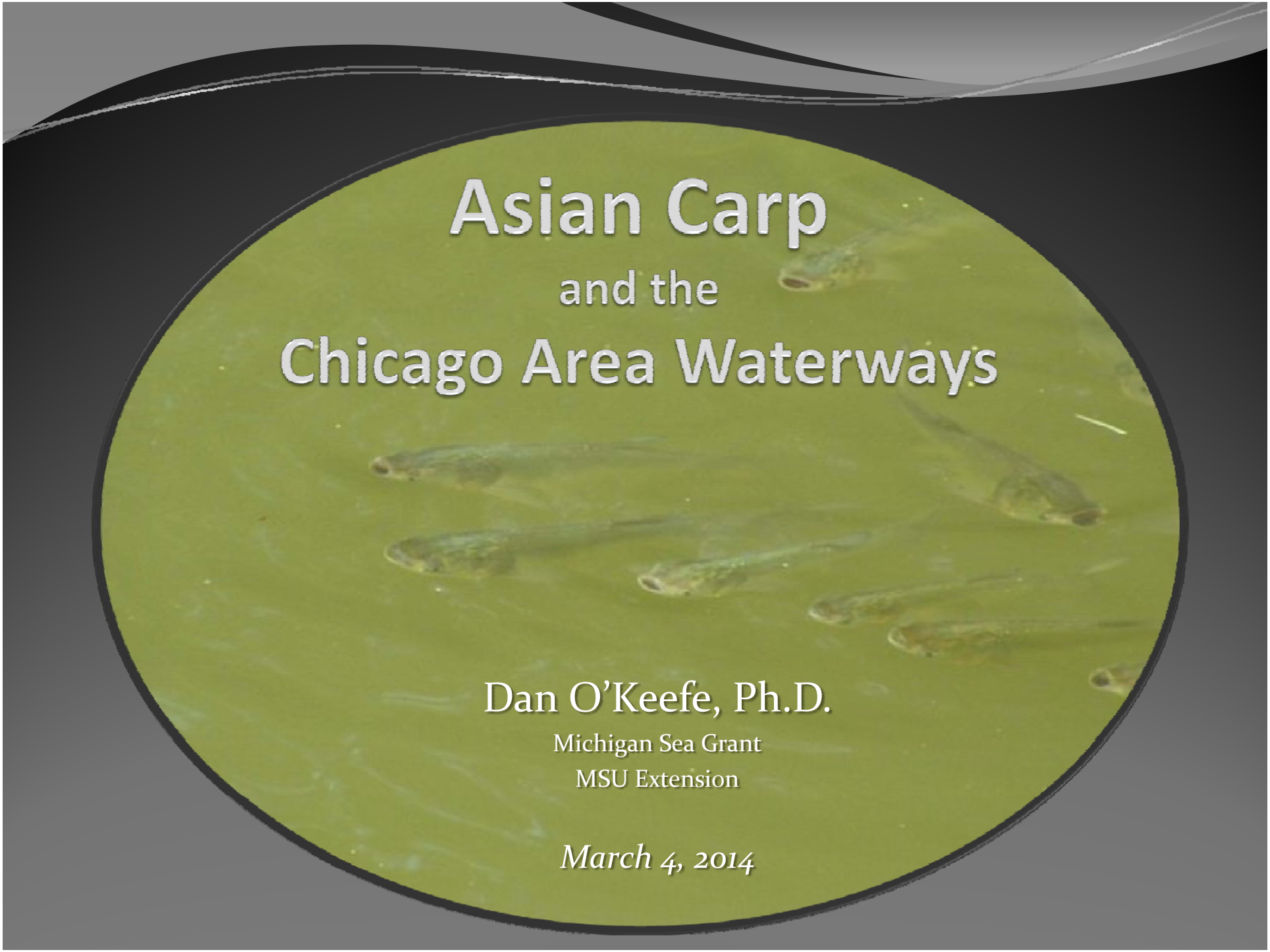


Asian Carp
and the
Chicago Area Waterways

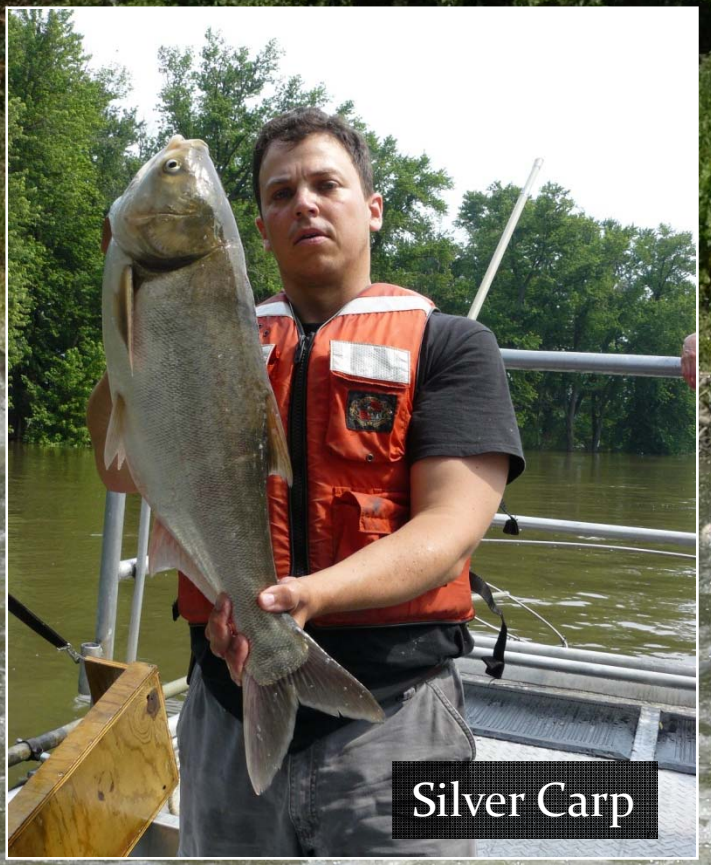
Dan O'Keefe, Ph.D.
Michigan Sea Grant
MSU Extension

March 4, 2014

Asian Carps

Two filter feeding species in Illinois

Bighead Carp

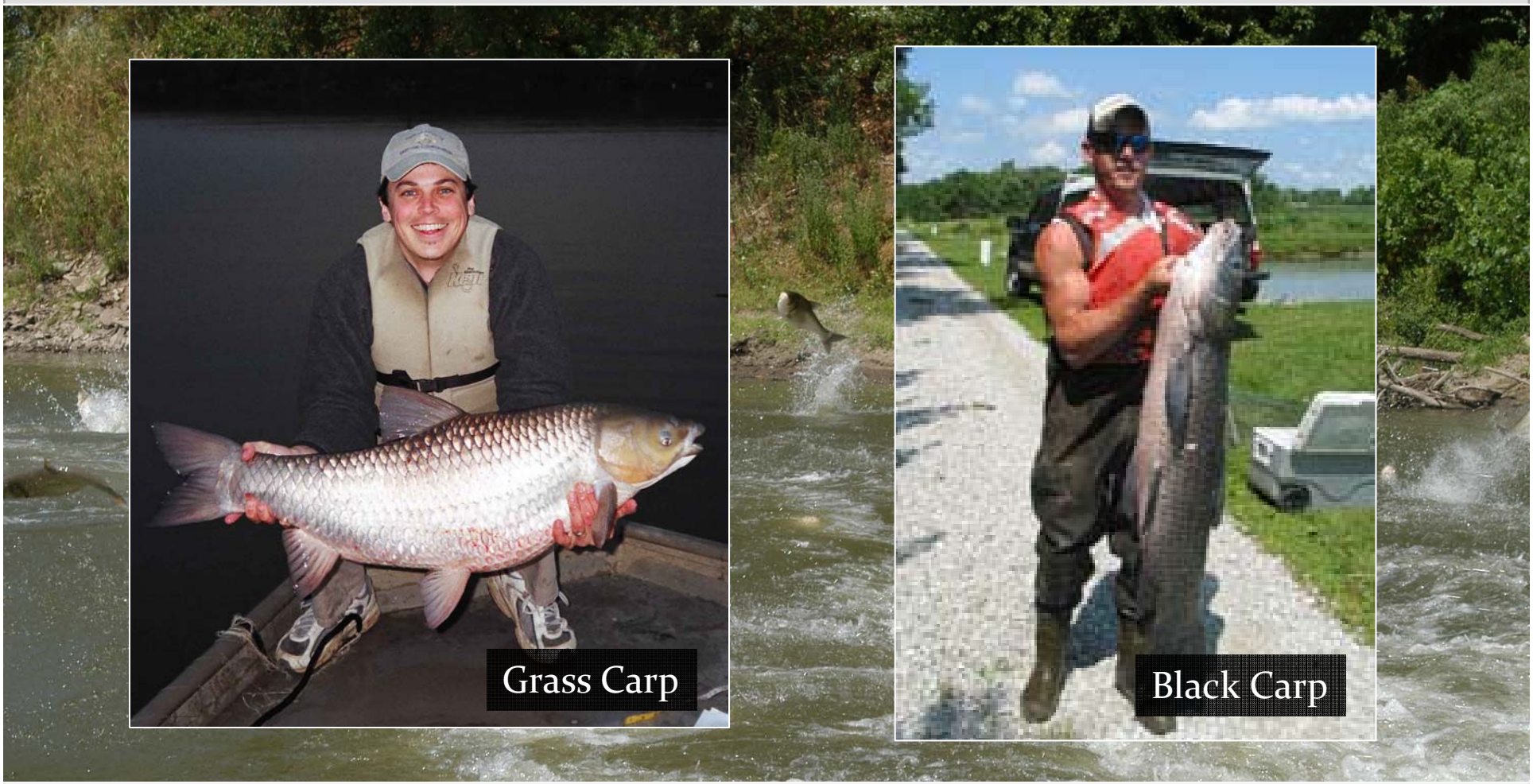


Silver Carp


COUNTY OF MUSKEGON
JOB OPPORTUNITIES
TRANSIT SUPERVISOR
DIRECTOR OF PROPERTY DEVELOPMENT
Professional, Managerial
Cars Imports
Bids
HIGHLIGHT YOUR AD
Make your ad stand out by adding a colored highlight.
Call Classified Marketplace, (231)726-3200, today to find out how you can add some wow to your ad for a very low price!
PHARMACIST:
Best Care Nursing
616-455-8800
Camper

Asian Carp

Two species that do not filter feed



Grass Carp

- Consumes huge quantities of aquatic plants (100 lbs/day)
- Can severely impact fish and wildlife habitat
- Feeds on desirable plants and not nuisance plants
- Can lead to nuisance algae blooms (digests <50% of food)

Ecological Risk of Bighead & Silver Carps

PROBABILITY OF INTRODUCTION & **MAGNITUDE OF CONSEQUENCES**

LIKELIHOODS OF

- ARRIVAL
- SURVIVAL
- ESTABLISHMENT
- SPREAD

ECOLOGICAL

OVERALL RISK

ARRIVAL

▶ The most likely entry point to the Great Lakes is via an existing physical connection with an already invaded waterbody nearby, specifically the **Chicago Area Waterway System (CAWS)**, into Lake Michigan.

▶ Other physical connections exist and were assessed, but are lower risk.

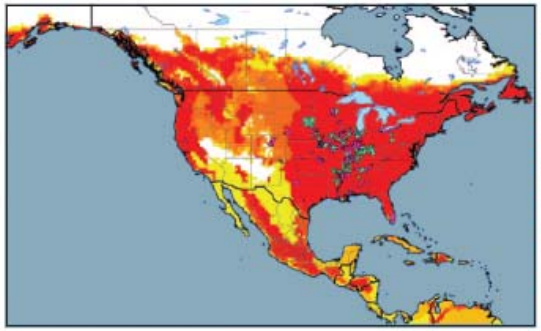
▶ Movement through commercial trade for food or bait was assessed, but this pathway has greater uncertainty.

SURVIVAL

▶ Enough food and habitat exists throughout all five of the Great Lakes, especially Lake Erie, for these fishes to survive and overwinter.

▶ These species will consume bottom debris to survive, and will not compete with Zebra Mussels.

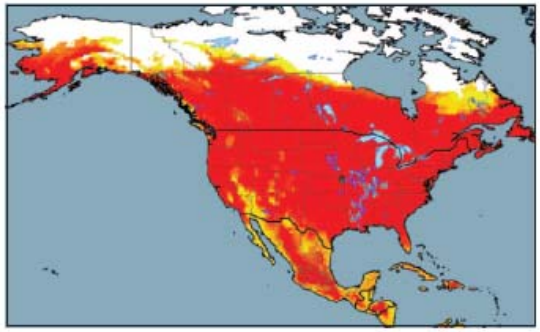
BIGHEAD CARP



Habitat match level

- 5-10
- 11-20
- 21-30
- 31-40
- 41-50
- 51-60
- 61-70
- 71-80
- 81-90
- 91-100
- *Established populations*
- *Collected specimens*

SILVER CARP



RED AREAS INDICATE A GREATER HABITAT MATCH LEVEL

ESTABLISHMENT

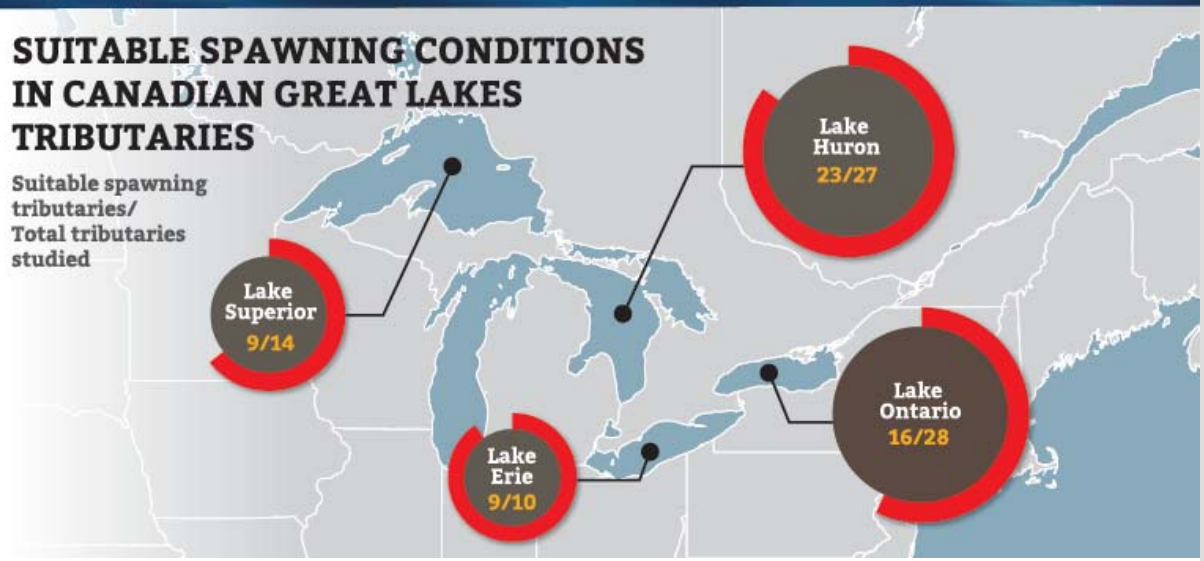
▶ Suitable spawning conditions exist in up to 57 Canadian rivers.

▶ Extensive wetlands available for nursery habitat.

▶ Requires as few as ten adult females and a similar number of males for a >50% chance of annual successful spawning – likelihood of establishment is therefore approximately 100%.

SUITABLE SPAWNING CONDITIONS IN CANADIAN GREAT LAKES TRIBUTARIES

Suitable spawning tributaries/ Total tributaries studied



Fisheries and Oceans Canada

Pêches et Océans Canada

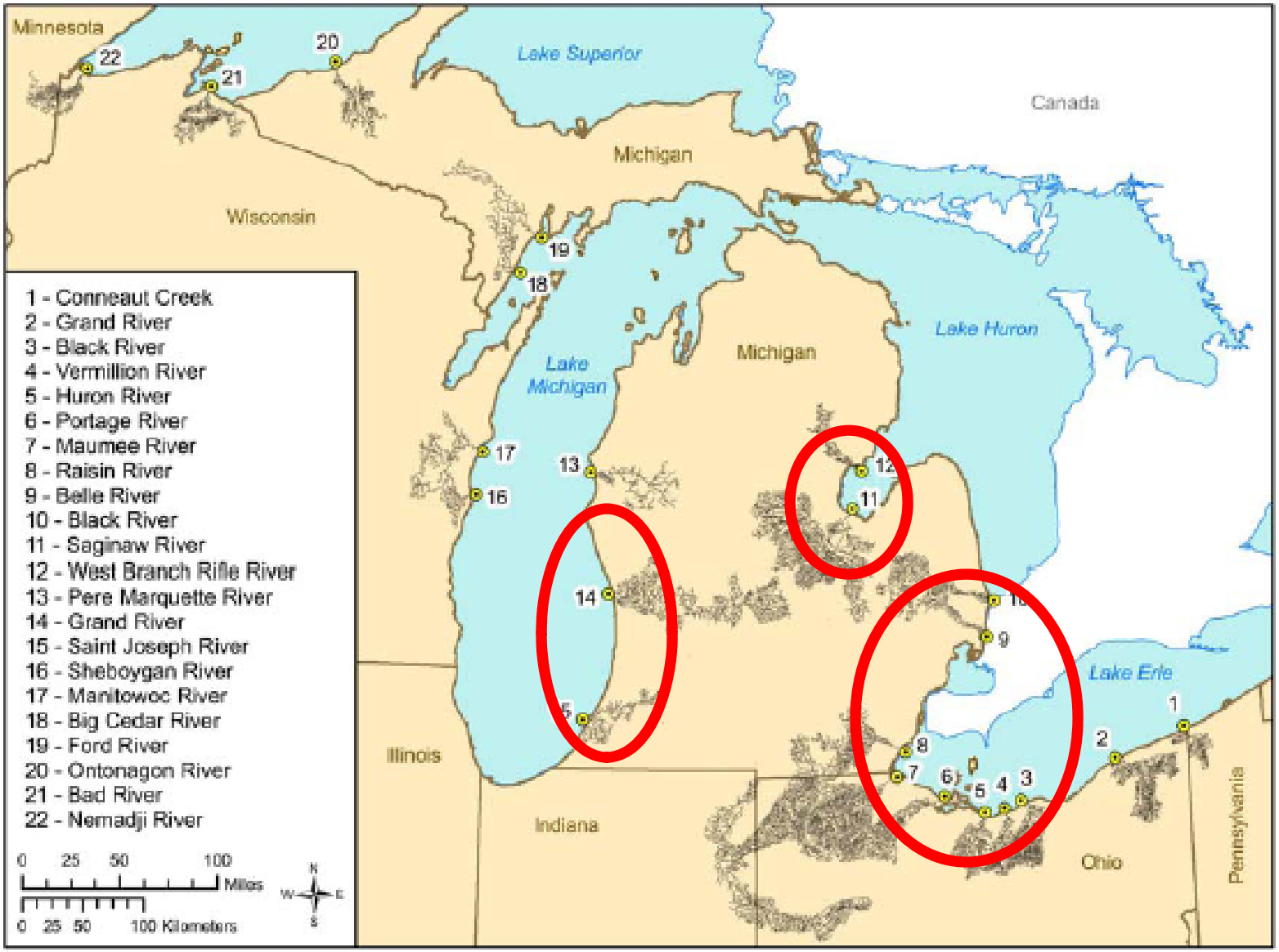


Figure 29. Map of Lakes Erie, Huron, St Clair, Michigan, and Superior indicating rivers lacking dams and having a minimum length of 100 kmthat may be suitable for spawning by Bighead (*Hypophthalmichthys nobilis*) and Silver (*H. molitrix*) carps. Map developed by C. Lowenburg, U.S. Geological Survey.

Kolar et al. (2005)

New Findings on Asian Carp Reproduction

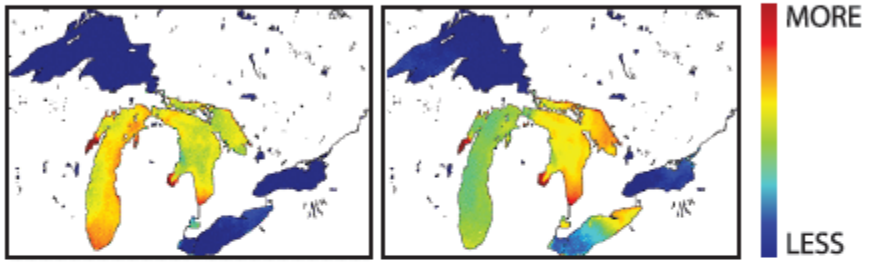
- Temperature affects length of river needed (USGS 2013)
- Rise in water level may not be needed (Goforth et al. 2013)
- Wabash River, IN, smallest silver carp spawning river
- Grass carp have spawned in 14 miles of Sandusky R. (Chapman et al. 2013)

SPREAD

Following the introduction into a single lake, these species would be expected to spread to other lakes within 20 years. Spread will be more rapid for lakes Michigan, Huron, and Erie, and potentially Lake Superior; longer for Lake Ontario.

SPREAD IF INTRODUCED TO LAKE MICHIGAN:

5 YEARS **20 YEARS**



ECOLOGICAL CONSEQUENCES

▶ Most of Canada's fishes rely on plankton at some point during their lifecycle. All of these species, such as Bigmouth Buffalo, would be forced to compete with Bighead and Silver carps for their primary food source. Bighead and Silver carps are extremely effective at consuming plankton and have a voracious appetite. This will significantly reduce the number of these native fishes in the Great Lakes region and will negatively impact the delicate food web.

Bigmouth Buffalo

© Joseph R. Tomelleri

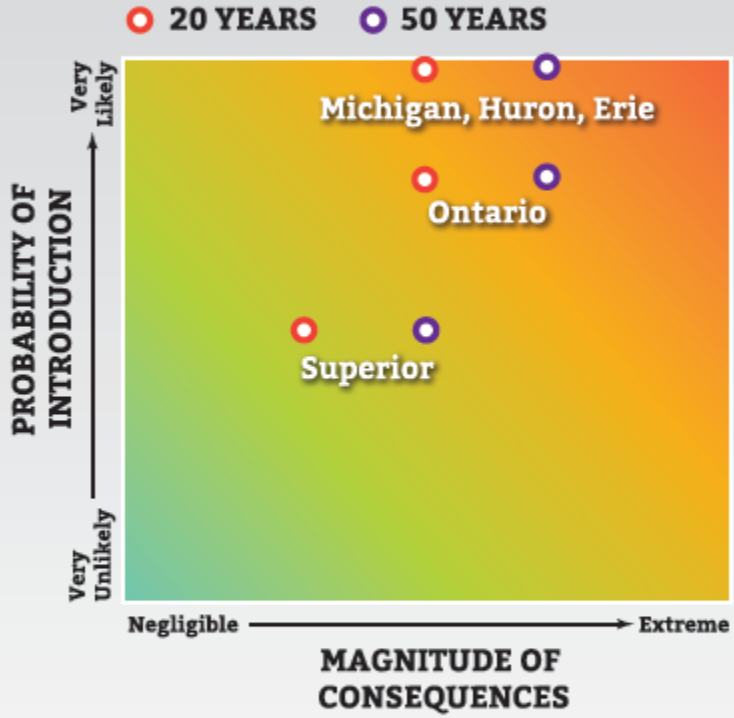
▶ In turn, the reduction of these native fishes would reduce the number of predatory fishes (such as Yellow Perch and Walleye).

Walleye

Bonnie Ross, Ross Illustrations

OVERALL RISK

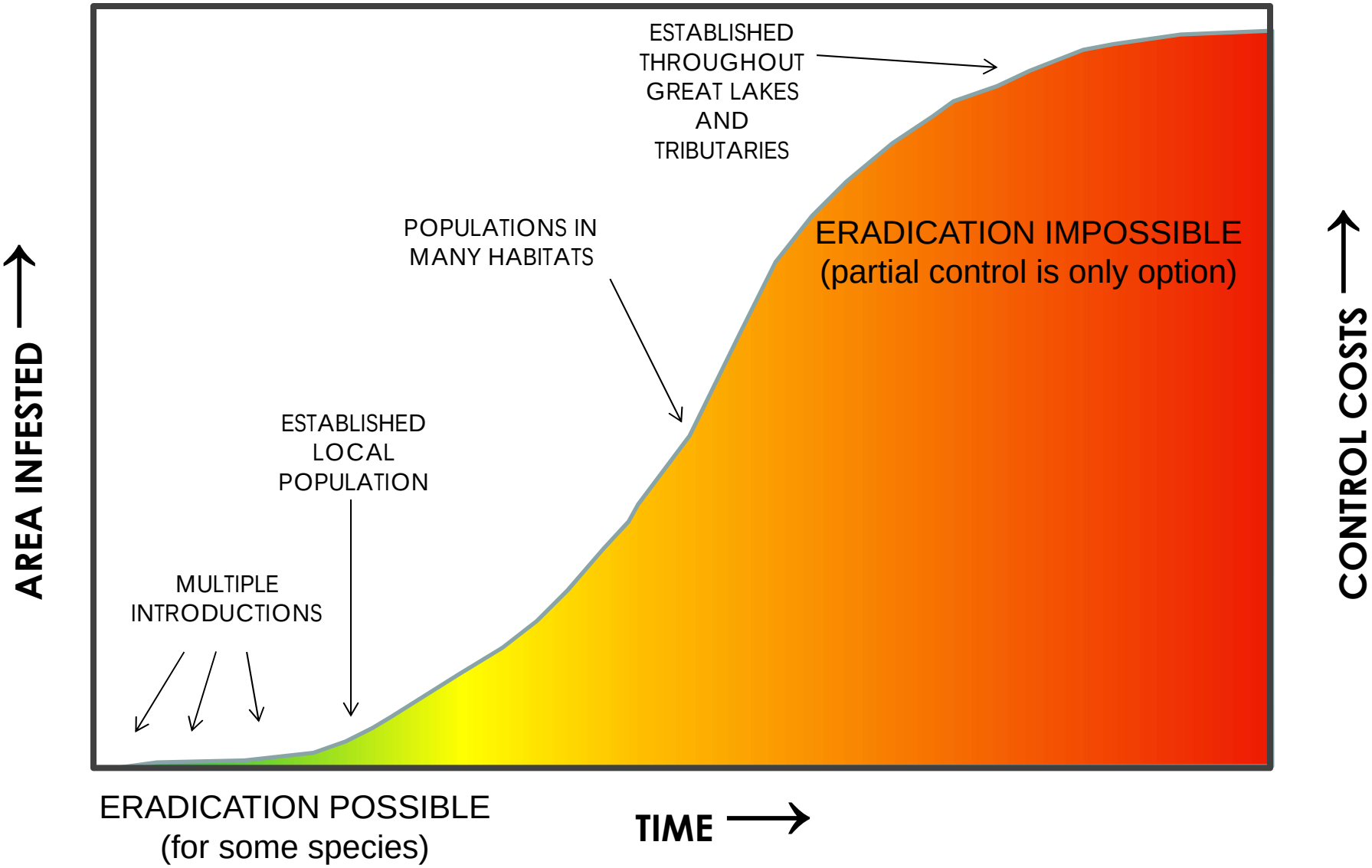
If no additional actions are taken, the overall ecological risk of Bighead and Silver carps to the Great Lakes is generally high, especially to the central lakes, with impacts increasing over time.



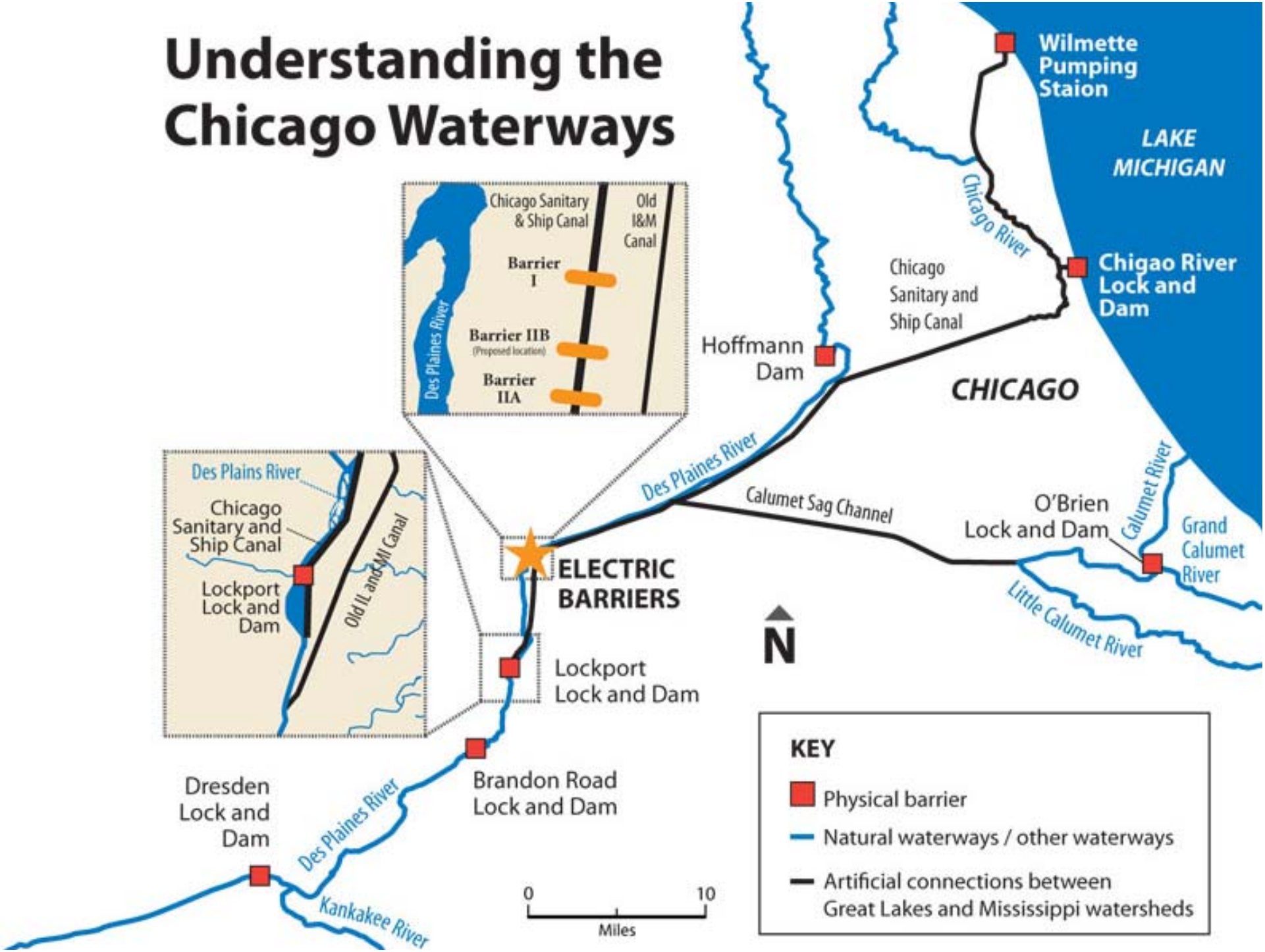
The impact of these species on the Great Lakes is directly related to establishment. Therefore, preventing establishment is critical. In Canada, we need to focus on preventing the introduction of these species into Canadian waters.

Fisheries and Oceans Canada | Pêches et Océans Canada

AQUATIC SPECIES INVASION TIMELINE



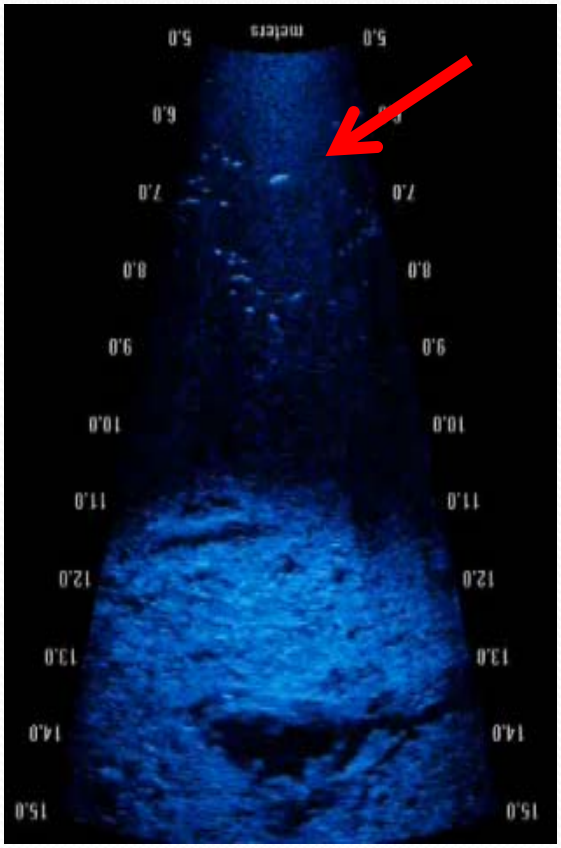
THE JURY IS IN…


Understanding the Chicago Waterways
Wilmette Pumping Staion
LAKE MICHIGAN
Chicago River
Chigao River Lock and Dam
Chicago Sanitary and Ship Canal
Hoffmann Dam
CHICAGO
Chicago Sanitary & Ship Canal
Old I&M Canal
Barrier I
Barrier IIB
(Proposed location)
Barrier IIA
Des Plaines River
Des Plains River
Chicago Sanitary and Ship Canal
Lockport Lock and Dam
Old IL and MI Canal
Des Plaines River
Calumet Sag Channel
O'Brien Lock and Dam
Calumet River
Grand Calumet River
Little Calumet River
ELECTRIC BARRIERS
N
Lockport Lock and Dam
Brandon Road Lock and Dam
Dresden Lock and Dam
Des Plaines River
Kankakee River
0
10
Miles
KEY
Physical barrier
Natural waterways / other waterways
Artificial connections between Great Lakes and Mississippi watersheds

Recent Findings on Electric Barriers

- Even at increased voltage small fish (2-4”) swim through freely (USACE 2013)
- Metal barges disrupt electric field and large fish may pass in wake (USACE 2013)

Figure 12. Picture of two barges traversing the electrical barrier with the square ends in the front of the barge configuration. The circle denotes the small void space that two live fish swam into and became entrained past the barrier.



DIDSON image of fish near the electric barrier in Chicago (USACE image).

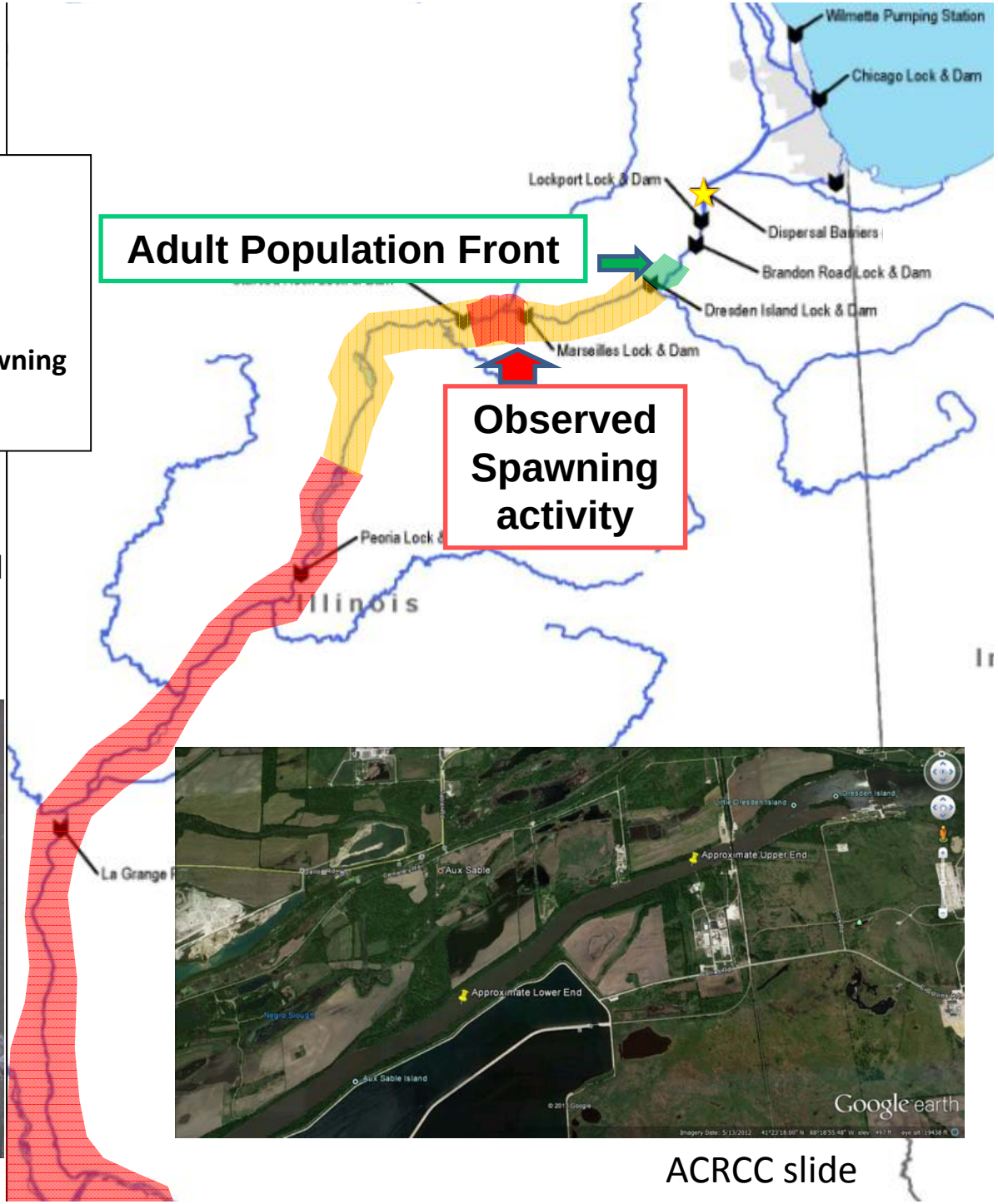
2013

Distances from Lake Michigan

37 miles	**Dispersal barriers** ★
55 miles	**Adult Population Front**
62 miles	**Presence of Adults/Potential Spawning**
62 miles	**Verified Spawning**

Areas of Concern

1) Verified Spawning Marseilles Pool
2) Verified Identification of AC eggs and larvae near Henry Illinois



ACRCC slide

Why can't we just dam up the CAWS?

- Flooding of low-lying areas
- More polluted water flowing to Lake Michigan
- Mitigation costly but not impossible
  - Costs and timelines depend on assumptions
  - Two studies have estimated costs for separation options

RESTORING THE
NATURAL DIVIDE

SEPARATING THE GREAT LAKES AND MISSISSIPPI RIVER BASINS IN THE CHICAGO AREA WATERWAY SYSTEM

Down River

$3.9-9.5 billion

10-17 years

Mid-System

$3.3-$4.3 billion

10-17 years

Near Lake

$9.5 billion

~15 years

GLMRIS

Great Lakes and Mississippi River Interbasin Study

Aquatic Nuisance Species

Ecosystems

Navigation

Recreation

Flood Risk Management

Water Use

COMMENT PERIOD EXTENDED TO MARCH 31

1 Baseline Alternative – Sustained Activities

- No new federal action as a result of GLMRIS
- Continuing current efforts supported by federal and state agencies
  - Ruffe, snakehead, sea lamprey, etc
- Asian carp activities include
  - USACE operation of the electric barriers
  - Local, State and Federal activities
    - GLRI Program support for ANS-related activities;
    - Interagency Monitoring & Response: telemetry, electrofishing/netting, eDNA and response actions;
    - Population control (fish harvesting); and,
    - Research & implementation of Asian carp controls;

2 Nonstructural Control Technologies Alternative

- ANS Controls that do not require construction of structures and may be implemented quickly
- Examples
  - Active management
    - Monitoring
    - Chemical controls
  - Education and outreach
    - Public awareness campaigns
    - Self-imposed cleaning of watercraft
  - Laws and regulations
    - Inspection and enforcement
    - Bilge and ballast water management
- Successful implementation is a shared responsibility
- Nonstructural controls are effective best management practices to complement other Alternative Plans

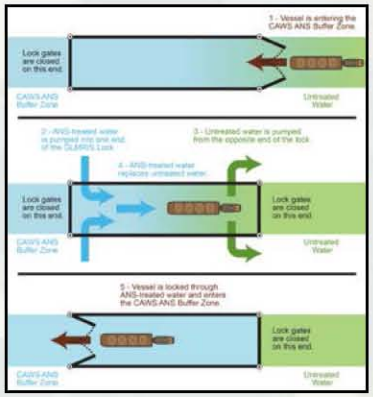
Estimated Time to Completion: **0 yr**

Estimated Cost: **$68M**
(Annually)

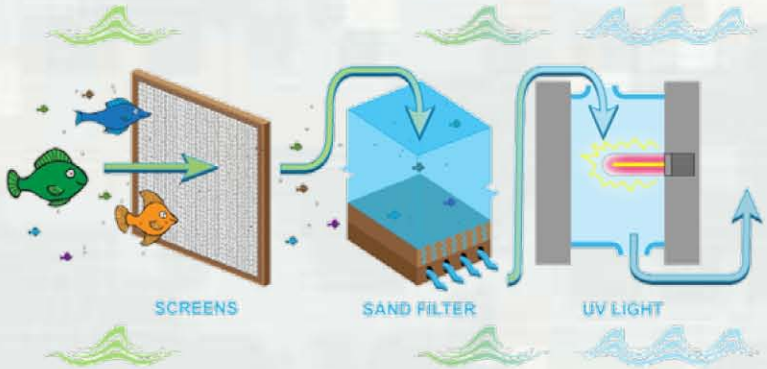
ANS Control Technologies

- Address modes of ANS movement
  - Swimming
  - Floating
  - Hitchhiking

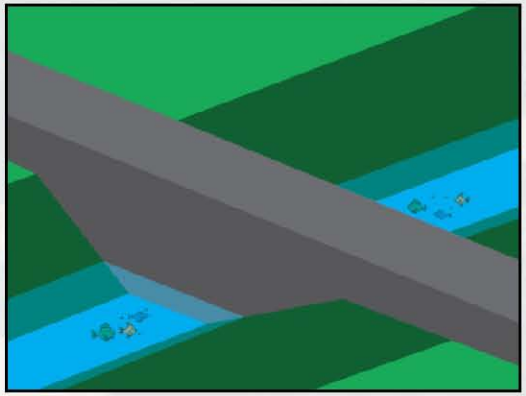
GLMRIS Lock



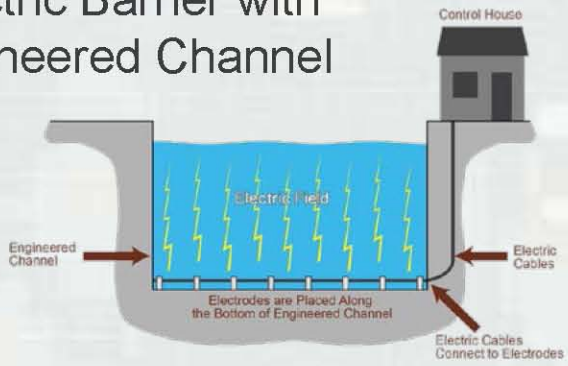
ANS Treatment Plant



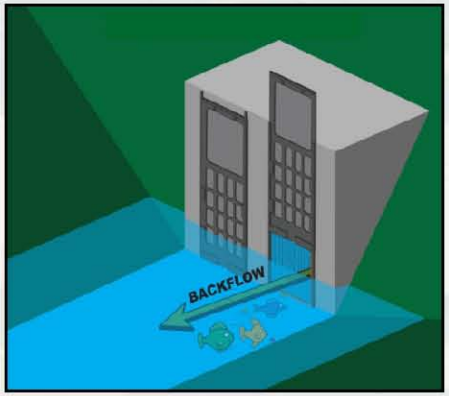
Physical Barrier



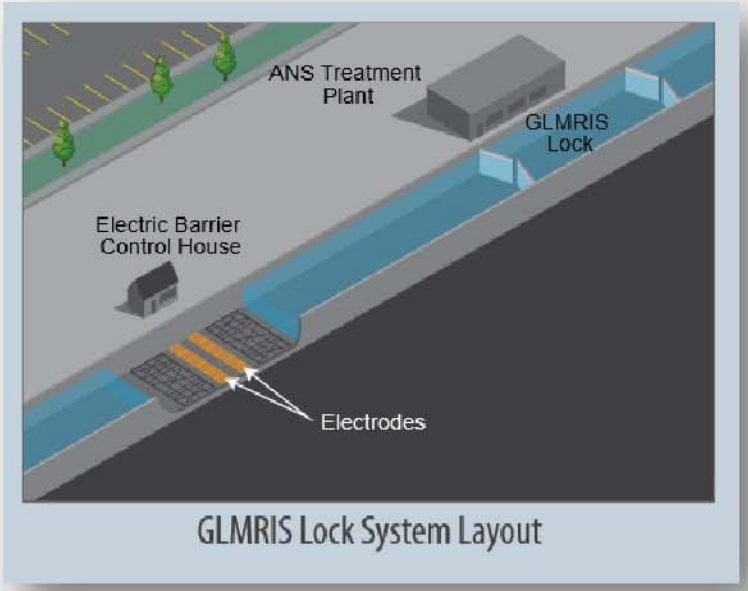
Electric Barrier with Engineered Channel



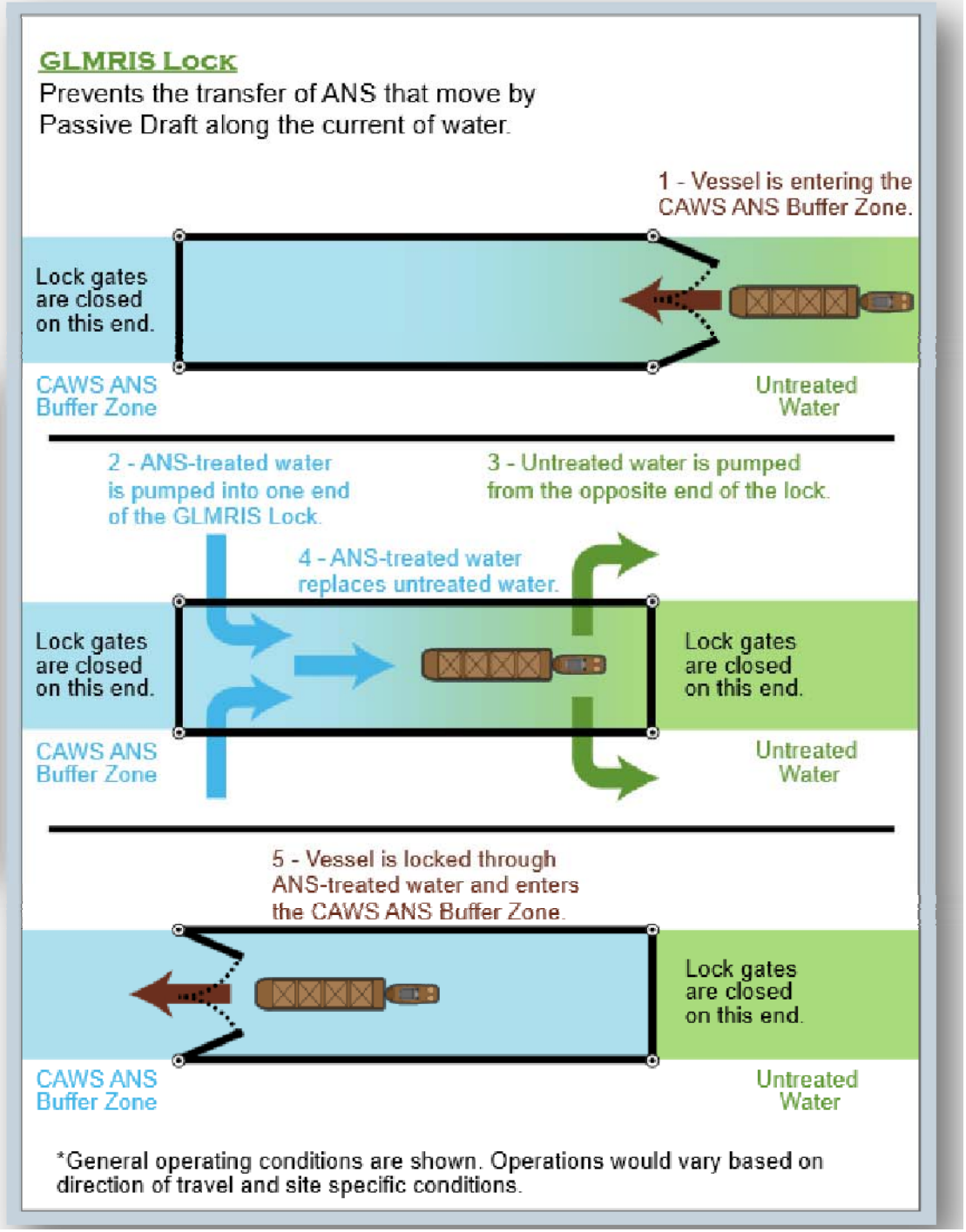
Screened Flow Gates



What the heck is a GMRIS Lock?



GLMRIS Lock System Layout



I.3.4 ANS Treatment Plants

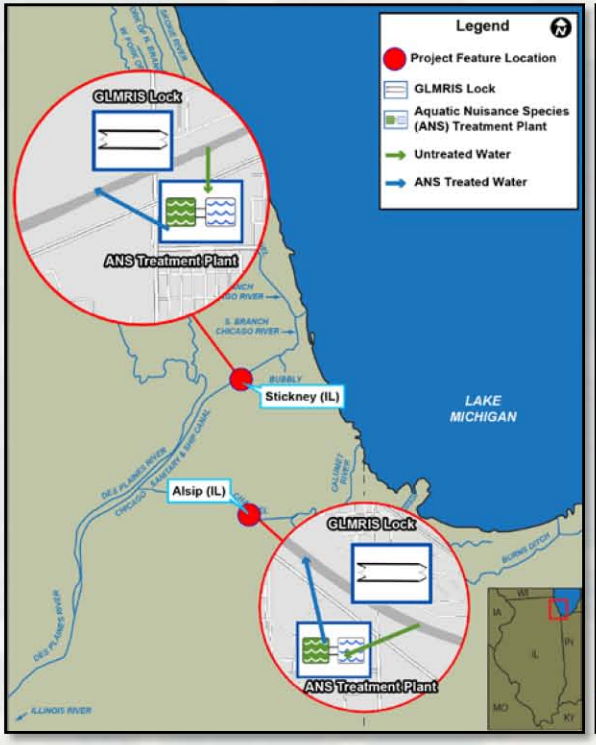
See other portions of the report for general features of the ANS Treatment Plants. No detailed facility layout has been performed as part of this study, but the processes and general facility requirement have been based on similar sized Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) wastewater treatment facilities.

- Appendix I, Page 19

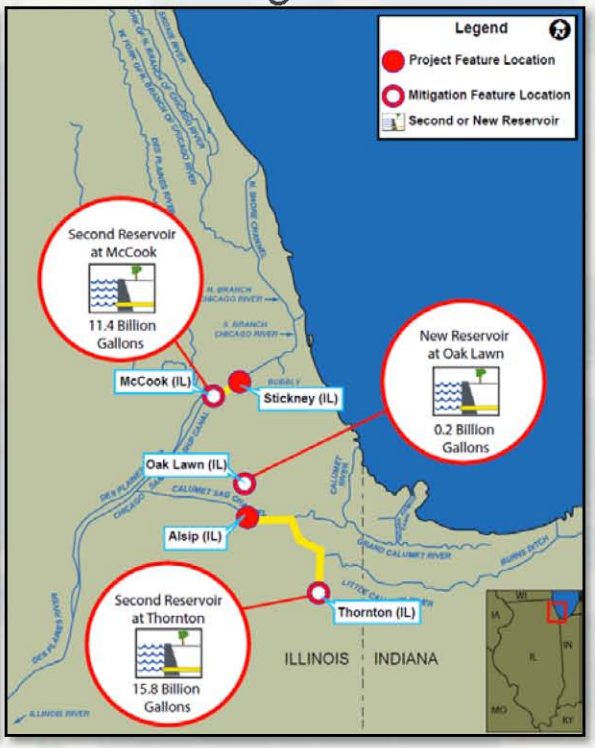
3 Flow Bypass Alternative

- Overview
  - Single, two-way control points
  - Volume of waterways diverted through an ANS treatment facility
  - GLMRIS Lock feature
  - Maintains existing CAWS flow regime
- Mitigation
  - Flood risk *(Significant)*
    - Reservoirs
    - Conveyance tunnels and infrastructure

Overview



Mitigation



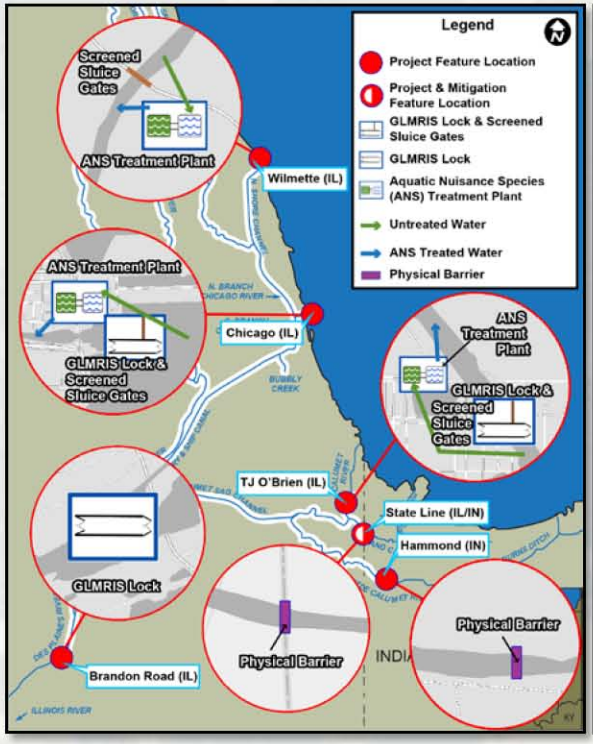
Estimated Time to Completion: **25 yr**

Estimated Cost: **$15.5B**

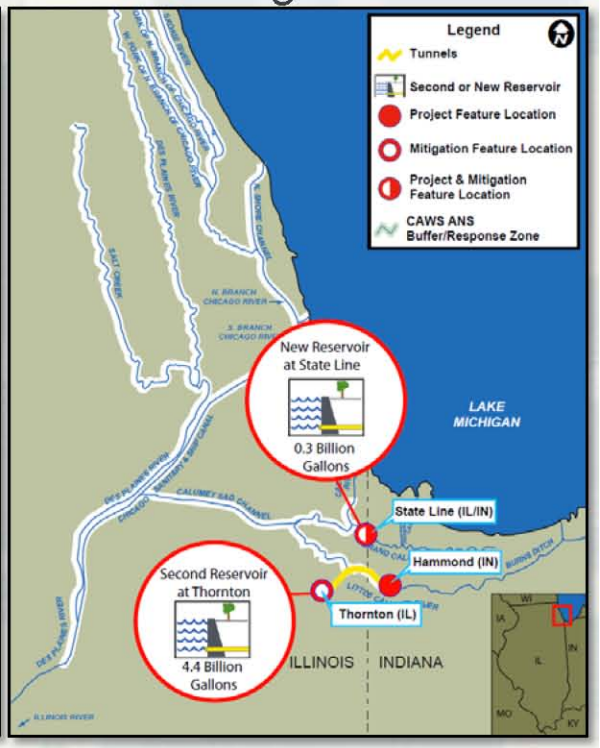
4 CAWS Buffer Zone Alternative

- Overview
  - Multiple one-way control points for ANS
  - Operate CAWS as ANS-controlled zone
    - Facilitates monitoring and response
  - Preserves majority of CAWS flow regime
  - Adaptive Management: Opportunity for phased implementation
- Mitigation
  - Flood risk
    - Reservoirs
    - Conveyance tunnels and infrastructure

Overview



Mitigation



Estimated Time to Completion: **10 yr**

Estimated Cost: **$7.8B**

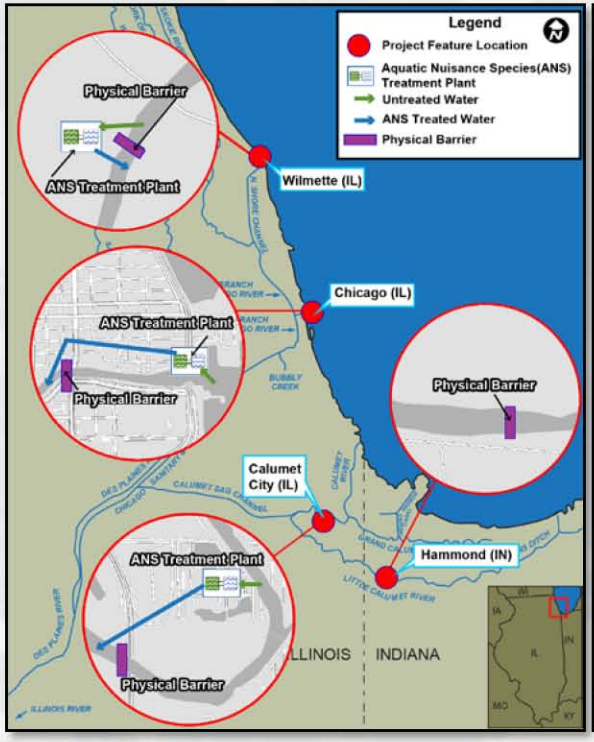
ESTIMATED COSTS

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**

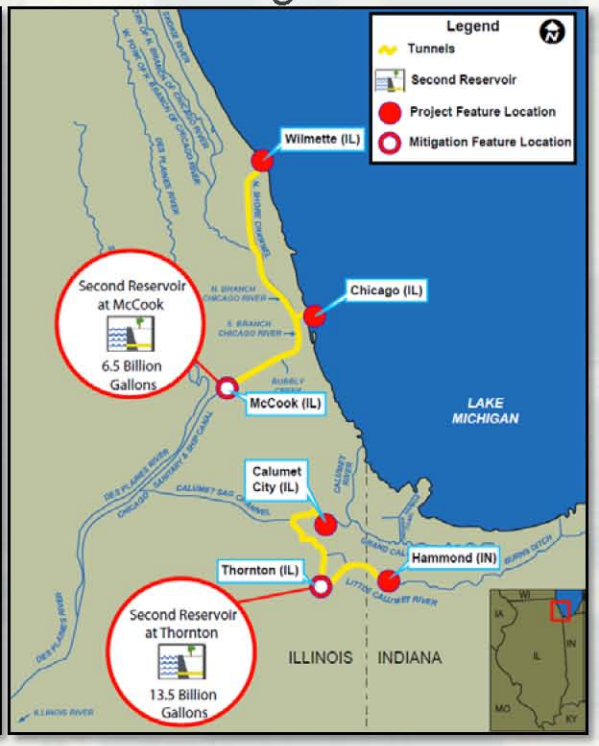
5 Lakefront Hydrologic Separation

- Overview
  - Four barrier locations
  - Risk reduction is not achieved until all barriers are complete
  - Mitigation measures control completion schedule of barriers
- Mitigation
  - Flood risk *(Significant)*
    - Tunnels & Reservoirs
  - Water quality
    - ANS treatment for water flow/quality
  - Navigation
    - Recreational boat storage

Overview



Mitigation



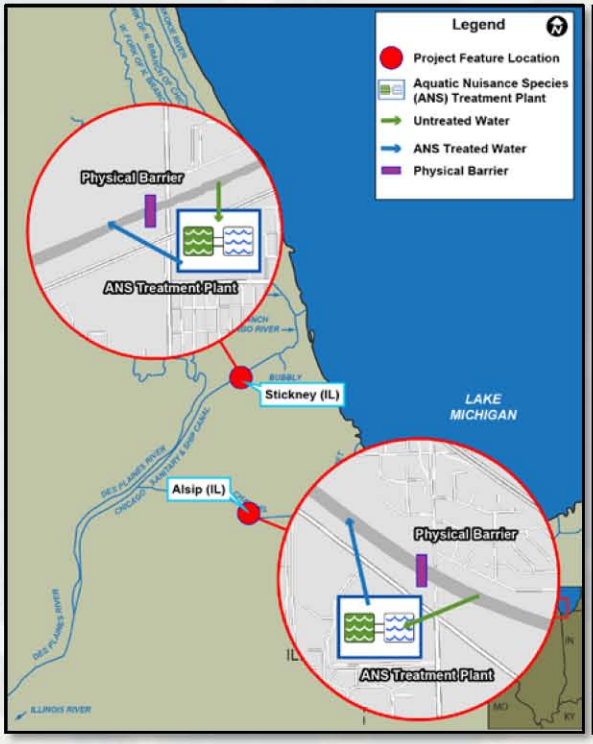
Estimated Time to Completion: **25 yr**

Estimated Cost: **$18.4B**

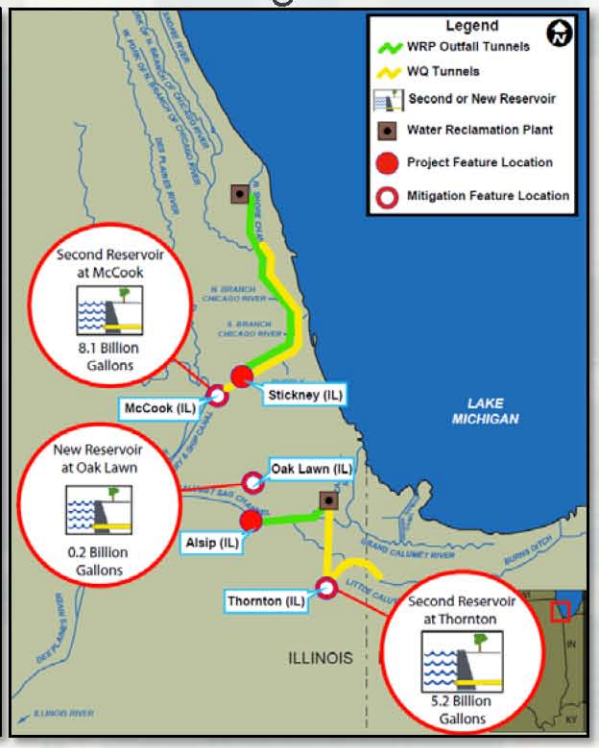
6 Mid-System Hydrologic Separation

- Overview
  - Two barrier locations
  - Risk reduction is not achieved until all barriers are complete
  - Mitigation measures control completion schedule of barriers
- Mitigation
  - Water quality *(Significant)*
    - CSO capture
    - Re-route water reclamation plant (WRP) effluent
    - Sediment remediation

Overview



Mitigation



Estimated Time to Completion: **25 yr**

Estimated Cost: **$15.5B**

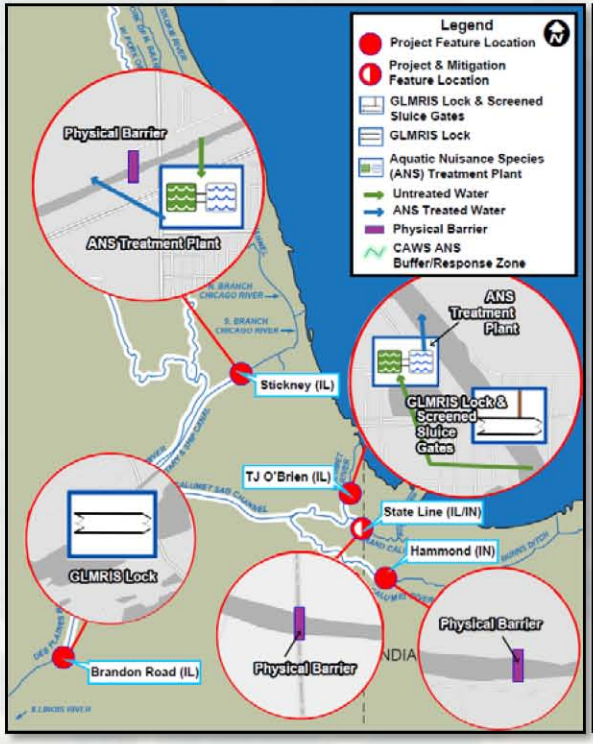
ESTIMATED COSTS

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**

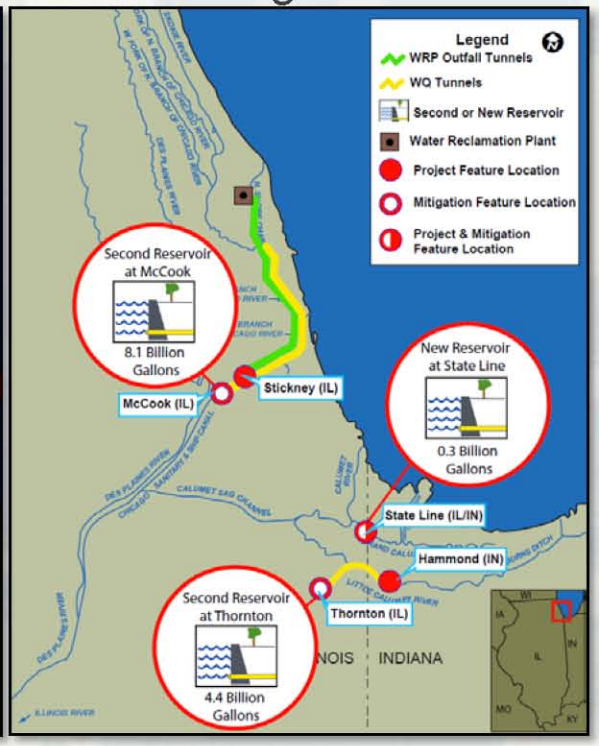
7 Hybrid – Cal-Sag Open

- Overview
  - Combines technology and barrier features
  - Minimize impacts to uses/users
  - Adaptive Management: Opportunity for phased implementation
- Mitigation
  - Water quality *(Significant)*
    - CSO capture
    - Re-route WRP effluent
    - Sediment remediation
  - Flood risk mitigation
    - Reservoirs
    - Conveyance tunnels, infra.

Overview



Mitigation



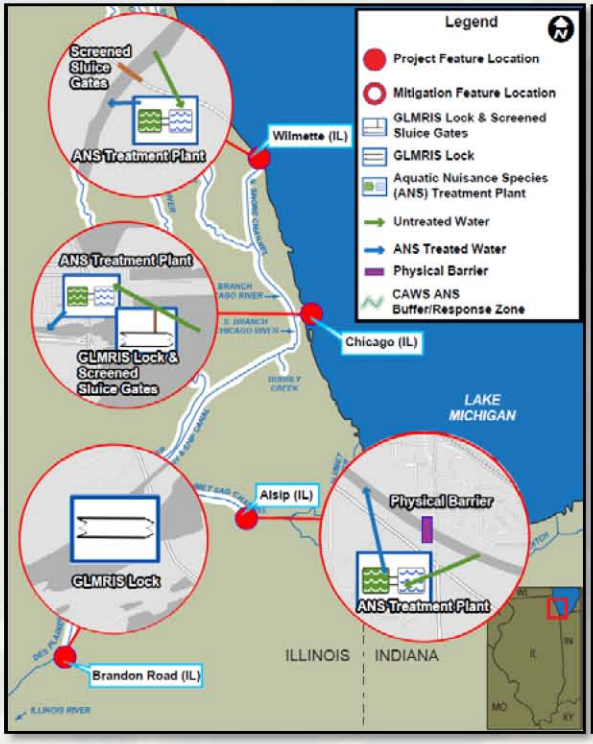
Estimated Time to Completion: **25 yr**

Estimated Cost: **$15.1B**

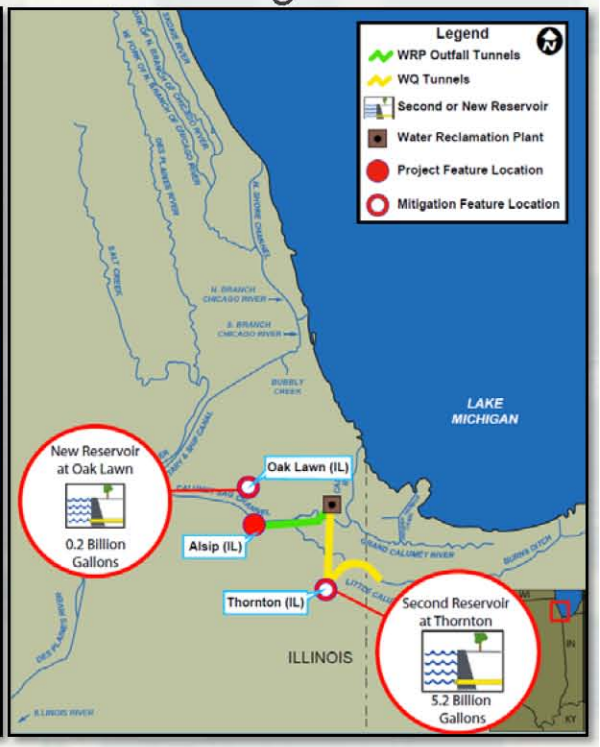
8 Hybrid – CSSC Open

- Overview
  - Combines technology and barrier features
  - Minimize impacts to uses/users
  - Adaptive Management: Opportunity for phased implementation
- Mitigation
  - Water quality *(Significant)*
    - CSO capture
    - Re-route WRP effluent
    - Sediment remediation
  - Flood risk mitigation
    - Reservoirs
    - Conveyance tunnels, infra.

Overview



Mitigation



Estimated Time to Completion: **25 yr**

Estimated Cost: **$8.3B**

The GLMRIS Report

The Great Lakes and Mississippi River Interbasin Study (GLMRIS) Report 15.8 MB

Appendices

A – Alternative Development Analyses 6.4 MB

B – Affected Environment 5.4 MB

Appendix C – Risk Assessment

- Part 1 1.3 MB
- Part 2 3.6 MB
- Part 3 9.9 MB
- Part 4 2.5 MB
- Part 5 5.7 MB
- Part 6 7.5 MB
- Part 7 5.7 MB
- Part 8 5.1 MB
- Part 9 5.9 MB
- Part 10 6.5 MB
- Part 11 5.9 MB

D – Economic Analyses 25.7 MB

E – Hydrologic and Hydraulic Analyses 6.2 MB

F – Water Quality Analyses 26.5 MB

G – Phase I HTRW Site Assessments 14.9 MB

H – Geotechnical Engineering 24.4 MB

I – Structural Engineering 19.9 MB

J – Civil Design 5.5 MB

K – Cost Engineering 1.1 MB

L – Real Estate 10.5 MB

M – Correspondence 17.7 MB

N – Focus Area 2 2.6 MB

Aerial carp shooting in Shimano's Xtreme Fishing video game

Silver carp in the Illinois River

(INHS photo)

Darin Opel's 92.5 pound world record bighead carp from Alton, Illinois