DRAFT

Great Lakes and Mississippi River Interbasin Study – Brandon Road
Feasibility Study
Project Management Plan

A 100% Federally-Funded USACE Feasibility Report

30 April 2015

Introduction

The Great Lakes and Mississippi River Interbasin Study (GLMRIS) – Brandon Road (BR) Interim Report is an interim feasibility study that is building on the foundation of the Great Lakes and Mississippi River Interbasin Study (GLMRIS) Report released in Jan 2014. The Summary of the GLMRIS Report is found in Appendix A. This feasibility study will assess the viability of establishing a single point to control the upstream transfer of aquatic nuisance species (ANS) from the Mississippi River (MR) Basin into the Great Lakes (GL) Basin in the vicinity of the Brandon Road Lock and Dam in Joliet, Illinois (Figure 1). Currently, the MR ANS that are subject to this study are two species of Asian carp, the silver carp (*Hypophthalmichthys nobilis*),and the bighead carp (*H. molitrix)* and the scud (*Apocorophium lacustre*). As an interim feasibility study to the GLMRIS study authority, this study will not address certain aspects of the study authority. Particularly, this study will not examine: 1) downstream transfer of ANS from the Great Lakes Basin to the Mississippi River Basin; and 2) transfer of ANS along the entire basin divide. This study is fully federal funded.

The Project Management Plan (PMP) details the tasks, costs and schedule necessary for planning decisions and general estimates for tasks necessary to complete the study. This PMP has been developed utilizing tools such as the Decision Management Plans (DMPs) and Risk Registers prepared by the project delivery team (PDT). Updates to this PMP will be prepared as needed, generally near each milestone. The information contained in the PMP will be used to update appropriate budgetary and other related document for this feasibility study.

Stakeholders' Assistance

The waterway upstream and downstream of BR Lock and Dam is subject to an extensive monitoring program in which local, state and federal agencies, the Asian Carp Regional Coordinating Committee, work cooperatively to monitoring Asian carp abundance and invasion front. (See http://asiancarp.us/ for more information.) State and federal agencies and academia continue to research methods to control the spread of Asian carp and to improve monitoring techniques. Additionally, numerous state and federal agencies and academia research potential impacts these fish will have on newly invaded ecosystems. The PDT will utilize the most recent information and data gathered by these stakeholders to inform the analysis. The PDT will use available monitoring and control information pertaining to the scud, to inform the study as well.

Project Management Plan Tasks

After consideration of input provided by the vertical team, the scope of work is estimated to cost up to $8.2 million in additional funds and has duration of approximately four years. Approximately, $1.1 million has been spent scoping the study, processing the exemption package, initiating investigations, and performing initial evaluation of alternatives. The $8.2 million scope is the subject of this PMP with the schedule noted in Table 1. The Decision Management Plan (DMP) is found in Appendix B, and the Risk Registers are found in Appendix C.

Figure 1. Brandon Road Lock and Dam

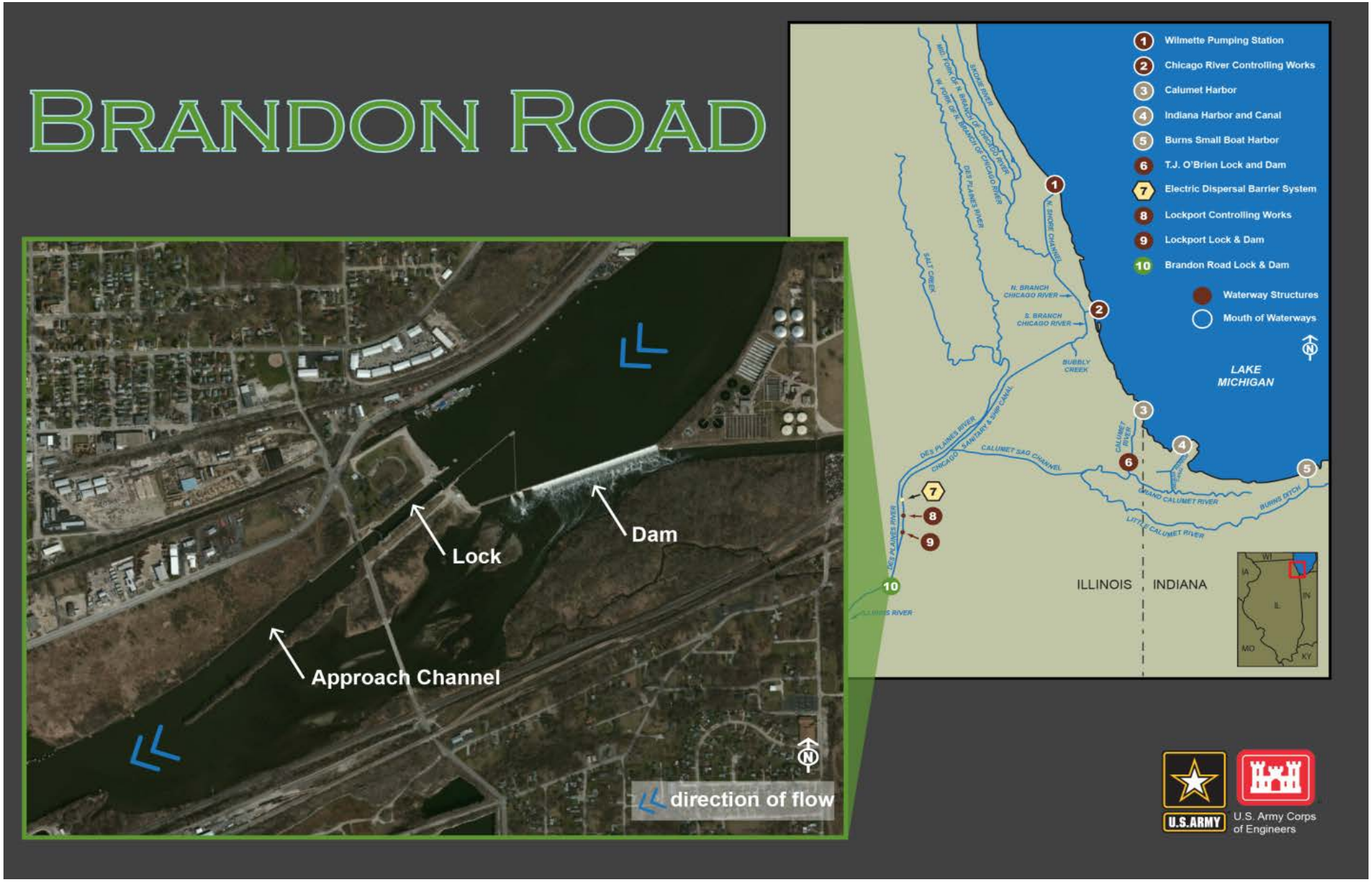


Table 1. GLRMIS-BR Study Milestones

	Activity	Date
Scoping	ASA Direction to Initiate Formal Evaluation	September 2014
	Notice of Intent to Prepare Draft EIS	November 2014
	Public Meetings	January 2015
	Exemption Approval	April 2015
Alternative Evaluation and Analysis	Alternatives In Progress Review*	April 2015
	Alternatives Milestone	May 2015
	Decision Point - Alternative Development	May 2016
	Tentatively Selected Plan (TSP) Milestone	January 2017
Feasibility Level Analysis	Analysis & Conceptual Design on TSP	April 2017
	Begin ATR, IEPR, Policy Review, NEPA	May 2017
	Agency Decision Milestone	November 2017
	Feasibility Report & CSRA Complete	June 2018
	CWRB Milestone	August 2018
	S&A Review	January 2019
	Chief's Report Milestone	February 2019

* Additional IPRs will be scheduled throughout the planning process, as needed.

Summary of Cost Estimates

Approximately, $1.1 million has been spent to date and $8.2 million is needed to complete the study. A breakdown of costs is included in (Table 2) and anticipated need of funds by year is shown in (Table 3). A detailed Work Breakdown Structure is included in Appendix C.

Table 2. Summary of Activities and Costs

ACTIVITIES	COST
I. Inventory and Forecast of ANS Passage	$245,000
II. Engineering and Design	$3,106,000
III. Alternative Effectiveness	$800,000
IV. Natural Resources and NEPA Analysis	$1,750,000
V. Planning, Project Management & Stakeholder Engagement	$2,331,600
TOTALS	$8,232,600

Table 3. Brandon Road Study Option C Anticipated Funding Need

Anticipated Funding Stream Needed to Meet Schedule

FY15	FY16	FY17	FY18	FY19
$1.7M	$2.3M	$2.3M	$1.8M	$0.1M

Appendix A. Summary of the GLMRIS Report

Summary of the GLMRIS Report

Great Lakes and Mississippi River Interbasin Study

U.S.ARMY

Great Lakes and Interbasin Mississippi River Study (GLMRIS): Description and Geographic Focus

This document summarizes the information set forth in the GLMRIS Report. The entire GLMRIS Report, including Technical Appendices, can be downloaded on the GLMRIS web site at http://glmris.anl.gov.

WHAT IS GLMRIS?

GLMRIS is the Great Lakes and Mississippi River Interbasin Study conducted by the United States Army Corps of Engineers (USACE) as authorized by the United States Congress. USACE is conducting the study in consultation with other federal agencies, Native American tribes, state agencies, local governments, and nongovernmental organizations.

The goal of GLMRIS is to present a range of options and technologies to prevent the transfer of aquatic nuisance species (ANS) between the Great Lakes and Mississippi River basins through aquatic pathways.

These options are presented in the GLMRIS Report as eight alternative plans. Impacts to uses and users of the waterways affected by the plans were evaluated, and methods to address significant impacts are included in the alternatives. The report outlines potential plans for decision makers; a recommended plan was not selected for the project.

WHY THE NEED FOR GLMRIS?

The Great Lakes and Mississippi River basins are ecosystems of great importance in the United States. In recent years, invasions of ANS have severely impacted the economic and environmental resources of these ecosystems.

GLMRIS addresses the need for a comprehensive effort to reduce the risk of future ANS transfers between the two basins.

AQUATIC NUISANCE SPECIES: POTENTIAL IMPACTS AND PREVENTION

Aquatic nuisance species can threaten native plants and animals; reduce abundance and variety of native species; harm important terrestrial and aquatic ecosystems; degrade water quality; transport diseases; and result in economic, political, and social impacts. For these reasons, ANS are of national and global concern.

Because ANS populations span watershed and government jurisdictional boundaries, efforts to manage them must be coordinated across these boundaries.

Prevention is recognized as the best defense against ANS. For GLMRIS, USACE has interpreted the term "prevent" to mean the reduction of risk to the maximum extent possible, because it may not be technologically feasible to achieve an absolute solution.

What are Aquatic Nuisance Species or ANS?

Aquatic nuisance species (ANS) are organisms, which can be plants, animals, or pathogens, that when introduced into a new habitat can produce harmful impacts on aquatic ecosystems and to the human uses of these systems.

Recent ANS invasions to the Great Lakes and Mississippi River Basins include zebra mussels, quagga mussels, Eurasian ruffe, and Asian carp.

Eurasian Ruffe Photo credit: Tiit Hunt

GEOGRAPHIC FOCUS

GLMRIS Study Area

The GLMRIS study area includes the Great Lakes and Mississippi River basins of the United States. Potential aquatic pathways between the basins exist along the

nearly 1,500-mile boundary of the two watersheds. This boundary is the primary focus of GLMRIS.

Detailed Study Area

A detailed study area was defined along the boundary of the two watersheds. This area includes the regions where the largest economic, environmental and social impacts of GLMRIS project alternatives are anticipated.

The detailed study area includes the Upper Mississippi and Ohio River basins and the Great Lakes basin.

Focus Areas 1 and 2

The Chicago Area Waterway System, or CAWS, lies within the detailed study area. The CAWS consists of 128 miles of waterways in and around the Chicago Metropolitan area. Five aquatic pathways between the Great Lakes and Mississippi River basins exist in the CAWS. These are the primary continuous aquatic pathways between the basins. This area has been termed Focus Area 1 and is the focal point of the GLMRIS Report. The CAWS is described further on page 4.

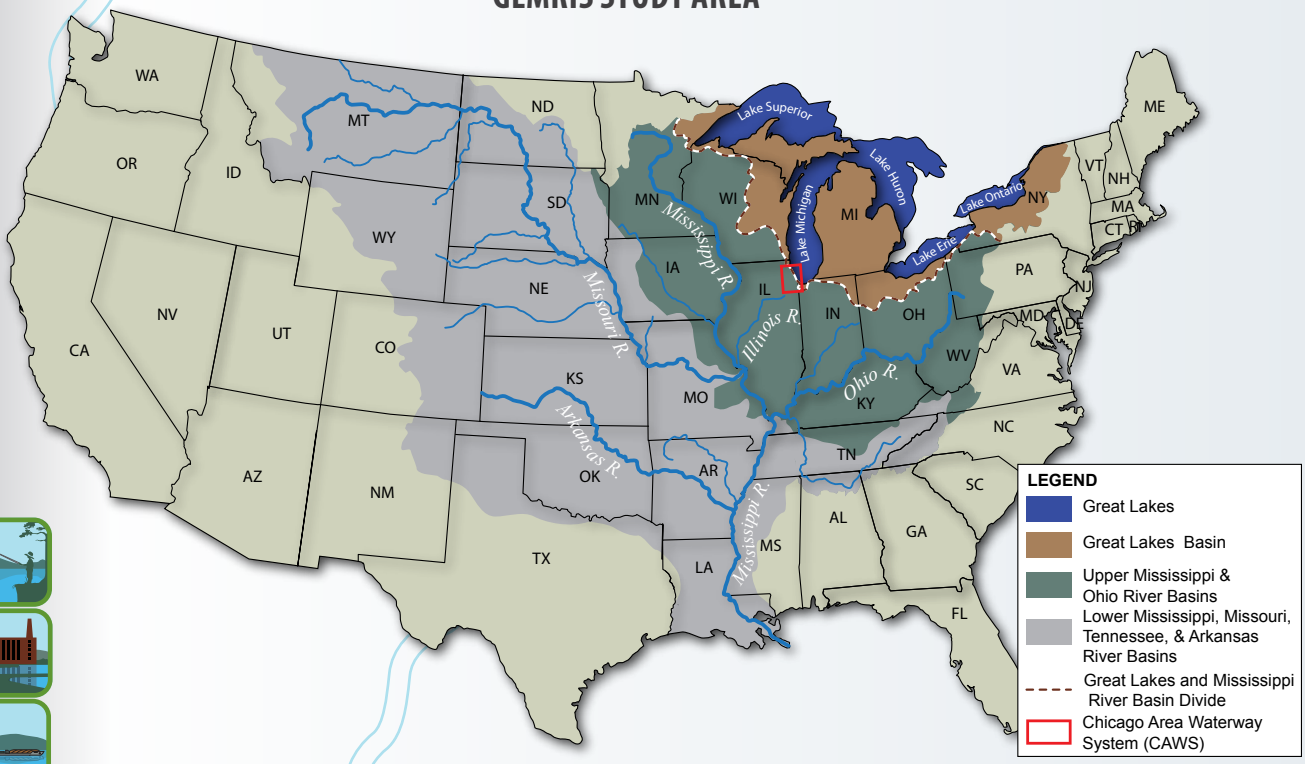
Focus Area 2 includes all other potential aquatic pathways between the two basins that may become transfer sites during flooding. More information on Focus Area 2 activities can be found at http://glmris.anl.gov/.

What are Aquatic and Non-Aquatic Pathways?

Aquatic pathways are means of transport of species between basins through natural and man-made waterways. Examples include streams, rivers and channels, as well as intermittent connections such as seasonal flows and streams.

Non-aquatic pathways are means of transport of species between basins that are not aquatic. Examples include land-based transfer, waterfowl migration, recreational uses (such as fishing and watersports), and accidental and unregulated stocking.

GLMRIS STUDY AREA



GLMRIS Authorization and Project Approach

AUTHORIZING LEGISLATION

GLMRIS was authorized by Congress in 2007 in Section 3061(d) of the Water Resources Development Act of 2007, Public Law 110-114 (WRDA 2007).

To provide a thorough and comprehensive analysis, GLMRIS includes an analysis of the impacts to uses and users of the CAWS that might occur if any alternative were implemented.

In 2012, Congress modified the direction of GLMRIS in Section 1538 of the Moving Ahead for Progress in the 21st Century Act, Public Law 112-141, to focus on the five direct aquatic pathways of the CAWS between the Great Lakes and the Mississippi River basins.

STUDY GOAL

The goal of GLMRIS is to present a range of options and technologies to prevent the transfer of aquatic nuisance species (ANS) between the Great Lakes and Mississippi River basins through aquatic pathways.

The GLMRIS Report addresses this goal by presenting eight alternative plans. These GLMRIS Alternatives were developed with two objectives:

- Preventing ANS transfer
- Mitigating impacts to resources (uses) and users of any plan implementation

STAKEHOLDER ENGAGEMENT

The alternative plans were developed by USACE with input from federal, state, and local agencies, Native American tribes, nongovernmental organizations, and the public at key milestones in the study.

At the study outset, USACE held 12 meetings in the Great Lakes and Mississippi River basins to gather input used to help define the study problem, opportunities, and constraints.

A collaborative stakeholder participation process is employed to engage interested parties, including establishing a multi-agency advisory committee, sharing study products as they became available, and having a strong presence on the Internet and social media.

GLMRIS REPORT

The GLMRIS Report presents eight alternative plans designed to prevent the transfer of ANS between the Great Lakes and Mississippi River basins. Impacts to uses and users of the CAWS were evaluated for each alternative, and methods to address these impacts were included in the alternatives.

The GLMRIS Report does not recommend a specific plan. However, evaluation criteria are included in the report that could be used by decision makers to further evaluate and compare the alternative plans.

This document summarizes the information set forth in the GLMRIS Report. The entire GLMRIS Report, including Technical Appendices, can be downloaded on the GLMRIS web site at http://glmris.anl.gov.

Fishing on the Mississippi River

Chicago Area Waterway System (CAWS)

CAWS LOCATION AND DESCRIPTION

The Chicago Area Waterway System (CAWS) is the primary focus of GLMRIS. There are five continuous aquatic pathways between the Great Lakes and Mississippi River basin located within the system.

The CAWS is a network of canals and channelized rivers in northeastern Illinois and northwestern Indiana. It is a complex, multipurpose waterway with many uses and users that developed as the City of Chicago expanded.

The CAWS is operated by the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC), primarily to transport stormwater and wastewater treatment plant discharges. USACE maintains the CAWS for commercial and recreational navigation.

Nearly half of the CAWS is excavated, man-made channels. The rest is made up of formerly natural streams that have been highly altered and no longer resemble their original condition.

Flow of water through the CAWS in Illinois is generally from north to south and from east to west. The system slowly drains away from Chicago and Lake Michigan into the Mississippi basin and down toward Lockport.

Much of the water in the CAWS comes indirectly from Lake Michigan. Water intakes located offshore in Lake Michigan supply water that is treated and then used in homes, offices, and industries. That water eventually makes its way to wastewater treatment plants. There are five wastewater treatment plants, called "water reclamation plants," in the CAWS. These WRPs are O'Brien, Stickney, Calumet, and Lemont in Illinois, and Gary in Indiana.

About 70 percent of the total annual flow out of the CAWS at Lockport is treated wastewater discharged from the WRPs in Illinois.

Aquatic Pathways between Lake Michigan and the Mississippi River Basin in the CAWS

1. Wilmette Pumping Station, IL
2. Chicago River Controlling Works, IL
3. Calumet Harbor, IL
4. Indiana Harbor, IN
5. Burns Small Boat Harbor, IN

Waterways in the CAWS

WATER REGULATING STRUCTURES

Water moving into and out of the CAWS is mostly regulated by a series of structures that include:

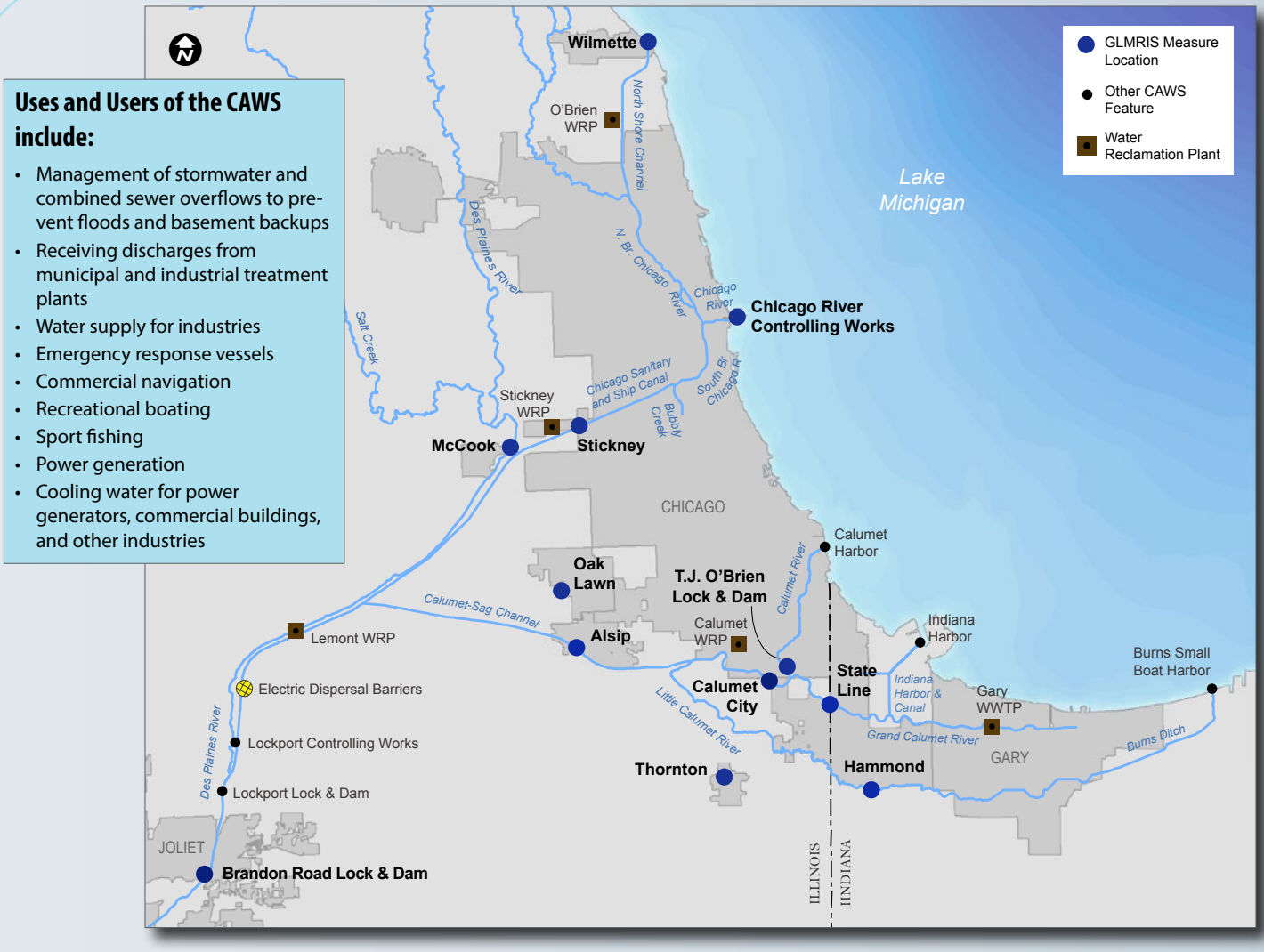
- **Wilmette Pumping Station, IL** at the north end of the system.
- **Chicago River Controlling Works, IL** on the Chicago River and the **O'Brien Lock and Dam, IL** on the Calumet River provide passage for ships and boats to and from Lake Michigan and regulate flow of water to the CAWS from Lake Michigan.
- **Dams at Lockport, IL and Brandon Road, IL** control the southward discharge into the Des Plaines River and the Illinois River system.

OTHER IMPORTANT LOCATIONS

The GLMRIS Alternatives include controls or other measures affecting several of the WRPs and regulating structures listed above. In addition to these locations, controls and structures were also sited at:

- **Alsip, IL**
- **Calumet City, IL**
- **Chicago, IL**
- **McCook, IL**
- **Oak Lawn, IL**
- **Thornton, IL**
- **Stateline, IL/IN**
- **Hammond, IN**

CHICAGO AREA WATERWAY SYSTEM



Aquatic Nuisance Species (ANS) Considered in GLMRIS

TARGET ANS SPECIES FOR GLMRIS

A list of ANS was compiled to provide focus for the set of options or control alternatives developed in GLMRIS to prevent ANS from transferring between the Great Lakes and Mississippi River basins.

ANS SCREENING PROCESS

A total of 254 ANS were determined by the GLMRIS Team to be present in either the Great Lakes or Mississippi River basins or both. Once this overall list of ANS in the study area was developed, several steps were completed to shorten the list. Species were removed from the list if they were:

- Already in both the Great Lakes and Mississippi River basins
- Not likely to move from one basin to the other through the CAWS
- Not likely to become a nuisance or invasive
- Not likely to cause moderate to severe harm

These steps shortened the list from 254 to 35 species. An assessment was completed to identify the level of risk or likelihood of each of the 35 species to cause harm if they were to enter a new basin. This process is called a "risk assessment."

As a result of the risk assessment, each species was given a rating of high, medium, or low, based on two factors:

- Whether the species were likely to enter and become established in the other basin; and
- The likelihood of causing harmful impacts if the species were to become established in the other basin.

After the ratings were assigned, species identified as having a low likelihood of impacts were removed from the list. The list of 35 species was reduced to a final list of 13 ANS target species identified as having either a medium or high risk of transfer between basins.

ANS RISK REDUCTIONS

Potential reductions in the risk of transfer were evaluated for each of the 13 species for each alternative plan. For descriptions of the ANS risk ratings and the ANS risk reduction expected for each alternative plan, please see the GLMRIS Report.

ANS Species Considered in GLMRIS Alternative Plans

Species Posing Risk to the Great Lakes Basin:

1. Scud
2. Bighead carp
3. Silver carp

Species Posing Risk to the Mississippi River Basin:

4. Bloody red shrimp
5. a Diatom
6. Fishhook waterflea
7. Grass kelp
8. Red algae
9. Reed sweetgrass
10. Ruffe
11. Threespine stickleback
12. Tubenose goby
13. Viral Hemorrhagic Septicemia virus (VHSv)

Silver Carp Photo credit: Desidor

Threespine Stickleback Photo credit: Carin Gondar

ANS Control Technologies Considered in GLMRIS Alternatives

SELECTION OF ANS CONTROL TECHNOLOGIES

Technologies that can be used to control the transfer of the 13 target ANS for GLMRIS were identified through a series of studies. From the original list of 96 technologies that were identified, several were selected as appropriate for consideration in the CAWS to minimize and/or prevent the transfer of ANS between the Great Lakes and Mississippi River basins.

ANS controls are either nonstructural or structural methods. Structural methods include the building and operation of structures to control the transfer of ANS.

NONSTRUCTURAL CONTROLS

Nonstructural controls can be installed or applied quickly and have relatively few potential safety risks associated with their use. They include methods like:

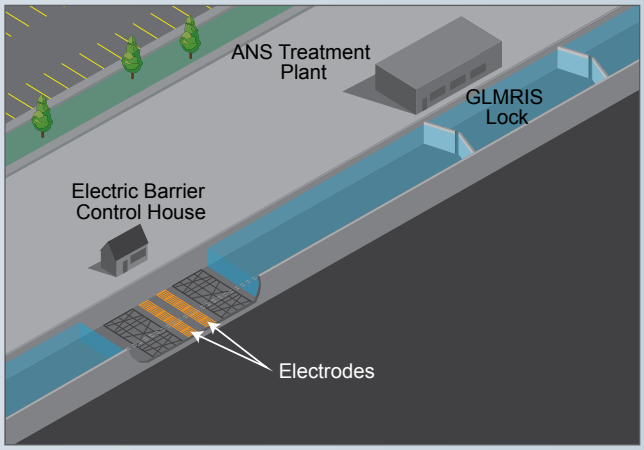
- Using nets to remove fish from a water body;
- Using registered chemicals to control plants or animals in a water body;
- Controlling boat access to a waterway and making cleaning stations available to boats going between different water bodies; and
- Education programs to help the general public understand the issues associated with ANS and how their everyday actions can influence the spread of ANS.

STRUCTURAL CONTROLS

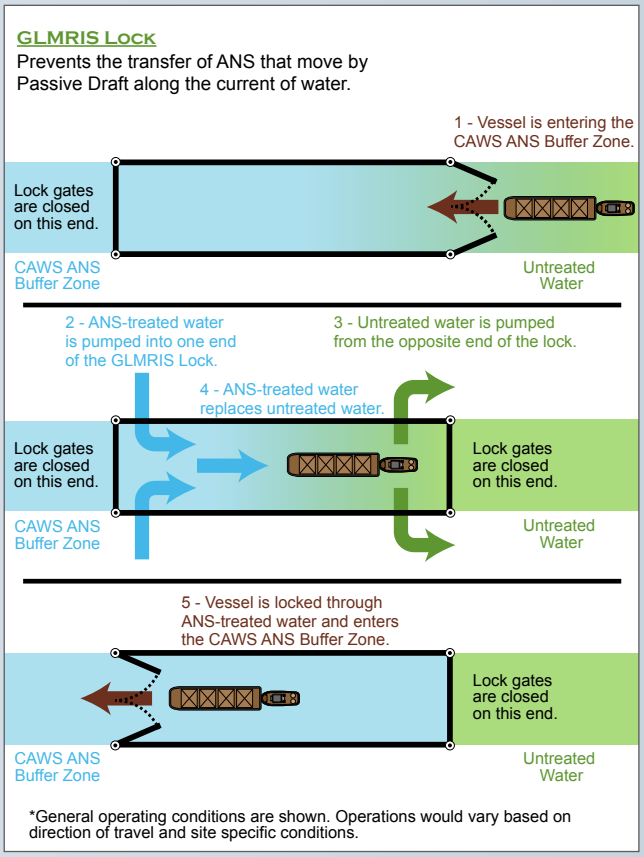
Structural control methods for the CAWS include GLMRIS Locks, electric barriers, ANS Treatment Plants, screened sluice gates, and physical barriers.

The GLMRIS Lock is a gate system that allows boat traffic to pass between water bodies and uses a system of structures and special equipment to control the transfer of ANS.

The lock is closed after a boat enters. ANS-treated water is then pumped into the lock, replacing the water that came in with the boat. The lock is then opened and the boat continues on its way. Electric barriers and ANS Treatment Plants are used in combination with the GLMRIS Lock system.

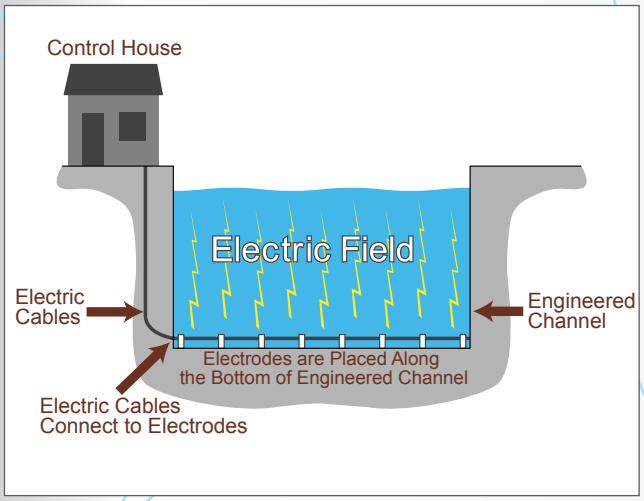


GLMRIS Lock System Layout



Boat Passing through a GLMRIS Lock

Electric barriers are included as part of the GLMRIS Lock to reduce the possibility of fish getting through the lock. The barrier uses electrodes in the bottom of the channel, powered by a control house, to create an electric field in the waterway. Fish are repelled or stunned by the electric field, which restricts their movement into the GLMRIS Lock.

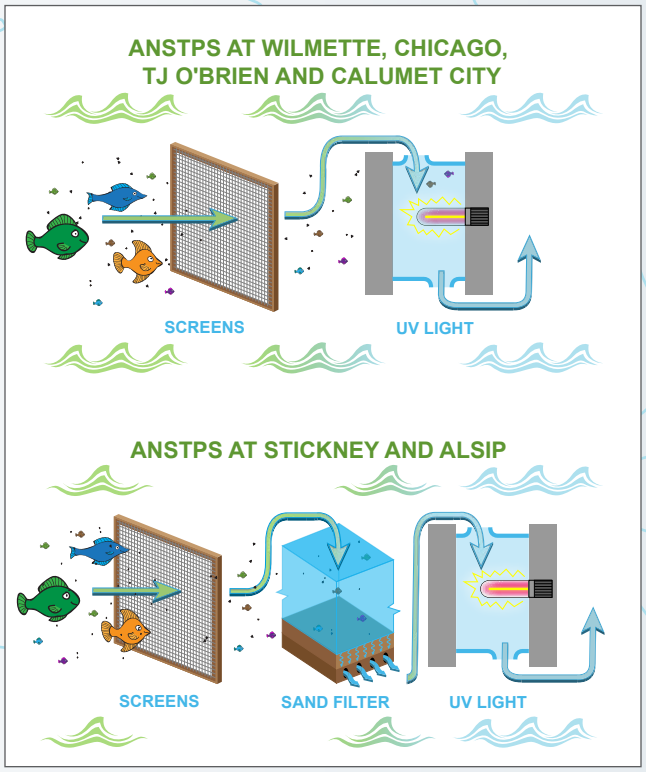


GLMRIS Electric Barrier Layout

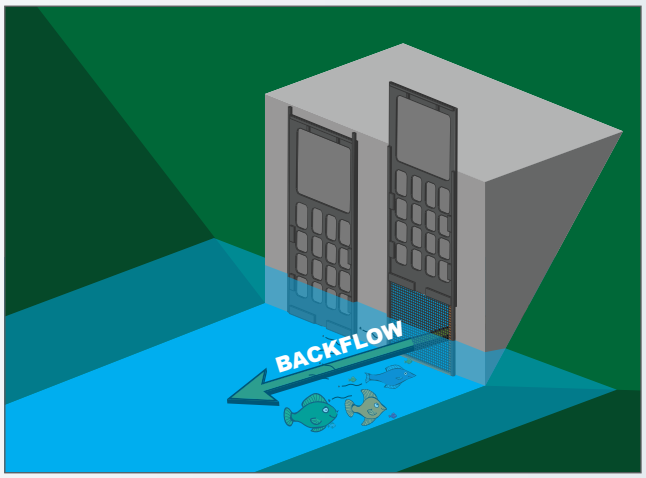
The ANS Treatment Plant (ANSTP) is a system to remove ANS from water used for operation of the GLMRIS Lock. The process of treating the water includes screening, filtration, and exposure to ultraviolet light (UV).

Screened sluice gates are used to control ANS transfer during flood conditions. They allow water to pass during significant flood conditions, but the screen controls fish passage through the structure.

Physical barriers are structural control measures used to separate one water body from another. Separation of water bodies provides a relatively high level of confidence that the transfer of ANS will be controlled. Barriers are built using concrete and sheet pile and could also be used as park space or pedestrian bridges.



GLMRIS ANS Treatment Plant Process



Screened Sluice Gates Operation

GLMRIS Alternatives: Overview

GLMRIS ALTERNATIVE PLANS

Eight alternative plans, including a "No New Federal Action-Sustained Activities" baseline alternative, were developed in the study with the goal of preventing ANS transfer between the Great Lakes and Mississippi River basins. The focus of these alternatives is control of the 13 target ANS species. Overviews of each alternative plan are presented in the following pages.

STRATEGIES USED IN ALTERNATIVE PLANS

There are several strategies for ANS control used in the GLMRIS Alternatives:

- **Nonstructural controls**- examples include education and outreach, pesticide use, and mechanical removal.
- **Structural ANS control technologies**- GLMRIS Locks, electric barriers, ANS treatment plants, screened sluice gates, and physical barriers.
- **Buffer zone**- an ANS-treated area of waterway created between upstream and downstream control technologies.
- **Hydrologic separation**- use of physical barriers placed in waterways to block aquatic connections between basins.
- **Hybrids**- combinations of the individual strategies.

USES AND USERS

In developing each GLMRIS Alternative, impacts to uses and users of the CAWS and Lake Michigan were evaluated, and the alternatives were formulated with the goal of minimizing impacts to them.

STRATEGIES USED IN EACH GLMRIS ALTERNATIVE

Alternative Plan	No New Actions	Non-structural Controls	Structural Control Technologies	Buffer Zone	Hydrologic Separation
1	X*				
2		X			
3		X	X		
4		X	X	X	
5		X	X		X
6		X	X		X
7		X	X	X	X
8		X	X	X	X

*Current and previously planned activities sustained

Among a larger array of uses and users of the CAWS, the primary elements considered in the study include:

Uses

- Flood risk management
- CAWS ecosystem
- CAWS water quality
- Lake Michigan water quality

Users

- Commercial navigation
- Noncommercial navigation
- Hydropower

MITIGATION

If significant impacts could not be minimized in an alternative, methods were developed to address the impacts as possible for each use or user. The planned methods for addressing impacts are termed "mitigation."

A set of four measures for mitigation of impacts were used in the GLMRIS Alternatives:

- **ANS Treatment Plant**- used in some alternatives for water quality mitigation in addition to ANS control.
- **Conveyance tunnel**- collects stormwater or wastewater and transports it to a storage reservoir; or reroutes WRP effluent to mitigate water quality impacts.
- **Reservoirs**- provides storage for excess stormwater and wastewater during rain events.
- **Sediment remediation**- cleanup of contaminants in sediments that may impact Lake Michigan in some alternatives.

PLANNING HORIZON

The effectiveness and impacts of each alternative were evaluated over a 50-year period. Conditions under the alternatives were compared to the baseline condition (Alternative Plan 1) at 0 years and at 10, 25, and 50 years.

COST OF THE ALTERNATIVE

For each alternative, the GLMRIS Report includes a rough estimate of the costs of implementing the alternative. This estimate includes the costs for both the ANS controls and any required mitigation to implement the alternative, though some of these costs may be borne by entities other than USACE.

Alternative Plan 1: No New Federal Action - Sustained Activities

ALTERNATIVE DESCRIPTION

Alternative Plan 1 assumes that the current and previously planned future actions for ANS control will continue without any additional GLMRIS controls. Therefore, the alternative serves as a reference point or "baseline condition" to compare with Alternative Plans 2 through 8.

For this baseline condition, the following local, state, and federal actions are assumed to occur:

- Commercial harvesting of Asian carp (bighead and silver carp).
- Electrofishing and response actions for Asian carp.
- Electric Dispersal Barriers Project for Asian carp (includes current and planned barriers).
- Research and development on ANS monitoring and control methods.

The alternative also assumes that all other ANS education, outreach, monitoring, and prevention activities currently supported will continue.

KEY STRUCTURAL ELEMENTS

There are no new structural ANS controls or mitigation structures for Alternative Plan 1.

ANS RISK REDUCTION

There is no reduced risk of ANS establishment with implementing Alternative Plan 1, as it is the baseline condition.

IMPACTS TO USES AND USERS

There are no additional impacts to uses and users for Alternative Plan 1, as this is the baseline condition.

ESTIMATED COSTS

There are no estimated costs for Alternative Plan 1, as this is the baseline condition.

ESTIMATED TIME UNTIL ALTERNATIVE IS COMPLETED = Not applicable. This is the baseline condition

Alternative Plan 2: Nonstructural Control Technologies

ALTERNATIVE DESCRIPTION

Alternative Plan 2 includes ANS Controls that do not require implementation of structural features and may be implemented relatively quickly.

Examples of nonstructural control measures include removal (e.g., netting), chemical control (e.g., use of herbicides), controlled waterway use (e.g., inspection and cleaning of watercraft before or after entry to a water body), and educational programs.

Successful implementation of this alternative is a shared responsibility. Since the activities proposed are not traditionally performed by USACE, these measures may need to be implemented by other stakeholder groups such as other federal agencies, state agencies, local municipalities, and nongovernmental organizations.

Nonstructural control technologies are most effective for fish and plant ANS.

KEY STRUCTURAL ELEMENTS

There are no new structural ANS controls or mitigation structures for Alternative Plan 2.

ANS RISK REDUCTION

Alternative Plan 2 is expected to reduce the risk of ANS establishment at the time steps shown below in green.

	Reduction in Risk at Year			
Species	**0**	**10**	**25**	**50**
Species Posing Risk to Great Lakes Basin				
Scud				
Bighead carp				
Silver carp				
Species Posing Risk to Mississippi River Basin				
Bloody red shrimp				
a Diatom				
Fishhook waterflea				
Grass kelp		X	X	X
Red algae				
Reed sweetgrass				X
Ruffe				
Threespine stickleback				
Tubenose goby		X		
VHSv				

IMPACTS TO USES AND USERS

The nonstructural measures are not anticipated to have significant impacts to waterway uses and users.

ESTIMATED TIME UNTIL ALTERNATIVE IS COMPLETED = 0 years - Immediate

ESTIMATED COSTS

Nonstructural Measure	Annual Cost
Education & Outreach	$4,000,000
Monitoring	$1,000,000
Pesticides	$2,000,000
Watercraft Inspection and Research	$1,500,000
Total Annual Cost per State	$8,500,000
States Nearest to the CAWS Participating	Minnesota, Wisconsin, Illinois, Indiana, Ohio, Michigan and Pennsylvania
Alternative Total	**$68,000,000**

Alternative Plan 3: Mid-System Control Technologies without a Buffer Zone

ALTERNATIVE DESCRIPTION

Alternative Plan 3 focuses on maintaining the current operations of the CAWS with a minimal number of control points. It includes nonstructural measures and two single-point ANS Control technologies located at Stickney and Alsip. These technologies reduce the risk of transfer of ANS between basins in both directions. The nonstructural measures described in Alternative 2 would also be implemented.

At both Stickney and Alsip, a new GLMRIS Lock would be constructed on the Chicago Sanitary and Ship Canal (CSSC) and the Cal-Sag Channel.

Approach channels would be built on either side of the lock and would include electric barriers to control fish from entering the lock chamber during use. An ANS Treatment Plant would provide the water for lockages to flush the locks of ANS not affected by the electric barriers.

The new locks would remain closed at all times unless a vessel needed to cross to the other side. The locks would remain closed to prevent passage of ANS during maintenance or power failures of the electric barriers.

The normal flow of the CAWS would be diverted from the channel on the lake side of the new locks, through ANS Treatment Plants at each location, and then discharged back to the river side of the new locks.

Significant flooding would result from this alternative without mitigation. Therefore, this alternative includes construction of three new GLMRIS reservoirs and conveyance tunnels to mitigate additional flooding risks.

KEY STRUCTURAL ELEMENTS

ANS Control Technologies

Location	GLMRIS Lock	Electric Barrier	ANS Treatment Plant	Screened Sluice Gates	Physical Barrier
Stickney	X	X	X		
Alsip	X	X	X		

Flood Risk Management Mitigation Measures

GLMRIS Reservoirs:

- McCook (Second reservoir) - 11.4 billion gallons
- Thornton (Second reservoir) - 15.8 billion gallons
- Oak Lawn (New reservoir) - 0.2 billion gallons

Conveyance Tunnels:

- Along the CSSC to McCook - 5 miles long, 14 feet in diameter
- Alsip to Thornton - 5 miles long, 16 feet in diameter

ANS RISK REDUCTION

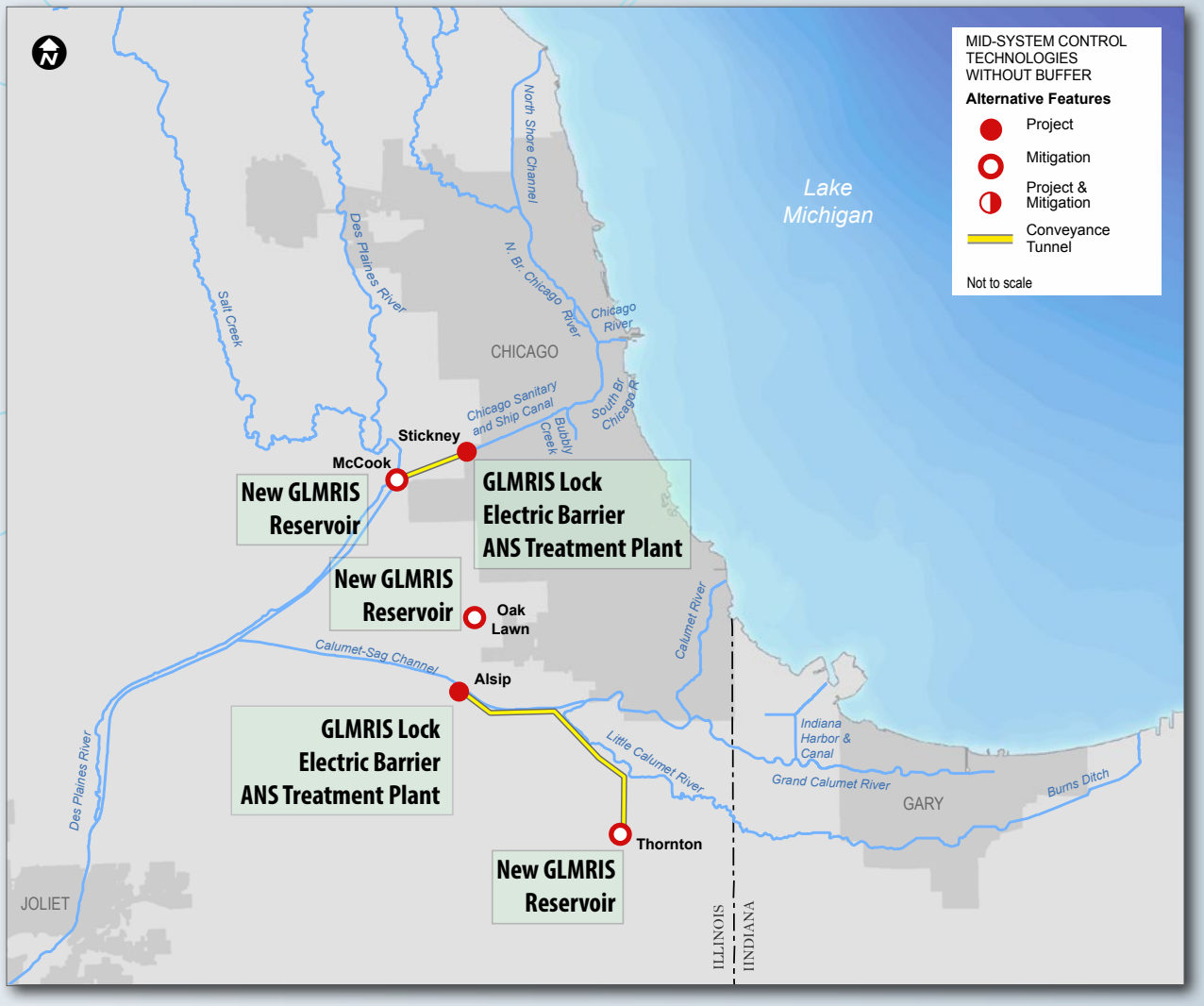
Alternative Plan 3 is expected to reduce the risk of ANS establishment at the time steps shown below in green.

	Reduction in Risk at Year			
Species	**0**	**10**	**25**	**50**
Species Posing Risk to Great Lakes Basin				
Scud				
Bighead carp			X	X
Silver carp			X	X
Species Posing Risk to Mississippi River Basin				
Bloody red shrimp			X*	X*
a Diatom				
Fishhook waterflea				
Grass kelp		X	X	X
Red algae				
Reed sweetgrass				X
Ruffe				X
Threespine stickleback			X*	X*
Tubenose goby		X	X	X
VHSv				

*Probability of establishment is high or medium at earlier time steps. Risk of ANS establishment is reduced provided no establishment occurs before plan implementation.

ESTIMATED TIME UNTIL ALTERNATIVE IS COMPLETED = 25 years

LOCATIONS OF ANS PREVENTION AND MITIGATION MEASURES



IMPACTS TO USES AND USERS

Uses Impacted

- [x] Flood Risk Management
- [x] CAWS Ecosystem
- [ ] CAWS Water Quality
- [ ] Lake Michigan Water Quality

Users Impacted

- [x] Commercial Navigation
- [x] Noncommercial Navigation
- [ ] Hydropower

ESTIMATED COSTS

Element	Costs (2014 dollars)
ANS Control Measures	$4,032,000,000
CAWS Ecosystem Mitigation Measures	$44,000,000
Water Quality Mitigation Measures	NA
Flood Risk Management Mitigation Measures	$9,140,000,000
Design/Construction Management	$2,257,000,000
Lands, Easements, Rights of Way Relocations, and Disposal Areas	$70,000,000
Operation, Maintenance, Repair, Replacement, & Rehabilitation (annual)	$145,500,000
Nonstructural Controls (annual)	$68,000,000
Alternative Total (does not include annual costs)	**$15,543,000,000**

Alternative Plan 4: Control Technology Alternative with a Buffer Zone

ALTERNATIVE DESCRIPTION

Alternative Plan 4 focuses on maintaining the current operations of the CAWS and creates an ANS-treated buffer zone within the CAWS. The buffer zone is the segment of the CAWS between the lakefront and the CAWS at Brandon Road.

The buffer zone is created by installing ANS control measures along the five aquatic pathways between the CAWS and Lake Michigan and by installing ANS control measures at the single downstream point of the CAWS at Brandon Road. The nonstructural measures described in Alternative 2 would also be implemented. The Buffer Zone allows for backup control points in the system and would serve as a zone where ANS response actions could occur, if necessary.

GLMRIS Locks with flushing chambers, engineered channels, and electric barriers would be installed at Chicago, T.J. O'Brien, and Brandon Road. ANSTPs and screened sluice gates would be included at Wilmette, T.J. O'Brien, and Chicago. Physical barriers would be constructed in the waterway at Stateline and Hammond.

Conveyance tunnels and reservoirs are included to mitigate for increased flood risks caused by the ANS control structures.

KEY STRUCTURAL ELEMENTS

ANS Control Technologies

Location	GLMRIS Lock	Electric Barrier	ANS Treatment Plant	Screened Sluice Gates	Physical Barrier
Wilmette			X	X	
Chicago	X	X	X	X	
T.J. O'Brien	X	X	X	X	
Stateline					X
Hammond					X
Brandon Road	X	X			

Flood Risk Management Mitigation Measures

GLMRIS Reservoirs:

Stateline (New reservoir) - 0.3 billion gallons

Thornton (Second reservoir) - 4.4 billion gallons

Conveyance Tunnels:

Hammond to Thornton - 7 miles long, 14 feet in diameter

ANS RISK REDUCTION

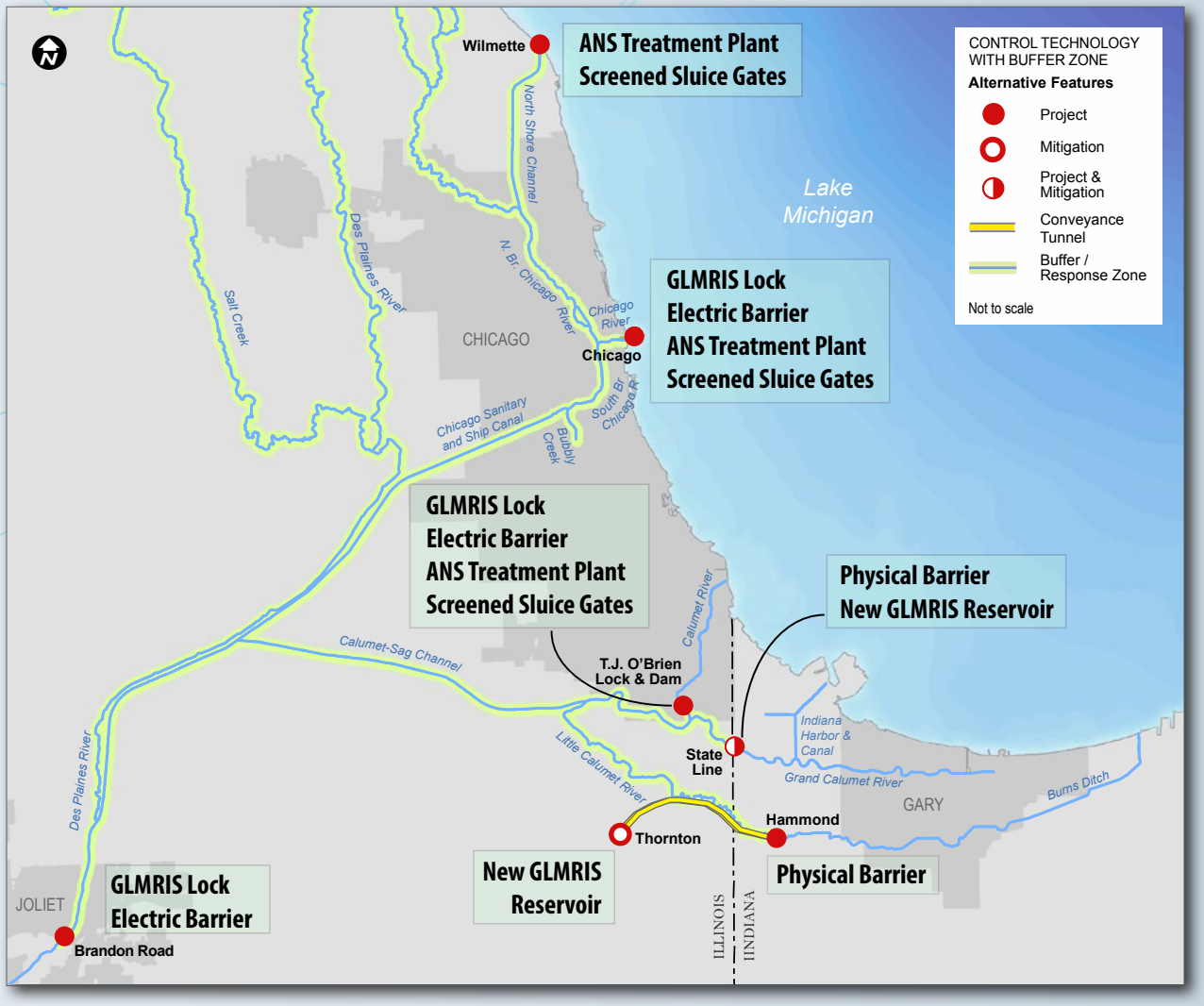
Alternative Plan 4 is expected to reduce the risk of ANS establishment at the time steps shown below in green.

	Reduction in Risk at Year			
Species	**0**	**10**	**25**	**50**
Species Posing Risk to Great Lakes Basin				
Scud				
Bighead carp			X	X
Silver carp			X	X
Species Posing Risk to Mississippi River Basin				
Bloody red shrimp		X*	X*	X*
a Diatom				
Fishhook waterflea				
Grass kelp		X	X	X
Red algae				
Reed sweetgrass				X
Ruffe				X
Threespine stickleback		X*	X*	X*
Tubenose goby		X	X	X
VHSv				

*Probability of establishment is high or medium at earlier time steps. Risk of ANS establishment is reduced provided no establishment occurs before plan implementation.

ESTIMATED TIME UNTIL ALTERNATIVE IS COMPLETED = 10 years

LOCATIONS OF ANS PREVENTION AND MITIGATION MEASURES



IMPACTS TO USES AND USERS

Uses Impacted

- ☒ Flood Risk Management
- ☒ CAWS Ecosystem
- ☒ CAWS Water Quality
- ☐ Lake Michigan Water Quality

Users Impacted

- ☒ Commercial Navigation
- ☒ Noncommercial Navigation
- ☐ Hydropower

ESTIMATED COSTS

Element	Costs (2014 dollars)
ANS Control Measures	$3,175,000,000
CAWS Ecosystem Mitigation Measures	$25,000,000
Water Quality Mitigation Measures	$1,559,000,000
Flood Risk Management Mitigation Measures	$1,980,000,000
Design/Construction Management	$1,037,000,000
Lands, Easements, Rights of Way Relocations, and Disposal Areas	$30,000,000
Operation, Maintenance, Repair, Replacement, & Rehabilitation (annual)	$150,500,000
Nonstructural Controls (annual)	$68,000,000
Alternative Total (does not include annual costs)	**$7,806,000,000**

Alternative Plan 5: Lakefront Hydrologic Separation

ALTERNATIVE DESCRIPTION

Alternative Plan 5 is focused on separating the hydrologic connection between the Great Lakes and Mississippi River basins at the Lake Michigan lakefront. This will be achieved through physical barriers located at Wilmette, Chicago, Calumet City, and Hammond. The nonstructural measures described in Alternative 2 would also be implemented.

Stagnant conditions and other water quality impacts are expected near the dead-end reaches of the CAWS where physical barriers would be placed. Therefore, this alternative includes ANS Treatment Plants located at Wilmette, Chicago, and Calumet City that would take flow from Lake Michigan, treat it, and discharge it into the CAWS to improve water movement and water quality.

Water quality in Lake Michigan would improve under this alternative because combined sewer and stormwater flows from the CAWS would not flow into Lake Michigan.

Significant flooding would result from this alternative without mitigation. Therefore, this alternative includes construction of two new GLMRIS reservoirs and conveyance tunnels to mitigate additional flooding risks.

KEY STRUCTURAL ELEMENTS

ANS Control Technologies

Location	GLMRIS Lock	Electric Barrier	ANS Treatment Plant	Screened Sluice Gates	Physical Barrier
Wilmette			X*		X
Chicago			X*		X
Calumet City			X*		X
Hammond					X

*For water quality mitigation in the CAWS

Flood Risk Management Mitigation Measures

GLMRIS Reservoirs:

McCook (Second reservoir) - 6.5 billion gallons
Thornton (Second reservoir) - 13.5 billion gallons

Conveyance Tunnels:

Wilmette to Chicago - 13 miles long, 22 feet in diameter
Chicago to McCook - 13 miles long, 42 feet in diameter
Calumet City to Thornton - 6 miles long, 30 feet in diameter
Hammond to Thornton - 7 miles long, 14 feet in diameter

ANS RISK REDUCTION

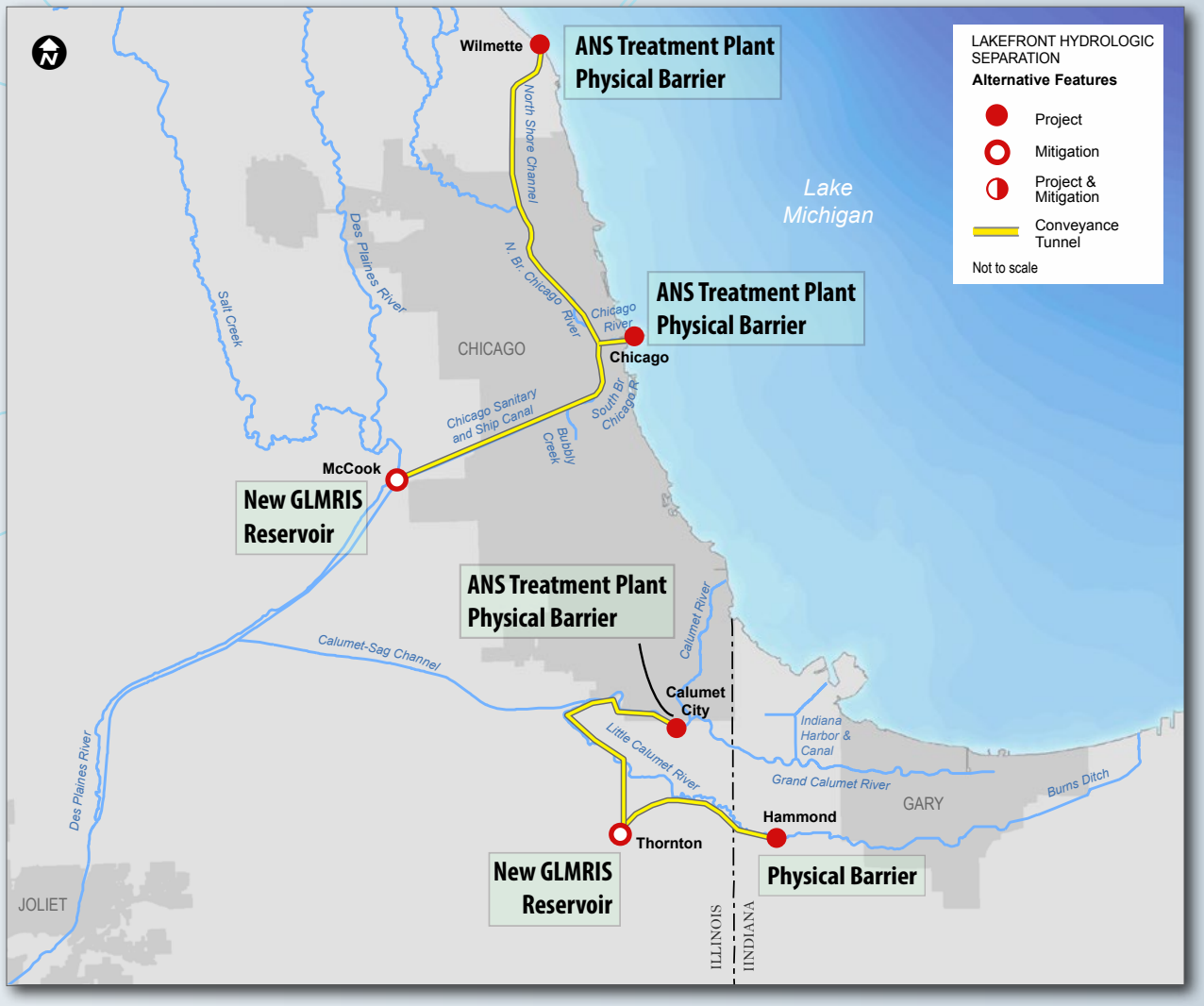
Alternative Plan 5 is expected to reduce the risk of ANS establishment at the time steps shown below in green.

	Reduction in Risk at Year			
Species	**0**	**10**	**25**	**50**
Species Posing Risk to Great Lakes Basin				
Scud			X*	X*
Bighead carp			X	X
Silver carp			X	X
Species Posing Risk to Mississippi River Basin				
Bloody red shrimp			X*	X*
a Diatom			X*	X*
Fishhook waterflea			X	X
Grass kelp		X	X	X
Red algae			X*	X*
Reed sweetgrass				X
Ruffe				X
Threespine stickleback			X*	X*
Tubenose goby		X	X	X
VHSv			X*	X*

*Probability of establishment is high or medium at earlier time steps. Risk of ANS establishment is reduced provided no establishment occurs before plan implementation.

ESTIMATED TIME UNTIL ALTERNATIVE IS COMPLETED = 25 years

LOCATIONS OF ANS PREVENTION AND MITIGATION MEASURES



IMPACTS TO USES AND USERS

Uses Impacted

- ☒ Flood Risk Management
- ☒ CAWS Ecosystem
- ☒ CAWS Water Quality
- ☐ Lake Michigan Water Quality

Users Impacted

- ☒ Commercial Navigation
- ☒ Noncommercial Navigation
- ☐ Hydropower

ESTIMATED COSTS

Element	Costs (2014 dollars)
ANS Control Measures	$446,000,000
CAWS Ecosystem Mitigation Measures	$47,000,000
Water Quality Mitigation Measures	$534,000,000
Flood Risk Management Mitigation Measures	$14,451,000,000
Navigation Mitigation Measures Cost	$129,000,000
Design/Construction Management	$2,704,000,000
Lands, Easements, Rights of Way Relocations, and Disposal Areas	$78,000,000
Operation, Maint., Repair, Replacement, & Rehabilitation (annual)	$87,000,000
Nonstructural Controls (annual)	$68,000,000
Alternative Total (does not include annual costs)	**$18,389,000,000**

Alternative Plan 6: Mid-System Hydrologic Separation

ALTERNATIVE DESCRIPTION

Alternative Plan 6 is focused on preventing the mixing of untreated water between the Great Lakes and Mississippi River basins by separating the hydrologic connection between the two basins. This alternative was developed to have minimal increased flood risk created by the separation. The nonstructural measures described in Alternative 2 would also be implemented.

This alternative differs from Alternative 5 in the location of the hydrologic separation. Two physical barriers would be placed at Stickney and Alsip- close to the historical separation point of the basins.

Stagnant conditions and other water quality impacts are expected in the CAWS if physical barriers are placed. Therefore, this alternative includes ANS Treatment Plants located at Stickney and Alsip that would take flow from the Lake Michigan side of the barriers, treat it, and discharge it into the CAWS to improve water movement and water quality.

The greatest impacts of Alternative Plan 6 are on Lake Michigan water quality. Treated discharges from the O'Brien and Calumet WRPs, hundreds of combined sewer overflows (CSOs), dozens of storm sewers, and discharges from five CSO pumping stations would be directed towards Lake Michigan on a continuous basis as a result of this alternative. Urban stormwater runoff and contaminated sediments would also contribute to project impacts to Lake Michigan.

For these reasons, the mitigation measures for this alternative include relocation of the WRP outfalls to discharge on the river side and construction of a new tunnel and reservoir system to capture all CSOs to prevent their discharge to the CAWS. Sediments would also be cleaned up on the lake side of the physical barriers.

ESTIMATED TIME UNTIL ALTERNATIVE IS COMPLETED = 25 years

KEY STRUCTURAL ELEMENTS

ANS Control Technologies

Location	GLMRIS Lock	Electric Barrier	ANS Treatment Plant	Screened Sluice Gates	Physical Barrier
Stickney			X*		X
Alsip			X*		X

*For water quality mitigation in the CAWS

Flood Risk Management Mitigation Measures

GLMRIS Reservoir:

Oak Lawn (New reservoir) - 0.2 billion gallons

Water Quality Mitigation Measures

Water Reclamation Plant Outfall Tunnels:

O'Brien WRP to Stickney - 12.5 miles long, 13 feet in diameter

Calumet WRP to Alsip - 5.3 miles long, 13 feet in diameter

GLMRIS Reservoirs:

McCook (Second reservoir) - 8.1 billion gallons

Thornton (Second reservoirs) - 5.2 billion gallons

Conveyance Tunnels:

North Shore Channel to McCook - 13 miles long, 32 feet in diameter

Hammond to Thornton - 7 miles long, 14 feet in diameter

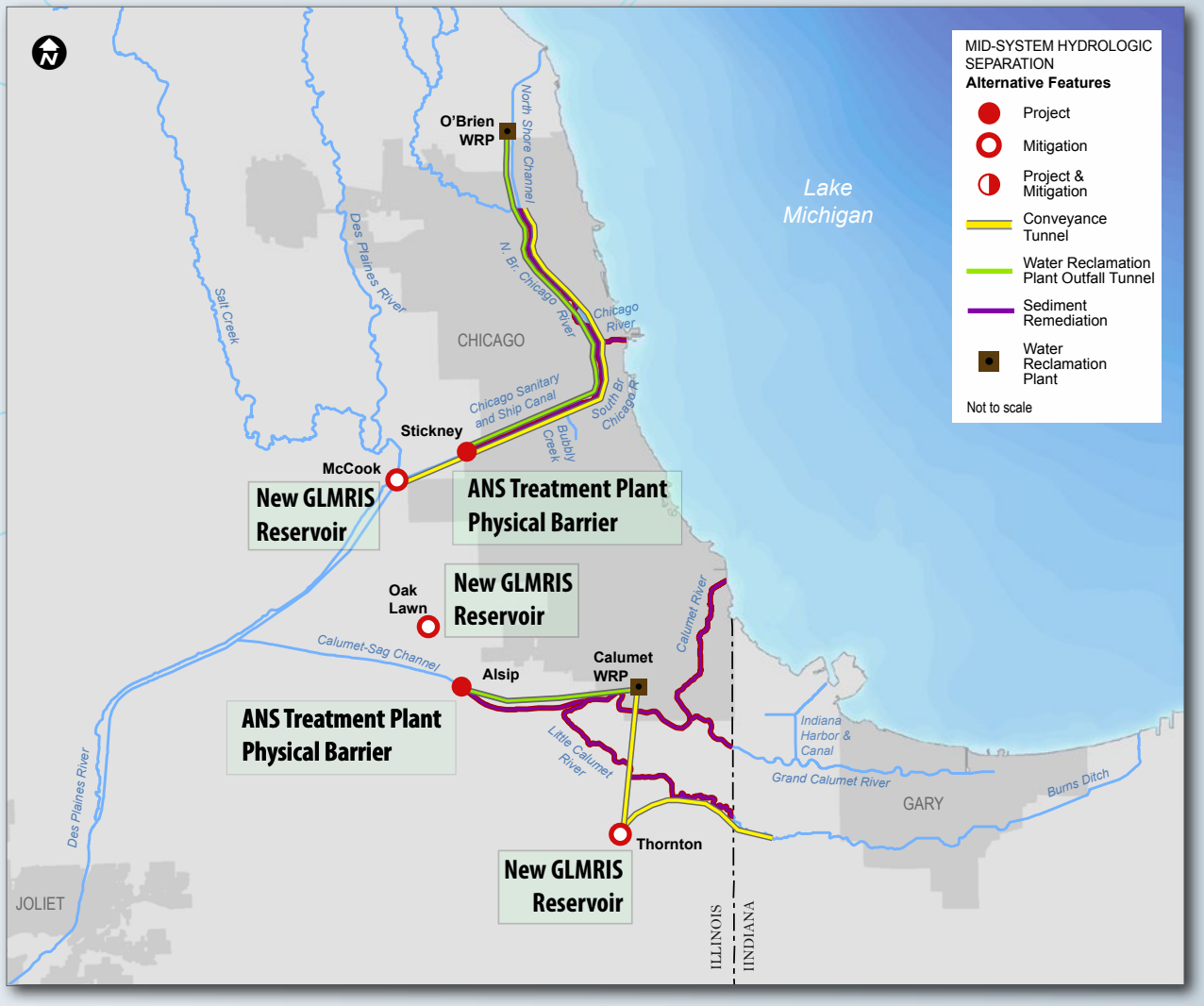
ANS RISK REDUCTION

Alternative Plan 6 is expected to reduce the risk of ANS establishment at the time steps shown below in green.

	Reduction in Risk at Year			
Species	**0**	**10**	**25**	**50**
Species Posing Risk to Great Lakes Basin				
Scud			X*	X*
Bighead carp			X	X
Silver carp			X	X
Species Posing Risk to Mississippi River Basin				
Bloody red shrimp			X*	X*
a Diatom			X*	X*
Fishhook waterflea			X	X
Grass kelp		X	X	X
Red algae			X*	X*
Reed sweetgrass				X
Ruffe				X
Threespine stickleback			X*	X*
Tubenose goby		X	X	X
VHSv			X*	X*

*Probability of establishment is high or medium at earlier time steps. Risk of ANS establishment is reduced provided no establishment occurs before plan implementation.

LOCATIONS OF ANS PREVENTION AND MITIGATION MEASURES



IMPACTS TO USES AND USERS

Uses Impacted

- ☒ Flood Risk Management
- ☒ CAWS Ecosystem
- ☒ CAWS Water Quality
- ☒ Lake Michigan Water Quality

Users Impacted

- ☒ Commercial Navigation
- ☒ Noncommercial Navigation
- ☐ Hydropower

ESTIMATED COSTS

Element	Costs (2014 dollars)
ANS Control Measures	$223,000,000
CAWS Ecosystem Mitigation Measures	$42,000,000
Water Quality Mitigation Measures	$12,886,000,000
Flood Risk Management Mitigation Measures	$24,000,000
Design/Construction Management	$2,257,000,000
Lands, Easements, Rights of Way Relocations, and Disposal Areas	$80,000,000
Operation, Maintenance, Repair, Replacement, & Rehabilitation (annual)	$67,000,000
Nonstructural Controls (annual)	$68,000,000
Alternative Total (does not include annual costs)	**$15,512,000,000**

Alternative Plan 7: Mid-System Separation Cal-Sag Open Control Technologies with a Buffer Zone

ALTERNATIVE DESCRIPTION

Alternative Plan 7 combines technologies and hydrologic separation to minimize impacts to existing CAWS uses and users. It includes three physical barriers located at Stickney, Stateline, and Hammond that will hydrologically separate four of the five aquatic pathways between the CAWS and Lake Michigan. The nonstructural measures described in Alternative 2 would also be implemented.

ANS control technologies would be located at T.J. O'Brien and Brandon Road to create a Buffer Zone on the remaining aquatic pathway. GLMRIS Locks with flushing chambers, engineered channels, and electric barriers would be included between T.J. O'Brien and Brandon Road. ANSTPs would be included at Stickney, Chicago, and T.J. O'Brien. Screened sluice gates would be included at T.J. O'Brien.

The Stickney barrier is expected to cause significant impacts to water quality in the South Branch Chicago River and the CSSC. An ANS Treatment Plant would be constructed at Stickney to mitigate these impacts. The T.J. O'Brien ANS Treatment Plant would also serve to mitigate impacts in the Cal-Sag Channel.

The greatest impacts of Alternative Plan 7 are on Lake Michigan water quality. Treated discharges from the O'Brien WRP, CSOs, storm sewers, and discharges from CSO pumping stations would be directed towards Lake Michigan on a continuous basis as a result of this alternative. Urban stormwater runoff and contaminated sediments will also contribute to project impacts to Lake Michigan.

For these reasons, the mitigation measures for this alternative include relocation of the O'Brien WRP outfall to discharge on the river side of the Stickney barrier and construction of a new tunnel and reservoir system to capture all CSOs on the Chicago River system and prevent their discharge to the Lake Michigan basin. Sediments would also be cleaned up on the lake side of the Stickney barrier.

ESTIMATED TIME UNTIL ALTERNATIVE IS COMPLETED = 25 years

KEY STRUCTURAL ELEMENTS

ANS Control Technologies

Location	GLMRIS Lock	Electric Barrier	ANS Treatment Plant	Screened Sluice Gates	Physical Barrier
Stickney			X*		X
T.J. O'Brien	X	X	X	X	
Stateline					X
Hammond					X
Brandon Road	X	X			

*For water quality mitigation in the CAWS

Flood Risk Management Mitigation Measures

GLMRIS Reservoirs:

Stateline (New reservoir) - 0.3 billion gallons

Thornton (Second reservoir) - 4.4 billion gallons

Conveyance Tunnels:

Hammond to Thornton - 7 miles long, 14 feet in diameter

Water Quality Mitigation Measures

Water Reclamation Plant Outfall Tunnels:

O'Brien WRP to Stickney - 12.5 miles long, 13 feet in diameter

GLMRIS Reservoirs:

McCook (Second reservoir) - 8.1 billion gallons

Conveyance Tunnels:

North Shore Channel to McCook - 13 miles long, 32 feet in diameter

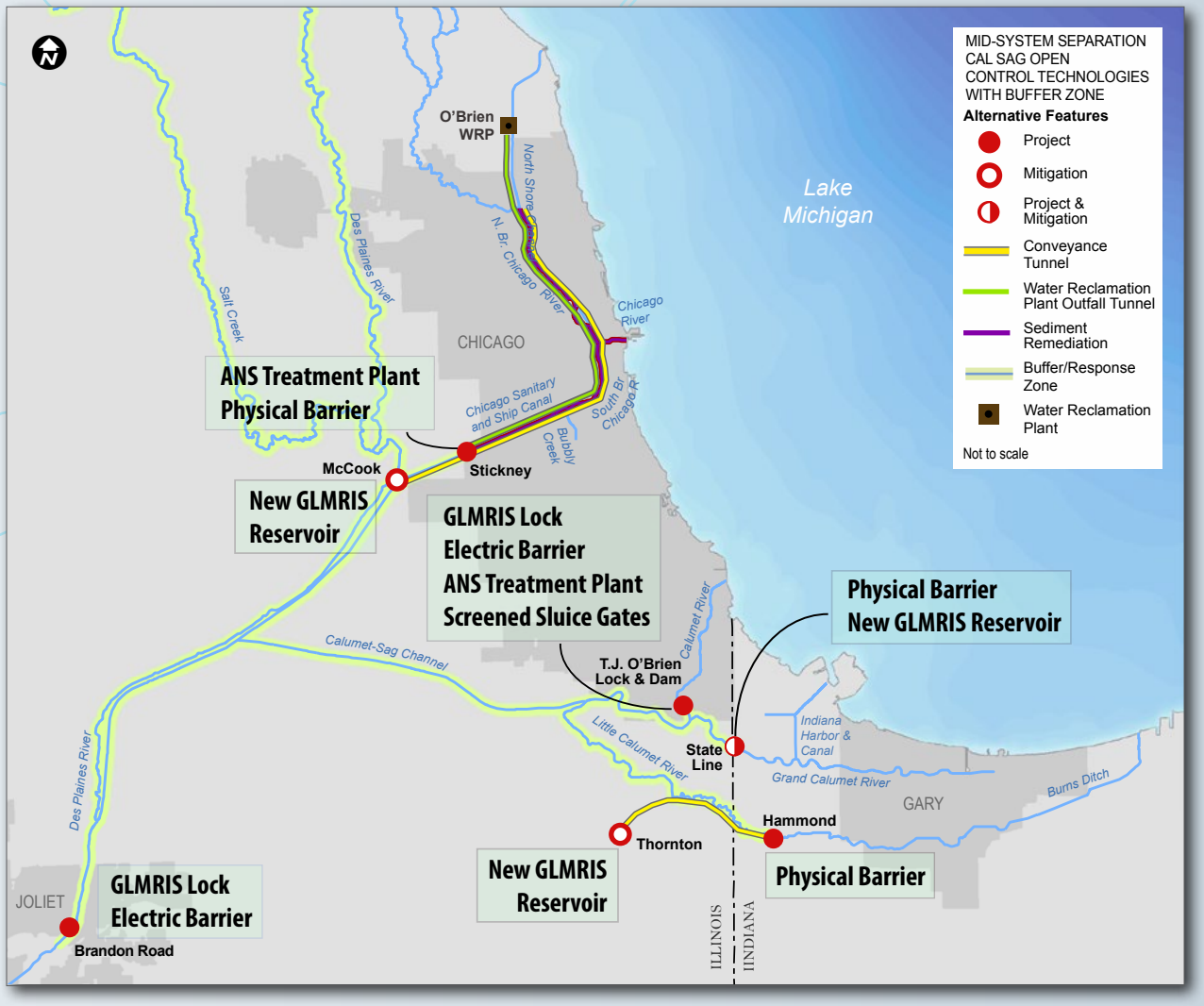
ANS RISK REDUCTION

Alternative Plan 7 is expected to reduce the risk of ANS establishment at the time steps shown below in green.

	Reduction in Risk at Year			
Species	**0**	**10**	**25**	**50**
Species Posing Risk to Great Lakes Basin				
Scud				
Bighead carp			X	X
Silver carp			X	X
Species Posing Risk to Mississippi River Basin				
Bloody red shrimp			X*	X*
a Diatom				
Fishhook waterflea				
Grass kelp		X	X	X
Red algae				
Reed sweetgrass				X
Ruffe				X
Threespine stickleback			X*	X*
Tubenose goby		X	X	X
VHSv				

*Probability of establishment is high or medium at earlier time steps. Risk of ANS establishment is reduced provided no establishment occurs before plan implementation.

LOCATIONS OF ANS PREVENTION AND MITIGATION MEASURES



IMPACTS TO USES AND USERS

Uses Impacted

- ☒ Flood Risk Management
- ☒ CAWS Ecosystem
- ☒ CAWS Water Quality
- ☒ Lake Michigan Water Quality

Users Impacted

- ☒ Commercial Navigation
- ☒ Noncommercial Navigation
- ☐ Hydropower

ESTIMATED COSTS

Element	Costs (2014 dollars)
ANS Control Measures	$2,716,000,000
CAWS Ecosystem Mitigation Measures	$44,000,000
Water Quality Mitigation Measures	$8,280,000,000
Flood Risk Management Mitigation Measures	$1,863,000,000
Design/Construction Management	$2,152,000,000
Lands, Easements, Rights of Way Relocations, and Disposal Areas	$42,000,000
Operation, Maintenance, Repair, Replacement, & Rehabilitation (annual)	$110,200,000
Nonstructural Controls (annual)	$68,000,000
Alternative Total (does not include annual costs)	**$15,097,000,000**

Alternative Plan 8: Mid-System Separation CSSC Open Control Technologies with a Buffer Zone

ALTERNATIVE DESCRIPTION

Alternative Plan 8 combines technologies and hydrologic separation to minimize impacts to existing CAWS uses and users. It includes a physical barrier at Alsip that will hydrologically separate three of the five aquatic pathways between the CAWS and Lake Michigan. The nonstructural measures described in Alternative 2 would also be implemented.

ANS control technologies would be located at Wilmette, Chicago, and Brandon Road to create Buffer Zones on the remaining aquatic pathways. GLMRIS Locks with flushing chambers, engineered channels, and electric barriers would be included at Chicago and Brandon Road. ANS Treatment Plants would be included at Wilmette, Chicago, and Alsip. Screened sluice gates would be included at Wilmette and Chicago.

The Alsip barrier is expected to cause significant impacts to water quality in the Cal-Sag Channel. The ANS Treatment Plant at Alsip would help mitigate these impacts.

The greatest impacts of Alternative Plan 8 are on Lake Michigan water quality. Treated discharges from the Calumet WRP, CSOs, storm sewers, and discharges from CSO pumping stations would be directed towards Lake Michigan on a continuous basis as a result of this alternative. Urban stormwater runoff and contaminated sediments will also contribute to project impacts to Lake Michigan.

For these reasons, the mitigation measures for this alternative include relocation of the Calumet WRP outfall to discharge on the river side of the Alsip barrier and construction of a new tunnel and reservoir system to capture all CSOs on the Calumet River system to prevent their discharge to the Lake Michigan basin. Sediments would also be cleaned up on the lake side of the Alsip barrier.

ESTIMATED TIME UNTIL ALTERNATIVE IS COMPLETED = 25 years

KEY STRUCTURAL ELEMENTS

ANS Control Technologies

Location	GLMRIS Lock	Electric Barrier	ANS Treatment Plant	Screened Sluice Gates	Physical Barrier
Wilmette			X*	X	
Chicago	X	X	X*	X	
Alsip			X*		X
Brandon Rd	X	X			

*For water quality mitigation in the CAWS

Flood Risk Management Mitigation Measures

GLMRIS Reservoir:

Oak Lawn (New reservoir) - 0.2 billion gallons

Water Quality Mitigation Measures

Water Reclamation Plant Outfall Tunnels:

Calumet WRP to Alsip - 5.3 miles long, 13 feet in diameter

GLMRIS Reservoir:

Thornton (Second reservoir) - 5.2 billion gallons

Conveyance Tunnels:

Hammond to Thornton - 7 miles long, 14 feet in diameter

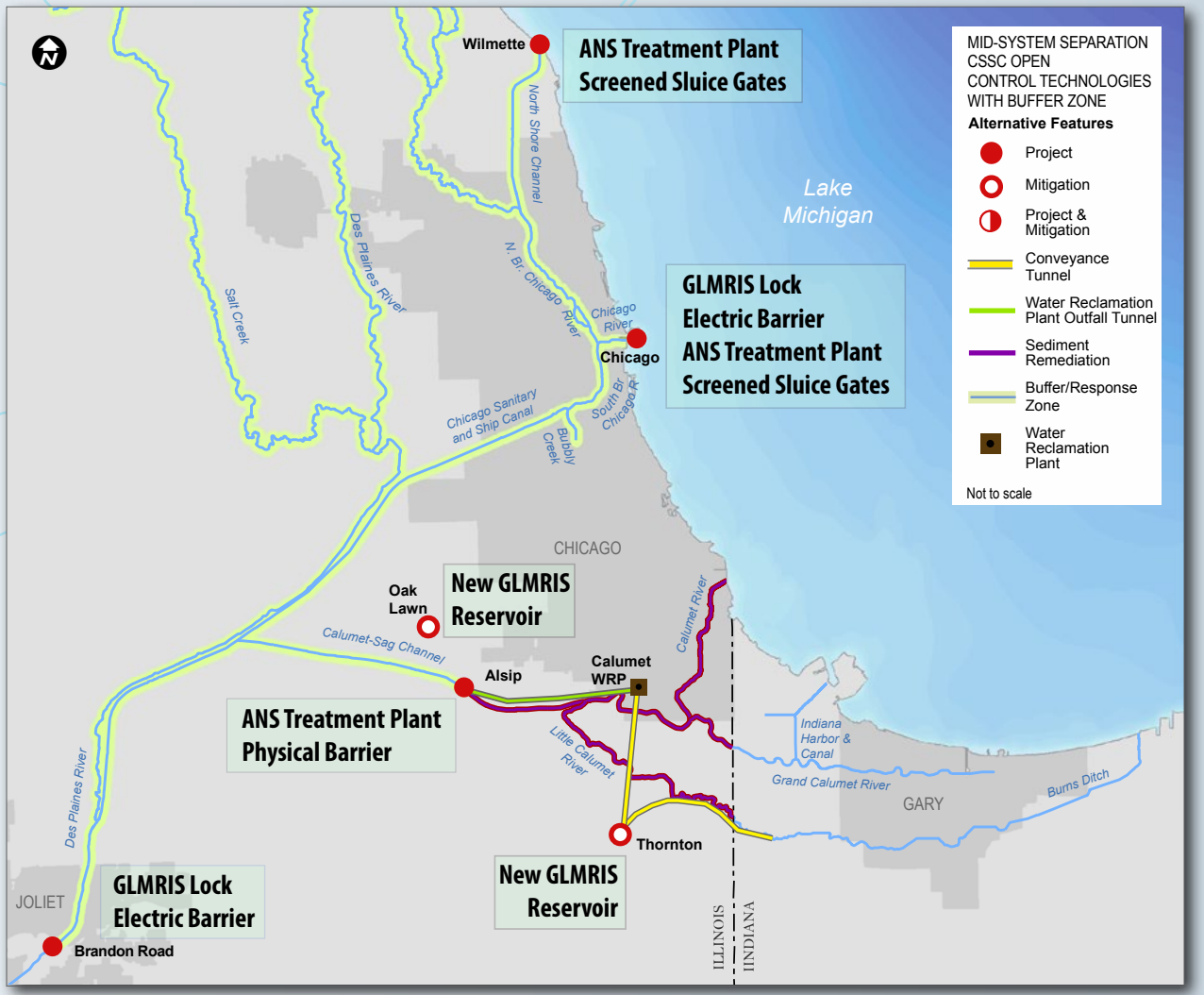
ANS RISK REDUCTION

Alternative Plan 8 is expected to reduce the risk of ANS establishment at the time steps shown below in green.

	Reduction in Risk at Year			
Species	**0**	**10**	**25**	**50**
Species Posing Risk to Great Lakes Basin				
Scud				
Bighead carp			X	X
Silver carp			X	X
Species Posing Risk to Mississippi River Basin				
Bloody red shrimp			X*	X*
a Diatom				
Fishhook waterflea				
Grass kelp		X	X	X
Red algae				
Reed sweetgrass				X
Ruffe				X
Threespine stickleback			X*	X*
Tubenose goby		X	X	X
VHSv				

*Probability of establishment is high or medium at earlier time steps. Risk of ANS establishment is reduced provided no establishment occurs before plan implementation.

LOCATIONS OF ANS PREVENTION AND MITIGATION MEASURES



IMPACTS TO USES AND USERS

Uses Impacted

- ☒ Flood Risk Management
- ☒ CAWS Ecosystem
- ☒ CAWS Water Quality
- ☒ Lake Michigan Water Quality

Users Impacted

- ☒ Commercial Navigation
- ☒ Noncommercial Navigation
- ☐ Hydropower

ESTIMATED COSTS

Element	Costs (2014 dollars)
ANS Control Measures	$2,643,000,000
CAWS Ecosystem Mitigation Measures	$26,000,000
Water Quality Mitigation Measures	$4,337,000,000
Flood Risk Management Mitigation Measures	$145,000,000
Design/Construction Management	$1,146,000,000
Lands, Easements, Rights of Way Relocations, and Disposal Areas	$36,000,000
Operation, Maintenance, Repair, Replacement, & Rehabilitation (annual)	$96,500,000
Nonstructural Controls (annual)	$68,000,000
Alternative Total (does not include annual costs)	**$8,333,000,000**

Conclusions and Next Steps

As described by this Summary document, the GLMRIS Report provides valuable information for both the public and decision-makers, including ideas regarding available options to control ANS, as well as the identification of potential impacts that alternatives may have on existing uses and users of the waterways. The Report also outlines mitigation measures that could be implemented for each identified alternative to minimize any adverse impacts on existing uses such as water quality, flood risk management, and commerce.

As ANS control is a shared responsibility among federal, state, and local agencies, as well as the public, continued participation by stakeholders is essential to reach a decision and authorization for a collaborative path forward. In order to promote this dialog, the engagement of regional stakeholders will continue to be a focus of the study team after the release of the GLMRIS Report.

Immediately after the release of the GLMRIS Report, an open public comment period will allow interested parties to provide statements for the record using the study web site, via traditional mail, or at a series of public meetings held throughout the Great Lakes and Upper Mississippi River basins.

As the conversation continues, collaborative groups such as the Asian Carp Regional Coordinating Committee, which is comprised of federal, state, and local governments and associated regulatory agencies – will continue to play a significant leadership role. Continued partnerships among these agencies will facilitate coordinated efforts toward the protection of aquatic and environmental resources and shape future decisions regarding long-term ANS strategies.

Lake Superior near Brimley, MI

Lockport Locks

Mississippi River

Glossary

Algae – a simple, nonflowering plant that contains no stems, roots, or leaves and can range in size from single-celled plants (such as red algae) to large seaweed (such as grass kelp).

Aquatic nuisance species (ANS) - plants, animals, or pathogens that, when introduced into a new habitat, can produce harmful impacts on aquatic ecosystems and on human uses of these systems.

Aquatic pathway – a means of transport of species between basins through natural and man-made waterways. Examples include streams, rivers and channels, as well as seasonal and intermittent connections.

Non-aquatic pathway - a means of transport of species between basins that is not aquatic. Examples include land-based transfer, waterfowl migration, recreational uses (such as fishing and water sports) and accidental and unregulated stocking.

Basin – the land area drained by a river and its tributaries. For example, the Great Lakes basin includes the land area from which streams and rivers ultimately flow to one of the Great Lakes.

Biodiversity (also referred to as biological diversity) - the abundance and variety of plant and animal species in a particular area or region. The presence of aquatic nuisance species can impact biodiversity by competing with native species for food, resulting in the decline of native species abundance.

Buffer zone – a segment of waterway between the lakefront and downstream control points that serves as a zone where an aquatic nuisance species response action could occur, if necessary.

Crustaceans – an aquatic animal, such as a crab or lobster, that has several pairs of legs and a body made of sections that are covered in a hard outer shell. Several crustaceans, including the fishhook waterflea, scud, and bloody red shrimp, have been identified as aquatic nuisance species in the study area.

Ecosystem – a complex system of interdependent relationships between a community of plants and animals with its environment.

Electric dispersal barrier – a technology used to control the movement of fish within the study area. The barrier is created by a system that creates an electric field in the water that discourages fish from crossing.

Flood risk management - reducing flood risk through mitigation planning, preparation, response, and recovery. The CAWS is used to convey floodwater away from the Chicago area to minimize the risk of flood damages.

Hydrologic separation – a method to separate connected waterways by placing physical structures at key points in the waterway system to control the movement of aquatic nuisance species between the basins.

Jurisdictional – the boundaries defined by a government or other authority, e.g., a city or a county.

Lockage – the passage of a boat or ship through a lock like those found on the CAWS.

Watershed – the land area drained by a river and its tributaries. For example, the Great Lakes basin includes the land area from which streams and rivers ultimately flow to one of the Great Lakes.

To find out more about GLMRIS, visit the following locations:

Web: http://glmris.anl.gov/

Twitter: https://twitter.com/glmris

Facebook: https://www.facebook.com/glmris

Contact the GLMRIS Project Team via email at:

glmris@usace.army.mil

Ecosystems | Aquatic Nuisance Species | Navigation | GLMRIS Great Lakes and Mississippi River Interbasin Study | Recreation | Flood Risk Management | Water use

Appendix B. Decision Management Plan

Alternatives Milestone (VT Concurrence on Final Viable Array of Alternatives)
DECISION MANAGEMENT PLAN

ID	Criteria	Metric	Information Needed	Action (What are we going to get this info)	Lead	Level at which Decision needs to be made	Due Date
Technical Significance Decisions							
P1	Effectiveness at Preventing Interbasin Transfer (At time of implementation)	Qualitative Rating of one to four stars based on semi-quantitative value obtained using a ranking algorithm - RISK REDUCTION	Existing data collected in the GLMRIS Report including FWOP conditions, information on potential ANS Control measures, and ANS Risk Assessments.	Create plans based on formulation strategies of: nonstructural; controls that target three modes of transport (Active swimming, floating by current, and adhering to objects moving through the waterway); and combinations of controls targeting modes of transport. Establish interdependencies. Eliminate odd combos that don't make sense. Screen out redundancies. Additional vertical team IPRs may be required before the TSP to discuss alternatives as they move from strategies to combinations of ANS control measures	Kendall Zaborowski	PDT	30-Jan-15
P2	(For new lock management measures) - Transportation efficiency	Qualitative evaluation of the potential benefits for replacing the existing 600ft Navigation Lock with a 1200 ft Navigation Lock	Review of LMPS data along the Illinois waterway to determine the vessel traffic passing through Brandon Road and the closest navigation structures	Determine if evaluating expanding the lock in addition to constructing a new lock as part of ANS Control measures	Chris Bouquot	PDT	15-Dec-14
E1	Flow availability in the Federal Channel	Determine the minimum required flow in the channel to support exchange of water in the existing lock	Existing flow data of the Illinois Waterway	Determine the minimum flow required to inform engineering on flushing lock management measures	Kirk Sunderman	PDT	1-Dec-14
E2	New lock construction	Effectiveness of lock at preventing ANS transfer	Existing condition of lock; potential navigation impacts of rehabbing old lock; cost to rehab; cost of new construction; rehabilitation requirements of existing lock	Conduct assessment of existing lock conditions and viability of retrofitting it to add ANS control component. Review impacts to navigation due to construction schedule of retrofitting of new locks. Evaluate costs of retrofitting versus new construction. Determine effectiveness of retrofit versus new construction	Kirk Sunderman	PDT	30-Jan-15
E3	Flushing lock as a viable control measure for floating ANS	Effectiveness at exchanging water within a reasonable time frame to allow for navigation	Methods of exchanging water; timing of those methods; limiting safety factors for barges and other vessels within a lock chamber while exchange is occurring	Conduct numeric and 3-D models to determine most viable method of exchanging / flushing water in an active lock. Conduct a physical model of the most viable alternative	Kirk Sunderman	PDT	30 Jan 2015 / 1 Nov 2015
P3	Consequence Assessment of impacts of ANS on the Great Lakes	Economic impacts to specific GL species due to the establishment of ANS in the GL	Current GL species of economic interest; affect of ANS on GL species populations	Perform consequence assessment by utilizing existing NOAA developed ecological models of Lakes Michigan, Huron, Erie, and Ontario that show the impacts and changes of biomass of GL species due to the establishment of Asian Carp. Use the results of those ecological models to feed an economic model that will show impacts to specific GL species (determined to be most economically significant)	Kendall Zaborowski	PDT	30-Oct-14
P4	Availability of ANS Controls	ANS Control is available and would be effective if applied in a field application	Latest research from USGS, IL-DNR and other agencies on the development of ANS Controls	Reach out to other resource agencies and researchers to update the GLMRIS Report baseline information and find out the latest status and availability of ANS Controls	Johnna Potthoff	PDT	30-Jan-15

P5	Reduction in the Probability of Establishment based on GLRMIS Risk Assessment methodology	Change in probability percentage (displayed with uncertainty bounds)	Information to populate five probability elements (Pathways exists, ANS arrival at pathway, ANS transit pathway, ANS Colonize, ANS spread)	Conduct an update of the GLMRIS qualitative Risk Assessment, turning it into a quantitative Risk Assessment using expert elicitation to characterize the uncertainty for some of the probability elements	Kendall Zaborowski	PDT	30-Jun-14
P6	Measures are combinable without reducing effectiveness of physical separation of the waterway	Measures are combinable without reducing effectiveness	Barge structural capability out of water; Hull fouling ANS	Barge lifting measures will not be considered with this planning effort	Kendall Zaborowski	PDT	15-Nov-14
P7	Environmental and Economic condition of the GL	Existing Great Lakes species	Review of Great Lakes species and the economic status	Establish a Reference Condition equal to the existing condition of the GL	Kendall Zaborowski	PDT	15-Nov-14
Institutional Significance Decisions							
P8	The study is exempt from the $3M total cost restriction	3 x 3 x 3 Exemption waiver from HQUSACE	Detailed PMP, Risks, and study Decisions	The PDT is going to seek a 3 x 3 x 3 Exemption Waiver for this planning effort for the overall cost of the study effort	Susanne Davis	DCG - CEO	25-Dec-14
P9	Nonfederal Sponsor requirement	Guidance from HQUSACE on how to proceed in the absence of a nonfederal sponsor	USACE policy and guidance on nonfederal sponsors	Coordinate with the vertical team on policy and guidance on continuing the study without a Nonfederal Sponsor	Susanne Davis	ASA (CW)	28-Feb-15
P10	Ecosystem Protection	Guidance from HQUSACE on how to proceed as an ecosystem protection study	USACE policy and guidance on nonfederal sponsors	Coordinate with the vertical team on policy and guidance on conducting the study as Ecosystem Protection under the ecosystem restoration business line	Susanne Davis	HQUSACE	28-Feb-15
P11	FWOP Condition Assessment of Asian Carp management actions	Actions that are planned for the likely future	Current actions of other resource management agencies	Meet with Illinois DNR, USFWS, and USGS to determine if they will continue taking actions that affect the probability of establishment of Asian Carp in the GL	Susanne Davis	PDT	28-Feb-15
P12	ANS Management as a USACE Mission	Guidance from HQUSACE on participating in ANS Management actions	USACE mission areas, policies, and guidance	Coordinate with the vertical team on policy and guidance regarding ANS Management as a USACE mission	Susanne Davis	HQUSACE	28-Feb-15
Public Significance Decisions							
P13	NEPA Scoping Comments	NEPA Scoping comment period	Relevant agencies and stakeholder groups	Conduct two public NEPA Scoping meetings in the project area, send out agency scoping letters, and maintain a comment system on the GLMRIS web site through the duration of the NEPA scoping period	Susanne Davis	PDT	30-Jan-15
P14	Scope of the Study effort	Scope of the study	GLMRIS Report findings on Brandon Road	One way transfer	Kendall Zaborowski	HQUSACE	15-Dec-15
P15	Scope of the Study effort	Scope of the study	GLMRIS Report findings on Brandon Road	Aquatic Pathways near Brandon Road	Kendall Zaborowski	HQUSACE	15-Dec-15

Tentatively Selected Plan
DECISION MANAGEMENT PLAN

ID	Criteria	Metric	Information Needed	Action (What are we going to get this info)	Lead	Due Date
P1	Effectiveness at Preventing Interbasin Transfer (At time of implementation)					
E	Implementation (years)					
	Effectiveness: Swimmers					
	Effectiveness: Floaters					
	Effectiveness: Hitchhikers					
P2/N	Negative Environmental Impacts (vicinity of Brandon Rd Lock & Dam)					
E	Negative Water Quality Impacts					
E	Water Quality Mitigation Measures Cost					
P3	Commercial Cargo Cost Impacts - during construction		FWOP - None. FWOP condition established. FWP - Construction duration. Would businesses wait for two years? If not, annual impacts may occur. Need information about tonnage offloaded at Joliet	Verify nav data. Utilize existing nav surveys.	Econ: Chris, Dena, James	
P4	Commercial Cargo Cost Impacts - annual		Obtain most current waterborne commerce data and LPMS data from appropriatte sources Survey - How long would a construction period/temporary closure last before you went out of business? How would permanent lock closure affect your business? How much additional lockage time could you accept before you changed current business practices	Perform survey; coordinate with Inland Nav Design Center to get construction and lockage time approximations (?); Collect new data from WCSC	Dena Abou - Chris Bouqout	Time Frame …. Max … Max 1 year. June 2015 … (?)
P5	Non-Cargo Navigation Impacts		Review LMPS data at Brandon Road	H/M/L rating based on existing Brandon Road data	Dena Abou - Chris Bouqout	Time Frame …. Max … Max 1 year. June 2015 … (?)
P6	Complexity of Regulatory Compliance					
E	Cost of the Alternative					
	(ANS Control and Mitigation Measures)					
E	Nonstructural and OMRR&R Costs					
E/N	Health and Safety Impacts					
	(is this covered in reg compliance?)					
E	Uncertainty of Technologies					
P7/N	Regional Impacts		Not economic … more like AQ based on more trucks on the road and such …			
			Economic evaluation is Dependent on FWOP? Regional impacts analysis on jobs /etc ?			
	ENGINEERING START					
	Effectiveness at Preventing Interbasin Transfer		What is the low flow history at Brandon Rd. Lock and Dam?	Obtain records for flow from USGS, MWRD, NOAA	Toby Hunemuller	10/31/14
	Effectiveness at Preventing Interbasin Transfer		What is the base flow requirements for flushing of the lock? Volume 11x600x110	Calculate volume requirements for flushing low pool lock chamber	Toby Hunemuller	10/31/14
	Effectiveness at Preventing Interbasin Transfer		What's the risk of fish passing through the headgates? When are the headgates open? Other measures might be needed if so (fish screens)	Look at distribution of velocity across gate opening, the time of operatings, and then do a risk assessment	Toby Hunemuller and Johnna Pothoff	10/31/14
	Effectiveness at Preventing Interbasin Transfer		Investigate alternative pathways. Where is the sewer outflow? Little I&M gate and lock?	Review historic documents; Efficacy Study and implementation of Fish Barrier Bypass Fence	Kirk Sunderman	10/31/14

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			Effectiveness of individual ANS Control measures. Identify incremental benefit of risk reduction			
	Cost of the Alternative		What should the configuration of the enginnering channel be? Concrete flume? Steel structure? Essentially the typical cross section of the channel. (NOT CHANNEL ALIGNMENT)	Determine Engineered Channel Configuration:	Zach Langel; Laura Vanden Berg	
			To handle Electric Current from EB	Assumption of CHANNEL ALIGNMENT based on building a new lock versus retrofitting old lock		
			To handle hydrogun pressure			
			To handle consistent CO2 deployment			
			Other consistent chemical applications			
			What is electric supply at Brandon Road - is it sufficient (issues at current electric barrier)			
	Effectiveness at Preventing Interbasin Transfer		What is the level of effectiveness of a flushing lock? Potentially not enough water supply in that pool. What level of detail is necessary to include in final alternatives array?	1. Ask fisheries guys what velocity they need for how long. Define what level/speed/volume of flushing is needed. Do this measure first		
				What is the necessary level of water in the pool?		
	Cost of the Alternative			How will we phase construction of the alternative? Design and Construction.		
	Effectiveness at Preventing Interbasin Transfer			What are the performance criteria for each of the measures and associted mitigation needs for adverse impacts (nav, safety, env etc). Reliability		
	Implementation years		# of years. Sooner is better. Operational in less than 10 years necessary.	How long will it take to design and construct. Schedule of implementation		
				Existing condition of lock structure and assessed value		
	Effectiveness at Preventing Interbasin Transfer			Assess effectiveness/performance of other measures - list out here and assign people		
	Negative Water Quality Impacts		HML	Assess impacts of selected measures on water quality	Modeling exercise	
	Nonstructural and OMRR&R Costs			What is utility and supply bill? Additional lock staff, equimpment replacement. What is baseline value of navigation going through the lock?		
	Health and Safety			What are health impacts of measures? Related to reliability.	Get information from OSHA, Coast Guard, use national standards from NEMA code	

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Appendix C. Risk Registers

A	B	C	D	E	F	G	H	I
Milestone	**Risk Number**	**Date**	**Scoping Choice or Event**	**Risk and its cause**	**Risk Type**	**Consequence**	**Consequence rating**	**Evidence for Consequence rating**
SMART milestone or IPR (for summary sheet only)	*Id number*	*Date entry was last updated*	*This is the scoping choice (task, decision, problem, question, issue) or event (action, hazard or opportunity) that is to be managed.*	*Briefly identify the risk. Considering the entry in column* **D**, *what can go wrong as a result of the scoping choice or event and how can it happen?*	*Select: Study Risk (Analytical error, study delays, study cost increase, poor planning decision), Implementation Risk (schedule and cost of implementation, redesign), or Outcome Risk (hazard risk and project performance risk)*	*Describe the consequence of the column* **E** *risk. If things do "go wrong" in the way described what is the specific consequence for the study or project outcomes? (List the most significant consequence first if more than one.)*	*If the most significant consequence in column* **G** *occurs what is its potential magnitude?*	*Enter specific evidence used to support the consequence rating in column* **H.** *If relying on an event from a previous study, list study and date.*
	1 Planning	18-Sep-14	Conduct mathematical and physical model of ANS Flushing Lock concept (aka GLMRIS Lock)	The flushing concept behind the GLMRIS lock is regularly used in chemical engineering applications, but has never been used on this scale. There is a level of uncertainty of the potential ANS control that can only be brought down with mathematical and physical models. The model may not be needed ultimately to recommend a TSP and the resources spent in creating it could have been used to advance other areas of the study.	Study Risk	Without conducting the model, there is a risk that the ANS control may not be effective. There will also be large uncertainty in how effective it is, uncertainty to what its impacts to navigation are, and uncertainty if it can produce a safe operating environment. Without conducting the model in the study phase, if a lock modification were to be recommended the model would need to then be built, delaying implementation of time sensitive solutions. Other uncertainties in the study may have been ignored to fund a component that was not needed to make a TSP.	High	The proposed GLMRIS Lock in the GLMRIS Report has never been constructed. The concept is applied regularly, just not at this scale or for this purpose.
	2 Planning	18-Sep-14	Collect up-to-date research about ANS Controls being developed outside of USACE	New information about ANS Controls not included in GLMRIS Report Alternatives is available, particularly from USGS and Il DNR. This new information could identify potentially more effective ANS Controls for use.	Study Risk	Without considering these ANS Controls, USACE may not select the most effective or acceptable ANS Control as part of it's recommendation	High	Stakeholder support of an alternative is going to be crucial to the success of ANS control. ANS Control is a shared responsibility among many different agencies and stakeholder groups.
	3 Planning	18-Sep-14	Conduct ecological models to conduct a quantitative consequence assessment of ANS establishment in the GL	The uncertainty of how ANS will behave in a new environment.	Study Risk	The FWOP condition is not accurately described.	High	The large uncertainty in the scientific community.
	4 Planning	20-Nov-14	Continue the Study without an identified Nonfederal sponsor	The study could complete without a nonfederal sponsor	Implementation Risk	Based on law, a cost sharing partner is required for ecosystem restoration projects, without one a project may not proceed to construction.	High	Recommendations would not be able to be implemented
		20-Nov-14	Continue the Study without an identified Nonfederal sponsor	Study could be deemed noncompliant with USACE policy	Study Risk	The study could be terminated	High	Existing USACE policies
	5 Planning	20-Nov-14	Conduct the study with a priority of ecosystem protection under the ecosystem restoration mission area	Study could be deemed noncompliant with USACE policy because it may not include restoration elements with protection elements	Study Risk	A study that is nontraditional in terms of USACE policy	Low	This is an atypical look at ecosystem restoration in terms of USACE planning and policy
	6 Planning	20-Nov-14	This study will only consider preventing the one way transfer of Mississippi River ANS into the Great Lakes	The study authority calls for two way prevention of ANS from the MR into the GL and vice versa	Study Risk	A recommendation that does not address the entirety of the study authority	Low	Based on findings in the GLMRIS Report and the fact that there is a consensus around stakeholder groups that addressing transfer in this direction is an appropriate first step.
	7 Planning	20-Nov-14	The study will only consider preventing the transfer of ANS via aquatic pathways near Brandon Road	The study authority calls for preventing ANS transfer along aquatic pathways along the GL and MR basin divide, although it does specifically indicate the CAWS as the priority aquatic pathway	Study Risk	A recommendation that does not address the entirety of the study authority	Low	Based on findings in the GLMRIS Report and the fact that there is a consensus around stakeholder groups that addressing transfer along this pathway is an appropriate first step.
	8 Planning	20-Nov-14	Lifting barges over physical barriers will not be considered as a management measure because they reintroduce the residual risk of hull fouling species bypassing control points	The full range of management measures are not considered	Study Risk	A different plan could possibly be recommended	Low	This was studied previously in the GLMRIS Report
	9 Planning	20-Nov-14	Utilize GLMRIS Risk Assessment that identified ANS of Concern while updating with up-to-date information of ANS	New information about ANS not included in GLMRIS Report Alternatives could be available, particularly from USGS and Il DNR. This new information could identify changes in the existing list of ANS of concern.	Study Risk	The full range of species may not be considered, or a species that is already established in both basins may be considered	High	Potential ANS could cause significant impacts to ecosystems
	10 Planning	20-Nov-14	The FWOP condition relies upon the Shared Responsibility belief that other resource management agencies will continue to take their actions in managing Asian Carp populations	Resource Managers may not continue management actions with the same robust effort into the future	Study Risk	FWOP condition of Asian Carp risk of establishment may be under represented	High	The current level of effort taken by other resource management agencies to control the Asian Carp population
	11 Planning	20-Nov-14	ANS management actions are not a stand alone USACE mission area	The study may identify recommendations that may not be within USACE's mission to implement (outside the Federal interest)	Implementation Risk	Recommendations may not be implemented	Medium	An action would not be taken to address the study authority
	12 Planning	20-Nov-14	The ecological reference condition of the Great Lakes will be the same as the existing condition of the Great Lakes. The Great Lakes ecosystem has a variety of native and non-native species already established.	This study is being operated as an ecosystem protection study. As such, the reference condition is the same as the existing condition. The Great Lakes is currently a degraded ecosystem.	Study Risk	Actions to restore the condition of the Great Lakes will not be considered, so degration may continue due to causes other than the establishment of MR ANS in the GL that transferred via CAWS aquatic pathways	Low	The Great Lakes have a long history of human impacts. Any reference condition would include consideration of past human activities.
	13 Planning	20-Nov-14	The measured benefit of alternatives will be the reduction in the probability of passage of individual ANS based upon the implementation of an alternative. The probablity of passage is based on the risk assessment methodology developed in the GLMRIS Report. An traditional NED or NER analysis will not be conducted.	Study could be deemed noncompliant with USACE policy	Study Risk	A study that is noncompliant with USACE policy	Low	There have been other recent USACE studies that have evaluated alternatives through means other than traditional NED or NER analyses
	14 Planning	21-Nov-14	Apply for a waiver to the $3M study requirement of the 3 x 3 x 3 planning process.	If the study is conducted at the $3M limit, several elements of large uncertainty would remain in the study, affecting the ability of USACE to confidently recommend a plan, or provide enough evidence in selecting a plan that would reasonably satisfy policy, NEPA, and stakeholder requirements.	Outcome Risk	Lawsuits filed by many various entities attacking the lack of supporting evidence for a recommendation.	High	USACE has already faced several lawsuits about its role in preventing ANS transfer from many different states and stakeholder groups.

J	K	L	M	N	O	P	Q
Likelihood rating	**Evidence for likelihood rating**	**Uncertainty rating**	**Risk Rating**	**Risk Management Options**	**Conclusion/ Recommendation**	**POC**	**Affected Study Component**
*What is the likelihood that the most significant consequence in column **G** will occur?*	*Enter specific evidence used to support the likelihood rating in column **J**. If relying on an event from a previous study, list study and date.*	*How great is the uncertainty about either the consequence or likelihood of the risk identified in column **E** ?*	*Qualitative risk rating from lookup table.*	*Enter options for reducing the risk and estimate time/cost impacts associated with the management option.*	*Identify any preferred recommendation for managing the risk. Tolerating the risk is the default option.*	*Name(s) of person(s) assessing the task and responsible for task*	*What other analyses of the study are affected by this risk? For example, what other analyses use outputs from the scoping choice as their input.*
Medium	The concept is proven, just not this application.	High	High	1. Build a demonstration project.	Tolerate the risk and proceed	A. Planner	Cost, Real Estate, Engineering, Planning, Economics
Medium	A lot of research was done for the GLMRIS Report and USACE continues to participate in regional ANS control meetings	High	High	1. Conduct models of other ANS Controls 2. Apply other ANS Controls in field applications to determine effectiveness	Tolerate the risk and proceed	A. Planner	Cost, Real Estate, Engineering, Planning
High	There is very little evidence or data to support accurate predictions.	High	High	1. Conduct a live study of allowing ANS to establish in a very similar water body and document their affects. 2. Conduct a qualitative consequence assessment	Tolerate the risk and proceed	A. Planner	Planning, Economics
High	Currently there is not a nonfederal sponsor identified. Local and regional stakeholders view this as a Federal issue	High	High	1. Work to identify a nonfederal sponsor 2. Coordinate with USACE vertical team on policy requirements of this issue	Adopt suggested risk management options	A. Planner	Planning, Real Estate, Engineering, Cost
Medium	Uncertainty in if a policy waiver would be granted	Medium	High	1. Coordinate with USACE vertical team on policy requirements of this issue	Adopt suggested risk management options	A. Planner	Planning
Medium	Recent large USACE studies in the Louisiana Coastal Area have examined measures under ecosystem protection	Low	Low	1. Coordinate with USACE vertical team on policy requirements of this issue	Adopt suggested risk management options	A. Planner	Planning
High	The scope of this study is set such that the entirety of this study authority will not be addressed by the study's recommendation	Low	Medium	1. Rescope the study to include the evaluation of two way transfer solutions	Tolerate the risk and proceed	A. Planner	Cost, Real Estate, Engineering, Planning, Economics
High	The scope of this study is set such that the entirety of this study authority will not be addressed by the study's recommendation	Low	Medium	1. Rescope the study to include the evaluation of solutions along the entire basin divide	Tolerate the risk and proceed	A. Planner	Cost, Real Estate, Engineering, Planning, Economics
Low	This was studied previously in the GLMRIS Report	Low	Low	1. Consider barge lifting management measures	Tolerate the risk and proceed	A. Planner	Planning
Medium	A large amount of data was collected for the GLMRIS Report, although there was not much or recent data for some ANS	Medium	High	1. Conduct detailed field surveys for ANS	Adopt suggested risk management options	A. Planner	Planning, Economics
Medium	Fiscal uncertainty in governmental budgets at all levels	Medium	High		Tolerate the risk and proceed	A. Planner	Planning
Low	Work has been done under this study authority for four previous years	Low	Low	1. Coordinate with USACE vertical team on policy requirements of this issue	Adopt suggested risk management options	A. Planner	Planning
High	Actions to restore the condition of the Great Lakes will not be considered	Low	Medium	1. Coordinate with USACE vertical team on policy requirements of this issue	Tolerate the risk and proceed	A. Planner	Planning, Economics
High	Measuring Habitat Units or creating a BCR are not practical for this study	Low	Medium	1. Coordinate with USACE vertical team on policy requirements of this issue 2. Develop a different methodology in analyzing project benefits	Adopt first suggested risk management option	A. Planner	Planning, Economics
High	USACE has already faced several lawsuits about its role in preventing ANS transfer from many different states and stakeholder groups.	Low	High	1. Conduct the study for more than $3M to target key uncertainties in the study.	Adopt suggested risk management options	A. Planner	Planning, Economics, Engineering, Real Estae, Cost

Item	Date	Scoping Choice or Event	Risk and its cause	Risk Type	Consequence	Consequence rating	Evidence for Consequence rating	Likelihood rating
Id number	*Date entry was last updated*	*This is the scoping choice (task, decision, problem, question, issue) or event (action, hazard or opportunity) that is to be managed.*	*Briefly identify the risk. Considering the entry in column* **D**, *what can go wrong as a result of the scoping choice or event and how can it happen?*	*Select: Study Risk (Analytical error, study delays, study cost increase, poor planning decision), Implementation Risk (schedule and cost of implementation, redesign), or Outcome Risk (hazard risk and project performance risk)*	*Describe the consequence of the column* ***E*** *risk. If things do "go wrong" in the way described what is the specific consequence for the study or project outcomes? (List the most significant consequence first if more than one.)*	*If the most significant consequence in column* ***G*** *occurs what is its potential magnitude?*	*Enter specific evidence used to support the consequence rating in column* **H.** *If relying on an event from a previous study, list study and date.*	*What is the likelihood that the most significant consequence in column* ***G*** *will occur?*
1 Eng	3-May-12	Use WSE from H&H and topo to determine heights and lengths of levees, floodways, or other features	Those lengths and heights used could be wrong		Affects the cost estimate	Medium	There is an inherint margin of error and iteration with H&H	High
2 Eng	3-May-12	Cost of alternative based on levee alignment	Cost is wrong		Could screen alternatives incorrectly	High	Cost is a key Evaluation Criteria	High

Evidence for likelihood rating	Uncertainty rating	Risk Rating	Risk Management Options	Conclusion/ Recommendation	POC	Affected Study Component	Notes
*Enter specific evidence used to support the likelihood rating in column **J**. If relying on an event from a previous study, list study and date.*	*How great is the uncertainty about either the consequence or likelihood of the risk identified in column **E** ?*	*Qualitative risk rating from lookup table.*	*Enter options for reducing the risk and estimate time/cost impacts associated with the management option.*	*Identify any preferred recommendation for managing the risk. Tolerating the risk is the default option.*	*Name(s) of person(s) assessing the task and responsible for task*	*What other analyses of the study are affected by this risk? For example, what other analyses use outputs from the scoping choice as their input.*	*Make note of any significant information not provided in the other cells.*
First iteration. It is likely that H&H will change WSE	High	High	1. Use better topo data. 2. Get locations of utility, infrasturcture, HTRW, Farmland Trusts, etc. 3. Site visit/recon.	Tolerate the risk and proceed	A. Planner	Cost, Real Estate, Cultural Resources, Environmental, Geotech	
It is not likely that a huge error would occur	High	High	1.Use unit costs 2. 10% design detail cost estimates	Tolerate the risk and proceed	B. engineer	Economics, Real Estate, Design, Environmental	

This page contains information used to define ratings for the Consequence, Likelihood, and Confidence columns.
The Risk Rating is calculated / autofilled based on the Likelihood and Consequence ratings according to the table below.

Determination of Risk Rating

		Consequence Rating			
		High	Medium	Low	None
Likelihood Rating	High	High	High	Medium	None
	Medium	High	Medium	Low	None
	Low	Medium	Low	Low	None
	None	None	None	None	None

Consequence Rating

High—the consequence of this risk is unacceptable
Medium—the consequence of this risk can be tolerated
Low—the consequence of this risk is ofrelatively insignificant concern
None--there are no undesirable consequences associated with the proposed action

Likelihood Rating

High—the undesirable consequence is more likely than not to occur
Medium—the undesirable consequence is about as likely to occur as not occur
Low—the undesirable consequence is more likely not to occur than to occue
None—the probability of undesirable consequence is zero or so low as to be effectively treated as a zero based on evidence.

High
Medium
Low
None

Confidence Rating

High-all relevant facts are known
Medium-good evidence is available, data gaps are not significant
Low-there is some good evidence and but the data gaps include some significant ones
None-there is little to no concrete evidence available

Study Risk
Implementation Risk
Outcome Risk

Appendix D. Work Breakdown Structure

I. Inventory and Forecast of ANS Passage

I.D.	Risk Management Option	Description of Risk Management Option	Total Costs
I.1	Review current literature	● Review current literature for a qualitative description of Asian carp impacts on the Great Lakes Basin (GL).	$ 100,000
I.2	Analysis and QA/QC of NOAA's Modeled Assessment	● QA/QC of the NOAA foodweb models that were designed to identify the impacts of Asian Carp on the Great Lakes fisheries.	$ -
I.3	Food Web Modeling of ANS Impacts on Great Lakes - Collaboration with NOAA	● Running NOAA foodweb models for USACE specific scenarios (scud - uncertain).	$ -
I.4	Analysis of Social and Political Impacts of ANS	● Utilize literature and expert analysis to quantify social and/or political impacts of ANS transfer	$ 75,000
I.5	Fisheries Economic Analysis	● Results of the NOAA food web models will identify the impact of Asian carp may have on commercial, recreational, and charter fishing activities. ●Economic analysis is to establish the change to the value of these fishing activities given Asian carp establishment.	$ 70,000
		Subtotal	**$245,000**

II. Engineering Analysis

I.D.	Risk Management Option	Description of Risk Management Option	Total Costs
		Numerical and Physical Modeling	
II.1	Numeric modeling of the ANS Lock Flushing alternatives	● Approximate flushing time ● H&H analysis of water supply ● Develop 3-D model of lock chamber ● In stream data collection ● Analysis of flushing method alternatives	$ 152,000
II.2	Numeric modeling Eng Flushing Channel	● Approximate flushing time ● Hydraulic gradient flow conditions ● H&H analysis of water supply ● Develop 2-D HEC-RAS model ● Develop 3-D model of engineered channel ● Analyze effect of barge induced current on flushing	$ 225,000
II.3	Physical Model of ANS Flushing Lock and Engineered Channel	● Validation of numerical model ● Accurate estimates of locking times	$ 1,400,000
II.4	Electric Barrier Operations Optimization	● Consultation and development of optimized operating parameters	$ -
II.5	Barge Entrainment Analysis	● Review the laboratory testing that was previously completed for the current electric barrier system ● Assess engineering considerations for electric barrier	$ -
II.6	Barge Entrainment Study	● Physical model and laboratory testing to further analyze fish entrainment and methods to minimize it	$ -
		Subtotal	**$1,777,000**

I.D.	Risk Management Option	Description of Risk Management Option	Total Costs
		ENGINEERING INVESTIGATION	
II.7	Geotechnical Exploration	● Obtain soil borings of existing approach channel bottom	$ -
II.8	HTRW	● Prepare a technical appendix that identifies and evaluates recognized environmental conditions at or near the proposed project site.	$ 15,000
II.9	Hull Fouling	● Compile information about 20 biocides, 4 piscicides, 6 aquatic herbicides, and 5 water treatment chemicals identified in ANS Control Report, including: neutralization mechanism; contact time; health and safety concerns; product availability; cost; required dose and permitting requirements.	$ 24,000
II.10	Stray Current Investigation (Assuming Electric Barrier selected)	● Determine possible impacts to surrounding facilities due to electric barrier and how to mitigate stray current	$ 100,000
		Subtotal	**$139,000**

I.D.	Risk Management Option	Description of Risk Management Option	Total Costs
		ENGINEERING ANALYSIS	
II.11	ANS Lock Analysis	● Analysis of the ANS Lock and conceptual level construction costs	$ 400,000
II.12	Engineered Channel Ananlysis	● Structural analysis of an approach channel for implementation of ANS controls and continued ANS control research; conceptual level construction costs (If electric barrier is selected, see stray current investigation below.)	$ 450,000
II.13	ANS Control Analysis	● Evaluation and optimizing operating parameters to maximize effectiveness and minimize operational costs; conceptual level construction costs; power source	$ 270,000
		ENGINEERING REVIEW	
II.11	VE Study	● Assessment of the project to find efficiencies	$ -
II.12	Cost Schedule Risk Analysis	● To identify opportunities and risks to the project	$ -
II.13	Reviews	● Targeted ATR of engineering evaluation	$ -
		MISC.	
II.17	Travel	● Travel for meetings and site visits	$ 70,000
		Subtotal	**$1,190,000**
		Total	**$3,106,000**

III. Alternative Effectiveness

I.D.	Risk Management Option	Description of Risk Management Option	Total Costs

III.1	Update ANS Control Research and Research Mississippi River ANS	● Research Mississippi Basin ANS to determine whether conditions of the previously assessed ANS have changed and warranted changed status to high or medium risk ANS. ● Update information pertaining to ANS controls based on new research.	$ 100,000
III.2	Scud (Apocorophium Lacustre) Survey	● Research the current location of the scud and conduct a survey to determine whether the scud is established in the Great Lakes Basin. (Can't complete till summer 2015.)	$ -
III.3	Quantitative Assessment of the Probability of Establishment	● Convene expert elicitation panels: 1) without project and 2) with project conditions Asian carp and possibly the scud. Perform expert elicitations to inform the uncertainty of each alternative.	$ 325,000
III.4	Plan Formulation and Evaluation of Alternatives	● Identify requirements for Brandon Road study ● Analysis to compile gathered information ● Prepare and screen alternative plans	$ 375,000
		Subtotal	**$800,000**

IV. Level of Impacts and NEPA Analysis

I.D.	Risk Management Option	Description of Risk Management Option	Total Costs
IV.1	Inventory and forecast resource conditions	● Inventory and forecast economic, biological, existing waterway uses, social/env justice and special status species ● Fish and Wildlife Coordination Act Coordination	$ 150,000
IV.2	Evaluation of alternative impacts	● Evaluate alternative impacts on existing waterway uses & users, regional rail/truck, and bio resources	$ 200,000
IV.3	Cumulative effects assessment of the TSP	● Evaluate the physical/biological, socio-economic and secondary and tertiary effects of the TSP	$ 250,000
IV.4	Mitigation Planning	● Develop mitigation plans to address TSP impacts to native species connectivity, navigation, cultural resources (i.e. historic properties, etc.), water quality, etc.	$ 180,000
IV.5	Statutory and Other Applicable Requirements	● Assess and identify the requirements of the Clean Air Act (general conformity), Clean Water Act, fishing treaties, etc. for the alternatives.	$ 150,000
IV.6	Adaptive Management and Monitoring	● Develop ANS control testing plan development and efficacy testing. ● Collaborate and consult with other local, state and federal agencies regarding this work. ● Develop a plan to adaptively manage the TSP.	$ 200,000
IV.7	NEPA EIS comment analysis	● Create and manage a database of comments received during the draft EIS public comment period to allow for comprehensive consideration of comments and comment evaluation.	$ 160,000
IV.8	Document Preparation and Editing	● Complete editorial and formatting services on the Environmental Impact Statement document. ● Draft the document and edit it to incorporate comments received during the NEPA public comment period and State and Agency Review, etc.	$ 100,000
IV.9	Economic evaluation of navigation impacts associated with alternatives	● Each alternative plan has two considerations, navigation impacts for near-term construction period and long-term operational changes. ● Includes baseline, future with, and future without project conditions ● Results will show changes to transportation cost savings for each alternative plan.	$ 360,000
		Subtotal	**$1,750,000**

V. Planning, Project Management & Stakeholder Engagement

I.D.	Major Planning Study Tasks	Description of Tasks	Total Costs
V.1	Project Management	● Integrate bi-divisional, national study team ● Oversight of schedule, budget, and execution ● Maintain stakeholder, congressional, and media relationships	$ 720,000
V.2	Planning Management	●Integrate bi-divisional planning team ●Oversight of all planning and economics activities	$ 381,600
V.3	Preparation of 3x3x3 Exemption Request	● Prepare documentation for 3x3x3 exemption ● Respond to vertical team review/comments	$ 50,000
V.4	Study Scoping	● Preparation of report synopsis ● General coordination among study teams; vertical team	$ 150,000
V.5	Alternatives Milestone	● Prepare documentation for Alternatives Milestone Meeting ● Incorporate vertical team comments	$ 50,000
V.6	Planning Model Certification	● Certification of models utilized as part of the Planning process	$ 180,000
V.7	Tentatively Selected Plan (TSP) Milestone	● Compilation of analyses, DQC ● Prepare draft feasibility report ● Update DMP, Risk Register, Decision Log ● Real Estate Plan ($50K)	$ 80,000
V.8	Agency Technical Review	● Funding ATR reviewers ● Study team responses ● Comment resolution	$ 150,000
V.9	Idependent External Peer Review	● Funding IEPR Panel ● ECO-PCX Review Manager ● Study team responses ● Comment resolution	$ 250,000
V.10	Planning Policy Review of TSP	● MSC & HQUSACE comment responses and resolution	$ 60,000
V.11	Agency Decision Milestone	● Complete Feasibility Activities/Report ● Incorporate resolved public review comments into planning documents ● Incorporate resolved ATR and IEPR comments into planning documents ● Incorporate resolved Planning Policy review comments into planning documents	$ 160,000
V.12	Civil Works Review Board	● Finalize decision document ● Team prep for CWRB	$ 50,000
V.13	State & Agency Review	● Transmit final decision document to appropriate entities ● Respond and resolve comments	$ 20,000
V.14	Chief's Report	● Incorporate resolved state and agency review comments into planning documents ● Finalize Chief's Report	$ 30,000
		Subtotal	**$2,331,600**
		Total	**$8,232,600**