



# Great Lakes RESTORATION

## Great Lakes Restoration Initiative Action Plan II

September 2014



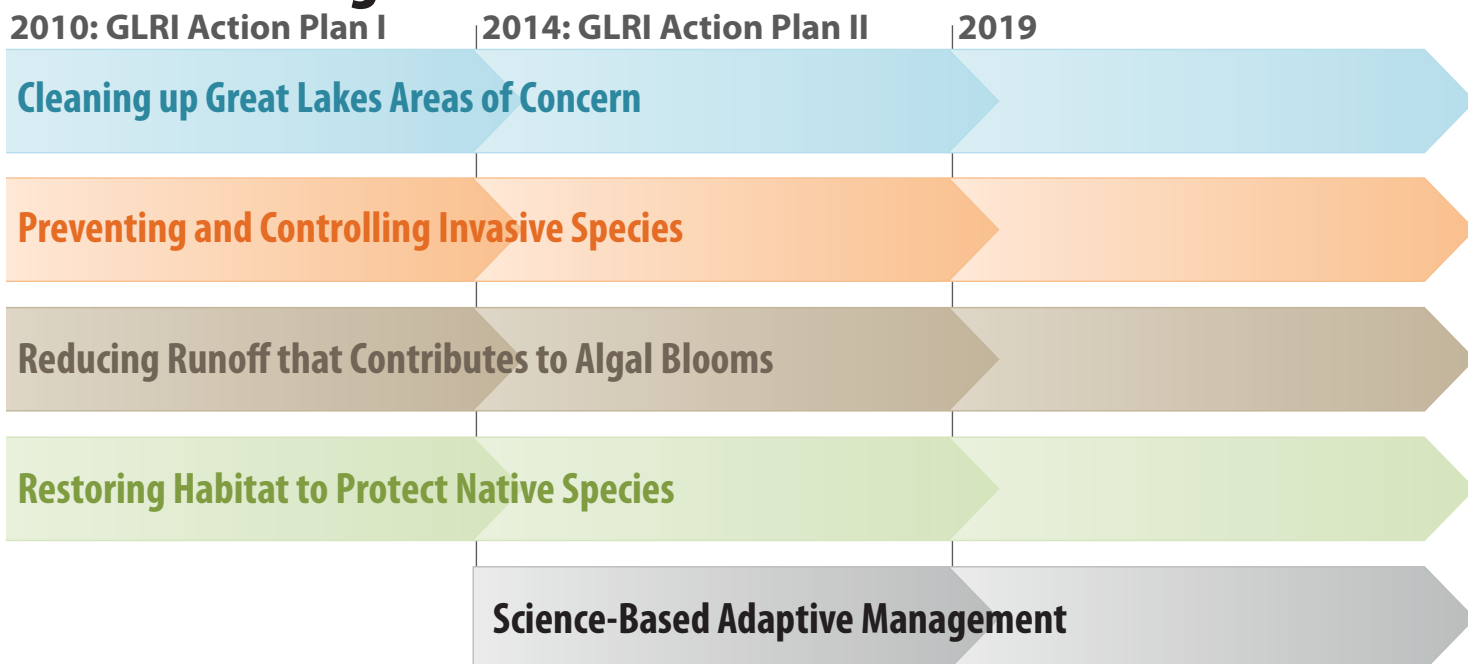


**The Great Lakes Restoration Initiative** was launched in 2010 to accelerate efforts to protect and restore the largest system of fresh surface water in the world — to provide additional resources to make progress toward the most critical long-term goals for this important ecosystem.

The Great Lakes Restoration Initiative has been a catalyst for unprecedented federal agency coordination — through the Interagency Task Force and the Regional Working Group, which are led by EPA. This coordination has produced unprecedented results. Great Lakes Restoration Initiative resources have supplemented agency base budgets to fund the cleanup actions required to delist five Great Lakes Areas of Concern and to formally delist the Presque Isle Bay Area of Concern — a major change from the 25 years before the Initiative, during which only one Area of Concern was cleaned up and delisted. Great Lakes Restoration Initiative resources have also been used to double the acreage enrolled in agricultural conservation programs in watersheds where phosphorus runoff contributes to harmful algal blooms in western Lake Erie, Saginaw Bay and Green Bay. So far, Great Lakes Restoration Initiative resources have been used to fund over 2,000 projects to improve water quality, to protect and restore native habitat and species, to prevent and control invasive species and to address other Great Lakes environmental problems.

During the next five years, federal agencies plan to continue to use Great Lakes Restoration Initiative resources to strategically target the biggest threats to the Great Lakes ecosystem and to accelerate progress toward long term goals — by combining Great Lakes Restoration Initiative resources with agency base budgets and by using these resources to work with nonfederal partners to implement protection and restoration projects. To guide this work, federal agencies have drafted GLRI Action Plan II, which summarizes the actions that federal agencies plan to implement during FY15-19 using Great Lakes Restoration Initiative funding. GLRI Action Plan II outlines the next phase of work on Great Lakes environmental problems and associated human health issues — many of which will take decades to resolve. GLRI Action Plan II lays out the necessary next steps to get us closer to the day when we will be able to achieve our long-term goals for the Great Lakes and our commitments under the U.S.-Canada Great Lakes Water Quality Agreement.

## The Great Lakes Restoration Initiative is Accelerating Great Lakes Protection and Restoration



# GLRI Action Plan II

**GLRI Action Plan II** summarizes the actions that federal agencies plan to implement during FY15-19 using Great Lakes Restoration Initiative funding — actions to protect and restore the largest fresh surface water system in the world. These actions will build on restoration and protection work carried out under the first GLRI Action Plan, with a major focus on:

- Cleaning up Great Lakes Areas of Concern
- Preventing and controlling invasive species
- Reducing nutrient runoff that contributes to harmful/nuisance algal blooms
- Restoring habitat to protect native species

**GLRI Action Plan II** incorporates a science-based adaptive management framework that will be used to prioritize ecosystem problems to be targeted with GLRI resources, to select projects to address those problems and to assess the effectiveness of GLRI projects (see pages 28-29). Measures of Progress have been developed to track all actions implemented under GLRI Action Plan II. These Measures of Progress focus on outputs and/or outcomes that can be measured over the five year period covered by this Action Plan, rather than the longer term ecological benefits that will be produced by GLRI-funded projects and will take years to document in an ecosystem as large and complex as the Great Lakes. There are ten Measures of Progress with annual targets and other Measures of Progress that will be reported annually to track progress toward long term goals (see below) that will take more than five years to reach.

**GLRI Action Plan II** commits agencies to develop and incorporate climate resiliency criteria in project selection processes. Agencies will develop standard criteria to ensure climate resiliency of GLRI-funded projects (see pages 24-25).

**GLRI Action Plan II** includes many ideas developed during the first five years of the Great Lakes Restoration Initiative that were contributed by the Great Lakes Advisory Board, the U.S. EPA Science Advisory Board, the U.S. Government Accountability Office, the Congressional Research Service, states, tribes, municipalities and the general public. All of the federal agencies involved in the Great Lakes Restoration Initiative are grateful for these recommendations and will be actively seeking additional input as part of the science-based adaptive management cycle — as we implement and improve the Great Lakes Restoration Initiative and as we work with our many partners to protect and restore the Great Lakes.

## Long Term Goals for the Great Lakes Ecosystem



Fish safe to eat

Water safe for recreation

Safe source of drinking water

All Areas of Concern delisted

Harmful/nuisance algal blooms eliminated

No new self-sustaining invasive species

Existing invasive species controlled

Native habitat protected and restored to sustain native species

# FY15-19 Great Lakes Restoration Initiative Action Plan Summary\*

Focus Areas	Objectives	Commitments
Toxic Substances and Areas of Concern	Remediate, restore and delist Areas of Concern	<ul style="list-style-type: none"> <li>• Implement management actions necessary to remove Beneficial Use Impairments and delist Areas of Concern</li> </ul>
	Increase knowledge about contaminants in Great Lakes fish and wildlife	<ul style="list-style-type: none"> <li>• Reduce human exposure to contaminants from Great Lakes fish consumption</li> <li>• Identify emerging contaminants and assess impacts on Great Lakes fish and wildlife</li> </ul>
Invasive Species	Prevent new introductions of invasive species	<ul style="list-style-type: none"> <li>• Block pathways through which aquatic invasive species can be introduced to the Great Lakes ecosystem</li> <li>• Conduct early detection monitoring activities</li> <li>• Work with Great Lakes states to conduct rapid response actions or exercises</li> </ul>
	Control established invasive species	<ul style="list-style-type: none"> <li>• Implement control projects for GLRI-targeted invasive species</li> </ul>
	Develop invasive species control technologies and refine management techniques	<ul style="list-style-type: none"> <li>• Develop/enhance technologies and methods to prevent the introduction and to control the spread of invasive species</li> <li>• Develop/enhance invasive species specific collaboratives to support rapid responses and communicate the latest control and management techniques</li> </ul>
Nonpoint Source Pollution Impacts on Nearshore Health	Reduce nutrient loads from agricultural watersheds	<ul style="list-style-type: none"> <li>• Implement agricultural practices or other nutrient reduction practices in GLRI targeted watersheds.</li> </ul>
	Reduce untreated runoff from urban watersheds	<ul style="list-style-type: none"> <li>• Implement watershed management projects in urban areas that have adopted a watershed strategy</li> </ul>
Habitats and Species	Protect, restore and enhance habitats to help sustain healthy populations of native species	<ul style="list-style-type: none"> <li>• Remove or bypass barriers on Great Lakes tributaries to facilitate fish passage</li> <li>• Protect, restore and enhance Great Lakes coastal wetlands</li> <li>• Protect, restore and enhance GLRI-targeted habitats in the Great Lakes basin</li> </ul>
	Maintain, restore and enhance populations of native species	<ul style="list-style-type: none"> <li>• Promote the recovery of priority federally-listed endangered, threatened and candidate species</li> <li>• Promote self-sustaining populations of GLRI-targeted native non-threatened and non-endangered species</li> </ul>
Foundations for Future Restoration Actions	Ensure climate resiliency of GLRI-funded projects	<ul style="list-style-type: none"> <li>• Develop and incorporate climate resiliency criteria in project selection processes</li> </ul>
	Educate the next generation about the Great Lakes ecosystem	<ul style="list-style-type: none"> <li>• Promote Great Lakes-based ecosystem education and stewardship, with a focus on educator training</li> </ul>
	Implement a science-based adaptive management approach for GLRI	<ul style="list-style-type: none"> <li>• Evaluate the effectiveness of GLRI-funded projects</li> <li>• Assess the overall health of the Great Lakes ecosystem and identify the most significant remaining problems</li> <li>• Identify watersheds, habitats, and species to be targeted by the GLRI</li> <li>• Report on GLRI progress and Great Lakes ecosystem health</li> </ul>

\*Objectives and targets in this plan may be adjusted annually based on appropriations and performance.

## Measures of Progress\*\*

- Areas of Concern where all management actions necessary for delisting have been implemented
- Area of Concern Beneficial Use Impairments Removed

- Number of people provided information on the risks and benefits of Great Lakes fish consumption by GLRI-funded projects
- Number of GLRI-funded projects that identify and/or assess impacts of emerging contaminants on Great Lakes fish and wildlife

- Number of GLRI-funded projects that block pathways through which aquatic invasive species can be introduced to the Great Lakes ecosystem
- Number of GLRI-funded early detection monitoring activities conducted
- Number of GLRI-funded Great Lakes rapid responses or exercises conducted

- Number of acres controlled by GLRI-funded projects
- Number of tributary miles protected by GLRI-funded projects

- Number of technologies and methods field tested by GLRI-funded projects
- Number of collaboratives developed/enhanced with GLRI funding

- Number of GLRI-funded nutrient and sediment reduction projects in targeted watersheds (measured in acres)
- Projected phosphorus reductions from GLRI-funded projects in targeted watersheds (measured in pounds)
- Measured nutrient and sediment reductions from monitored GLRI-funded projects in targeted watersheds (measured in pounds)

- Number of GLRI-funded projects implemented to reduce the impacts of untreated urban runoff on the Great Lakes
- Projected volume of untreated urban runoff captured or treated by GLRI-funded projects
- Measured volume of untreated urban runoff captured or treated by monitored GLRI-funded projects

- Number of miles of Great Lakes tributaries reopened by GLRI-funded projects
- Number of miles of Great Lakes shoreline and riparian corridors protected, restored and enhanced by GLRI-funded projects
- Number of acres of Great Lakes coastal wetlands protected, restored and enhanced by GLRI-funded projects
- Number of acres of other habitats in the Great Lakes basin protected, restored and enhanced by GLRI-funded projects

- Number of GLRI-funded projects that promote recovery of federally-listed endangered, threatened, and candidate species
- Number of GLRI-funded projects that promote populations of native non-threatened and non-endangered species self-sustaining in the wild

- By 2016, a standardized set of climate resiliency criteria will be developed for GLRI-projects
- Starting in 2017, projects will include climate resiliency criteria in planning and implementation

- Number of educators trained through GLRI-funded projects
- Number of people educated on the Great Lakes ecosystem through GLRI-funded place-based experiential learning activities

- Project evaluations completed and used to prioritize GLRI funding decisions each year
- Annual Great Lakes monitoring conducted and used to prioritize GLRI funding decisions each year
- GLRI-targeted watersheds, habitats and species identified and used to prioritize GLRI funding decisions
- Issue annual GLRI Reports to Congress and the President
- Issue Great Lakes Water Quality Agreement Triennial Progress Reports of the Parties
- Issue triennial State of the Lakes reports
- Periodically update publicly available online information about the GLRI

**\*\*Most GLRI Action Plan II Measures of Progress track outputs and/or outcomes produced solely by GLRI-funded projects. AOC-related measures track results produced using GLRI funding and, in some cases, using other sources of funding, as well. Many GLRI-funded projects supplement other Great Lakes restoration activities that are funded by agency base budgets and are reported independently by agencies. Action Plan II Measures of Progress include: several Action Plan I Measures of Progress; several Action Plan I Measures of Progress that have been modified to accurately track actions funded by GLRI; and a number of new Measures of Progress.**

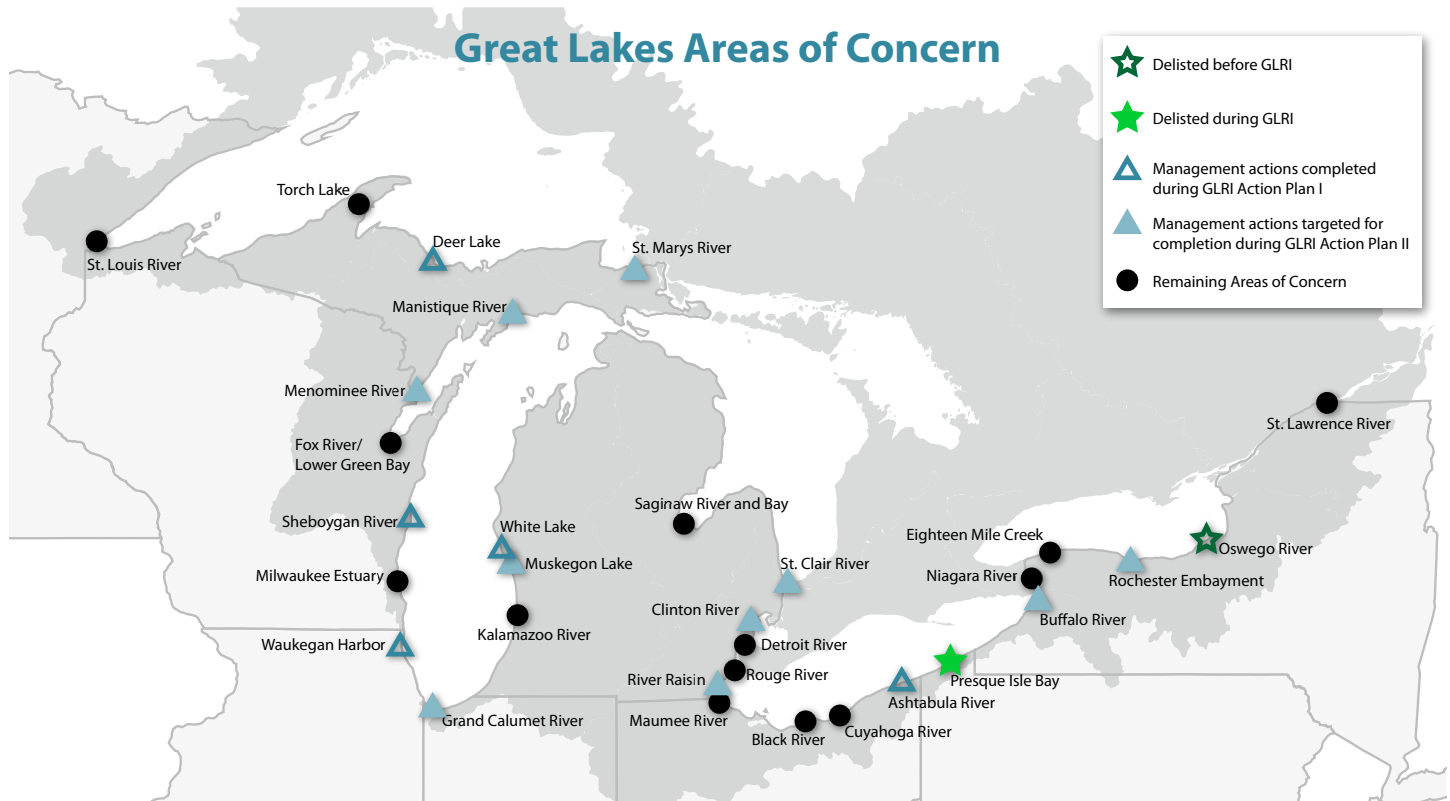
# Toxic Substances and Areas of Concern

## Objective

Remediate, restore and delist  
Areas of Concern

## Commitment

• Implement management actions necessary to remove Beneficial  
Use Impairments and delist Areas of Concern



**During the first five years of the Great Lakes Restoration Initiative**, federal agencies and their partners completed all of the management actions required to remove five Areas of Concern from the list of areas designated as the most contaminated sites on the Great Lakes by the 1987 Great Lakes Water Quality Agreement:

- Ashtabula River
- Sheboygan River
- White Lake
- Deer Lake
- Waukegan Harbor

The Presque Isle Bay Area of Concern was also delisted in 2013 — only the second delisting on the U.S. side of the border since Areas of Concern were designated pursuant to the 1987 Great Lakes Water Quality Agreement.

**Under GLRI Action Plan II**, federal agencies and their partners will continue to remediate and restore Areas of Concern. Federal agencies will implement critical management actions in all of the remaining AOCs and will complete all management actions required to delist the following ten:

- Buffalo River
- Menominee River
- St. Clair River
- Clinton River
- Muskegon Lake
- St. Marys River
- Grand Calumet River
- River Raisin
- Manistique River
- Rochester Embayment

Remediation and restoration in these Areas of Concern will include dredging contaminated sediment and restoring habitat (e.g., improving fish passage, restoring wetlands and removing dams).

## Great Lakes Restoration Initiative Action Plan II

### Measures of Progress with Annual Targets\*

- Areas of Concern where all management actions necessary for delisting have been implemented (cumulative)
- Area of Concern Beneficial Use Impairments Removed (cumulative)

Baseline/ Universe	2015 Target	2016 Target	2017 Target	2018 Target	2019 Target
Baseline: 7 Universe: 31	8	9	11	12	17
Baseline: 52 Universe: 255	60	65	72	78	85

\* AOC-related measures track results produced using GLRI funding and, in some cases, using other sources of funding, as well

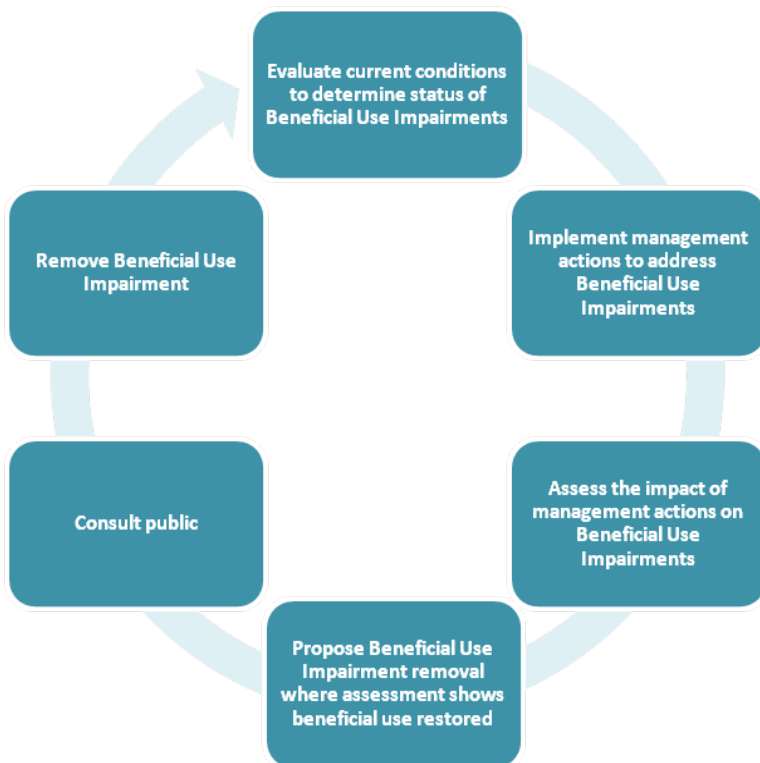
**During the first five years of the Great Lakes Restoration Initiative**, federal agencies and their partners removed 42 Beneficial Use Impairments in 17 Areas of Concern — quadrupling the number of Beneficial Use Impairments removed in the preceding 22 years.

**Under GLRI Action Plan II**, federal agencies and their partners\* will continue to remove 34 additional Beneficial Use Impairments in the remaining 29 Areas of Concern. These Beneficial Use Impairments include beach closings, restrictions on drinking water consumption, nuisance algal blooms, restrictions on dredging, fish and wildlife deformities, restrictions on fish and wildlife consumption, loss of fish and wildlife habitat.

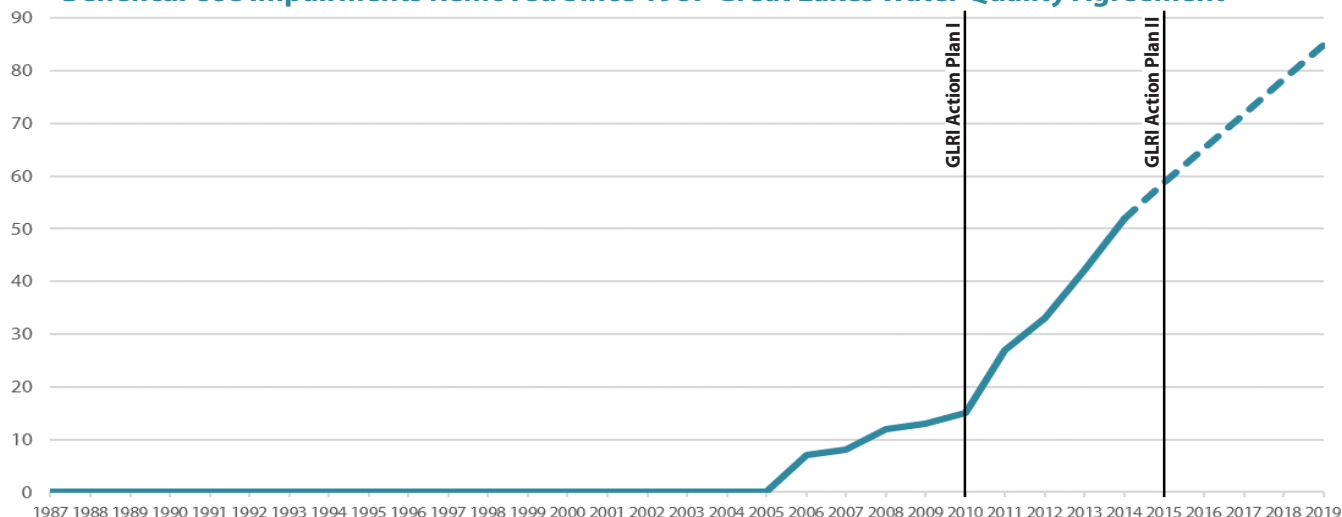
**The process for removing Beneficial Use Impairments and delisting Areas of Concern** starts with a scientific assessment to determine the extent to which beneficial uses are impaired and the types of management actions required to remediate the Area of Concern. After management actions are implemented, a scientific assessment is conducted to determine whether beneficial uses have been restored. An Area of Concern is eligible to be delisted when all Beneficial Use Impairments have been removed.

\*Including local Area of Concern advisory groups.

### Removing Beneficial Use Impairments in Areas of Concern



### Beneficial Use Impairments Removed Since 1987 Great Lakes Water Quality Agreement





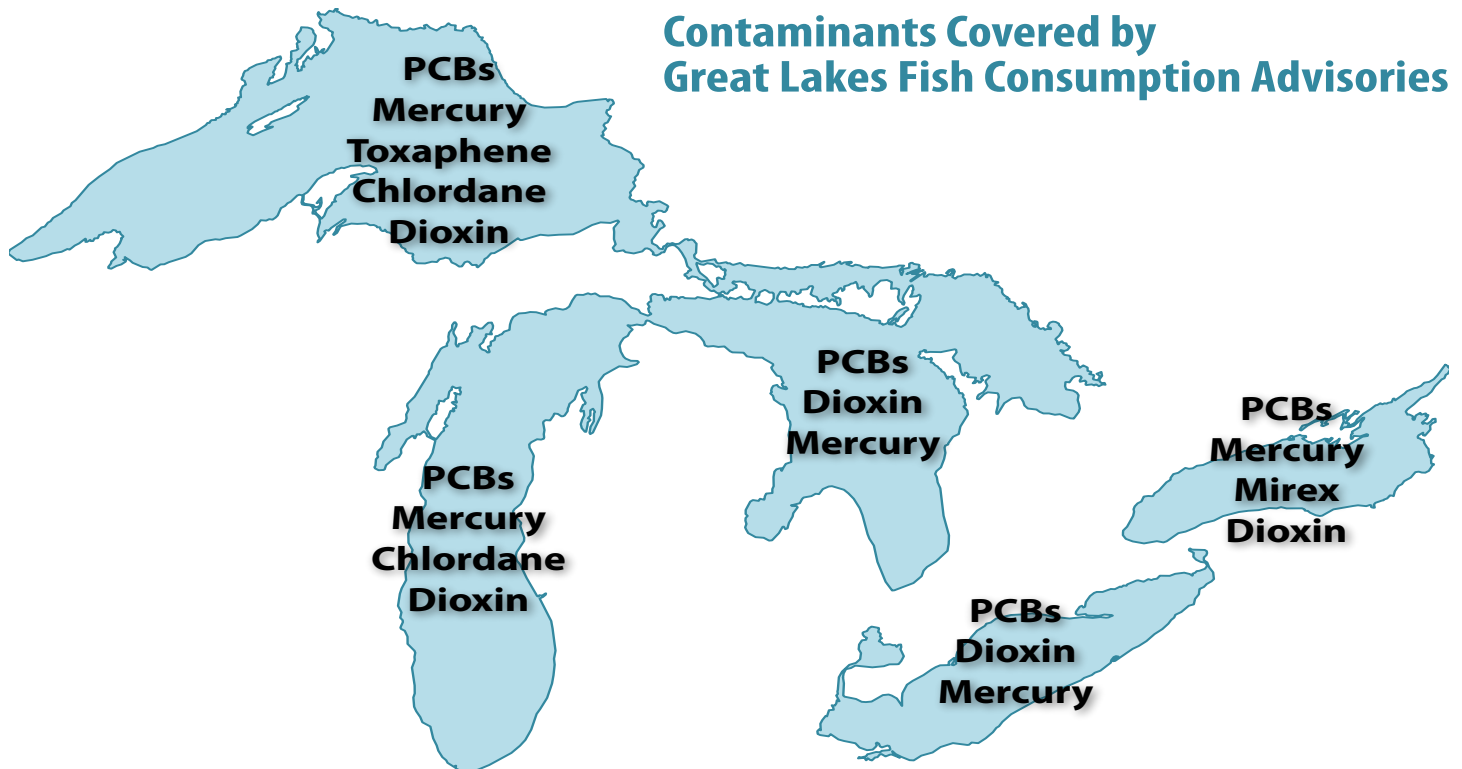
# Toxic Substances and Areas of Concern

## Objective

Increase knowledge about contaminants in Great Lakes fish and wildlife

## Commitment

- Reduce human exposure to contaminants from Great Lakes fish consumption
- Identify emerging contaminants and assess impacts on Great Lakes fish and wildlife



**During the first five years of the Great Lakes Restoration Initiative**, federal agencies and their partners implemented projects to protect human health from contaminants in Great Lakes fish while clean up efforts continued. Federal agencies and their partners updated fish consumption advisories and provided improved public information on the health risks and benefits of Great Lakes fish consumption.

Federal agencies and their partners focused outreach on those populations with the highest risk of contaminant exposure, including:

- Women who may become pregnant
- Children
- Urban anglers
- Tribal communities, and
- People who rely heavily on Great Lakes fish in their diets.

Federally funded research documented elevated blood mercury levels in some newborns in the western Lake Superior basin. Additional GLRI funding was provided to train healthcare professionals to advise patients about safe fish consumption choices (e.g., testing the effectiveness of fish consumption advisories; working with health care providers to “screen” patients for fish consumption practices and blood contaminant levels).

**Under the GLRI Action Plan II**, federal agencies and their partners will continue to provide improved information on the health risks and benefits of Great Lakes fish consumption. Targeted outreach to high-risk fish consuming populations will be used to promote healthy fish consumption choices that minimize the risk of contaminant exposure. Outreach activities will incorporate culture, ethnicity, gender, age, and other factors to maximize the effectiveness of fish consumption advisories.



### Measures of Progress

- Number of people provided information on the risks and benefits of Great Lakes fish consumption by GLRI-funded projects
- Number of GLRI-funded projects that identify and/or assess impacts of emerging contaminants on Great Lakes fish and wildlife

**During the first five years of the Great Lakes Restoration Initiative,** federal agencies and their partners characterized and assessed risks that emerging contaminants may pose to Great Lakes fish and wildlife. Agencies and their partners were able to gain a better understanding of the presence and distribution of emerging contaminants, potential routes of exposure and potential impacts on fish and wildlife.

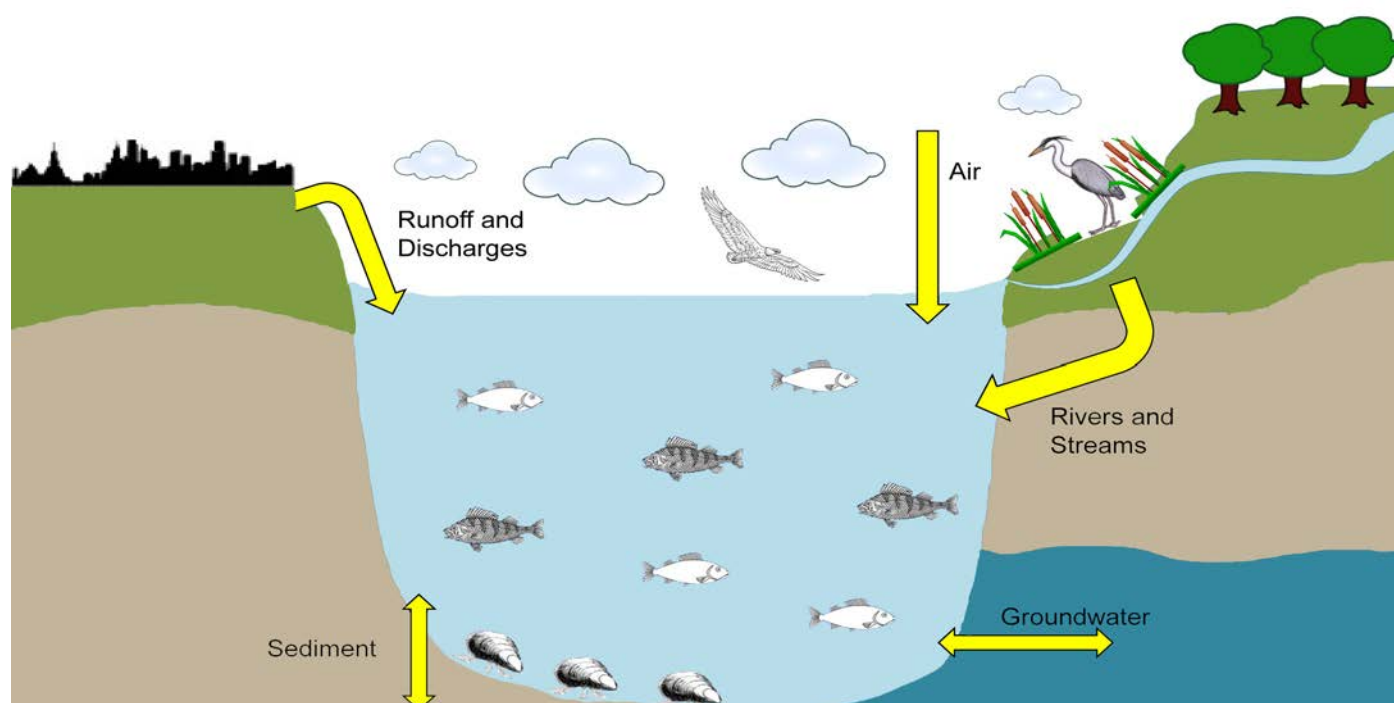
**Under GLRI Action Plan II,** federal agencies and their partners will continue to further evaluate emerging contaminants that have the greatest potential to adversely impact Great Lakes fish and wildlife – impacts which may also result in ecological, economic and recreational consequences. Federal agencies will assess the extent to which identified risks may impede environmental quality and resource management goals. Agencies and their partners will conduct laboratory and/or field studies to evaluate biological effects from chemical mixtures, evaluate long term exposure of fish to contaminants, conduct additional field sampling where effects are being observed and sample other high priority wildlife such as migratory birds, mussels and amphibians. These projects will be evaluated on an annual basis and the results will be used to prioritize the design and implementation of future laboratory and field studies.

### Potential Impacts of Emerging Contaminants on Great Lakes Fish and Wildlife

- Increased feminization (vitellogenin) in male fish and decrease in overall size and ability to compete for mates
- Irregular courtship and nest guarding behavior
- Decrease in reaction time and predator escape response
- Decreased population genetic diversity
- Declines in prey species populations as well as sportfish populations



### Contaminant Pathways



# Invasive Species

## Objective

Prevent new introductions of invasive species

## Commitment

- Work with Great Lakes states to conduct rapid response actions or exercises
- Block pathways through which aquatic invasive species can be introduced to the Great Lakes ecosystem
- Conduct early detection monitoring activities

**During the first five years of the Great Lakes Restoration Initiative**, federal agencies and their partners engaged in an unprecedented level of activity to prevent new introductions of invasive species in the Great Lakes ecosystem. Agencies and their partners prevented bighead and silver carp from becoming established in the Great Lakes ecosystem. Surveillance programs formed the foundation for a multi-species early detection network. Partner agencies responded to several detections, including red swamp crayfish in Wisconsin, grass carp in Michigan, Hydrilla in New York and eDNA for silver and bighead carp in the Chicago Area Waterway System. Federal agencies and their state partners have reduced the risk of invasive species in ballast water discharges. No new introductions have occurred through the ballast water pathway since 2006. Federal agencies and their partners have conducted species risk assessments for organisms posing risks to the Great Lakes ecosystem. Public education efforts have helped boaters, anglers and other resource users prevent the spread of invasive species.

## How Can Invasive Species Get into the Great Lakes?

- Canals and waterways
- Recreational boating
- Commercial shipping
- Illegal trade of banned species
- Release of aquarium species
- Release of live bait
- Spread of plant species purchased through nurseries, internet sales and water garden trade

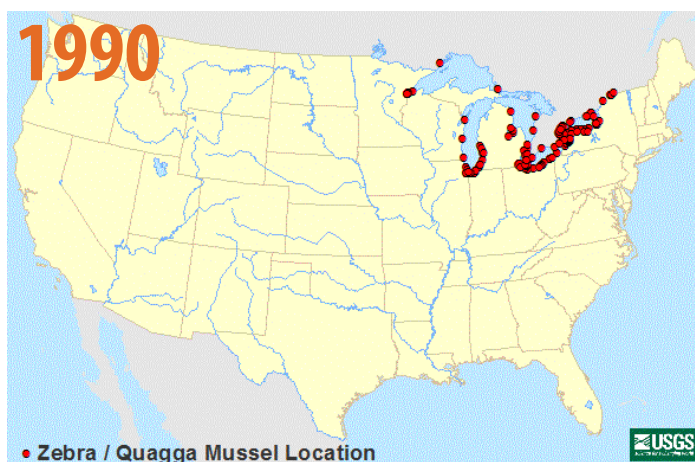
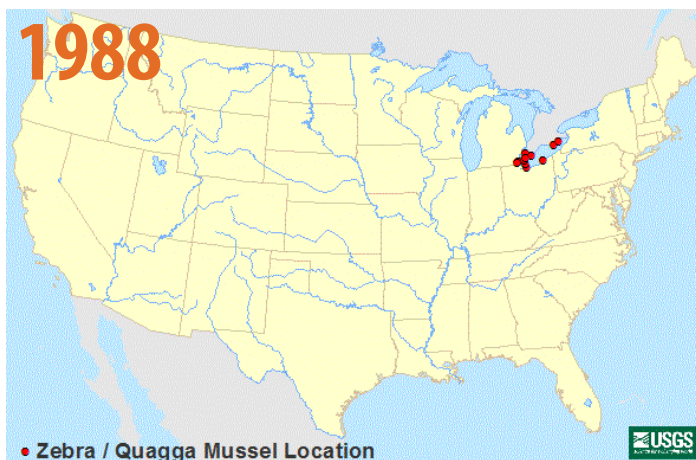


## Protecting the Great Lakes from Asian Carp

The Great Lakes Restoration Initiative provides support to the Asian Carp Regional Coordinating Committee, which has implemented the Asian Carp Control Strategy Framework—including surveillance, response actions and testing of new control technologies. More information about the ACRCC is available at <http://www.asiancarp.us>.

## Preventing the Introduction of Invasive Species into the Great Lakes Protects the Entire Nation

*The rapid spread of invasive zebra and quagga mussels in the United States illustrates that invasive species can spread very quickly. Consequently, preventing the introduction of invasive species is critically important.*



### Measure of Progress with Annual Targets

• Number of GLRI-funded Great Lakes rapid responses or exercises conducted\*

Baseline/  
Universe

Baseline: 0  
Universe: N/A

2015  
Target

8

2016  
Target

8

2017  
Target

8

2018  
Target

8

2019  
Target

8

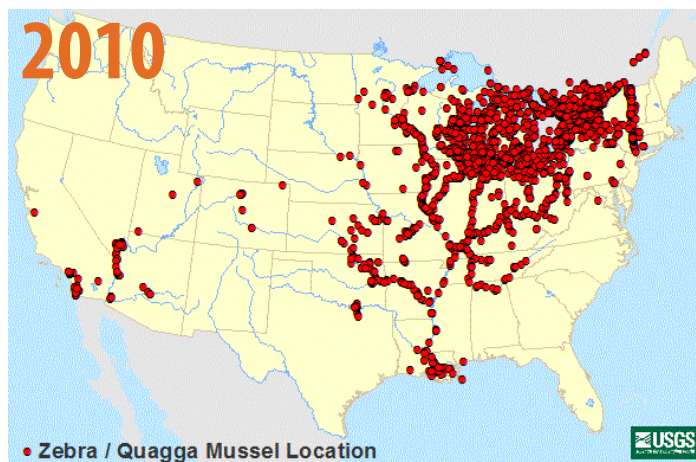
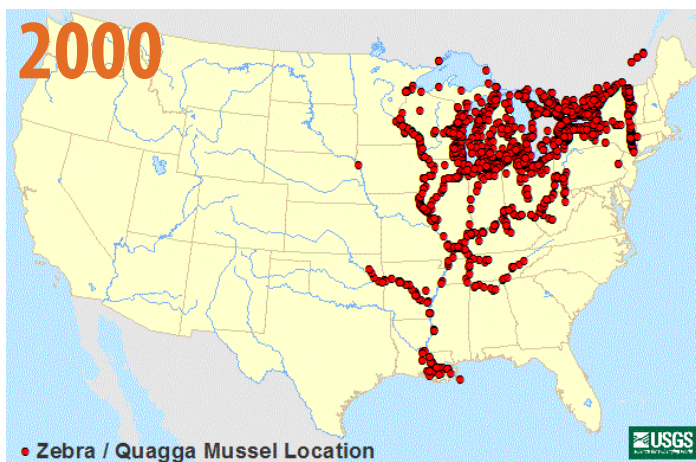
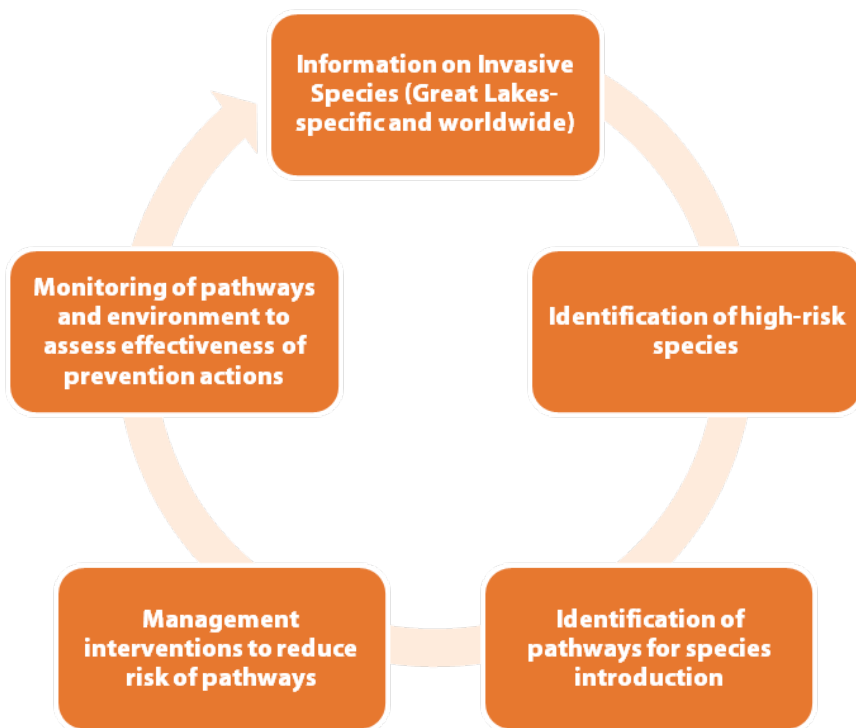
### Additional Measures of Progress

- Number of GLRI-funded projects that block pathways through which aquatic invasive species can be introduced to the Great Lakes ecosystem
- Number of GLRI-funded early detection monitoring activities conducted

*\*This Measure of Progress is a modification of an Action Plan I Measure of Progress that has been modified to more accurately track actions funded by GLRI. The baseline is zero because the new Action Plan II Measure of Progress is not the same metric as the Action Plan I Measure of Progress.*

**Under GLRI Action Plan II**, federal agencies and their partners will continue to prevent new invasive species from establishing self-sustaining populations in the Great Lakes ecosystem. Federal agencies and their partners will work to increase the effectiveness of existing surveillance programs by establishing a coordinated, multi-species early detection network. Federal agencies will support state and tribal efforts to develop and implement Aquatic Nuisance Species Management Plans which will be used for annual “readiness exercises” and actual responses to new detections of invasive species. Competitive grant programs will continue to be used to fund new initiatives to block pathways through which invasive species can be introduced to the Great Lakes ecosystem. Risk assessments will continue to be refined to inform the targeting of species, pathways and sites for early detection monitoring. Because the Great Lakes can be a freshwater invasion pathway to the 31 states within the Mississippi River watershed and beyond, these prevention efforts will also benefit the entire Nation.

## Assessing the Risk of Invasive Species





# Invasive Species

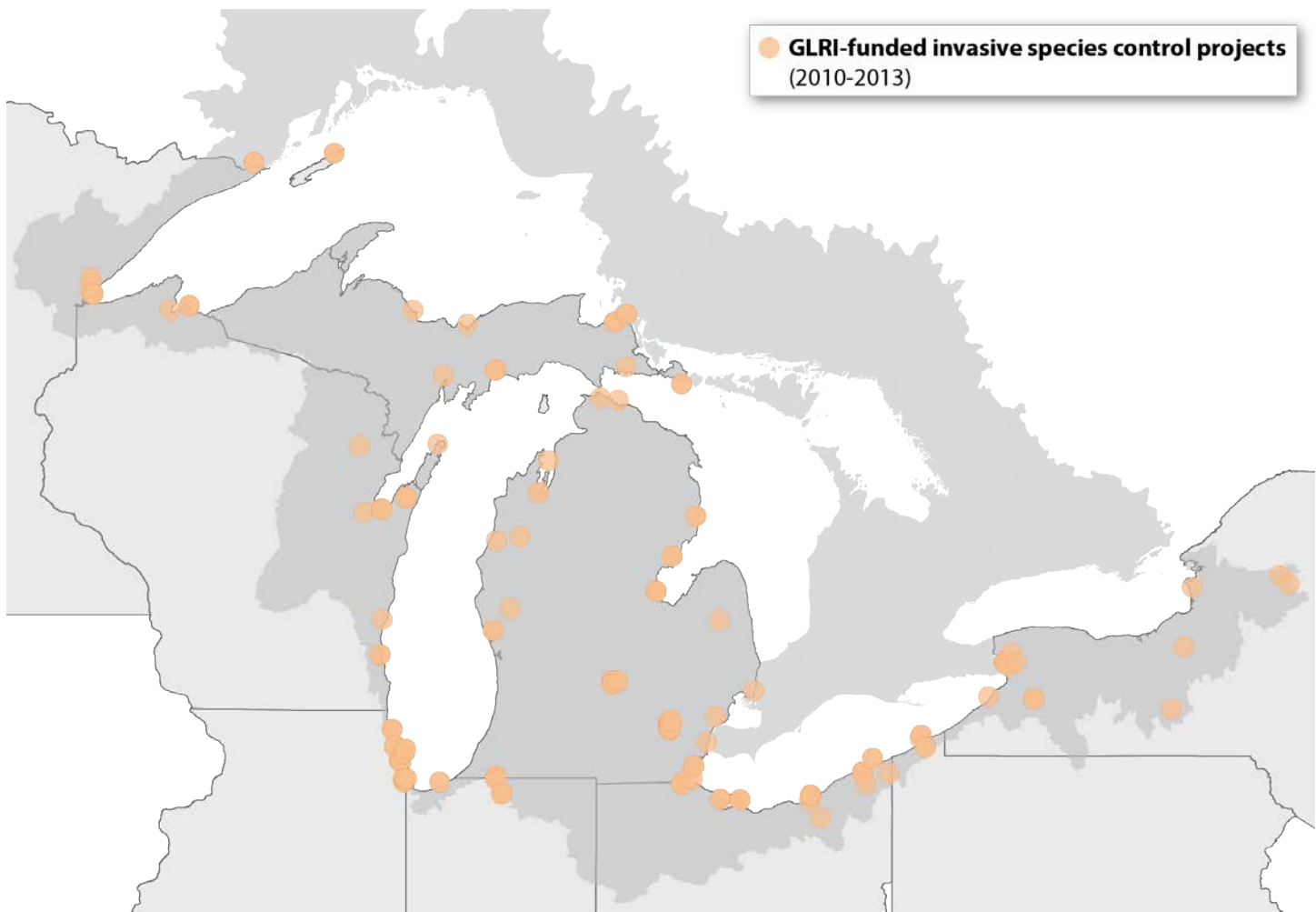
## Objective

Control established invasive species

## Commitment

• Implement control projects for GLRI-targeted invasive species

## Controlling Invasive Species in the Great Lakes Basin



**During the first five years of the Great Lakes Restoration Initiative**, federal agencies and their partners controlled invasive species including:

- baby's breath
- bighead carp
- buckthorn
- emerald ash borer
- Eurasian watermilfoil
- garlic mustard
- grass carp
- Japanese barberry
- Japanese knotweed
- lyme grass
- invasive strains of Phragmites
- purple loosestrife
- silver carp
- sea lamprey
- wild parsnip

These control projects were done with partners who will continue maintenance and stewardship beyond the duration of the federally funded projects. Most projects will require additional, low-level maintenance as sites progress toward full recovery.

**Measure of Progress with Annual Targets**

- Number of aquatic/terrestrial acres controlled by GLRI-funded projects

Baseline/  
UniverseBaseline: 36,000  
Universe: N/A2015  
Target

50,000

2016  
Target

60,000

2017  
Target

70,000

2018  
Target

80,000

2019  
Target

90,000

**Additional Measure of Progress**

- Number of tributary miles protected by GLRI-funded projects

**Under GLRI Action Plan II**, federal agencies and their partners will continue to restore sites degraded by aquatic, wetland and terrestrial invasive species. Federal agencies will implement control projects in national forests, parks and wildlife refuges where they have direct implementation responsibility. These federal land management agencies will also partner with states and neighboring communities to promote larger scale protection and restoration through the Midwest Invasive Plant Network and the Cooperative Weed Management Area control programs. The Great Lakes Sea Lamprey Control Program will expand the strategic use of tributary barriers and traps as an alternative to chemical control methods. The location of these barriers will be determined by considering both the benefits of additional sea lamprey control and habitat connectivity concerns. Invasive species control projects will be evaluated on an annual basis and the results of these evaluations will be used to prioritize the design, location and implementation of future invasive species control projects.

**Supporting Sustainable Invasive Species Control through Community Projects**

The GLRI is actively building the capability of Great Lakes communities to manage invasive species through funding on-the-ground and in-the-water control projects by supporting step 3 of this process.

**Step 1**

- Identify project site

**Step 2**

- Develop plans for short-term control and long-term stewardship

**Step 3**

- Provide funding for initial control activities and the assessment of project effectiveness. Project implementation also provides opportunities for communities to:
  - create volunteer stewardship program
  - provide job skills training
  - provide employment opportunities, including the use of "civilian conservation corps" type initiatives

**Step 4**

- Maintain significantly improved site through community stewardship

# Invasive Species

## Objective

Develop invasive species control technologies and refine management techniques

## Commitment

- Develop/enhance technologies and methods to prevent the introduction and to control the spread of invasive species
- Develop/enhance invasive species specific collaboratives to support rapid responses and communicate the latest control and management techniques

## The Importance of Developing Invasive Species Control Technologies

A number of effective control technologies have been developed to control invasive species in the Great Lakes. One of the longest-running and most effective invasive control technology programs is the sea lamprey control program. Its success is largely due to a multi-year effort to test almost 6,000 chemical compounds to identify the compound that most effectively controls sea lampreys without harming other species. The Great Lakes Restoration Initiative is working to further refine sea lamprey control techniques and is working to develop targeted control methods for other invasive species impacting the Great Lakes ecosystem.



## Developing Invasive Species Control Technology for the Great Lakes Ecosystem

### Focus of GLRI Support

GLRI provides support for invasive species control technologies with proven potential that require additional testing.

Phase 1

- Develop conceptual designs

Phase 2

- Complete proof-of-concept studies

Phase 3

- Perform lab testing and small scale field testing

Phase 4

- Demonstrate control technology on a large-scale in the Great Lakes Ecosystem

Phase 5

- Deploy technology



### Measures of Progress

- Number of technologies and methods field tested by GLRI-funded projects
- Number of collaboratives developed/enhanced with GLRI funding

During the first five years of the Great Lakes Restoration Initiative, federal agencies and their partners worked to develop and enhance several invasive species control technologies. Researchers worked to develop Asian carp control techniques that target Asian carp without harming other fish species and worked to develop techniques to detect, attract and remove Asian carp to improve the effectiveness of control methods. For example, seismic pressure (aka, “waterguns”) and carbon dioxide have been demonstrated to act as barriers that prevent the movement of Asian carp and may also be used to herd invasive fish to increase the effectiveness of other control technologies. Sea lamprey pheromones were synthesized and field-tested to assess whether pheromones can be used to improve trapping efficiency. New procedures were developed and refined for testing the efficacy of ballast water treatment systems in the Great Lakes and several promising ballast water management systems were performance tested. Researchers also investigated the use of a common soil bacterium to limit the spread of zebra mussels in a manner that has minimal impacts on native mussels and other organisms. Researchers also tested “gene silencing” technology to control the spread of invasive Phragmites.

### A Model for Great Lakes Invasive Species Specific Collaboration



Under GLRI Action Plan II, federal agencies and their partners will continue to develop and enhance technologies to control Great Lakes invasive species. Federal agencies will also develop and enhance invasive species “collaboratives” to support rapid responses and to communicate the latest control and management techniques. The Great Lakes Phragmites Collaborative is a model for this work (<http://greatlakesphragmites.net/>). This collaborative facilitates communication across the region and serves as a resource center for information on Phragmites biology, management and academic research. Species-specific collaborations will be established or enhanced for Phragmites, monocious Hydrilla and grass carp, as well as other invasive species.

# Nonpoint Source Pollution Impacts on Nearshore Health

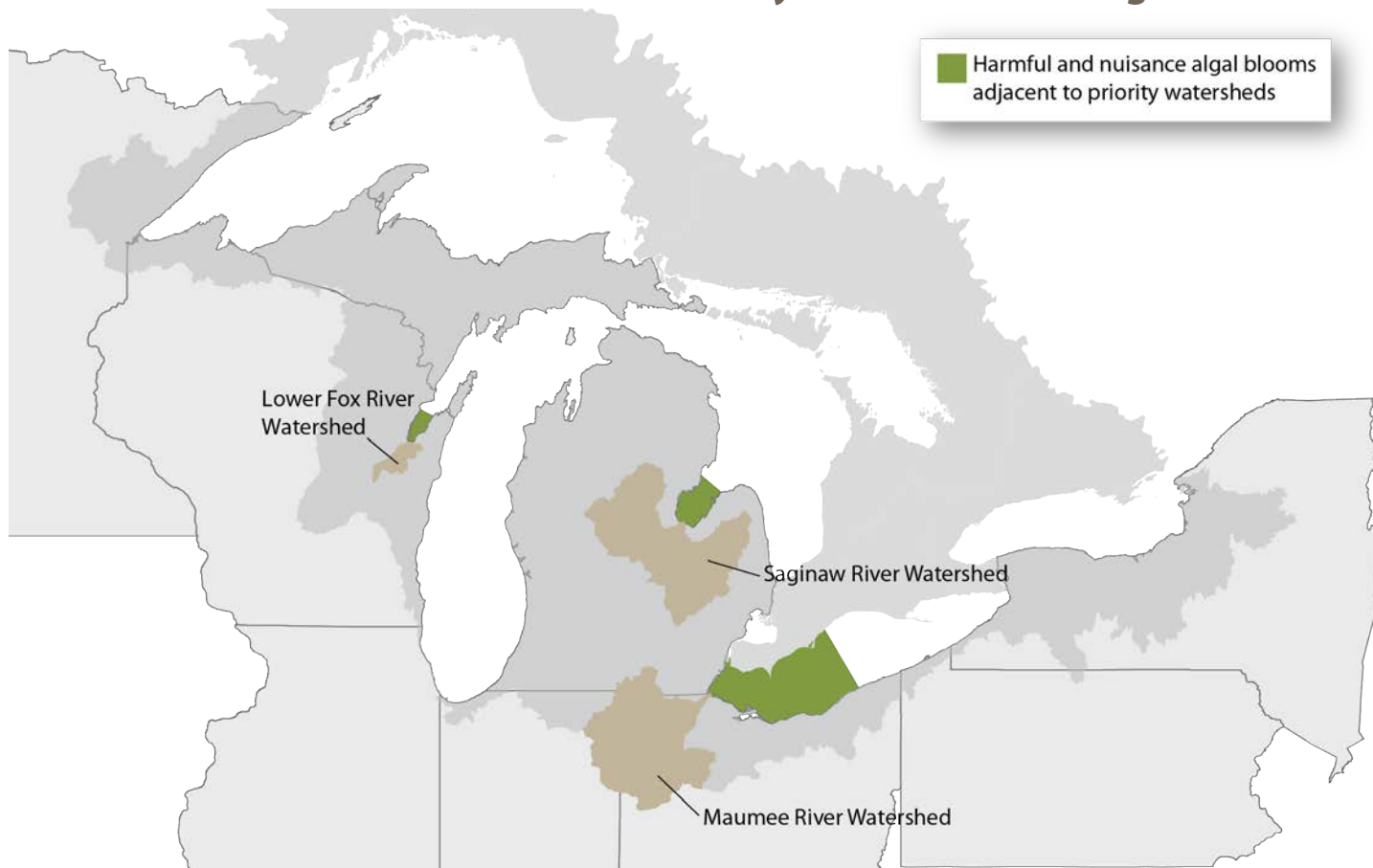
## Objective

Reduce nutrient loads from agricultural watersheds

## Commitment

- Implement agricultural practices or other nutrient reduction practices in GLRI targeted watersheds.

## Great Lakes Restoration Initiative Priority Watersheds During 2010-2014



**During the first five years of the Great Lakes Restoration Initiative**, federal agencies and their partners targeted activities to reduce the largest nonpoint source of phosphorus inputs to Great Lakes nearshore areas: nutrient runoff from agricultural lands. Excess phosphorus loadings threaten the Great Lakes ecosystem by contributing to harmful algal blooms that can cause human health effects, drinking water impairments, beach closures, exacerbate dead zones and result in loss of recreational opportunities. Under GLRI Action Plan I, federal agencies and their partners provided farmers with financial and technical resources to implement conservation systems to reduce nutrient runoff and to control soil erosion. Federal agencies used GLRI support to more than double the number of acres of farmland enrolled in agricultural conservation programs in GLRI priority watersheds. These programs help producers reduce phosphorus in runoff that impacts the Great Lakes nearshore waters, contributing to nuisance and harmful algal blooms and hypoxia. GLRI partners conducted edge-of-field monitoring to evaluate the impact of various agricultural conservation measures on water quality. Water quality baseline data was collected downstream of fields to be used in later studies to gauge long-term changes in water quality associated with nutrient reduction activities.

### Measure of Progress with Annual Targets

• Projected phosphorus reductions from GLRI-funded projects in targeted watersheds (measured in pounds)

Baseline/  
Universe  
  
Baseline: 0  
Universe: N/A

2015  
Target  
130,000

2016  
Target  
310,000

2017  
Target  
525,000

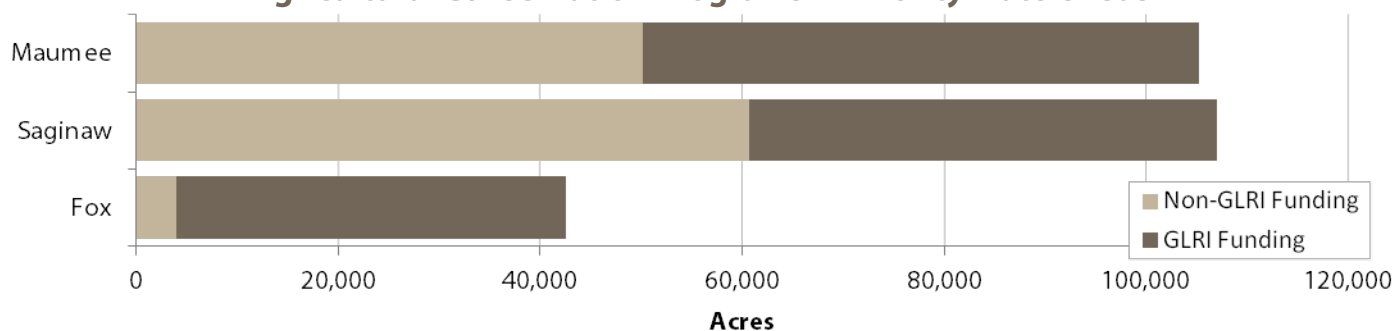
2018  
Target  
795,000

2019  
Target  
1,070,000

### Additional Measures of Progress

- Number of GLRI-funded nutrient and sediment reduction projects in targeted watersheds (measured in acres)
- Measured nutrient and sediment reductions from monitored GLRI-funded projects in targeted watersheds (measured in pounds)

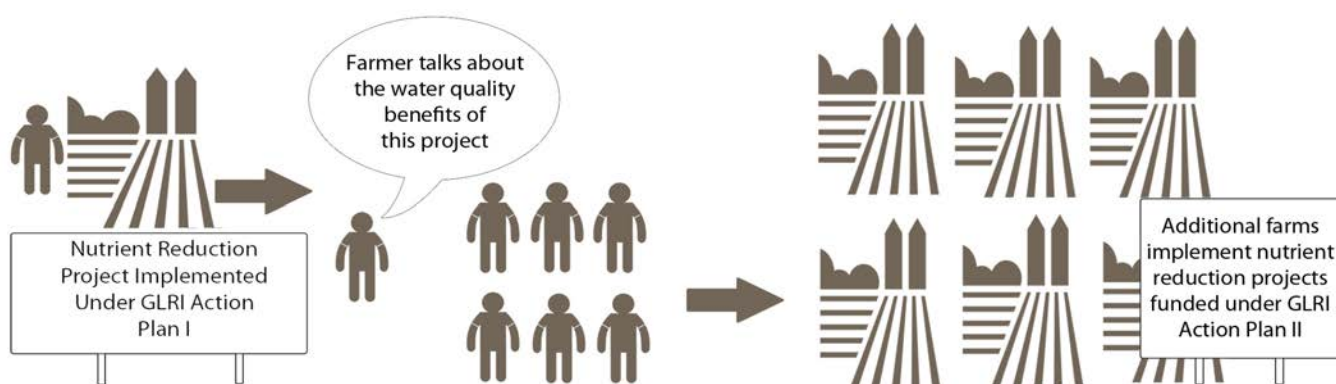
### GLRI Funding Supplements Other Federal Programs: GLRI Doubled the Acres Enrolled in Agricultural Conservation Programs in Priority Watersheds



**Under GLRI Action Plan II**, federal agencies and their partners will continue to reduce nutrient runoff in watersheds targeted through the GLRI science-based adaptive management process. The work will:

- Advance drinking water source protection.
- Increase voluntary agricultural conservation practices to achieve downstream water quality improvements.
- Track nutrient and sediment reductions achieved through conservation practices.
- Use voluntary, incentive-based and existing regulatory approaches to reduce nutrient losses.
- Encourage producers and agribusinesses to adopt innovative technologies and approaches to reduce nutrient runoff and soil losses.
- Educate agricultural producers about the links between long-term productivity, nutrient conservation and water quality.

GLRI nutrient runoff reduction projects will be evaluated on an annual basis to prioritize the type, location and longevity of future nutrient reduction work. In addition, GLRI partners will assess the extent to which harmful algal blooms are impacted by phosphorus loading, in-lake mixing, climate change and invasive species. The relationship between algal blooms and hypoxia will also be assessed.





# Nonpoint Source Pollution Impacts on Nearshore Health

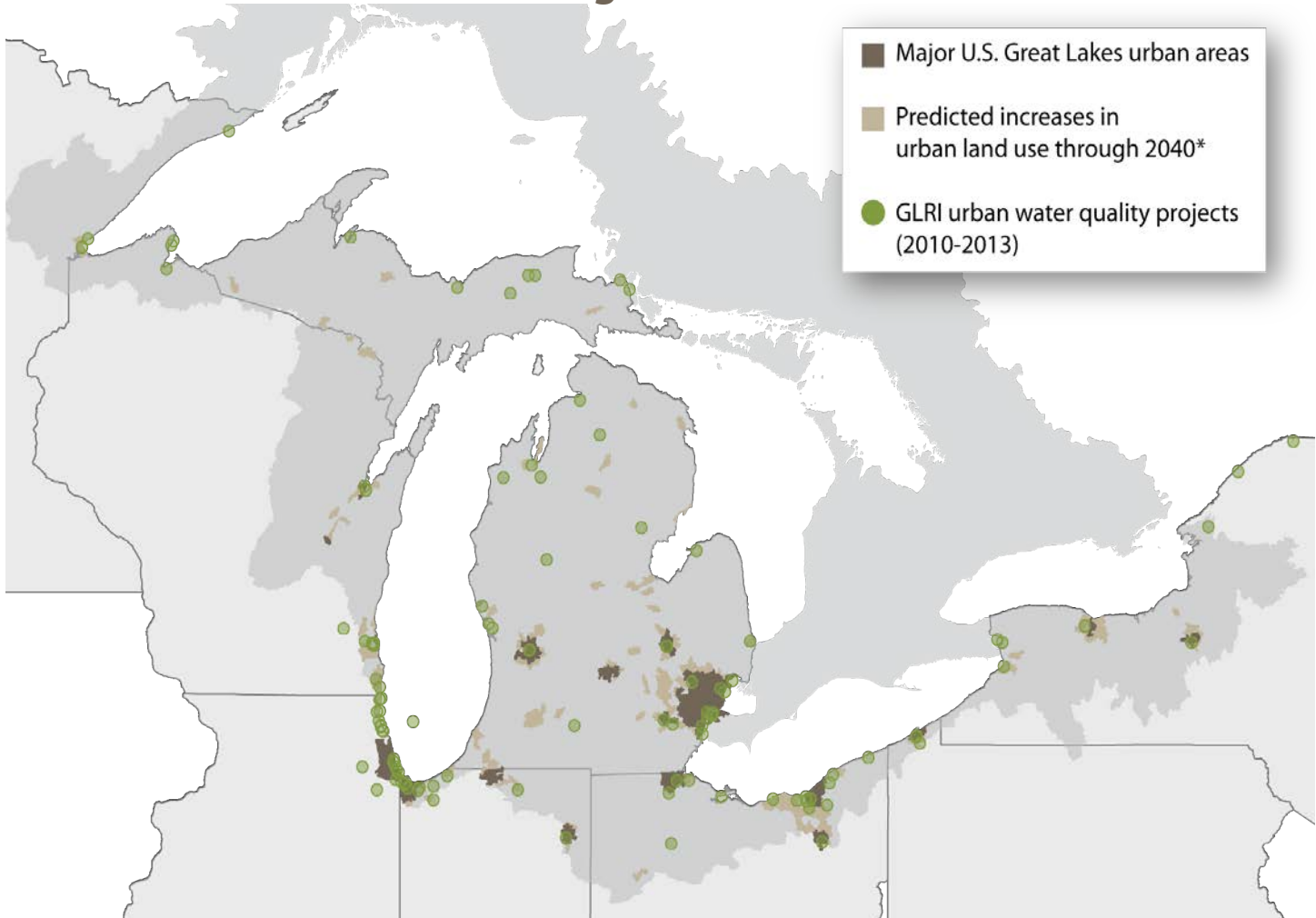
## Objective

Reduce untreated runoff from urban watersheds

## Commitment

- Implement watershed management projects in urban areas that have adopted a watershed strategy

## Reducing Urban Runoff



GLRI Action Plan I projects in urban areas reduced polluted runoff to Great Lakes tributaries and nearshore waters. GLRI Action Plan II projects implemented under this principal initiative will focus on major urban areas and on areas where urbanization is expected to increase in the near future.

**During the first five years of the Great Lakes Restoration Initiative,** federal agencies and their partners implemented projects in urban areas to reduce sediment, nutrient, toxic contaminant and pathogen loadings to Great Lakes tributaries and nearshore waters. The GLRI funded green infrastructure projects in Great Lakes shoreline cities to reduce untreated stormwater runoff and to improve nearshore water quality. These green infrastructure projects reduce flooding, increase greenspace in urban areas and return vacant properties to productive use. Watershed management projects were also implemented to stabilize stream banks, increase forest cover, restore wetlands and improve water quality at beaches in urban areas.

*\*Urban land use predictions generated through the USGS Climate Change Impacts Program and provided by Dr. Bryan C. Pijanowski, Purdue University (<http://ltm.agriculture.purdue.edu/>)*

### Measure of Progress with Annual Targets

- Projected volume of untreated urban runoff captured or treated by GLRI-funded projects (measured in millions of gallons)

Baseline/  
Universe

Baseline: 0  
Universe: N/A

2015  
Target

2016  
Target

2017  
Target

2018  
Target

2019  
Target

30

70

120

185

250

### Additional Measures of Progress

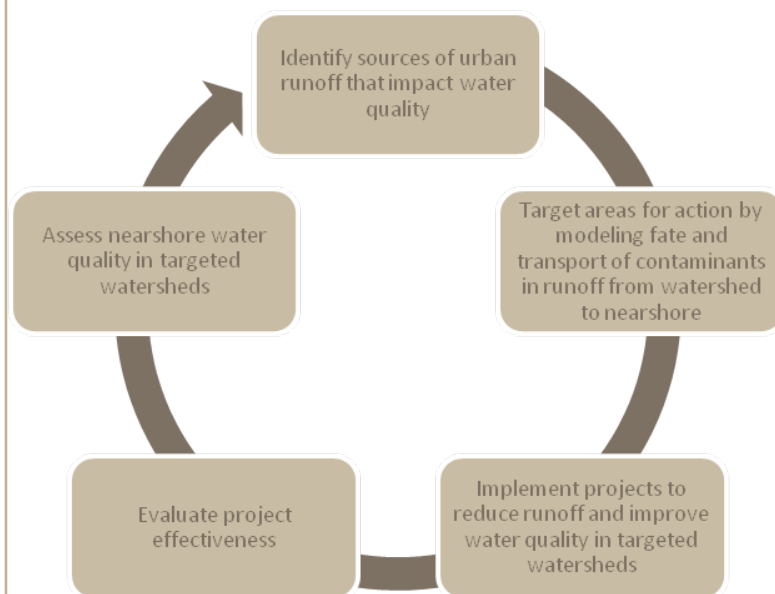
- Number of GLRI-funded projects implemented to reduce the impacts of untreated urban runoff on the Great Lakes
- Measured volume of untreated urban runoff captured or treated by monitored GLRI-funded projects

Under GLRI Action Plan II, federal agencies and their partners will continue to implement watershed management and green infrastructure projects to reduce the impacts of polluted urban runoff on nearshore water quality at beaches and in other coastal areas. These projects will capture or slow the flow of untreated runoff and filter out sediment, nutrients, toxic contaminants, pathogens and other pollutants prior to entering Great Lakes tributaries and nearshore waters.

Federal agencies and their partners will build green infrastructure, install tributary buffers, restore coastal wetlands, and re-vegetate and re-forest areas near Great Lakes coasts and tributaries.

These and other actions to reduce untreated runoff will be implemented in urban areas that have adopted watershed management strategies. Urban runoff reduction projects will be evaluated to determine their effectiveness. This information along with the assessment of water quality will be used to target future actions.

### Reducing Runoff and Improving Nearshore Health in Urban Watersheds



### Green Infrastructure Captures and Filters Urban Runoff

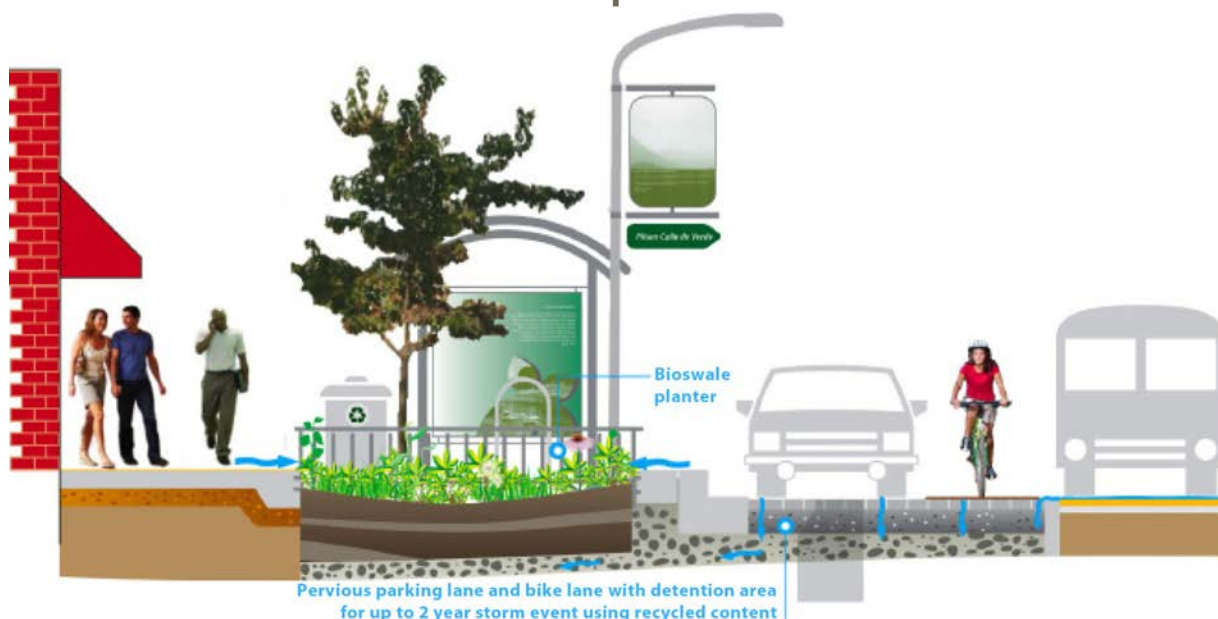


Image courtesy of Chicago Department of Transportation

# Habitats and Species

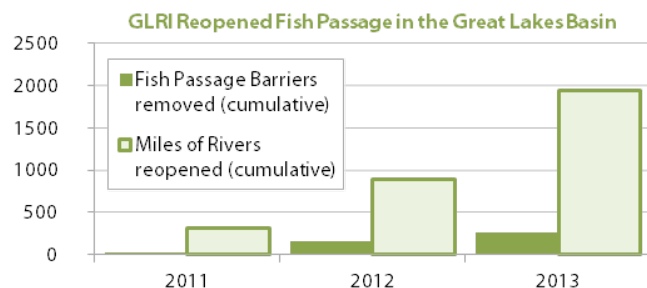
## Objective

Protect, restore and enhance habitats to help sustain healthy populations of native species

## Commitment

- Remove or bypass barriers on Great Lakes tributaries to facilitate fish passage
- Protect, restore and enhance Great Lakes coastal wetlands
- Protect, restore and enhance GLRI-targeted habitats in the Great Lakes basin

## Great Lakes Restoration Initiative Habitat Restoration and Species Protection Projects (2010-2013)



**During the first five years of the Great Lakes Restoration Initiative**, federal agencies and their partners, including states and tribes, worked to protect, restore and enhance habitat in the Great Lakes basin. Projects were implemented to maintain healthy populations of native species in aquatic and terrestrial habitats. More than 600 habitat protection, restoration, and enhancement projects were implemented throughout the Great Lakes basin by federal agencies and their partners. More than 80,000 acres of wetlands and 33,000 acres of coastal, upland, and island habitat were protected, restored and enhanced. Over 250 barriers were removed or bypassed in Great Lakes tributaries, enabling access by fish and other aquatic organisms to over 1,900 additional miles of river. Data was also collected to document baseline conditions for fish, amphibian, invertebrate, bird, plant and water quality for all coastal wetlands in order to inform protection and restoration decisions.



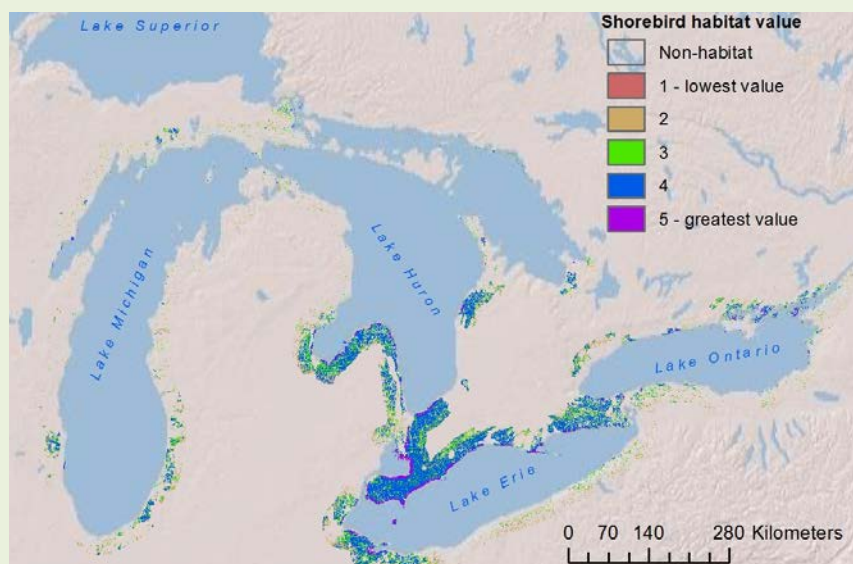
Measures of Progress with Annual Targets	Baseline/Universe	2015 Target	2016 Target	2017 Target	2018 Target	2019 Target
• Number of miles of Great Lakes tributaries reopened by GLRI-funded projects	Baseline: 1,900 Universe: N/A	2,200	2,500	2,800	3,100	3,400
• Number of miles of Great Lakes shoreline and riparian corridors protected, restored and enhanced by GLRI-funded projects*	Baseline: 0 Universe: N/A	75	100	175	225	300
• Number of acres of Great Lakes coastal wetlands protected, restored and enhanced by GLRI-funded projects*	Baseline: 0 Universe: 260,000	7,000	15,000	30,000	52,000	60,000
• Number of acres of other habitats in the Great Lakes basin protected, restored and enhanced by GLRI-funded projects	Baseline: 117,000 Universe: 1,290,000	127,000	147,000	167,000	187,000	207,000

\*This Measure of Progress is a modification of an Action Plan I Measure of Progress that has been modified to more accurately track actions funded by GLRI. The baseline is zero because the new Action Plan II Measure of Progress is not the same metric as the Action Plan I Measure of Progress.

**Under GLRI Action Plan II**, federal agencies and their partners will implement protection, restoration and enhancement projects focused on open water, nearshore, connecting channels, coastal wetland and other habitats in the Great Lakes basin. Projects will include:

- Removing dams and replacing culverts to create fish habitat and reconnect migratory species to Great Lakes tributaries
- Restoring riparian and in-stream habitat to prevent erosion and to create sufficient habitat for aquatic species
- Protecting and restoring coastal wetlands
- Restoring habitat necessary to sustain populations of migratory native species
- Implementing offshore reef rehabilitation projects to promote natural fish spawning, and
- Protecting, restoring, and managing existing wetlands and high-quality upland areas to sustain diverse, complex, and interconnected habitats for species reproduction, growth, and seasonal refuge.

The process for protecting, restoring and enhancing habitats will begin with identifying projects based on priorities in the Lake Biodiversity Conservation Strategies and other regional-scale conservation strategies. Projects will contribute to the complexity of habitat types necessary to sustain populations of native species. A range of habitat assessment and evaluation activities will inform the prioritization, execution, and measurement of GLRI actions. The activities will also provide information on ecosystem processes, stressors and changing conditions due to emerging problem such as urban growth and climate change.



### Great Lakes Migratory Bird Stopover Habitat

Migratory stopover sites are places where migrating birds stop to rest, refuel and seek shelter en route between breeding and wintering areas. The map shows the best sites on the Great Lakes shoreline (in blue and purple) that can shelter and provide food for these birds. GLRI is protecting, restoring and enhancing the sites most suitable for migratory birds.

*Ewert et. al., On a Wing and a GIS Layer: Prioritizing Migratory Bird Stopover Habitat along Great Lakes Shorelines, November 2012*

# Habitats and Species

## Objective

Maintain, restore and enhance populations of native species

## Commitment

- Promote the recovery of priority federally-listed endangered, threatened and candidate species
- Promote self-sustaining populations of GLRI-targeted native, non-threatened and non-endangered species

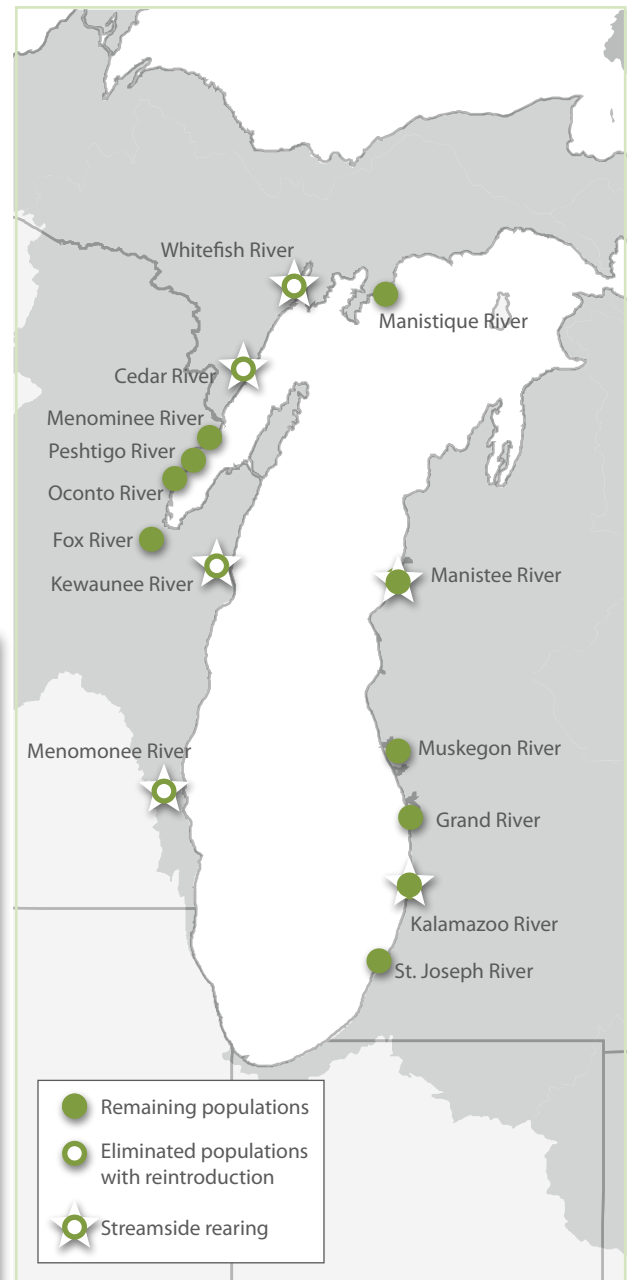
### During the first five years of the Great Lakes Restoration Initiative

**Initiative**, federal agencies and their partners worked to maintain, restore and enhance populations of native fish and wildlife species. The following actions were taken to conserve native species that were once broadly distributed across the lakes:

- Assisting with the delisting of the federally endangered Lake Erie water snake;
- Improving conditions for the following endangered and threatened species: bog turtle, Canada lynx, copperbelly water snake, Eastern Massasauga rattlesnake, Hines emerald dragonfly, Karner blue butterfly, Kirtland's warbler, lakeside daisy, Mitchell's satyr butterfly, piping plover, and Pitchers thistle; and,
- Implementing projects that led to 48 populations of native aquatic non-threatened and non-endangered species becoming self-sustaining in the wild.



The Great Lakes Restoration Initiative is supporting projects to protect endangered populations of **piping plover** in the Great Lakes region. At Wilderness State Park in Michigan, recovery efforts were implemented to support 3-6 pairs of piping plover. At Sleeping Bear Dunes National Lakeshore, federal agencies and their partners are protecting and monitoring the largest concentration of breeding piping plover in the Great Lakes region.



**Lake sturgeon** declined dramatically in the late 1800s due to overfishing, pollution and habitat loss. Though many populations were wiped out long ago, lake sturgeon still persist in ten rivers around Lake Michigan at a small fraction of their historic abundance. GLRI is supporting stream-side rearing units around the Lake to reintroduce or supplement juvenile lake sturgeon in Lake Michigan rivers.

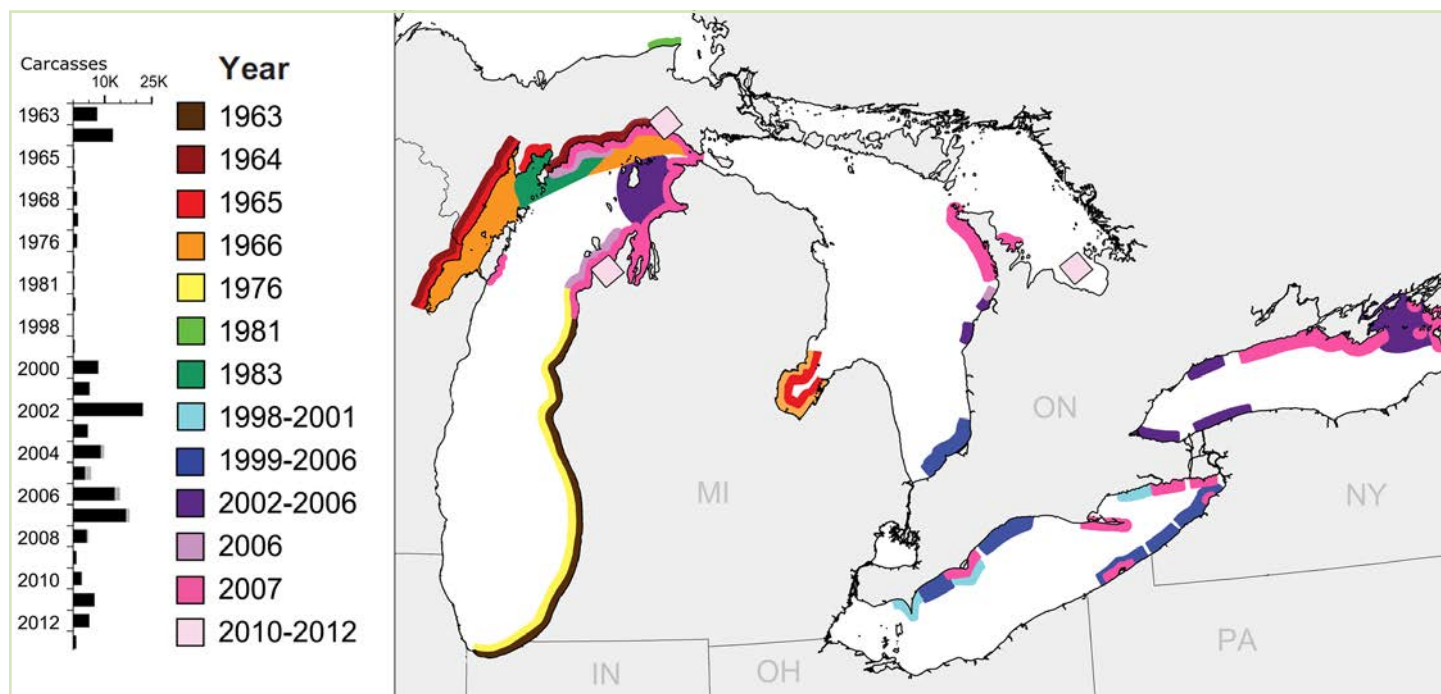
### Measures of Progress

- Number of GLRI-funded projects that promote recovery of federally-listed endangered, threatened, and candidate species
- Number of GLRI-funded projects that promote populations of native non-threatened and non-endangered species self-sustaining in the wild

**Under GLRI Action Plan II**, federal agencies and their partners will work to maintain, restore and enhance populations of native fish and wildlife species. Projects will:

- Protect and restore species diversity
- Reintroduce populations of native species to restored habitats and evaluate their survival
- Protect or restore species that are culturally significant to tribes in the Great Lakes region
- Manage invasive species that inhibit the sustainability of native species
- Pioneer species propagation and relocation techniques, and
- Implement other activities necessary for the eventual recovery of federal and state threatened and endangered species

These GLRI-funded species protection, restoration and enhancement projects will be targeted based on Great Lakes restoration and conservation plans. These projects will often be conducted in tandem with GLRI-funded habitat projects. Federal agencies and their partners will evaluate population dynamics, biological complexity, and within-species diversity to aid in successfully maintaining fish and wildlife communities. These projects will be evaluated on an annual basis and the results of these evaluations will be used to prioritize the locations and species to be targeted in the future.



**Botulism outbreaks** cause extensive mortality of fish and fish-eating birds in the Great Lakes. Although periodic outbreaks have occurred in the Great Lakes since the 1960s, outbreaks have become more common and widespread since 1999 — particularly in Lakes Michigan, Erie, and Ontario. Botulism has been responsible for over 80,000 bird deaths on the Great Lakes since 1999. GLRI projects are identifying the causes of and potential solutions to this problem. (Redrawn from Zuccarino-Crowe 2009. Bird carcass data from USGS, Michigan Department of Natural Resources, Canadian Wildlife Health Center and the Canadian Wildlife Health Service.)



# Foundations for Future Restoration Actions

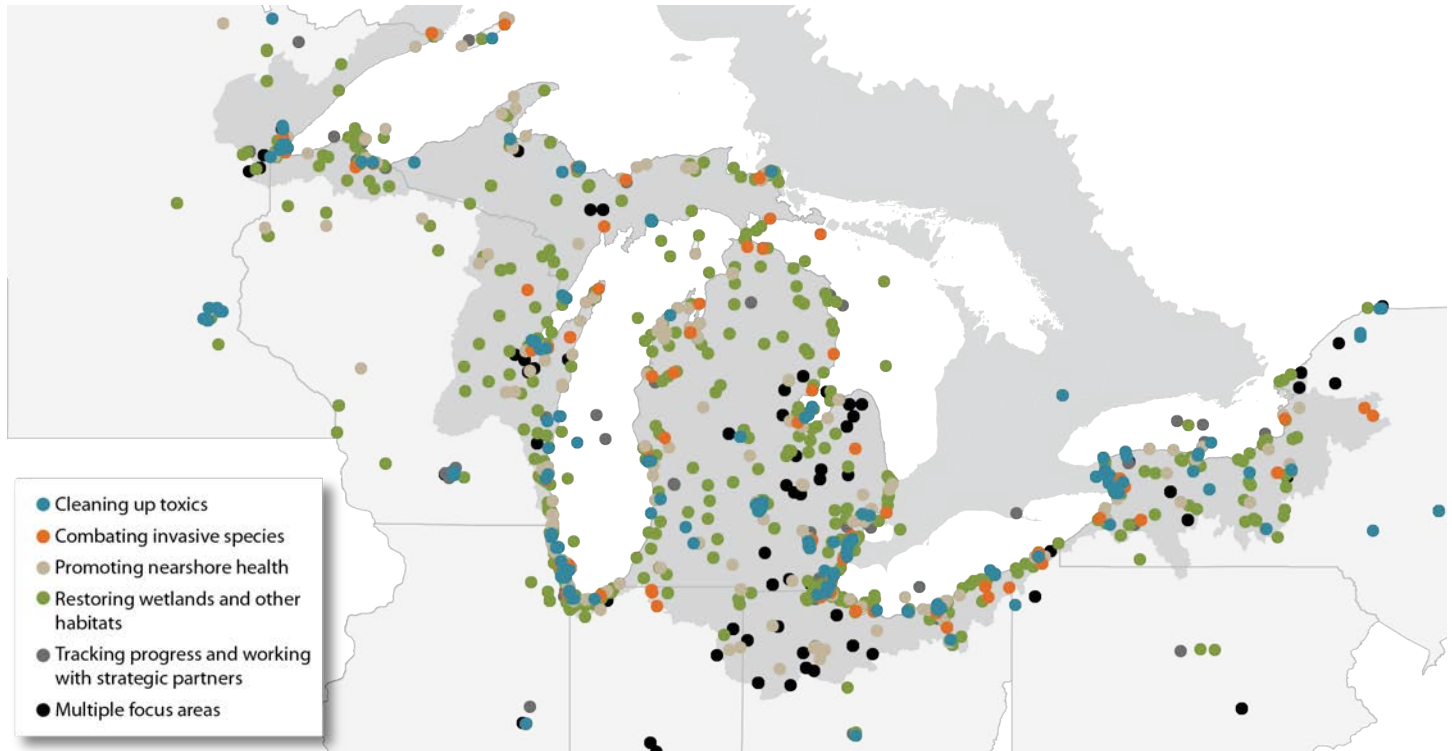
## Objective

Ensure climate resiliency of GLRI-funded projects

## Commitment

• Incorporate climate resiliency criteria in project selection processes

## Great Lakes Restoration Initiative Projects Funded During 2010 - 2013



**During the first five years of the Great Lakes Restoration Initiative**, federal agencies funded over 2,000 projects across the Great Lakes basin. These projects address the most urgent issues in the Great Lakes: cleaning up toxics and areas of concern, combating invasive species, promoting nearshore health by protecting watersheds from polluted runoff and restoring wetlands and other habitats.

The Government Accountability Office and the EPA Science Advisory Board recommend that federal agencies consider the potential impacts of climate change on the restoration and protection work funded by GLRI. The Great Lakes Advisory Board recommends that the GLRI Action Plan:

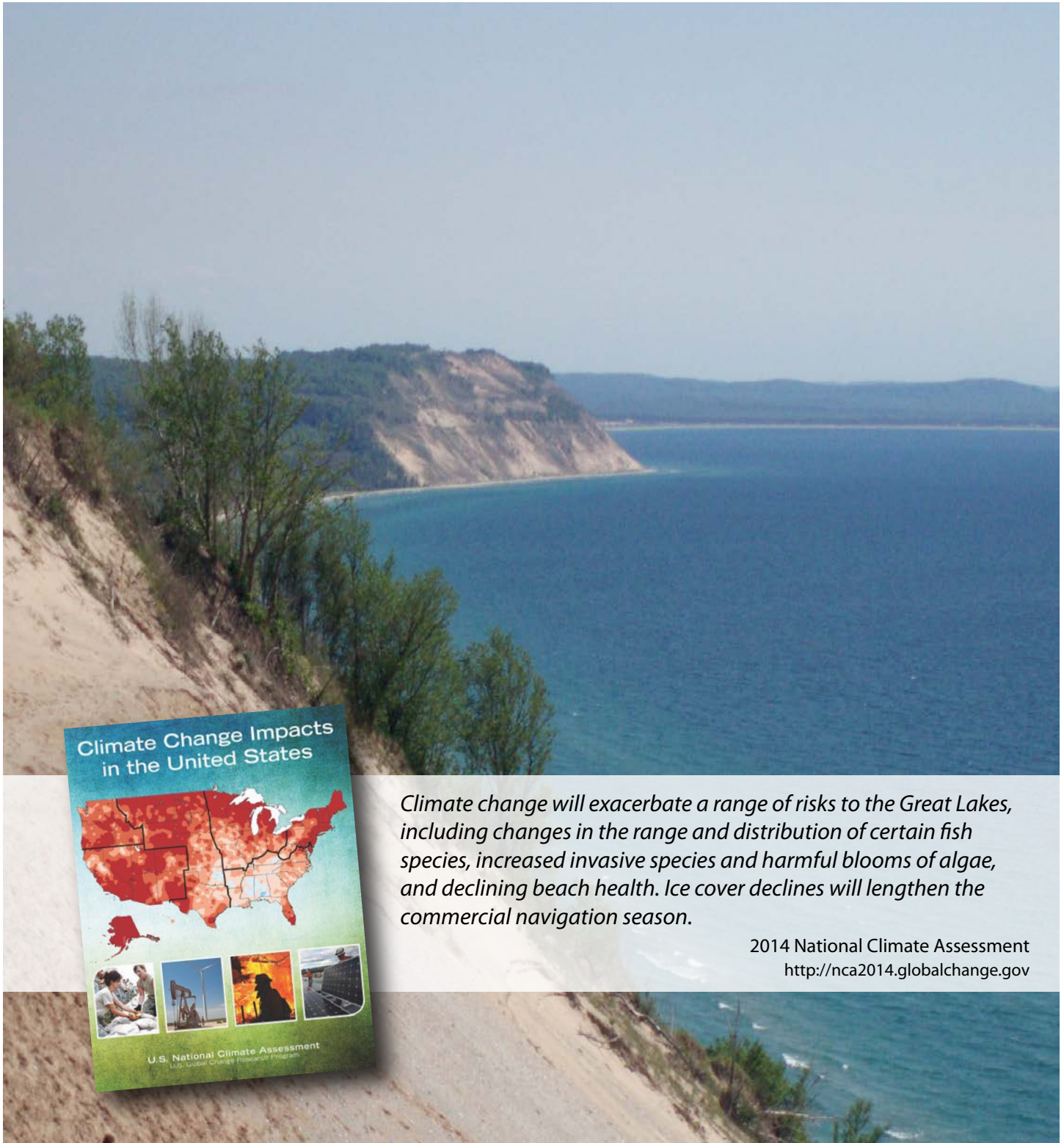
...acknowledge that climate change, and the resulting changes to local meteorology, can compromise the long-term effectiveness of the restoration work being done through the GLRI. To ensure the long-term viability of any specific restoration project, the GLRI awarding agency should consider how each proposed project may be affected by any impacts of climate change. This is best done during the project selection process.

**Under GLRI Action Plan II**, federal agencies will develop standardized climate resiliency criteria that will be used to design and select GLRI projects. The standardized criteria will be developed using lessons learned from previous and ongoing GLRI-projects and will also draw on federal agencies' climate adaptation plans and other project assessment tools that measure resiliency. These criteria will ensure, for example, that GLRI restoration projects incorporate plant and tree species that are suitable for current and projected future climatic conditions. Similarly, these criteria will be used to design watershed restoration projects to take into account potential impacts of more frequent or intense storms on water flow, erosion and runoff. Information about the climate resiliency criteria will be distributed to GLRI partners so that climate change resiliency can be incorporated into the early stages of the GLRI project development process. The federal agencies will review the standardized climate resiliency criteria on an annual basis and incorporate updated climate change information.

## Great Lakes Restoration Initiative Action Plan II

### Measures of Progress

- By 2016, a standardized set of climate resiliency criteria will be developed for GLRI-projects
- Starting in 2017, projects will include climate resiliency criteria in planning and implementation



*Climate change will exacerbate a range of risks to the Great Lakes, including changes in the range and distribution of certain fish species, increased invasive species and harmful blooms of algae, and declining beach health. Ice cover declines will lengthen the commercial navigation season.*

2014 National Climate Assessment  
<http://nca2014.globalchange.gov>

# Foundations for Future Restoration Actions

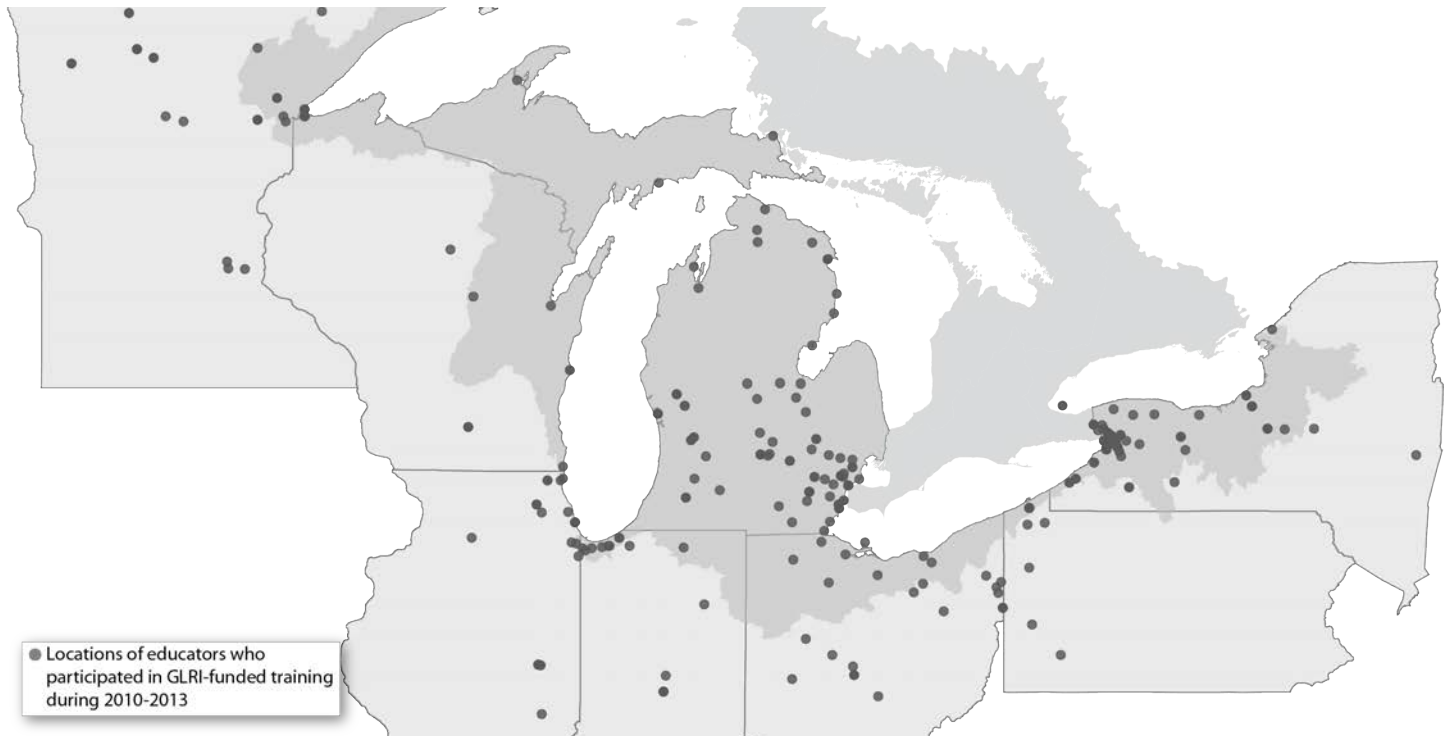
## Objective

Educate the next generation about the Great Lakes ecosystem

## Commitment

• Promote Great Lakes-based ecosystem education and stewardship, with a focus on educator training

## Great Lakes Restoration Initiative Trains Educators Across the Great Lakes Region



**During the first five years of the Great Lakes Restoration Initiative**, federal agencies and their partners implemented a number of efforts to promote Great Lakes-based environmental education and stewardship, including:

- The Center for Great Lakes Literacy (CGLL) was established by the Great Lakes Sea Grant Network to develop a community of Great Lakes-literate educators, students, scientists, environmental professionals and citizen volunteers dedicated to improved Great Lakes stewardship.
- The Great Lakes Bay Watershed Education and Training Program (B-WET) was created to promote hands-on environmental activities that are aligned with academic learning standards.

Collectively, CGLL, B-WET and other education projects have resulted in over 850 educational institutions incorporating Great Lakes specific material into their broader environmental education curricula. It is estimated that more than 115,000 students have participated in these classes.



### The Great Lakes Restoration Initiative Funds Great Lakes Sea Grant "Teach the Teachers" Projects

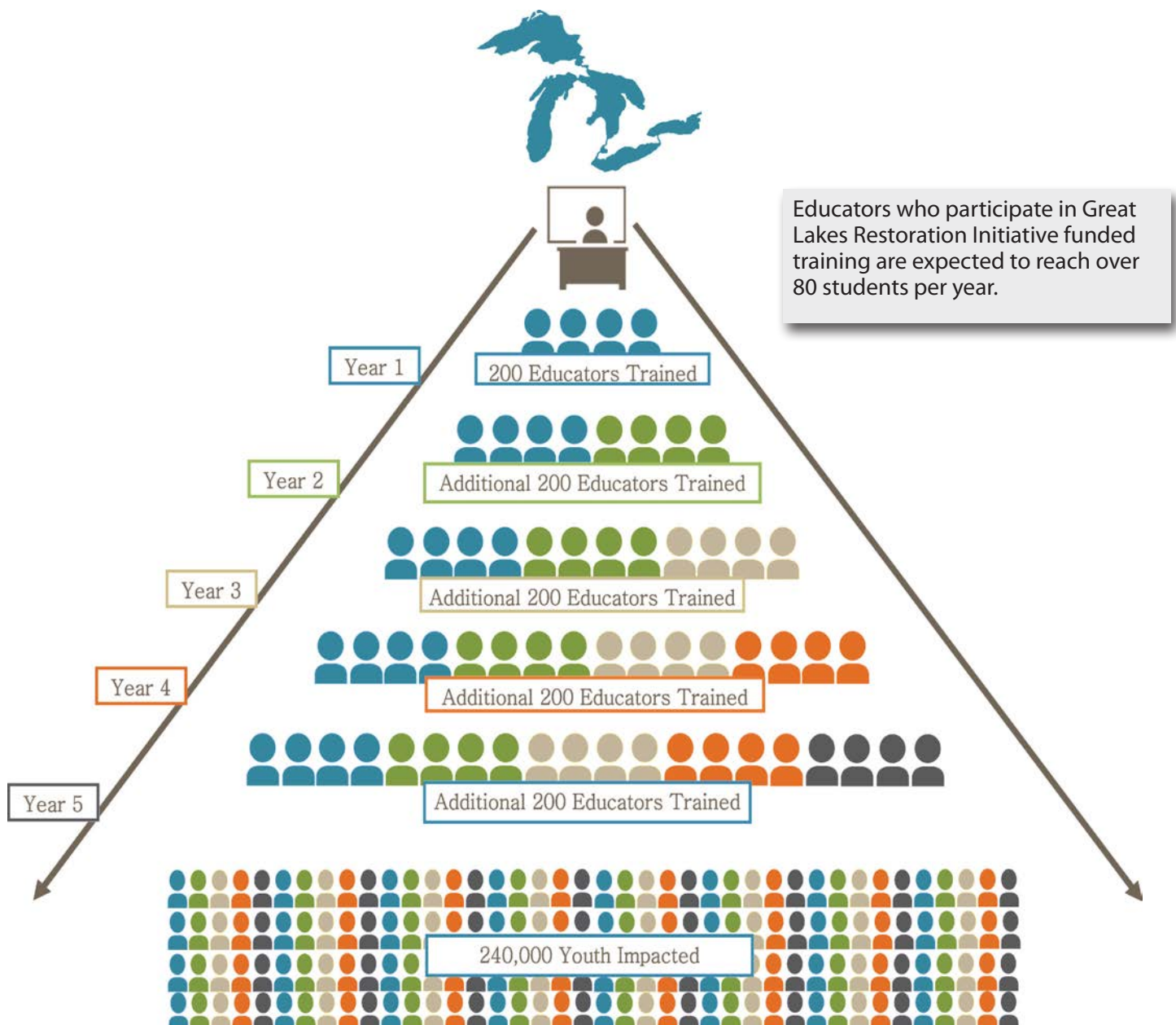
During the summer of 2013, elementary and high-school teachers from five states participated in a seven day Shipboard and Shore line Science workshop on Lake Ontario aboard the Lake Guardian, a U.S. Environmental Protection Agency (EPA) research vessel. The teachers assisted with collecting water and bottom sediment samples at numerous nearshore and offshore field stations including sites near Toronto, Rochester, Oswego, Clayton and the Thousand Islands Biological Station. This workshop was one of several courses for environmental educators funded through the Great Lakes Restoration Initiative.



### Measures of Progress

- Number of educators trained through GLRI-funded projects
- Number of people educated on the Great Lakes ecosystem through GLRI-funded place-based experiential learning activities

**Under GLRI Action Plan II**, federal agencies and their partners will continue to promote Great Lakes-based ecosystem education and stewardship for K-12 school students and other interested audiences (e.g., courses at parks, nature centers, museums and zoos). GLRI partners will work with existing environmental education programs, foster the growth of new programs, and align new and/or existing curricula with the Great Lakes Literacy Principles as well as state and national academic learning standards. There will be an emphasis on training educators in order to maximize the number of students engaged over time. Federal agencies that are stewards of lands and waters important to the Great Lakes ecosystem will also provide place-based experiential learning to the public. GLRI projects will include an evaluation component to ensure that the education programs directed towards educators are ultimately implemented in the classroom.



# Foundations for Future Restoration Actions

## Objective

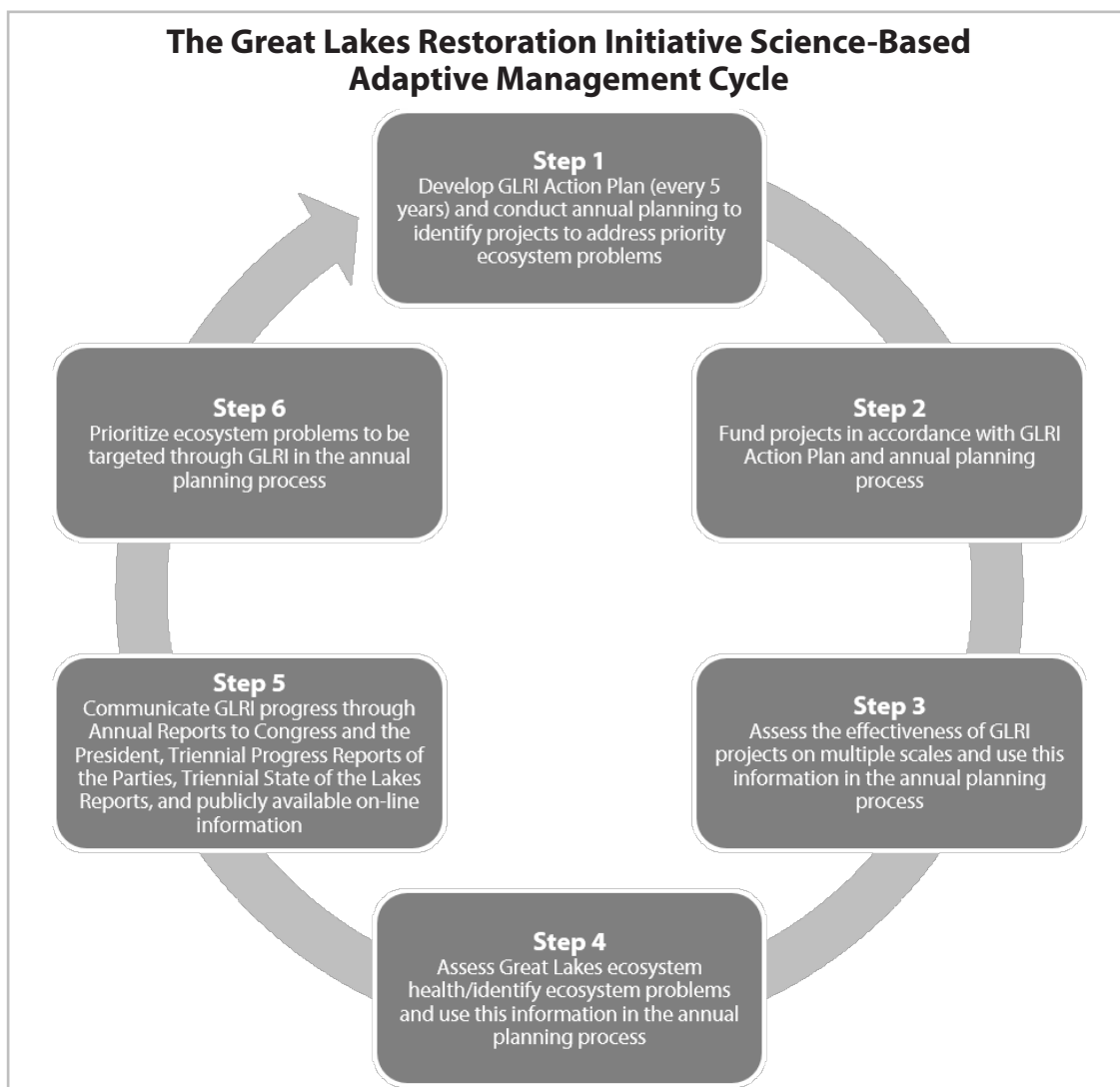
Implement a science-based adaptive management approach for GLRI

## Commitments

- Evaluate the effectiveness of GLRI-funded projects
- Assess the overall health of the Great Lakes ecosystem and identify the most significant remaining problems
- Identify watersheds, habitats, and species to be targeted by the GLRI
- Report on GLRI progress and Great Lakes ecosystem health

The GLRI science-based adaptive management process is intended to guide restoration and protection actions by using the best available science and applying lessons learned from past and ongoing GLRI projects and programs. Federal agencies involved in the GLRI will use this science-based adaptive management cycle to identify the most critical environmental problems in the Great Lakes ecosystem and to select projects that will most effectively address those problems. As part of this process, federal agencies will consult with their state and tribal partners and will seek input from the Great Lakes Advisory Board, the scientific community, Lakewide Action and Management Plan partnerships and the general public.

The cycle consists of two science-based planning processes — one that occurs every five years and one that is implemented annually. Every five years, federal agencies develop a GLRI Action Plan to establish principal initiatives, commitments, metrics and long-term goals. Federal agencies also conduct annual planning to identify specific projects and programs to target the highest priority problems in the Great Lakes ecosystem.





### Measures of Progress

- Project evaluations completed and used to prioritize GLRI funding decisions each year
- Annual Great Lakes monitoring conducted and used to prioritize GLRI funding decisions each year
- GLRI-targeted watersheds, habitats and species identified and used to prioritize GLRI funding decisions
- Issue annual GLRI Reports to Congress and the President
- Issue Great Lakes Water Quality Agreement Triennial Progress Reports of the Parties
- Issue triennial State of the Lakes reports
- Periodically update publicly available online information about the GLRI

#### **Step 1: Conduct annual planning to identify projects to address priority ecosystem problems consistent with the GLRI Action Plan.**

Federal agencies prepare a GLRI Action Plan that establishes long-term goals, objectives, commitments and measures of progress. Federal agencies also conduct an annual planning process to prioritize restoration and protection work to address the most critical Great Lakes ecosystem problems. The annual planning process identifies specific projects and programs to target priority Great Lakes ecosystem problems. The annual planning process relies on the best available scientific information on the current state of Great Lakes ecosystem health and an assessment of the effectiveness of past GLRI projects.

#### **Step 2: Fund projects in accordance with the GLRI Action Plan and annual planning process.**

Federal agencies fund individual restoration and protection projects in accordance with the GLRI Action Plan and the annual planning process. Individual agencies use grants, contracts, cooperative agreements and direct implementation to fund projects within each agency's area of expertise. For example, the Fish and Wildlife Service focuses on habitat restoration and species protection work and the Natural Resources Conservation Service focuses on soil and water conservation projects that reduce nutrient loading in the Great Lakes basin. In addition, agencies often use GLRI funds to leverage projects funded by their base budgets and vice versa.

#### **Step 3: Assess effectiveness of GLRI projects on multiple scales.**

Every project is evaluated upon completion to ensure that it was implemented as proposed. Select projects are assessed to determine project effectiveness so that future GLRI investments are maximized taking into account "lessons learned." Project assessments can occur on an individual project basis or, where feasible, on an "aggregation of projects" basis. Information from these assessments will be used in the annual planning process.

#### **Step 4: Assess Great Lakes ecosystem health and identify ecosystem problems.**

Federal agencies and partners assess ecosystem health on a periodic basis in order to measure progress towards the long-term goals identified at the beginning of this action plan and to continually identify the most significant ongoing and emerging problems in the Great Lakes ecosystem. Federal agencies conduct monitoring activities (e.g., water quality monitoring, fish monitoring, air monitoring, human health monitoring) that produce information used in these assessments. This information will be used in the annual planning process.

#### **Step 5: Communicate GLRI progress through Annual Reports to Congress and the President, Triennial Progress Reports of the Parties, Triennial State of the Lakes Reports, and publicly available on-line information.**

Because of the tremendous interest in the health of the Great Lakes, federal agencies periodically produce a variety of reports on GLRI activities and ecological indicators of the overall health of the Great Lakes ecosystem. Agencies also frequently update publicly available on-line information about the Great Lakes and the GLRI.

#### **Step 6: Prioritize ecosystem problems to be targeted through GLRI.**

Every year, federal agencies restart the adaptive management cycle by modifying priorities, as appropriate, based on knowledge gained by assessing completed GLRI projects and by assessing the health of the Great Lakes ecosystem and the long-term goals identified at the beginning of this action plan.



## Great Lakes Interagency Task Force

