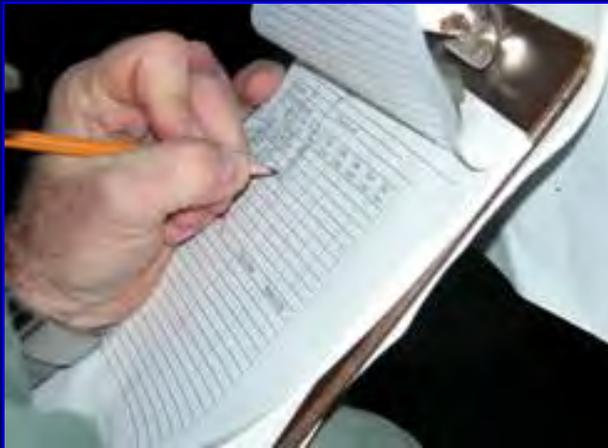


# Fish Passage Barrier Inventory, Assessment, and Prioritization



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# Inventory, assessment, and prioritization

- How many crossings are out there?
- How many are bad?
- Where do we begin fixing problem sites?



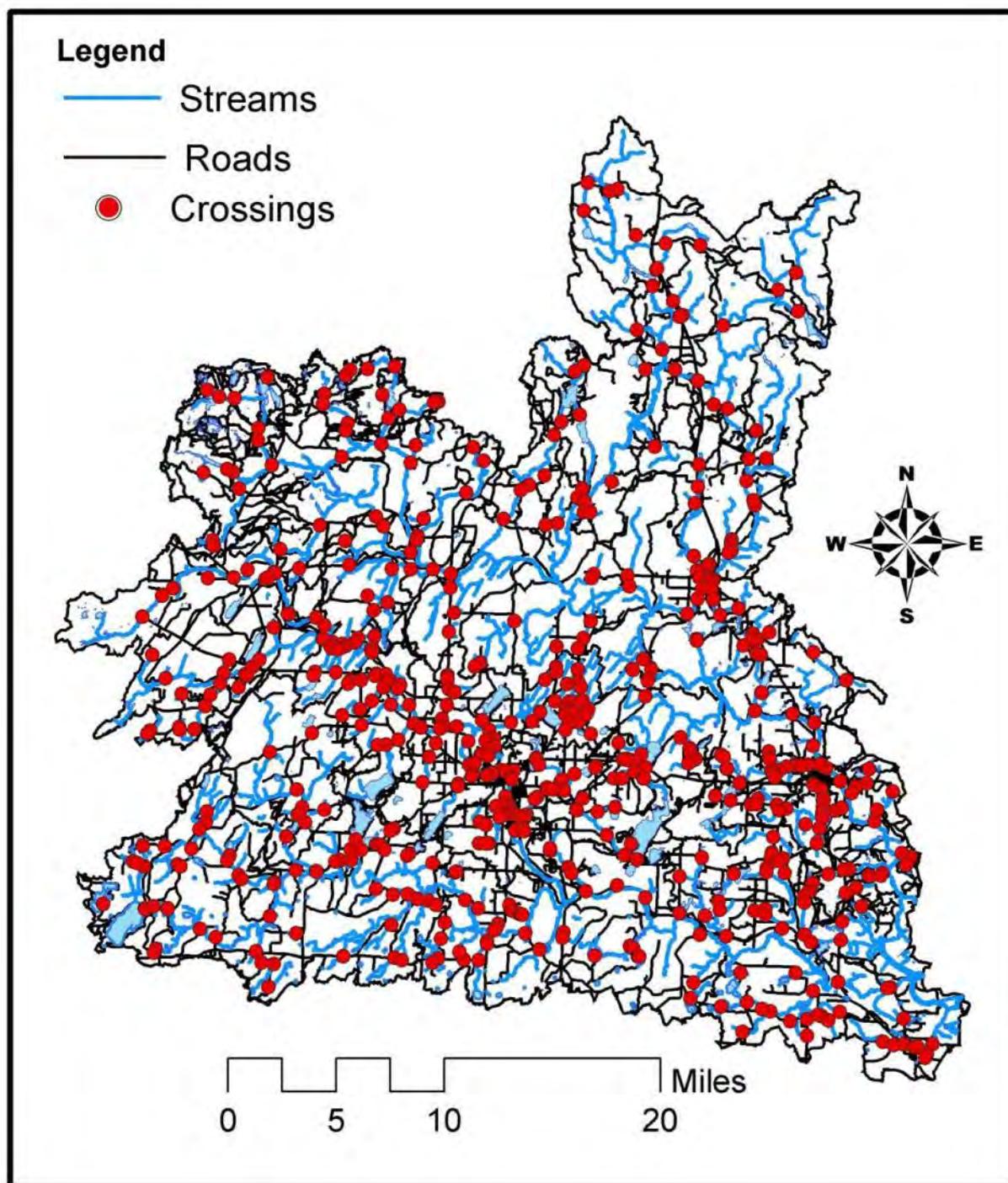
# How many road/stream crossings are out there?

(Velocity barrier)



# Upper Menominee Watershed

649  
Crossings!

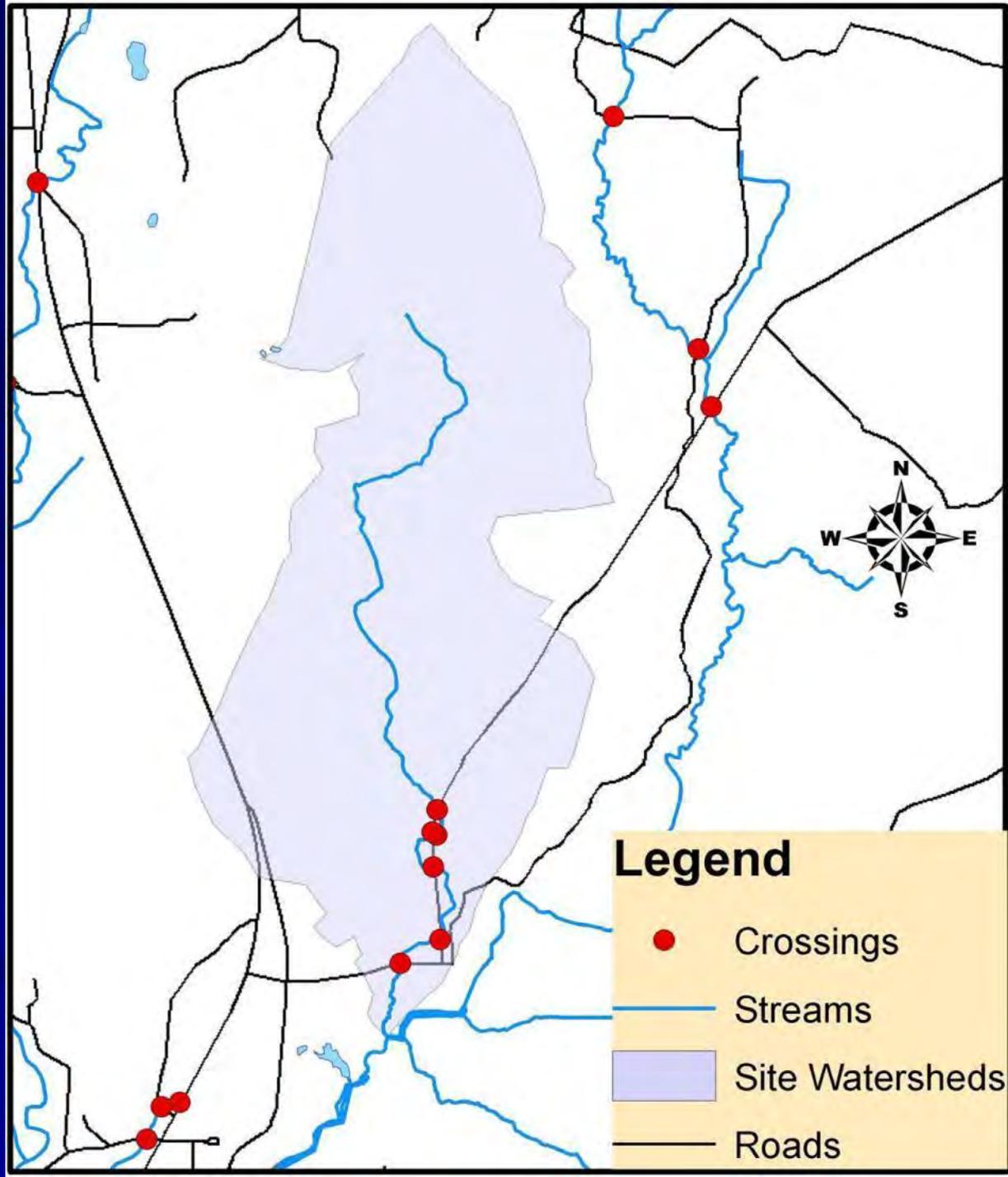


# A few cautions

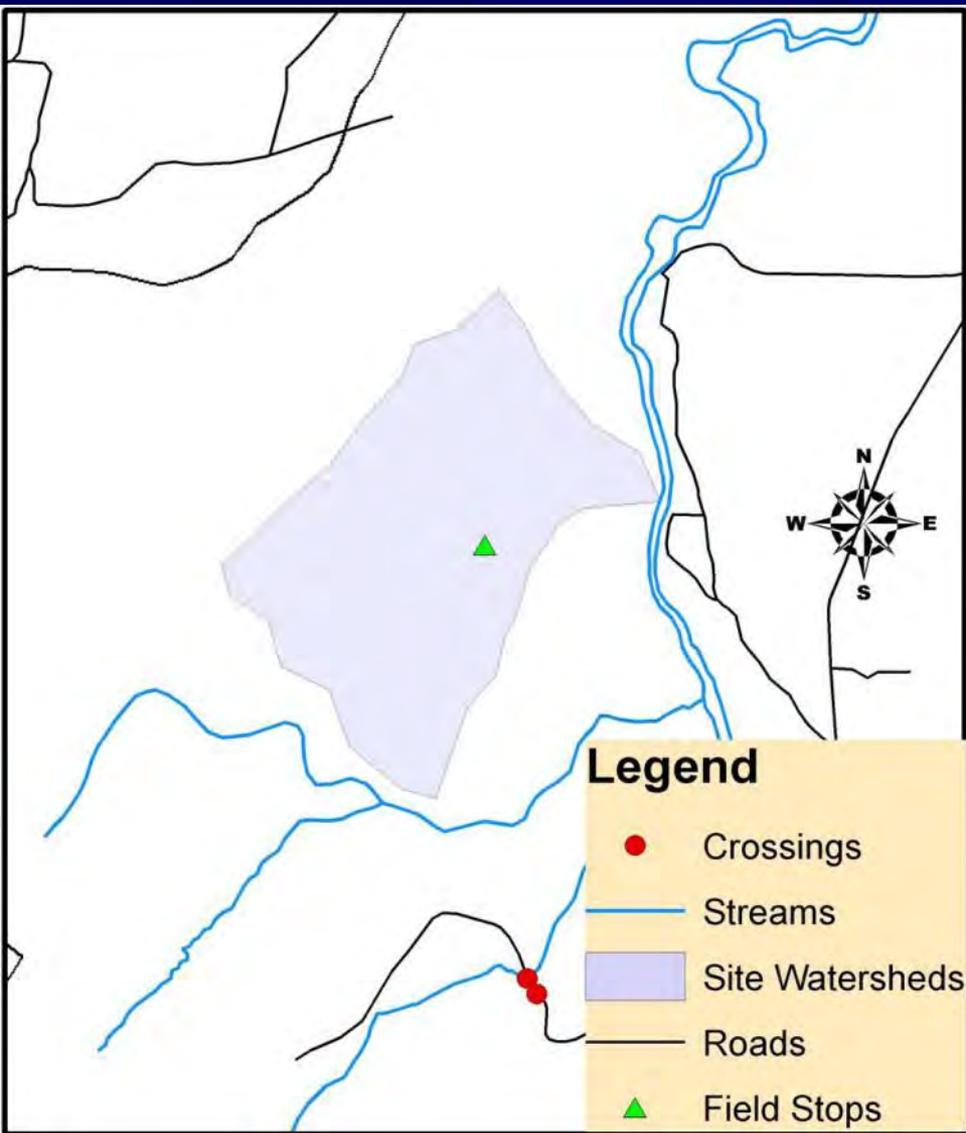
- Scale matters
- Some roads are not mapped
- Some streams are not streams
- Some roads are not roads
- Some crossings are not crossings
- Some crossings don't show up

Zoom in to  
field sites

Looks good!

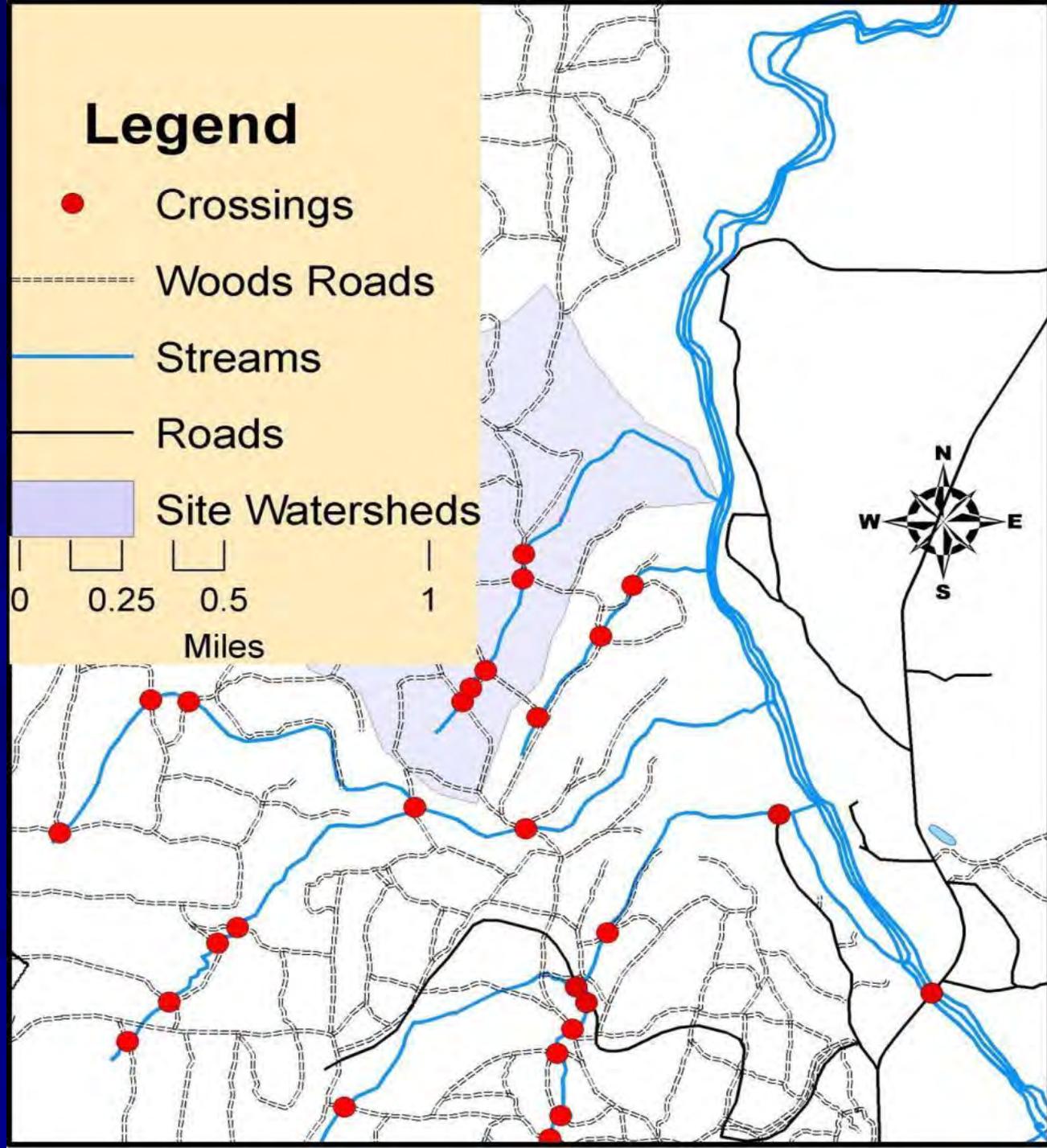


# What crossing?



27  
Crossings  
in 4  
Square  
Miles

Scale Matters –  
Use the finest  
scale possible



# Some roads are not mapped

1,462 miles mapped

3,050 miles unmapped



# Unmapped stream crossings

789 mapped crossings

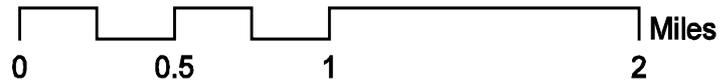
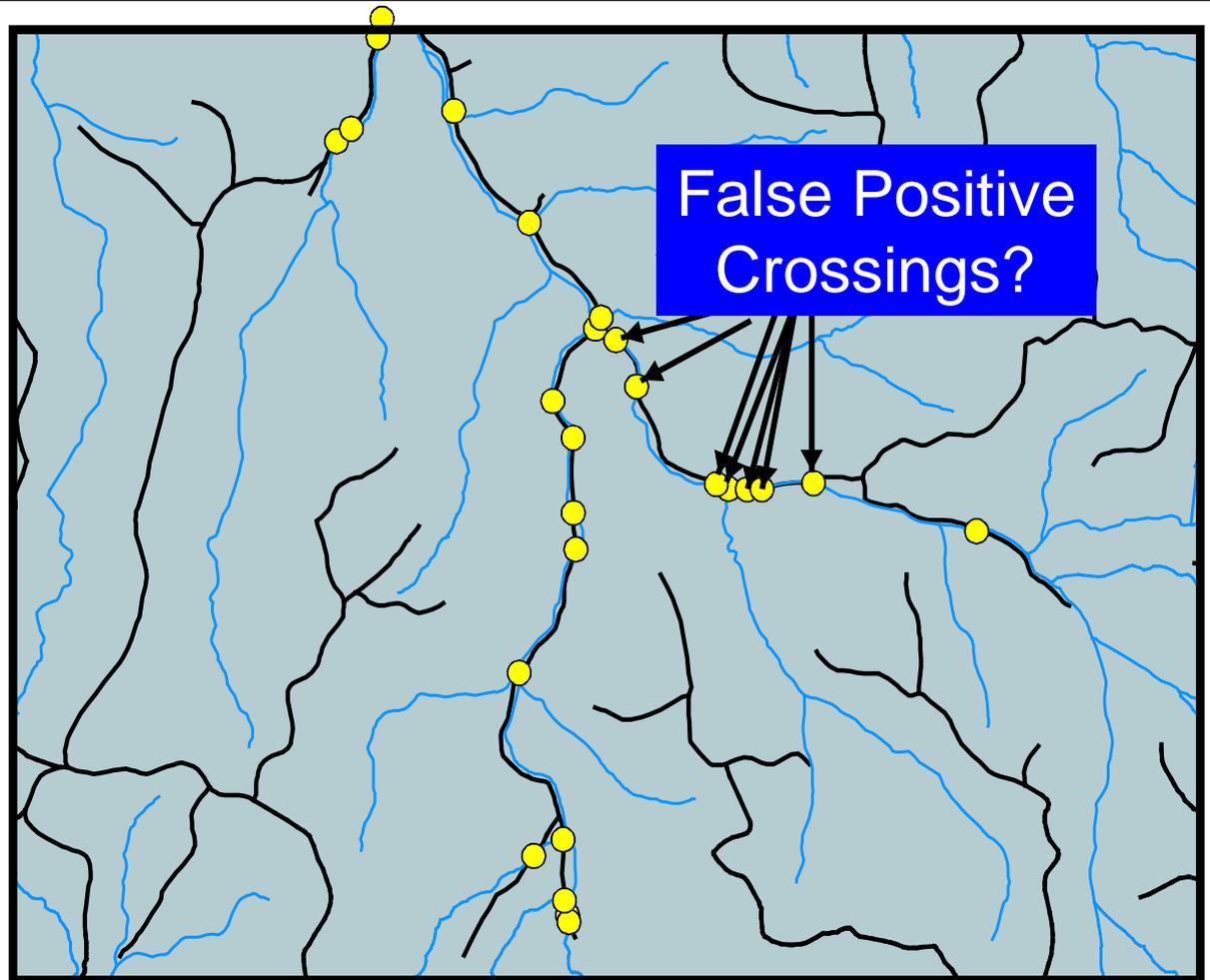
1,441 unmapped



# Some crossings may not be crossings

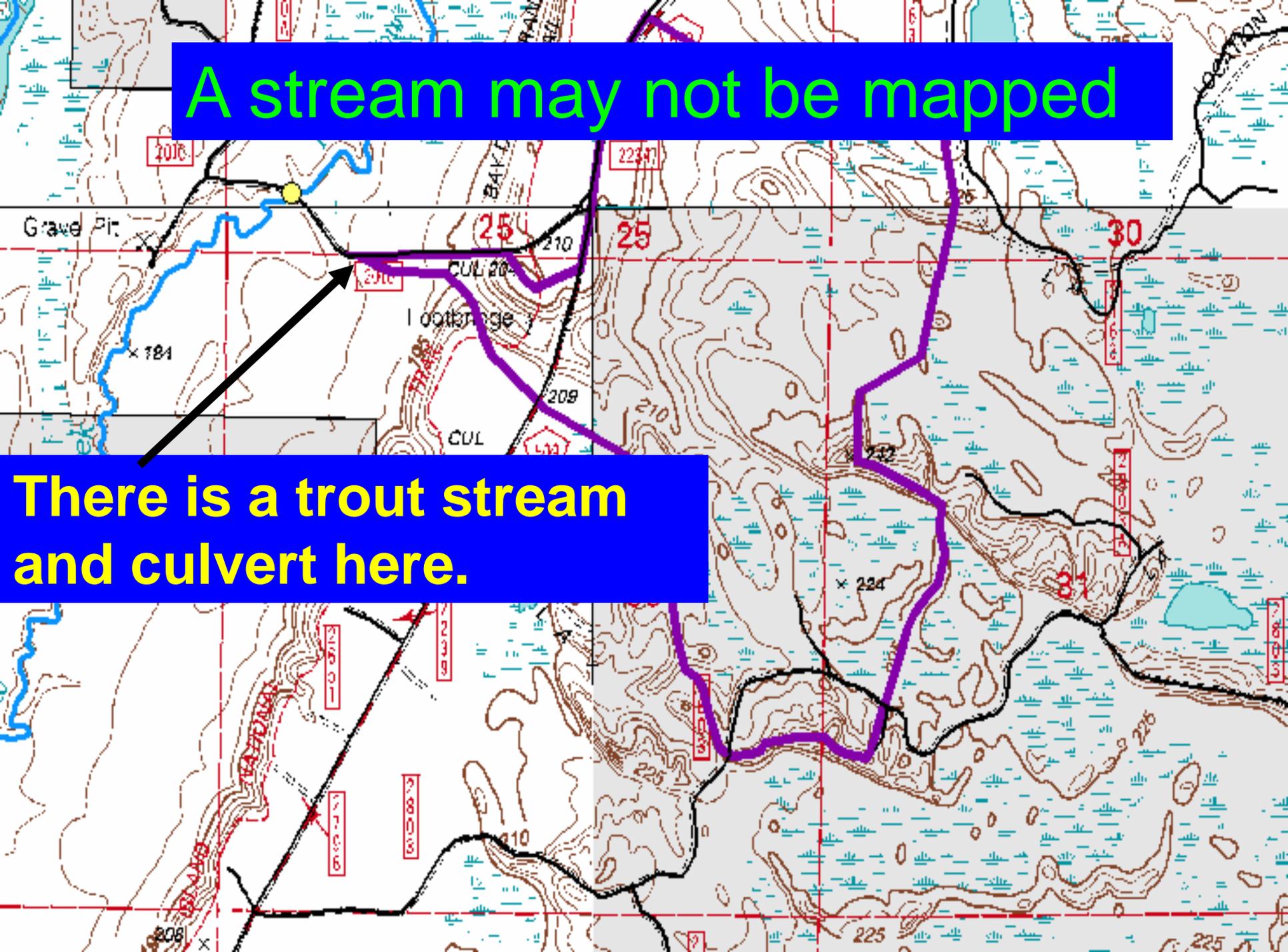
## Legend

-  National Forest
-  Watersheds
-  Watershed 7140102040
-  Clip FS Roads
-  Clip FS Streams
-  FS\_crossings



**A stream may not be mapped**

**There is a trout stream and culvert here.**



# Inventory & Assessment

## ■ Goals:

- What kinds of problems are out there?
- How bad are they?



# Two tier approach to inventory

- Tier 1– Rapid assessment (volunteers)
- Tier 2 – More in-depth (more equipment and skills required)



# Two tier approach to inventory

- Tier 1– Rapid assessment (volunteers)
- Tier 2 – More in-depth (more equipment and skills required)





Communication plan, first aid kit,  
sunscreen, insect repellent, water,  
knowledge of safety hazards.

# Data Collection

## Stream Crossing Data Sheet

Site ID: \_\_\_\_\_

### General Information

Stream Name: \_\_\_\_\_ Road Name: \_\_\_\_\_

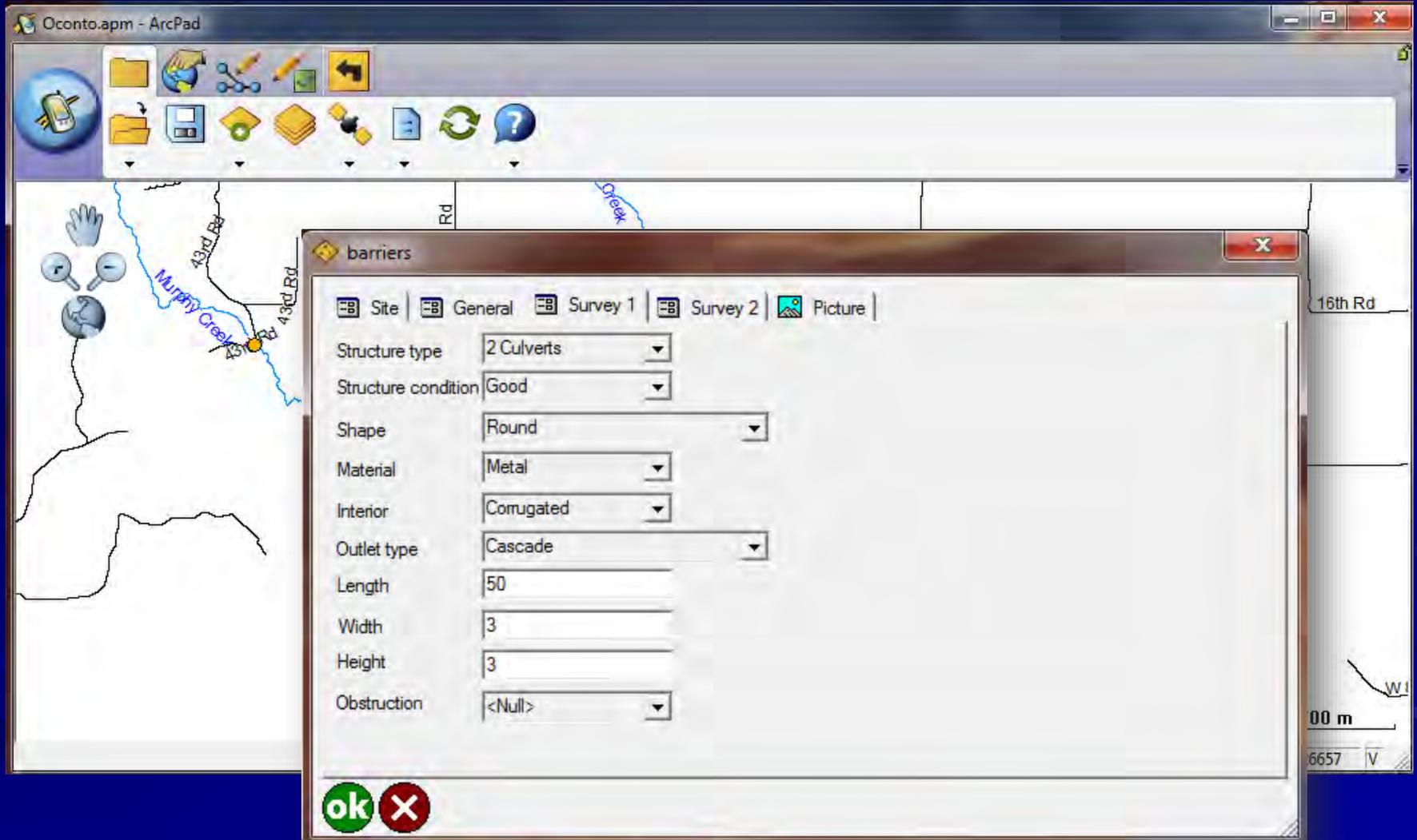
Name of Observer(s): \_\_\_\_\_ Date: \_\_\_\_\_

GPS Waypoint: \_\_\_\_\_ GPS Lat/Long: \_\_\_\_\_

County: \_\_\_\_\_ Township: \_\_\_\_\_ Range: \_\_\_\_\_ Sec: \_\_\_\_\_

Adjacent Landowner Information: \_\_\_\_\_ Additional Comments: \_\_\_\_\_

# Data Collection



# Site sketch



# Database

Site ID	1926-6918	Stream	Little Fishdam River	Road	Garden Grade Rd	Date	09/06/2012
Outcome	Survey 2	Structure type	1 Culvert	Surveyed by	DNR		
Road type	Road	Shape	Round	Owner	Michigan town		
Road surface	Gravel	Material	Metal	Passability	0		
Road width	11 ft	Length	32 ft	Pass Method	Outlet drop		
Scour pool	Yes	Width	3.5 ft	April flow	4.62 cfs		
Upstream pond	No	Height	3.5 ft	Cost	\$68,246		
Obstruction		Measured velocity	1.4 ft/s	Rank	27		
Condition	Fair	Modeled velocity		Habitat Gain	103.7 acres		
Bankfull width	9 ft	Outlet drop	1.3 ft	Outlet type	Freefall		

## NOTES:

second smaller rusted out culvert must carry water, see "other" photo

OUTLET



INLET

No Image Available

# Quick assessment metrics

- Outlet drop
- Compare culvert geometry and hydraulics to natural channel
  - Water velocity
  - Water depth
  - Structure width
- Substrate?

0

# Estimating passability

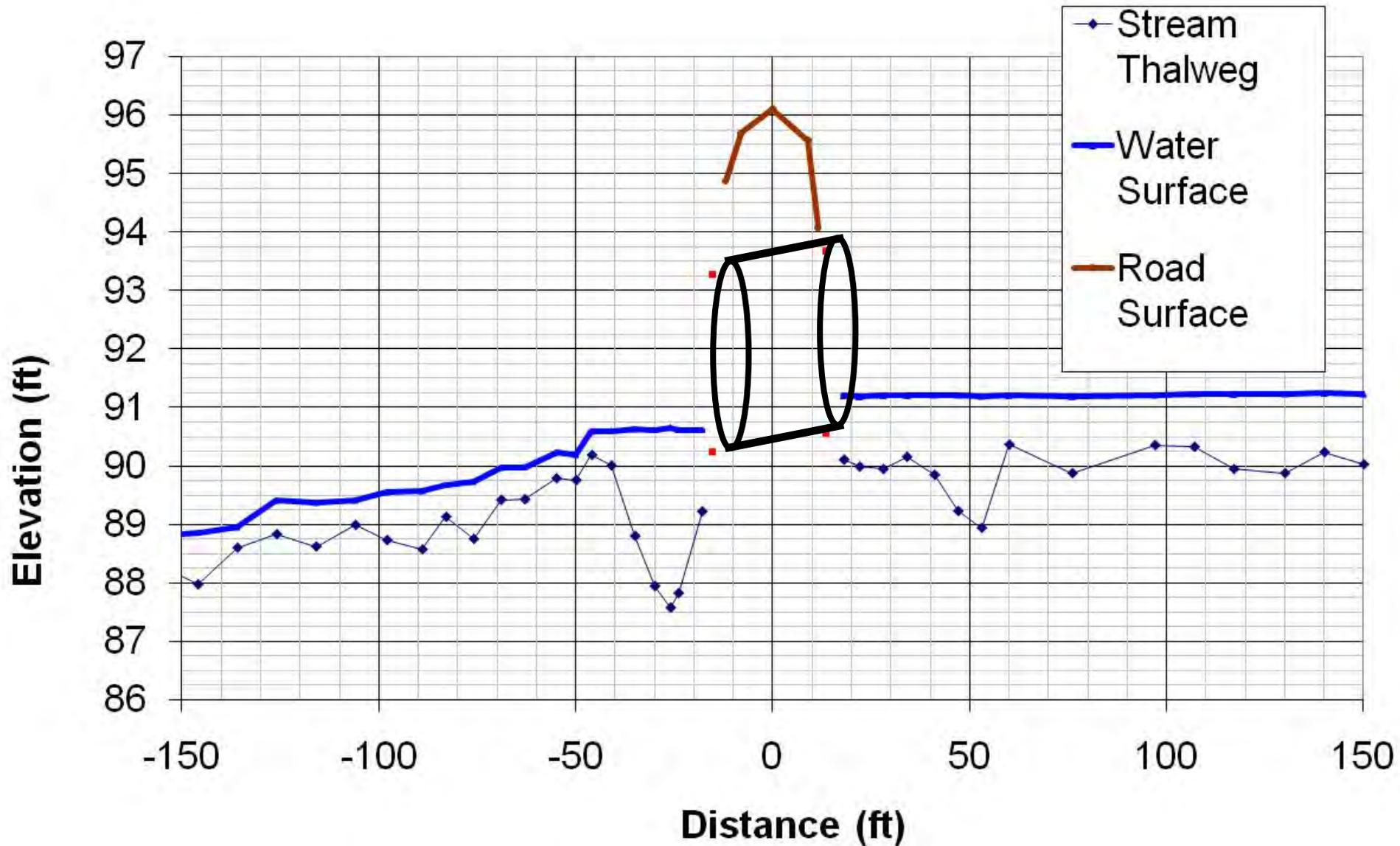
0.5



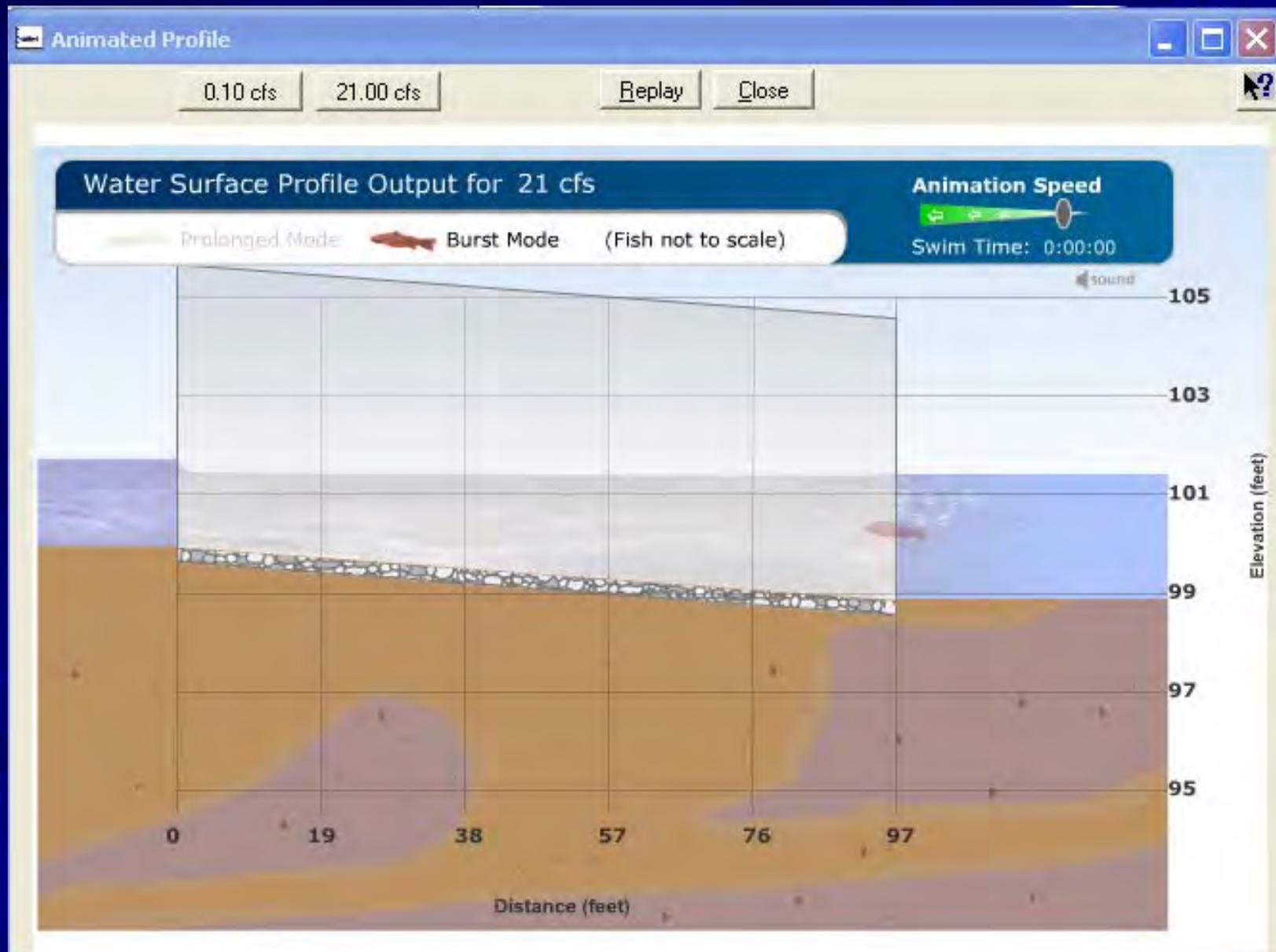
0.9

1

# Tier 2 assessment



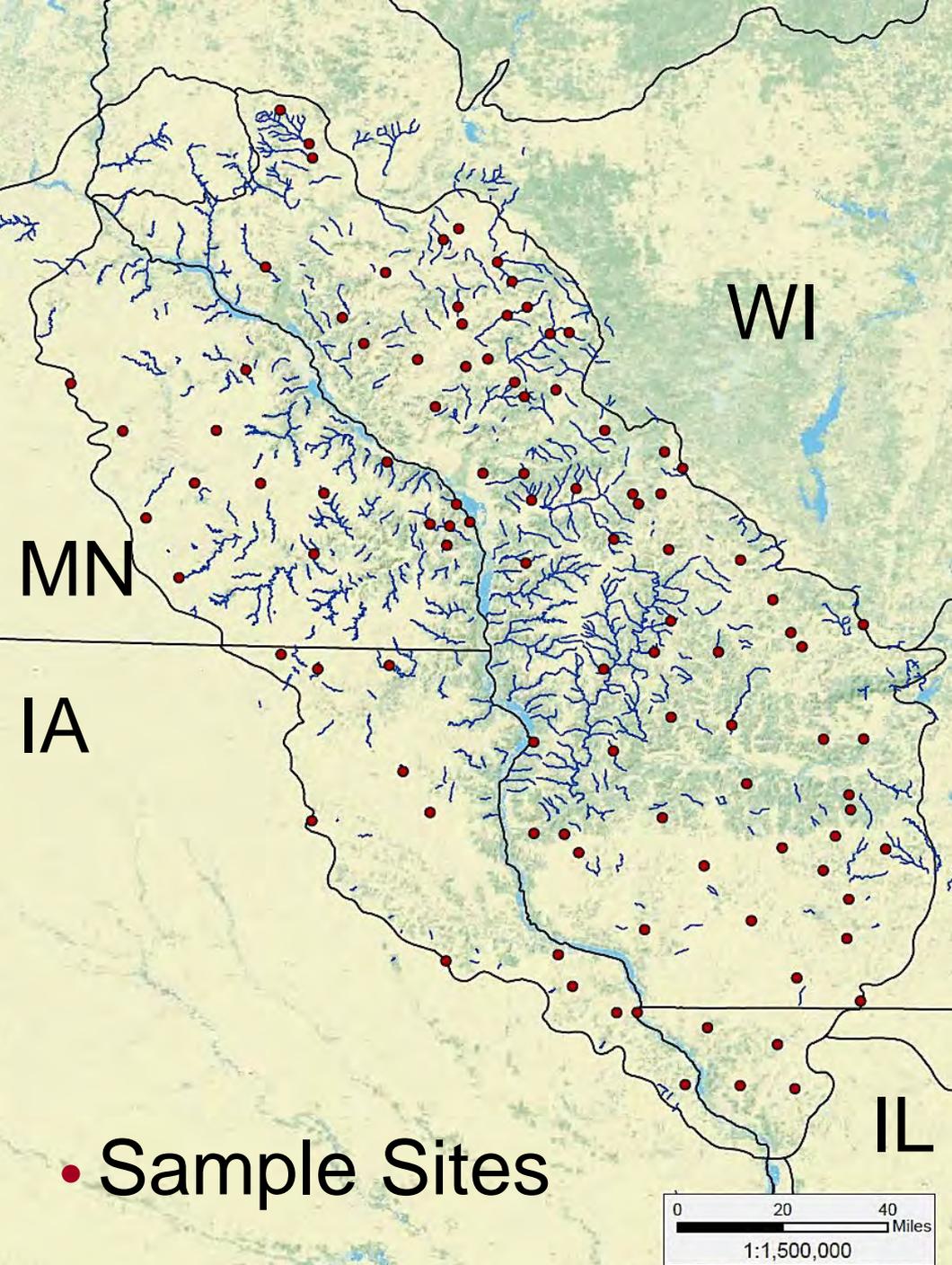
# FishXing <http://stream.fs.fed.us/fishxing/>



# Driftless Area Stream Crossing Survey

## Sampling Design:

- 8,660 intersections of NHD streams and TIGER roads
- n = 100 (perennial)
- Probabilistic





## Complete Barriers:

- 10% of culvert sample
- 2% of bridge sample



# Partial Barriers:

(> 30' long, no substrate)

- 49% of culvert sample
- 2% of bridge sample

# Partial Barriers:

(Water Velocity 2-3 fps)

- Bridges 17%
- Culverts 5%



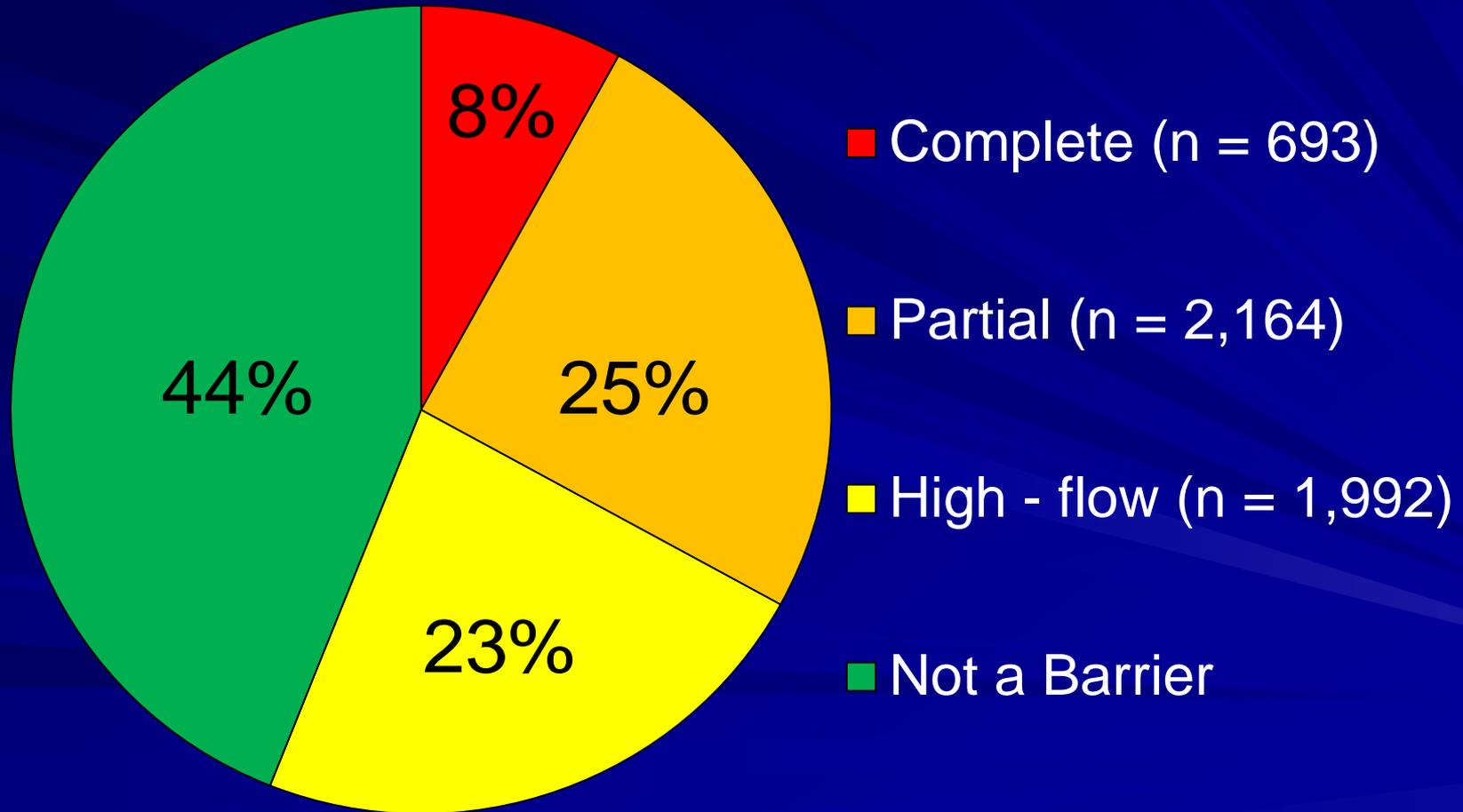


## Temporary (High Flow) Barriers:

- Culverts: 33% of sample
- Bridges: 24% of sample

# Roadway Barrier Proportions and Total Number Estimates

(8,660 Crossings in Driftless Area)

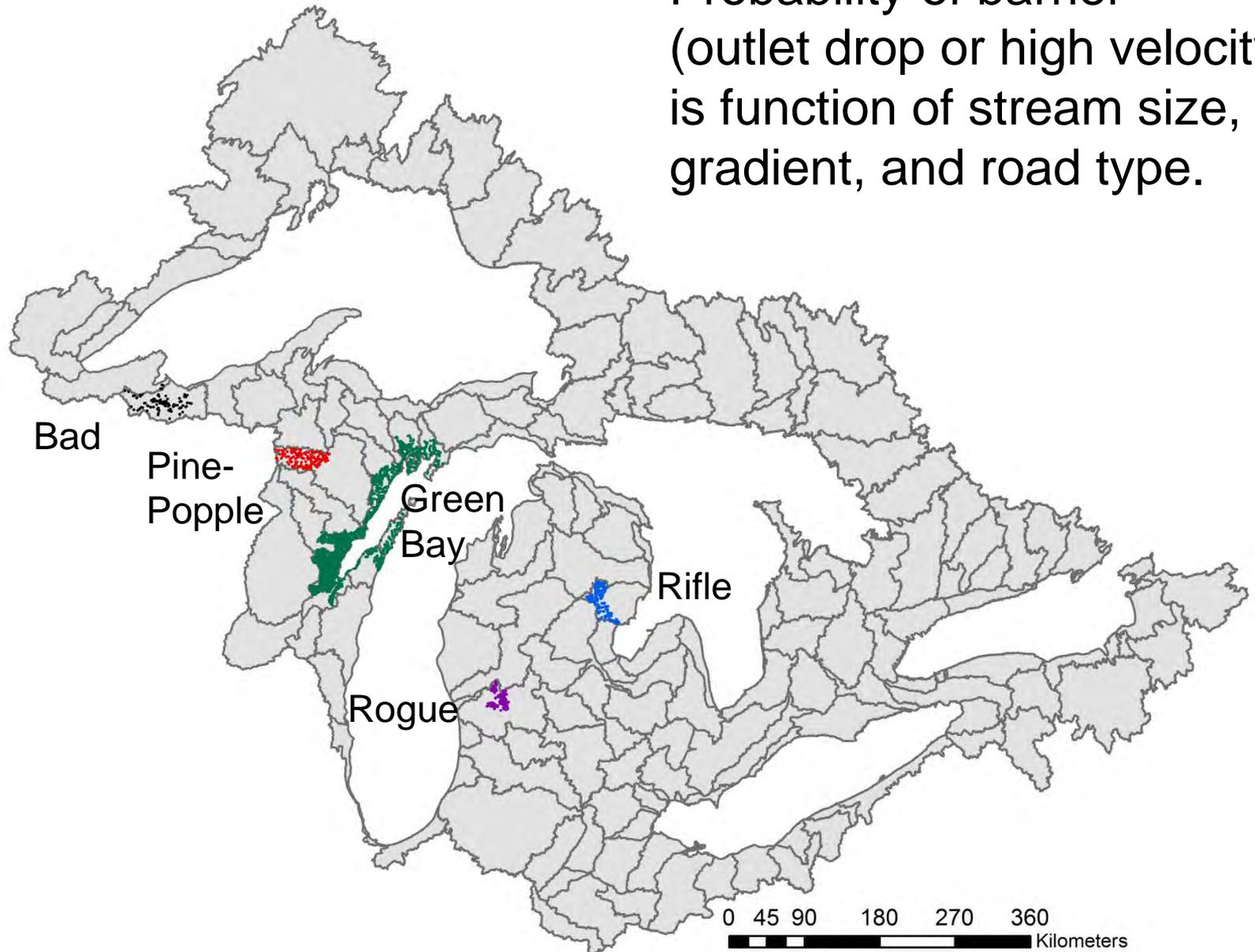


# Prioritization

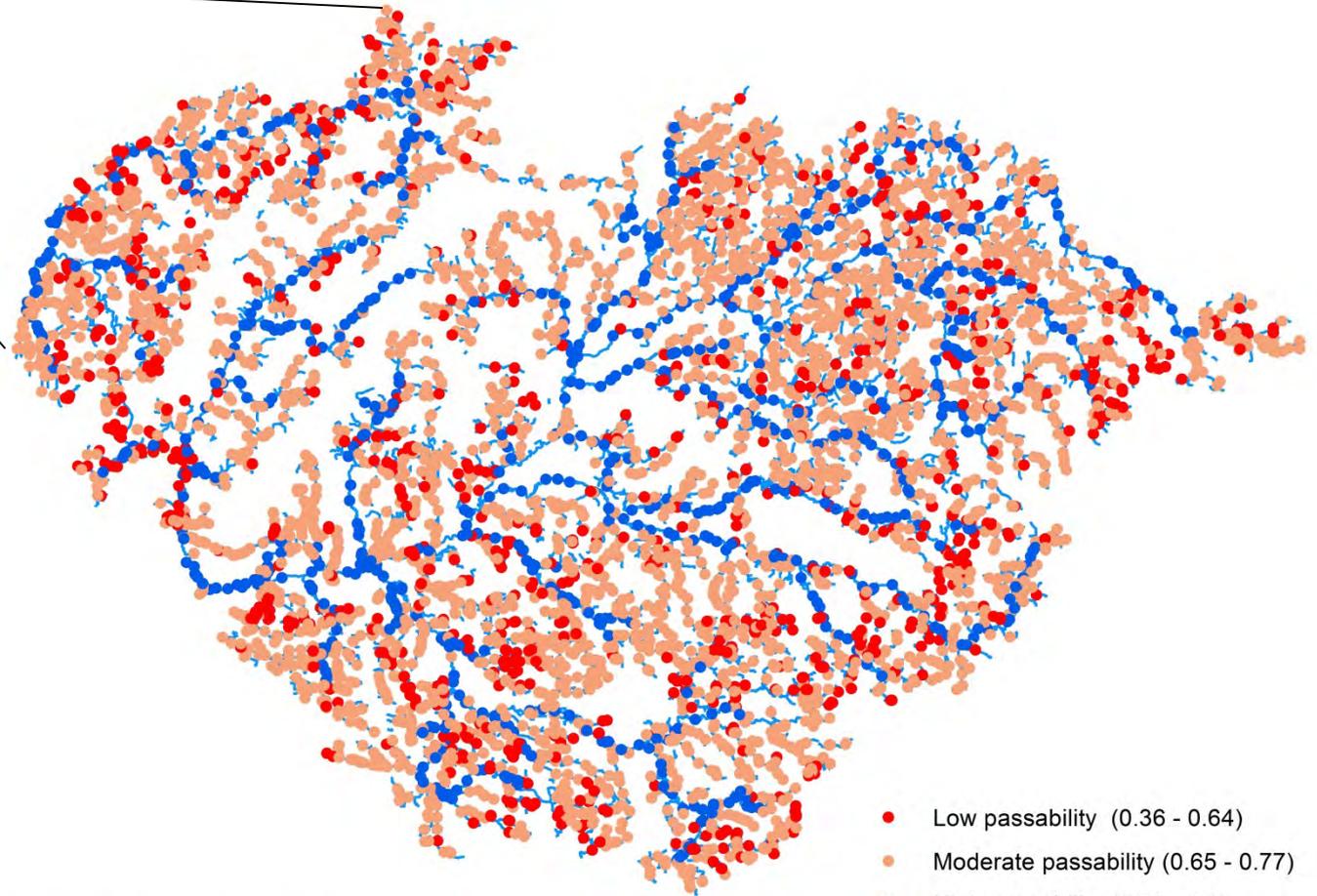
- Screening tools
  - Passability model
  - LiDAR assessment
- Selecting projects
  - Factors to consider
  - Tools

# Passability Model

Probability of barrier  
(outlet drop or high velocity)  
is function of stream size,  
gradient, and road type.



# Passability Model



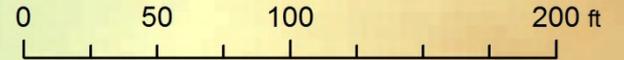
0 5 10 20 30 40  
Kilometers

- Low passability (0.36 - 0.64)
- Moderate passability (0.65 - 0.77)
- High passability (0.78 - 1.0)
- St Joseph river and tributaries

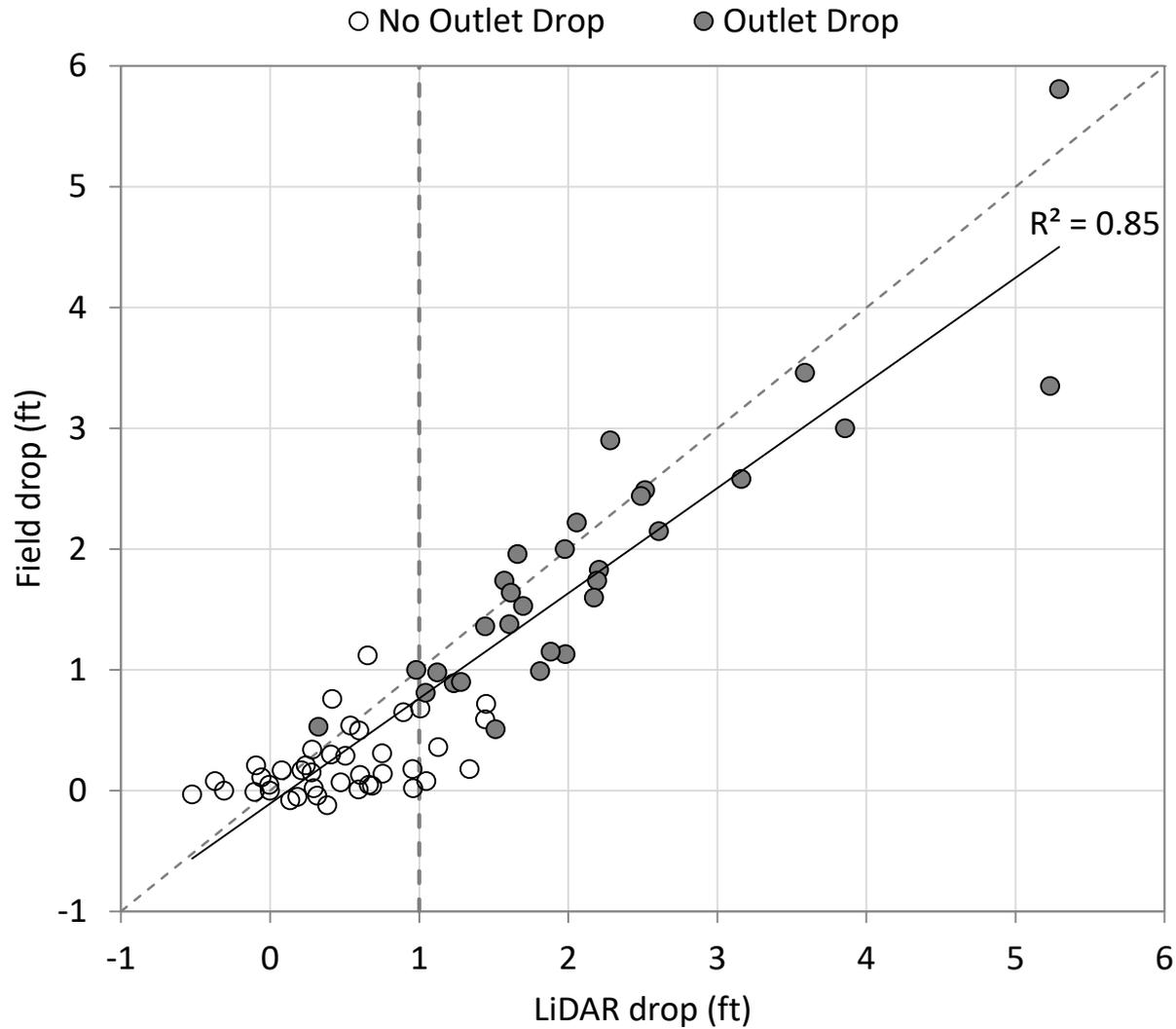
# LiDAR Screening

899.5 ft

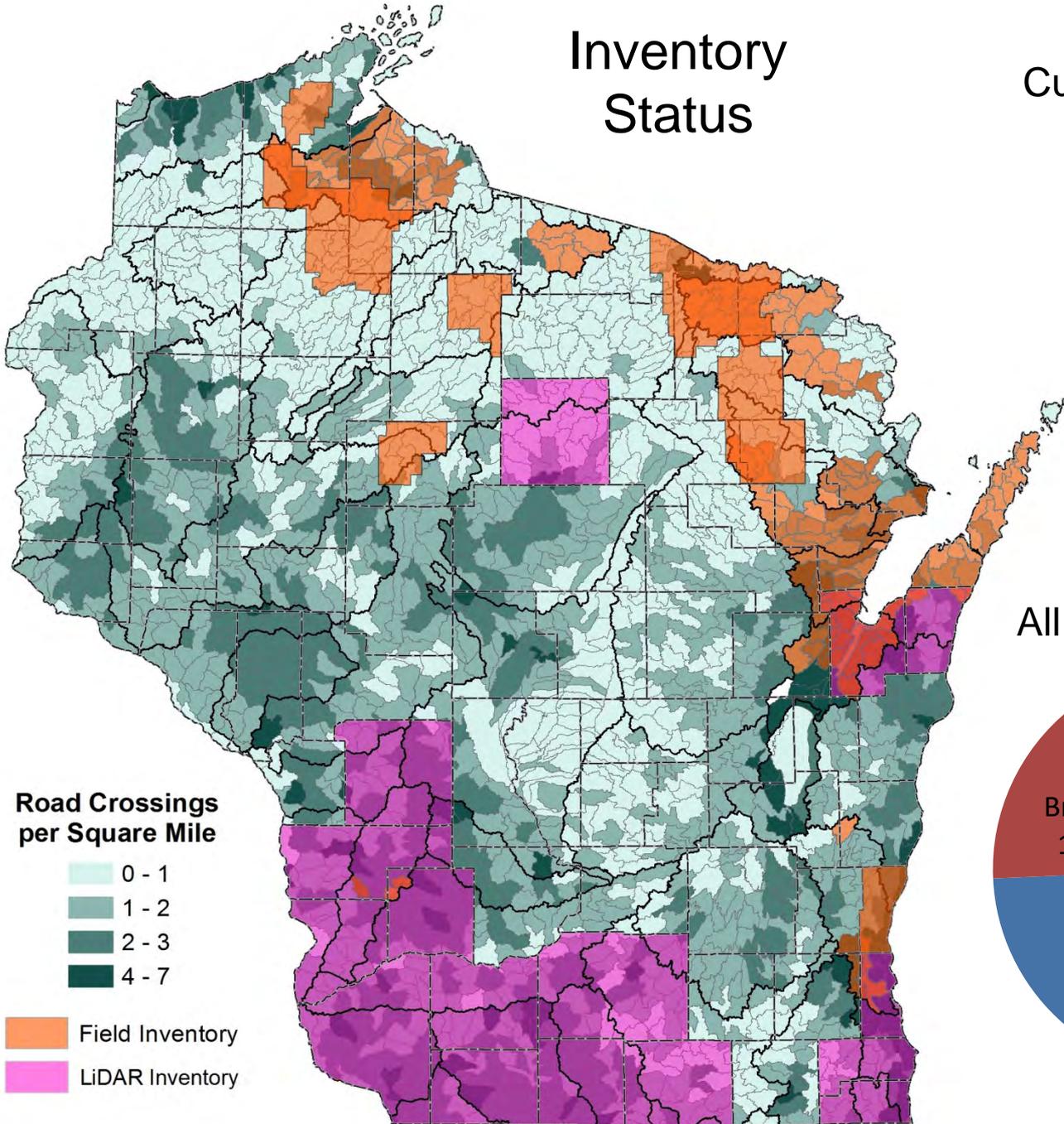
896.0 ft



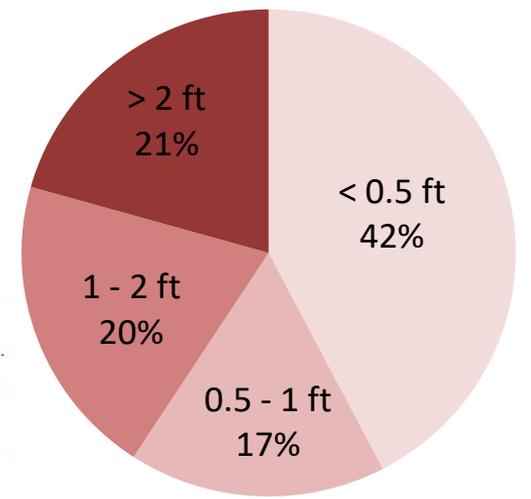
# Accuracy of LiDAR Assessment



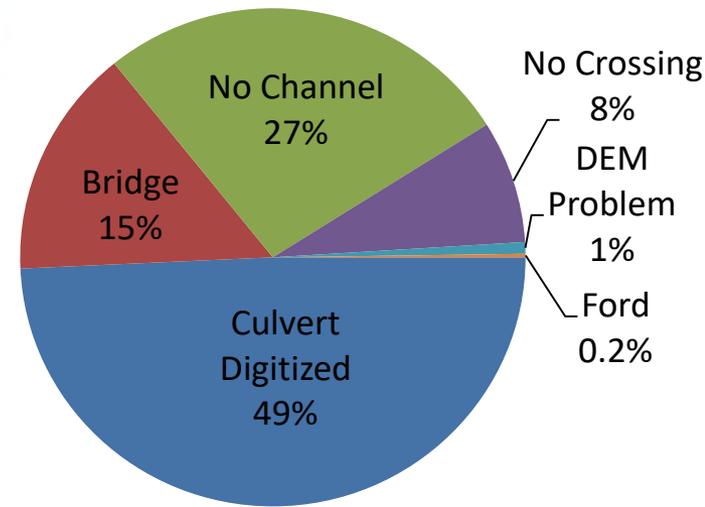
# Inventory Status



## Culvert Vertical Drop (8,760)

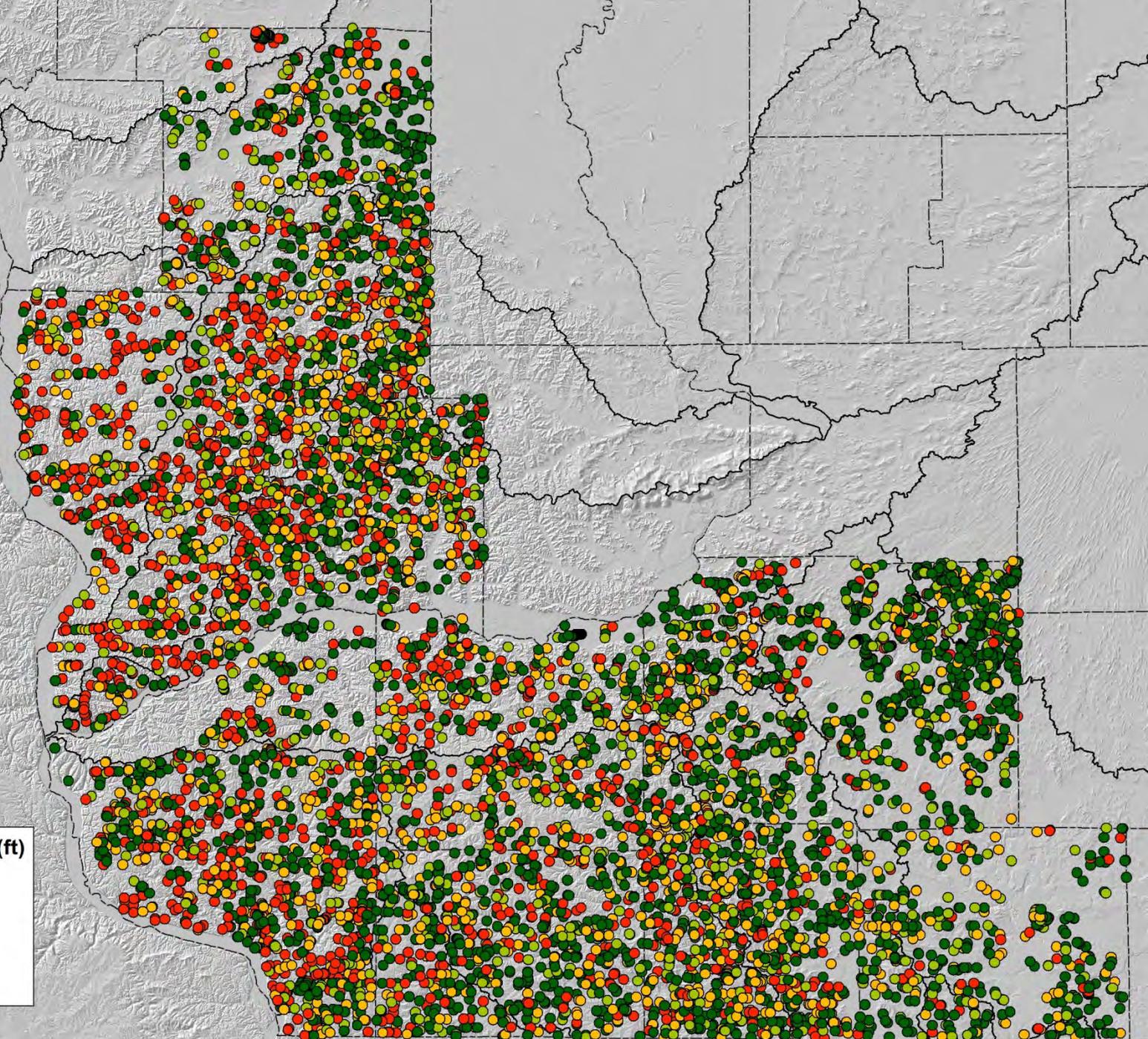


## All Road Crossings (19,420)



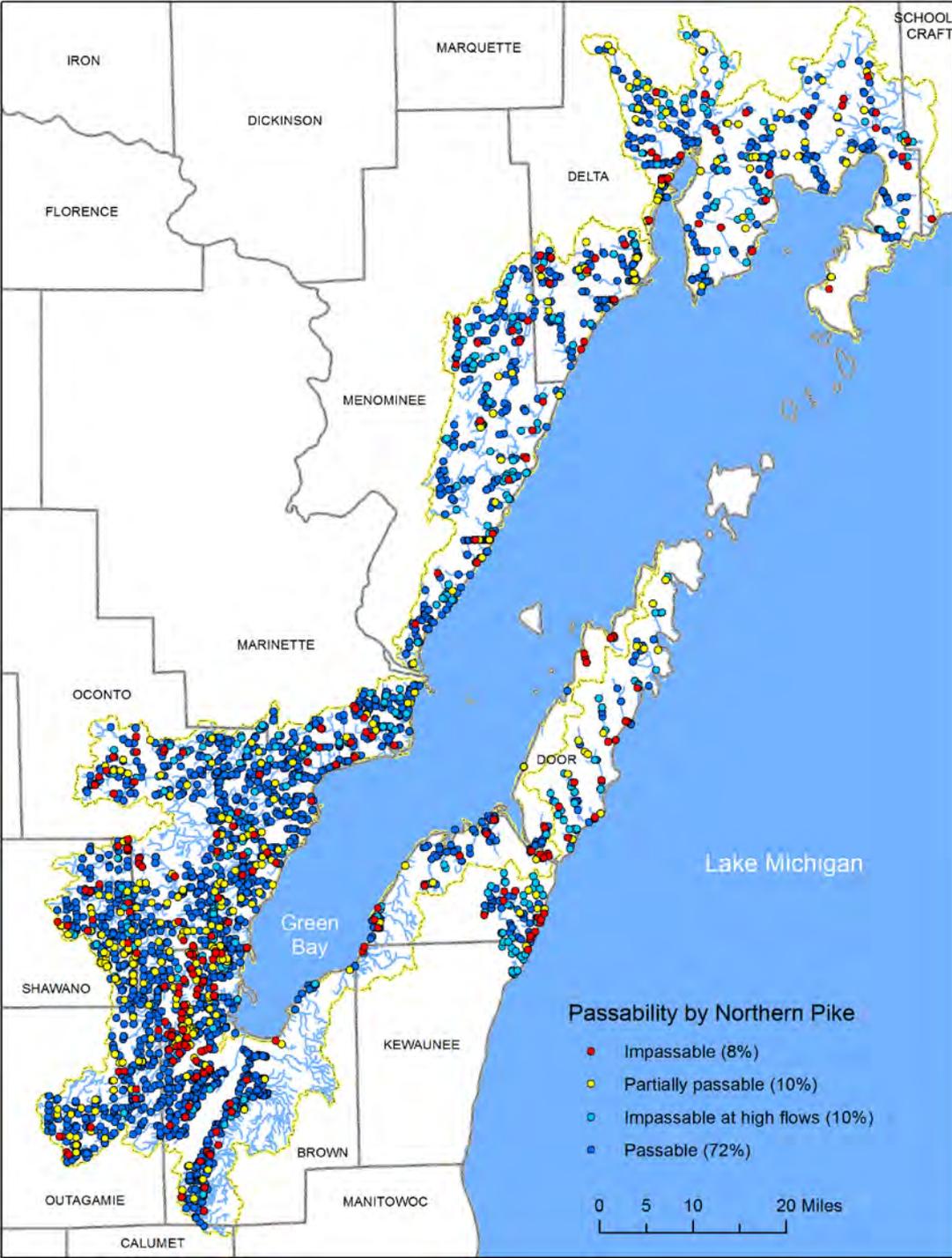
**Elevation Drop (ft)**

- < 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- > 2

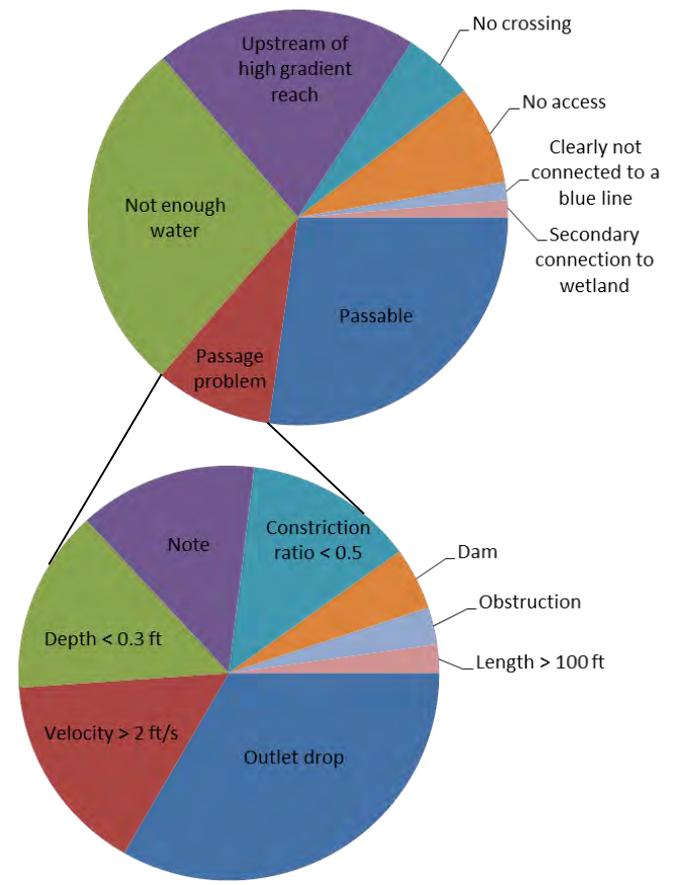


# Comparison of Methods

Criteria		Fish Xing	Field Surveys	LiDAR	Statistical Model
Accuracy	Passability	Highest	High	Moderate-High	Low-Moderate
	Cost	Highest	High	Moderate-High	Low-Moderate
Speed		1 site/day	20 sites/day	200 sites/day	Completed for all RSX in GL Basin
Completeness		Depends on methods used to identify crossings for field surveys		Highest	Moderate
Other		Estimate how passability varies with flow	Identify defined channels / fish habitat		Evaluate landscape factors that influence passability
		Identify site-specific factors that influence replacement cost		Condition DEM for hydrography development	



# Need for Prioritization



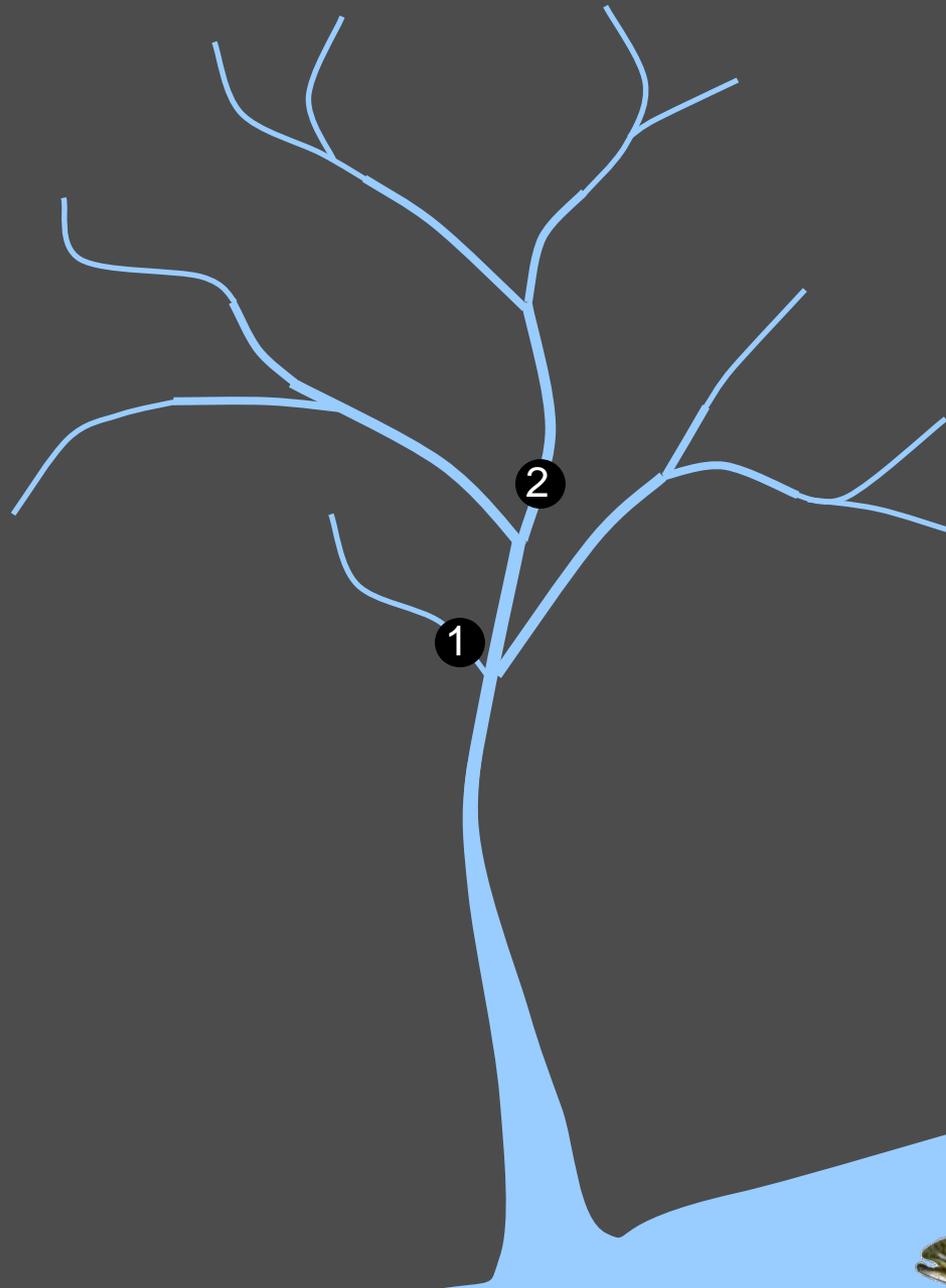
Habitat Quantity

Habitat Quality

Habitat Type

Migration Distance

Natural Barriers



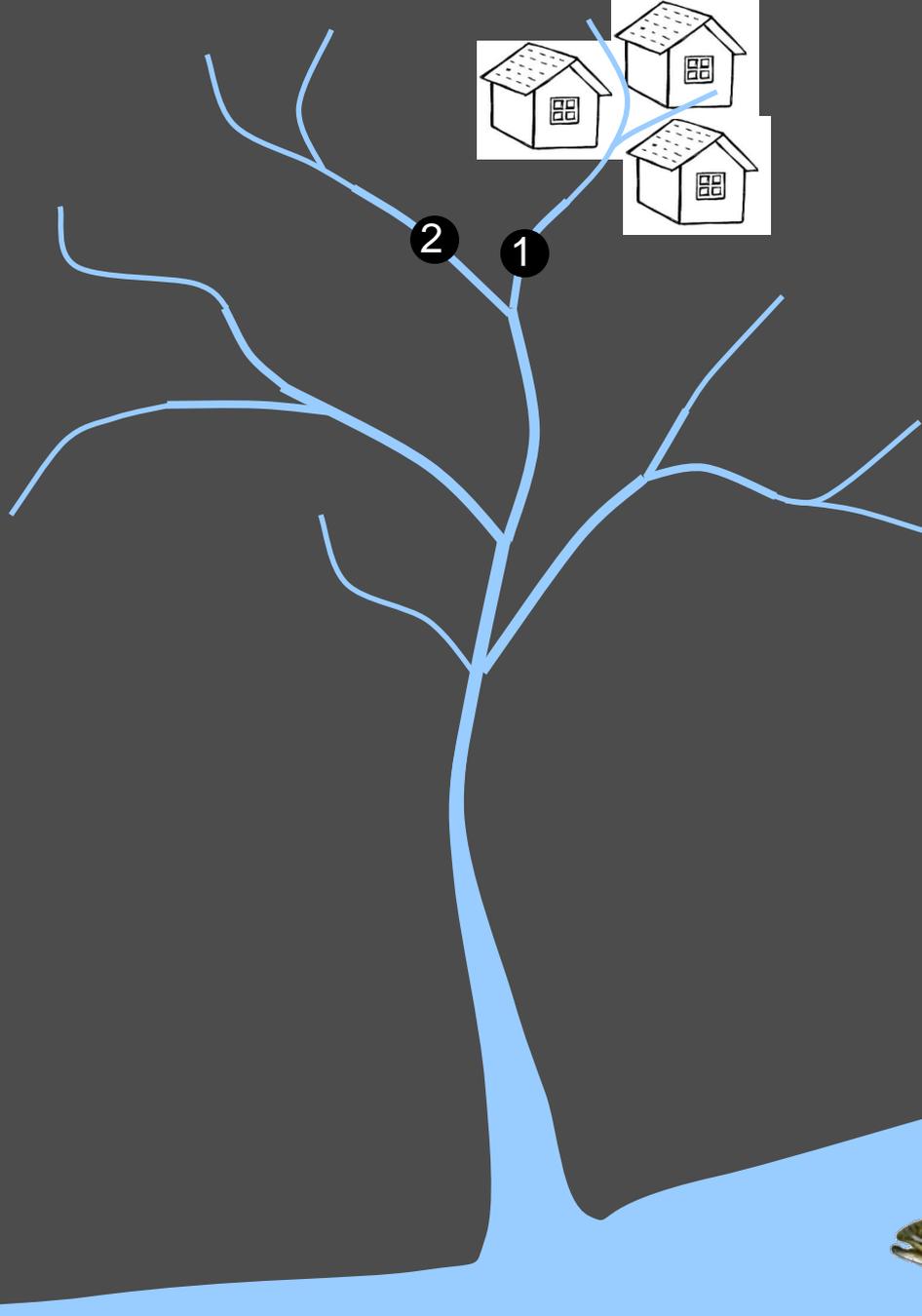
Habitat Quantity

Habitat Quality

Habitat Type

Migration Distance

Natural Barriers



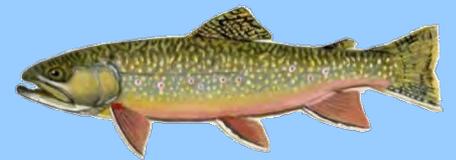
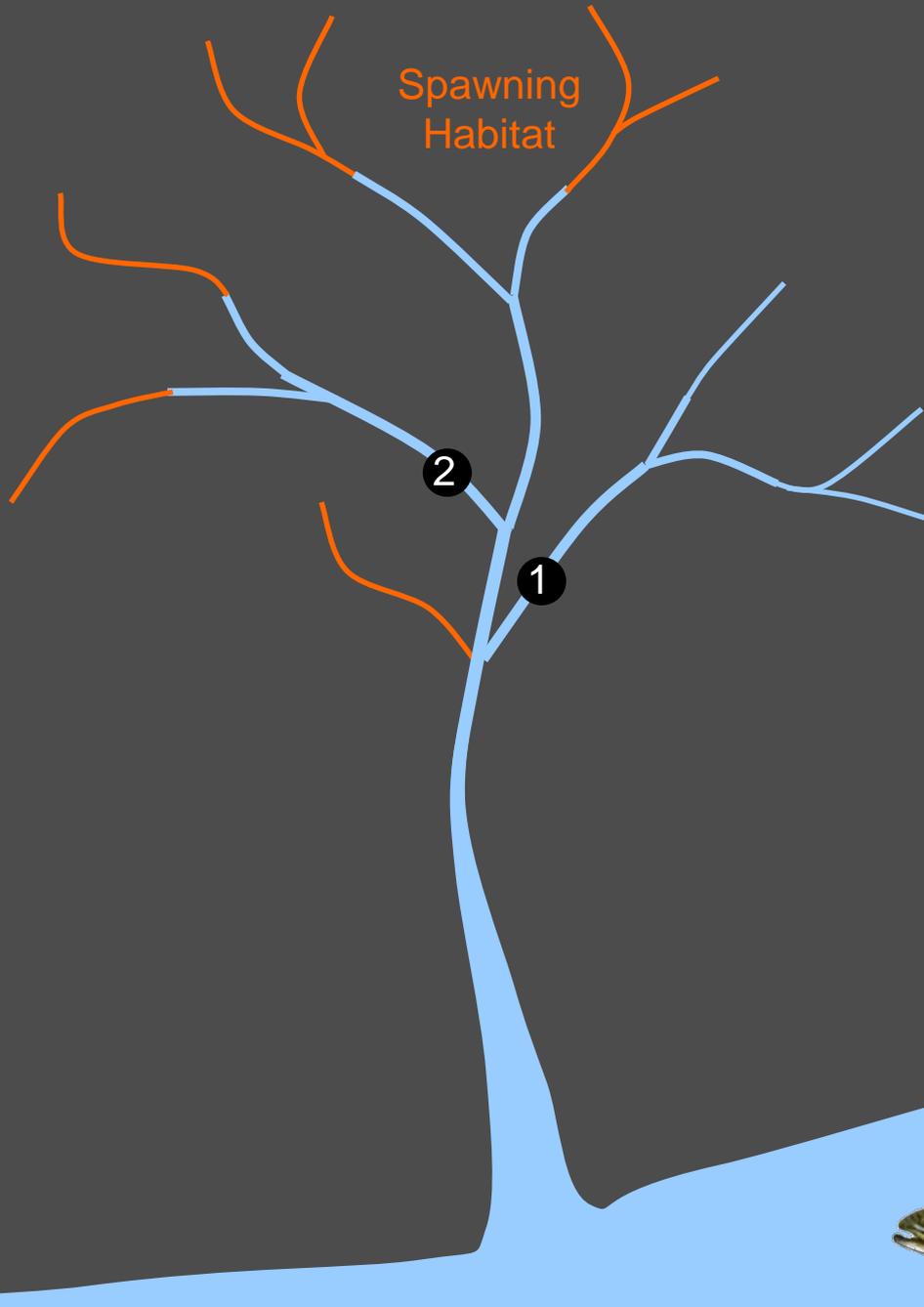
Habitat Quantity

Habitat Quality

Habitat Type

Migration Distance

Natural Barriers



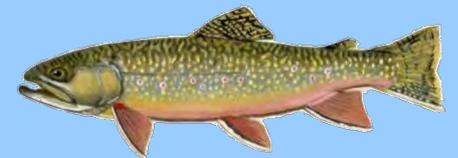
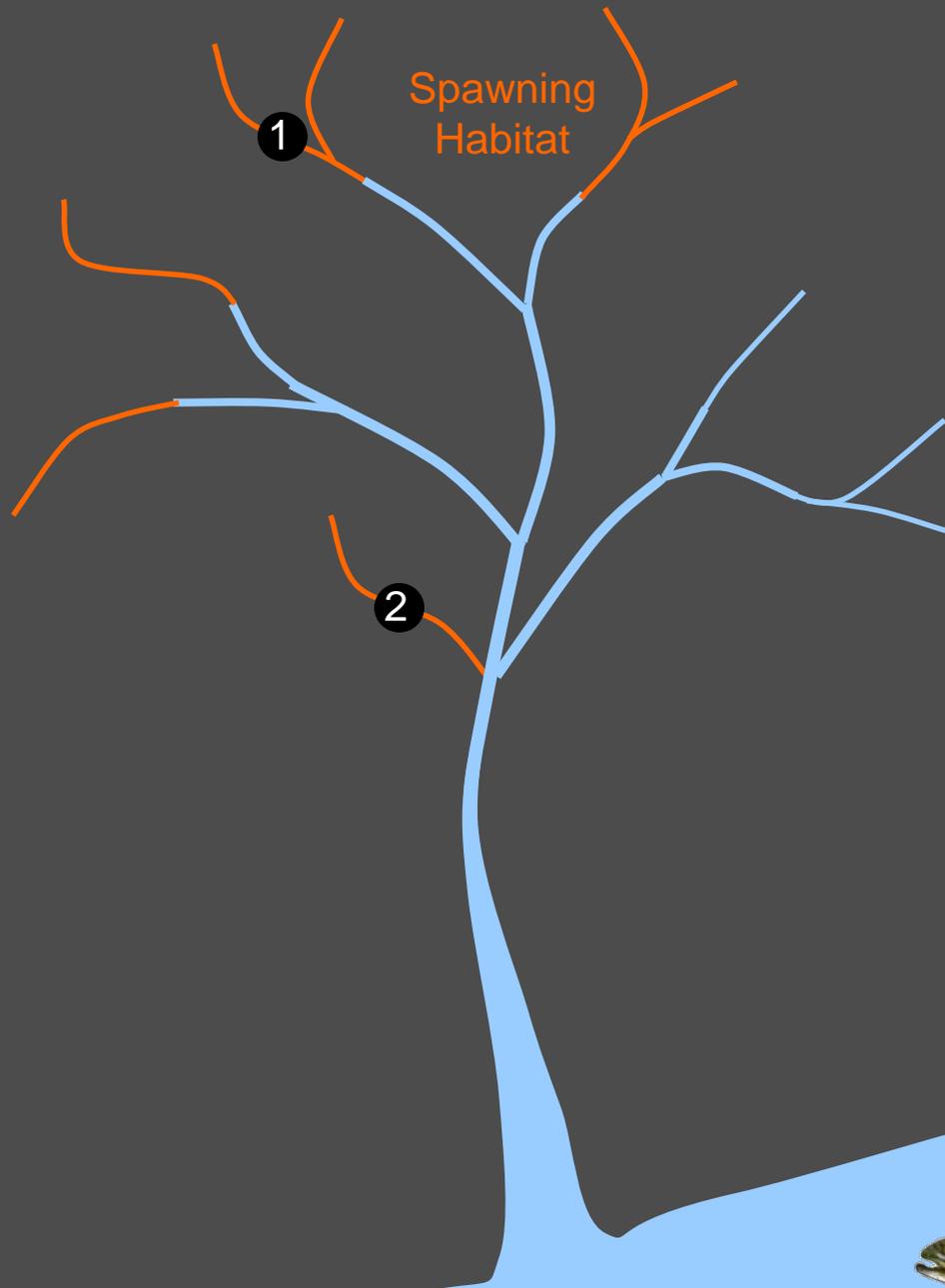
Habitat Quantity

Habitat Quality

Habitat Type

Migration Distance

Natural Barriers



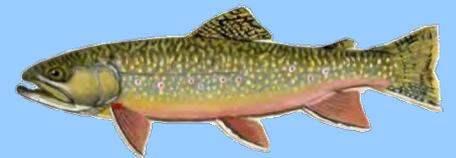
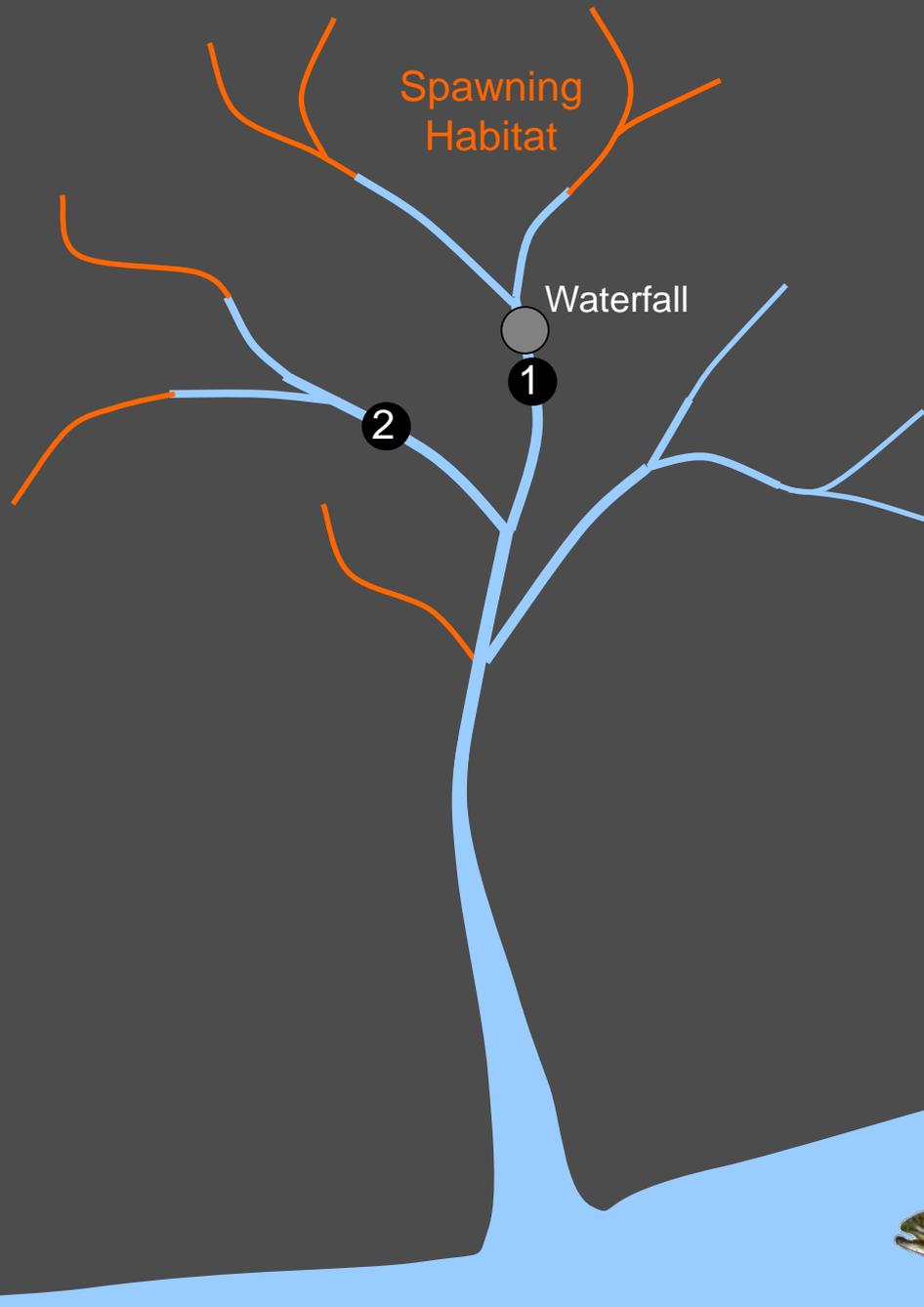
Habitat Quantity

Habitat Quality

Habitat Type

Migration Distance

Natural Barriers



# OptiPass

- ArcGIS Toolbox (10.1)
- Recommends a set of projects to maximize increase in accessible habitat for a given budget
- Developed by The Cadmus Group, Inc., and Ecotelligence, LLC for The Nature Conservancy
- Input requirements
  - Barriers
    - Passability
    - Cost to replace/remove
  - Streams
    - Quality index
    - Habitat type

# Online decision support tool

[www.greatlakesconnectivity.org](http://www.greatlakesconnectivity.org)

The screenshot displays the Fishworks web application interface, which is divided into several functional panels:

- Filter Barriers:** A sidebar on the left with filters for Removal Cost Per Barrier, Passability Rating, Upstream Habitat, Great Lake Basin, Counties, Watersheds, State / Province, Nation, Barrier Type, First Barrier, and Barrier ID.
- View Barriers:** A central map of the Great Lakes region with a black box labeled "Visualize" overlaid on it.
- Construct Scenario:** A table at the bottom left for creating scenarios, with a black box labeled "Scenarios" overlaid on it.
- Inspect Barrier Attributes:** A table at the bottom center showing barrier details, with a black box labeled "Inspect" overlaid on it.
- View Scenario Results:** A panel on the right showing a table of scenario comparisons, a bar chart of habitat change, and a table of removed barriers, with a black box labeled "Results" overlaid on it.

**View Scenario Results Table:**

Compare	Scenario Name	Total Cost	Habitat (km)	Date
<input type="checkbox"/>	UNMODIFIED / DEFAULT	\$0.00	0.0	2014-01-01
<input type="checkbox"/>	test1	\$8,927,594.15	143,679.5	2015-01-21
<input checked="" type="checkbox"/>	county_all	\$987,882.13	144,212.1	2015-01-28
<input type="checkbox"/>	county_all2	\$0.00	143,667.2	2015-01-28
<input checked="" type="checkbox"/>	county_all2	\$1,990,509.92	144,274.2	2015-01-28
<input checked="" type="checkbox"/>	county_all3	\$5,369,523.59	144,261.7	2015-01-28

**Quick Summary Table:**

Scenario Name	Count	Total Cost	Habitat (km)
county_all	8	\$987,882.13	144,212.1 km
county_all2	18	\$1,990,509.92	144,274.2 km
county_all3	26	\$5,369,523.59	144,261.7 km

**Change in Habitat (%) Bar Chart:**

Classification	s_0 (%)	s_1 (%)	s_2 (%)
Guild 1	~0.38	~0.42	~0.42
Guild 2	~0.35	~0.38	~0.38
Guild 3	~0.38	~0.42	~0.42
Invasives	~0.38	~0.42	~0.42

**Removed Barriers Table:**

Barrier ID	Nation	Basin	State	Cost	Is Dam	Guild 1	Guild 7	Guild 4	Up Hab
500766	USA	Lake Michigan	Michigan	112969.9399	<input checked="" type="checkbox"/>	0.099539453	0.078336376	0.007512716	1.54717886
519133	USA	Lake Michigan	Michigan	162000	<input type="checkbox"/>	0.034524677	0.866987165	0.760745187	2435.800462
519037	USA	Lake Michigan	Michigan		<input type="checkbox"/>			0.800453774	4431.917709
525593	USA	Lake Michigan	Michigan		<input type="checkbox"/>			0.680228942	2156.562322
518479	USA	Lake Michigan	Michigan		<input type="checkbox"/>			0.658830663	0.055097867
526857	USA	Lake Michigan	Michigan		<input type="checkbox"/>			0.686470216	3309.724572
526856	USA	Lake Michigan	Michigan	300000	<input type="checkbox"/>	0.869122413	0.829495631	0.710370462	3098.046255
526855	USA	Lake Michigan	Michigan	39099.24006	<input type="checkbox"/>	0.662635684	0.648359038	0.584859104	619.6556113
519039	USA	Lake Michigan	Michigan	100000	<input type="checkbox"/>	0.940928511	0.939059385	0.773407575	256.8133055

# Summary

- How many crossings are out there?
  - Use GIS to get an estimate of road/stream crossing numbers and locations
- How many are bad?
  - Simple inventories can be conducted quickly
  - More detailed assessments require surveying skills
- Where do we begin?
  - Prioritization can identify where you can get the most bang for the buck



Questions?