

## **Appendix 1. Economic Statistics for the Great Lakes Region**

Draft - Great Lakes Recreational Boating Economic Benefits Study (Nov. 2004), Prepared for the U.S. Army Corps of Engineers by the Great Lakes Commission.

Following are direct quotes from the Executive Summary, found on pages 7-9

### **Numbers and types of registered boats in the Great Lakes (p. 7)**

- There are almost 4.3 million recreational boats in the eight Great Lakes states. This comprises a third of all numbered U.S. recreational vessels, and represents a 1.3 increase over the five-year period between 1999 and 2003.
- The most prevalent size boat on the Great Lakes is between 16 and 20 feet in length, which covers about 28 percent of the Lakes' recreational fleet.
- The most popular type of boat on the Lakes is the 16 to 24-foot fiberglass runabout.

### **Economic impact of Great Lakes marinas (p. 7)**

- It is estimated that there are more than a quarter million marina slips available in Great Lakes states. Most (89 percent) are seasonal rental slips.
- An average of 93 percent of the accessible seasonal slips in Great Lakes counties were occupied the summer of 2004, which means that about 107,000 boats were kept in Great Lakes county marinas during the boating season.
- At a typical Great Lakes marina, Tower Marine in Saugatuck, Michigan, the 395 boats renting slips spent \$2.85 million on annual craft expenses and another \$2.85 million on boating trips, accounting for 15,000 days of boating in 2004. The direct economic impacts of trip spending was \$1.8 million in sales, \$661,000 in wages and salaries and \$952,000 in value added to the local economy, supporting 37 jobs. Annual craft expenses directly supported an additional 44 jobs from \$2.6 million in direct sales, \$834,000 in wages and salaries and \$1.5 million in value added.

### **Boat sales and watercraft manufacturing (p. 7-8)**

- Residents of Great Lakes states represent almost a quarter (23.6 percent) of the 2003 nationwide purchases of new power boats, outboard motors, trailers and accessories.
- The majority of the manufacturers headquartered in Great Lakes states produce powerboats including outboards (58 manufacturers), inboards/outboards (47 manufacturers), pontoons (39 manufacturers) and inboards (18 manufacturers). There are also 47 canoe/kayak makers and 23 sailboat manufacturers.
- Retail boat sales in Great Lakes states in 2003 totaled \$2.025 billion.
- It is estimated that 182,700 watercraft were manufactured in 2003 by the 250 manufacturers with headquarters in Great Lakes States.
- It is conservatively estimated that watercraft manufacturers in the Great Lakes states employ 18,500 persons.

### **Economic impact of charter fishing (p. 8)**

- The average cost of the half-day lake trout and salmon charter, the most popular trip, is \$328 per boat. This cost ranges from \$25 to \$560 across the region.
- Charter captains in the Great Lakes spend an average of \$10,568 annually on operating expenses for a total of \$20.72 million.
- The direct and secondary impacts of charter fishing on Great Lakes communities are approximately \$61 million in sales, \$25 million in salaries and wages and \$37 million in value added. The total employment impact of charter fishing in Great Lakes states is 1,266 jobs.

### **Boater spending (p. 8)**

- Registered watercraft in Great Lakes states spent almost \$10 billion on boating trips in 2003 and \$5.7 billion on craft expenses for a total of almost \$16 billion.
- The greatest trip expenses are for boat fuel (22%), restaurants and bars (17%) and groceries (14%).
- The majority of annual craft expenses are for equipment (39%), maintenance and repair (29%) and insurance (14%).

### **Economic impacts of boater spending (p. 9)**

- The \$9.9 billion in boater trip spending has a direct economic impact on the region of \$6.8 billion in sales, \$2.5 billion in personal income, \$1.7 billion in value added, and 107,000 jobs.
- With secondary effects, the total impact of boater trip spending is 160,000 jobs and \$4.3 billion in personal income.
- Combining trip and craft-related spending, the total impact on the region's economy is 244,000 jobs and \$7.2 billion in personal income.
- There were 110,000 boats kept at Great Lakes marinas in 2003, the majority in Michigan and Ohio. These boats spent \$665 million on trip-related expenses and \$529 million on craft-related items.
- Direct economic impact of registered boats on Great Lakes states' economies include almost \$11.5 billion annually in sales, \$4 billion in personal income and \$6.4 billion in value added, for a total of over \$22 billion.
- With secondary impacts added, the total impact on Great Lakes states' economies of registered recreational boats is over \$19 billion in sales, \$6.4 billion in personal income \$9.2 billion in value added, and 246,117 jobs.

### **Additional Great Lakes Resource Values**

- Forestry - \$24B annually in (GLFIC, Undated) – Michigan State University (MSU) (<http://www.bsrsi.msu.edu/glfic/index.html>)
- Tourism - ~\$30B annually (GL Forest Information Center – MSU) (<http://www.bsrsi.msu.edu/glfic/index.html>)
  - Beach visits \$15-25 each along Lake Erie (Sohngen, et al, 1998)
- Industry – 45% of Canada's industry (Mills, 2004)
- Ag – 25% of Canada's ag revenue (Mills, 2004)
- Trade -- \$180B between Canada and U.S. in GL Region (Mills, 2004)
- Recreational Boating and Fishing –
  - \$18.8M ('84 \$) or \$35M ('05 \$) annually in Central basin of Lake Erie (Dutta, 1984)
  - According to the Great Lakes Commission's Recreation Boating Study, boats from Ohio account for 11.7% of all boating on the Great Lakes (GLC, 2000). Extrapolating from above, the total effect from the Great Lakes would be \$296M.
  - According to a Great Lakes Fishery Commission study, sportfishing in the GL accounts for \$1.4B annually ('85\$) or \$2.5B ('05\$). (Talhelm, 1988)
  - Recreation and Tourism total=\$15B annually with \$6.89B related to fishing. (U.S. FWS, et al, 1994). In 2005\$ that would be \$19.5B and \$9.0B respectively.

### **Sources**

Dutta, Nilima, 1984. [\*The Value of Recreational Boating and Fishing in the Central Basin Portion of Ohio's Portion of Lake Erie\*](#), Ohio Sea Grant Technical Bulletin OHSU-TB-18, Ohio State University

Great Lakes Forest Information Center, Undated. *Great Lakes Forest Watch: The Upper Great Lakes Region*. Website: <http://www.bsrsi.msu.edu/glfic/index.html>, visited May, 2005, GLFIC, Michigan State University.

Great Lakes Commission, 2000. "Recreational Boating of the Great Lakes-St. Lawrence Region: Overview", GLC report publication, 23 pp, <http://www.glc.org/docs/subject.html>.

Sohnngen, B., Lichtkoppler F., and Bielen, M., 1998. *The value of day trips to Lake Erie beaches*. Department of Agricultural, Environmental and Development Economics, and The Ohio Sea Grant College Program, Ohio State University.

Talhelm, D.R. 1988. *Economics of Great Lakes Fisheries: A 1985 Assessment*. Great Lakes Fishery Commission. Technical Report No. 54.

U.S. Fish and Wildlife Service, 1995. *Great Lakes Fishery Resources Restoration Study. A Report to Congress*. U.S. Fish and Wildlife Service, Washington, D.C. 198 pp.

## **Appendix 2. Great Lakes Conservation Targets (compiled by The Nature Conservancy and partners)**

Reference: *Toward a New Conservation Vision for the Great Lakes Region: A Second Iteration*. The Nature Conservancy's Great Lakes Program, 2000. ([nature.org/greatlakes](http://nature.org/greatlakes).)

The document cited above provides a list of Great Lakes conservation targets that includes native species, natural communities and aquatic systems intended to represent the full range of biological diversity in the Great Lakes ecoregion. The Nature Conservancy and partners compiled this list to guide the development of a Conservation Blueprint for the Great Lakes. The species list includes all endemic plants and animals (e.g. dwarf lake iris, Lake Erie water snake); rare and vulnerable plants and animals (e.g. Pitcher's thistle, Kirtland's warbler); and declining and vulnerable birds, reptiles and amphibians (e.g. piping plover, Blanding's turtle, green tree frog). All natural community types found in the Great Lakes ecoregion are included (e.g. Great Lakes coastal marsh, lakeplain prairie). An aquatic ecosystem classification system was developed to determine the list of stream, lake, and nearshore ecosystem types in the Great Lakes ecoregion (e.g. groundwater-fed headwater streams, peat lakes, baymouth/barrier beaches with sand nearshore). Natural community targets and aquatic systems targets function as coarse filters for capturing common and representative species. As we learn more about the status of biological diversity of the Great Lakes region, the target list will likely be refined.

This document also provides background information on the development and application of this list of conservation targets.

### **Appendix 3. Partial Listing of Laws, Regulations, Executive Orders, Programs and Issues Regarding Great Lakes Habitat/Species**

#### ***Laws, Regulations, Executive Orders***

##### International:

Kyoto Agreement  
North American Waterfowl Management Plan  
Tripartite Agreement on wetlands between Canada, U.S. and Mexico  
U.S.-Canada Great Lakes Water Quality Agreement

##### Federal:

36 CFR Part 10 Subpart (b)  
Anderson-Mansfield Reforestation and Re-vegetation Joint Resolution  
Bankhead-Jones Farm Tenant Act of 1937  
Clean Lakes Program of 1972  
Clean Water Act of 1986  
Coastal Zone Management Act of 1972  
Comprehensive Environmental Response, Compensation, and Liability Act of 1980  
Consolidated Appropriations resolution, 2003  
Cooperative Forestry and Assistance Act of July 1, 1978  
Endangered Species Act of 1973  
Executive Order 11987 (May 24, 1977)  
Executive Order 13112 (February 3, 1999)  
Executive Order 13148 (April 21, 2000)  
Executive Order 13352 (August 26, 2004)  
Federal-Aid Highways Act of 1968 -- As amended by the Department of Transportation Act of 1966  
Federal Land Policy and Management Act (FLPMA) of 1976  
Federal Power Act of June 5, 1920  
Fish and Wildlife Act of 1956  
Fish and Wildlife Conservation Act  
Food Security Act of 1985  
Granger-Thye Act of 1950  
Great Lakes Legacy Act of 2002  
Healthy Forests Restoration Act (H.R. 1904) of November 21, 2003  
Knutson-Vanderberg Act of June 9, 1930  
Lacey Act of 1900  
Migratory Bird Conservation Act of 1929  
Multiple Use-Sustained Yield Act of 1960  
National Environmental Policy Act of 1969  
National Estuary Program  
National Forest Management Act of 1976  
National Historic Preservation Act of 1966  
Non-indigenous Aquatic Invasive Species Act of 1990  
North American Wetlands Conservation Act of 1989  
Organic Administration Act of 1897  
Rivers and Harbors Act of 1938  
Safe Drinking Water Act Amendments of 1996  
Sikes Act (Fish and Wildlife Conservation) of September 15, 1960  
Surface Mining Control and Reclamation Act of 1977

Transportation Equity Act for the 21st Century of 1998  
Water Quality Act of 1987  
Water Resources Development Acts (WRDA) of 1986, 1988, 1990, 1992, 1996, 2000  
    WRDA 1996, Section 206 – Aquatic Ecosystem Restoration  
    WRDA 1999, Section 506 – Projects for the Improvement of the Environment  
    WRDA 2000, Section 506 – Great Lakes Fishery and Ecosystem Restoration  
Watershed Protection and Flood Prevention Act of 1954  
Wild and Scenic Rivers Act of 1968  
Wilderness Act of 1964

States:

Summaries of state biodiversity laws are found at the following websites:

<http://ipl.unm.edu/cwl/statbio/illinois.html>  
<http://ipl.unm.edu/cwl/statbio/indiana.html>  
<http://ipl.unm.edu/cwl/statbio/michigan.html>  
<http://ipl.unm.edu/cwl/statbio/minnesota.html>  
<http://ipl.unm.edu/cwl/statbio/newyork.htm>  
<http://ipl.unm.edu/cwl/statbio/ohio.htm>  
<http://ipl.unm.edu/cwl/statbio/pennsylvania.htm>  
<http://ipl.unm.edu/cwl/statbio/wisconsin.htm>

***Habitat/Species Programs (an incomplete listing)***

Illinois

Illinois Natural History Program  
Illinois Endangered and Threatened Species Program  
Conservation 2000

Indiana

Wildlife Habitat Incentives Program (Indiana)  
Indiana Important Bird Area Program  
Indiana Aquatic Nuisance Species Management Plan  
Indiana Biodiversity Initiative

Michigan

Non-game Wildlife Funding Program (Michigan)  
Michigan Natural Features Inventory

Minnesota

Minnesota Wildlife Habitat Incentives Program  
Endangered and Threatened Species Recovery Program (Minnesota)  
Endangered Species Program (Minnesota)  
Conservation Economic Program (Minnesota)

New York

New York Natural Heritage Program  
Great Lakes Program

Ohio

Wildlife Diversity and Endangered Species Program (Ohio)  
Northwest Ohio Windbreak Program  
Ohio Wetland Stamp Program

## Pennsylvania

State Wildlife Grants Program  
Partners Program  
Endangered and Threatened Species Program

## Wisconsin

Endangered Resources Landowner Contact Program  
Invasive Plant Program  
Wildlife Habitat Incentives Program

## U.S. Fish and Wildlife Service

U.S. Fish and Wildlife Service programs that contribute to wetland restoration include the Great Lakes Fish and Wildlife Restoration Act of 1998, the Coastal Program, Partners for Fish and Wildlife, the National Coastal Wetlands Program, the Aquatic Invasive Species Program, and the Natural Resource Damage Assessment and Restoration Program.

## Coastal Zone Management

The Coastal Zone Management Act is implemented at the state level. The law authorizes the use of federal funds to address the cumulative and secondary impacts of development and land use change. Many state coastal management programs fund and support multi-jurisdictional land use planning initiatives. This emphasis on coordinated planning and management is expected to grow. An example is the January 2005 Memorandum of Agreement between NOAA and EPA on the development and implementation of smart growth strategies for coastal communities. Currently, the incentive-based and regulatory arms of many state coastal management programs use ecosystem-based approaches that promote resource protection.

## Coastal and Estuarine Land Conservation Program

In 2002, Congress passed legislation directing the Secretary of Commerce to establish a Coastal and Estuarine Land Conservation Program (CELC). Coastal states that develop their own CELC programs consistent with NOAA guidance are eligible to receive federal funds for acquiring coastal and estuarine areas that have significant ecological value. States may opt to include inland areas within their CELC program boundary.

## Other programs

The Great Lakes Fish and Wildlife Restoration Act of 1998 authorizes the U.S. Fish and Wildlife Service to partner with state, Indian tribes, and other federal agencies to restore fish and wildlife populations and their habitats in the Great Lakes.

The Great Lakes Fishery Act of 1956 establishes the Great Lakes Fishery Commission to restore the fisheries of the Great Lakes through the control of sea lamprey populations in tributary streams and implementation of a research program.

## ***Habitat/Species Issues***

### Coastal wetlands

Great Lakes coastal wetlands are addressed by numerous laws, policies and programs at international, federal, state and local levels. No single government agency has management authority. Sections 401 and 404 of the Clean Water Act give the U.S. Army Corps of Engineers (in consultation with the U.S. EPA and, in some cases, state agencies) regulatory authority over permitted development in coastal wetlands. Numerous federal agencies, either directly or through state agencies, fund conservation or restoration projects in coastal wetlands. Tribal programs,

including the Tribal Wetland and Waterfowl Enhancement Initiative, are funded by the Bureau of Indian Affairs.

Lakewide Management Plans and Remedial Action Plans for Areas of Concern focus on localized Great Lakes issues. However, many of these programs are wetland specific. Wetlands may also be included in larger programs that conserve habitats and species or programs that study and protect wetland-dependant animal and plant populations.

Beyond state and federal government programs, non-governmental organizations have established coastal wetlands programs. Attachment 5, "Proposed Technical Framework for Habitat/Species Conservation," includes a comprehensive list of laws, policies and programs affecting Great Lakes coastal wetlands.

#### Water Use

The use of water is regulated primarily through state and local laws. While most Great Lakes states do not explicitly protect in-stream flows, most do have some legislation governing withdrawals or transfers of water. However, none are sufficient to address the growing demands for export of Great Lakes water outside the basin. Minnesota is the only Great Lakes state with a law that explicitly protects in-stream flows. There is some protection in Michigan, however, according to information from *Establishing a Baseline: Status of Water Policy in the Great Lakes and Southeastern States, 1998 and 2003* by American Rivers, National Wildlife Federation, Southern Environmental Law Center, and the Upper Chattahoochee Riverkeeper (December 15, 2003), the following states have no specific law to protect the use of water: Illinois, Indiana, Ohio, Wisconsin, and New York. The Wild and Scenic Rivers Act (federal) and state designations of critical waters provide limited protections to streams.



## Appendix 4. Habitat/Species Issue Summaries

This document summarizes the desired state, key threats (including stresses and their likely sources) and the current issues that are keeping open/nearshore waters; coastal wetlands; coastal shore; streams, tributaries, connecting channels; inland lakes and wetlands; and uplands from reaching their desired states. The host of problems presented is inherent to the basin, and individual problems may be specific to certain regions. Until now, there has been a lack of prioritization of priority issues. Meaningful restoration of these systems can occur only in the context of ongoing protection.

The information in this document expands on the “Proposed Technical Framework for Habitat/Species Conservation” (<http://www.glin.net/habstrategyteam/documents/habspeciesmatx020305.pdf>) developed for the Habitat/Species Strategy Team (<http://www.glin.net/habstrategyteam/>) of the Great Lakes Regional Collaboration (GLRC) (<http://www.epa.gov/glnpo/collaboration/index.html>). The issues described below are listed in priority order by system according to the authors’ assessment of the priority setting criteria established by the GLRC Executive Team (see [http://www.great-lakes.net/habstrategyteam/documents/GLRCPriorityGuidanceDraft\\_.pdf](http://www.great-lakes.net/habstrategyteam/documents/GLRCPriorityGuidanceDraft_.pdf)). At the end of each system section, issues relevant to the Habitat/Species Strategy Team have been combined into a single paragraph. In addition, terrestrial invasive species are addressed by the Habitat/Species Team in the last paragraph of these summaries.

### Open/Nearshore Waters

#### **Desired State:**

Open and nearshore waters possess a full array of natural habitats required to meet the growth and reproductive needs of fish and wildlife. Open and nearshore waters harbor self-sustaining fish and wildlife communities that include reproducing native fish species, especially ciscos, lake whitefish, lake trout, coaster brook trout, lake sturgeon, perch and walleye, as a significant component. Self-sustaining populations of non-native game fish contribute to stabilize fish communities. These areas are also providing safe and healthy habitat for migratory waterfowl and waterbirds, as well as threatened and endangered species, including unionids, reptiles, and fishes. Competition for habitat, predation and disruptions to the food webs from native and non-native invasive species are eliminated or neutralized by stopping new introductions and controlling existing populations. The food webs are free of toxic contaminants and provide wholesome food.

#### **Key Threats:**

<b><i>Stresses</i></b>	<b><i>Potential Source(s) of Stress</i></b>
1. Competition/predation/altered food webs and community structure by invasive non-native species	Ballast water exchange by ocean-going and inter-lake shipping vessels; hydrologic connections to adjacent ecosystems; importation of non-native species for aquaculture, horticulture, bait, pet trades; diseases carried by non-native invasive species
2. Depletion of native fish and wildlife and their habitats and invertebrate populations and vegetation	Inadequate protection of fish stocks from over-fishing, food web displacement or decreased reproductive potential because of invasive species; predation by invasive species; dredging; marina and shoreline structures such as docks, and development; failure to reproduce; dams and dam operation blocking access to

	suitable historic spawning habitat, loss of healthy submersed vegetation
3. Excess sediment and nutrient introductions	Nonpoint source runoff from agriculture, urban and rural development, forestry practices, inadequate waste-water treatment, tributary inflows, stormwater
4. Disruption of sediment transport	Shoreline hardening, lake-level management (dams), and dredging
5. Altered lake-levels	Climatic change, lake-level management, dredging, withdrawals
6. Toxic Contaminants	Atmospheric deposition, industrial discharge, pesticide application, nonpoint sources, stormwater, dredging
7. Temperature increases	Climatic change and industrial discharge

**Current Issues:**

Great Lakes native fish species—lake trout, lake sturgeon, coaster brook trout, lake herring, deep water cisco, yellow perch, walleye and lake whitefish—have been severely depleted or extirpated, and reduced in diversity from a significant portion of their historic range. Native wildlife species have been reduced in diversity and number due to habitat loss and degradation. Habitat quality, competition, predation, food webs and community structure have been altered by invasive native and non-native species. Toxic compounds, altered lake levels, and sediment and nutrient introductions have contributed to habitat degradation and destruction.

1. Aquatic invasive species have severely if not catastrophically disrupted food webs and new species continue to invade the Great Lakes.

*Stresses:* Competition/predation/altered food webs and community structure by invasive native and non-native species; sediment and nutrient introductions

*Action:* Address jointly with the Invasive Species Team

2. Restoration of sustainable native lake trout remains elusive in Lakes Michigan, Huron, Erie, and Ontario.

*Stresses:* Competition/predation/altered food webs and community structure by invasive native and non-native species (sea lamprey predation); depletion of native fish, invertebrate populations, and vegetation

*Action:* Address jointly with the Invasive Species Team

*Research/monitoring/information needs:*

- A recent review of impediments to lake trout restoration showed that the level of stocking is inadequate to reestablish lake trout stocks basin-wide.
- Sea lamprey mortality continues to be a major impediment and lamprey population targets are not met in all the Great Lakes. Research on innovative control mechanism such as the use of pheromones to concentrate lampreys shows promise and needs increased funding.
- The role of thiaminase and the pathway through the food chain to lake trout, its ability to reduce thiamine in lake trout eggs causing early mortality syndrome (EMS), and the extent that EMS impedes restoration is not completely understood.
- State-of-the-art stock assessment methods that enhance managers’ ability to control harvest and determine mortality vectors are underutilized.
- The extent of spawning habitat degradation is not well understood.
- Research on control of invasive species to reduce predation on lake trout eggs during incubation is needed.

*Federal policies/laws/regulations that apply:*

Great Lakes Fish and Wildlife Restoration Act of 1998  
Great Lakes Fishery Act of 1956  
2000 Consent Decree – Western District Court of Michigan  
Fish and Wildlife Act of 1956  
Fish and Wildlife Coordination Act  
WRDA 1996, Section 206  
WRDA 1999, Section 506  
WRDA 2000, Section 506

*Ongoing efforts:*

Lake trout restoration activities by the states, Indian tribes and federal governments are coordinated by restoration plans developed for each Great Lake through the Lake Committee framework of the Great Lakes Fishery Commission (GLFC). The USACE and GLFC are constructing sea lamprey barriers throughout the Great Lakes.

*Recommendations*

- Inventory of existing shallow water spawning habitat using remote sensing techniques.
- Increase numbers of lake trout stocked for restoration through hatchery expansion or reallocation.
- Conduct research on the role and pathway of thiaminase in the Great Lakes.
- Implement statistical catch at age modeling procedures for all management units in the Great lakes.
- Evaluate the impact of predation from invasive species on the survival of lake trout eggs.
- Increase sea lamprey control efforts.
- Research new and innovative techniques to control sea lamprey numbers.

3. Lake sturgeon are reduced in abundance and recruitment is highly variable across the Great Lakes.

*Stresses:* Depletion of native fish and invertebrate populations; competition/predation/altered food webs and community structure by invasive native and non-native species

*Action:* Address within HS team.

*Research/monitoring/information needs:*

- Determine the status remnant lake sturgeon populations and monitor trends in sturgeon abundance.
- Complete a habitat assessment of potential lake sturgeon spawning streams to determine habitat limitations caused by degradation and the blockage to upstream habitat by dams.
- Evaluate the available genetic diversity of sturgeon in the Great Lakes basin and develop a conservation plan.
- Develop streamside rearing capabilities to enhance fidelity to the rivers stocked for restoration.
- Research the effect of contaminants on the hatching success of lake sturgeon eggs and compare to contaminant levels in wild populations to determine if contaminants are an impairment.

*Federal policies/laws/regulations that apply:*

Great Lakes Fish and Wildlife Restoration Act of 1998  
Great Lakes Fishery Act of 1956  
Fish and Wildlife Act of 1956  
Fish and Wildlife Coordination Act

*Ongoing efforts:*

Lake sturgeon restoration activities by the states, Indian tribes and federal governments are coordinated by restoration plans developed for each Great Lake through the Lake Committee framework of the Great Lakes Fishery Commission. Many states have developed restoration plans for their waters.

*Recommendations:*

- Complete a basinwide habitat assessment including habitat below and above barriers to upstream migration.
- Develop a decisions analysis system to evaluate where habitat enhancement will be most effective.
- Conduct habitat improvements and dam removals where warranted.
- Enhance recruitment of sturgeon through enhancement of remnant stocks of stocking in extirpated rivers.
- Assess impairment of contaminants on sturgeon egg survival.
- Establish monitoring and assessment to determine long term trends.

4. The abundance of *Diporeia* has declined substantially in Lakes Michigan and Ontario.

*Stresses:* Competition/predation/altered food webs and community structure by invasive native and non-native species; depletion of native fish and invertebrate populations and vegetation

*Action:* Address jointly with the Invasive Species Team

*Research/monitoring/information needs:*

Research the cause for decline of *diporeia* in the Great Lakes.

Increase monitoring of remaining populations.

*Federal policies/laws/regulations that apply:*

Great Lakes Fish and Wildlife Restoration Act of 1998

Great Lakes Fishery Act of 1956

Fish and Wildlife Act of 1956

Fish and Wildlife Coordination Act

*Ongoing efforts:*

GLERL is conducting research to determine the cause for the decline in *diporeia*. State, tribal, and federal fishery agencies are evaluating the fish community impacts as a result of *diporeia* decline.

*Recommendations:*

- Continue research to determine cause of decline.
- Monitor status of population and evaluate if *diporeia* populations are becoming threatened in the Great Lakes.

5. Native lake herring and deep water cisco species are depleted or absent from offshore fish communities.

*Stresses:* Competition/predation/altered food webs and community structure by invasive native and non-native species; depletion of native fish and invertebrate populations and vegetation; altered lake-levels

*Action:* Address jointly with the Invasive Species Team

*Research/monitoring/information needs:*

- Research on the cause for depressed herring or deepwater cisco populations in some of the Great Lakes.

- Identification of donor stocks for restoration efforts.
- Evaluation of stocking strategies to achieve restoration.

*Federal policies/laws/regulations that apply:*

Great Lakes Fish and Wildlife Restoration Act of 1998  
 Great Lakes Fishery Act of 1956  
 Fish and Wildlife Act of 1956  
 Fish and Wildlife Coordination Act

*Ongoing efforts:*

Development of a plan to reintroduce deepwater cisco in Lake Ontario is underway. Fishery agencies are considering developing restoration plans for lake herring on Lakes Michigan and Huron.

*Recommendations:*

- Complete restoration plans to reestablish lake herring and deepwater cisco in the Great lakes basin where needed.
- Develop and implement an aquaculture strategy to adequately address supplementation programs in the Great Lakes.

6. Yellow perch, walleye, lake whitefish, and cisco populations have been unstable because of poor recruitment and/or excessive mortality.

*Stresses:* Competition/predation/altered food webs and community structure by invasive native and non-native species; depletion of native fish and invertebrate populations and vegetation; altered lake-levels

*Action:* Address jointly with the Invasive Species Team

*Research/monitoring/information needs:*

- Poor recruitment of yellow perch and lake whitefish may be caused by invasive species and further research is needed to understand the interactions.
- The impact of the decline in *Diporeia* on the recruitment of lake whitefish is unknown.
- The role of cormorants in the survival of yellow perch is contentious and requires further research to determine specific impacts.
- Habitat requirements for walleye in the Great Lakes needs evaluation.
- Harvest management strategies need to be further refined for perch and walleye stocks.

*Federal policies/laws/regulations that apply:*

Great Lakes Fish and Wildlife Restoration Act of 1998  
 Great Lakes Fishery Act of 1956  
 2000 Consent Decree – Western District Court of Michigan  
 Fish and Wildlife Act of 1956  
 Fish and Wildlife Coordination Act  
 WRDA 1996, Section 206  
 WRDA 2000, Section 506

*Ongoing efforts:*

State, tribal and federal agencies are addressing management of shared stocks through the Lake Committee framework of the Great Lakes Fishery Commission. The impact of cormorants on yellow perch is being studied in Lakes Ontario, Huron, and Michigan. Recruitment dynamics of yellow perch and lake whitefish are being studied by state, tribal, federal and academic investigators.

*Recommendations:*

- Conduct a basinwide habitat assessment of in-lake and river habitat critical to walleye.
- Continue investigation into recruitment mechanisms for walleye, yellow perch and lake whitefish.
- Implement statistical catch at age stock assessment procedures for all management units in the Great Lakes.
- Lake-run brook trout (coaster brook trout)

7. Lack of oxygen in Lake Erie has produced a “dead zone” that is poorly understood.

*Stresses:* Competition/predation/altered food webs and community structure by invasive native and non-native species; toxic compounds

*Action:* Address jointly with Invasive Species and Nonpoint Source Teams

8. The lake-run brook trout (coaster brook trout) is either severely depleted or extirpated from most of its former range.

*Stresses:* Competition/predation/altered food webs and community structure by invasive native and non-native species (sea lamprey predation); depletion of native fish and invertebrate populations and vegetation; destruction of tributary habitat; over-fishing

*Action:* Address jointly with the Invasive Species Team.

*Research/monitoring/information needs:*

- Lake-wide population assessment methods are needed to enhance managers’ ability to determine status and evaluate response to rehabilitation and management strategies.
- Research into life history attributes of coaster populations and habitat needs of all life stages.
- Survey and quantify the reach scale, watershed scale, and lake scale habitat requirements of current populations
- Genetic identification of coaster stocks and relationship to stream-resident stocks.
- Describe comparative relationship between coaster brook trout and introduced salmonids, and their hybrids in spawning and nursery habitats.
- Determine appropriate strain and life stage for rehabilitation stocking.

*Federal policies/laws/regulations that apply:*

Great Lakes Fish and Wildlife Restoration Act of 1998

Great Lakes Fishery Act of 1956

Fish and Wildlife Act of 1956

Fish and Wildlife Coordination Act

WRDA 1996, Section 206

WRDA 2000, Section 506

*Ongoing efforts:*

- Lake-wide coaster brook trout restoration activities by the states, Indian tribes and federal governments are coordinated by restoration plans developed for each Great Lake through the Lake Committee framework of the Great Lakes Fishery Commission.
- Fish passage barrier removal and other habitat restoration is underway at Grand Portage Indian Reservation (MN), Red Cliff Indian Reservation (WI), Bad River Indian Reservation (WI), Whittlesey Creek National Wildlife Refuge (WI), Salmon Trout River (MI), Bark River (WI), and others.

- Stocking and stocking evaluation is underway at Grand Portage Indian Reservation (MN), Red Cliff Indian Reservation (WI), Whittlesey Creek National Wildlife Refuge (WI), Salmon Trout River (MI), Isle Royale National Park (MI), and others.
- Stock assessments are underway at Apostle Islands (WI) and Pictured Rocks (MI) National Lake Shores, Bad River Indian Reservation (WI), Bayfield Peninsula rivers (WI), Isle Royale NP (MI).
- Conference and synthesis session on future research and management initiatives for coaster brook trout rehabilitation recently held and results being published.
- The USACE and Great Lakes Fishery Commission are constructing sea lamprey barriers throughout the Great Lakes.

*Recommendations:*

- Protect riverine and lake habitats, and watersheds that currently support the coaster populations.
  1. Identify long term threats to habitats and strategies to overcome these threats.
  2. Protect watershed scale habitat by developing and implementing watershed strategies that maintain and improve habitat.
  3. Educate private and public landowners about best watershed management practices.
- Implement habitat rehabilitation initiatives in-stream and at watershed scale where riverine habitat conditions are currently unsuitable and do not support coasters.
- Conduct research to address needs identified above.

9. Filamentous algae fowls beaches.

*Stresses:* Sediment and nutrient introductions

*Action:* Address jointly with Coastal Health Team.

10. Spawning substrates and submerged aquatic plants have been disrupted by sedimentation and dredging.

*Stresses:* Disruption of sediment transport

*Action:* Address jointly with Nonpoint Source Team.

11. Loss of species and habitats continues.

*Stresses:* Competition/predation/altered food webs and community structure by invasive native and non-native species; depletion of native fish and invertebrate populations and vegetation; temperature increases

*Action:* Address jointly with the Invasive Species Team.

12. Poorly understood periodic outbreaks of botulism leading to high numbers of bird deaths in nearshore waters of some of the Great Lakes.

*Stresses:* Competition/predation/altered food webs and community structure by invasive native and non-native species; toxic compounds

*Action:* Address jointly with the Invasive Species Team.

**Wetlands**

**Desired State:**

Coastal wetland acreage of every type is sufficient to support native plants and animals. Wetland quality remains consistent or is improved for all major trophic levels when compared to reference sites. Targeted and coordinated restoration and protection of priority wetlands results in an overall net gain in quantity

and qualitative improvement according to biological integrity metrics. Wetlands in hydrologically modified environments are improved according to biological integrity metrics. Native species dominate non-native species in the vegetative composition in basin wetlands.

**Key Threats:**

The table below lists the major stresses that are impacting coastal wetlands along with the likely sources of those stresses. These stresses are then linked to the major issues in the last section.

<i>Stresses</i>	<i>Potential Source(s) of Stress</i>
1. Alteration of natural water-level fluctuations and flows	Lake-level management (dams), impervious surfaces, climate change, ditching, upland hydrological modifications, diking, diversions, withdrawals, agricultural drainage, incompatible storm water management, excessive groundwater withdrawal, bridges and road building, floodplain alterations, partial drainage of wetlands
2. Invasive native and non-native species	Competition/predation/altered food webs and community structure including: ballast water, aquaculture, pet trade, horticulture, bait, boating vectors, landscaping
3. Direct destruction, fragmentation	Draining/filling for development, agriculture, roads
4. Temperature increases	Climate change, industrial discharge, impervious surfaces, incompatible forestry
5. Alteration of sediment transport	Shoreline hardening (jetties, seawalls, etc.), lake-level management (dams), climate change, floodplain impacts, ditching, diking
6. Addition of toxic compounds	Atmospheric deposition; industrial or stormwater discharge; nonpoint sources (agriculture, urban runoff and stormwater, forestry), new mining
7. Sedimentation	Non-point source runoff from agricultural, development and forestry practices; scouring due to impervious surfaces
8. Eutrophication (nutrient enrichment)	Incompatible development, incompatible wastewater treatment, incompatible fertilizer use, runoff, stormwater

**Current Issues: Coastal Wetlands**

Coastal wetland loss and degradation continues, resulting in loss of native species that are dependent on coastal wetlands for breeding and migration habitat, resting sites, required nutrition, and as refugia from invasive native and non-native species. Alteration of natural water-level fluctuations and flows; habitat degradation; competition/predation/altered food webs and community structure by invasive native and non-native species; direct destruction of habitat; water temperature increases; alteration of sediment transport, the addition of toxic compounds; and, sedimentation are the major stressors. Impacts of the stressors to biota are difficult to calculate because coastal wetland quality and quantity are not currently consistently monitored. Currently there are few incentives for private wetland owners to sustain and maintain their wetlands.



1. Wetland loss and degradation continues, but since coastal wetland quality and quantity are not currently consistently monitored across the basin, impacts to biota are difficult to calculate. Enforcement of existing regulations is insufficient and data collection is lacking.  
*Stresses:* Direct destruction from development

*Action:* Address within HS Team.

2. Non-indigenous species continue to invade coastal wetlands and spread to dominant monocultures.  
*Stresses:* Primarily non-native species; indirectly water-level and flow alterations; sedimentation; temperature alterations.

*Action:* Address indirect stresses jointly with other teams. Address spread of non-native within HS Team.

3. Water-level controls and hydrological modifications in many areas have diminished biotic diversity and wetland function.  
*Stresses:* Alteration of natural water-level fluctuations and flows

*Action:* Address jointly with Sustainable Development Team.

4. Intact coastal wetlands are breeding habitat and refugia for native fish and wildlife; however, such areas are in need of restoration to maintain current functioning. Restoration initiatives suffer from a lack of coordination, monitoring, and prioritization.  
*Stresses:* Non-native species; water flow and level alteration; direct destruction from development.

*Action:* Address stresses jointly with SD and AIS Teams. Address coordination and monitoring of restoration initiatives within HS Team.

5. Loss of native species and habitats continues.  
*Stresses:* Direct destruction; non-native species; water-level and flow alterations; sedimentation; temperature increases

*Action:* Address stresses jointly with multiple teams. Address conservation and biodiversity restoration coordination within HS Team.

6. Contaminants are affecting the breeding efficacy of wetland-resident species.  
*Stresses:* Addition of toxic compounds.

*Action:* Address through PBT Team.

*Research/Monitoring/Information Needs:*

One of the most critical needs for improving Great Lakes coastal wetlands management is consistent monitoring across the basin. Consistent monitoring information would provide a basis for assessing progress toward management goals. The information will help us determine not only the quantity of wetlands that are being restored, conserved, or destroyed, but also the functional quality of those wetlands from an ecological perspective. In addition, there is a need for a number of research projects to answer specific management questions. A list of the most critical basinwide monitoring and research needs is presented in priority order below.

- Regular coastal imaging with high enough resolution to detect wetland boundary and land cover change. This could be a new program or it could be undertaken through established efforts including the NOAA Coastal Great Lakes Land Cover and Land Change Mapping Project and the National

Wetlands Inventory, but, currently, those programs are under-funded. Classification methods need to align with standards in the basin.

- Annual sampling of biological metrics from a set of coastal wetlands stratified by type and lake basin to generate data for biological integrity indicators. This data is needed for determining changes in wetland quality relative to natural or human disturbance.
- A monitoring, reporting and rapid-response system for the early detection of non-indigenous species.
- Further research into the effects in wetland quantity and quality from reducing fluctuations of Great Lakes water levels on wetlands and how to manage water levels in ways that minimize these impacts.
- Development of a database to track coastal wetland permitted development in and near coastal wetlands, wetland restoration projects, and potentially vulnerable or restorable wetland sites.
- Long-term trend data on wetland biota-stressor interactions.
- Continued research to increase scientific understanding of coastal ecosystems, including functioning, processes and human disturbance impacts.

#### *Current Policies and Programs:*

Coastal wetlands of the Great Lakes are addressed from numerous management directions by laws, policies and programs at international, federal, state and local levels. No single agency or governmental level has management authority over coastal wetlands. Sections 401 and 404 of the Clean Water Act give the U.S. Army Corps of Engineers (in consultation with the U.S. EPA and, in some cases, state agencies) regulatory authority over permitted development in coastal wetlands. Numerous federal agencies either directly or through state agencies fund conservation or restoration projects in coastal wetlands. Tribal programs include the Tribal Wetland and Waterfowl Enhancement Initiative that is funded through the Bureau of Indian Affairs. Lakewide Management Plans and Remedial Action Plans for Areas of Concern focus on lake and local issues. Many of these programs are wetland specific, but others include wetlands in larger programs to conserve habitat and biodiversity. Still other programs seek to study and protect wetland-dependant animal and plant populations. Beyond governmental programs, there are notable basinwide programs established by NGOs that affect coastal wetlands. See the “Proposed Technical Framework for Habitat/Species Conservation” matrix for a more comprehensive list of laws, policies and programs affecting Great Lakes coastal wetlands.

Service programs that contribute to restoration of wetlands include the Great Lakes Fish and Wildlife Restoration Act of 1998, the Coastal Program, Partners for Fish and Wildlife, the National Coastal Wetlands Program, the Aquatic Invasive Species Program, and the Natural Resource Damage Assessment and Restoration Program.

#### *Recommendations:*

As was discussed in the issues section, there are several critical issues impacting the integrity and sustainability of Great Lakes coastal wetlands. Below, we present policy and management recommendations for addressing these issues. The recommendations are organized by issue area.

#### *Habitat/species conservation:*

- Implement the Great Lakes Coastal Wetland Consortium’s long term coastal wetland monitoring program that utilizes Great Lakes indicators.
- Coordinate permitted development regulation across the basin. An annual report on coastal wetland loss from permitted development and other causes should be generated. The report should also include a summary of enforcement actions and assess the success of wetland mitigation programs.
- Coordinate, track and jointly report on the success (based on standard quantity and quality measures) of all federally funded coastal wetland protection, restoration and enhancement programs. This should be conducted in concert with GLCWC monitoring, and should reflect the success of conservation of wetland breeding populations. The report should highlight priority areas for enhancing the success of

native populations, and indicate future steps being taken to address concerns. The annual report should include a prioritized list of data and restoration funding needs for the next fiscal year.

*Invasive non-indigenous species:*

- Establish a monitoring system for early detection of non-indigenous species. The system should also include a reporting and rapid response plan to prevent non-indigenous species from establishing in coastal wetlands.
- Programs working to eradicate or control the spread of non-indigenous species should track and report on their progress annually. Reporting should be done in conjunction with GLCWC monitoring and should highlight invasive “hot spots” and outline measures to be taken to address these areas over the next year. A list of specific funding needs for the next fiscal year should also be included.

*Water-level control and flow alteration:*

- The *International Lake Ontario-St. Lawrence River Study* should be given sufficient resources and time to complete the data integration and modeling of impacts from lake-level control scenarios. The final control plan should ensure that impacts on coastal wetlands are sufficiently considered. Lake Ontario coastal wetlands should then be monitored in coordination with the GLCWC to verify model forecasts and adjust control guidelines. A further effort should be made to translate results to the Lake Superior basin.
- A comprehensive assessment of the impact of flow alterations on coastal wetland quality and function should be undertaken. Flow alterations to be assessed should include tributary damming, channelization, diking, shoreline hardening, barrier removal, and increasing imperviousness in a wetland catchment. Specific recommendations for addressing key areas of impact should be made as part of this assessment. Restoration programs should coordinate to carry out the recommendations on a priority basis.

*Sedimentation/non-point sources:*

- Ensure that recommendations made by the Non Point Source Strategy Team acknowledge and account for sedimentation impacts on coastal wetlands.

**Current Issues – Inland Wetlands:**

Development setbacks and vegetated buffers are insufficient to protect inland lakes and wetlands. As a result, inland wetlands continue to be drained and filled for home and commercial development and agriculture; inland lakes continue to suffer from nutrient enrichment. Invasive native and non-native species are impacting native habitats and species. Conservation priorities have not been established so that sufficient wetland complexes and inland lakes maintain original habitats and self-sustaining populations of native fish and wildlife.

1. Inland wetlands continue to be drained and filled for home and commercial development and agriculture.

*Stresses:* Direct destruction, altered hydrology, temperature increases

*Action:* Address within HS Team.

*Research/Monitoring/Information Needs:*

- Baseline inventory and assessment of the plants and animals, ecosystem structures and functions, ecosystem services provided, and threats to inland wetlands.
- A data collection-monitoring program for inland wetlands and its species that leads to their prioritization for protection or restoration.
- Monitor species for trends in biodiversity loss.

*Policies/Laws/Regulations:*

Section 319 of the Clean Water Act (nonpoint source grants to states); Clean Lakes Program of 1972 (as section 314 of the Federal Water Pollution Control Act)--not funded in recent years); Transportation Equity Act for the 21st Century of 1998; Coastal Zone Management Act (land use planning, zoning, and habitat inventory grants provided by the state coastal management programs.)

*Ongoing Efforts:*

USFWS Joint Ventures, The Nature Conservancy Blueprint, DU Strategic Plan, FWS Partners Program, Farm Bill conservation Programs, National Wetlands Research Center, Coastal and Estuarine Land Conservation Program plans; State and Tribal protection plans (Tribal Wetland and Waterfowl Enhancement Initiative funded through the Bureau of Indian Affairs); RAPs and LaMPs; Local watershed planning efforts; numerous restoration projects (DU, PF, FWS, TNC, GLNPO, etc.)

*Recommendations:*

- Amend existing wetland regulatory frameworks to ensure that all wetlands are protected, including isolated wetlands.
- Update the FWS National Wetlands Inventory.
- Prioritize and conserve areas of key wetland complexes (focus areas).
- Reestablish sufficient quantity of wetlands to achieve desired ecosystem benefits.
- Maintain widely distributed, self-sustaining populations in as many original habitats as is practical.
- Maintain, enhance and rehabilitate self-sustaining populations where the species occurred historically basinwide.
- Increase the net wetland resource base by one million acres by the year 2025.

2. Inland lakes continue to suffer from nutrient enrichment.

*Stresses:* Eutrophication (nutrient enrichment)

*Action:* Address within HS Team.

*Research/Monitoring/Information Needs:*

- A data collection and monitoring program for trends in biodiversity loss from nutrient enrichment.

*Policies/Laws/Regulations:*

Section 319 of the Clean Water Act (nonpoint source grants to states); Clean Lakes Program of 1972 (as section 314 of the Federal Water Pollution Control Act)—not funded in recent years); Transportation Equity Act for the 21st Century of 1998; Coastal Zone Management Act (land use planning, zoning, and habitat inventory grants provided by the state coastal management programs)

*Ongoing Efforts:*

USFWS Joint Ventures, The Nature Conservancy Blueprint, DU Strategic Plan, FWS Partners Program, Farm Bill conservation Programs, National Wetlands Research Center, Coastal and Estuarine Land Conservation Program plans; State and Tribal protection plans; RAPs and LaMPs; Local watershed planning efforts; numerous restoration projects (DU, PF, FWS, TNC, GLNPO, etc.)

*Recommendations:*

- Establish development setbacks and vegetated buffers sufficient to protect water quality and habitat from new development.

3. Aquatic invasive species are impacting inland wetland and lake species and communities.

*Stresses:* Competition, altered food webs, altered structure

*Action:* Address jointly with IS Team

*Research/Monitoring/Information Needs:*

- A data collection and monitoring program for inland wetlands and lakes for changes due to aquatic invasive species.

*Policies/Laws/Regulations:*

Section 319 of the Clean Water Act (nonpoint source grants to states); Clean Lakes Program of 1972 (as section 314 of the Federal Water Pollution Control Act)--not funded in recent years); Transportation Equity Act for the 21st Century of 1998

*Ongoing Efforts:*

USFWS Joint Ventures, The Nature Conservancy Blueprint, DU Strategic Plan, FWS Partners Program, Farm Bill conservation Programs, National Wetlands Research Center, State and Tribal protection plans; RAPs and LaMPs; Local watershed planning efforts; numerous restoration projects (DU, PF, FWS, TNC, GLNPO, etc.)

*Recommendations:*

- Develop an invasive species mitigation plan for inland lakes and wetlands.
- Set up a system of early detection monitoring of non-indigenous species.

### **Riverine Habitats and Related Riparian Areas**

#### **Desired State:**

Stream, rivers, and connecting channels are conserved or restored to ensure their long-term viability, defined by their connections to riparian floodplains and wetlands; ability to sustain the growth and reproductive requirements of native and naturalized fishes, other aquatic biota, and other wildlife that depend on intact stream corridors, such as migratory birds. Land and water management practices are in place to support a natural-flow regime (or in highly modified environments, a flow regime that emulates natural systems), including protection of ground water sources, and to prevent excessive harmful inputs of nutrients, toxics and sediment. Rivers and connecting channels remain important spawning areas for a variety of fish including the lake sturgeon, coaster brook trout, suckers and redhorse. The riverine systems are of such good quality that most or all of the recruitment for fisheries is through self sustaining, natural reproduction.

#### **Key Threats:**

Threat stresses and sources for riverine systems ranked in order of impact.

<b><i>Stresses</i></b>	<b><i>Potential Source(s) of Stress</i></b>
1. Physical modification of stream banks and channels; habitat degradation	Conversion of riparian zone, road and bridge building, stream channelization, and shoreline stabilization/hardening.
2. Invasive native and non-native species	Competition /altered food webs/altered structure including: non-intentional introductions, escaped garden plants, recreation

	(boating), aquatic invasive species introduced through ballast water, aquaculture, pet trade, bait, recreation (boating); direct stocking
3. Alteration or disruption of stream flow patterns and groundwater recharge	Dams and dam operation, diversions, excessive withdrawals, agricultural drainage (tiling), incompatible storm water management, impermeable surfaces (housing and commercial development), exclusion of floodplains
4. Altered sediment regime	Incompatible agricultural practices (tiling, tillage), incompatible forestry, incompatible development, road building and maintenance, and past land uses
5. Fragmentation	Dams, culverts, road/stream crossings
6. Temperature increases	Excessive groundwater withdrawal, impermeable surfaces (housing and commercial development), riparian vegetation removal, impoundments, industrial discharge, climate change
7. Physical deformities and failure to reproduce (fish, birds, mussels)	Industrial/municipal emissions and discharge; incompatible mining practices; atmospheric deposition
8. Excessive nutrients/contaminants	Atmospheric deposition (energy production); industrial discharge; nonpoint sources (agriculture, urban runoff and stormwater, forestry); road salt; sewage overflows

### Current Issues:

Land use decision making is highly local, resulting in uncoordinated decision-making that fails to provide long-term conservation of ecological priorities, track cumulative impacts, or maintain ecological functions that sustain habitats and species. Physical modification of stream banks and channels and the alteration or disruption of stream flow patterns and groundwater recharge, point to a focus on engineered solutions to control erosion and a lack of incentives for non-structural shoreline protection and functional stream restoration. The lack of understanding of hydrology as a key process to maintain stream integrity is reflected in the lack of laws to address water quantity, source water protection and flow patterns. In addition, fragmentation and invasive native and non-native species continue to disrupt tributary habitats. An updated and integrated approach to drainage is needed that promotes reconnection of floodplains, establishment of riparian buffers, and storage capacity of wetlands. More incentives are needed for private landowners to maintain the integrity of riverine systems and their floodplains.

1. Land use decision making is highly local, resulting in uncoordinated decision-making that fails to provide long-term conservation of ecological priorities, track cumulative impacts, or maintain ecological functions that sustain habitats and species.

*Stresses:* Physical modification of stream banks and channels, alteration or disruption of stream flow patterns and groundwater recharge, altered sediment regime, fragmentation, cumulative impacts

*Action:* Address within HS Team.

2. Focus on engineered solutions to erosion and lack of incentives and appreciation for non-structural shoreline protection.

*Stresses:* Physical modification of stream banks and channels, alteration or disruption of stream flow patterns and groundwater recharge, altered sediment regime

*Action:* Address within HS Team.

3. Understanding of hydrology being a key process that maintains stream integrity is low and this is reflected the lack of laws to address water quantity, source water protection, and flow patterns.

*Stresses:* Physical modification of stream banks and channels, alteration or disruption of stream flow patterns and groundwater recharge, fragmentation

*Action:* Address within HS Team.

4. Impacts to riverine systems are cumulative in nature.

*Stresses:* Competition /altered food webs/altered structure, physical deformities and failure to reproduce (fish, birds, mussels)

*Action:* Address jointly with NP and PBT Teams

5. Non-indigenous invasive species continue to disrupt tributary habitats.

*Stresses:* Competition /altered food webs/altered structure

*Action:* Address jointly with IS Team

6. Non-point source runoff into streams contributes to contamination at river mouths and in the Lakes. The sediment regime has been altered due to incompatible agricultural, forest, land development, bridge and dam construction, and road and building and maintenance practices.

*Stresses:* Physical deformities and failure to reproduce (fish, birds, mussels)

*Action:* Address jointly with NP and PBT Teams

*Research Need(s):*

- Establish target flow regimes for every watershed in the Great Lakes basin.
- Prioritize dam removal and assess potential impacts of removal at specific locations.
- Identify problem road/stream crossings and culverts in priority forested watersheds.

*Existing Legislation and its adequacy:*

The use of water is regulated primarily through state and local laws. While most Great Lakes states do not explicitly protect in-stream flows, most do have some legislation governing withdrawals or transfers of water. However, all have been seen as insufficient to address the growing demands for export of Great Lakes water outside the basin. Minnesota is the only Great Lakes state with law that explicitly protects instream flows. There is some protection in MI, and the following have no specific law—IL, IN, OH, WI, NY. (information is from Establishing a Baseline: Status of Water Policy in the Great Lakes and Southeastern States, 1998 and 2003. American Rivers, National Wildlife Federation, Southern Environmental Law Center, and Upper Chattahoochee Riverkeeper, December 15, 2003).

Wild and Scenic Rivers Act (federal) and state designations of critical waters provide limited protections to streams. The Great Lakes Fish and Wildlife Restoration Act of 1998 authorizes the U.S. Fish and Wildlife Service to partner with state, Indian tribes, and other federal agencies to restore fish and wildlife populations and their habitats in the Great Lakes. The Great Lakes Fishery Act of 1956 establishes the Great Lakes Fishery Commission to restore the fisheries of the Great Lakes through the control of sea lamprey populations in tributary streams and implementation of a research program.

*Ongoing efforts:*

- Great Lakes Charter Annex 2001
- The Nature Conservancy Conservation Blueprint

- Numerous watershed plans (Little Traverse Bay Watershed Protection Plan
- Clinton River Watershed Council
- Watershed Diagnostic of the Little Calumet-Galien River Watershed
- Sheboygan County Natural Areas and Critical Resources Plan)
- Remedial Action Plans for Areas of Concern
- Conservation Programs
- NAWMP/Joint Ventures
- USDA Farm Bill
- EPA 319
- TMDLs
- GLNPO habitat funds
- Lakewide Management Plans
- Brook Trout Rehabilitation Plan for Lake SU
- Eastern Brook Trout Venture (USDA Forest Service)
- Coaster Brook Trout Initiative (USDA Forest Service)
- USFWS National Fish Passage Program
- USFWS Partners for Fish and Wildlife
- USFWS Great Lakes Fish and Wildlife Restoration Act Project Funding
- USFWS Coastal Program

*Recommendations:*

- Fund USGS to develop target flow regimes.
- States enact water management legislation to address water quantity, source protection and flow patterns.
- Allocate resources to improve fish passage where impaired by road/stream crossing, culverts, and dams in priority forested watersheds identified in TNC’s Conservation Blueprint, such as:
  - Upper Menominee (WI/MI)
  - Pine, Popple, Peshtigo Rivers (WI)
  - Brule River (MN)
  - Ontonagon River (MI)

**Coastal and Upland Habitats**

**Desired State:**

Coastal shore habitats and natural processes that sustain them—such as sediment transport, natural succession lake-level fluctuation, and wetland migration—are maintained and restored and/or managed efficiently in highly altered environments. These coastal habitats sustain long-term viable populations of all native species, especially endemic species; meet federal and state recovery plan goals for threatened and endangered species; and provide habitat for migratory and resident wildlife. Upland habitats remain sufficiently large and connected to maintain plant and animal diversity. Upland habitats are adequately connected to provide migration corridors for species. Native plant and animal populations are thriving. Erosion to surface waters is controlled and groundwater is recharged.

**Key Threats:**

Threat stresses and sources for coastal shore systems in order of impact.

<i>Stresses</i>	<i>Potential Source(s) of Stress</i>
1. Direct destruction, habitat degradation	Shoreline hardening; home, marina, urban and commercial development; sand dune and alvar mining,



	noncompatible recreational uses
2. Alteration of sediment transport	Shoreline hardening (jetties, seawalls, etc.), lake-level management (dams), floodplain alteration
3. Sedimentation	Non-point source runoff from incompatible agricultural, development and forestry practices
4. Invasive native and non-native species	Competition /altered food webs/altered structure including: non-intentional introductions, escaped garden plants, recreation (boating), management of/for certain species (deer, maple, aspen, etc.); pathogens
5. Toxic contaminants	E. coli, chemical pollutants from point and nonpoint runoff
6. Fragmentation, direct destruction	Incompatible development, conversion to agriculture, incompatible forestry practices, new mine development
7. Altered fire regime	Fire management policy of suppression.

### Current Issues: Coastal Habitats

Island and coastal shorelines are under intense development pressure and most land use decisions are made at the local level. Provision of economic incentives and establishment of political structures that promote multi-jurisdictional planning/zoning are currently the responsibility of the states. The Great Lakes states have achieved different levels of progress in promoting coordinated decision-making that provides for long-term conservation of ecological priorities, maintenance of ecological functions that sustain habitats and species, or the tracking of cumulative losses. Islands are especially vulnerable because they can only support about 25 percent of the number of species as a comparable mainland area and are globally rare. Best management practices are needed for project siting and construction to reduce impacts (e.g., setbacks, vegetative buffers, shoreline overlays, etc.).

1. Island and coastal shorelines are under intense development pressure and land use decision making is highly local (due to lack of economic incentives and political structures that promote multi-jurisdictional planning/zoning), resulting in uncoordinated decision-making that fails to provide long-term conservation of ecological priorities, maintain ecological functions that sustain habitats and species, or track cumulative losses.

*Stresses:* Direct destruction

*Action:* Address within HS Team.

2. Laws and enforcement to prevent sand and limestone mining in ecologically sensitive areas are ineffective.

*Stresses:* Direct destruction

*Action:* Address within HS Team.

3. 80% of the Great Lakes shoreline in the U.S. is privately owned; there are a lack of incentives and appreciation for non-structural shoreline protection, a lack of awareness regarding ecological sensitivity, and ineffective land use ordinances to provide for best management practices.

*Stresses:* Habitat degradation, alteration of sediment transport

*Action:* Address within HS Team.

4. Sedimentation and pollution from non-point source runoff is continuing to result from incompatible agriculture, land development, and forestry practices. Shoreline processes are disrupted and pollution impacts species and human health.

*Stresses:* Sedimentation, alteration of sediment transport

*Action:* Address through Nonpoint Source and PBT Teams

5. Non-indigenous invasive species continue to disrupt coastal habitats and biological diversity.

*Stresses:* Competition /altered food webs/altered structure by invasive native and non-native species

*Action:* Address jointly with the Invasive Species Team

*Research/Information Needs:*

- Regular coastal imaging to classify coastal habitats and monitor land cover change
- Monitoring shoreline species for trends in abundance and composition
- A prioritized conservation strategy to identify areas of high ecological value

*Existing Legislation and its adequacy:*

Coastal Zone Management Act – implemented at the state level. The law authorizes the use of federal funds to address the cumulative and secondary impacts of development and land use change. Many state coastal management programs fund and support multi-jurisdictional land use planning initiatives. This emphasis on coordinated planning and management is expected to grow as witnessed, for example, by the January 2005, Memorandum of Agreement between NOAA and EPA on the development and implementation of smart growth strategies for coastal communities. Currently, the incentive-based and regulatory arms of many state coastal management programs use ecosystem-based approaches toward resource protection.

In 2002, Congress passed legislation directing the Secretary of Commerce to establish a Coastal and Estuarine Land Conservation Program (CELC). Coastal states that develop their own CELC programs consistent with NOAA guidance are eligible to receive federal funds for acquiring coastal and estuarine areas that have significant ecological value. States may opt to include inland areas within their CELC program boundary.

*Ongoing efforts:*

- Great Lakes Islands Collaborative
- Lake Ontario Dunes Coalition
- Lake Michigan Dunes Alliance
- Areas of Concern
- The Nature Conservancy Conservation Blueprint
- Great Lakes Environmental Indicators
- Endangered Species Recovery Program
- Remedial Action Plans for Areas of Concern
- Lakewide Management Plans
- NOAA Great Lakes Coastal Program
- Coastal and Estuarine Land Conservation Program
- GLNPO habitat funds

*Recommendations:*

1. Implement conservation at islands identified through priority setting work of Great Lakes Islands Collaboration

2. Fund USFWS and state natural features inventory/natural heritage programs to monitor shoreline species (perhaps this could build on CWCP – where states identified species of greatest conservation need)
3. Fund USGS and NOAA Coastal Services Center to conduct regular coastal imaging.
4. Fund action at TNC Conservation Blueprint Portfolio—priority coastal sites, for example:
  - a. Keweenaw South Shore and Bluffs
  - b. Presque Isle Shoreline
  - c. Dune sites on west coast of Michigan (Point Betsie in the Sleeping Bear-Manitou Islands portfolio site, Elberta-Portage Point, Saugatuck Dunes)
5. Support NOAA and EPA efforts to develop comprehensive, cooperative conservation strategies to protect Great Lakes coastal resources.
6. Fund federal, state, tribal, and other partners to implement recovery actions for rare, threatened, and endangered species.
7. Fully fund the Coastal and Estuarine Land Conservation Program.

### **Current Issues: Upland Habitats**

The economic and ecological value of prairies/grasslands, savannas, barrens, forests, and other upland habitats are not properly accounted for in cost-benefit assessments. The results are destruction and fragmentation of natural habitats as well as the ecosystem services they provide, such as groundwater recharge areas and migration corridors and habitats for many species. Invasive native and non-native species continue to disrupt habitats. Poor management practices have contributed to loss of native habitat and biota in native ecosystems.

1. The economic and ecological value of prairies/grasslands, savannas, barrens, forests, and other upland habitats are not properly accounted for in cost-benefit assessments. This results in destruction and fragmentation of natural habitats as well as the ecosystem services they provide, such as groundwater recharge areas and migration corridors and habitats for many species. Large landholdings formerly in timber production are coming on the market and are vulnerable to development if not protected.

*Stresses:* Fragmentation, direct destruction.

*Action:* Address within the HS Team.

#### *Research/Monitoring/Information Needs:*

- Baseline inventory and assessment of the plants and animals, ecosystem structures and functions, ecosystem services provided, and threats to prairies/grasslands, savannas, barrens, forests, and other upland habitats.
- A data collection-monitoring program for each habitat type and its species that leads to their protection and benefits other water and land resources.

*Policies/Laws/Regulations:* National Environmental Policy Act of 1969; Endangered Species Act (ESA) of 1973; Federal Land Policy and Management Act (FLPMA) of 1976; National Forest Management Act of 1976; Water Quality Act of 1987; Healthy Forests Restoration Act (H.R. 1904) of November 21, 2003

*Ongoing Efforts:* The Nature Conservancy Blueprint; Land and Resource Management Plans for the Superior, Chequamegon-Nicolet, Ottawa, Hiawatha, and Huron Manistee National Forests; Coastal and Estuarine Land Conservation Program plans; Great Lakes National Park plans; Native Plant Framework (USDA Forest Service Eastern Region); USDA Forest Service Strategic Plan for the Years 2004-2008; State and Tribal protection plans; RAPs and LaMPs; Local watershed planning efforts; numerous restoration projects (DU, PF, FWS, TNC, GLNPO, etc.)

*Recommendations:*

- Identify existing and significant upland habitats; evaluate the potential for protection and restoration; and, implement programs to increase the most critical habitats.
- Maintain, enhance and rehabilitate self-sustaining plant and animal populations where the species occurred historically and in as many original habitats as is practical.

2. Non-indigenous invasive species continue to disrupt upland habitats.

*Stresses:* Altered composition/altered structure

*Action:* Address jointly with IS Team

*Research/Monitoring/Information Needs:*

- Baseline inventory of native and non-native invasive species.
- Universally accepted risk assessment protocols for invasive plants and animals.
- Effective treatment protocols for priority invasive species.

*Policies/Laws/Regulations:* National Environmental Policy Act of 1969; Endangered Species Act (ESA) of 1973

*Ongoing Efforts:* The Nature Conservancy Blueprint; Land and Resource Management Plans for the Superior, Chequamegon-Nicolet, Ottawa, Hiawatha, and Huron Manistee National Forests; Great Lakes National Park plans; Midwest Invasive Plant Network, Framework for Plants and Animals of the Eastern Region (2003), Native Plant Framework (USDA Forest Service Eastern Region); USDA Forest Service Strategic Plan for the Years 2004-2008; Invasive Species Management (USDA Forest Service 2004), State and Tribal protection plans; RAPs and LaMPs; Local watershed planning efforts; numerous restoration projects (DU, PF, FWS, TNC, GLNPO, etc.)

*Recommendations:*

- Establish universally accepted risk assessment protocols for invasive plants and animals and effective treatment protocols for priority invasive species.
- Maintain, enhance and rehabilitate self-sustaining plant and animal populations where the species occurred historically and in as many original habitats as is practical.

3. Habitats and species continue to be lost due to poor management practices such as the suppression of fire.

*Stresses:* Altered fire regime

*Action:* Address within the HS Team.

*Research/Monitoring/Information Needs:*

- Best management practices are not established for each habitat type.

*Policies/Laws/Regulations:*

National Environmental Policy Act of 1969; Endangered Species Act (ESA) of 1973; Federal Land Policy and Management Act (FLPMA) of 1976; National Forest Management Act of 1976; Water Quality Act of 1987; Healthy Forests Restoration Act (H.R. 1904) of November 21, 2003

*Ongoing Efforts:*

The Nature Conservancy Blueprint; Land and Resource Management Plans for the Superior, Chequamegon-Nicolet, Ottawa, Hiawatha, and Huron Manistee National Forests; Great Lakes National

Park plans; Midwest Invasive Plant Network, Framework for Plants and Animals of the Eastern Region (2003), Native Plant Framework (USDA Forest Service Eastern Region); USDA Forest Service Strategic Plan for the Years 2004-2008; Invasive Species Management (USDA Forest Service 2004), State and Tribal protection plans; RAPs and LaMPs; Local watershed planning efforts; numerous restoration projects (DU, PF, FWS, TNC, GLNPO, etc.)

*Recommendations:*

- Establish best management practices for each habitat type.

**Terrestrial Invasive Species**

A key threat to both existing species and to restoration efforts is the destructive presence of terrestrial invasive species. Significant damages result from releases of insects, plants, and animals introduced through intentional and unintentional human actions. Buckthorn, garlic mustard, honeysuckle or multiflora rose spread rapidly and without their native controls soon out-compete native vegetation. Emerald ash borer, chestnut blight and Japanese beetles have exacted a tremendous economic and ecological toll on our native forest species and the animal life they supported. All the remaining unique habitat areas and most of the desired wildlife they support remain at risk until solutions to prevent new introductions are put in place. Where populations have started to gain a foothold control measures must be effectively utilized to reduce the risk of “naturalization” of these exotic species. Therefore the recommendation calling for funding to restore terrestrial habitats and associated species must include the capacity for reducing or eliminating the non-native invaders which destroy important habitats and desired native species.

## PROPOSED TECHNICAL FRAMEWORK FOR GREAT LAKES HABITAT/SPECIES CONSERVATION

As Great Lakes Tribes and First Nations remind us, the health of Great Lakes habitats and species is dependent on sustaining the processes and functioning of the following systems: open/nearshore waters; coastal wetlands; coastal shore; streams, tributaries, connecting channels; inland lakes and wetlands; and uplands. Human health as well is dependent on the vitality of these systems, for they comprise the

life support system upon which all else depends. The Lakes, for example, provide us with drinking water; wetlands help control floodwaters; forests provide oxygen while reducing erosion and sedimentation; coastal habitats provide stability; upland landscapes produce topsoil and habitats for pollinators and biocontrol agents. These systems are the natural capital of the Great Lakes region. When they are healthy,

we enjoy abundant natural capital. Conversely, when these systems are degraded, polluted, over-used, or wasted, this and future generations of all living species are impoverished.

<b>GREAT LAKES SYSTEMS</b> Outlines six systems and their processes and functions in order to frame the issues and recommendations and lists major habitats and species within each system. This is not an exhaustive listing; however, it is the basis for further goal and objective setting.	<b>DESIRED STATE</b> Presents a general vision statement for each system.	<b>KEY THREATS</b> Lists the current and major threats to habitats and species within each system; general statements of the human activities that contribute to the threats. These are the organizing principles by which goals and objectives are set and decisions are made.		<b>CURRENT ISSUES</b> Lists the current and critical problems that need our immediate attention.	<b>RESEARCH/MONITORING INFORMATION NEEDS</b> Statements of known research, monitoring and information needs for each system. This listing is incomplete.	<b>POLICIES/LAWS/REGULATIONS</b> An incomplete list of laws for each system. Most of the laws (e.g., Lacey, Fish and Wildlife, Clean Water, Endangered Species, Food Security, and Federal Highway Aid acts) apply to or impact (by design or default) more than one or even all systems.	<b>ONGOING EFFORTS</b> An incomplete listing of plans, restoration activities, and efforts by federal, state, tribal, local, NGO, academic entities.	<b>RECOMMENDATIONS</b> Intended to list concise recommendations to begin to deal with the current issues. Recommended actions should address multiple threats and issues. Meaningful restoration can occur only in the context of ongoing protection.
		<b>Stresses</b>	<b>Sources of Stresses</b>					
<p><b>Open/nearshore waters</b>—Lakes Superior, Michigan, Huron, Erie and Ontario exert climatic influence over the entire region. The Lakes are among the world's largest freshwater bodies and the only ones of such scale located in a temperate climate. The Lakes provide the bulk of the basin's human population with drinking water, commerce and recreation. Phytoplankton convert the energy of sunlight and chemical nutrients found in the surrounding waters to biomass via photosynthesis. The Great Lakes fishery is dependent on nearshore aquatic habitats for spawning and life cycle needs. Waterfowl, raptors and colonial waterbirds dependent on open waters for food.</p> <p><i>Habitats/Biodiversity:</i> Reefs (natural and artificial), islands</p> <p>Phytoplankton, algae, zooplankton, benthic invertebrates, and numerous species of fish, both native and non-native. Importance of submersed aquatic plants</p>	<p>Great Lakes open and nearshore waters are free of toxic contamination; non-indigenous species have been prevented and controlled; and the Lakes contain a full array of natural habitats and species.</p> <p>Water is of sufficient quality and clarity to support submersed aquatic plants.</p> <p>Native species are a functioning, self sustaining component of the fish community.</p>	<ol style="list-style-type: none"> <li>1. Competition /altered food webs by invasive non-indigenous species</li> <li>2. Toxic compounds</li> <li>3. Introduction of nutrients/sedimentation</li> <li>4. Changes in the acid-base balance</li> <li>5. Salinity changes</li> <li>6. Depletion of fish populations</li> <li>7. Temperature increases</li> <li>8. Disruption of sediment transport</li> <li>9. Altered lake levels</li> </ol>	<ol style="list-style-type: none"> <li>1. Ballast water, aquaculture, pet trade, bait.</li> <li>2. Atmospheric deposition (energy production); industrial discharge.</li> <li>3. Non-point source runoff from incompatible agricultural, development, and forestry practices; incompatible waste-water treatment</li> <li>6. Overfishing</li> <li>7. Climate change, industrial discharge.</li> <li>8. Shoreline hardening, lake level management (dams), dredging</li> <li>9. Climate change, lake level management</li> </ol>	<ol style="list-style-type: none"> <li>a. The aquatic food web has been severely—some would say catastrophically—disrupted.</li> <li>b. Aquatic non-indigenous species continue to enter the Lakes via ballast water.</li> <li>c. Periodic outbreaks of botulism in Lakes Erie and Ontario are little understood.</li> <li>d. <i>Diporeia</i> have largely disappeared from Lake Michigan.</li> <li>e. Spawning substrates and submersed aquatic plants have been disrupted by sedimentation and dredging impacts.</li> <li>f. Loss of species and biodiversity continues.</li> </ol>	<ol style="list-style-type: none"> <li>a. Continue to investigate food web interactions.</li> <li>b. Set up a system of early detection monitoring of non-indigenous species.</li> <li>c. Continue research into reasons for botulism outbreaks.</li> <li>d. Continue research into the disappearance of <i>Diporeia</i>.</li> <li>e. Classify, inventory, and map nearshore substrate and fish and wildlife habitats, as well as the severity of sedimentation and dredging impacts.</li> <li>f. Evaluate the success of native fish species protection and restoration.</li> </ol>	<p><b>International:</b> U.S.-Canada Great Lakes Water Quality Agreement</p> <p><b>Federal Laws:</b> Clean Water Act of 1986; Great Lakes Legacy Act of 2002; Non-indigenous Aquatic Invasive Species Act of 1990; Water Resources Development Acts;; Lacey Act of 1900; Fish and Wildlife Act of 1956; Fish and Wildlife Conservation Act; Comprehensive Environmental Response, Compensation, and Liability Act of 1980; North American Waterfowl Plan; Coastal Zone Management Act of 1972</p>	<p><u>Cooperative programs</u> IADN NISA Great Lakes Panel on ANS Binational Toxic Strategy <u>G L Fishery Commission</u> Plan, goals and objectives Joint Strategic Plan for Great Lakes Fisheries <u>LaMP/RAP-related</u> LaMP/Lakes Huron and St. Clair L. ER Prot. and Rest. Plan RAPs for Areas of Concern Lake Sturgeon Rehab Plan-SU <u>NOAA</u> GLERL programs Great Lakes Observing System Partners for Fish and Wildlife Program Coastal and Habitat Programs <u>State Programs</u> Lake Ontario Study; Coastal and Estuarine Land Cons.; Water quality/fish monitoring programs <u>USACE</u> WRDA 2000, Section 206, Great Lakes Fishery and Ecosystem Restoration Program WRDA 1999, Sec 506, Projects for the Improvement of the Environment WRDA 1996, Sec 206, Aquatic Ecosystem Restoration <u>USDA</u> Farm Bill Conservation <u>USEPA</u> 208 Water Quality Mgmt. Plans EPA 319 GLNPO habitat funds <u>USFWS</u> Great Lakes Coastal Restoration NAWMP</p>	<p><b>Invasive non-indigenous species:</b> - Set up a system of early detection monitoring of non-indigenous species to prevent non-indigenous species from entering the Lakes.</p> <p><b>Toxic compounds:</b> - Appropriate full amount for the Legacy Act plus funding for technology research and education.</p> <p><b>Nutrients/sedimentation:</b> - Identify, eliminate, control and monitor point and non-point sources of pollution and excess sedimentation. - Reduce or stop open lake disposal of fine-grained dredge material. - Re-establish construction grants or SRF program. - Support and recommend \$xxx for the 319 Program. - Regulate and enforce stormwater discharges to ensure that quality, quantity, and hydro period of receiving waters are not adversely impacted.</p> <p><b>Habitat/species conservation:</b> - Collaboratively inventory, assess, protect, and restore nearshore aquatic habitats in order to improve the health and productivity of Great Lakes fishery and wildlife populations. - Maintain widely distributed, self-sustaining populations in as many original habitats as is practical. - Maintain, enhance and rehabilitate self-sustaining populations where the species occurred historically basinwide. - Restore and reestablish lake trout, lake herring, deepwater ciscoes, and open water habitats to sustain native and introduced salmonid and percid predators in support of support sport and commercial fisheries.</p>

							USGS Coastal and Wetland Ecology Branch and National Water Quality Assessment Program	
<p><b>Coastal wetlands</b>—More than 216,000 hectares of coastal wetlands have been recently classified binationally. Coastal wetlands are dominated by large lake processes, including major water level fluctuations, severe wave action and wind tides or seiches. They store and cycle nutrients and organic material from the land into the aquatic food web. They sustain large numbers of common or regionally rare bird, mammal, herptile and invertebrate species, including many land-based species that feed from the highly productive marshes. Fish species depend upon them for some portion of their life cycles. They are migratory bird staging and feeding areas. Periodic inundation re-sets succession and maintains the highly productive herb-dominated system. In many areas where the natural systems have been highly modified, vegetated coastal wetlands persist only because of intensive management.</p> <p><i>Habitats/Biodiversity</i> Lacustrine, riverine, barrier protected (plus sub-categories including estuaries and island coastal wetlands)</p> <p>Wide diversity of plant and animal species – many of which breed in coastal wetlands Coastal wetlands provide critical staging habitats for migratory birds and waterfowl.</p>	Coastal wetland quantities remain consistent at baseline levels and quality is restored for fish and wildlife; targeted and coordinated restoration and protection of high potential/critical need wetlands results in a net gain; hydrologically modified environments are maintained and improved to provide for fish and wildlife benefits; native species are a functioning, self sustaining component of the fish community.	<ol style="list-style-type: none"> <li>1. Alteration of lake levels and natural fluctuations</li> <li>2. Competition/altered food webs/altered structure by invasive non-indigenous species</li> <li>3. Addition of toxic compounds</li> <li>4. Temperature increases</li> <li>5. Alteration of sediment transport</li> <li>6. Direct destruction</li> <li>7. Sedimentation</li> </ol>	<ol style="list-style-type: none"> <li>1. Lake level management (dams), climate change.</li> <li>2. Ballast water, aquaculture, pet trade, bait, landscaping</li> <li>3. Atmospheric deposition (energy production); industrial discharge.</li> <li>4. Climate change, industrial discharge.</li> <li>5. Shoreline hardening (jetties, seawalls, etc.), lake level management (dams), climate change</li> <li>6. Draining/filling for development, agriculture</li> <li>7. Non-point source runoff from incompatible agricultural, development and forestry practices</li> </ol>	<ol style="list-style-type: none"> <li>a. Wetland loss and degradation continues, but since coastal wetland quality and quantity are not currently consistently monitored across the basin, impacts to fish and wildlife are difficult to calculate.</li> <li>b. Water level controls and hydrological modifications in many areas have diminished wetland diversity and function.</li> <li>c. Intact coastal wetlands are breeding habitat or refugia for native fish and wildlife; however, such areas are in need of restoration to maintain current functioning.</li> <li>d. Loss of species and biodiversity continues.</li> <li>e. Non-indigenous species continue to invade coastal wetlands.</li> </ol>	<ol style="list-style-type: none"> <li>a. Regular coastal imaging with high enough resolution to detect wetland boundary and land cover change. Increase scientific understanding of coastal ecosystems, including functioning, processes and human disturbance impacts.</li> <li>b. Research the effects of reducing fluctuations of Great Lakes water levels on wetlands and how to manage water levels in ways that minimize these impacts.</li> <li>c. Development of a database of potentially restorable sites.</li> <li>d. Spring migrant bird staging study by DU/TNC others. Long-term trend data on wetland biota-stressor interactions.</li> <li>e. Set up a system of early detection monitoring of non-indigenous species.</li> </ol>	<p><b>International:</b> North American Waterfowl Management Plan; Tripartite Agreement on wetlands between Canada, U.S. and Mexico</p> <p><b>Federal Laws:</b> Sections 401 and 404 of the Clean Water Act; Clean Water Act's 1987 National Estuary Program; State Wetland Protection Grants; recent court ruling on definition of wetland; North American Wetlands Conservation Act of 1989; Rivers and Harbors Act of 1938; Farm Bill; Water Resources Development Acts; Great Lakes Fish and Wildlife Act; North American Waterfowl Plan; Coastal Zone Management Act</p>	<p><u>Cooperative programs</u> North American Waterfowl Plan Great Lakes Coastal Wetlands Consortium Numerous restoration projects <u>LaMPs/RAPs</u> RAPs for Areas of Concern <u>NGO Programs</u> The Nature Conservancy Blueprint DU Strategic Plan <u>State/Tribal Programs</u> State Comprehensive Wildlife Conservation Plans Integrated Resource Management Plans State/Provincial wetland monitoring programs Lake Ontario Study State Wildlife Programs <u>USEPA</u> GLNPO habitat funds National Estuary Program <u>USFWS</u> UMR/Great Lakes Joint Venture Plan NAWMP Coastal Program National Wetlands Research Center Private Lands Program <u>USGS</u> Coastal and Wetland Ecology Branch <u>USACE</u> WRDA 2000, Section 206, Great Lakes Fishery and Ecosystem Restoration Program WRDA 1999, Sec 506, Projects for the Improvement of the Environment WRDA 1996, Sec 206, Aquatic Ecosystem Restoration</p>	<p><b>Habitat/species conservation:</b> - Implement the Coastal Wetland Consortium's long term coastal wetland monitoring program that utilizes Great Lakes indicators and based on the monitoring information, expand wetland protection, restoration and enhancement programs to protect and restore priority coastal wetlands in order to provide healthy habitats for fish and wildlife. - Maintain widely distributed, self-sustaining populations in as many original coastal wetland habitats as is practical. - Maintain, enhance and rehabilitate self-sustaining populations where the species occurred historically basinwide. - Maintain/enhance the yellow perch/walleye fishery. <b>Invasive non-indigenous species:</b> - Set up a system of early detection monitoring of non-indigenous species to prevent non-indigenous species from entering coastal wetlands (currently the refugia for native species). <b>Sedimentation/non-point sources:</b> - Identify, eliminate, control and monitor point and non-point sources of pollution and excess sedimentation.</p>
<p><b>Coastal shore</b>--Water levels, surface and groundwater interactions, wind, waves and longshore sediment transport are the dominant forces shaping some 11,000 lineal miles of coastal ecosystems, including more than 30,000 islands. The coastline is dominated by the effects of the Great Lakes, including wind, wave action, hydrology, temperature and humidity. Extensive freshwater sand dunes support more endemic species than any other part of the Great Lakes basin. Sandy sediments from eroding banks and tributary mouths are carried by longshore currents and form dunes as well as bars and spits that shelter many highly productive marshes. Lake level fluctuations are important in this cycle of erosion, sediment transport and dune maintenance. Shoreline systems absorb the brunt of wind and wave energy from the lakes, buffering the inland systems from disruptive forces.</p>	A representative number of coastal shore habitats are protected/restored and functioning as buffers to inland systems; sufficient diversity and amount of coastal habitat is protected to sustain endemic species populations.	<ol style="list-style-type: none"> <li>1. Competition /altered food webs/altered structure by invasive non-indigenous species</li> <li>2. Alteration of sediment transport</li> <li>3. Direct destruction</li> <li>4. Sedimentation</li> </ol>	<ol style="list-style-type: none"> <li>1. Landscaping, introductions</li> <li>2. Shoreline hardening (jetties, seawalls, etc.), lake level management (dams), climate change</li> <li>3. Sand dune and alvar mining, shoreline hardening, home and commercial development</li> <li>4. Non-point source runoff from incompatible agricultural, development and forestry practices</li> </ol>	<ol style="list-style-type: none"> <li>a. Development, including home, agriculture, shipping, industry, marina, etc., is continuing to destroy coastal shore habitats and disrupt shoreline replenishment processes.</li> <li>b. Channel expansion—both historical and future—continues to disrupt habitats.</li> <li>c. Shoreline habitats are not well inventoried; therefore, it is difficult to track changes.</li> <li>d. Loss of species and biodiversity continues.</li> <li>e. Wind farm construction has the potential to impact migratory birds.</li> </ol>	<ol style="list-style-type: none"> <li>a. Increase scientific understanding of coastal ecosystems, including functioning, processes and human disturbance impacts.</li> <li>b. Research the impact of channel expansion/dredging on nearshore habitats.</li> <li>c. Regular coastal imaging with high enough resolution to map and classify coastal habitats and land cover change.</li> <li>d. Monitor shoreline species for trends in biodiversity loss.</li> <li>e. Research impact of wind farms to migratory bird species.</li> </ol>	<p><b>International:</b> Kyoto Agreement</p> <p><b>Federal Laws:</b> Coastal Zone Management Act of 1972; Endangered Species Act of 1973; Federal-Aid Highways Act of 1968 -- As amended by the Department of Transportation Act of 1966 (requires approval to build Federal highways through wildlife refuges and other designated areas); Migratory Bird Conservation Act of 1929</p>	<p><u>Cooperative Programs</u> Great Lakes Islands Collaborative Lake Ontario Dunes Coalition Lake Michigan Dunes Alliance Eastern Lake MI Coastal Conservation Plan <u>LaMPs/RAPs</u> Areas of Concern <u>NOAA</u> Coastal and Habitat Programs <u>NGO Programs</u> The Nature Conservancy Blueprint <u>State/Tribal Programs</u> Coastal and Estuarine Land Conservation Program (OH) <u>USEPA</u> GLEI Project</p>	<p><b>Habitat/species conservation:</b> - Inventory and assess Great Lakes coastal habitats (islands, sand beaches and dunes, cobble/bedrock shores, jack pine barrens, alvars and consolidated bluffs; prioritize them for protection and restoration; implement protection and restoration activities. - Maintain widely distributed, self-sustaining populations in as many original habitats as is practical. - Maintain, enhance and rehabilitate self-sustaining populations where the species occurred historically basinwide. <b>Areas of Concern:</b> - Conduct detailed monitoring of Areas of Concern. - Provide ongoing funding leading to de-listing of habitat-related beneficial use</p>

<p><i>Habitats/Biodiversity</i> Dunes, beaches, islands, alvars, cobble/bedrock shores, jack pine barrens, consolidated bluffs. Migratory birds and waterfowl, shore birds Examples of rare endemic species found on coastal shores: Dune thistle (<i>Cirsium pitcheri</i>), Houghton's goldenrod (<i>Solidago houghtonii</i>) and the Lake Huron locust (<i>Trimerotropis huroniana</i>), dwarf lake iris (<i>Iris lacustris</i>) and ram's head lady's slipper (<i>Cypripedium arietinum</i>), Lake Huron Tansy</p>				f. Non-indigenous invasive species continue to disrupt coastal habitats.	f. Universally accepted risk assessment protocols for non-native invasive plants and animals.		GLNPO habitat funds <b>USACE</b> WRDA 2000, Section 206, Great Lakes Fishery and Ecosystem Restoration Program WRDA 1999, Sec 506, Projects for the Improvement of the Environment WRDA 1996, Sec 206, Aquatic Ecosystem Restoration	impairments in Areas of Concern.
<p><b>Streams, tributaries, connecting channels</b>— These are the primary conduits for drainage of waters from the basin's landscape to the Great Lakes. They transport sediments, nutrients and organic material throughout the watershed. Biodiversity elements of tributaries depend upon the oxygenation of water and the balance of nutrients and organic materials to maintain favorable habitat conditions. Tributaries provide important spawning habitat for several Great Lakes fish, as well as migration corridors for other wildlife, including migratory birds.</p> <p><i>Habitats/Biodiversity:</i> Coldwater, warmwater fish and wildlife habitats, islands</p> <p>World's richest freshwater mussel fauna. Two endemic species: the copper redhorse (<i>Moxostoma hubbsii</i>), Hungerford's crawling water beetle (<i>Brychius hungerfordi</i>); several rare fish species including the lake sturgeon.. Migrant bird corridors, resident wildlife habitats.</p>	Cold and warm water tributary access is sufficient to allow natural sustainability of native fisheries; buffers adequately reduce sedimentation and nutrient inflow; riparian floodplains and wetlands are reconnected; stream habitat is improved to support migratory birds and other wildlife; native species are a functioning, self sustaining component of the fish community.	<ol style="list-style-type: none"> <li>1. Direct destruction</li> <li>2. Alteration or disruption of amount and frequency of stream flows</li> <li>3. Alteration of water table</li> <li>4. Toxic compounds</li> <li>5. Competition /altered food webs/altered structure</li> <li>6. Temperature increases</li> <li>7. Altered sediment regime</li> <li>8. Fragmentation</li> </ol>	<ol style="list-style-type: none"> <li>1. Stream channelization, road building, and shoreline hardening.</li> <li>2. Dams and dam operation, diversions, withdrawals, agricultural drainage (tiling), incompatible stormwater management</li> <li>3. Excessive groundwater withdrawal</li> <li>4. Industrial/municipal discharge; incompatible mining practices</li> <li>5. Aquatic invasive species introduced through ballast water, aquaculture, pet trade, bait, recreation (boating); direct stocking</li> <li>6. Stream channelization, incompatible forestry, industrial discharge, climate change</li> <li>7. Incompatible agricultural practices (tiling, tillage), incompatible forestry, incompatible development, road building and maintenance</li> <li>8. Dams, culverts, road/stream crossings</li> </ol>	<ol style="list-style-type: none"> <li>a. Thousands of dams block water flow as well as fish passage, thus fragmenting habitats in streams and rivers and disrupting the rate and flow of water to the Lakes.</li> <li>b. Non-point source runoff into streams contributes to contamination at river mouths and in the Lakes.</li> <li>c. Legacy sediment contamination is still impacting species.</li> <li>d. Loss of floodplains, riparian buffers and channelization, continued tile and surface drainage, and groundwater depletions are impacting habitats.</li> <li>e. Loss of species and biodiversity continues.</li> <li>f. Non-indigenous invasive species continue to disrupt tributary habitats.</li> </ol>	<ol style="list-style-type: none"> <li>a. Study the impacts of dam removal at specific locations.</li> <li>b. Evaluate buffers in reducing nutrient and sediment inflow.</li> <li>c. Continue to research the impact of contaminated sediments on species.</li> <li>d. Continue to research loss of floodplains, riparian habitats, and groundwater and surface water changes to habitats.</li> <li>e. Monitor species for trends in biodiversity loss.</li> <li>f. Universally accepted risk assessment protocols for non-native invasive plants and animals.</li> </ol>	<p><b>Federal Laws:</b> Wild and Scenic Rivers Act of 1968; Watershed Protection and Flood Prevention Act of 1954; Farm Bill; Water Resources Development Acts; Great Lakes Fish and Wildlife Act; Coastal Zone Management Act; Great Lakes River Restoration Act</p>	<p><u>Cooperative programs</u> Annex 2001 <u>LaMP/RAP Programs</u> RAPs for Areas of Concern <u>NGO Programs</u> The Nature Conservancy Blueprint Numerous watershed plans (Little Traverse Bay Watershed Protection Plan Clinton River Watershed Council Watershed Diagnostic of the Little Calumet-Galien River Watershed <u>State programs</u> Sheboygan County Natural Areas and Critical Resources Plan) Great Lakes River Rest. Act (OH) <u>USDA</u> USDA Farm Bill Eastern Brook Trout Venture (USDA Forest Service) Coaster Brook Trout Initiative (USDA Forest Service) <u>USEPA</u> EPA 319 TMDLs GLNPO habitat funds <u>USFWS</u> NAWMP/Joint Ventures Brook Trout Rehabilitation Plan for Lake SU USFWS National Fish Passage Program Private Lands Program <u>USACE</u> WRDA 2000, Section 206, Great Lakes Fishery and Ecosystem Restoration Program WRDA 1999, Sec 506, Projects for the Improvement of the Environment WRDA 1996, Sec 206, Aquatic Ecosystem Restoration</p>	<p><b>Dams:</b> - Prioritize and coordinate dam removal and tributary restoration projects.</p> <p><b>Buffers:</b> - Establish development setbacks and vegetated buffers sufficient to protect water quality and habitat from new development.</p> <p><b>Altered sediment regime:</b> - Implement watershed plans to reduce nutrient and sediment inputs, including wetland restoration and riparian buffers.</p> <p><b>Habitat/species conservation:</b> - Maintain widely distributed, self-sustaining populations in as many original habitats as is practical. - Maintain, enhance and rehabilitate self-sustaining populations where the species occurred historically basinwide. - Restore and reestablish lake sturgeon.</p> <p><b>Invasive non-indigenous species:</b> - Develop an invasive species mitigation plan for each major tributary.</p>
<p><b>Inland lakes and wetlands</b>—These are important reservoirs for water within the basin's drainage system, regulating volumes, periodicity, sediment content and chemical/temperature characteristics. They also serve as centers of nutrient retention, storage and exchange. Wetlands are often highly</p>	Inland wetlands have been inventoried and losses from development tracked basinwide; wetland complexes increase/are restored (net gain) to	<ol style="list-style-type: none"> <li>1. Direct destruction</li> <li>2. Altered hydrology</li> </ol>	<ol style="list-style-type: none"> <li>1. Draining and filling for home and commercial development and agriculture.</li> <li>2. Dams and dam operation, diversions,</li> </ol>	a. Loss and degradation of wetlands/lakes and their functions are continuing.	a. Monitor wetlands/lakes for changes. Inventory/classify wetlands/lakes. Update the National Wetlands Inventory. Identify and evaluate potentially	<p><b>Federal laws:</b> Section 319 of the Clean Water Act (nonpoint source grants to states); Clean Lakes Program of 1972 (as section 314 of the Federal Water Pollution Control</p>	<p><u>Cooperative Programs</u> North American Waterfowl Plan <u>NGO Programs</u> The Nature Conservancy Blueprint DU Strategic Plan</p>	<p><b>Buffers:</b> - Establish development setbacks and vegetated buffers sufficient to protect water quality and habitat from new development.</p> <p><b>Regulations:</b> - Amend existing wetland regulatory</p>



<p>productive from a biological standpoint and are important to the life cycles of many species, including wetland, threatened and endangered species and many upland species which breed or feed in wetlands.</p> <p><i>Habitats/Biodiversity:</i> bogs, fens, islands threatened and endangered species, e.g.: Mitchell's satyr butterfly (<i>Neonympha mitchellii</i>) Resident breeding birds, amphibians, reptiles &amp; mammals.</p>	<p>sufficiently meet the needs of wildlife, water quality, ground water recharge, flood attenuation and recreation; native species are a functioning, self sustaining component of the fish community.</p>	<p>3. Toxic compounds 4. Competition /altered food webs/altered structure</p> <p>5. Temperature increases</p> <p>6. Eutrophication (nutrient enrichment)</p> <p>7. Fragmentation of wetlands</p>	<p>withdrawals, agricultural drainage (tiling), incompatible stormwater management, excessive groundwater withdrawal. 3. ? 4. Aquatic invasive species introduced through aquaculture, pet trade, bait, recreation (boating), landscaping; direct stocking. 5. Incompatible forestry, incompatible water management, climate change. 6. Incompatible development, incompatible wastewater treatment. 7. Dams, culverts, road/stream crossings.</p>	<p>b. Aquatic invasive species are impacting inland wetland/lake species and communities. c. Loss of species and biodiversity continues.</p>	<p>restorable wetlands. b. Set up a system of early detection monitoring of non-indigenous species. c. Monitor species for trends in biodiversity loss.</p>	<p>Act)--not funded in recent years); Transportation Equity Act for the 21st Century of 1998; Farm Bill; Water Resources Development Act; Great Lakes Fish and Wildlife Act; North American Waterfowl Plan</p>	<p>Mentor Marsh Special Area Management Plan Issues Identification <u>State/Tribal Programs</u> State Comprehensive Wildlife Conservation Plans Integrated Resource Management Plans WI DNR Wetlands Strategy MN Wetlands Conservation Plan <u>USDA</u> Farm Bill conservation Programs <u>USEPA</u> GLNPO habitat funds <u>USFWS</u> UMR/Great Lakes Joint Venture FWS Partners Program National Wetlands Research Center Private Lands Program <u>USACE</u> WRDA 2000, Section 206, Great Lakes Fishery and Ecosystem Restoration Program WRDA 1999, Sec 506, Projects for the Improvement of the Environment WRDA 1996, Sec 206, Aquatic Ecosystem Restoration</p>	<p>frameworks to ensure that all wetlands are protected, including isolated wetlands. <b>Habitat/species conservation:</b> - Update the FWS National Wetlands Inventory. - Prioritize and conserve areas of key wetland complexes (focus areas). - Reestablish sufficient quantity of wetlands to achieve desired ecosystem benefits. - Maintain widely distributed, self-sustaining populations in as many original habitats as is practical. - Increase the net wetland resource base by one million acres by the year 2025. <b>Invasive non-indigenous species:</b> - Develop an invasive species mitigation plan for inland lakes and wetlands.</p>
<p><b>Uplands--</b> This system covers a large percentage of the basin and forms the principle collector for precipitation inputs to the rest of the system. 51% of the basin is forested. Through their character and health, inland terrestrial communities influence the rate, periodicity and quality of incoming precipitation, and direct its flow to surface drainage and groundwater recharge. The ecological integrity of this system is also important in controlling erosion, which is a major factor in the ecological health of tributaries and coastal areas. The inland terrestrial system provides migration corridors and habitat for portions of the life cycles of species principally associated with other systems.</p> <p><i>Habitats/Biodiversity:</i> Forest lands, oak savannas, prairies, oak and pine barrens, agricultural lands, islands</p> <p>Moonwort, neotropical migrant birds, endemic Kirtland's warbler (<i>Dendroica kirtlandii</i>)</p>	<p>Sufficiently large and connected habitats to allow upland diversity and population sustainability are protected and restored. There is a net gain in prairies/grasslands and savannas. Native species are a functioning, self sustaining component of upland communities.</p>	<p>1. Fragmentation and direct destruction 2. Altered fire regimes 3. Altered composition/altered structure</p>	<p>1. Incompatible development, conversion to agriculture, incompatible forestry practices. 2. Fire management policy (suppression). 3. Management of/for certain species (deer, maple, aspen, etc.); invasive species from management activities, accidental introduction, landscaping; pathogens; climate change.</p>	<p>a. Value of prairies/grasslands, savannas, barrens, and other upland habitats are consistently undervalued. b. Loss of species and biodiversity continues. c. Non-indigenous invasive species continue to disrupt upland habitats.</p>	<p>a. Inventory and assess the functioning of existing prairies, significant grassland and other upland habitats. b. Monitor species for trends in biodiversity loss. c. Inventory of non-native invasive species. Universally accepted risk assessment protocols for non-native invasive plants and animals. Effective treatment protocols for priority species.</p>	<p><b>Federal Laws:</b> National Forest Management Act of 1976; Food Security Act of 1985; Wilderness Act of 1964; Safe Drinking Water Act Amendments of 1996; Organic Administration Act of 1897; Knutson-Vanderberg Act of June 9, 1930, 46 Stat.527, as amended; 16 U.S.C. 576, 576a-576b); Bankhead-Jones Farm Tenant Act of 1937; Anderson-Mansfield Reforestation and Revegetation Joint Resolution, Act of October 11, 1949; Granger-Thye Act of 1950; Sikes Act (Fish and Wildlife Conservation) of September 15, 1960; 16 U.S.C.670g-670l, 670o - Sec. 201b); Multiple Use-Sustained Yield Act of 1960; Wilderness Act of 1964; National Historic Preservation Act of 1966; National Environmental Policy Act of 1969; Federal Water Pollution Control Act of 1948, as revised in 1972 and amended in the Water Quality Act of 1987; The Endangered Species Act (ESA) of 1973; Federal Land Policy and Management Act (FLPMA) of 1976; The National Forest Management Act of 1976; Surface Mining Control and Reclamation Act of 1977;</p>	<p><u>Cooperative Programs</u> Midwest Invasive Plant Network <u>NGOs</u> The Nature Conservancy Blueprint Oak Savanna Recovery Plan Numerous restoration projects (DU, PF, FWS, TNC, etc.) Sheboygan County Natural Areas and Critical Resources Plan <u>State/Tribal</u> Coastal and Estuarine Land Conservation Program (OH) <u>USDA</u> Land and Resource Management Plans for the Superior, Chequamegon-Nicolet, Ottawa, Hiawatha, and Huron Manistee National Forests Non-native Invasive Species Framework for Plants and Animals of the Eastern Region (2003) Native Plant Framework (USDA Forest Service Eastern Region) USDA Forest Service Strategic Plan for the Years 2004-2008 National Strategy and Implementation Plan for Invasive Species Management (USDA Forest Service 2004) <u>USEPA</u> GLNPO habitat funds <u>USACE</u> WRDA 2000, Section 206,</p>	<p><b>Habitat/species conservation:</b> - Identify existing and significant grassland habitats and evaluate the potential for restoration and implementation of programs to increase these critical habitats. - Maintain widely distributed, self-sustaining populations in as many original habitats as is practical. - Maintain, enhance and rehabilitate self-sustaining populations where the species occurred historically basinwide.</p>

						<p>Cooperative Forestry and Assistance Act of July 1, 1978; 16 U.S.C. 2101; North American Wetland Conservation Act of December 13, 1989; Section 323 of Public Law 108-7; Consolidated Appropriations resolution, 2003; Healthy Forests Restoration Act (H.R. 1904) of November 21, 2003; The Federal Power Act of June 5, 1920; Wild and Scenic Rivers Act of October 2, 1968; Farm Bill; Water Resources Development Acts; Great Lakes Fish and Wildlife Act</p> <p><b>Regulations:</b> 36 CFR Part 10 Subpart (b)</p> <p><b>Executive Orders:</b> Executive Order 11987 (May 24, 1977); Executive Order 13112 (February 3, 1999); Executive Order 13148 (April 21, 2000); Executive Order 13352 (August 26, 2004)</p>	<p>Great Lakes Fishery and Ecosystem Restoration Program WRDA 1999, Sec 506, Projects for the Improvement of the Environment WRDA 1996, Sec 206, Aquatic Ecosystem Restoration</p>	
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## **Appendix 6. Wetland Restoration Information**

**Justification:** Wetland loss in the 8 Great Lakes states from the 1780s to the 1980s totals 23.6 million acres (Dahl 1990), or more than two-thirds of the natural Great Lakes wetlands. Primary causes of this loss (filling or draining) have been due to agriculture, urban uses, shoreline development, recreation and resource extraction (such as peat mining). The loss of these wetlands poses special problems for hydrological processes and water quality because of the natural storage and cleansing functions of wetlands. These losses have also impacted wildlife and fisheries, resulting in loss of fish and wildlife-associated economic benefits. In the 8 Great Lakes states, approximately 28.2 million persons take part in wildlife-related recreation, expending \$21.3 billion annually. This generates 421,500 jobs within those states. Economic losses due to flooding, removing excess sediment to maintain drainage and shipping, and beach closures to due excess nutrients probably total in the billions.

Funding needs are based on a cost estimate of \$1,000 per restored acre based upon average costs of wetland restorations undertaken by Ducks Unlimited and USDA's Wetland Reserve Program. Some wetland restorations will cost less, but acquisitions will cost more, therefore the \$1,000/acre average is a ballpark estimate.

Wetland conservation activities should include: fee title acquisition, permanent conservation easements, long-term leases (30 years), wetland restoration including ditch plugs, tile breaks, berms, floodplain reconnection, and other methods to restore or emulate hydrologic conditions to sustain wetlands, and wetland enhancement activities such as controlling exotic invasive species, water level management, planting of native vegetation, and other acceptable techniques as listed in scientific manuals and guides.

**Wetland priority areas for the Great Lakes** – These areas exist in many active ongoing plans. Immediately available priority areas with active partnerships and implementation teams include:

1. Several watersheds currently active under USDA's Conservation Reserve Enhancement Programs in the Saginaw Bay watershed, western Lake Erie watershed (OH), River Raisin and Macatawa watersheds (MI), and Eastern Wisconsin riparian areas.
2. The 271 sites designated as critical habitat according to the Great Lakes Conservation Blueprint. These sites conserve critical coastal shore and upland habitats for numerous wildlife and plant species.
3. The focus areas of the Upper Mississippi/Great Lakes Joint Venture, which benefits all migratory birds specifically in Minnesota: Agassiz Lowlands and Border Lakes focus areas; in Wisconsin: SE, Winnebago, Green Bay and Wild Rice focus areas; in Illinois: the NE focus area; in Indiana: the Kankakee and NE focus areas; in Michigan: all focus areas; in Ohio: the Lake Erie Marshes and Mosquito Creek/Grand River focus areas, in Pennsylvania: the NW focus area, and in New York: the Niagara River/Buffalo Harbor, Iroquois NWR, Lakeshore Marshes, and Lake Ontario Islands focus areas.
4. State Comprehensive Wildlife Conservation Plans compiled by all State Department of Natural Resources. These plans have been developed with significant stakeholder and partner involvement, and benefit a wide range of fish and wildlife, including many unique and important habitats.
5. The Great Lakes Islands report (Great Lakes Basin Ecosystem Team)

## **Federal and State Funding Programs for Wetlands**

1. USDA - Farm Bill Conservation Title programs including Wetland Reserve Program, Conservation Reserve Program (including CREP), Wildlife Habitat Incentive Program, Environmental Quality Incentives Program, and Conservation Security Program;
2. USDI - North American Wetlands Conservation Act, FWS Coastal Program, Great Lakes Fish and Wildlife Restoration Act, Partners for Fish and Wildlife,
3. USCOE - WRDA
4. EPA – Great Lakes National Program Grants
5. NOAA – Coastal Zone Programs
6. States – Land and Water Conservation Fund, State Wildlife Grants, Fish and Wildlife Fund (license revenue), Checkoff Funds, EPA 319, Coastal Management Zone funds.

## **Monitoring for Functional Improvement of Wetlands**

It is not enough to fund programs to conserve and restore wetlands unless monitoring is also included to determine if the wetland functions successfully return following restoration activities. Optimally, restored wetlands should be monitored for several years following restoration activities to determine if they are on a trajectory to achieve restoration objectives and then the entire set of wetlands in the basin should be sampled each year to understand overall trends. A number of strategies have been developed to sample and monitor wetland functions. The Information and Indicators Strategy Team may need to coordinate with other monitoring as well. Examples of some of the most comprehensive programs are included below:

1. **Great Lakes Coastal Wetlands Consortium** – an inventory and set of protocols for monitoring coastal wetland quantity and biological integrity across the Great Lakes basin. <http://www.glc.org/wetlands/>
2. **Great Lakes Environmental Indicators program** – initiative to test the effectiveness of coastal indicators and monitoring protocols across the Great Lakes basin. <http://glei.nrri.umn.edu/default/default.htm>
3. **Ohio Rapid Assessment Method for Wetlands** – a set of protocols, associated documentation and training for bioassessment and biocriteria development for inland and coastal wetlands. <http://www.epa.state.oh.us/dsw/wetlands/WetlandEcologySection.html>

## Appendix 7. The Nature Conservancy Great Lakes Priority Conservation Areas Chart

This set of action sites was selected from the U.S. portion of the *Binational Conservation Blueprint for the Great Lakes*<sup>1</sup> to represent places distributed across the Great Lakes basin where the goals and recommendations under discussion by the Collaboration could be advanced, where there are opportunities for protection as well as restoration, and where conservation actions will contribute to the overall health of the Great Lakes ecosystem. These sites all provide important habitat and ecosystem services; investing in them now will save significant costs of restoration and/or remediation action in the future. The Nature Conservancy has detailed information available on each project to guide conservation action. This is only a subset of potential sites for consideration.

### KEY TO CHART

**Basin**

ER – Lake Erie  
 HU – Lake Huron  
 MI – Lake Michigan  
 ON – Lake Ontario  
 SU – Lake Superior  
 SL – St. Lawrence

**System (Based upon Habitat/Species Team classification)**

Open/Nearshore Waters  
 Wetlands (coastal, inland lakes & wetlands)  
 Riverine Habitats & Related Riparian Areas  
 Coastal Shore  
 Uplands

Project Name (Conservation Blueprint site name if different)	State	Basin	System	Recommended Action
Illinois Beach State Park (Chiwaukee Prairie-Illinois Beach)	IL/WI	MI	<ul style="list-style-type: none"> <li>• Wetlands (coastal)</li> <li>• Coastal Shore</li> <li>• Uplands</li> </ul>	<ul style="list-style-type: none"> <li>• Implement non-structural erosion control</li> </ul>
Lake Michigan Lakefront	IL	MI	<ul style="list-style-type: none"> <li>• Coastal Shore</li> </ul>	<ul style="list-style-type: none"> <li>• Coordinate land use planning/mgt.</li> <li>• Implement non-structural erosion control</li> <li>• Protection through acquisitions/easements</li> </ul>
Indiana Dunes	IN	MI	<ul style="list-style-type: none"> <li>• Wetlands (coastal)</li> <li>• Coastal Shore</li> <li>• Uplands</li> </ul>	<ul style="list-style-type: none"> <li>• Prevent, eradicate, and control invasives</li> <li>• Implement non-structural erosion control</li> <li>• Coordinate land use planning/mgt.</li> <li>• Protect, restore, and enhance wetlands</li> <li>• Implement ecologically appropriate fire mgt. regimes</li> <li>• Protection through acquisitions/easements</li> <li>• Promote responsible recreation</li> <li>• Reduce deer browse</li> </ul>

<sup>1</sup> The Nature Conservancy & Nature Conservancy of Canada. in prep. *Binational conservation blueprint for the Great Lakes*. [brochure]. <http://nature.org/greatlakes>.

<b>Project Name (Conservation Blueprint site name if different)</b>	<b>State</b>	<b>Basin</b>	<b>System</b>	<b>Recommended Action</b>
Calumet Basin (Indiana Tolleston)	IN/IL	MI	<ul style="list-style-type: none"> <li>• Wetlands (coastal)</li> <li>• Coastal Shore</li> <li>• Uplands</li> </ul>	<ul style="list-style-type: none"> <li>• Prevent, eradicate, and control invasives</li> <li>• Coordinate land use planning/mgt.</li> <li>• Prevent or remediate toxics</li> <li>• Implement ecologically appropriate fire mgt. regimes</li> <li>• Protect, restore, and enhance wetlands</li> <li>• Protection through acquisitions/easements</li> <li>• Promote responsible recreation</li> </ul>
Hoosier Prairie	IN	MI	<ul style="list-style-type: none"> <li>• Wetlands (coastal)</li> <li>• Uplands</li> </ul>	<ul style="list-style-type: none"> <li>• Prevent, eradicate, and control invasives</li> <li>• Coordinate land use planning/mgt.</li> <li>• Implement ecologically appropriate fire mgt. regimes</li> <li>• Protection through acquisitions/easements</li> <li>• Promote responsible recreation</li> </ul>
Highest priority dune sites on eastern shore of Lake Michigan <sup>2</sup> (Cathead Bay, Elberta – Portage Point Shoreline, Fox Islands, Grand River Bayoux, Herring Lake Dunes, Beaver Islands, Lower Manistee River, Saugatuck Dunes, Sleeping Bear-Manitou Islands, Betsie Bay Bayoux, Big Sable Point – Hamlin Lakes, Fisherman’s Island, Stony Creek – Camp Miniwanca, Waugoshance)	MI	MI	<ul style="list-style-type: none"> <li>• Coastal Shore</li> </ul>	<ul style="list-style-type: none"> <li>• Protection through acquisitions/easements</li> <li>• Prevent, eradicate, and control invasives</li> <li>• Promote responsible recreation</li> <li>• Reduce deer browse</li> </ul>
Elberta-Portage Point	MI	MI	<ul style="list-style-type: none"> <li>• Coastal Shore</li> </ul>	<ul style="list-style-type: none"> <li>• Protection through acquisitions/easements</li> <li>• Prevent, eradicate, and control invasives</li> </ul>

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<sup>2</sup> Michigan Dune Alliance. July 2003. *Eastern Lake Michigan shoreline plan.*

<b>Project Name (Conservation Blueprint site name if different)</b>	<b>State</b>	<b>Basin</b>	<b>System</b>	<b>Recommended Action</b>
Northern Great Lakes Forest – Upper Peninsula (Porcupine Mountains/Presque Isle River, Michigamme Highlands, Whitefish-Au Train Rivers, Whitefish-Grand Marais Shoreline, Two Hearted River, Seney Fens, and East Branch Fox River, Lower Tahquamenon – Tahquamenon Falls State Park, Hiawatha)	MI	MI/SU	<ul style="list-style-type: none"> <li>• Wetlands</li> <li>• Riverine Habitats</li> <li>• Uplands</li> </ul>	<ul style="list-style-type: none"> <li>• Protection through acquisitions and working forest easements</li> <li>• Implement sustainable forestry practices</li> <li>• Implement best practices in road/stream crossing designs</li> </ul>
Garden Peninsula	MI	MI	<ul style="list-style-type: none"> <li>• Wetlands (coastal)</li> <li>• Coastal Shore</li> <li>• Uplands</li> </ul>	<ul style="list-style-type: none"> <li>• Prevent, eradicate, and control invasives</li> <li>• Protection through acquisitions/easements</li> <li>• Reduce deer browse</li> </ul>
Keweenaw South Shore and Bluffs	MI	SU	<ul style="list-style-type: none"> <li>• Coastal Shore</li> </ul>	<ul style="list-style-type: none"> <li>• Promote responsible recreation</li> <li>• Protection through acquisitions/easements</li> </ul>
Point Betsie (Sleeping Bear-Manitou Islands)	MI	MI	<ul style="list-style-type: none"> <li>• Coastal Shore</li> </ul>	<ul style="list-style-type: none"> <li>• Coordinate land use planning/mgt.</li> <li>• Protection through acquisitions/easements</li> <li>• Prevent, eradicate, and control invasives</li> </ul>
Presque Isle Shoreline	MI	HU	<ul style="list-style-type: none"> <li>• Wetlands (coastal)</li> <li>• Coastal Shore</li> </ul>	<ul style="list-style-type: none"> <li>• Coordinate land use planning/mgt.</li> <li>• Protection through acquisitions/easements</li> </ul>
Saugatuck Dunes	MI	MI	<ul style="list-style-type: none"> <li>• Coastal Shore</li> </ul>	<ul style="list-style-type: none"> <li>• Coordinate land use planning/mgt.</li> <li>• Protection through acquisitions/easements</li> <li>• Promote responsible recreation</li> <li>• Reduce deer browse</li> </ul>
Ontonagon River Watershed	MI/WI	SU	<ul style="list-style-type: none"> <li>• Riverine Habitats</li> </ul>	<ul style="list-style-type: none"> <li>• Implement best practices in road/stream crossing designs</li> <li>• Protection through acquisitions and working forest easements</li> <li>• Implement sustainable forestry practices</li> </ul>
Upper Menominee Headwaters (Iron, Brule, Paint Rivers)	MI/WI	MI	<ul style="list-style-type: none"> <li>• Riverine Habitats</li> </ul>	<ul style="list-style-type: none"> <li>• Implement best practices in road/stream crossing designs</li> <li>• Protection through acquisitions and working forest easements</li> <li>• Implement sustainable forestry practices</li> <li>• Coordinate land use planning/mgt.</li> </ul>
Brule River and Brule Lake Complex	MN	SU	<ul style="list-style-type: none"> <li>• Wetlands (inland lakes &amp; wetlands)</li> <li>• Riverine Habitats</li> </ul>	<ul style="list-style-type: none"> <li>• Implement best practices in road/stream crossing designs</li> <li>• Protection through acquisitions and working forest easements</li> <li>• Implement sustainable forestry practices</li> <li>• Coordinate land use planning/mgt.</li> </ul>

<b>Project Name (Conservation Blueprint site name if different)</b>	<b>State</b>	<b>Basin</b>	<b>System</b>	<b>Recommended Action</b>
Manitou River	MN	SU	<ul style="list-style-type: none"> <li>Wetlands (inland lakes &amp; wetlands)</li> <li>Riverine Habitats</li> </ul>	<ul style="list-style-type: none"> <li>Coordinate land use planning/mgt.</li> <li>Protection through acquisitions and working forest easements</li> <li>Implement sustainable forestry practices</li> <li>Implement best practices in road/stream crossing designs</li> </ul>
Sand Lakes/Seven Beavers (Sand Lake Complex and St. Louis River Headwaters)	MN	SU	<ul style="list-style-type: none"> <li>Wetlands (inland lakes &amp; wetlands)</li> <li>Riverine Habitats</li> </ul>	<ul style="list-style-type: none"> <li>Implement best practices in road/stream crossing designs</li> <li>Coordinate land use planning/mgt.</li> <li>Protection through acquisitions and working forest easements</li> <li>Implement sustainable forestry practices</li> <li>Protect and restore forest structure and species composition</li> </ul>
St. Louis River Estuary	MN	SU	<ul style="list-style-type: none"> <li>Wetlands (coastal)</li> <li>Riverine Habitats</li> <li>Uplands</li> </ul>	<ul style="list-style-type: none"> <li>Protect, restore, and enhance wetlands</li> <li>Coordinate land use planning/mgt.</li> <li>Prevent, eradicate, and control invasives</li> <li>Restore altered hydrologic regimes (river flows and lake levels)</li> <li>Protection through acquisitions/easements</li> <li>Protect, restore, and enhance fisheries</li> <li>Develop alternative dredging and disposal plans</li> </ul>
Eastern Lake Ontario Watershed	NY	ON	<ul style="list-style-type: none"> <li>Wetlands (coastal)</li> <li>Riverine Habitats</li> <li>Coastal Shore</li> </ul>	<ul style="list-style-type: none"> <li>Restore dune habitats</li> <li>Restore altered hydrologic regimes (river flows and lake levels)</li> <li>Prevent, eradicate, and control invasives</li> <li>Reduce nutrient inputs</li> <li>Implement agricultural best mgt. practices</li> </ul>
Montezuma Wetlands Complex	NY	ON	<ul style="list-style-type: none"> <li>Wetlands (inland lakes &amp; wetlands)</li> <li>Riverine Habitats</li> </ul>	<ul style="list-style-type: none"> <li>Protect, restore, and enhance wetlands</li> <li>Coordinate land use planning/mgt.</li> <li>Restore altered hydrologic regimes (river flows and lake levels)</li> </ul>
Salmon River (East Branch Fish Creek – Tug Hill Matrix)	NY	ON	<ul style="list-style-type: none"> <li>Riverine Habitats</li> <li>Uplands</li> </ul>	<ul style="list-style-type: none"> <li>Protect, restore, and enhance wetlands</li> <li>Restore altered hydrologic regimes (river flows and lake levels)</li> <li>Protection through acquisitions/easements</li> <li>Implement sustainable forestry practices</li> <li>Implement watershed planning/assessment</li> </ul>
Jefferson County Alvars	NY	ON/SL	<ul style="list-style-type: none"> <li>Uplands</li> </ul>	<ul style="list-style-type: none"> <li>Protect and restore alvar core habitats</li> <li>Prevent, eradicate, and control invasives</li> </ul>
St. Lawrence Corridor	NY	ON/SL	<ul style="list-style-type: none"> <li>Wetlands (inland lakes &amp; wetlands)</li> <li>Uplands</li> </ul>	<ul style="list-style-type: none"> <li>Protect, restore, and enhance wetlands</li> <li>Maintain grasslands for breeding birds</li> <li>Restore altered hydrologic regimes (river flows and lake levels)</li> <li>Implement agricultural best mgt. practices</li> <li>Implement sustainable forestry practices</li> <li>Implement watershed planning/assessment</li> </ul>



<b>Project Name (Conservation Blueprint site name if different)</b>	<b>State</b>	<b>Basin</b>	<b>System</b>	<b>Recommended Action</b>
Southern Lake Ontario Coastal Marshes (Nine-Mile Point-Derby Hills, Sodus Bay to Nine-Mile Point Lakeshore Marshes, Braddock Bay Complex)	NY	ON	<ul style="list-style-type: none"> <li>Wetlands (coastal)</li> <li>Coastal shore</li> </ul>	<ul style="list-style-type: none"> <li>Protection through acquisitions/easements</li> <li>Restore altered hydrologic regimes (river flows and lake levels)</li> <li>Prevent, eradicate, and control invasives</li> <li>Implement agricultural best mgt. practices</li> <li>Reduce nutrient inputs</li> <li>Coordinate land use planning/mgt.</li> </ul>
Western Finger Lakes (Hemlock-Canadice-Honeoye-Canandaigua Lakes)	NY	ON	<ul style="list-style-type: none"> <li>Wetlands (inland lakes &amp; wetlands)</li> <li>Uplands</li> </ul>	<ul style="list-style-type: none"> <li>Protection through acquisitions/easements</li> <li>Implement sustainable forestry practices</li> <li>Protect, restore, and enhance wetlands</li> <li>Prevent, eradicate, and control invasives</li> </ul>
Cattaraugus Creek/Zoar Valley	NY	ER	<ul style="list-style-type: none"> <li>Riverine Habitats</li> <li>Coastal Shore</li> <li>Uplands</li> </ul>	<ul style="list-style-type: none"> <li>Protection through acquisitions/easements</li> <li>Implement sustainable forestry practices</li> <li>Implement watershed planning/assessment</li> </ul>
Tonawanda Marshes – Iroquois National Wildlife Refuge	NY	ON	<ul style="list-style-type: none"> <li>Wetlands (inland lakes &amp; wetlands)</li> <li>Riverine Habitats</li> <li>Uplands</li> </ul>	<ul style="list-style-type: none"> <li>Protect, restore, and enhance wetlands</li> <li>Prevent, eradicate, and control invasives</li> </ul>
Grand River	OH	ER	<ul style="list-style-type: none"> <li>Riverine Habitats</li> </ul>	<ul style="list-style-type: none"> <li>Protection through acquisitions/easements</li> <li>Restore altered hydrologic regimes (river flows and lake levels)</li> <li>Implement sustainable forestry practices</li> <li>Implement agricultural best mgt. practices</li> <li>Prevent, eradicate, and control invasives</li> <li>Promote responsible recreation</li> </ul>
Upper Cuyahoga River	OH	ER	<ul style="list-style-type: none"> <li>Wetlands (inland lakes &amp; wetlands)</li> <li>Riverine Habitats</li> </ul>	<ul style="list-style-type: none"> <li>Restore altered hydrologic regimes (river flows and lake levels)</li> <li>Coordinate land use planning/mgt.</li> </ul>
Western Lake Erie Tributaries (Sandusky River, Huron River – DuPont Marsh, Old Woman Creek, Lower Vermillion River – Bradley Woods)	OH	ER	<ul style="list-style-type: none"> <li>Wetlands (coastal)</li> <li>Riverine Habitats</li> <li>Coastal Shore</li> </ul>	<ul style="list-style-type: none"> <li>Sediment reduction/management</li> <li>Restore altered hydrologic regimes (river flows and lake levels)</li> <li>Prevent, eradicate, and control invasives</li> </ul>
Western Lake Erie Islands and Reefs	OH	ER	<ul style="list-style-type: none"> <li>Open/Nearshore Waters</li> <li>Wetlands (coastal)</li> <li>Coastal Shore</li> </ul>	<ul style="list-style-type: none"> <li>Coordinate land use planning/mgt.</li> <li>Protection through acquisitions/easements</li> <li>Prevent, eradicate, and control invasives</li> <li>Implement agricultural best mgt. practices</li> <li>Restore altered hydrologic regimes (river flows and lake levels)</li> </ul>
Western Lake Erie Marshes – Cedar Point National Wildlife Refuge	OH	ER	<ul style="list-style-type: none"> <li>Wetlands (coastal)</li> </ul>	<ul style="list-style-type: none"> <li>Protect, restore, and enhance wetlands</li> <li>Prevent, eradicate, and control invasives</li> </ul>

<b>Project Name (Conservation Blueprint site name if different)</b>	<b>State</b>	<b>Basin</b>	<b>System</b>	<b>Recommended Action</b>
Brule River Conservation Area (Brule River State Forest)	WI	SU	<ul style="list-style-type: none"> <li>• Riverine Habitats</li> <li>• Uplands</li> </ul>	<ul style="list-style-type: none"> <li>• Coordinate land use planning/mgt.</li> <li>• Implement sustainable forestry practices</li> <li>• Restore altered hydrologic regimes (river flows and lake levels)</li> </ul>
Chequamegon Bay	WI	SU	<ul style="list-style-type: none"> <li>• Open/Nearshore Waters</li> <li>• Wetlands (coastal)</li> </ul>	<ul style="list-style-type: none"> <li>• Protect, restore, and enhance wetlands</li> <li>• Priority area for protection (National Estuarine Research Reserve designation)</li> <li>• Protect hydrologic regimes (river flows and lake levels)</li> </ul>
Door Peninsula and Green Bay Watershed (Door Peninsula, Cat Island)	WI	MI	<ul style="list-style-type: none"> <li>• Wetlands (coastal)</li> <li>• Riverine Habitats</li> <li>• Coastal Shore</li> <li>• Uplands</li> </ul>	<ul style="list-style-type: none"> <li>• Prevent, eradicate, and control invasives</li> <li>• Protection through acquisitions/easements</li> <li>• Protect, restore, and enhance wetlands</li> <li>• Implement sustainable forestry practices</li> <li>• Implement agricultural best mgt. practices</li> <li>• Restore altered hydrologic regimes (river flows and lake levels)</li> <li>• Prevent or remediate toxics</li> </ul>
Pine, Popple and Peshtigo Rivers	WI	MI	<ul style="list-style-type: none"> <li>• Riverine Habitats</li> </ul>	<ul style="list-style-type: none"> <li>• Implement best practices in road/stream crossing designs</li> <li>• Implement sustainable forestry practices</li> <li>• Protection through acquisitions/easements</li> </ul>