2019 Act 157 Demonstration Projects
Ashland County Report

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Executive Summary

Background

Northern Wisconsin has faced significant flooding challenges due to multiple 100 and 500-year storms in recent years. These severe events have endangered public safety and inflicted substantial damage at vulnerable road-stream crossings. County level departments, including those concerned with emergency management, public safety, conservation, transportation, and economic development, are proactively preparing for floods with actions that mitigate future flood damages and enhance climate resilience.

2019 Act 157

To address these challenges and pilot new approaches to flood mitigation, 2019 Act 157 allocated $150,000 to Ashland County from the urban nonpoint source water pollution abatement and stormwater management fund to support up to three innovative natural flood risk reduction demonstration projects. The legislation required Ashland County to submit a report to the Department of Natural Resources (DNR) summarizing the outcomes of these projects. The DNR, in turn, was tasked with reporting to the Legislature and Wisconsin Division of Emergency Management, recommendations for state policy or funding adjustments to improve the use of nature-based solutions to reduce flood risks. This report satisfies Ashland County's reporting requirements and provides input to the DNR and other decision makers on policy and funding recommendations.

ASHLAND COUNTY LAND AND WATER CONSERVATION DEPARTMENT

Wisconsin Wetlands ASSOCIATION

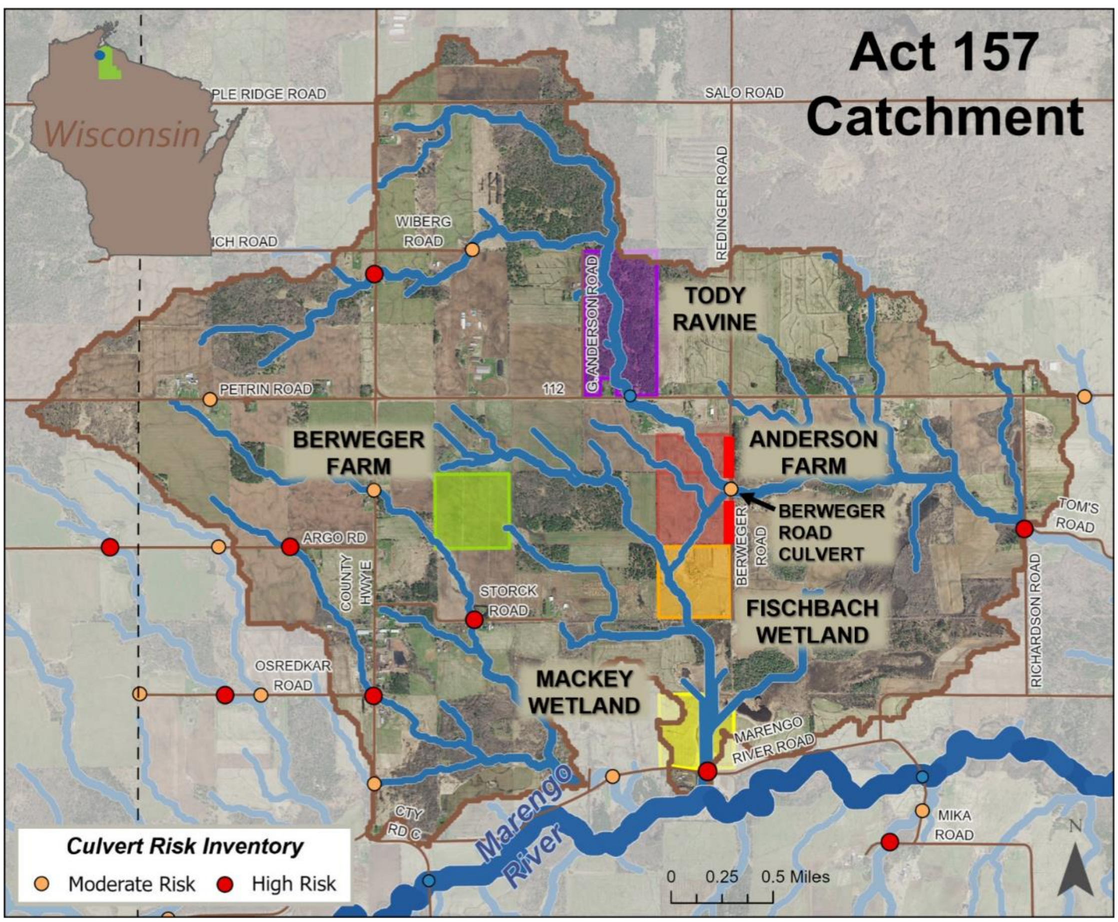
PROJECT LEADERSHIP

The Ashland County Land and Water Conservation Department led the Act 157 project in collaboration with staff from the Wisconsin Department of Agriculture, Trade, and Consumer Protection's Conservation Engineering Section, Wisconsin Wetlands Association, and many other collaborators. The County was uniquely qualified for this work due to recent flood vulnerability assessments and the adoption of climate adaptation and hazard mitigation strategies focused on restoring hydrology to reduce flood risks and damages.

FOCUS AREA

Act 157 projects were centered in the Marengo River Watershed, an area characterized by steep terrain and erodible clay and sandy soils. Historic hydrologic alterations and intense rain events have exacerbated excess erosion and deposition, impacting transportation infrastructure, water quality, and habitat conditions.

Restoration projects were informed by recently generated data on erosion hazards and hydrologic conditions, through discussions with local landowners and the input of engineers, hydrologists, and program managers at a field-based design session. These efforts culminated in the decision to focus on the restoration of multiple hydrologically connected sites within a defined drainage area (see map below). The project team also leveraged the Act 157 award to secure additional funding to expand the number of projects pursued.



Project Summary

The project team completed two projects (including four conservation practices), both of which focused on mitigating erosion hazards and restoring headwater wetlands and streams. A third complementary project was designed and built with leveraged funding to restore wetlands and reduce flood flashiness and sediment loads. See Appendix A for descriptions of the site conditions, goals, results, and reflections from built projects.

Two additional projects were planned and fully designed, but not implemented due to regulatory challenges, state agency coordination issues, and other constraints which forced project dollars to be turned back and flood risks to remain unaddressed. See Appendix B for descriptions of projects that did not advance.

The project team embraced a hydrologic restoration strategy, in which projects are designed, to the extent possible, to return wetland, stream, and floodplain hydrology to a more natural and self-regulating condition to achieve a variety of goals. Therefore, elements of projects that involved the restoration of wetland, stream, and floodplain hydrology are also referred to as hydrologic restoration throughout this report.

The hydrologic restoration goals at multiple sites included reducing flood peaks and improving flood resilience. To work toward these goals, the project team proposed using a combination of nature-based and structural solutions to reestablish the landscape's capacity to capture, store, infiltrate, and slowly release runoff. This hydrologic restoration strategy is also known as natural flood management (NFM). The project team placed specific emphasis on mitigating the loss of headwater wetland storage and floodplain connectivity along the small tributaries to prevent future flood damages.

Headcut causing loss of soil and flood storage in a headwater wetland.

Stream incision preventing water from accessing the floodplain, resulting in floodplain disconnection.

Lessons Learned and Recommendations

The lessons learned in this report resulted from knowledge gained and the project team's direct experiences working on both built and abandoned projects. Though experiences differed somewhat at each site, the lessons learned are broad takeaways that apply over multiple sites.

Likewise, the recommendations address these larger lessons and are actionable in the near term. Highlights of lessons learned and recommendations from the Act 157 projects include:

Lesson: There is an urgent need for hydrologic restoration to enhance flood resilience, and recent legislative and program developments provide valuable funding opportunities.	**Recommendation:** Continue to advance state strategies to increase flood resilience, including reauthorization of funding for Wisconsin's Pre-Disaster Flood Resilience Grant Program, and review state grant programs (i.e., DATCP Soil and Water Resource Management Program) to create alignment of incentives for hydrologic restoration work.
Lesson: Clear team structures are needed to improve coordination and understanding among partners in complex projects.	**Recommendation:** Develop streamlined regulatory approaches for hydrologic restoration projects enabled through the above new policies and operationalize those systems through establishment of interagency memoranda of understanding. Listing key staff or key agency positions would help improve communication.
Lesson: Stream and floodplain regulations stifle innovative approaches to hydrologic restoration.	**Recommendation:** Identify and enact policy improvements to better enable hydrologic restoration in regulated waters.
Lesson: Implementing hydrologic restoration at a catchment scale can maximize benefits but adds complexity.	**Recommendation:** Adjust program criteria to better enable multi-site and multi-year projects and establish funding for the coordination of efforts to plan and implement restoration opportunities at a catchment-scale.
Lesson: A lack of data and decision support tools hinders hydrologic restoration work.	**Recommendation:** Invest in data that helps identify and evaluate flood vulnerabilities and prioritize strategic restoration opportunities.

See Part 3 Lessons Learned & Part 4 Recommendations for more detailed information.

Part 1. Background

Ashland County Flooding

Flooding is Wisconsin's most frequent and costly disaster. Like many areas of the state, Ashland County has recently been affected by severe rain events, including multiple 100- and 500-year storms. These events have endangered public safety resulting in the loss of human life, caused many millions in damage to transportation infrastructure and private property, impacted water quality, and caused degradation of wildlife habitat. For these reasons, flooding is a significant concern for Ashland County departments tasked with emergency management, public safety, conservation, transportation, and economic development.

In northern Ashland County, road-stream crossings have been particularly vulnerable because this area is naturally challenged by steep terrain and erodible clay and sandy soils. Many forms of current and historic land use alterations have taken place such as clearcut logging, ditching, beaver removal, and road infrastructure. These complex landscape conditions, combined with more frequent and extreme rain events, have caused or accelerated the development of erosion hazards that increase flood damages.

This area has abundant headwater storage and low energy ephemeral streams, but there is evidence on the landscape that erosion hazards are multiplying and intensifying the loss of headwater storage and floodplain connectivity. As a result, flashy flood flows and excess sediment and debris are causing repetitive and severe flood damages.

2019 Act 157 Overview

In response to these concerns, 2019 Act 157 allocated $150,000 to Ashland County from the urban nonpoint source water pollution abatement and storm water management fund. This funding was designated for up to three innovative natural flood risk reduction demonstration projects. According to Act 157, Ashland County is required to submit a report to the Department of Natural Resources (DNR) summarizing the results of these demonstration projects. Additionally, the DNR must report to the Legislature and Wisconsin Division of Emergency Management with a summary of results and recommendations for state policy or funding adjustments to create incentives to protect and restore natural infrastructure and reduce floods.

Ashland County Flood Resilience Work

Ashland County has proactively engaged in a variety of watershed-scale vulnerability assessment and planning projects, resulting in the adoption of strategies to restore the hydrologic functions of wetlands, streams, and floodplains. Examples include:

- Land and Water Resource Management Plan: Developed in collaboration with the Northern Institute of Applied Climate Science (NIACS) to address increased precipitation and flooding.

- Hazard Mitigation Plan Addendum: Adopted to recognize the benefits of restoring hydrology to reduce flood risks and damages. This addendum, titled "*A Strategy for Natural Flood Management and Climate Resilient Infrastructure*," emerged from a FEMA-funded project that assessed erosion hazards and prioritized restoration opportunities.

- Many local and regional organizations, such as Lake Superior Collaborative partners also contribute greatly to protection, restoration, & climate resilience efforts in the Wisconsin portion of the Lake Superior watershed.

PROJECT TEAM AND COLLABORATORS

***<u>Project Team</u>**: The following core team members collaborated on the site selection, design, engineering, and construction of the two Act 157 projects and one complementary project. The team navigated this effort through planning, regulatory, and construction phases. The team continues to work together in the monitoring of project results.*

- Ashland County Land Conservation Department: led the Act 157 initiative due to its existing role in implementing soil and water conservation practices, many of which address erosion and flood damages.

- Wisconsin Wetlands Association: supported Ashland County by providing technical assistance so the county could manage a catchment-scale effort that included Act 157 projects and complementary projects.

- Department of Agriculture, Trade, and Consumer Protection Conservation Engineering Unit: provided engineering assistance to Ashland County in project design and implementation.

***<u>Other Collaborators</u>**: Various entities contributed to this phased effort, some of which are listed below.*

- Department of Natural Resources Office of the Secretary – Northern Office: served to lead the DNR's participation and facilitate coordination with multiple DNR programs.

- Department of Natural Resources Bureau of Environmental Analysis & Sustainability: provided the permitting approval of Act 157 projects.

- Department of Natural Resources Bureau of Waterways: Provided funding for the complementary Fischbach Wetland project through general permit surcharge revenue.

- Department of Natural Resources Office of Great Waters: provided key support to enable the hiring of a natural flood management coordinator, identified funding sources to supplement Act 157 funds, and provided design support for Act 157 projects.

- Natural Resources Conservation Service: participated in design session and the project employed various NRCS technical standards in Act 157 and complementary projects.

- United States Geological Survey Upper Midwest Science Center: deployed cameras and monitoring equipment to observe the Tody Ravine project under varying flow conditions.

- Inter-Fluve: facilitated field-based discussions at the design charrette and provided input on early design concepts for the Tody Ravine project.

- Trout Unlimited: participated in the design charrette and provided input on the Tody Ravine project.

- Superior Rivers Watershed Association: Assisted through multiple site visits to conduct baseline monitoring and assist with plantings and adjustments at the Tody Ravine project.

Part 2. Project Overview

Approach and Implementation

The Act 157 projects in Ashland County utilized a hydrologic restoration approach referred to regionally as natural flood management or "NFM". NFM utilizes a combination of nature-based and structural solutions that restore hydrology to reestablish the landscape's capacity to capture, store, infiltrate, and slowly release floodwaters. NFM often involves a catchment approach to mitigate the loss of headwater wetland storage and floodplain connectivity along the small tributaries of rivers to prevent future flood damages.

The **Lake Superior Collaborative** has a **Slow the Flow Team** that supports NFM work regionally throughout the Lake Superior Basin. **"Slow the Flow"** refers to slowing the movement of water on the landscape by using a watershed-scale hydrologic restoration approach that increases in-channel roughness and channel sinuosity, land surface roughness, water storage in wetlands, and infiltration in catchment areas.

More information about the Collaborative is available at: https://lakesuperiorcollaborative.org/

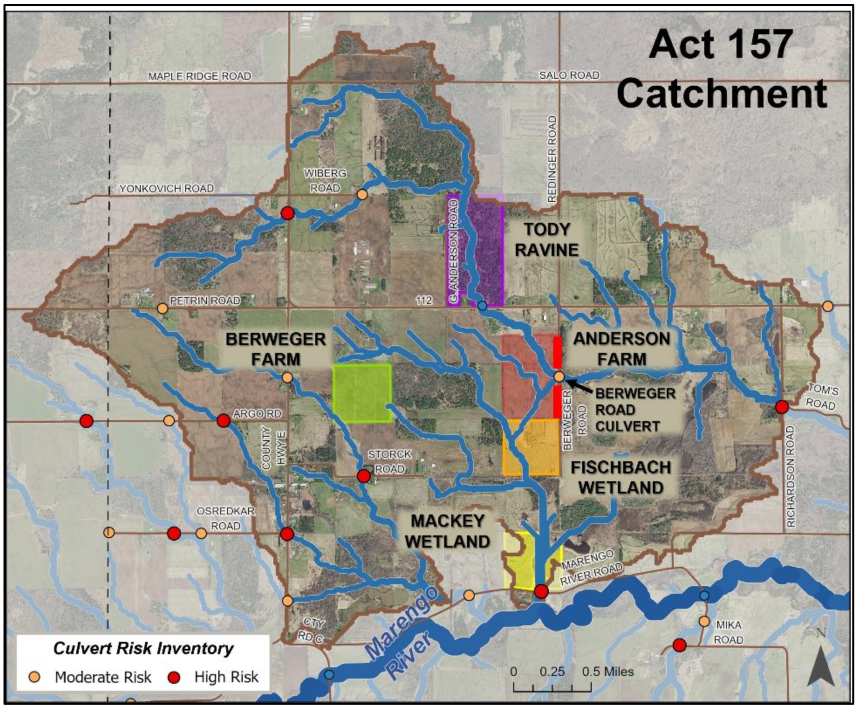
Focus Area

All Act 157 projects were located in the Marengo River Watershed, an area well known to be challenged by steep terrain, erodible soils, historic and current hydrologic alterations, and severe storms. These factors have led to erosion and loss of headwater storage and floodplain connectivity, resulting in repetitive flood damages along vulnerable road-stream crossings and farmlands.

Potential project areas were identified through a field-based design session hosted by the Wisconsin Wetlands Association, which explored flood vulnerabilities and restoration opportunities within this watershed. Discussions soon centered on a catchment upstream from the main stem of the Marengo River, with its outlets affecting flows near high-risk culverts on Marengo River, Richardson, and Mika Roads. The catchment was selected due to the degraded headwaters and high repetitive loss due to flood damage. Abundant opportunities to reestablish headwater storage and reduce flood peaks and excess sediment loads also influenced this choice. The project team developed a catchment-scale restoration strategy, which identified goals and desired outcomes for multiple sites along shared flow paths within this catchment.

Restoration Sites and Funding

The vulnerabilities and opportunities in this catchment far outweighed the funding provided through Act 157, so Ashland County and the Wisconsin Wetlands Association successfully applied for grants to pursue additional projects within the Act 157 Catchment. The map and text below describe the sites identified to help address flood vulnerabilities and landowner goals within the focus area.



Tody Ravine: Located in the headwaters of this catchment, Tody Ravine consists of a valley that has recently transformed from a low-energy wet meadow complex into an incised unstable channel that is amplifying flows and sediment loads downstream. The project team constructed a series of post-assisted log structures (PALs), root wads, and riffles at the beginning and end of the project. This project is designed to rebuild floodplain connectivity to allow for more water and sediment to be captured, stored, and slowly released on the landscape and reduce flood flashiness and sediment loads moving downstream.

Berweger Farm: Located in the headwaters of an adjacent catchment, Berweger Farm contains a large gully that is actively expanding into a cropped field and sending sediment-laden water downstream. Recent roadwork upstream has diverted flows that have exacerbated gully expansion and disrupted land productivity. In this highly altered landscape, the project team implemented several practices designed to work together: wetland scrape, grassed waterway, zuni bowl, and gully stabilization. The main hydrologic goals were to stabilize the gully and reduce flood flashiness and sediment loads moving downstream.

Fischbach Wetland: This area is in the middle part of the catchment where large rain events have carved new flow paths resulting in more water and sediment from the upstream Anderson Farm. These conditions, along with historic alterations to this wetland, have reduced its ability to manage flows. The project team designed five in-line wetland scrapes along an ephemeral stream to capture runoff and provide wildlife habitat.

Anderson Farm, Berweger Road Culvert, and Mackey Wetland: These projects did not advance due to barriers and obstacles, which are discussed in more detail in Appendix B - Projects that did not advance.

Find more information on detailed project results and reflections in Appendix A. For more information on the status and performance of individual proposed projects, contact Ashland County Conservationist MaryJo Gingras at MaryJo.Gingras@ashlandcountywi.gov.

Part 3 – Ten Lessons Learned

1. Need for Hydrologic Restoration

Like many rural communities, Ashland County faces erosion and hydrologic challenges that require urgent attention. Recent legislative and programmatic developments in Wisconsin, such as the Hydrologic Restoration General Permit (2019 WI Act 77), cost-share eligibility for hydrologic and stream restoration under ATCP 50, and the Pre-Disaster Flood Resilience Grant program present valuable opportunities for flood-prone communities to restore hydrology to increase flood resilience.

2. Establishing Effective Teams

Some complex restoration projects would benefit from a clear, field integration team structure. This would help clarify complex roles and responsibilities, especially in multi-partner or large-scale projects, leading to better understanding and coordination among applicants, collaborators, and regulatory agencies.

3. Engaging Landowners and Utilizing Local Knowledge

Making strides for flood resilience requires work on privately owned lands. County Land Conservation Departments are particularly well suited to cultivate the necessary relationships with landowners. The Act 157 project team collaborated with agricultural landowners and needed to incorporate the landowners' vision and goals for their property.

The project team engaged area agricultural producers and town officials to understand local flood risks.

Project team and collaborating state agencies met to tour the PALs at Tody Ravine.

4. Catchment-Scale Approach Benefits & Challenges

Implementing hydrologic restoration at a catchment scale can leverage funding and amplify benefits but it also increases complexity. The project team needed to manage a higher volume of programs, grants, and regulatory coordination, highlighting the need for more resources and planning for such large-scale efforts.

5. Importance of Headwaters Repair

Proactively addressing issues in headwaters can prevent problems from worsening downstream. Restoring headwaters is essential for reducing high-energy flows, sediment loads, and water quality impairments. However, there is a need for better data and tools to identify opportunities and effectively design projects to restore hydrology in degraded headwaters.

6. Outcome-Based Restoration Strategies

The Act 157 project emphasized achieving healthier hydrologic outcomes rather than focusing on individual practices. Combining innovative, low-tech, and structural approaches to address flood vulnerabilities offered an effective way to ensure restoration efforts fit within the modern landscape and meet landowner needs. Regulatory decision support tools are also needed to recognize and account for the diversity of flow paths in headwater settings. (In Appendix A, see item 5 in Tody Ravine Preliminary Observations)

7. Embracing Innovation and Low-Tech Practices

The Act 157 project highlighted the effectiveness of innovative approaches, including low-tech, process-based practices such as Post-Assisted Log Structures (PALs), which are designed to restore natural processes. These practices were impactful and cost effective, but also faced regulatory challenges in part because these are not currently permitted practices in Wisconsin. The project demonstrated that while innovative methods can address complex hydrologic problems, the existing regulatory framework often struggles to accommodate and support these novel approaches.

8. Importance of Field-Based Data

In this project field-based assessments complemented spatially generated data, helping to identify vulnerable areas and evaluate restoration options to adapt to rapidly changing conditions. Balancing field-based insights with technical standards compliance is crucial for effective project design and implementation.

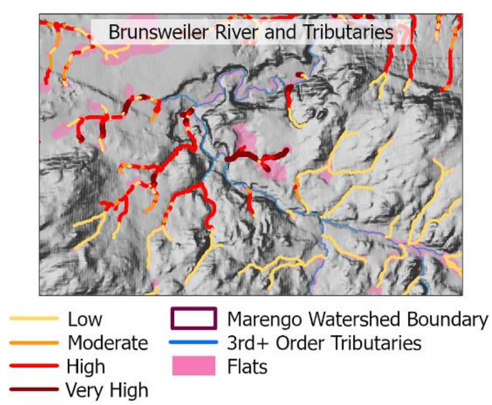
9. Challenges with Floodplain Regulations

Complex regulations can hinder flood resilience projects. For example, the proposed replacement of the Berweger Road culvert faced obstacles due to timelines and costs associated with required flood insurance rate map amendments. Outdated floodplain data and rigid regulatory requirements remain significant challenges.

10. Importance of Conservation Partnerships

The work to be done surpasses what Ashland County can accomplish alone. Developing a shared vision with other regional organizations for supporting or nature-based solutions in Ashland County and the greater Wisconsin Lake Superior Basin has helped extend the possibilities and impact of proactive restoration.

The project team met with landowners and elected officials to discuss local flood risks, project goals, and regulatory challenges.



Spatially generated data and field-assessments identified vulnerable areas within this area and inform future natural flood management work sites.

Part 4 – Recommendations

Building upon the key findings and lessons learned from the Act 157 projects, the project team identified various needs and opportunities that could improve incentives to protect and restore wetlands, streams, and floodplains to increase flood resilience. The recommendations below reflect those most immediately actionable.

1. **ADVANCE STATE STRATEGIES**: *Degraded hydrologic conditions are pervasive in Ashland County and throughout much of the state. Many opportunities exist to utilize nature-based solutions to reduce flood risks, and Wisconsin should embrace initiatives that can help us realize more of this important work.*

    - Maintain or increase funding for the statewide Pre-disaster Flood Resilience Grant, which was funded at $2 million in the 2023-25 state budget. This state-directed program helps communities assess flood vulnerabilities and plan and implement hydrologic restoration projects that reduce flood risks.
    - Incorporate a strategy for restoring hydrology to reduce flood risks and damages into the 2026 State Hazard Mitigation Plan update.
    - Review existing DNR/DATCP grant programs to create incentives for hydrology-focused assessment and restoration, which yields benefits for flood resilience, water quality, and fish and wildlife habitat.

2. **BUILD CAPACITY:** *Proactive nature-based flood resilience work is rare due to a lack of dedicated staff, time, data, and understanding of how to go about these efforts at a stream-reach or catchment scale. In addition to the recommendations below under "Data," we need to build* workforce *capacity incrementally.*

    - Consider adjustments to the Soil and Water Resource Management program to support counties interested in hydrologic restoration at the stream or catchment-scale by enabling multi-site and multi-year projects.
    - Explore opportunities to increase access by Wisconsin's rural communities to hydrologic engineering services for restoration work (e.g., public private partnerships).
    - Create opportunities for counties and Tribes that have adopted proactive flood risk reduction strategies in their Land and Water Resource Management Plan or Hazard Mitigation Plan to receive funding for identifying and implementing restoration opportunities at a catchment or stream-reach scale.

3. **IMPROVE DATA DEVELOPMENT AND DISTRIBUTION**: *Lacking appropriate data and patchwork approaches to data development can require time, expense, and technical expertise to adjust. To be strategic about restoring hydrology to reduce flood risks, Wisconsin should invest in baseline data useful for watershed-scale vulnerability assessments and scoping and designing hydrologic restoration projects.*

    - Invest in data that helps identify and evaluate flood risks and strategically prioritize restoration opportunities. Examples of this data include: hydro-enforced digital elevation models; better mapping and characterization of headwater streams and wetlands; streamflow conditions from gages; and improved flood models.
    - Develop decision support tools that help engineers understand dynamic landscape characteristics and predict (and/or quantify) potential restoration responses related to water movement, storage, infiltration, and other hydrologic connections.

- Regulatory decision support tools such as the Stream Quantification Tool need to be adapted to better support restoration of headwater systems of multiple small channels or no channel at all.

4. ***Improve Agency Coordination:*** *It can be difficult to navigate the various programs, roles, and responsibilities involved in project review. Develop efficient approaches for inter- and intra-agency coordination and collaboration with project partners on complex hydrologic restoration projects.*

- Develop streamlined approaches for coordination on projects enabled through new policies such as the Pre-Disaster Flood Resilience Grant, new ATCP 50 Hydrologic Restoration and Stream Restoration practices, and Hydrologic Restoration General Permit. These approaches should enable the project to efficiently move through project scoping, design, permitting, and construction with a shared vision and continued focus on project outcomes. Operationalize this coordination in Memoranda of Understanding between WDNR and implementing agencies. (i.e., DATCP)
- Consider assigning a field integration team that includes the relevant state agencies and programs to improve coordination on large or complex hydrologic projects. This team should be transparent to the applicant, invite the applicant to key meetings, and remain focused on project outcomes.

5. ***Reform Regulations:*** *Restoration projects can be altered or abandoned due to regulatory complexity. Restoring hydrology requires effective and efficient permitting processes that make sense in the context of project outcomes and the urgency of flood risks.*

- Review regulations in neighboring states to identify potential policy improvements, and update Wisconsin policies to better enable hydrologic restoration in regulated waters. Recommended topics to examine include:

  i. The ability to use channel-spanning structures in stream and floodplain restoration without triggering dam safety regulations (i.e., when through-flow is maintained, absence of at-risk structures downstream, etc.);
  ii. Exemptions from engineering analysis and floodplain permit requirements for projects designed to increase floodplain connectivity and storage along the small tributaries of rivers;
  iii. Regulatory treatment of erosion-induced drainage features with no or uncertain stream history; and
  iv. Cost-effective approaches to using best available data (i.e., dynamic 2D models) and tools for hydrologic and hydraulic analyses and engineering when mapped base flood elevations are tied to outdated models.

- Support efforts to change federal flood insurance program policies to reduce the regulatory burden on restoration projects in mapped floodplains. Changes should recognize the risk reduction benefits of restoration. Increases in base flood elevation may be a necessary and desirable outcome of reestablishing floodplain connectivity. There needs to be a more cost-effective and efficient process for the review and approval of projects that reduce risk and pose no risk to structures and nearby landowners.

Appendix A
2019 Act 157 *Project Descriptions and Preliminary Observations*

The purpose of this appendix is to provide site-specific information for three related projects funded either directly by Act 157 funds, or through other sources. These projects are intended to demonstrate cost-effective, nature-based approaches for restoring wetland, stream, and floodplain hydrology to help address flood vulnerabilities in the Marengo River watershed of Ashland County, Wisconsin. All of the projects were voluntary and occurred on private land.

A Catchment Approach

The Act 157 project team chose to concentrate the demonstration projects described here all within a specific catchment to show how a suite of approaches can be used together to address flood vulnerabilities across the landscape. The catchment chosen (see description below) consists of multiple small drainage areas that influence the movement of water, sediment, and debris along headwater streams and associated wetlands. The Act 157 Catchment was chosen based on the variety of hydrologic issues contained in a localized area. The team used local knowledge, landowner engagement, vulnerability assessment tools, and an interdisciplinary design charrette to help identify the projects and approaches needed for restoration. It is important to note that when truly working to address hydrologic problems, a multitude of projects are often needed throughout a catchment area.

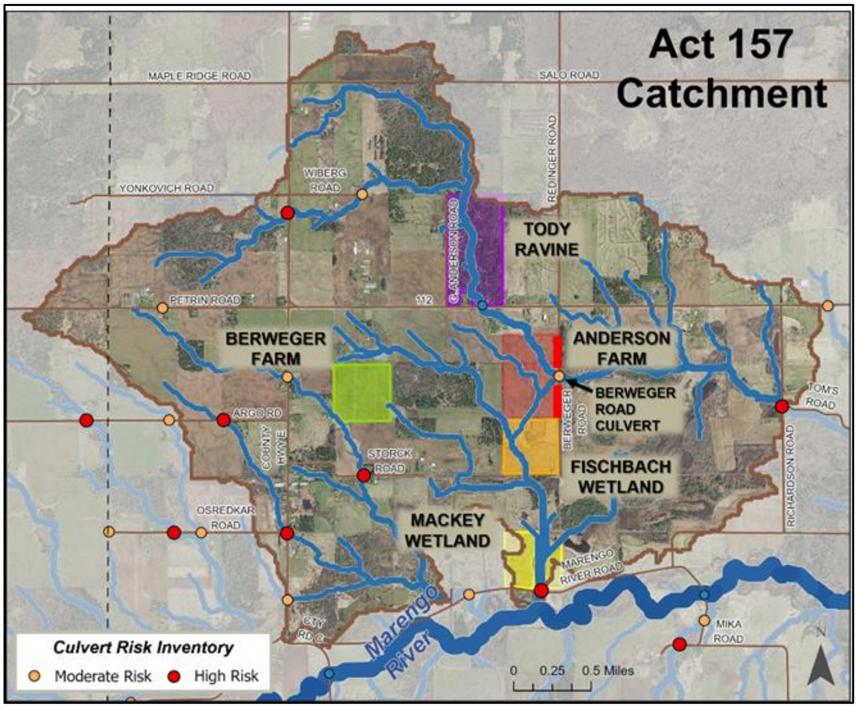
Catchment characteristics include:

- A headwater-dominant landscape where wetland loss, floodplain disconnection, and other disturbances have reduced the ability of the catchment to store and slow the flow of floodwaters upstream of high-risk sections of the Marengo River.
- A productive agricultural landscape where the presence of erosion hazards poses future public safety concerns by compromising flood storage and threatening road-stream crossings.
- Landscape features that allow for a "headwaters down" approach, and to combine and stack restoration practices along flow paths from the upper to lower reaches of the catchment.
- The potential to work with and solve problems with dairy farmers active in both Ashland and Bayfield County.

Map of Act 157 Catchment Area

A catchment-scale strategy was developed to locate restoration actions along flow paths to address the root causes of high-energy flows and excess sediment and debris. The flood vulnerabilities in this catchment involve wetland loss, recently cut channels in headwater areas, undersized culverts at road crossings, extreme gullies, and more. Hydrologic alteration (ditching), beaver removal, and legacy effects of the historic forest cutover are underlying drivers of this landscape's limited capacity to withstand extreme storms.

Project locations are shown in the catchment map below. The focus of the Act 157 effort was on demonstrating how to cost-effectively establish, as much as possible, self-regulating hydrologic conditions while accommodating landowner goals and preferences for their properties. Two projects originally included in this catchment-scale effort, are on hold. Summaries for the Anderson Farm/Berweger Road Culvert, and Mackey Wetlands projects are discussed in Appendix B.



Projects

1. **Tody Ravine** (purple area) to reconnect an eroding and incising channel to its floodplain.
2. **Anderson Farm/Berweger Road Culvert** (red area) to reconnect floodplains and construct a road crossing that accommodates future flows and excess sediment and debris. *This project did not advance due to issues related to FEMA Zone AE and other waterway regulations.*
3. **Fischbach Wetland** (orange area) to restore degraded habitat and allow wetlands to capture and slow the flow of runoff that enters the property from the north.
4. **Berweger Farm** (green area) to mitigate severe gullying, improve soil health, and reduce flashy runoff and sediment loads from a large, eroding ravine encroaching on cropland.
5. **Mackey Wetlands** (yellow area) to preserve and improve hydrologic conditions upstream of structural risks near Marengo River Road. *This project did not advance due to issues related to FEMA Zone AE and other waterway regulations.*

Tody Ravine - Headwaters Repair

The Tody Ravine site is located in a soil transition area. It contains highly erodible soils within a partially confined valley. It serves as a transition zone connecting erosive headwater gullies and downstream depositional settings, where wider floodplains begin to form and evolve across the valley bottom. The valley changed dramatically after the extreme storms of 2016 and 2018, transforming the historic low-energy stream and wet meadow complex into an incised unstable channel with 4–6-foot banks. The unstable channel is amplifying flows and sediment loads downstream.

The summary provided for *Tody Ravine-Headwaters Repair* contains more detailed information than those provided in the summaries for the other projects in this appendix. This is because the Tody project utilized new and innovative practices and additional funds were secured for the U.S. Geological Survey (USGS) Upper Midwest Water Science Center to support pre- and post-restoration monitoring.

The Problem

- The Tody Ravine is experiencing severe gully erosion exacerbated by recent extreme storms interacting with a landscape containing the effects of upstream hydrologic alteration.
- Upstream gully erosion has caused sediment deposition across the valley bottom. Erosion through the deposited sediment has formed an unstable channel.
- As the unstable channel carves deeper into the valley bottom during high runoff events, floodplain disconnection increases and flood storage decreases.
- The result is flashy flows swiftly moving water and sediment downstream and ultimately into the Marengo River.

Light equipment was needed for PALS installation in dense clay soils.

Aerial image of two installed PALS at the Tody Ravine. Bank incision visible on outward bend. (Credit: Trout Unlimited)

Historic Context

Reliable information regarding historic conditions and hydrologic functions at the Tody site is not widely available. To account for a lack of historic documentation, the Act 157 Project Team relied on information related to landscape setting, landowner knowledge, and other tools such as the General Land Office (GLO) surveys and historic aerial photos. Though incomplete, some basic conclusions were made regarding historic conditions at the Tody Ravine.

These conclusions include:

- A navigable channel, with defined bed and banks, may have never existed in the valley (no stream history). Flat portions of the Tody Ravine likely contained wetlands with multiple small channels flowing through densely vegetated areas or no channels at all.
- Large portions of the valley bottom likely received groundwater input to maintain wetland conditions between flood events. Many groundwater seeps still exist at the base of the eastern valley edge.
- Beaver activity as recent as 2015-2016 was reported by landowners. Data collected by USGS confirmed the recent presence of beaver activity.

PROJECT GOALS

- Reduce flood flashiness and sediment loads moving downstream.
- Rebuild floodplain connectivity to allow for more water and sediment to be captured, stored, and slowly released on the landscape.
- Test and explore the cost-effectiveness of low-tech approaches that mimic, promote, and sustain natural processes such as wood accumulation and floodplain formation.

PROJECT ACTIVITIES

The installation of channel-spanning post-assisted log structures (PALS) was selected as a low-tech approach to establish wetland, stream, and floodplain conditions that achieve project goals along the 850-foot project site. These structures were designed to capture sediment in the incised channel, lifting the grade of the channel to reestablish more frequent floodplain connectivity during small and large floods.

- Nine PALS were originally planned to be installed approximately 100ft apart in straight sections of the project corridor. Eleven PALS were ultimately authorized and installed as extra material was available.
- Two rock riffle structures were placed at the upper and lower portions of the channel to stabilize the project site. Angular rock was used to minimize the potential for failure of the constructed riffles.

DESIGN APPROACH

- No state-approved technical standards currently exist for channel-spanning features that stabilize channel beds with large wood. Methods developed in the western United States were used as a guide for PALS installation. These methods were adapted to fit the unique regional conditions of Lake Superior watersheds. An interdisciplinary team helped determine the number, sizing, and configuration of the channel-spanning structures.

- A combination of hand-built and machinery-assisted construction methods were used at the Tody Ravine to account for the abundance of clay soils and the need to use larger wood to accommodate flashy flows (7+ inch diameter logs, 30+ feet long). Light equipment was used to move and place logs, excavate material, and drive the vertical posts far enough into the channel bed and floodplains to minimize the risk of scour and excess debris transporting downstream to the County Highway 112 bridge. The Tody Ravine project is considered “low-tech” because the design required minimal engineering and each structure was built with materials harvested near the site, e.g., logs, root wads, and woody material.

- The regulatory process required a design that restored and maintained a low-energy channel with a depth of 1.1 feet. To meet this requirement, PALS were built to uniform heights to achieve the required channel geometry at each location.

PRELIMINARY OBSERVATIONS

1. Cost-effectiveness. PALS seem to be a cost-effective way to capture wood and sediment in low gradient situations. Materials, labor, and equipment cost a total of $30,727. The cost of each structure was between $2,800 and $3,400.

2. Minimal engineering needed. PALS are not an engineered practice and fall more into the ecological practices category set by the federal Natural Resources Conservation Service (NRCS). Effective PALS installation relies on knowledge of fluvial processes to create and revitalize desired hydrologic features. Installation must be adaptive to site-specific conditions and the stream corridor where interventions will occur. Field-based, interdisciplinary discussions can inform design decisions on the number, placement, configuration, and sizing of large wood structures. If Wisconsin-specific technical standards are developed for PALS, they should enable flexible, field-based decision-making during final design and construction.

3. Redundancy is key. Multiple, closely spaced structures are needed to dissipate energy and erase the effects of incised channels. Additional PALS within the project corridor could have helped reduce the energy of the runoff flows affecting each PALS. Because of the low cost of PALS installations relative to engineered solutions, future PALS projects should plan to space the structures as close together as possible to achieve project goals.

4. Beaver recolonization is likely. In the past, beaver activity influenced natural processes at the Tody Ravine. Increased in-channel and floodplain roughness should be used to reduce the energy of runoff to the extent beaver activity can resume and be maintained without conflicts to farmland and infrastructure. Although not a stated project goal, resumed beaver activity could be an important factor allowing self-regulating hydrologic conditions to persist.

5.★ Key Lesson! Think beyond the single-channel system. Form-based permit standards that promote a specific single channel geometry can reduce the effectiveness of PALS installations. The DNR Individual Permit specifications for the Tody Ravine site required that a single-thread, 1.1-foot deep, low-energy channel be maintained at every installed structure. To comply with this standard, the Act 157 Project Team built structures to uniform heights across the entire project (1.1 feet below the top of the streambank). This requirement resulted in partial failure of some of the structures from flanking erosion and undercutting. Because the structures were not constructed to the top of the incised banks, more water stayed in channel versus connecting with the surrounding floodplain. The energy of the confined flows, then, caused flanking erosion around some structures. These structures need to be repaired. More guidance is needed for decision-making in situations like those at the Tody Ravine where watercourses flow through or interact with wetlands and/or flat portions of watersheds. In many healthy wetland-dominant, low-gradient situations, single-channel streams naturally become multi-thread systems or are completely erased as water spreads out across and through the wetland. Regulatory decision structures need to be updated to account for the diversity of flow paths across watersheds, especially in headwater settings.

6. ★ Key Lesson! Height matters. The regulatory requirement to maintain a single thread channel prevented tying of the PALS to the crest of the incised banks. Structures tied into the crest of the incised banks would have more effectively allowed flows to engage with the floodplain before the flows become erosive. Because the structure height was set below bank full elevation, overbank flows appeared to not be occurring at the desired frequency during small storms in the spring of 2024. Floodplain connections effectively reduce the erosive energy of flood flows. As discussed above, this structural flaw resulted in the partial flanking erosion and undercutting of some of the PALS.

7. Overbuild the keyed zone. For channel-spanning and bank-attached structures, large horizontal logs should be trenched into the channel bed to prevent undercutting and flanking. Logs should be placed laterally well into the bank to prevent flanking failure. In this situation, NRCS technical recommendations for keying-in structures were used. These proved to be inadequate due to the flanking that occurred. It will be important moving forward that site-specific conditions be carefully examined to help determine whether recommended design standards should be maintained or exceeded.

Additional experimentation on the placement and configuration of root wads within and near each structure is also needed. The root wad logs used with some structures were more robust than logs used with other structures. At some locations the root wad logs prevented flanking. In contrast, at other locations, the root wads appeared to contribute to flanking erosion due to the turbulent flows the root wads created near bank edges. Once again, the freedom to make site-specific decisions to determine the correct application of techniques on a site-by-site basis is crucial.

8. Prioritize energy dispersal. No matter what techniques are used, the goal of most hydrologic restoration projects is to reduce the energy of flood flows. Because the area above and below the project corridor remained incised, it was crucial to incorporate rock riffles to prevent headcutting at the upper and lower ends of the site where restored and unrestored conditions meet. It is important that flows engage the floodplain as soon as possible during floods. Floodplain connectivity reduces erosive energy of flows. The sooner flows leave the channel, the sooner energy is reduced, and healthy stable conditions are achieved.

9. Expect and plan for adjustments. Flanking erosion is occurring around the sides of five PALS in the upper end of the project corridor. If flanking erosion accelerates, this could limit the effectiveness of the PALS and their ability to tolerate floods and create desired conditions. Simple interventions and ongoing maintenance may be needed for 2-3 years after construction. Watershed associations and land trusts may have the technical and organizational capacity to assist project teams with the initial adjustments and repairs. Monitoring actions, and short-term maintenance interventions are always required for projects that involve flowing water. Funding and regulatory processes must allow activity for a period of time (1-3 years) after the initial restoration is complete to conduct adjustments as needed.

10. Start at the top. For future PALS installations and whenever possible, it is best to select sites that enable starting at the uppermost reaches of headwater tributaries. For Act 157, the opportunity to work with a willing landowner occurred in the middle-upper portion of the catchment. PALS will be more cost-effective if structures are installed in flat, low-energy areas. Opportunities remain upstream of the Tody site and in the upper portions of numerous headwater streams throughout the Marengo River Watershed.

Post-Restoration Initial Observations

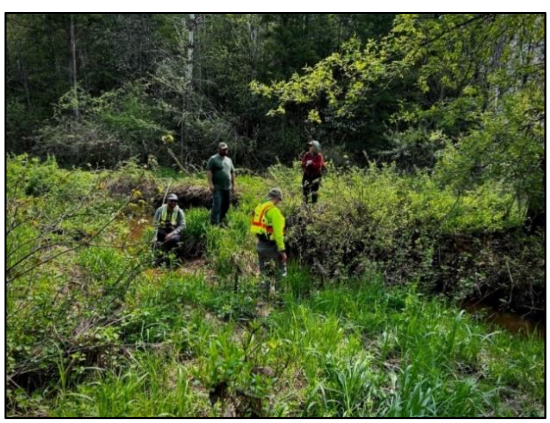
Wood, debris, and sediment appear to be accumulating behind the flow-through PALS as intended. With Great Lakes Restoration Initiative (GLRI) funding, the USGS is providing technical support to advise and assist the Act 157 Project Team with monitoring of project goals and design objectives. Assessments will be completed in the Fall 2024 by USGS to measure short-term changes in bank erosion, floodplain connectivity, and water table elevations. Longer term monitoring beyond 2024 would be beneficial, but additional funding would be needed.

The PALs are slowing the flow of water and allowing sediment to accumulate behind the structures as intended.

Flanking erosion around the sides of the PALs will require adjustments so flows do not bypass the structures.

USGS deployed a Hydrologic Imagery Visualization and Information System (HIVIS) to help monitor the Tody project. HIVIS cameras will allow USGS and the Act 157 Project Team to observe the site and structural performance during varying flow conditions. To view the camera images, go to:

- Camera #1 – Mid Reach: (https://apps.usgs.gov/hivis/camera/WI_Tody_Ravine_Mid_Reach_Upstream_of_HWY_112_near_Marengo)
- Camera #2 – Hwy 112 Bridge: https://apps.usgs.gov/hivis/camera/WI_Tody_Ravine_at_HWY_112_near_Marengo



USGS and Wisconsin Wetlands Association assessing baseline pre-restoration conditions in Tody Ravine.

FISCHBACH WETLAND RESTORATION

The Fischbach Wetland project was complementary to Act 157-funded projects. Funding for this project was provided through DNR Wetland General Permit Surcharge Funds. This approximately 10-acre wetland is situated in the middle portion of the Act 157 catchment, receiving flows and sediment from both Berweger and Anderson Farm properties during flood events. Historically, this wetland was ditched and farmed but taken out of production due to persistent wet soil conditions. The disturbed condition of this wetland reduced its ability to manage flood flows and provide healthy wildlife habitat.

THE PROBLEM

The Fischbach Wetland is located along the flow pathways downstream of the completed Tody Ravine and Berweger Farm projects, and proposed Anderson Farm projects. It is located on the flow pathway between the pending Anderson Farm/Berweger Road Crossing and Mackey projects. Multiple times per year, flashy sediment-laden flows pass through the property on their way toward the Marengo River. The flows entering the Fischbach Wetland have become more frequent and intense in recent years due to the inability of the Berweger Road culvert to pass excess water, sediment, and debris. Flows that previously moved east through Berweger Road and into a large wetland complex are now increasingly diverted south, through the Anderson Farm toward the Fischbach Wetland and along the road ditch. Before this project was completed, ditching of an ephemeral stream running through the property and other disturbances to the Fischbach wetland prevented this site from slowing and reducing the energy of the increasing volume of floodwaters entering the site from upstream.

Flow entry point (inlet) into the Fischbach Wetland from the Anderson Farm. This area needs headcut control to manage high-energy flows and prevent activating gullies in adjacent cropland.

PROJECT GOALS

- Slow the flow of sediment-laden runoff and spread flows through restored wetlands (smooth the hydrograph).
- Erase the effects of ditching and channelization along the ephemeral stream.
- Improve wildlife habitat.

PROJECT ACTIVITIES

- Construct five in-line wetland scrapes along an ephemeral stream to provide wildlife habitat and capture runoff.
- Construct a berm to help distribute flows throughout the reconnected wetlands and to prevent headcutting.
- Replace an undersized (18-inch) culvert with a rock spillway along the access road to improve hydrologic connections to adjoining wetlands.

PRELIMINARY OBSERVATIONS

1. Accommodate landowner goals. Hydrologic restoration goals must take landowner goals and preferences into consideration. In this situation, the landowner's motivation for the project was to create improved habitat conditions and slow the flow of floodwaters.

2. Hydrologic restoration can be accomplished in a variety of ways. The funding source for this project (DNR Wetland General Permit Surcharge Fees) emphasizes habitat restoration. Scrapes were constructed at this site to help address the wildlife habitat needs of the funding source and the landowner. To accommodate the hydrologic restoration goals, the scrapes were arranged in a manner that also helped distribute and slow the flow of runoff. The hydrologic goals could have been met in other ways (such as re-establishing wet meadows without excavating basins), but the approach used here elegantly addressed the needs of the funding source, landowner, and hydrologic needs. Most hydrologic restoration projects can be designed in ways to meet a variety of goals.

3. The need for monitoring. As with most conservation projects conducted in agricultural landscapes, adjustments and/or maintenance activities are required periodically after the initial project is complete. Neither the County Land and Water Conservation Department, nor the DNR have dedicated staff or funds to monitor this site. It is incumbent on the landowner, then, to sustain the desired hydrologic conditions and connections. Post-project monitoring should be included in agricultural-based projects to make sure that desired conditions are being maintained over time.

4. The need for periodic adjustments. Periodic maintenance will be needed to maintain the desired habitat and hydrologic conditions at the Fischbach Wetland. Attention to vulnerable and unstable locations within the project site should be addressed. Areas containing small elevation changes may require the installation of hardened structures to reduce headcutting at specific locations. One year after project completion, four locations are currently in need of adjustment to stabilize flow paths and reduce the energy of flood flows.

These include:

a) The eastern flow entry point at the north border of the project site. A headcut is beginning to move north into the Anderson Farm;

b) The rock crossing through the ephemeral channel. It is beginning to wash out on its west side and could fail if not addressed. A failure of this crossing could result in channel incision, reducing the ability of flood flows to engage with the restored wetlands;

c) The elevation change on the east side of the berm. A headcut is forming that needs to be stabilized. If it not stabilized, the resulting headcut could reduce the ability of flood flows to engage with the scrapes; and

d) The pre-existing channel crossing at the lower end of project. It has washed out on its west side, rendering it unusable. A spillway should be installed at the site of the washout.

Headcuts are beginning to activate on main flow paths, near spillways that were installed at the Fischbach Wetland.

BERWEGER FARM – GULLY STABILIZATION

Like the Tody Ravine, the Berweger Farm is located in highly erodible soils sensitive to gully formation and loss of flood storage capacity along headwater streams and wetlands. The Berweger Farm straddles the top of two small drainages within the Act 157 Catchment. Historic ditching and changes in flow paths send excess water and sediment in two directions. Runoff from the east portion of the site flows to the Fischbach Wetland. Runoff from the west portion of the site flows south to an adjoining headwater tributary to the Marengo River. The Berweger Farm project addresses gully formation caused by excess water flowing to the headwater tributary to the south.

The Problem

A large gully on the west portion of the site is actively headcutting northward into a cropped field. Gully expansion occurs several times per year following floods. As a result, flashy runoff flows passing through the gully deliver increased amounts of sediment-laden water downstream each year. Upstream of this site, recent roadwork on both County Highway E and Highway 112 diverted flows into the western portion of this site, exacerbating gully expansion and disruption to land productivity.

Severe gullying encroaching into the cropped fields on the Berweger Farm.

Downstream from this ravine, sediment makes its way through a degraded headwater tributary to the Marengo River.

Project Goals

- Reduce flood flashiness and sediment loads moving downstream.
- Intercept flood flows from road and agricultural drainage ditches, to reduce gully expansion and reduce flood peaks and soil loss during small and severe storms.
- Accommodate landowner preferences for the pastured and cropped fields, including the use of structural practices to maintain farm access and control water levels to support agricultural needs.

Project Activities

A combination of hydrologic restoration practices were selected for the Berweger Farm to improve soil health and the ability of the landscape to cope with and endure extreme weather events.

- Construct a wetland scrape at the upper edge of the field to manage ditch flows entering the site. A water control structure is incorporated to support on-farm water management.
- Create a grassed waterway to stabilize an eroding agricultural ditch and manage flows from the wetland scrape to the downstream stream corridor.
- Stabilize the outlet of the grassed waterway that enters the severe gully in a manner that dissipates energy and creates steps within the eroded channel.
- Construct a Zuni Bowl at the outlet of the grassed waterway and head of the severe gully to dissipate energy and create steps within the eroded ravine channel. A Zuni Bowl is a low-profile “Zeedyk” or grade control structure made of rock to capture sediment and restore headwater wetlands impacted by headcutting, gully erosion, and channel incision.

- Install a rock-lined waterway and apron to stabilize the grade of the eroding ravine.

Preliminary Observations

1. Accommodate landowner goals. As was discussed in the Fischbach section of this appendix, hydrologic restoration goals must take landowner goals and preferences into consideration. At the Berweger Farm, the landowner's motivation for the project was to prevent expansion of the eroding gully, and to increase the effectiveness of managing water for on-farm purposes. The inclusion of water control structures was essential in meeting the landowners needs without detracting from the hydrologic benefits of the project. In this situation, the project would not have occurred without the inclusion of the water control structure.

2. Expand the toolbox. More on-farm tools and demonstrations are needed to help landowners utilize cost-effective approaches to manage gully formation, the energy of flows, and other flood vulnerabilities in catchments with steep terrain. There are techniques to address degraded hydrology that are more commonly used in other parts of the country than in Wisconsin. Learning from successful projects conducted in other regions will help Wisconsin expand the suite of available techniques that are flexible, innovative, cost-effective, and complimentary to the needs of landowners.

3. Apply an outcomes-based approach. The Berweger Farm project used traditional conservation practices in innovative ways that addressed the cause of the problem, not just the symptoms. Common gully stabilization and water control practices were combined and stacked along flow paths to address the hydrologic needs of the property. Project planning must take a catchment-scale approach to understand the root causes of on-site problems. Using this understanding to determine desired outcomes will most successfully lead to the selection of appropriate practices.

Post-Restoration Observations

The Berweger Gully Stabilization was completed in September 2024. Therefore, there have been limited opportunities to monitor the project's success.

Construction of zuni bowl, which will allow water to 'step down' the newly stabilized ravine.

Water control structure visible at outlet of newly constructed scrape, and grassed waterway between cropped fields.

Appendix B
Projects That Did Not Advance

A Work in Progress

The Act 157 Catchment was rife with opportunities to address the problem shared among landowners in this catchment: flashy sediment-laden flood flows through an unstable and erosion-prone landscape.

Appendix A describes completed projects, but three additional and urgently needed projects were unable to advance beyond the preliminary design stage. The barriers associated with these projects were largely regulatory in nature and are summarized below. These stalled projects informed the lessons learned and recommendations in Parts 3 and 4 of this report as much as, if not more than, the projects that were built.

To truly facilitate and encourage proactive nature-based flood resilience work, Wisconsin needs a multi-faceted approach to address regulatory barriers. Unless or until such adjustments are made, sites such as the ones described below remain at high risk for future flood damages and will continue to contribute to the flood vulnerabilities of this catchment area.

Anderson Farm and Berweger Road Culvert

Importance

These combined projects were identified by local residents and included among the sites visited in the field-based design session described in the Background section of this report. The sites are located just downstream from Tody Ravine. The flow of water and excess sediment, coupled with an undersized culvert on the downstream end are causing the following problems:

1. Excess sediment has prevented an existing channel from adequately conveying flow, sediment, and debris.
2. Water that should flow east under Berweger Road where it could be slowed and stored by a large wetland complex before reaching the Marengo River is instead being backed up behind the culvert.
3. Needing somewhere to go, the backed-up water has cut gullies through actively farmed crop fields, forcing flows and erosion towards the Fishbach Property to the south.

Project Activities

Preliminary design work was completed using Act 157 funding for practices designed to improve conveyance and better manage flow while protecting adjacent cropland. An additional $200,000 grant was secured from the United States Fish and Wildlife Service (USFWS) Coastal Program to replace the culvert with one that is more capable of handling existing flows. Other planned activities included: stabilizing the gullies on the property to enable them to handle excess emergency flows during large rain events without causing further erosion and damage to the Anderson and Fischbach properties; and stabilizing road ditches to slow and disperse flood flows into desired areas.

Project status & Barriers

Though sufficient funding was available through Act 157 and USFWS to complete the design and construction of the proposed work, the location of the project in a FEMA mapped floodplain added costly and time-consuming regulatory requirements. These rendered the project unviable within the available budget and grant-prescribed timeframes. As such, none of the planned work has been able to proceed and the $200,000 grant from USFWS was returned unspent.

Specific issues encountered include, but were not limited to:

- FEMA mapped the area covering the tributary along Anderson Farm as a Zone AE floodplain in 1977. These 47-year-old maps do not accurately reflect current conditions, but still set the baseline against which project derived changes in base flood elevation must be measured.

- More accurate data and more sophisticated modeling is available for the Marengo Watershed. However, in order to use this data, federal and state policy requires either that: communities adopt entirely new maps based on the new data; or that applicants correct the original 1977 Zone AE data and predict post-restoration conditions using the same type of model used in 1977. Either option adds significant time and expense and limits the use and utility of the best available data.

- The proposed work would have reduced risk at a vulnerable road-stream crossing. The plan would also have slowed and spread water into former and existing wetlands, resulting in nominal increases in flood elevations with no increased risk to people or property. Under current law, projects that will result in *any increase* in base flood elevation must secure a regulatory approval called a Conditional Letter of Map Revision (CLOMR). The CLOMR process requires additional modeling, a permit fee of $8,000, and a federal review process of up to 9 months. Completion of this process does not guarantee project approval.

- County Land Conservation Departments do not have the capacity or expertise to complete this type of modeling on their own, and public and private sector engineers are reluctant to work on projects located in Zone AE floodplains. In this project, Ashland County sought technical assistance from multiple state and federal agencies, and four private engineering firms. All entities declined the work based on their own experiences of delays and project uncertainties when working in FEMA-regulated floodplains.

SUMMARY

- Requiring project sponsors to take on the expense of using and updating antiquated Flood Insurance Study maps makes it cost-prohibitive to restore stream, floodplain, and wetland hydrology and create climate-resilient structures. These policies discourage implementation of proactive flood preparedness strategies and incentivize the replacement of culverts to the same size and configuration that caused failures during past floods.

Backwatering before the Berweger Culvert after heavy rain. Water is finding new paths onto a farmed field and along road ditches.

New flow paths have eroded productive cropland at Anderson Farm.

The channel leading to Berweger Culvert is overwhelmed with sediment, not allowing flow and debris passage.

Sediment buildup before culvert, and water finding new paths.

Mackey Wetland (Complementary project)

Importance

The Mackey Wetland was identified as a critical site for hydrologic restoration because the large wetland is located at the bottom of the catchment where capacity to manage and store flood flows is essential.

During the 2016 and 2018 floods, an existing embankment partially failed, compromising the site's flood storage capacity and channelizing flows near vulnerable culverts on Marengo River Road. Although the Mackey Wetland was not a candidate for Act 157 funding, Ashland County and WWA were actively exploring external funding to remove the embankment and reestablish self-regulating hydrologic conditions at the site. The downstream culvert has been identified as a repetitive loss structure, susceptible to future risk.

Without intervention, the remaining embankment will undoubtedly fail completely, allowing a headcut to form at the Marengo River Road culvert and travel north into the wetland. This would drain or partially drain the wetland, causing loss of critical flood storage and delivery of additional excess flow and sediment to the main stem of the Marengo River.

Aerial view of Mackey Wetlands (left) and close up view of the partially failed embankment (right).

Proposed Activities

Meetings were held with WDNR regulatory staff, including those administering potential restoration funding to discuss design ideas. Discussions centered around the need to remove the failed embankment and stabilize the site to improve hydrologic processes and prevent future headcutting at the property outlet during floods.

PROJECT STATUS & BARRIERS

This is a complex and high-stakes site due to the extensive wetlands sitting upstream from a highly vulnerable road crossing that delivers flow to the Marengo River, and the fact that the wetland storage is currently being held in place by a historic, partially failed embankment. No work has yet been authorized or funded to implement the proposed risk reduction activities.

- As with the Anderson Farm and Berweger Culvert projects, the Mackey site also lies within a Zone AE floodplain. As such, it would have been subject to the same costly and time-consuming regulatory requirements and would be hindered by the lack of funding or engineering support needed to comply.
- The site required a steady focus on proposed project outcomes (i.e., use a low-profile structure to protect the culvert and maintain extensive wetland storage following removal of the failed embankment); however, discussions with regulatory staff got stalled on the terminology of proposed practices and the eligibility of those practices for funding. The original funding request described the structure as a spillway. Later the landowner requested a basic water control structure to allow management of vegetation and water levels. Though both options would have allowed the passage of water and would protect rather than endanger downstream infrastructure, they were interpreted as meeting the definition of a "dam" for regulatory purposes. The DNR indicated the new structure would likely be denied permitting.

SUMMARY

Situations like this, where natural and build infrastructure interact and become interdependent, are common in developed landscapes. Policy flexibility is needed to ensure that active risks can be mitigated in ways that meet landowners needs and preserve wetland and waterway health. Recommendations to this effect can be found in Part 4 (Recommendations) of this report.

Appendix C

Act 157 Catchment Budget Summary

Project & Purpose	Associated Practices	Funding	Status
Tody Ravine Stabilization: Reduce flood flashiness and sediment loads	Post-assisted log structures (PALS) Rock Riffles	Great Lakes Protection Fund $33,084.96 Act 157 $5,000.00 **TOTAL ACT 157: $5,000**	Complete
Berweger Farm: Mitigate erosion hazards Reduce soil loss and gullying		Act 157 $120,446.25 *(construction)* $10,256.25 *(design/permitting)* **TOTAL ACT 157: $130,702.50**	Complete
Anderson Farm: Reestablish healthy channel Reconnect floodplains	2-stage channel Bioengineering	Act 157 $14,297.50 *(H&H engineering services via Enginuity for FEMA compliance)* Estimated Cost (May 2022) $94,250.50 *(construction)* *+10,000 DATCP cost-share* **TOTAL ACT 157: $14,297.50**	Not Implemented
Fischbach Wetland: Reestablish hydrologic processes Reduce flood flashiness	Wetland restoration	DNR General Permit Surcharge $40,108.50 USFWS Grant $5,000.00	Completed
Act 157 Budget Summary	$150,820 (*estimate*)		
Natural Flood Management Marengo River Watershed Project Coordinator	Project management	Great Lakes Restoration Initiative $87,364.97	Completed
Anderson Farm & Berweger Road Project Design	2-stage channel Bioengineering Aluminum box culvert & stabilization	Department of the Army U.S. Army Corp of Engineers $90,000.00	Completed
Complementary Projects			
Berweger Road Culvert: Restore natural flows Reconnect floodplains	New road-stream crossing	USFWS Coastal Program $200,000 $218,128 (est. 5/2022)	Not Implemented
Mackey Wetland: Preserve and rebuild flood storage, stabilize outlet	TBD	TBD	Not Implemented
OTHER POSSIBLE CATCHMENT WORK CONGRUENT TO ACT 157			
Long Island Engineer CLOMR Process	H&H Modeling	$75,000 (*estimate**) *to complete Zone AE process for Anderson Farm and Berweger Road Culvert	Pending