



Rapid Ecological Assessment for Shaw Marsh and Horicon Marsh State Wildlife Areas

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

Properties included in this report are:

Horicon Marsh State Wildlife Area

Fourmile Island Rookery State Natural Area

Shaw Marsh State Wildlife Area

Wisconsin's Natural Heritage Inventory Program
Bureau of Endangered Resources
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- Left: Great-blue Herons, by Robert Queen
- Top-right: Horicon Marsh, by Ryan Hagerty, U.S. Fish & Wildlife Service
- Bottom-right: Shaw Marsh State Wildlife Area, by Amy Staffen

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Horicon and Shaw Marsh State Wildlife Areas At a Glance

Exceptional Characteristics of the Study Area

- **Globally Important Habitat for Birds.** Horicon Marsh State Wildlife Area contributes about 11,000 acres to the 32,000-acre greater Horicon Marsh (National Wildlife Refuge plus State Wildlife Area), representing the largest freshwater cat-tail marsh in the United States. The large emergent wetlands and associated open water areas of Horicon Marsh Wildlife Area, combined with seasonal mudflats, offer waterfowl, shorebirds, wading birds, and colonial waterbirds diverse habitats during the migratory seasons. The site also provides important breeding habitat for both common and rare or declining waterfowl, marsh birds, and colonial waterbirds. Horicon Marsh State Wildlife Area also provides important winter habitat for wandering Arctic birds.
- **Rare Birds.** Horicon Marsh (including the National Wildlife Refuge) hosts the largest breeding population of a rare duck east of the Mississippi River (USFWS 2007). A great variety of marsh bird species, including some that are rare or declining, nest within the emergent aquatic habitats of Horicon Marsh State Wildlife Area.
- **Bird Rookeries.** For almost 50 years, Fourmile Island harbored the largest colonial waterbird rookery in the state, hosting 800-1,000 nesting pairs. It was designated a State Natural Area in 1965 due to the site's importance as a rookery. Currently, only great blue herons are nesting there; nests have also been found on Cotton, Rudebush, and Koch Islands in the State Wildlife Area.

Site Specific Opportunities for Biodiversity Conservation

Two ecologically important sites, or "Primary Site," were identified at Horicon Marsh; none were identified at Shaw Marsh. "Primary Sites" are typically delineated because they 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.

- **Horicon Marsh State Wildlife Area.** Horicon Marsh harbors approximately 9,000 acres of wetlands (mostly Emergent and Submergent Marsh), more than 1,300 acres of open water/aquatic communities, and approximately 31 miles of river, creek, channel and ditch. A dam on the Rock River in the town of Horicon allows artificial regulation of the waters of Horicon Marsh State Wildlife Area. A number of ditches and dikes throughout the site create expanses of open water of various sizes and configurations. The site is seasonally flooded in some areas and permanently flooded in others.
- **Fourmile Island Rookery.** This island was designated a State Natural Area in 1965 due to the site's importance as a rookery. See above section on "Bird Rookeries" for further details.

Introduction

Purpose and Objectives

This report is intended to be used as a source of information for developing a new master plan for Shaw Marsh State Wildlife Area, Horicon Marsh State Wildlife Area, and Fourmile Island Rookery State Natural Area (Figure 1; hereafter referred to as “HSWA”). The federally-owned Horicon Marsh National Wildlife Refuge is not part of the study area for this report. The regional ecological context for HSWA is provided to assist in developing the Regional and Property Analysis that is part of the master plan.

The primary objectives of this project were to collect biological inventory information relevant to the development of a master plan for HSWA 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 HSWA 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. There will undoubtedly be gaps in our knowledge of the biota of this property, especially for certain taxa 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 website (*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 HSWA 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 and 2) taxa specific surveys.

The most recent taxa-specific field surveys for the study area were conducted during 2011. Surveys were limited in scope and focused on documenting high quality natural communities, breeding birds, and herptiles. The collective results from all of these surveys were used, along with other information, to identify ecologically important areas (Primary Sites) at HSWA.

Survey locations were identified or guided by 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 HSWA, key inventory considerations included the identification of high quality wetlands and the location of habitats that had the potential to support rare species. Private lands, including easements, surrounding HSWA were not surveyed.

Scientific names for all species mentioned in the text are included in a list on page 36.

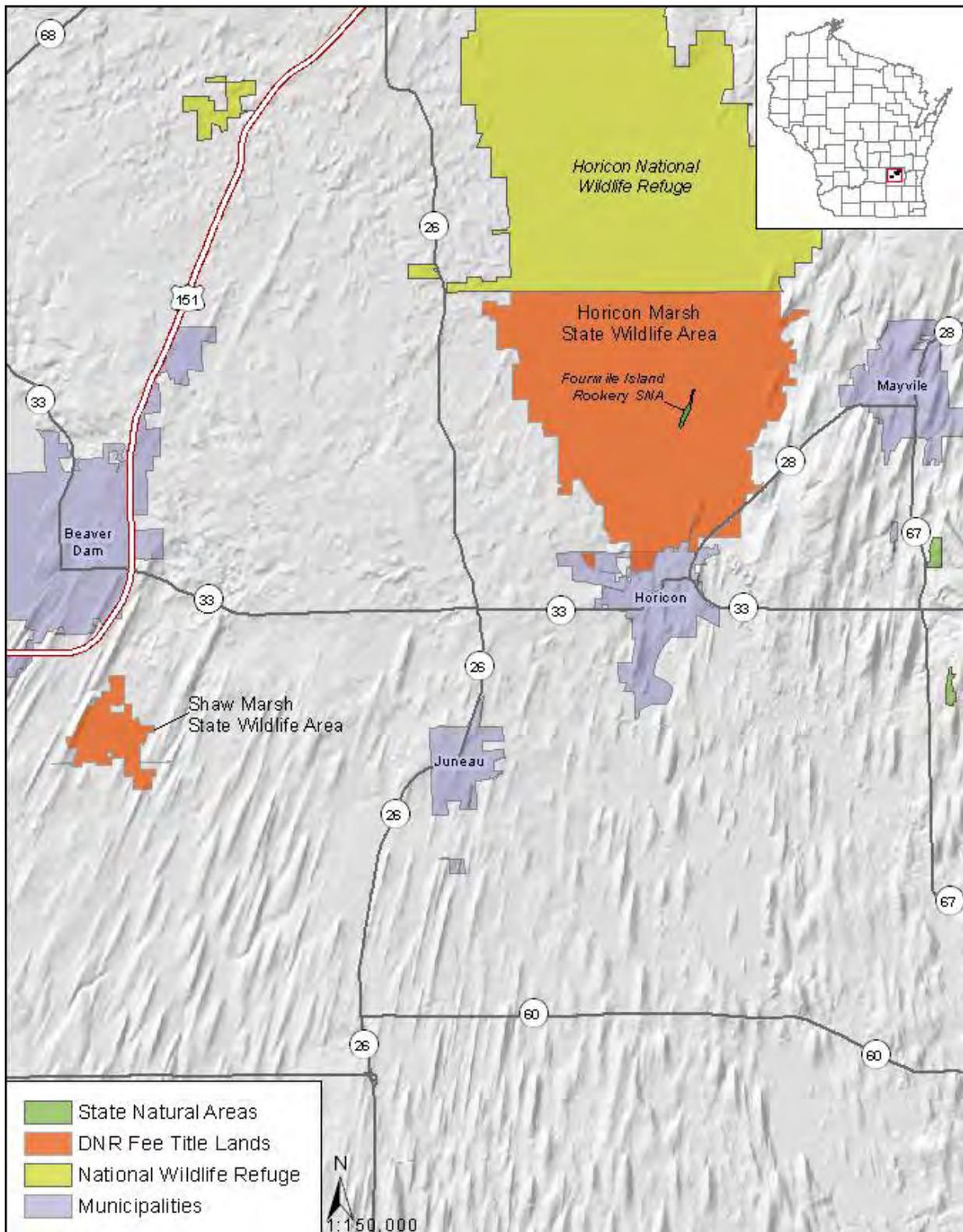


Figure 1. Location of Shaw Marsh State Wildlife Area, Horicon Marsh State Wildlife Area, and Fourmile Island Rookery SNA

Background on Past Efforts

Various large-scale research and planning efforts have identified Horicon Marsh as being ecologically significant. The following are examples of such projects and the significant features identified. Unless otherwise specified, these designations apply to the entire “Horicon Marsh,” which includes both the National Wildlife Refuge and the State Wildlife Area. No past efforts have identified Shaw Marsh as being ecologically significant.

Important Bird Area

Important Bird Areas (IBA; WDNR 2007) are critical sites for the conservation and management of Wisconsin’s birds. **Horicon Marsh IBA** harbors the largest freshwater cat-tail marsh in the United States. With 32,000 acres of cat-tail marsh, open water, brush, and hardwood forest, along with grassland, woodlots, and agriculture in the uplands, this IBA supports significant numbers of waterfowl & shorebirds during migration. Horicon Marsh IBA hosts the largest breeding population of a rare duck east of the Mississippi River. It also supports significant breeding populations of waterbirds, many of which are rare. Grassland habitat in the surrounding uplands supports some upland-nesting waterfowl such as mallard (*Anas platyrhynchos*) and blue-winged teal (*Anas discors*), as well as grassland birds like bobolink (*Dolichonyx oryzivorus*) and dickcissel (*Spiza americana*). Horicon Marsh was similarly recognized by the American Bird Conservancy as a “Globally Important Bird Area” in 1997, primarily due to the fact that over 50% of the Mississippi Valley Population of Canada Goose (*Branta canadensis interior*) uses Horicon Marsh as a fall migratory stopover (USFWS 2007).

Wisconsin Wildlife Action Plan: Conservation Opportunity Area

The Wisconsin Wildlife Action Plan (WAP; WDNR 2006a) recognized Horicon Marsh as a Conservation Opportunity Area (COA) (see Appendix B). Conservation Opportunity Areas are places in Wisconsin that contain ecological features, natural communities, or Species of Greatest Conservation Need (SGCN) habitat for which Wisconsin has a unique responsibility for protection when viewed from the global, continental, upper Midwest, or state perspective. Horicon Marsh COA is significant for its immense cat-tail marsh and impounded areas with the ability to manipulate water levels and upland grass for the benefit of waterfowl, shorebirds, grassland birds, marsh birds, colonial nesting birds, and Blanding’s turtle.

Legacy Place

The Land Legacy Report (WDNR 2006b) was designed to identify Wisconsin’s most important conservation and recreation needs for the next 50 years. Two related “Legacy Places” were identified:

- **Horicon Marsh** was identified as a Legacy Place, and was assigned the highest level of conservation significance, primarily for its importance as habitat for breeding and migratory birds.
- The **Upper Rock River** was identified as a Legacy Place for its potential to combine natural resource protection, high recreational value, and farmland protection. The Upper Rock River flows from Horicon Marsh south for 58 miles to Fort Atkinson.

Ecoregional Functional Site

The Nature Conservancy’s Prairie-Forest Border Ecoregion Conservation Plan (TNC 2001) recognized Horicon Marsh as an important “Functional Site” that provides habitat for rare birds and water filtration at a ‘large-patch’ scale.

Wetland Designation

Horicon Marsh is recognized as a Wisconsin Wetlands Association “Wetland Gem” (WWA 2010) as well as a Ramsar Convention “Wetland of International Importance.” The Convention on Wetlands of International Importance, or “Ramsar Convention,” is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

Special Management Designations

State Natural Areas (SNA) are places on the landscape that protect outstanding examples of native natural communities, significant geological formations, and archaeological sites. Designation confers a significant level of land protection through state statutes, administrative rules, and guidelines. **Fourmile Island Rookery** is a 15-acre State Natural Area that lies within Horicon Marsh State Wildlife Area. The SNA was designated in 1965, and contains one of the largest heron and egret rookeries in the Midwest.

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 its lands, supporting economic activities, protecting wildlife habitat, and providing recreational opportunities.

The Ice Age National Scientific Reserve

Horicon Marsh State Wildlife Area is a unit of the Ice Age Reserve system, which is an affiliated area of the National Park System. Horicon was selected for inclusion in the Ice Age Reserve because it is an outstanding example of an extinct post-glacial lake.

Regional Ecological Context

Southeast Glacial Plains Ecological Landscape

This section largely reproduced from Ecological Landscapes of Wisconsin Handbook (WDNR In Prep. a).

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.

Shaw Marsh and Horicon Marsh State Wildlife Areas are located in the Southeast Glacial Plains Ecological Landscape (WDNR In Prep. a) (Figure 2). This Ecological Landscape makes up the bulk of the non-coastal land area in southeast Wisconsin. Most of the area consists of glacial plains and moraines created during the Wisconsin Ice Age. The soils are lime-rich tills overlain in most areas by silt-loam loess. Most of the rare natural communities that remain are associated with large moraines or are in areas where the Niagara Escarpment occurs close to the surface.

Historically, upland vegetation in the Southeast Glacial Plains consisted of a mix of prairie, oak savanna, and maple-basswood forest. Wet-mesic Prairie, Southern Sedge Meadow, Emergent Marsh, and Calcareous Fen were found in the lowlands. Agricultural and urban land use practices have drastically changed the land cover of the Southeast Glacial Plains since Euro-American settlement: the dominant land cover type is agricultural cropland.

The Southeast Glacial Plains has the highest aquatic productivity of any Ecological Landscape in the state for plants, insects, invertebrates, and fish. A number of significant river systems course through this landscape, including the Rock, though most riparian zones have been degraded through forest clearing, urban development, and intensive agricultural practices. Numerous and various types of wetlands, including Horicon Marsh, provide important habitat for many rare plants and animals. Unfortunately, most of these wetlands have experienced ditching, grazing, and infestation by invasive plants. Watershed pollution in the Ecological Landscape is about average according to rankings by Wisconsin DNR, but groundwater pollution is worse than average compared to the rest of the state.



Figure 2. Ecological Landscapes of Wisconsin and the study area.

Regional Biodiversity Needs and Opportunities

Opportunities for sustaining natural communities in the Southeast Glacial Plains Ecological Landscape were developed in 2005 by the Ecosystem Management Planning Team (EMPT; not published until 2007) and later focused on wildlife Species of Greatest Conservation Need and their habitat in the Wisconsin Wildlife Action Plan (WDNR 2006a). The goal of sustaining natural communities is to manage for natural community types that 1) historically occurred in a given landscape and 2) have a high potential to maintain their 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. Based on the EMPT’s criteria, these are the most appropriate community types that could be considered for management activities within the Southeast Glacial Plains Ecological Landscape.

There are management opportunities for 38 natural communities in the Southeast Glacial Plains Ecological Landscape. Of these, 21 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 13 natural communities are considered “important” in the Southeast Glacial Plains Ecological Landscape. An “important” opportunity indicates that although the natural community does not occur extensively or commonly in the Ecological Landscape, one to several occurrences are present 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 Southeast Glacial Plains Ecological Landscape (EMPT 2007 and WDNR 2006a)

Bog Relict	Impoundments/Reservoirs	Southern Dry-mesic Forest
Calcareous Fen	Inland lakes	Southern Sedge Meadow
Dry Cliff	Mesic Prairie	Southern Tamarack Swamp (rich)
Dry Prairie	Oak Opening	Surrogate Grasslands
Dry-mesic Prairie	Oak Woodland	Warmwater rivers
Emergent Marsh	Shrub Carr	Warmwater streams
Floodplain Forest	Southern Dry Forest	Wet-mesic Prairie

Rare Species of the Southeast Glacial Plains Ecological Landscape

Numerous rare species are known from the 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.” Table 2 lists the

number of species known to occur in this landscape based on information stored in the NHI database as of 2012.

Table 2. Listing Status for rare species in the Southeast Glacial Plains Ecological Landscape as of 2012.

Source is the NHI database. Listing Status is based on the Working List published June 2011.

Listing Status	Taxa					Total Fauna	Total Plants	Total Listed
	Mammals	Birds	Herptiles	Fishes	Invertebrates			
State Endangered	0	9	7	5	11	32	10	42
State Threatened	1	9	3	6	5	24	27	51
State Special Concern	2	18	3	8	54	85	48	133
Federally Endangered	0	0	0	0	2	2	0	2
Federally Threatened	0	0	0	0	0	0	2	2
Federal Candidate	0	0	1	0	2	3	0	3

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 may be:

- 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 21 vertebrate SGCN significantly associated with the Southeast Glacial Plains Ecological Landscapes. 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

Horicon Marsh State Wildlife Area (11,145 acres), Fourmile Island Rookery State Natural Area (15 acres), and Shaw Marsh State Wildlife Area (924 acres) are in Dodge County. Areas based on Geographical Information System (GIS) acreage derived from ArcSDE/Oracle WDNR Managed Lands (DML) shapefile as of August 2011. See Figure 1 for a map of the study area.

Ecoregion

Land Type Associations (LTAs) of Wisconsin represent a further definition of the National Hierarchical Framework of Ecological Units (NHFEU). The NHFEU is a classification system that divides landscapes into ecologically significant regions at multiple scales. Ecological types are classified and units are mapped based on the associations of biotic and environmental factors which include climate, physiography, water, soils, air, hydrology, and potential natural communities. Figure 3 shows that the “Horicon Marsh” and “Beaver Dam Drumlins” are the most significant LTAs in the study area, although two others are also present within the periphery of Horicon Marsh State Wildlife Area.

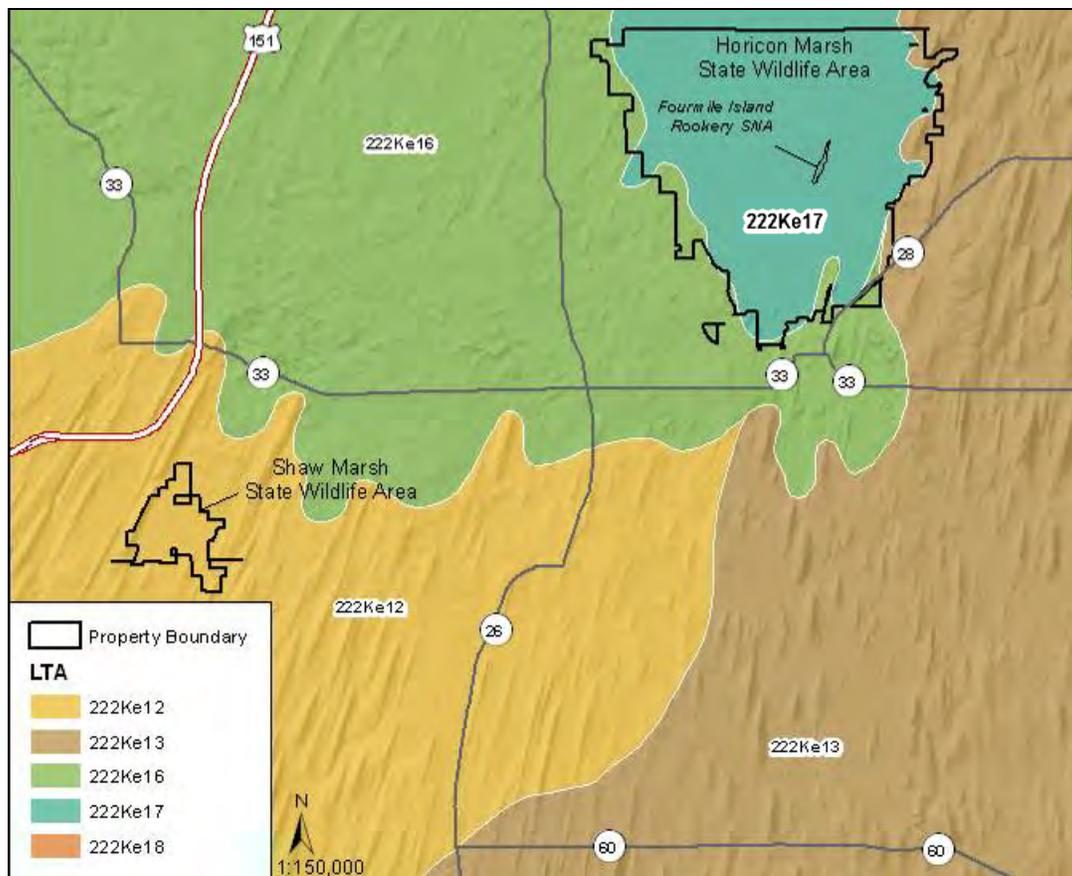


Figure 3. Landtype Associations for Shaw Marsh and Horicon Marsh State Wildlife Areas, and Fourmile Island Rookery State Natural Area.

Key to Figure 3

- **Horicon Marsh (222Ke17).** Characteristic landform pattern is nearly level marsh with organic deposits. Soils are predominantly very poorly drained muck. This LTA comprises approximately 95% of Horicon Marsh State Wildlife Area.
- **Ladoga Till Plain (222Ke16).** The characteristic landform pattern is undulating till plain. Soils are predominantly well-drained silt over calcareous loam till. This LTA comprises approximately 3% of Horicon Marsh State Wildlife Area.
- **Watertown Drumlins (222Ke13).** The characteristic landform pattern is undulating till plain with drumlins, lake plains, and muck areas common. Soils are predominantly moderately well-drained silt and loam over calcareous sandy loam till or silty, loamy and clayey lacustrine. This LTA comprises approximately 2% of Horicon Marsh State Wildlife Area.
- **Beaver Dam Drumlins (222Ke12).** Characteristic landform pattern is rolling till plain with drumlins and scattered muck deposits. Soils are predominantly well-drained silt over calcareous sandy loam till. This LTA comprises 100% of Shaw Marsh.

Physical Environment

Geology (Source: USDA 1980)

The landforms of Dodge County were created by the Green Bay lobe of the Wisconsin glaciation during the Pleistocene era. HSWA lie within this landscape of rolling till plains, lake basins, and one of the highest concentrations of drumlins in the world. The Glacial Lake Horicon basin was carved out by glacial meltwater that dammed up behind a moraine. As the Rock River eroded the morainal dam, the lake drained, allowing the deposition of silt, clay and peat, and setting the stage for the development of Horicon Marsh.

The bedrock underlying the study area and surroundings is primarily dolomite, which is covered mostly by loess, glacial drift, alluvium, residuum, and lacustrine deposits.

Soils (Source: USDA 1980)

The dominant soil at HSWA is Houghton muck. Pella silty clay loam also figures prominently at Shaw Marsh. Upland soils, including those of the drumlin islands within Horicon Marsh, are mostly silt loams.

Hydrology

Horicon Marsh State Wildlife Area and Fourmile Island Rookery State Natural Area lie within the Upper Rock River watershed. The Rock River forms at Horicon Marsh where its east and west branches conjoin. The east branch of the Rock River is the most significant source of water for Horicon Marsh. A dam on the Rock River in the town of Horicon allows artificial regulation of the waters of Horicon Marsh State Wildlife Area. Spring Brook originates from springs and flows into Burnett Ditch at the northwest corner of Horicon Marsh State Wildlife Area. A number of ditches and dikes throughout Horicon Marsh State Wildlife Area create expanses of open water of various sizes and configurations. Level ditches are flat-bottomed and closed at both ends so that they do not drain water, but instead hold it, while lift pumps flood areas behind the dikes, creating impoundments (Kernen et al. 1965). Horicon Marsh is therefore seasonally flooded in some areas and permanently flooded in others. The complex history of hydrological alterations at Horicon Marsh is discussed in further detail in the section below entitled “historical vegetation.”

Horicon Marsh is listed on the Impaired Waters List due to low dissolved oxygen levels and degraded habitat, resulting from elevated levels of total phosphorus and suspended sediment. The sources of these pollutants are from a mix of point and nonpoint sources (WDNR 2010a).

Shaw Marsh lies within the Beaver Dam River watershed. Water quality monitoring indicates that polluted runoff effects are severe on most streams and lakes within this watershed (WDNR 2002). Because of this, WDNR selected the watershed as a priority project in 1991. Shaw Brook and its tributary, Schultz Creek, flow through Shaw Marsh, both of which were partially channelized in the past. Drainage tiles and ditches were installed here, and several artificial ponds were excavated.

Water Quality Monitoring at Horicon Marsh

Copied directly from WDNR website (Search for "Upper Rock River" and "Watershed Detail;" then click on "Water Condition" tab.)

In October 1997, a project was initiated by a local group to monitor sediment and phosphorous loading to Horicon Marsh. A DNR lake planning grant was obtained, and the U.S. Geological Survey (USGS) was hired to do the project. A continuous flow monitoring station was installed on the West Branch Rock River, on Hwy 49, prior to the West Branch entering Horicon Marsh but after the South Branch and West Branch combine. Stations were also installed on the East Branch Rock River prior to it entering the state end of Horicon Marsh and in the City of Horicon as the Rock River leaves Horicon marsh. In addition to continuous flow monitoring, an automatic sampler was installed at each station. The samplers were to monitor base flow conditions and storm/runoff events. Data was collected for two years and then analyzed and published by USGS.

Since that 1997-99 project, the US Fish & Wildlife Service (USFWS) initiated a watershed project to get best management practices, buffer strips and other practices installed and implemented on lands within the watershed. In 2006, USFWS secured funding to hire a retired Natural Resources Conservation Service (NRCS) District Conservationist through the Fond du Lac County Land & Water Conservation Dept. The employee was able to successfully work with the area landowners to identify critical source areas, improve relationships with farmers, increase awareness of available programs and get practices implemented. Additional funding was obtained to continue the work through 2009 and is ongoing at this time.¹

Since initiation of the project, 726 tracts of land have been evaluated, which included contacts with 316 individuals. More than 16 miles of buffers have been installed and more than 47, 200 acres now have a conservation or nutrient management plan in place.

In addition to the watershed work, Administrative Code NR 217 was implemented which requires point source dischargers meet a 1 mg/l phosphorous discharge limit. This resulted in large decreases of phosphorous to the West and South branches of the Rock River.

In 2009, USFWS received a challenge cost share fund for another two-year monitoring project. Other partners for this project included USGS, DNR, Rock River Coalition, and Friends of the Horicon Marsh National Wildlife Refuge and the City of Horicon. A DNR river protection grant was obtained along with matching funds from USGS. The monitoring project began in October 2009 as a follow up to the monitoring project in 1997. The current monitoring is being conducted to assess the effectiveness of the point source reductions as well as the previous watershed work. Preliminary data suggests that the phosphorous reductions to the West and South branches of the Rock River have been substantial with base flow concentrations being reduced tenfold.

¹Outdated information. Additional funding from Ducks Unlimited has been obtained to continue work on this effort through 2012.

Vegetation

Historical Vegetation

There is value in determining the nature of a site's vegetation before European settlement as well as its historical alterations and uses. The purpose of examining historical conditions is to identify ecosystem factors that formerly sustained species and communities that are now altered in number, size, or extent, or which have been changed functionally (for example, by constructing dams, or suppressing fires). Maintaining or restoring some lands to more closely resemble historic systems and including some structural or compositional components of the historic landscape within actively managed lands can help conserve important elements of biological diversity (WDNR In Prep. a).

The early vegetation of Wisconsin was mapped by Robert Finley and published in 1976 (Fig. 4; Finley, 1976), and was based on notes and maps from the original Public Land Surveys. Finley's map indicates that both Shaw and Horicon Marshes were dominated by "Marsh and sedge meadow, wet prairie, lowland shrubs," with smaller amounts of oak opening and forest around the property edges. The surveyor notes for Dodge County were also summarized in 1957 by Neuenschwander. Other sources provide more detailed information, and are described below.

Shaw Marsh. In 1835, the public land surveyor at Shaw Marsh described the area as "marsh," and noted the vegetation as "cattail (*Typha* sp), flagg (*Iris* sp), cane (*Phragmites* sp?), prairie, and grass" (Wisconsin Board of Commissioners of Public Lands 1835). The Land Economic Inventory of 1939 (Bordner 1939) labeled Shaw Marsh as "Grass Marsh" with small pockets of "tag alder (*Alnus* sp), willow (*Salix* sp), dogwood (*Cornus* sp), etc." Similarly, the 1955 wetland inventory conducted by the Wisconsin Conservation Department (WCD 1961) described Shaw Marsh as a "fresh meadow" with a small pocket of "shrub swamp." The two more recent survey protocols utilized descriptors for deep water cat-tail marshes, but these were not applied here. This fact, combined with previous mention of prairie, grass, and meadow, indicate that the area was probably historically dominated by Wet-mesic Prairie and Southern Sedge Meadow with pockets of Shrub-carr and Emergent Marsh. Surrounding uplands most likely supported Dry-mesic Prairie and Oak Opening/Woodland, given that the early surveyor described them as "prairie," "dry prairie" and "scattered timber" of white oak (*Quercus alba*), black oak (*Q. velutina*) and burr oak (*Q. macrocarpa*) as well as hickory (*Carya* sp). Section corner trees ranged in size from 16-24" DBH (Diameter at Breast Height; black oaks) and from 8-11" DBH (burr oaks). In addition, two small woodlots were identified in the 1939 Bordner Survey: a 10-acre oak-hickory stand in the northwest part of the site, and an eight-acre swamp hardwoods stand in the south central part of the site.

Approximately 235 acres at the periphery of Shaw Marsh were plowed in the past. Shaw Brook and Schultz Brook were channelized, and drainage tiles and ditches were installed in a number of places. In 1939, Blackbird Lane is shown as spanning the entire north-south stretch of the marsh all the way to Parker Road as an unimproved dirt road; remains of this road persist today as an elevated berm.

Horicon Marsh. Public Land Surveys for the area of Horicon Marsh State Wildlife Area were conducted between 1836 and 1837 (Wisconsin Board of Commissioners of Public Lands 1836-37). Surveyors clearly described the areas as "deep marsh," described challenges in setting permanent corner section posts in the absence of trees and with saturated muck soils, and noted some of the species (cattail and flagg [iris]). They also described the surrounding uplands as prairie, with "grass and weeds," along with scattered burr, black and white oaks. Corner trees (all burr oaks) ranged in size from 6" DBH to 20" DBH.

In 1846, early European settlers built a dam on the Rock River at Horicon to power a sawmill, grist mill and iron works (*Horicon Marsh Human History*). This resulted in an impoundment covering the marsh

with water nine feet above current levels. In 1869, the dam was removed by order of the State Supreme Court, which ruled in favor of landowners whose land was flooded and thus unusable. In the years that followed, the marsh regained its previous status as a haven for wildlife. From the 1870's to the early 1900's, unregulated hunting devastated the duck populations on the marsh, rendering the landscape as 'useless' in the eyes of many landowners and policy makers. From 1910 to 1914, attempts were made, therefore, to drain the marsh and convert it into farmland. These attempts failed as exposed peat soils caught fire, thus cropland conversion attempts were eventually abandoned. In 1927, the state legislature passed the Horicon Marsh Wildlife Refuge Bill, providing for the construction of a dam to raise the water to normal levels and for the acquisition of the land by the government. This also provided the foundation for establishing the State Wildlife Area. Initiatives to restore the site's wildlife habitat began shortly thereafter, and continue to this day.

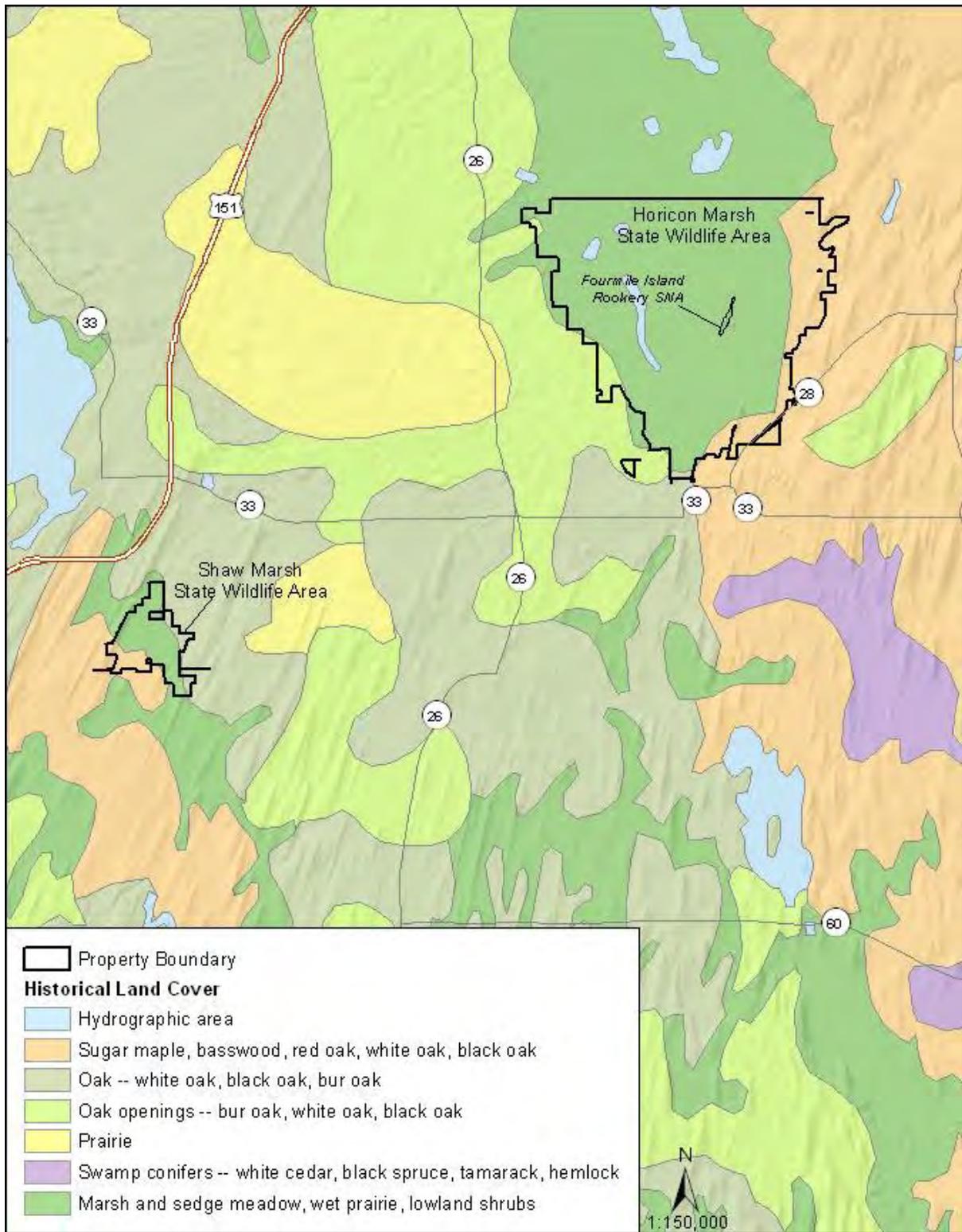


Figure 4. Original Vegetation of Shaw Marsh and Horicon Marsh State Wildlife Areas, and Fourmile Island Rookery State Natural Area. Data from Finley (1976).

Current Vegetation

As shown in Figure 5, HSWA are embedded in a largely agricultural landscape with small towns and low-density development in the vicinity. At both properties, wetlands occupy the largest core areas, while uplands represent a minor subset of the total acreages. Uplands of both Wildlife Areas consist mostly of small woodlots and prairie plantings at the periphery, and earthen dikes and wooded drumlin islands within the wetland core of the two complexes.

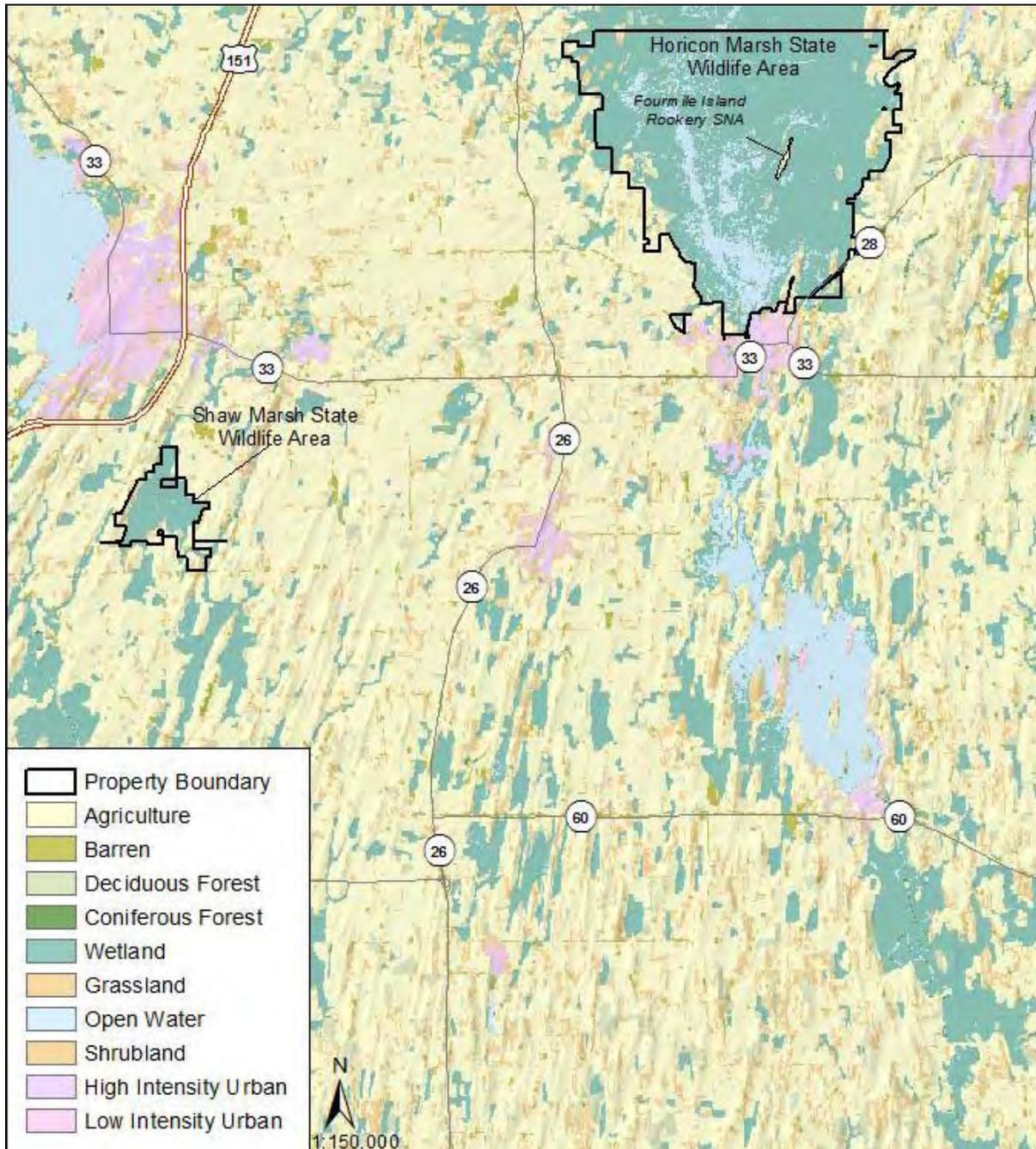


Figure 5. Landcover for Shaw Marsh and Horicon Marsh State Wildlife Areas and Fourmile Island Rookery State Natural Area from the Wisconsin DNR. Wisland GIS coverage (WDNR 1993).

Horicon Marsh harbors approximately 9,000 acres of wetlands, more than 1,300 acres of open water/aquatic communities, and approximately 31 miles of river, creek, channel and ditch (estimates using ArcMap 10.0 and 2010 NAIP aerial photo). The dominant cover types of Horicon Marsh are Emergent Marsh and Submergent Marsh.

Shaw Marsh has approximately 900 acres of wetlands, along with approximately four miles of channels, ditches and creek. The dominant cover types at Shaw Marsh are Emergent Marsh and wetlands that resemble Southern Sedge Meadow. Major cover types are described in detail below.

Emergent Marsh

At both Horicon Marsh and Shaw Marsh, the dominant Emergent Marsh species are cat-tail (*Typha X glauca*, *T. latifolia* and *T. angustifolia*), arrowhead (*Sagittaria* spp.), bur-reed (*Sparganium eurycarpum*), bulrush (*Scirpus* spp), common reed (*Phragmites australis*)¹, and reed canary grass (*Phalaris arundinacea*). At 32,000 acres, Horicon Marsh in its entirety (National Wildlife Refuge plus State Wildlife Area) represents the largest freshwater cat-tail marsh in the United States.

Shrub-carr

At Horicon Marsh State Wildlife Area, river margins often have bands of Shrub-carr of varying widths that grade into cat-tail marsh; this is more pronounced in peripheral areas than in the marsh interior. Scattered dogwood and willow clones have also gained purchase within mostly open marsh areas, providing key habitat for shrubland birds such as the willow flycatcher. Narrow fringes of large cottonwoods (*Populus deltoides*) and willows can often be seen along the rivers' margins as well. A small area of Shrub-carr occurs at Shaw Marsh along the west-central edge of the marsh, and is typified by willows, red-osier dogwood (*Cornus stolonifera*) and silky dogwood (*C. amomum*) with an understory of reed canary grass.

Reed canary grass-dominated wetlands

Reed canary grass-dominated wetlands are the dominant community type at Shaw Marsh, and occupy about one-fifth of the area at Horicon Marsh. These wetlands were most likely former Southern Sedge Meadow given their position in the landscape and their hummocky nature (discerned under-foot during surveys). A small number of forb generalists may be found occasionally in these wetlands, and include sawtooth sunflower (*Helianthus grosseserratus*), joe-pye weed (*Eupatorium maculatum*), giant goldenrod (*Solidago gigantea*), redstem aster (*Aster puniceus*), New England aster (*Aster novae-angliae*), and tall meadowrue (*Thalictrum dasycarpum*). These wetlands fit well the definition of 'Wet Meadow' as described by Eggers and Reed (1997), who explain that this wetland type is created following intensive disturbance such as drainage, siltation, cultivation or pasturing. Determining the potential of these wetlands in terms of native community restoration would require more intensive investigation that could involve soil coring, hydrological evaluation, prescribed burning/herbicide application (to suppress reed canary grass and release native vegetation), or other assessments, all of which go beyond the scope of this study.

There are occasional patches and zones at both Horicon and Shaw Marsh where native species that are typical of Southern Sedge Meadow have not completely succumbed to reed canary grass (Fig. 7). These native species include Canada bluejoint grass (*Calamagrostis canadensis*), Canada goldenrod (*Solidago canadensis*), spotted joe-pye-weed, and swamp milkweed (*Asclepias incarnata*), Angelica (*Angelica atropurpurea*), prairie cordgrass (*Spartina pectinata*), common water-hemlock (*Cicuta maculata*), and boneset (*Eupatorium perfoliatum*).

¹ In the State Wildlife Area, this is mostly the native genotype of common reed (Brenda Kelly, personal communication).



Figure 6. Canada bluejoint grass at Shaw Marsh. Photo by Amy Staffen.

Submergent Marsh

Submergent Marsh macrophytes occur in the open water areas of Horicon Marsh, typically in deeper water than aquatic emergents, but sometimes their boundaries overlap. Dominant species include various species of pondweeds (*Potamogeton* spp.), duckweeds (*Lemna* spp.), and milfoils (*Myriophyllum* spp.). Wild rice (*Zizania* sp.) also persists at Horicon Marsh, and shows a significant resurgence during draw-downs and in areas where cat-tails underwent herbicide treatment (Christopher Cole, personal communication).

Wet-mesic Prairie

The reed canary grass-dominated wetlands of Shaw Marsh are occasionally punctuated by small areas with native species that are typical of Wet-mesic Prairie, presumably in areas where the soils are less saturated. Some of these typical species include New England aster, stiff cowbane (*Oxypolis rigidior*), and golden Alexander (*Zizia aurea*). Another typical Wet-mesic Prairie species, prairie dock (*Silphium terebinthinaceum*), grows along the south side of Parker Road, including in the private inholding on this road that is being mowed for marsh hay.

Additional Cover Types

Little plant community data was collected for areas with the following cover types, but they should not be overlooked for their provision of important cover, nesting, and foraging areas for numerous wildlife species, or for future restoration opportunities.

Woodlots. At both properties, wooded uplands occur at the periphery of the core wetland areas and on drumlin islands. (There are 36 wooded drumlin islands within Horicon Marsh, the largest of which is

Fourmile Island, at 15 acres.) These wooded uplands are typically small and low-diversity, with dense brushy undergrowth and ruderal or invasive ground flora. Occasional open-grown burr and white oaks are found being engulfed by other trees and shrubs. Cottonwood and aspen (*Populus* spp.) are particularly common on the drumlins at both properties. At Shaw Marsh, woodlots can be found with very large black and burr oaks (some up to 36in DBH), and sizeable white oaks (14-24in DBH), shagbark hickory (*Carya ovata*, 6-12in DBH), and swamp white oaks (along Shaw Brook in middle of property), but their ground layers are devastated by heavy infestations of garlic mustard (*Alliaria petiolata*), common buckthorn (*Rhamnus cathartica*), common prickly-ash (*Zanthoxylum americanum*) and other aggressive or invasive species.

Flowages / Impoundments. HSWA has 11 impoundments ranging in size from 10-350 acres (Main Pool, Burnett, Chaya, Mieske, Goose Pond, I1-4, Red Head, and Greenhead) and many miles of ditches that are relicts of historical attempts to drain the marsh for agriculture (see "Hydrology" section). WDNR wildlife managers now utilize the dikes, along with water control structures, pump houses, and portable pumps to manipulate water levels and vegetation at various times of year to provide and enhance wildlife habitat, particularly for waterfowl and migratory birds. In the northwestern part of the site, Chaya Marsh underwent an extensive habitat enhancement project that was completed in 2007, affecting 410 acres. Nearly 12,000 feet of levee and five new water control structures were installed here, allowing WDNR staff to manipulate water levels to control invasive cat-tails and to promote the growth of beneficial plants. In the southeastern part of the site, the 200-acre Bacchuber Flowage provides a mix of open water, mud flats and wetland habitat for birds and other wildlife.

Surrogate grasslands. Old fields (dominated by exotic cool-season grasses such as smooth brome [*Bromus inermis*]) and prairie plantings can provide important habitat for grassland birds and provide a buffer for adjacent wetlands from deleterious agricultural runoff. Surrogate grassland occupies approximately 500 acres at Horicon Marsh, as compared to approximately 200 acres at Shaw Marsh.

Cropland. Approximately 20 acres at Shaw Marsh are share-cropped (marsh hay mowing), as compared to five acres at Horicon Marsh State Wildlife Area.

Rare Species of HSWA

Rare species and high-quality examples of native communities have been documented in the three townships within which HSWA is located (T12N R15E, T12N R16E, T11N R14E). Table 4 shows the rare species and high-quality natural communities currently known in those three townships. *Note: Many of the species, natural communities, and natural features included on Wisconsin's NHI Working List are vulnerable to collection and disturbance. Accordingly, the locations of elements on the NHI Working list are generalized to township level. Since HSWA occupies just parts of these three townships, species in Table 4 do not necessarily occur on HSWA.*

Table 3. Documented rare species and high-quality natural communities of the three townships (T12N R15E, T12N R16E, T11N R14E) within which Shaw Marsh Wildlife Area and Horicon Marsh State Wildlife Areas are located.

For an explanation of state and global ranks, as well as state status, see Appendix C. State status, tracking status, and ranks are based on the working list published June 1, 2011. Species of Greatest Conservation Need as defined in Wisconsin's Wildlife Action Plan are listed in the "SGCN" column. In the "Tracked by NHI" column, a "Y" signifies species that are tracked in the NHI database, while a "W" signifies species that 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.

Scientific Name	Common Name	Last Obs	State Status	Federal Status	SGCN	Tracked by NHI
Birds						
American Bittern	<i>Botaurus lentiginosus</i>	2011	SC/M		Y	Y
American White Pelican	<i>Pelecanus erythrorhynchos</i>	2005	SC/M			Y
Black Tern	<i>Chlidonias niger</i>	2011	SC/M		Y	Y
Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>	1989	SC/M			Y
Blue-winged Teal	<i>Anas discors</i>	2011	SCM		Y	W
Brown Thrasher	<i>Toxostoma rufum</i>	2000	SC/M		Y	W
Common Moorhen	<i>Gallinula chloropus</i>	2011	SC/M			W
Common Nighthawk	<i>Chordeiles minor</i>	2011*	SC/M			Y
Forster's Tern	<i>Sterna forsteri</i>	2009	END		Y	Y
Great Blue Heron	<i>Ardea herodias</i>	2010	SC/M			W
Great Egret	<i>Ardea alba</i>	1996	THR		Y	Y
King Rail	<i>Rallus elegans</i>	2011	SC/M		Y	Y
Least Bittern	<i>Ixobrychus exilis</i>	2009	SC/M			Y
Northern Harrier	<i>Circus cyaneus</i>	2000*	SC/M		Y	W
Redhead	<i>Aythya americana</i>	2011	SC/M		Y	Y
Ruddy Duck	<i>Oxyura jamaicensis</i>	2003	SC/M			W
Whooping Crane	<i>Grus americana</i>	2011*	SC/FL	NEP	Y	W
Willow Flycatcher	<i>Empidonax traillii</i>	2011	SC/M		Y	W
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>	2000*	SC/M			Y
Bird Rookery	<i>Bird Rookery</i>	2010	SC			

*Observation does not meet standards for inclusion in NHI database.

Scientific Name	Common Name	Last Obs	State Status	Federal Status	SGC N	Tracked by NHI
Mammals						
Big brown bat	<i>Eptesicus fuscus</i>	2005*	END		Y	Y
Eastern pipistrelle	<i>Perimyotis subflavus</i>	2005*	THR			Y
Eastern red bat	<i>Lasiurus borealis</i>	2005	SC/N			
Franklin's Ground Squirrel	<i>Spermophilus franklinii</i>	1916	SC/N			
Hoary bat	<i>Lasiurus cinereus</i>	2005	SC/N			
Little brown bat	<i>Myotis lucifugus</i>	2005*	THR			Y
Northern long-eared bat	<i>Myotis septentrionalis</i>	2005*	THR		Y	Y
Prairie Vole	<i>Microtus ochrogaster</i>	1896	SC/N			
Silver-haired bat	<i>Lasionycteris noctivagans</i>	2005	SC/N			
Fish						
American Eel	<i>Anguilla rostrata</i>	1900	SC/N		Y	Y
Pugnose Minnow	<i>Opsopoeodus emiliae</i>	1971	SC/N			Y
Redfin Shiner	<i>Lythrurus umbratilis</i>	1927	THR		Y	Y
Amphibians						
Northern Cricket Frog	<i>Acris crepitans</i>	1983	END		Y	Y
Plants						
Slim-stem Small Reed Grass	<i>Calamagrostis stricta</i>	1931	SC			Y
Swamp Bedstraw	<i>Galium brevipes</i>	1960	SC			Y
Honey Vertigo	<i>Vertigo tridentata</i>	1997	SC/N			Y
Natural Communities						
Southern Dry-mesic Forest	<i>Southern dry-mesic forest</i>	1978	NA			Y
Southern Mesic Forest	<i>Southern mesic forest</i>	1988	NA			Y
Wet-mesic Prairie	<i>Wet-mesic prairie</i>	1978	NA			Y

Management Considerations and Opportunities for Biodiversity Conservation

Habitat for Migratory, Breeding, and Wintering Birds

The large open wetland and aquatic habitats at Horicon Marsh State Wildlife Area, combined with seasonal mudflats, wooded islands, grasslands, and shrublands, offer important resources for numerous birds throughout the entire year. Shaw Marsh also provides bird habitat in its large, open wetlands with smaller areas of shrubs and surrogate grassland. Excellent diversity and high species richness from several bird groups accumulate at Horicon Marsh during migration due to the provision of extensive food, water, and shelter. Both properties provide habitat to support over-wintering birds that typically breed well north of Wisconsin. Finally, Horicon Marsh supports significant breeding populations of both common and uncommon marsh birds, colonial water birds, and waterfowl; this is true to a lesser degree at Shaw, where much smaller numbers of common marsh birds and waterfowl breed.

When considering the value and potential of Horicon Marsh for bird conservation, the sum is greater than the two parts (State Wildlife Area and National Wildlife Refuge). Initiatives taken to maintain and enhance breeding bird habitat at Horicon Marsh State Wildlife Area will be most effective when considered under consultation with National Wildlife Refuge staff. The two areas can offer different yet complementary types of habitat to meet the diverse life history needs of many bird species.

Migratory Bird Habitat

The large emergent wetlands and associated open water areas of Horicon Marsh State Wildlife Area, combined with seasonal mudflats, offer migratory birds such as waterfowl, shorebirds, and colonial waterbirds diverse habitats during the migratory seasons. At 32,000 acres, Horicon Marsh in its entirety (National Wildlife Refuge plus State Wildlife Area, or “Greater Horicon Marsh”) represents the largest freshwater cat-tail marsh (*i.e.*, emergent aquatic habitat) in the United States. Greater Horicon Marsh was recognized by the American Bird Conservancy as a “Globally Important Bird Area” in 1997, primarily due to the fact that over 50% of the Mississippi Valley Population of Canada Goose uses Horicon Marsh as a fall migratory stopover, and 2% of the flyway population of mallards use Greater Horicon Marsh as a fall migratory stopover (USFWS 2007); designation as an Important Bird Area logically followed (IBA; WDNR 2007). Shorebirds such as greater and lesser yellowlegs (*Tringa melanoleuca* and *T. flavipes*), semipalmated sandpiper (*Calidris pusilla*), least sandpiper (*C. minutilla*) and pectoral sandpiper (*Calidris melanotos*) also rely on Horicon Marsh State Wildlife Area as an important migratory stopover (Fig. 7); water level draw-downs are timed here, in part, to coincide with their migration, and are designed to provide exposed mudflats and shallow water. These habitats provide a variety of food sources that help sustain avian migrants during their journeys: emergent aquatic plants such as cat-tails, smartweeds (*Polygonum* spp.), and arrowheads; open water areas teaming with amphibians, fish, and aquatic invertebrates; and mudflats with abundant invertebrates and insect larvae. Since restoration efforts began at Necedah National Wildlife Refuge in 2002, the federally endangered whooping crane (*Grus americana*) has also used the wetlands and nearby uplands of Horicon Marsh (including the State Wildlife Area) for roosting and foraging during both spring and fall migrations (*Whooping Crane Eastern Partnership Database*).



Figure 7. Horicon Marsh provides migratory stopover habitat for shorebirds such as the greater yellow legs.
Photo by U.S. Fish & Wildlife Service.

Wind turbines may cause mortality of birds that utilize Horicon Marsh during migration. The Forward Energy Center consists of 86 1.5-megawatt wind turbines that lie approximately five kilometers east of Horicon Marsh. From July 15–November 15, 2008 and July 15–October 15, 2009, 29 of the 86 wind turbines were searched for dead birds and bats (Grotsky and Drake, 2011). A total of 20 bird fatalities were recorded during mortality searches at the Forward Wind Project. Based on the modified Huso estimator, bird mortality rates were 5.6 birds/turbine/spring and fall combined during the first year (90% ci: 2.34 to 9.82), and 0.93 birds/turbine/spring and fall combined during the second year (90% ci: 0 to 2.25). Based on the Jain estimator, bird mortality rates were 5.14 birds/turbine/spring and fall combined for the first year of study (90% ci: 2.75 to 8.37), and 1.00 birds/turbine/spring and fall combined for the second year of study (90% ci: 0 to 2.32). These numbers have been adjusted for scavenger removal rates and searcher efficiency. For unknown reasons, 12 of the 20 total bird fatalities were found during spring of 2009. A concurrent two-year raptor study at the same site found that raptor abundance following wind turbine construction was reduced by 47% compared to pre-construction levels, and that flight behavior varied by raptor species, but most individuals remained at a distance of at least 100 meters from the turbines and above the height of the rotor zone (Garvin et al., 2011). This decline in raptor abundance post-construction together with other lines of evidence suggests some displacement from the wind project area. Because bird mortality tends to be less than that of bats at wind farms (see "Bat Conservation"), questions about study design such as whether injured birds may die outside the search area remain unknown at this site.

Breeding Bird Habitat

Horicon Marsh State Wildlife Area provides important breeding habitat for both common and rare or declining marsh birds, waterfowl, colonial waterbirds and, to a lesser extent, grassland and shrubland birds. Numerous rare marsh birds nest within the emergent aquatic habitats of Horicon Marsh State Wildlife Area. Greater Horicon Marsh hosts the largest breeding population of a rare duck east of the Mississippi River (USFWS 2007). Other waterfowl such as blue-winged teal (Special Concern) favor grassy uplands or meadows in proximity to aquatic foraging areas for nest sites, all of which are available at Horicon Marsh State Wildlife Area. (The area of grassland habitat is much greater at Horicon Marsh Wildlife Refuge to the north.)

Although upland grasslands within Horicon Marsh's DNR property boundary are too small and fragmented to provide significant habitat for grassland birds, the open wetland expanses here are utilized by a few grassland bird species for breeding, most notably the area-sensitive northern harrier (Bill Volkert, personal communication). There is some concern that the currently small area of upland grasslands at Horicon Marsh State Wildlife Area creates a population sink for the blue-winged teal (Ron Gatti, personal communication). The Master Plan Team may consider, therefore, expanding the property boundary of Horicon Marsh State Wildlife Area to allow expansion of upland grassland habitat to benefit both upland nesting waterfowl and area-sensitive grassland birds. Scattered brushy thickets within an open grass- or sedge-dominated landscape at Horicon Marsh are also known to support declining bird species, including the willow flycatcher.

For almost 50 years, Fourmile Island harbored the largest colonial waterbird rookery in the state, hosting 800-1,000 nesting pairs birds (Volkert, 1992). It was designated a State Natural Area in 1965 due to the site's importance as a rookery. Due to various natural causes, the trees that supported the rookery declined during the 1990's, resulting in a catastrophic decline in nesting birds there. Through trial and error, property managers were able to create surrogate habitat for the colonial nesters in the form of artificial nesting platforms (Fig. 9; WDNR 2009b), though currently only great blue herons are utilizing the structures. In 2011, 61 nests were observed here, 48 of which were active; 84 fledglings were counted during surveys (Chris Cole, personal communication). Great blue herons have also initiated nest building



Figure 8. DNR crews replace poles for nesting structures. Photo by Brenda Kelly.

on Rudebush and Koch Islands in Horicon Marsh State Wildlife Area, though the productivity of these nests remains undetermined.

It is also notable that 2011 marked the beginning of annual whooping crane releases in Green Lake and northern Dodge Counties, which may lead to increased use of HSWA wetlands by whooping cranes in coming years, including potential for nesting (WDNR 2006c). Habitat restoration initiatives at HSWA may therefore support Department efforts to restore whooping cranes

in Wisconsin.

Several rare bird species historically nested in Horicon Marsh State Wildlife Area, but now only do so on the federal refuge. It is surmised that the habitat conditions in the State Wildlife Area are no longer suitable for these birds due to higher water conditions and a commensurately flimsier and soggy vegetative substrate on which to build nests (Mossman, 1988; William Volkert, personal communication). The regular and abundant presence of these species in the State Wildlife Area during foraging expeditions, however, illustrates the importance of the greater Horicon Marsh (State Wildlife Area plus the National Wildlife Refuge) in fulfilling all life history needs during breeding season for these and other rare bird species.

Although Shaw Marsh provides important breeding habitat for common marsh birds such as sandhill crane (*Grus canadensis*), marsh wren (*Cistothorus palustris*) and swamp sparrow (*Melospiza georgiana*), rare species were not noted here during breeding bird surveys, possibly due to the dominance of reed canary grass. Shaw Marsh does provide important nesting habitat for blue-winged teal, however, evidenced by Glacial Habitat Restoration Area Duck Surveys: an average of four nesting pairs per square mile per year were observed from 1991-2011 (Ron Gatti, WDNR, personal communication). Species that prefer open grass- and sedge-dominated habitats with scattered thickets also find appropriate habitat for breeding at Shaw Marsh, including willow flycatcher and brown thrasher.

Wintering Bird Habitat

A number of bird species from the Arctic visit this region of Wisconsin during winter. The following species have been documented at Greater Horicon Marsh in winter: roughlegged hawk (*Buteo lagopus*), northern shrike (*Lanius excubitor*), snowy owl (*Bubo scandiacus*), snow bunting, (*Plectrophenix nivalis*), and Lapland longspur (*Calcarius lapponicus*) (Horicon Marsh Bird Club [no date]). 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. Although not documented in winter at Shaw Marsh, habitat at this site would most likely be suitable for these arctic wanderers.

Avian Habitat Degradation and Opportunities for Restoration

Water quality issues at Horicon Marsh pose a significant threat to both resident and visiting birds, and mostly stem from agricultural, urban, and road runoff. Excessive nutrient and sediment loading from this runoff has fostered phenomenal growth of cat-tails, resulting in a near-monoculture of this aggressive plant. Non-native carp are also abundant at Horicon Marsh State Wildlife Area, further reducing water quality by roiling marsh sediments and uprooting aquatic plants. Invasive species such as reed canary grass, cat-tails, and purple loosestrife (*Lythrum salicaria*) further contribute to habitat simplification. All of these effects result in a diminishment of habitat for birds, specifically in terms of lower and less diverse food sources, and loss of appropriate and diverse nesting habitats. Initiatives to promote diversity in native plant species, habitat structure (open water, wetland, shrubland, grassland), and food sources

(aquatic tubers, mudflat colonizers, etc.) and to enhance water quality will all benefit birds who utilize the marsh during migration and breeding season.

Three bird conservation plans have been developed that can provide further guidance on promoting bird habitat during property management planning: 1) North American Waterfowl Management Plan (Upper Mississippi River/Great Lakes Joint Venture Implementation Plan; USFWS 1986); 2) Shorebird Habitat Conservation Strategy (Upper Mississippi Valley/Great Lakes Region Joint Venture; Potter et al. 2007); and 3) Upper Mississippi Valley/Great Lakes Waterbird Conservation Plan (Wires et al. 2010). The first would apply to both Wildlife Areas, while the second and third would only be applicable to Horicon Marsh.

Bat Conservation

During fall acoustical surveys that the WDNR conducted at Horicon Marsh State Wildlife Area, seven bat species were observed, two of which are state-threatened and three of which are special concern. Horicon Marsh provides an important source of insects for bats, especially during the fall, when they need to build up fat reserves for winter hibernation and long-distance migration. Horicon Marsh does not appear to be a critical habitat resource for bat species during spring emergence from hibernacula nor for the three species of bats migrating north for the summer, based on acoustical surveys.

Wind-turbine mortality presents a significant threat to the bats that forage over Horicon Marsh during fall migration. The Forward Energy Center consists of 86 1.5-megawatt wind turbines that lie approximately five kilometers east of Horicon Marsh. From July 15–November 15, 2008 and July 15–October 15, 2009, 29 of the 86 wind turbines were searched for dead birds and bats (Grotsky and Drake, 2011). Mortality for bats was calculated using two different estimators (modified Huso and Jain). A two-year average of 23.44 dead bats/turbine/spring and fall combined (90% ci: 17.16 to 29.72) was calculated using the Huso estimator. A two-year average of 27.26 dead bats/turbine/spring and fall combined (90% ci: 22.37 to 33.83) was calculated using the Jain estimator. The majority of the bats found as mortalities were migratory, tree-roosting bats, including hoary bats, silver-haired bats, and eastern red bats. However, approximately 25 percent of the identifiable bat carcasses in the two years of study were cave bats, i.e., little brown bat, big brown bat and northern-long eared bat.

There are no measures planned at the Forward Energy Center to reduce bat mortality. The WDNR-BER broad incidental take permit for cave bat species prioritizes protecting cave bats from losses due to white-nose syndrome (WNS) and currently has not required measures to reduce cave bat mortality at wind projects. Moreover, the permit does not cover long-distance migrating bat species (i.e., tree bats). Measures to reduce bat mortality at wind projects may be called for in the future depending on the nature and extent of the impact that WNS has on bat populations when considered together with turbine-induced mortality.

Wisconsin's Wildlife Action Plan

Ecological Priorities for SGCN

The Wisconsin Wildlife Action Plan 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. Note that these Ecological Priorities include all of the natural communities that we have determined to provide the best opportunities for management at HSWA from an ecological/biodiversity perspective.

Priority Conservation Actions

The Wildlife Action Plan developed Priority Conservation Actions that make effective use of limited resources and address multiple species with each action. Implementing these actions and avoiding activities that may preclude successful implementation of these actions in the future would greatly benefit the SGCN at HSWA. Priority Conservation Actions identified in the Wisconsin Wildlife Action Plan (WDNR 2006b) for the Southeast Glacial Plains Ecological Landscape that apply to HSWA include:

- There are many opportunities for restoration and management of wetlands such as Horicon Marsh, shallow water lakes (Lake Winnebago Pools, Rush Lake, and Koshkonong, for example), and larger lakes that support fisheries (Madison area lakes, Waukesha county lakes). Cedarburg Bog warrants hydrologic restoration as well as reconnection to its formerly linked wetland systems.
- Water quality in many watersheds within the Ecological Landscape needs improvement.
- There is potential for increasing public land ownership to accommodate recreation needs and ecological functions.

Natural Community Opportunities

The Wisconsin Wildlife Action Plan (WAP) (WDNR In Prep.) identifies 34 natural communities for which there are “Major” or “Important” opportunities for protection, restoration, or management in the Southeast Glacial Plains Ecological Landscapes, eleven of which are present at HSWA (Table 6), albeit in mostly degraded states:

Table 6. Natural Communities of Horicon Marsh and Shaw Marsh State Wildlife Areas for which there are “Major” or “Important” Opportunities within Wisconsin's Wildlife Action Plan.

<u>Major Opportunity</u>	<u>Important Opportunity</u>
Emergent Marsh	Submergent Marsh
Impoundment/Reservoir	
Inland Lake	
Shrub-carr	
Southern Sedge Meadow	
Surrogate Grassland	
Warm Water River	
Warm Water Stream	
Wet-mesic Prairie	

At Shaw Marsh, an opportunity may exist to restore Wet-mesic Prairie and Southern Sedge Meadow, as large areas show evidence of remnant, unplowed sod (they were probably grazed in the past, though). See the previous section called “Current Vegetation” for a detailed description. These areas lie east of Shaw Brook, north and south of Parker Road. Prescribed burning, herbicide application, perhaps combined with sediment removal, could release the native wetland species that continue to persist here in the form of suppressed plants and seeds in the seed bank. Wet-mesic Prairie is exceptionally rare in Wisconsin, and its protection and restoration is vital to the preservation of Wisconsin’s native biodiversity, including SGCN that are specialists to this type of ecosystem.

Non-Native Invasive Species

Many non-native invasive plants, animals and pathogens, both terrestrial and aquatic, are present at HSWA, as well as in the surrounding landscape. Non-native invasive species thrive in newly disturbed areas, but also may invade and compromise high-quality natural areas. They establish quickly, tolerate a wide range of conditions, are easily dispersed, and are free of the diseases, predators, and competitors that kept their populations in check in their native range.

In uplands and wetlands, non-native invasive plants out-compete and even kill native plants by monopolizing light, water, and nutrients, by altering soil chemistry and, in the case of garlic mustard, by altering mycorrhizal relationships. In situations where non-native invasive plants become dominant, they may even alter ecological processes by limiting one’s ability to use prescribed fire (a striking example being common buckthorn), by modifying hydrology (e.g., reed canary grass can alter surface flow and clog culverts), and by limiting tree regeneration (Gorchov and Trisel 2003, Collier et al. 2002) and ultimately forest composition (WDNR In prep.b). In addition to the threats on native communities and native species diversity, terrestrial non-native invasive species negatively impact forestry (by reducing tree regeneration, growth and longevity), recreation (by degrading wildlife habitat and limiting access), agriculture, and human health (plants that cause skin rashes or blisters).

Similarly to terrestrial invasives, aquatic invasives are successful because they originate in other regions or continents, thus lacking natural checks and balances. Early and abundant growth of aquatic plants not only overwhelms native plants, it may disrupt aquatic predator-prey relationships by fencing out larger fish, and may limit important aquatic food plants for waterfowl. The die-off of non-native plants in summer can cause oxygen depletion in waterbodies, and decaying plants can contribute to nutrient loading and algal blooms.

Recreational usage can significantly contribute to the introduction and spread of non-native invasive species throughout the study area. Trails, waterbodies, and other high-use areas are typical entry points for non-native invasive species that are introduced by visitors’ footwear, clothing, vehicle tires, boats, and recreational equipment. Once established, these invasives may continue to spread along natural corridors (e.g., waterways) and along human-made corridors (e.g, trails and roads). Non-native invasive species may also be spread inadvertently through management activities such as timber operations and roadside mowing, especially if Best Management Practices aren’t followed.

Non-native invasive species that are widespread at HSWA and pose the greatest immediate threat to native species diversity, rare species habitats, or high-quality natural communities are listed in Table 7. Although resources for complete control of these widespread invasives may be lacking, containment (i.e., limiting further spread) may be considered as an alternative action.

Early detection and rapid control of new and/or small infestations, however, may be considered for higher prioritization in an invasive species management strategy (Boos et al. 2010). Two non-native invasive

species are, in fact, new or are not yet widespread at HSWA, or are known in the vicinity (Table 8); monitoring for these species and rapid response to small infestations represent high-impact actions.

For recommendations on controlling specific invasive species consult with DNR staff, refer to websites on invasive species, such as that maintained by the DNR and by the Invasive Plants Association of Wisconsin (<http://www.ipaw.org>), and seek assistance from local invasive species groups. Also refer to invasive species Best Management Practices (BMPs) for forestry, recreation, urban forestry, and rights-of-way, which were developed by the Wisconsin Council on Forestry (<http://council.wisconsinforestry.org/>).

Table 7. Widespread Invasive Species of Horicon Marsh and Shaw Marsh State Wildlife Areas

Common Name	Latin Name	Upland Habitats		Wetland Habitats		Aquatic	Abundance Comments
		Open	Wooded	Open	Wooded		
Plants							
Canada thistle	<i>Cirsium arvense</i>	X	X	X			Moderate at both sites.
Common buckthorn	<i>Rhamnus cathartica</i>	X	X	X	X		Common at both sites.
Common reed	<i>Phragmites australis</i>			X			Most of the aggressive non-native genotype has been controlled by Wildlife staff at both sites.
Cut-leaved teasel	<i>Dipsacus laciniatus</i>	X					Rare. Appearing in Dodge County, found at Horicon.
Eurasian bush honeysuckles	<i>Lonicera</i> spp.	X	X				Moderate at Horicon Marsh. Common in wooded areas at Shaw Marsh, rare in open areas.
Eurasian water-milfoil	<i>Myriophyllum spicatum</i>					X	Present at Horicon Marsh.
Garlic mustard	<i>Alliaria petiolata</i>		X		X		Common at both sites.
Hybrid cattail	<i>Typha x glauca</i>			X			Abundant at Horicon Marsh. Common at Shaw Marsh.
Kentucky bluegrass	<i>Poa pratensis</i>	X		X			Common at both sites.
Leafy spurge	<i>Euphorbia esula</i>	X					Present at Horicon Marsh.
Narrow-leaved cattail	<i>Typha angustifolia</i>			X			Moderate to rare at both sites.
Purple loosestrife	<i>Lythrum salicaria</i>			X			Common at Horicon Marsh. Rare at Shaw Marsh.
Reed canary grass	<i>Phalaris arundinacea</i>			X	X		Abundant at both sites.
Smooth brome	<i>Bromus inermis</i>	X					Common at both sites.
Spotted knapweed	<i>Centaurea biebersteinii</i>	X					Grows along roadsides in the vicinity of Horicon Marsh. Most plants on WDNR land have been controlled by Wildlife staff.
Wild parsnip	<i>Pastinaca sativa</i>	X		X			Common at both sites.
Yellow and white sweet clover	<i>Melilotus officinalis</i> & <i>M. alba</i>	X					Moderate to rare at Horicon Marsh. Common at Shaw Marsh.
Animals							
Common carp	<i>Cyprinus carpio</i>					X	Abundant at Horicon Marsh.

Table 8. “Watch” Invasive Species of Horicon Marsh and Shaw Marsh State Wildlife Areas

Common Name	Latin Name	Upland Habitats		Wetland Habitats		Aquatic	Abundance Comments
		Open	Wooded	Open	Wooded		
Japanese knotweed	<i>Polygonum cuspidatum</i>	X	X	X	X		Reported in Mayville, including on the banks of the Rock River. Probably elsewhere in region.
Tall manna grass*	<i>Glyceria maximis</i>			X			Known infestation at Waterloo WA, ~20 mi to SW of Horicon Marsh, ~12 mi to SSW of Shaw Marsh..

*NR-40 Restricted Species in Dodge County

Primary Sites: Site-specific Opportunities for Biodiversity Conservation

Two ecologically important sites, or “Primary Sites,” were identified at Horicon Marsh State Wildlife Area (Figure 10); none were identified at Shaw Marsh State Wildlife Area. Primary Sites are 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.

A description of the Primary Sites can be found in Appendix D. 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.

Shaw Marsh and Horicon Marsh State Wildlife Areas Primary Sites

- HSWA01** Horicon Marsh Wildlife Area
- HSWA02** Fourmile Island Rookery

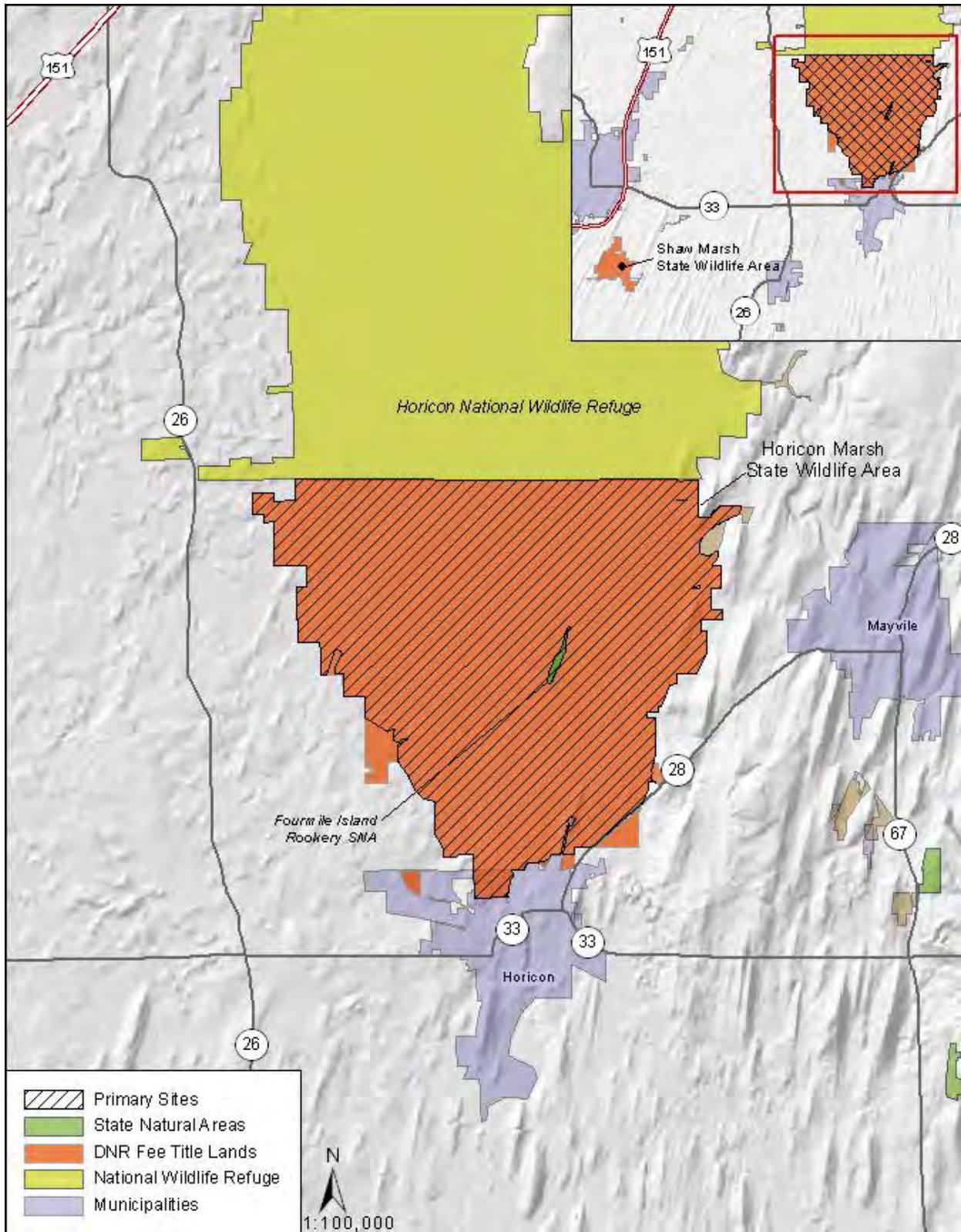


Figure 9. Primary Sites of Shaw Marsh and Horicon Marsh State Wildlife Areas

Future Needs

This project was designed to provide a rapid assessment of the biodiversity values for Shaw Marsh and Horicon Marsh State Wildlife Areas. 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 Shaw Marsh and Horicon Marsh State Wildlife Areas.

- Continued invasive species monitoring and control is needed. Public lands throughout Wisconsin are facing major management problems because of serious infestations of highly invasive species. 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 Shaw Marsh and Horicon Marsh State Wildlife Areas, a comprehensive invasive species monitoring and control plan will be needed for detecting and rapidly responding to new invasive threats.
- Locations and likely habitats should be identified for conducting additional rare plant and animal surveys during appropriate seasons. This should include additional vertebrate and invertebrate animal taxon groups.
- Continue research on colonial bird rookeries at Horicon Marsh State Wildlife Area vis-à-vis the following (per Volkert 1992): 1) viability of artificial nesting platforms; 2) soil amendments to mitigate guano toxicity and allow for new nest tree recruitment; 3) bird survival and population turnover rates. Also consider expanding focus to entire Horicon Marsh system, including the Rock River watershed. Continue monitoring statewide rookeries, particularly in relation to implementation of the Wisconsin Great Egret Recovery Plan (Fruth 1988).
- At Shaw Marsh State Wildlife Area, an opportunity may exist to restore Wet-mesic Prairie and Southern Sedge Meadow, as large areas show evidence of remnant, unplowed sod. These areas lie east of Shaw Brook, north and south of Parker Road. Sedge meadow remnants are also in evidence at Horicon Marsh State Wildlife Area. Prescribed burning, herbicide application, perhaps combined with sediment removal, could release the native wetland species that continue to persist here in the form of suppressed plants and seeds in the seed bank. Further delineation of these areas and evaluation of their restoration potential within the constraints of current funding and resources is recommended. Land managers may consider seeking assistance from local conservation volunteers (e.g., Prairie Enthusiasts) to lead the restoration effort.

Glossary

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.

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.

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.

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 2006a).

Species List

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

Animals	
Common Name	Scientific Name
blue-winged teal	<i>Anas discors</i>
bobolink	<i>Dolichonyx oryzivorus</i>
brown thrasher	<i>Toxostoma rufum</i>
Canada goose	<i>Branta canadensis</i>
common carp	<i>Cyprinus carpio</i>
dickcissel	<i>Spiza americana</i>
great blue heron	<i>Ardea Herodias</i>
greater yellowlegs	<i>Tringa melanoleuca</i>
Lapland longspur	<i>Calcarius lapponicus</i>
least sandpiper	<i>Calidris minutilla</i>
lesser yellowlegs	<i>Tringa flavipes</i>
mallard	<i>Anas platyrhynchos</i>
marsh wren	<i>Cistothorus palustris</i>
northern shrike	<i>Lanius excubitor</i>
pectoral sandpiper	<i>Calidris melanotos</i>
rough-legged hawk	<i>Buteo lagopus</i>
ruddy duck	<i>Oxyura jamaicensis</i>
sandhill crane	<i>Grus canadensis</i>
semipalmated sandpiper	<i>Calidris pusilla</i>
snow bunting	<i>Plectrophenix nivalis</i>
snowy owl	<i>Bubo scandiacus</i>
swamp sparrow	<i>Melospiza georgiana</i>
whooping crane	<i>Grus americana</i>
willow flycatcher	<i>Empidonax traillii</i>

Plants	
Common Name	Scientific Name
Angelica	<i>Angelica atropurpurea</i>
arrowheads	<i>Sagittaria</i> spp
aspen	<i>Populus</i> spp
black oak	<i>Quercus velutina</i>
boneset	<i>Eupatorium perfoliatum</i>
broad-leaved cat-tail	<i>Typha latifolia</i>
bulrush	<i>Scirpus</i> spp
burr oak	<i>Quercus macrocarpa</i>
Canada bluejoint grass	<i>Calamagrostis canadensis</i>
Canada goldenrod	<i>Solidago canadensis</i>
Canada thistle	<i>Cirsium arvense</i>
cat-tails	<i>Typha</i> spp
common buckthorn	<i>Rhamnus cathartica</i>
common prickly-ash	<i>Zanthoxylum americanum</i>
common reed	<i>Phragmites australis</i>
common water-hemlock	<i>Cicuta maculata</i>
cottonwood	<i>Populus deltoides</i>
dogwoods	<i>Cornus</i> spp
duckweeds	<i>Lemna</i> spp
Eurasian bush honeysuckles	<i>Lonicera</i> spp
Eurasian water-milfoil	<i>Myriophyllum spicatum</i>
garlic mustard	<i>Alliaria petiolata</i>
giant bur-reed	<i>Sparganium eurycarpum</i>
giant goldenrod	<i>Solidago gigantea</i>
giant reed grass	<i>Phragmites australis</i>
golden Alexander	<i>Zizia aurea</i>
hybrid cat-tail	<i>Typha X glauca</i>
hybrid cat-tail	<i>Typha x glauca</i>
iris	<i>Iris</i> spp
Japanese knotweed	<i>Polygonum cuspidatum</i>

joe-pye weed	<i>Eupatorium maculatum</i>
Kentucky bluegrass	<i>Poa pratensis</i>
leafy spurge	<i>Euphorbia esula</i>
milfoil	<i>Myriophyllum sp</i>
narrow-leaved cat-tail	<i>Typha angustifolia</i>
New England aster	<i>Aster novae-angliae</i>
pondweeds	<i>Potamogeton spp</i>
prairie cordgrass	<i>Spartina pectinata</i>
prairie dock	<i>Silphium terebinthinaceum</i>
purple loosestrife	<i>Lythrum salicaria</i>
red-osier dogwood	<i>Cornus stolonifera</i>
redstem aster	<i>Aster puniceus</i>
reed canary grass	<i>Phalaris arundinacea</i>
sawtooth sunflower	<i>Helianthus grosseserratus</i>
shagbark hickory	<i>Carya ovata</i>
silky dogwood	<i>Cornus amomum</i>
smartweeds	<i>Polygonum spp</i>
smooth brome	<i>Bromus inermis</i>
spotted knapweed	<i>Centaurea biebersteinii</i>
stiff cowbane	<i>Oxypolis rigidior</i>
swamp bedstraw	<i>Galium brevipes</i>
swamp milkweed	<i>Asclepias incarnata</i>
tag alder	<i>Alnus spp.</i>
tall manna grass	<i>Glyceria maximis</i>
tall meadow-rue	<i>Thalictrum dasycarpum</i>
white oak	<i>Quercus alba</i>
white sweet clover	<i>Melilotus alba</i>
wild parsnip	<i>Pastinaca sativa</i>
wild rice	<i>Zizania sp.</i>
willows	<i>Salix spp.</i>
yellow sweet clover	<i>Melilotus officinalis</i>

Reference List

- Boos, T., K. Kearns, C. LeClair, B. Panke, B. Scriver, and B. Williams. 2010. A Field Guide to Terrestrial Invasive Plants of Wisconsin. Wisconsin DNR, Madison, WI. 124 pp.
- Bordner, J. 1939. Land Economic Inventory of Dodge County, WI. Map collection accessible at <http://digital.library.wisc.edu/1711.dl/EcoNatRes.WILandInv>.
- Cleland, D.T.; Avers, P.E.; McNab, W.H.; Jensen, M.E.; Bailey, R.G., King, T.; Russell, W.E. 1997. National Hierarchical Framework of Ecological Units. Published in, Boyce, M. S.; Haney, A., ed. 1997. Ecosystem Management Applications for Sustainable Forest and Wildlife Resources. Yale University Press, New Haven, CT. pp. 181-200.
- Collier, M.H., J.L. Vankat and M.R. Hughes. 2002. Diminished plant richness and abundance below *Lonicera maackii*, an invasive shrub. *American Midland Naturalist* 147(1):60-71.
- Curtis, J. T. 1959. The Vegetation of Wisconsin. University of Wisconsin Press, Madison, WI. 657 pp.
- Cutright, N., B. Harriman and R. Howe. 2006. Atlas of the Breeding Birds of Wisconsin. Wisconsin Society for Ornithology.
- Ecosystem Management Planning Team [EMPT]. 2007. Table of Opportunities for Sustaining Natural Communities by Ecological Landscape. WDNR website.
- Eggers, Steve D., and D.M. Reed. 1997. Wetland plants and communities of Minnesota and Wisconsin. U.S. Army Corps of Engineers, St. Paul District.
- Finley, R.W. 1976. Original Vegetation Cover of Wisconsin. Map compiled from General Land Office.
- Fruth, K. 1988. Wisconsin Great Egret recovery plan. Wisconsin Department of Natural Resources Report 39.
- Garvin, J.C., C.S. Jennelle, D. Drake, and S.M. Grodsky. 2011. Response of raptors to a windfarm. *Journal of Applied Ecology* 48: 199-209.
- Gorchov, D.L. and D.E. Trisel. 2003. Competitive effects of the invasive shrub, *Lonicera maackii* (Rupr.) Herder (Caprifoliaceae), on the growth and survival of native tree seedlings. *Plant Ecology* 166(1):13-24.
- Grodsky, S.M. and D. Drake. 2011. Assessing bird and bat mortality at the Forward Energy Center. Final report to Forward Energy LLC. University of Wisconsin-Madison, Department of Forest and wildlife Ecology.
- Horicon Marsh Human History*. Wisconsin Department of Natural Resources. Web. <http://dnr.wi.gov/org/land/wildlife/wildlife_areas/horicon/humhist.htm>
- Invasive Species Best Management Practices*. Wisconsin Council on Forestry. Web. <<http://council.wisconsinforestry.org/invasives/>>.

- Kernen, L.T., R.J. Poff and C.W. Threinen. 1965. Surface water resources of Dodge County. Published by Wisconsin Conservation Department.
- Munkwitz, N., D. Redell, E. Crain, G. Schuurman, T. Ryan and R. Paloski. 2010. Environmental assessment on rules to protect Wisconsin cave bats and manage *Geomyces destructans*, the fungus associated with white-nose syndrome. Wisconsin Department of Natural Resources.
- Neuenschwander, H.E. 1957. The vegetation of Dodge County, Wisconsin. 1833-1837. Transactions of the Wisconsin Academy of Sciences, Arts and Letters. 46: 233-254.
- Potter, B. A., R. J. Gates, G. J. Soulliere, R. P. Russell, D. A. Granfors, and D. N. Ewert. 2007. Upper Mississippi River and Great Lakes Region Joint Venture Shorebird Habitat Conservation Strategy. U. S. Fish and Wildlife Service, Fort Snelling, MN. 101pp.
- The Nature Conservancy. 2001. The Prairie-Forest Border Ecoregion: A conservation plan.
- United States Department of Agriculture [USDA]. 1980. Soil Survey of Dodge County, Wisconsin. Edited by R.E. Fox and G.B. Lee.
- United States Fish and Wildlife Service [USFWS]. 1986. North American Waterfowl Management Plan. Updated in 1994 and 1998. Strategic guidance and implementation framework developed in 2004.
- United States Fish and Wildlife Service [USFWS]. 2007. Horicon and Fox River National Wildlife Refuges Comprehensive Conservation Plan.
- Volkert, W.K. 1992. Population trends and proposed management plans for Fourmile Island Rookery at Horicon Marsh Wildlife Area. Passenger Pigeon. 54(1): 51-57.
- Whooping Crane Eastern Partnership Database*. Annual reports available at <http://bringbackthecranes.org>.
- Wires, L.R., S.J. Lewis, G.J. Soulliere, S.W. Matteson, D.V. Weseloh, R.P. Russell, and F.J. Cuthbert. 2010. Upper Mississippi Valley / Great Lakes Waterbird Conservation Plan. A plan associated with the Waterbird Conservation for the Americas Initiative. Final Report submitted to the U.S. Fish and Wildlife Service, Fort Snelling, MN.
- Wisconsin Board of Commissioners of Public Lands. 1835-1837. Wisconsin Public Land Survey Records: Original Field Notes and Plat Maps. Available digitally at <http://digicoll.library.wisc.edu/SurveyNotes/>.
- Wisconsin Conservation Department [WCD]. 1961. Dodge County Wetlands: Wisconsin Wetland Inventory.
- Wisconsin Department of Natural Resources [WDNR]. 1993. Wisconsin DNR Wiscland GIS coverage.
- Wisconsin Department of Natural Resources [WDNR]. In Prep. a. DRAFT Ecological Landscapes of Wisconsin. State of Wisconsin, Dept. of Nat. Resources, Handbook. 1805.1. Madison, WI
- Wisconsin Department of Natural Resources [WDNR]. 2002. Beaver Dam Watershed. Web. <http://dnr.wi.gov/water/watershedDetail.aspx?Code=UR03>. [Accessed October 6, 2011.]
- Wisconsin Department of Natural Resources [WDNR]. 2006a. Wisconsin Wildlife Action Plan. Available at <http://dnr.wi.gov/org/land/er/wwap/plan/>.

- Wisconsin Department of Natural Resources [WDNR]. 2006b. Wisconsin Land Legacy Report: an inventory of places critical in meeting Wisconsin's future conservation and recreation needs. Madison, WI.
- Wisconsin Department of Natural Resources [WDNR]. 2006c. Wisconsin Whooping Crane Management Plan. WDNR PUBL-ER-650-06.
- Wisconsin Department of Natural Resources [WDNR]. 2007. Important Bird Areas of Wisconsin: Critical Sites for the Conservation and Management of Wisconsin's Birds.
- Wisconsin Department of Natural Resources [WDNR]. 2009. DNR Land Certification. Available at: <http://dnr.wi.gov/forestry/certification/dnrland.html>
- Wisconsin Department of Natural Resources [WDNR]. 2010a. Upper Rock River Watershed. Web. <http://dnr.wi.gov/water/watershedDetail.aspx?Code=UR12>. [Accessed October 6, 2011.]
- Wisconsin Natural Heritage Working List*. Wisconsin Department of Natural Resources. Web. <<http://dnr.wi.gov/org/land/er/wlist/>>.
- Wisconsin Wetlands Association [WWA]. 2010. Wetland Gems. Wisconsin Wetlands Association. Madison, WI.

Additional Resources

Numerous online resources are available for learning more about the rare species, natural communities, and ecological concepts contained within this report. These are just a few of the resources that we recommend.

1. **Bureau of Endangered Resources' Animals, Plants, and Communities Web Pages**
Information for plants, animals, and natural communities on the Wisconsin Working List, as well as Species of Greatest Conservation Need from the Wisconsin Wildlife Action Plan. For reptiles and amphibians, information for more common species is also provided here. At this time, the level of detail available varies among species; some have detailed factsheets while others have only a short paragraph or a map. These pages will continue to evolve as more information becomes available and are the Bureau of Endangered Resources' main source of information for species and communities. dnr.wi.gov/org/land/er/biodiversity/
2. **Wisconsin Natural Heritage Inventory Working List**
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. This Web page offers a printable pdf file and a key to the Working List for use in conjunction with the information provided in #1 above. dnr.wi.gov/org/land/er/wlist/
3. **Ecological Landscapes of Wisconsin Handbook**
Wisconsin's 16 Ecological Landscapes have unique combinations of physical and biological characteristics such as climate, geology, soils, water, or vegetation. This handbook will contain a chapter for each of these landscapes with detailed information about their ecology, socioeconomics, and ecological management opportunities. An additional introductory chapter will compare the 16 landscapes in numerous ways, discuss Wisconsin's ecology on the statewide

scale, and introduce important concepts related to ecosystem management in the state. The full handbook is in development as of this writing, and chapters will be made available online as they are published. Currently, a set of Web pages provide brief Ecological Landscape descriptions, numerous maps, and other useful information, including management opportunities for natural communities and Species of Greatest Conservation Need. dnr.wi.gov/landscapes/

4. **The Wisconsin Wildlife Action Plan**

This plan is the result of a statewide effort to identify native Wisconsin animal species of greatest conservation need. The plan also presents priority conservation actions to protect the species and their habitats. The plan itself is available online, and there are several online tools to explore the data within the plan. The Web pages are closely integrated with the pages provided in items #1 and #3 above. The Wildlife Action Plan Web pages are quite numerous, so we recommend the following links as good starting points for accessing the information.

- the plan itself: dnr.wi.gov/org/land/er/wwap/
- explore Wildlife Action Plan data: dnr.wi.gov/org/land/er/wwap/explore/
- Wildlife Action Plan Implementation: dnr.wi.gov/org/land/er/wwap/implementation/

5. **Wisconsin's Biodiversity as a Management Issue - A Report to Department of Natural Resources Managers**

This now out-of-print report presents a department strategy for conserving biological diversity. It provides department employees with an overview of the issues associated with biodiversity and provides a common point of reference for incorporating the conservation of biodiversity into our management framework. The concepts presented in the report are closely related to the material provided in this report, as well as the other resources listed in this section.

dnr.wi.gov/org/es/science/publications/rs915_95.htm

6. **Wisconsin's Statewide Forest Strategy**

Wisconsin's Statewide Forest Strategy is a collection of many strategies and actions designed to address major issues and priority topics over the next five to ten years. It provides a long-term, comprehensive, coordinated approach for investing resources to address the management and landscape priorities identified in the Statewide Forest Assessment. Several of the strategies contain issues related to biodiversity and ecosystem management.

dnr.wi.gov/forestry/assessment/strategy/overview.htm

7. **2010 Wisconsin's Statewide Forest Assessment**

The goal of this project was to assess the "state of affairs" of Wisconsin's public and private forests and analyze the sustainability of our forested ecosystems. The Statewide Forest Assessment helps to explain trends, identify issues, and present an updated view of the status of forests in Wisconsin. The first chapter deals with biological diversity in Wisconsin's forests, and the major conclusions from this assessment were used to develop the strategies in # 6 above.

dnr.wi.gov/forestry/assessment/strategy/assess.htm

8. **North American Waterfowl Management Plan (Upper Mississippi River/Great Lakes Joint Venture Implementation Plan)**

Strategic guidance and implementation framework developed in 2004. Recognizing the importance of waterfowl and wetlands to North Americans and the need for international cooperation to help in the recovery of a shared resource, the U.S., Canadian and Mexican governments developed a strategy to restore waterfowl populations through habitat protection, restoration, and enhancement. First published in 1986. Updated in 1994 and 1998.

<http://www.fws.gov/birdhabitat/NAWMP/index.shtm>

9. **Shorebird Habitat Conservation Strategy**

(Upper Mississippi Valley/Great Lakes Region Joint Venture)

The goal of this document is to establish explicit regional goals for shorebird habitat conservation and identify and use available survey data and new technological tools to increase planning efficiency.

http://www.uppermissgreatlakesjv.org/docs/UMRGLR_JV_ShorebirdHCS.pdf

10. **Upper Mississippi Valley/Great Lakes Waterbird Conservation Plan**

The plan presents a wealth of historical and current information regarding status, threats, and life history of waterbirds in the region, and it provides research, monitoring, and management recommendations, with emphasis on species commonly occurring in the region as well as those of high conservation concern.

<http://www.pwrc.usgs.gov/nacwcp/umvgl.html>

11. **Horicon and Fox River National Wildlife Refuges Comprehensive Conservation Plan**

This plan articulates the management direction for Horicon and Fox River National Wildlife Refuges for the next 15 years. Through the development of goals, objectives, and strategies, this CCP describes how the refuges also contribute to the overall mission of the National Wildlife Refuge System.

<http://www.fws.gov/midwest/planning/Horicon/index.html#final>

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.

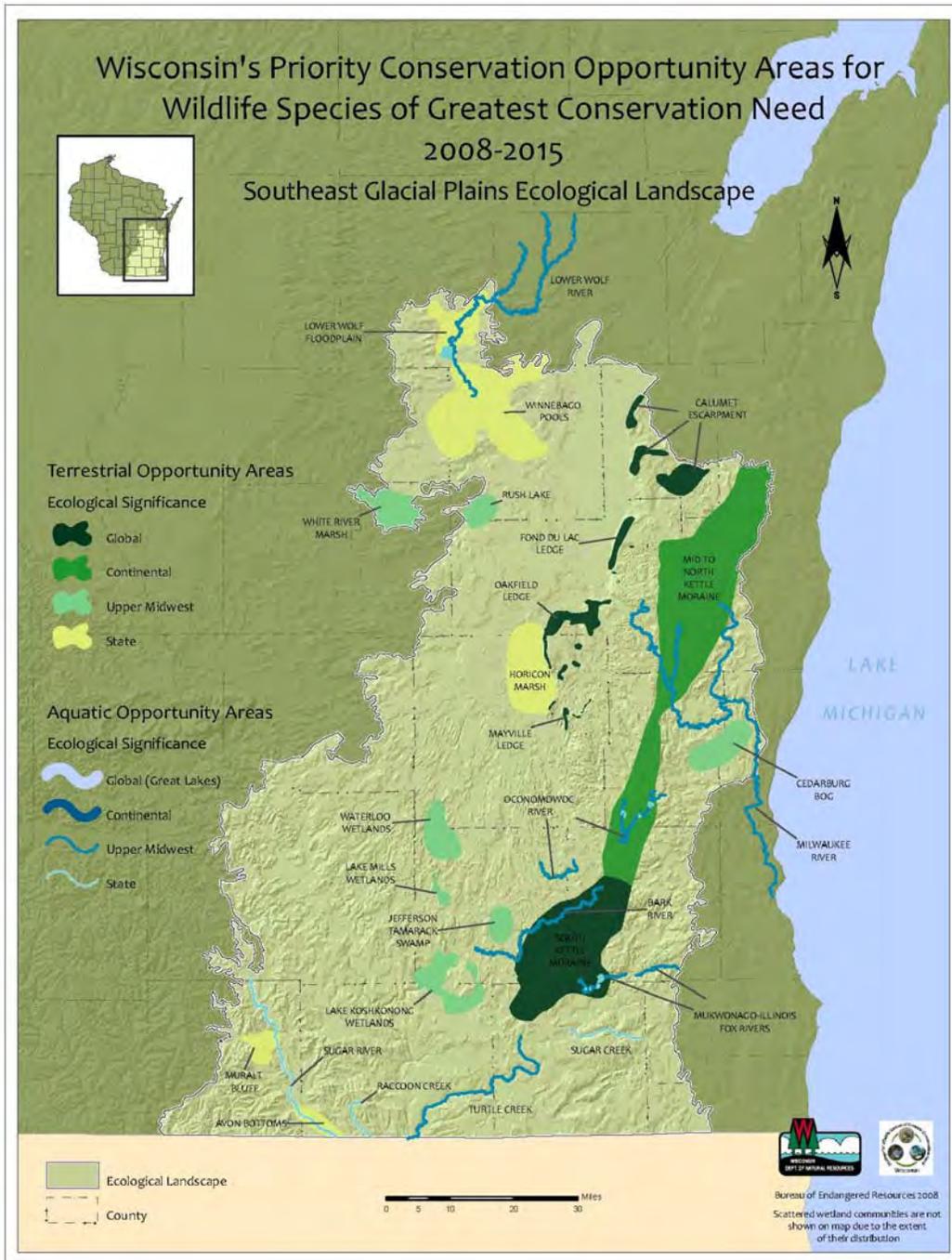
Interviews: Interviews with scientists, naturalists, land managers or others knowledgeable about the area to be surveyed often yield invaluable information.

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.

Appendix B



Appendix C

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 & 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 D

Primary Inventory Sites of Horicon Marsh and Shaw Marsh Wildlife Areas²

Two ecologically important sites, or ‘Primary Sites,’ were identified at Horicon Marsh Wildlife Area; none were identified at Shaw Marsh Wildlife Area. Primary Sites are 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 paragraph includes location information, a site map, a brief summary of the natural features present, the site’s ecological significance, and management considerations. Appendix H lists the rare species and high-quality natural communities currently known at Horicon and Shaw Marsh by Primary Site.

Primary Sites	page
HSWA01. HORICON MARSH WILDLIFE AREA	57
HSWA02. FOURMILE ISLAND ROOKERY	61

² A list of species referred to by common name is found at the end of this appendix.

HSWA01. HORICON MARSH WILDLIFE AREA

Location

Properties:	Horicon Marsh Wildlife Area, Fourmile Island Rookery State Natural Area
County:	Dodge
Landtype Association:	Horicon Marsh (222Ke17)
Approximate Size (acres):	10,855

Description of Site

Horicon Marsh harbors approximately 10,000 acres of wetlands (mostly Emergent and Submergent Marsh), approximately 850 acres of open water/aquatic communities, and approximately 31 miles of river, creek, channel and ditch (estimates using ArcMap 10.0 and 2010 NAIP aerial photo). The Rock River forms at Horicon Marsh where its east and west branches conjoin, while spring-fed Spring Brook flows into Burnett Ditch at the northwest corner of the site. A dam on the Rock River in the town of Horicon allows artificial regulation of the waters of Horicon Marsh Wildlife Area. A number of ditches and dikes throughout the site create expanses of open water of various sizes and configurations. Horicon Marsh is seasonally flooded in some areas and permanently flooded in others.

The dominant Emergent Marsh species are cat-tail (mostly the hybrid *Typha X Glauca*, with lesser amounts of *T. latifolia* and *T. angustifolia*), bur-reed (*Sparganium eurycarpum*), bulrush (*Scirpus* spp), common reed (*Phragmites australis*), and reed canary grass (*Phalaris arundinacea*). River margins often have bands of Shrub-carr of varying widths that grade into cat-tail marsh; this is more pronounced in peripheral areas than in the marsh interior. Scattered dogwood and willow clones have also gained purchase within mostly open marsh areas. Narrow fringes of large cottonwoods and willows can often be seen along the rivers' margins as well. A small area of Shrub-carr occurs at Shaw Marsh along the west-central edge of the marsh, and is typified by willows, red-osier dogwood and silky dogwood with an understory of reed canary grass. Reed canary grass-dominated wetlands occupy about one-fifth of the area at Horicon Marsh. These wetlands were probably formerly Southern Sedge Meadow given their position in the landscape and their hummocky nature (discerned under-foot during surveys). A small number of forb generalists may be found occasionally in these wetlands, and include sawtooth sunflower (*Helianthus grosseserratus*), joe-pye weed (*Eupatorium maculatum*), giant goldenrod (*Solidago gigantea*), redstem aster (*Aster puniceus*), New England aster (*Aster novae-angliae*), and tall meadowrue (*Thalictrum dasycarpum*)

Significance of Site

At 32,000 acres, Horicon Marsh in its entirety (National Wildlife Refuge plus State Wildlife Area) represents the largest freshwater cattail marsh in the United States. The large emergent wetlands and associated open water areas of Horicon Marsh Wildlife Area, combined with seasonal mudflats, offer waterfowl, shorebirds, and colonial waterbirds diverse habitats during the migratory seasons. Horicon Marsh Wildlife Area also provides important breeding habitat for both common and rare or declining waterfowl, marsh birds, and colonial waterbirds. Horicon Marsh (including the National Wildlife Refuge)

hosts the largest breeding population of a rare duck east of the Mississippi River (USFWS 2007). A great variety of marsh bird species, including some that are rare or declining, also nest within the emergent aquatic habitats of Horicon Marsh Wildlife Area.

While other rare birds nest on Horicon Marsh National Wildlife Refuge to the north, they regularly forage over Horicon Marsh Wildlife Area, illustrating the importance of the greater Horicon Marsh (Wildlife Area + National Wildlife Refuge) in fulfilling all life history needs for these and other bird species during breeding season.

With the degradation of colonial nesting habitat on Fourmile Island beginning in 1984 with a destructive windstorm (see separate primary site description), great blue herons are the only birds that continue to nest there, and only in greatly reduced numbers. Nests have also been found elsewhere within the Horicon Marsh Wildlife Area primary site, namely on Cotton, Rudebush, and Koch Islands, but breeding success has not been verified.

Horicon Marsh Wildlife Area also provides important winter habitat for wandering Arctic birds, including roughlegged hawk (*Buteo lagopus*), northern shrike (*Lanius excubitor*), snowy owl (*Bubo scandiacus*), snow bunting, (*Plectrophenix nivalis*), and Lapland longspur (*Calcarius lapponicus*) (Horicon Marsh Bird Club [no date]).

Management Considerations

When considering the value and potential of Horicon Marsh for bird conservation, the sum is greater than the two parts (Wildlife Area and National Wildlife Refuge). Initiatives taken to maintain and enhance wildlife habitat at Horicon Marsh Wildlife Area will be most effective when considered under consultation with National Wildlife Refuge staff. The two areas can offer different yet complementary types of habitat to meet the diverse life history needs of many wildlife species (especially birds and herptiles).

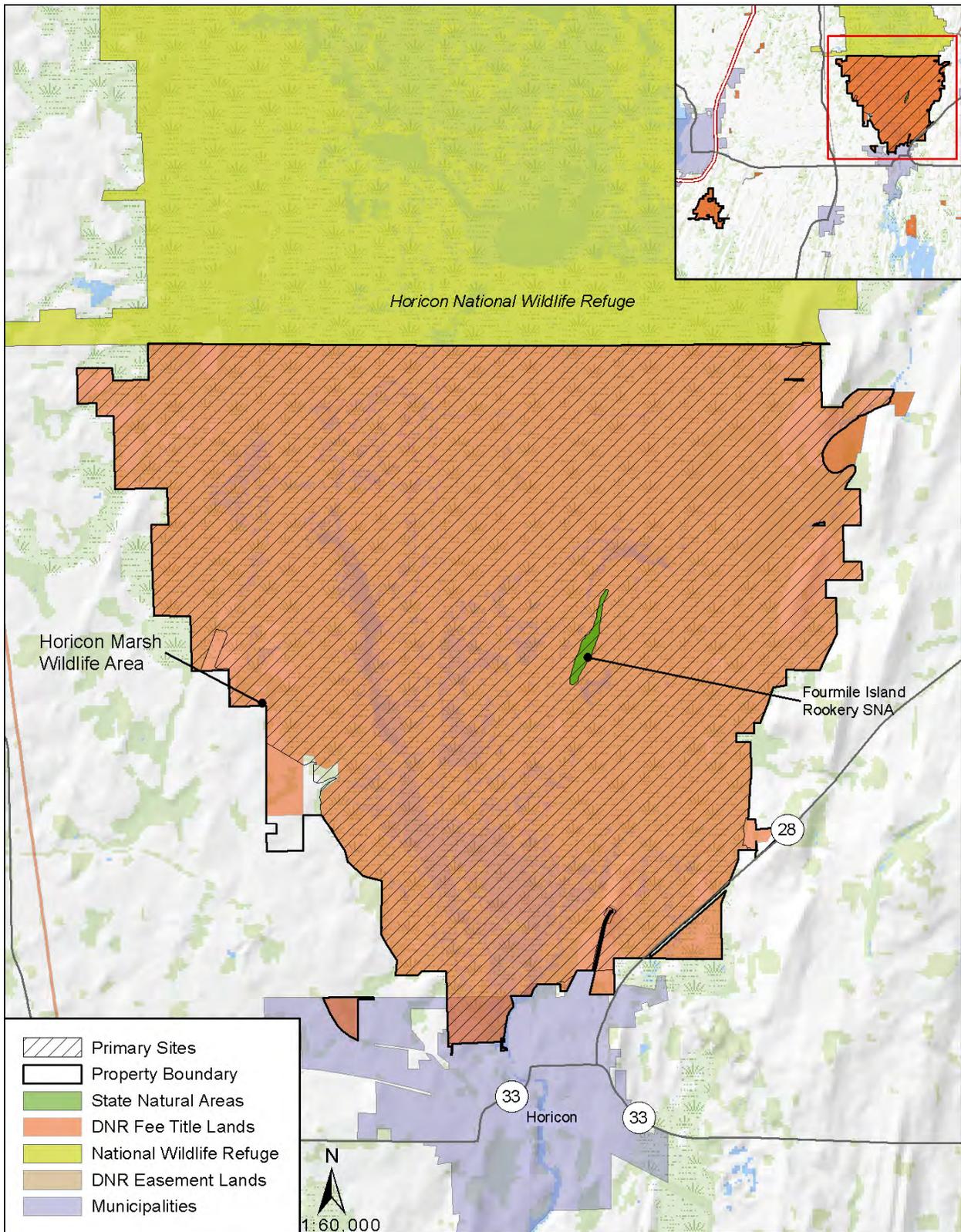
Water quality issues at Horicon Marsh pose a significant threat to both resident and visiting birds, and mostly stem from agricultural, urban, and road runoff. Excessive nutrient and sediment loading from this runoff has fostered phenomenal growth of cattails, resulting in a near-monoculture of this aggressive plant. Non-native carp (*Cyprinus carpio*) are also abundant at Horicon Marsh, further reducing water quality by roiling marsh sediments and uprooting aquatic plants. Invasive species (in addition to cattails) such as purple loosestrife (*Lythrum salicaria*) and common reed further contribute to habitat simplification. All of these effects result in a diminishment of habitat for birds, specifically in terms of lower and less diverse food sources, and loss of appropriate and diverse nesting habitats. Initiatives to promote diversity in native plant species, habitat structure (open water, wetland, shrubland, grassland), and food sources (aquatic tubers, mudflat colonizers, etc.) and to enhance water quality will all benefit birds who utilize the marsh during migration and breeding season.

One significant feature related to turtle populations and movement is State Highway 28 in the southeastern corner of the Horicon Marsh Wildlife Area. Numerous road-killed turtles were observed in 2011 along this section of highway. Road mortality because of nesting forays by females is a possible hypothesis, as one turtle was a female with eggs. However, several of the animals found were juvenile and one was a male, which suggests that road crossing here is the result of normal movements of these animals (Anderson 2011). Road mortality has a significant effect on reducing turtle populations (Anderson 2011). Anderson (2011) notes that while preventing road mortality is difficult, especially given the frequency of traffic along this road, one or more options do exist. One is to place turtle crossing signs along this section of road, to make motorists aware of the turtle

crossing. Second is to construct a drift fence to prevent crossings. The third is to accept the mortality at this location and conduct mitigation activities such as nesting site improvement or raccoon removal from other areas of the property.

Vogt's 1973 report to the WDNR documented turtle mortality as a result of the use of a fish-pesticide to eliminate carp in the SWA (Anderson 2011). It is possible that the relatively low turtle density in the rest of the marsh, outside of an impoundment adjacent to the WDNR office, is a possible result of this event. Careful consideration of how this impoundment is managed may illuminate management strategies that could benefit turtle populations across the rest of Horicon Marsh Wildlife Area.

HSWA01. Horicon Marsh



HSWA02. FOURMILE ISLAND ROOKERY

Location

Properties:	Horicon Marsh Wildlife Area, Fourmile Island Rookery State Natural Area
County:	Dodge
Landtype Association:	Horicon Marsh (222Ke17)
Approximate Size (acres):	15

Description of Site

The narrow island lies within the vast Horicon Marsh, and is forested with large oaks, basswood, elm, aspen, and cottonwood. The trees are used for nests by colonial nesting birds. A July 1984 windstorm toppled nearly 80 trees. This, along with Dutch elm disease and the effects of heron guano, have reduced the number of trees and therefore the nesting habitat in recent years.

Significance of Site

For almost 50 years, Fourmile Island harbored the largest colonial waterbird rookery in the state, hosting 800-1,000 nesting pairs of birds (Volkert, 1992). It was designated a State Natural Area in 1965 due to the site's importance as a rookery.

Management Considerations

Manage the site as a heron rookery and a breeding bird conservation site.

The native dominant tree species are managed passively. Death of trees and shrubs due to guano deposition or other natural processes may occur as long as herons use the site.

Augmentation of habitat by constructing nesting poles appropriate for use by heron species is a desirable management practice. Consult Endangered Resources Handbook for guidance.

The island is closed to all public use from April 1 to September 15. Maintenance of signage reflecting this is a high priority.

Species List

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

Animals	
Common Name	Scientific Name
common carp	<i>Cyprinus carpio</i>
common moorhen	<i>Gallinula chloropus</i>
double-crested cormorant	<i>Phalacrocorax auritus</i>
great blue heron	<i>Ardea Herodias</i>
Lapland longspur	<i>Calcarius lapponicus</i>
northern shrike	<i>Lanius excubitor</i>
redhead	<i>Aythya americana</i>
rough-legged hawk	<i>Buteo lagopus</i>
snow bunting	<i>Plectrophenix nivalis</i>
snowy owl	<i>Bubo scandiacus</i>
yellow-headed blackbird	<i>Xanthocephalus xanthocephalus</i>
Plants	
Common Name	Scientific Name
broad-leaved cattail	<i>Typha latifolia</i>
bulrush	<i>Scirpus spp</i>
common reed	<i>Phragmites australis</i>
giant bur-reed	<i>Sparganium eurycarpum</i>
giant goldenrod	<i>Solidago gigantea</i>
hybrid cattail	<i>Typha X glauca</i>
joe-pye weed	<i>Eupatorium maculatum</i>
narrow-leaved cattail	<i>Typha angustifolia</i>
New England aster	<i>Aster novae-angliae</i>
purple loosestrife	<i>Lythrum salicaria</i>
redstem aster	<i>Aster puniceus</i>
reed canary grass	<i>Phalaris arundinacea</i>
sawtooth sunflower	<i>Helianthus grosseserratus</i>
tall meadow-rue	<i>Thalictrum dasycarpum</i>

Reference List

- Anderson, Noah J. 2011. Horicon and Shaw Marsh State Wildlife Area Reptile and Amphibian Surveys and Habitat Assessment. A report conducted for the Natural Heritage Inventory, Bureau of Endangered Resources.
- Eggers, Steve D., and D.M. Reed. 1997. Wetland plants and communities of Minnesota and Wisconsin. U.S. Army Corps of Engineers, St. Paul District.
- Lang. 1969. Hibernation and movements of *Storeria occipitomaculata* in northern Minnesota. J. Herpetol. 8:196-197.
- United States Fish and Wildlife Service [USFWS]. 2007. Horicon and Fox River National Wildlife Refuges Comprehensive Conservation Plan.
- Volkert, W.K. 1992. Population trends and proposed management plans for Fourmile Island Rookery at Horicon Marsh Wildlife Area. Passenger Pigeon. 54(1): 51-57.