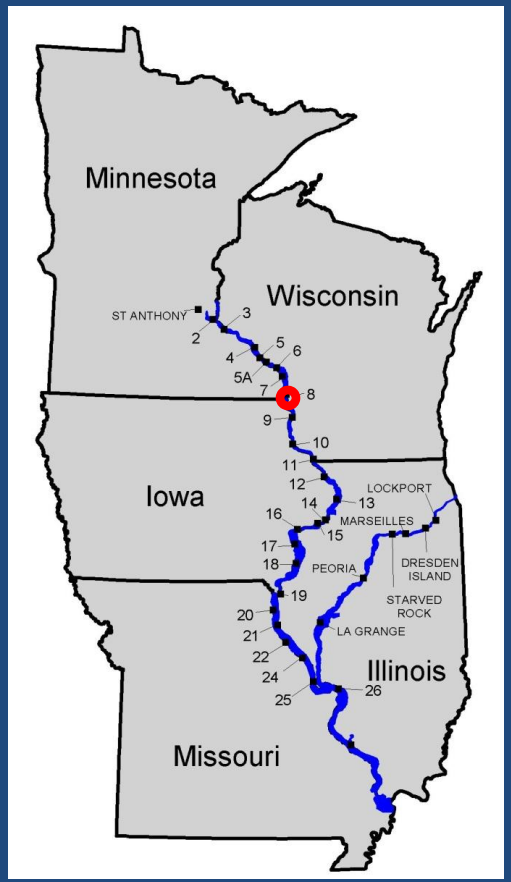
Island Construction: Rebuilding Natural Levees to Restore Hydrologic Connectivity in the Northern Reaches of the Upper Mississippi River (UMRS)



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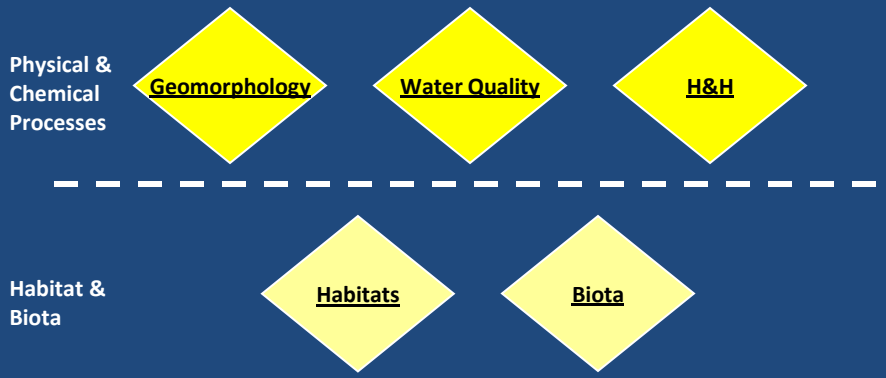
U.S. Army Corps of Engineers, St. Paul District

01 August 2011

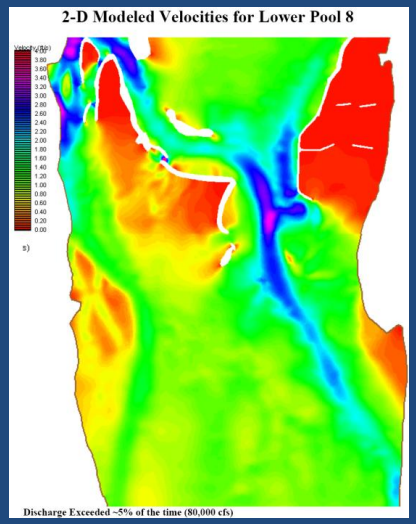
Topics Covered:

1. Stressors

2. Ecosystem Relationships



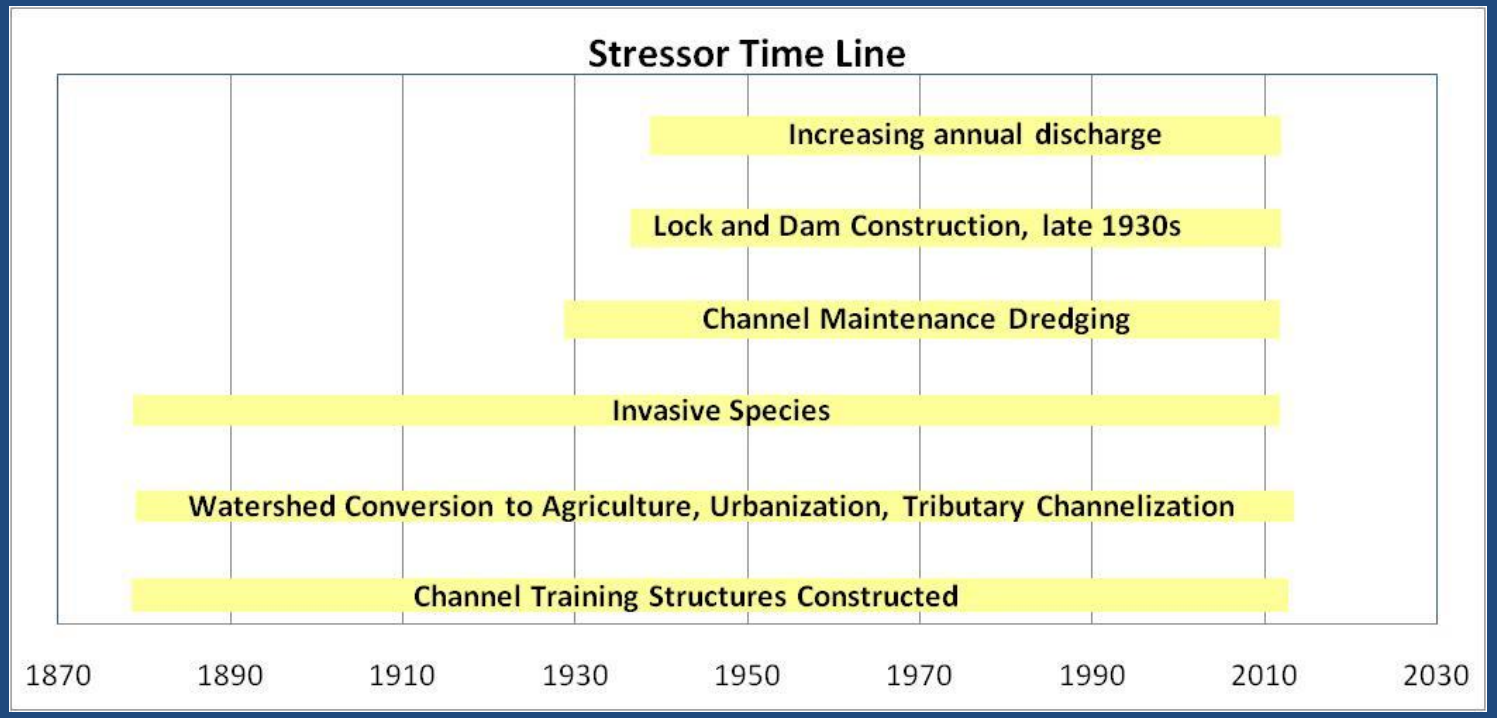
3. Tools

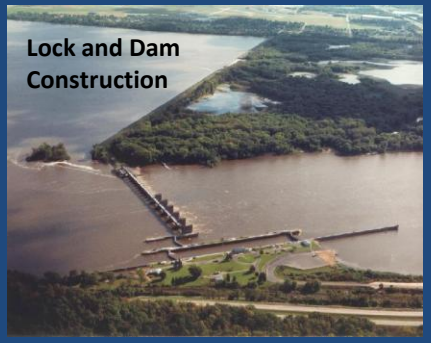


4. Management Actions

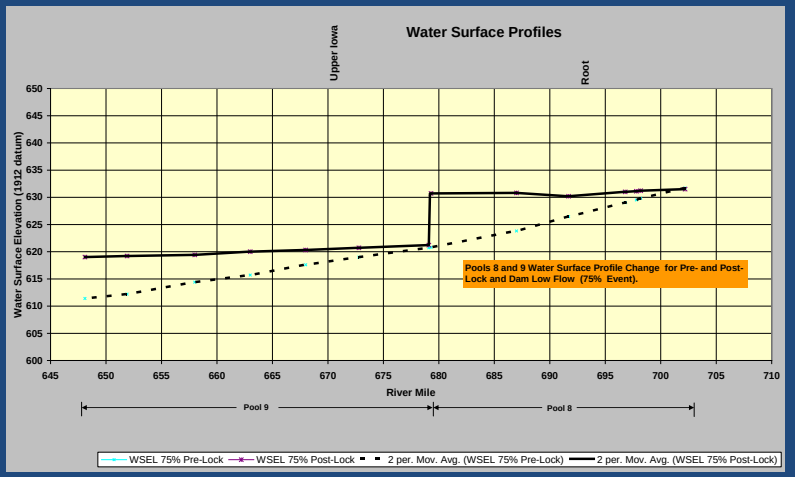
5. Connecting People

Many stressors affect ecological conditions on the UMRS today

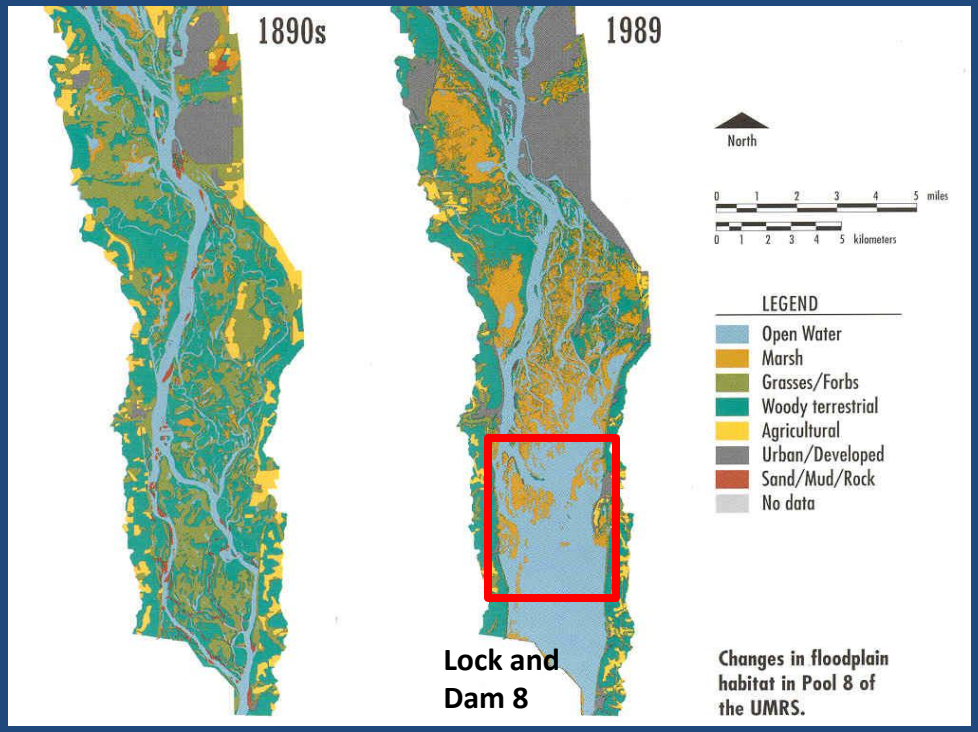




The most significant stressor was the construction of the Locks and Dams



23 miles



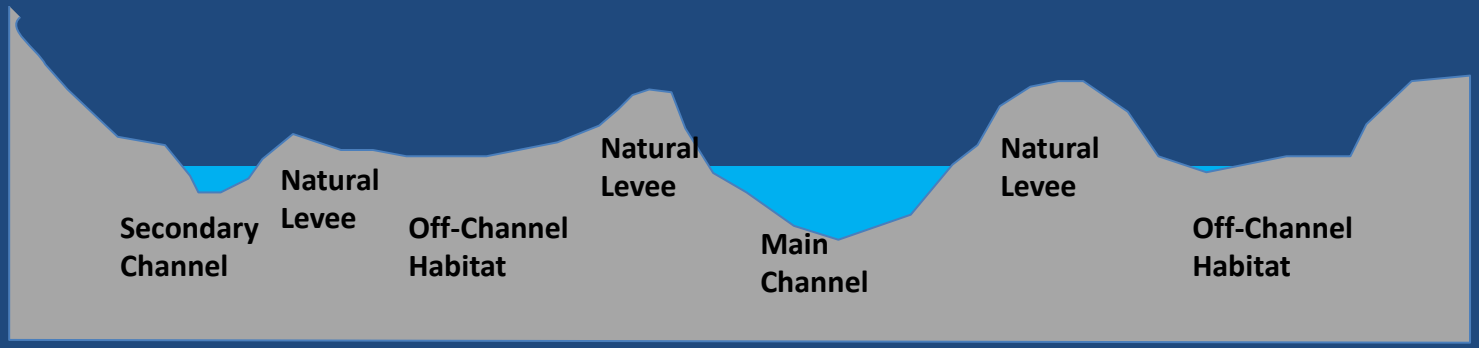
In lower pool 8, water levels were raised 10 feet submerging the floodplain upstream of the lock

Natural levees (Islands)

Definition: The high banks (green shaded areas on adjacent map) along channels where sediment deposits during flood events. They separate channel from off-channel habitat.

These natural levees were, and still are called islands

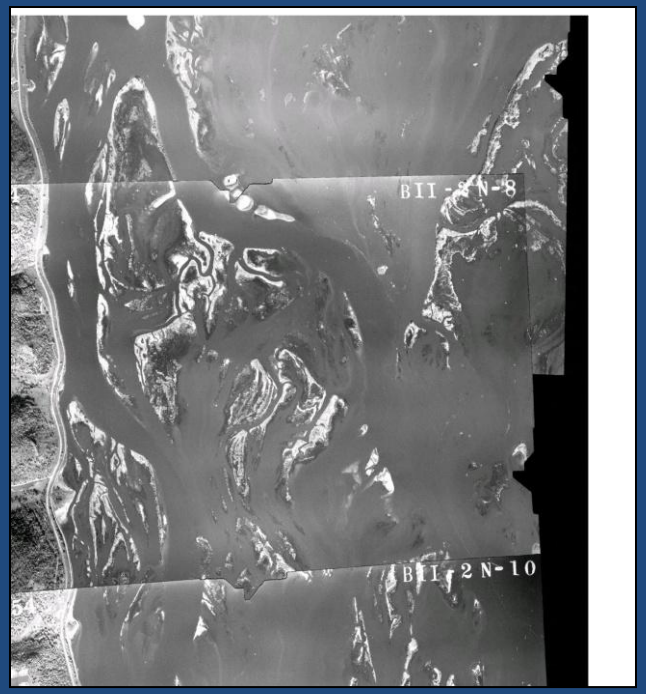
Lower Pool 8 (1890 Mississippi River Commission Map)



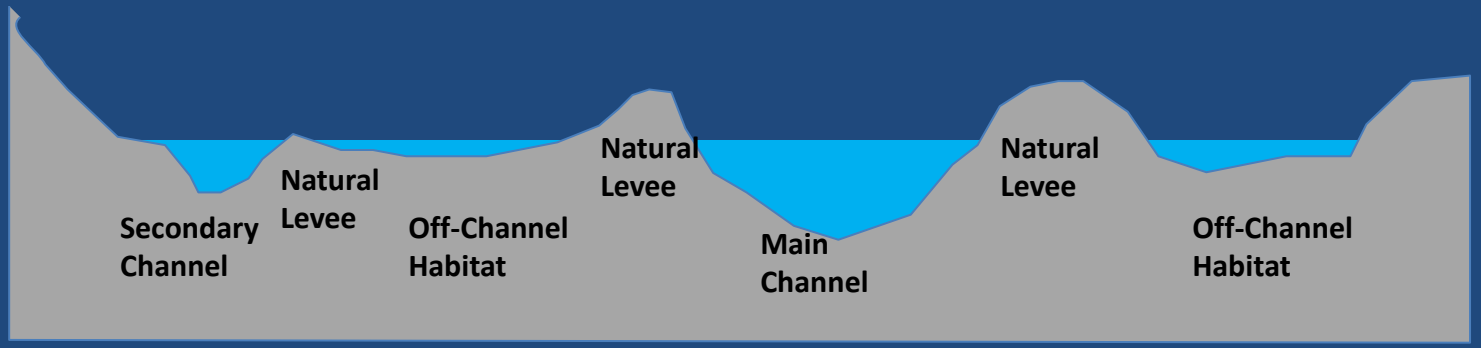
Lock and Dam Construction

Lock and dam construction :

1. **Submerged some of the natural levees and all of the off-channel habitat.**
2. **Stabilized water levels**



Lower Pool 8, 1954

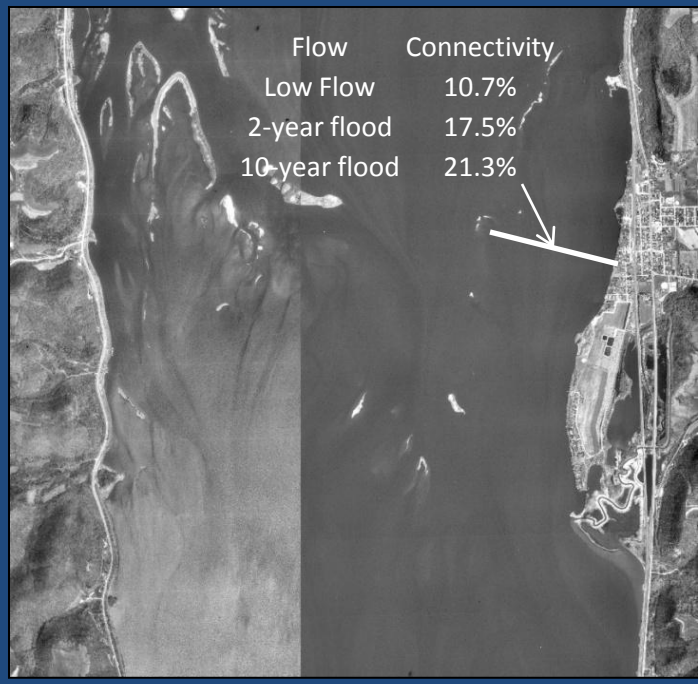


Hydrologic Connectivity:

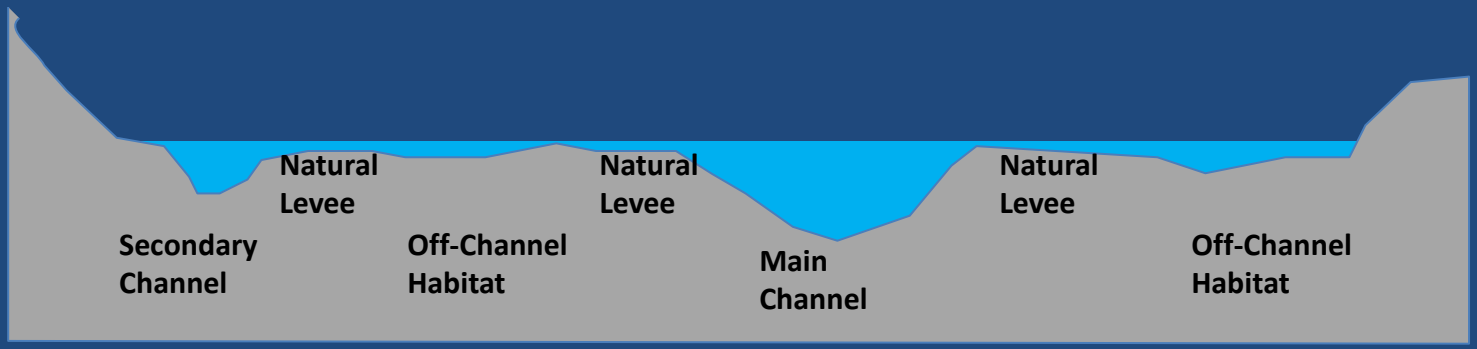
Definition: The exchange of water between adjacent water bodies (e.g. channel to off-channel areas)

HC = flow exchanged/total river flow

Following Lock and Dam 8 construction, island erosion increased hydrologic connectivity and decreased its' seasonal variation.



Lower Pool 8, 1991



Habitat Degradation

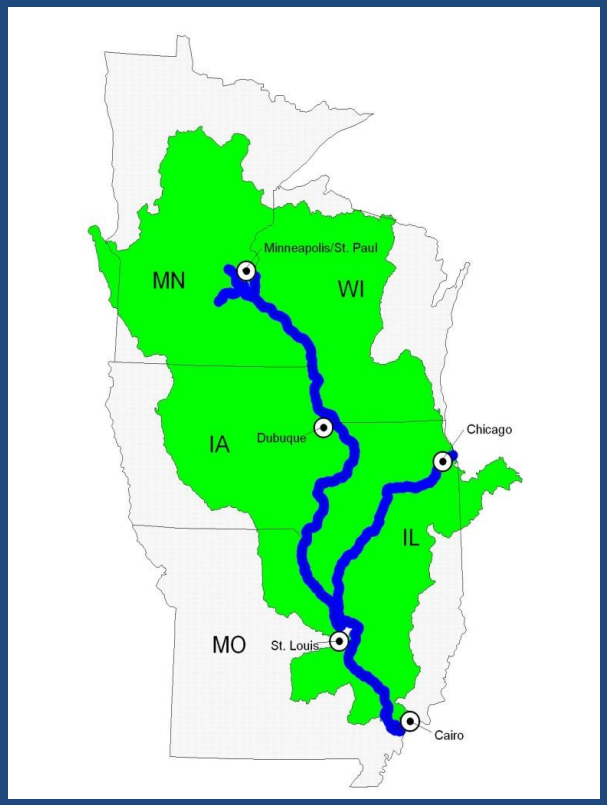
Between the 1930s and the 1980s, ongoing degradation of aquatic habitat caused significant concern. Physical parameters that consistently came up in discussions included:

- High and increasing hydrologic connectivity
- Lack of water level variation
- Increasing wind fetch
- Constituent loads

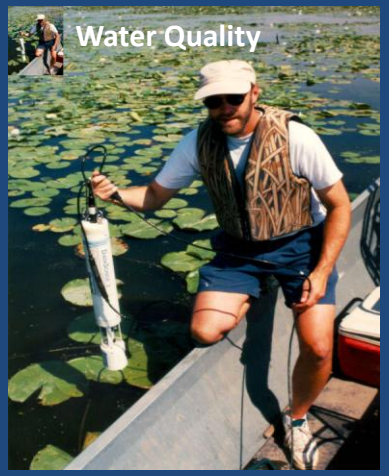
Natural Resource Managers had few options to deal with these physical parameters.

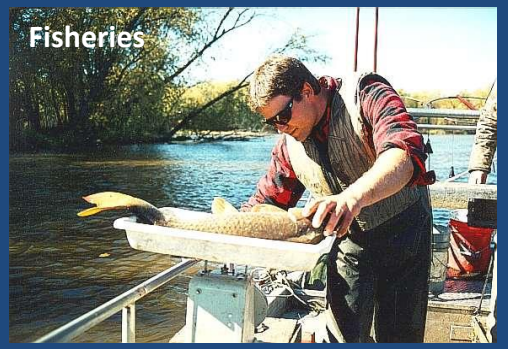
The Upper Mississippi River Environmental Management Program (EMP) made it possible to address these parameters

The EMP provides funds for work on the UMRS from Cairo, IL to St. Paul, MN



The EMP includes a habitat restoration Component along with a Long Term Resource Monitoring Program (LTRMP)





Interagency Teams established links between physical parameters, habitat, and biota

Stressor: Raised Water Levels

Physical & Chemical Processes

Geomorphology
Island Erosion

Water Quality
Winter Water Temperature Decreased

H&H
Backwater Inflows Increased

Habitat & Biota

Habitats
Overwintering Fish Habitat Degraded

Biota
Centrarchid Numbers Decreased

Project objectives and criteria were developed

Objectives were developed for lentic fish, waterfowl, and a number of other species.

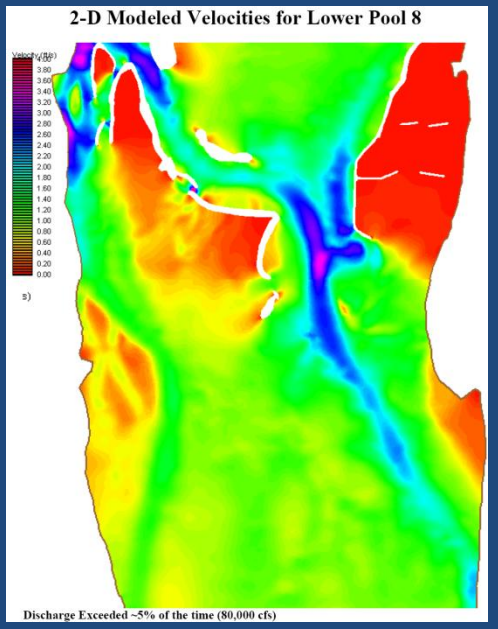
Criteria established links between physical parameters & biota

Example for backwater fish species

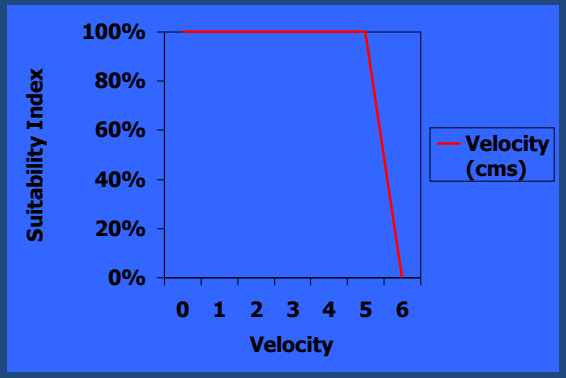
Objectives	Performance Criteria
Create 200 acres of overwintering habitat meeting the following criteria:	Dissolved oxygen levels > 3 mg/l Current velocity < 0.3 cm/sec over 80% of the area. Water temperature as follows: • 4°C over 35% of the area, • 2-4°C over 30% of the area, • 0-2°C over 35% of the area. Water depths > 4 feet over 40% of the wintering area in year 25.

Monitoring and modeling needs were established

Discharge measurements to quantify hydrologic connectivity

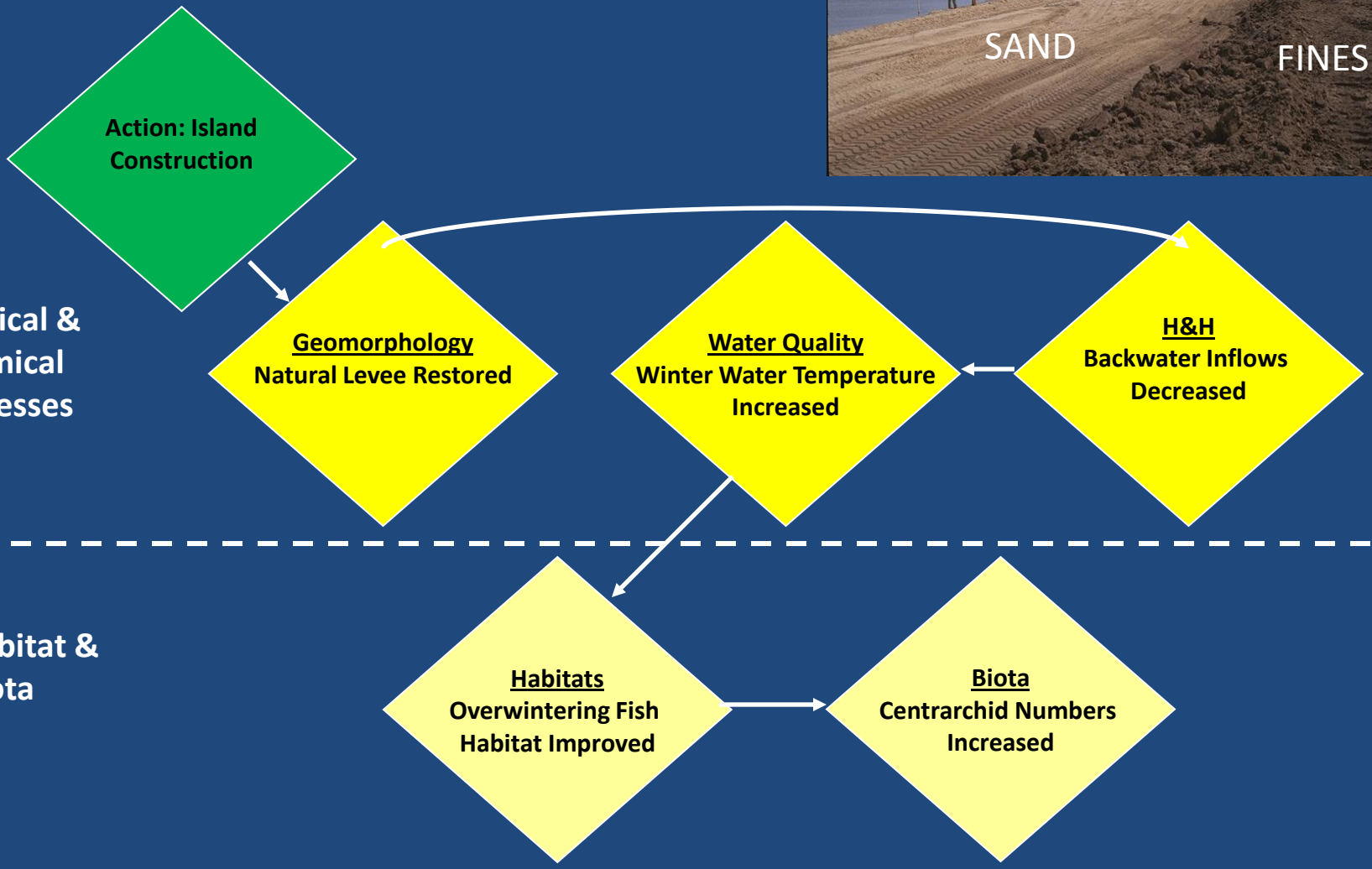


Two-dimensional hydraulic models based on LTRMP bathymetry and calibrated to discharge measurements

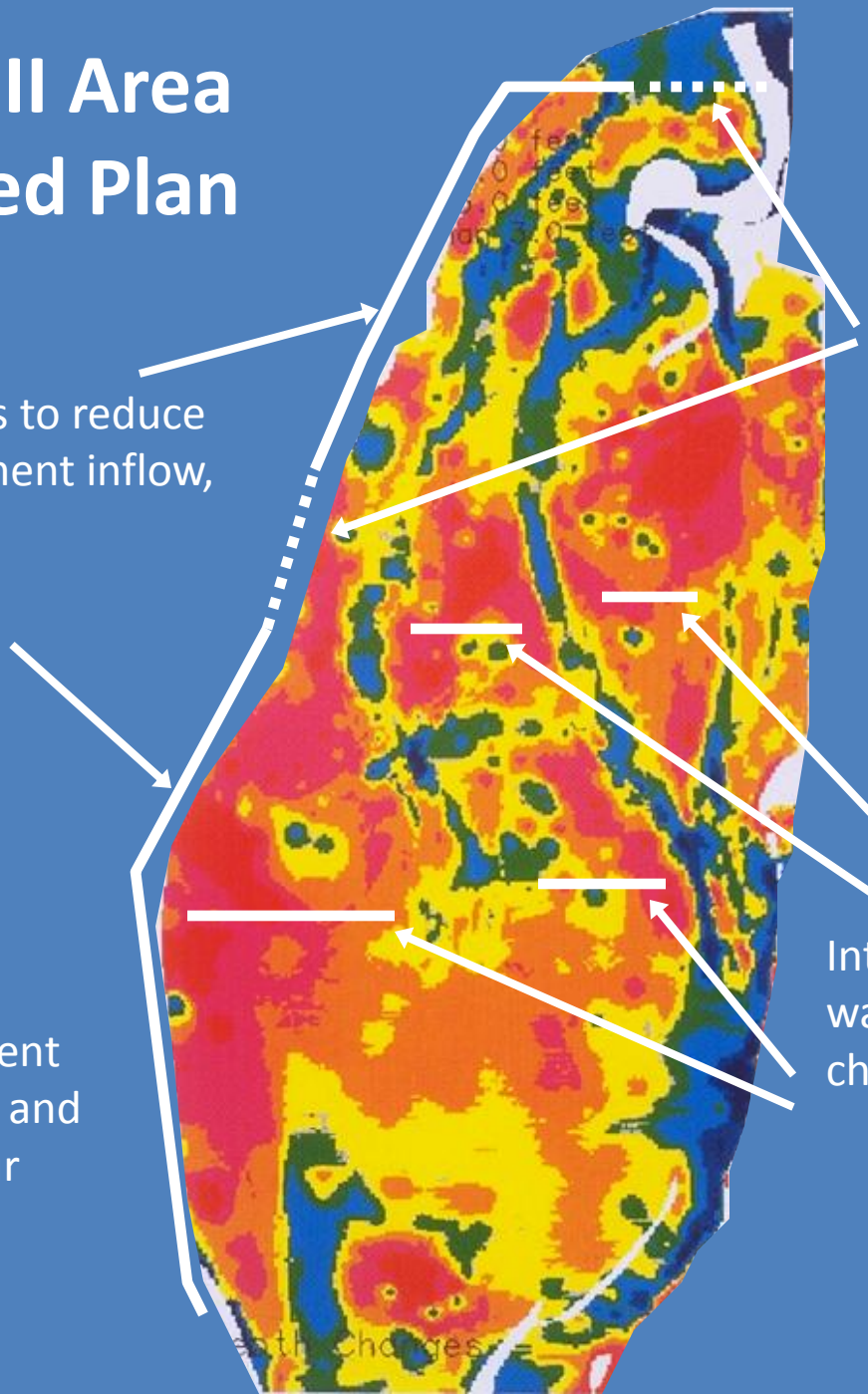


Habitat models

Island construction became the management action of choice



Pool 8 Phase II Area Recommended Plan



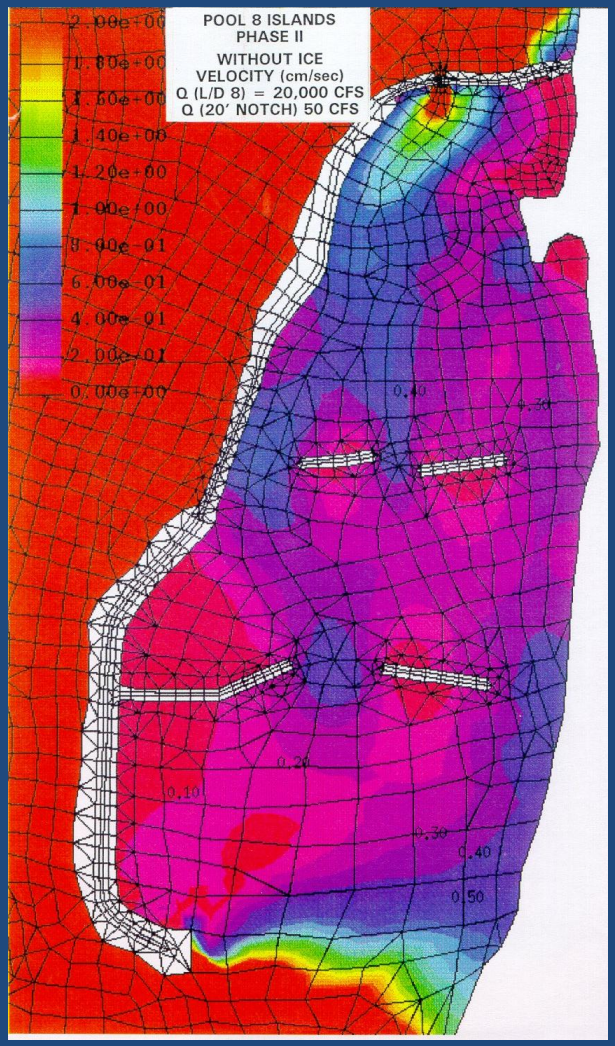
Large barrier islands to reduce velocities and sediment inflow,

Rock sills to allow floodplain conveyance during floods.
A small low flow notch is included in the upper sill.

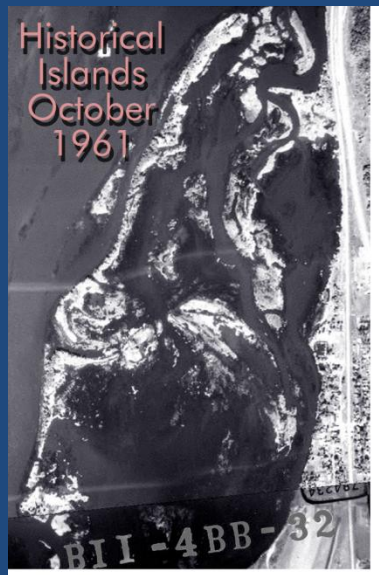
Interior Islands to force water to flow through the channels promoting scour

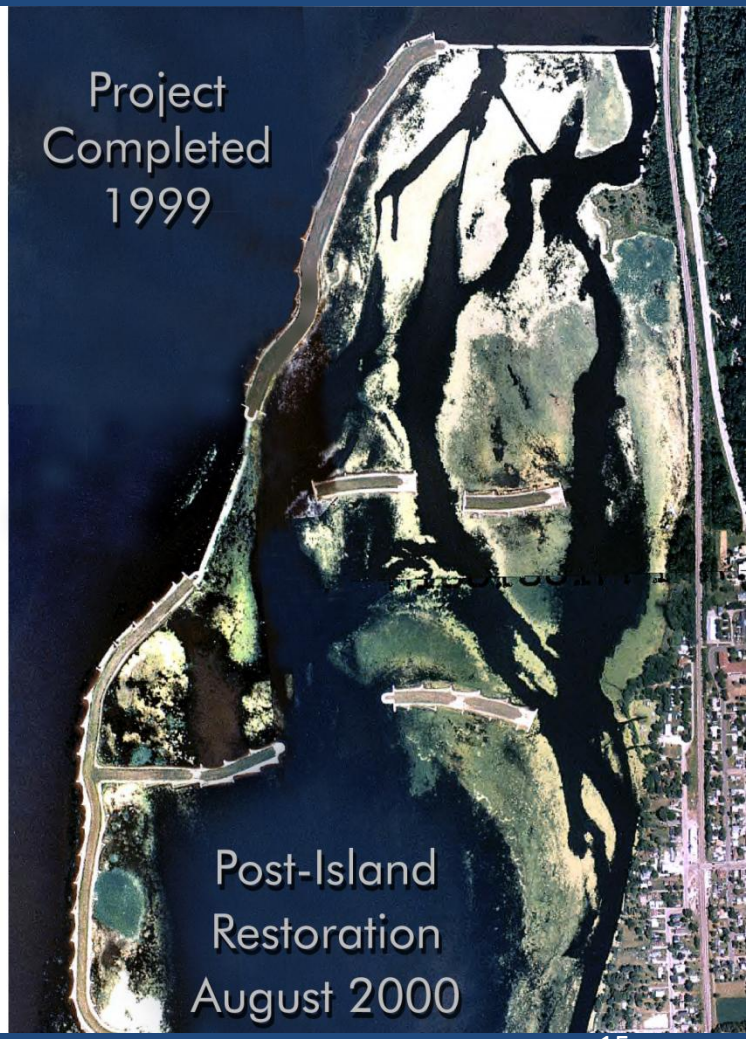
Background colors represent Sediment deposition (red and orange) and channel scour (green and blue).

2D model for Low flow conditions



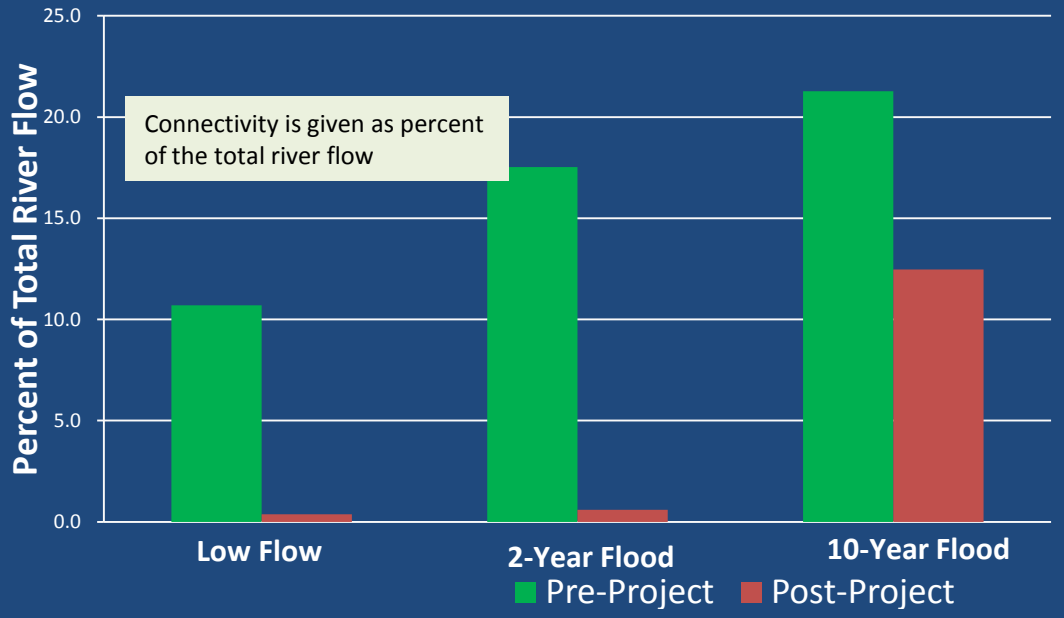
Series of aerial photos illustrating changes leading up to the project and response to the project



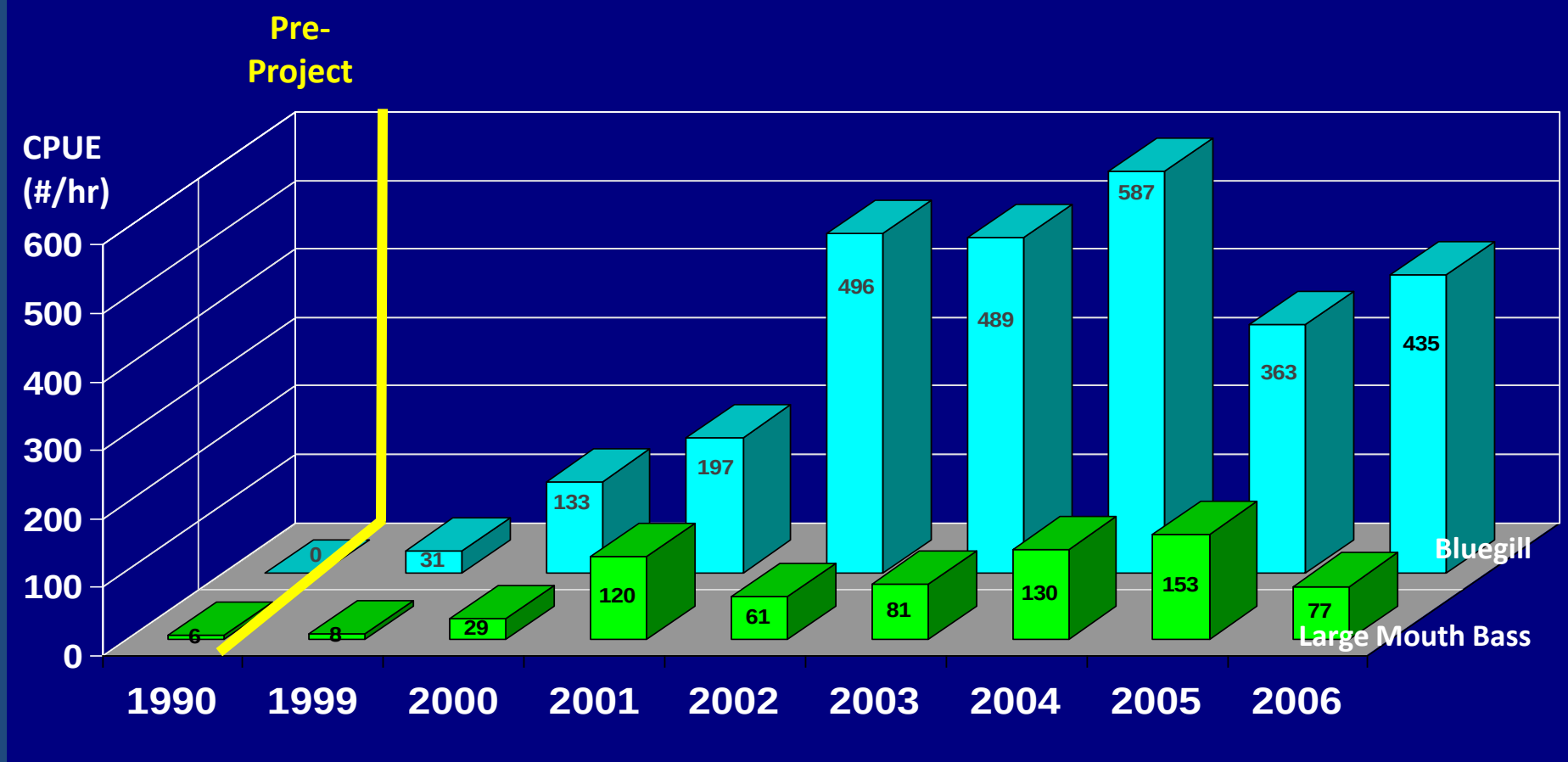


Hydrologic Connectivity in the Phase II Area was restored to a condition that helped meet criteria and achieve objectives.

For post-project conditions the seasonal variation in hydrologic connectivity was increased significantly with low connectivity for low flow to bankfull conditions and then increasing connectivity for floods.



Fall electro-fishing indicates continual increases in fish over time.



WDNR Data

Submerged Aquatic Vegetation (SAV) has improved due to regional factors and local management measures

In a comparison between Pools 8 and 13:

SAV abundance increased in both pools because of regional reductions in turbidity.

But patch size of SAV in Pool 8 was much more substantial.

These changes indicate that local modifications to water flow and wind fetch led to larger patches of SAV.

De Jager and Yin , USGS (2010)

Graphic from 2011 UMRCC News Letter

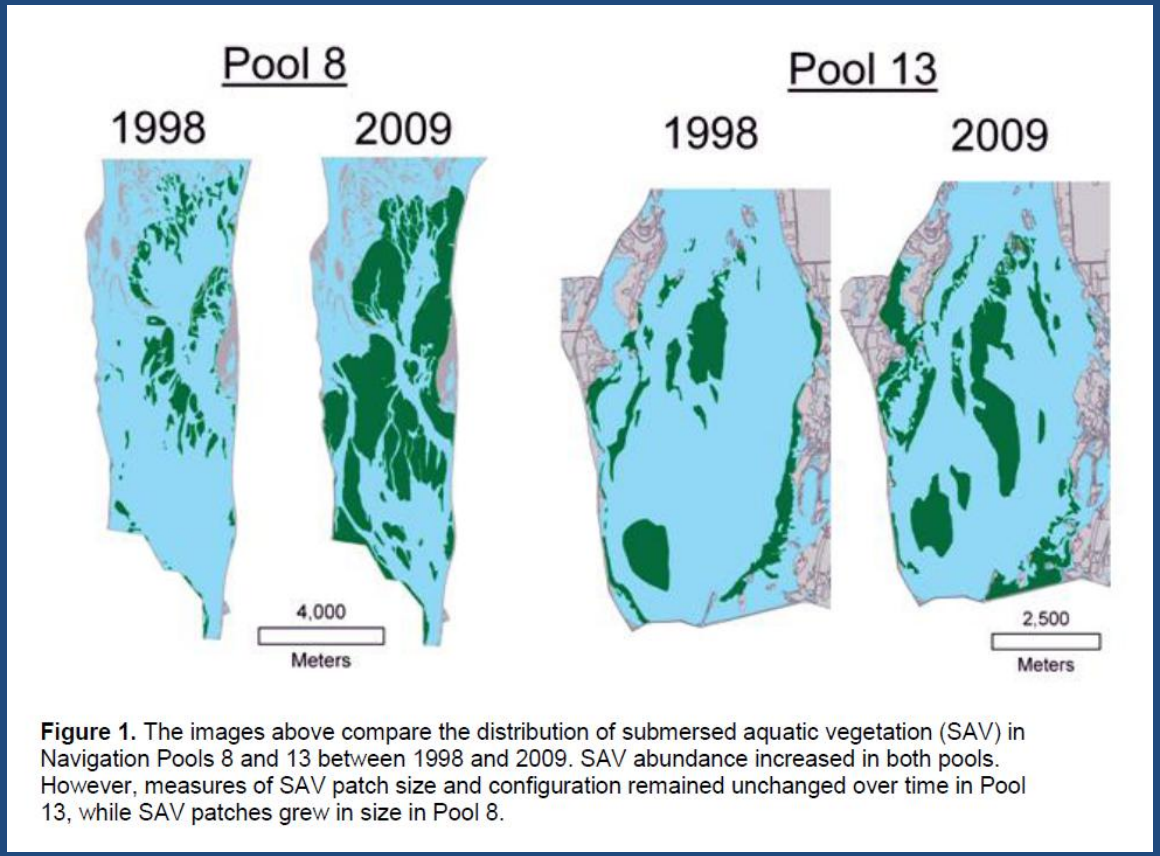


Figure 1. The images above compare the distribution of submersed aquatic vegetation (SAV) in Navigation Pools 8 and 13 between 1998 and 2009. SAV abundance increased in both pools. However, measures of SAV patch size and configuration remained unchanged over time in Pool 13, while SAV patches grew in size in Pool 8.

Planning and Design Team Communication

- In-house Planning Team
  - Project Manager
  - Engineers
  - Biologists
- Natural Resource Agencies
  - Local sponsor (USFWS)
  - Wisconsin and Minnesota DNR Biologists and Hydrologists
- Public
  - Public meetings
  - Provided insights on problems and concerns

The Pool 8 Island project has connected people

Conclusions:

Lock and Dam construction in the mid 1930s submerged and eroded natural levees (ie. islands)

This increased hydrologic connectivity and degraded habitat in the navigation pools

Funding through the Environmental Management Program (EMP) provided USACE a means to deal with hydrologic connectivity

Island construction in Lower Pool 8 is re-building natural levees and restoring hydrologic connectivity

This effort involved significant interagency and multi-discipline communication