State Transportation innovation Council
Final report on MDOT 2D Hydraulic Modeling Peer Exchange
MDOT Job Number 207495NI
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Description of Project:

The Michigan Department of Transportation (MDOT) is participating in the Federal Highway Administration's (FHWA) Every Day Counts – 5 (EDC-5) Collaborative Hydraulics: Advancing to the Next Generation of Engineering (CHANGE). MDOT had previously completed approximately one half-dozen crossings using advanced 2D modeling using SRH-2D through SMS. In order to better understand the challenges posed with adapting 2D modeling into standard practice, MDOT sought funds to host a Peer exchange with other DOT's from the Midwest. The peer exchange included participants from 10 States (including Michigan), FHWA, Michigan Department of Environment, Great Lakes, and Energy (formerly MDEQ) and a consultant who provides services to Local Government Agencies. The peer exchange included presentations from FHWA and other States regarding their experience with using 2D hydraulic modeling software. The peer exchange was held April 16 – 18, 2019 at the Earle Center.

Overall Budget:

The overall budget for this project was $31,496 and the final expenses were well under budget ($6,619).

How the Work Specifically Meets the Program Criteria:

The overall goals of the peer exchange were as follows:

- Establish the state of practice amongst other DOT's.
- Learn tips and tricks from other State DOT's who have been utilizing 2D hydraulic modeling.
- Discuss regulatory barriers with utilizing 2D hydraulic modeling.
- Discuss other challenges regarding 2D hydraulic modeling.

Goals of the TDIP funding:

- Significantly accelerate the adoption of innovative technologies by the surface transportation community.

- Provide leadership and incentives to demonstrate and promote state-of-the-art technologies, elevated performance standards, and new business practices in highway construction processes that result in improved safety, faster construction, reduced congestion from construction, and improved quality and user satisfaction.
- Construct longer-lasting highways through the use of innovative technologies and practices that lead to faster construction of efficient and safe highways and bridges.
- Improve highway efficiency, safety, mobility, reliability, service life, environmental protection, and sustainability.
- Develop and deploy new tools, techniques, and practices to accelerate the adoption of innovation in all aspects of highway transportation.

Results of the project:

The peer exchange noted that all the DOT attendees have some experience with 2D hydraulic modeling. Some states, such as Minnesota and Montana, have been utilizing advanced modeling practices for many years and have adopted the process into their regular practice. The States that have adopted 2D hydraulic modeling have noted many benefits to the practices, including (but not limited to) better communication with customers (internal and external), improved results (especially situations with multiple opening analysis and road overtopping), and improved data to perform scour analysis.

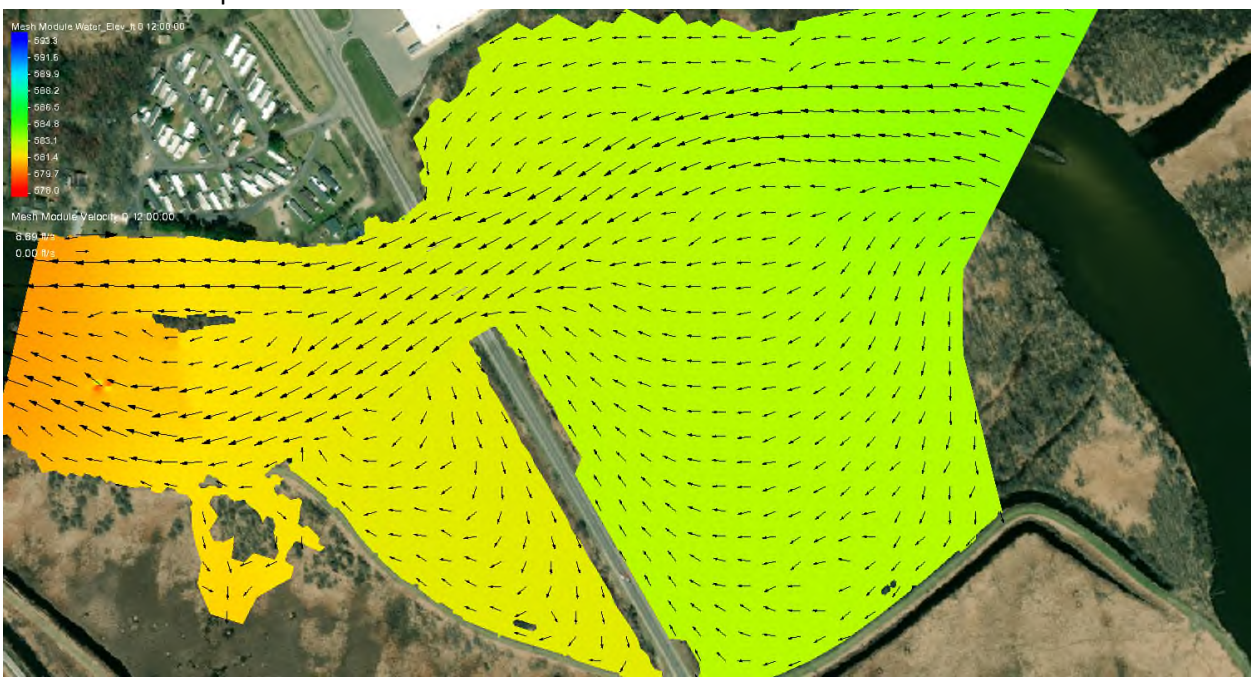
The biggest challenges regarding 2D hydraulic modeling are as noted:

- Survey data collection
- Regulatory agencies accepting 2D hydraulic models for their reviews
- Limited feel for Manning's coefficients with advanced modeling
- Training and experience
- Reporting standards

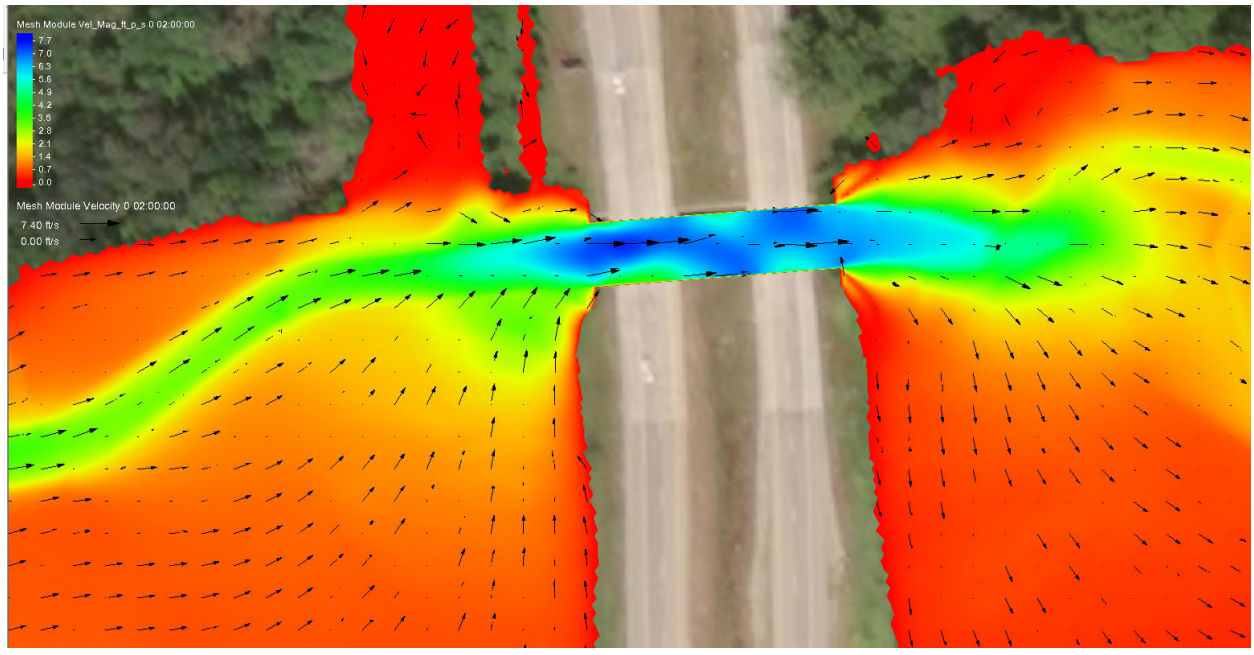
Since the peer exchange, MDOT has developed eight 2D hydraulic models, two of which were reviewed by FHWA's Hydraulic Resource Center. The reviews noted issues with the statewide LiDAR collected with the Michigan Statewide Authoritative Imagery & LiDAR (MISail) program. The issues were highlighted in FHWA's 2D Hydraulic Modeling User's Forum in the Summer of 2019 and in an article for AASHTO's Hydrolink Newsletter.

Details from six of the eight hydraulic models are provided below:

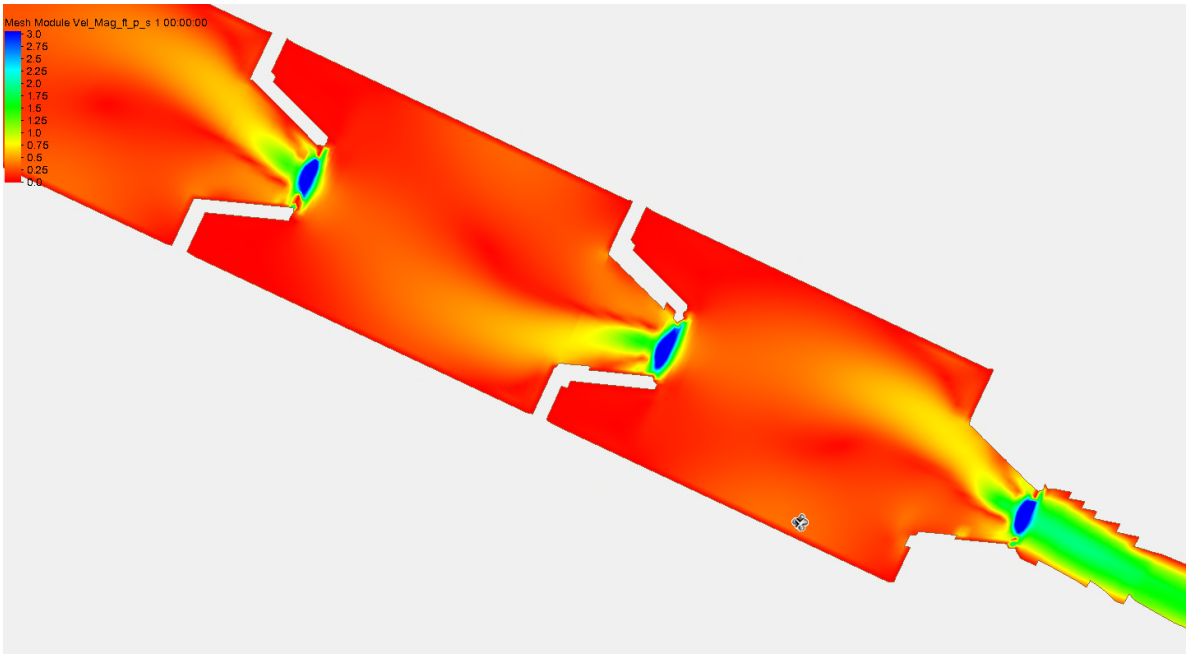
- US-31 over the Manistee River
    - 2D model developed as a check with scour calculations for proposed bridge replacement.



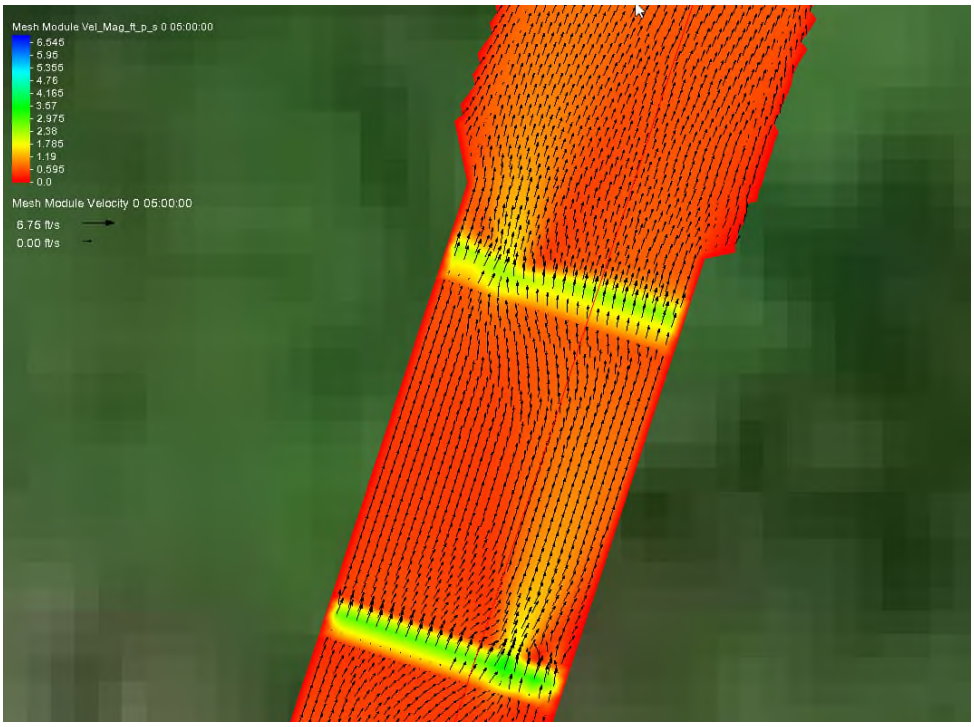
- US-127 over the Little Salt River
    - 2D model developed to aid in designing scour countermeasures for an existing scour critical structure.



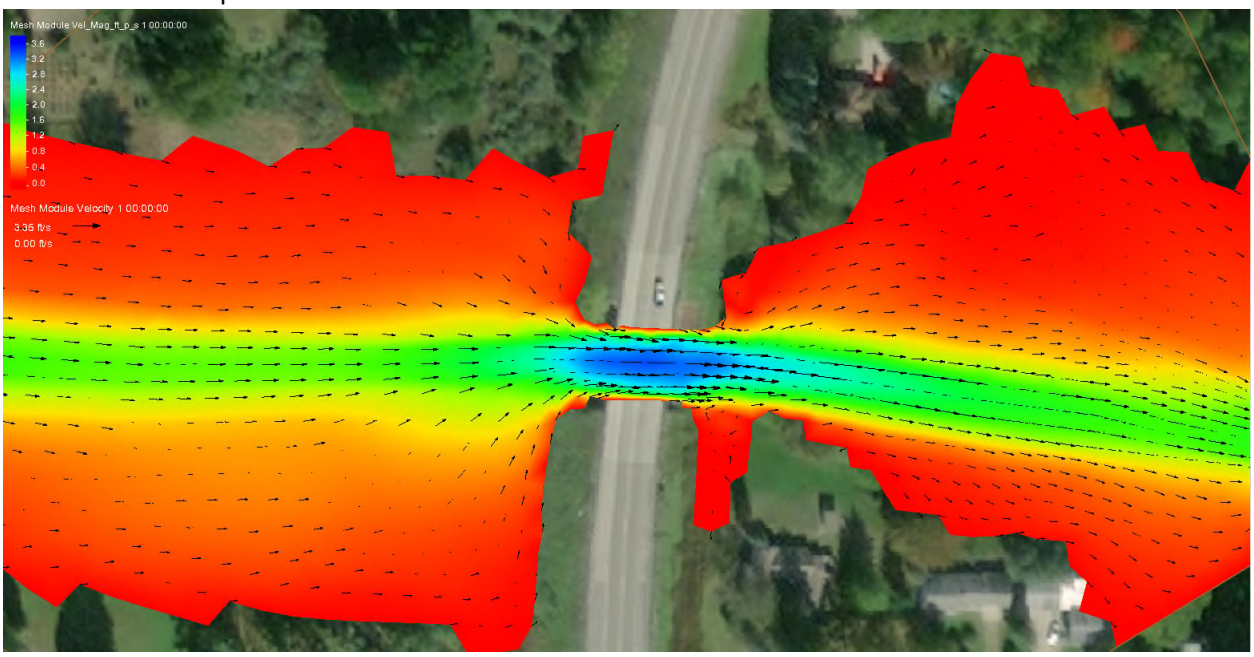
- I-196 over Pier Cove Creek
    - 2D model developed to provide visual support with design for Aquatic Organism Passage (AOP) with grade control.



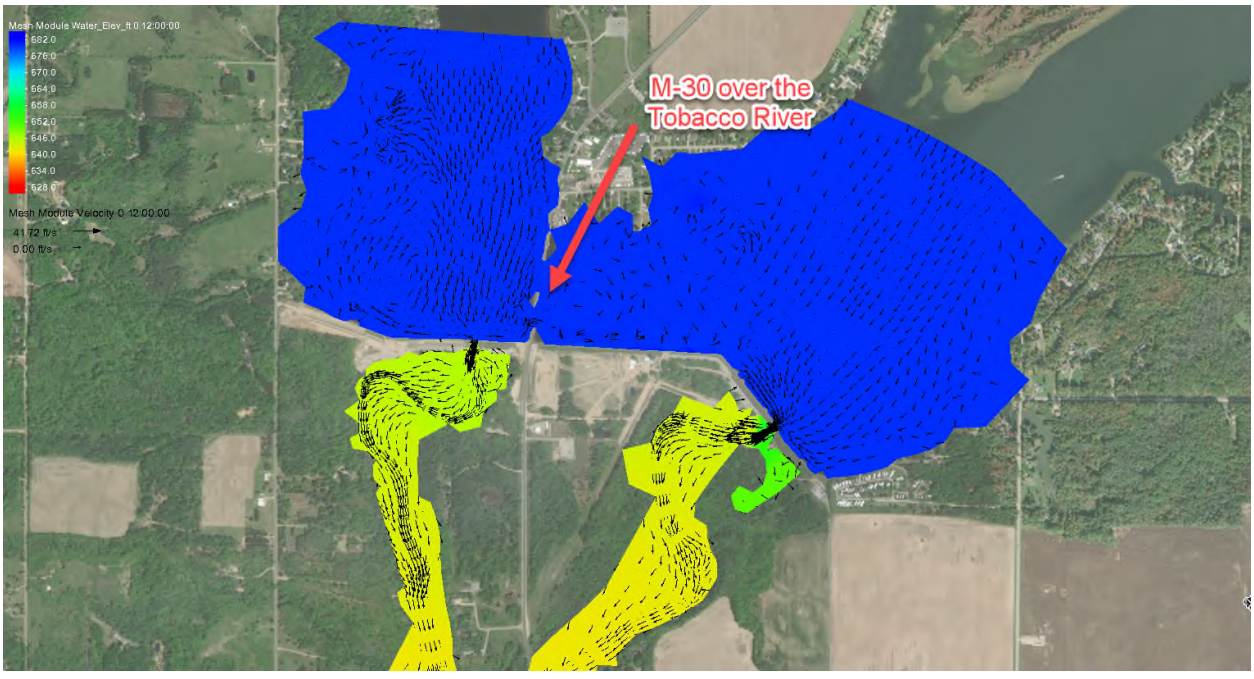
- M-139 over Buckhorn Creek
    - 2D model developed to provide visual support with design for AOP with grade control.

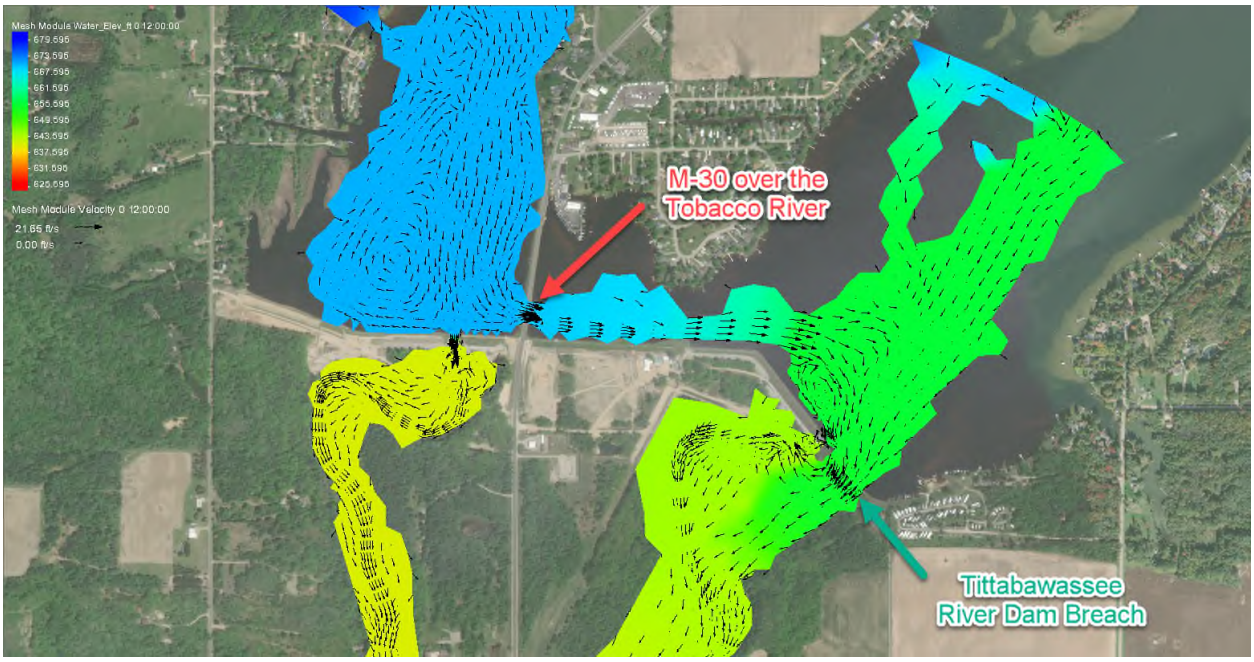


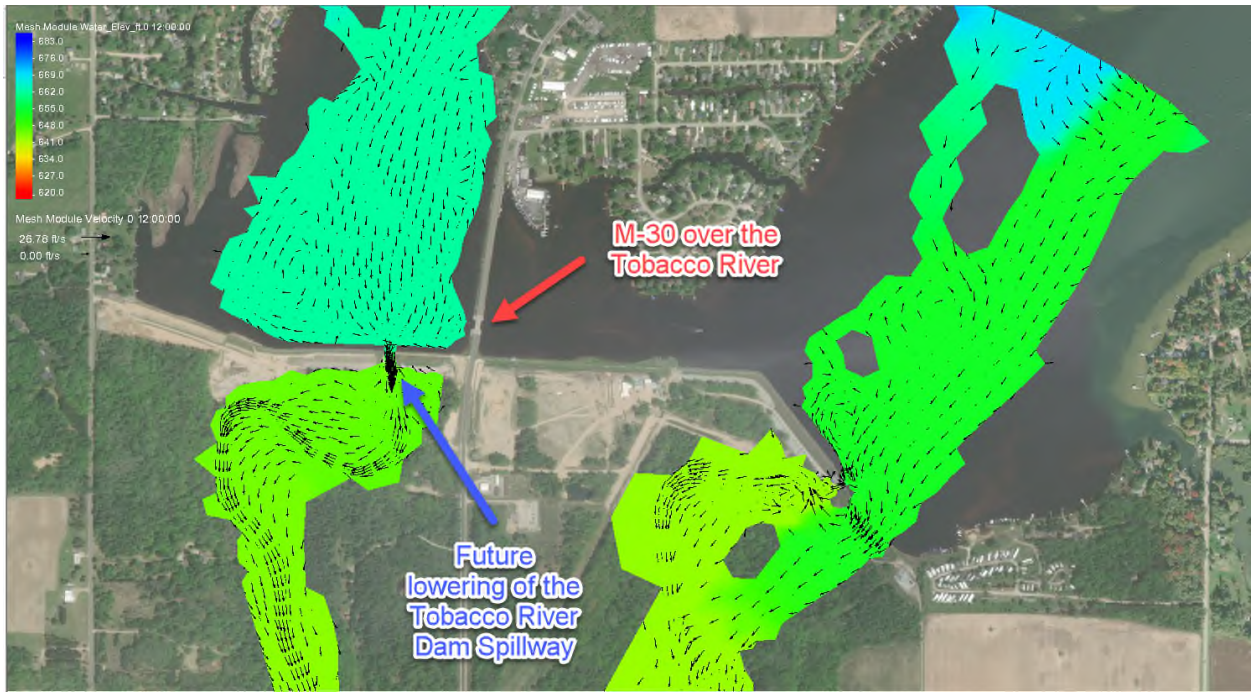
- M-52 over Marsh Creek
    - 2D model developed as a check with scour calculations for proposed bridge replacement.



- M-30 over the Tobacco River
    - 2D model developed to more accurately model flow splits with downstream dam that failed in May 2020 and assist with the design of a replacement structure. The dam failure led to the failure of our structure upstream of the dam due to scour.







Future Goals:

MDOT's goals moving forward with 2D Hydraulic Modeling are as follows:

- Continue to further develop and evaluate 2D hydraulic models.
- Develop better survey practices. Research topics have been submitted to refine the state of practice for hydraulic survey pickup.

- Follow and review the results of the upcoming research regarding Manning's Roughness values in 2D Hydraulic Models (NCHRP 24-49).
- Work with counterparts at EGLE to develop comfortability with the models.
- Adjust language in the Drainage Manual:
    - MDOT will modify language in the Drainage Manual to allow 2D modeling, pending approval from the Hydraulic Engineer.
    - MDOT will modify language in the Drainage Manual to recommend 2D modeling as the preferred method to evaluate scour for multi-span structures.
- MDOT will modify language in the Drainage Manual to recommend 2D modeling for scour countermeasure designs.

Attainment of the above goals will help address the following TDIP related goals:

- MDOT hopes to encourage and incorporate more advanced hydraulic modeling as part of normal business practice.
- MDOT hopes advanced hydraulic modeling will lead to more accurate hydraulic models to aid in calculating scour and scour countermeasure design, leading to more resilient designs.