



# Mussel Survey & Relocation at Bridge Projects

**Ryan Holem**  
**GEI Consultants**  
**March 12, 2024**

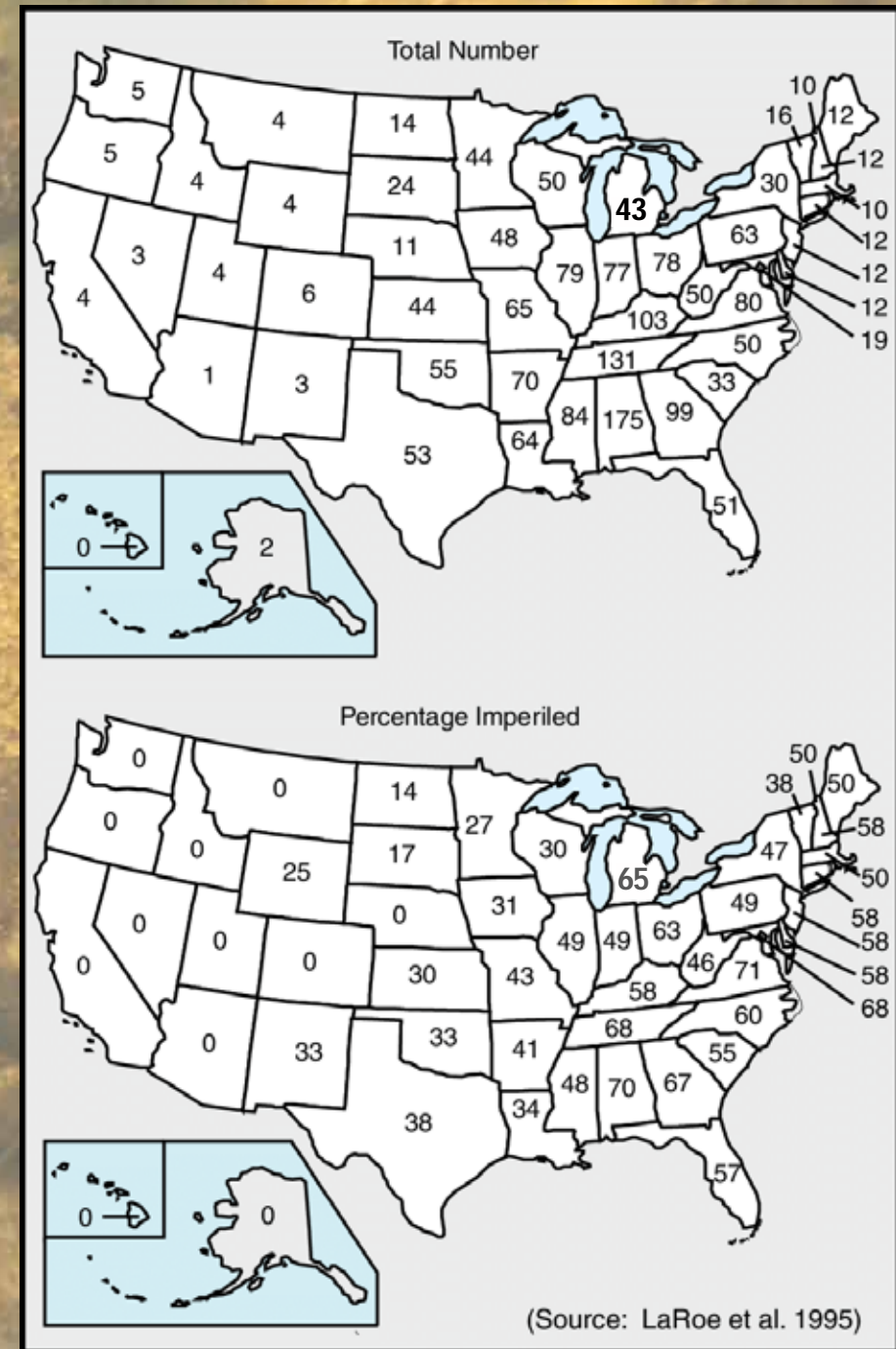
## AGENDA

- Status of mussels in Michigan
- Michigan mussel protocol
- Mussel survey/relocation
- Permitting & schedule
- Tips/lessons learned



# Freshwater Mussel (Unionidae) Population Status

- ~900 species worldwide
- ~300 Species in North America  
(10% extinct, 70% as T/E/SC)
- 43 species in Michigan
  - Fingernail clams (Sphaeriidae), Asian clams (Corbicula) and Zebra/Quagga mussels (Dreissenidae) not included



# Benefits & Threats to Freshwater Mussels

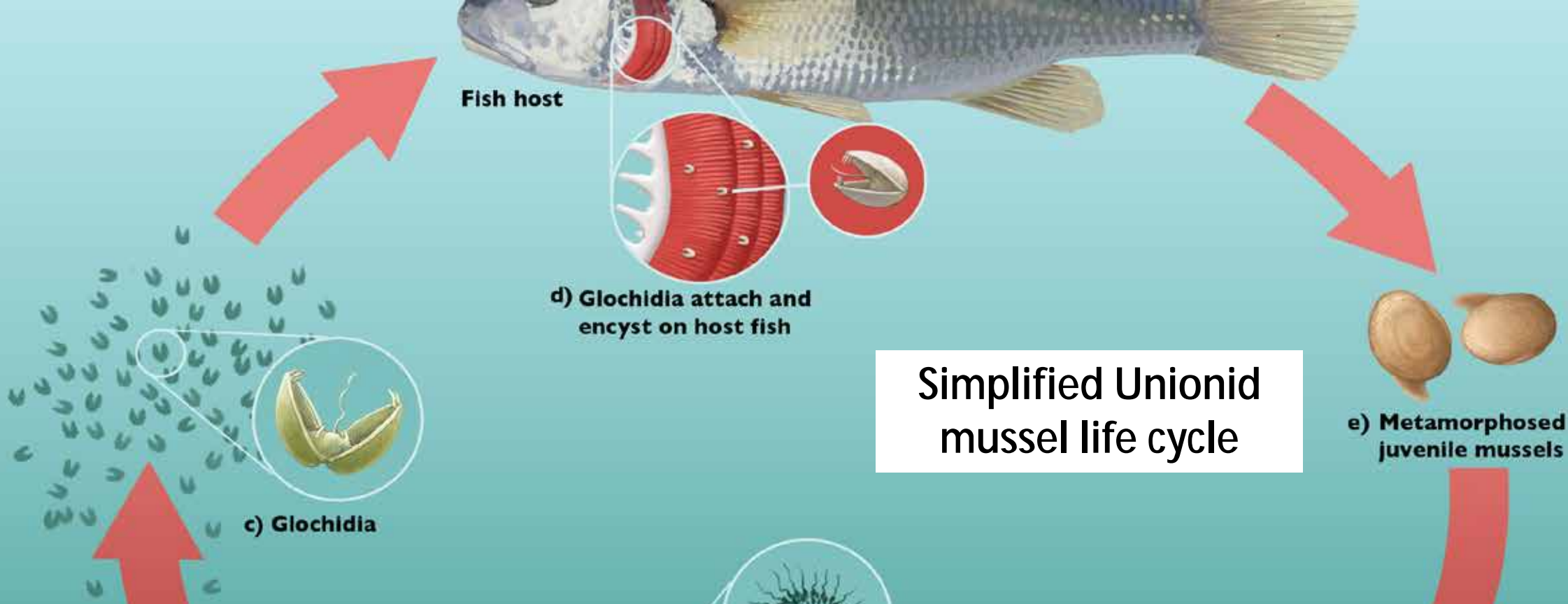
## Benefits:

- Benthic biomass (50-90%) - stabilize river bottom
- Filter large volumes of water
- Habitat creation – fish/invertebrates
- Sequester carbon – several hundred grams/m<sup>2</sup>/year

## Threats:

- Historic harvest for button industry
- Habitat fragmentation (e.g., dams)
- Channelized water courses (e.g., dredging)
- Decreased water quality (↓ DO, ↑ Conductivity)
- Invasive species
- Impacts to host fish!





Fish host

d) Glochidia attach and encyst on host fish

e) Metamorphosed juvenile mussels

c) Glochidia

b) Fertilization and brooding

### Biomimicry via mussel lures



Adult

# Michigan Mussel Protocol



## Projects that may trigger mussel work

### Will your project impact the stream bed?

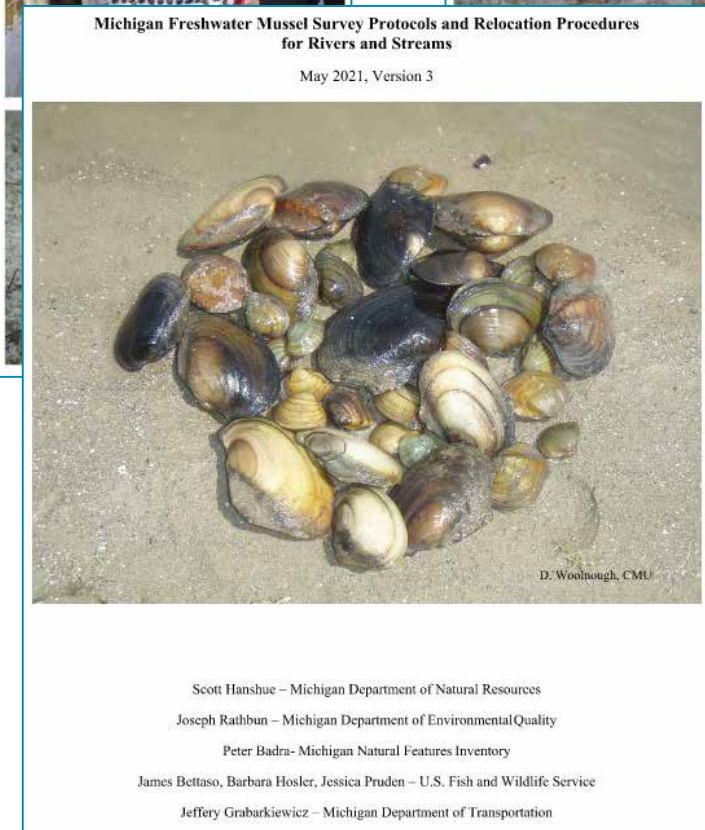
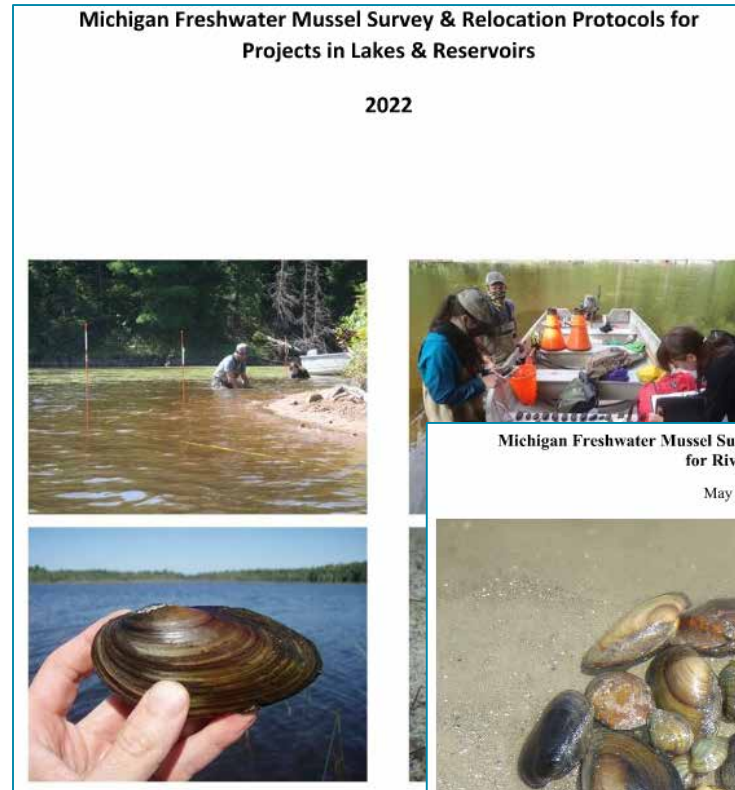
- Any impacts below OHWM of a river or stream may trigger mussel requirements
  - Bridge repair/replacement/scour countermeasures
  - Pipeline/utility crossings
  - Outfall replacement/repair
  - Walkway/boardwalks
  - Railroad crossings
  - Causeways into river for construction
- Reservoir drawdowns
- Dredging projects
  - Marinas, boat slips, contaminated sites

**Mussel survey and relocation window is June 1 – October 15**



# Michigan Mussel Protocol

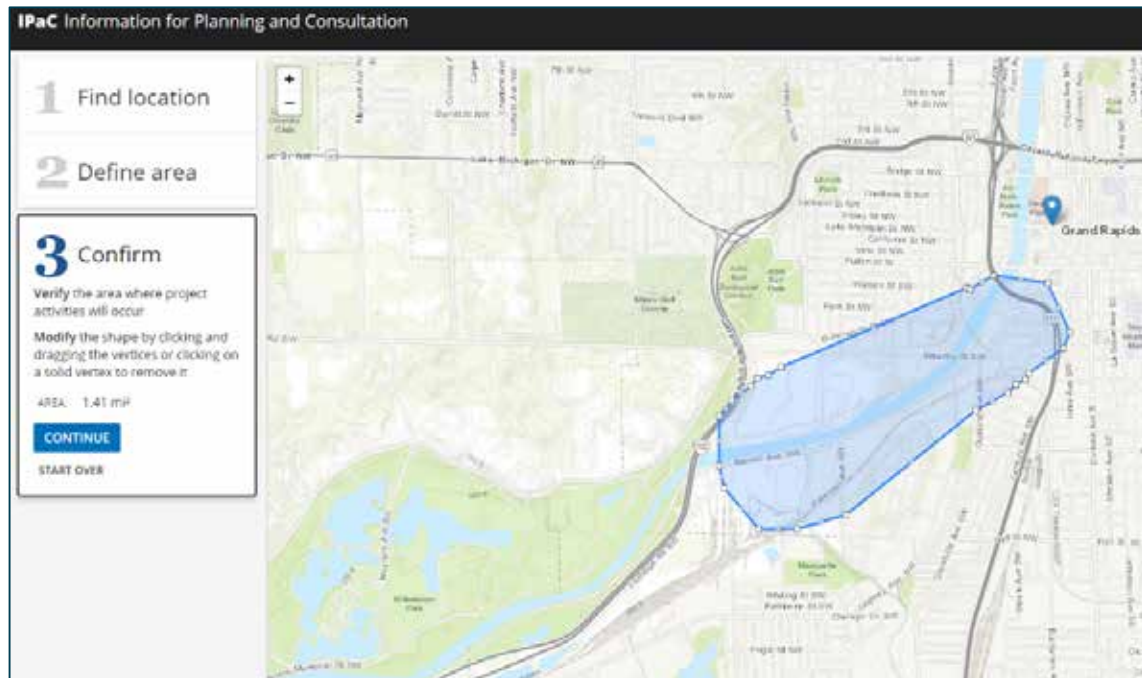
- Three protocol documents for MI
  1. River/Streams (2021)
  2. Lakes/Reservoirs (2022)
  3. Reservoir Drawdowns (2022)
- MI is one of several Midwest states with protocol (OH, WI, MN)
- Growing “baseline” mussel data + protocol = more projects requiring mussel work



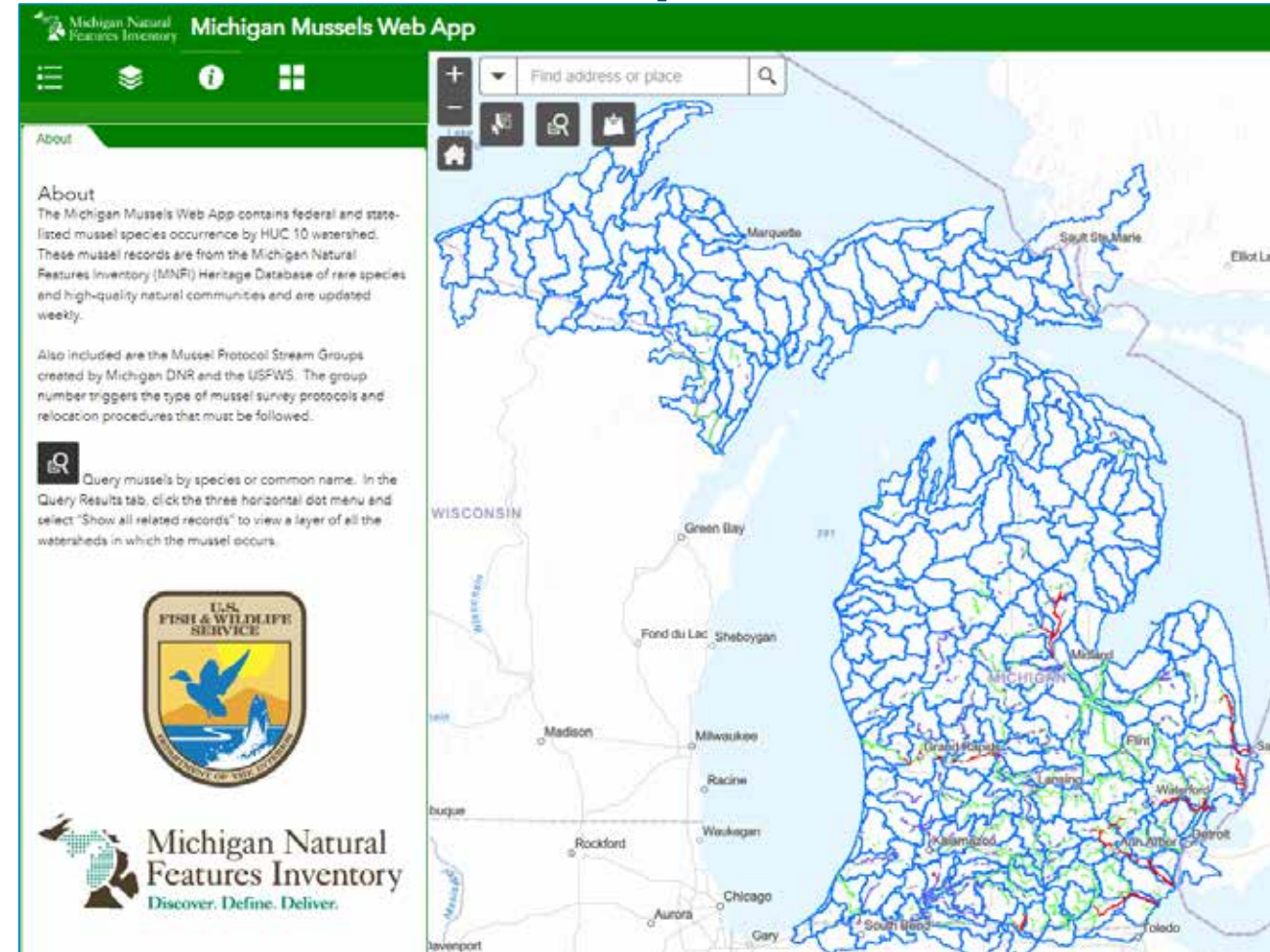


## Useful DIY Site-Screening Tools

- [USFWS IPAC](#) (Information for Planning and Consultation) – draw in your site, evaluate for federally-listed species (not just mussels)



- [Michigan Mussels Web App](#) – zoom in on your site to see if any mussel community data exists
- **Note: Lack of mussel data at a site does not mean mussels are not present**

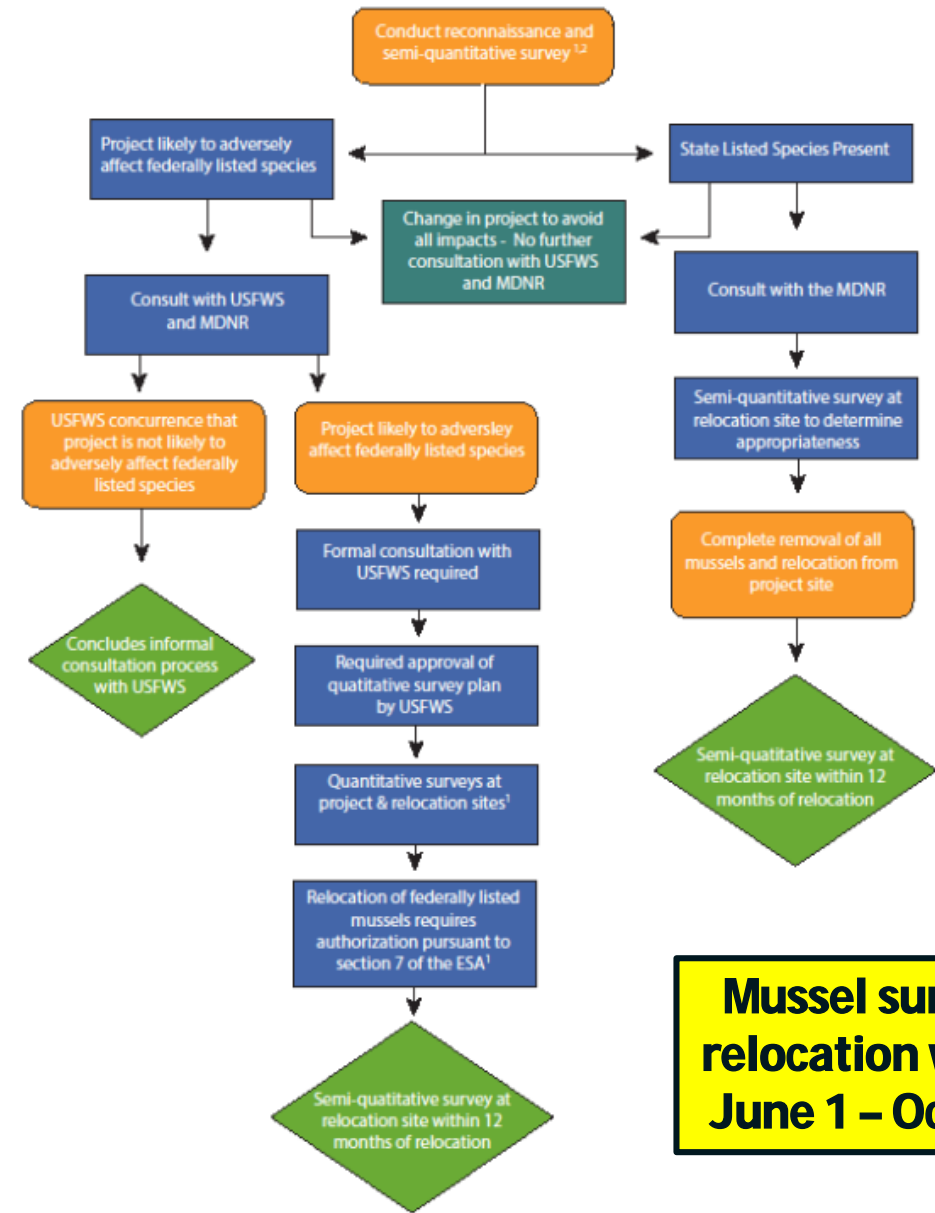


# River/Stream Protocol Overview

*"...designed to document the potential presence or absence of state or federally listed mussel species as well as provide guidance for survey and relocation activities to minimize impacts to native mussels in Michigan."*

## What is provided in the protocol?

- Stream-specific guidance & permitting
- Survey guidelines/techniques
- Mussel relocation procedures
- Reporting guidance
- Mussel habitat assessment form ("recon" form)



**Mussel survey and relocation window is June 1 – October 15**

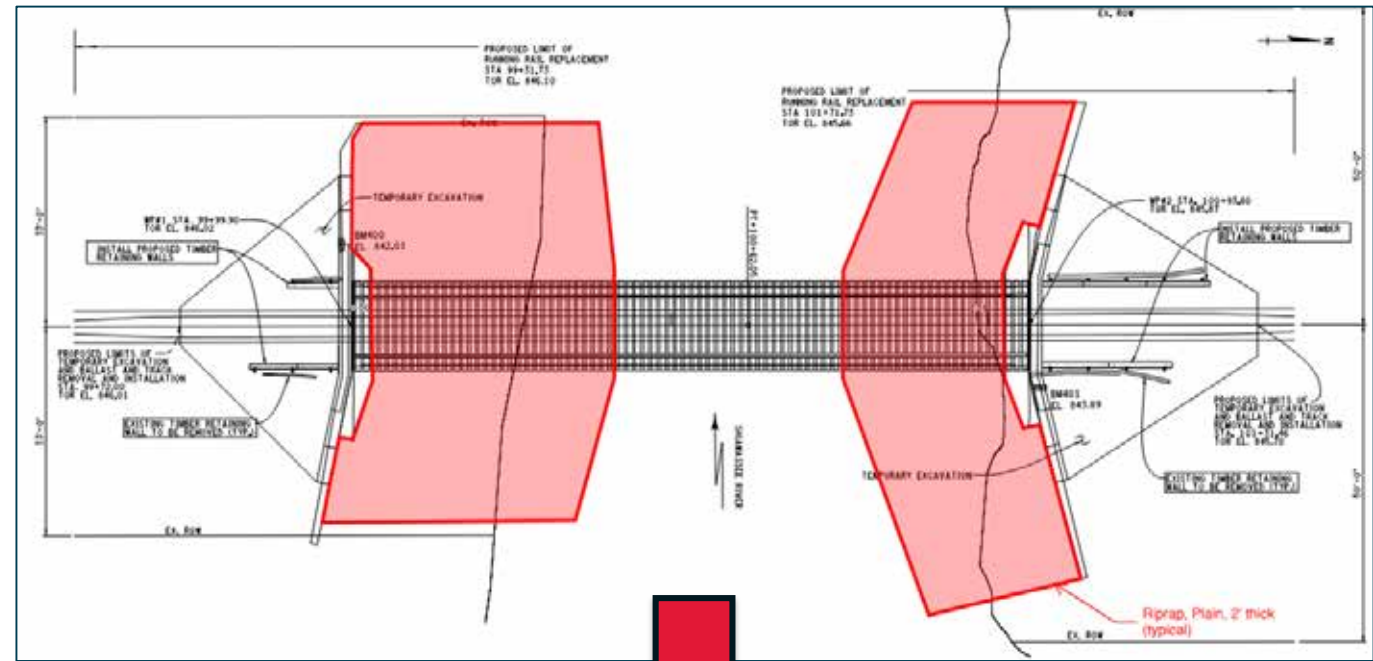
<sup>1</sup> ESA Section 10(a)1(A) permit required for Group 3 waters

<sup>2</sup> MDNR Scientific Collectors permit and State Threatened and Endangered Species permit required for Group 2 waters



## Determining the boundaries of a "mussel footprint"

- Use construction plans to identify & calculate mussel work area
  - Area of direct impact (ADI)
  - Buffer areas (USB, DSB, LB)
  - Square meter (m<sup>2</sup>)
- Buffer sizes somewhat project specific
  - Generally: 10-20 m DS and 5-10 m US



## Determining the boundaries of a "mussel footprint"

- Detailed project plans allow greater support/certainty in buffer sizing
  - Include stream width + water depth (if known)
- Include control measures
  - Turbidity curtains
  - Coffer dams
- Accurate sizing of mussel footprint is important for accurate pricing/cost



**Figure 1:** JN 208879, M-90 Flint River crossing Salvage Area which measures 1,949 m<sup>2</sup> (upstream buffer + downstream buffer + direct impact area)

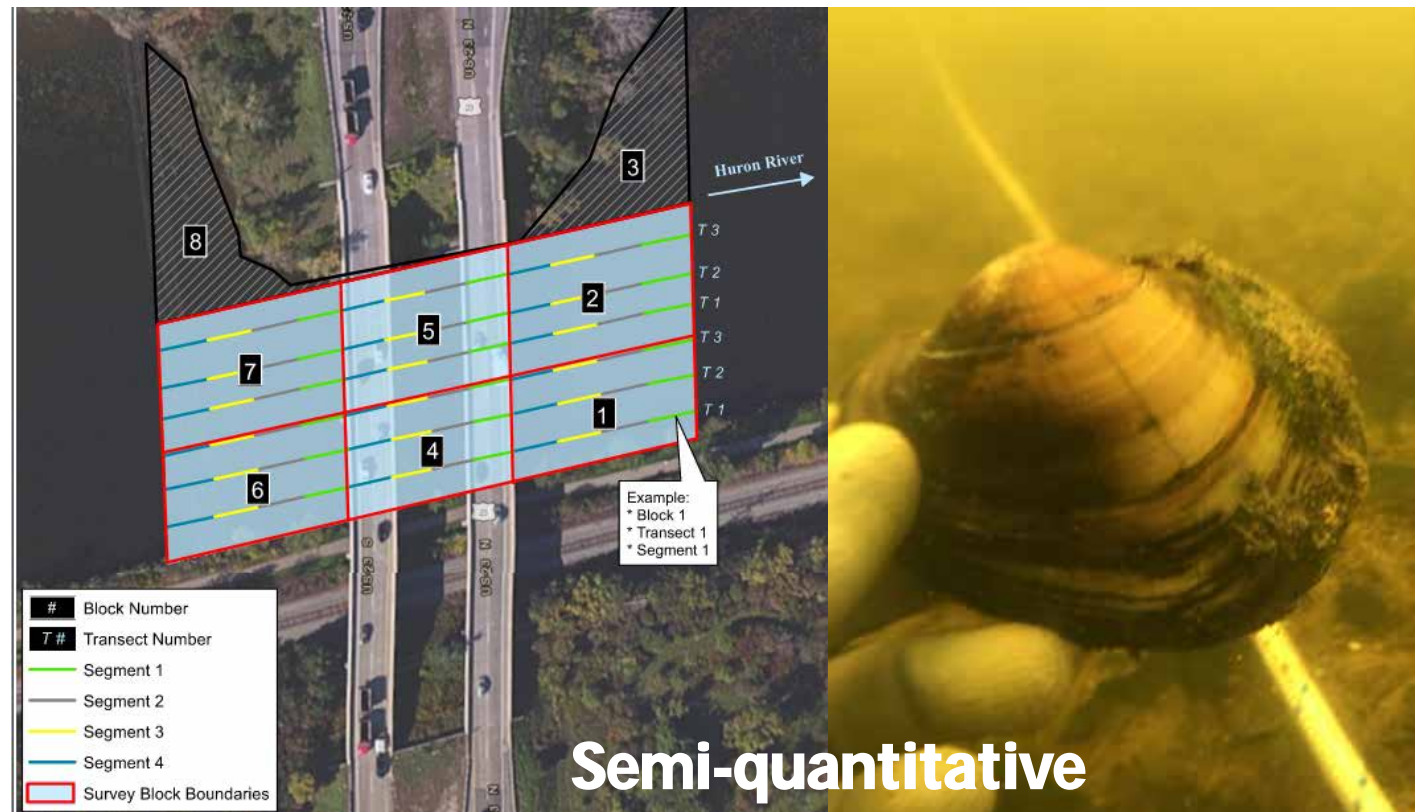


# Mussel Survey Types + Relocation



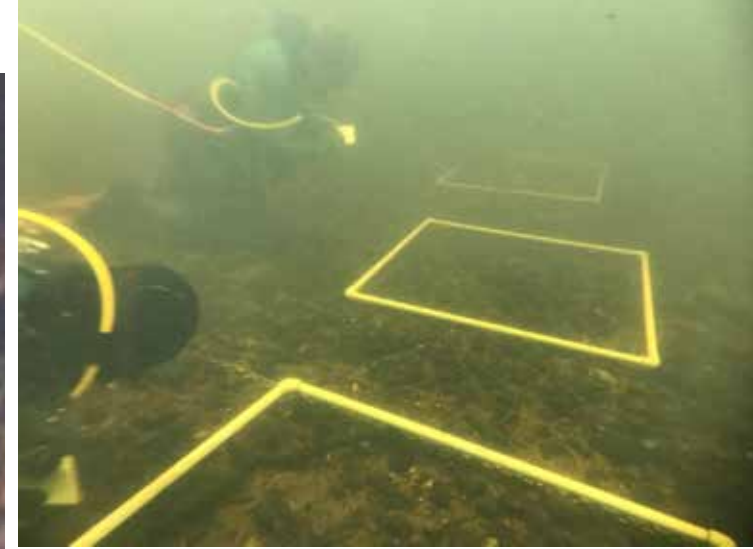
# Reconnaissance & Semi-Quantitative Mussel Surveys

- **Reconnaissance**
  - Couple of hours on site
  - Visual searches (not handling mussels)
  - Valuable for access, safety, gear requirements (e.g., scuba, boat)
- **Semi-quantitative**
  - Species assemblage? T/E species?
  - Timed searches (transects, meanders)
  - Requires mussel ID expertise
  - Search times: generally 1 min/m<sup>2</sup>
- **All survey data valid for 5 years**



# Quantitative Mussel Surveys

- **Quantitative**
  - Most frequently used on Group 3
  - Quadrat (0.25m<sup>2</sup> or 1m<sup>2</sup>) sampling
  - Generate mussel population estimates, detailed substrate data
- **Very informative, labor intensive**
  - Need agency approval of # of quadrats
- **Includes transplant area identification**

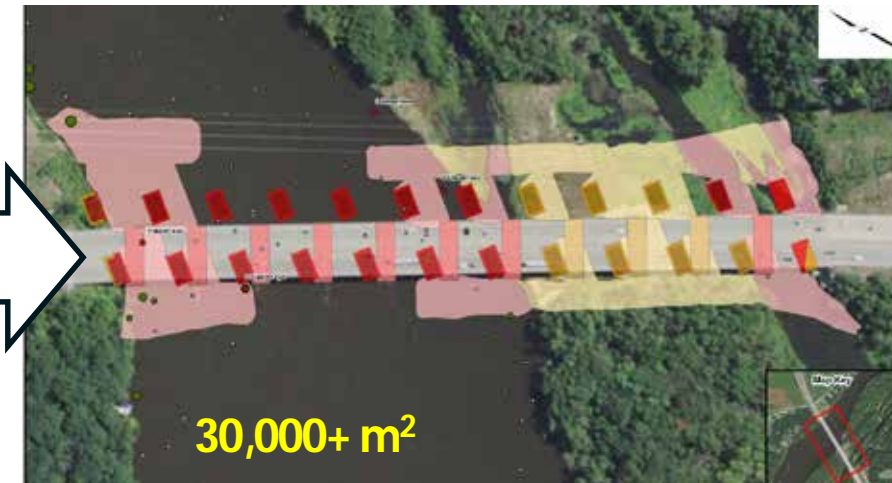


# Mussel Relocation

- Relocation (“salvage”)
  - Move mussels to approved transplant area
  - “Mow the lawn” underwater
  - Requires transplant area verification
  - Post-relocation monitoring if T/E found
  - Mussel tagging/markings
- 2 years or less before construction



30,000 m<sup>2</sup> area  
X 2 min/m<sup>2</sup> search time  
-----  
60,000 min (1,000 hrs)!





# Mussel Relocation

- Relocation = labor intensive, costly for large projects
  - Team sizes: 4 – 16 staff
  - Diving, mussel processing, mussel transplant all running at once
  - Reinforces need for accurate calculation of ADI and buffer areas
- Mussel density, diversity(?)
  - Highly variable + may not know going into project
- More mussels = more time (\$\$\$)
- T/E mussels at site?
  - Marking/tagging

Species <sup>1</sup>	Common Name	MI Status <sup>2</sup>	Federal Status <sup>2</sup>	Mussel Salvage Block (Phase I = Blocks 1-8; Phase II = Blocks 9-16)																Total
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
<i>Actinonaias ligamentina</i>	Mucket	-	-	5	11	1	6	0	0	2	1	5	0	0	3	3	8	0	0	45
<i>Alasmidonta marginata</i>	Elktoe	SC	-	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
<i>Amblema plicata</i>	Threeridge	-	-	93	135	3	52	10	26	43	30	70	11	9	12	106	107	11	6	726
<i>Cyclonaias pustulosa</i>	Pimpleback	-	-	31	53	2	23	8	11	20	19	22	2	3	7	15	22	10	4	252
<i>Epioblasma triquetra</i>	Snuffbox	E	E	1	1	0	0	0	1	0	0	4	0	0	1	0	0	0	0	8
<i>Fusconaia flava</i>	Wabash Pigtoe	-	-	4	5	0	2	2	2	1	4	3	0	1	0	8	7	0	0	39
<i>Lampsilis siliquoidea</i>	Fatmucket	-	-	22	28	0	8	4	1	0	2	69	16	1	19	54	45	3	1	273
<i>Lampsilis cardium</i>	Plain Pocketbook	-	-	80	65	14	69	16	34	34	23	65	17	2	26	26	43	5	5	524
<i>Lasmigona complanata</i>	White Heelsplitter	-	-	2	1	1	2	0	0	3	5	1	0	0	0	1	1	0	5	22
<i>Leptodea fragilis</i>	Fragile Papershell	-	-	47	46	10	77	8	12	22	23	59	6	2	16	33	50	2	6	419
<i>Ligumia recta</i>	Black Sandshell	E	-	4	6	1	2	1	4	3	0	1	1	1	4	2	2	1	0	33
<i>Potamilius olatus</i>	Pink Heelsplitter	SC	-	9	12	2	2	1	7	5	11	8	3	0	9	8	3	1	5	86
<i>Quadrula quadrula</i>	Mapleleaf	-	-	5	7	0	3	2	0	8	6	3	0	0	4	5	3	0	0	46
<i>Strophitus undulatus</i>	Strange Floater	-	-	7	18	4	9	2	10	19	16	59	9	1	21	40	45	2	5	283
<i>Truncilla truncata</i>	Deertoe	-	-	19	292	8	76	8	42	40	51	158	7	6	23	187	101	17	13	1224
<b>Total Mussels</b>				<b>522</b>	<b>681</b>	<b>46</b>	<b>331</b>	<b>62</b>	<b>150</b>	<b>200</b>	<b>191</b>	<b>527</b>	<b>72</b>	<b>26</b>	<b>144</b>	<b>491</b>	<b>437</b>	<b>52</b>	<b>50</b>	<b>3982</b>

<sup>1</sup> *Lasmigona compressa* (n=3) found during 2020 quantitative survey but not found during relocation; *Utterbackia imbecillis* (MI Special Concern species) shells found throughout site but no live specimens  
<sup>2</sup> Status as of 2022: SC = Special Concern, T = Threatened, E = Endangered



Species	Common Name	MI Status <sup>1</sup>	Salvage Block			Total
			1	2	3	
<i>Actinonaias ligamentina</i>	Mucket	-	0	1	0	1
<i>Alasmidonta marginata</i>	Elktoe	SC	0	1	0	1
<i>Amblema plicata</i>	Threeridge	-	107	443	43	593
<i>Eurynia dilatata</i>	Spike	-	1157	3640	323	5120
<i>Fusconaia flava</i>	Wabash Pigtoe	-	15	161	15	191
<i>Lampsilis siliquoidea</i>	Fatmucket	-	14	78	11	103
<i>Lampsilis cardium</i>	Plain Pocketbook	-	0	4	1	5
<i>Lasmigona costata</i>	Fluted-shell	SC	9	38	4	51
<i>Pleurobema sintoxia</i>	Round Pigtoe	SC	10	135	8	153
<i>Ptychobranhus fasciolaris</i>	Kidney-shell	SC	2	12	0	14
<i>Pyganodon grandis</i>	Giant Floater	-	1	9	0	10
<i>Strophitus undulatus</i>	Strange Floater	-	3	37	5	45
<i>Utterbackia imbecillis</i>	Paper Pondshell	SC	1	2	0	3
<i>Venustaconcha ellipsiformis</i>	Ellipse	SC	125	364	22	511
<i>Villosa iris</i>	Rainbow	SC	15	52	0	67
<b>Total Mussels</b>			<b>1459</b>	<b>4977</b>	<b>432</b>	<b>6868</b>



# Post-Relocation Monitoring

- Usually required at sites with T/E species
- **≥ 30 days after relocation is complete**
- Searching transplant area for tagged and/or marked mussels
- Assessing % recovery, survival
- Results variable
  - Rarely recover all mussels
  - Timing of relocation (early or late in season?)
  - Substrate in transplant area, flow events



Species	Common Name	MI Status <sup>1</sup>	# Tagged	# Tagged Recovered	Percent Recovered (%)
<i>Amblema plicata</i>	Threeridge	-	54	53	98
<i>Eurynia dilatata</i>	Spike	-	35	25	71
<i>Fusconaia flava</i>	Wabash pigtoe	-	3	3	100
<i>Lampsilis siliquoidea</i>	Fatmucket	-	8	5	63
<i>Lasmigona costata</i>	Fluted-shell	SC	6	5 <sup>2</sup>	100
<i>Pleurobema sintoxia</i>	Round pigtoe	SC	12	11	92
<i>Ptychobranthus fasciolaris</i>	Kidney-shell	SC	1	1	100
<i>Strophitus undulatus</i>	Strange floater	-	3	3	100
<i>Venustaconcha ellipsiformis</i>	Ellipse	SC	3	0	0
<b>Total Mussels</b>			<b>125</b>	<b>101</b>	<b>81</b>

Metric	2022	2023
Tagged mussels present in tagged mussel plot	131	246*
Tagged mussels recovered (% recovered)	79 (60%)	103 (42%)
Total mussels recovered alive (% recovered alive)	74 (56%)	95 (39%)

\*251 total mussels tagged; 5 found dead in plot in 2022, leaving 246 tagged mussels in plot in 2023




# Permitting + Schedule



# All mussel projects require permits

- In MI scientific collectors + state T/E handling permit (at minimum)
- Federal permit for Group 3 systems
- More states requiring mussel ID certification
  - Michigan certified required 2025
  - Ohio certified (MI reciprocity)
- End-of-year reporting (except for recon surveys)

Page 1 of 5  
NATIVE ENDANGERED & THREATENED SP. RECOVERY  
ENDANGERED & THREATENED WILDLIFE  
**Permit Number: TE33374D-0**  
Effective: 07/25/2019 Expires: 12/31/2024





Issuing Office:  
Department of the Interior  
U.S. FISH & WILDLIFE SERVICE  
Endangered Species Permit Office  
5600 American Boulevard, West, Suite 990  
Bloomington, MN 55437-1458  
permitsR3ES@fws.gov

Permittee:  
**GEI CONSULTANTS OF MICHIGAN, P.C.**  
PO BOX 6820  
TRAVERSE CITY, MI 49686-6820  
U.S.A.

Name and Title of Principal Officer:  
STUART N KOGGE - VICE PRESIDENT/WETLAND-AQUATIC BIOLOGIST

*[Signature]*  
for  
Chief - Endangered Sp.

STATE OF MICHIGAN  
DEPARTMENT OF NATURAL RESOURCES  
LANSING

GRETCHEN WHITMER  
GOVERNOR

DANIEL EICHINGER  
DIRECTOR

February 2, 2022

Ryan Holem  
GEI Consultants of Michigan, P.C.  
401 South Washington Square, Suite 103  
Lansing, MI 48933

Dear Ryan Holem,

This letter is an official attachment to your Threatened and Endangered Species Permit (**TE 029**). Your permit is issued in the *Consultant* category only. Your permit expires on **March 31, 2025**. Renewal information will be sent in December of 2024.

**Authorization:**  
To conduct the scientific activities listed under special conditions on the threatened/endangered species listed below. All activities are subject to the standard permit conditions within this letter.

Michigan Department of Natural Resources – Fisheries Division  
**SCIENTIFIC COLLECTOR'S PERMIT**  
*Issued under the authority of Public Act 451 of 1994, Part 487, as amended, section 324.48735.*

Under the provisions of Part 487, Act 451, P.A. 1994, as amended, being section 324.48735, permission is hereby granted to:

Title	First Name
Co-Permittee Stu Kogge	Ryan
Institution/Affiliation GEI Consultants of Michigan, P.C.	Co-Permittee Daniel Kowalski
Mailing Address 401 South Washington Square, Suite 103, Lansing, Michigan, 48933	

**State of Wisconsin**  
DEPARTMENT OF NATURAL RESOURCES  
101 S. Webster Street  
Box 7921  
Madison WI 53707-7921

Tony Evers, Governor  
Adam N. Payne, Secretary  
Telephone 608-266-2621  
Toll Free 1-888-936-7463  
TTY Access via relay - 711



**Wisconsin Regulatory Removals Broad Incidental Take Permit**

Coverage under this a Broad Incidental Take Permit is for specific state-listed endangered and threatened species during handling, removal and relocation activities associated with regulatory activities. This permit/authorization does not cover educational or scientific activities and is subject to annual reports.

Permit holder is responsible for obtaining and maintaining any other permits, licenses, or authorizations that may be required to conduct the above activities.

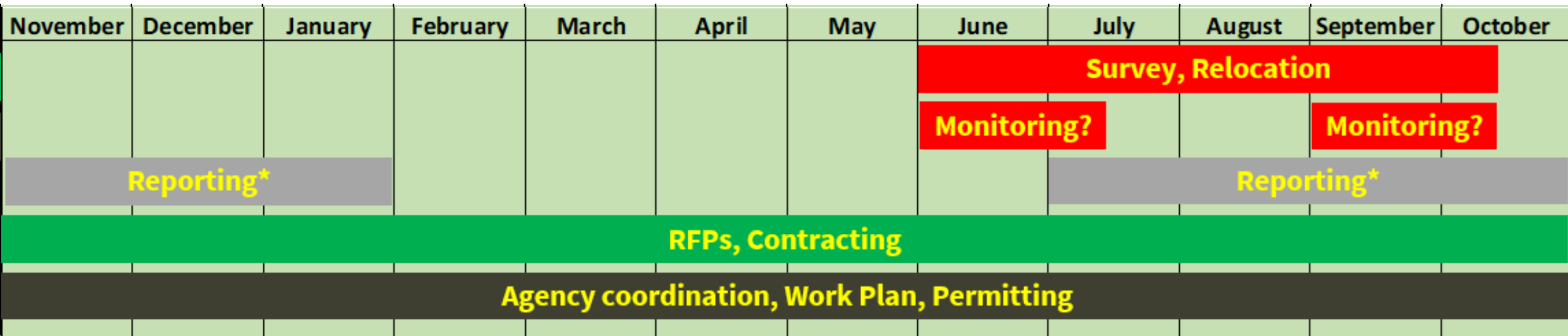
Notice: Rare species data collected from permit holders and applicants may be added to the Wisconsin Natural Heritage Inventory database. Personal information collected on this form will be used to process your request and may also be made available to requestors under Wisconsin's Open Records law (ss. 19.31-19.39, Wis. Stats.).

**Issued to:** Ryan Holem **BITPA Number** RR 1182  
**Company Name:** GEI Consultants, Inc. **Permit Start Date** 6/5/2020



# Timelines

- Revolves around 6/1 – 10/15 “mussel season”
- Federal permit for Group 3 systems



## Key questions related to timing:

Is the construction project permittable?

Target construction start/finish dates?

Are federally listed mussels expected?

\*45-day reporting timeframe in protocol – can be challenging to meet for early season efforts

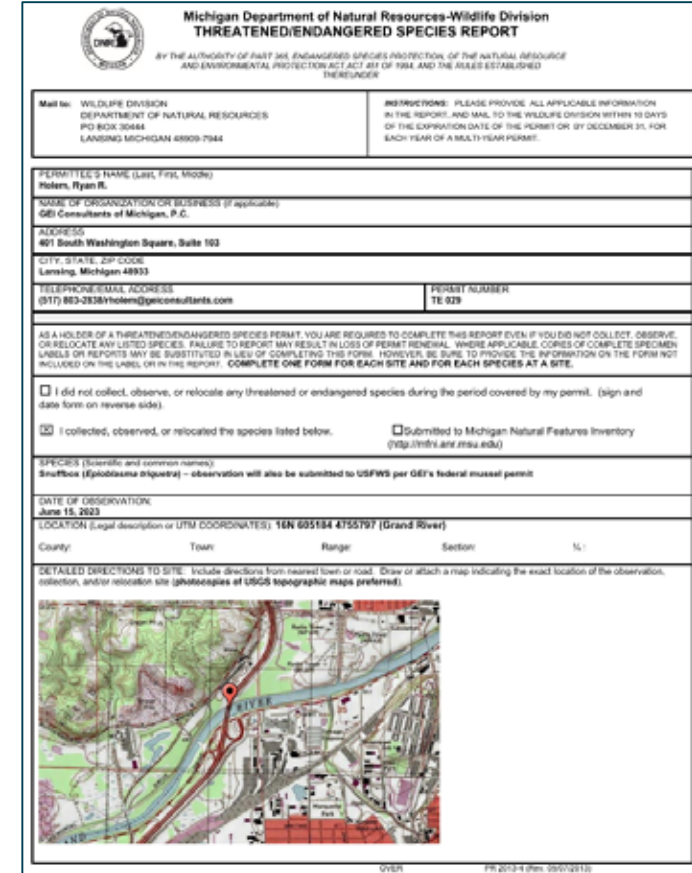


# Reporting notes

- There are two types of end-of-year reporting that must be completed:
  1. **Project Reporting to the Client**
    - Helpful reporting checklist is provided in the protocol
  2. **Permit Reporting to MDNR and USFWS**
    - Scientific Collector's
    - State T/E Handling
    - Federal
- Usually end of year deadlines for both project and permit reporting



The cover page features a header image of a stream with a person. The GEI Consultants logo is prominently displayed. The title is "Draft Interim Red Cedar (US-127) Mussel Relocation Report". Below the title, it specifies the location: "US-127 crossing Ingham County, MI (MDOT Job Number 132626)". It lists two submitters: "Submitted by: Michigan Department of Transportation, Jeff Grabarkiewicz, Ecologist" and "Submitted by: GEI Consultants of Michigan, P.C., 401 South Washington Square, Suite 103, Lansing, MI 48933". The date "February 3<sup>rd</sup>, 2023" is printed above a photograph of a river scene with a bridge in the background.



This is a standardized reporting form from the Michigan Department of Natural Resources-Wildlife Division. It includes the following sections:

- Header:** Michigan Department of Natural Resources-Wildlife Division, THREATENED/ENDANGERED SPECIES REPORT. Reference to the Michigan Natural Resources and Environmental Protection Act.
- Mail to:** Wildlife Division, Department of Natural Resources, PO Box 30444, Lansing, Michigan 48909-7944.
- Instructions:** Please provide all applicable information in the report, and mail to the Wildlife Division within 10 days of the expiration date of the permit or by December 31, for each year of a multi-year permit.
- Permittee's Name:** Holten, Ryan R.
- Name of Organization or Business:** GEI Consultants of Michigan, P.C.
- Address:** 401 South Washington Square, Suite 103.
- City, State, Zip Code:** Lansing, Michigan 48933.
- Telephone/Fax/Email Address:** (517) 853-2838/ryholten@geiconsultants.com. **Permit Number:** TE 029.
- Disclaimer:** AS A HOLDER OF A THREATENED/ENDANGERED SPECIES PERMIT, YOU ARE REQUIRED TO COMPLETE THIS REPORT EVEN IF YOU DID NOT COLLECT, OBSERVE, OR RELOCATE ANY LISTED SPECIES. FAILURE TO REPORT MAY RESULT IN LOSS OF PERMIT RENEWAL. WHEN APPLICABLE, COPIES OF COMPLETE SPECIMEN LABELS OR REPORTS MAY BE SUBMITTED IN LIEU OF COMPLETING THIS FORM. HOWEVER, BE SURE TO PROVIDE THE INFORMATION ON THE FORM NOT INCLUDED ON THE LABEL OR IN THIS REPORT. COMPLETE ONE FORM FOR EACH SITE AND FOR EACH SPECIES AT A SITE.
- Reporting Status:**  I did not collect, observe, or relocate any threatened or endangered species during the period covered by my permit. (sign and date form on reverse side).  I collected, observed, or relocated the species listed below.  Submitted to Michigan Natural Features Inventory (http://mnr.dnr.state.mi.us).
- Species:** Snuffbox (*Epilobium alpinum*) - observation will also be submitted to USFWS per GEI's federal mussel permit.
- Date of Observation:** June 15, 2023.
- Location:** 16N 605184 4755197 (Grand River). Fields for County, Town, Range, Section, and T are present.
- Detailed Directions to Site:** Include directions from nearest town or road. Draw or attach a map indicating the exact location of the observation, collection, and/or relocation site (photocopies of USGS topographic maps preferred).
- Map:** A topographic map showing the Grand River area with a red dot indicating the collection site.
- Footer:** DNR, PR 2013-4 (Rev. 05/01/2015).



# Summary of critical dates & timeframes

- Mussel plan review & approval
  - $\geq 15$  business days
- Permits
  - $\geq 30$  business days
- June 1 – October 15 “mussel season”
- Post-relocation monitoring
  - $\geq 30$  days following relocation
- Project reporting
  - Preliminary within 30 days
  - Full report within 45 days
- Permit reporting
  - Varies – best in conjunction with project report



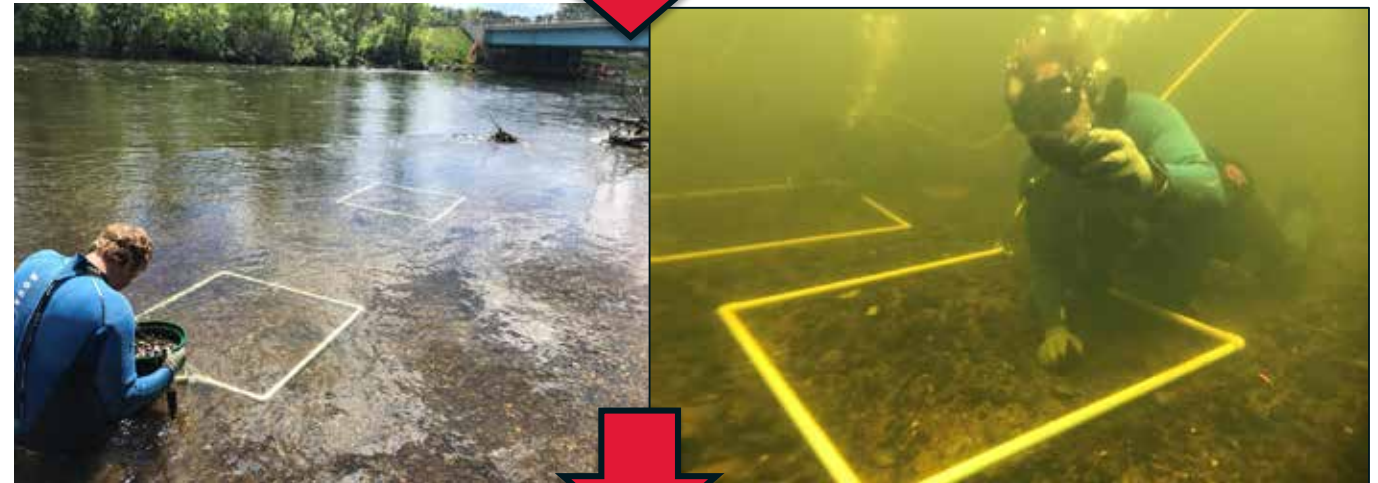
Michigan Department of Natural Resources – Fisheries Division

**SCIENTIFIC COLLECTOR'S PERMIT**

Issued under the authority of Public Act 451 of 1994, Part 487, as amended, section 324.48735.

Under the provisions of Part 487, Act 451, P.A. 1994, as amended, being section 324.48735, permission is hereby granted to:

Title	First Name Ryan	Last Name Holem
Co-Permittee Stu Kogge	Co-Permittee Daniel Kowalski	Co-Permittee Meghan Martinski
Institution/Affiliation GEI Consultants of Michigan, P.C.		
Mailing Address 401 South Washington Street, Suite 103, Lansing, Michigan, 48933		



Scientific Collector's Permit Activity Reporting

Michigan.gov/DNR

Michigan Department of Natural Resources - Wildlife and Fisheries Division

Report of Wildlife, Migratory Birds, Fish, Reptiles, Amphibians, Crustaceans or Mollusks Surveyed, Handled, Collected or Possessed Under a Cultural or Scientific Collector's Permit



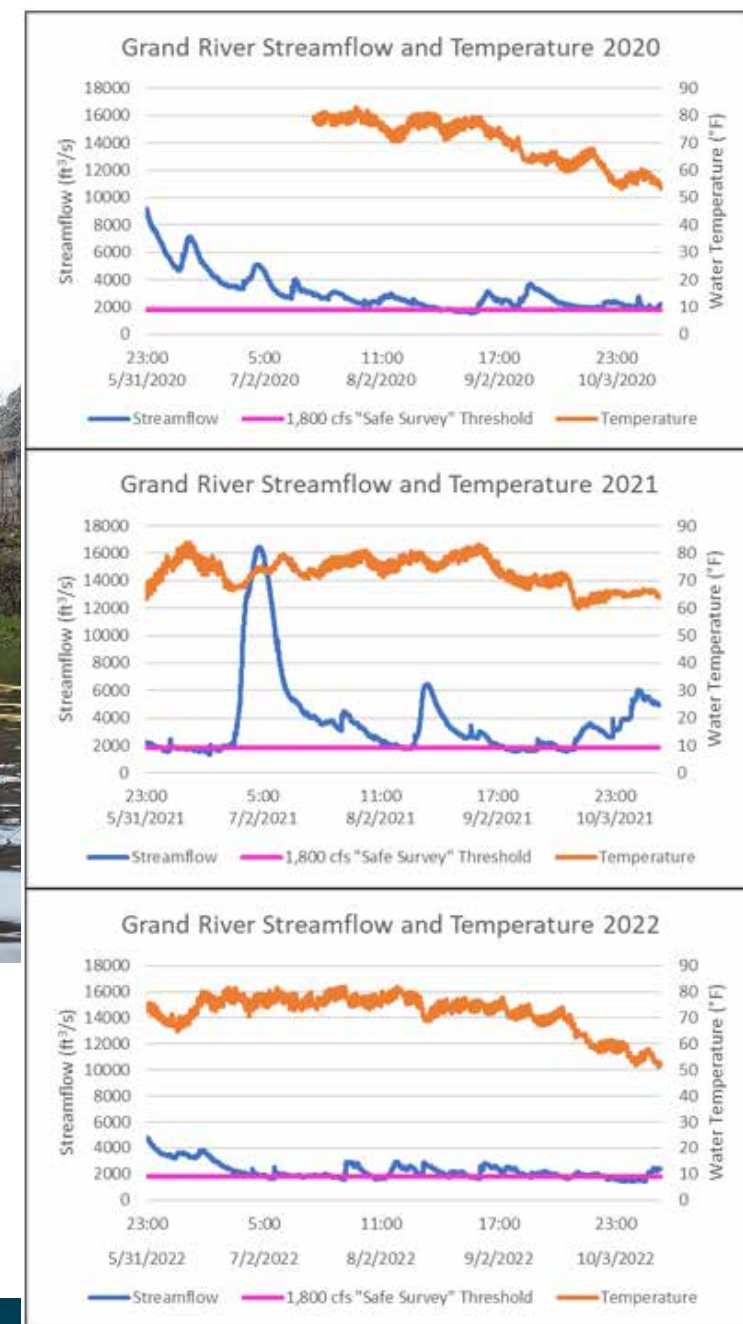
# Lessons Learned, FAQ's





## Valuable Lessons + FAQ's

- Why is it so expensive?
  - Specialized training & equipment, safety spotters for diving
- Can you provide cost estimates for mussel survey, relocation, and monitoring?
  - Yes...but...
- Know your watercourse
  - Flow conditions are important!
  - Getting "early start" not always best
  - Late season (9/15-10/15) mussel work may take longer



## Value of a site visit or mussel reconnaissance

- Low-cost effort, high potential ROI
- Evidence of mussels? Suitable substrate?
- Water depth/visibility/current?
- Access/safety issues?

**All are critical factors in estimating costs and can help reduce uncertainty**



## Provide detailed information for contractor(s)

### 1. Detailed ADI

- KMZ and/or shape files encouraged!
- Permit (if you have it)

### 2. Construction timing

- 2 years for relocation, 5 for survey

### 3. Water depth – diving required?

- Bridge inspection reports, grab it while doing a site survey

### 4. Site photos

- Access/safety issues?
- Indicators of current, visibility



**Figure 1:** JN 214904, M-71 Shiawassee River crossing. The total Salvage Area measures 1,641 m<sup>2</sup> (upstream buffer [yellow] + downstream buffer [purple] + direct impact area [red]).

10. (1) State Endangered mussel and (4) State Special Concern mussels are known to occur at or near this project site and may be impacted by your activities. A freshwater mussel survey and relocation shall occur prior to dredging and placement of riprap. A waiver has been granted to begin sheet pile portion of the project as soon as possible. Issuance of this permit does not obviate the need to obtain approval under Part 365, Endangered Species, of the NREPA from Michigan Department of Natural Resources (DNR) Natural Heritage Program prior to commencement of construction activity. Please contact Jennifer Johnson, Fisheries Division, MDNR, US Highway 2, Norway, MI 49870, or (906)563-9247, for additional information.



**Q & A**



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