The Chicago Area Waterway System, Asian Carp, and the Great Lakes

by
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Chicago River 2011

- History and physical setting of the waterway
- Lake Michigan Diversion Accounting
- USGS monitoring and waterway hydraulics
- Aquatic invasive species and Asian Carp
- Waterway Separation

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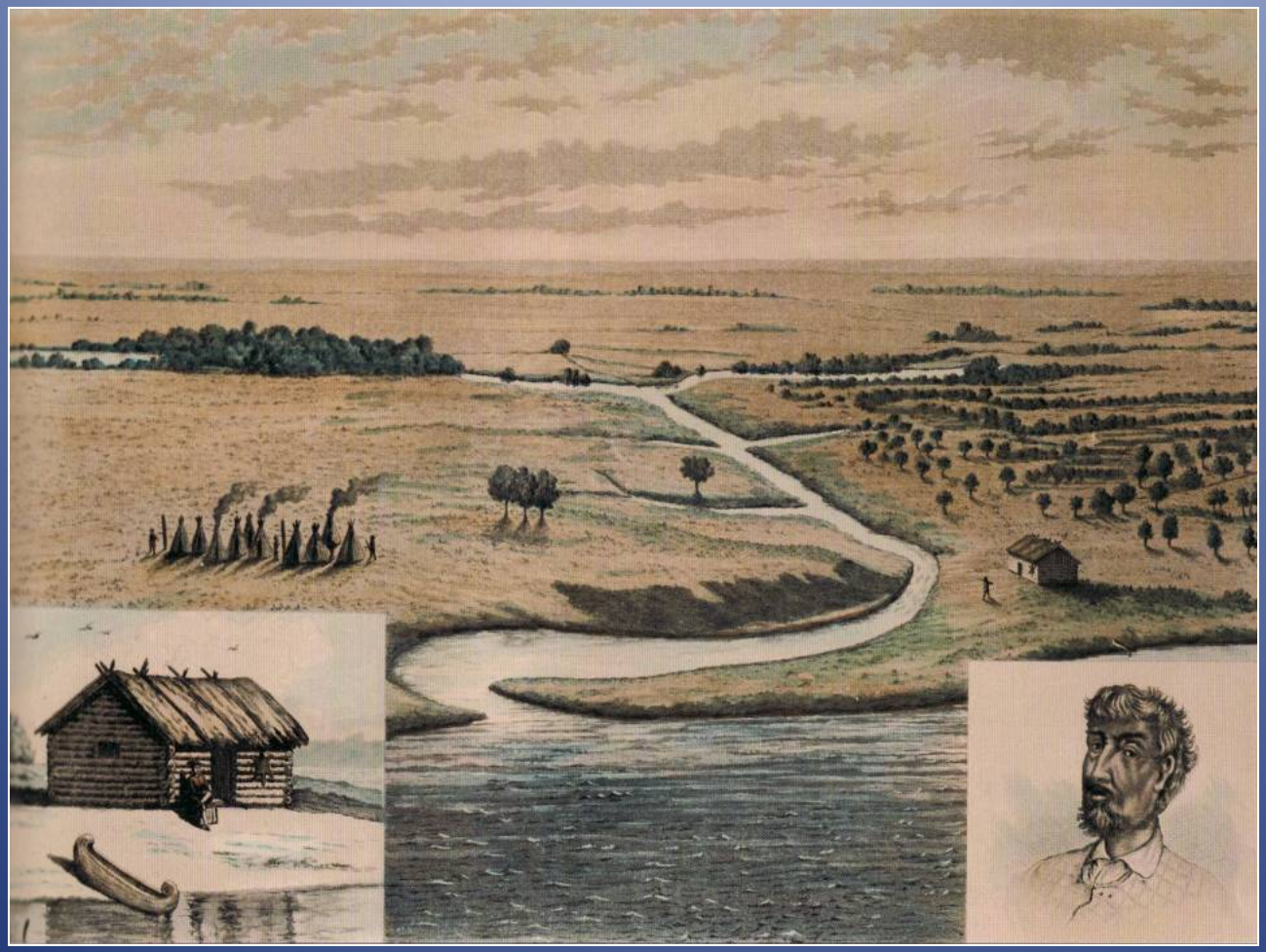
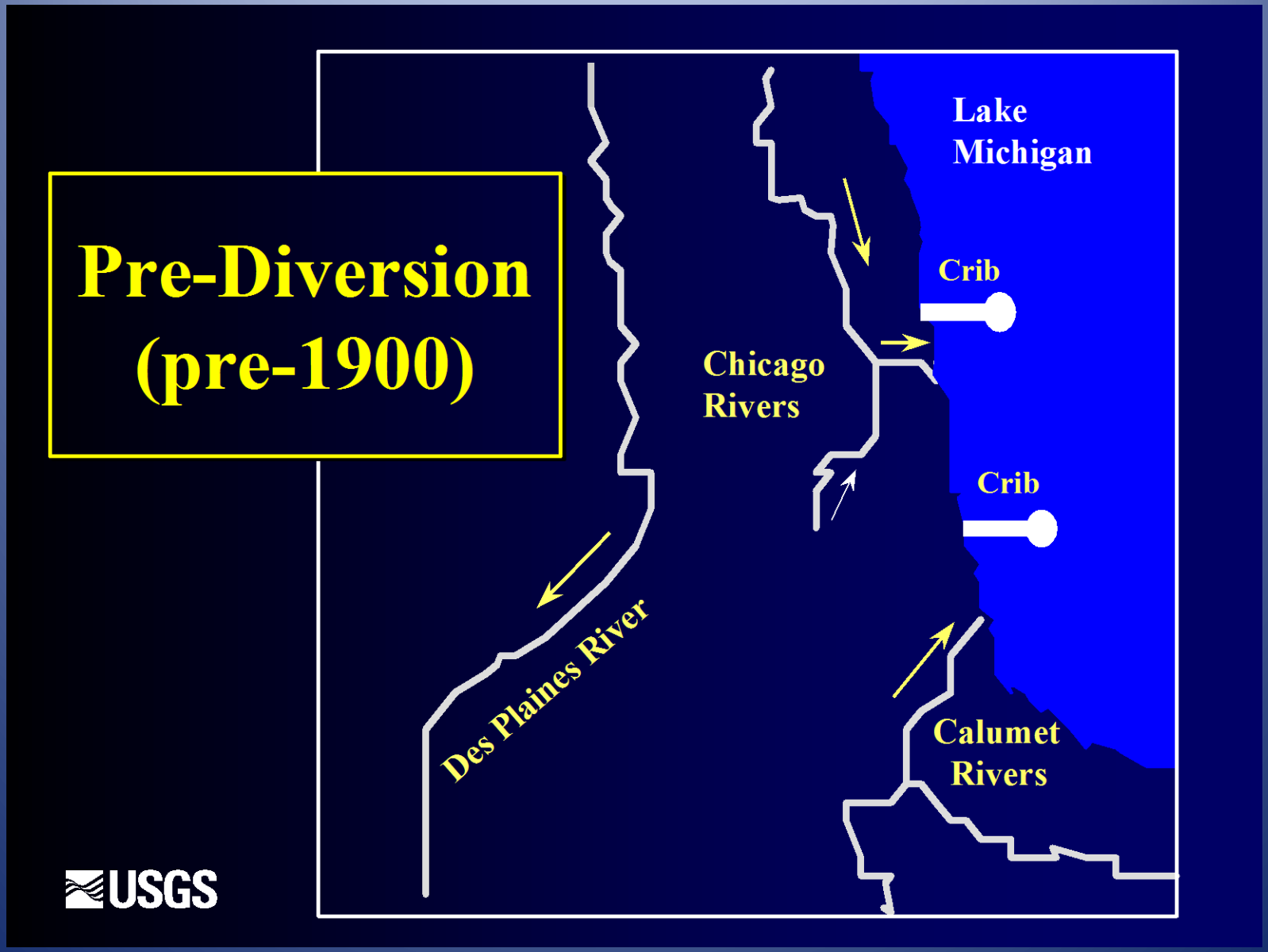
Chicago River 1800



courtesy Chicago History Museum

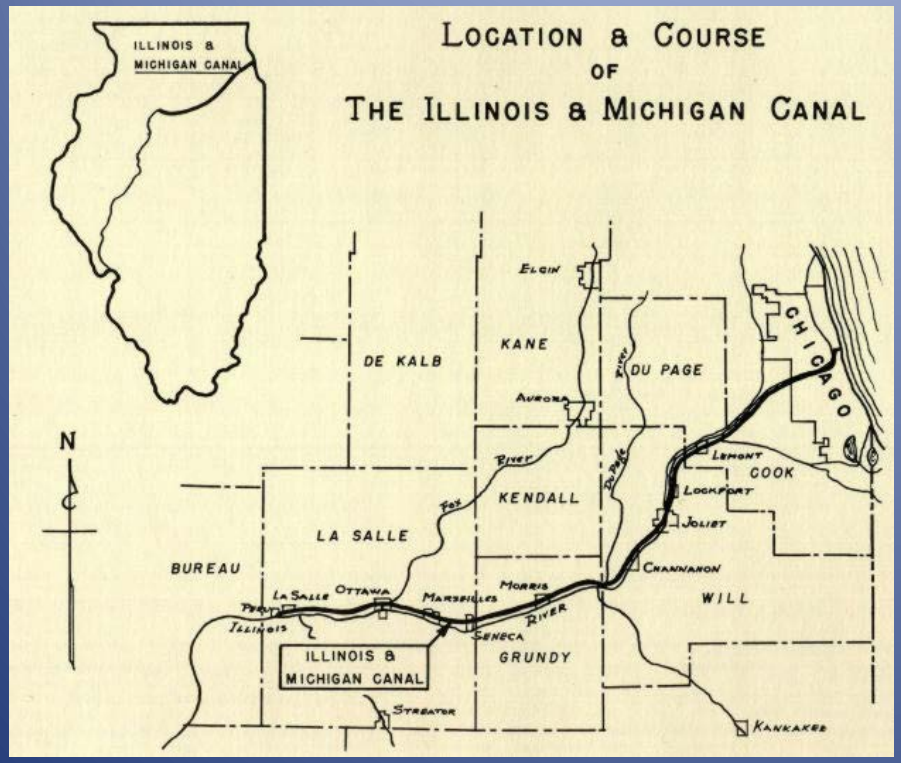

Pre-Diversion
(pre-1900)
Lake
Michigan
Crib
Chicago
Rivers
Crib
Des Plaines River
Calumet
Rivers
USGS

From 1850-1900, Chicago's population grew at a rate that exceeded the city' sewage system, resulting in unsanitary conditions throughout the city

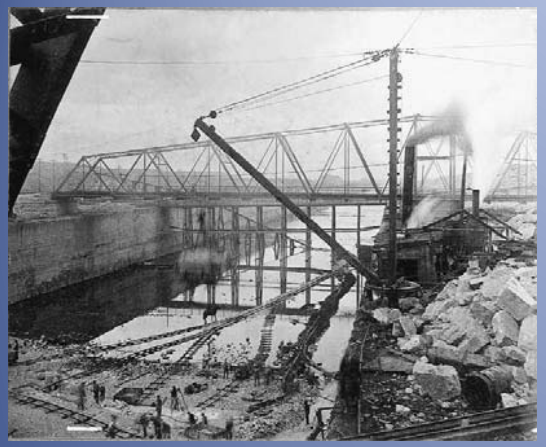
Year		Population
1833	-	350
1850	-	29,963
1860	-	112,172
1870	-	298,977
1880	-	503,185
1890	-	1,099,850
1900	-	1,698,575

Bubbly Creek, man standing on crusted sewage. Photo from Chicago History Museum.

Illinois and Michigan Canal-1848



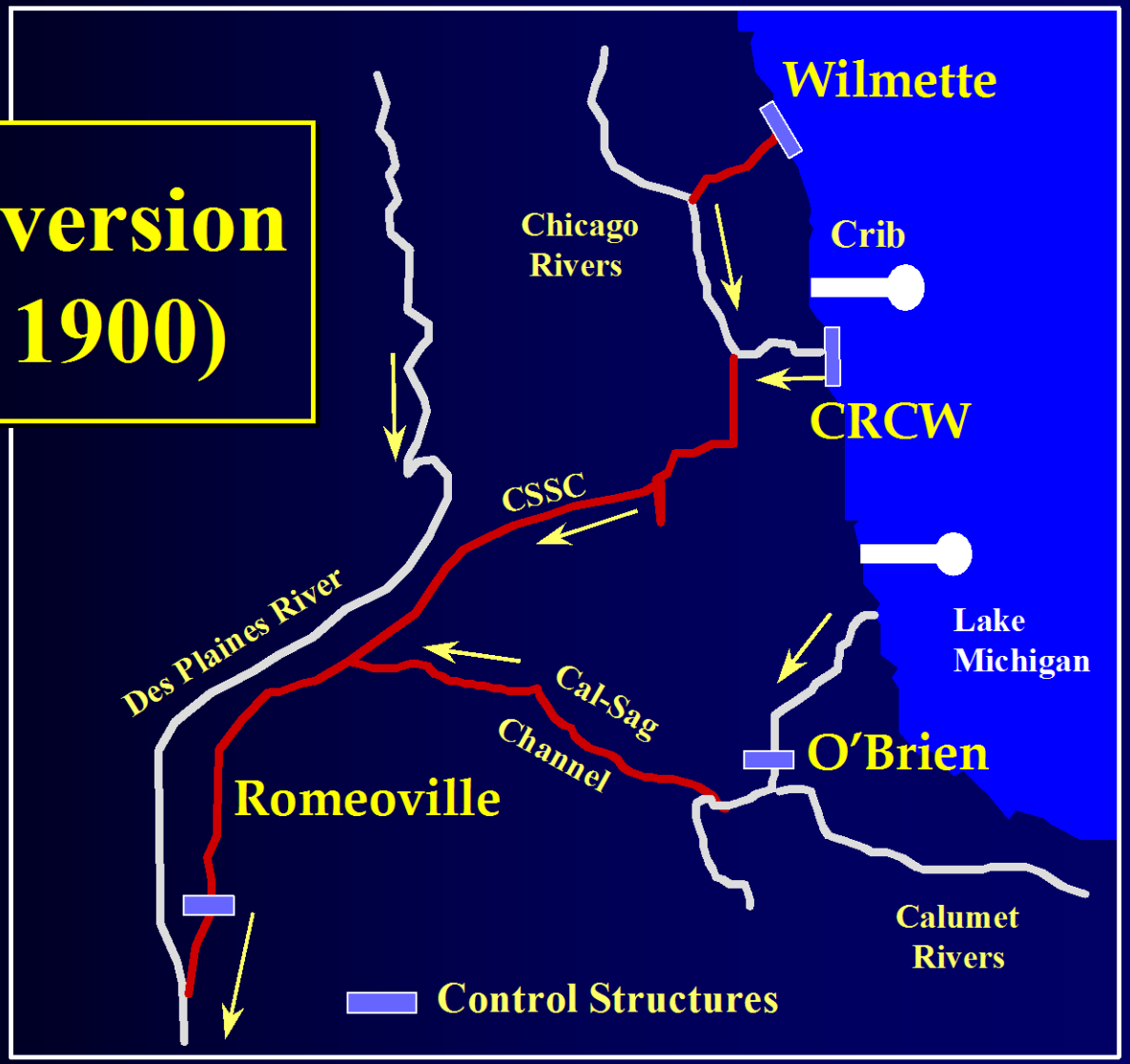
- Built for navigation.
- Mule-drawn barges
- Opened before railroads.
- 60 feet wide. 6 feet deep
- Not enough conveyance for Chicago sewage problems.



CAWS construction-historical timeline

- **1848** - completion of the Illinois and Michigan Canal
- **1900** - completion of the Chicago Sanitary and Ship Canal
- **1910** - completion of the North Shore Channel
- **1922** - completion of the Cal-Sag Channel

Post diversion (Post 1900)



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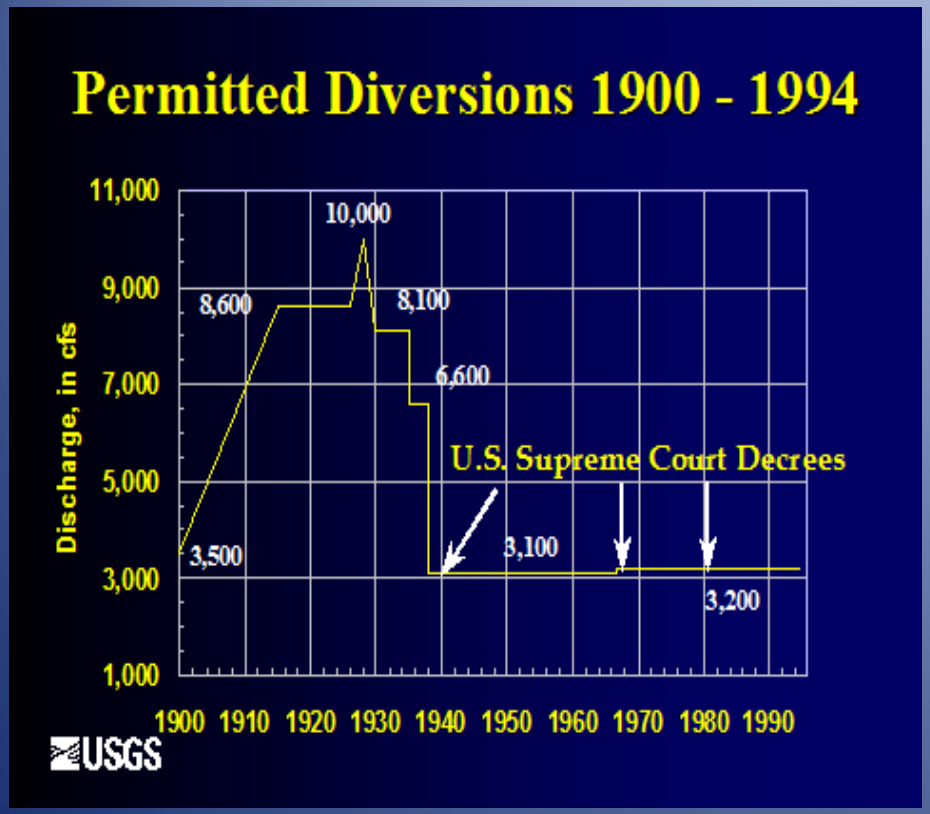
Chicago Area Waterway System-a modern engineered waterway

- A clean reliable municipal water supply.
- Transport of bulk goods in/out of the region.
- Flood-control for the Chicago metropolitan area.
- A modern wastewater system serving 10.3 million people.
- A recreational waterway.

Lake Michigan Diversion

- Withdrawing water from Lake Michigan and discharging that water to the Illinois/Mississippi River system via the CAWS
- Engineering marvel at it's time of construction.
- Largest public works excavation project ever undertaken up to its time.
- Resolved Chicago's long-standing sewage problems, providing for a clean municipal water supply, spurring economic growth and development
- **Contested by other Great Lakes states, all the way to U.S. Supreme Court.**
- Led to the development of water use legislation throughout the Great Lakes region.

Lake Michigan Diversion Accounting



- Diversion challenged in court by other Great Lakes states.
- U.S. Supreme Court decree limits the State of Illinois to 3,200 cfs mean annual flow
- Corps of Engineers responsible for accounting
- USGS technical expertise for flow monitoring

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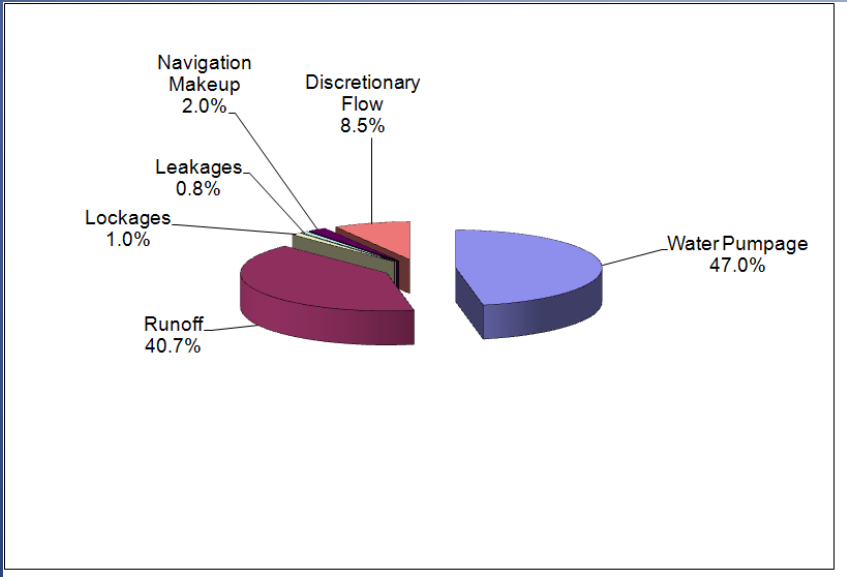
Diversion Components -2007

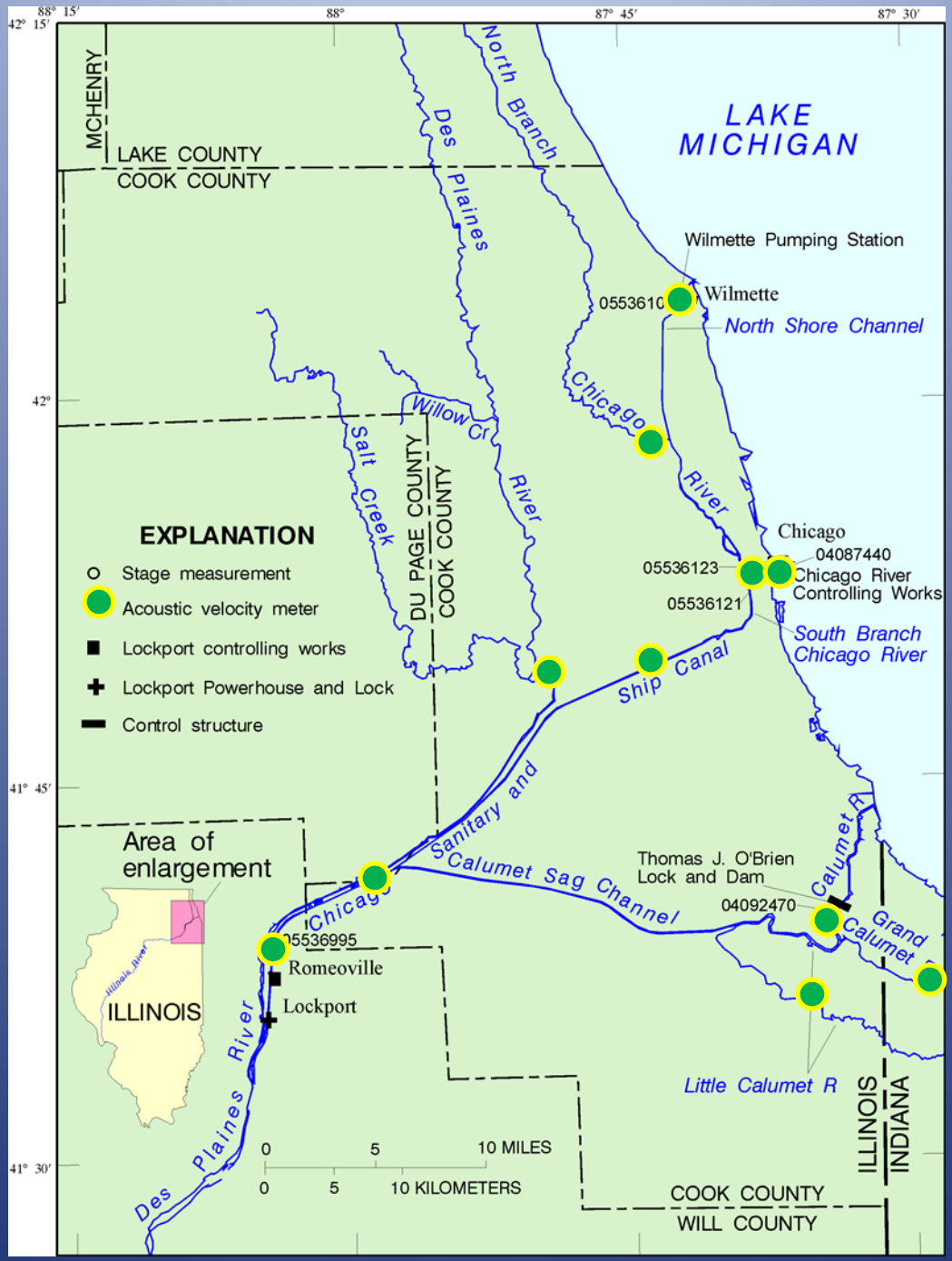


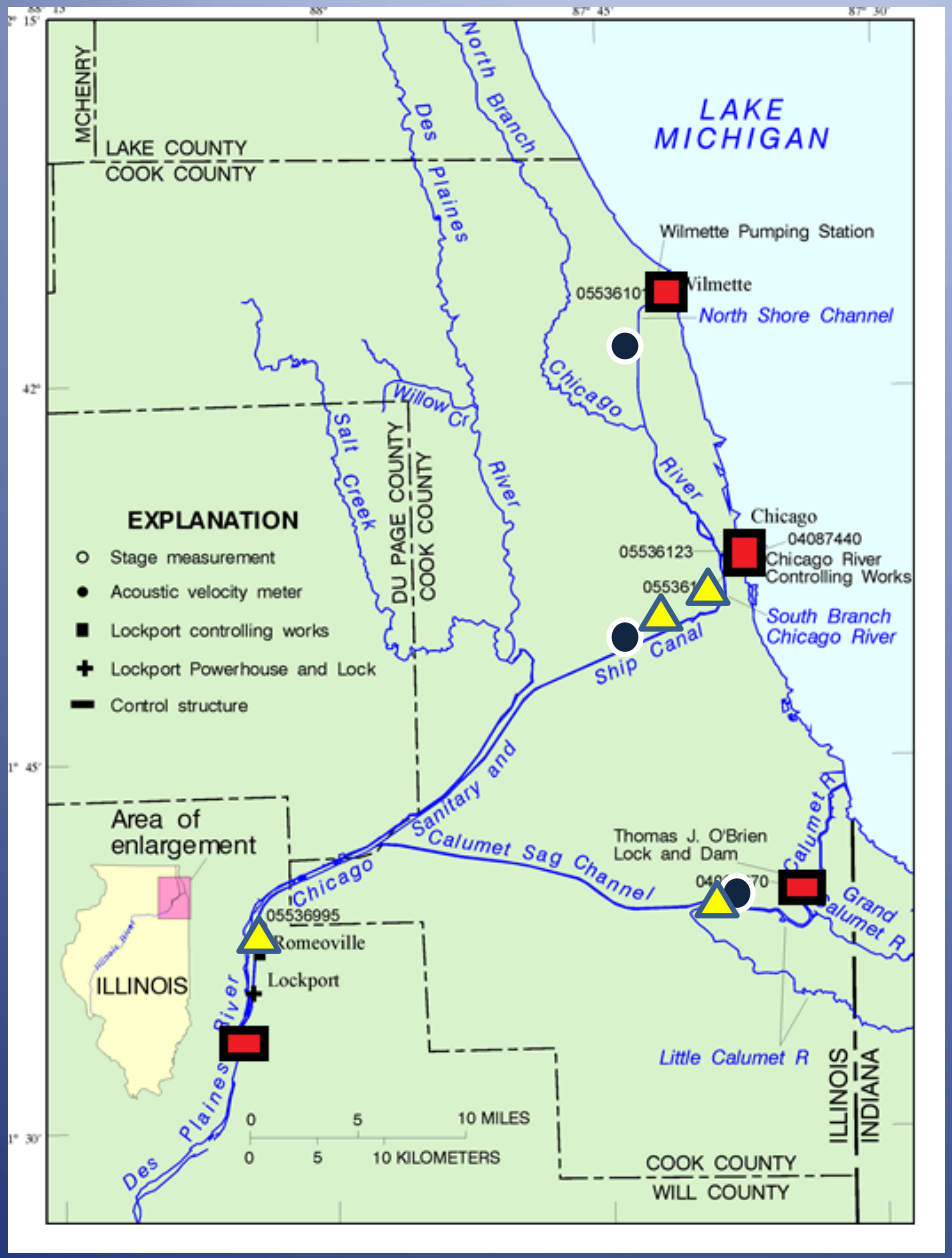
Total diversion = 3,094 cfs

- **Pumpage-municipal water supply**
- **Runoff-storm water runoff in the Chicago area that would have drained back to Lake Michigan.**
- **Direct diversions-Lake Michigan water that enters the CAWS through lakefront control structures. The bulk of the direct diversions occur April-November to maintain navigable depths and water quality standards.**

USGS monitoring of the Chicago Area Waterway

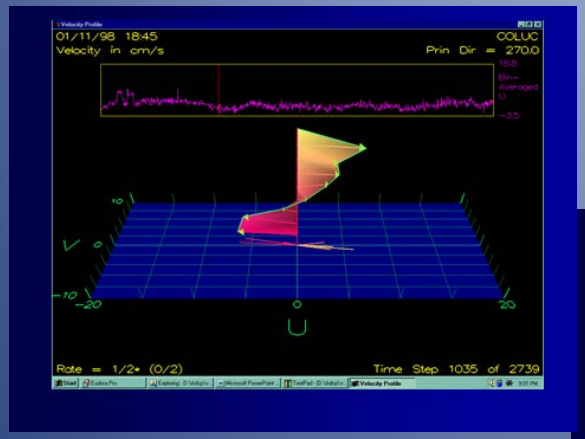
- **1984 -** USGS established acoustic velocity meter streamgaging station at Romeoville for Lake Michigan diversion accounting.
- **1996 -** USGS established lakefront acoustic velocity meter streamgaging stations at Columbus Drive, O'Brien Lock and Dam, and Wilmette.
- **2003** - USGS asked to relocate Romeoville gage due to construction of Corps Fish Barrier II.
- **2005** - USGS establishes acoustic velocity meter streamgaging station near Lemont as a replacement for the Romeoville streamgaging station.
- **2009** - USGS participation in Asian carp rapid response efforts.
- **2010** – USGS support of waterway separation studies.
- **2011** – USGS CAWS network evaluation in support of Great Lakes environmental restoration.

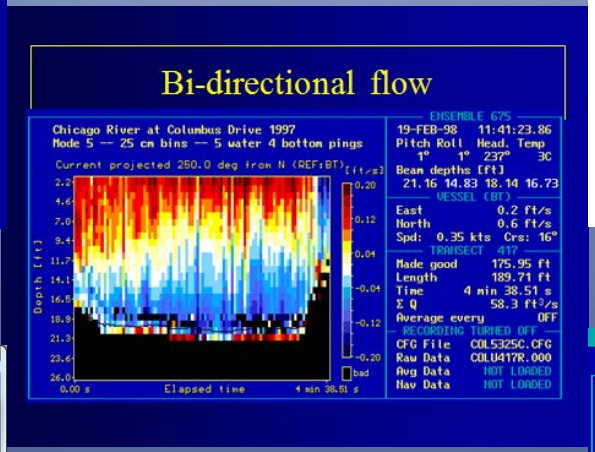

88° 15′
88°
87° 45′
87° 30′
42° 15′
42°
41° 45′
41° 30′
MCHENRY
LAKE COUNTY
COOK COUNTY
LAKE MICHIGAN
North Branch
Des Plaines
Wilmette Pumping Station
0553610
Wilmette
North Shore Channel
Chicago River
Willow Cr
Salt Creek
DU PAGE COUNTY
COOK COUNTY
River
Chicago
04087440
05536123
Chicago River
Controlling Works
05536121
South Branch
Chicago River
Ship Canal
EXPLANATION
Stage measurement
Acoustic velocity meter
Lockport controlling works
Lockport Powerhouse and Lock
Control structure
Area of
enlargement
Sanitary and
Calumet Sag Channel
Chicago
Thomas J. O'Brien
Lock and Dam
04092470
Calumet R
Grand
Calumet
05536995
Romeoville
Lockport
ILLINOIS
Illinois River
Des Plaines River
Little Calumet R
0 5 10 MILES
0 5 10 KILOMETERS
COOK COUNTY
WILL COUNTY
ILLINOIS
INDIANA

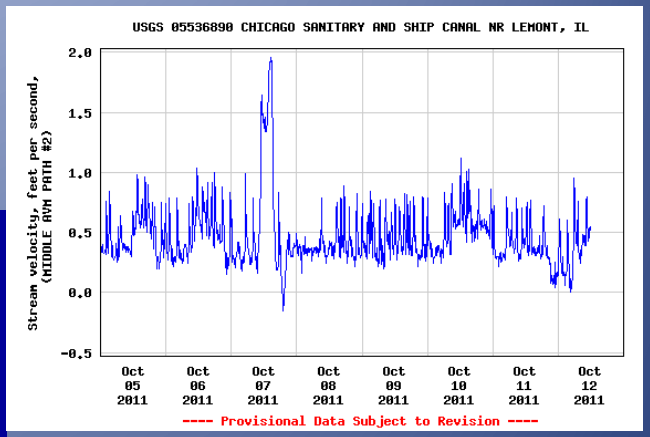


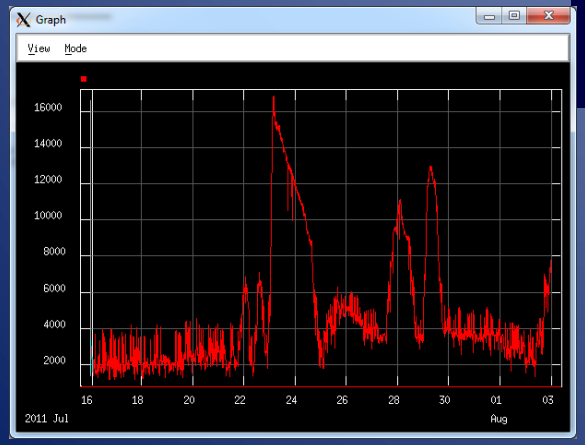
- Wastewater treatment plants:
  - -North Side
  - -Stickney
  - -Calumet
- Controlling Works:
  - -Chicago River CW
  - -Wilmette CW
  - - O'Brien L and D
  - -Lockport CW
- Lockport Powerhouse
- Thermal loads

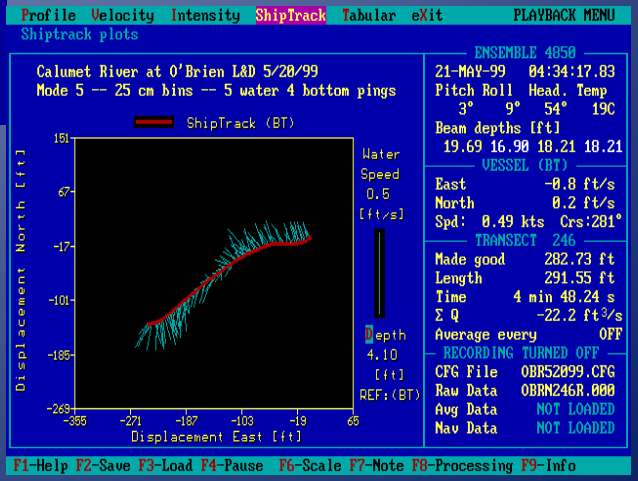
Chicago Area Waterway –
A very complex hydraulic system



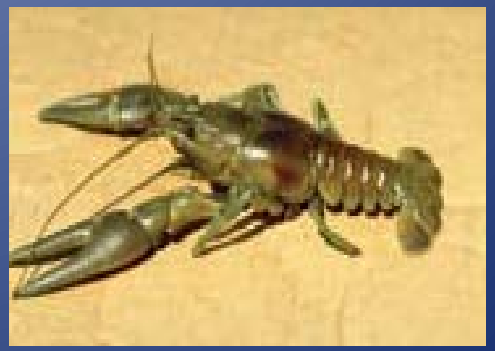




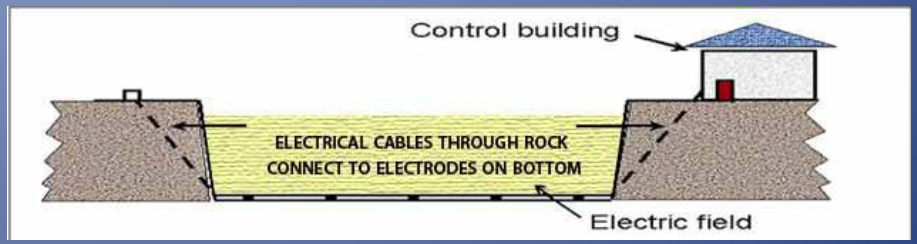




Aquatic invasive species



CSSC-Electric Fish Barrier 2002

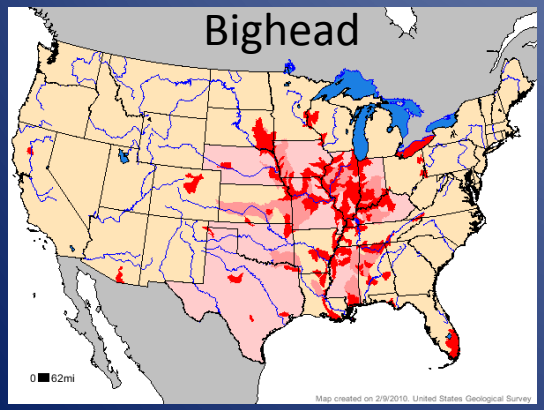


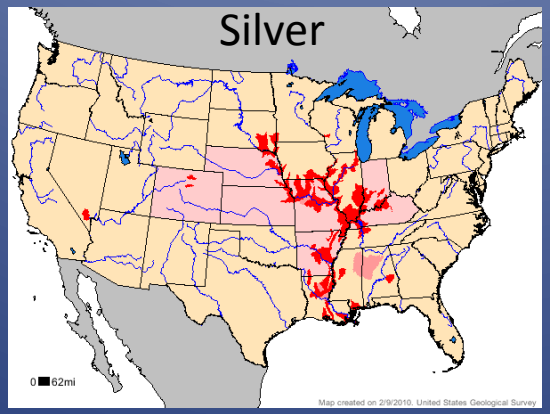
Courtesy of the USACE_Chicago District

Asian carp

- Four species commonly referred to as "Asian carps"
  - -grass carp (1963)
  - -black carp (1970's)
  - -silver and bighead carp(1970)
- Introduced into US for aquaculture and biological control of plankton
- All have escaped confinement.
- Migration through the Mississippi, and Illinois River system has been well-documented.
- Potential impact on the Great Lakes is unknown.
- Threaten a $ 7 Billion sport fishery.

Motivation





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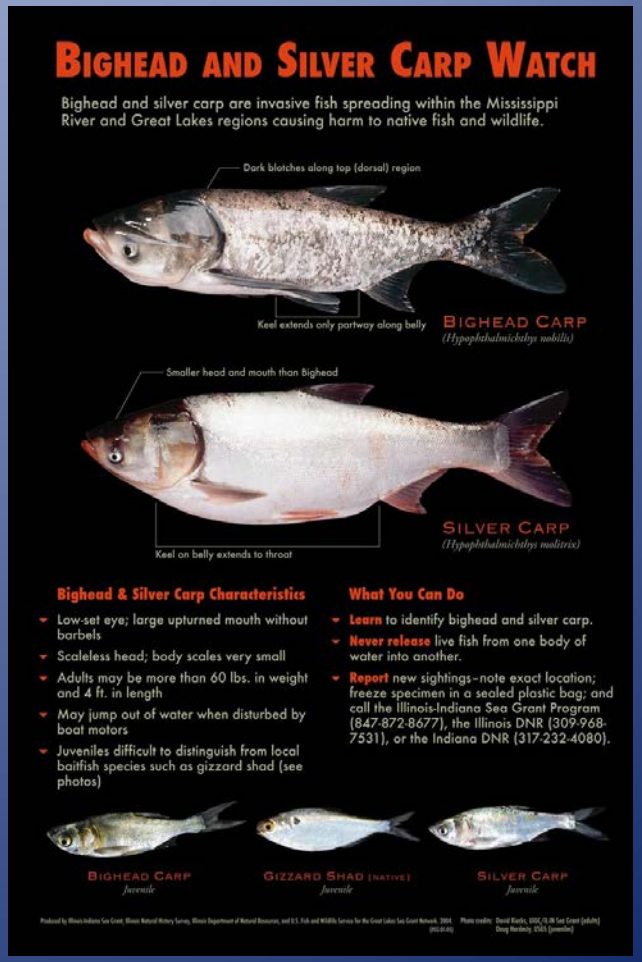
Asian carp-biology

- Native to fresh waters of eastern Asia.
- Four species-grass, black, bighead, and silver commonly referred to as “Asian carps”.
- Asian carp biology not fully understood.
- Silver and bighead carp are filter feeders.
- Compete with native fish for food.
- Prolific breeders
- Spawn in turbulent water on the rising limb of hydrograph.
- Eggs and young larvae are buoyant.
- Eggs require X miles of free-flowing channel for larvae development



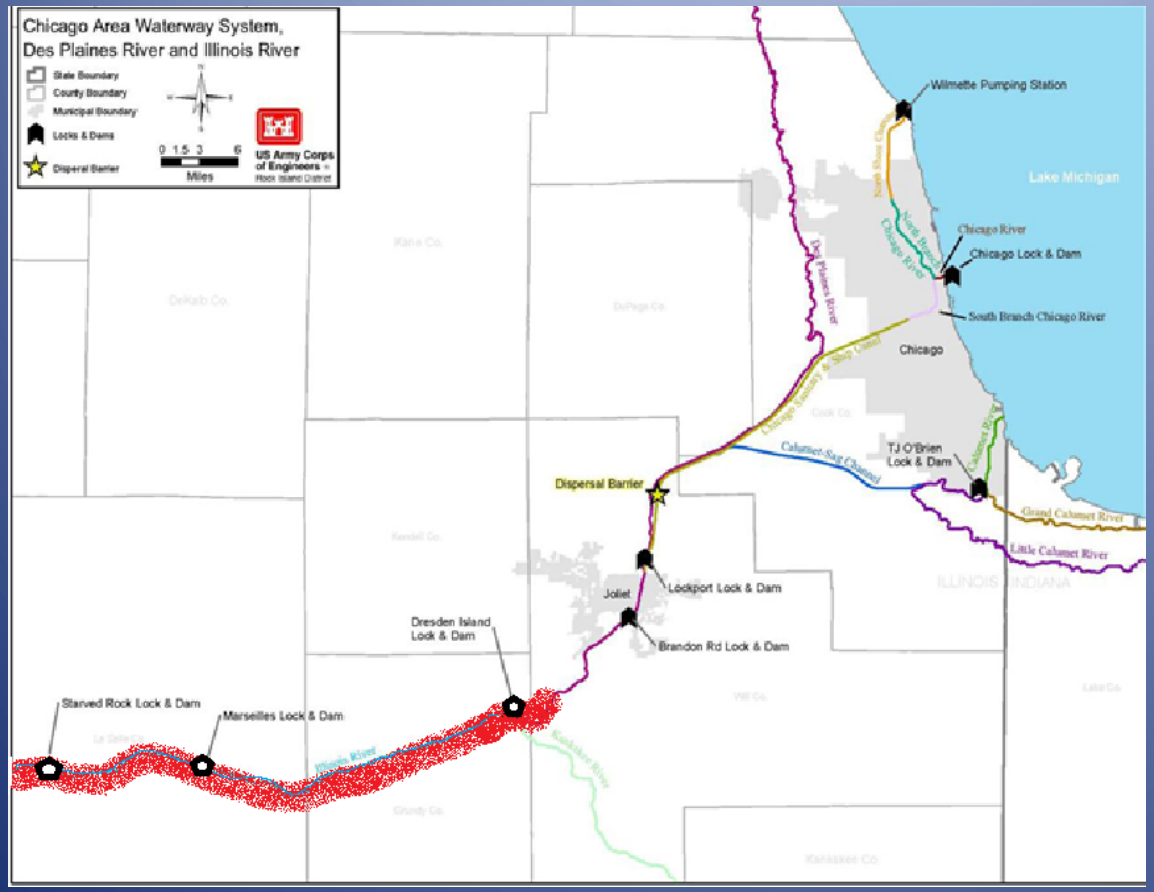
Asian carp: Unknowns

$$C = (R + A + S) + (F + U) + (\Delta B + G)$$

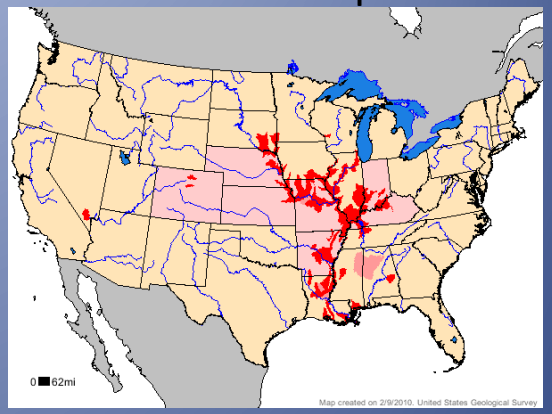
where: C = consumption
R = respiration
A = active metabolism
S = specific dynamic action
F = egestion
U = excretion
B = biomass
G = gonads/reproduction

- **Are the Great Lakes too cold for Asian carp?**
- **Are the Great Lakes suitable habitat for Asian carp?**
- **Is there an adequate food supply (phytoplankton)in the Great Lakes ?**
- **Are Great Lakes tributaries spawning habitat ?**

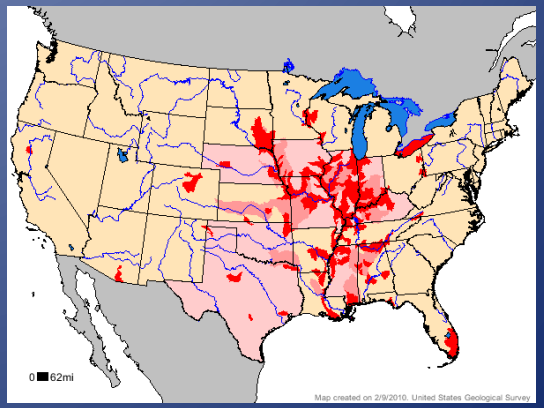
Asian Carp – migration status



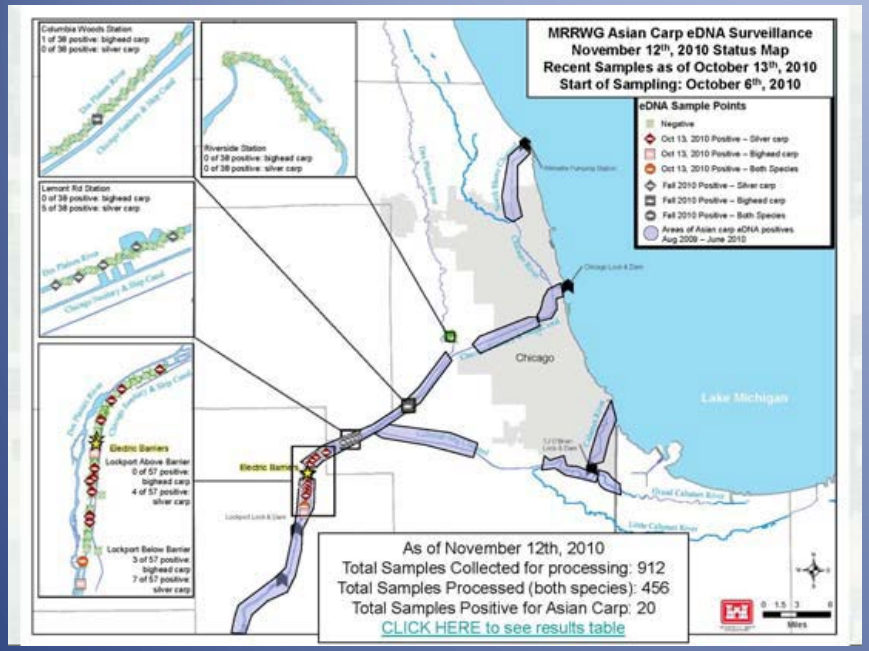
Silver carp



Bighead carp

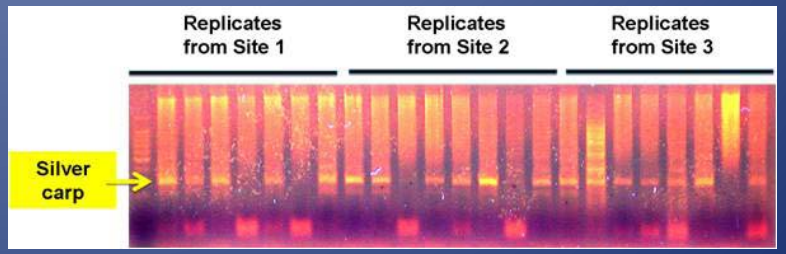


eDNA



- Used as an <u>early indicator of possible carp presence</u>.
- Since 2009 very low numbers of (+) eDNA results from above the barrier in the CAWS.
- Many uncertainties about what a (+)eDNA result indicates
- 2 Asian carp caught in/near the CAWS.

Silver carp DNA bands in gel electrophoresis (UND photo)



eDNA results are posted weekly to: http://www.lrcusace.army.mil/AsianCarp/

US Army Corps of Engineers

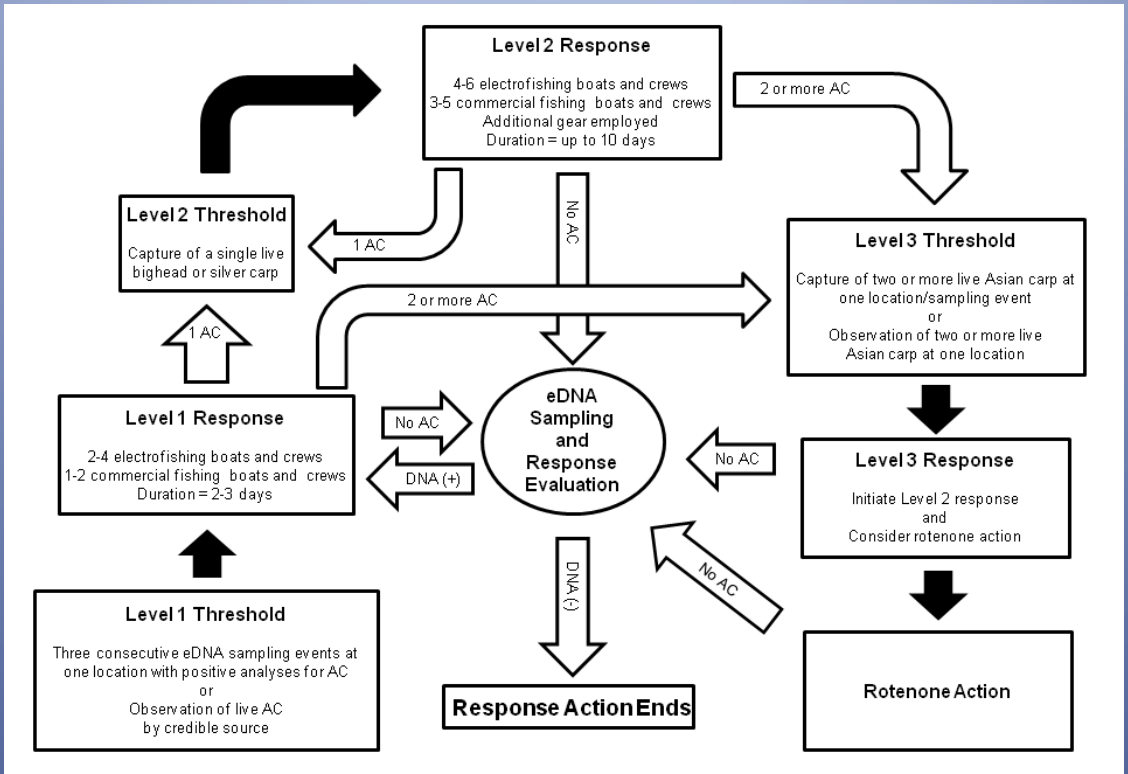
Asian Carp/eDNA issues

- Complex CAWS hydraulic setting complicates eDNA analysis.

- Unknown viability of Asian carp eDNA.

- Asian carp are able to avoid nets, electro-fishing and other traditional means of sampling, especially in deep water channels of CAWS.

- Spillover from the Des Plaines River into the Chicago and Sanitary and Ship Canal provides a waterway connection that bypasses the Corps Fish Barrier.



Thresholds for Asian carp (AC) response actions with conventional gears and rotenone.

(from Asian Carp Monitoring and Rapid Response Plan-May 2011)

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US Army Corps of Engineers

Asian carp rapid response protocol:
- increased sampling
- poisonings

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Today…frequent sampling of the CAWS with traditional gear, eDNA sampling and rapid response

Photo Courtesy of the Chicago Tribune

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Asian Carp-Commercial harvest

Governor Quinn Announces New Initiative to Control Asian Carp Population Agreement will Boost Commercial Fishing Industry, Creates 180 Jobs

CHICAGO – July 13, 2010. Governor Pat Quinn today announced a new initiative to stop the spread of invasive Asian carp species into the Great Lakes. Illinois is entering into a public-private partnership that will reduce Asian carp populations where they have been discovered in Illinois waters. This first-of-its-kind partnership will help enhance the commercial fishing industry, create approximately 180 jobs and relieve pressure on the U.S. Army Corps of Engineers Electric Barrier System designed to stop fish from moving further towards Lake Michigan.

Waterway Separation

Chicago Tribune
Breaking News, Since 1847

Traverse City, Mich.--Six attorneys general in the Great Lakes region called for a multi-state coalition Wednesday that would push the federal government to protect the lakes from invasive species such as Asian carp by cutting off their artificial link to the Mississippi River basin.

In a letter obtained by The Associated Press, the officials invited colleagues in 27 other states to join a lobbying campaign to separate the two watersheds, contending they have as much to lose as the Great Lakes do from migration of aquatic plants and animals that can do billions in economic damage and starve out native species.

Chicago Tribune
Aug. 31, 2011

Waterway Separation Studies

- **Great Lakes Commission Study (2011)**

- A one-year study to evaluate the economic, technical, and ecological feasibility of separation by illustrating scenarios to achieve it, along with associated costs, impacts and potential benefits of a re-engineered hydrologic system for greater Chicago;

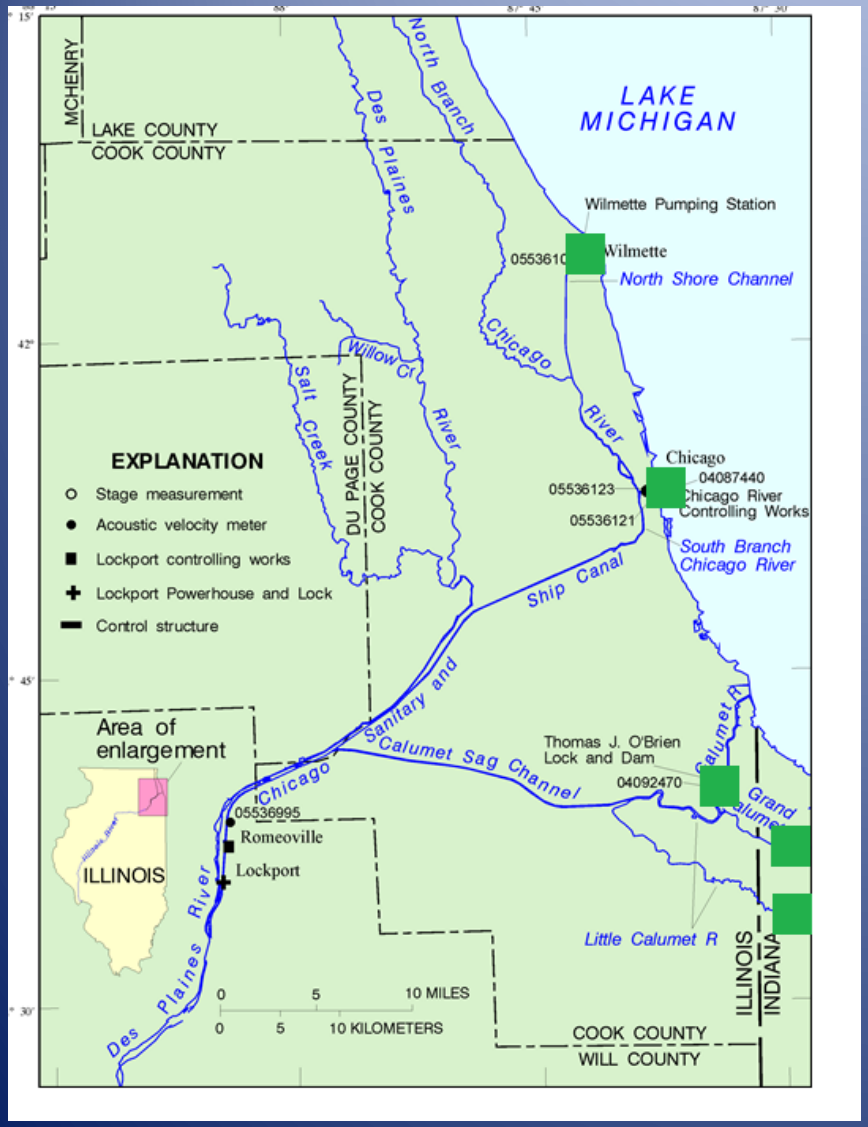
- **USACE Chicago District—GLMRIS Study (2015)**

- A five-year engineering study of impacts of waterway separation on transportation, flooding and economics.

Separation Scenarios

- **Scenario A**: **at** Wilmette PS, CRCW, O'Brien and **on** Grand Cal and Little Calumet rivers.
- **Scenario B**: **on** the CSSC **between** the Cal-Sag Junction and the Lockport Controlling Works.
- **Scenario C**: **on** the S. Br. Chicago River **west** of Bubbly Creek, and **just west of the confluence** of the Little Calumet River and the Cal-Sag Channel.
- **Scenario D**: **on** the S. Br. Chicago River **east** of Bubbly Creek and **just west of the confluence** of the Little Calumet River and the Cal-Sag Channel.
- **Scenario E**: **on** the S. Br. Chicago River **west** of Bubbly Creek and the Little Calumet River **east** of Calumet Water Reclamation Plant.
- **Scenario F**: **on** the S. Br. Chicago River **east** of Bubbly Creek and the Little Calumet River **east** of Calumet Water Reclamation Plant.

Scenario A:



Positive and Negative Aspects

(-) Five locations (increased cost and maintenance).

(-) **No** backflows to lake possible. Increased flooding.

(-) N. Br. Grand Ave gage flood volumes (~15,000 acre-feet: 2 events 2010 WY)

(-) Locks closed to navigation.

(-) No lake diversion so cooling water for powerplant intakes is warmer.

(-) without direct diversion water from lake, the location of DO sags changes and the operation/efficiency of SEPA stations changes.

(-) North Shore Channel north of NSWRP becomes stagnant.

(-) Mainstem Chicago River (Wolf Pt. to CRCW) becomes stagnant (no lake water from direct diversion , so the channel turns black in color and smells like wastewater).

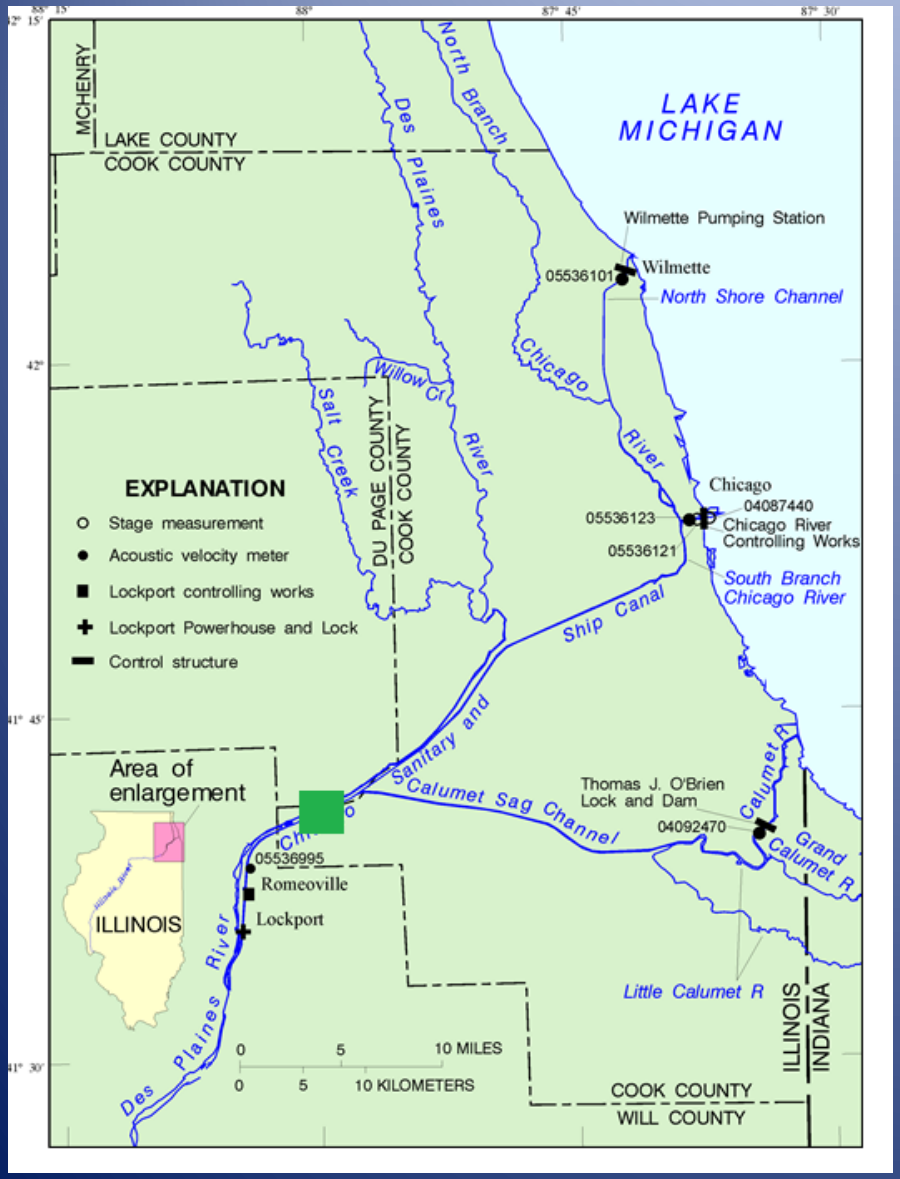
(-) Little Calumet River east of Calumet WRP becomes stagnant.

(+) **All** flows from N Br. NSWRP, RAPS, CWRP go downstream to Lockport.

(+) CAWS system open to boat and barge traffic-except exit to lake.

(+) no impact to Lake Michigan.

Scenario B:



Positive and Negative Aspects

(+) CAWS system open lakeside of separation point (benefits rec boaters?).

(+) only 1 separation point/structure (lower costs).

(+) riverside rec boat marinas still have access to lake.

(-) **All** flows from N Br., NSWRP, RAPS, Stickney WRP go to Lake Michigan.

(-) Bubbly Creek sediment transport to lakefront.

(-) Little Calumet River, Stoney Creek, Tinley Creek and Calumet WRP go to Lake Michigan.

(-) Increased flows to lake between O'Brien Lock and Dam. Increased velocities and increased sediment transport from Calumet River to Lake Michigan.

(-) Increased beach bacteria problems

(-) Changes to Chicago-DWM for drinking water intakes…crib system (ref: Milwaukee- Cryptosporidium).??

(-) **No barge traffic to industrial corridor along CSSC.**

(-) Cooling-water needs for Midwest Generation's Romeoville power plant.

(-) If waterway below separation point is open to navigation (coal barges to power plants, etc.)-how do you refill the pool after lockage's?

(-) spillover from Des Plaines River to waterway above separation point (fence failure) or Summit Conduit.

(-) how are water levels in the canal system (CSSC side and Cal-Sag) between the separation point on the lower CSSC and the Stickney and Calumet WRP's maintained

Transportation and Flooding

Transportation impacts

- All separation scenarios will impact the transportation industry.
- GLC study identifies waterway separation as an opportunity for new port development and improving the transportation infrastructure with links to Panama Canal expansion.
- Proposed intermodal port facilities (offload/onload).
- Proposed boat lift and decontamination facilities.
- Proposed new harbor development.

➢ **Strong opposition from industry groups.**

Flooding impacts

- GLC and Corps recognize potential flood impacts.
- Corps of Engineers to evaluate flood impacts through engineering studies.
- TARP Phase II completion 2029
- Even with a complete TARP system, there is insufficient storage in the system for events > 3 inches of rainfall.
- Separation eliminates the ability to backflow river system to Lake Michigan

The End …

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