Reconnecting Waters; Reconnecting Roads

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Laura MacFarland, Great Lakes Stream Restoration Manager
Wisconsin Lakes Convention | Stevens Point, WI | April 19, 2018

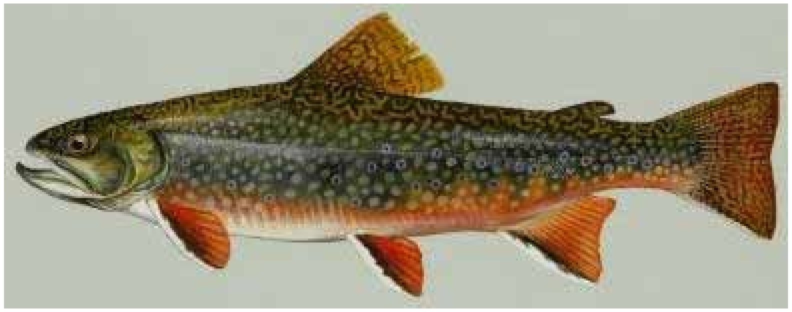
www.tu.org

Overview – Reconnecting Waters; Reconnecting Roads

- Introduction to TU and our Investment in Transportation Infrastructure
- How Road Stream Crossings Act as Barriers
  - Biological Processes
  - Geomorphologic Processes
- Ecological Impacts of Fragmentation of Aquatic Habitat
- Economical/Social Impacts of Inadequately Sized Road Stream Crossings
- Inventory, Assessment and Prioritization of Road Stream Crossings
- Restoring Connectivity

Trout Unlimited, Inc.

MISSION: To conserve, protect, and restore North America's coldwater fisheries and their watersheds.



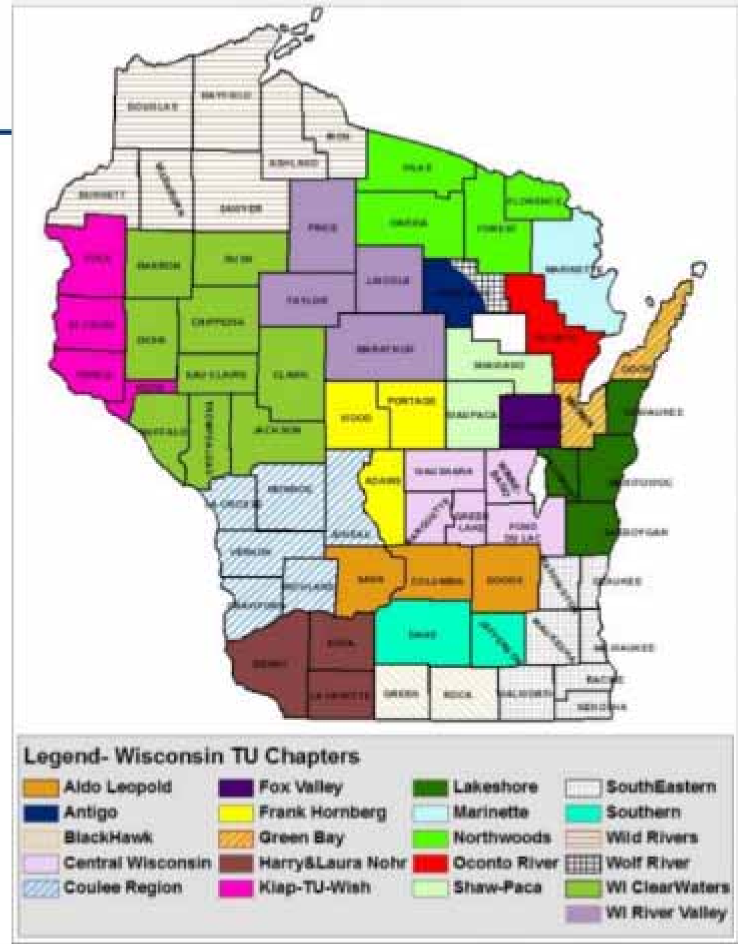
TU VISION: By the next generation, Trout Unlimited will ensure that robust populations of native and wild coldwater fish once again thrive within their North American range, so that our children can enjoy healthy fisheries in their home waters.

Our Approaches

- Protect Heathy Rivers and Landscapes
- Restore Degraded Habitat
- Reconnect Aquatic Systems
- Sustain Our Efforts

Our Grassroots

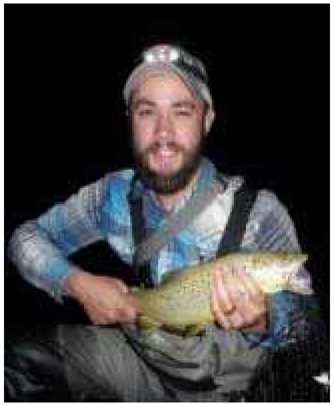
- 150,000 Members Nationally
- 385 Chapters Nationally
- 21 Chapters in Wisconsin



Trout Unlimited Staff in the Great Lakes Basin

Nichol De Mol
Great Lakes Habitat
Program Manager

Greg Orum
Great Lakes Stream
Restoration Specialist



Jeremy Geist
Great Lakes Stream
Restoration Manager
(Michigan)

Laura MacFarland
Great Lakes Stream
Restoration Manager
(Wisconsin)

Taylor Ridderbusch
Great Lakes Organizer

Wisconsin Phase I (2016/2017)

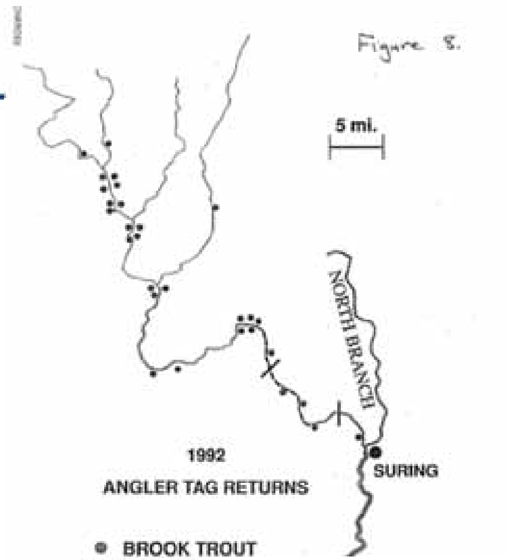
- >42 miles of coldwater habitat reconnected
- 1 Road Crossing Abandonment
- 10 Culvert Replacements
  - UNT Hay Creek
  - UNT Caldron Falls
  - UNT Chickadee Creek
  - Chickadee Creek (2)
  - Halley Creek
  - Spencer Creek
  - Shabadock Creek
  - UNT Armstrong Creek
  - Armstrong Creek

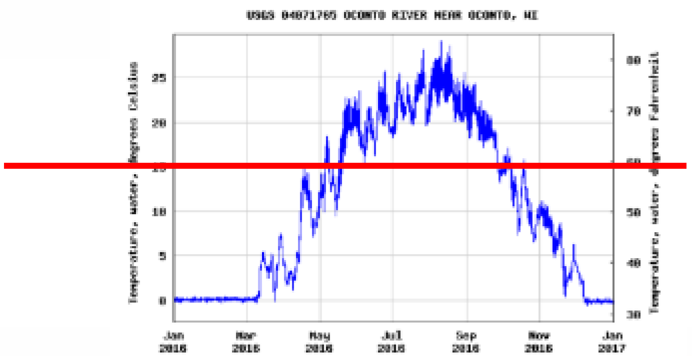
Ex. Brook Trout in the Oconto River

Annually and throughout their lifecycle, brook trout will seek a variety of habitats to thrive

- Larger streams and rivers = foraging grounds and habitat for overwintering
- Mid-order streams= refuge from **lethal temperatures** and flooding
- Small tributaries = spawning and rearing

- Trout were observed moving >30 miles seasonally



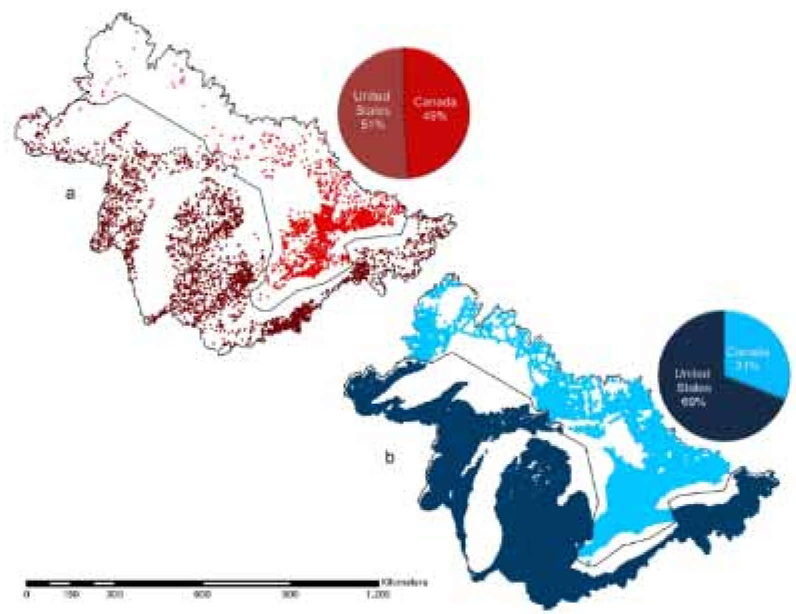


Where blue lines and black lines intersect on the map…

In the Great Lakes basin:

- 7,000 dams
- 265,000 road stream crossings

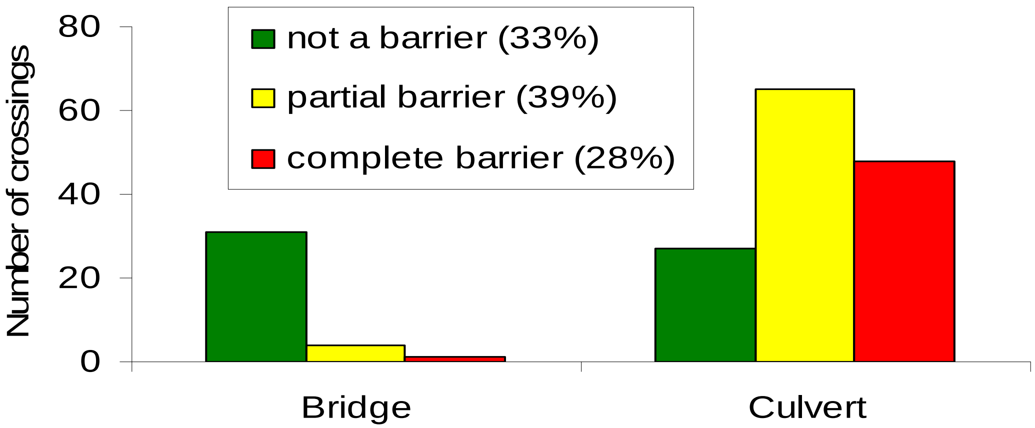
- An estimated 19% are barriers to fish movement, and this percentage is even higher in other areas of the state.



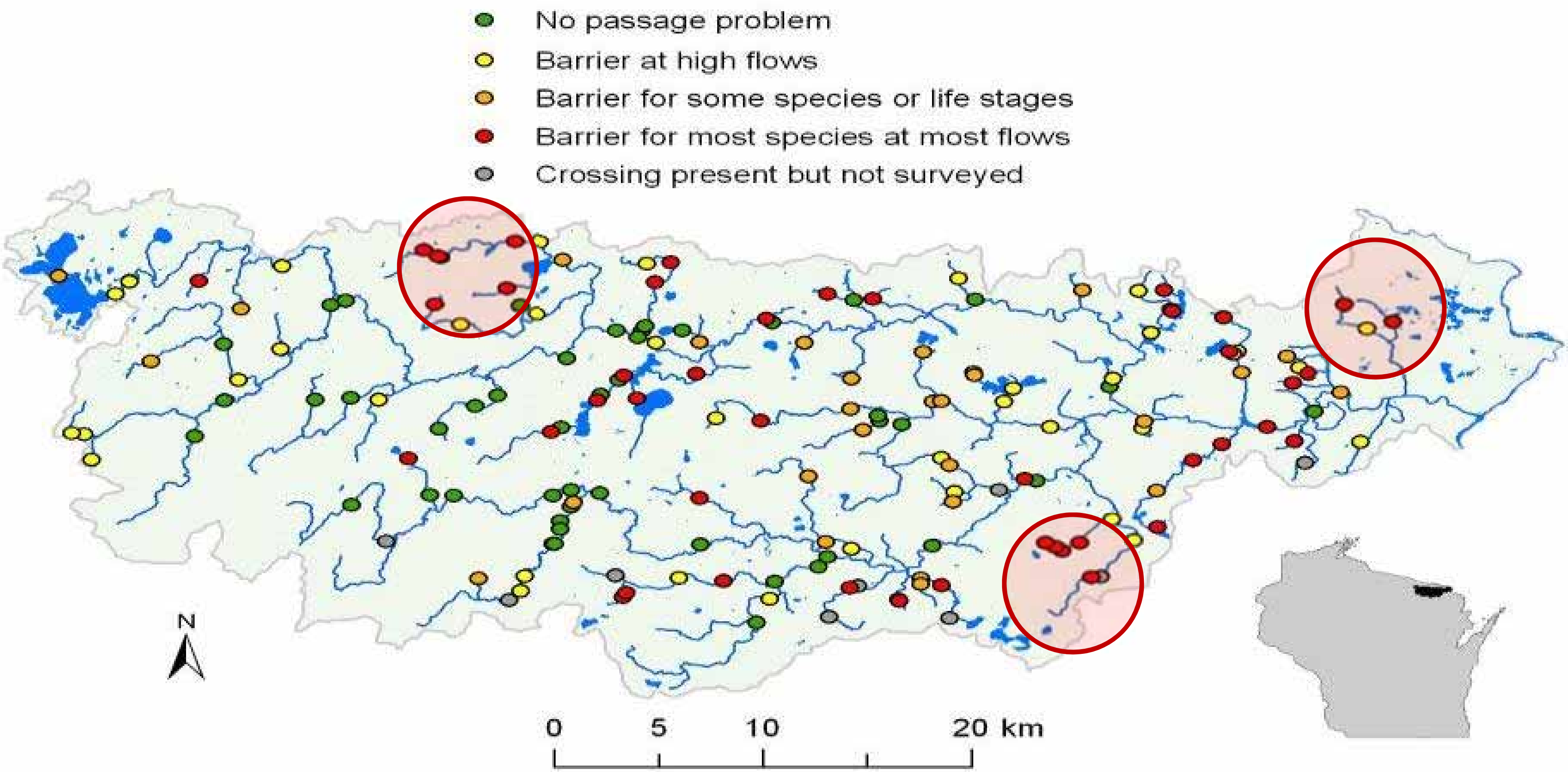
Maps of the distribution of dams and road crossings in the Great Lakes Basin Red = dams, blue = road crossings. Image courtesy of Stephanie Januchowski-Hartley
http://limnology.wisc.edu/blog/road-block-study-maps-stream-barriers-in-great-lakes-basin/

Bridges vs. Culverts

A 2008 Study in Pine-Popple watershed in Northern Wisconsin found 67% of 192 road crossings pose some sort of barrier to fish movement, and culverts are much more likely to act as a barrier than bridges.



Road Crossings in the Pine-Popple Watershed

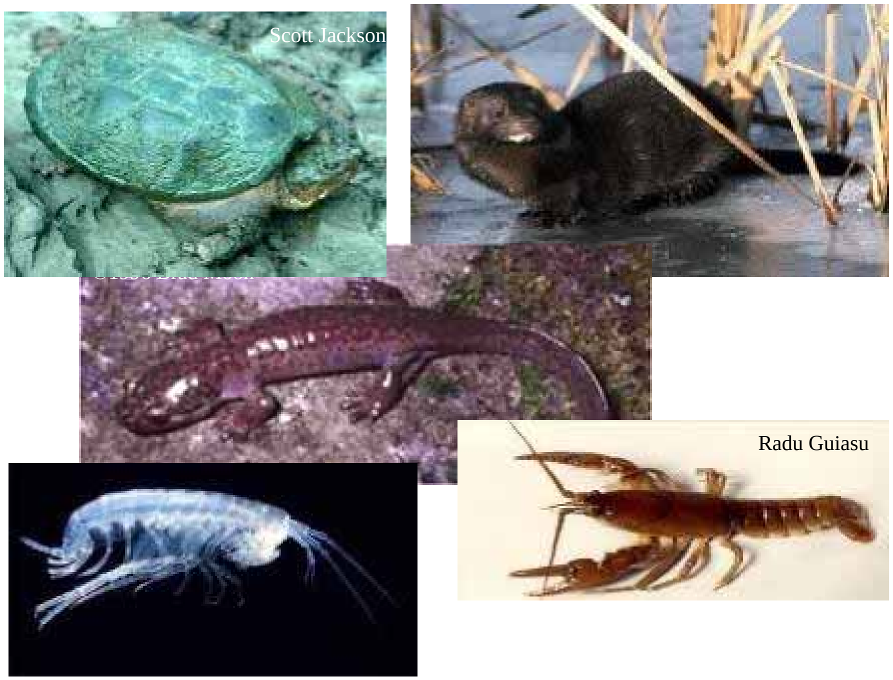


Importance and Vulnerability of Small Streams

- Make up a large percentage of stream miles
- Cumulatively provide more habitat than large rivers
- Support species not found in larger streams and rivers
- Provide important spawning & nursery habitat for fish
- More likely to have a culvert rather than a bridge
- Connectivity of intermittent streams often undervalued

The majority of Wisconsin's 115 fish species move during their life history

And its not just fish…



Snapping turtle swimming through a newly installed culvert on Halley Creek, Forest County, WI.

Local abundance and species richness of stream fishes influenced by barriers

Stream sections located above predicted impassable culverts had fewer than half the number of species and less than half the total fish abundance, while stream sections above and below passable culverts had essentially equivalent richness and abundance.

Nislow, K.H., M. Hudy, B.H. Letcher, & E.P. Smith. 2011. Variation in local abundance and species richness of stream fishes in relation to dispersal barriers: implications for management and conservation. Freshwater Biology. 56: 2135-2144.

Culverts acting as barriers to salamander movement influence abundance, diversity and richness

Northern two-lined salamander, Eurycea bislineata adult (above). Northern Spring Salamander, Gyrinophilus p. porphyriticus (below). Photo Sources: USGS, Christopher J. Leary

"..the presence of roads with culverts that were designated as being complete barriers to stream salamander movement was an important factor in dictating differences in salamander abundance, diversity, and richness at both the stream-level and the reach-level."

Culverts that exceed the channel width, are at grade with the streambed, and contain substrate will benefit stream salamanders!

Source: Anderson, J.T., Ward, R.L, Petty, J.T., Kite, S.J., and M.P. Strager. 2014. Culvert Effects on Stream and Stream-Side Salamander Habitats. International Journal of Environmental Science and Development, Vol. 5, No. 3, 2014.

Road mortality is a major threat to Blanding's turtle populations

- Blandings Turtle - Species of Concern
- An individual may cross a road 15 – 20 times in its life

** Barrier use, combined with underpasses (i.e. , bridges and culverts), allow this species to move between suitable habitats (i.e.,wetland to nesting habitat).

ARESCO, M. J. (2005), MITIGATION MEASURES TO REDUCE HIGHWAY MORTALITY OF TURTLES AND OTHER HERPETOFAUNA AT A NORTH FLORIDA LAKE. The Journal of Wildlife Management, 69: 549–560.

High velocities in culverts favor nonindigenous crayfish species

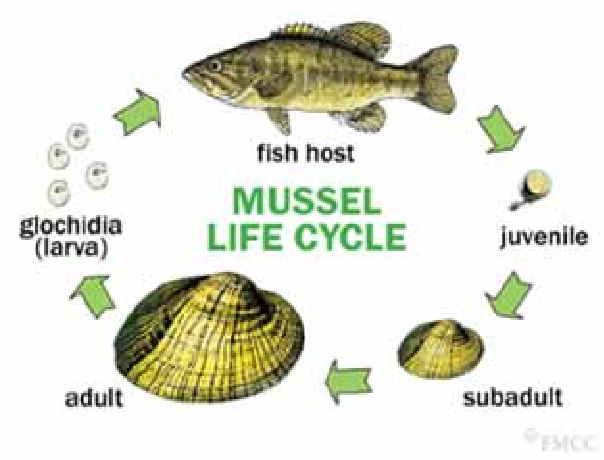
Orconectes rusticus were found to be more adept at moving upstream than native species. O. rusticus tolerated culvert flow velocities 24% higher than the O. virilis.

FOSTER, H. R., AND T. A. KELLER. 2011. Flow in culverts as a potential mechanism of stream fragmentation for native and nonindigenous crayfish species. Journal of the North American Benthological Society 30:1129–1137.)

Interdependencies

The occurrence of
some species is dependent on
the present of others.

For example many freshwater
mussel species are dependent
on specific fish hosts to
Complete their lifecycles.



Impacts of Fragmentation

- Reduced access to vital habitats
- Population fragmentation & isolation
- Disruption of processes that maintain regional populations
- Habitat loss and degradation
- Roadkill leading to loss of populations
- Alteration of ecological processes



"If the biota, in the course of eons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering." – Aldo Leopold, 1953

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How Road Stream Crossings Act as Barriers

Species differ in their ability to move

Slide Adapted from Mike Miller (WNDR) Ecological Considerations for Designing Stream Crossings
Photo Credit: Jason Neuswanger, Troutnut.com

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Jump Barrier

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Velocity Barriers

Culverts Create a Single High Velocity Corridor for Movement

Current Through Pipe is Too Strong for Some or ALL Organisms/Age Classes

Depth Barrier

Inefficient Swimming

Avoidance by Fish

Exhaustion Barrier

Certain Species or Age Classes Cannot Sustain Necessary Swim Speed for Entire Distance

Other Ways Culverts Act as Barriers

- Woody debris accumulation
- Absence of bank edge areas
- Discontinuity of channel substrate
- Behavioral barriers
- Riparian fragmentation

Barriers to sediment/debris transport

Prior to the replacement of this culvert there was an average silt depth of 32.48 cm with a maximum of 44cm due to impounding. Increased velocities reveal gravel post construction.

Chickadee Creek (left) 100 m upstream of a road stream crossing (above). The habitat changes dramatically as a result of the road crossing.

The Economics of Fish Friendly Culverts

The short-term vs. long-term cost of culverts

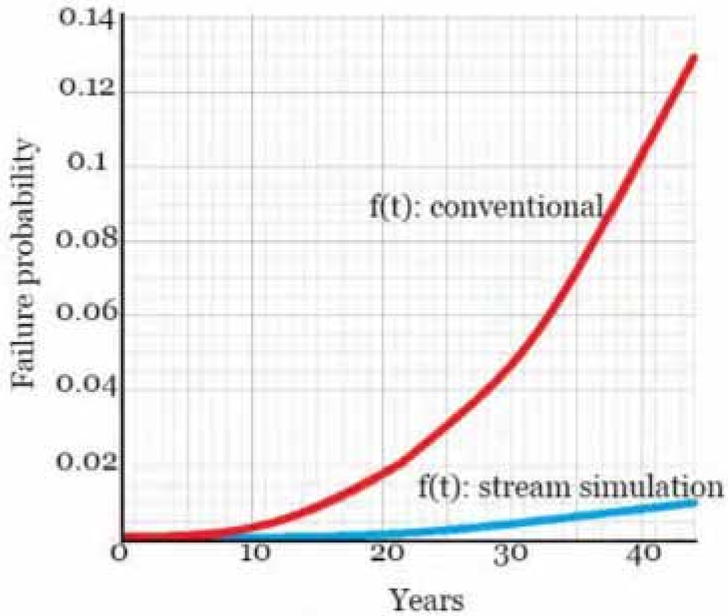
- Costs associated with culverts
  - Installation
  - Debris Clearing
  - Road/Embankment Maintenance
  - Emergency Response to Failures

Short-term threats to stability of crossing if not properly sized

- Plugging with debris
- Overtopping the road (surface damage)
- Erosion/degradation of embankment/shoulder
- Corrosion of pipe
- Risk of damage during maintenance

Long-term

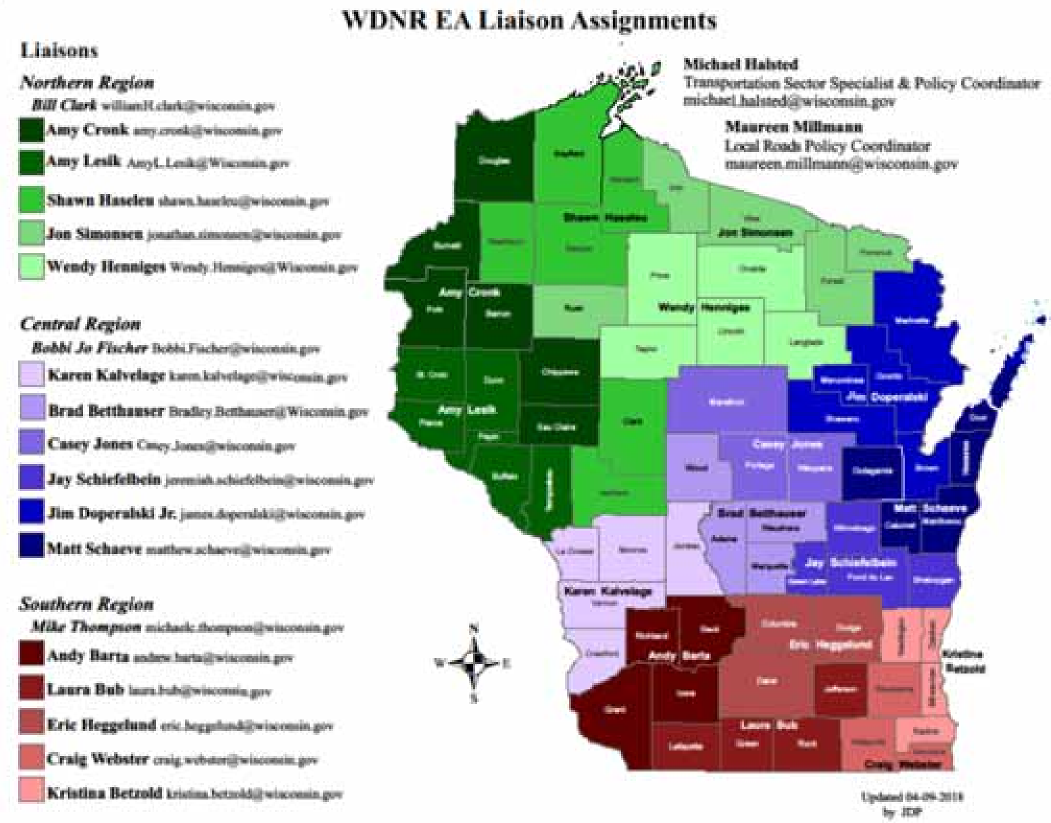
- Undersized culvert lifespan ~ 35 years
- Bankfull width culvert lifespan ~ 75 years



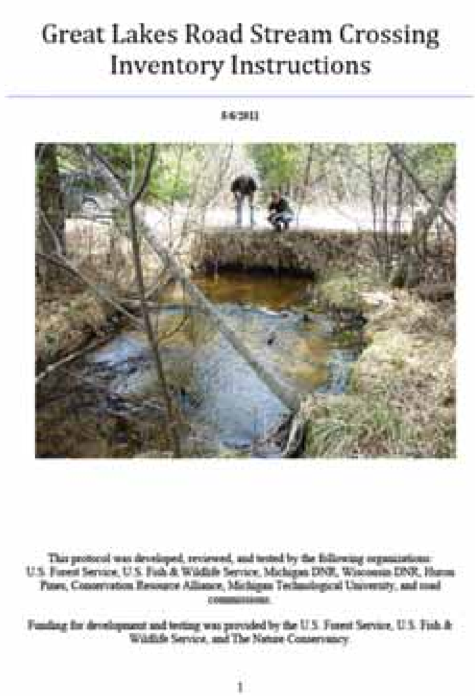
Identifying and Prioritizing Road Stream Crossing Projects

Your First Call

- Status of local inventories
- Capacity/knowledge of local municipalities
- Current laws/regulations
- Funding opportunities
- Other resources



Great Lakes Road Stream Crossing Inventory Instructions


Great Lakes Road Stream Crossing Inventory Instructions

This protocol was developed, reviewed, and tested by the following organizations: U.S. Forest Service, U.S. Fish & Wildlife Service, Michigan DNR, Wisconsin DNR, Huron Pines, Conservation Resource Alliance, Michigan Technological University, and road commissions.

Funding for development and testing was provided by the U.S. Forest Service, U.S. Fish & Wildlife Service, and The Nature Conservancy.

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Stream Crossing Data Sheet

Search "Road Stream Crossing Inventory" in the www.dnr.wi.gov search bar.

Inventory and Assessment Basics

Culvert

- Size of culvert (height, width, length)
- Velocity of water at outlet/inlet
- Depth of water in culvert
- Substrate in the culvert
- Condition of the culvert
- Erosion

Reference Reach

- Depth, velocities, width, substrate

TU volunteers compare the velocity within a reference reach to the velocity at the outlet of a culvert.

What you are looking for….

- How much is the channel constricted?
- Is the culverts invert above grade? Perched?
- Are the velocities increased due to constriction?
- Is the culvert piping or showing other signs of failure? Is road surface failing?
- Is there debris blocking the inlet?
- Is there ponding upstream? Or a scour hole downstream?

Prioritization

- Necessary due to limited resources
- Considerations
  - Objectives (eg. Target species)
  - Severity of barrier
  - Quality of the resource
  - Miles/acres reconnected
  - Condition of the crossing; risk of failure
  - Cost
- Include priority projects in planning documents (eg. Lake Management Plans)

Restoring Connectivity of Rivers

Our Objectives:

- Protect and restore the quality of the physical environment (habitat),
- Maintain intact communities of ALL aquatic organisms
- Not disrupt critical ecological processes such as sediment and nutrient transport
- Sufficient hydraulic capacity
- Minimize risk of failure through plugging or overtopping

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Do you really need the road stream crossing?

Abandoning Road Stream Crossings

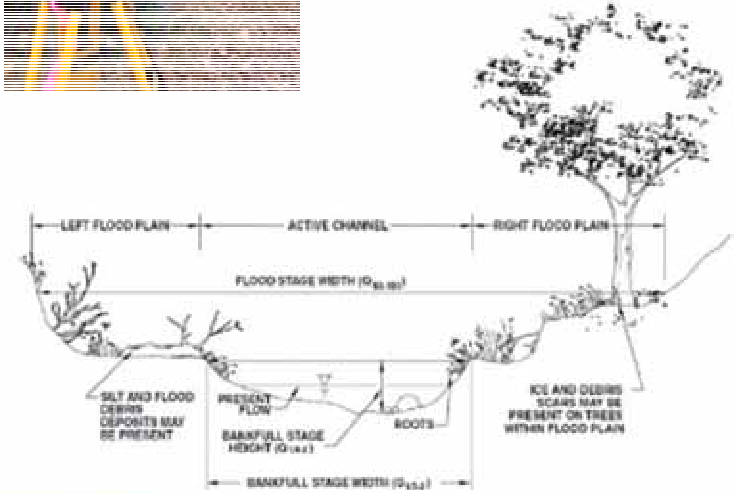
Culvert Replacement Design Methods

1. Hydraulic Design – designs based primarily on hydraulic capacity
2. Geomorphic-based Channel Design – reconnects the upstream and downstream channel while meeting most AOP movement and habitat needs (Applied on Low Gradient Streams <1%)
3. Stream Simulation Approach – simulating a reference reach through the crossing (USDA Forest Service 2008) (Applied on Higher Gradient Streams >1%)

Credit: Dale Higgins

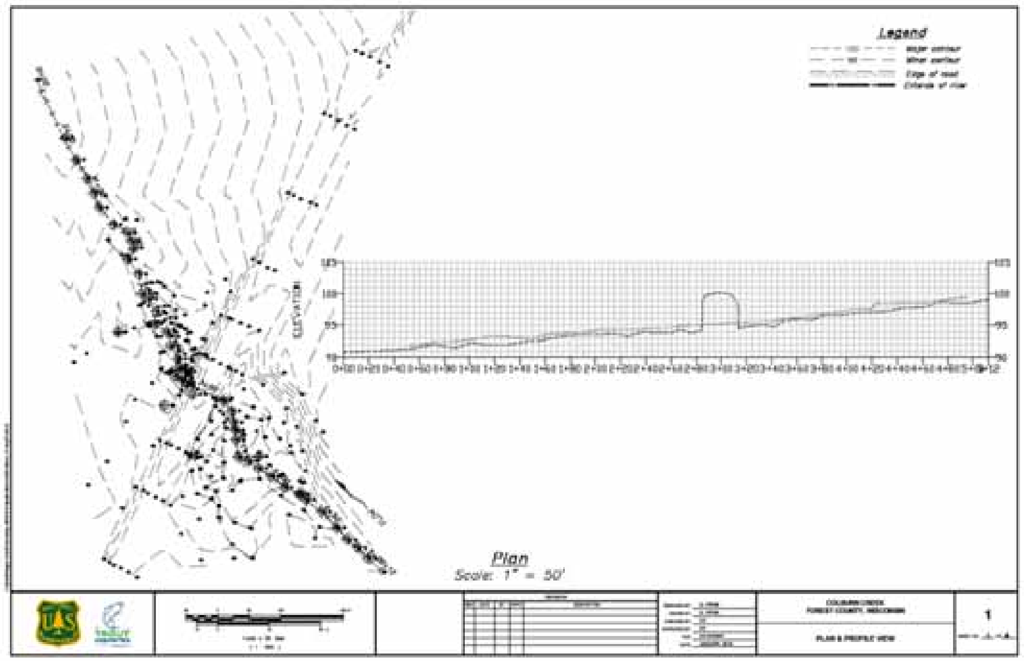
Surveying

- Geomorphic and topographic surveys
- Bankfull width measurements
- Longitudinal profile 20-30
- Grade control characterization
- Dimensions of riffles, pools, etc.
- Channel cross sections
- Floodplain characterization
- Pebble counts
- Flow measurements

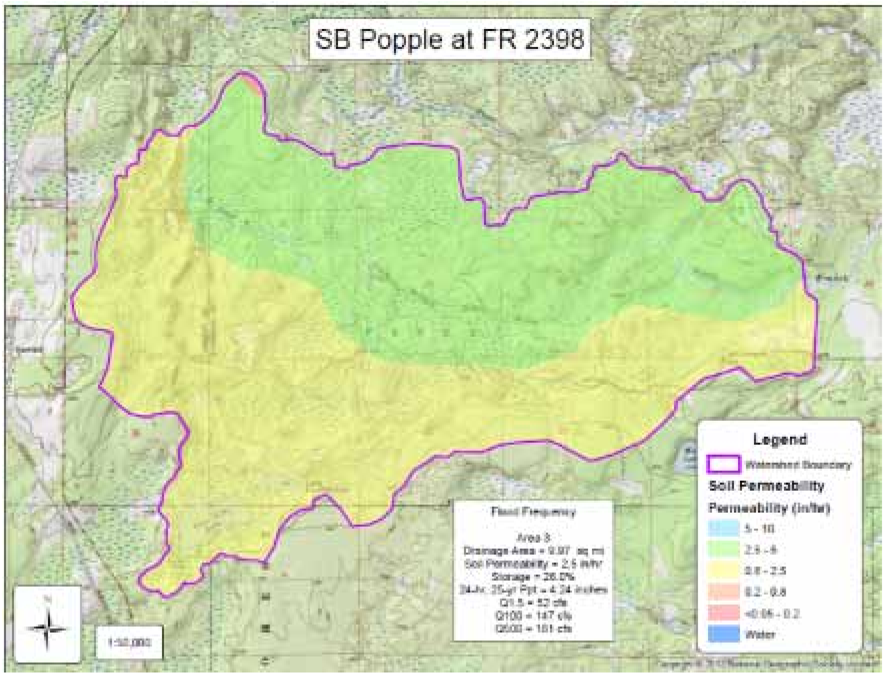


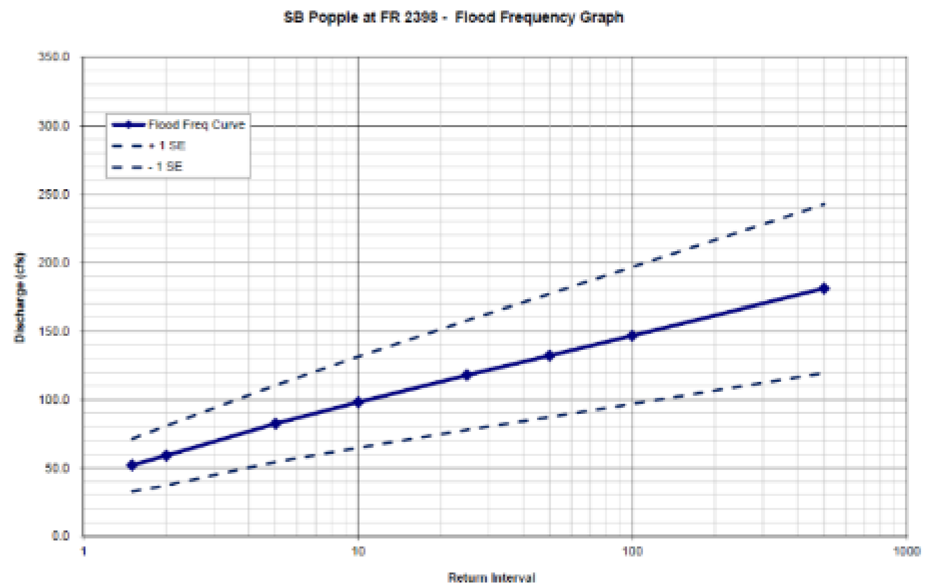
Longitudinal Profile

- Identify & evaluate grade controls and stability
  - Next stable grade control upstream and downstream
- Delineate and characterize slope segments
- Delineate new channel limits at proposed structure; determine slope at new structure
- Determine residual pool depth and lower Vertical Adjustment Potential (VAP)
- Determine potential reference reaches based on slope

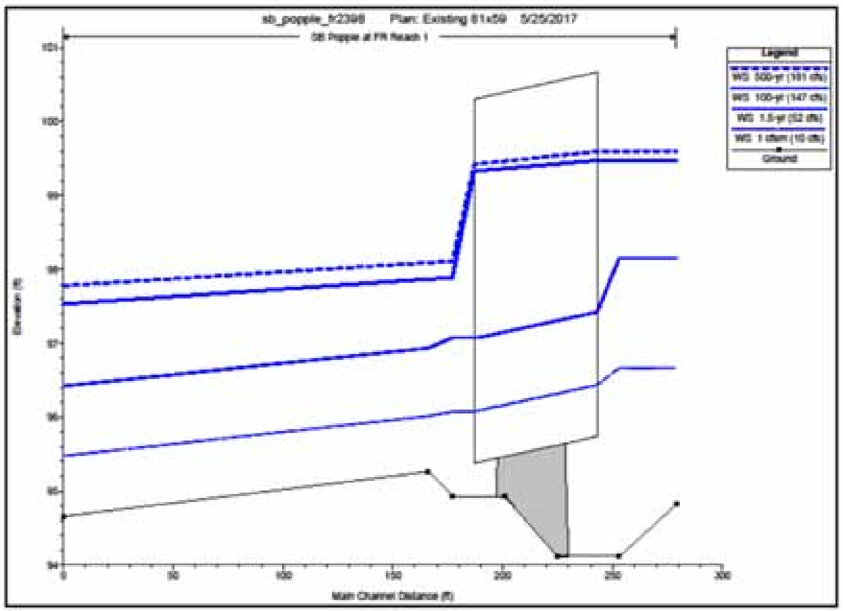


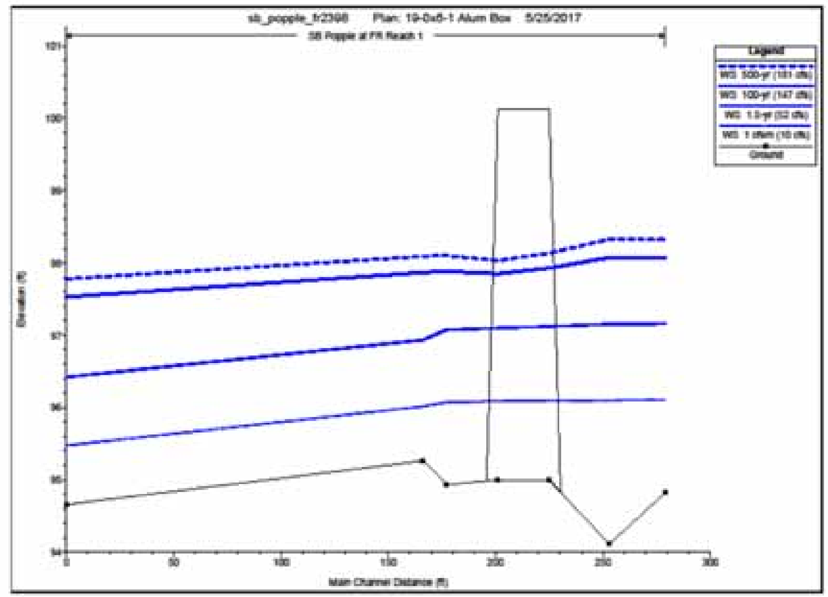
Calculating Flood Frequencies at Site Using Regression Equations



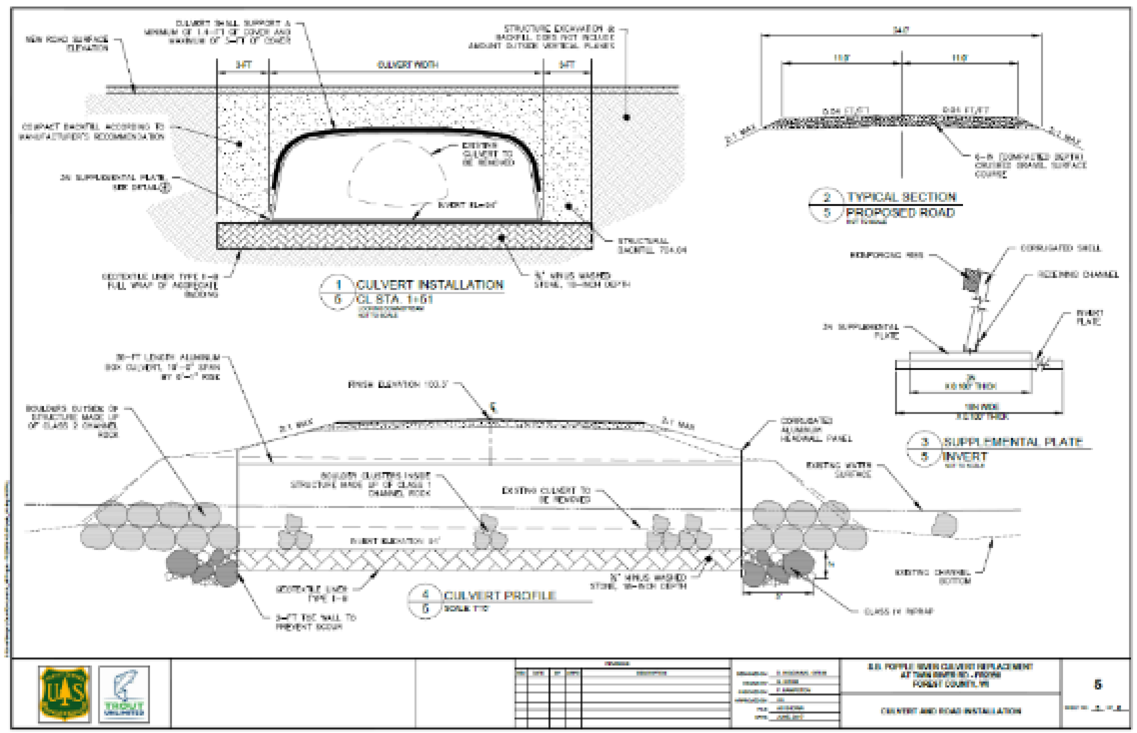


Hydraulic Model to Confirm Capacity of Alternatives (HECRAS)





Plans and Specifications



Before and After (Chickadee Creek & Halley Creek)

Before and After (Armstrong Creek & Spencer Creek)

Potential Partners

- Local Municipalities
- County Land and Water Department
- Wisconsin DNR Transportation Liaisons
- Wisconsin DNR Water Resource Specialists
- Wisconsin DNR Fisheries Biologists
- Wisconsin Department of Trade and Consumer Protection (DATCP)
- Natural Resources Conservation Service (private lands)
- Other non-governmental organizations like Trout Unlimited

Thanks to our supporters and partners!

- USDA United States Forest Service
- National Fish and Wildlife Foundation – Sustain Our Great Lakes Grant
- National Fish and Wildlife Foundation – Five Star Restoration Grant
- US Fish and Wildlife Service
- Forest County Potawatomi Community
- Wisconsin Department of Natural Resources
  - Surface Water Grants Program
  - Trout Stamp Funds
- Trout and Salmon Foundation
- Wisconsin Trout Unlimited State Council
- <u>TU Chapters and Local Partners (Like You!)</u>

For more photos and updates …..

TROUT UNLIMITED – GREAT LAKES STREAM RESTORATION

https://www.facebook.com/TUGreatLakes
https://www.facebook.com/greatlakesadvocacy

THANK YOU

FOR ALL YOU DO!

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