Regional and Property Analysis

Lower Wisconsin State Riverway

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(back of front cover)

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Table of Contents

I) Introduction and Overview 1

Purpose of Regional and Property Analysis 1

Introduction to the Property and Region 1

Background and Property History 4

Riverway Protection and Aesthetic regulations 6

II) THE REGIONAL CONTEXT 8

Social-economic Environment 8

Regional Population Centers and Transportation 8

Land Use 9

Land Values 9

Land Development 9

Population 10

Economic Context 13

Recreation 13

Biological Resources and Ecological Capability 15

Regional Ecological Context 15

Natural Communities 17

Rare Species 17

Species of Greatest Conservation Need (SGCN) 18

Other Works Highlighting the Ecological Importance of the LWSR 19

III. PROPERTY DESCRIPTION AND ANALYSIS 21

Boundary and Ownership 21

Topography, Geology, and Soils 21

Geology and Glacial History 21

Soils 22

The River and Other Water Resources *23*

Ecological Changes in Recent History 25

Agriculture *25*

Fire *26*

Hydrologic Changes *26*

Vegetation and Natural Communities of the LWSR and Opportunities to Conserve Them 27

Dry Upland Forests *27*

Southern Mesic Forests *28*

Southern Dry-mesic Forests *29*

Southern Dry Forests *29*

Pine Relicts *30*

Floodplain Forests *30*

Oak Openings and Oak Woodlands *30*

Barrens Natural Communities *31*

Prairies *31*

Rare Vascular Plants *32*

Opportunities for Biodiversity Conservation 32

Ecological Connections *32*

Migration Corridor *32*

Older Forests / Old-Growth Forests *33*

Floodplain Forests *33*

Aquatic Features *34*

Open Wetlands *35*

Oak Openings, Oak Woodlands, Prairies, and Barrens *35*

Mesic Forest Rare Plant Conservation *37*

Exceptional Site-specific Opportunities for Natural Community Conservation *38*

Wildlife of the LWSR 40

Mammals *40*
Birds *40*
Fish *41*
Mussels and other Aquatic Invertebrates *42*
Reptiles and Amphibians *43*
Terrestrial Invertebrates *44*
Management Opportunities for Rare Wildlife Species *44*
Threats to the Biodiversity of the LWSR *54*
Future Biological Inventory, Monitoring, and Research Needs *55*
Cultural History of the LWSR 56
Recreational Use and Facilities of the LWSR 57
Boating and sandbar camping: *57*
Fishing: *57*
Sunbathing and Swimming: *58*
Equestrian Use: *58*
Hiking and Cross-country Skiing: *59*
Picnicing: *59*
Special Events: *59*
Historic sites: *59*
Hunting *59*
Birding and Wildlife Viewing: *60*
Berry and Mushroom picking: *60*
Facilities *60*
Management Activities and Infrastructure on the LWSR 61
Infrastructure *61*
Current and Recent Management Activities *61*
Management Challenges and Limitations 65
Invasive Species *65*

Woody Succession and Conversion *66*

Deer Management *66*

Corridor Development and Land Use *66*

Climate Change *67*

Public Use Management and Development *67*

IV. FINDINGS AND CONCLUSIONS 69

Social-economic Context *69*

Recreation: Use, Demand, Significance and Capability *69*

Ecological Significance and Capability *70*

Conclusions *71*

GLOSSARY 72

SPECIES LIST 73

REFERENCES 78

APPENDIX A: Species of Greatest Conservation Need 82

APPENDIX B: Rare Plants Documented within the Riverway 87

APPENDIX C: Rare Animals Documented within the Riverway 89

APPENDIX D: LWSR Infrastructure 94

APPENDIX E: LWSR Maps 98

APPENDED MAPS

A: Regional Locator and Public Lands

Series B: Existing Property and Adjacent Public Lands

Series C: Management Units

Series D: Current Land Cover

Series E: Existing Infrastructure

I) Introduction and Overview

Purpose of Regional and Property Analysis

A regional and property analysis (RPA) is required by Chapter NR44, Wisconsin Administrative Code, when developing a master plan, plan revision, or plan amendment. The regional and property analysis forms the foundation of the master plan, providing the baseline information on the property as well as information on how the property fits into or relates to its larger ecological and social context. Functionally, it identifies the most suitable potential future roles or niches for the property and highlights those elements of the property's regional context that are most important to consider when planning the property.

The **Regional Analysis** component of this document describes the broader biological and ecological, cultural, economic, and recreational environment that affects the property and its use. It identifies significant ecological and recreational needs within the property's region. It also defines existing and potential social demands or constraints that affect the property that should be considered during the planning process.

The **Property Analysis** component of this document describes the property's resources, uses, management opportunities, limitations, and needs. This section also describes surrounding and adjacent lands, indicating how the character of these lands may affect the property or its use.

The **Findings and Conclusions** component is based on all the regional and property data in the body of the document, the Findings and Conclusions section outlines the best probable future role or niche for the property. It helps focus the planning process and becomes the foundation for building the plan's vision and goals, and action strategies.

The Lower Wisconsin State Riverway Regional and Property Analysis document draws heavily on a number of sources. They include the Biotic Inventory and Analysis of the Lower Wisconsin State Riverway (DNR 2011); Draft Ecological Landscapes of Wisconsin Handbook, Coulees and Ridges Chapter (DNR in Prep. a.); Socio Economic Profiles (Winkler and Pohlman 2010); and the Final Environmental Impact Statement, Proposed Lower Wisconsin Riverway (DNR 1988). Please refer to these documents for additional information.

Introduction to the Property and Region

The Lower Wisconsin State Riverway is a unique property and designation established by the legislature (ss. Chap. 30.40) for the purpose of protecting, maintaining and managing the rich and unique natural and cultural resources and outstanding natural scenic and recreational qualities of the lower river corridor. Lower Wisconsin State Riverway Board, a unique and separate state agency, is responsible for administering state laws and administrative rules pertaining to the Lower Wisconsin State Riverway.

The Riverway extends 92.3 miles along the Lower Wisconsin River in southwestern Wisconsin, beginning at the Prairie du Sac dam and ending with the Wisconsin River's confluence with the Mississippi River (see Figure 1). The Riverway boundary encompasses about 95,000 acres of public and private land. In 2012 the Department owned around 50,000 acres of land and has slightly over 3,200 acres of scenic easements and about 1,850 acres of hunting and fishing access easements within the Riverway boundary. Tower Hill and Wyalusing State Parks abut the LWSR but are not part of the Riverway; they do, however, provide additional developed recreational offerings that compliment the Riverway.

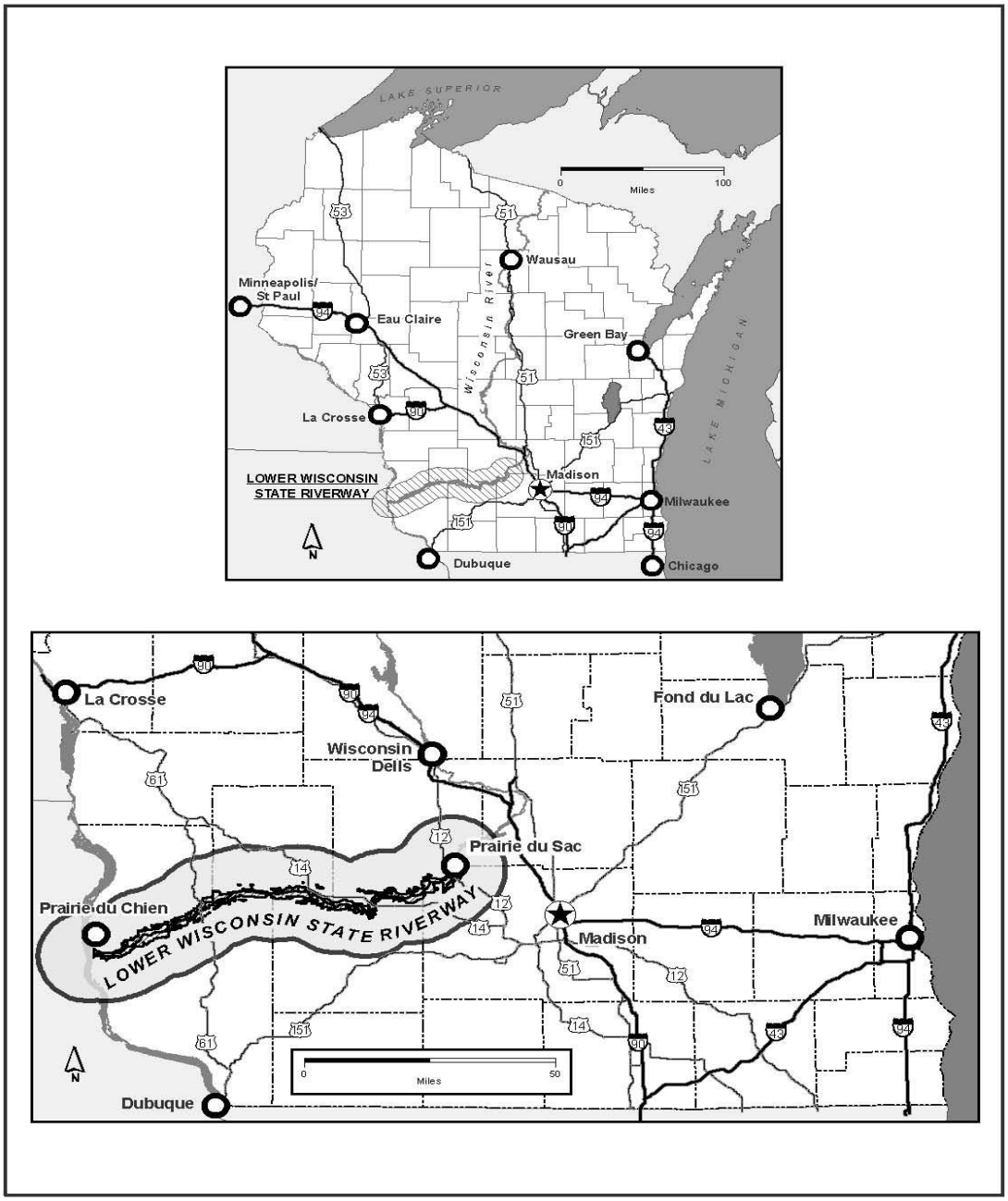

Figure 1: Lower Wisconsin State Riverway Locator Maps

The Lower Wisconsin State Riverway is a significant statewide and national resource. A 1979 U.S. Forest Service and U.S. Park Service study found the Lower Wisconsin eligible to be designated as a component of the National Wild and Scenic Rivers system. Wisconsin's 2006 *Land Legacy Report* (DNR 2006a) found the Riverway to be one of Wisconsin's most significant conservation and recreational areas. Further, the Department's *Wildlife Action Plan*[1] (DNR 2006b) identifies the river corridor as one of the highest priority areas for conservation and long-term protection of many of the state's Species of Greatest Conservation Need, terrestrial and aquatic.

This 92-mile-long Riverway, with its characteristic gradient from river, sloughs and marshes, to forested bottomlands to sand terraces to bluff tops, harbors high species and community diversity and richness. Its importance is magnified through common boundaries with the nationally significant Mississippi River, the Driftless Area, and the Upper Mississippi migratory bird flyway. The Riverway property is included in the Lower Wisconsin River *Important Bird Area* by the Wisconsin Bird Conservation Initiative, for the critical habitat it provides for many forest, grassland and marsh birds of conservation concern.

The Riverway's breadth and abundance of natural communities and rare species are of statewide and broader significance. Within the LWSR, there are 114 high-quality natural communities representing 26 different types and the property harbors four State Endangered, five State Threatened, and 35 State Special Concern plant species. Further, over 100 rare animals have been documented on the Riverway. Over 37% of the animals on the State Threatened and Endangered Species lists are found in the LWSR. Of these species, two Federally Endangered species and one candidate for federal listing is also known from the study area. The Riverway also is a highly important migration route for many terrestrial and aquatic species because of its shared boundaries with the nationally significant Mississippi River, the Driftless Area, and the Upper Mississippi migratory bird flyway.

State Natural Areas (SNA) represent the best remaining examples of native plant communities in the state, and as such, encompass a significant percent of the state's biodiversity. Twenty SNA's, totaling approximately 6,740 acres, have been established within the LWSR, harboring a broad spectrum of native terrestrial and aquatic plant communities that are an excellent reflection of the diversity of this biologically rich landscape.

The Lower Wisconsin River within the State Riverway boundary is listed as an Exceptional Resource Waterway by statute (ch. NR 102, Wis. Adm. Code), affording increased water quality protection. Furthermore, in the Driftless Area where natural lakes are scarce, an extensive network of Wisconsin River sloughs, floodplain and oxbow lakes function as ecologically significant areas for rare fishes, bryozoans, aquatic insects, reptiles and amphibians. Recent surveys of over 100 of these water bodies indicate that they are sanctuaries for aquatic plants and fish not typically found in the main channel. The floodplain lakes and sloughs may contain the most abundant populations of rare and endangered aquatic species in southern Wisconsin.

With over 92 miles of uninterrupted flow, the Lower Wisconsin River is one of the longest free flowing stretches of river in the Midwest. The miles of scenic, natural shoreline, sandbars and

[1] *The Wisconsin Wildlife Action Plan identifies ecological priorities in each Ecological Landscape. Ecological priorities focus on the natural communities in each Ecological Landscape that are most important to the Species of Greatest Conservation Need. Appendix C highlights the Ecological Priorities for the vertebrate SGCN on the LWSR.*

islands, and backwater channels offer an exceptional recreational setting. While it is not designated as a National Scenic River it did qualify for inclusion in the national system, which is testament to the Riverway's recreational significance.

The Riverway contains a highly diverse resource with a wide variety of historical and archaeological sites, wildlife, fisheries, and scenic beauty found nowhere else. The Riverway lies within a landscape dominated by privately owned lands where public recreation is extremely limited. In contrast, the river, backwaters, and uplands within the Riverway provide diverse recreational opportunities including boating, hiking, fishing, wildlife viewing, hunting, trapping, cross- country skiing, snowmobiling, horseback riding, and nature study. With many miles of accessible trails, rivers, prairies and forests, the Riverway is an important recreational resource for the state and Midwest and is one of the more important recreational resources for people of the southern half of Wisconsin and northern Illinois.

Background and Property History

Since early man first viewed the Lower Wisconsin in a time before recorded history, a variety of native peoples, explorers, traders, writers, soldiers, settlers, raftsmen, naturalists, artists and recreators have traveled the river. The earliest written thoughts about the Wisconsin were by the explorers, Joliet and Marquette in 1673, and though over 300 years have passed, have a familiar ring: "It is very wide, it has a sandy bottom, which form various shoals that render its navigation very difficult. It is full of islands covered with vines. On the banks one sees fertile land, diversified with woods, prairies and hills..." Another traveler of the 1830's was impressed by the "beautifully skirted banks and prairie bluffs". Now in the early 21st century, the river still maintains much of this scenic beauty. Long stretches of shoreline still appear as they did to pioneer travelers with long vistas of prominent wooded bluffs, many sandbars and islands, extensive lowland forests and open wetlands. The 92 miles of the Wisconsin River downstream of the dam at Prairie du Sac is one of the longest remaining free-flowing stretches of river left in Wisconsin and the Midwest.

The river's qualities are so unique that in 1979 the U.S. Forest Service and U.S. Park Service recommended the Lower Wisconsin join only a few other rivers in the country as a state administered component of the National Wild and Scenic Rivers system. While the Lower Wisconsin River qualified for designation as a Federal Wild and Scenic River, the state did not request Federal designation, electing instead to create its own project to protect and manage the river corridor's outstanding scenic and habitat values.

The acreage owned by the Department at the time the Riverway was established was within nine previously existing Department projects, mostly wildlife areas. The State Riverway consolidated and linked the nine existing projects to form a single comprehensive management unit for the entire lower river. Management of the Riverway emphasizes multiple use management with special emphasis on recreation and scenic quality. The overarching goal is to provide a quality public use area for unique river corridor activities and compatible recreational pursuits; maintain the generally natural and scenic landscape of the Lower Wisconsin Riverway; and manage the corridor's natural resources for the long-term benefit of the citizens of the area and state.

As stated in the*1988 EIS/Master Plan* (DNR 1988), the establishment of the Lower Wisconsin Riverway was prompted by five general factors:

- long-term development pressures that, if ignored, will threaten the outstanding scenic

and natural qualities of the river corridor;

- the deterioration of the quality of recreation in some locations along the river and the threat of the loss of additional high quality recreation opportunities in the future;
- the need to improve safety awareness among the large number of new recreational users to the river;
- the need for improved, more comprehensive management and protection of the river corridor's natural resources, including the area's valuable scientific and natural areas, archaeological and historic sites and endangered species; and
- the need to provide high quality outdoor recreation and education opportunities closer to Wisconsin's population centers and to preserve existing opportunities for future generations.

Soon after the decision was made to pursue creation of the Lower Wisconsin River project, Department staff and others recognized that the recreation and development pressures being placed on the river corridor were beyond the scope of management for the existing wildlife areas and that a new, broader management approach was needed.

The plan for the Riverway was created by a multi-disciplinary Department task force and was based in part on comments collected through a wide range of citizen involvement over a 10 year period. This effort included dedicated participation and leadership by the 34 member Lower Wisconsin River Citizen Advisory Committee (CAC), elected officials at many levels, and many other concerned citizens.

The original Riverway master plan was approved by the Natural Resources Board in December 1988. The following year, 1989, Governor Tommy Thompson signed Wisconsin Act 31 which created the Lower Wisconsin State Riverway project (see ss. Chapt. 30.40). The Department of Natural Resources is responsible for administering a land acquisition program within the project boundaries, and for management of DNR controlled lands within the boundary. A new state agency, the Lower Wisconsin State Riverway Board, was created to administer the "performance standards" of the new law, which are designed to protect the aesthetic integrity of the Riverway. Permits are required for structures, timber harvesting, utility facilities and other activities. The Board is composed of nine members, of which six must be local residents or local elected officials from the affected counties (Crawford, Dane, Grant, Iowa, Richland and Sauk).

Federal Funding History

Prior to creation of the Riverway, over 22,000 acres within the corridor were purchased for State Wildlife Areas. Funding from several Federal sources; the Federal Aid in Wildlife Restoration Act (also known as the Pittman-Robertson Act), Federal Aid in Sport Fish Restoration (also called the Dingle-Johnson Act), and the Land and Water Conservation Fund Act; were often used for acquisition and management of these lands. These funds come with guidance to state fish and wildlife agencies based on the authorizing legislation. The statutes and applicable regulations prohibit a state fish and wildlife agency from allowing recreational activities and related facilities that would interfere with the purpose for which the state acquired, developed, or are managing the land.

Riverway Protection and Aesthetic regulations

Unlike many other forested floodplains in the Upper Mississippi River watershed, the LWSR is protected through state ownership and easements, performance standards and aesthetic regulations. The Wisconsin DNR maintains an active acquisition program within the LWSR boundary.

The LWSR is protected from development by the Lower Wisconsin State Riverway Law and Wisconsin Administrative Code Chapters RB 1, RB 2, and NR 37. Included in this protection under ch. NR 37, Wis. Adm. Code are unique aesthetic performance standards for timber harvesting.

Timber harvesting within the State Riverway requires a permit issued by the Lower Wisconsin State Riverway Board (LWSRB). This Board is an independent state agency which includes representatives of the six affected counties and administers the performance standards. For more information go to the LWSRB website: http://lwr.state.wi.us/

Permit requirements vary by zone and establish conditions so that timber cutting or harvesting will have minimal impact on the scenic beauty and natural value of the LWSR. Zone boundaries are established on a case by case basis by LWSRB staff following inspection of the site. Within ch. NR 37 Wis. Adm. Code there are four timber harvesting zones. They are shown in Figure 2.

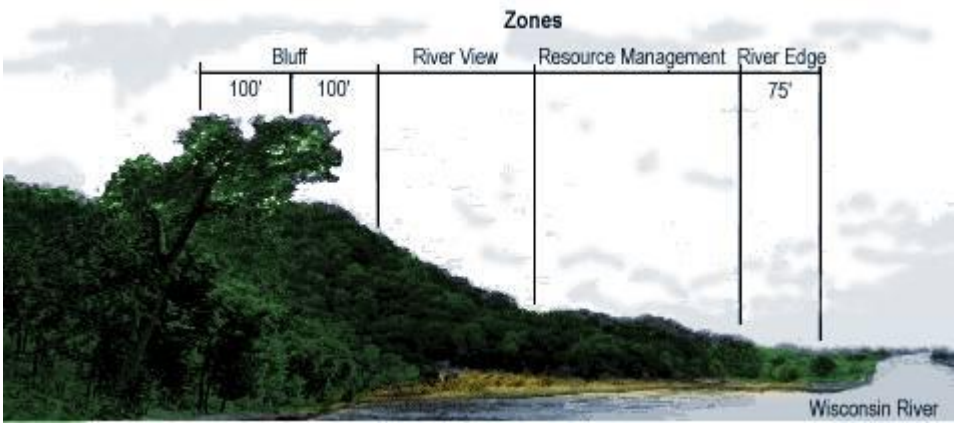

Figure 2: Timber Harvest Management Zones Administered by LWSRB

1. **The River Edge Zone** covers the area from where tree growth begins on the river's edge to a point 75 feet inland. Timber harvest requirements in this area are:

- selection cutting to minimum 60 ft.^{2} of basal area;
- ground frozen or dry; and
- leaves must be off deciduous trees.

Note: A 15-foot wide river access strip is also allowed for each property.

2. **The Resource Management Zone** is not visible from the Wisconsin River and refers to all land that is within the LWSR but not included in The River Edge Zone, Bluff Zone, or Riverview Zone. While there are no harvest restrictions within this area, consultation with a forester is encouraged.

3. **The River View Zone** encompasses all land within the LWSR which is visible from the River during the time when leaves are on deciduous trees, outside the Bluff and River Edge Zones. Timber harvest requirements in this area are:

- selection cutting to minimum 60 $ft.^2$ of basal area;
- ground frozen or dry; and
- leaves must be off deciduous trees.

  Note: Small regeneration cuts; with irregular boundaries and shelterwood harvests are allowed within this zone.

4. **The Bluff Zone** encompasses all land within the LWSR from 100 feet behind the bluff line to 100 feet below the bluff line. Timber harvest requirements in this area are:

- selection cutting to minimum 60 $ft.^2$ of basal area;
- ground frozen or dry; and
- leaves must be off deciduous trees.

In addition to established exemptions to ch. NR 37 (road maintenance, hazard tree removal, personal firewood, removal of diseased or infected trees, etc.), a person may cut or harvest timber or woody vegetation to:

- develop, restore or maintain a prairie or other native plant community;
- enhance wildlife habitat; and
- maintain a confirmed archaeological site.

In this situation, a DNR-approved State Riverway Management Plan is required per s. RB 2.06, Wis. Adm. Code, prior to a LWSRB permit being issued.

II) THE REGIONAL CONTEXT

Social-economic Environment

Regional Population Centers and Transportation

Madison is the largest city near the Riverway, it's about one half hour drive away from the western end of the LWSR and the Milwaukee metro area is a two hour drive. As Figure 3 shows, an estimated 13 million people live within a three hour drive of some portion of the Riverway.

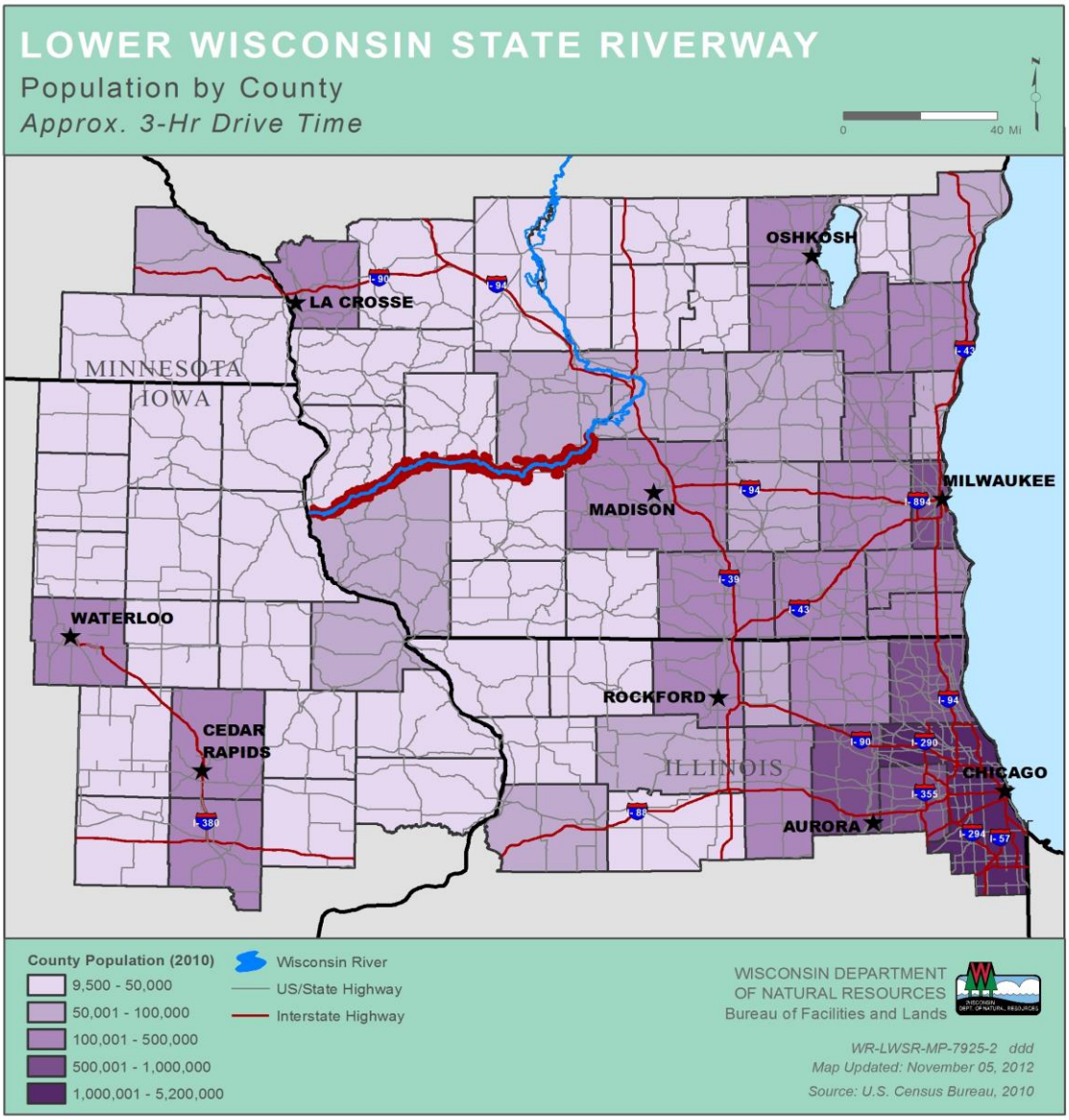

Figure 3.Population within Three Hour Driving Time of LWSR

The LWSR is served by a well-developed, maintained highway network. As is shown on Map A, Regional Public Lands Map, the interstate highway system delivers visitors from the Milwaukee and southeastern Wisconsin as well as the northern Illinois and Chicago area to within 25 miles of the Riverway. Good state and county highways provide ready access to the many river access points along the Riverway's 92 mile length.

Land Use

The heart of Wisconsin's driftless area, this region has the state's hilliest terrain and is dominated by small farms that mix pasture, tillable land and woodlots. The steep topography dictates the uses of land with the flatter areas typically being farmed or developed and the hillsides in forest cover or pasture. Agricultural lands make up from 50% to 75% of the lands in each of these counties. Forest lands make up from 20% to 30% of the landscape in all counties, except Dane which is only 10%.

As Map A, (Regional Public Lands Map) shows, southwestern Wisconsin has only a modest amount of public land, mostly it tends to be in small and scattered parcels. The largest holdings (over 52,000 acres) occur along the Lower Wisconsin River; even so, on average less then 6% of the land in the LWSR counties is public conservation land. The statewide average is 17%.

Land Values

For all counties, except Dane, land values are fairly homogeneous. Agricultural land values are near the state average of about $3,200 per acre, forest land values generally range from the state average of about $2,400 per acre up to $3,600 per acre. Wetland values range from about $1,200 per acre in Grant County to more than $2,000 per acre in Iowa County. Due to Dane County's economic vitality and population growth, high demand has pushed land values to among the highest in the state. Land values (2006 to 2008) range from nearly $10,000 per acre of farmland, to $4,700 per acre for forest land, and $2,300 per acre for wetlands. [*Data is from the Wisconsin Department of Revenue (2008) and the National Agricultural Statistics Service (2006-2008).]*

Land Development

Residential development consumed farmland at a record pace during the housing market boom years of the early 2000s. In just eight years (between 2000 and 2008), the state's acreage in residential land increased by approximately 21%. The number of acres in agriculture declined correspondingly by about 5%. At the same time, a substantial number of large tracts of agricultural and forest land were split into smaller parcels, often for recreational or development use purposes. Such parcelization occurs when a property owner divides his or her property into several smaller pieces for sale or transfer. Parcelization produces less public access because owners of smaller parcels tend to be less inclined to allow public on their property for hunting and other recreational activities. Furthermore, parcelization is often followed by new residential, commercial, and infrastructure development (e.g. roads, septic, utility lines, etc.). When such development occurs it can fragment plant and wildlife habitat, diminish water quality, and take land out of agricultural or timber production.

As Table 1 shows, the period of 2000 to 2008 saw undeveloped lands in the LWSR Region being subdivided (parcelized) with many parcels being developed. The number of undeveloped parcels declined in some areas because of conversion to residential or commercial uses. Undeveloped forest lands were the hardest hit. Crawford, Grant, and Richland -counties saw

the highest percent of loss in undeveloped forest land acreage being 15.2%, 19.1%, and 12.7% respectively. In spite of this conversion, the number of agricultural parcels increased in all but one county, suggesting a significant parcelization of the land that remained in agricultural use.

Table 1: Development & Parcelization of Undeveloped Land, 2000-2008

	% Change in Acreage		Change in # of Parcels		
	Ag	**Forest**	**Ag**	**Forest**	**Total Undeveloped**
Crawford County	5.5%	-15.2%	537	-82	**1,008**
Grant County	1.9%	-19.1%	676	-1,229	**96**
Richland County	3.2%	-12.7%	-658	-423	**- 40**
Iowa County	0.4%	-2.9%	409	-180	**416**
Sauk County	-0.9%	-4.5%	98	-74	**242**
Dane County	-4.6%	-3.1%	797	-154	**1,007**
State of Wisconsin	**-4.8%**	**0.5%**	**3,600**	**25,651**	**80,536**

Source: Wisconsin Department of Revenue, 2000 & 2008

Population

Most of the region is quite rural and sparsely populated (see Figure 4). With the exception of Dane County, the LWSR counties are among the least densely populated in southern Wisconsin with an estimated 42 persons per square mile in 2008. Dane County's 392 persons per square mile gives it a much more urban character then the rest of the region. The city of Madison and its surrounding inner ring suburbs are particularly densely populated.

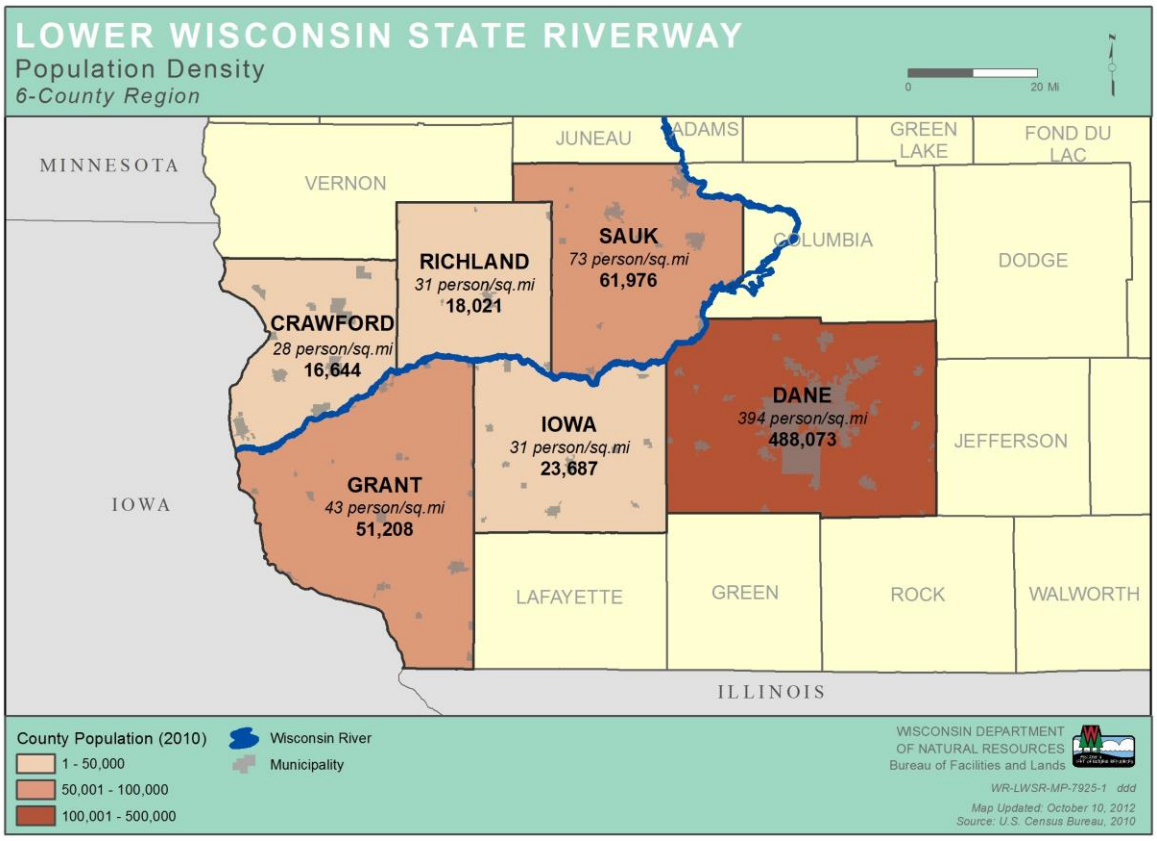

Figure 4 Population Density; LWSR Region

Recent Population Change

As Table 2 shows, the total population of the Region has been growing very slowly over the last several years. The western counties of Crawford, Richland and Grant experienced minimal growth ranging between -3% and 3.5% between 2000 and 2010. The eastern counties, Iowa, Sauk, and Dane, had more robust growth in recent years averaging 10%.

Compared to the statewide average rate of population growth of 5.8% the western counties have grown much more slowly and the eastern counties at a considerably faster pace than the state as a whole.

Table 2: Population Change, 2000-2010

County	Average Population growth rate
Crawford County	-3.5%
Richland County	0.5%
Grant County	3.2%
Iowa County	4.0%
Sauk County	12.2%
Dane County	14.4%
State of Wisconsin	**6.0%**

Source: Wisconsin Demographic Services Center

As shown on Table 3, over the next 10 to 25 years the population of the western portion of the LWSR region (Crawford, Grant and Richland counties) is projected to grow at a slow rate of 1 to 2% o. In fact, large parts of these counties are projected to decline in population. In strong contrast the population of the eastern portion of the region (Iowa, Sauk and Dane counties) is projected to grow at a rate higher than the state as whole. In fact, Dane and Sauk counties will be substantially higher.

Table 3: Projected Population Change, 2010-2035

	Census (2010)	Projection (2020)	Projection (2035)	% Change (2010-2015)	% Change (2010-2035)
Crawford County	16,644	16,835	17,265	1.15%	3.7%
Grant County	51,208	52,420	52,720	2.4%	3.07%
Richland County	18,021	18,275	18,625	1.4 %	3.3%
Iowa County	23,687	25,035	27,390	5.69%	15.6%
Sauk County	61,976	68,075	77,265	9.8%	24.6%
Dane County	488,073	530,620	593,440	8.7%	21.6%
State of Wisconsin	**5,686,986**	**6,005,080**	**6,476,270**	**5.6%**	**13.9%**

Source: Wisconsin Demographic Services Center

Population Age Structure

Understanding the age structure of the population is important for outdoor recreation planning because recreational activities that people pursue vary by age. Young people and older adults tend to participate in different recreational activities than people in the middle age groups. For instance, young adults are more likely to geocache or rock climb while older people are more likely to bird watch. Planners should also consider age with respect to age-related disabilities that may restrict or modify peoples' access to certain recreational activities. Further, older

population groups require special consideration because they are not of traditional working age and they may have more time to participate in recreational activities than working-age adults.

Table 4: Population by Age, 2008 & 2020

County	Under 20 (2008)	Over 65 (2008)	Under 20 (2020)	Over 65 (2020)
Crawford County	24.7%	16.5%	22.6%	21.7%
Grant County	24.5%	15.7%	25.4%	20.7%
Richland County	24.0%	17.1%	25.1%	21.1%
Iowa County	25.5%	13.1%	25.3%	16.8%
Sauk County	24.8%	14.5%	24.0%	18.2%
Dane County	26.1%	9.9 %	25.6%	14.4%
State of Wisconsin	**26.0%**	**13.2%**	**25.0%**	**17.1%**

Source: US Census Bureau, Population Estimates & Wisconsin Demographic Services Center Projections

Looking ahead to 2020 (Table 4), like the state as a whole, the population under age 20 in all the LWSR counties is projected to be nearly stagnate with growth of this age group at only 1% to 2%. Conversely, the over 65 Babyboom generation is showing its strength with growth ranging from about 3.5% to more than 5% across the region. The greatest growth of the older group will be in Crawford and Grant counties. The statewide average growth rate for the over 65 group during this period is projected to be 3.9%

Population Race/Ethnicity

Research has shown significant differences in outdoor recreation participation across race and ethnic groups. Whites tend to travel more for recreation than other race/ethnic groups, especially Blacks. Whites also tend to have the highest participation rates across a range of activities, except for fishing where the different groups participate at similar rates. Hispanics are most likely to participate as in larger social group activities. Such differences are important to consider as managers work to provide recreational opportunities that meet the needs of diverse race and ethnic groups.

According to US Census Bureau estimates, except for Dane County, the LWSR region is not an ethnically diverse area in comparison to the state of Wisconsin as a whole, which has a minority population of 4%. Dane County's minority population is significantly higher at 14%. The largest minority group in these counties is Hispanic with Asian being second.

Summary of Population Trends

Two primary population trends stand out as particularly interesting to consider with respect to outdoor recreation planning:

(1) the region is largely rural in character and with little population growth in the western half and significantly higher growth rates projected for the eastern half ; and
(2) the aging population, the population over age 65, makes up a growing proportion of the population across the region, especially in the western counties.

Overall, the population in the western part of the region (Crawford, Grant, and Richland counties) is growing, but at a much slower rate than the state average. In fact, these counties will continue to experience very little population growth. In contrast, the counties in the eastern part of the region will see significantly higher growth in the coming years. Dane County has the

fastest population growth rate in the state. Much of its growth is due to net in-migration. Population projections suggest that these trends will continue in the coming years. By 2030 the Dane County population is projected swell by nearly 20% and be well over 600,000.

At the same time, between 2008 and 2020 the population over age 65 is projected to grow by 4% to 5%. Except for Dane and Iowa counties which are slightly lower, nearly 1 in 5 persons in the region will be age 65 or older by 2020, which is above the state average.

Perhaps equally as significant for outdoor recreation planning for the Riverway is the large numbers of recreational visitors that come to the area. This population is not reflected by the data above. Recreational use by out of area visitors may very well eclipse use by locals, unfortunately data on the numbers and make-up of this important population is not available.

Economic Context

Manufacturing, health care and social assistance, retail trade, and educational services are the industries that employ the most people in the LWSR Region. Manufacturing was the only industry in the Region to experience significant decline in employment since 2000. Manufacturing employment decline has been especially dramatic in Crawford and Grant counties. Iowa County was the only county to see an increase. The health care and social assistance and retail trade are growing substantially in all counties. This suggests that the region is experiencing a shift from more industrial-oriented employment toward service industries, and some indication of diversification of the region's economy in general. In sum, the economy is growing steadily and may be diversifying a bit away from manufacturing and agricultural production and towards service and retail sectors.

Recreation

Public Recreational Lands of the LWSR Region

As shown on Map A, most recreational lands within the LWSR region are state parks and trails; although there are a number of smaller state fish and wildlife lands scattered across the region.

A number of state properties within the LWSR Region provide abundant campgrounds, hiking trails and other intensively developed recreational facilities. The major properties include Wyalusing State Park, Governor Dodge State Park, Devil's Lake State Park, Blue Mound State Park, and the Military Ridge State Trail. Several local and county parks also offer camping, picnicking and other recreational opportunities.

Recreational Significance of the LWSR

The LWSR plays a unique role in the region and state's recreational picture and is of regional as well as statewide importance. Being the largest public property in southern Wisconsin and one of the largest in the state it provides abundant public open space for a broad spectrum of recreational activities ranging from hunting and fishing to hiking, wildlife watching, horseback riding, and boating. River recreation, such as canoeing and sandbar camping and fishing, in particular are a major draw for people from across the state and upper Midwest, contributing important dollars to the local economy. Locally, the river and its associated natural lands are a key defining element for the residents of the communities dotting its banks.

Recreation Demand

In this section, outdoor recreation demand is defined according to the reported desires of users of outdoor recreational facilities within the region. As part of the SCORP 2005-2010 (DNR 2006c), outdoor recreation participation surveys were conducted by the National Survey on Recreation and the Environment (NSRE). The surveys examined 62 recreational uses by region of the state. Data collected from the surveys show the percentage of responders participating in each recreational activity. The recreational activities in Table 5 are selected from the 62 uses found in the NSRE survey as the top 10 uses in the Southern Gateways SCORP region that are nature-based activities. The Southern Gateways region does not include the two Mississippi River counties, Crawford and Grant, but the region is believed to be reasonably representative of recreational demand for all of the LWSR.

Table 5: Participation Level for the Most Popular Activities

	Recreational Uses*	Participation Level	
Rank		Regional Residents (%)	State Average (%)
1	Picnicking	62.5%	56.6%
2	Boating	48.5%	47.6%
3	Visit a beach	43.4%	47.3%
4	Swimming in lakes, streams, etc.	42.7%	45.8%
5	Snow/ice activities (any type)	40.8%	44.4%
6	Visit a wilderness or primitive area	39.9%	38.3%
7	Day hiking	38.0%	35.0%
8	Freshwater fishing	35.1%	40.7%
9	Developed camping	31.4%	32.3%
10	Mountain biking	30.9%	34.4%

* *Selection of SCORP 2005-2010 recreational uses determined to be nature-based*

In 2004, the Wisconsin Department of Tourism surveyed the Chicago and Minneapolis-St. Paul Designated Market Areas (DMAs) to gauge out-of-state recreation demand. The 5 most popular activities identified by study for the Southern Gateways SCORP region are shown in Table 6.

Table 6: Most Popular Activities for Out-of-State Residents

Rank	Chicago DMA	Twin Cities DMA
1	Downhill skiing	Sightseeing
2	Sightseeing	Bird watching
3	Picnicking	Hiking
4	Camping	Picnicking
5	Hiking	Camping

Recreation Supply Shortages

Outdoor recreational supply shortages happen when the demand for a specific use exceeds the supply of that use. The supply shortages for the Southern Gateways SCORP region were identified using regional demand, regional supply, local park and recreation plans, and public input. These data helped determine which recreational resources in a relative sense, are in short supply (Table 7). The use categories included here are limited to nature-oriented activities.

Table 7: Recreation Supply Shortages in the Region *

Backcountry/walk-in camping	Parks

Boat launches – carry-in and trailer	Picnic areas
Natural areas	Horse trails
Public water access	Hiking trails

** Limited to nature-based activities*

Hunting and Fishing

The importance of the LWSR for hunting and fishing for residents of the region is not well documented by SCORP 2005-2010 (DNR 2006c). The Riverway provides nearly 50,000 acres of land open for hunting, the majority of public hunting lands in southwest Wisconsin. Except for the Mississippi River, the Lower Wisconsin River provides the only opportunity in southwestern Wisconsin to fish larger waters and go after a range of game species found in few other places.

Fishing and hunting license sales in the six counties bordering the Riverway is one measure of the importance of hunting and fishing in the region. In 2010 nearly 130,000 fishing licenses were sold in these counties. In 2010 gun deer license sales totaled more than 61,393 and archery licenses were nearly 27,500. More than 36,000 deer were harvested.

Recreation Summary

As the SCORP survey suggests, water-based activities are the most popular outdoor activities for regional residents. The rugged and scenic topography of the region also generates considerable interest in snow and ice activities, hiking, biking, camping, and visiting a wilderness or primitive area. Supply shortages include hiking and horse trails, as well as a broad range of other recreational developments. Hunting and fishing activities are particularly important on the Riverway as it provides a large percentage of the public hunting and, along with the Mississippi River, the warm water fishing opportunities in this part of the state.

Biological Resources and Ecological Capability

Regional Ecological Context

Western Coulee and Ridges Ecological Landscape

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

The DNR 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. The majority of the LWSR is located within the Mississippi-Wisconsin River Ravines Subsection of the NHFEU.

The LWSR study area is located in the Western Coulee and Ridges Ecological Landscape, shown in Figure 5 (DNR In prep. a). The Western Coulee and Ridges Ecological Landscape

covers more than 9,642 square miles, representing 17.2% of the land area of the state of Wisconsin. It is the largest Ecological Landscape in the state.

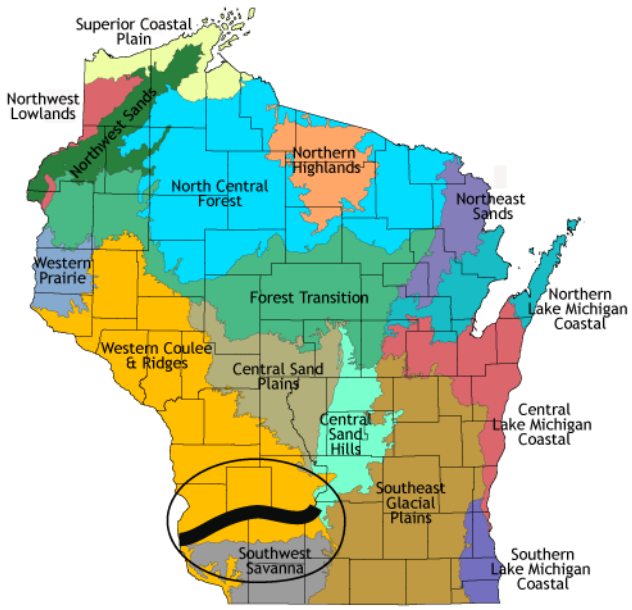

Figure 5. Location of the study area and the Ecological Landscapes of Wisconsin

The Western Coulee and Ridges Ecological Landscape in southwestern and west central Wisconsin is characterized by its lack of glaciation. It is part of the region called the "Driftless Area" because it lacks glacial deposits (although glacial outwash materials do occur in river valleys). The topography here is unique in Wisconsin due to the long period of erosion, with dissected ridges, steep-sided valleys, and extensive networks of streams. The Western Coulee and Ridges is still relatively heavily forested as compared with the rest of southern Wisconsin. The Baraboo Range, formed primarily of the Precambrian Baraboo Quartzite, is located in the eastern part of the Ecological Landscape. Several large rivers including the Wisconsin, Mississippi, Chippewa, Kickapoo and Black flow through or border the Ecological Landscape.

Historical vegetation for the Western Coulee and Ridges Ecological Landscape consisted of southern hardwood forests, oak savanna, scattered prairies, and floodplain forests and marshes along the major rivers. As a result of widespread Euro-American settlement, most of the relatively flat land on ridge tops and in valley bottoms were cleared of oak savanna, prairie, and forest for agriculture. The steep slopes between valley bottom and ridge top, unsuitable for raising crops, grew into oak-dominated forests after the pre-settlement wildfires were suppressed.

Biodiversity Needs and Opportunities

Opportunities for sustaining natural communities in the Western Coulee and Ridges 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 (DNR 2006a).

The goal of sustaining natural communities is to manage for natural community types that historically occurred in a given landscape and have a high potential to maintain its characteristic composition, structure, and ecological function over a long period of time (e.g., 100 years). This list can help guide land and water management activities so that they are compatible with the local ecology of the Ecological Landscape while maintaining important components of ecological diversity and function. These are the most appropriate community types that could be considered for management activities within the Western Coulee and Ridges Ecological Landscape.

Natural Communities

The Wisconsin Wildlife Action Plan (WAP) (DNR 2006b) identifies 34 natural communities for which there are "Major" or "Important" opportunities for protection, or restoration, or management in the Western Coulee and Ridges Ecological Landscape. Twenty-five of these natural communities are present on the LWSR, they are:

- Dry cliff
- Moist cliff
- Pine Relict
- Cedar glade
- Sand Prairie
- Dry Prairie
- Dry-mesic Prairie
- Mesic prairie
- Wet-mesic Prairie
- Southern Sedge Meadow
- Surrogate grasslands
- Oak Barrens
- Oak Opening
- Oak woodland
- Pine Barrens
- Southern Dry Forest
- Southern Dry-mesic Forest
- Southern Mesic Forest
- Floodplain Forest
- Shrub-carr
- Alder thicket
- Ephemeral pond
- Emergent Marsh
- Warm-water rivers
- Coolwater stream

Rare Species

Numerous rare species are known from the Western Coulee and Ridges Ecological Landscape. "Rare" species include all of those species on the DNR's NHI Working List (*Wisconsin Natural Heritage Working List*) that are classified as "Endangered," "Threatened," or "Special Concern." Table 8 shows the extent of species known to occur in the Southeast Glacial Plains Ecological Landscape based on information in the NHI database as of November 2009 (DNR In Prep. a).

Table 8: Listing Status for rare species in the Western Coulee and Ridges Ecological Landscape as of 2009.

Listing Status	Birds	Fishes	Herptiles	Invertebrates	Mammals	Plants	Total Fauna	Total Flora	Total Listed
WI Endangered	6	7	5	16	0	18	34	18	52
WI Threatened	9	9	2	10	0	28	30	28	58
WI Special Concern	15	11	11	70	7	84	114	84	198
U.S. Endangered	0	0	0	2	1	0	3	0	3
U.S. Threatened	0	0	0	0	0	2	0	2	2
U.S. Candidate	0	0	1	2	0	0	3	0	3

Covering less than 1% of the Western Coulee and Ridges Ecological Landscape, the LWSR supports 47% of the rare species and 71% of the natural communities (that are major management opportunities) that are known from this landscape.

Species of Greatest Conservation Need (SGCN)

The Wisconsin Wildlife Action Plan (DNR 2006b) denoted Species of Greatest Conservation Need (SGCN). SGCN are animals that have low and/or declining populations that are in need of conservation action. They include various birds, fish, mammals, reptiles, amphibians, and invertebrates (e.g. dragonflies, butterflies, and freshwater mussels) that are:

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

There are 72 vertebrate SGCN significantly associated with the Western Coulee and Ridges Ecological Landscape. These species and their associated natural communities are listed in Appendix A. These SGCN are (and/or historically were) significantly associated with the Ecological Landscape and that restoration of natural communities with which they are associated would significantly improve conditions for their survival. SGCN status is independent of State Listing Status and the NHI Working List. Most but not all SGCNs are on the NHI Working List (published April 2009); in addition, the NHI Working List also includes rare species that are not designated as SGCN.

Priority Conservation Actions identified in the Wisconsin Wildlife Action Plan that are applicable to the LWSR include:

- Focus management and restoration efforts in the loess-influenced forest Conservation Opportunity Areas to emphasize a matrix of older oak-central hardwood forest with smaller patches of oak woodland, Oak Opening, regenerating younger forest, native prairies and relict forests.
- Focus management and restoration efforts in the sandstone-influenced Conservation Opportunity Areas to emphasize dry oak savanna, oak woodland and Sand Prairie communities with smaller embedded patches containing oak forest, Pine Relicts, Dry Prairie, open shrubby barrens, closed canopy oak forest, and rock outcrops.
- Protect the ecological river corridor gradients from lowlands to uplands, along with protection of the floodplain corridor. This will enlarge the amount of habitat available, allow for the movement of species upslope and downslope as environmental conditions change over time, provide migratory bird stopover habitat, and provide suitable habitat for species that require large areas or are dependent upon a mosaic of interconnected habitats, including a full range of seral stages, for their long-term survival.
- Maintain and connect large blocks of older floodplain forest to provide habitat for the large number of SGCN that utilize this habitat while addressing the regeneration difficulties associated with dense stands of reed canary grass.
- Restore Oak Openings and woodlands and expand and enhance Dry Prairie and shrub habitats on public lands in appropriate Conservation Opportunity Areas through fire, ground layer enhancement, and timber management.
- Manage appropriate native Sand Prairie and Sand Prairie restoration sites for nesting ornate box and Blanding's turtles. Continue head starting program for ornate box turtles.
- Protect and restore appropriate habitat in the Mississippi and Lower Wisconsin Rivers for shoal chub (*Macrhybopsis aestivalis*).

- Protect and restore appropriate natural stream habitat with focus on accommodating the habitat needs of wood turtle.

Other Works Highlighting the Ecological Importance of the LWSR

Wisconsin Wildlife Action Plan: Conservation Opportunity Area

The LWSR was recognized in the Wisconsin Wildlife Action Plan (DNR 2006b) as being within the following Conservation Opportunity Areas (COA), the Lower Wisconsin Bluffs and Floodplain COA, the Lower Wisconsin River COA, the Snow Bottom COA and the Dodgeville Wyoming Oak Woodlands/Savanna COA. All are of continental significance.

Conservation Opportunity Areas are places in Wisconsin containing ecological features, natural communities, or Species of Greatest Conservation Need (SGCN) habitat for which Wisconsin has a unique responsibility for protecting when viewed from the global, continental, upper Midwest, or state perspective (DNR 2006b).

The Lower Wisconsin Bluffs and Floodplain COA and the Lower Wisconsin River COA were recognized because of the large river system that includes riparian natural and upland natural communities that support numerous Species of Greatest Conservation Need.

The Snow Bottom COA and Dodgeville Wyoming Oak Woodlands/Savanna COA were recognized because of the Driftless Area natural communities - a continuum of Dry Prairie, Dry-Mesic Prairie, Oak Opening, Oak Woodland, Southern Dry Forest, Southern Dry-mesic Forest, Southern Mesic Forest, Shrub-carr, Dry Cliffs, and Moist Cliffs that support SGCN.

The Nature Conservancy's Prairie Forest Border Ecoregion: A Conservation Plan

The Nature Conservancy's (TNC) Prairie-Forest Border Ecoregion Conservation Plan (TNC 2001) recognized the Lower Wisconsin River as a "Functional Landscape." A functional landscape is a portfolio site selected for both coarse-scale aquatic and terrestrial targets and is intended to represent many other ecological systems, communities, and species (i.e., "all" biodiversity). The Lower Wisconsin River was recognized because it represents an aquatic system of the highest ecological significance, as it supports numerous rare species of fish, mussels, and insects. The diversity of natural communities adjoining the river is exceptional, including prairies of many types, Oak Barrens, Pine Barrens, Emergent and Submergent Marshes, Floodplain Forest, and upland hardwood forests. Several of these communities are represented by occurrences that are among the largest and most viable of their respective types. Plant and animal life is correspondingly rich, and this landscape must be regarded as critical habitat for many rare or otherwise sensitive species.

The Nature Conservancy's Rivers of Life: Critical Watersheds for Protecting Freshwater Biodiversity Report

The Lower Wisconsin River was one of 327 small watersheds, identified by The Nature Conservancy as a critical watershed to protect and restore to conserve all at-risk freshwater fish and mussel species in the United States (Master 1998). This 1998 report identified the following threats to these communities: pollution (point and non-point), non-native species, dams and associated operations, land-use changes/alterations, and water extraction.

Important Bird Area

Important Bird Areas (IBA; DNR 2007) are critical sites for the conservation and management of Wisconsin's birds. The Lower Wisconsin River IBA includes all but the final 6 miles of the 92 mile stretch of the Lower Wisconsin River. The Lower Wisconsin River IBA is especially significant for: 1) birds of floodplain and upland forest, especially species that require large tracts; 2) barrens (ranging from sand prairie to oak-pine woodland); and 3) open wetlands (ranging from wet prairie to shallow and deep marsh and shrub carr) (M. Mossman personal communication). Especially important within the IBA are the gradual and fairly natural ecotones between various community types.

Wisconsin Wetlands Association Wetland Gems

The LWSR, along with Wyalusing State Park, was recognized by the Wisconsin Wetlands Association (WWA) as being a "wetland gem." "Wetland gems" support habitats that are critically important to Wisconsin's biodiversity, provide nearby communities with valuable functions and services, and serve as recreational and educational opportunities (WWA 2009). The LWSR was recognized because the floodplain wetlands are critical to maintaining the health of the Wisconsin River and support a variety of rare and sensitive species.

Grassland Bird Habitat Management

The Lower Wisconsin River Prairies and Barrens was recognized as a Priority Landscape for Grassland Bird Management (Sample and Mossman 1997) because of the complex of sites that contains high quality bird habitat of dry or sand prairie and oak or river barrens sites, which are especially important for lark sparrows (*Chondestes grammacus*) and associated species. This Priority Landscape has the potential for connecting sites along the river corridor and expanding grassland acreage through restoration and buffering.

III. PROPERTY DESCRIPTION AND ANALYSIS

Boundary and Ownership

The Riverway project boundary encompasses about 95,086acres (2010 data) of public and private land (See Map B) extending from the Prairie du Sac dam to the Mississippi River. Current state ownership (DNR managed land) within the boundary is approximately 50,073acres. Also there are 4,600 acres of scenic easements and about 8,000 acres of hunting and fishing easements.

Topography, Geology, and Soils

Geology and Glacial History

Thick layers of sandstone, limestone, and dolomite, deposited 600 to 430 million years ago during Cambrian and Ordovician times, originally covered all the Lower Wisconsin River region. Through time, forces of erosion cut a deep, V-shaped gorge down through the layers carving a valley as much as 500 feet deep.

This gorge was the start of the Lower Wisconsin River Valley. Four miles wide at Sauk City, the gorge narrows down to two miles at Muscoda and only about a mile near Wauzeka. The funnel shape of the gorge can be explained by the differences in the uppermost layers of rock found on the bluffs as one proceeds from east to west. Relatively soft Cambrian sandstones dominate the valley walls at the east end of the valley while harder Ordovician age dolomites dominate the bluffs toward the west end. The river was able to carve a wider gorge in the softer rock.

Beginning about one million years ago, glaciers in the northern and eastern parts of the state leveled hills and valleys, and covered the bedrock surface with a great amount of rock debris (called drift or glacial till) of varying composition and thickness. However, the south-western portion of Wisconsin, including the Lower Wisconsin River Valley, was not covered by glaciers. This "driftless" landscape is unique in the state. The prominent river valley hillsides were not smoothed off by glacial ice, nor was the valley filled in with drift. The Lower Wisconsin River Valley (gorge) was not totally unaffected by the glaciers. When the glaciers finally receded 10,000 years ago, melt water from glaciers to the north found its way into the Wisconsin River. This river of melt-water carried glacial sand and gravel (glacial outwash) south and deposited it up to 150 feet deep in the river valley. The river later cut down through this deposit of glacial outwash to form a series of terraces that tend to run parallel to the river. Although the valley floor is fairly flat, the elevation rises slightly with each of the terraces. The ancient sides of the gorge not covered by glacial outwash deposits can still be seen. They are the steep hillsides (bluffs) with bedrock outcrops that rise abruptly 300 to 400 feet above the valley floor. The river continues to move glacial outwash and eroded sandstone downriver forming islands and constantly changing sandbars.

In contrast to glaciated areas of the state, naturally occurring lakes are few in number in the driftless region.

Soils

Soils of the Lower Wisconsin River Valley can generally be grouped into categories that closely relate to their position in the landscape; ridge-tops; valley walls; terraces; and floodplains. Each is discussed in more detail below. Additional information about soils in the Lower Wisconsin Valley is available in the soils surveys for each county (Ref. #7 thru #12).

As their name implies, soils of the floodplain are wet or subject to flooding. These bottomland soils have very gentle slopes that mainly range from 0 to 2%. Most areas are mucky or peaty on the surface, underlain by sand and silts deposited by the river at various depths. These characteristics severely limit their use for building sites, on-site sewage disposal systems, and agriculture. However, the better drained bottomland soils can be utilized for nature trails when they aren't flooded.

Within the project area, the soils of the stream terraces generally have the most potential for providing sites for homes or recreational facilities, including on-site sewage disposal. They are also well suited for wildlife habitat and woodland production. Formed on sandy glacial outwash, their droughty nature makes them susceptible to wind erosion. While generally suitable for recreational use, care must be taken to control erosion if these soils are used for trails. With gentle to moderate slopes (generally from 2 to 15% although some areas are as steep as 30%) they can be used for agricultural purposes. However, in many areas intensive (and expensive) land management tools such as irrigation, herbicides, and fertilizer are needed to produce acceptable crop yields.

By their nature, soils of the valley walls are definitely limited in their capacity to provide sites for agriculture, building sites, on-site sewage disposal systems, and recreational use and development; they are too thin and steep. Slopes mainly range between 20 and 30%, although some areas have slopes ranging up to 60%. Bedrock is often exposed. Despite these limitations for human use, these soils are important because they support habitat for rare or important plants and animals. The more gently sloping cove and foot-slope areas of the valley walls could be used for scenic paths and trails if these are constructed on the contour with care taken to control erosion. The steeper areas are unsuitable for most recreational trail uses unless they receive intensive erosion control and site modification (such as cutting into the hillside to widen the path area).

Soils of the upland ridge-tops formed in windblown silt that covers the uppermost layers of bedrock on the bluffs overlooking the Wisconsin River Valley. Within the property boundary, most of these soils have slopes ranging from 10 to 20%, although there are a few areas with slopes less than 10% or greater than 20%. The more gently sloping ridge-top soils tend to have good moisture holding capacity, are relatively fertile, and under proper management, suffer no more than a moderate amount of erosion when crops are grown on them. Crops are sometimes grown on the more steeply sloping ridge-top soils, but they require careful management to protect them from erosion. Many of these steeper soils have already lost over half of their topsoil to erosion.

If they are protected from erosion, gently sloping (less than 10% slope) soils of the upland ridge-tops have generally good potential for recreational use such as camping, picnicking, and trails. Intensive erosion control is needed on the steeply sloping soils (10% to 20% slope) of the upland ridge-tops if they are to be used for recreational trails. However, they could withstand light recreational use such as occasional picnicking and hiking if care is taken to maintain the vegetative cover.

The River and Other Water Resources

The Watershed

Wees-Kon-San, the Chippewa Indian name for "the gathering of waters", amply describes the Wisconsin River as it flows 430 miles through the state. Flowing southerly from its headwaters on the Michigan-Wisconsin state line in Vilas County, the entire Wisconsin River drains a watershed covering 12,280 square miles, or 7,859,200 acres.

Much has changed since the time the Native Americanswere the main inhabitants of the region. Water levels of the Wisconsin River are now greatly influenced by the extensive system of 21 storage reservoirs (most are off the main stem of the river) and 26 hydro dams on the 338 miles of river that lay upstream of the dam at Prairie du Sac. These impoundments, particularly the reservoirs on the northern end of the river, serve to temper the river's flow by slowly releasing stored water in low-flow periods and holding back water in high-water periods. However, while the upper river system of impoundments has a tremendous ability to manage the river in the north, its effect decreases downstream. There are no storage reservoirs below the Big Eau Pleine Reservoir near Mosinee (about 164 miles upstream of Prairie du Sac). The long-term storage capacity of the downstream power dam reservoirs, such as at Prairie du Sac, the Kilbourn Dam at Wisconsin Dells and even on the large Petenwell and Castle Rock flowages, is quite limited, especially during the summer and fall.

The power dams are owned by private industry and public utilities, and the storage reservoirs are owned and operated by the Wisconsin Valley Improvement Corporation (WVIC). These dams and reservoirs (except for the Kilbourn and Prairie du Sac dams) are licensed by the Federal Energy Regulatory Commission (FERC). All of the dams and reservoirs are regulated by the Department. FERC authority over operations for the FERC licensed dams parallel the DNR's authority in the areas of dam safety, fish and wildlife concerns, and setting minimum flows to be passed under low-flow conditions.

The Prairie du Sac dam is operated as a "run of the river" facility (i.e. water is passed through the dam at approximately the same rate as the river flows into the reservoir above the dam). The Prairie du Sac Dam is owned and operated by Wisconsin Power and Light Co., primarily to produce hydroelectric power. The power company is required to maintain a fairly constant level in Lake Wisconsin (usually + or - 3 inches) to maintain the water level necessary for the Merrimac Ferry to operate.

The Lower River

The stretch of the River from the last dam to the confluence with the Mississippi River, about 92.3 miles, lies within the LWSR. The Lower Wisconsin River within the State Riverway boundary is listed as an Exceptional Resource Waterway by statute (ch. NR 102, Wis. Adm. Code), affording increased water quality protection. It's one of the longest free-flowing stretches of any river in the Midwest. Here the river is a broad, braided stream with many islands and sandbars. The channel averages an eighth to a quarter of a mile wide and carries sediment dominated by medium to coarse sand and small pebbles (Dott and Attig 2004).

The river slowly descends at a rate of 1.5 feet per mile on its way toward the Mississippi River. The current is only one to two miles per hour (measured at Muscoda), and there are no falls or rapids below the dam at Prairie du Sac. At seasonal low flows, the river is scarcely deep enough in some places for canoes, but at flood stage it spreads over a floodplain in places that are several miles in width.

The largest tributary to the Lower Wisconsin River below the Prairie du Sac dam is the Kickapoo River, a warm water river that enters at Wauzeka. Other tributaries include Honey Creek, Pine River, Mill Creek, Blue Mounds Creek, and Blue River.

The meandering characteristics of the river have allowed shallow, "oxbow" lakes and ponds to form in backwater areas. Some are cut-off from the river with their water levels being primarily supported by the water table. Many of these backwater bodies are quite shallow and have a very limited flow through them during non-flood periods. In many, the original depth between the sand on the bottom and the water surface was 10 feet. However, now less than four feet of maximum water depth is typical, as most of their basins are filled with loose sediment. These shallower lakes closely resemble bog lakes with dense aquatic vegetation and sedge mats, and are often oxygen deficient. Some of the larger floodplain lakes are named, including Avoca Lake (48 acres), Woodman Lake, and Bakken's Pond, both around 20 acres and connected to the river during high water.

Sloughs, Lakes, and Spring Ponds

Some sloughs and ponds are connected to the main channel flow much of the year and share much of the water quality characteristics with the main channel and support both riverine and lake species.

Other ponds and cut-off oxbows are largely supported by springs and groundwater. Studies suggest that upland groundwater plays an important role in sustaining off-channel fish habitats. Pfieffer et al. (2006) describe the groundwater surrounding the Lower Wisconsin River as a dynamic river aquifer consisting of deep, intermediate and shallow groundwater flow systems. Elsewhere, upland or hillslope groundwater has been recognized as an important factor in the survival of many fish species (Amoros and Bornette 2002). The highest quality floodplain lakes, sloughs and oxbows surveyed were biologically productive, but were relatively clear due to a combination of upland groundwater inputs and rooted aquatic plant suppression of planktonic algae (Marshall 2008, 2009, 2010). Many of these unique waterbodies are ecologically diverse, supporting an unusual blend of both lake and riverine fishes, aquatic plants, mussels and other aquatic animals not commonly found in the main channel of the river. They contribute greatly to the overall ecological diversity of the Riverway.

Five wetland impoundments are maintained in the LWSR. Flowage water levels are managed by periodic draw-downs to enhance waterfowl food production, to maintain a 1:1 ratio of open water and emergent vegetation, to allow for dam inspections and to control plant community succession. Small wetland scrapes have also been created to increase open water in lowlands and floodplain forests (DNR 2010a).

Hydrology

The hydrology of the Wisconsin River has been manipulated by humans for the past 180 years (Durbin 1997). Today, the continued focus on manipulating the river's hydrology for water storage and power generation has resulted in a shift in the timing of floods and a decrease in the natural extremes of the river flow. Since the construction of large reservoirs on the Wisconsin River, minimum flows on the Lower Wisconsin River have decreased by as much as 17% and maximum flows have decreased by 10 to 15% (Pfeiffer 2001).

The hydrology of the lower river is significantly influenced by the lower watershed as well as the flows from the river's upper reaches. There is little water storage capacity in the flowages on

the lower river, that area below the Castle Rock Flowage. As the dams on the lower river are "run of the river", meaning that for the most part the flow entering the flowage is passed on downstream, water levels in the lower river can change dramatically in response to southern Wisconsin regional weather conditions.

Water Quality

The Wisconsin River has suffered a long history of water pollution, including sedimentation since the first paper mills became established in Wisconsin during the late 1800s. By the early 1970s combined daily pollutant loads from 29 major industrial and municipal wastewater discharges resulted in frequent fish kills, unpalatable fish flesh, and severe aquatic nuisance bacteria, fungi and protozoans. A combination of distance from industrial waste sources and upstream impoundments partially spared Lake Wisconsin and the Lower Wisconsin River from impacts of wastewater discharges, but not entirely. The Lower Wisconsin River is classified as a warm water sport fish community. Contaminants such as mercury and polychlorinated biphenyls (PCB) still persist, resulting in a PCB and mercury advisory for safe eating guidelines for carp, lake sturgeon, and other fish species in the Lower Wisconsin River.

Water quality of the Lower Wisconsin River is greatly influenced by Lake Wisconsin. The lake is a hyper-eutrophic impoundment plagued by recent excessive cyano-bacteria (blue-green algae) blooms, excessive phosphorus and frequent oxygen depletion. These water quality problems are transferred to the Lower Wisconsin River. Nonpoint-source water pollution is now considered the most significant threat within the Lower Wisconsin Basin. The porous sandy soils allow nitrogen and phosphorus from adjacent farms to move though groundwater to sloughs, oxbow lakes, and the river. Recent 2007 water quality sampling in the tailwater area below the Prairie du Sac (Alliant Energy) dam indicated frequent high levels of total phosphorus, and dissolved oxygen levels below the standard of 5 mg/l as outlined in ch. NR 102, Wis. Adm. Code.

Ecological Changes in Recent History

The vegetation that historically occurred within the LWSR developed within a complex environment comprised of both elements that are static over ecological time (e.g., soils, underlying landforms) and dynamic ecological processes (e.g., hydrological cycles, nutrient cycles, disturbance regimes). Many of the dynamic ecological processes that shaped the landscape of the LWSR have been altered by humans.

Agriculture

The landscape also has been changed by agriculture (row crops, haying, and grazing). Terraces, grasslands, and wetlands were converted into crop production areas and savannas, woodlands, and forests were altered by grazing. In addition, many farms drained wetlands by ditching or tiling their fields to increase crop production. Now, as former agricultural lands are acquired by the state within the LWSR, they are converted to permanent vegetative cover, primarily grassland or forest cover, reducing or eliminating grazing, and plugging old ditches to restore wetland habitat.

The many streams, and groundwater as well, flowing into the Lower Wisconsin River also greatly influence water quality, carrying agricultural nonpoint sources of sediment, pesticides, and manure-generated ammonia, phosphorus, bacteria and biological oxygen demand (BOD).

Urban nonpoint sources include sediment, bacteria, chlorides, pesticides, heavy metals and other toxics.

Fire

Historically, the natural communities along the LWSR were shaped by disturbance regimes that have been greatly altered since European settlement. Pre-settlement prairies, oak savannas, Oak Woodlands, and forests were all directly or indirectly influenced by frequent, low-intensity ground fires. These fires favored stands of fire resistant/resilient tree species such as bur oak, black oak and white oak. (Grazing by roaming herds of bison and elk historically could have played a role in some areas as well.) Numerous sources and indicators have shown that the upland terraces and bluffs once featured a more open prairie, barrens and savanna landscape, occupied by woody and herbaceous species that tolerated fire. Fire also influenced the herbaceous ground layer and adjacent plant communities, including sedge meadows, prairies, and barrens. Today, fire is far less frequent. The removal of fire from the uplands, along with changes in timber harvesting and removal of cattle from many woodlands have allowed the proliferation of tree species that were formerly less prevalent on the landscape (e.g., red maple, sugar maple, bitternut hickory, elm), in largely even-aged or two-aged stands.

Hydrologic Changes

How the upstream dams have impacted the Lower River's plant and animal communities is not fully known. In general, dams affect aquatic species and habitats by fragmenting them into disjunct segments, preventing the movements of some species between different stretches of the river. In addition, natural hydrological fluctuations associated with free-flowing rivers and streams are integral to wetlands formed under fluctuating water levels and the many species that depend upon them, including amphibians that rely on a specific hydrological regime to complete certain life-stages (PARC 2002). Canopy tree dominants that may have used the natural hydrological fluctuations to obtain a niche on certain geomorphic surfaces (point bars, levees, swales) may have declined in dominance, while opportunistic species importance may have increased (Tingle et al. 2001).

Possibly the most significant impact for the LWSR from the hydrological manipulations are related to the decrease in variability of water levels, especially at high water and low water extremes and the impacts this has on floodplain landform development (sand bars, islands, slough channels, levees, etc.) and inundation period of floodplain habitats. Pfeiffer (2001) showed that the decrease in the maximum flows has had a significant impact on the frequency of complete inundation of the Deacon Thomas Slough area (also known as Cambell Bottoms) of the LWSR. This has resulted in a decrease in the amount of time the ridges and higher areas of the floodplain are fully saturated, therefore oxygen depletion of the root zone occurs less frequently, and there may be greater tree survival possibly leading to a more closed-canopy forest. The impacts from the decrease in flood severity and length of periods of flooding may also be impacting the lower floodplain areas as less scouring is occurring and anoxic conditions may not be long enough to favor species that can tolerate these conditions. Landform development within the floodplain may be impacted by changes in hydrology and since diversity in landforms is correlated with plant species diversity (Crow et al. 2000); this has the potential to have long-term impacts on vegetation.

Certainly the lowland floodplain forests have been impacted by the upstream dam's stabilization of river flows. Historically, floodplain forests were molded primarily by higher seasonal flooding that both established regeneration and maintained stands of flood tolerant tree species. Within

the “bottoms,” frequent disturbance, ecologically unstable systems, high micro-site variability, and the lack of long-lived shade tolerant species resulted in complex vegetation dynamics that rarely reflected traditional concepts of succession and “old growth” forest. Under the river’s natural disturbance regime, old, multi-aged bottomland hardwood communities rarely developed, due to periodic disturbance by flooding, wind and fire. In a strict sense, steady state conditions did not exist in floodplains. However, on today’s bottomland sites, upstream dams and the resulting altered flow regime (lower magnitude and shorter duration floods) has largely stabilized the Wisconsin River floodplain. These changes to the historic bottomland hardwood disturbance regime have limited the regenerative potential of many current and formerly dominant bottomland tree species (willow, cottonwood, river birch) and allowed floodplain forest species composition to be driven largely by shade tolerance rather than flood tolerance.

Given the long history of hydrological manipulation of the Wisconsin River and the likely impacts it is going to continue to have on the plant and animal communities of the LWSR it is unlikely vegetation management is going to be able to fully mitigate for such large changes. The loss of sediment due to the blockage at the Prairie du Sac dam, the change in variability of flooding events, and human impacts to the ground water that feeds the wetlands of the LWSR, thus it is unlikely that plant and animal communities will ever exactly resemble those seen by the early settlers of the area.

Vegetation and Natural Communities of the LWSR and Opportunities to Conserve Them

Current vegetation of the LWSR is greatly influenced by historical disturbance patterns and recent changes to those patterns. Land use changes over the last 150 years have greatly impacted the current vegetation and habitat quality and availability. Turner et al. (2004) also found that within the Wisconsin River floodplain, landform and flood regime were particularly important in predicting occurrence, community composition, and abundance of trees. The cover current types and their relative abundance on the LWSR are shown on Figure 6 and Map C. The forest component is broken down further in the pie chart in Figure 7. It shows the dominance of the bottomland hardwood and oak cover types. They comprise 88 percent of the forested acres.

Additional information, beyond what is presented in these pages, on the Riverway’s vegetation, natural communities and, and rare species may be found in the *Biotic Inventory and Analysis of the Lower Wisconsin State Riverway* (DNR 2011).

Dry Upland Forests

Dry Upland Forests of the LWSR have changed dramatically in size and quality since widespread Euro-American settlement. The Oak Openings that were once the most common upland type (Finley 1976), along with Oak Woodland, and Southern Dry Forests have largely converted to closed-canopy oak-dominated forests due to suppression of fire or have been cleared and converted to agriculture. Forest Reconnaissance data show that these forest stands are dominated by older age classes with stand maximum ages clustered between 60 – 100 years (WISFIRS 2010). The majority of the oak forests (48% of the total oak forest acreage) have oak as a secondary type and almost 40% of the acreage has either central

hardwoods or northern hardwoods as a secondary type. Forests that are typed as oak have 50% or more of the basal area in oak. Secondary types are the next most common forest type, by basal area.

Over many years these forests, as well as the closed-canopy Southern Dry-mesic Forests, have been impacted by continued fire suppression, grazing, unsustainable timber harvesting, and invasive species. Most of these areas, including the previously open forests, have now developed into closed-canopy forests that may have a mix of forest, savanna, and prairie species.

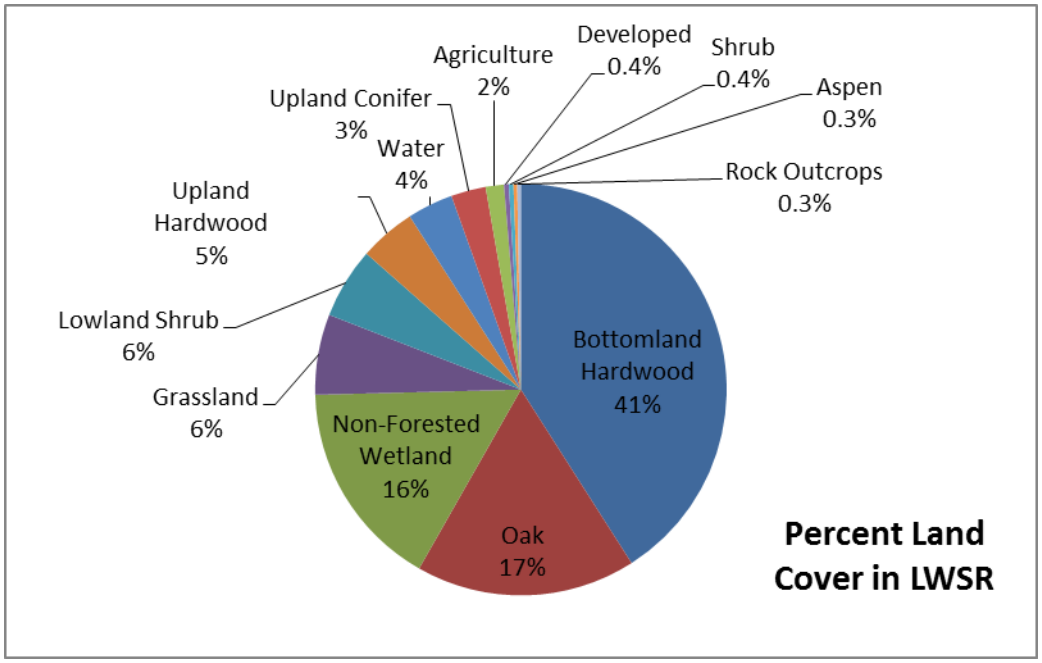

Figure 6. Cover types of the LWSR.

Data was compiled by the Bureau of Facilities & Lands, January 2014. Land cover data for DNR managed lands is derived from the Division of Forestry Wisconsin Forest Inventory & Reporting System (WisFIRS), January 31, 2014.

Southern Mesic Forests

Southern Mesic Forests of the LWSR are typically located in ravines and on steep north-facing slopes. Based on current knowledge of the study area high-quality examples of this type are uncommon in the LWSR and have a dense canopy of large sugar maple and red oak with basswood, black walnut, hackberry, and white ash as canopy associates. The sapling and shrub layer varies and includes species such as sugar maple and basswood saplings and bladdernut. The ground layer is dense, rich, and diverse with wood nettle, hairy sweet cicely, spring beauty, maidenhair fern, wild geranium, bishop's-cap, and Virginia waterleaf. Associated Moist cliffs and seepages may occur with sugar maple, red oak, club mosses, lichens, liverworts, wood nettle, giant wood fern, wild leek, and mayapple.

Southern Dry-mesic Forests

High quality Southern Dry-mesic Forests are rare, though extant examples have recovered well from previous disturbances and sometimes only have small populations of invasive plant species. Red oak is the most abundant canopy species with sugar and red maple, white oak, and basswood as important associates. These forests generally have a diverse ground layer that varies from rich mesic herbs on lower slopes to drier, savanna species on upper slopes. Associated Dry cliffs are known from the north side of the river on south-facing slopes. These steep sandstone cliffs have smooth cliff brake, wild columbine, sand cress, bittersweet nightshade, bristly greenbrier, Virginia creeper, bladder fern, mosses, and lichens and are embedded within Southern Dry-mesic Forests.

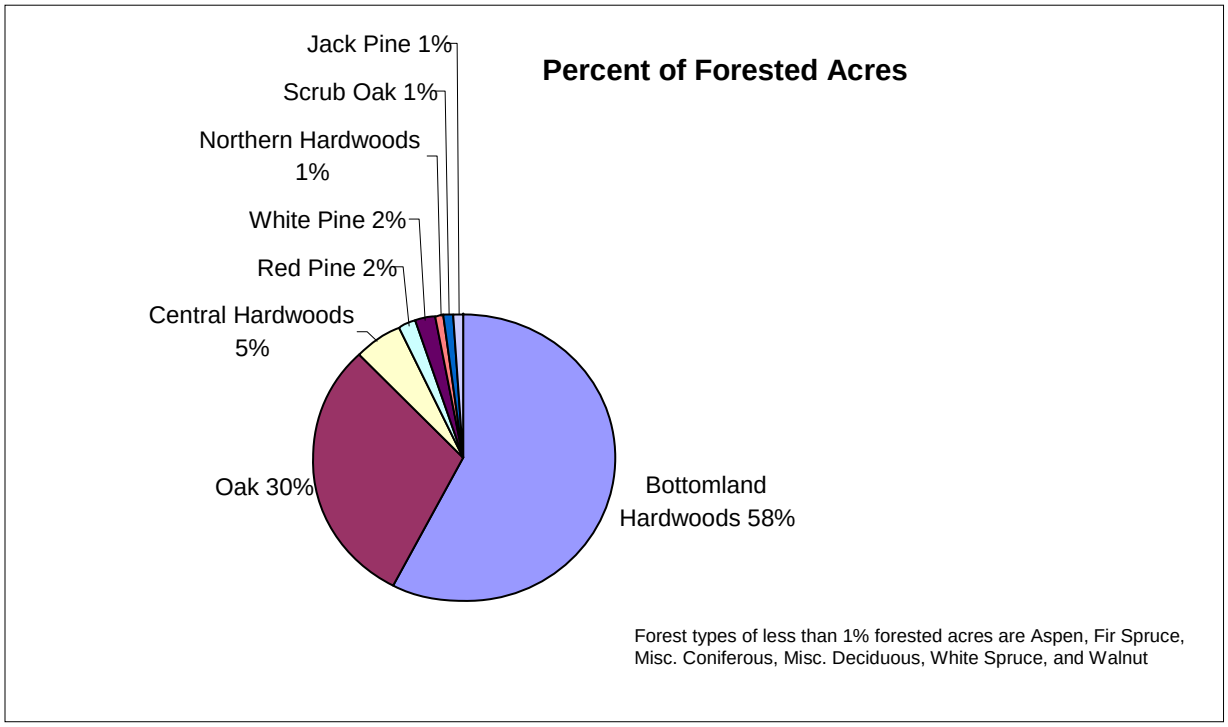

Figure 7. Forested cover types of the LWSR.

(Data are from the Division of Forestry WISFIRS, November 4, 2010.)

Southern Dry Forests

Based on current knowledge of the study area, high-quality Southern Dry Forests are currently very rare on the LWSR and are only represented by one low-quality example on a south-facing slope. About 20-40% of the canopy trees are black oak, with hackberry and basswood also common. Prickly-ash, raspberry, blackberry, and sand cherry are present in the sapling/shrub

Historical Vegetation

- The uplands of the LWSR study area historically supported Oak openings as the most common type (Finley 1976). The top four most often reported trees by the early surveyors for the PLSS were: white oak, black oak, northern pin oak, and bur oak.
- The wetlands of the LWSR study area historically supported lowland hardwoods as the most common type (Finley 1976). The eight most often reported trees by the early surveyors for the PLSS (representing almost 80% of the trees within the wetlands) were: white oak, bur oak, elm, white maple (silver maple), black oak, white ash, pin oak, and hickory.

layers. Common ground layer species include wild geranium, false Solomon's-seal and hog-peanut.

Pine Relicts

Pine Relicts are pine-dominated conifer forests that occur as discrete, isolated stands in the Driftless Area. Within the LWSR, Pine Relicts are extremely rare and based on current knowledge of the study area only one high-quality example is known. Above a 30-foot sandstone ridge is a forest with a white pine (12-20 inches dbh) dominated canopy with white oak (to dbh of 30+ inches), red oak, white oak, red maple, and big-tooth aspen as canopy associates. The subcanopy cover is dense, dominated by white pine and red maple, with red and white oaks as associates. The sapling layer has a moderate cover of red maple with red oak, hackberry, bitter-nut hickory, and shagbark hickory. The shrub layer has a moderate cover of prickly ash, Alleghany blackberry, Virginia creeper, and red raspberry. Ground layer species generally considered as indicators of Pine Relicts are rare at this site. The current ground layer is sparse and includes wood nettle, wood anemone wild sarsaparilla, partridgeberry, and hairy sweet cicely.

Floodplain Forests

Floodplain Forests of the LWSR are represented by many large, high-quality examples. The dominant trees of these forests can vary depending on local elevation differences, hydrology, soil characteristics, and disturbance history. Canopy trees include silver maple, river birch, green ash, hackberry, swamp white oak, quaking aspen, basswood, bitternut hickory, eastern cottonwood, honey locust, and black walnut. Around small streams, spring ponds, and oxbow lakes, shrubs such as buttonbush may be abundant.

Floodplain forest within the Lower Wisconsin State Riverway. Photo by Christina Isenring.

Ground layer species include wood nettle, sedges (e.g., Gray's sedge, common hop sedge, bottlebrush sedge, and bent-seeded hop sedge), native grasses (e.g., common wood-reed, silky wild-rye, and white grass), ostrich fern, and green-headed coneflower. Lianas and herbaceous vines such as Virginia creeper, grapes, Canada moonseed, and poison-ivy reach their highest density in floodplain forests.

Oak Openings and Oak Woodlands

Oak Openings and Oak Woodlands were historically common on the LWSR. Fire suppression, agriculture, and other previous disturbances have largely reduced these types. Based on current knowledge of the study area high-quality examples persist in only three areas of the LWSR and only under an intensive regime of prescribed fire and brush removal. Based on current knowledge of the study area remnant Oak Woodlands are found at two sites, Ferry Bluff and Millville Woodland & Adiantum Woods, and are characterized by semi open-grown white and bur oaks over a ground layer for which species composition varies. These small examples

of Oak Openings and Oak Woodlands are embedded within high-quality natural matrices of upland oak forest.

Barrens Natural Communities

Barrens natural communities of the LWSR are present on the broad sandy river terraces of the Lower Wisconsin River and include Pine Barrens, Oak Barrens, and Sand Barrens. Pine Barrens and Oak Barrens of the LWSR are very similar, except that the Pine Barrens are dominated by jack pine in the overstory and Oak Barrens are dominated by black oak with bur oak and occasionally white oak. Based on current knowledge of the study area Pine Barrens are only known from one high-quality example, Gotham Jack Pine Barrens SNA, and Oak Barrens are known from four sites, Mazomanie Oak Barrens, Blue River – Muscoda Sand Barrens, Millville Woodland and Adiantum Woods, and Smith Slough. Many of the highest quality barrens sites are being managed for these types through prescribed burning and brush and tree removal. Generally these barrens sites have scattered trees over a ground layer typical of Sand Prairies with lichens common. Sand Barrens are potentially anthropogenic in origin and may have developed from attempts to farm the unstabilized or semi-stabilized sands along the Lower Wisconsin River. Unvegetated “blow-outs” are characteristic features. Barrens, Dry Prairie and Sand Prairie plants such as false-heather, bearberry, sedges, sand cress, three-awn grasses, rock spikemoss, and the earthstar fungi are present in this community.

Prairies

Prairies of the LWSR, although never historically abundant, play an important role in the floodplain wetlands, sandy river terrace barrens, and the upland woodland/forest complex. Prairie types currently represented by high-quality examples in the LWSR include Dry Prairie, Dry-mesic Prairie, Wet-mesic Prairie, and Sand Prairie. Many Dry Prairie remnants are small and occur on steep south or west-facing slopes or at the summits of river bluffs with sandstone or dolomite bedrock near the surface. Remnant Dry-mesic Prairies are very rare on the LWSR because of agricultural conversion and woody encroachment. The only remaining known high-quality examples are on upper slopes of south-facing ridges and have a diverse ground layer with characteristic tall grasses (big blue-stem and Indian grass).

False-heather at Woodman Lake Sand prairie and Dead Lake SNA. Photo by Kathryn Kirk.

Very few high-quality examples of Wet-mesic Prairie are known from the LWSR. The highest-quality site, Avoca Prairie and Savanna SNA, is located on an extensive outwash sand terrace along the Wisconsin River and contains one of the largest natural tall-grass prairies east of the Mississippi River, with more than 200 species of vascular plants. Frequent flooding has created braided stream topography characterized by low, sandy ridges with barrens vegetation interspersed with small linear wetlands giving a local relief of four feet. Tall grasses (big blue-stem, prairie cord grass [*Spartina pectinata*], and Indian grass) and sedges characterize the low Wet-mesic Prairie. Historically, Sand Prairies may have been common on the broad sandy terraces of the Lower Wisconsin River. Many of these areas were farmed, planted to pine

plantations, developed for residential use, or through succession, developed into forests. Today, Sand Prairie remnants are generally represented by small openings within a barrens-dominated area or by long, narrow prairies along railroad corridors maintained by periodic accidental fires.

Open Wetlands

Open wetlands of the LWSR are found within the floodplain of the Lower Wisconsin River, often in very large complexes that include Southern Sedge Meadow, Emergent Marsh, Submergent Marsh, and Shrub-carr. These wetlands show typical zonation of dominant plants likely based on age and depth of peat, with the younger, less consolidated peat supporting Emergent Marsh and the firmer peat supporting Southern Sedge Meadow and Shrub-carr. Characteristic Southern Sedge Meadow species include tussock sedge, blue-joint grass, northern bugleweed, spotted Joe Pye-weed, broad-leaved cat-tail, and swamp milkweed. Characteristic Emergent Marsh species include cat-tails, bulrushes, common bur-reed, pickerel-weed, arrowheads, common spike rush, and wild rice. Characteristic Submergent Marsh species include pondweeds, waterweed, slender naiad, and milfoil. Characteristic Shrub-carr species include red-osier dogwood and slender willow over typical Southern Sedge Meadow species.

Rare Vascular Plants

The LWSR supports 92 known element occurrences of 44 NHI Working List plant species, including 4 State Endangered, 5 State Threatened, and 35 State Special Concern species. They are detailed in Appendix B. Particularly significant are rare plants associated with four groups of natural communities: 1) Floodplain Forest, 2) Southern Mesic Forest, 3) Oak Barrens, and 4) Oak woodland/Oak Openings. See Conservation Opportunities for Biodiversity and Natural Communities for information on conservation opportunities for rare plants associated with these communities.

Opportunities for Biodiversity Conservation

Ecological Connections

The LWSR offers a significant opportunity to manage a landscape mosaic of diverse habitats. The connection of upland forests with bedrock outcrops of Dry Prairie to the expansive lowland forests and wetlands of the river valley bottom are an exceptional opportunity for landscape level management.

This mosaic of diverse habitats meets the needs of many animal species that require a variety of habitat types for shelter, foraging, rearing their young, and hibernating. By providing this waterbody-to-wetland-to-upland continuum, the habitat needs for wildlife are maximized, and their safe movement from one habitat type to the next is ensured.

Migration Corridor

The Wisconsin River, flowing 430 miles from its point of origin on the Wisconsin-Michigan border at Lac Vieux Desert to its confluence with the Mississippi, provides a critical link from the forests of the north to the Mississippi River and the Gulf of Mexico. In particular, the LWSR is important to the migration of many terrestrial and aquatic species because of its shared boundaries with the nationally significant Mississippi River, the Driftless Area, and the Upper Mississippi migratory bird flyway.

The LWSR is a well-known bird migration corridor, hosting hundreds of thousands of birds in spring and fall, from songbirds to shorebirds, waterbirds and raptors. In the winter, raptors such as Rough-legged hawk, American kestrel, sharp-shinned hawk, northern goshawk, and sometimes short-eared owl concentrate in the river valley. Large populations of bald eagles, diving ducks and gulls occur in winter, often congregating below the Prairie du Sac dam when the river freezes elsewhere. Numerous wooded bluffs, including Ferry Bluff, Lone Rock Bluffs and Sugarloaf are important roost sites for wintering bald eagles (Mossman and Steele In prep.). Since 2002, during the spring and fall migrations, whooping cranes have used the wetlands of the LWSR for foraging and roosting.

Older Forests / Old-Growth Forests

Older forests (greater than 100-120 years old) in Wisconsin are rare and declining, largely due to timber harvesting and conversion to other land uses (DNR 2010b). The DNR has identified a need to conserve, protect, and manage old-growth forests (DNR 2004, DNR 1995) and old-growth management is a component of Forest Certification. Old-growth stands are sometimes characterized by a multi-layered, uneven age and size class structure; a high degree of compositional and structural patchiness and heterogeneity; and significant amounts of coarse woody debris and tip-up mounds (DNR In Prep. a). The structural diversity provided by old-growth and older forests that support unique assemblages of plants, birds, and other animals.

The LWSR offers exceptional opportunities to manage for older forests and old-growth forests on a landscape level and the prospect for old-growth stand development is very good on the LWSR within the next 20 years (DNR 2011). In Wisconsin, bottomland hardwood types older than 100 years represent less than 2.4% of this type's total acreage statewide (DNR In Prep. b). On the LWSR, currently 32% of the bottomland hardwood forests are over 100 years old. Although only 4% of Wisconsin's forests are over 100 years old and most are between 60 and 80 years old (DNR 2010b), DNR Forest Reconnaissance data for the LWSR indicate that 16% of the oak forests are over 100 years old (WISFIRS 2010c). Another 11% of the forests are between 96 and 100 years old.

Older forests of the LWSR provide habitat for many rare and declining species in the state, including red-shouldered hawk, cerulean warbler, prothonotary warbler, Kentucky warbler, Acadian flycatcher, and all of Wisconsin's summer resident forest bats including the recently state listed big brown, little brown, eastern pipistrelle, and northern long-eared bats.

Floodplain Forests

The LWSR contains some of the most extensive Floodplain Forest in the state, and the Western Coulee and Ridges Ecological Landscape is a major conservation opportunity for this community type (DNR In prep. a). Floodplain Forests along the LWSR support the state's entire population of purple rocket as well as significant populations of several other rare species. The LWSR contains approximately 20% of the known populations in the state of: Kentucky coffee-tree, sycamore, spreading chervil, small forget-me-not, and sweet-scented Indian-plantain. This habitat occurs along the entire LWSR, but is particularly important in the Richwood, Millville, and Woodman units.

Changes to the historical disturbance regimes in the lowland forests of the LWSR are described in the previous section titled Ecological Changes in Recent History. These alterations have undoubtedly changed the lowland forests of the LWSR over the past 180 years. Floodplain

Forests and other natural communities of the LWSR and throughout Wisconsin may be transitioning to novel ecosystems. Understanding how these alterations have changed the composition, structure, and age class distribution of these forests is difficult and determining how to protect and enhance these forests in the future given the continued alterations to historical disturbance regimes is even more challenging.

(Ecological restoration that aims to restore plant communities to reflect undisturbed conditions may not be appropriate given the long history of hydrologic modification and other disturbances (Tingle et al. 2001).) Given that many of the changes to these forests were made by factors that are likely to continue into the future, key management considerations are how to maximize the beneficial changes to these forests (habitat for rare and declining species as an example) and reduce the less beneficial aspects (ecological simplification for example).

Slough within a Floodplain Forest. Photo by Janeen Laatsch.

Because of the unique circumstances on the LWSR, including a wide valley that supports the development of extensive forests, limited urban and industrial development, and 92 miles of free-flowing LWSR, conservation opportunities to support Floodplain Forests and the rare plants are perhaps greater here than anywhere else in the state. Critical sites on the Riverway for protecting and managing Floodplain Forest and their associated flora and fauna are the following Primary Sites: Richwood Bottoms Area, Wauzeka Bottoms, Mazomanie Bottoms, Weniger Island and Forest, Millville Woodland and Adiantum Woods, Cynthia Slough, Bakken's Pond Marsh and Woods, Cedar Island, and Smith Slough.

Aquatic Features

Unique aquatic resources present in the LWSR include springs, spring ponds, spring runs, oxbow lakes, and sloughs. In the Driftless Area where natural lakes are scarce, the extensive network of Wisconsin River sloughs, floodplain and oxbow lakes function as ecologically significant areas for rare fishes, bryozoans, aquatic insects, reptiles and amphibians (DNR 2010a).

Floodplain lakes and spring ponds in the LWSR are especially important as habitat for a number of rare fish. These groundwater influenced waterbodies typically have high water clarity, colder water temperatures, higher dissolved oxygen levels, low sedimentation, and are relatively stable with very little change in water temperature, water flow, or chemical composition.

These waterbodies typically have much greater plant and fish diversity than those fed mainly by alluvial riverine water similar to the main channel of the river. These features are highly susceptible to damage, and land use practices that lead to soil or hydrological disturbance

should be avoided. Recharge areas need to be identified and managed carefully if the springs and seeps are to remain functional.

Floodplain lakes and the main channel of the Lower Wisconsin River support a unique blend of riverine and lake fish populations, and contain perhaps the most abundant populations of rare and endangered aquatic species in southern Wisconsin (DNR 2010a). These important areas are susceptible to the effects of area land use development because potential stormwater runoff and groundwater impacts may degrade habitat and water quality (Marshall et al. 2011).

Important Primary Sites[1] for the protection of aquatic features are the Goodwiler Lake Lowlands, Smith Slough, Avoca Prairie and Savanna, Bakken's Pond Marsh and Woods, Orion Mussel Bed, and Fishtrap Flowage and Bottoms. In addition, Jones, Wood, and Norton sloughs on private lands near Spring Green have high importance for aquatic features and should be a priority for acquisition.

Open Wetlands

Open wetlands (wetlands not dominated by woody vegetation) of the LWSR include Southern Sedge Meadows, Emergent Marsh, and Wet-mesic Prairie. These wetlands are an important part of the habitat needs of numerous invertebrates, birds, fish, and amphibians and perform important ecological services such as water filtration and flood mitigation.

The LWSR offers several opportunities to manage and protect wetlands within a mosaic of native grasslands, older forests, and good-quality aquatic communities. Some of the best wetlands could be considered for special management and protection designation, particularly where rare and declining species have been documented. Primary sites with opportunities to protect and manage open wetlands and their associated flora and fauna are: Bakken's Pond Marsh and Woods, Smith Slough, Avoca Prairie and Savanna, Goodwiler Lake Lowlands, Fishtrap Flowage and Bottoms, and Wauzeka Bottoms.

Oak Openings, Oak Woodlands, Prairies, and Barrens

Prairies, Oak Openings, Oak Woodlands, and Barrens were historically common in Wisconsin but are now rare throughout the state. Restoration of these globally rare natural communities is critical to the survival of many rare plants and animals that depend on them. The LWSR offers opportunities to restore prairies, Oak Openings, Oak Woodlands, and barrens on a landscape scale and within a matrix of other habitats.

Oak Openings were historically abundant in Wisconsin, covering approximately 5.5 million acres (Curtis 1959). Review of historical literature indicates that Oak Openings once supported an exceptionally diverse flora, about 25% of the entire native flora of Wisconsin (Leach and Givnish 1999). Of the about 75,000 acres (Hoffman 2009) of Oak Opening remaining in Wisconsin, many of these are highly degraded or have succeeded to closed-canopy oak forests. The few extant remnants are mostly on drier sites, with the mesic and wet-mesic Oak Openings almost totally destroyed by conversion to agricultural or residential uses and by the encroachment of other woody plants due to fire suppression.

[1] "Primary Sites" are specific sites on the property that contain relatively undisturbed, high-quality, natural communities; provide important habitat for rare species; offer opportunities for restoration; provide important ecological connections; or some combination of these factors.

Oak woodland once occupied approximately 1.4 million acres (Curtis 1959) in pre-widespread Euro-American settlement Wisconsin; today, it is extraordinarily rare – only about 140,000 acres remain in the state (Hoffman 2009). Most of these remnants are highly degraded and have converted to closed-canopy oak forest.

Oak Openings and Oak woodland have suffered drastic declines since the early 1800s, primarily due to fire suppression, grazing, and unsustainable logging. These natural communities typically occur on south-facing or west-facing slopes, and are often interspersed with small prairie openings and Dry cliffs. The LWSR presents a unique opportunity to manage for Oak woodland, Oak Openings, and Dry cliffs. Several rare plants associated with Oak Openings/oak woodland occur along the LWSR. Rare plants in this habitat with a significant number of their known populations along the LWSR include chinquapin oak, lance-leaved buckthorn, and upland boneset.

Prairie once occupied approximately 2.1 million acres in Wisconsin. Now, approximately 2,000 acres remain – less than 0.1% (Leach and Givnish 1999). Of these, only those prairies that occurred at the wet and dry ends of the soil spectrum survived. Wisconsin has more Dry Prairies than any other state in the Upper Midwest because of the many steep-sided bluffs in the extensive Driftless Area. Oak Barrens and Dry Prairies are found on sandy terraces deposited by glacial meltwater. Oak Barrens are uncommon in Southern Wisconsin. The LWSR provides one of the best conservation opportunities in southwest Wisconsin for rare plant species associated with these communities.

Historically maintained by periodic fire, Oak Barrens and associated species now require prescribed burning and may also benefit from tree and shrub clearing. During the Dust Bowl era, treeless barrens were often planted to conifers due to perceived threats of soil erosion. Today, removal of aging pine plantations may present an opportunity to restore Oak Barrens and enlarge habitat for rare and declining species. In particular, Oak Barrens present an opportunity to manage for plants like prairie fame-flower and clustered poppy-mallow. Globally rare, these species reach their greatest abundance nationwide in Wisconsin. Other rare plants associated with Oak Barrens and Dry Prairies include; American fever-few, arrow-headed rattle-box, cleft phlox, hairy wild-petunia, Narrow-leaved dayflower, one-flowered broomrape, pale false foxglove, prairie false-dandelion, prairie fame-flower, prairie Indian plantain, prairie ragwort, prairie turnip, Richardson sedge, violet bush-clover, and yellow gentian. Since these species require open sandy soil with sparse vegetation, careful management of Oak Barrens could help protect these species from further declines. Significant areas for rare plants associated with Oak Barrens include the Avoca, Blue River, Buena Vista, Mazomanie, Lone Rock, and Millville units.

Many former Oak Woodlands are now closed-canopy forests that provide critical habitat for numerous species. Ecological restoration that converts closed-canopy forests to Oak woodland may benefit some savanna specialist species at the expense of other species. As with all ecological restoration opportunities, sufficient resources must be available to ensure success of the project before the difficult decision of limiting habitat for some species in favor of other species is made.

Opportunities exist in the LWSR to restore Oak Openings, Oak Woodlands, prairies, and barrens, increase connectivity between remnant sites, and improve habitat for many grassland, savanna, woodland, and barrens plants and animal specialists. Primary sites with opportunities to protect and manage prairie, Oak Opening, Oak woodland, barrens and their associated flora

and fauna are; Ferry Bluff, Avoca Prairie and Savanna, Blue River Barrens, Gotham Jack Pine Barrens, Smith Slough, Richwood Bottoms Area, Mazomanie Oak Barrens, and Millville Woodland and Adiantum Woods.

Mesic Forest Rare Plant Conservation

Southern Mesic Forests, which occur on north-facing slopes and ravines along the LWSR, present a significant conservation opportunity for rare plants. The LWSR supports significant populations of putty root and great water-leaf. Other rare species present in these forests include the southwestern-most populations of snow trillium and broad beech fern. These habitats are especially significant in the Richwood, Millville, and Wyalusing units. Two additional plants, jeweled shooting star and Short's rock-cress occur in more specific habitat within Southern Mesic Forests. These species are found where Moist cliffs and outcrops occur on shaded, north-facing slopes.

Southern Mesic Forests have drastically declined since about 1800 due to unsustainable logging, clearing for agriculture, and grazing. Today, these forests are threatened by invasive species like garlic mustard and non-native earthworms (Hale et al. 2005). Opportunities that seek to promote older, larger trees (>100 years of age), maintain an intact forest canopy, mitigate threats, and minimize disturbance will help conserve these forests and plants.

Exceptional Site-specific Opportunities for Natural Community Conservation

The Wisconsin Wildlife Action Plan (WAP) (DNR 2006b) identifies 34 natural communities for which there are "Major" or "Important" opportunities for protection, or restoration, or management in the Western Coulee and Ridges Ecological Landscape. Twenty-two of these natural communities are present on the LWSR. They are:

- Cedar glade
- Dry Prairie
- Dry-mesic Prairie
- Emergent Marsh
- Ephemeral pond
- Floodplain Forest
- Wet-mesic Prairie
- Shrub-carr
- Moist cliff
- Oak Barrens
- Oak Opening
- Oak woodland
- Pine Barrens
- Pine Relict
- Sand Prairie
- Southern Dry Forest
- Southern Dry-mesic Forest
- Southern Mesic Forest
- Southern Sedge Meadow
- Surrogate grasslands
- Warmwater River
- Warmwater Streams

The best known opportunities for management or protection of these natural communities on the LWSR are represented by areas called "Primary Sites", described below.

Primary Sites

Twenty-eight "Primary Sites" were identified on the LWSR. These "Primary Sites" are identified because they contain relatively undisturbed, high-quality, natural communities; provide important habitat for rare species; offer opportunities for restoration; provide important ecological connections; or some combination of the above factors. Figures 8 and 9 illustrate the locations of the Primary Sites. Not all of the study area was thoroughly surveyed because of budget and time constraints, therefore there may be other ecologically important areas not identified as Primary Sites.

In depth descriptions for each of the Primary Sites can be found in Appendix G of the biotic inventory report; *Biotic Inventory and Analysis of the Lower Wisconsin State Riverway* (DNR 2011). Information provided includes location information, a site map, brief summary of the natural features present, the site's ecological significance, and management considerations.

Lower Wisconsin State Riverway Primary Sites

LWSR01	Mazomanie Oak Barrens
LWSR02	Ferry Bluff SNA
LWSR03	Mazomanie Bottoms SNA
LWSR04	Boneset Savanna
LWSR05	Cedar Island
LWSR06	Buttonweed Barrens
LWSR07	Arena Pines and Sand Barrens SNA
LWSR08	Tower Hill Bottoms
LWSR09	Cynthia Slough
LWSR10	Bakken's Pond Marsh and Woods

LWSR11	Smith Slough
LWSR12	Gotham Jack Pine Barrens SNA
LWSR13	Avoca Prairie and Savanna SNA
LWSR14	Bogus Bluff
LWSR15	Orion Mussel Bed SNA
LWSR16	Avoca-Muscoda Barrens
LWSR17	Goodwiler Lake Lowlands
LWSR18	Fishtrap Flowage and Bottoms
LWSR19	Blue River – Muscoda Sand Barrens
LWSR20	Pine Relict
LWSR21	Blue River Bluffs SNA
LWSR22	Richwood Bottoms Area
LWSR23	Clear Creek Lowlands
LWSR24	Woodman Lake Sand Prairie and Dead Lake SNA
LWSR25	Woodman Habitat Preservation Area
LWSR26	Wauzeka Bottoms
LWSR27	Millville Woodland and Adiantum Woods
LWSR28	Weniger Island and Forest

Figure 8. Primary Sites on the eastern half of the Lower Wisconsin State Riverway.

(Site descriptions are provided in Appendix G of the LWSR Biotic Inventory and Analysis [DNR 2011].)

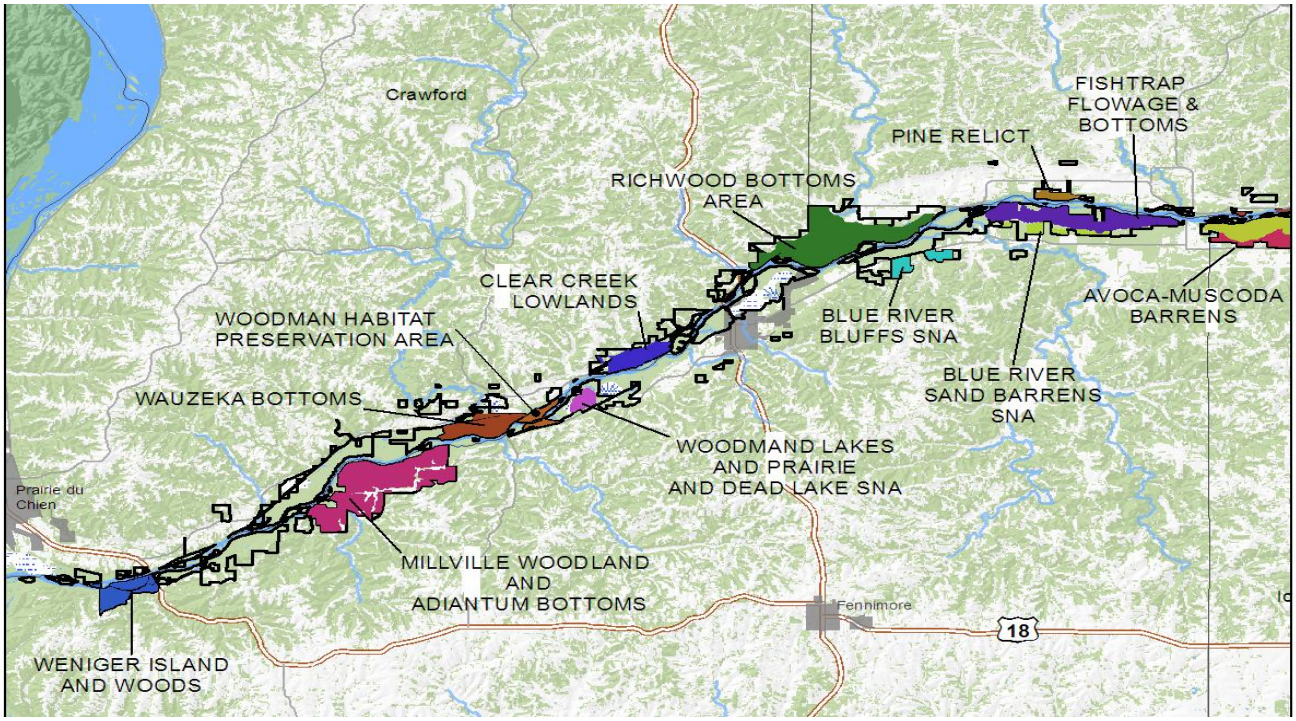

Figure 9. Primary Sites on the western half of the Lower Wisconsin State Riverway.

(Site descriptions are provided in Appendix G of the LWSR Biotic Inventory and Analysis [DNR 2011].)

Wildlife of the LWSR

The Lower Wisconsin State Riverway is rich in wildlife resources. Many common game and non-game animals are abundant, and the Riverway is one of the richest sites in the state for a broad spectrum of rare species. The Riverway has 480 known occurrences of 122 rare animal species (including 3 Federally listed or candidates for listing, 15 State Endangered species, 21 State Threatened species, and 84 state Special Concern species). Over 37% of the animals on the State Threatened and Endangered Species lists are found in the LWSR. They are detailed in Appendix C.

Mammals

Important common game species include cottontail rabbits, grey and fox squirrels, raccoons, and white-tail deer. Mink, muskrats, and beavers are abundant in the floodplains, marshes and sloughs. The river otter is also common in the Lower Wisconsin River Valley.

Rare mammals

The LWSR provides excellent habitat for rare small mammals and bat populations. Several records of the prairie vole are located within the LWSR at Sand Prairie and barrens habitats. More survey work is needed to detail the rarity of this species statewide, but the LWSR appears to be an important landscape for maintaining this uncommon small mammal. All bat species known to occur in Wisconsin within the past fifty years are represented within the LWSR. Excellent habitat is present throughout the LWSR to maintain strong bat populations through a critical period for bat management nationwide as White Nose Syndrome spreads across the country and threatens large populations of over-wintering cave bats.

Birds

The Lower Wisconsin valley is an excellent area to observe birds. About 285 species have been recorded in the area. It's suspected that 146 of these regularly breed here and 84 species are considered abundant, common, or fairly common breeders here. The remainder, such as common loon, peregrine falcon and chestnut-sided warbler, are migrants, passing through or pausing briefly in the corridor on their biannual flights. Thirty nine of the resident species are considered rare.

Upland game birds include ruffed grouse, ring-necked pheasant, gray partridge, woodcock, mourning dove, and wild turkey. Historically, wild turkeys were abundant in the region but declined soon after European settlement. Efforts to reestablish this big game bird have been very successful and turkeys are again abundant in the river valley. Ring-necked pheasants are regularly stocked on selected state hunting grounds along the river because of the high demand for this game bird. Although suitable winter cover is found along the Lower Wisconsin River, natural reproduction of pheasants is very limited.

Twenty-three species of waterfowl may be seen migrating through the area, and seven species nest within the corridor. The many protected backwaters provide important brood areas as well as resting and staging areas during migration flights. The timbered bottomlands with associated marshes provide ideal habitat for wood ducks and reproduction is excellent. Ground nesting species, such as mallards and blue-winged teal, nest in the area but predators and occasional

flooding limits their success. Numerous backwater areas are popular with duck hunters.

Rare birds

- Greater than 25 red-shouldered hawk nesting territories are known from the Riverway with the most significant areas at Richwood Bottoms, Clear Creek Lowlands, and from Spring Green downriver to Bakken's Pond and Long Island. This species requires large tracts of mature, closed canopy forest in close proximity to wetlands and water, predominately found throughout the extensive Floodplain Forests of the LWSR. The LWSR may support the largest population in the state for this State Threatened species with estimates of 40-80 breeding pairs likely present (Mossman and Steele in *Press*). Prothonotary warbler (Special Concern) was also found in very high numbers in these lowland forests. This species requires cavities in trees near open water for nesting.
- Bald eagles are found nesting in abundance (27 to 28 active territories) throughout the LWSR along the main channel, floodplain lakes, and large open impoundments. The LWSR is also an important wintering area for bald eagles with several roost areas present. Wintering bald eagles seek out roost locations with appropriate features that include large, mature canopy trees in close proximity to open water foraging areas. The eagles have a reduced activity level in winter as compared to the breeding season, so the proximity of the roosts to good open water foraging areas is a critical component of winter habitat selection (Hall 2005). Eagles tend to utilize large portions of the LWSR for these foraging and roosting areas when the river is open, but begin to congregate more near the Prairie du Sac dam as more and more of the river becomes iced-over. This makes the Prairie du Sac dam the single most highly utilized area by wintering eagles in the state (Martell et al 1991).
- The LWSR is one of the few remaining major forested landscapes of southern Wisconsin and supports good populations of conservative, area-sensitive birds. Much of this is attributed to the large, expansive floodplain forest habitats, but connections to upland mesic and dry-mesic forests add to the importance of these areas.
- Significant populations of barrens, savanna, and grassland birds breed along the river terraces and open bluffs, including lark sparrow, brown thrasher, blue-winged warbler, field sparrow, red-headed woodpecker, a suite of rare grassland birds, and what may be the largest population of whip-poor-will in southern Wisconsin (Mossman and Steele in Prep.)
- Marsh bird surveys from the larger open marshes and sedge meadows detected uncommon marsh-dwelling birds including the American bittern, least bittern, common moorhen, and a possible king rail (all Special Concern).

Fish

The Lower Wisconsin River Fishery varies greatly in fish habitat and fishing activity along its 92.3 mile length. The river appears to support two distinct fisheries; one being the flowing channels, and the other the backwater sloughs, flowages and spring ponds. These two fisheries primarily interact during periods of high water; at other times the backwaters are cut off, or nearly cut off from the main river channel.

Because it is connected to the Mississippi River, southern and western species of fish are able to move through the Mississippi drainage basin to the Lower Wisconsin River. Thus, the large number of fish species found in the Lower Wisconsin River is not surprising. Studies reveal there are 84 species of fish representing 20 families.

The Lower Wisconsin River has a balanced warm water fish and aquatic life community. The main channel supports significant numbers of walleye, sauger, channel catfish, flathead catfish, smallmouth bass, rock bass, and bluegills, along with lesser but still important numbers of freshwater drum, lake sturgeon and shovelnose sturgeon. Also found here are significant numbers of carp, smallmouth buffalo fish, redhorse, various carpsuckers, white sucker, longnose gar, mooneye, and a variety of minnows.

The 3.5 mile stretch of the river immediately downstream of the dam at Prairie du Sac is heavily influenced by the dam, and is not typical of the rest of the river. The fish population in this stretch below the dam also includes significant numbers of white bass and chestnut lamprey.

There are a number of open water lakes in the Lower Wisconsin River bottoms whose water levels are supported by the water table. These lakes historically had good fisheries for largemouth bass, northern pike, bluegill and crappie. Many of these backwater bodies are quite shallow and have a very limited flow through them during non-flood periods. In many, the original depth between the sand on the bottom and the water surface was 10 feet. However, less than four feet of maximum water depth now occurs in many of them as most of their basins are filled with loose sediment. These shallower lakes closely resemble bog lakes. Rooted aquatic vegetation and sedge mats have choked off some areas and are threatening other areas of open water available to fish. They become oxygen deficient during much of the year, particularly in the winter. The fishery of the larger backwater sloughs, flowages, and lakes of the Lower Wisconsin River Valley is comprised of a mixture of fish which one would expect to find in most any southern Wisconsin eutrophic (nutrient rich) lake, including significant numbers of bullhead, bluegill, largemouth bass, northern pike, and crappie. Also, the larger, deeper backwaters that are permanently connected to the river often contain channel catfish, walleye and sauger. Other fish found in these backwaters and ponds in significant numbers are bowfin, carp and various quillbacks and buffalo fish. The fishery in the oxygen deficient, shallow backwater lakes is limited to a population of stunted black bullheads or no fish at all.

Rare fishes

The Lower Wisconsin River harbors no fewer than 20 species of fishes identified by the Bureau of Endangered Resources' Working List as being endangered, threatened or of special concern in the state.

- The floodplain lakes and sloughs have been found to support a healthy distribution of the State Endangered starhead topminnow (documented from 55 waterbodies to date), good numbers of Special Concern fish species including lake chubsucker, pirate perch, mud darter, least darter, weed shiner, and pugnose minnow.
- The main channel of the Lower Wisconsin River supports globally rare fishes. Ten state listed fish species are present within the LWSR, including globally rare species like crystal darter, blue sucker, and western sand darter.

Mussels and other Aquatic Invertebrates

With mussels having such exotic names as pink heel-splitter, lilliput, flat floater mussel; the Lower Wisconsin River has one of the most diverse mussel faunas in the state along with the St. Croix and Mississippi Rivers. A number of rare mussel species have their stronghold in the Lower Wisconsin River. Several important mussel beds scattered throughout the LWSR support significant populations of the Federally Endangered Higgins' eye pearly mussel and sheepnose, a candidate for Federal listing, along with eight additional state listed mussel

species. (See Appendix C for a full listing of rare mussel species.) The LWSR was chosen by the US Fish and Wildlife Service and the DNR for long-term monitoring and conservation of the Higgins' eye pearly mussel population, because it was one of the few tributaries of the Mississippi River that had an existing population of Higgins' eye, and was not immediately threatened by zebra mussels.

The Riverway hosts two state endangered mayflys and one state endangered beetle. Worthy of special mention is the recent discovery of a population of the Federally Endangered Hine's emerald dragonfly in the LWSR. The wide variety of habitats in the river and its associated backwaters and spring ponds create a diverse and specie-rich aquatic invertebrate community, one of the richest in Wisconsin.

The vast majority of the main channel is sand bottomed harboring a number of sand dwelling specialists including many that are rare like the Pecatonica River mayfly, the flat-headed mayfly, and the yellow sandshell mussel. Snags, which are common along the shoreline and down-stream sandbar edges, create areas of turbulence that often harbor unique fauna, including several rare riffle beetles like Knobel's riffle beetle and mayflies like Wallace's deepwater mayfly.

Backwaters and spring ponds also have a great diversity of species, hosting rare species such as the state imperiled white-spangled skimmer, swamp darner, and Mississippi grass shrimp. One of the hottest spots of aquatic invertebrate species diversity occur where the main channel flows adjacent to an upland bluff and the substrate shifts from the loose sand to firm gravel, rubble or even bedrock bottom. These areas are especially important for mussels which require firm substrate in which to establish them. In terms of relative area this amounts to about 13% of the river's shore line.

Reptiles and Amphibians

The many habitat types of the Lower Wisconsin River corridor support a diverse population of reptiles and amphibians. These two classes of animals are represented by four species of salamanders, eleven frogs and toads, thirteen snakes, eleven turtles, and two lizards with many of these species being quite rare in the state.

Of particular concern are the prairie reptiles, these species utilize open dry bluff prairies, Sand Prairies, mesic prairies, and barrens and savannas which are all habitats having suffered significant losses from their historic acreages. The LWSR represents one of the best opportunities in the state for management of these habitats to enhance existing populations of rare reptiles. Numerous large-bodied snakes including timber rattlesnake, gophersnake, and North American racer den and nest in the bluffs along the Riverway and spend their summers basking and foraging in open prairies, barrens, and savannas here. Additionally, lizards are cold-blooded species seeking similarly hot and dry locations to regulate their body temperatures. Maintaining or enhancing open, dry bluffs or sandy prairies and barrens are critical for the two lizard species found in the LWSR.

Five rare turtle species are found in the Lower Wisconsin River corridor. Warmwater marshes with nearby sandy fields throughout the LWSR, but especially from Avoca to Blue River are critical habitat for Blanding's turtles (State Threatened); it is estimated that hundreds of females nest in this area. Sandy terraces in Dane, Sauk, and Iowa counties provide critical habitat for some of the best remaining populations of the State Endangered ornate box turtle. Several rare "big river" turtle species (map turtles, and smooth soft shell turtle) utilize the main channel,

islands, and sandy terraces of the Lower Wisconsin River and are found at few other locations in the state.

Among the rare frogs and toads present in the corridor is the bullfrog, a species of special concern. The bullfrog, the largest frog in Wisconsin, is most often heard singing from the wooded sloughs and backwaters along the river. The numbers of this slowly-maturing species has declined in recent years. The Special Concern pickerel frog and northern leopard frog are also found along small tributaries, springs, and marshes of the Lower Wisconsin River. Increasing numbers of the state endangered northern cricket frog are again being discovered in or near the Lower Wisconsin River. This is a species that has experienced a major range contraction in the state and is of major management concern. Enhancing populations of this frog should be explored.

Terrestrial Invertebrates

Numerous terrestrial invertebrate taxa are represented in the LWSR but very poor data exists on current populations especially compared to aquatic invertebrates. The following is known about rare species:

The bluff prairies and mesic prairies found in the floodplain of the river support populations of rare leafhoppers and Lepidoptera. The State Threatened prairie leafhopper is known from five sites within LWSR. Rare butterflies and moths found in open prairies and wetlands on the floodplain terraces include the Leonard's skipper, gorgone checker spot, several species of dusky wing butterflies (wild indigo dusky wing, Columbine dusky wing, and mottled dusky wing), and three Special Concern moth species. The sandy terrace openings and barrens, islands and sand blows support populations of rare grasshoppers (five species of Special Concern were located in 2009 at separate locations throughout). Tiger beetles and bees and wasps are also found in these habitats. Several species of tiger beetle are found in the Lone Rock and Buena Vista Units. Additional terrestrial invertebrate survey efforts in the LWSR are an important future inventory need because of a general lack of baseline inventory data (poor weather conditions during this study's scheduled survey period prevented a complete inventory) and the vital importance of considering terrestrial invertebrate conservation during the management planning process.

Management Opportunities for Rare Wildlife Species

The LWSR plays a critical role in conserving several taxa in particular. They include: forest interior birds, grassland birds, marsh birds, fishes, herptiles, aquatic invertebrates, terrestrial invertebrates, and bats. Each is discussed in detail below. This large number of rare animals from numerous taxonomic groups reflects the overall diversity of good-quality habitats that are present throughout the property.

Birds

Forest Interior Birds

The LWSR is one of the few remaining major forested landscapes of southern Wisconsin and holds one of the highest opportunities in the state to manage for southern forest birds, particularly those associated with Floodplain Forest and area-sensitive species requiring large blocks of forested habitats (e.g. prothonotary and cerulean warbler; Mossman and Steele in Prep). An impressive assemblage of rare forest interior breeding birds (Table 9) is present

throughout the LWSR. The area-sensitive species are utilizing the minimally fragmented, contiguous, and older forests present on the LWSR.

Protected large blocks of forest interior habitat are rare in Southcentral Wisconsin and slightly more common in Southwestern Wisconsin. The total land area for the Western Coulee and Ridges Ecological Landscape is approximately 6.2 million acres, of which 38% is classified as timberland and only a small percentage (3%) is in protected public land ownership (DNR In Prep. a). Important opportunities exist in the LWSR to provide large blocks of forest spanning from the extensive mature bottomland forests in the valley bottom to Southern Dry-mesic Forests on the steep slopes and ridge tops. These areas that were unsuitable for raising crops grew into oak-dominated forests after the ubiquitous presettlement wildfires were suppressed (DNR in Prep. a). The Oak Openings that were once the most common upland type (Finley 1976) have largely converted to closed-canopy oak-dominated forests. Forest Reconnaissance data show that these forest stands are dominated by older age classes with stand maximum ages clustered between 60 – 100 years old (WISFIRS 2010c). For many species, the LWSR likely provides the most viable forest habitat in the southern portion of the state.

Many of the rare forest interior birds found on the LWSR have had significant population declines in Wisconsin and throughout their range, further reinforcing the importance of the LWSR for providing habitat. Breeding Bird Survey data show an annual decline of 4.4% for cerulean warblers in Wisconsin (Mossman 2006). Other forest interior birds that may be declining include Acadian flycatcher, least flycatcher and veery. Species that have had population increases continue to be threatened by the edge effects of forest fragmentation.

Primary determinants of interior forest habitat quality include stand composition, age, size, structure, canopy closure, proximity to water or roads, slope and aspect, stand size and shape, and proximity to other stands on the landscape (Wilson 2008). Limiting fragmentation associated with, but not limited to, clear-cutting, road building, or utility and pipeline development is important to the continued viability of these large blocks of forest and their associated bird species (DNR 2006b).

Maintaining the vertical structural diversity currently found within less fragmented forest stands is also important for some forest interior species. Cerulean, Kentucky, and hooded warblers, as well as veery and wood thrush all require a complexity of forest layers for nesting. These species use both shrub and tree species. Some forest interior birds also rely on limb structure that promotes horizontal canopy nesting areas.

Oak savanna and Oak Woodlands, in the context of large contiguous forest patches, can provide a ‘soft edge’ between other habitat types and a closed-canopy forest. Oak woodland restoration, within a large forested area, could promote understory growth and development of full-canopied oaks that produce horizontal limb structure for nesting that is favorable for cerulean warblers and other area-sensitive species such as Kentucky warbler, hooded warbler, veery, and wood thrush.

Maintaining and expanding large blocks of contiguous, mature forests in southern Wisconsin is critical for the future of many forest interior birds. The LWSR offers opportunities, within a landscape context to provide habitat for these species. Primary sites that provide excellent habitat and likely support source populations of forest interior birds in the LWSR (Figure 10) are Mazomanie Bottoms, Tower Hill Bottoms and Cynthia Slough (combined, these sites represent the size and conditions needed for a breeding population), Bakken’s Pond Marsh and Woods,

Richwood Bottoms, Wauzeka Bottoms, and Millville Woodland. These areas should be considered for maintaining forest interior bird populations.

Red-shouldered Hawk. Photo by Brian M. Collins.

Table 9. Forest interior breeding birds of the LWSR. (Listing status is based on the NHI Working List published April 2009.)

Common Name	Scientific Name	State Status
Acadian flycatcher	*Empidonax virescens*	THR
cerulean warbler	*Dendroica cerulea*	THR
hooded warbler	*Wilsonia citrina*	THR
Kentucky warbler	*Oporornis formosus*	THR
least flycatcher	*Empidonax minimus*	SC/M
Louisiana waterthrush	*Seiurus motacilla*	SC/M
Ovenbird	*Seiurus aurocapilla*	none
prothonotary warbler	*Protonotaria citrea*	SC/M
red-shouldered hawk	*Buteo lineatus*	THR
scarlet tanager	*Piranga olivacea*	none
Veery	*Catharus fuscescens*	SC/M
whip-poor-will	*Caprimulgus vociferus*	SC/M
wood thrush	*Hylocichla mustelina*	SC/M
worm-eating warbler	*Helmitheros vermivorus*	END
yellow-billed cuckoo	*Coccyzus americanus*	SC/M
yellow-crowned night-heron	*Nyctanassa violacea*	THR
yellow-throated vireo	*Vireo flavifrons*	none

yellow-throated warbler	*Dendroica dominica*	END

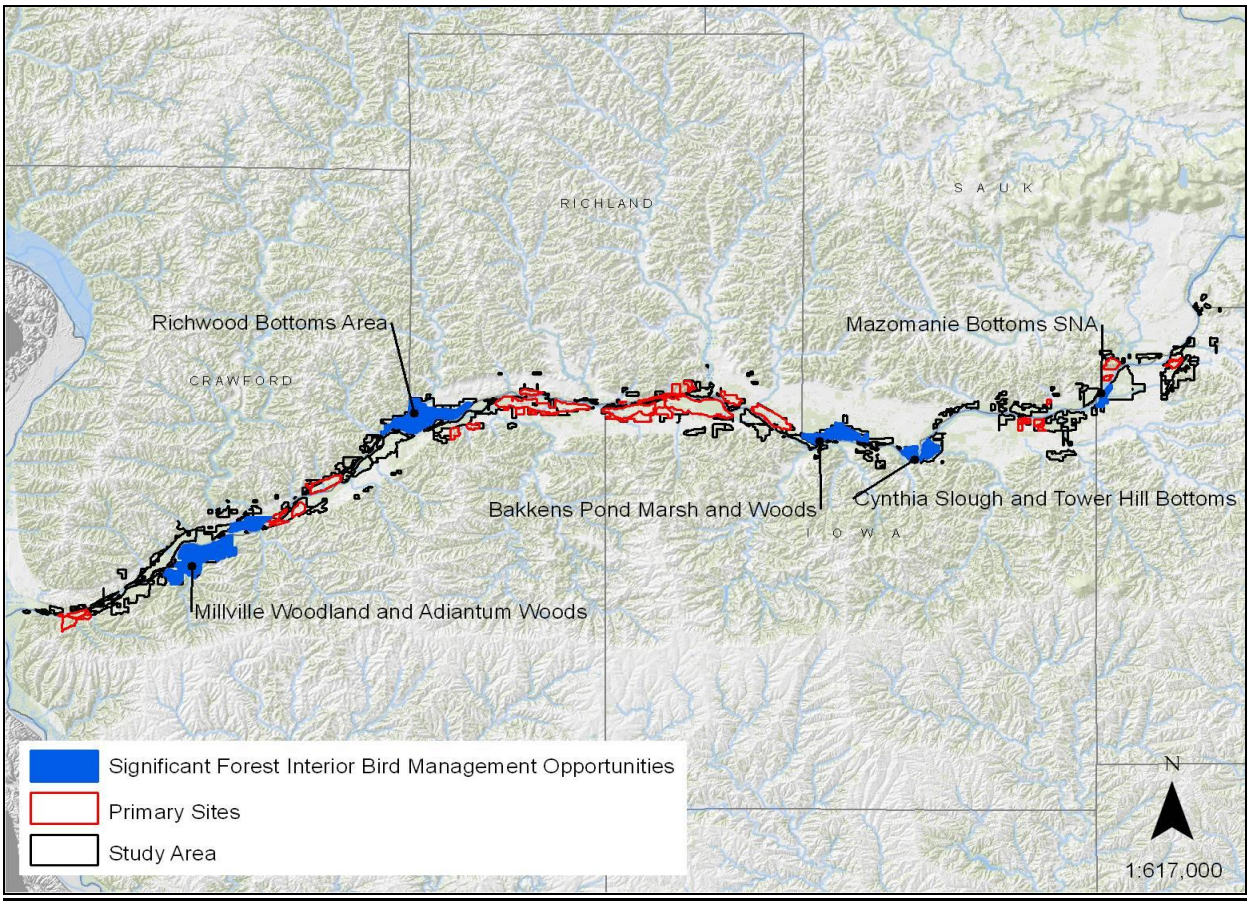

Figure 10. Primary sites with significant management opportunities for forest interior birds.

Grassland Birds

Biologists and birders are concerned about population declines of many grassland bird species. Since the North American Breeding Bird Survey (BBS) began in 1966, grassland birds have declined more steeply than any other group of birds in North America and the Midwest (Sample and Mossman 1997; Askins et al. 2007). The Lower Wisconsin River Prairies and Barrens from Sauk City to Blue River Sand Barrens SNA is noted as one of the highest priority landscapes for grassland birds in the state with current grassland acreage totaling over 2,000 acres with potential for 5,000 grassland acres (Sample and Mossman 1997; DNR 2006b). This grassland acreage supports numerous uncommon bird species (Table 10) and is made up of a highly diverse mix of remnant prairies (from Dry to Wet-mesic), Sand Prairie and barrens, surrogate grassland, Southern Sedge Meadow, upland shrub, and Oak Opening.

Grassland bird habitat is most effectively maintained as large landscapes of continuous grassland, uninterrupted by hedgerows, with the cover of woody plants less than 5% (Sample and Mossman 1997). Hedgerows fragment grasslands and provide habitat/movement corridors for predators of grassland birds. Structural diversity within the grassland, including short and tall grass, a mix of grasses and forbs, and a management rotation of type, intensity, and frequency, is also important for grassland bird habitat. Many grassland bird species, however, require the

structure present in other habitats within a grassland complex, including upland shrubs (Bielefeldt 2010). Managing from a landscape perspective can better accommodate complex habitat needs, including wetland, upland, and savanna components, needed for grassland birds and other grassland obligate species. Much of the need for grassland bird management in the LWSR is for connection of sites along the river corridor (Sample and Mossman 1997). With continuing grassland, wet prairie/meadow, and barrens restoration work in the LWSR, the potential for connection and additional expansion of these open habitats could provide substantial benefits to the full suite of grassland birds.

Remnants of original prairie and savanna and expansive grasslands should be retained/maintained and possibly expanded where appropriate to benefit grassland and savanna birds. Areas with marginal habitat for grassland-dependent species, such as ridgetops and old-fields embedded within a forested landscape should be evaluated for potential for reforestation as interior forest bird habitat is more valuable in these areas (M. Mossman, personal communication).

The best opportunities for maintaining viable source populations of area-sensitive grassland bird species in a landscape context are at Avoca Prairie and Savanna SNA, Mazomanie Unit, Cassel Prairie Unit, Helena Unit, the barrens from Bakken's Pond to Sauk County Forest, Buena Vista Unit – Gotham Jack Pine Barrens SNA, and Boscobel Unit.

Table 10. Bird species of conservation concern found in grassland habitats of the LWSR.
(Listing status is based on the NHI Working List published April 2009**.)**

Common Name	Scientific Name	State Status
Bell's vireo	*Vireo bellii*	THR
black-billed cuckoo	*Coccyzus erythropthalmus*	SGCN
blue-winged warbler	*Vermivora pinus*	SGCN
Bobolink	*Dolichonyx oryzivorous*	SGCN
brown thrasher	*Toxostoma rufum*	SGCN
Dickcissel	*Spiza americana*	SC/M
eastern meadowlark	*Sturnella magna*	SGCN
field sparrow	*Spizella pusilla*	SGCN
grasshopper sparrow	*Ammodramus savannarum*	SGCN
Henslow's sparrow	*Ammodramus henslowii*	THR
northern harrier	*Circus cyaneus*	SGCN
lark sparrow	*Chondestes grammacus*	SC/M
loggerhead shrike	*Lanius ludovicianus*	END
vesper sparrow	*Pooecetes gramineus*	SGCN
western meadowlark	*Sturnella neglecta*	SC/M
willow flycatcher	*Empidonax traillii*	SGCN
yellow-breasted chat	*Icteria virens*	SC/M

Marsh Birds

Open wetland types including Emergent Marsh and Southern Sedge Meadow are not common in the Western Coulee and Ridges Ecological Landscape, but examples are present within major river bottoms including the Lower Wisconsin River. There are several large, high-quality marsh and meadow complexes in the LWSR supporting a unique assemblage of secretive marsh-dwelling birds. Uncommon marshbirds located in moderate numbers during nocturnal surveys in extensive open marsh habitats include least bittern, common moorhen, yellow-

headed blackbird, and American bittern (in wetlands larger than 50 acres). The best examples of these habitats and associated marshbirds exist at the following primary sites: Bakken's Pond Marsh; Smith Slough; East Avoca; Fishtrap Flowage and Bottoms; and Wauzeka Bottoms. Additionally, large, open meadow complexes, especially those in close proximity to upland grasslands, are increasingly important to grassland-associated species like savannah sparrow, eastern meadowlark, bobolink, northern harrier, and short-eared owl. Examples of these types occur at Fisher Lake, Cruson Slough, and Avoca Prairie. Of high importance for birds throughout the LWSR are the shrubby meadows and marshes throughout the river bottoms. These areas support good populations of species of conservation need including willow flycatcher, Bell's vireo, black-billed cuckoo, blue-winged warbler, and American woodcock.

Fishes

The Black, Chippewa and Wisconsin Rivers present very important opportunities to maintain and improve the ecological function of large rivers with extensive floodplain areas (DNR in Prep. a). They all have high "Indices of Biotic Integrity" indicating high quality and healthy ecosystems with the Lower Wisconsin River supporting 98 species of the 147 native fishes in the state (Marshall and Lyons 2008). The unimpeded 92-mile stretch of the Lower Wisconsin River from Prairie du Sac to the Mississippi River supports probably the largest remaining populations in WI of the State Threatened paddlefish, blue sucker, and black buffalo along with the exceedingly rare goldeye, crystal darter and river redhorse. In all, there are 20 rare fishes known from the LWSR, 10 species of Special Concern, six State Threatened, and four State Endangered. Many of the populations represent some of the last remaining strongholds for large river fishes in the Upper Midwest.

The floodplain or oxbow lakes and sloughs, largely overlooked in the past during fish survey efforts, were assessed in 2007 and 2008 by Dave Marshall through a DNR river planning grant. These diverse habitats are a reflection of a natural river floodplain, unlike impounded rivers where the off-channel habitats became permanently flooded and destroyed (Marshall 2008). The recent sampling found significant populations of water-quality sensitive species such as pirate perch (SC), lake chubsucker (SC), mud darter (SC), starhead topminnow (END), and weed shiner (SC) in the spring-fed floodplain lakes and sloughs. The diversity and distribution of these nongame fish, sensitive to environmental degradation, serve as good indicators for the health of streams and lakes (Table 11).

Table 11. Sensitive fish species identified in the Lower Wisconsin River (Marshall and Lyons 2008). (Listing status is based on the NHI Working List published April 2009.)

Common Name	Scientific Name	State Status
chestnut lamprey	*Ichthyomyzon castaneus*	none
silver lamprey	*Ichthyomyzon unicuspis*	none
Mississippi silvery minnow	*Hybognathus nuchalis*	none
pallid shiner (no records since 1962)	*Hybopsis amnis*	End
spottail shiner	*Notropis hudsonius*	none
weed shiner	*Notropis texanus*	SC/N
shoal chub	*Macrhybopsis hyostoma*	THR
highfin carpsucker	*Carpidoes velifer*	none
black buffalo	*Ictiobus niger*	THR
northern hog sucker	*Hypentilium nigricans*	none
spotted sucker	*Minytrema melanops*	none
greater redhorse (no recent	*Moxostoma valenciennesi*	THR

records)		
muskellunge (stocked)	*Esox masquinongy*	none
smallmouth bass	*Miropterus dolomieu*	none
rock bass	*Ambloplites rupestris*	none
western sand darter	*Ammocrypta clara*	SC/N
crystal darter	*Crystallaria asprella*	END
rainbow darter	*Etheostoma caeruleum*	none
Iowa darter	*Etheostoma exile*	none
least darter	*Etheostoma microperca*	SC/N
banded darter	*Etheostoma zonale*	none
slenderhead darter	*Percina phoxocephala*	none
mottled sculpin	*Cottus bairdii*	none

Herptiles

The LWSR was identified as supporting or having potential for restoring habitat for rare herptiles. In particular, a suite of high conservation priority reptiles associated with Sand Prairies, Sand Barrens, and bluff prairies (Casper 2009). Dramatic declines of these community types have occurred since widespread Euro-American settlement with losses being attributed to fire suppression, agriculture and subsequent planting to pines, over-grazing, invasion of woody species, poaching, and invasive species. Natureserve (2010) identifies Oak Openings and barrens communities as globally imperiled (G1 or G2) and Leach and Givnish (1999) note that less than 0.1% of the approximately 2.1 million acres of original prairie remains in Wisconsin. Extensive prairie, Oak Opening, and barrens habitats still occur within the LWSR on sand terraces and extend to adjacent bluffs overlooking the river. Numerous records exist for uncommon lizards, snakes, and turtles utilizing these areas. The LWSR presents one of the best opportunities in the state to protect and enhance populations of ornate box turtles, Blanding's turtle, gophersnake, timber rattlesnake, North American racer, gray ratsnake, prairie ring-necked snake, and six-lined racerunner.

Management that mimics natural disturbance regimes is needed to restore and maintain these fire-dependant habitats, however, the poor dispersal abilities of many herptiles needs to be taken into account when planning habitat management and species recovery. Species conservation actions should focus on known sites of species occurrence, while management plans for specific sites should take into account the needs of the species present or targeted for recovery (Casper 2009). Initial conservation efforts should focus on securing extant viable populations, followed by recovering known dwindling populations (Casper 2009). Units present within the LWSR with management needs aimed at continued maintenance or restoring open prairie or savanna / barrens conditions to enhance target reptile populations include Mazomanie, Blackhawk, Cassel Prairie, Spring Green, Bakken's Pond, Buena Vista, Blue River, and Millville.

Uncommon amphibians are known from the study area as well, but the LWSR generally represents only a small portion of each of these species overall population abundance and distribution in the state. Examples include common mudpuppy, American bullfrog, and pickerel frog. Good or likely better opportunities exist for management of these species in other ecological landscapes. One possible exception is the northern cricket frog. This species has experienced a severe range contraction since the 1960's and is now restricted to extreme southwestern Wisconsin. Numerous historical records exist but only a few records post-1972 are available from the study area. However, current populations are known in close proximity to

the LWSR and thus warrant ongoing survey effort to allow for discovering and protecting populations (Casper 2009).

Aquatic Invertebrates

Aquatic habitats in the Lower Wisconsin River range from flowing to semi-flowing to springs to isolated waters, from shaded to open canopy, from herbaceous to non-vegetated, and from sand to gravel to muck substrates. The wide variety of habitats within the river and its associated backwaters and spring ponds support a diverse and species rich aquatic invertebrate community. Federal and State Endangered and Threatened aquatic invertebrate species found within the Lower Wisconsin River are listed in Table 12.

Table 12. Federal and State Endangered and Threatened aquatic invertebrate species known from the Lower Wisconsin River. (Listing status is based on the NHI Working List published April 2009.)

Common Name	Scientific Name	State Status	Federal Status
Knobel's riffle beetle	*Stenelmis knobeli*	END	
Pecatonica River mayfly	*Acanthametropus pecatonica*	END	
Wallace's deepwater mayfly	*Spinadis simplex*	END	
rock pocketbook	*Arcidens confragosus*	THR	
Butterfly	*Ellipsaria lineolata*	END	
ebony shell	*Fusconaia ebena*	END	
Higgins' eye	*Lampsilis higginsii*	END	LE
yellow and slough Sandshells	*Lampsilis teres*	END	
Bullhead	*Plethobasus cyphyus*	END	C
Monkeyface	*Quadrula metanevra*	THR	
Wartyback	*Quadrula nodulata*	THR	
salamander mussel	*Simpsonaias ambigua*	THR	
Buckhorn	*Tritogonia verrucosa*	THR	

The main channel hosts a large diversity of invertebrates. Rock and gravel bottom substrates harbor many of these species and are relatively rare, making up an estimated 13% of the total shoreline area. These hot spots of invertebrate species diversity occur where the main channel flows adjacent to an upland bluff and the substrate shifts from the loose sand to firm gravel, rubble or even bedrock bottom. These areas are especially important for mussels which require firm substrate in which to establish themselves (see Mussels section below for more details). The vast majority of the main channel is sand bottomed. This habitat is highly variable ranging from loose unconsolidated sand and ripple bottomed 'sand dunes' to firm depositional sand. A number of sand dwelling specialists occupy these habitats and include many that are rare like the Pecatonica River mayfly, the flat-headed mayfly, and the yellow sandshell mussel. Snags, which are common along the shoreline and down-stream sandbar edges create areas of turbulence that often harbor unique fauna (Lillie and Hilsenhoff 1992). Snags include woody debris and other irregularly shaped substrates like cobble. These habitats support several rare riffle beetles like Knobel's riffle beetle and mayflies like Wallace's deepwater mayfly. The backwaters and spring ponds also have a great diversity of species, hosting rare species such as the state imperiled white-spangled skimmer, swamp darner, flat floater mussel, and Mississippi grass shrimp.

The Lower Wisconsin River is highly significant for aquatic invertebrates. The Lower Wisconsin River has a large diversity of species within a wide variety of taxonomic groups. It's the third most species-rich water in the state and has the highest count of globally and state imperiled species and SGCN species, and the second highest count for Wisconsin Endangered/Threatened species.

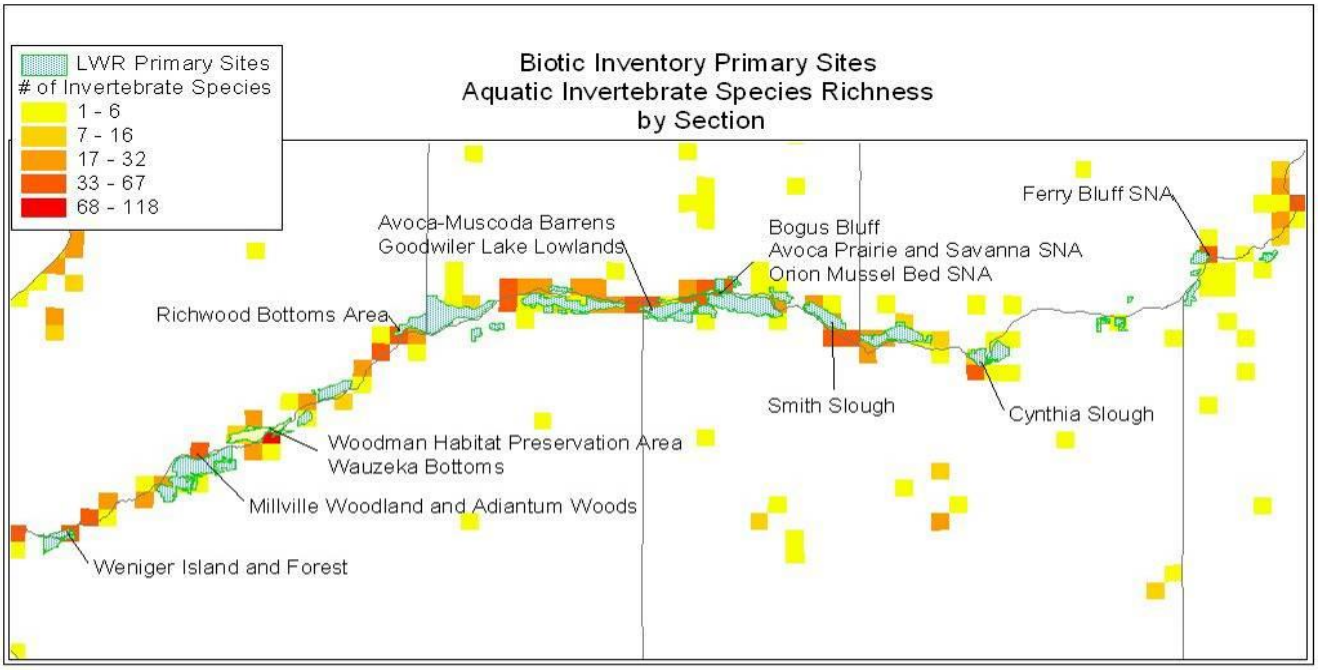

Figure 11. Aquatic invertebrate species richness with Primary Sites labeled. (Data are from DNR-ER's Invertebrate Atlas database [data accessed Jan. 27, 2011]).

The only documented occurrence in Wisconsin of Knobel's riffle beetle, a Globally and State imperiled and State Endangered riffle beetle, is in the Lower Wisconsin River. Half of the Wallace's deepwater mayfly populations, also Globally and State imperiled and a State Endangered Species, are in the Lower Wisconsin River. Worthy of special mention is the recent discovery of a population of the Federally Endangered Hine's emerald dragonfly in the LWSR. Adult occurrences were documented at three general areas near Muscoda between 2008 and 2010. Although the exact breeding sites have not been located, potential breeding sites can be characterized as open herbaceous wetlands with a minor shrub component, near or adjacent to the upland sand terrace bordering the floodplain, with spring seeps or runs discharging into the wetland from the terrace (above and or below the surface), and with burrowing crayfish present. Searches for new populations and to document breeding are planned.

Wisconsin's mussel populations are part of the Upper Mississippi River fauna which is significant to the whole diversity of the mussel fauna of North America (DNR in Prep. a). There are 26 currently known and mapped mussel beds scattered throughout the LWSR. These areas are largely responsible for supporting the 15 rare (state or federally listed and Special Concern) mussel species occurring in the LWSR. There is one Federally Endangered mussel, the Higgins' eye pearly mussel, and one candidate for federal listing, the bullhead, occurring in the LWSR. The LWSR was chosen by the US Fish and Wildlife Service and the DNR for long-term monitoring and conservation of the Higgins' eye pearly mussel population. The Lower Wisconsin River was one of the few tributaries of the Mississippi River that had an existing

population of Higgins' eye, and was not immediately threatened by zebra mussels. Although zebra mussels have now been documented in the Lower Wisconsin, the threat remains low at this time.

Mussels are important ecologically because their presence in streams and rivers increases the diversity of other aquatic invertebrates (insects, crayfish, and snails) by both providing food (through pseudofeces) and habitat (bioturbation of the substrate) (DNR in Prep. a). Mussels and other aquatic invertebrates serve as water-quality indicators and important food sources for numerous vertebrate species such as fish, birds, and mammals. In addition, mussels filter nutrients from waterways helping maintain the water quality of streams and rivers. Mussels have declined globally due to loss of water quality, and sometimes quantity, as well as habitat alteration. Declines can be direct impacts to the mussels themselves or indirect from the loss of a host fish, and subsequent loss of reproduction (DNR in Prep. a). Mussel sites in the river that are worthy of mentioning because of the number of individuals and species found there are Orion and Woodman boat landings.

Terrestrial Invertebrates

The LWSR supports numerous terrestrial invertebrate taxa. Population surveys of these species for this assessment were limited and upland habitats targeted were 1) old river terrace sand, 2) sand blows, 3) dry bluff prairie, 4) Sand Barrens, and 5) Pine and Oak Barrens. Most of these habitats within the LWSR have suffered many years of human encroachment including recreational vehicle trails, road-building, conversion of natural habitats to monotypic pine plantations and agriculture, fire suppression, and sand removal. Pennsylvania sedge has taken over the open sand areas and pushed out many of the native Sand Prairie plants and reducing the availability of open sand areas for insects to live or lay eggs (Kirk 2009). In many cases, management for prairie herptiles and small mammals, favoring short bunch-forming grasses and bare sand would benefit terrestrial insects as well (Kirk 2009).

A big river feature extremely well represented in the Lower Wisconsin River is open sandbars. The presence of sand bars is directly related to the abundant sand substrate and fluctuation of flow levels. Taxa found in the open sand islands of the river channels include two species of rare tiger beetles (*Cicindela hirticollis hirticollis* and *Cicindela macra*). These rare species rely on large patches of open sand habitat created by river dynamics. Larvae of *C. hirticollis* have been shown to be sensitive to trampling which may be an issue at some upper section sand bars.

Other habitats of the LWSR that support terrestrial invertebrates include barrens and sand blows, both often located on old river terraces or dunes. Terrestrial invertebrates of the barrens of the LWSR include a rare tiger beetle (*Cicindela patruela*) and the spotted-winged grasshopper (*Orphulella pelidna*). Sand blows, open, loose sand-dominated habitats, support *Cicindela lepida*, a State imperiled tiger beetle, as well as several species of wasps. In mixed woodland areas with open sand or dune habitats the Special Concern northern marbled locust (*Spharagemon marmorata*) was located. Dry-bluff prairies are also important sites for terrestrial invertebrates and sites within the LWSR support the state Threatened *Polyamia dilata*.

Numerous terrestrial invertebrate taxa are represented in the LWSR but very poor data exists on current population size and status especially compared to aquatic invertebrates. Additional terrestrial invertebrate survey efforts in the LWSR are an important future inventory need for a couple of reasons: a general lack of baseline inventory data (poor weather conditions during

this study's scheduled survey period prevented a complete inventory), and the vital importance of considering terrestrial invertebrate conservation during the management planning process.

Primary sites currently supporting the best populations of terrestrial invertebrates are Blue River Bluffs SNA, Blue River – Muscoda Sand Barrens, Millville, and Avoca-Muscoda Barrens. Gotham Jack Pine Barrens SNA has high potential for supporting rare terrestrial invertebrate populations but additional surveys and management aimed at restoring the open barrens and Sand Prairie habitat is needed.

Bat Conservation

The Driftless Area of Wisconsin is particularly rich in known and potential bat hibernacula sites within easy commuting distance to the LWSR for summer resident bat populations. The LWSR also functions as a critical migratory corridor for bats.

The older forests of the LWSR provide favorable characteristics for bats by offering roosting, foraging, and commuting habitat. Extensive, mobile water-based acoustic bat surveys were conducted in the LWSR during the 2009 summer residency periods. The surveys indicated the presence of seven of the possible eight bat species known to historically occur in Wisconsin with the only species not detected being the Indiana bat (*Myotis sodalis*), which has not been detected in Wisconsin since 1954.

Opportunities to promote bat habitat include providing resources for roosting, foraging, and drinking. Bats of the LWSR roost under loose, peeling bark and in crevices and cavities. Often these attributes are found in older forests with snags of varying decay level, size, and height. Foraging is done in and along small to medium forest openings or gaps, such as ponds, natural and artificial openings, roads, or water courses (Taylor 2006). Maintaining diverse forest flora and reducing non-native plant abundance is important for promoting invertebrate prey diversity and thus promoting foraging opportunities for bats (DNR 2006b). Water resources are used for drinking, travel, and foraging. Maintaining high-water quality and access to water is important for protecting bat populations. Wide buffers (generally wider than those recommended in Best Management Practices for water quality) around water, including rivers, streams, and wet meadows, are important for bats and other wildlife species using these areas (Taylor 2006). Hibernaculum disturbance, habitat degradation, and wind-turbine mortality are threats that affect all bat species found in Wisconsin.

An emerging threat to Wisconsin's bats, White-Nose Syndrome, has been called the "most precipitous wildlife decline in the past century in North America" by Bat Conservation International and has devastated bat populations in the eastern United States since 2006 (*White-nose Syndrome)*. It is currently unknown how the fungus (*Geomyces destructans)* causing White-Nose Syndrome kills the bats. Due to the emerging threats that bat populations face in Wisconsin, more information in the form of surveys (acoustic and roost) are needed to more accurately describe the bats that use the LWSR.

Threats to the Biodiversity of the LWSR

Potential threats to the biodiversity of the LWSR are all interrelated and include ecological simplification, habitat fragmentation, altered ecological processes, invasive species, deer abundance, climate change, and stormwater runoff and non-point source pollution. Each of these threats is discussed in detail in the *Biotic Inventory and Analysis of the Lower Wisconsin State Riverway* (DNR 2011).

Future Biological Inventory, Monitoring, and Research Needs

While a great deal has been learned about the Riverway's diverse natural resources and management, there is much more to be learned. Below are a number of inventory, monitoring and research activities that would help fill important knowledge gaps.

Aquatic Plants – Detailed submerged, floating, and emergent aquatic plant inventories within the floodplain and specifically in the backwater sloughs and floodplain lakes is needed.
Aquatic Animals – Although much data exists for aquatic species in the LWSR, continued monitoring and research of rare fish and invertebrates is vital due to the importance of the river for extremely large numbers of globally rare mussels and fish species.
Bats – Due to the emerging threats that bat populations face in Wisconsin, more information in the form of surveys (acoustic and roost) are needed to more accurately describe the bats that use the LWSR.
Biofuel Harvesting – Using best management practices, determine where biofuel harvesting may be used as a technique to restore a natural community.
Fire-sensitive Species – Research and monitoring is needed to determine effects of prescribed burning on fire-sensitive species.
Floodplain Sloughs, Lakes, and Ponds – Additional surveys are necessary since very few of these areas have been monitored quantitatively for fish and aquatic plants. More comprehensive ground and surface water quality monitoring would provide data to support the link between ground water quality, floodplain lakes water quality, and integrity of biota.
Forest Interior Bird Research – More research is needed on the effects of forest management, including timing and intensity of thinnings and regeneration harvests, and savanna restoration on forest interior birds in southern Wisconsin. Continue a LWSR study to develop a monitoring protocol for forest interior birds with respect to forest management.
Herptiles – The LWSR represents one of the best opportunities in Wisconsin to protect and enhance reptile populations associated with prairies, barrens, and Southern Dry Forests. Inventory efforts during the course of this project were largely restricted to habitat assessments and historical records review. Additional extensive inventory work for reptiles is needed to inform adaptive management throughout the LWSR.
Invasive Species – Continued monitoring and control of terrestrial and aquatic non-native invasive species will be critical on the LWSR.
Islands – Biotic inventory of the islands during this survey effort was limited. These islands provide important habitat to many species and a systematic survey of them is needed.
Prescribed Burning – Identify the conditions and constraints of prescribed burning to assess where it can be applied at a large scale to maximize limited funding.
Road Mortality – Identify places where herptile mortality on roadways is a problem and consider use of road signs or ecopassages in these areas.
Sandbars – The extensive series of sandbars on the Lower Wisconsin River are a unique resource in the state because their large size provides habitat for a distinct community of terrestrial invertebrates and plants. Systematic surveys are needed to determine the rarity of the species present and how best to protect and manage these unique areas.
Small Mammals – Several records of the prairie vole are located within the LWSR at Sand Prairie and barrens habitats. More survey work is needed to detail the rarity of this species statewide, but the LWSR appears to be an important landscape for maintaining this uncommon small mammal.
Terrestrial Invertebrates – Because 2009 was among the worst years on record for sampling insects across the Midwest, and these groups impact management in the LWSR, further surveys of upland barrens, prairies, sand blows and savannas is needed.

Tributary Streams – Tributary streams are numerous in the LWSR, and should have baseline monitoring for water chemistry, fish, habitat and aquatic insects to assess how they are impacting the LWSR.

Cultural History of the LWSR

The cultural sequence in this region begins with PALEOINDIAN peoples (ca. <10,000 to 8000 BC). As glaciers receded from the Upper Midwest, migratory groups of people settled throughout the area's open woodlands and succeeding grasslands, hunting native herding animals such as bison and mastodon, and exploiting available small-game, fish and plant resources as well. Tool kits of the time included spear-like projectile points (Clovis, Folsom and Plano types), flaked knives, simple choppers, and large scrapers. The well-known Boaz Mastodon site, an apparent PaleoIndian kill site, is located a few miles north of the LWSR.

The succeeding ARCHAIC period (ca. 8000 to 500 BC) was characterized by a continued reliance on large game hunting (e.g., bison) and increasingly diversified technologies associated with hunting, trapping, fishing, foraging, woodworking and plant processing – reflecting adaptation to local environmental conditions as climatic trends shifted to a cooler, wetter configuration, a pattern which continues to this day. Chipped stone tools such as stemmed and notched projectile points dominate the tool kit, but the use of pecked and ground stone implements (e.g., axes) also became widespread, and use of copper is apparent late in the period. Related habitation sites in the LWSR tend to be located along the bluff-line, as well as along tributaries of the River.

The WOODLAND period (ca. 500 BC to 1000 AD) in the region appears to have been associated with early plant domestication, but intensive gathering provided the bulk of subsistence needs. Settlement patterns resembled those appearing previously. An especially significant technological innovation of the Woodland peoples is the development of pottery. Earthwork (mound) construction, frequently associated with mortuary activity, also developed at this time, although earlier peoples buried their dead as well. Because of the especially dense concentration of animal-shaped effigy mounds in the state, Wisconsin is considered the center of what is referred to as “effigy mound culture”. The LWSR evidences large numbers of mounds, including effigy mounds - many of which are located in areas open to public use. Burial mounds are protected from unauthorized disturbance by State law.

Evidence of ONEOTA occupation (ca. 1000 AD to historic contact) is reported for areas of Wisconsin, with the largest identified sites located along the margins of major river valleys or their tributaries. These peoples appear to have developed a blended subsistence strategy based on simple agriculture (including corn, beans, and squash), gathering and bison hunting, and extensive trade. Wisconsin’s first farmers!

Early in the HISTORIC period (ca. 1650 to present), European fur traders had moved into the region by the late 1600s, to be succeeded, in turn, by American traders. EuroAmerican settlement of the area accelerated in the early 1800s, while Indian Nations such as the Ho-Chunk were displaced from ancestral lands (these removal attempts often proved ineffective as many Indian families returned to Wisconsin to rebuild their communities). The area saw a rapid expansion of agriculture during the mid- to late 1800s, and many historic-era sites presently dot the landscape as archaeological sites, historic buildings (many still in use), or as other historic

features. Tower Hill State Park is the site of early historic structures associated with the heyday of Wisconsin's lead mining and lead shot production industries.

People have settled here, raised families here, worked here, and died here for thousands of years. But the story of Lower Wisconsin State Riverway is not just a story of the past; it is our story as well, for the story of this place continues …

Recreational Use and Facilities of the LWSR

Recreational use on the Riverway is quite broad, with boating and associated river uses being the most prominent. Current LWSR recreational facilities are shown on Map E.

Boating and sandbar camping:

During the summer months canoeing\kayaking and power boating and sandbar camping are predominant Riverway activities, and tubing is popular in some areas as well. In terms of numbers, paddlers make up the largest group. They are well supported by the numerous canoe liveries who rent canoes and kayaks and shuttle paddlers to and from river access points up and down the river.

As has long been the case, there tends to be more recreational boaters and camping on the upper river segments; however, use levels down river continue to increase. Crowding is evident on the upper river segments on good weather summer weekends. Use levels are likely higher on the upper river segments because they are closer to larger population centers and sandbars are more abundant there.

There are a number of facility additions and renovations that would improve boating experiences. They include:

- Construction of additional river access sites along the entire length of the property. Also, many DNR managed boat/canoe access sites need improvement to ease access and reduce user conflicts between boaters and canoers. Paddlers often are perceived as blocking up boat access ramps or taking up too much room in parking areas. Additional disabled accessible piers and renovation of piers at Woodman Lake.

Fishing:

Fishing is popular along the entire length of the Riverway with boater and shore use fairly evenly distributed. Areas with higher shore-fishing use are listed below in Table 13.

Table 13: High Use Shore-fishing Sites:

Location	Comments
○ West Point	Volunteer trails, off road vehicle use occurring
○ Statz Memorial Launch	
○ Western Escape	*ice fishing*
○ Arena Landing	*volunteer trails*
○ Pecks Landing	
○ Bakkens Pond	*all 3 lots*
○ Lone Rock (Rock Dam)	*volunteer trails, off road vehicle use occurring*
○ Cruson and Smith Sloughs	*volunteer pull-offs*
○ Hay Lane	*off road vehicle use occurring*
○ Lemanski	*volunteer trails*

○ Paffenrath	
○ Fish Trap Flowage	*off road vehicle use occurring*
○ Garner Lake	*volunteer pull-offs*
○ Highway 60 / 61 area North of Boscobel	
○ Woodman Lake	
○ Wyalusing Unit Lot	

There also are numerous additional non-developed sites where anglers pull-off the highway or off interior access roads to fish. Additional developed and maintained shore fishing sites are needed.

Ice fishing is also popular on the property in winter. Some sites are plowed for access. Popular ice fishing locations are:

- Helena / Goofy Slough
- Western Escape – Rainbow Slough
- Brummer – Hills Slough
- Bakkens Pond
- Long Lake
- Cruson and Smith Sloughs
- Jonas
- Goodwiler Lake
- Woodman Lake (contract with township)

Sunbathing and Swimming:

Sunbathers and swimmers use multiple locations on the Riverway. By far the most popular is the Mazo Beach. Peck's Landing and the Statz Memorial landing are also popular swimming and sunbathing locations. Over the past few years, Arena Landing has gained in popularity for swimming and sunbathing due to the newly developed sandbar.

The Mazo Beach site has very high use on weekends and is busy during week days as well. Primary use is by nudists. There is a long standing culture of nudity at this location, and as such, numerous other problems with lewd behavior, drugs, etc. exist there. Many people have stopped using this area. During the summer of 2013, the department implemented a new policy of closing the beach and the access road leading to it during the week. The number of citations issued was significantly reduced over the summer, though this may be a function of reduced DNR presence rather than reduced poor behavior. The "beach" continues to be a source of conflict and is an ongoing management issue.

Equestrian Use:

Horse riding is allowed in three areas on the Riverway. They are Blackhawk, Millville, and the Muscoda – Blue River trails. The most use, by far, is at Blackhawk with some use at Millville and very little use on the Muscoda – Blue River trail.

Trail improvement for all three bridle trails should be considered as well as considering if each of the bridle trails is located at the right location. Improved access and larger parking areas are needed at Blackhawk. Current demand indicates improved access at Blackhawk would create more use there. The Millville and Blackhawk trails both need some degree of rerouting for better trail conditions. The Muscoda – Blue River Trail should be considered for rerouting or

abandonment. There is interest in creating a new trail in the Arena area. Residents there have approached the Department about development of bridle trails there.

Hiking and Cross-country Skiing:

Developed hiking trails exist in tandem with the above horse trails as well as at Ferry Bluff. Moderate hiking use occurs at Blackhawk and Ferry Bluff.
There is a fair level of public interest for developing a trail along the entire length of the Riverway. A trail along the entire length would have many challenges including slope, soil conditions and gaps in ownership. However, shorter trails connecting some communities seem feasible.

For example, recently, Muscoda residents have asked for development of additional hiking trails in their area. The Village of Boscobel has also expressed interest in additional hking trails between the downtown and the Riverway.

Cross country ski use is seen to a very minor extent at Blackhawk and in the Bakkens Pond areas. No trails are groomed or maintained for skiing in the Riverway.

Picnicking/Day Use:

Picnic use occurs at several locations. Only Pecks Landing and Blackhawk Ridge have picnic tables. Informal picnicking occurs at many other locations. Future development of day use areas or addition of more picnic tables would likely generate an increase in short visits to the Riverway and picnicking use.

Special Events:

The Blackhawk unit has a reservable shelter and historic cabin, both are available for special events such as weddings, graduation parties, etc. Portable toilets, water, and electricity are available at these sites. Currently a reservation system is set up with keys available at the Sauk Prairie Chamber of Commerce, there is no charge for the reservations.

The Mazomanie Class I Field Trial Grounds and Dog Training Area is located off of County Trunk Highway Y. The dog trial area is 200 acres total. This area is managed by the Spring Green Wildlife Management office, and scheduling is coordinated through a club organization. A shelter, water, and portable toilets are available at the site. Additionally, there are a designated dog training areas at Goodwiler Lake in the Muscoda Unit and at Prairie du Bay near Boscobel.

Historic sites:

A Blackhawk war battle site (Battle of Wisconsin Heights) is located on the Blackhawk Unit. Development of an interpretive display and maintenance of the historic battle site has been advocated for particularly by Sauk City, Prairie du Sac and Mazomanie residents.

Hunting

Deer hunting and turkey hunting are the primary hunting uses. Pheasant, squirrel, rabbit and waterfowl hunting occur on the property as well. There is a good level of use for all seasons. Hunting is fairly evenly distributed along the entire property.

Birding and Wildlife Viewing:

Birders and other wildlife viewers use the property, but not at particularly high levels. Use may increase if more information is made available to the public on the exceptional opportunities the Riverway affords

Berry and Mushroom Picking:

Berry and mushroom pickers use the property as seasons allow. This activity is wide spread over the entire property, but not at high levels. Morel hunting is especially popular in the Muscoda area

Facilities

Recreational users of the Riverway enjoy a wide variety of activities. Facilities supporting these uses are provided by the Department, other governmental units, including many local villages and towns, as well as private cooperators. A summary of the primary public infrastructure serving Riverway users is shown in Table 14. A more detailed breakdown is in Appendix D.

Table 14: LWSR Recreational Facilities

	Number	Managed by
Public Access		
River boat landings	27	11 DNR, 16 County or municipal
Pond or slough boat landings	14	DNR
Hunter and fisher parking lots	83	DNR
Other parking lots	9	DNR
Trails *(some mileage may overlap due to dual-use designation)*		
Auto trail miles	10.8	Other
Hiking/cross country ski trail miles	27.6 hike, 22.4 ski	DNR
Nature trail miles	.6	DNR
Interpretive Display	2	1 DNR – LWSR, 1 DNR – S.P.
Snowmobile trail miles	7	Club managed
Equestrian trail miles	20	DNR
Camping (developed campgrounds with daily occupancy)	5	2 DNR – S.P., 3 village
Fishing Piers	3 ADA, 9 not ADA	DNR

Handicapped Hunting Structure	2	DNR
Picnicking (sites with facilities)	16	5 DNR, 11 other
Highway Waysides	3	Other
Observation Towers/lookouts	3	1 DNR - LWSR, 2 DNR – S.P.
Dog Trial Areas	1 (200 acres)	DNR

Management Activities and Infrastructure on the LWSR

Infrastructure

In addition to recreational facilities, there is other Department managed infrastructure on the Riverway. That includes seven permanent buildings/structures, 20 miles of gravel surface access roads, 30 miles of interior non-improved roads, 61 gates, as well as numerous of other signs and boundary markers. See Map E.

Current and Recent Management Activities

Management of the Lower Wisconsin State Riverway is a cooperative effort by a wide range of Department programs. Each program plays an important role in the successful management of this 50,000 plus acre property. The management activities of each of the principle programs are described below.

Forestry Program

Since 2003, LWSR Forestry staff has inventoried approximately 32,000 acres. Detailed stand and property level data for the LWSR can be found in the WisFIRS database, property code 2232. The current inventory protocol has been established to collect data which allows managers to holistically address ecological management.

Since the inception of the LWSR, timber sales have been an important tool for forest management to create and maintain wildlife habitat. However, of the approximately 9,660 acres (cumulative) prescribed for timber management since 1989, only 1,313 have been harvested. This difference in prescribed vs. actual may be attributed to a combination of market-driven issues (i.e. species available, product marketability) and conservative management due to aesthetic and other natural resource concerns. Since 2004, timber sales have been established by LWSR forestry staff employing intermediate thinning and uneven-aged management (group selection), predominantly in bottomland hardwood stands. These sales have been designed to mimic gap phase regeneration while altering stand composition and establishing advance regeneration. These sales have generated mostly pulp and consist primarily of intermediate and suppressed trees.

As in past years, LWSR Forestry staff is also working with the LWSR Board as a part of the Board's Forest Health Ad Hoc Committee. In preparation for gypsy moth defoliation, LWSR Forestry staff have developed specific action plans to help prepare oak stands for defoliation

and help to educate and raise public awareness of this issue.

Wildlife Management Program

Over the past 10 years, Wildlife Management staff has primarily focused their habitat work on the establishment and maintenance of native grasslands, savanna management, and wetland restoration and maintenance. Throughout all of these habitat types, the greatest obstacles are woody species invasion, succession and conversion and the control of invasive plant species.

As properties have been purchased and added to the LWSR project, existing agricultural fields typically received the largest amount of management attention. After acquisition, agricultural fields are cropped for several years through the Sharecrop program in an effort to prepare them for conversion to grassland habitat. As field conditions, time and budgets allow, fields are converted primarily to native grassland vegetation but where soil or habitat conditions dictate, woodland restorations may be done. Currently there are approximately 260 acres in the Sharecrop program, and 600 acres of former agricultural fields have been converted to native prairie. Wildlife Management also administers hay cutting permits on about 200 acres and grazing permits on 70 acres as management tools to prevent woody plant succession. Additional acres are mowed, cut and/or receive herbicide applications periodically to maintain the converted fields.

Prescribed fire is an important management tool for managing many of the historical and existing habitat types within the LWSR and it is especially critical following the establishment of native prairie on a previous agricultural field. In 2009 a prescribed fire was conducted at the Millville Unit to promote the white oak component and enhance remnant plant communities. The results in this 760-acre prescribed fire unit show promise. However, continued implementation of this management tool will be extremely important to attempt to reduce the shrub layer and accomplish the overall objectives.

Five wetland impoundments are maintained in the LWSR. Flowage water levels are managed by periodic drawdowns to enhance waterfowl food production, to maintain a 1:1 ratio of open water and emergent vegetation, to enable dam inspections and to control plant succession. Small wetland scrapes have also been created to increase open water in lowlands and Floodplain Forests.

Control of invasive plant species is another recent and ongoing activity. Woody invasives are a particular problem in and along the edges of established and remnant prairies. Herbaceous invasive plants are also a problem in wetlands, grasslands and woodlands. Recent efforts have focused on spotted knapweed, garlic mustard, teasel, poison hemlock and purple loosestrife.

Wildlife Management staff continue to participate in annual surveys of deer, woodcock, quail, grouse, pheasant, turkeys, rabbits, eagles, osprey and waterfowl within the LWSR. Rare animal reports are investigated. On average 350 ducks and 100 mourning doves are banded each year. Wildlife health is monitored by responding to sick or dead wildlife and assisting with the surveillance of Chronic Wasting Disease. Assistance is provided to the public in cases of nuisance wildlife.

Hunting is one of the most popular activities in the Riverway. The promotion of wildlife populations through habitat management is the primary mechanism to provide increased hunting opportunities.

Natural Heritage Conservation Program

A variety of surveys for endangered resources have occurred across the LWSR since its establishment in 1988. These surveys have ranged from long-term bird and amphibian calling surveys along the entire Riverway to more comprehensive biotic inventories for rare species and natural communities.

The Natural Heritage Conservation program manages the State Natural Areas (SNAs) on the Riverway. SNAs represent the best remaining examples of native plant communities in the state, and as such, encompass a significant percent of the State's biodiversity. Twenty SNA's, (18 on DNR land and two on land owned by others) totaling approximately 6,740 acres, have been established within the LWSR, harboring a broad spectrum of native terrestrial and aquatic plant communities that are an excellent reflection of the diversity of this biologically rich landscape.

The SNA program manages the invasive species, both native and exotic, that are degrading these native plant communities n Natural Areas. Work typically involves the direct removal of invasive species by cutting, pulling, mowing, and spraying. In conjunction with these activities, SNA staff has an active prescribed burn program in an attempt to return to the landscape the element that was so critical to the development and maintenance of these areas in the first place.

There is also a significant rare aquatic component to the LWSR, which includes the significant mussel beds found at the Orion Mussel Bed State Natural Area. The Lower Wisconsin River was chosen by the Fish & Wildlife Service and the DNR for long-term monitoring and conservation of the federally endangered Higgins' eye pearlymussel. From 2000 – 2008, populations at the Orion bed and below the Prairie du Sac dam have been enhanced via introductions of both mussels and their host fish.

Fisheries, Research and Water Resources Programs

Water Resources, Science Services (research), and Fisheries Management Programs' staff collect information to evaluate waters for compliance with the Clean Water Act, and make recommendations for fish and habitat protection and management. Long-term trends monitoring by Water Resources staff occurs at Muscoda and Wisconsin Dells. The goal is to document trends in water quality parameters including nutrients, e-coli and fecal coliform, chemistry, temperature, and transparency.

Staff continues to track long-term trends in fish community dynamics, data that is critical to assessing changes in the overall health of the Wisconsin River. The dam tailwater is important spawning and feeding habitat for fish. Yearly monitoring in the tailwater for sportfish abundance, fish reproductive success, fish size structure and growth rates of game fishes over time, is useful for setting fish management priorities, and determining changes in fish community dynamics. Yearly surveys repeated at the same sites throughout the Lower Wisconsin River provide information on presence/absence and in some cases fish migration of non-game, rare, threatened, endangered and non-native fishes. Tributary streams are also surveyed and evaluated using fish and macroinvertebrate indices of biological integrity, combined with water quality sampling to determine overall health of streams flowing to the Lower Wisconsin River.

Continuing biotic inventories of floodplain lakes and sloughs provide water quality, fish, and aquatic plant information on many waters not previously inventoried or having very little

information. These surveys provide presence/absence information for fish and plants, provide information on water quality and water sources of sloughs and lakes, and identify critical habitats for slough/lake fishes. These studies also provide a data baseline as well as management recommendations for protection of floodplain sloughs and lakes.

The USGS continues to monitor water flow at Muscoda and Alliant Energy monitors water flow at the Prairie du Sac dam turbines. After a fish passage is installed at the Prairie du Sac dam, monitoring will be used to evaluate fish passage and protection.

Facilities and Lands Program

The Facilities and Lands program provides overall management and oversight of the Riverway property, including facility and habitat management and land acquisition. The program functions as the LWSR property manager; coordinating work planning for operational and maintenance activities, serving as the public liaison, and the Department's liaison with the Lower Wisconsin Riverway Board.

Planning and oversight for the LWSR is coordinated by the Facilities and Lands property manager with appropriate input and assistance from other Department programs. The property manager also maintains relationships with adjoining property owners, local officials, and user groups.

Facilities and Lands is the lead program for conducting basic property management activities. Staff duties include;

- site reclamation (well abandonment, fence removal, selling/removing buildings, etc.),
- posting and maintaining information signs and posting maps,
- developing and maintaining vehicle access roads and parking, and vehicle control gates,
- installing and maintaining machinery/livestock stream crossings and livestock watering access sites,
- installing and maintaining trails, bridges, boat launches, piers, docks, angler fence crossings or other public access facilities,
- litter pick up,
- well water sampling,
- inspections of designated use areas,
- planning, constructing and maintaining property line/easement fences, and
- enforcement of public use regulations (if credentialed).

Law Enforcement Program

Conservation wardens deal with a wide range of issues on the Riverway. In addition to responding to public safety calls, wardens deal issues such as alcohol and drug use, illegal off-road vehicle use, and education and enforcement on litter and glass rules, boating safety, and invasive species transport.

Conservation wardens conduct patrols on the Lower Wisconsin State Riverway as part of their regular duties, checking recreational boaters as well as anglers and hunters. Wardens use these contacts to promote the use of personal floatation devices, and general boating safety.

Underage drinking and the noisy atmosphere has been an ongoing issue on many beaches and sandbars. Regular patrols serve to abate some of those problems. In cooperation with those sheriffs' departments with jurisdiction on the Riverway, wardens have provided boats to transport deputies and drug detection dogs to sandbars.

Mazomanie beach has had problems with illegal sexual activity and other illicit behavior for which citations are issued. Wardens have concentrated on detecting and abating illegal sexual and drug activities there through a number of measures.

Like many state properties, lands in the Riverway experience damage from off road vehicle use when drivers can get around gates or go “cross-country” though adjacent private lands. The wardens working in the Riverway diligently pursue cases of illegal off-road activity.

Wardens educate on and enforce a variety of regulations related to minimizing the spread of invasive species and infectious diseases..

Management Challenges and Limitations

Invasive Species

Invasive plant and animal species are impeding efforts to restore natural communities and maintain native plant/animal diversity.

Invasive plant species, woody and herbaceous, native and exotic, continue to multiply and expand across the LWSR. Common invasive tree and shrub species in this corridor include: Eurasian honeysuckle, common buckthorn, autumn olive, Japanese barberry, multiflora rose, and black locust. *(Note: In some natural communities, native species may be considered invasive or opportunistic. These species include aspen, dogwood, and willow.)* Common invasive h*erbaceous plants include: g*arlic mustard, spotted knapweed, teasel, sweet-clover, exotic vetch, purple loosestrife, reed-canary grass, and the aquatic invasive Eurasian water milfoil.

It may be difficult or impossible to eradicate or control well established non-native species, so it is important to detect and control new invaders early. Examples of some of these species that on or in proximity to the Riverway are Japanese knotweed, common teasel, Japanese hops, and oriental bittersweet. For a complete listing of species of concern, see the LWSR Biotic Inventory and Analysis, Tables 9 and 10 [DNR 2011].

Invasive animal species are also present ranging from insects to mussels to fish. Invasive insect species such as gypsy moth and emerald ash borer (EAB) may dramatically alter tree species composition. Gypsy moth may indirectly lead to oak mortality. In general, due to the quantity and age of the LWSR’s oak resource, the risk of oak mortality due to defoliation is expected to be medium to high. EAB will likely eliminate all true ash species (white, green, and black ash) from LWSR stands. The Lower Wisconsin River fishes, mussels and aquatic wildlife face many challenges and threats from invasive aquatic species, and loss of habitat. The river’s connection to the Mississippi River and thousands of tributary streams provides an open conduit for travel by Asian carp, mosquitofish, zebra and quagga mussels, spiny water fleas and other invasive animals most recently documented in southern Wisconsin. Biological diversity of floodplain lakes and sloughs also depends on the ability of native fish species to outcompete non-indigenous species that appear to be expanding their ranges, perhaps due to climate changes. Management efforts to reduce the spread of aquatic invasives are a necessary component to ensure the health of native species.

Woody Succession and Conversion

Plant succession has significantly increased forested habitat for certain species (e.g., forest-interior birds), which was not as widely available along the pre-settlement Riverway landscape. However, the trade-off is a reduction of habitat for open forest canopy and early successional habitat dependent species. Efforts to set back or even halt succession, especially on a landscape scale, are time-consuming and expensive. Without significant efforts, many oak-dominated stands will likely succeed to maple. As more forests mature, canopy closure will cause significant changes to herbaceous and woody understory vegetation.

From the 1930s until the 1970s, red pine plantations were planted across fallow fields on the Riverway sand terraces to stabilize soils, provide wildlife habitat, and provide local income on nutrient poor and droughty sites. While these plantations accomplished their purpose at the time, they now have the potential to shade out and fragment barrens habitats used by a number of species (e.g., nesting turtles and other reptiles), and serve as a seed source for pine expansion into natural areas.

Deer Population Management

Based on research conducted in the upper Midwest and eastern states, high numbers of deer cause high levels of herbivory on native plants, suppressed oak regeneration and often cause bioconversion of native habitats to more simplified and degraded habitats. While the solution to high deer numbers is beyond the scope of management of the LWSR, it should be recognized that the high deer numbers may be a limiting factor for achieving certain native community management goals.

Beginning in 2014, the deer population goal for each county in the LWSR will switch from a specific overwinter population goal of deer per square mile (e.g. 25 deer/mi^2) to an objective of “increase”, “stabilize” or “decrease” that will be evaluated every 3 years by Deer Management Advisory Committees in each county in the LWSR. Southern Farmland counties, including all counties in the LWSR will have a “stabilize” objective for 2014.
The recommendation for a specific county deer population objective will be based on a variety of metrics or categories of data that could include:

- Deer Health indicators
- Deer Impacts on other natural resources
- Societal impacts
- Information provided from hunters (deer seen/hour of effort)
- Population model estimates

Corridor Development and Land Use

Increased development of roadways, housing developments, and agricultural facilities on lands surrounding the LWSR continues to threaten all habitat types by fragmenting contiguous tracts. The establishment of invasive species often follows disturbances associated with development activities. Predation on avian and small mammal species increases with greater edge effect which results from habitat fragmentation. Frogs, salamanders, turtles, birds, and other animals migrate from uplands to the river and associated lowlands throughout their yearly life cycles. Species movement and genetic drift are compromised by barriers (roads, houses) resulting in the loss of genetic diversity and declines in animal and plant populations.

Critical habitats containing native vegetation not usually found in the main river channel are susceptible to the effects of area development (e.g., stormwater runoff and groundwater impacts). Scores of braided channel oxbow and other floodplain lakes provide necessary habitats for numerous fish, mussels and other aquatic plant and animal communities within a transitional area linking the Lower Wisconsin River with tributary streams and extensive wetlands. Shoreland, floodplain and upland land use and development activities threaten to degrade habitat and water quality of some of these lakes. Floodplain lakes support a unique blend of riverine and lake fish populations, and perhaps contain the most abundant populations of rare and endangered aquatic species in southern Wisconsin. During recent surveys conducted in floodplain lakes of the Lower Wisconsin State Riverway, rare fish generally were not found along developed shorelines where aquatic plants and coarse woody debris had been removed.

Climate Change

Over time, climate change may limit species at the southern end of their range as species range distributions shift north. For example, in the LWSR, tree species toward the southern end of their range include eastern white pine and jack pine. Southern species such as honey locust, Kentucky coffee tree, sycamore and chinquapin oak may migrate northward and become more prevalent along the LWSR.

Further, an increase in extreme weather events (i.e., floods, droughts, tornadic winds, etc), while introducing “natural” disturbance factors, may be of such an increased magnitude and frequency to complicate management efforts.

Public Use Management and Development

Vandalism and Litter

Litter is an ongoing problem throughout the Riverway. Refuse from camping and picnicking on the sandbars, islands, and shoreline areas, raises a number of concerns. In addition to the “standard” litter there is a long standing issue with dumping of construction debris, appliances, furniture, household garbage, etc. on the Riverway.

Vandalism of signs, kiosks, etc. occur regularly at intensive-use areas near boat landings and parking lots. The maintenance costs associated with these activities must be considered when planning future development of trails, vehicle access, and both developed and primitive campground sites.

Illegal Off-road Vehicle Use:

Unauthorized vehicle use is an ongoing and widespread management issue across the property. Both ATVs and full size vehicles are being used illegally to access areas for fishing, boating, and hunting. This may indicate the need for additional or relocated facilities and river access points in some areas. Additionally, incidents of off road “joy riding” have also occurred with resulting habitat damage.

Hunting Stand and Blind Placement

Hunters may construct and use tree stands and waterfowl blinds on Riverway lands. The legal time limits for the placement of stands and blinds are frequently violated, resulting in debris left well after waterfowl season is over. Exceeding the legal time limits also has the effect of

monopolizing prime hunting locations. These activities also can damage vegetation when tree steps are screwed into the trunks and "shooting lanes" are cut through the vegetation. Hunters also have been using plastic flagging and other non-biodegradable materials to mark paths into stand and blind locations and not removing these items at the end of the hunting season.

Alcohol and Drug Use

Conservation Wardens have noticed an increase in recreational drug and alcohol use by canoeists and campers in the Riverway. Wardens have been working with local law enforcement drug task forces and sheriff's department K-9 units to address the illegal drug use. Problems that are associated with drug and alcohol use include intoxicated operation of motor boats, potentially hazardous actions by swimmers, waders and non-motorized boat users, loud parties and illegal marijuana growing on Riverway lands.

Mazomanie "Beach"

The area within the Mazomanie Unit of the LWSR commonly known as Mazomanie "Beach" in northwestern Dane County is a popular location for nude sunbathers. Despite the fact that the beach is only accessible by water or by way of a pedestrian roadway that is one mile long (vehicles are allowed on the roadway in summer months for those with disabilities), hundreds of visitors are present on the beach on any summer weekend. This presents unique challenges to law enforcement. Nude sunbathers have gained somewhat exclusive use of the beach and continue to try to expand the boundaries where nudism is overlooked. Overt sexual activity has become more prevalent, generating complaints from other beach visitors, canoe concession owners, and Riverway users. The presence of members of a group protesting beach activities and verbally harassing the public accessing the area, has required increased attention from law enforcement agencies (including DNR Law Enforcement Officers), to prevent physical confrontations from becoming violent.

Trail and Other Recreational Facility Development

The Riverway's steep slopes and abundant sandy or wet soils pose significant limitations for the development of recreational facilities. Therefore, on-site soil conditions must be carefully analyzed when siting prospective locations for new trails or structures.

IV. FINDINGS AND CONCLUSIONS

The LWSR is of statewide and national significance for the ecological and recreational values it provides.

The Riverway was established by the DNR Board and the Legislature by Act 31, 1989 (Chap 30.40 Wis. Stats.) to provide for the long-term protection and management of the outstanding scenic, recreational, and natural resource values of the lower river corridor. As are most DNR managed properties, the Riverway's lands are open for traditional outdoor uses including hunting, fishing, trapping, walking, nature study, and berry picking. Other compatible recreational uses may be allowed by the property's Master Plan if those uses do not detract from the primary purpose of the property.

While the Riverway's state owned lands are managed by the DNR, the scenic quality of the Riverway is more broadly protected by scenic easements and by building development and forest management performance standards and aesthetic regulations. The performance standards and aesthetic regulations are administered by an independent state agency, the Lower Wisconsin State Riverway Board.

Social-economic Context

The river corridor is largely rural, rugged terrain with a mix of agricultural and forest land. A number of villages and small cities front the lower river along its 92 mile length. Most of the region is comparatively sparsely populated, Dane County being the one exception. Local residents have personal connections to the river. It forms a strong thread in the local identity.

Population levels of the western half of the region are projected to stagnate over the next 10 to 20 years. In the eastern counties; Dane, Sauk, and Iowa; growth is expected to be strong. In fact, Dane County has been the fastest growing county in the state.

Recreation: Use, Demand, Significance and Capability

Compared to the northern two thirds of the state, southern Wisconsin has only a small amount of public land and a higher population density. Being the largest public property in southern Wisconsin and one of the largest in the state, the Riverway provides abundant public open space for a broad spectrum of recreational activities ranging from hunting and fishing to hiking, wildlife watching, and horseback riding. Unlike state parks, the Riverway has few developed facilities; however, some picnic, camping and other facilities are provided by local parks along the length of the river. Abundant opportunities for more developed recreational uses, including camping with RVs, are provided at several state parks; Tower Hill, Wyalusing, Governor Dodge, and Devils Lake.

River recreation, such as canoeing and sandbar camping and fishing in particular, are a major draw for people from across the state and upper Midwest. An estimated 13 million people live within a three hour drive of some portion of the LWSR.

According to Riverway managers, there is demand for additional boat access sites along the entire length of the river, and many exiting sites are in need of improvement as well. There is demand for more developed picnic sites and more developed shore fishing sites and accessible

piers and hunting blinds. The existing equestrian trails need improvement as well. Also, there have been requests for the development of a hiking trail running the length of the property from Sauk City to the Mississippi. Providing for recreational uses sustainably on the Riverway is not without its challenges due to the steep bluffs, wetlands, sandy soils, and abundant sensitive resource sites.

There are a number of recreational supply shortages in the region (SCORP 2005-2010). While the Riverway already provides for many of these opportunities, there may be opportunities for increases in some categories. The regional shortages include backcountry and walk-in camping, boat launches and other water access, natural areas, picnic areas, horse trails, and hiking trails.

Population trends will also help shape future recreational use demand. Overall, hunting and fishing pressure and recreational opportunity demand will grow with the expanding population of southern Wisconsin. Additionally, the ballooning over-65 population will put pressure on demand for more passive recreational opportunities, like wildlife viewing, and easier access to some sites.

Ecological Significance and Capability

The LWSR lies within the Western Coulee and Ridges Ecological Landscape. Of the 34 natural communities in this landscape for which there are “Major” or “Important” opportunities for protection, or restoration, or management, 25 of them are represented on the LWSR. The Riverway’s ecological importance is further underscored by the fact that the property covers less than 1% of the Ecological Landscape, yet supports 47% of the rare species and 71% of the natural communities (with major management opportunities) that are known here. The protection and enhancement of rare and endangered species and natural communities is a primary mission of the department.

The Wisconsin Wildlife Action Plan places the LWSR within three Conservation Opportunity Areas of continental significance. The Nature Conservancy recognizes the area as a critical “functional landscape”. Of particular importance for this recognition is the large river system with a diversity of exceptional natural communities providing a continuum of habitats from river; to wetland; to open, dry habitats; to woodland; to moist cliffs supporting a long list of bird, fish, mussel, reptile, amphibian, and insect Species of Greatest Conservation Need.

More specifically, 44 rare plants (four State Endangered) are found on the LWSR. Particularly significant are those plant species associated with Floodplain Forest, Southern-mesic forest, Oak Barrens, and oak woodland/Oak Openings. Of special note is that the Riverway holds one of the most extensive Floodplain Forests in the state. The Riverway is well known for eagles, but it is a significant refuge for many other rare animal species as well. The property harbors over 37% of animals on the state Threatened & Endangered list. Included are 121 rare animal species **(**LWSR Biotic Inventory and Analysis, DNR 2011), three are Federally listed or are candidates for listing, 15 are State Endangered species and 21 are State Threatened species. The LWSR plays a critical role in conserving several animal taxa in particular. They are forest interior and grassland birds; herptiles; fishes; aquatic and terrestrial invertebrates; and bats. This large number of rare animals from numerous taxonomic groups reflects the overall diversity of good-quality habitats that are present throughout the property. Of particular importance for conserving rare plant and animal species on the Riverway is maintaining or restoring older forests, open wetlands, aquatic features (such as springs, oxbow lakes, and sloughs),

Floodplain Forests, Southern Mesic Forests, Oak Barrens and Dry Prairie, oak woodland and Oak Openings.

Twenty-eight "Primary Sites" have been identified on the Riverway as being worthy of protection or management. These "Primary Sites" contain relatively undisturbed, high-quality, natural communities; provide important habitat for rare species; offer opportunities for restoration; provide important ecological connections.

The LWSR is a well-known bird migration corridor, hosting hundreds of thousands of birds in spring and fall, from songbirds to shorebirds, water birds and raptors. In the winter, raptors such as rough-legged hawk, American kestrel, sharp-shinned hawk, northern goshawk, and sometimes short-eared owl concentrate in the river valley. Large populations of bald eagles, diving ducks and gulls occur in winter, often congregating below the Prairie du Sac dam when the river freezes elsewhere. Numerous wooded bluffs, including Ferry Bluff, Lone Rock Bluffs and Sugarloaf are important roost sites for wintering bald eagles. Since 2002, during the spring and fall migrations, whooping cranes have used the wetlands of the LWSR for foraging and roosting.

Conclusions

The Lower Wisconsin and its adjoining lands are of continental ecological significance; having one of the most significant assemblages of natural communities and habitats for rare species in the Upper Midwest.

The Riverway is one of the state's most important properties for reptiles and amphibians; forest and grassland birds, rare fish, mussels, and other aquatic invertebrates. Because of the unique circumstances on the LWSR, conservation opportunities to support Floodplain Forests and rare plants are perhaps greater here than anywhere else in the state. The sandy terraces in the Riverway provide one of the best conservation opportunities in Southern Wisconsin for rare plant species associated with Oak Barrens and Dry Prairie. The LWSR offers a significant opportunity to manage a landscape mosaic of diverse habitats at a level found on few other state-managed properties. The connection of upland forests with bedrock outcrops of Dry Prairie to the expansive lowland forests and wetlands of the river valley bottom are an exceptional opportunity for landscape level management.

The Lower Wisconsin River is one of the longest reaches of free flowing rivers remaining in the Midwest. Its broad waters filled with islands and sandbars and are flanked by largely undeveloped banks and bluff lands making this waterway a truly unique and prized recreational resource. When one also considers the wide variety of upland recreational opportunities available, it is easy to see that the LWSR plays a unique role in the region and state's recreational picture and see why it's of regional and statewide importance.

GLOSSARY

bioturbation – the alteration and disturbance of a site by living organisms; the turning and mixing of sediments by organisms, as rodents.

ecological landscape – landscape units developed by the DNR 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.

ecopassage – a series of guidewalls and/or under-highway tunnels that allow wildlife to safely cross roadways.

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

loess – windblown, silt-size dust derived mostly from the glacial four carried by outwash rivers. It typically forms a cover over the landscape that thins with distance downwind from braided outwash rivers.

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

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

novel ecosystem – ecosystems containing new combinations of species that arise through human action, environmental change, and the impacts of the deliberate and inadvertent introduction of species from other parts of the world.

pseudofeces – are a way that filter-feeding bivalve mollusks (and filter-feeding gastropod mollusks) get rid of suspended particles which have been rejected as unsuitable for food.

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," DNR 2006b).

SPECIES LIST

Common Name	Scientific Name
Animals	
Acadian flycatcher	*Empidonax virescens*
American bittern	*Botaurus lentiginosus*
American bullfrog	*Lithobates catesbeianus*
American kestrel	*Falco sparverius*
American woodcock	*Scolopax minor*
bald eagle	*Haliaeetus leucocephalus*
Bell's vireo	*Vireo bellii*
big brown bat	*Eptesicus fuscus*
black buffalo	*Ictiobus niger*
black-billed cuckoo	*Coccyzus erythropthalmus*
Blanding's turtle	*Emydoidea blandingii*
blue sucker	*Cycleptus elongatus*
blue-winged warbler	*Vermivora pinus*
bobolink	*Dolichonyx oryzivorus*
brown thrasher	*Toxostoma rufum*
bullhead/sheepnose	*Plethobasus cyphyus*
cerulean warbler	*Dendroica cerulea*
channel shiner	*Notropis sp.*
common moorhen	*Gallinula chloropus*
common mudpuppy	*Necturus maculosus*
crystal darter	*Crystallaria asprella*
devil crayfish	*Cambarus diogenes*
eastern massasauga rattlesnake	*Sistrurus catenatus*
eastern meadowlark	*Sturnella magna*
eastern pipistrelle bat	*Perimyotis subflavus*
emerald ash borer	*Agrilus planipennis*
European earthworms	*Acanthodrilidae, Lumbricidae, Megascloedidae*
field sparrow	*Spizella pusilla*
flat floater mussel	*Anodonta suborbiculata*
goldeye	*Hiodon alosoides*
gophersnake	*Pituophis catenifer*
gray ratsnake	*Pantherophis spiloides*
Higgins' eye pearly mussel	*Lampsilis higginsii*
Hine's Emerald Dragonfly	*Somatochlora hineana*
hooded warbler	*Wilsonia citrina*
Indiana bat	*Myotis sodalis*
Kentucky warbler	*Oporornis formosus*
king rail	*Rallus elegans*
Knobel's riffle beetle	*Stenelmis knobeli*
lake chubsucker	*Erimyzon sucetta*
lark sparrow	*Chondestes grammacus*
least bittern	*Ixobrychus exilis*
least flycatcher	*Empidonax minimus*
little brown bat	*Myotis lucifugus*

Common Name	Scientific Name
Animals	
map turtle	*Graptemys pseudogeographica*
Mississippi grass shrimp	*Palaemonetes kadiakensis*
mud darter	*Etheostoma asprigene*
North American racer	*Coluber constrictor*
northern cricket frog	*Acris crepitans*
northern goshawk	*Accipiter gentilis*
northern harrier	*Circus cyaneus*
northern long-eared bat	*Myotis septentrionalis*
ornate box turtle	*Terrapene ornata*
Ozark minnow	*Notropis nubilus*
paddlefish	*Polyodon spathula*
pallid shiner	*Notropis amnis*
Pecatonica River mayfly	*Acanthametropus Pecatonica*
pickerel frog	*Lithobates palustris*
pirate perch	*Aphredoderus sayanus*
prairie ring-necked snake	*Diadophis punctatus arnyi*
prairie vole	*Microtus ochrogaster*
prothonotary warbler	*Protonotaria citrea*
rare tiger beetles	*Cicindela hirticollis, C. macra, C. patruela huberi, C. lepida*
red-shouldered hawk	*Buteo lineatus*
red-headed woodpecker	*Melanerpes erythrocephalus*
river redhorse	*Moxostoma carinatum*
rough-legged hawk	*Buteo lagopus*
savannah sparrow	*Passerculus sandwichensis*
sharp-shinned hawk	*Accipiter striatus*
shoal chub	*Macrhybopsis aestivalis*
short-eared owl	*Asio flammeus*
six-lined racerunner	*Aspidoscelis sexlineata*
smooth softshell turtle	*Apalone mutica*
starhead topminnow	*Fundulus dispar*
white-spangled skimmer	*Libellula cyanea*
swamp darner	*Epiaeschna heros*
timber rattlesnake	*Crotalus horridus*
veery	*Catharus fuscescens*
Wallace's deepwater mayfly	*Spinadis simplex*
weed shiner	*Notropis texanus*
western sand darter	*Ammocrypta clara*
whip-poor-will	*Caprimulgus vociferus*
white-tail deer	*Odocoileus virginianus*
willow flycatcher	*Empidonax traillii*
wood thrush	*Hylocichla mustelina*
wood turtle	*Glyptemys insculpta*
yellow sandshell mussel	*Lampsilis teres*
yellow-headed blackbird	*Xanthocephalus Xanthocephalus*
zebra mussel	*Dreissena polymorpha*

Common Name	Scientific Name
Plants	
arrowheads	*Sagittaria sp*
ash	*Fraxinus sp(p)*
aspen	*Populus sp*
basswood	*Tilia americana*
bearberry	*Arctostaphylos uva-ursi*
bent-seeded hop sedge	*Carex tuckermanii*
big blue-stem	*Andropogon gerardii*
bigtooth aspen	*Populus grandidentata*
bishop's-cap	*Mitella diphylla*
black ash	*Fraxinus nigra*
black oak	*Quercus velutina*
black walnut	*Juglans nigra*
bladdernut	*Staphylea trifolia*
blue-joint grass	*Calamagrostis canadensis*
bottlebrush sedge	*Carex hystericina*
box elder	*Acer negundo*
broad beech fern	*Phegopteris hexagonoptera*
broad-leaved cat-tail	*Typha latifolia*
bur oak	*Quercus macrocarpa*
buttonbush	*Cephalanthus occidentalis*
Canada moonseed	*Menispermum canadense*
cat-tails	*Typha spp*
chinquapin oak	*Quercus muhlenbergii*
clustered poppy-mallow	*Callirhoe triangulata*
common blackberry	*Rubus allegheniensis*
common bur-reed	*Sparganium eurycarpum*
common hop sedge	*Carex lupulina*
common spike-rush	*Eleocharis palustris*
common wood-reed	*Cinna arundinacea*
eastern cottonwood	*Populus deltoides*
false-heather	*Hudsonia tomentosa*
false Solomon's-seal	*Smilacina racemosa*
garlic mustard	*Alliaria petiolata*
giant wood fern	*Dryopteris goldiana*
glossy buckthorn	*Rhamnus frangula*
grapes	*Vitis sp*
Gray's sedge	*Carex grayi*
great water-leaf	*Hydrophyllum appendiculatum*
green ash	*Fraxinus pennsylvanica*
green-headed coneflower	*Rudbeckia laciniata*
hackberry	*Celtis occidentalis*
hairy sweet cicely	*Osmorhiza claytonii*
hog-peanut	*Amphicarpaea bracteata*
honey locust	*Gleditsia triacanthos*
hybrid cat-tail	*Typha X glauca*
jack pine	*Pinus banksiana*

Common Name	Scientific Name
Plants	
jeweled shooting star	*Dodecatheon amethystinum*
Kentucky coffee-tree	*Gymnocladus dioica*
lance-leaved buckthorn	*Rhamnus lanceolata*
maidenhair fern	*Adiantum pedatum*
mayapple	*Podophyllum peltatum*
narrow-leaved cat-tail	*Typha angustifolia*
narrow-leaved day-flower	*Commelina erecta*
northern bugleweed	*Lycopus uniflorus*
ostrich fern	*Matteuccia struthiopteris*
partridgeberry	*Mitchella repens*
pickerel-weed	*Pontederia cordata*
poison-ivy	*Toxicodendron radicans*
prairie cord grass	*Spartina pectinata*
prairie fame-flower	*Phemeranthus rugospermus*
prairie ragwort	*Senecio plattensis*
prickly ash	*Zanthoxylum americanum*
purple rocket	*Iodanthus pinnatifidus*
putty root	*Aplectrum hyemale*
raspberry	*Rubus idaeus*
red maple	*Acer rubrum*
red oak	*Quercus rubra*
red osier dogwood	*Cornus stolonifera*
reed canary grass	*Phalaris arundinacea*
river birch	*Betula nigra*
sand cherry	*Prunus pumila*
sand cress	*Arabis lyrata*
Sand sedges	*Cyperus filiculmis* and *C. schweinitzii*
shagbark hickory	*Carya ovata*
Short's rock-cress	*Arabis shortii*
silky wild-rye	*Elymus villosus*
silver maple	*Acer saccharinum*
slender willow	*Salix petiolaris*
small forget-me-not	*Myosotis laxa*
snow trillium	*Trillium nivale*
spotted Joe-Pye-weed	*Eupatorium maculatum*
spreading chervil	*Chaerophyllum procumbens*
spring-beauty	*Claytonia virginica*
stinging nettle	*Urtica dioica*
sugar maple	*Acer saccharum*
swamp milkweed	*Asclepias incarnata*
swamp white oak	*Quercus bicolor*
sweet-scented Indian-plantain	*Cacalia suaveolens*
sycamore	*Platanus occidentalis*
three-awn grasses	*Aristida* spp
tussock sedge	*Carex stricta*
upland boneset	*Eupatorium sessilifolium*

Common Name	Scientific Name
Plants	
violet bush-clover	*Lespedeza violacea*
Virginia creeper	*Parthenocissus quinquefolia*
Virginia waterleaf	*Hydrophyllum virginianum*
white ash	*Fraxinus americana*
white grass	*Leersia virginica*
white oak	*Quercus alba*
white pine	*Pinus strobus*
wild geranium	*Geranium maculatum*
wild leek	*Allium tricoccum*
wild rice	*Zizania aquatica*
wild sarsaparilla	*Aralia nudicaulis*
willow	*Salix sp*
wood anemone	*Anemone quinquefolia*
wood nettle	*Laportea canadensis*
yellow Indian grass	*Sorghastrum nutans*
Bitter-nut hickory	*Carya cordiformis*

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APPENDIX A: Species of Greatest Conservation Need

The following are vertebrate Species of Greatest Conservation Need (SGCN) associated with natural community types that are present on the Lower Wisconsin State Riverway study area in the Western Coulee and Ridges Ecological Landscape. Communities shown here are those that were identified as management opportunities in the Wisconsin Wildlife Action Plan. Letters indicate the degree to which each species is associated with a particular habitat type (S=significant association, M=moderate association, and L=low association). Animal-community combinations shown here that are assigned as either "S" or "M" are also Ecological Priorities, as defined by the Wisconsin Wildlife Action Plan (see dnr.wi.gov/org/land/er/WWAP/ for more information about these data). Shaded species have been documented on the study area.

SGCN Species of the LWSR and Their Habitats

	Major																		Important						Present
	Cedar Glade	Coolwater streams	Dry Cliff	Dry Prairie	Dry-mesic Prairie	Emergent Marsh	Floodplain Forest	Moist Cliff	Oak Barrens	Oak Opening	Oak Woodland	Pine Relict	Sand Prairie	Shrub-carr	Southern Dry Forest	Southern Dry-mesic Forest	Southern Mesic Forest	Surrogate Grasslands	Warmwater rivers	Alder Thicket	Ephemeral Pond	Mesic Prairie	Pine Barrens	Southern Sedge Meadow	Wet-mesic Prairie	Warmwater streams
Species that are Significantly Associated with the Western Coulee and Ridges Landscape																									
Acadian Flycatcher							M								L	S	S								
American Woodcock							L		L	L				S	L			L		S	L		L			
Bald Eagle							L												S						
Bell's Vireo				M	M					L			M	M				M				L			M	
Black Buffalo																			M							
Black Rat Snake	S		S	S	M		M			M	S	S	L		S	S	S					M				
Black-billed Cuckoo							M		M	L				S						S			M			
Blanchard's Cricket Frog		S				S													S					S		S
Blanding's Turtle	M	M		S	M	S	M		S	S	M		S	M		M	M		M	M	S	M	S	M	M	M
Blue Sucker																			S							
Blue-winged Teal				L	M	S	M						L					M	L		L	M		M	M	
Blue-winged Warbler							M		L	M	M			M	M	M	M									
Bluntnose Darter																			S							

	Major																			Important						Present
	Cedar Glade	Coolwater streams	Dry Cliff	Dry Prairie	Dry-mesic Prairie	Emergent Marsh	Floodplain Forest	Moist Cliff	Oak Barrens	Oak Opening	Oak Woodland	Pine Relict	Sand Prairie	Shrub-carr	Southern Dry Forest	Southern Dry-mesic Forest	Southern Mesic Forest	Surrogate Grasslands	Warmwater rivers	Alder Thicket	Ephemeral Pond	Mesic Prairie	Pine Barrens	Southern Sedge Meadow	Wet-mesic Prairie	Warmwater streams
Bobolink					S					L								S				S		M	S	
Species that are Significantly Associated with the Western Coulee and Ridges Landscape																										
Brown Thrasher				M	M				S	S			S					M					S			
Canvasback						L													S							
Cerulean Warbler							S				M				L	S	M									
Crystal Darter																			S							
Dickcissel				L	S				L	L								S				S			L	
Eastern Massasauga Rattlesnake				S	S	S	S		S				S	S						S	S	S	S	S	S	
Eastern Meadowlark				M	S					M			M					S				S		M	M	
Field Sparrow	S			S	M				M	S			S					M				M	M		M	
Four-toed Salamander		M				S	S	L						S			S			S	S			M		
Goldeye																			M							
Gophersnake	S		S	S	S				S	S	S	M	S		M	M	M					M	S			
Grasshopper Sparrow	L			S	S				M	L			S					S				L	L			
Great Egret						S	M												M							
Henslow's Sparrow					S					M								S				S		L	M	
Hooded Warbler																S	S									
Kentucky Warbler							S									M	S									
Lake Sturgeon																			S							
Lark Sparrow	S			M					S				S										M			
Least Flycatcher							M				L			L	L	L	L									
Lesser Scaup						L													M							
Louisiana Waterthrush		S														S	S									
Midland Smooth Softshell Turtle																			S							

	Major																			Important						Present
	Cedar Glade	Coolwater streams	Dry Cliff	Dry Prairie	Dry-mesic Prairie	Emergent Marsh	Floodplain Forest	Moist Cliff	Oak Barrens	Oak Opening	Oak Woodland	Pine Relict	Sand Prairie	Shrub-carr	Southern Dry Forest	Southern Dry-mesic Forest	Southern Mesic Forest	Surrogate Grasslands	Warmwater rivers	Alder Thicket	Ephemeral Pond	Mesic Prairie	Pine Barrens	Southern Sedge Meadow	Wet-mesic Prairie	Warmwater streams
Northern Bobwhite				M	M					M	L		L					S				M			M	
Northern Harrier				M	M	L			M				L	L				S		L		S	M	M	S	
Northern Long-eared Bat	L	S				M	M		M	L	M	L		M	M	M	M		M	M	S			M		M
Northern Prairie Skink	S		M	S	M				S	S	M		S		M	M							S			
Ornate Box Turtle	S			S	M					S	S		S		S	S	M									
Ozark Minnow																										S
Species that are Significantly Associated with the Western Coulee and Ridges Landscape																										
Paddlefish																			M							
Pallid Shiner																			S							
Peregrine Falcon			S																							
Pickerel Frog		S				S	M							M			M		S	M	S	M		S	S	S
Prairie Racerunner	S			S					S	S			S													
Prairie Ringneck Snake	S			S	S				M	S	M		M		M	M										
Prothonotary Warbler							S																			
Red-headed Woodpecker							M		M	S	S				M	M							L			
Red-shouldered Hawk							S									M	M				S					
Redside Dace		M																								M
River Redhorse																			M							
Rusty Blackbird						M	S							M						M	M					
Shoal Chub (Speckled Chub)																			S							
Short-billed Dowitcher						S																				
Starhead Topminnow																			S							S
Timber Rattlesnake	S		S	S	M		M			S	S	S	S		S	S	S					M				
Veery							M				L	M		S		M	M			S						
Vesper Sparrow				S	M				S	M			S					L					S			

	Major																			Important						Present
	Cedar Glade	Coolwater streams	Dry Cliff	Dry Prairie	Dry-mesic Prairie	Emergent Marsh	Floodplain Forest	Moist Cliff	Oak Barrens	Oak Opening	Oak Woodland	Pine Relict	Sand Prairie	Shrub-carr	Southern Dry Forest	Southern Dry-mesic Forest	Southern Mesic Forest	Surrogate Grasslands	Warmwater rivers	Alder Thicket	Ephemeral Pond	Mesic Prairie	Pine Barrens	Southern Sedge Meadow	Wet-mesic Prairie	Warmwater streams
Western Meadowlark				M	S				M				M					S				L	L			
Western Sand Darter																			M							
Western Slender Glass Lizard				S	S				S	M			S										S			
Western Worm Snake	S			S											M	M										
Whip-poor-will							L		M		S	M			S	S	L						M			
Willow Flycatcher				L	M		L			L			L	S				M				M		M	M	
Wood Thrush							M				M				M	S	S									
Wood Turtle		S		S	M		S		S	M	M		S	S			M		S	S	M		S	M		S
Worm-eating Warbler															M	S	M									
Yellow-bellied Racer	S		M	S	M				M				S		M	M							M			
Yellow-billed Cuckoo							S				L			M	L	M	M									
Species that are Significantly Associated with the Western Coulee and Ridges Landscape																										
Yellow-crowned Night-Heron						M	S							M					M		S					
Species that are Moderately Associated with the Western Coulee and Ridges Landscape																										
American Golden Plover					M	M												M				M		L	M	
Black Tern						S																		L		
Buff-breasted Sandpiper					M	M												M							M	
Eastern Red Bat	L	S				M	M		M	M	M	M		M	M	M	M		M	M	S		L	M		M
Franklin's Ground Squirrel				L	S				S	S	M		S					M				M	S		M	
Gilt Darter																			S							S
Hoary Bat	L	S				M	M			L	L	M		M	L	L	L		M	M	S			M		M
King Rail						S																		M		
Osprey																			S							
Prairie Vole				S	S				M	M			S					M				M	L			
Short-eared Owl				M	M	L							L	M				S				S		M	S	

	Major																			Important						Present
	Cedar Glade	Coolwater streams	Dry Cliff	Dry Prairie	Dry-mesic Prairie	Emergent Marsh	Floodplain Forest	Moist Cliff	Oak Barrens	Oak Opening	Oak Woodland	Pine Relict	Sand Prairie	Shrub-carr	Southern Dry Forest	Southern Dry-mesic Forest	Southern Mesic Forest	Surrogate Grasslands	Warmwater rivers	Alder Thicket	Ephemeral Pond	Mesic Prairie	Pine Barrens	Southern Sedge Meadow	Wet-mesic Prairie	Warmwater streams
Silver-haired Bat	L	S				M	M			L	L			M	L	L	L		M	M	S			M		M
Solitary Sandpiper		M				S	S							L						L	S			L		M
Upland Sandpiper				S	S				M	L			M					S				M	M	L	M	
Whooping Crane						S																		M		
Woodland Vole							L		L	S	S				S	S	L									
Yellow-throated Warbler							S									M										

APPENDIX B: Rare Plants Documented within the Riverway

For an explanation of state and global ranks, as well as state status, see Appendix F of the Biotic Inventory and Analysis of the Lower Wisconsin State Riverway (DNR 2011). Listing status is based on the NHI Working List published April 2009.

Common Name	Scientific Name	Last Observed Date	State Rank	Global Rank	State Status	Federal Status
American fever-few	*Parthenium integrifolium*	2008	S3	G5	THR	
arrow-headed rattle-box	*Crotalaria sagittalis*	1992	S1	G5	SC	
broad beech fern	*Phegopteris hexagonoptera*	2008	S2	G5	SC	
buttonweed	*Diodia teres var. teres*	2009	S1	G5T5	SC	
chinquapin oak	*Quercus muehlenbergii*	2009	S1S2	G5	SC	
cleft phlox	*Phlox bifida*	1993	S1	G5?	SC	
cluster fescue	*Festuca paradoxa*	1941	SH	G5	SC	
clustered poppy-mallow	*Callirhoe triangulata*	2009	S3	G3	SC	
glade mallow	*Napaea dioica*	1997	S3	G4	SC	
great water-leaf	*Hydrophyllum appendiculatum*	2008	S2S3	G5	SC	
hairy wild-petunia	*Ruellia humilis*	2008	S2	G5	END	
heart-leaved skullcap	*Scutellaria ovata*	2008	S3	G5	SC	
hooker orchid	*Platanthera hookeri*	1985	S2S3	G4	SC	
jeweled shooting star	*Dodecatheon amethystinum*	2008	S2	G4	SC	
Kentucky coffee-tree	*Gymnocladus dioicus*	2008	S2	G5	SC	
lanced-leaved buckthorn	*Rhamnus lanceolata var. glabrata*	2008	S1	G5T4T5	SC	
narrow-leaved dayflower	*Commelina erecta var. deamiana*	2009	S1	G5T5	SC	
nodding pogonia	*Triphora trianthophora*	1957	S2	G3G4	SC	
one-flowered broomrape	*Orobanche uniflora*	2008	S3	G5	SC	
pale false foxglove	*Agalinis skinneriana*	2001	S2	G3G4	END	
pale green orchid	*Platanthera flava var. herbiola*	2009	S2	G4T4Q	THR	
pink milkwort	*Polygala incarnata*	2007	S1	G5	END	
prairie false-dandelion	*Microseris cuspidata*	1998	S2	G5	SC	
prairie fame-flower	*Phemeranthus rugospermus*	2009	S3	G3G4	SC	
prairie Indian plantain	*Cacalia tuberosa*	2008	S3	G4G5	THR	
prairie ragwort	*Senecio plattensis*	2008	S3	G5	SC	

Common Name	Scientific Name	Last Observed Date	State Rank	Global Rank	State Status	Federal Status
prairie turnip	*Pediomelum esculentum*	1974	S3	G5	SC	
purple milkweed	*Asclepias purpurascens*	2007	S3	G5?	END	
purple-stem cliff-brake	*Pellaea atropurpurea*	2008	S2	G5	SC	
putty root	*Aplectrum hyemale*	2009	S2S3	G5	SC	
Richardson sedge	*Carex richardsonii*	2008	S2	G4	SC	
shadowy goldenrod	*Solidago sciaphila*	2008	S3	G3G4	SC	
Short's rock-cress	*Arabis shortii*	2009	S2	G5	SC	
small forget-me-not	*Myosotis laxa*	2009	S2	G5	SC	
snow trillium	*Trillium nivale*	2009	S3	G4	THR	
spreading chervil	*Chaerophyllum procumbens*	2009	S1	G5	SC	
sweet-scented Indian-plantain	*Cacalia suaveolens*	2009	S3	G4	SC	
sycamore	*Platanus occidentalis*	1985	S2	G5	SC	
upland boneset	*Eupatorium sessilifolium var. brittonianum*	2009	S3	G5T3T5	SC	
violet bush-clover	*Lespedeza violacea*	2009	S2	G5	SC	
whip nutrush	*Scleria triglomerata*	2001	S2S3	G5	SC	
white camas	*Zigadenus elegans var. glaucus*	1977	S2S3	G5T4T5	SC	
Wilcox panic grass	*Panicum wilcoxianum*	1940	SH	G5	SC	
yellow gentian	*Gentiana alba*	2002	S3	G4	THR	

APPENDIX C: Rare Animals Documented within the Riverway

For an explanation of state and global ranks, as well as state status, see Appendix F of the Biotic Inventory and Analysis of the Lower Wisconsin State Riverway (DNR 2011). Listing status is based on the NHI Working List published April 2009.

Species with a "W" in the "Tracked by NHI" column are on the Watch List and are not mapped in the NHI database. Various sources were used to determine the Watch List species and SGCN present and this may not be a complete list.

Common Name	Scientific Name	Last Observed Date	State Rank	Global Rank	State Status	Federal Status	SGCN	Tracked by NHI
Amphibians								
American bullfrog	*Lithobates catesbeianus*	2009	S3	G5	SC/H		N	Y
pickerel frog	*Lithobates palustris*	1995	S3S4	G5	SC/H		Y	Y
Beetles								
a tiger beetle	*Cicindela macra*	2001	S1S2	G5	SC/N		Y	Y
Cicindela patruela huberi	*Cicindela patruela huberi*	1978	S3	G3T3	SC/N		Y	Y
Bird								
Acadian flycatcher	*Empidonax virescens*	2010	S3B	G5	THR		Y	Y
American bittern	*Botaurus lentiginosus*	2008	S3B	G4	SC/M		Y	Y
American woodcock	*Scolopax minor*	2009	S4B	G5	SC/M		Y	W
bald eagle	*Haliaeetus leucocephalus*	2010	S4B,S2N	G5	SC/P		Y	Y
Bell's vireo	*Vireo bellii*	2008	S2B	G5	THR		Y	Y
black-billed cuckoo	*Coccyzus erythropthalmus*	2008	S4B	G5	SC/M		Y	W
blue-winged teal	*Anas discors*	2008	S4B	G5	SC/M		Y	W
blue-winged warbler	*Vermivora pinus*	2010	S4B	G5	SC/M		Y	W
bobolink	*Dolichonyx oryzivorus*	2010	S4B	G5	SC/M		Y	W
brown thrasher	*Toxostoma rufum*	2010	S4B	G5	SC/M		Y	W
Canada warbler	*Wilsonia canadensis*	2008	S3B	G5	SC/M		Y	Y
cerulean warbler	*Dendroica cerulea*	2010	S2S3B	G4	THR		Y	Y
common moorhen	*Gallinula chloropus*	2009	S2B	G5	SC/M		N	Y
dickcissel	*Spiza americana*	1993	S3B	G5	SC/M		Y	Y
eastern meadowlark	*Sturnella magna*	2010	S4B	G5	SC/M		Y	W
field sparrow	*Spizella pusilla*	2010	S4B	G5	SC/M		Y	W
golden-winged warbler	*Vermivora chrysoptera*	2009	S4B	G4	SC/M		Y	W

Common Name	Scientific Name	Last Observed Date	State Rank	Global Rank	State Status	Federal Status	SGCN	Tracked by NHI
grasshopper sparrow	*Ammodramus savannarum*	2010	S4B	G5	SC/M		Y	W
Henslow's sparrow	*Ammodramus henslowii*	2009	S3B	G4	THR		Y	Y
hooded warbler	*Wilsonia citrina*	2010	S2S3B	G5	THR		Y	Y
Kentucky warbler	*Oporornis formosus*	2008	S1S2B	G5	THR		Y	Y
lark sparrow	*Chondestes grammacus*	2009	S2B	G5	SC/M		Y	Y
least bittern	*Ixobrychus exilis*	2009	S3B	G5	SC/M		N	Y
least flycatcher	*Empidonax minimus*	2010	S4B	G5	SC/M		Y	W
prothonotary warbler	*Protonotaria citrea*	2010	S3B	G5	SC/M		Y	Y
red-headed woodpecker	*Melanerpes erythrocephalus*	2009	S3B	G5	SC/M		Y	W
red-shouldered hawk	*Buteo lineatus*	2009	S3S4B,S1N	G5	THR		Y	Y
sedge wren	*Cistothorus platensis*	2010	S4B	G5	SC/M		N	W
trumpeter swan	*Cygnus buccinator*	2010*	S4B	G4	SC/M		Y	Y
veery	*Catharus fuscescens*	2008	S4B	G5	SC/M		Y	N
vesper sparrow	*Pooecetes gramineus*	2010	S4B	G5	SC/M		Y	W
whip-poor-will	*Caprimulgus vociferus*	2008	S3B	G5	SC/M		Y	N
willow flycatcher	*Empidonax traillii*	2010	S4B	G5	SC/M		Y	W
wood thrush	*Hylocichla mustelina*	2010	S4B	G5	SC/M		Y	W
worm-eating warbler	*Helmitheros vermivorus*	2004	S1B	G5	END		Y	Y
yellow-billed cuckoo	*Coccyzus americanus*	2009*	S3B	G5	SC/M		Y	Y
yellow-breasted chat	*Icteria virens*	1995	S2B	G5	SC/M		N	Y
yellow-crowned night heron	*Nyctanassa violacea*	2009*	S1B	G5	THR		Y	Y
yellow-throated warbler	*Dendroica dominica*	1993*	S1B	G5	END		Y	Y
Butterflies and Moths								
a looper moth	*Euchlaena milnei*	1981	S1S2	G2G4	SC/N		Y	Y
Columbine dusky wing	*Erynnis lucilius*	2010	S2	G4	SC/N		Y	Y
dusted skipper	*Atrytonopsis hianna*	1991	S3	G4G5	SC/N		N	Y
gorgone checker spot	*Chlosyne gorgone*	1991	S3	G5	SC/N		N	Y
Leonard's skipper	*Hesperia leonardus*	2010	S3	G4	SC/N		N	Y
mottled dusky wing	*Erynnis martialis*	1938	S2	G3	SC/N		Y	Y
phyllira tiger moth	*Grammia Phyllira*	2001	S2	G4	SC/N		Y	Y
Whitney's underwing moth	*Catocala whitneyi*	1996	S3	G3G4	SC/N		Y	Y
wild indigo dusky wing	*Erynnis baptisiae*	1989	S2S3	G5	SC/N		Y	Y

Common Name	Scientific Name	Last Observed Date	State Rank	Global Rank	State Status	Federal Status	SGCN	Tracked by NHI
Crustaceans								
Mississippi grass shrimp	*Palaemonetes kadiakensis*	2009	S1	G5	SC/N		Y	Y
Dragonflies and Damselflies								
Cyrano darner	*Nasiaeschna pentacantha*	1992	S3	G5	SC/N		N	Y
fragile forktail	*Ischnura posita*	1989	S2S3	G5	SC/N		Y	Y
Hine's emerald	*Somatochlora hineana*	2009	S1	G2G3	END	LE	Y	Y
plains clubtail	*Gomphurus externus*	1991	S2	G5	SC/N		N	Y
russet-tipped clubtail	*Stylurus plagiatus*	1988	S2	G5	SC/N		N	Y
smoky shadowfly	*Neurocordulia molesta*	1993	S2S3	G4	SC/N		N	Y
swamp darner	*Epiaeschna heros*	1991	S1?	G5	SC/N		Y	Y
white-spangled skimmer	*Libellula cyanea*	1988	S1	G5	SC/N		Y	Y
Fishes								
American eel	*Anguilla rostrata*	2004	S2	G4	SC/N		Y	Y
black buffalo	*Ictiobus niger*	2010	S2	G5	THR		Y	Y
blue sucker	*Cycleptus elongatus*	2010	S2	G3G4	THR		Y	Y
crystal darter	*Crystallaria asprella*	2009	S1	G3	END		Y	Y
goldeye	*Hiodon alosoides*	2010	S2	G5	END		Y	Y
greater redhorse	*Moxostoma valenciennesi*	1957	S3	G4	THR		Y	Y
lake chubsucker	*Erimyzon sucetta*	2009	S3	G5	SC/N		Y	Y
lake sturgeon	*Acipenser fulvescens*	2010	S3	G3G4	SC/H		Y	Y
least darter	*Etheostoma microperca*	2004	S3	G5	SC/N		Y	Y
mud darter	*Etheostoma asprigene*	2009	S3	G4G5	SC/N		N	Y
paddlefish	*Polyodon spathula*	2010	S2	G4	THR		Y	Y
pallid shiner	*Hybopsis amnis*[1]	1962	S2	G4	END		Y	Y
pirate perch	*Aphredoderus sayanus*	2009	S3	G5	SC/N		N	Y
pugnose minnow	*Opsopoeodus emiliae*	2004	S3	G5	SC/N		N	Y
river redhorse	*Moxostoma carinatum*	2010	S2	G4	THR		Y	Y
shoal chub	*Macrhybopsis hyostoma*[2]	2009	S2	G5	THR		Y	Y

[1] *Notropis amnis* on Wisconsin's List of Threatened and Endangered Species

[2] *Macrhybopsis aestivalis* on Wisconsin's List of Threatened and Endangered Species.

Common Name	Scientific Name	Last Observed Date	State Rank	Global Rank	State Status	Federal Status	SGCN	Tracked by NHI
silver chub	*Macrhybopsis storeriana*	2010	S3	G5	SC/N		N	Y
starhead topminnow	*Fundulus dispar*	2009	S2	G4	END		Y	Y
weed shiner	*Notropis texanus*	2009	S3	G5	SC/N		N	Y
western sand darter	*Ammocrypta clara*	2010	S3	G3	SC/N		Y	Y
Grasshoppers								
large-headed grasshopper	*Phoetaliotes nebrascensis*	2006	S3?	G5	SC/N		Y	Y
northern marbled locust	*Spharagemon marmorata*	2009	S3	G5	SC/N		Y	W
sand locust	*Psinidia fenestralis*	2009	S3?	G5	SC/N		Y	Y
short-winged grasshopper	*Dichromorpha viridis*	1998	S3?	G5	SC/N		Y	Y
spotted-winged grasshopper	*Orphulella pelidna*	2009	S2S3	G5	SC/N		Y	Y
yellow-winged grasshopper	*Arphia xanthoptera*	2008	S3?	G5	SC/N		Y	Y
Leafhoppers and True Bugs								
prairie leafhopper	*Polyamia dilata*	1998	S2	GNR	THR		Y	Y
Mammals								
prairie vole	*Microtus ochrogaster*	2009	S1S2	G5	SC/N		Y	Y
western harvest mouse	*Reithrodontomys megalotis*	2005	S3	G5	SC/N		N	Y
Mayflies								
a flat-headed mayfly	*Macdunnoa persimplex*	1995	S1?	G4	SC/N		Y	Y
a flat-headed mayfly	*Pseudiron centralis*	1992	S3	G5	SC/N		Y	Y
a small minnow mayfly	*Paracloeodes minutus*	1995	S1?	G5	SC/N		Y	Y
Pecatonica River mayfly	*Acanthametropus pecatonica*	1998	S1	G2G4	END		Y	Y
Wallace's deepwater mayfly	*Spinadis simplex*	1990	S1	G2G4	END		Y	Y
Mussels								
buckhorn	*Tritogonia verrucosa*	2005	S2	G4G5	THR		Y	Y
sheepnose	*Plethobasus cyphyus*	2002	S1	G3	END	C	Y	Y
butterfly	*Ellipsaria lineolata*	2003	S2	G4	END		Y	Y
ebony shell	*Fusconaia ebena*	1988	S1	G4G5	END		Y	Y
elktoe	*Alasmidonta marginata*	2002	S4	G4	SC/P		N	Y
fawnsfoot	*Truncilla donaciformis*	2004	S1S2	G5	SC/P		Y	Y
flat floater	*Anodonta suborbiculata*	1988	S1S2	G5	SC/P		Y	Y
Higgins' eye	*Lampsilis higginsii*	2009	S1	G1	END	LE	Y	Y
mapleleaf	*Quadrula quadrula*	2002	S2S3	G5	SC/P		Y	Y

Common Name	Scientific Name	Last Observed Date	State Rank	Global Rank	State Status	Federal Status	SGCN	Tracked by NHI
monkeyface	*Quadrula metanevra*	2004	S2	G4	THR		Y	Y
rock pocketbook	*Arcidens confragosus*	2002	S1S2	G4	THR		Y	Y
round pigtoe	*Pleurobema sintoxia*	2002	S3	G4G5	SC/P		N	Y
salamander mussel	*Simpsonaias ambigua*	1997	S2S3	G3	THR		Y	Y
wartyback	*Quadrula nodulata*	1988	S1S2	G4	THR		Y	Y
yellow and slough sandshells	*Lampsilis teres*	2005	S1	G5	END		Y	Y
Reptiles								
Blanding's turtle	*Emydoidea blandingii*	2010	S3	G4	THR		Y	Y
eastern hog-nosed snake*	*Heterodon platirhinos*	1998	S3?	G5	SC/H		N	Y
false map turtle	*Graptemys pseudogeographica*	1992	S4	G5	SC/H		N	Y
gophersnake	*Pituophis catenifer*	2010	S2S3	G5	SC/P		Y	Y
gray ratsnake	*Pantherophis spiloides*	2010	S2S3	G5T5	SC/P		Y	Y
North American racer	*Coluber constrictor*	2009	S2	G5	SC/P		Y	Y
ornate box turtle	*Terrapene ornata*	2010	S1	G5	END		Y	Y
prairie ring-necked snake	*Diadophis punctatus arnyi*	2009	S3	G5T5	SC/H		Y	Y
six-lined racerunner	*Aspidoscelis sexlineata*	2009	S3	G5	SC/H		Y	Y
smooth softshell	*Apalone mutica*	1988	S3	G5	SC/H		Y	Y
timber rattlesnake	*Crotalus horridus*	2009	S2S3	G4	SC/P		Y	Y
wood turtle	*Glyptemys insculpta*	1998	S2	G4	THR		Y	Y

*This record is not yet mapped in the NHI database or the last observation date is more recent than what is in the NHI database.

APPENDIX D: LWSR Infrastructure

LWSR Recreational Facility Summary	**Upper Segment**	**Middle Segment**	**Lower Segment**
Public access			
River boat landings (number)	**9** (3 canoe only) 5 are DNR	**11** (2 canoe only) 3 are DNR	**7** (1 on Kickapoo River) 3 are DNR
Pond or Slough boat landings (number)	**2** (8 total veh.) 2 are DNR	**11** (70 total veh.) 8 are DNR	**1** (4 total veh.)
Hunter parking lots *(number /capacity)*	**17** (75 total veh.) All are DNR	**31** (250 total veh.) All are DNR	**14** (50 total veh.) All DNR
Fishing Access lots – (primarily use)	**2** All are DNR	**16** (80) All are DNR	**3** (15 total veh.) All are DNR
Other parking lots	**6** (300 total veh.) Blackhawk, Mazo Beach All are DNR	**2** (5 total veh.) Bloyer and Eagle Mounds All are DNR	**1** (20 total veh.) Millville Bridle Trail All are DNR
Trails *(mileage may overlap)*			
Auto trail miles	**1.8**	**15**	**2**
Hiking/cross country ski trail miles	**14** (hike) / **10.8** (cc) **2** miles @ Tower Hill	**6.5** (hike/cc)	**5.1** (hike/cc)
Nature trail miles	**.6**	**0**	**0**
Interpretive Display	**1** @ Ferry Bluff	**0**	**1** @ Wyalusing SP

Snowmobile trail miles	**1** Mile Club managed	**6** Miles Club managed	**0**
Equestrian trail miles	**8.4** all DNR	**6.5** all DNR	**5.1** all DNR
Camping (developed campgrounds with daily occupancy)	**2** Prairie du Sac, Tower Hill S.P.	**2** Muscoda and Avoca	**1** Wyalusing S.P.
Disabled accessible fishing piers	**2** Helena Landing, Peck's Landing	**1** Garner Lake	**0**
Disabled accessible hunting structures	**1** Turkey Blind @ Blackhawk	**1** Waterfowl Pier @ Whites Slough	**0**
Fishing piers (non-ADA)	**0**	**0**	**9** Woodman Lake
Picnicking (sites with facilities)	**7** 7 DNR	**6** all not DNR	**3** all not DNR
Highway waysides	**0**	**2** all not DNR	**1** all not DNR
Observation towers/lookouts	**2** Tower Hill SP, Ferry Bluff	**0**	**1** Wyalusing SP
Dog trial areas (number and acres)	**1** (200 acres)	**0**	**0**

River Boat/Canoe Access Sites and Amenities	Managed by:		Amenities							
	DNR	Other Gov.	Surfaced Roads and Parking	Signing and Information	Toilets	Picnicking	Drinking Water	Quiet-water Launch Area	Separate Motor - Non-motor Access	Usually Open in High Water
Upper River Segment										
Prairie du Sac		*	*	*	*	*	*		*	*
Sauk City		*	*	*					*	*
Statz Memorial Launch	*		*	*	*				canoe only	*
Town of Mazomanie		*	*	*	*	*	*			*
Ferry Bluff	*		*	*				*	canoe only	*
Arena	*		*	*	*	*		*	*	
Highway 14 Bridge		*	*	*						
Tower Hill SP	*		*	*	*	in park	in park	*		*
Peck's Landing	*		*	*	*	*			canoe only	*
Middle River Segment										
Otter Creek		*	*	*				*	*	*
Lone Rock		*	*	*				*	canoe only	
Buena Vista		*	*	*		in park			*	
Orion		*	*	*	*	in park				
Lemanski	*							*		
Muscoda Victora Riverside Park (camping)		*	*	*	*	*	*	*	*	
Muscoda West	*		*	*						
Newburn Lane		?								*
Port Andrew		*	*	*	up hill	up hill	up hill			
Blue River		*	*	*	*	*		*		
Boscobel Von Haden		*	*	*	*	*	*	*	*	*
Boscobel East	*		*	*					canoe only	
Lower River Segment										
Boydtown / HWY 60	*							*		*
Woodman Lake	*		*	*		*		*	electric motor only	*
Green River		*	*	*	*	*		*	*	*
Wauzeka		*	*	*			*	*		
Millville		*	*	*	*	*		*		*
Bridgeport		*	*	*				*	*	*
Kickapoo River @ Highway 60	*		*					*		

Slough and Pond Landings

Location:	Watercraft Type:
Helena Landing (Goofy Slough / Helena Lake)	Boat or Canoe
Rainbow Road – Private but used often by public	Boat or Canoe
Pearl Road (Hills Slough)	Canoe carry-in
Bakkens Pond (2)	Boat or Canoe and Canoe
McKenna Park (not DNR)	Boat or Canoe
Smith Slough	Boat or Canoe
Cruson Slough	Boat or Canoe
Avoca Village Park (not DNR); (paved ramp and parking)	Boat or Canoe,
Jonas	Canoe drag in
Goodwiler Lake	Boat or Canoe (paved ramp)
Highbank Road	Volunteer Boat, Impromptu Canoe
Paffenrath	Canoe carry-in, Volunteer boat
Fish Trap Flowage	Volunteer Canoe
Garner Lake	Volunteer Boat or Canoe
Blue River Unit Sign	Canoe carry-in
Semrad Slough	Canoe carry-in

Recreational Shelters

Location:	Shelter Type:
Blackhawk Unit	• Cabin (a.ka. Rhinelander Cabin)
	• Picnic Shelter (water available)
	• Open Arena
Mazomanie Unit	• Dog Trial Area Shelter (water available)

Maintenance Structures

Location:	Building Type and Name:
Blackhawk Unit	• Storage barn (water)
Mazomanie Unit	• Zerwick Shed
Spring Green Unit	• Leone Road Storage Building (to be built 2012 / 2013)
Bakkens Pond Unit	• Brummer Barn (water)
Bakkens Pond Unit	• Brummer Shed (water)
Avoca Unit	• WP&L Shed (water)

Other Buildings

Location:	Building Type and Name:
Blackhawk Unit	• Wachter Cabin (historic structure)

APPENDIX E: LWSR Maps