland loss has been significant in the Southeast Glacial Plains compared to the extent of wetlands prior to European settlement.

Agricultural and urban land use practices have drastically changed the land cover of the Landscape since Euro-American settlement. The current vegetation is primarily agricultural cropland. Emergent marsh / wet meadow are the most common wetland communities (330,284 acres). Forested wetlands (246,414 acres) are also common, followed by shrub swamps (125,981 acres). Of special significance in this Landscape are rare wetland communities such as low prairies, fens, and lowland conifer swamps.

Regional Biodiversity Needs and Opportunities

Opportunities for sustaining natural communities in the Central Lake Michigan Coastal and Southeast Glacial Plains Ecological Landscapes were developed by the Ecosystem Management Planning Team (EMPT 2007) and later presented in the Wisconsin Wildlife Action Plan (WDNR 2006b). The goal of sustaining natural communities is to manage for natural community types that historically occurred in a given landscape and have a high potential to maintain its characteristic composition, structure, and ecological function over a long period of time (e.g., 100 years). This list can help guide land and water management activities so that they are compatible with the local ecology of the Ecological Landscape while maintaining important components of ecological diversity and function. These are the most appropriate community types that could be considered for management activities within the Central Lake Michigan Coastal and Southeast Glacial Plains Ecological Landscapes.

There are management opportunities for 55 natural communities in the Central Lake Michigan Coastal and Southeast Glacial Plains Ecological Landscape. Of these, 26 are considered “major” opportunities (Table 1). A “major” opportunity indicates that the natural communities can be sustained in the Ecological Landscape, either because many significant occurrences of the natural community have been recorded in the landscape or major restoration activities are likely to be successful in maintaining the community’s composition, structure, and ecological function over a longer period of time. An additional 26 natural communities are considered “important” in these landscapes. An “important” opportunity indicates that although the natural community does not occur extensively or commonly in the Ecological Landscape, one to several occurrences does occur and are important in sustaining the community in the state. In some cases, important opportunities may exist because the natural community may be restricted to just one or a few Ecological Landscapes within the state and there may be a lack of opportunities elsewhere.

Table 1. Major Natural Communities Management Opportunities in the Central Lake Michigan Coastal and Southeast Glacial Plains Ecological Landscape (EMPT 2007; WDNR 2006b)

Alvar	Floodplain Forest	Mesic Prairie	Southern Sedge Meadow
Bog Relict	Great Lakes Dune	Oak Opening	Southern Tamarack Swamp (rich)
Calcareous Fen	Great Lakes Beach	Oak Woodland	Surrogate Grasslands
Dry Cliff	Great Lakes Ridge and Swale	Shrub Carr	Warmwater rivers
Dry Prairie	Impoundments/Reservoirs*	Southern Dry Forest	Warmwater streams
Dry-mesic Prairie	Inland Lakes*	Southern Dry-mesic Forest	Wet-mesic Prairie
Emergent Marsh	Lake Michigan		

*Natural Communities that were listed in the Wisconsin Wildlife Action Plan only.

Rare Species of the Central Lake Michigan Coastal and Southeast Glacial Plains Ecological Landscape

Numerous rare species are known from the Central Lake Michigan Coastal and Southeast Glacial Plains Ecological Landscapes. “Rare” species include all of those species that appear on the WDNR’s NHI Working List (*Wisconsin Natural Heritage Working List*) classified as “Endangered,” “Threatened,” or

“Special Concern.” Tables 2 and 3 list the number of species known to occur in the Central Lake Michigan Coastal and Southeast Glacial Plains Ecological Landscape based on information stored in the NHI database as of November 2009 (WDNR In Prep).

Table 2. Listing Status for rare species Central Lake Michigan Coastal Ecological Landscape as of December 2009 (WDNR In Prep.)

Listing Status	Birds	Fishes	Herps	Invertebrates	Mammals	Plants	Total Fauna	Total Flora	Total Rare
WI Endangered	7	1	1	3		5	12	5	17
WI Threatened	7	4	3	7		12	21	12	33
WI Special Concern	20	7	3	66	2	28	98	28	126
U.S. Endangered				2			2	0	2
U.S. Threatened						2	0	2	2
U.S. Candidate							0	0	0

Table 3. Listing Status for rare species in Southeast Glacial Plains Ecological Landscape as of November 2009 (WDNR In Prep.)

Listing Status	Birds	Fishes	Herps	Invertebrates	Mammals	Plants	Total Fauna	Total Flora	Total Rare
WI Endangered	8	4	7	11		10	30	10	40
WI Threatened	10	6	3	5		28	24	28	52
WI Special Concern	19	10	6	61	5	71	101	71	172
U.S. Endangered				2			2	0	2
U.S. Threatened						2	0	2	2
U.S. Candidate			1				1	0	1

The Wisconsin Wildlife Action Plan denoted Species of Greatest Conservation Need (SGCN). Species of Greatest Conservation Need are animals that have low and/or declining populations that are in need of conservation action. They include various birds, fish, mammals, reptiles, amphibians, and invertebrates (e.g. dragonflies, butterflies, and freshwater mussels) that are:

- Already listed as threatened or endangered;
- At risk because of threats to their life history needs or their habitats;
- Stable in number in Wisconsin, but declining in adjacent states or nationally;
- Of unknown status in Wisconsin and suspected to be vulnerable.

There are 47 vertebrate SGCN significantly associated with the Central Lake Michigan Coastal and Southeast Glacial Plains Ecological Landscapes (See Appendix D). This means that the species is (and / or historically was) significantly associated with the Ecological Landscape, and restoration of natural communities this species is associated with, in the Ecological Landscape, would significantly improve conditions for the species.

Description of the Study Area

Location and Size

The ELWWA is a cluster of Wildlife Areas located in Calumet, Fond du Lac, and Manitowoc counties (Figure 1). Comprising ca. 22,876 acres, three of the properties are located along the Manitowoc River including the North and South Branches and all are located in close proximity to Lake Winnebago and the population centers of the Fox River Valley (cities of Fond du Lac, Oshkosh, and Appleton).

Properties included in the ELWWA are:

- **Brillion Wildlife Area** (5,129 acres) is located in northeast Calumet County at the headwaters of the North Branch Manitowoc River, between the city of Brillion and village of Hilbert along State Highway 57 and US Highway 10.
- **Collins Marsh Wildlife Area** (4,356 acres) is located in west-central Manitowoc County along the Manitowoc River in the township of Rockland approximately two miles south of Reedsville.
- **Eldorado Wildlife Area** (6,379 acres) is located in north-central Fond du Lac County along the West Branch Fond du Lac River and approximately two miles west of the city of Fond du Lac along US Highway 41.
- **Killsnake Wildlife Area** (7,012 acres) is located on the border of Calumet and Manitowoc counties, at the confluence of the South Branch and Manitowoc Rivers just east of the city of Chilton along US Highway 151.

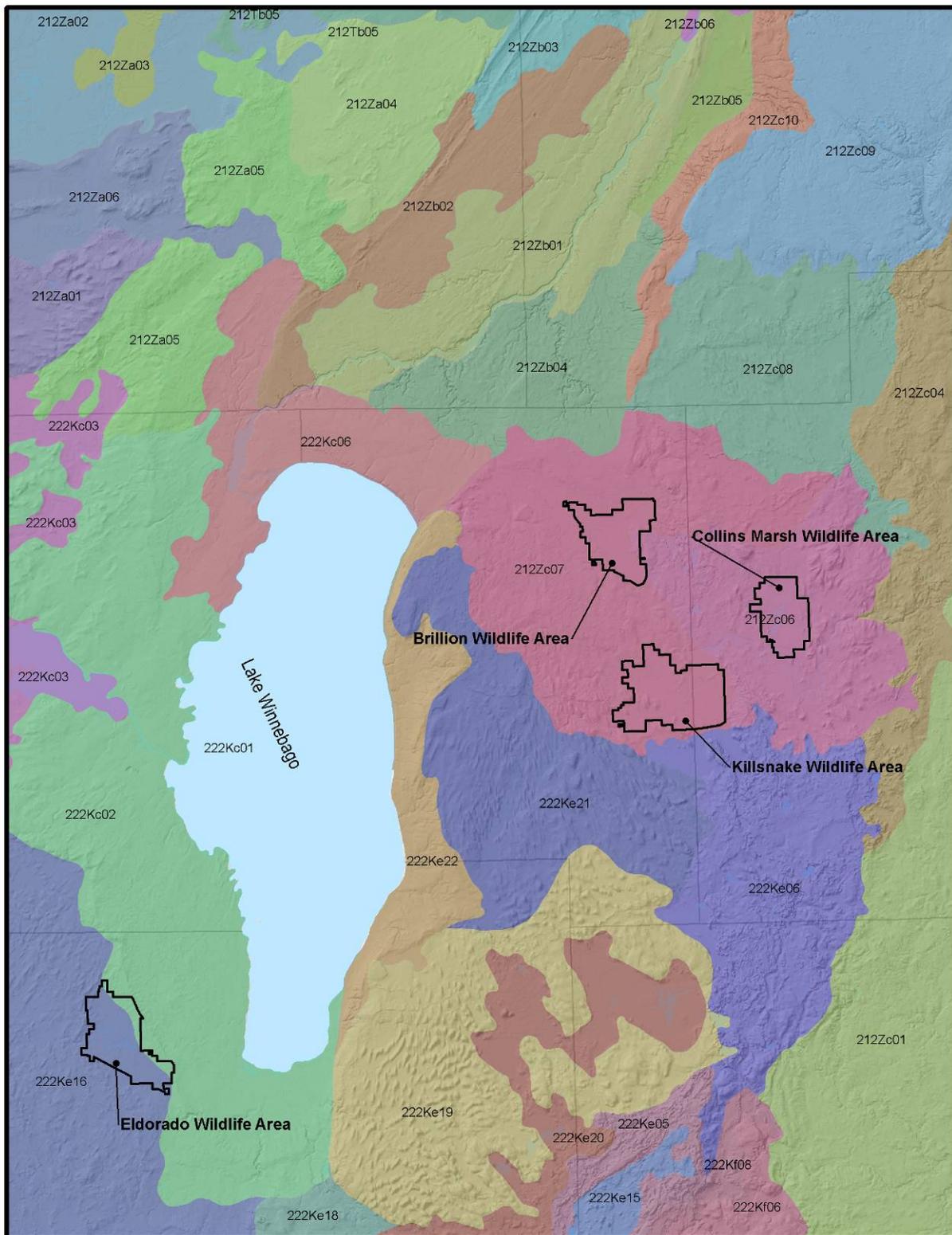
Ecoregion

From the National Hierarchical Framework of Ecological Units (NHFEU), the units most relevant to this study are two Subsections: the Manitowoc Till Plain (212Zc) and the Southern Green Bay Lobe (222Ke) and four Landtype Associations (LTA; Figure 3). The Manitowoc Till Plain subsection lies along Lake Michigan and includes three properties within the ELWWA (Brillion, Collins Marsh, and Killsnake Wildlife Areas), while the Southern Green Bay Lobe subsection includes Eldorado Wildlife Area.

Landtype Associations represent an area of 10,000 – 300,000 acres and contain similarities of landform, soil, and vegetation. The following Landtype Associations are within the study area:

- **Hilbert Moraines LTA (212Zc07)**. The characteristic landform pattern is undulating moraine. Soils are predominantly well drained loam over calcareous clay till.
- **Collins Moraines LTA (212Zc06)**. The characteristic landform pattern is undulating moraine with common bedrock knolls and many swamps. Soils are predominantly well drained loam over calcareous clay till.
- **Oshkosh Moraines LTA (222Kc02)**. The characteristic landform pattern is undulating till plain. Soils are predominantly moderately drained silt and clay over calcareous clay or loam till.
- **Ladoga Till Plain LTA (222Ke16)**. The characteristic landform pattern is undulating till plain. Soils are predominantly well drained silt over calcareous loam till.

Figure 3: Landtype Associations for the area comprising the Eastern Lake Winnebago Wildlife Areas Planning Group.



Physical Environment

Geology and Geography

The ELWWA is primarily underlain by dolomite with some limestone, sandstone, and shale (WDNR In Prep.). It is generally covered by a thick layer of soils of glacial origin (>50 feet). Bedrock depth, ranging from 5-50 feet with a few areas as deep as 100 feet, is highly variable in this area where erosion and abrasion during glaciation has highly altered the landscape. The southernmost exposures of the dolomite Niagara Escarpment occur east and south of Lake Winnebago within the ELWWA, but little to no exposed rock outcrops exist in the study area. The ELWWA lies just west of the interlobate moraine of the southward-flowing ice of the Green Bay lobe and the westward-flowing ice of the Lake Michigan lobe of the Laurentide ice sheet of the Wisconsin glaciation. This area is characterized by ground moraines, low-relief till plains, and pitted outwash plains (Dott and Attig 1994). Swamps and marshes abound in eastern Wisconsin, but several including the Manitowoc Swamp, east of Chilton, represent extinct lakes once occupying shallow basins formed by glaciation (Martin 1965).

Soils

Soils in the **Manitowoc Till Plain (Subsection 212Zc)** are calcareous in mineral content, ranging from well drained to somewhat poorly drained clayey soils with a loam surface over calcareous clay till, along with very poorly drained nonacid organic soils. Terrain of this subsection ranges from nearly level lakeplain areas of lacustrine deposits, variable topography over areas of outwash, to rolling hills of ground moraines.

Most lowland soils on outwash plains and lake plains range from somewhat poorly drained to very poorly drained silty loam with thin loess over clayey till and muck of herbaceous organic material. The available water capacity for these areas ranges from moderate to very high. The well drained till plains and moraines are characterized by thin loamy drift over calcareous clayey till materials. The available water capacity is moderate.

(From the Ecological Landscapes of Wisconsin Handbook [WDNR In Prep.]) The **Southern Green Bay Lobe (Subsection 222Ke)** was formed by the Green Bay Lobe of the Wisconsin glacier. The dominant soils are calcareous loamy tills; there are also areas of outwash sands and gravel, and silty lacustrine materials. Soils on the moraine uplands and drumlins are formed in brown calcareous sandy loam to loam till. They range from well-drained to somewhat poorly drained and generally have silt loam surface textures, moderate to very slow permeability, and moderate to high available water capacity.

The outwash plains have upland soils with loamy alluvium or loess surfaces over calcareous outwash sands and gravel. They range from well-drained to somewhat poorly drained and generally have silt loam to loam surface textures, moderately rapid to moderate permeability, and moderate available water capacity.

Most lowland soils are very poorly drained non-acid muck, but may also be silty and clayey lacustrine, or loamy till. The major river valleys have soils formed in loamy to silty alluvium or non-acid muck; they range from moderately well-drained to very poorly drained, and have areas subject to periodic flooding.

Hydrology

All of the ELWWA properties, except Eldorado Wildlife Area, are within the Lakeshore Basin. Eldorado Wildlife Area is within the Upper Fox River Basin. The ELWWA is drained by a large number of warmwater streams and rivers. Lakes are not as common as rivers and streams on the ELWWA. There

are no sizable named lakes on any of the properties but some very small un-named lakes are scattered throughout. Impoundments are located on a few properties, creating open water habitat used by some species.

The Manitowoc River, which flows through the very south end of **Collins Marsh Wildlife Area**, is fed by Mud Creek, the major drainage of Collins Marsh. The stream has a low gradient and sluggish flow with brown-stained water and muck bottom characteristic of streams draining marsh complexes (Weber et al 1968). The Manitowoc River is the major drainage system in the county flowing generally eastward through the city of Manitowoc before entering Lake Michigan (Weber et al 1969).

The North Branch Manitowoc River is the major drainage of **Brillion Wildlife Area**. Two tributaries of this river within Brillion Marsh are Black Creek, an intermittent stream, and Spring Creek, a clear, very hard water stream (Fassbender 1971). Aders Creek is another perennial, small tributary stream of the North Branch Manitowoc River and is planned for restoration in 2011 to its original channel.

The South Branch Manitowoc River is the longest stream in Calumet County, and flows through **Killsnake Wildlife Area** just before meeting the North Branch and forming the Manitowoc River. Killsnake River and Cedar Creek are major tributaries feeding the South Branch Manitowoc River within Killsnake Wildlife Area.

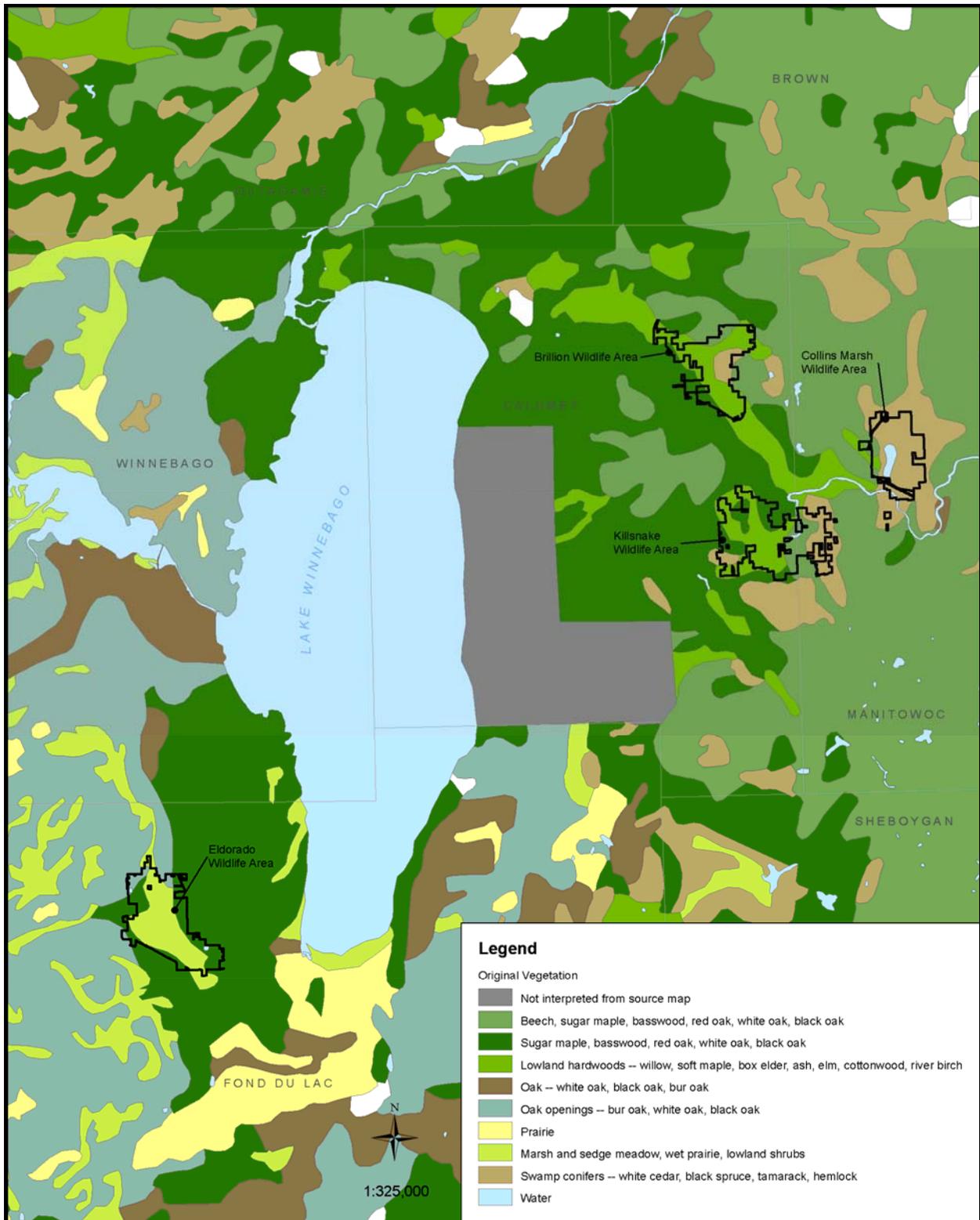
The West Branch Fond du Lac River constitutes the major water source for the Eldorado Marsh (Weber et. al 1969) and flows through the wetlands of **Eldorado Wildlife Area**. The West and East Branch later meet to form the Fond du Lac River before flowing into Lake Winnebago.

Vegetation

Historic Vegetation

Data from Wisconsin's original Public Land Surveys are often used to infer vegetation cover types prior to Euro-American Settlement. Public Land Surveys for the ELWWA were completed between 1832 and 1835. Finley's (1976) Pre-settlement Vegetation map (Figure 4) identifies the study areas as being dominated by lowland hardwood forests (**Brillion** and **Killsnake Wildlife Areas**) of willow, soft maple, box-elder, ash, and elm, large acreages of marsh and sedge meadow at **Eldorado Wildlife Area**, and some conifer swamps of northern white-cedar, black spruce (*Picea mariana*), and tamarack largely at **Collins Marsh Wildlife Area** but with smaller areas at **Killsnake** and **Brillion Wildlife Areas**. Small upland areas were located at all properties except Collins Marsh and supported mixed deciduous mesic forests of sugar maple, basswood, red oak (*Quercus rubra*), white oak (*Quercus alba*), and black oak (*Q. velutina*). Land conversion, hydrological changes, invasive species, and severe weather events have all had dramatic effects on both the plant communities and wildlife throughout the study area.

Figure 4: Vegetation for the study area prior to Euro-American settlement. Data are from Finley (1976).



Current Vegetation

The ELWWA properties are embedded in a largely agricultural landscape with high density development in close proximity in the Fox River Valley (Figure 5). Currently most of the properties are comprised of open wetlands including emergent marsh, southern sedge meadow as well as forested wetlands including southern hardwood swamp, northern wet-mesic forest, and shrub-carr. The conifer forest type present here is near the southern extent of their range in the state. Small areas of riverine mud flat add to the overall diversity of the wetlands. The uplands are comprised of forests (southern dry-mesic and southern mesic), prairie plantings and surrogate grassland, and farmland. Current vegetation for all properties is described by community type.

Emergent Marsh

One of the more common natural communities on the ELWWA is emergent marsh. Large examples of this community type are present at **Brillion, Collins Marsh, and Eldorado Wildlife Areas**. Most are dominated by cattails (*Typha* spp.) with mixed broad-leaved sedges including common lake sedge (*Carex lacustris*) along with common bur-reed (*Sparganium eurycarpum*) and orange jewelweed (*Impatiens capensis*). Willows (*Salix* spp.), ash (*Fraxinus* spp.), and red-osier dogwood (*Cornus stolonifera*) typically are scattered throughout the marshes. Reed canary grass is a common invasive species of these marshes on several properties. **Brillion and Eldorado Wildlife Areas** have some of the most extensive emergent marshes inventoried, while **Collins Marsh Wildlife Area** has smaller amounts. Although these communities are low in plant diversity, they are still important for a number of animal species including numerous uncommon birds.

Southern Sedge Meadow

A good-sized, moderate quality southern sedge meadow is found at **Killsnake Wildlife Area** on the east side of the South Branch Manitowoc River at the confluence of a small unnamed tributary. Dominant species include reed canary grass, common lake sedge, and Canada blue-joint grass (*Calamagrostis canadensis*) with water-horehound (*Lycopus uniflorus*) and spotted joe-pye-weed (*Eupatorium maculatum*). There is very little shrub cover in this area.

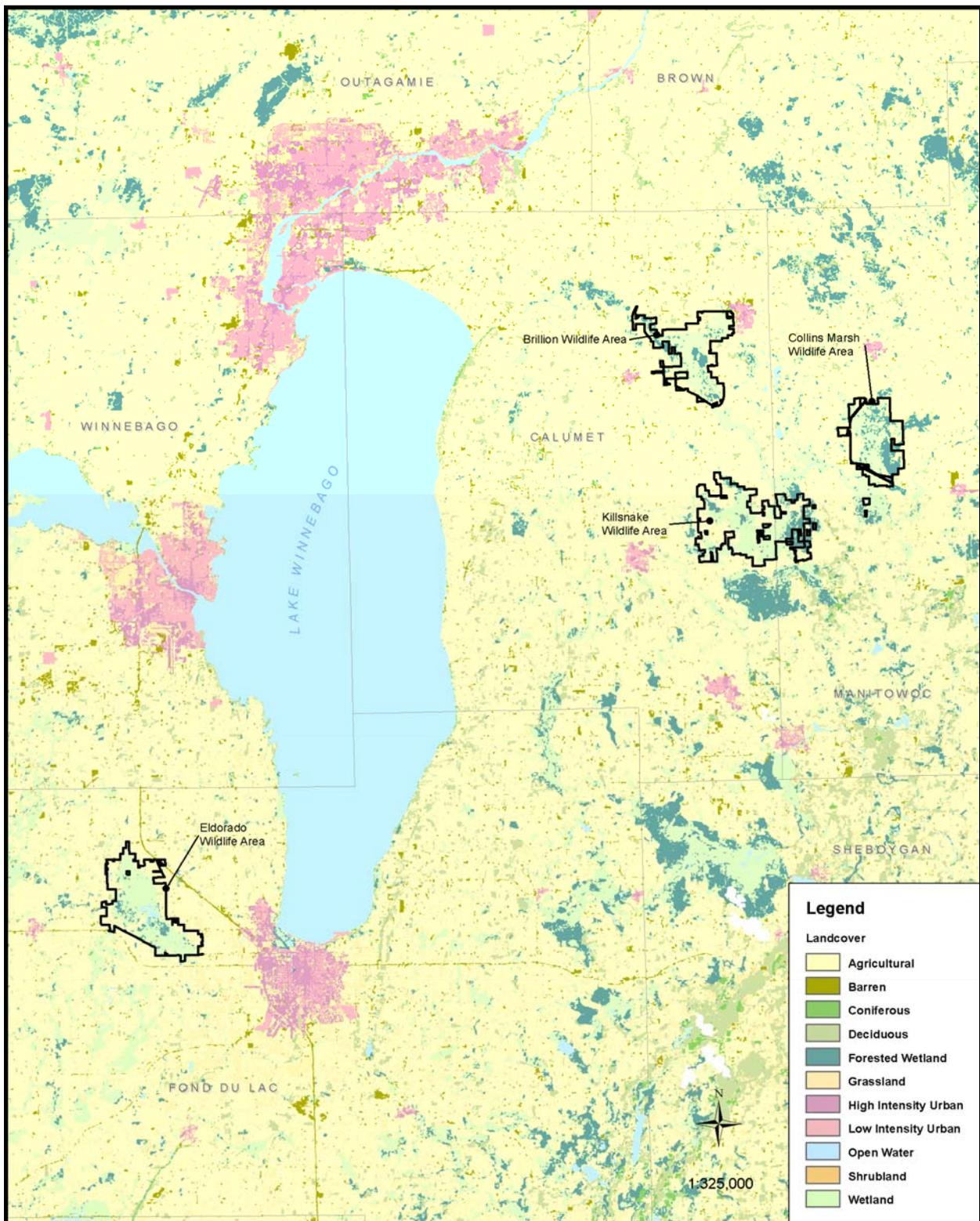
Riverine Mud Flat

A fairly extensive area of riverine mud flat was noted at **Collins Marsh Wildlife Area**, along Mud Creek above the junction with the Manitowoc River. This is a sparsely vegetated herbaceous community dominated by low, usually annual herbs occurring on muddy streambanks or in shallow water of river backwaters and old oxbow ponds. The vegetation composition, height, and density are dependant on annual flooding but can vary due to timing of these events; inundations regularly occur every spring with flats exposed when water levels recede in summer. The herbaceous layer is dense, mostly water smartweed (*Polygonum amphibium*) with reed canary grass, river bulrush (*Bolboschoenus fluviatilis*), curly dock (*Rumex crispus*), and common yellow-cress (*Rorippa palustris*) in scattered patches. Reed canary grass invasion is a major threat.

Shrub-carr

Shrub-carr is a common natural community type on the ELWWA that is represented at each of the properties with good to poor quality examples. This community is dominated by the tall shrubs, red-osier dogwood, and silky dogwood (*C. amonum*), white meadowsweet (*Spiraea alba*), slender willow (*Salix petiolaris*) and pussy willow (*S. discolor*). The herbaceous layer is dominated by Canada bluejoint grass, reed canary grass, common lake sedge, tussock sedge (*Carex stricta*), swamp loosestrife (*Lysimachia thyrsoflora*), and giant goldenrod (*Solidago gigantea*). It occurs in close association with emergent marsh and southern sedge meadow areas in the ELWWA and often intergrades with these types. Good quality examples are found at **Collins Marsh and Killsnake Wildlife Areas**.

Figure 5: Landcover for the ELWWA from the Wisconsin DNR Wisland GIS coverage (WDNR 1993).



Southern Hardwood Swamp

Hardwood swamps are common on the study area and consist of both the northern (classified in NHI as “hardwood swamp”) and southern (classified in NHI as “southern hardwood swamp”) variants. The hardwood swamps are along the tension zone and impacted climatically by Lake Michigan resulting in a mixture of “northern” and “southern” species. Southern hardwood swamps are very rare in the state and examples tend to be degraded due to hydrological disturbance and invasive species. Many of the hardwood swamps in the study area have been temporarily classified as southern hardwood swamps until more data can be collected to potentially develop a new natural community classification.

Southern hardwood swamps were documented at **Brillion, Collins Marsh, and Killsnake Wildlife Areas**. Quality and extent varies greatly between the sites. The most extensive and best quality swamp is at **Collins Marsh Wildlife Area** with a canopy dominated by silver maple (*Acer saccharinum*) green ash (*Fraxinus pennsylvanica*), and bur oak (*Quercus macrocarpa*) with red maple, black ash, and a small, logged, pocket of mature northern white-cedar. The canopy is moderately dense, and depending on the location within the Wildlife Area, the canopy trees average from about 18-24 inch diameter breast height (dbh) up to 30+ inch dbh. The dense sub-canopy includes green and black ash with a few bur oak and northern white cedar. The shrub layer is sparse with common winterberry (*Ilex verticillata*). The ground flora is dense and includes cinnamon fern (*Osmunda cinnamomea*) and royal fern (*Osmunda regalis*) with sensitive fern (*Onoclea sensibilis*), fowl manna grass (*Glyceria striata*), fox sedge (*Carex stipata*), and greater bladder sedge (*Carex intumescens*). Reed canary grass is common throughout the swamp and may be linked to the altered hydrology caused by the dam on Mud Creek.

A fairly large southern hardwood swamp occurs at **Brillion Wildlife Area**. The canopy is moderately sparse, silver maple with a few cottonwoods (*Populus deltoides*) ranging from 16-20" dbh. The subcanopy is dense and mostly silver maple with green ash, trembling aspen (*Populus tremuloides*), some cottonwood, and American elm (*Ulmus americana*). The sapling layer is moderately dense, consisting of silver maple with green ash and American elm. The shrub layer is sparse but includes common buckthorn (*Rhamnus cathartica*), glossy buckthorn (*Rhamnus frangula*), and black currant (*Ribes americanum*). Ground layer cover is moderate, dominated by jewelweed and reed canary grass with sensitive fern, fowl manna grass, wood nettles (*Laportea canadensis*), and stinging nettles (*Urtica dioica*). The site is disturbed with abundant reed canary grass, common buckthorn, and glossy buckthorn.

Scattered, small, southern hardwood swamps are present at **Killsnake Wildlife Area** with most located near streams and rivers on the property. The swamps are characterized by a dense canopy dominated by 16-20" dbh silver maple with some green and black ash. The sapling layer is moderately sparse silver maple with green ash, some black ash, and American elm. There is essentially no shrub layer present. The herbaceous layer is dominated by reed canary grass with false nettle (*Bohemaria cylindrica*), swamp loosestrife, and stinging nettle.

Northern Wet-mesic Forest

There is a moderate-sized and -quality northern wet-mesic forest in the northeast portion of **Killsnake Wildlife Area** embedded within a larger southern hardwood swamp. The dense canopy is dominated by 8-12" dbh northern white-cedar with some tamarack, black ash, red maple, and paper birch (*Betula papyrifera*). Blow downs are common. The sapling and shrub layer is moderately dense and includes northern white-cedar and black ash with paper birch, yellow birch (*Betula alleghaniensis*), and American elm. Some areas are devoid of northern white-cedar regeneration due to deer browse. The ground flora is moderately dense and diverse and includes species such as cinnamon fern, fowl manna grass, jewelweed, wood nettle, dwarf red raspberry (*Rubus pubescens*), rough-leaved goldenrod (*Solidago patula*), lady fern

(*Athyrium felix-femina*), and white snakeroot (*Eupatorium rugosum*). The non-native invasive reed canary grass is common.

Southern Dry-mesic Forest

A small southern dry-mesic forest with a dense canopy dominated by 18-20" dbh bur oak with red oak and, to a lesser extent, white ash (*Fraxinus americana*) is present at **Collins Marsh Wildlife Area**. The sapling layer is moderate with the same species as in the canopy. The shrub layer is very sparse. The ground layer is moderately dense and fairly diverse, including species indicating more mesic conditions, such as Virginia waterleaf (*Hydrophyllum virginianum*), trout lily (*Erythronium americanum*), may-apple (*Podophyllum peltatum*), wild geranium, and annual bedstraw (*Galium aparine*). Non-native invasive species are present in low abundance including reed canary grass and Bell's honeysuckle (*Lonicera x bella*).

Southern Mesic Forest

There is a very small, moderate-quality southern mesic forest along former railroad tracks, now converted to a recreational trail, in the southern portion of **Eldorado Wildlife Area** bordering a reed canary grass and cattail wetland. The dense canopy is dominated by 12-16" dbh sugar maple, red oak, basswood, white ash, and bur oak. Sugar maple saplings are common along with basswood, white ash, and shagbark hickory (*Carya ovata*). The shrub layer is sparse with patches of prickly ash (*Zanthoxylum americanum*). The ground flora is moderately dense and diverse, with wild geranium, black snakeroot (*Sanicula gregaria*), Virginia waterleaf, enchanter's nightshade, and common blue violet (*Viola sororia*).

Additional Natural Communities

Also within the ELWWA are small woodlots, flowages / impoundments, surrogate grasslands, and prairie restorations. Small and moderate to low-quality examples of mesic forest are present in the uplands including at **Brillion Wildlife Area** near the Nature Center. These areas were formerly pastured to a limited extent and are currently used primarily for educational purposes and include numerous recreational trails and structures including a maple syrup shack. Cutting, thinning, and opening of canopy, subcanopy, sapling layers has taken place. The canopy is dominated by 16-20" dbh sugar maple and basswood with subcanopy associates including white and green ash, white and bur oak, and a few white pine. The impoundments are managed for waterfowl production and are utilized during migration by numerous ducks, geese, swans, and shorebirds.

Many of the uplands within the ELWWA have been restored to prairie with native, warm-season grasses being common and widely scattered shrubs throughout. Other uplands remain as fallow fields or surrogate grasslands. These types now represent the vast majority of grassland habitat in the state. Surrogate grasslands include agricultural habitats such as hayfields, small grains (oats, wheat, and barley), fallow fields, old fields, pastures, and set-aside fields (e.g., CRP) planted to non-native cool-season grasses (such as smooth brome, timothy, red-top, orchard-grass, bluegrass, and quack-grass) or native warm-season grasses (such as big bluestem, little bluestem, Indiangrass, switchgrass, and sideoats grama). Little plant community data was collected for these areas but they provide important cover, nesting, and foraging areas for numerous wildlife species.

Rare Species and High Quality Natural Communities of the Eastern Lake Winnebago Wildlife Areas Planning Group

Numerous rare species and high-quality examples of native communities have been documented within the ELWWA (Table 4). Table 4 shows the rare species and high-quality natural communities currently known from the ELWWA. See Appendix C for summary descriptions for the species and natural communities that occur on the ELWWA.

Table 4. Documented rare species and high-quality natural communities for the Eastern Lake Winnebago Wildlife Areas Planning Group. More than one element occurrence of a particular species or natural community may be at each property. For an explanation of state and global ranks, as well as state status, see Appendix A. Listing status is based on the NHI Working List published April 2009. Species with a “Watch” in the “Tracked by NHI” column are on the Watch List and are not mapped in the NHI database. Various sources were used to determine the Watch List species and SGCN present and this may not be a complete list.

Common Name	Scientific Name	Last Observation Date	State Rank	Global Rank	State Status	SGCN	Tracked by NHI
Animal							
American Bittern	<i>Botaurus lentiginosus</i>	2010	S3B	G4	SC/M	Yes	Yes
American White Pelican*	<i>Pelecanus erythrorhynchos</i>	2009	S1B,S1N	G3	SC/M	No	Yes
American Woodcock	<i>Scolopax minor</i>	2010	S4B	G5	SC/M	Yes	Watch
Barn Owl*	<i>Tyto alba</i>		S1B, S1N	G5	END	Yes	Yes
Black Tern	<i>Chlidonias niger</i>	2010	S2B	G4	SC/M	Yes	Yes
Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>	2009	S4B	G5	SC/M	Yes	Watch
Black-crowned Night-heron	<i>Nycticorax nycticorax</i>	2009	S2B	G5	SC/M	No	Yes
Blue-winged Teal	<i>Anas discors</i>	2010	S4B	G5	SC/M	Yes	Watch
Blue-winged Warbler	<i>Vermivora pinus</i>	2009	S4B	G5	SC/M	Yes	Watch
Bobolink	<i>Dolichonyx oryzivorus</i>	2010	S4B	G5	SC/M	Yes	Watch

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Common Name	Scientific Name	Last Observation Date	State Rank	Global Rank	State Status	SGCN	Tracked by NHI
Broad-winged Skipper	<i>Poanes viator</i>	1990	S3	G5	SC/N	No	Yes
Cattle Egret*	<i>Bubulcus ibis</i>	2009	S1B	G5	SC/M	No	Yes
Common Moorhen	<i>Gallinula chloropus</i>	2009	S2B	G5	SC/M	No	Yes
Eastern Meadowlark	<i>Sturnella magna</i>	2010	S4B	G5	SC/M	Yes	Watch
Field Sparrow	<i>Spizella pusilla</i>	2009	S4B	G5	SC/M	Yes	Watch
Gorgone Checkerspot	<i>Chlosyne gorgone</i>	2009	S3	G5	SC/N	No	Yes
Grasshopper Sparrow	<i>Ammodramus savannarum</i>	2009	S4B	G5	SC/M	Yes	Watch
Great Egret	<i>Ardea alba</i>	2010	S2B	G5	THR	Yes	Yes
Henslow’s Sparrow	<i>Ammodramus henslowii</i>	2009	S3B	G4	THR	Yes	Yes
King Rail	<i>Rallus elegans</i>	2009	S1B	G4	SC/M	Yes	Yes
Least Bittern*	<i>Ixybrychus exilis</i>	1999	S3B	G5	SC/M	No	Yes
Least Flycatcher	<i>Empidonax minimus</i>	2009	S4B	G5	SC/M	Yes	Watch
Northern Cricket Frog	<i>Acris crepitans</i>	1984	S1	G5	END	Yes	Yes
Northern Harrier	<i>Circus cyaneus</i>	2010	S3B,S2N	G5	SC/M	Yes	Watch
Northern Ringneck Snake	<i>Diadophis punctatus</i>	1986	S3?	G5T5	SC/H	No	Yes
Osprey	<i>Pandion haliaetus</i>	2010	S4B	G5	SC/M	Yes	Yes
Pickerel Frog	<i>Lithobates palustris</i>	1992	S3S4	G5	SC/H	Yes	Yes
Red-necked Grebe	<i>Podiceps grisegena</i>	1999	S1B	G5	END	Yes	Yes
Red-shouldered Hawk	<i>Buteo lineatus</i>	2009	S3S4B,S1N	G5	THR	Yes	Yes

Table 4. Documented rare species and high-quality natural communities for the Eastern Lake Winnebago Wildlife Areas Planning Group. More than one element occurrence of a particular species or natural community may be at each property. For an explanation of state and global ranks, as well as state status, see Appendix A. Listing status is based on the NHI Working List published April 2009. Species with a “Watch” in the “Tracked by NHI” column are on the Watch List and are not mapped in the NHI database. Various sources were used to determine the Watch List species and SGCN present and this may not be a complete list.

Common Name	Scientific Name	Last Observation Date	State Rank	Global Rank	State Status	SGCN	Tracked by NHI
Short-eared Owl*	<i>Asio flammeus</i>	2009	S1B	G5	SC/M	Yes	Yes
Snowy Egret*	<i>Egretta thula</i>	2010	S1B	G5	END	Yes	Yes
Solitary Sandpiper	<i>Tringa solitaria</i>	2009	S4N	G5	SC/M	Yes	Watch
Veery	<i>Catharus fuscescens</i>	2009	S4B	G5	SC/M	Yes	Watch
Willow Flycatcher	<i>Empidonax traillii</i>	2009	S4B	G5	SC/M	Yes	Watch
Wood Thrush	<i>Hylocichla mustelina</i>	2009	S4B	G5	SC/M	Yes	Watch
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	2009	S3B	G5	SC/M	Yes	Yes
Yellow Rail	<i>Coturnicops noveboracensis</i>	2009	S1B	G4	THR	Yes	Yes
Plants							
Waxleaf Meadowrue	<i>Thalictrum revolutum</i>	2009	S2	G5	SC		Yes
Natural Community							
Emergent Marsh		2009	S4	G4			Yes
Northern Wet-mesic Forest		2009	S3S4	G3?			Yes
Southern Hardwood Swamp		2009	S2	G4?			Yes
Other							
Herp Hibernaculum		2010	SU	GNR	SC		Yes
Migratory Bird Concentration Site		2006	SU	G3	SC		Yes

*This record is not yet, or will not be mapped in the NHI database. Several rare bird observations listed do not meet the NHI breeding bird methodology for inclusion in the NHI database. See Appendix A for more information.

Management Considerations and Opportunities for Biodiversity Conservation

Habitat for Migratory, Wintering, and Breeding Birds

The wide range of habitats on the ELWWA including grasslands, large open marshes / wet meadows, shrub and forested lowlands, and aquatic areas offers important resources for numerous birds throughout the entire year. Excellent diversity and high species richness from various bird groups accumulate at the ELWWA during migration because the properties offer this diversity of habitats and other important resources to migrating birds including food, water, and shelter. In addition, these properties provide habitat to support over-wintering birds that typically breed well north of Wisconsin. Finally, the ELWWA also supports breeding populations of uncommon marsh, water, and grassland birds as well as an impressive diversity of nesting raptors.

Large emergent wetlands and associated open water areas as well as shrubland and forests offer migratory birds such as waterfowl, shorebirds, songbirds, and waterbirds like herons and egrets diverse habitats during the migratory seasons. Important features include emergent aquatic plants such as cattails, smartweed (*Polygonum* spp.), and arrowheads (*Sagittaria* spp.); open water areas that team with amphibians, fish, and aquatic invertebrates; and mudflats with abundant invertebrates and insect larvae. This plant and animal life provide important foraging opportunities during spring and fall migration for waterfowl, herons, bitterns, cranes, and shorebirds. Additionally, lowland shrubs, southern hardwood



Perched short-eared owl. Photo by Jack Bartholmai

swamps, and oak forests present in the ELWWA offer migrating songbirds protection from severe weather and predators and feeding opportunities during a critical time in their life cycle.

Lowland shrubs offer perches for capturing emerging aquatic insects in spring and food in the form of fruiting shrubs in fall; are high in energy and are utilized by migrants to build fat reserves necessary for sustaining long migratory flights. The ELWWA also attracts good numbers of wintering birds from the arctic region that include short-eared owl (*Asio flammeus*), snowy owl (*Bubo scandiacus*), rough-legged hawk (*Buteo lagopus*), northern shrike (*Lanius excubitor*), snow bunting (*Plectrophenix nivalis*), and lapland longspur (*Calcarius lapponicus*) (eBird 2010).

These are birds of open grasslands and wetlands that move south to seek out more abundant prey and better conditions that will allow them to survive during a vulnerable period in their lives.

Portions of the ELWWA were identified as a migratory bird concentration area through modeling efforts and workshops (Grveles and Matteson 2008). Modeling was done by the WDNR for the Western Great Lakes Coastal region for Bird Migration Stopover Habitats Project (Grveles and Matteson 2008) using parameters based on high amounts of oak forest, undeveloped tracts of land, good-quality aquatic features, and prevalence of fruit-producing low shrubs. Results of the modeling and workshops included two sites within the ELWWA being identified as having high potential for songbirds, shorebirds, waterbirds, and waterfowl in areas along major waterways and surrounding wetlands.

Threats to Migratory Bird Stopover Sites and migratory birds include habitat destruction and alteration (Duncan 2002). Habitat alteration includes the simplification of forest structure or the alteration of forest composition, including invasive species that may change the kinds, quantity, and quality of food resources (Duncan 2002). Many wetlands, similar to those found on the ELWWA, have been filled for agriculture or developed, threatening the viability of this declining resource. Streams are susceptible to pollutants from nutrient runoff and road salts which could harm prey species if water quality diminishes.

Extensive habitat exists throughout the ELWWA for nesting and foraging by uncommon birds of several assemblages. Emergent marshes are among the most productive of all habitats for waterfowl and other waterbirds (Eldridge 1990). The emergent marsh and wet meadows of the ELWWA harbor good numbers of breeding marsh birds including American bittern (*Botaurus lentiginosus*), black-crowned night-heron (*Nycticorax nycticorax*), king rail (*Rallus elegans*), Virginia rail (*Rallus limicola*), and sora rail (*Porzana carolina*), common moorhen (*Gallinula chloropus*), and yellow-headed blackbird (*Xanthocephalus xanthocephalus*). The flowages within these marsh and meadow complexes offer nesting and foraging habitat for red-necked grebe (*Podiceps grisegena*), a full suite of rare egrets, black terns (*Chlidonias niger*), American white pelicans (*Pelecanus erythrorhynchos*), and breeding waterfowl including blue-winged teal (*Anas discors*).



American White Pelican in flight. Photo by Brian Collins

Surrogate grassland habitats within the ELWWA include old or fallow fields and planted prairie areas and support good numbers of obligate grassland birds. Grassland bird species are exhibiting one of the most significant declines of any suite of bird species in Wisconsin and across the Midwest (Herkert 1995). The major cause for this decline has been the alteration and loss of breeding habitat (Robbins et al 1996). The ELWWA presents opportunities for addressing the habitat requirements of several area sensitive bird

species that need large grassland patches or a matrix of treeless meadows, marshes, and grasslands. Good numbers of Henslow's sparrow (*Ammodramus henslowii*), eastern meadowlark (*Sturnella magna*), bobolink (*Dolichonyx oryzivorus*), and grasshopper sparrow (*Ammodramus savannarum*) were noted during limited breeding bird survey efforts. Continued restoration, expansion, and connecting various open grassland types would be beneficial, with the best opportunities existing at **Killsnake and Brillion Wildlife Areas**.

All of these habitats and the hardwood swamps throughout the ELWWA support an impressive diversity of conservative raptor species. Ospreys (*Pandion haliaeetus*) are very prevalent throughout the project area with nesting noted at three of the four properties near flowages on nesting platforms. Other raptors of conservation concern, noted as nesting on the ELWWA, are bald eagles (*Haliaeetus leucocephalus*), northern harriers (*Circus cyaneus*), and red-shouldered hawks (*Buteo lineatus*).

Hydrology and High-quality Wetlands

The properties that make up the ELWWA are largely dominated by forested and non-forested wetland types. Wetlands are particularly susceptible to disturbance through various hydrological modifications that can cause direct and indirect disturbance of natural processes. Hydrological manipulation and degradation occurs through many means, including damming, ditching, draining, sedimentation, and erosion. Dams affect aquatic species and habitats by fragmenting them into disjunct segments and preventing the movements of some species between different stretches of streams. In addition, they can alter natural hydrological fluctuations associated with free-flowing rivers and streams that are integral to wetland formation and renewal for the many species that depend upon them (PARC 2002).

Opportunities exist to protect large hardwood swamps from hydrological changes and fragmentation on the ELWWA. For hardwood swamps in contained systems with little or no water movement, a partial or complete removal of the overstory without advance regeneration often result in a lack of reproduction and loss of site. A rise in the water table from decreased transpiration inhibits stump sprouting and seedling establishment, essentially flooding the stand and causing deforestation (WDNR 2010a). These forests are at risk of invasive plant infestations, including reed canary grass and buckthorns, and special care may be needed to minimize or avoid their spread. Additionally, emerald ash borer appears to be a significant threat to hardwood swamps, therefore developing management and response plans should be considered. Swamp hardwood stands are often found in close association with other wetland types or aquatic features, and there can be important ecotones and hydrological connections among adjacent communities. A broad approach to ecosystem management that goes beyond the individual stand to include nearby and adjacent features, while striving to avoid fragmentation and hydrological disruption, would be optimal (WDNR 2010a).

Non-forested wetlands are important components of the vegetation mosaic in the ELWWA. There are fairly extensive areas of emergent marsh and shrub-carr with smaller inclusions of southern sedge meadow. Southern sedge meadows at one time covered nearly one million acres in the state, but wetland losses increased with technological advancements in converting wetlands to agriculture in the mid 1900's. Now only about 200,000 acres remain and many of these acres are now dominated by the invasive reed canary grass (Hoffman 2002). The biggest threats to these areas are invasive species, changes to hydrology, and sedimentation. Protecting, managing, and restoring the remaining sedge meadows would benefit the many specialized plants and animals requiring these open wetland types. Continued control of invasive cattails and reed canary grass in the ELWWA could restore the natural transition from upland grasslands to sedge meadows and shrub-carr, creating good habitat for numerous grassland and shrubland bird species.

Ecological Priorities for SGCN

The Wisconsin Wildlife Action Plan (WAP; WDNR 2006b) identifies ecological priorities in each Ecological Landscape. Ecological priorities are the natural communities in each Ecological Landscape that are most important to the Species of Greatest Conservation Need. Appendix D highlights the Ecological Priorities for vertebrate SGCN on the ELWWA. Note that these Ecological Priorities include all of the natural communities that have been determined to provide the best opportunities for management on the ELWWA from an ecological / biodiversity perspective.

Natural Community Management Opportunities

The Wisconsin Wildlife Action Plan (WDNR 2006b) identifies 41 natural communities for which there are “Major” or “Important” opportunities for protection, restoration, or management in the Central Lake Michigan Coastal and Southeast Glacial Plains Ecological Landscapes. Nine of these natural communities are present on the ELWWA:

- Emergent Marsh
- Impoundments/Reservoirs
- Northern Wet-mesic Forest
- Southern Mesic Forest
- Surrogate Grassland
- Shrub-carr
- Southern Dry-mesic Forest
- Southern Hardwood Swamp
- Southern Sedge Meadow

Invasive Plants

Several non-native invasive plants are well-established within the study area. Reed canary grass is the dominant species in some of the open and shrub wetlands and has begun to invade canopy gaps in the southern hardwood swamps and other forested wetlands at **Brillion, Collins Marsh, and Killsnake Wildlife Areas**. Logging and other management activities at these forested sites should be assessed for their impact on the spread of reed canary grass and other invasives present that are often associated with opening up the canopy. The sedge meadow community types were once much more widespread in Wisconsin but land conversion, including to reed canary meadows, has destroyed much of this important wetland type and associated plant diversity.

Wild parsnip (*Pastinaca sativa*) is a present and expanding threat in upland grasslands at **Collins Marsh Wildlife Area**. Both species of European buckthorn and garlic mustard are present at **Brillion Wildlife Area**, and non-native bush honeysuckle is found in the Southern Dry-mesic Forest at **Collins Marsh Wildlife Area**. Efforts are underway at **Eldorado Wildlife Area** to control purple loosestrife, garlic mustard, dame’s rocket (*Hesperis metronalis*), and Russian olive (*Elaeagnus angustifolia*). Common buckthorn, bush honeysuckle, and likely glossy buckthorn are also present at **Eldorado Wildlife Area**. Other invasive plants are present but not dominant in the ELWWA.

Possible future threats to biodiversity include: helleborine orchid (*Epipactis helleborine*), garlic mustard, common reed grass, Japanese knotweed (*Polygonum cuspidatum*), common or cut-leaved teasel (*Dipsacus fullonum* and *D. laciniatus*), and invasive cattails. Occurrences of Japanese knotweed have been noted near several wildlife areas in the ELWWA, along with observations of teasel in this area (WDNR 2010b). In addition, a sizable population of tall manna grass (*Glyceria maxima*) was discovered in July, 2010 northwest of **Brillion Wildlife Area** (20N 19E). These three non-native invasive plants have potential for invading wetlands and grasslands similar to those found on the ELWWA.

Primary Sites: Site-specific Opportunities for Biodiversity Conservation

Two ecologically important sites were identified on the ELWWA. These “Primary Sites” were delineated because they generally encompass the best examples of 1) rare and representative natural communities, 2) documented occurrences of rare species populations, and/or 3) opportunities for ecological restoration or connections. These sites warrant high protection and/or restoration consideration during the development of the property master plan. This report is meant to be considered along with other information when identifying opportunities for various management designations during the master planning process.

Descriptions for each of the Primary Sites can be found in Appendix E. Information provided in the summary paragraphs includes location information, a site map, a brief summary of the natural features present, the site’s ecological significance, and management considerations.

Eastern Lake Winnebago Wildlife Areas Planning Group Primary Sites

ELWWA01 Collins Hardwood Swamp

ELWWA02 Dyke Road Flowage and Marsh

Future Needs

This project was designed to provide a rapid assessment of the biodiversity values for the ELWWA. Although the report should be considered adequate for master planning purposes, additional efforts could help to inform future adaptive management efforts, along with providing useful information regarding the natural communities and rare species contained in the ELWWA.

- Invasive species monitoring and control – establishing an invasives early detection and monitoring protocol will be critical for the ELWWA. State wildlife areas and many other public lands throughout Wisconsin are facing major management problems because of serious infestations of highly invasive species such as emerald ash borer, garlic mustard, reed canary grass, European buckthorns, and Eurasian honeysuckles. Some of these species are easily dispersed by humans and vehicles; others are spread by birds, mammals, insects, water, or wind. In order to protect the important biodiversity values of the ELWWA, a comprehensive plan will be needed for detecting and rapidly responding to new invasive threats. Citizens, such as trail users or hunters, could be encouraged to report new sightings of invasive plants and animals and, perhaps, cooperate with property managers in control efforts.
- Emerald ash borer monitoring -- The emerald ash borer is of major concern for the ELWWA as populations have been detected in the vicinity of the project area. Counties in and adjacent to the ELWWA (Brown, Fond du Lac, and Sheboygan) have been quarantined to help prevent the spread of EAB and include restrictions on moving any hardwood firewood, ash nursery stock or ash logs or timber out of the quarantine area. Southern hardwood swamps and other forest types in the project area consist of a considerable percentage of ash species putting them at risk for invasion. Monitoring for symptoms of EAB with rapid response and management for new invasions is critical to slow or halt the spread and protect the ash resource and the forest diversity. To report suspect trees and insects, contact should be made with the DNR regional health specialist.
- Vegetation plot data should be collected from the southern hardwood swamps types in this region. Establishing baseline vegetation transects will help to better understand these unique and uncommon natural communities occurring near the tension zone and aid in developing a classification for this type.
- Locations and likely habitats should be identified for conducting additional rare plant and animal surveys during appropriate seasons. This should at a minimum include additional breeding bird surveys in the southern hardwood swamp at Collins Marsh Wildlife Area, additional plant and natural community surveys in the emergent marsh at Eldorado Wildlife Area, and baseline reptile and amphibian surveys at all properties. Frog and toad calling survey routes should be expanded throughout the ELWWA for inventory and monitoring purposes with particular attention to northern cricket frog (*Acris crepitans*), known historically from the ELWWA. Targeted Blanding's turtle (*Emydoidea blandingii*) surveys should be performed in open wetland areas and upland nesting sites should be identified.
- Additional bird surveys should be done focusing on spring and fall migratory bird concentration areas noting bird abundance and richness. Breeding bird surveys should be done in upland grasslands and shrubby grasslands. Numerous SGCN are known to utilize these areas and should be targeted to identify species rich areas and locations that grassland expansion could take place.

Glossary

adaptive management - a formal, structured approach to dealing with uncertainty in natural resource management, using the experience of management as an ongoing and continually improving process.

dolomite – a sedimentary, often bedded rock similar to limestone but differing due to the addition of magnesium ions.

drumlin – streamlined, teardrop shaped hills created by glacial action. The long axis parallels the direction of past glacial movement.

Ecological Landscape - landscape units developed by the WDNR to provide an ecological framework to support natural resource management decisions. The boundaries of Wisconsin's sixteen Ecological Landscapes correspond to ecoregional boundaries from the National Hierarchical Framework of Ecological Units, but sometimes combine subsections to produce a more manageable number of units.

ecological priority – the natural communities (habitats) in each Ecological Landscape that are most important to the Species of Greatest Conservation Need, as identified in the Wisconsin Wildlife Action Plan (WDNR 2006b). Three sources of data were used to derive this information: 1) the probability that a species will occur in a given landscape, 2) the degree to which a species is associated with a particular natural community, and 3) the degree to which there are opportunities for sustaining a given natural community in any given Ecological Landscape. See dnr.wi.gov/org/land/er/wwap/explore/tool for more information.

element - the basic building blocks of the Natural Heritage Inventory. They include natural communities, rare plants, rare animals, and other selected features such as colonial bird rookeries, bat hibernacula, and mussel beds. In short, an element is any biological or ecological entity upon which we wish to gather information for conservation purposes.

element occurrence - an Element Occurrence (EO) is an area of land and/or water in which a rare species or natural community is, or was, present. An EO should have practical conservation value for the Element as evidenced by potential continued (or historic) presence and/or regular recurrence at a given location. For species, the EO often corresponds with the local population, but when appropriate may be a portion of a population (e.g., a single nest territory or long distance dispersers) or a group of nearby populations (e.g., metapopulation). For communities, the EO may represent a stand or patch of a natural community or a cluster of stands or patches of a natural community. Because they are defined on the basis of biological information, EOs may cross jurisdictional boundaries (modified from <http://whiteoak.natureserve.org/eodraft/index.htm>)

escarpment - a long, precipitous, clifflike ridge of land, rock, or the like, commonly formed by faulting or fracturing of the earth's crust.

esker – a ridge, commonly sinuous, composed of sand and gravel deposited by a stream that flowed in an ice-walled channel beneath a glacier (Dott and Attig 2004).

Forest Certification – a market-based, non-regulatory forest conservation tool designed to recognize and promote environmentally-responsible forestry and sustainability of forest resources. The certification process involves an evaluation of management planning and forestry practices by a third-party according to an agreed-upon set of standards (from <http://www.pinchot.org/project/59>). See <http://dnr.wi.gov/forestry/certification/> regarding certification of WDNR managed lands.

kame – steep-sided hills or mounds of water-sorted sands and gravels that were built when streams of meltwater draining from stagnant glacial ice dropped their load of sediment as their velocity decreased (Schultz 1986).

kettle lake – lakes formed from a depression caused by a block of buried glacier ice that gradually melted, causing the overlying land surface to collapse downward.

Landtype Association (LTA) - a level in the National Hierarchical Framework of Ecological Units (see next entry) representing an area of 10,000 – 300,000 acres. Similarities of landform, soil, and vegetation are the key factors in delineating LTAs.

Migratory Bird Stopover Site – describes a site comprising a set of habitats that birds select during migration. Ideal stopover sites provide accessible water, protection, and food so that birds can not only survive but also regain energy lost during their travels (Duncan 2002).

moraine – landforms composed of unsorted materials deposited by glaciers. They can cover broad geographic areas of millions of acres. Topography can vary from nearly level “till” plains to rough end moraine landscapes composed of steep dry ridges interspersed with deep kettle holes. These glacial “kettles” are frequent locations for lakes and wetlands.

natural community – an assemblage of plants and animals, in a particular place at a particular time, interacting with one another, the abiotic environment around them, and subject to primarily natural disturbance regimes. Those assemblages that are repeated across a landscape in an observable pattern constitute a community type. No two assemblages, however, are exactly alike.

representative - native plant species that would be expected to occur in native plant communities influenced primarily by natural disturbance regimes in a given landscape - e.g., see Curtis (1959).

SGCN (or “Species of Greatest Conservation Need”) – native wildlife species with low or declining populations that are most at risk of no longer being a viable part of Wisconsin’s fauna (from the “Wisconsin Wildlife Action Plan,” WDNR 2006b).

Tension Zone – a narrow region extending from northwest to southeast across Wisconsin. The tension zone separates the mixed conifer-hardwood forests of the north from the prairie/savanna/hardwood forests of the south. Many native plant and animal species occupy ranges roughly delineated by the tension zone.

Species List

The following is a list of species referred to by common name in the report text.

Common Name	Scientific Name
Animals	
American Bittern	<i>Botaurus lentiginosus</i>
American White Pelican	<i>Pelecanus erythrorhynchos</i>
Bald Eagle	<i>Haliaeetus leucocephalus</i>
Black Tern	<i>Chlidonias niger</i>
Black-crowned Night Heron	<i>Nycticorax nycticorax</i>
Blanding's Turtle	<i>Emydoidea blandingii</i>
Blue-winged Teal	<i>Anas discors</i>
Bobolink	<i>Dolichonyx oryzivorus</i>
Common Moorhen	<i>Gallinula chloropus</i>
Eastern Meadowlark	<i>Sturnella magna</i>
Grasshopper Sparrow	<i>Ammodramus savannarum</i>
Henslow's Sparrow	<i>Ammodramus henslowii</i>
King Rail	<i>Rallus elegans</i>
Lapland Longspur	<i>Calcarius lapponicus</i>
Least Bittern	<i>Ixobrychus exilis</i>
Northern Cricket Frog	<i>Acris crepitans</i>
Northern Harrier	<i>Circus cyaneus</i>
Northern Shrike	<i>Lanius excubitor</i>
Osprey	<i>Pandion haliaetus</i>
Red-necked Grebe	<i>Podiceps grisegena</i>
Red-shouldered Hawk	<i>Buteo lineatus</i>
Rough-legged Hawk	<i>Buteo lagopus</i>
Short-eared Owl	<i>Asio flammeus</i>
Snow Bunting	<i>Plectrophenax nivalis</i>
Snowy Owl	<i>Bubo scandiacus</i>
Sora Rail	<i>Porzana carolina</i>
Virginia Rail	<i>Rallus limicola</i>
Yellow Rail	<i>Coturnicops noveboracensis</i>
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>
Plants	
American beech	<i>Fagus grandifolia</i>
American elm	<i>Ulmus americana</i>
Annual bedstraw	<i>Galium aparine</i>
Arrowheads	<i>Sagittaria spp.</i>
Ash	<i>Fraxinus spp.</i>
Basswood	<i>Tilia americana</i>
Bell's honeysuckle	<i>Lonicera x bella</i>
Black ash	<i>Fraxinus nigra</i>
Black currant	<i>Ribes americanum</i>
Black oak	<i>Quercus velutina</i>
Black spruce	<i>Picea mariana</i>
Broad-leaf enchanter's-nightshade	<i>Circaea lutetiana</i>
Bur oak	<i>Quercus macrocarpa</i>
Canada blue-joint grass	<i>Calamagrostis canadensis</i>
Canadian wood-nettle	<i>Laportea canadensis</i>
Cattails	<i>Typha spp.</i>
Cinnamon fern	<i>Osmunda cinnamomea</i>

Clustered black snakeroot	<i>Sanicula gregaria</i>
Common blue violet	<i>Viola sororia</i>
Common buckthorn	<i>Rhamnus cathartica</i>
Common bur-reed	<i>Sparganium eurycarpum</i>
Common fox sedge	<i>Carex stipata</i>
Common lake sedge	<i>Carex lacustris</i>
Common reed grass	<i>Phragmites australis</i>
Common teasel	<i>Dipsacus fullonum</i>
Common winterberry	<i>Ilex verticillata</i>
Common yellow-crest	<i>Rorippa palustris</i>
Curly dock	<i>Rumex crispus</i>
Cut-leaved teasel	<i>Dipsacus laciniatus</i>
Dame' rocket	<i>Hesperis metronalis</i>
Dwarf red raspberry	<i>Rubus pubescens</i>
Fowl manna grass	<i>Glyceria striata</i>
Garlic mustard	<i>Alliaria petiolata</i>
Giant goldenrod	<i>Solidago gigantea</i>
Glossy buckthorn	<i>Rhamnus frangula</i>
Greater bladder sedge	<i>Carex intumescens</i>
Green ash	<i>Fraxinus pennsylvanica</i>
Helleborine orchid	<i>Epipactis helleborine</i>
Japanese knotweed	<i>Polygonum cuspidatum</i>
Lady fern	<i>Athyrium filix-femina</i>
Mayapple	<i>Podophyllum peltatum</i>
Northern bugleweed	<i>Lycopus uniflorus</i>
Northern white-cedar	<i>Thuja occidentalis</i>
Orange jewelweed	<i>Impatiens capensis</i>
Paper birch	<i>Betula papyrifera</i>
Plains cottonwood	<i>Populus deltoides</i>
Prickly ash	<i>Zanthoxylum americanum</i>
Purple loosestrife	<i>Lythrum salicaria</i>
Pussy willow	<i>Salix discolor</i>
Red maple	<i>Acer rubrum</i>
Red oak	<i>Quercus rubra</i>
Red osier dogwood	<i>Cornus stolonifera</i>
Reed canary grass	<i>Phalaris arundinacea</i>
River bulrush	<i>Bolboschoenus fluviatilis</i>
Rough-leaved goldenrod	<i>Solidago patula</i>
Royal fern	<i>Osmunda regalis</i>
Russian olive	<i>Elaeagnus angustifolia</i>
Sensitive fern	<i>Onoclea sensibilis</i>
Shagbark hickory	<i>Carya ovata</i>
Silky dogwood	<i>Cornus amomum</i>
Silver maple	<i>Acer saccharinum</i>
Slender willow	<i>Salix petiolaris</i>
Small-spike false nettle	<i>Boehmeria cylindrica</i>
Smartweed	<i>Polygonum spp.</i>
Spotted Joe-Pye-weed	<i>Eupatorium maculatum</i>
Stinging nettle	<i>Urtica dioica</i>
Sugar maple	<i>Acer saccharum</i>
Swamp loosestrife	<i>Lysimachia thyrsiflora</i>
Swamp white oak	<i>Quercus bicolor</i>
Tamarack	<i>Larix laricina</i>
Trembling aspen	<i>Populus tremuloides</i>

Trout lily	<i>Erythronium americanum</i>
Tussock sedge	<i>Carex stricta</i>
Virginia waterleaf	<i>Hydrophyllum virginianum</i>
Water-horehound	<i>Lycopus uniflorus</i>
Water smartweed	<i>Polygonum amphibium</i>
Wax-leaf meadowrue	<i>Thalictrum revolutum</i>
White ash	<i>Fraxinus americana</i>
White meadowsweet	<i>Spiraea alba</i>
White oak	<i>Quercus alba</i>
White pine	<i>Pinus strobus</i>
White snakeroot	<i>Eupatorium rugosum</i>
Wild geranium	<i>Geranium maculatum</i>
Willows	<i>Salix spp.</i>
Wood nettles	<i>Laportea canadensis</i>
Yellow birch	<i>Betula alleghaniensis</i>
Yellow trout-lily	<i>Erythronium americanum</i>

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Appendix A

Natural Heritage Inventory Overview and General Methodology

This biotic inventory and analysis was conducted by the Wisconsin Natural Heritage Inventory (NHI) program. The Wisconsin NHI program is part of the Wisconsin DNR's Bureau of Endangered Resources and a member of an international network of Natural Heritage programs representing all 50 states, as well as portions of Canada, Latin America, and the Caribbean. These programs share standardized methods for collecting, processing, and managing data for rare species, natural communities, and certain other natural features (e.g., bird rookeries). NatureServe, an international non-profit organization, coordinates the network. This appendix provides a general overview of the methodology we use for these projects. Please see the NatureServe Web site for more detailed information about standard methods used by the Heritage Network (www.NatureServe.org) for locating, documenting, and ranking rare species and natural community occurrences.

General Process Used when Conducting Biotic Inventories for Master Planning

The Wisconsin NHI Program typically uses a “coarse filter-fine filter” approach to conducting biotic inventory projects for master planning. This approach begins with a broad assessment of the natural communities and aquatic features present, along with their relative quality and condition. The area's landforms, soils, topography, hydrology, current land uses, and the surrounding matrix are also evaluated using Geographic Information Systems (GIS) and other electronic and hardcopy data sources. Data that describe conditions for the area prior to Euro-American settlement are often used during this step and at other times to further understand the ecological capabilities of the area. Often, we consult with local managers, biologists, or others familiar with the ecology of the area when preparing for an inventory project. The goals for this step are to identify the important ecological attributes and biological processes present, as well as to focus our inventory efforts.

The level of survey intensity varies based on the size and ecological complexity of the property or group of properties, as well as the resources available. For larger properties such as state forests, biotic inventory efforts typically take more than one year. Ideally, taxa surveys are conducted following a coarse-filter analysis that sometimes include extensive natural community surveys. There is often time for “mop-up work” during the year following the completion of the main survey effort, whereby additional surveys are conducted for areas that could not be reached the first year or for which new information has become available. For smaller properties, a “Rapid Ecological Assessment” often takes the place of a full-scale biotic inventory. The level of effort for these projects varies based on the needs of the study area, although surveys are almost always completed during one field season. Coarse filter work for rapid assessments is often done based on GIS data, aerial photos, data acquired from previous efforts, and information from property managers and others knowledgeable about the area.

Taxa-specific surveys can be costly and intensive and sometimes must be completed during a very narrow period of time. For example, bird surveys must be completed within an approximately one-month time window. For this and several other reasons, ***our surveys cannot locate every rare species occurrence within a given area.*** Therefore, it is important to use resources as efficiently as possible, making every effort to identify the major habitats present in the study area from the start. This approach concentrates inventory efforts on those sites most likely to contain target species to maximize efficient use of resources. Communication among biologists during the field season can help identify new areas of interest or additional priorities for surveys. The goal is to locate species populations with the highest conservation value whenever possible.

After all of the data are collected, occurrences of rare species, high-quality natural communities, and certain other features are documented, synthesized, and incorporated into the NHI Database. The NHI program refers to this process as “mapping” the data and uses a tabular and spatial database application designed specifically for the Heritage Network. Other secondary databases are also used by the Wisconsin NHI Program for storing additional species and community information such as species lists, GPS waypoints, photos, and other site documentation.

Once the data mapping and syntheses are completed, the NHI Program evaluates data from the various department biologists, contractors, and other surveyors. This information is examined along with many other sources of spatial and tabular information including topographic maps, various types of aerial photography, digital soil and wetland maps, hydrological data, forest reconnaissance data, and land cover data. Typically, GPS waypoints and other spatial information from the various surveys are superimposed onto these maps for evaluation by NHI biologists.

In addition to locating important rare species populations and high-quality natural community occurrences, the major products culminating from all of this work are the “Primary Sites.” These areas contain relatively undisturbed, high-quality, natural communities; provide important habitat for rare species; offer opportunities for restoration; could provide important ecological connections; or some combination of the above factors. The sites are meant to highlight, based on our evaluation, the best areas for conserving biological diversity for the study area. They often include important rare species populations, High Conservation Value Forests, or other ecologically important areas.

The final report describes the Primary Sites, as well as rare or otherwise notable species, and other ecological opportunities for conserving or enhancing the biological diversity of the study area. The report is intended for use by department master planning teams and others and strives to describe these opportunities at different scales, including a broad, landscape context that can be used to facilitate ecosystem management.

Select Tools Used for Conducting Inventory

The following are descriptions of standard tools used by the NHI Program for conducting biotic inventories. Some of these may be modified, dropped, or repeated as appropriate to the project.

File Compilation: Involves obtaining existing records of natural communities, rare plants and animals, and aquatic features for the study area and surrounding lands and waters from the NHI Database. Other databases with potentially useful information may also be queried, such as: forest reconnaissance data; the DNR Surface Water Resources series for summaries of the physical, chemical, and biological characteristics of lakes and streams (statewide, by county); the Milwaukee Public Museum's statewide Herp Atlas; the Wisconsin Breeding Bird Atlas; other NHI “atlas” and site databases; museum/herbarium collections for various target taxa; soil surveys; geological surveys; and the department's fish distribution database.

Additional data sources are sought out as warranted by the location and character of the site, and the purpose of the project. Manual files maintained within the Bureau of Endangered Resources, including the State Natural Area files, often contain information on a variety of subjects relevant to the inventory of natural features for an area.

Literature Review: Field biologists involved with a given project consult basic references on the natural history and ecology of the area, as well as any documented rare species. This sometimes broadens and/or sharpens the focus of the inventory efforts.

Target Elements: Lists of target elements including natural communities, rare plants and animals, and aquatic features are developed for the study area. Field inventory is then scheduled for the times when these

elements are most identifiable or active. Inventory methods follow accepted scientific standards for each taxon.

Compilation of Maps and Other Spatial Data: USGS 7.5 minute topographic quadrangles, most often in digital form, serve along with aerial photos as the base maps for field survey and often yield useful clues regarding access, extent of area to be surveyed, developments, and the presence and location of special features. These are used in conjunction with numerous GIS layers, which are now a basic resource tool for the efficient and comprehensive planning of surveys and the analysis of their results.

WDNR wetland maps consist of aerial photographs upon which all wetlands down to a scale of 2 or 5 acres have been delineated. Each wetland polygon is classified based on characteristics of vegetation, soils, and water depth. These polygons have been digitized for most counties, and the resulting GIS layers can be superimposed onto other maps.

Ecoregion GIS layers are useful for comprehensive projects covering large geographic areas such as counties, national and state forests, and major watersheds. These maps integrate basic ecological information on climate, landforms, geology, soils, and vegetation. Ecological Landscapes provide the broad framework most often used in Wisconsin; however smaller units, including Landtype Associations, can be very helpful for evaluating ecoregions at finer scales.

Aerial photographs: These provide information on a study area not available from maps, paper files, or computer printouts. Examination of both current and historical photos, taken over a period of decades, can be especially useful in revealing changes in the environment over time. The Wisconsin NHI Program uses several different types of both color and black and white air photos. Typically, these are in digital format, although paired photos in print format can be valuable for stereoscopic viewing. High-resolution satellite imagery is often cost-prohibitive but is available for some portions of the state and is desirable for certain applications.

Original Land Survey Records: The surveyors who laid out the rectilinear Town-Range-Section grid across the state in the mid-nineteenth century recorded trees by species and size at all section corners and along section lines. Their notes also included general impressions of vegetation, soil fertility, and topography, and note aquatic features, wetlands, and recent disturbances such as windthrow and fire. As these surveys typically occurred prior to extensive settlement of the state by Europeans, they constitute a valuable record of conditions prior to extensive modification of the landscape by European technologies and settlement patterns. The tree data are available in GIS format as raw points or interpreted polygons, and the notes themselves can provide helpful clues regarding the study area's potential ecological capabilities.

Interviews: Interviews with scientists, naturalists, land managers or others knowledgeable about the area to be surveyed often yield invaluable information.

Global Positioning Systems (GPS): Small, portable GPS units are now a routine piece of field equipment used for virtually all NHI survey work. Collecting coordinates (waypoints) facilitates mapping and makes it easy to quickly communicate specific locations among biologists. Often waypoints are paired with photos and/or other information and stored in a waypoint tracking database.

Aerial Reconnaissance: Fly-overs are desirable for large sites, and for small sites where contextual issues are especially important. When possible, this should be done both before and after ground level work. Flights are scheduled for those times when significant features of the study area are most easily identified and differentiated. They are also useful for observing the general lay of the land, vegetation patterns and patch sizes, aquatic features, infrastructure, and disturbances within and around the site

Wisconsin Natural Heritage Working List Explanation

The Wisconsin Natural Heritage Working List contains species known or suspected to be rare in the state and natural communities native to Wisconsin. It includes species legally designated as "Endangered" or "Threatened" as well as species in the advisory "Special Concern" category. Most of the species and natural communities on the list are actively tracked and we encourage data submissions on these species. This list is meant to be dynamic - it is updated as often as new information regarding the biological status of species becomes available. See the Endangered Resources Program web site for the most recent Natural Heritage Inventory Working List (<http://dnr.wi.gov/org/land/er/wlist/>).

Key

Scientific Name: Scientific name used by the Wisconsin Natural Heritage Inventory Program.

Common Name: Standard, contrived, or agreed upon common names.

Global Rank: Global element rank. See the rank definitions below.

State Rank: State element rank. See the rank definitions below.

US Status: Federal protection status in Wisconsin, designated by the Office of Endangered Species, U.S. Fish and Wildlife Service through the U.S. Endangered Species Act. LE = listed endangered; LT = listed threatened; XN = non-essential experimental population(s); LT,PD = listed threatened, proposed for de-listing; C = candidate for future listing.

WI Status: Protection category designated by the Wisconsin DNR. END = endangered; THR = threatened; SC = Special Concern.

WDNR and federal regulations regarding Special Concern species range from full protection to no protection. The current categories and their respective level of protection are SC/P = fully protected; SC/N = no laws regulating use, possession, or harvesting; SC/H = take regulated by establishment of open closed seasons; SC/FL = federally protected as endangered or threatened, but not so designated by WDNR; SC/M = fully protected by federal and state laws under the Migratory Bird Act.

Special Concern species are those species about which some problem of abundance or distribution is suspected but not yet proved. The main purpose of this category is to focus attention on certain species before they become threatened or endangered.

Global and State Element Rank Definitions

Global Element Ranks:

G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

G2 = Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single state or physiographic region) or because of other factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100.

G4 = Apparently globally secure, though it may be quite rare in parts of its range, especially at the periphery.

G5 = Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

GH = Of historical occurrence throughout its range, i.e., formerly part of the established biota, with the expectation that it may be rediscovered.

GU = Possibly in peril range-wide, but their status is uncertain. More information is needed.

GX = Believed to be extinct throughout its range (e.g. Passenger pigeon) with virtually no likelihood that it will be rediscovered.

G? = Not ranked.

Species with a questionable taxonomic assignment are given a "Q" after the global rank.

Subspecies and varieties are given subranks composed of the letter "T" plus a number or letter. The definition of the second character of the subrank parallels that of the full global rank. (Examples: a rare subspecies of a rare species is ranked G1T1; a rare subspecies of a common species is ranked G5T1.)

State Element Ranks

S1 = Critically imperiled in Wisconsin because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation from the state.

S2 = Imperiled in Wisconsin because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from the state.

S3 = Rare or uncommon in Wisconsin (21 to 100 occurrences).

S4 = Apparently secure in Wisconsin, with many occurrences.

S5 = Demonstrably secure in Wisconsin and essentially ineradicable under present conditions.

SA = Accidental (occurring only once or a few times) or casual (occurring more regularly although not every year); a few of these species (typically long-distance migrants such as some birds and butterflies) may have even bred on one or more of the occasions when they were recorded.

SE = An exotic established in the state; may be native elsewhere in North America.

SH = Of historical occurrence in Wisconsin, perhaps having not been verified in the past 20 years, and suspected to be still extant. Naturally, an element would become SH without such a 20-year delay if the only known occurrence were destroyed or if it had been extensively and unsuccessfully looked for.

SN = Regularly occurring, usually migratory and typically non-breeding species for which no significant or effective habitat conservation measures can be taken in Wisconsin. This category includes migratory birds and bats that pass through twice a year or, may remain in the winter (or, in a few cases, the summer) along with certain lepidoptera which regularly migrate to Wisconsin where they reproduce, but then completely die out every year with no return migration. Species in this category are so widely and unreliably distributed during migration or in winter that no small set of sites could be set aside with the hope of significantly furthering their conservation.

SZ = Not of significant conservation concern in Wisconsin, invariably because there are no definable occurrences in the state, although the taxon is native and appears regularly in the state. An SZ rank will generally be used for long-distance migrants whose occurrence during their migrations are too irregular (in terms of repeated visitation to the same locations), transitory, and dispersed to be reliably identified, mapped, and protected. Typically, the SZ rank applies to a non-breeding population.

SR = Reported from Wisconsin, but without persuasive documentation which would provide a basis for either accepting or rejecting the report. Some of these are very recent discoveries for which the program hasn't yet received first-hand information; others are old, obscure reports that are hard to dismiss because the habitat is now destroyed.

SRF = Reported falsely (in error) from Wisconsin but this error is persisting in the literature.

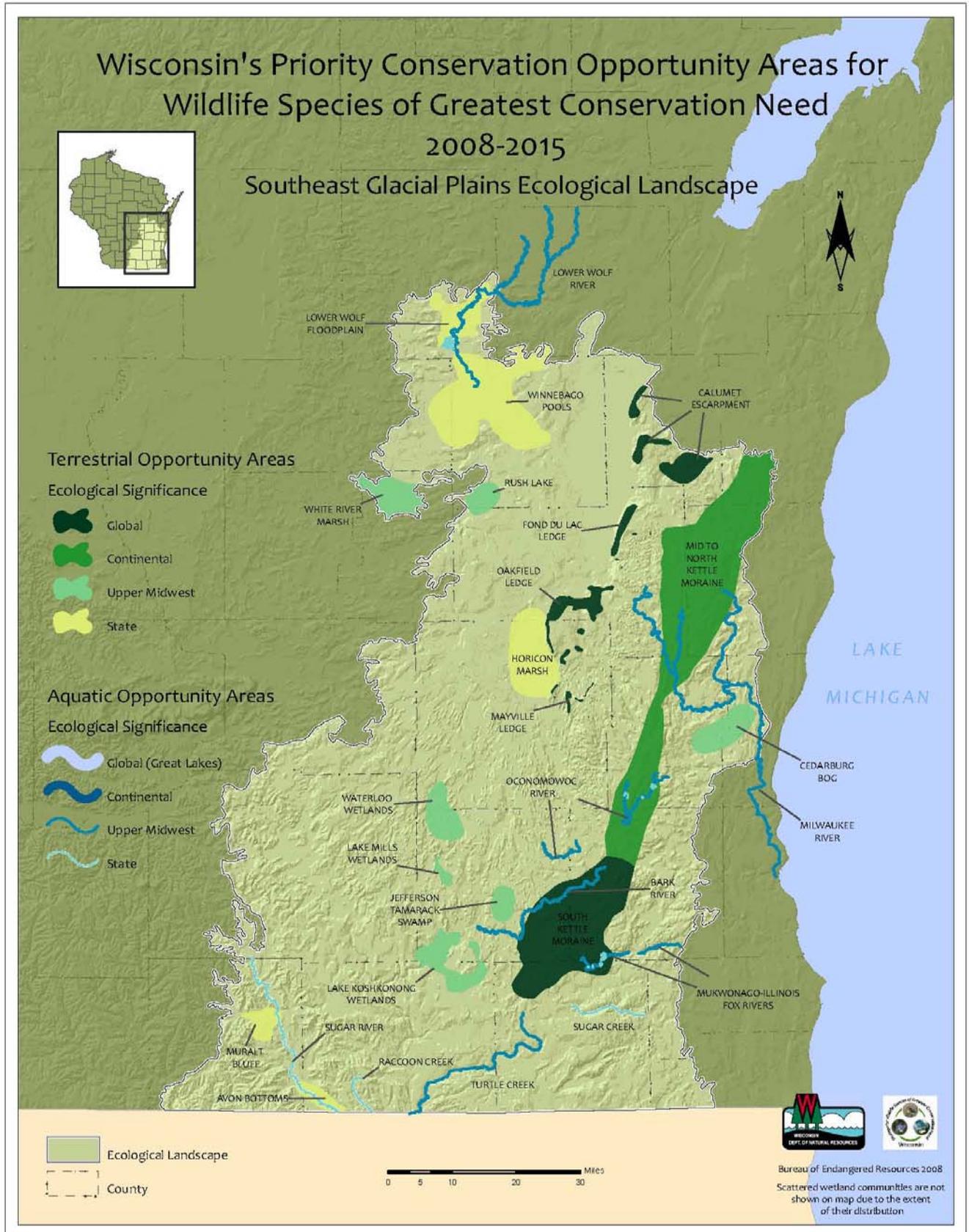
SU = Possibly in peril in the state, but their status is uncertain. More information is needed.

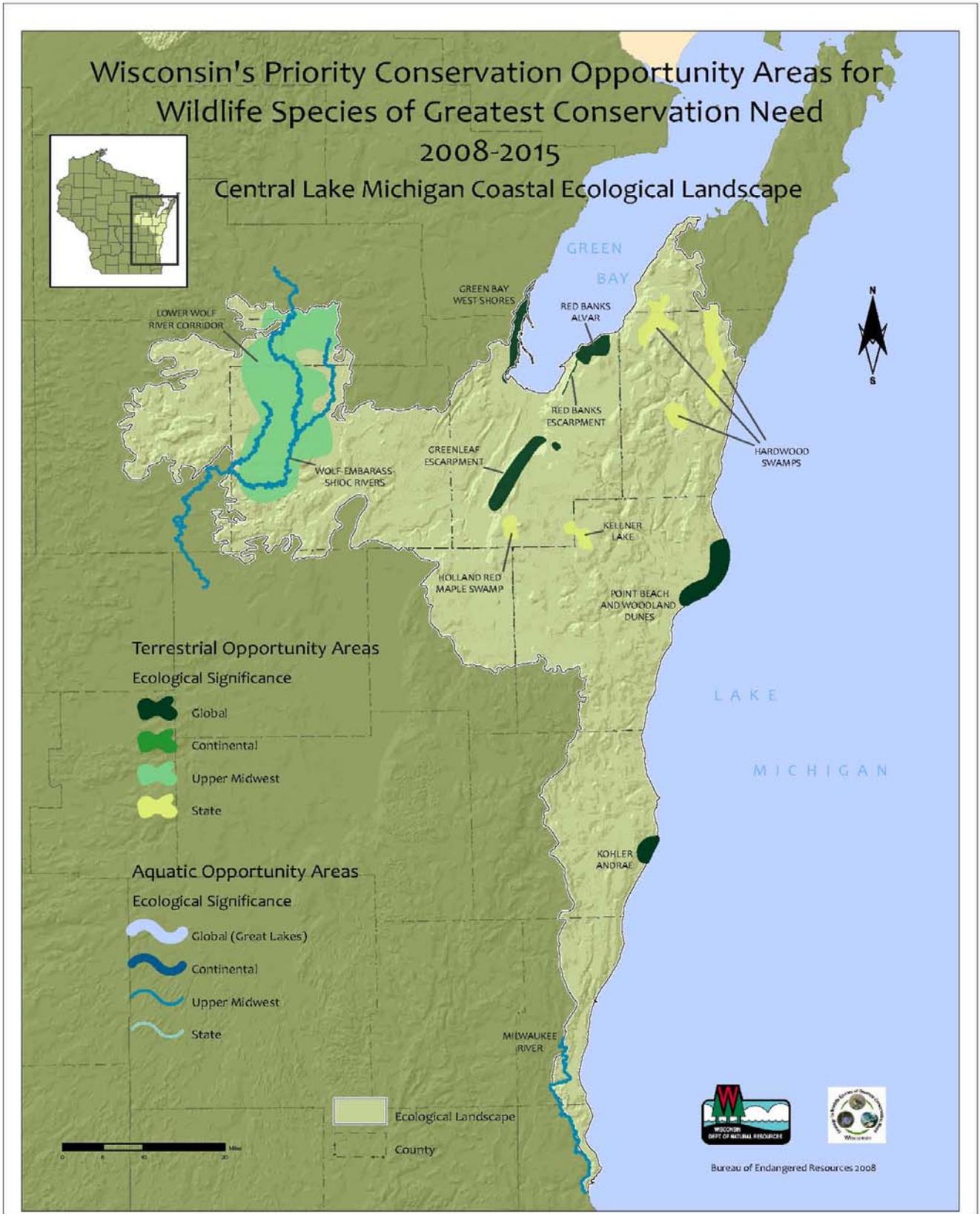
SX = Apparently extirpated from the state.

State Ranking of Long-Distance Migrant Animals:

Ranking long distance aerial migrant animals presents special problems relating to the fact that their non-breeding status (rank) may be quite different from their breeding status, if any, in Wisconsin. In other words, the conservation needs of these taxa may vary between seasons. In order to present a less ambiguous picture of a migrant's status, it is necessary to specify whether the rank refers to the breeding (B) or non-breeding (N) status of the taxon in question. (e.g. S2B,S5N).

Appendix B





Appendix C

Summary Descriptions for Rare Species and High Quality Natural Communities Documented on the Eastern Lake Winnebago Wildlife Areas Planning Group

The following paragraphs give brief summary descriptions for some of the rare species and high quality natural communities documented on the Eastern Lake Winnebago Wildlife Areas Planning Group and mapped in the NHI Database. More information can be found on the Endangered Resources Web site (www.dnr.wi.gov/org/land/er/) for several of these species and natural communities.

Rare Animals

American Bittern

American Bittern (*Botaurus lentiginosus*) preferred breeding habitat is thick marsh grass, sometimes adjacent to stands of willow and tamarack, and usually within 6 meters of water. Habitat degradation is the greatest threat to its survival. The most urgent management need is the preservation of grasslands and large, shallow, freshwater wetlands with dense emergent growth.

Black Tern

Black Tern (*Chlidonias niger*), a bird listed as Special Concern, prefers large shallow marshes with abundant vegetation adjacent to open water. Nesting occurs from May through the end of July.

Black-crowned Night-heron

Black-crowned Night-heron (*Nycticorax nycticorax*), a bird listed as Special Concern, prefers freshwater wetlands dominated by bulrush and cattail with small groves of alder, willow, or other brush. Their breeding season occurs from mid-April through mid-September.

Broad-winged Skipper

Broad-winged skipper (*Poanes viator*), a State Special Concern butterfly, is a wetland obligate. It is found in small localized colonies in sedge marsh/swamp with *C. lacustris*, *aquatilis*, *lasiocarpa*. Perhaps needs a relatively high water table where it is found with cattails and sedges. This is a univoltine species with adults present in July or into early August. The hibernation site is unknown but broadwinged skippers overwinter as partially grown larvae.

Common Moorhen

Common Moorhen (*Gallinula chloropus*), a Special Concern bird, prefers shallow marshes, especially where shallow lakes are rimmed with ample marsh vegetation. The breeding season extends from mid-May to late July.

Gorgone Checker Spot

Gorgone checker spot (*Chlosyne gorgone*), a State Special Concern butterfly, is found in barrens, dry fields and prairies, sandy ridges, glades in woodlands, and open pine forests. This species has two flight periods, one from late May through June and again in early August to early September.

Grasshopper Sparrow

Grasshopper Sparrow (*Ammodramus savannarum*), a bird listed as Special Concern, prefers prairies, retired cropland, unmowed highway right-of-ways, pastures (Kentucky bluegrass and timothy), shrub-carr

wetlands, northern sedge meadows, and managed grasslands maintained for duck production. This bird will nest in areas of 5-25 cm height-density that has bare patches and a diverse structure with stiff forbs for song perches. The breeding season extends from early May through mid-August.

Great Egret

Great Egret (*Casmerodius albus*) prefers freshwater wetlands, rivers and streams with waterside deciduous forest communities and willow thickets. Breeding occurs from early April through September.

Henslow's Sparrow

Henslow's Sparrow (*Ammodramus henslowii*) a bird listed as Threatened in Wisconsin, prefers old fields, open grasslands, wet meadows, unmowed highway right-of-ways, undisturbed pastures, timothy hay fields, and fallow land grown up to tall weeds. The breeding season extends from mid-May through mid-July.

King Rail

King Rail (*Rallus elegans*), a bird listed as Special Concern, prefers shallow marshes. The breeding season extends from mid-May to mid-July.

Northern Cricket Frog

Northern cricket frog (*Acris crepitans*), an endangered species in Wisconsin, prefer ponds, lakes, and a variety of habitats along and adjacent to streams and rivers including, marshes, fens, sedge meadows, low prairies, and exposed mud flats. The species tends to breed in quite water (no or low flow) and may also move from streams and rivers to adjacent wetlands and ponds. Cricket frogs cannot tolerate freezing or complete inundation for more than 24 hours during the winter and seek a variety of microhabitats that provide suitable overwintering conditions, including crayfish burrows, small mammal burrows, rotted-out root channels, seepage areas where groundwater flow prevents freezing at the surface or spaces created by sloughing streambanks. Cricket frogs are active from late-March through November. Breeding occurs from mid-May through mid-August, with some larvae not transforming until late September.

Northern Harrier

Northern Harrier (*Circus cyaneus*), a bird listed as Special Concern, prefer retired cropland (timothy/quackgrass), old field habitat, sedge meadow, and restored prairies. The breeding season extends from early April through late August.

Northern Ring-necked Snake

Northern ringneck snakes (*Diadophis punctatus edwardsii*), a species of Special Concern, prefer moist to moderately dry deciduous forests. They also are found in openings within the woods or near woods edges, but almost always are under cover such as rocks, downed woody debris or artificial materials. Within the forest, this species may also be found between the bark and core wood of tree stumps or within rotting logs. No specific overwintering habitat has been described in Wisconsin, although they likely use rotted out root channels and other structures that offer a moist, no-freeze environment. They are active from mid-April through early October, breed late April through early June and lay their eggs between late-June and early July. Eggs may be laid communally by two or more females. Hatching occurs in August or early September.

Osprey

Osprey (*Pandion haliaetus*) prefer large trees in isolated areas in proximity to large areas of surface water, large complexes of deciduous forest, coniferous forest, wetland, and shrub communities. Large lakes and rivers with nearby tall pine trees are preferred for nesting. The breeding season extends from late April through August.

Pickerel Frog

Pickerel frogs (*Lithobates palustris*) are a Species of Special Concern in Wisconsin. It has a rather complex habitat range as it prefers to overwinter in cold water streams, seepage pools or spring holes, often taking advantage of water cress for cover. It moves to warmer water ponds to breed and lay eggs from April through mid-June. Adults spend most of the active season foraging on land in riparian habitats along streams and rivers. This species is active from late March to early November but can remain semi-active in winter under water. Larvae metamorphose from mid-July to mid-August.

Red-necked Grebe

Red-necked Grebe (*Podiceps grisegena*), a bird listed as Endangered in Wisconsin, prefers seasonally or permanently flooded wetlands with extensive beds of aquatic plants and large beds of softstem bulrush in open country. Nesting habitat includes wetlands with patches of open water and stands of bulrush (*Scirpus validus*, *S. acutus*) or similar emergents.

Red-shouldered Hawk

Red-shouldered Hawk (*Buteo lineatus*), a bird listed as Threatened in Wisconsin. This species prefers larger stands of medium-aged to mature lowland deciduous forests, dry-mesic and mesic forest with small wetland pockets. Breeding occurs from mid-March through early August.

Yellow Rail

Yellow Rail *Coturnicops noveboracensis*, a State Threatened bird, is a rare migrant as well as a rare summer resident in both the north and east of Wisconsin. Yellow Rails are approximately the size of a sparrow, about 6-7 inches long. They have short bills and are a deep tawny-yellow in color with dark stripes crossed by white bars. In flight, the yellow rail is the only rail with a white patch on the trailing edge of each wing. These birds lay their 8-10 pinkish eggs from late May through mid-June in nests that are woven cups of dead grass placed above the water on tussocks. Parents incubate the eggs for approximately 17 days and the following fledgling period is about 35 days long. Yellow Rail habitat is primarily extensive meadows of "wiregrass" sedge and sometimes bluejoint, with little or no shrub encroachment. Preservation of large unfragmented bottomland forests will benefit this neotropical migrant.

Yellow-billed Cuckoo

Yellow-billed Cuckoo (*Coccyzus americanus*) prefer open deciduous woodlands with dense shrubby undergrowth, especially along the backwaters of a major river or slow moving creek. Breeding occurs most often in early June, but can be found as late as mid-August.

Rare Plants

Waxleaf Meadowrue

Waxleaf Meadowrue (*Thalictrum revolutum*), a State Special Concern plant, is found in moist, often calcareous meadows. It is also naturalized on railroad embankments. Blooming occurs throughout June; fruiting occurs throughout July. The optimal identification period for this species is throughout June.

Natural Communities

Emergent Marsh

These open, marsh, lake, riverine and estuarine communities with permanent standing water are dominated by robust emergent macrophytes, in pure stands of single species or in various mixtures. Dominants include cattails, bulrushes (particularly *Scirpus acutus*, *S. fluviatilis*, and *S. validus*), bur-reeds,

giant reed, pickerel-weed, water-plantains, arrowheads, the larger species of spikerush (such as *Eleocharis smallii*), and wild rice.

Aquatic plants, including both emergent and submergent aquatic vegetation, form the foundation of healthy and flourishing aquatic ecosystems - both within lakes and rivers and on the shores and wetlands around them. They not only protect water quality, but they also produce life-giving oxygen. Aquatic plants are a lake's own filtering system, helping to clarify the water by absorbing nutrients like phosphorus and nitrogen that could stimulate algal blooms. Plant beds stabilize soft lake and river bottoms and reduce shoreline erosion by reducing the effect of waves and current.

Aquatic plants also serve as spawning habitat for fish and amphibians, as shelter for various life stages of a variety of species, and as nesting habitat for birds. Plant beds support populations of aquatic insects that serve as a food base for other species. Seeds and other plant parts provide vital nutrition to a number of waterfowl and other bird species. Healthy, native aquatic plant communities also help prevent the establishment of invasive exotic plants like Eurasian watermilfoil.

Northern Wet-mesic Forest

This forested minerotrophic wetland is dominated by northern white cedar, and occurs on rich, neutral to alkaline peats and mucks throughout much of northern Wisconsin. Balsam fir, black ash, and spruces are among the many potential canopy associates. The understory is rich in mosses, lichens, liverworts, ferns, sedges, orchids, and wildflowers such as goldthread, fringed polygala, and naked miterwort, and trailing sub-shrubs such as twinflower and creeping snowberry. A number of rare plants occur more frequently in the cedar swamps than in any other habitat. Older cedar swamps are often structurally complex, as the easily wind-thrown cedars are able to root from their branch tips. Some of the canopy associates have the potential to reach heights considerably beyond those usually attained by cedar, producing a multi-layered canopy. The tall shrub layer is often well-developed and may include speckled alder, alder-leaved buckthorn, wild currants, and mountain maple. Canada yew was formerly an important tall shrub in cedar swamps but is now rare or local.

Seepages, springs, and spring runs contribute to stand complexity and provide critical habitat for additional plants and animals. Cedar swamps are relatively common in depressions that receive mineral-enriched groundwater, and can be associated with both ground moraine and outwash landforms.

Shrub Carr

This wetland community is dominated by tall shrubs such as red-osier dogwood, silky dogwood, meadowsweet, and various willows. Canada bluejoint grass is often very common. Associates are similar to those found in alder thickets and tussock-type sedge meadows. This type occupies areas that are transitional between open wetlands such as wet prairie, calcareous fen, or southern sedge meadow, and forested wetlands such as floodplain forest or southern hardwood swamp. Shrub-carr can persist at a given site for a very long time if natural hydrologic cycles are maintained. This type often occurs in bands around lakes or ponds, on the margins of river floodplains, or, more extensively, in glacial lakebeds. It is common and widespread in southern Wisconsin but also occurs in the north. In the south, shrub-carr was often an integral part of prairie-savanna landscapes, though it also occurred in wetlands within more forested regions. In the north, the landscape matrix around the shrub-carr type was usually upland forest. Statewide, shrub-carr remains quite common, and has fared considerably better than many of the other native wetland types within its range.

Past drainage and marsh hay mowing likely had a negative effect on shrub-carr, whereas clearing of conifer swamps likely produced more of this habitat. Once fire was controlled and hay mowing was discontinued in lowland meadows, shrub-carr likely increased in extent. Drainage of meadows and marshes has also allowed shrub-carr habitats to increase in some areas. As a result of wetland drainage

and fire suppression, shrub-carr now occupies many sites that formerly supported much more extensive marsh, wet meadow, prairie, and fen vegetation, and therefore, it is sometimes targeted for elimination. However, it is an important native wetland type that has its place on our landscape and should be protected, managed, and restored at appropriate locations.

Southern Dry-mesic Forest

Red oak is a common dominant tree of this upland forest community type. White oak, basswood, sugar and red maples, white ash, shagbark hickory, and black cherry are also important. The herbaceous understory flora is diverse and includes many species listed under southern dry forest plus jack-in-the-pulpit, enchanter's-nightshade, large-flowered bellwort, interrupted fern, lady fern, tick-trefoils, and hog peanut.

Southern dry-mesic forests occur on loamy soils of glacial till plains and moraines, and on erosional topography with a loess cap, south of the tension zone. This community type was common historically, although white oak was considerably more dominant than red oak, and the type is still common today. However, to the detriment of the oaks, mesophytic tree species are becoming increasingly important under current management practices and fire suppression policies. Oak forests are succeeding to more mesic species (e.g., central and northern hardwood forest types), or to brush.

Southern Hardwood Swamp

This is a deciduous forested wetland community type found in insular basins with seasonally high water tables. This type is best developed in glaciated southeastern Wisconsin, but was not of large extent even prior to EuroAmerican settlement. Finley (1976) classified less than 1% of southeastern Wisconsin as lowland hardwood forest, and this figure includes bottomland forests along rivers as well as hardwood swamps in closed basins. Dominant tree species are red maple, green and black ashes, and formerly, American elm. Another species that also occurs in these forests is silver maple, as well as hybrids of red and silver maples. Southern hardwood swamps are noted for a high component of lianas, including poison ivy, Virginia creepers, and grapes. In the relatively undisturbed sites, there can be a rich spring flora. Microtopographic differences account for the existence of patches of spring ephemerals as well as many wetland species. The exotic reed canary grass has become dominant in the understory of many hardwood swamps.

This Natural Heritage Inventory community type partly includes the southern wet-mesic forest of the Curtis (1959) classification. Curtis describes these types as occurring on lake plains, both around the margins of larger existing lakes and on extinct glacial lakes. He referred to them as “lacustrine forests”, and noted that their soils have a high organic matter content, approaching peat conditions. This differentiates them in part from floodplain forests where processes of flooding and scouring tend to remove organic detritus. Also, in floodplains, much of the water movement is lateral, while in hardwood swamps the water table tends to fluctuate vertically. Southern hardwood swamps are not necessarily restricted to lake plains; some occur in lower-lying portions of till plains that may not have held ponded water for any significant length of time during or after glaciation.

Southern Mesic Forest

This upland forest community occurs on rich, well-drained loamy soils, mostly on glacial till plains or loess-capped sites south of the tension zone. The dominant tree species is sugar maple, but basswood, and near Lake Michigan, American beech may be co-dominant. Many other trees are found in these forests, including those of the walnut family, ironwood, red oak, red maple, white ash, and slippery elm. The understory is typically open, or sometimes brushy with species of gooseberry on sites with a history of grazing, and supports fine spring ephemeral displays. Characteristic herbs are spring-beauty, trout-lilies, trilliums, violets, bloodroot, blue cohosh, mayapple, and Virginia waterleaf.

Historically, southern mesic forests were quite common throughout southern Wisconsin. For example, forests dominated by sugar maple or beech occupied 41% of the Southern Lake Michigan Coastal, 25% of the Southeast Glacial Plains, and 18% of the Western Coulees and Ridges Ecological Landscapes (Finley 1976). Most of these forests were cleared for agriculture, as the soils are very fertile.

Southern Sedge Meadow

Widespread in southern Wisconsin, this open wetland community is most typically dominated by tussock sedge and Canada bluejoint grass. Common associates of relatively undisturbed sedge meadows are other sedges (e.g., *Carex diandra*, *C. sartwellii*), marsh bellflower, marsh wild-timothy, water horehound, panicled aster, swamp aster, blue flag, spotted Joe-Pye weed, marsh fern, and swamp milkweed. Reed canary grass may be dominant in grazed and/or ditched stands, sometimes to the exclusion of virtually all other species.

Sedge meadows are most common in glaciated landscapes, where they often border streams or drainage lakes. The southern sedge meadow community occurred with prairie, savanna, and hardwood forest communities, and many of them apparently burned periodically. In the absence of fire, shrubs and trees are able to readily encroach on the open wetlands; encroachment can be exacerbated when wetlands are drained. Many sedge meadows in southeastern Wisconsin are influenced by alkaline groundwater, and occur in complexes with emergent marsh, calcareous fen, wet prairie, wet-mesic prairie, and shrub-carr. Differentiating between these communities can be difficult, as they frequently intergrade.

Appendix D

Eastern Lake Winnebago Wildlife Areas Planning Group Species of Greatest Conservation Need

The following are vertebrate Species of Greatest Conservation Need (SGCN) associated with natural community types that are present on the Eastern Lake Winnebago Wildlife Areas Planning Group (ELWWA) in the Central Lake Michigan Coastal and Southeast Glacial Plains Ecological Landscape. Only SGCN with a high or moderate probability of occurring in the Central Lake Michigan Coastal and Southeast Glacial Plains Ecological Landscape are shown. Communities shown here are limited to those identified as “Major” or “Important” management opportunities in the Wisconsin Wildlife Action Plan (WDNR M006b). Letters indicate the degree to which each species is associated with a particular habitat type (S=significant association, M=moderate association, and L=low association). Animal-community combinations shown here that are assigned as either “S” or “M” are also Ecological Priorities, as defined by the Wisconsin Wildlife Action Plan (see dnr.wi.gov/org/land/er/WWAP/ for more information about these data). Shaded species have been documented for the ELWWA.

	Important						
	Emergent Marsh	Hardwood Swamp	Northern Wet-mesic Forest	Shrub Carr	Southern Dry-mesic Forest	Southern Sedge Meadow	Surrogate Grasslands
Species that are Significantly Associated with the Central Lake Michigan Coastal Landscape							
American Woodcock		M	L	S			L
Black Tern	S					L	
Black-billed Cuckoo		L		S			
Blue-winged Teal	S					M	M
Bobolink						M	S
Brown Thrasher							M
Cerulean Warbler					S		
Common Tern	M						
Dickcissel							S
Dunlin	M						
Eastern Meadowlark						M	S
Field Sparrow							M
Forster's Tern	S					L	
Four-toed Salamander	S	M	S	S		M	
Great Egret	S						
Hudsonian Godwit	S						
Least Flycatcher		M	L	L	L		
Lesser Scaup	L						
Northern Harrier	L			L		M	S

Northern Ribbon Snake				M			
Red-headed Woodpecker					M		
Short-billed Dowitcher	S						
Upland Sandpiper						L	S
Veery		S	L	S	M		
Vesper Sparrow							L
Whimbrel	M						
Willow Flycatcher				S		M	M
Wood Thrush		L	L		S		

Species that are Moderately Associated with the Central Lake Michigan Coastal Landscape

Acadian Flycatcher					S		
American Bittern	S			L		M	L
American Golden Plover	M					L	M
Blanding's Turtle	S			M	M	M	
Blue-winged Warbler				M	M		
Buff-breasted Sandpiper	M						M
Butler's Garter Snake	S			S		S	
Canada Warbler		S	S	L			
Canvasback	L						
Eastern Red Bat	M	M	M	M	M	M	
Golden-winged Warbler		M	L	S	L		
Grasshopper Sparrow							S
Henslow's Sparrow						L	S
Hoary Bat	M	M	M	M	L	M	
Hooded Warbler					S		
King Rail	S					M	
Loggerhead Shrike							S
Marbled Godwit	S						M
Northern Long-eared Bat	M	M	L	M	M	M	
Pickerel Frog	S		M	M		S	
Rusty Blackbird	M			M			
Short-eared Owl	L			M		M	S
Silver-haired Bat	M	M	M	M	L	M	
Snowy Egret	S						
Solitary Sandpiper	S			L		L	
Western Meadowlark							S
Whip-poor-will					S		
Wilson's Phalarope	S					L	
Wood Turtle		M	M	S		M	
Yellow-billed Cuckoo				M	M		
Yellow-crowned Night-Heron	M			M			

	Major						Important		
	Emergent Marsh	Impoundments/Reservoirs	Shrub Carr	Southern Dry-mesic Forest	Southern Sedge Meadow	Surrogate Grasslands	Northern Wet-mesic Forest	Southern Hardwood Swamp	Southern Mesic Forest
Species that are Significantly Associated with the Southeast Glacial Plains Landscape									
Acadian Flycatcher				S					S
American Bittern	S		L		M	L			
American Golden Plover	M	M			L	M			
American Woodcock			S			L	L	L	
Black Tern	S	M			L				
Black-billed Cuckoo			S					L	
Blanding's Turtle	S	S	M	M	M			M	M
Blue-winged Teal	S	M			M	M		L	
Blue-winged Warbler			M	M				L	M
Bobolink					M	S			
Brown Thrasher						M			
Buff-breasted Sandpiper	M					M			
Butler's Garter Snake	S		S		S				
Canvasback	L	M							
Cerulean Warbler				S					M
Common Tern	M	L							
Dickcissel						S			
Dunlin	M	M							
Eastern Massasauga Rattlesnake	S		S		S			M	
Eastern Meadowlark					M	S			
Field Sparrow						M			
Forster's Tern	S	M			L				
Four-toed Salamander	S		S		M		S	S	S
Franklin's Ground Squirrel						M			
Grasshopper Sparrow						S			
Greater Redhorse		M							
Henslow's Sparrow					L	S			
Hooded Warbler				S					S
Hudsonian Godwit	S	L							
King Rail	S				M				
Lake Sturgeon		S							
Least Flycatcher			L	L			L	L	L
Lesser Scaup	L	M							
Louisiana Waterthrush				S					S
Northern Harrier	L		L		M	S			
Northern Ribbon Snake			M						
Ornate Box Turtle				S					M
Ozark Minnow									

Pickerel Frog	S	S	M		S		M	M	M
Queen Snake	S	M	S		S				
Redfin Shiner		M							
Redhead	S								
Red-headed Woodpecker				M					
Red-necked Grebe	S								
Rusty Blackbird	M		M					S	
Short-billed Dowitcher	S	M							
Short-eared Owl	L		M		M	S			
Vesper Sparrow						L			
Western Meadowlark						S			
Whooping Crane	S				M				
Willow Flycatcher			S		M	M		L	
Wood Thrush				S			L	L	S
Yellow-billed Cuckoo			M	M				M	M
Species that are Moderately Associated with the Southeast Glacial Plains Landscape									
Bell's Vireo			M			M			
Black Buffalo		M							
Eastern Red Bat	M	L	M	M	M		M	M	M
Golden-winged Warbler			S	L			L	L	L
Hoary Bat	M	L	M	L	M		M	L	L
Loggerhead Shrike						S			
Marbled Godwit	S	L				M			
Mudpuppy		S							
Northern Bobwhite						S			
Northern Long-eared Bat	M	L	M	M	M		L	M	M
Prairie Vole						M			
Red-shouldered Hawk				M			L	L	M
Silver-haired Bat	M	L	M	L	M		M	L	L
Snowy Egret	S								
Solitary Sandpiper	S		L		L			L	
Upland Sandpiper					L	S			
Veery			S	M			L	L	M
Whimbrel	M	L							
Whip-poor-will				S					L
Wilson's Phalarope	S				L				
Woodland Vole				S					L
Yellow-bellied Racer				M					
Yellow-crowned Night-Heron	M		M					M	
Yellow-throated Warbler				M					

APPENDIX E

Primary Inventory Sites within the Eastern Lake Winnebago Wildlife Areas Planning Group¹

Two ecologically important sites were identified on the Eastern Lake Winnebago Wildlife Areas Planning Group (ELWWA). These “Primary Sites” were delineated because they generally encompass the best examples of 1) rare and representative natural communities, 2) documented occurrences of rare species populations, and/or 3) opportunities for ecological restoration or connections. These sites warrant high protection and/or restoration consideration during the development of the property master plan. This report is meant to be considered along with other information when identifying opportunities for various management designations during the master planning process.

Information provided in the summary paragraphs includes location information, a site map, a brief summary of the natural features present, the site’s ecological significance, and management considerations.

Primary Sites	page
ELWWA01. Collins Hardwood Swamp.....	58
ELWWA02. Dyke Road Flowage and Marsh	61
Species List	63

¹ A list of species referred to by common name is found at the end of this appendix.

ELWWA01. COLLINS HARDWOOD SWAMP

Location

Property:	Collins Marsh Wildlife Area
County:	Manitowoc
Landtype Association:	212Zc06. Collins Moraines
Approximate Size (acres):	942

Description of Site

This site is dominated by a large tract of good-quality southern hardwood swamp. The canopy is moderately dense in the northern and southern portions, but a more open canopy is present in the middle portion of the swamp. The canopy is dominated by large diameter silver maple (*Acer saccharinum*), green ash (*Fraxinus pennsylvanica*), and bur oak (*Quercus macrocarpa*) with red maple (*Acer rubrum*), black ash (*Fraxinus nigra*), and a small, logged, pocket of mature northern white-cedar (*Thuja occidentalis*). Shrubs and saplings are moderate to sparse and include canopy associates as well as common winterberry (*Ilex verticillata*), gray dogwood (*Cornus racemosa*), and speckled alder (*Alnus incana*). The herbaceous layer is dense and includes cinnamon (*Osmunda cinnamomea*), royal (*Osmunda regalis*), and sensitive ferns (*Onoclea sensibilis*), fowl manna grass (*Glyceria striata*), and sedges (*Carex stipata* and *C. intumescens*). There are dense patches of reed canary grass (*Phalaris arundinacea*) in some of the canopy gaps and throughout the forest. The hydrology of the site may be affected by a dam on Mud Creek. This site is pre-dominantly owned by Wisconsin Department of Natural Resources (WDNR) with some small areas on private lands.

Significance of Site

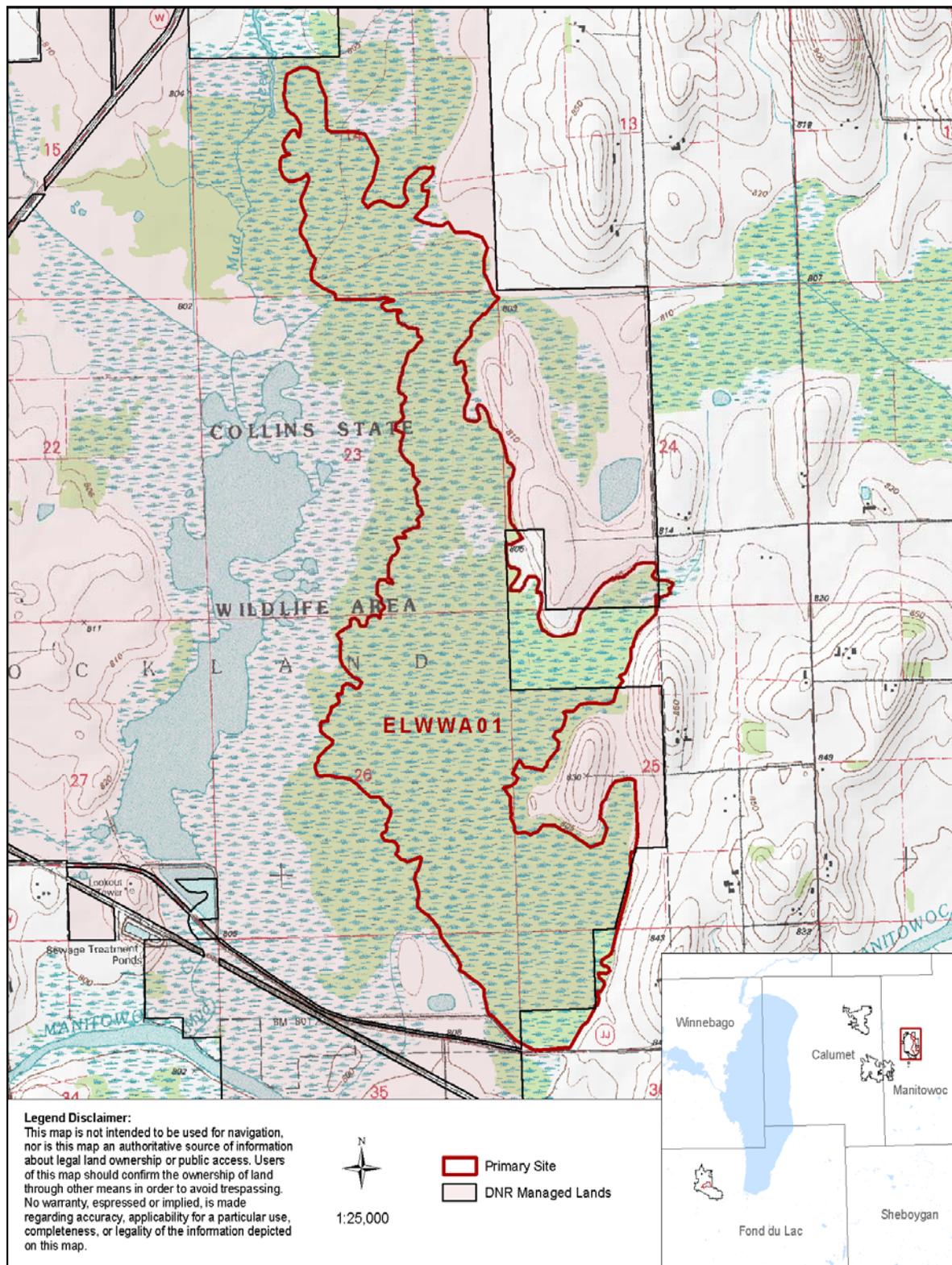
Intact or high-quality southern hardwood swamps are very rare, therefore maintaining and protecting these forests where opportunities exist should be considered (WDNR 2006b). This site constitutes an extensive, heavily forested hardwood swamp with mature canopy trees in a landscape largely dominated by agriculture with some areas of open wetlands. The site was assessed for rare plants and natural community features but little or no rare animal survey work was undertaken and is a priority for future surveys. Hardwood swamps can support numerous rare species; this site presents important habitat features that rare species could potentially utilize. In general, attributes of significance for rare species likely include large, mature forests with high canopy cover, abundant cavities, coarse woody debris, and other structural features, benefitting the majority of uncommon species associated with these forests. Of high importance, would be for breeding bird surveys to take place within the site. The site is part of a large Migratory Bird Concentration Site, it was noted for its importance to landbirds (>1,000) including numerous rare species.

Management Considerations

This site presents an opportunity to protect a good quality natural community feature that is uncommon in the state. Identifying and controlling invasive species is an important management consideration for this site with particular concern for controlling reed canary grass. Monitoring and management of emerald ash borer (EAB) infestations found at or near the site would be of high importance as green and black ash are important tree species within this ecosystem. Large-scale loss of ash in this area, whether through EAB-caused mortality or harvesting, could cause a cascade of negative impacts: Degradation of diverse, high-quality forests and loss of forest cover could further lead to diminishment of important habitat for

rare plants and animals (especially forest interior birds), elevated water tables, and infestation of disturbance-loving invasives such as reed canary grass and glossy buckthorn (*Rhamnus frangula*; WDNR 2010c).

ELWWA01. Collins Hardwood Swamp Primary Site at Collins Marsh Wildlife Area



ELWWA02. DYKE ROAD FLOWAGE AND MARSH

Location

Property:	Eldorado Wildlife Area
County:	Fond du Lac
Landtype Association:	222Ke16. Ladoga Till Plain
Approximate Size (acres):	1,548

Description of Site

This large site is primarily a cattail-dominated emergent marsh surrounding an impoundment of the West Branch Fond du Lac River occurring just north of Dyke Road within Eldorado Wildlife Area. The marsh is dominated by dense cattails (*Typha spp.*) with some river bulrush (*Bolboschoenus fluviatilis*), soft-stem bulrush (*Sparganium americanum*), arrow-head (*Sagittaria latifolia*), wild rice (*Zizania spp.*), bur-reed (*Sparganium spp.*), and reed canary grass along the edges. The surrounding area includes dense reed canary grass meadows with scattered groves of cottonwood (*Populus deltoides*), green ash, willow (*Salix spp.*), trembling aspen (*Populus tremuloides*), and bur oak. The upland edges are old fields with grass and shrubby areas. The primary site is almost exclusively owned by WDNR except for a small private inholding.

Significance of Site

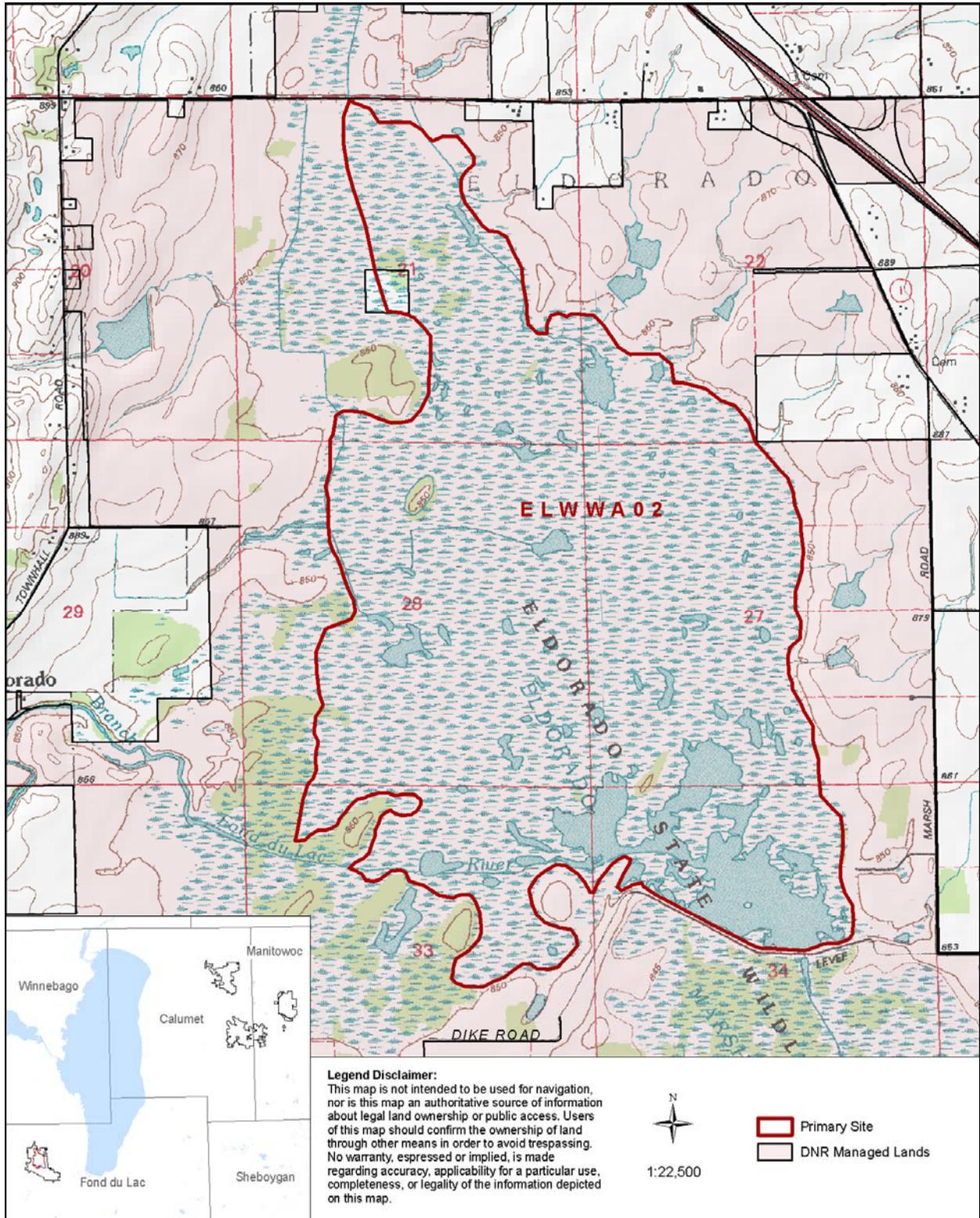
Bird survey data indicate that numerous rare birds are breeding and / or foraging at this site. Colonial waterbird, marshbird, and landbird species located include those that are state Endangered, Threatened, Special Concern, and of Greatest Conservation Need. The upland fields and ditches near the site contain a rare plant species of special concern.

Management Considerations

Sedimentation, eutrophication, and water pollution can cause detrimental changes to emergent marsh community composition, structure, and function (WDNR 2006b). In addition, ditching and dams can reduce hydrological fluctuations eventually leading to raised water levels and a loss of plant diversity. In its current state, the flowage and marsh produce some areas of emergent aquatic vegetation (bulrush, reeds, arrow-head) used by rare marshbird and colonial waterbirds for nesting and for foraging by waterfowl.

With continued invasive species control of reed canary grass and non-native cattails and restoring hydrology, there is potential to restore the vegetation of this marsh area to more historical marsh and meadow conditions. Good-quality sedge meadow communities are becoming rare in the state and provide habitat for uncommon marshbirds and grassland birds. The planning team could investigate management options at the site to weigh opportunities to revert the site back to its historical state versus continuing the current management regime. Both management regimes are likely to support different suites of rare species and important migratory bird habitats.

ELWWA02. Dyke Road Flowage and Marsh Primary Site at Eldorado Wildlife Area



SPECIES LIST

List of species referred to by common name in Appendix E.

Common Name	Scientific Name
Animals	
American Bittern	<i>Botaurus lentiginosus</i>
American White Pelican	<i>Pelecanus erythrorhynchos</i>
Black Tern	<i>Chlidonias niger</i>
Black-crowned Night-heron	<i>Nycticorax nycticorax</i>
Blue-winged Teal	<i>Anas discors</i>
Common Moorhen	<i>Gallinula chloropus</i>
King Rail	<i>Rallus elegans</i>
Red-necked Grebe	<i>Podiceps grisegena</i>
Veery	<i>Catharus fuscescens</i>
Willow Flycatcher	<i>Empidonax traillii</i>
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>
Yellow Rail	<i>Coturnicops noveboracensis</i>
Plants	
Arrow-head	<i>Sagittaria latifolia</i>
Black ash	<i>Fraxinus nigra</i>
Bur oak	<i>Quercus macrocarpa</i>
Bur-reed	<i>Sparganium spp.</i>
Cattails	<i>Typha spp.</i>
Cinnamon fern	<i>Osmunda cinnamomea</i>
Common fox sedge	<i>Carex stipata</i>
Common winterberry	<i>Ilex verticillata</i>
Fowl manna grass	<i>Glyceria striata</i>
Giant goldenrod	<i>Solidago gigantea</i>
Glossy buckthorn	<i>Rhamnus frangula</i>
Gray dogwood	<i>Cornus racemosa</i>
Greater bladder sedge	<i>Carex intumescens</i>
Green ash	<i>Fraxinus pennsylvanica</i>
Northern white-cedar	<i>Thuja occidentalis</i>
Plains cottonwood	<i>Populus deltoides</i>
Red maple	<i>Acer rubrum</i>
Reed canary grass	<i>Phalaris arundinacea</i>
River bulrush	<i>Bolboschoenus fluviatilis</i>
Royal fern	<i>Osmunda regalis</i>
Sensitive fern	<i>Onoclea sensibilis</i>
Silver maple	<i>Acer saccharinum</i>
Soft-stem bulrush	<i>Sparganium americanum</i>
Speckled alder	<i>Alnus incana</i>
Trembling aspen	<i>Populus tremuloides</i>
Wax-leaf meadow-rue	<i>Thalictrum revolutum</i>
Wild rice	<i>Zizania spp.</i>
Willows	<i>Salix spp.</i>

