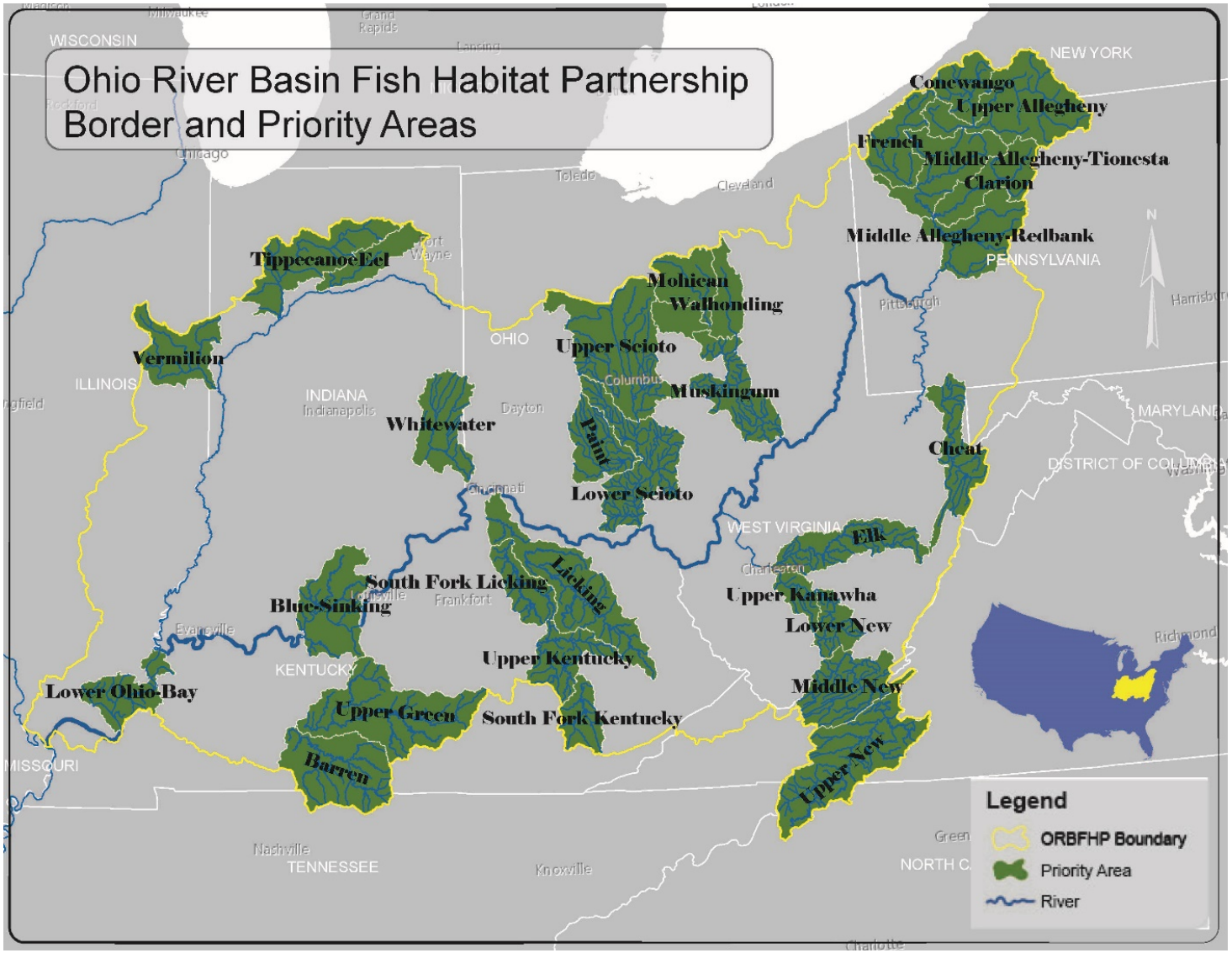
# Ohio River Basin

## FISH HABITAT PARTNERSHIP

# ORBFHP Priority Areas

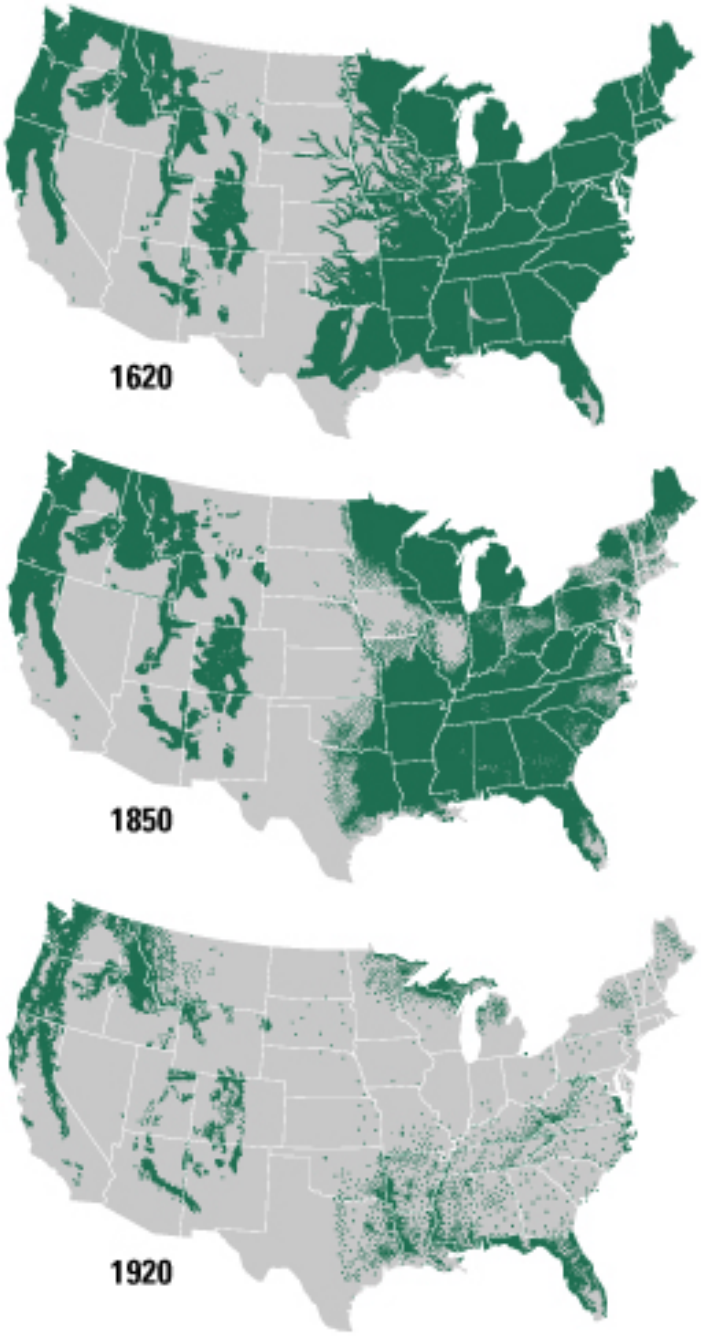



Eel River Ecosystem:
Stream Response to
Restoration Strategies

“One of the penalties of an ecological education is that one lives alone in a world of wounds. Much of the damage inflicted on land is quite invisible to laymen. Ecologists must either harden their shells and make believe the consequences of science are none of their business, or they must be the doctor who sees the marks of death in a community that believes itself well and does not want to be told otherwise.”

--Aldo Leopold

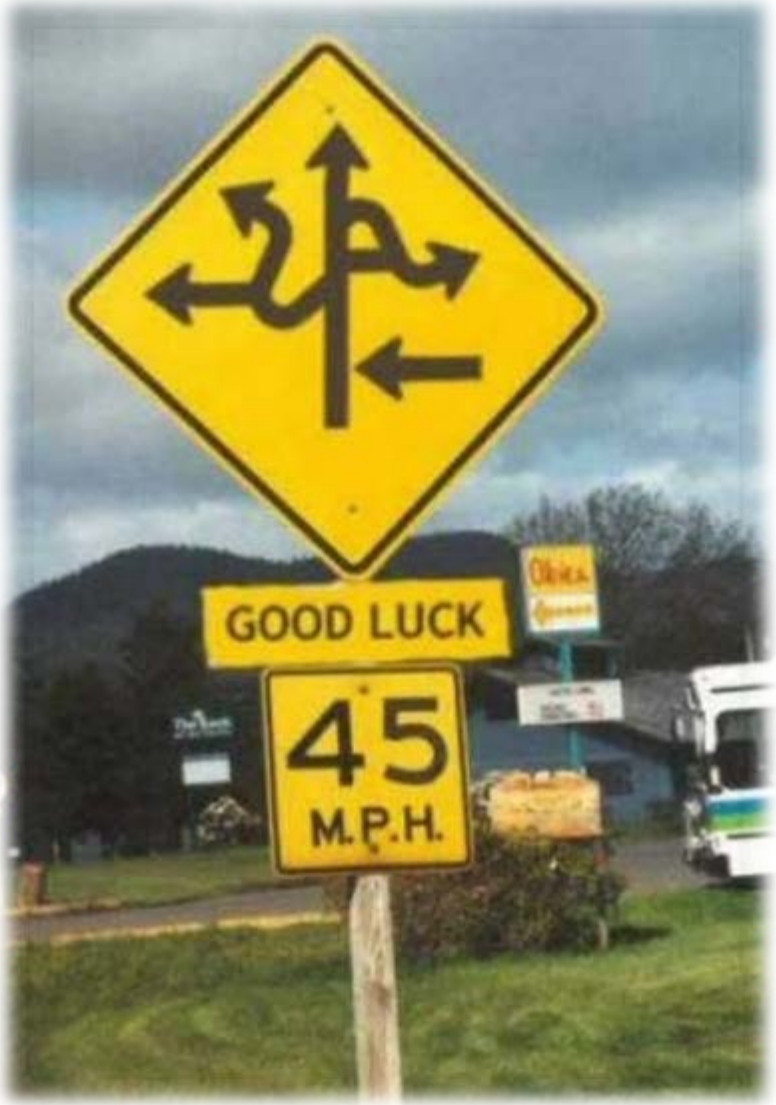
# Approximate location of virgin old-growth forest




Meyer, 1995

# Restoration Quandary

- Human dimensions?
- Funding?
- Where and when?
- Parameters?
- How long?
- Assessment?

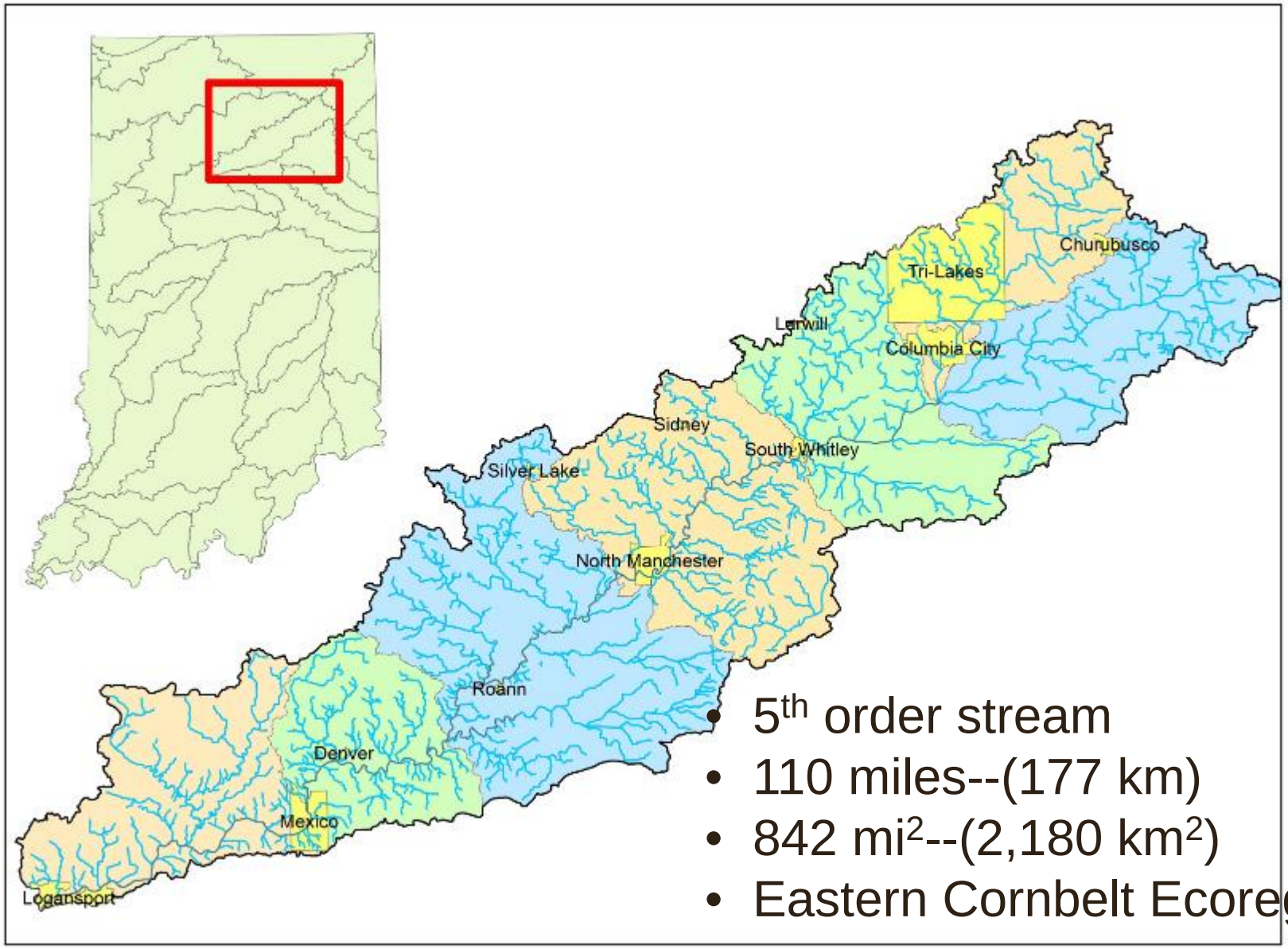


# Rationale

- Raise young scientists
- Increase scientific understanding
- Partnerships

# Connect critical upland processes with aquatic ecosystems

# Eel River Basin




- 5th order stream
- 110 miles--(177 km)
- 842 $mi^2$--(2,180 $km^2$)
- Eastern Cornbelt Ecoregion

# Eel River Fishes

- 52 species
  - One State endangered species

**Greater Redhorse**
*Moxostoma valenciennesi*

# Eel River Freshwater Mussels

- 25 species
  - 22 live
  - 3 shells only
  - 2 Federally endangered

# Ohio River Basin Fish Habitat Partnership

- Removal of three dams and counting…
- Prototype fish Ladder
- Mussel reintroduction
- 319 grants

# Ohio River Basin Fish Habitat Partnership

- Paired-watershed research
- Natural channel design
- Smallmouth bass movement and response to stream sediment
- Four graduate degrees
- 80 undergraduate technicians

NFHP Economic Calculator results

Technical Services Expenditures: $2,176,000

Construction Labor Expenditures: $93,000

Results:

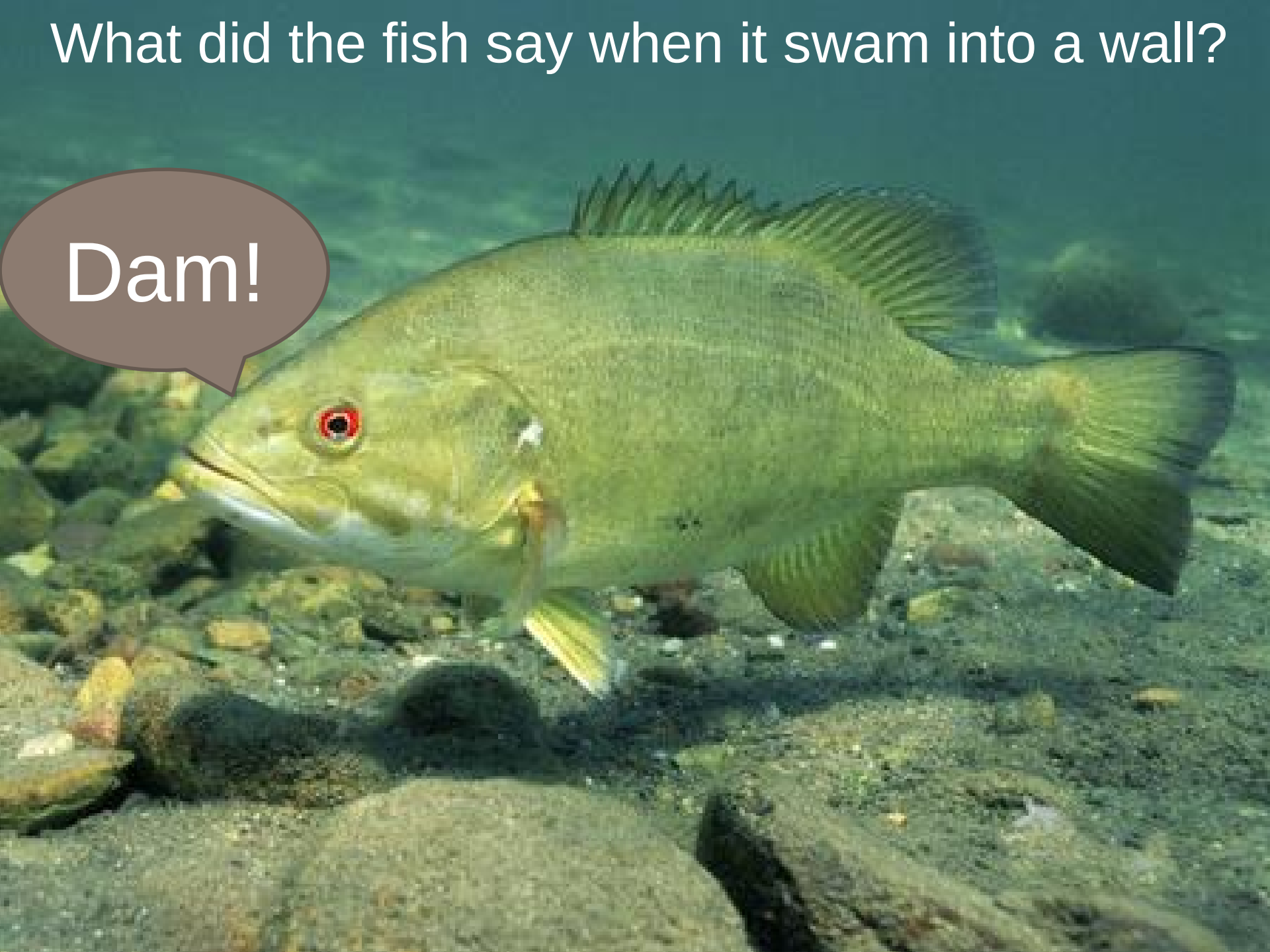
| | |
|---|---|
| Jobs: | 44.8 |
| Total Sales: | $4,283,188 |
| Value Added: | $ 2,245,373 |
| Income: | $1,829,726 |

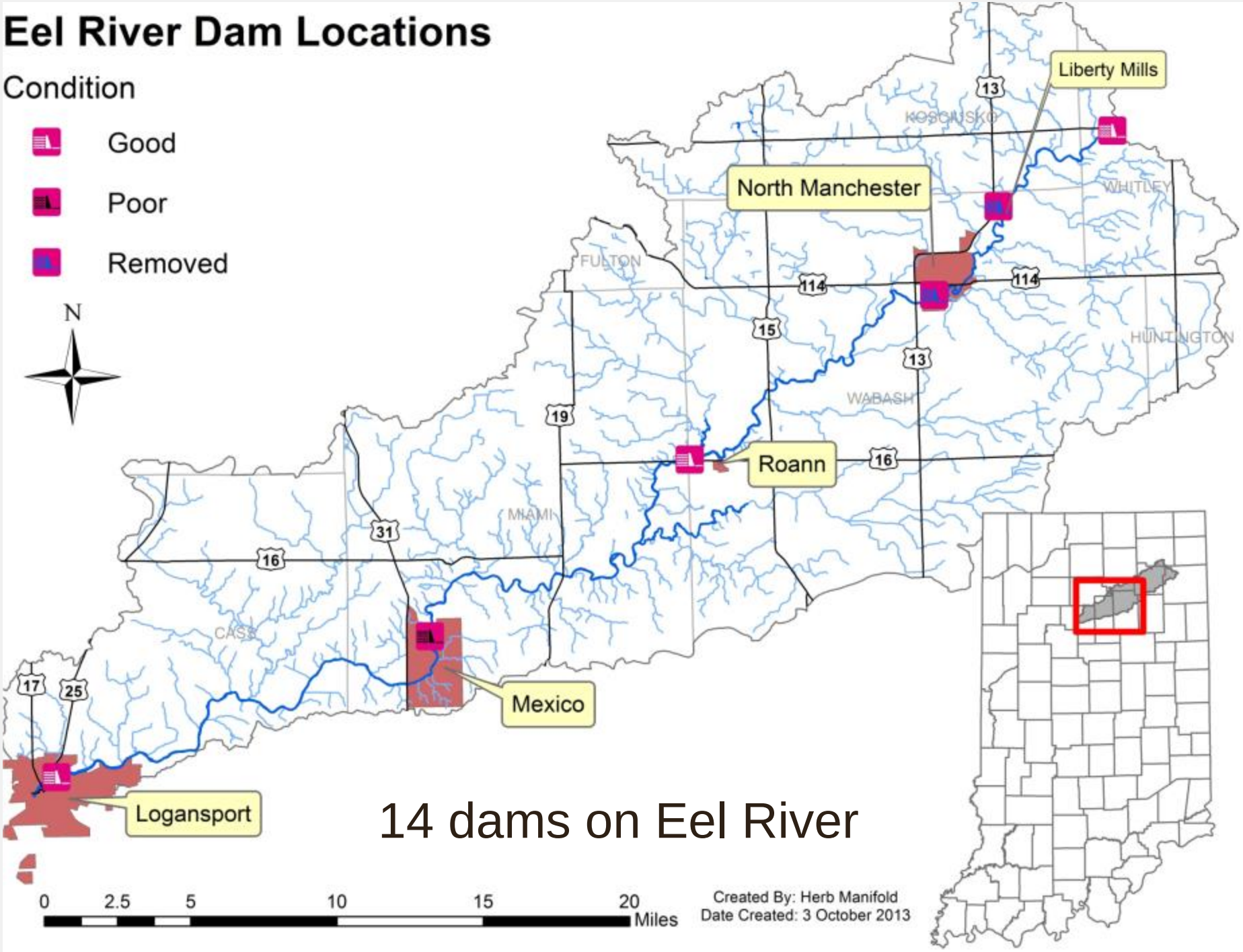
# Outcomes

- Partnerships
  - Education
  - Stakeholders
- Scientific understanding through relevant research
- Tangible ecological restoration results
- Human dimensions

What did the fish say when it swam into a wall?

What did the fish say when it swam into a wall?




Eel River Dam Locations
Condition
Good
Poor
Removed
N
Liberty Mills
North Manchester
Roann
Mexico
Logansport
14 dams on Eel River
KOSCIUSKO
WHITLEY
FULTON
HUNTINGTON
WABASH
MIAMI
CASS
13
114
15
19
16
31
17
25
0 2.5 5 10 15 20 Miles
Created By: Herb Manifold
Date Created: 3 October 2013

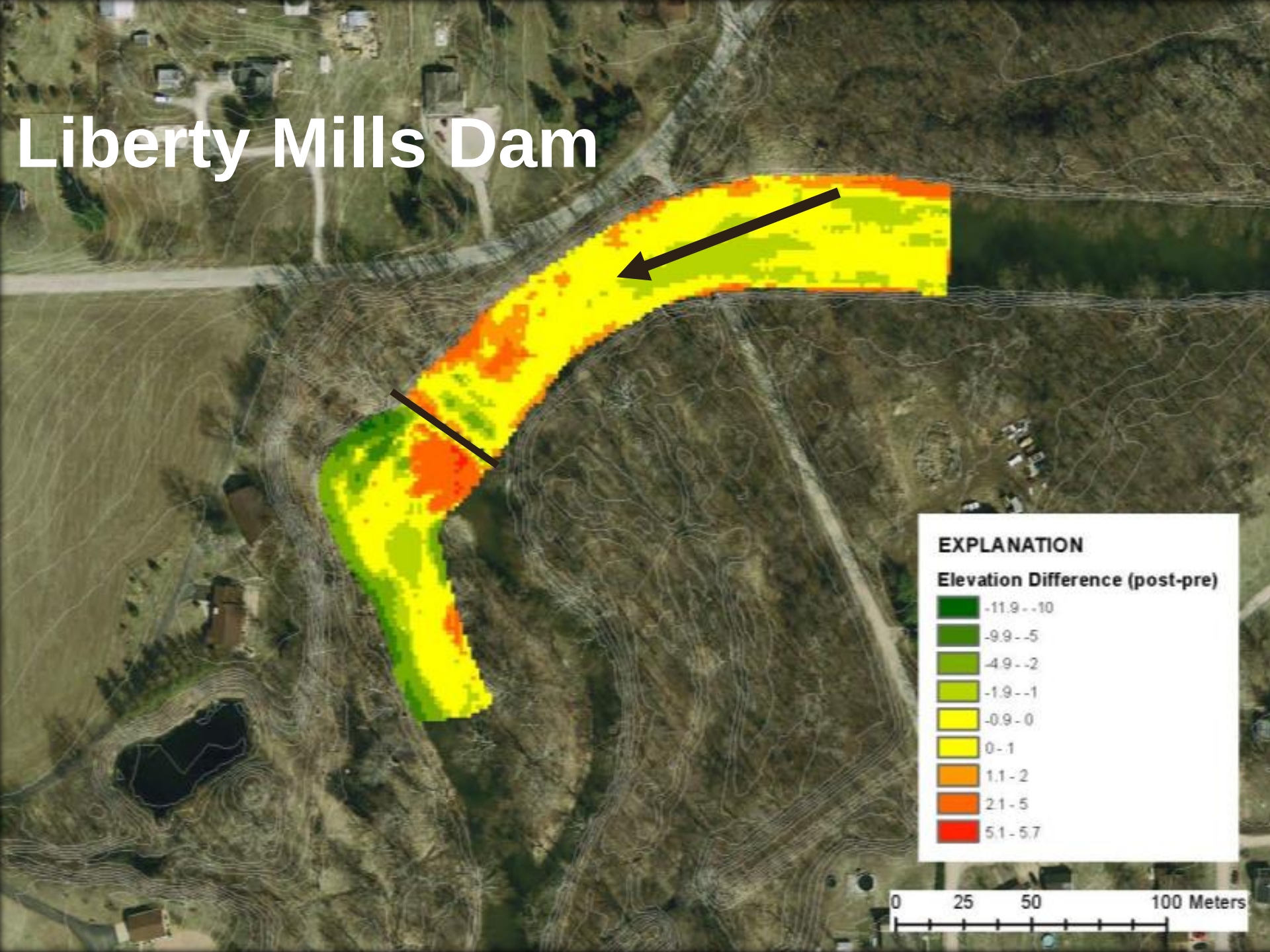
Liberty Mills
Late 1800s


**Figure 12.** Undated photograph of the Liberty Mills dam, view north (North Manchester Historical Society, North Manchester, Indiana).

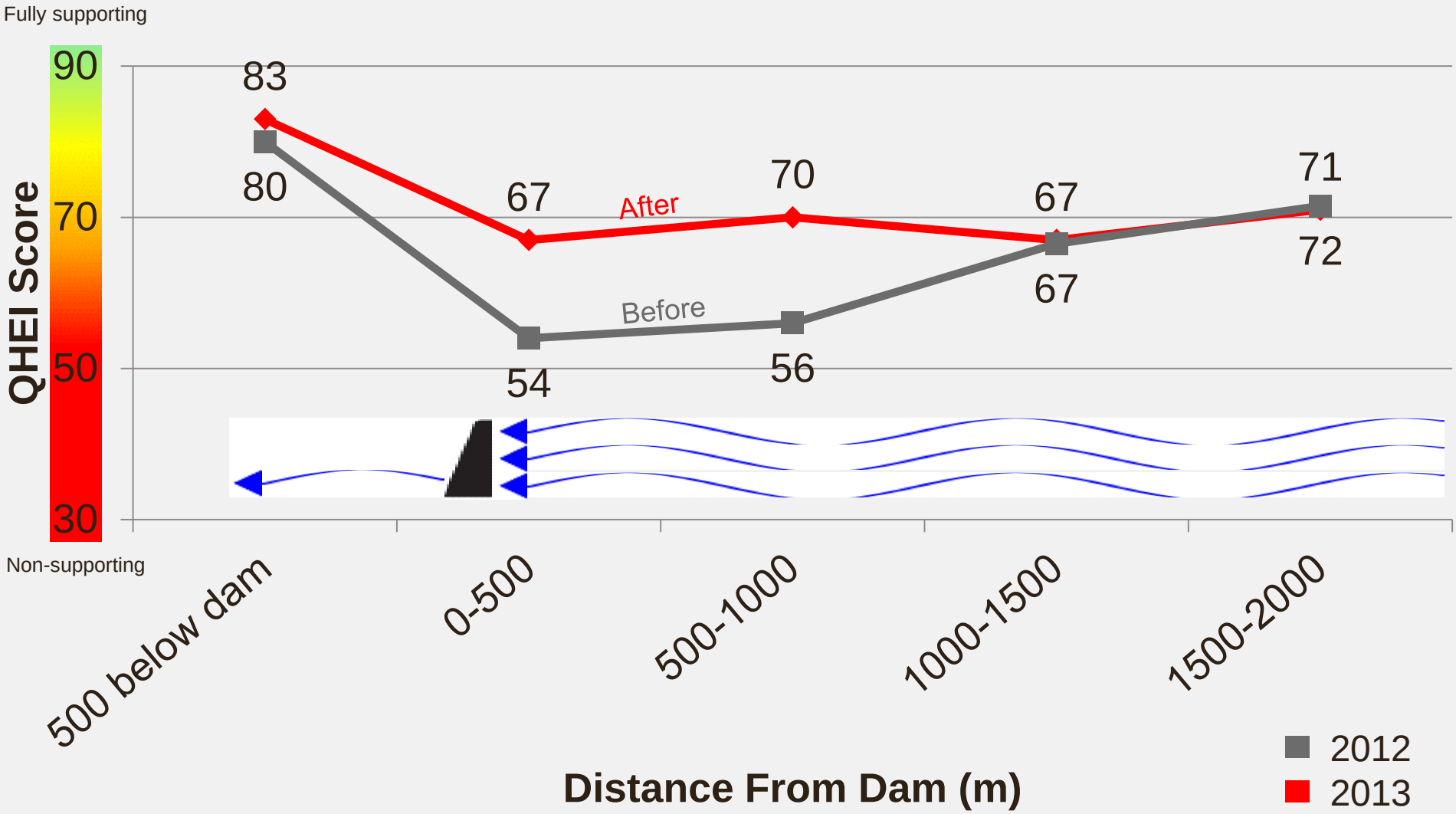
# Liberty Mills Site


October 2012

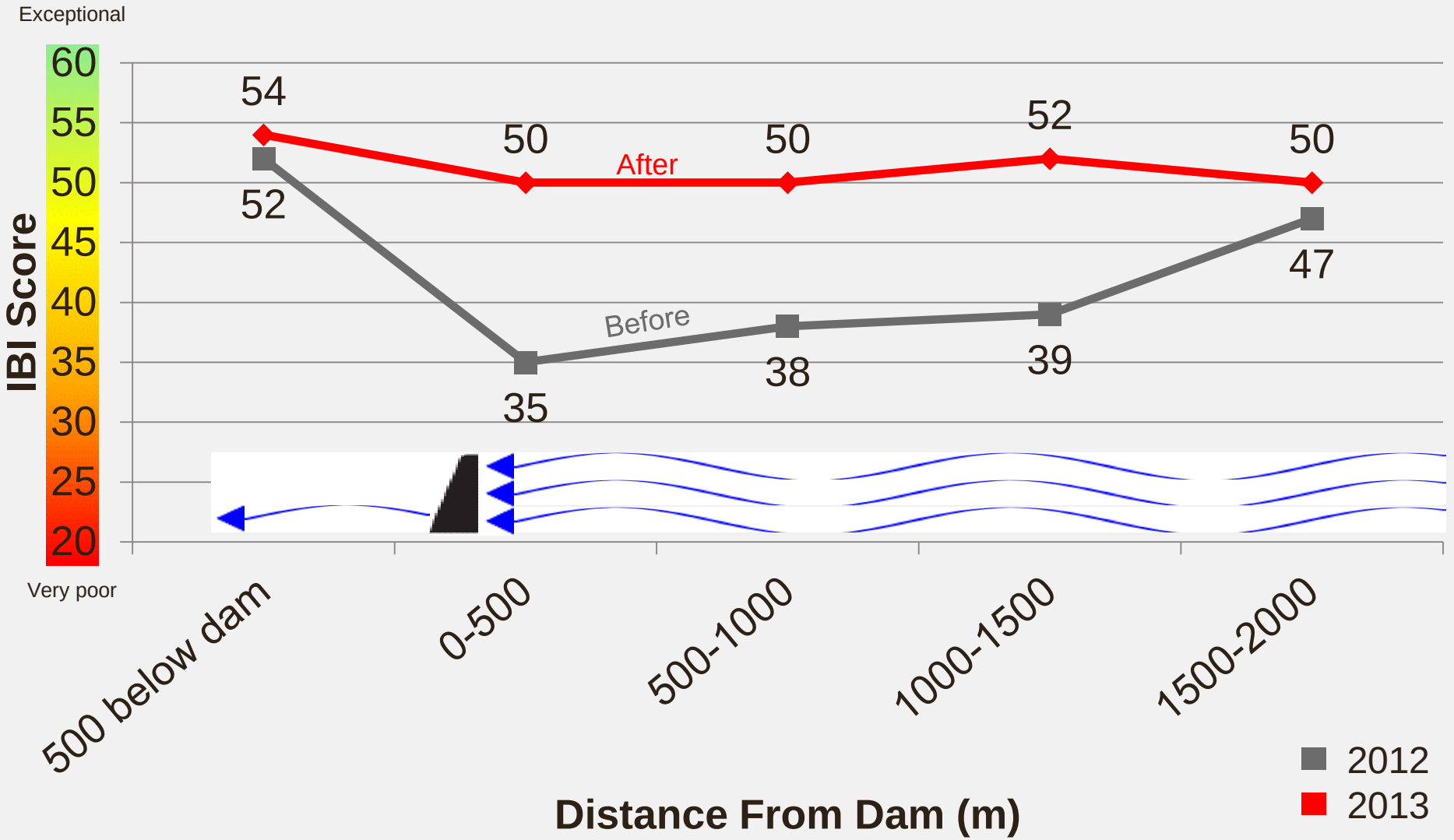
# Liberty Mills Dam



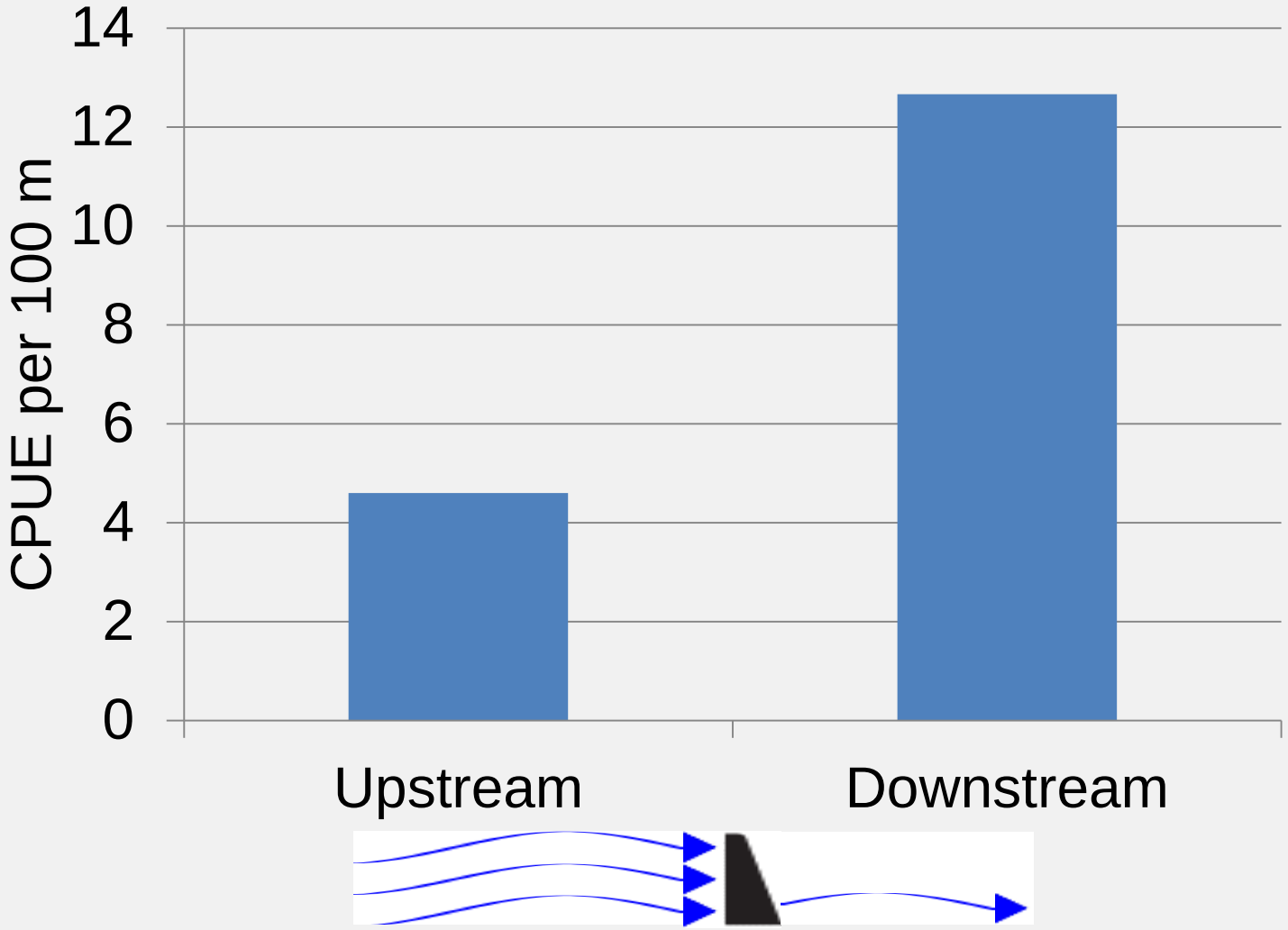
# Liberty Mills
# Pre and Post Removal QHEI Scores



# Liberty Mills
# Pre and Post Removal IBI Score



# Liberty Mills
# Mussel CPUE 2013



# Summer, 2017

# Results

- 42 of 52 species (80%)
- 60 of 2,500 tagged fish
- Over 12,000 fish processed
- Largest=485 mm
- Smallest=45 mm
- Otters!

# Fish Passage

745 stream miles reconnected

# Beargrass Creek, 2013

# Beargrass Creek, 2016

# November, 2016

# Beargrass Creek, 2019

# Researcher Technicians

# My Fish

“There is no greater fan of fly fishing than the worm”. – Patrick McManus

# Partnerships

- Ohio River Basin Fish Habitat Partnership
- Local Producers
- Private donations
- IDNR
- IDEM
- Environmental Defense Fund
- U.S. Fish and Wildlife Service
- U.S. Geological Survey
- Natural Resources Conservation Service
- Indiana Association SWCD
- Soil and Water Conservation Districts (Wabash County)
- Indiana Corn Marketing Council
- Indiana Soybean Alliance
- The Nature Conservancy

# Ohio River Basin

## FISH HABITAT PARTNERSHIP

# Dam Safety Documentary sparked from Eel River removals – as well as regional and legislative momentum

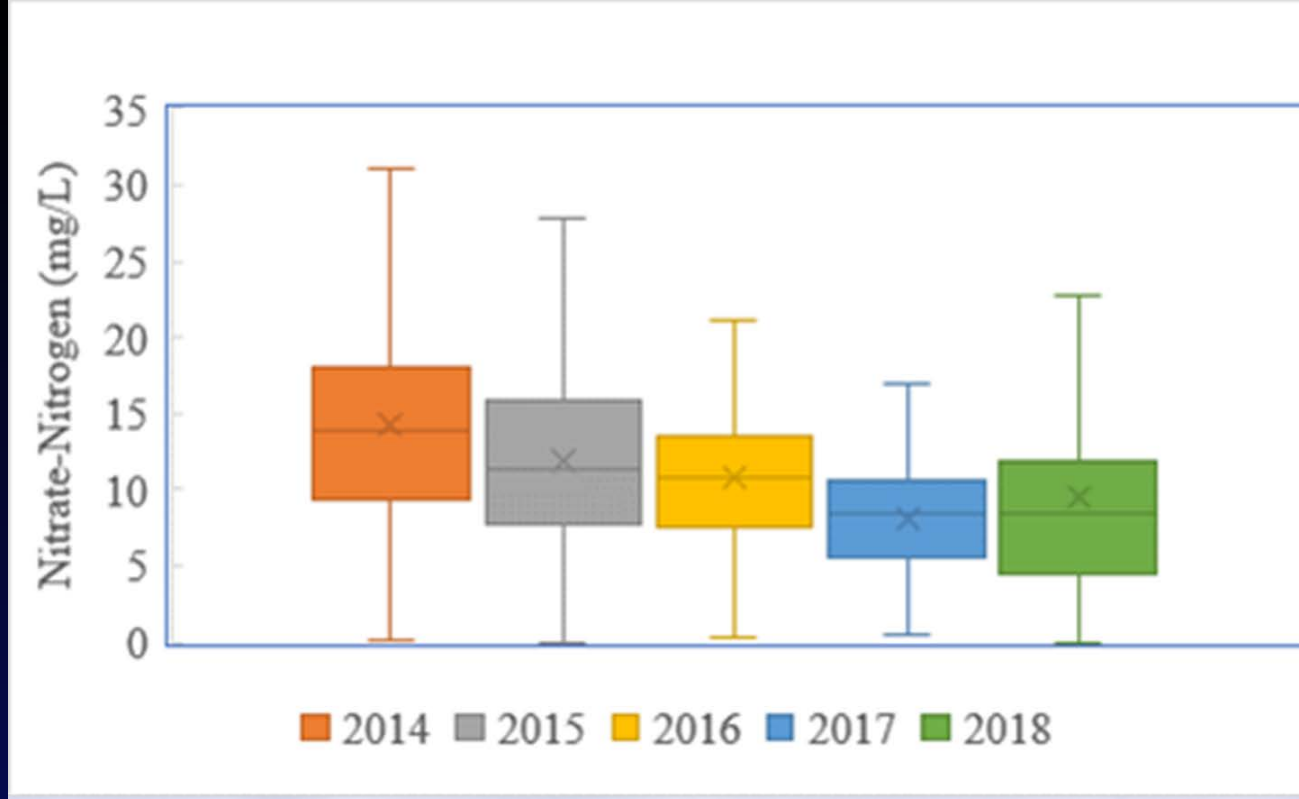
# Eel River Mussel Augmentation

- Eel/Tippecanoe, IN Riffleshell and Clubshell Mussel Augmentation
  - ORB Mussels - 130 species (38 federally listed)
  - Survival setting the standard for future translocations as we restore populations across historic range
  - Now evaluating bed stability with native vegetation and instream structure for mussels

# Eel River – Paired Watershed Study

- Evaluating effects of agricultural BMP's on nutrients, sediment, water chemistry, habitat, biological integrity, and producer yields.
  - 60%+ of experimental watershed in cooperation
  - Larger Implications from results

Two Stage Ditch gaining traction in Ohio programs – H2Ohio

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**NFHP: $135,000**

NFPP: $372,300

Match: $2,361,400

# Multipurpose Restoration

Economic

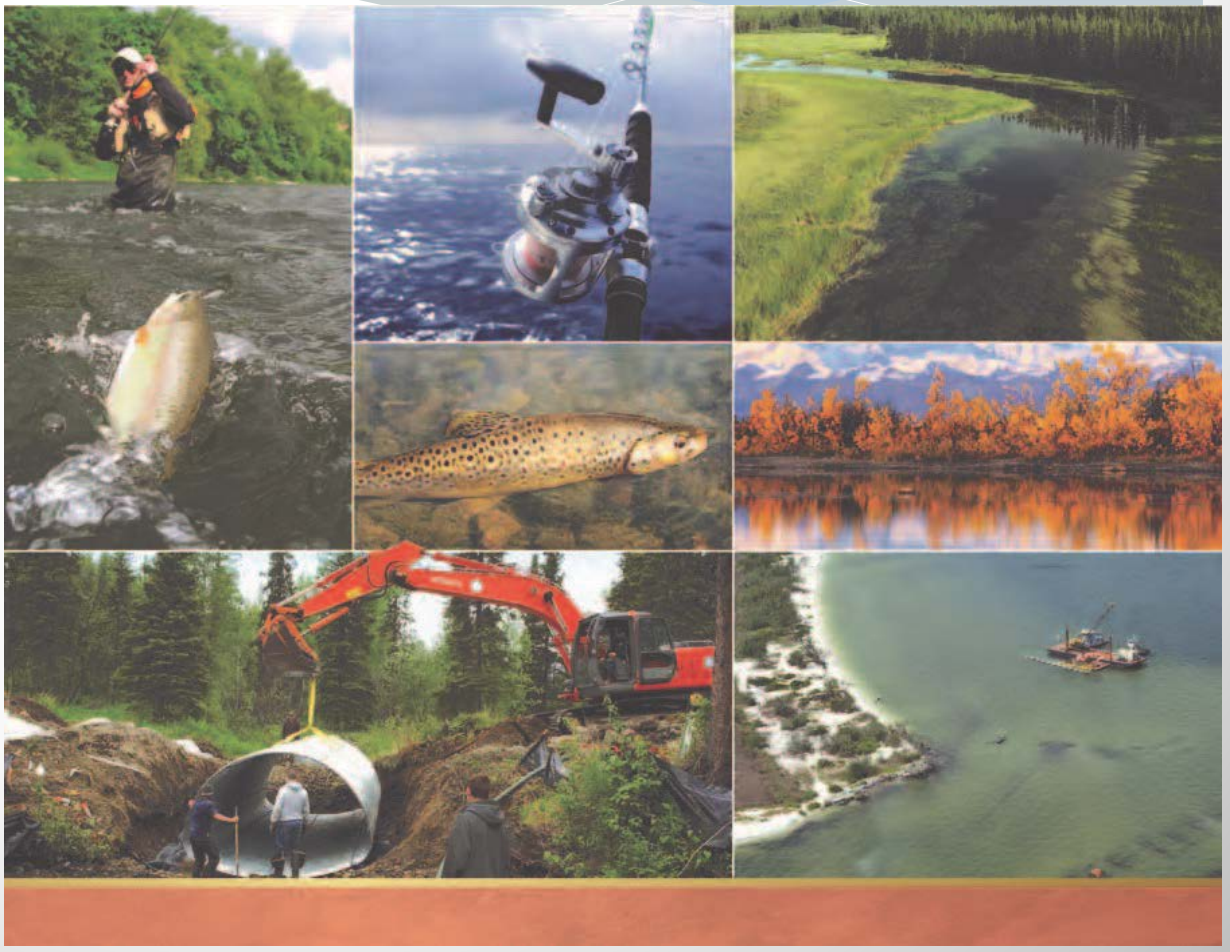
Industrial

Recreation

Social

Safety

..and much more

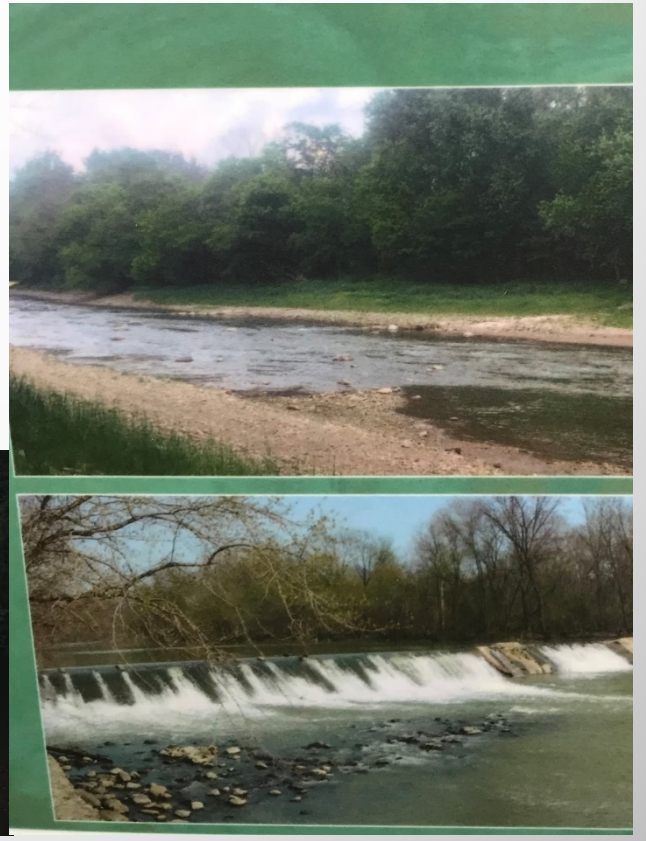


# Great Miami River, OH

* Municipalities striving to capitalize on their greatest asset
  * Dayton, Middletown, Troy, Piqua, Miamisburg, Sidney, Tipp City, etc..


# Great Miami River, OH

* Support for investing in river restoration
  * Recreation – paddling sports are the fastest growing sport in America. Liveries and Angling guides growing
  * Destination Location – vacations and staycations
  * Downtown development – restaurants, bars, shops

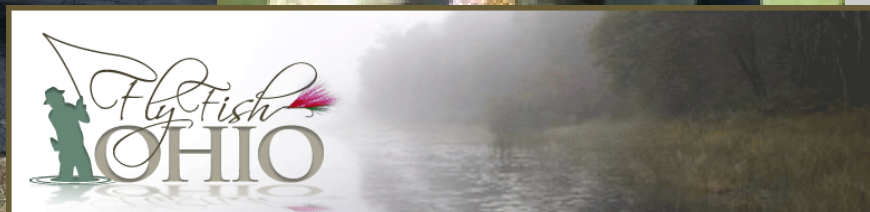


# Great Miami River, OH

* Obstacles  to capitalizing on this asset
  * Safety – low head dams
  * Infrastructure
  * Pooled reaches – little to no use, poor water quality, takes up valuable green space

# Great Miami River, OH

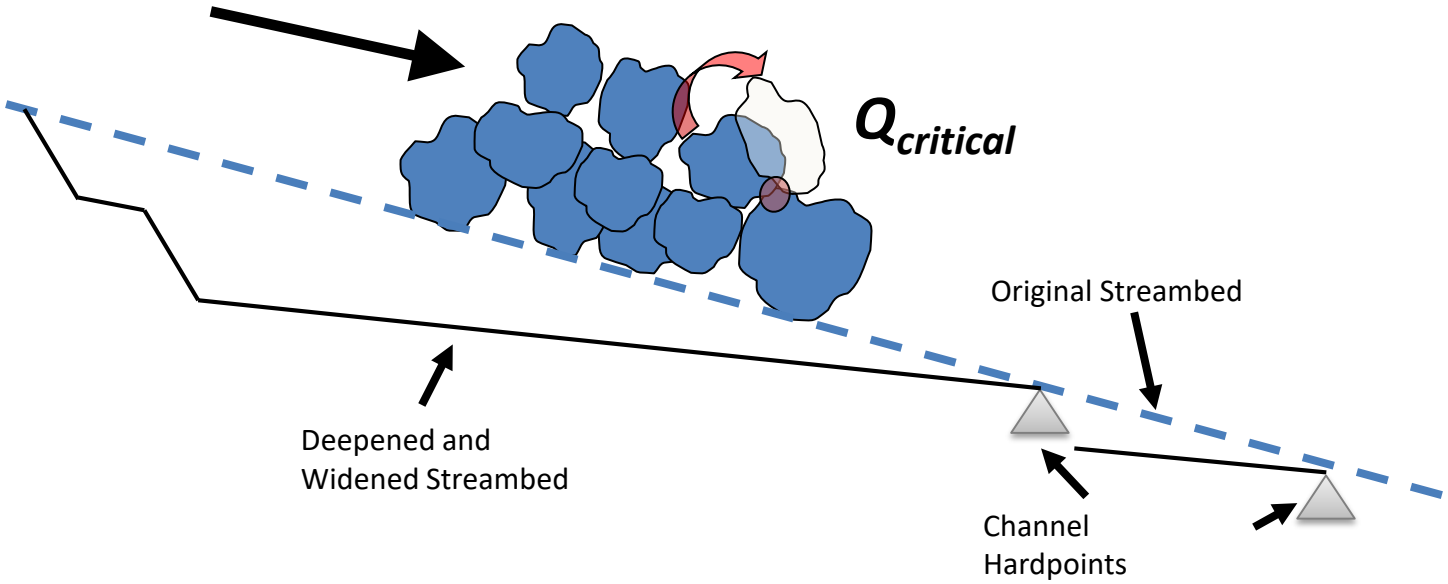
* We are striving for the same goals.
  * People interacting with and valuing their resource, promoting ecosystem and economic benefits

# ORB Flooding 2019

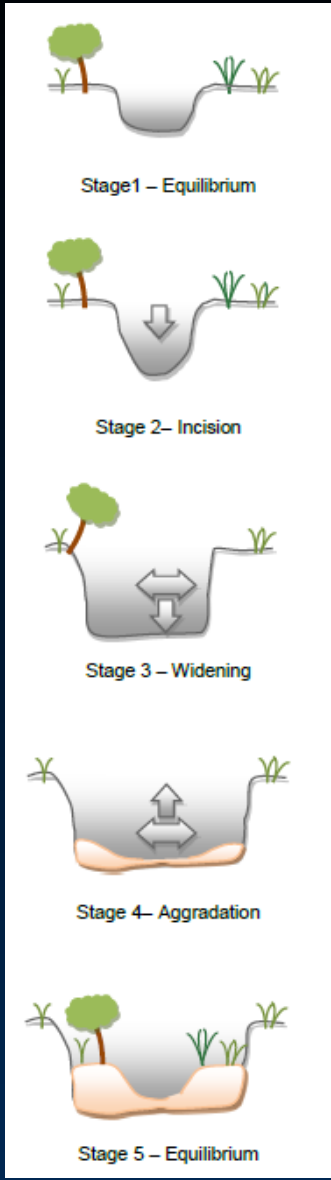

# Excess Streambed Erosion Can Lead to:

- **Stream Deepening & Widening**
- **Property & Tree Loss**
- **Water Quality Impacts**



## Energy Impacts

- Incision
- Widening
- Sedimentation
- Bed Movement
- Benthic Community
- Carbon loss
- Flooding
- Infrastructure




# A Guide for Sustainable Watershed Planning

- **1.1 Purpose:**
- A step-by-step guide to cost-effective watershed-scale management that is tailored to produce in-stream results.

- **1.2 Objective:**
- Hydrology is the centerpiece of this approach. Changes to the watershed hydrology impact the geomorphology, water quality, and biology of the system (Poff et al., 1997, Stream Functions Pyramid (Harman et al., 2012)). By focusing on hydrologic restoration, and in particular, restoration of the natural bed sediment disturbance regime, watershed-scale management can promote a shift toward geomorphic equilibrium, reduced nutrient loadings associated with bank erosion, and improved benthic habitat that is more supportive of ecosystem function.
- This approach promotes strategies that are orders of magnitude less expensive than conventional approaches in order to allow wide-scale implementation and produce meaningful results in the stream. The guidance will explain how to model and implement this approach and provide several innovative, cost-effective solutions and case studies that make a big impact on hydrologic restoration.

# Big Creek, Cache River Southern Illinois

* By the 1970's drastic conversion of forest and wetland to crops had occurred. Issues that came from this were: altered hydrology, increase in sediment loss, stream bank instability and incision, soil erosion, water quality, and **flooding**.

# Big Creek, Cache River Southern Illinois

* Modeling process identified key water retention areas
* 69 water retention basins installed in the upper watershed with support of the landowners
* 5-6% of the upper watershed runs through detention basins
* Created 396 acre feet of storage
* Created ~200 acres of surface water

# Big Creek, Cache River Southern Illinois

* Natural Resource Benefits:
  * Reduced sedimentation due to streambank erosion (10's of 1000's of tons)
  * Reduced channel incision
  * Decreased sediment deposition in Cypress Creek NWR
  * Decrease nutrient loss/inputs
  * Stabilized 4 headcuts
  * Ultimately, restored stream function (stable bed, organic matter, invert stability, etc)

# Big Creek, Cache River Southern Illinois

* Economic Benefits:
  * Before the detention basins, a 9 inch rain in 24 hours flooded 22 houses, closed two highways for 3 days, closed secondary roads for more than a week
  * After the detention basins, a 13 inch rain in 26 hours caused overbank flow but no flooding in homes and no roads or infrastructure impacted
  * AND HAS NOT FLOODED SINCE

# Scott AFB Flooding

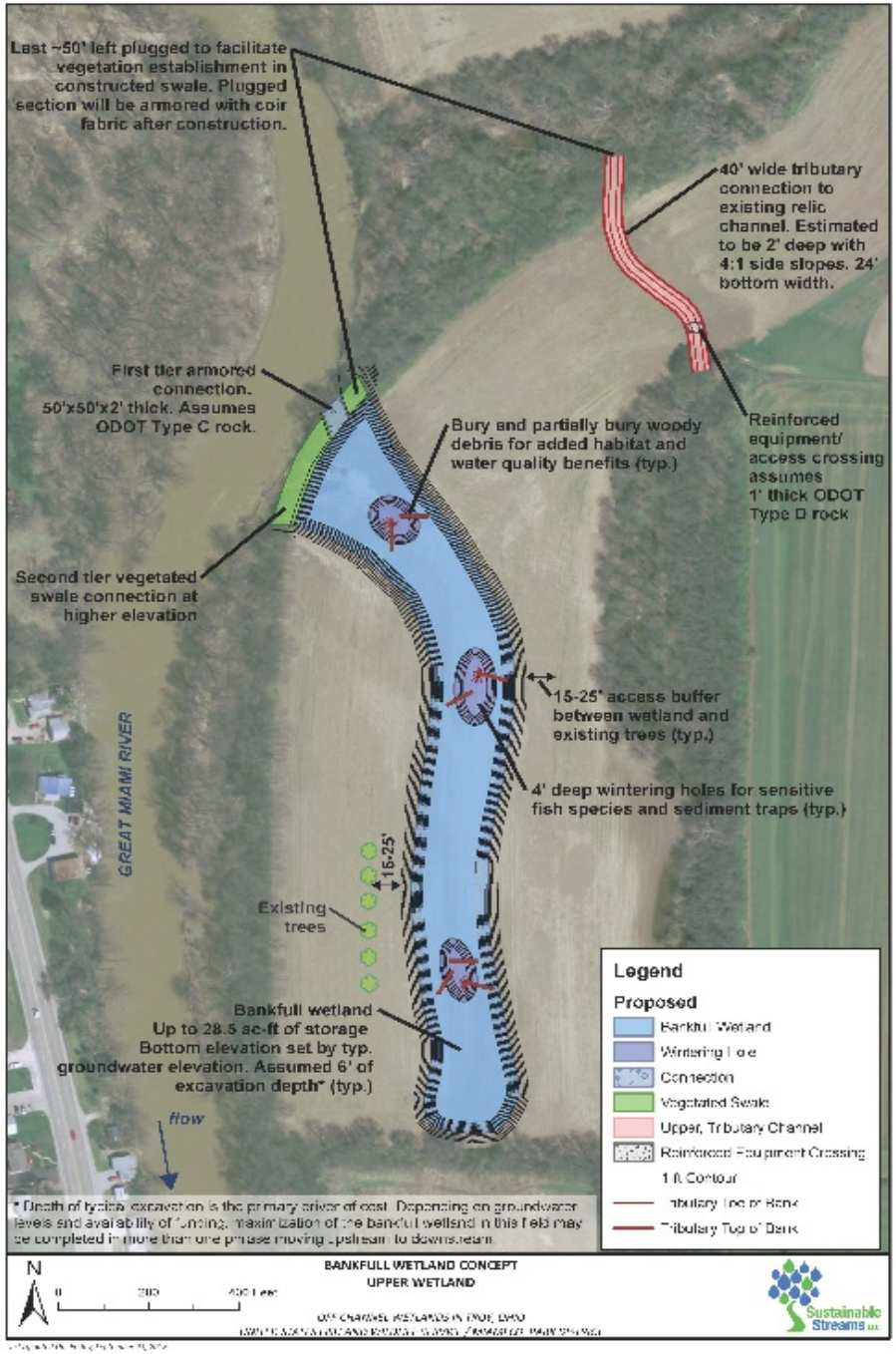
- Founded in 1917
- St. Louis Metro East has exploded to the east and NE
- Ag expansion to N and W
- All drain through Scott AFB
- No water retention in those areas
- Permitting for development continues
- Flooding and changing hydrology plague the base

# Scott AFB Flooding

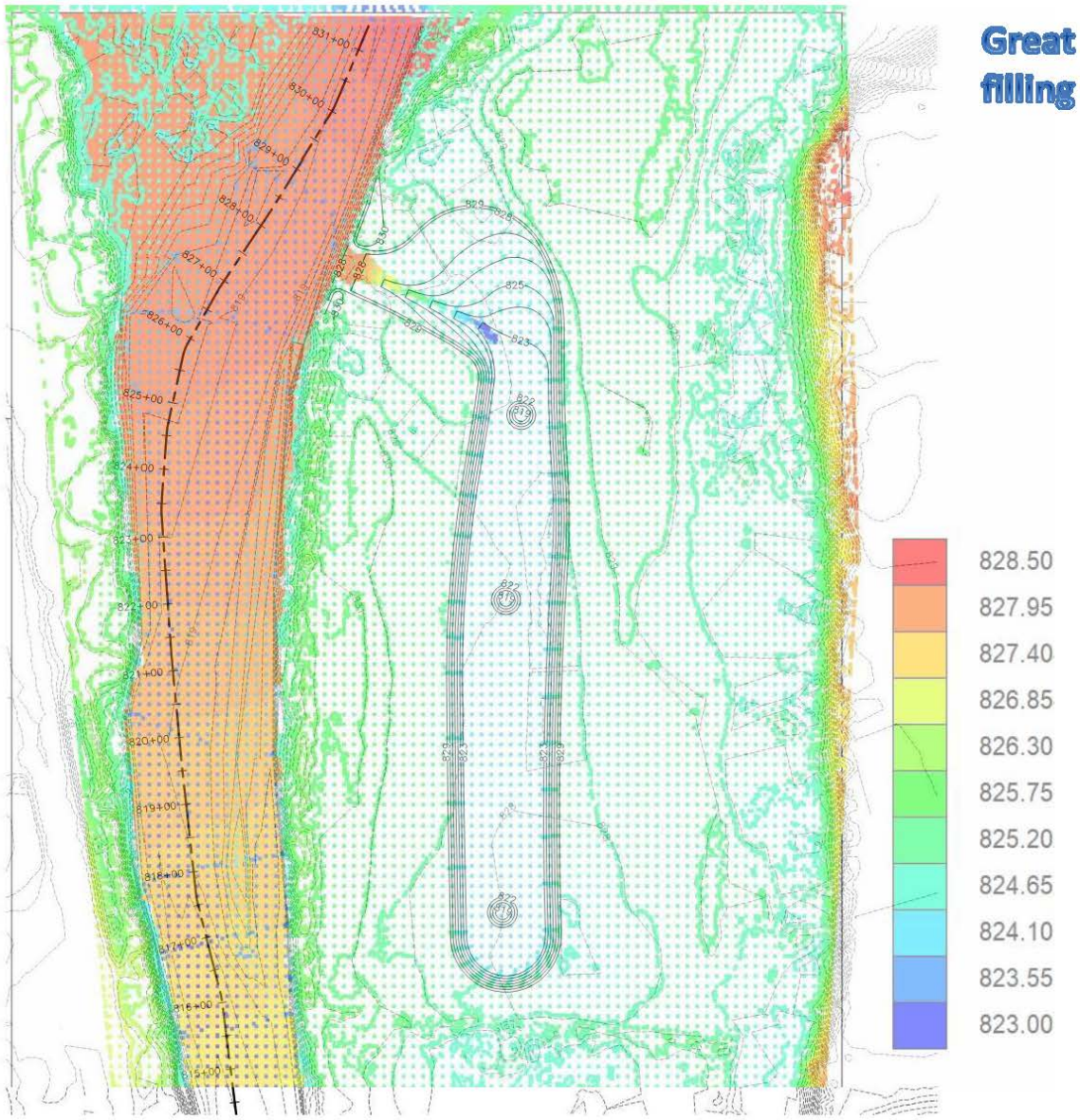
* Restore upstream retention
* Restore the floodplain “Sponge”
* Minimize BASH
* Stream and floodplain health enhanced


## Managing Energy and Water Downstream

## Great Miami River "Bankfull Wetland" Floodplain Connectivity Troy, OH

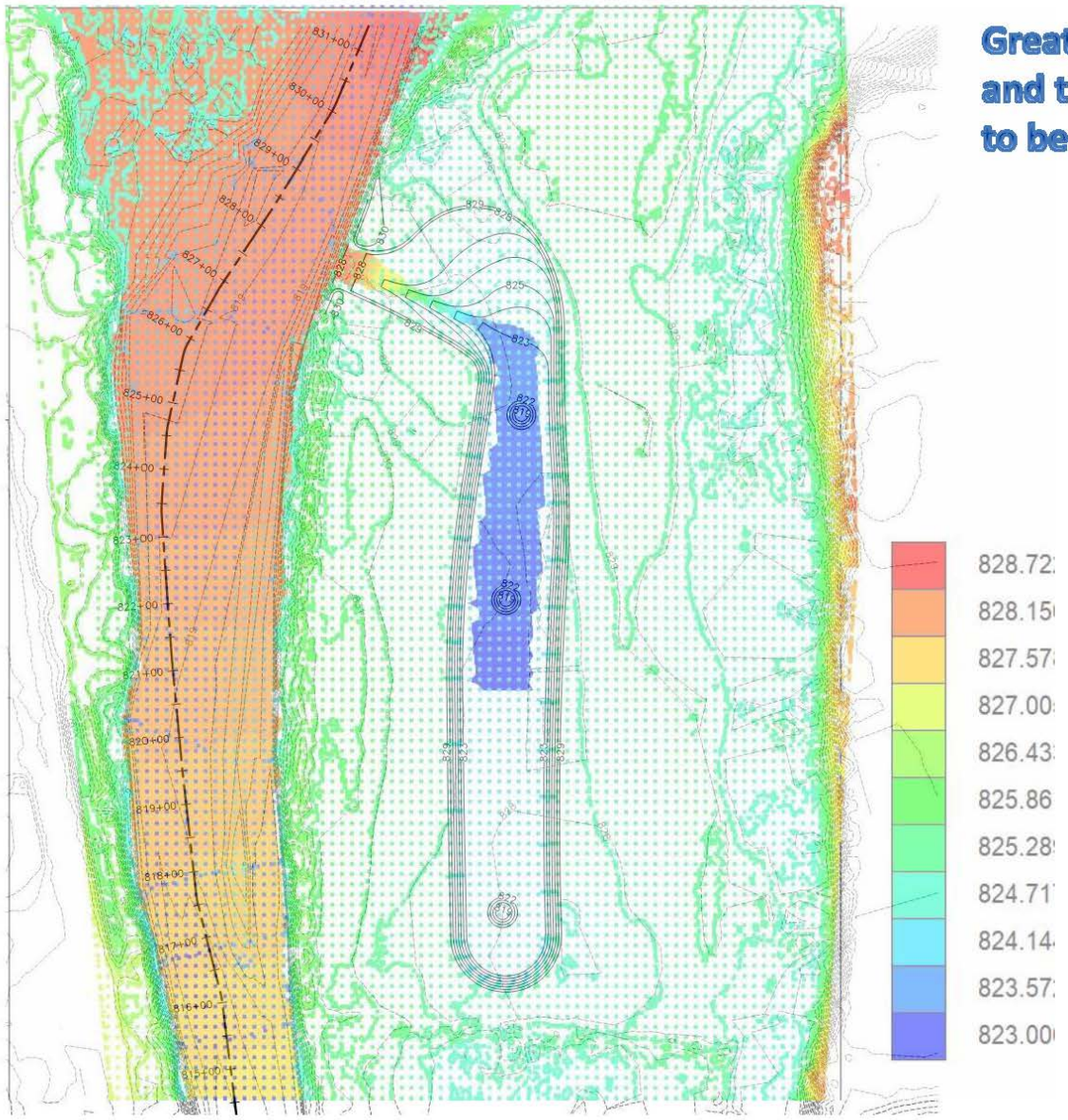


# RiverFlow2D Results – 0:45 – 5500 cfs



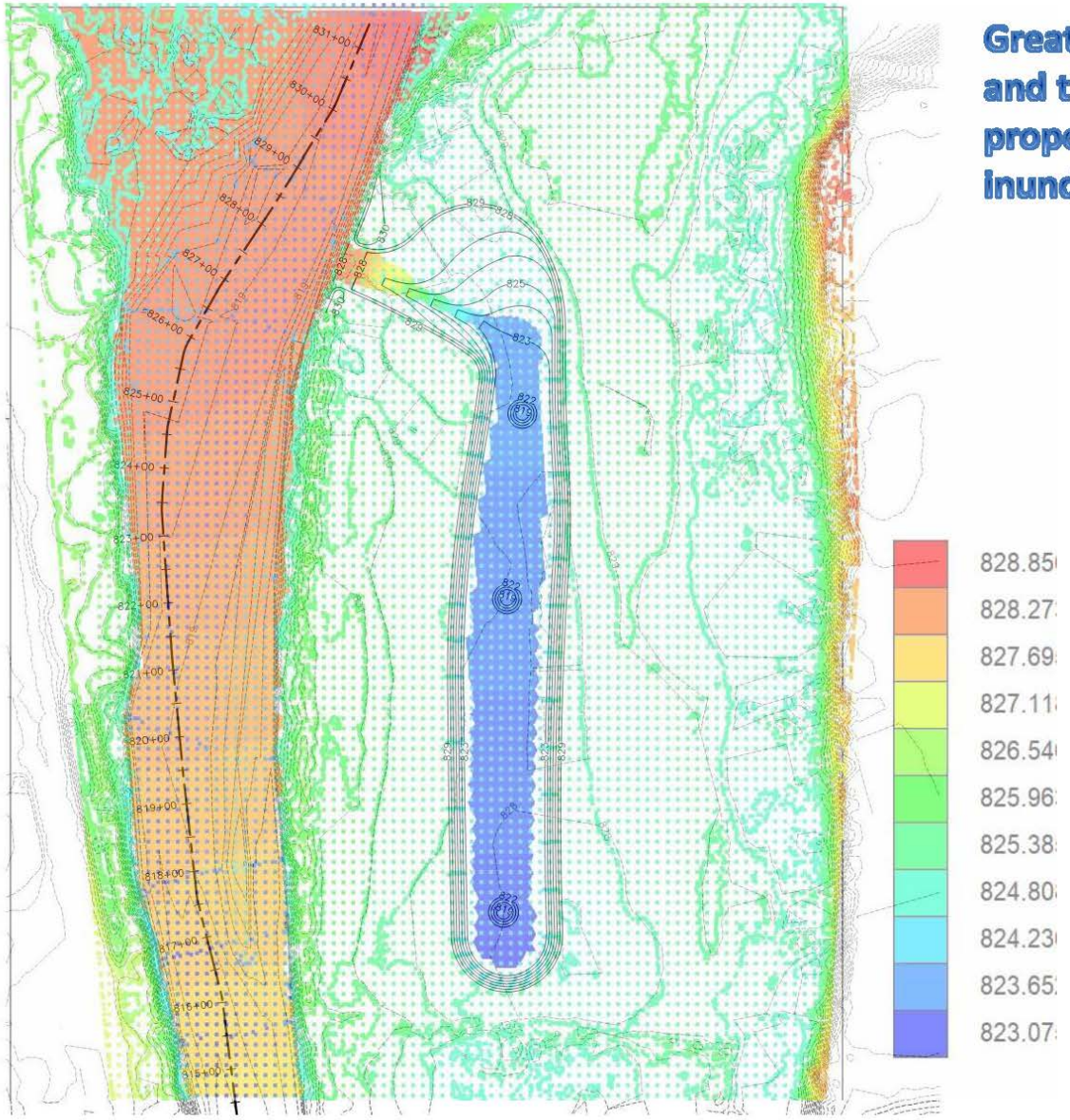

**Great Miami begins filling the basin.**

# RiverFlow2D Results – 1:30 – 5680 cfs



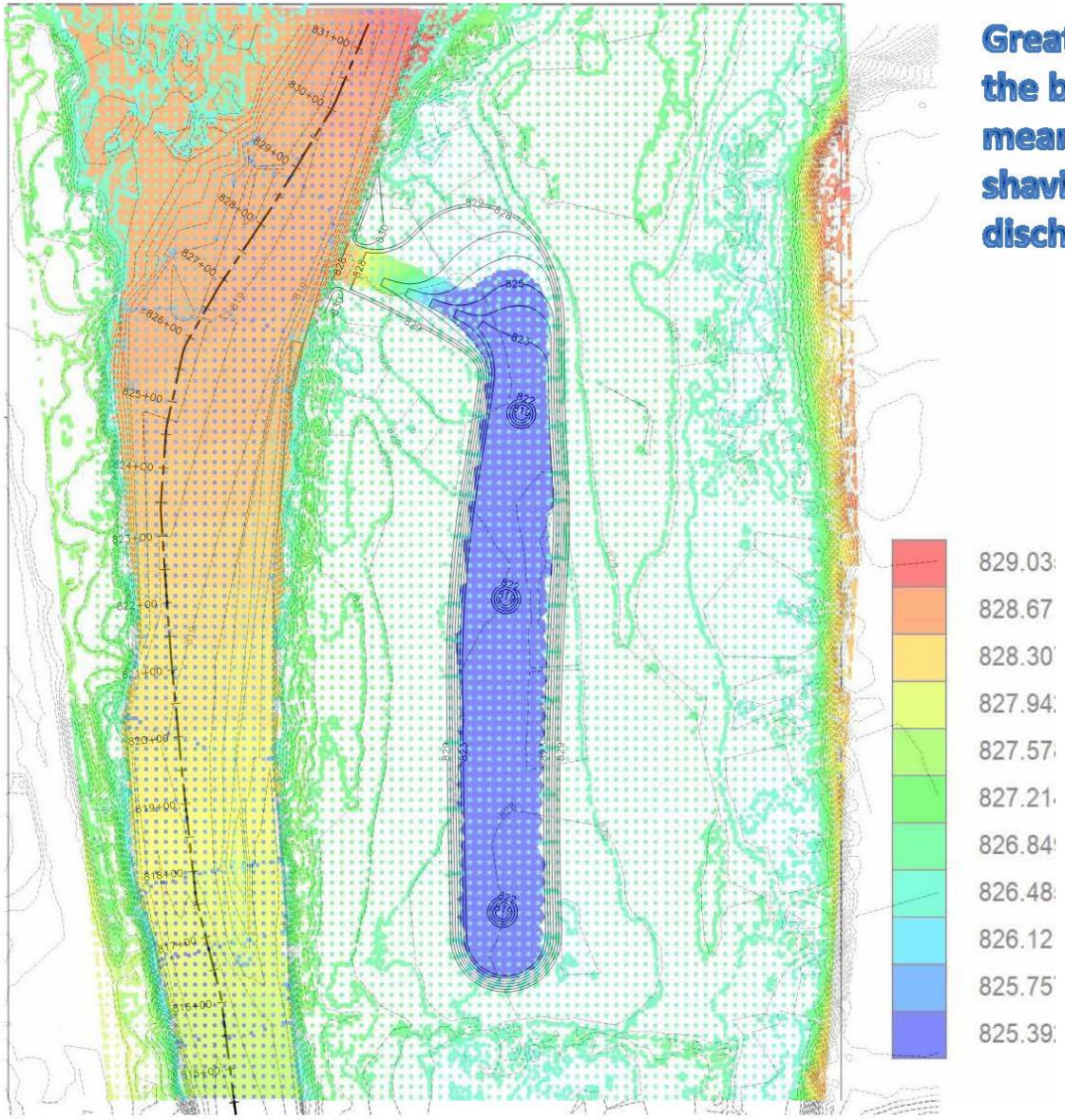

**Great Miami is still rising and the basin is beginning to become inundated.**

# RiverFlow2D Results – 2:00 – 5790 cfs



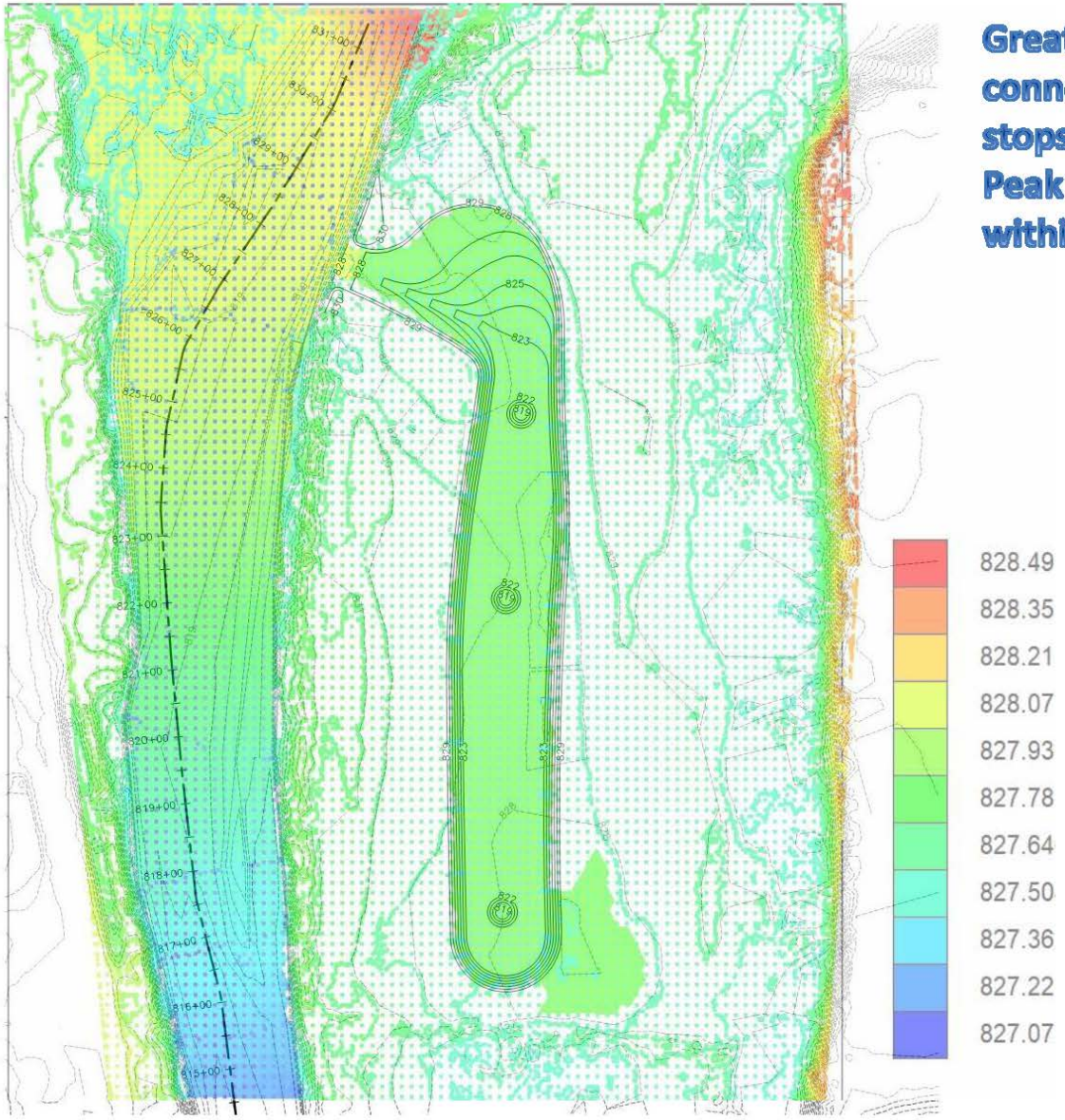

**Great Miami is still rising and the entire floor of the proposed basin is now inundated.**

# RiverFlow2D Results – 4:00 – 5990 cfs



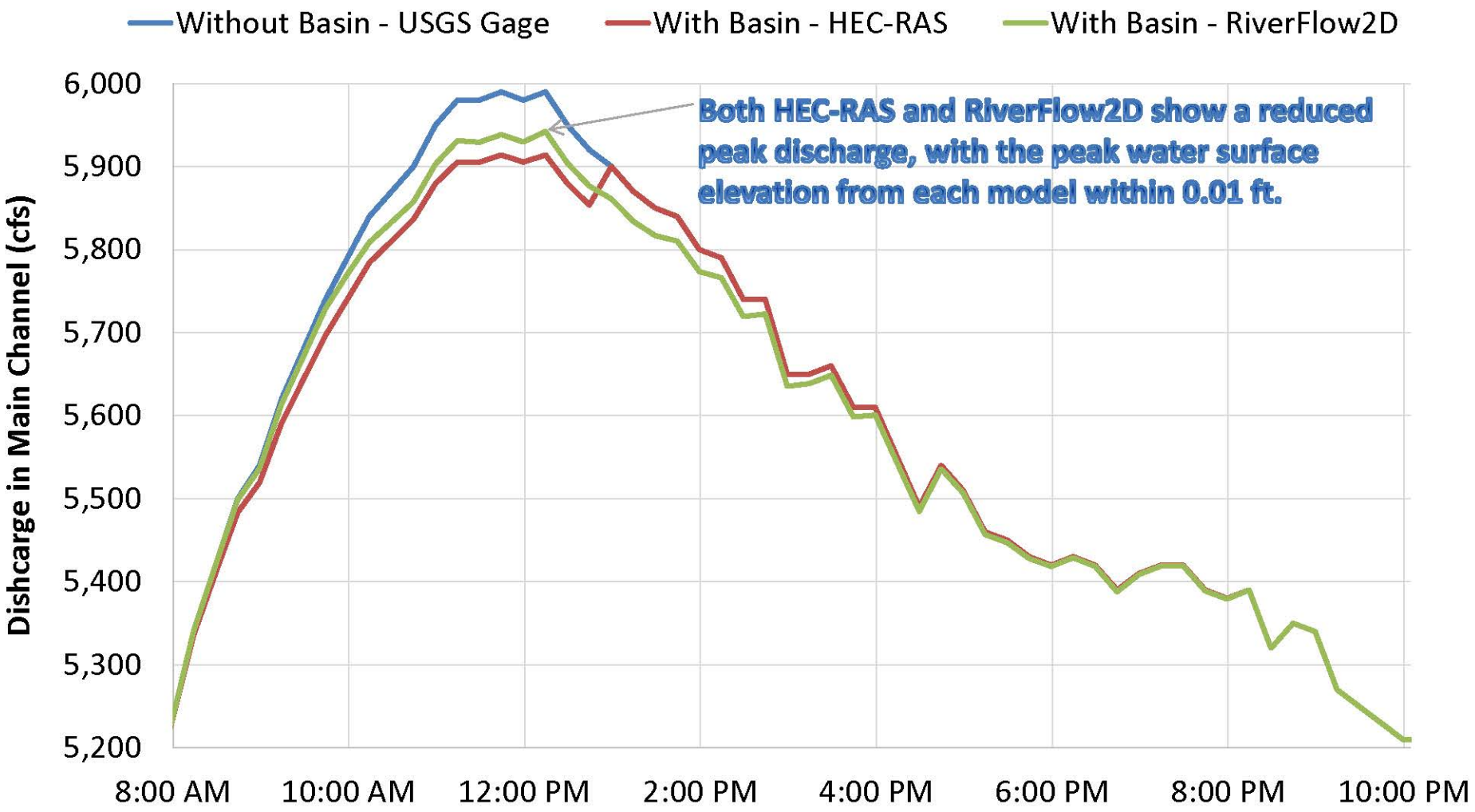

**Great Miami crests and the basin is still filling meaning the basin is shaving the peak discharge.**

# RiverFlow2D Results – 11:45 – 5390 cfs



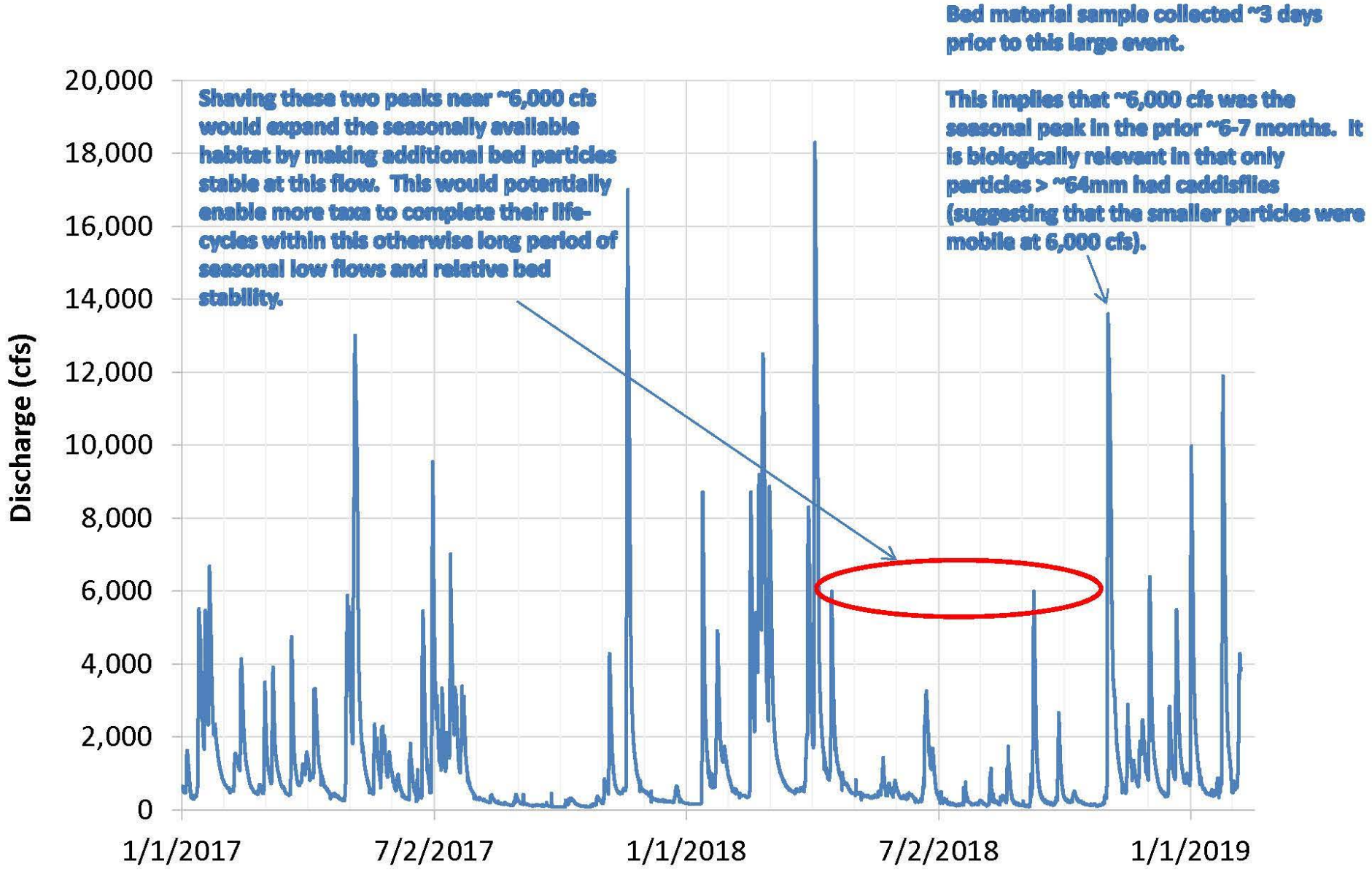

**Great Miami drops below connection elevation and stops filling the basin. Peak WSE in the basin is within ~0.1 ft of the top.**

# Both 1-D and 2-D Models Show Peak Shaving near the $Q_{critical}$ Target of 6,000 cfs



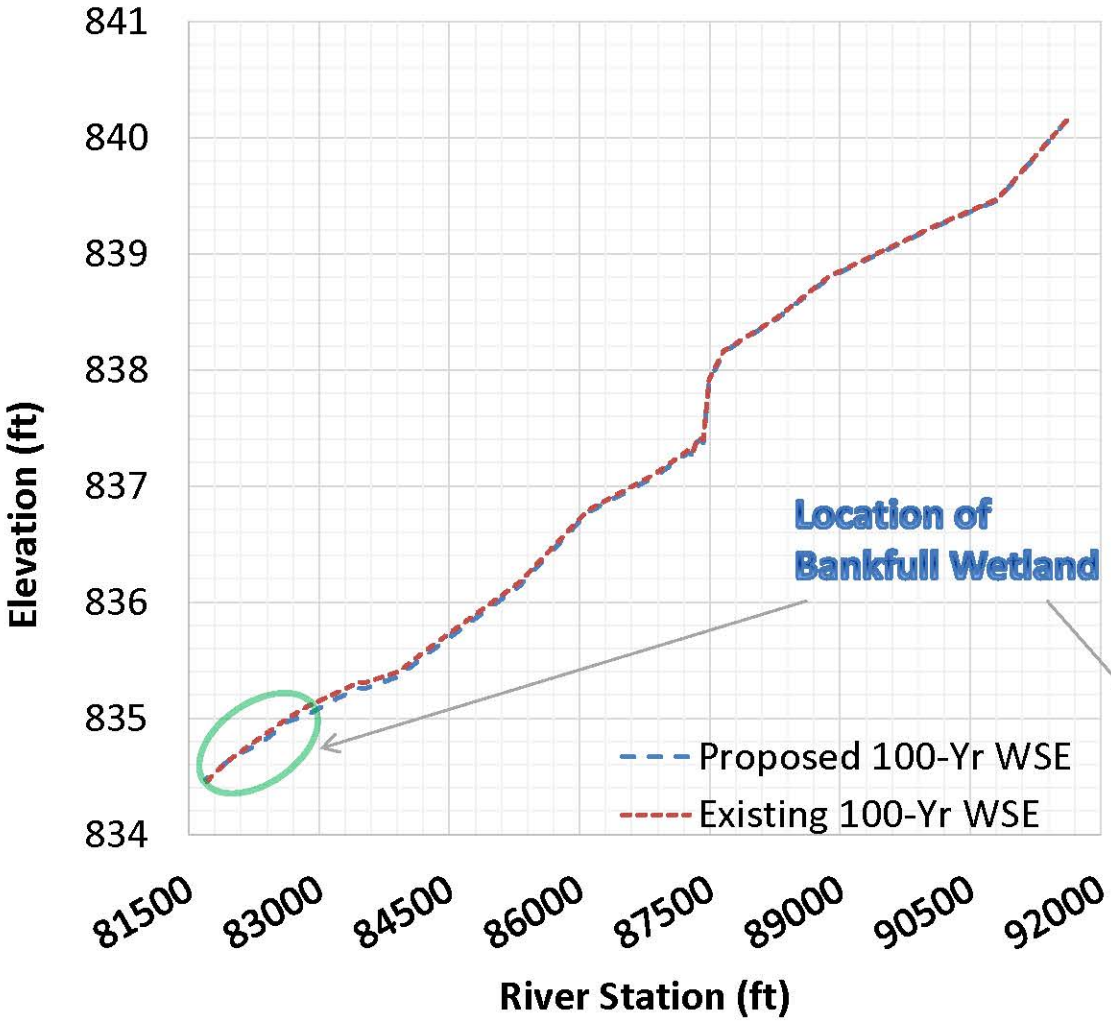

USGS Great Miami River at Troy

# 6,000 cfs Is a Seasonal Disturbance Threshold



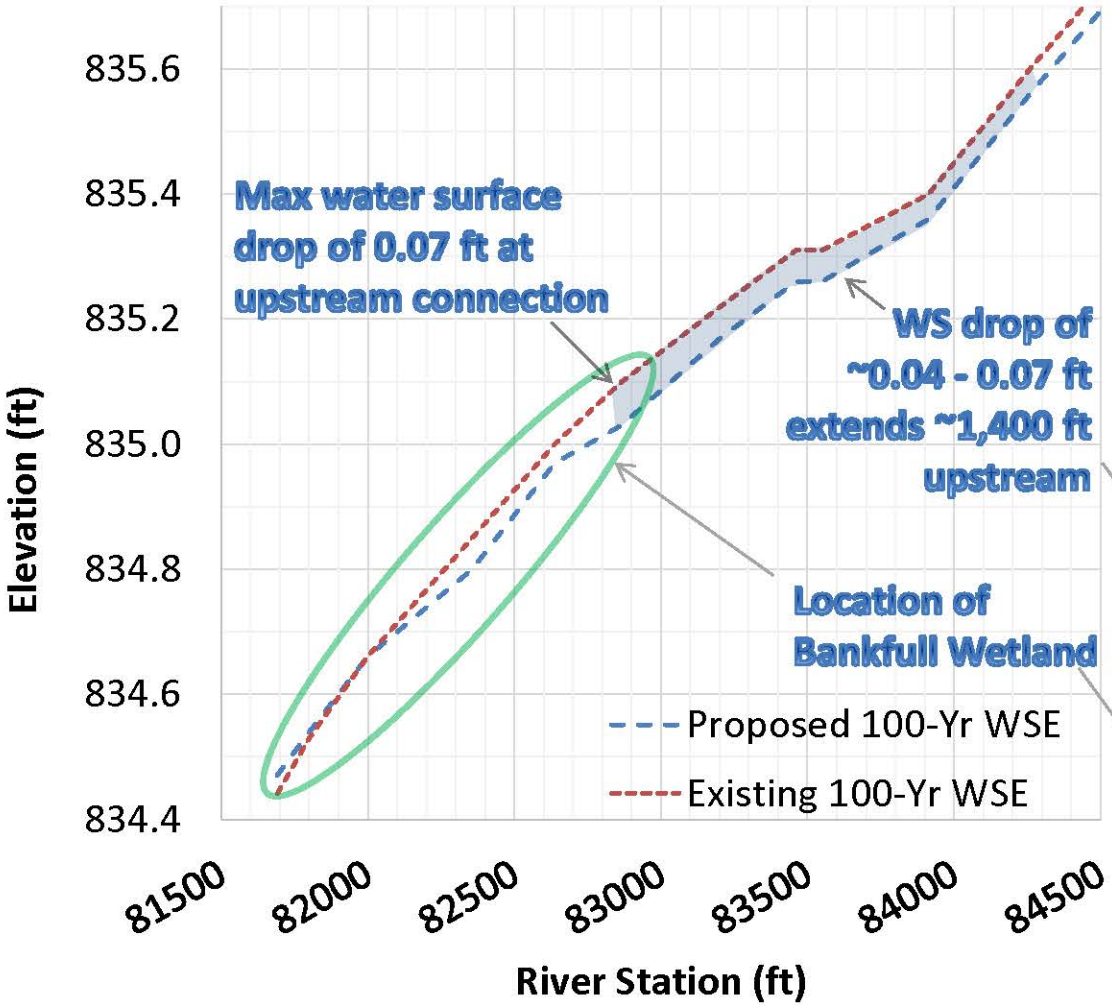

USGS Great Miami River at Troy

# 100-Yr Flood Benefits per FEMA Model




| River Station ft | Existing 100-Yr WSE ft | Proposed 100-Yr WSE ft | Change in WSE ft |
|---|---|---|---|
| 91612 | 840.15 | 840.15 | 0.00 |
| 90814 | 839.47 | 839.46 | -0.01 |
| 90096 | 839.24 | 839.23 | -0.01 |
| 88868 | 838.80 | 838.79 | -0.01 |
| 88276 | 838.45 | 838.44 | -0.01 |
| 87657 | 838.16 | 838.15 | -0.01 |
| 87493 | 837.91 | 837.89 | -0.02 |
| 87426 | 837.40 | 837.37 | -0.03 |
| 87391 | 837.41 | 837.39 | -0.02 |
| 87354 | 837.40 | 837.38 | -0.02 |
| 87304 | 837.29 | 837.26 | -0.03 |
| 87258 | 837.31 | 837.29 | -0.02 |
| 86863 | 837.10 | 837.08 | -0.02 |
| 86093 | 836.79 | 836.77 | -0.02 |
| 85311 | 836.17 | 836.14 | -0.03 |
| 84259 | 835.60 | 835.56 | -0.04 |
| 83915 | 835.40 | 835.36 | -0.04 |
| 83550 | 835.31 | 835.26 | -0.05 |
| 83461 | 835.31 | 835.26 | -0.05 |
| 83204 | 835.22 | 835.17 | -0.05 |
| 82866 | 835.10 | 835.03 | -0.07 |
| 82638 | 835.00 | 834.97 | -0.03 |
| 82356 | 834.85 | 834.80 | -0.05 |
| 81999 | 834.66 | 834.66 | 0.00 |
| 81800 | 834.53 | 834.54 | 0.01 |
| 81690 | 834.44 | 834.47 | 0.03 |
| | | Weighted Average Departure: | -0.02 |

# 100-Yr Flood Benefits per FEMA Model (Zoomed In)

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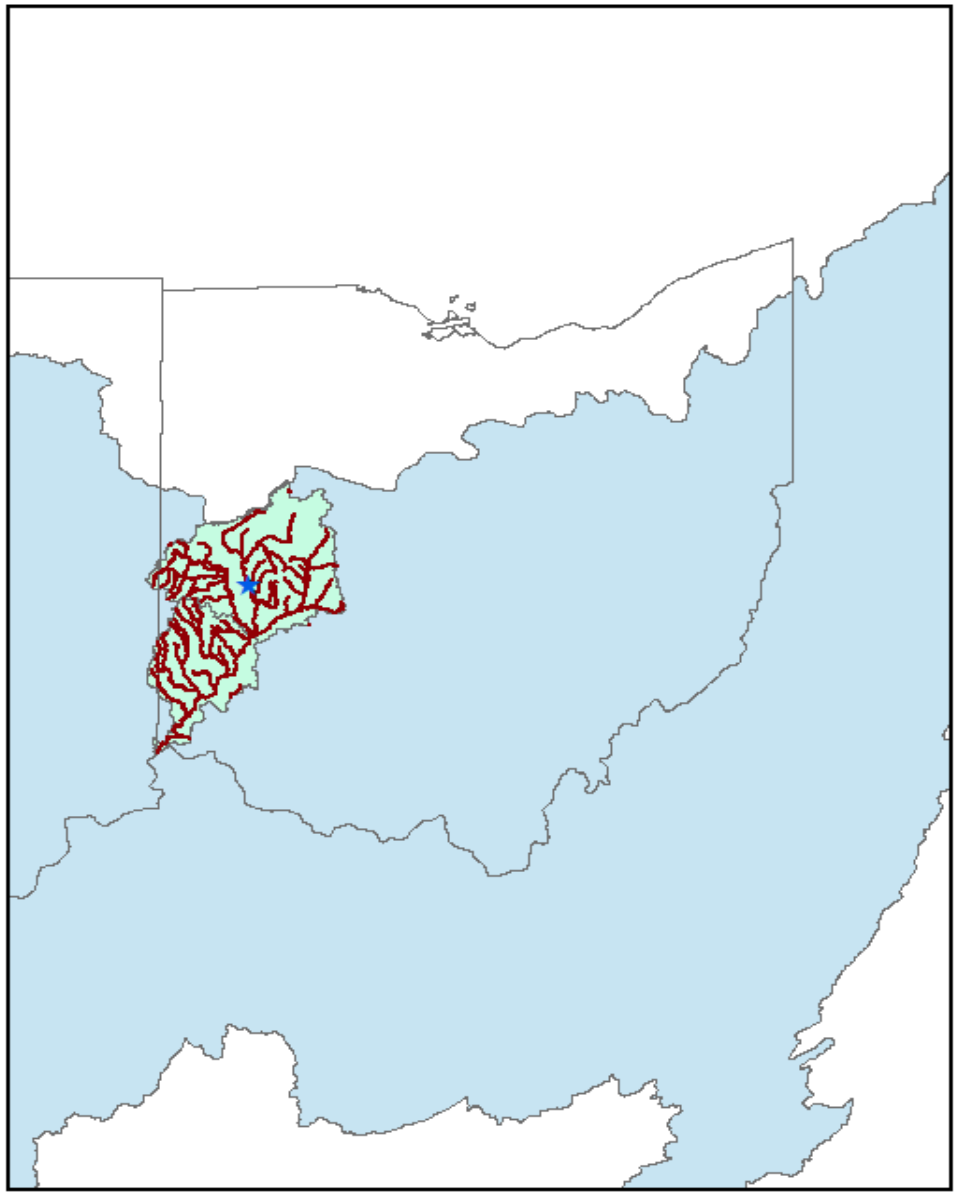
| | | Weighted Average Departure: | -0.02 |

**Great Miami River**

**Basin size**: 5,373 sq mi (13,920 km$^2$)

**Length**: 170 miles (270 km)



# Great Miami River "Bankfull Wetland"

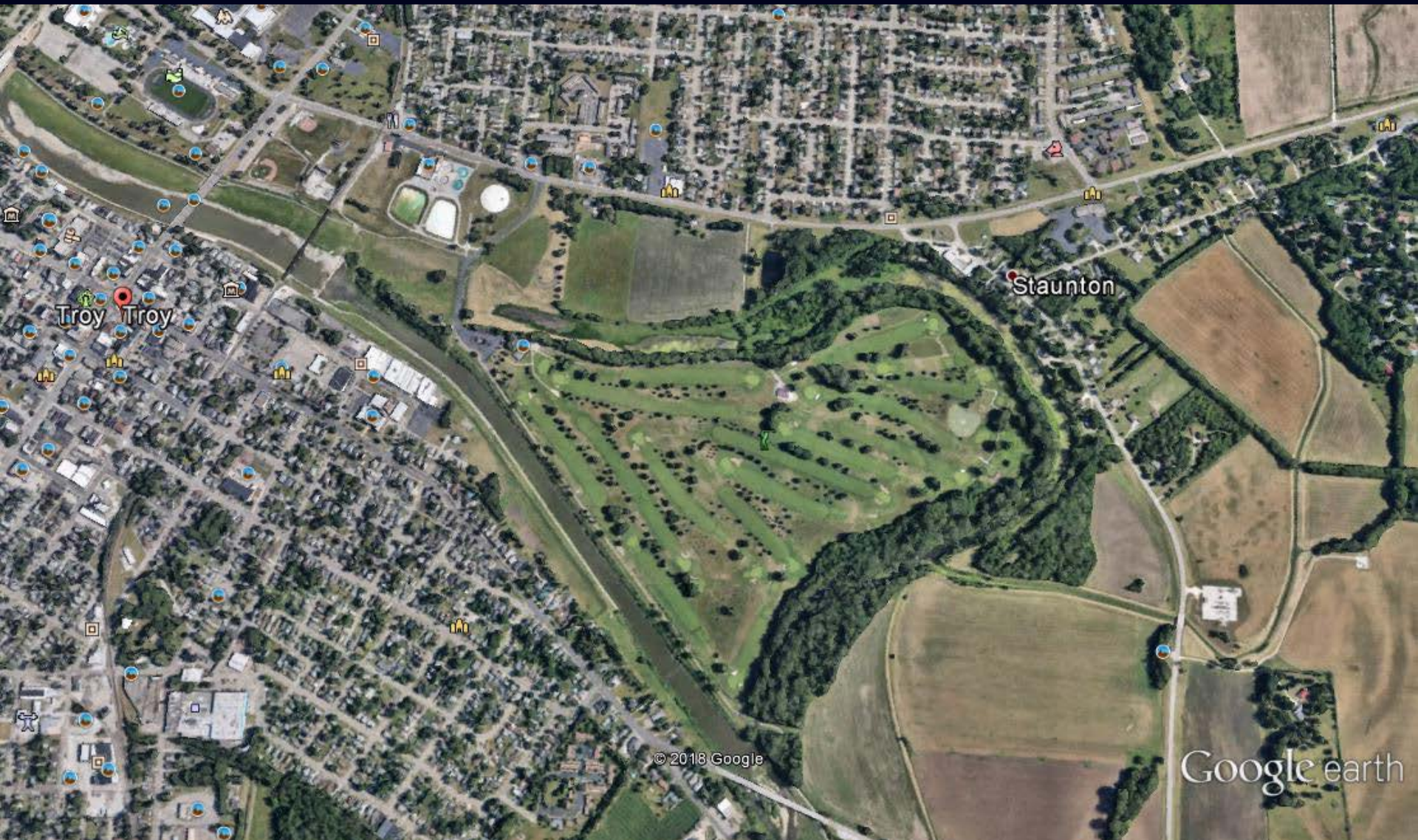
- Based on preliminary sediment data from USGS these "oxbow habitats" could last between ~1 and 5 centuries before filling up with sediment.

- In terms of Water Quality, the Troy wetland can potentially remove:
- ~200,000 to 1.3M pounds of TSS per year
- ~1,000 to 9,000 pounds of Nitrogen per year
- ~100 to 900 pounds of Phosphorus per year

Reintroduction of two extirpated wetland species, Blacknose Shiner and Lake Chubsucker (USFWS ES, OSY, ODNR)

Restoration of extirpated Eel Grass with Dr. Sweetenand Virgina Tech

# Troy, OH Oxbow



# Restoration Can Save Infrastructure Costs