Minnesota Sea Grant Green Infrastructure Code Audit

Project Final Report

Sea Grant MINNESOTA

NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce

Natural Resources Research Institute
University of Minnesota
Driven to Discover℠

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Acknowledgements

Authors and Contributions:

Madison Rodman[1], Tiffany Sprague[2], Jessy Carlson[1], and Juli Beth Hinds[3]

[1] University of Minnesota Sea Grant College Program, [2] University of Minnesota Natural Resources Research Institute, [3] Birchline Planning LLC and University of California San Diego

The authors contributed to the report and project as follows: project funding acquisition – M. Rodman and T. Sprague; code audit process and completion of project deliverables – J. Carlson, J.B. Hinds, M. Rodman, and T. Sprague; primary report authors – M. Rodman, T. Sprague, and J. Carlson; report review and editing – M. Rodman, and T. Sprague.

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To learn more about this project visit z.umn.edu/CodeAudit or contact Madison Rodman, Resilience Extension Educator, University of Minnesota Sea Grant Program, at mrodman@umn.edu or 218-726-8536.

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University of Minnesota Sea Grant Program
31 West College Street
Duluth, MN 55812
Email: seagr@d.umn.edu
Phone: (218) 726-8106
seagrant.umn.edu

173 McNeal Hall
St. Paul, MN 55108
Email: seagr@d.umn.edu
Phone: (218) 726-8106
seagrant.umn.edu

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Green Infrastructure Code Audit Project Final Report

Introduction

Overview

Background and introduction

This project supported the University of Minnesota Sea Grant College Program and the Natural Resources Research Institute in addressing interrelated adaptation and resilience issues in northeast Minnesota: water quality impairments, damaging large precipitation events, and flooding impacts from extreme storms along Lake Superior's North Shore.

While streams and rivers in northeast Minnesota are relatively pristine, increased recreational demand and population in northern Minnesota have led to pockets of development along the North Shore of Lake Superior. Increased recreational use and development can put pressure on water resources, accelerate streambank and shoreline erosion, and challenge shoreline management practices.[1] As a result, there are growing concerns over increased sediment and turbidity in streams near development sites, as well as a need to maintain the cool water temperatures Brook Trout need for spawning and survival.

Compounding these water quality issues, the Midwest is experiencing increased precipitation and large storm events. The 2014 National Climate Assessment documented increasing precipitation in the Midwest, and stated that " … extreme rainfall events and flooding have increased during the last century, and these trends are expected to continue, causing erosion, declining water quality, and negative impacts on transportation, agriculture, human health, and infrastructure."[2] The Minnesota Department of Natural Resources (MN DNR) has documented an increasing frequency of mega-rain events in Minnesota (including the 2012 mega-rain event in the Duluth area). Furthermore, an analysis of climate trends for the Lake Superior-South Watershed, where Duluth, Minnesota, is located, showed increasing precipitation totals over the period of record from 1895-2020.[3,4]

Green Stormwater Infrastructure

Green Stormwater Infrastructure (GSI), and other strategies for mitigating water quality and landscape-level impacts of increased storm events, represent feasible and cost-effective solutions for climate adaptation to water quality and quantity issues. In the 2019 Water Infrastructure Improvement Act, green infrastructure was defined as " ... the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspirate stormwater and reduce flows to sewer systems or to surface waters."[5] Green infrastructure includes a variety of built practices such as green roofs, rain gardens, tree wells, and pervious pavements, as well as natural systems such as forests and wetlands (Figure 1).

GSI can help improve water quality and reduce flooding; however, specific language in local land-use codes and ordinances can unintentionally prohibit or discourage the implementation of many of these practices. Often, outdated language in local codes and ordinances and "habits" around site planning practices contribute to ongoing problems with water quality. Municipalities may want to implement green infrastructure, but are often stymied by code language that requires, for example, mowed turfgrass, berms, and ornamental plants. The methods to shift these practices to a more resilient

approach require detailed knowledge of how to construct more effective code standards. In addition, in less populous communities, volunteer boards and small community staff members filling multiple roles are not likely to have the time or the expertise to evaluate current codes, develop new ones, and shepherd these changes through the amendment process.

Figure 1. Common urban green stormwater infrastructure. Graphic credit: C. Dettmann/MNSG.

Many examples of code language unintentionally prohibit the use of GSI. For example, codes often require parking lot islands to be surrounded by raised curbs and gutters, covered with turfgrass, or planted with trees. This limits the use of landscaped areas for stormwater management: raised curbs and gutters block runoff from entering the planted area inside the curb, turfgrass requirements prevent bioretention plantings, and trees may not be suitable for bioretention systems. Another example is code language that requires all paved areas to be "asphalt or concrete," or to be seal coated every x number of years. While likely unintentional, this wording effectively prohibits the use of pervious pavement. With thoughtful revisions, such ordinances can support – rather than hinder – the use of green infrastructure practices.

Northeastern Minnesota Communities

Recent planning documents and research efforts in the Duluth Urban Area Watershed highlighted the importance of green infrastructure implementation as a mechanism for addressing water quality and quantity.

Green infrastructure was listed as a recommended strategy for protecting unimpaired streams and improving water quality in impaired streams for all of the urban watersheds in the October 2020 Duluth Urban Area Watershed Restoration and Protection Strategy (WRAPS) Report:[6]

- Implement green infrastructure and stormwater management practices to address altered hydrology and reduce loading.
- Land Use Planning and Ordinances: Utilize audit tools like EPA's Water Quality Scorecard or Sea Grant's 'Barriers to Green Infrastructure' to systematically address ordinance deficiencies and gaps.

Green infrastructure was also incorporated into the Imagine Duluth 2035 Comprehensive Plan update for the City of Duluth.[7] The general development chapter contained an entire policy area on green infrastructure, with strategy #1 stating:

- Incorporate green infrastructure into UDC [Unified Development Chapter] requirements for development and redevelopment projects. In coordination with the City's Municipal Separate Storm Sewer System (MS4), create a mechanism to provide resources to ensure that green infrastructure on privately owned sites is maintained over time.

Updating ordinances is also one of the areas of agreement within the Duluth Urban Watershed Advisory Committee (DUWAC). Minnesota Sea Grant partnered with the Minnesota Pollution Control Agency (MPCA) to create and facilitate DUWAC, which consists of the nine communities within the Duluth Urban Area Watershed as well as the broader St. Louis County and interested agency and organizational partners. In 2018, this group of communities finalized a Memorandum of Understanding (MOU) outlining the group's purpose, vision, and areas of agreement. The DUWAC's vision seeks to ensure that "our water resources and associated ecosystems become healthier and more resilient through public engagement and local government collaboration." The DUWAC's vision statement addresses the need to protect, restore, and manage the shared water resources of these watersheds for multiple purposes, including meeting the goals of the Clean Water Act, ensuring high-quality water resources for the enjoyment of residents and visitors, and reducing damage from, and improving our community's resilience to, flooding. DUWAC's protection and management objectives are advanced through agency and community collaboration, knowledge and resource sharing, ordinance and policy review, and project prioritization. One of the areas of agreement in the MOU is to:

- Identify potential options to update our local codes and ordinances affecting water resources and associated ecosystems, as desired by each stakeholder.

Beyond the Duluth area, other northeastern Minnesota community efforts support GSI. In addition to state agency-driven watershed management plans, Grand Marais in Cook County and Two Harbors in Lake County have stormwater management plans, with nearby Silver Bay currently considering development of such a plan.[8, 9, 10,11] These stormwater management plans prioritize GSI as a strategy for mitigating flooding, however organizational capacity is limited in these communities to implement plan recommendations.

Code Audit Projects

To address northeastern Minnesota communities' needs relating to GSI and coastal resilience, Minnesota Sea Grant and the Natural Resources Research Institute were awarded two grants to fund the efforts described in this report:

- NOAA FY2022 National Sea Grant Office Coastal Adaptation and Resilience funding opportunity, “Code Audits & Community-Government Partnerships: Facilitating Pathways to Resilience with Green Infrastructure in Minnesota Communities”, 8/1/2022-1/31/2025, $125,000. Henceforth, Code Audit Phase One.
- NOAA FY2023 National Sea Grant Office Coastal Adaptation and Resilience funding opportunity, “Code Audit Phase Two: Enhancing pathways to coastal resilience through green infrastructure", 8/1/2023-4/30/2025, $125,000. Henceforth, Code Audit Phase Two.

Project team

- Principal investigators:
    - Madison Rodman, Resilience Extension Educator, University of Minnesota Sea Grant Program
    - Tiffany Sprague, Organizational Development Manager, University of Minnesota, Natural Resources Research Institute
- Key project personnel:
    - Jessy Carlson, Resilience Extension Associate, University of Minnesota Sea Grant Program
    - Juli Beth Hinds, Principal, Birchline Planning LLC and Staff Research Associate & Instructor, Department of Urban Studies & Planning, University of California San Diego
- Collaborators:
    - Karina Heim, Coastal Training Program Coordinator, Lake Superior National Estuarine Research Reserve (Nature-Based Solutions training development and delivery in phase two)
    - Maggie Karschnia, Stormwater Extension Educator, University of Minnesota Sea Grant Program and Water Resources Center (Watershed Game facilitation in phase one)

Participating communities

Given the long-standing relationships with DUWAC communities, they were given the opportunity to participate in phase one of this project at three levels of involvement: option one: to receive individualized and custom review of sections of their community’s codes and ordinances that relate to water quality protections (a “deep dive”), option two: to receive a high-level review of the key components of specific codes and ordinances in comparison to their neighboring DUWAC communities, or option 3: to not participate in the project. The City of Duluth and Midway Township volunteered to receive option one, what we called a “deep dive” review of their codes and ordinances. The City of Hermantown, City of Rice Lake, Gnesen Township, and St. Louis County, in addition to the City of Duluth and Midway Township, participated in a high-level review of water quality protection oriented codes and ordinances in comparison to one another (option two). The City of Proctor, Normanna Township, Lakewood Township, and Thomson Township did not participate in this project (option three). These last four communities have maintained minimal involvement in DUWAC over the years, so their lack of involvement in this project was not surprising. Normanna Township, in particular, defers administration of codes to St. Louis County, so they do not “control” much local enforcement, and thus would have little input to a review of codes for green infrastructure implementation.

We expanded the communities we worked with during phase two of our funding. Our goal was to work with two additional North Shore communities. Ideally, one community from Cook County and one from Lake County. In order to choose the phase two communities to support, we first identified communities in these counties that could benefit from a green infrastructure code and ordinance review and then

hosted meetings to develop relationships and learn about community priorities. The following communities and parties were engaged in phase two during the summer and fall of 2023: City of Grand Marais, Cook County, Cook County Soil and Water Conservation District (SWCD), Cook County Higher Education, Cook County Energy Project, Lake County SWCD, Arrowhead Regional Development Commission, City of Two Harbors, and City of Silver Bay. After multiple scoping and needs assessment meetings, the City of Grand Marais, Cook County, and Lake County agreed to participate in the audit process.

In total, communities that participated in the both phases of the code audit project included:

- City of Duluth
- City of Grand Marais
- Cook County
- Lake County
- Midway Township
- DUWAC Participating Communities:
    - City of Duluth
    - City of Hermantown
    - City of Rice Lake
    - Gnesen Township
    - Midway Township
    - Saint Louis County
    - Representatives from the MN DNR, MPCA, South St. Louis SWCD, and MN DNR Lake Superior Coastal Program also participated in this project as part of their membership in DUWAC.

For more detail about the participating communities, see table 1.

Table 1. Participating communities with principal contact(s)

Community	Participating Phases	Principal contact(s)
City of Duluth	Phases one and two	● Jenn Moses, Senior Planner, City of Duluth ● Clark Christenson, City Forester, City of DuluthGSI ● Kyle Deming, Planner II, City of Duluth ● Ryan Granlund, Utility Programs Coordinator, City of Duluth Public Works and Utilities ● Tom Johnson, Senior Project Engineer, City of Duluth Public Works and Utilities ● Kate Kubiak, Natural Resources Coordinator, City of Duluth
City of Grand Marais	Phase two	Shane Steele, Sustainability Coordinator, City of Grand Marais
City of Hermantown	Phases one and two	Trish Crego, Utility and Infrastructure Director, City of Hermantown
City of Rice Lake	Phases one and two	Carley Hungerford, Building and Zoning, City of Rice Lake
Cook County	Phase two	Neva Maxwell, Planning and Zoning Administrator, Cook County

Gnesen Township	Phases one and two	Jon Nelson, Chair, Gnesen Town Board
Lake County	Phase two	Tanya Feldkamp, Environmental Services Director, Lake County
Midway Township	Phases one and two	● Grant Forsyth, Planning and Zoning Administrator, Midway Township ● Margaret Taylor, Midway Township Supervisor
Saint Louis County	Phases one and two	● Ryan Logan, Director, Planning and Zoning, St. Louis County ● Carol Andrews, Environmental Engineer, St. Louis County ● Ada Tse, Senior Planner, St. Louis County

General audit process

In general, the code audit project focused on aligning community needs and interests with resources and expertise to offer recommendations and education on code changes that could enhance adoption and implementation of GSI practices. We accomplished this through the following efforts:

- Learning about prior code audit efforts across the Midwest, notably the City of Superior, Wisconsin effort, to better understand the potential challenges and opportunities.
- Identifying and hiring team members with the necessary skills and expertise to conduct the code audits (consultant, Juli Beth Hinds and resilience associate, Jessy Carlson).
- Meeting with community contacts and listening to their concerns, challenges, interests and capacities to participate in a code audit and the feasibility of adopting our recommendations.
- Developing rapport among the code audit team (co-PIs Rodman and Sprague and team members Carlson and Hinds) through monthly meetings (September 2022 - April 2025) and developing a process for responding to community inquiries, education needs and reporting on the progress of the audits.
- Maintaining frequent engagements with community teams and their respective departments on project progress or to ask specific code-related questions; engagements occurred in-person and virtually through email, Zoom, and/or phone calls.
- Meeting with agency partners, such as the MN DNR, to help increase understanding or fill in knowledge gaps for our team. For example, Minnesota State Shoreland Standards was a topic with which we needed assistance.
- Facilitating in-person meetings with the code audit team and the project communities:
    - Phase one: March 28-30, 2023, Kickoff meetings with City of Duluth, DUWAC, Midway Township including playing the Watershed Game with local leaders (see Figure 2)
    - Phase one: September 25-28, 2023, Update meetings with City of Duluth, DUWAC, Midway Township
    - Phases one & two April 3-5, 2024, Update meetings with City of Duluth, DUWAC, Midway Township, and initial in-person meetings with Cook County and Lake County
    - Phases one & two: September 17-20, 2024, Update meeting with City of Grand Marais, Cook County, Lake County, DUWAC Shoreland Workshop, final Midway Township Planning and Zoning Commission Meeting, Nature-Based Solutions for Northern Climates training
    - For the audits specifically, consultant Juli Beth Hinds reviewed community codes and ordinances in the context of stormwater management and watershed health, based on

priorities identified by municipal staff and/or elected representatives. This review process involved assessing existing regulatory structures for areas of opportunity or improvement and drafting recommended changes. When appropriate, the audit process also included reviewing and assessing existing organizational procedures, such as internal employee training and information sharing practices, or enforcement procedures. Suggestions were then developed for how the community might address challenges or needs within their organizational or enforcement procedures.

Figure 2. Kickoff meeting with City of Duluth staff March 28, 2023. Photo credit: M. Rodman/MNSG.

Code Audit Outcomes

City of Duluth

In the spring of 2023, the code audit team met on multiple occasions with representatives of the City of Duluth's Planning Department, Utilities and Public Works Department, and Sustainability Officer, to discuss Duluth's priorities regarding surface water protection, flood mitigation, ordinances, and development standards. Multiple meetings with city staff allowed the team to narrow the scope of work down to three priority tasks.

The City of Duluth staff requested assistance with:

1) Redesigning parking lot landscape design standards so that required plantings have enough soil to survive, can function as stormwater features, are distributed to optimize parking lot maintenance and utility, and are not unnecessarily costly for developers.
2) Redesigning tree preservation standards to be enforceable, reasonable, and to accomplish the stated goal of preserving or increasing tree coverage on new development parcels.
3) Developing a self-certification form to support updated parking lot landscape design standards.

In response, the following materials were drafted:

1) Updated and redesigned parking lot landscape design standards.
2) Updated and redesigned tree preservation standards.
3) New self-certification form to support updated parking lot landscape design standards.
4) Updated list of recommended tree and shrub species, eliminating invasive species from recommended species list including species names.
5) Re-organization and clarification of technical standards for post-construction stormwater management.

The project team presented to the City of Duluth's Natural Resources Commission on December 4, 2024 to discuss the project outcomes and next steps. The Natural Resources Commission passed a resolution indicating their support for broader implementation of green infrastructure across the city to promote overall environmental quality, and to recommend the planning commission commit to reviewing the recommendations and advance changes as appropriate. As such, project leads from the Natural Resources Research Institute and Minnesota Sea Grant are committed to supporting the City of Duluth in their next steps to move recommendations of their choosing through the planning and public processes. For more detail on Duluth deliverables please see Appendix A.

Midway Township

In the spring of 2023, the code audit team met on multiple occasions with the Midway Township Planning & Zoning Commission to discuss Midway's priorities regarding surface water protection, flood mitigation, and township ordinances. Based on those discussions, we were able to develop a work plan to guide our collaboration over the course of the Code Audit Phase One & Two Projects.

Midway Township had already adopted a construction erosion control ordinance in 2013 (Ordinance #200), as well as a related 2021 Zoning Amendment, which incorporated the provisions of the Haul and Fill Ordinance into Midway's existing Zoning Ordinance. Although adopted, many members of the Planning & Zoning Commission were unaware Ordinance #200 existed because there was not a digital or paper copy available in the Midway Township records. Consequently the ordinance was not being actively enforced by Midway Township. Upon the death of a prior Planning & Zoning Commission member, a paper copy of Ordinance #200 was located in a basement filing cabinet and was sent to Minnesota Sea Grant staff for revision and digitization.

Midway Township Planning & Zoning requested:

1) Digitization of Ordinance #200 (haul and fill) and Ordinance #203 (subdivision of property).
2) Suggestion of updates and improvements to help preserve Midway's rural character, prevent property damage due to flooding, and preserve the quality of Midway's streams, wetlands, and other surface waters.
3) Development of materials to support the preservation of collectively held knowledge, such as processes and procedures for inspecting construction sites.

In response, the following materials were drafted:

- Updates to the haul and fill ordinance and associated zoning ordinance that clearly identifies which activities are regulated and what specific actions should be taken to reduce erosion and prevent sedimentation in Midway's streams and wetlands.
- A new haul/fill or land disturbance permit application that facilitates administration of the updated haul and fill ordinance.
- A new shoreland and wetland regulation explainer flier for residents.

Our team also provided the Planning & Zoning Commission and Midway's staff with an overview and example of surface water flow path mapping completed for the City of Bayfield, Wisconsin. This example was referenced because the project contractor, Birchline Planning, previously worked with the City of Bayfield to complete this mapping project. Flow path mapping shows how water travels across the land, based on topography and the locations and positions of storm drains, buildings, and roads. There was a lot of enthusiasm for finding a way to create flow path mapping for Midway, since this map would have many uses for landowner outreach, public works, flood prevention and mitigation. This type of mapping would also increase community understanding of why flooding and/or erosion are happening in certain locations. Our team engaged the MN DNR Lake Superior Coastal Program, and they reserved approximately $19,000 of their budget to create a flow path map for Midway Township. To confirm map accuracy and retrieve necessary data layers, we worked with Tim Beaster at South St. Louis SWCD, Bri Speldrich with MN DNR, and Jeff Jasperson with MPCA. Coastal Program staff, led by Clinton Little, intend to have a draft map available in summer 2025.

The revised and updated haul and fill ordinance was passed by the Planning & Zoning Commission, and Midway Township is applying what they learned through this code audit process as they draft a driveway ordinance for the community. For more detail on Midway deliverables please see Appendix B.

Duluth Urban Watershed Advisory Committee (DUWAC)

As described earlier, most DUWAC communities chose to participate in option two of our code audit efforts: to receive a high-level review of the key components of specific codes and ordinances in comparison to their neighboring DUWAC communities. Participating DUWAC communities were introduced to the Code Audit Project in March 2023 with an introduction to contractor Juli Beth Hinds and an initial discussion on how development takes place in each DUWAC community, what agencies get involved for water quality regulations, and what challenges may exist for parking lot and landscaping designs.

In September of 2023, DUWAC members were invited to indicate their top priorities related to stormwater management and green infrastructure. However, due to flash flooding, attendance at that meeting was low, and responses collected did not accurately represent the perspectives of DUWAC members as a whole. Therefore, in October of 2023, a survey was conducted via email to gather input regarding which topics respondents would like included on an ordinance comparison table across the DUWAC communities. These responses have value as an indication of topics that are of interest to local government unit (LGU) elected officials and staff as well as state agency representatives.

All responses, top 8 topics (n=13):

- Surface water setbacks and buffers (n=10)
- Parking lots and parking lot landscaping (n=9)
- Maintenance of stormwater infrastructure and green stormwater infrastructure (n=9)
- Construction erosion controls (n=8)
- Effective development regulations (n=8)
- Snow storage (n=7)
- Staff and elected official trainings, education (n=7)
- Multi-purpose parks and open spaces as flood management sites (n=7)

Just agency staff responses, top 8 topics (n=8):

- Surface water setbacks and buffers (n= 8)
- Multi-purpose parks and open spaces as flood management sites (n= 5)
- Staff and elected official trainings and education (n= 5)

- Snow storage (n= 5)
- Parking lots and parking lot landscaping (n= 5)
- Maintenance of stormwater infrastructure and green stormwater infrastructure (n= 4)
- Construction erosion control (n= 4)
- Encouraging use of deep-rooted plantings for ecological value (n= 4)
- Effective development regulations (n= 4)

Just local government representative responses, top 8 topics (n=5):

- Maintenance of stormwater infrastructure (n= 5)
- Construction erosion control (n = 4)
- Parking lots and parking lot landscaping (n = 4)
- Effective development regulations (n = 4)
- Surface water setbacks and buffers (n=3)
- Reducing and disconnecting impervious surfaces (n=3)
- Trash management and reducing potential sources of pollution (n=3)
- Multi-purpose parks and open spaces as flood management sites (n=2)
- Staff and elected official trainings, education (n=2)
- Snow storage (n=2)
- Sanitary sewer and storm sewer management (n=2)

Several iterations of a DUWAC community ordinance comparison table highlighting key components of specific codes and ordinances were tested, but it was clear these tables would require a high investment of time to construct, while providing very limited benefit to LGU staff. We therefore shifted our focus from construction of a comparison table to development of an interactive workshop for DUWAC members. However, the process of attempting to construct a comparison table yielded useful information which has the potential to guide future work within DUWAC communities. This information has been recorded in the document entitled “DUWAC’s Green Infrastructure Code Audit: Summary of Findings” and was shared with DUWAC communities (see Appendix C).

A third meeting with DUWAC was hosted by the code audit team in April 2024 to discuss the notable differences that were discovered in how some DUWAC communities manage erosion control measures. For example, the state mandates that erosion control measures are required when at least one acre of disturbance occurs. Across the DUWAC communities, Hermantown mandates erosion control measures occur at 500 square feet of land disturbance, while that area is 5,000 square feet in the City of Rice Lake, and 30,000 square feet in St. Louis County. This discussion highlighted the opportunity to better standardize erosion control measures for development across the region. This meeting also highlighted the need for wetland buffers, particularly in the City of Duluth, as well as confusion about how to enforce St. Louis County shoreland standards. DUWAC members noted it is frustrating to work through the various agency reporting structures, and no one is entirely sure where certain authorities lie.

This meeting led to subsequent discussions with individual representatives of DUWAC LGUs, which revealed a shared need for clarity regarding shoreland development regulations. In particular, it became evident that small rural township staff as well as larger county staff were struggling to understand and enforce their existing shoreland ordinances. The code audit team worked with Dan Petrik with MN DNR, who is responsible for assisting local governments with their local shoreland ordinances, to explore the possibility of a customized training for DUWAC communities on the topic of shoreland ordinance administration and enforcement. Over the course of these discussions, the team learned that St. Louis County’s shoreland ordinance was never approved by the MN DNR, which has resulted in confusion

regarding township and city shoreland ordinance standards, enforcement, and jurisdiction. It was determined that a workshop for DUWAC communities would be beneficial.

Figure 3. DUWAC Meeting April 3, 2024. Photo credit: T. Sprague/NRRI.

This DUWAC workshop was held in September 2024 and gave LGU staff the opportunity to ask MN DNR and county representatives questions so LGU staff could better understand their ordinances and their jurisdictional responsibilities, while also establishing communication pathways between state, county, and local shoreland ordinance administrators. MN DNR local area hydrologists discussed their role in shoreland regulations. The group then ran through a scenario about excessive development along a lake shoreline and how each community would address the situation and communicate with the homeowner, and what the restoration requirements would be. This process revealed that each community had a unique process, with some communities expressing interest in learning more from each other to better support their own enforcement processes. This workshop highlighted how important it is for each community to fully understand their zoning code as it relates to shoreland development and setbacks.

As a result of these needs, we developed informational fliers on shoreland regulations for the general public and LGU staff, and these were customized to each community (Figure 4). In addition to the summary of findings and shoreland-related products and events, DUWAC members received a folder containing useful resources such as workshop slide decks and manuals and publications from other communities (such as construction erosion control guides, small-scale BMP design manuals, model ordinances and forms, etc.).

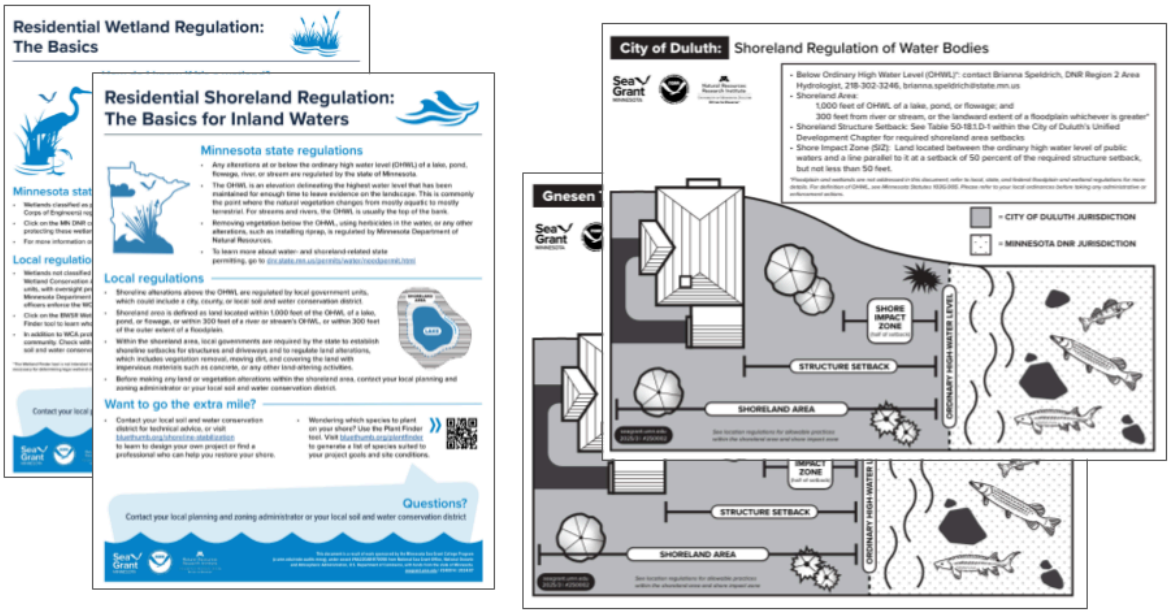

Figure 4. Examples of fliers to support local government communications on shoreland regulations for lakeshore residents (left) and staff (right). Graphic design credit: C. Dettmann/MNSG. For copies of these resources please contact Minnesota Sea Grant.

Lake County

Lake County was interested and open to a full review of their codes looking particularly at how to best make them functional and address codes that impact source water including land and vegetation disturbance, erosion control, and stormwater. Overall, we heard a need for a code that was usable, practical, enforceable, and had effective language and regulations.

After the code audit team review of the Lake County codes and ordinances a few opportunities to make the code more organized and functional for staff and residents were identified, including:

- Reorganizing the code to consolidate similar provisions.
- Creating a table of uses to replace lengthy text describing prohibited and allowed uses.
- Identifying uses that are duplicative (“dwelling unit” “residences” “dwellings”) or not defined.
- Creating a table of dimensional standards, with updates applied to parking ratios etc., including diagrams and illustrations.
- Aligning definitions with the content of the ordinances.
- Establishing a SWCD/County task force to evaluate water resource standards to identify which are in use and which are not, removing guidance from the actual standards.

After meetings and discussions with Lake County staff, the following proposed updates and full reorganization of the code were completed to address these opportunities:

- Addition of definitions in language for terms used throughout the code and removal of definitions that were not used. The definitions were aligned with current standards.
- Creation of tables of uses and dimensional standards while removing text that was previously displayed in list format over many pages.

- A full revision and update of Article 8, Water Resources, Stormwater, and Erosion Control to align with Minnesota state model shoreland ordinance. The updated article establishes the Hydrology Technical Committee and adds additional clarity and descriptive standards for stormwater control.
- Movement of guidance language into appendices. Wetland standards, functional analysis model, stormwater detention structure design standards and lawn, chemical and vegetative regulations are now appendices for easier updates and modifications as needed.

Lake County plans to complete a review of the draft reorganized code and bring forward updates during the next comprehensive plan update. As a test of the feasibility and efficiency of using the tables of uses and dimensions, they plan to try using the tables in the next few months when applications and questions are received.

Cook County

Initial discussions with Cook County Planning & Zoning and Soil & Water Conservation District staff focused on a desire for updated ordinance changes, especially shoreland ordinances, with enforceable standards and remediation requirements (e.g. if you break this rule, you will need to do x to fix it or else y). The main desire was for clear language that is practical and easy for landowners to understand.

After team review of Cook County codes, the following opportunities were identified:

- Updating the organization of standards to streamline code through tables of uses and dimensional standards.
- Updating definitions, especially related to vegetated stormwater practices, landscaping, and stormwater management.
- Updating landscaping standards to be more clear and objective, with an option to consolidate performance standards and provisions related to screening, fencing, and lighting (Section 5.11).
- Updating standards for required vegetative buffers with what is allowed or not within a buffer.

The code audit team provided:

- A redlined version of zoning ordinance number 37.
- Consolidated tables of uses, bulk and dimensional standards, and parking.
- Supplemental definition list based on the City of Eau Claire, Wisconsin code update.
- A Grade & Fill and Small Site Stormwater Permit Application Checklist for Filling & Grading Permits.

We especially thank Samantha Lee and Matthew Lippert, undergraduate students at University of California San Diego, who worked with Juli Beth Hinds to draft updates for Lake and Cook counties.

City of Grand Marais

The City of Grand Marais commissioned a Stormwater Plan in 2018. This plan contained goals and action items, one of which is to develop a City Stormwater Ordinance. Since Grand Marais did not yet have a draft stormwater ordinance, it was decided that drafting this ordinance would be the best use of project resources for the City of Grand Marais. The drafted stormwater ordinance for the City of Grand Marais was based on successful ordinances from other Great Lakes municipalities, and included a review of current zoning with a focus on stormwater and shoreland areas.

City staff response to the drafted ordinance revealed a hesitance to adopt such an ordinance due to a lack of capacity to enforce any stormwater regulations. Further discussions need to be held to propose solutions to this barrier, including with the city administrator. As of March 2025, Grand Marais planned to present the new ordinance to city council and for comments sometime in late 2025 or 2026.

Affiliated Outreach and Engagement

In addition to working directly with counties and municipalities as described above, this project also included outreach and engagement on coastal adaptation and resilience for both professional and resident audiences. These events helped share lessons learned from work in the regulatory space with professionals and community alike.

Workshops for Professionals

Nature-Based Solutions for Northern Climates: Making Vegetated Stormwater Practices Work

Background

A major focus of the Code Audit Phase Two efforts was to share learning from code audit work in communities with stormwater professionals in northern Minnesota. In partnership with the Lake Superior National Estuarine Research Reserve Coastal Training Program, the code audit project team developed and hosted a day-long workshop/training on using vegetated stormwater management practices and how to enhance vegetation performance for stormwater. Another goal of this event was to cement knowledge and learning through local site visits of green stormwater infrastructure.

To help shape the scope, content, and align the event with local needs, we developed an informal advisory committee of three local stormwater professionals (two representatives from cities in Minnesota and Wisconsin and one Minnesota county representative). The advisory committee met twice in the planning process to support event development and the code audit team is grateful for their time and contributions to shaping the event (Figure 5).

Event overview

We held the Nature-Based Solutions for Northern Climates: Making Vegetated Stormwater Practices Work workshop on Friday September 20, 2024, from 9:00am-4:00pm at the University of Minnesota Duluth. Of the 40 registrants, 30 attendees participated in the day-long training.

Advertised event description

When carefully planned and managed, many stormwater and community benefits can be realized by integrating plants into stormwater infrastructure projects. Communities are increasingly investing in nature-based solutions and green stormwater infrastructure, but when and how are vegetated stormwater practices practical and successful in northern Minnesota and northern Wisconsin?

In this one-day workshop, grow your pragmatic plant knowledge, and focus on what can make vegetated stormwater infrastructure successful in northern climates. Learn from vegetation and stormwater experts and deepen your understanding through discussion, activities, and a local site tour featuring new and mature stormwater installations.

Attend this training if you…

- are a stormwater practitioner, or your work frequently intersects with stormwater management.
- are working in the Duluth-Superior area or other communities in northern Minnesota and Wisconsin.
- would like to hear from fellow practitioners about how to make vegetated stormwater practices actually work.

Figure 5. Photos from the Nature-Based Solutions Training on September 20, 2024. Photo credit: M. Rodman/MNSG.

Event outcomes

By the end of this training you will be able to (outcomes)

- Identify vegetated stormwater practices that can be beneficial and successful in northern Minnesota and Wisconsin.
- Apply knowledge and practices, in the context of site preparation, installation, and maintenance of vegetated stormwater solutions, that improve the likelihood of vegetation health and project success.
- Draw knowledge, inspiration, and lessons from other northern communities with successful vegetated stormwater projects.

Speakers

- Rich Harrison, PLA, Co-Director of Design, Metro Blooms Design + Build
- Juli Beth Hinds, AICP, Staff Research Associate & Lecturer, Department of Urban Studies & Planning, University of California San Diego
- Isaac Kasper, Fleet & Grounds Supervisor, University of Minnesota Duluth
- Dan Schutte, Owner, Shoreview Natives
- Chris Schultz, CPM, ENV SP Senior Project Manager, Milwaukee Metropolitan Sewerage District (virtual)

Sticky note activity summary

During this training, twenty-five of the attendees brainstormed and recorded responses to the following two prompts:

1. “What is holding you back from doing vegetated stormwater practices well?”
2. “What are some of your keys to vegetated practice success?”

There were 72 responses to prompt #1 and 54 responses to prompt #2. The responses were categorized into themes (see Figures 6-9).

Culture, Norms, Aesthetics

- Clean/mowed ditches are "pretty" not sedge or rush
- Community support. Mixed feelings. Old school vs open minded
- As a contractor, buy-in
- Aesthetics
- My city values parking spaces and lawns
- Getting landowners on board (maintenance, concerns about blocking view/access)
- Delayed gratification, 3-4 years before it "looks good"
- Social norms. It's easy to stay with the status quo
- Old knowledge, native looks "weedy"
- Land user buy-in. Aesthetics. Stuck in how it has been done
- Hesitant/resistant to change

Expertise, Knowledge

- Expertise
- Knowledge - How to take care of vegetated systems - What plants to use
- Lack of experience and knowledge
- Lack of client/LGU education on maintenance/expectations
- I haven't found a good way to convert Kentucky bluegrass (mowed) into no-mow fine fescue/natives without glyphosate of stripping off valuable sod layer
- Contractor knowledge/ability (low bid)
- Feeling confident in knowing what I really need to know to make sure the project will be successful and not fail and/or inadvertently cause more problems
- Communicating benefits, maintenance requirements to land users
- Technical expertise

Maintenance

- Identifying who will maintain the vegetation
- Maintenance. Not It. Money for long term
- Time at the early stages when it may be more critical to futz with the plants so they establish well and minimize invasive and/or undesirable weeds in the SW practice
- Invasives
- Perceived high maintenance
- Maintenance guidance for green infrastructure practices
- Training on the maintenance side of plant identification
- The unknowns of maintenance needs when the "normal" practices already are not maintained.

Money

- Upfront cost
- Cost
- Financial support
- Resources, $, time, staff
- Funding projects. Design Fees. Install Fees. Maintenance Fees
- Funding limitations
- Cost for replacement or upgrades

Capacity (time, staff)

- Staff capacity to run public process
- LGU capacity
- Personnel involvement on installation
- Time (priority)
- Staff capacity to run public process
- LGU capacity
- Time (priority)

Codes, Standards, Procedures

- Limited ordinances (in process of reworking)
- Code "not required"
- Zoning favors development = easy/cheap
- Clear requirements in RFP building and construction standards. (Besides meet MPCA requirements).
- Zoning changes only happen from laws or public not by staff
- Updated codes that are specific and localized to our ecosystem
- Analysis of what in our current code doesn't work and why

Leadership

- City Council - divided -negativity
- Convincing decision-makers of the benefits.
- City council
- Limited support from Board of Supervisors
- Political interest
- Political leadership …assuming anything related to changing regs is negative for business/development!

Site Conditions

- Bedrock/soil conditions
- Lack of space (right-of-way) along urban roads
- Space
- Site constraints (utilities, grade limitations)

Agency (decision-making power)

- Upstream construction (after system is built)
- Contractors don't propose new ideas
- Future development
- Property ownership: standard among companies -> traditional landscaping

Opportunity Lacking

- Limited Development - We are a rural township with basic 5 acre development (homes)
- Old commercial development grandfathered in
- The "right" project

Design, Planning

- Lack of pretreatment (old systems)
- Plant/species specification followed with OPM
- Lack of education of positioning the infrastructure. "Poor siting". Example - Mall Retention Basin

Collaboration, Communication

- Challenging to find consistent and universal language between engineers, contractors, and stormwater professionals
- Being able to take a watershed-wide approach, starting from top and interconnecting projects

Supply Chain

- Materials specced but don't exist/difficult to propagate

Figure 6. Responses to the prompt “What is holding you back from doing vegetated stormwater practices well?” Total number of responses: 72.

Maintenance

- Knowledgeable maintenance staff
- Landowner buy-in on maintenance
- Monitoring. Maintenance.
- Removal/treatment of invasives multiple times per year…especially in early years of establishment
- Convincing the owner that these can be easier to own/maintain
- 2 years weeding, filling in, curating what works @ site
- Maintenance. O&M requirements enforced.
- Long term commitment: Maintenance, time
- Training the responsible party on maintenance and them being engaged, interested and invested in the ownership/success of the space.
- MAINTENANCE PLAN
- Maintenance plans
- Include budget for 2-3 years of contracted veg maintenance in estim. Costs and grant applications
- INVASIVE SPECIES MANAGEMENT
- Maintenance done by contractors and financial assistance to maintenance
- Suitable stewards for MAINTENANCE

Expertise, Knowledge

- Good data to inform best practices
- Guidance on best practices
- Education
- Public knowledge
- Research and development
- Education programs that are easy to access
- Site prep adequate
- Hiring Dan Schutte with Shoreview Natives

Design, Planning

- Poorly/well-suited plant material
- Native plants
- Proper site analysis/planning
- Using aggressive species suited for site conditions
- PROPER PLANT SELECTION AND SUITABILITY
- Follow LA Fred Rozumalski's advice "you can have big areas that look 'messy' as long as you have a crisp edge" (mowed grass, wall, etc.)
- Using the right plants at right location
- Front end planning: conversations, budget, maintenance, stewardship education

Culture, Norms, Aesthetics

- Buy-in: Education, support, Q&A
- Having landowners excited about it!
- Community support
- Changing public works perception

Codes, Standards, Procedures

- Using storm water fee for plants not just culverts
- Zoning board wanting to change code
- Have a well written contract in place
- Detailed and clear O&M plans

Capacity (time, staff)

- Knowledgeable people as support
- Time
- Resources: time, staff
- Adequate staff time to track and review processes

Collaboration, Communication

- Stakeholder involvement (business, developers)
- GREAT relationships with LGUs
- Trust with land users and our organization

Agency (decision-making power)

- Controlling materials imported (soils)
- Communicate expectations and hold to it.

Money

- Resources: $
- Providing available resources

Outreach, Marketing, Visibility

- Results: seeing benefits, WQ improvement
- SIGNS extolling purpose, benefits

Site Conditions

- Weather

Leadership

- Local champions

Figure 7. Responses to the prompt: “What are some of your keys to vegetated practice success?” Total number of responses: 54

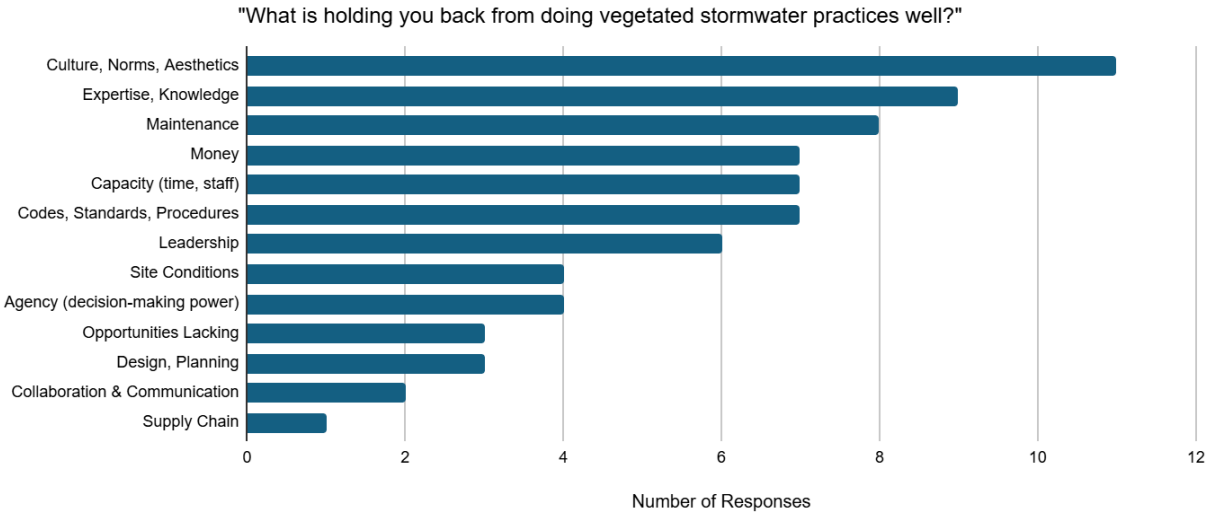

Figure 8. Responses to the prompt: "What is holding you back from doing vegetated stormwater practices well?" Total number of responses: 72.

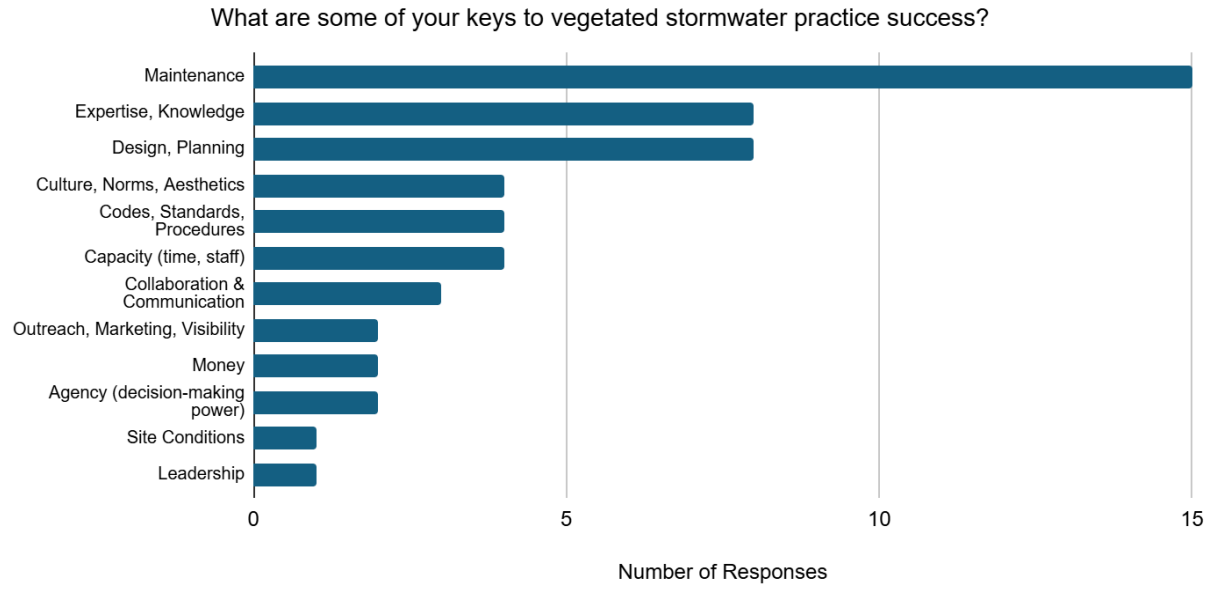

Figure 9. Responses to the prompt: "What are some of your keys to vegetated practice success?" Total number of responses: 54.

Most of the attendees who contributed these responses live near the Twin Ports of Duluth, MN, and Superior, WI. Some live in Lake and Cook counties, and one respondent lives in Minneapolis. They work in conservation, water management, engineering, planning, zoning, or maintenance (see Table 2) and are employed by local and state governments, universities, and private sector consulting firms (see Table 3).

Table 2. Respondents' job function (n=25).

Participants' job function	Number
Conservation/Water	12
Engineering	3
Planning/Zoning	8
Maintenance	2

Table 3. Respondents' sectors. (n=25)

Participants' job sector	Number
Local Government	17
State Government	2
Academia	3
Private Sector	3

Evaluation summary

Out of the 30 participants who attended the workshop, 19 completed the post-event evaluation distributed at the end of the day. The evaluations were overwhelmingly positive and provided valuable feedback on topics and considerations for future program development and delivery.

Participants reported that the workshop met or exceeded its stated outcomes. Of the participants who responded to the evaluation, 100% agreed or strongly agreed that the following areas had improved:

- Identify vegetated stormwater practices that can be beneficial and successful where you live & work (73% strongly agree, 26% agree).
- Apply knowledge and practices that improve the likelihood of vegetation health and project success (68% strongly agree, 32% agree).
- Draw knowledge, inspiration, and lessons from other northern communities with successful vegetated stormwater projects (95% strongly agree, 5% agree).

When participants were asked to share one thing that they were feeling more confident or knowledgeable about after the workshop, responses broadly fell into the following categories: technical and design skills; where to access information/how to get questions answered; networking, partnerships, and communities of practice; supply, sourcing; and maintenance.

When participants were asked what they would like the workshop providers to consider doing differently, they shared comments relating to both content and delivery. Content suggestions included: more background on green infrastructure, policy, engineering and design specs, and a focus on regional clay soils. Delivery suggestions included: having more time, more in depth topics, hands on training, more time for relationship building and networking, and a focus on lessons learned.

Lastly, when asked what other topics or concepts should be included in future workshops, participants shared many ideas including a desire for plant identification and selection, policy, hands on exercises and case studies.

DUWAC Shoreland Ordinance Workshop

Background

This workshop gave LGU staff the opportunity to ask MN DNR and county representatives questions to help them better understand their ordinances and their jurisdictional responsibilities, while also

establishing communication pathways among state, county, and local shoreland ordinance administrators.

Event Overview

This workshop was held at the MPCA office in Duluth, Minnesota on September 18, 2024, from 10:00am - 12:00pm and had 22 attendees.

Advertised Event Description

This will be an interactive workshop! We will run through a scenario where someone has been a bit naughty, and developed on their property without the proper permissions. We will talk about how you would apply your zoning regulations/codes to the situation, who you would get involved and why, and what actions you would require to bring the property owner into compliance.

The goal is to learn from each other - who has what and why (and where does it live in your codes), chat about what works and what doesn't and why, and what opportunities do we have to improve the enforceability of local codes to protect our surface waters across the region.

The intent of this workshop is a working session with peers in a safe space to talk about sticky points and opportunities for improvement, not about pointing fingers at any one community. Our focus is how we improve surface water protection across our region through zoning codes and ordinances.

Agenda

September 18, 2024; MPCA Office, Duluth, MN

10:00-10:10	Welcome & introductions
10:10-10:25	Regulatory Authorities that Protect Shoreland Areas (hear from MN DNR Area Hydrologists)
10:25 - 10:30	Code audits: What we've been looking for & finding about shoreland ordinances
10:30 - 11:15	Exercise: What would happen in your community IF this happened?
11:15 - 11:30	Check in: What are you finding? What would be permitted, denied, enforced?
11:30 - 11:50	Moving ahead: What code changes, information, or resources would support better decision-making and reduce enforcement needs?
11:50 - 12:00	Wrap up

Workshop Summary

MN DNR local area hydrologists discussed their role in shoreland regulations. The group then ran through a scenario on excessive development along a lake shoreline and how each community would address the situation, communicate with the homeowner, and what the restoration requirements would be. This process revealed that each community has a very unique process, with some communities expressing interest in learning more from each other to better support their own enforcement processes. This workshop highlighted how important it is for each community to fully understand their zoning code as it relates to shoreland development and setbacks.

Public Outreach

"Which Plants Should I Plant?" Webinars

One of the requests that was shared repeatedly during discussions with LGU staff was for plant species lists to be used for applications such as roadside median strips and other vegetated stormwater

practices. Many similar lists are already in existence, but they have limited value because they are location and project-specific. While researching existing species lists and databases, we learned that the MN DNR was working with an organization called Blue Thumb to update and revise their existing plant species selection tool so that it could be used for professional stormwater practitioners. The code audit team connected with the Blue Thumb team responsible for the tool's update and partnered with them to promote the tool's release. Code audit project partners were directed to the new tool as a way to generate their own project-specific and site-specific species lists.

As part of the tool's promotional campaign, the code audit team developed and delivered webinars for the general public, which demonstrated the tool and how it can be used to assist with the design of different types of plantings, including rain gardens and other stormwater management projects. A flier was also developed to accompany webinars as well as to be used independently, to direct the general public to the tool.

Figure 10. Flier advertising "Which Plants Should I Plant?" Webinars and resource flier accompanying the webinars. Graphic design credit: C. Dettmann/MNSG. For copies of these resources please contact Minnesota Sea Grant.

Description:
Grow your knowledge of native Minnesota plants as you prepare your own gardens with Minnesota Sea Grant's Jessy Carlson and Metro Blooms' John Bly for a free webinar hosted by Cook County Higher Education. Adding native plants to your yard is a great idea. Native species can provide pollinator habitat, prevent erosion, filter stormwater runoff and add beauty. But how do you know which species to choose? In this 1-hour, interactive webinar, we will simplify the process of making a native garden species list. We will cover how to:

- Clarify your project goals
- Identify site conditions, which will determine your species list
- Introduce the Blue Thumb Plant Finder (bluthumb.org/plantfinder), an online, Minnesota-specific,species selection tool that can provide you with a species list tailored for your project and your site

Webinars were held on June 13, 2024, 1:00-2:00 pm with 36 attendees and June 20, 2024, 6:00-7:00 pm with 11 attendees. A video recording for the presentation is available from Cook County Higher Education.

Midway Township National Night Out

University of Minnesota Sea Grant and the Natural Resources Research Institute hosted a special table focused on rain readiness and green infrastructure during Midway Township's National Night Out event on August 6, 2024. We shared simple tips and resources for making your home and property more rain-ready. Approximately 50 Midway Township residents engaged with the table.

Springing into Action: Building Resilient Communities with Green Infrastructure Webinar Series

In March 2025, we held a three-part webinar series for residents in northeastern Minnesota to learn more about green stormwater infrastructure in their communities and practices homeowners could implement on their properties. Webinars were designed for an adult public audience for residents in Carlton, St. Louis, Lake, and Cook counties of Minnesota and presented using the Zoom webinar platform (Figure 11).

Goals

The goals of the webinar were to:

- Empower residents in northeastern Minnesota to feel more comfortable and confident in considering green infrastructure practices on their property.
- Educate the public in northeastern Minnesota about how green infrastructure is currently used in public and private spaces across the region.
- Connect the general public to regional resources, agencies and organizations that support stormwater, native plants and green infrastructure.
- Demonstrate how green infrastructure is a powerful tool as part of coastal community resilience

Outcomes

By the end of the webinar series, participants would be able to:

- Identify green infrastructure practices that are suitable for residential property in NE MN.
- Understand the value, benefits and uses of native plants in multi-beneficial green infrastructure practices.
- Understand the role and value of green infrastructure across the community landscape; ability to recognize community-based landscape practices.

Objectives

Our objectives of the webinar series were to:

- Deliver three thematically grouped webinars on green infrastructure (GI) in March 2025 for northeastern Minnesota residents. Topics to include:
    - Basic GI around the home
    - Native plants
    - Public GI in the community
- Use webinars as a tool to share resources and expertise from local organizations such as SWCDs, native plant suppliers/groups, and NRRI/Minnesota Sea Grant

Series Description

Get ready to "spring" into action with our engaging three-part webinar series. This series is designed to empower northeastern Minnesota residents to explore green infrastructure and how it can help build

resilient communities. Whether you're dreaming of a summer project on your own property or curious about GI's role in bigger community landscapes, we've got you covered.

Join us as we dig into practical GI techniques for your home, discover the importance of native and deep-rooted perennial plants, and see how green infrastructure works in our public spaces. By the end, you'll be ready to get your hands dirty with new ideas, connect with local experts, and make your property—and community—greener and more sustainable. Join us for one or all of these free events!

Figure 11. Springing Into Action webinar series flier. Graphic design credit: C. Dettmann/MNSG.

Attendance Details:

In total, we received 169 registrations and had 77 attendees across the three webinars. Of all registrations, 92% were from Minnesotans and of those, 75% were from St. Louis County, 14% were from Lake County, 4% from Cook County, and then smaller percentages from Carlton, Itasca, Ramsey, and Sherburne counties. Wisconsin residents made up 5% of all registrations, with Canadian residents making up 3% of registrants. Figure 12 shows a geographic distribution of Northern Minnesota attendees for all webinars and table 4 includes details on each webinar. While we distributed an evaluation for each webinar during and after each webinar via email we had low response rates (n = 2, n=0, n = 1). Thus, these data are not a representative sample of our attendees and we cannot accurately summarize the evaluation data.

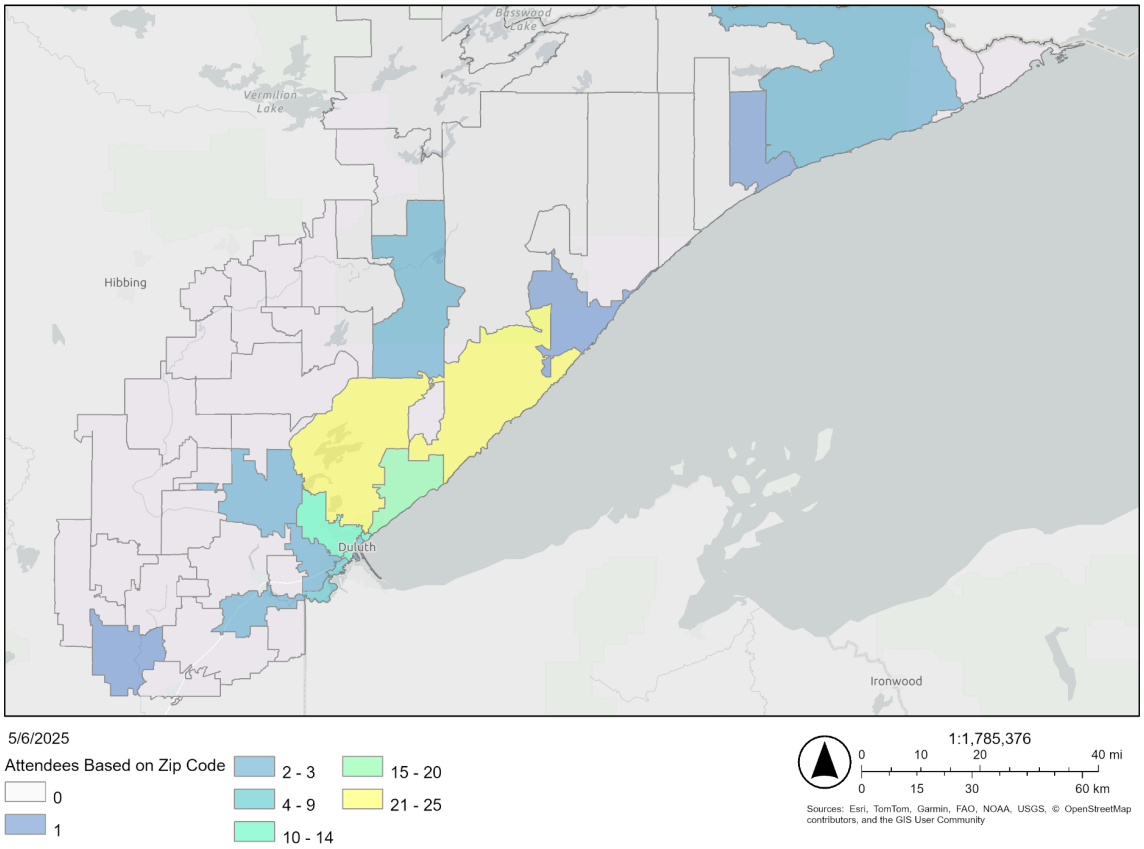

Figure 12. Springing Into Action Attendees in Northern Minnesota based on Zip Code.

Table 4. Springing Into Action webinar series details

Webinar Title	Date and Time	Guest Speaker(s)	Attendees	Registrations	Recording
Going Green at Home: Green Infrastructure That Works	Tuesday March 11, 2025, 5:30-6:30pm	Alyssa Bloss, District Manager, Carlton SWCD	34	60	Webinar 1 recording link
Blooming with Benefits: Native and Deep-rooted Perennial Plants	Tuesday March 18, 2025, 6-7pm	Cathy Wood, President, Arrowhead - Wild Ones Erin Loeffler, Ecological Science Conservationist, Minnesota Board of Water and Soil Resources	28	65	Webinar 2 recording link
Greener Together: Green Infrastructure in the Community	Tuesday March 25, 2025, 6-7pm	Ryan Granlund, Utility Programs Coordinator, City of Duluth Kari Hedin, Community Conservationist, Lake County SWCD	15	44	Webinar 3 recording link

While the 2025 webinar series was a success, we originally planned to facilitate three in-person community outreach events in the spring and summer of 2024. These workshops were scheduled for Duluth, Silver Bay, and Two Harbors, in collaboration with local community education entities. Each 2-hour workshop, titled "Drip, Drop, Prep: A Workshop on Rain-Ready Homes and Communities," aimed to educate participants on creating rain-ready homes.

Course description: "Let's get you — and your home — rain ready! In this class we will: share expertise on rain patterns and Minnesota's changing climate; discuss water runoff and its impact on homes and communities; give you ideas for using green stormwater infrastructure at home (rain barrels, plants, rain gardens, and more); and share resources for what communities can do be ready for rain."

However, due to low enrollment and advertising challenges, we decided to cancel these planned events. Further discussions with local Soil and Conservation District staff led us to modify our engagement strategy, resulting in the development of webinar resources for residents.

Professional Presentations

In addition to public and professional training and outreach, we also presented about the green infrastructure code audit efforts to nearly 400 people at various professional conferences and networking events in Minnesota and Wisconsin (see Table 5).

Table 5. Professional presentations about the Code Audit Phase One & Two projects.

Date	Group or Program	Location	Presentation Title	Attendance	Presenting Author(s)
4/25/2023	Twin Ports Climate Conversations	Duluth, MN	Green Infrastructure Code Audit for Duluth-area Communities	28	Tiffany Sprague
10/26/2023	Midwest Climate Resilience Conference	Duluth, MN	Partnering With Local Governments For Climate Adaptation	30	Jessy Carlson
3/6/2024	St. Louis River Summit	Superior, WI	Green Stormwater Infrastructure Code Audits: Updating Local Regulatory Structures for a Changing Climate	15	Jessy Carlson
4/18/2024	Minnesota Stormwater Seminar Series	Minneapolis, MN	Plants for Stormwater Design, Interactive Selection Tool for Stormwater Professionals and the Public	150	Jessy Carlson
5/1/2024	Twin Ports Freshwater Folk Poster Session	Duluth, MN	Green Stormwater Infrastructure Code Audits: Updating Local Regulatory Structures for a Changing Climate	75	Madison Rodman
10/16/2024	Water Resources Conference	St. Paul, MN	Partnering with Local Governments to Optimize Stormwater Management Outcomes Through Code and Ordinance Reviews	70	Jessy Carlson
3/4/2025	St. Louis River Summit	Superior, WI	Community Codes & Ordinances: Powerful Tools for Protecting our Waters	30	Madison Rodman and Tiffany Sprague

Leveraged Funds

As part of Code Audit Phase One and Two efforts we leveraged the following funds in support of the project's goals. They included:

- **Phase One:** City of Duluth staff time, in-kind contributions of $21,571.56. As part of the project city staff in Planning & Development, Engineering, Parks & Recreation, and Sustainability Departments dedicated time to preparing for and attending meetings, reviewing the results, and working with the code audit team toward adoption of priority recommended updates to our ordinances.
- **Phase Two:** University of Minnesota Natural Resources Research Institute salary and fringe match for Tiffany Sprague of $8,775 and University of Minnesota Sea Grant salary and fringe match for Madison Rodman and Jessy Carlson of $37,521.
- **Additional Efforts:** Flow path mapping effort for Midway Township, $19,000 from MN DNR Lake Superior Coastal Program (see Midway Township section for more information).

Conclusions

Our work with northern Minnesota communities during the Code Audit project identified an array of challenges and opportunities for the adoption of green stormwater infrastructure across the region.

Challenges

The common challenges we heard or observed from communities we worked with during this project were:

- Typically, a few individuals are championing code language updates, and gathering the buy-in of a full department or board takes more time, education and patience.
- Oftentimes, champions need to identify the right moment to address code language updates, as changes in leadership and/or council members may shift the focus of a community.
- Enforcement of water quality protection standards and codes is layered and complex, with many agencies and levels of government involved, and in many instances, it is challenging for communities to navigate the necessary steps and systems.
- Many communities do not have sufficient capacity to follow-up to make sure green stormwater infrastructure practices are functioning and properly maintained; often, staff are more familiar and comfortable with grey stormwater infrastructure.

Opportunities

The common opportunities we heard or observed from communities we worked with during this project were:

- Residents and local government unit staff have a desire to see more green stormwater infrastructure across the region, so the general interest is there. Often, we do not need to convince them it is a good thing to do.
- Agencies and local governments can work together to provide greater regional consistency in applying and enforcing shoreland regulations. To do this will require better understanding of state requirements at the local level.
- Communities can look at development standards, such as parking lot landscaping, for both aesthetics and water management controls.

- Opportunities to enhance water quality protection does not have to start with writing green infrastructure-specific codes. It can also be achieved by making the current codes more effective and easier to use by implementing checklists, tables and refined definitions to improve interpretation, use and enforcement.
- Minnesota Sea Grant is well poised to work with partners and agencies to help provide personalized education for local government units on land use ordinances, shoreland area regulation and small site erosion control.

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Appendices

A. Duluth's Green Infrastructure Code Audit Summary of Findings

April 30, 2025

Overview

Through the "Code Audits & Community-Government Partnerships: Facilitating Pathways to Resilience with Green Infrastructure in Minnesota Communities" and "Code Audit Phase Two: Enhancing pathways to coastal resilience through green infrastructure" projects, University of Minnesota Sea Grant, University of Minnesota Natural Resources Research Institute, Birchline Planning LLC, and University of California San Diego worked with the City of Duluth on an audit of its codes, ordinances and standards to identify barriers to, and opportunities to enhance, the use of green stormwater infrastructure. This effort, underway since the fall of 2022, has resulted in the preparation of options for revision to certain provisions of the City of Duluth municipal code, the City's stormwater engineering guidelines, and other City practices related to development approvals. The goal of these revisions, in keeping with the "Pathways to Resilience" focus of the project, is to identify those changes to codes, ordinances, or practices that, if adopted, would facilitate greater use of green stormwater infrastructure and overall resilience to storms and environmental stressors within the City, when private and public projects are implemented. These strategies include, but are not limited to, zoning and code requirements that lead to improved health, durability, and ecological function of trees, soils, and vegetation; regulations that reduce the potential for conflicts between the built environment and natural processes such as floods; and planning and policy strategies that further reinforce resilient and green practices.

Key Project Findings

In the process of the audit, the City has asked the team to identify the following:

- Significant barriers to the use of green stormwater infrastructure by the development community.
- Requirements within City code, particularly the zoning code and standards for tree protection, that may be leading to undesirable outcomes with respect to vegetation health and overall resilience.
- Code language, interpretation, or practices that might be adding to the cost of development (whether indirectly through time, or directly through monetary costs) without enhancing ecological function, use of green stormwater infrastructure, or overall resilience.

In the course of this project, staff members who work for the City of Duluth or serve on its boards, and others who work with the City's codes and ordinances, contributed time and knowledge to the code audit process. From their input and contributions, and from the team's professional knowledge and research, the following have been identified as the most substantive needs for the City to address to facilitate greater use of green stormwater infrastructure, and to ensure that investments enhance Duluth's environmental resilience:

- Modification to Section 50-25 of the UDO, Landscape and Tree Preservation, with a focus on bolstering landscaping practices to promote ecologically effective landscaping that can thrive and also positively support stormwater controls, as well as updates to existing tree preservation standards to support ecological health goals outlined in Imagine Duluth 2035.
- Re-organization and clarification of technical standards for post-construction stormwater management, to provide stronger and clearer direction on the use of green infrastructure and other stormwater management measures on development sites in Duluth.

- Development of a self-certification process by which applicants verify that site plan features - including green stormwater infrastructure - have been installed in accordance with approved plans.
- Updates to the city's recommended landscape planting list to account for the newest research on plants that pose a threat to our native landscapes, including the addition of scientific names to the list.

Cost Impacts of Regulatory Change

During the audit, concerns were raised that green infrastructure approaches, and associated amendments to existing codes, could be difficult to advance due to financial barriers. This is a common concern for municipalities needing to balance economic development with natural resource protection. For the purpose of this audit and the enclosed recommendations, we focused on how the City's current regulations affect outcomes for water quality and resilience, and did not evaluate specific costs for, as examples, plant and soil materials, paving systems, or stormwater management strategies. Unfortunately, the cost of compliance with stormwater requirements is one of the most notoriously site specific and challenging areas of development costs to estimate. Our efforts to present associated green infrastructure costs or savings would result in such a large range specific to a variety of sites and scenarios as to be nearly of little realistic use or value. We offer additional resources that may be of use when considering green infrastructure costs:

- US EPA Green Infrastructure Cost-Benefit Resources
- Center for Neighborhood Technology Green Values Stormwater Management Calculator
- World Resources Institute Integrating Green and Gray: Creating Next Generation Infrastructure

While specific cost savings are not calculated here, the recommended code updates do point to many instances where changes from the current regulatory approach, and improvements in the City's processes or public information, are likely to affect costs in a positive manner through one or more direct or indirect ways:

- Reduce the time required to submit permit applications.
- Reduce uncertainty associated with the permit review process.
- Improve the efficiency of required investments in landscaping and stormwater, so that (as examples) trees and planted medians can be co-designed to provide stormwater control.
- Reduce the potential for maintenance needs on the part of the City or a land owner/property manager from certain types of landscaping that deteriorate quickly over time.

Next Steps

The project team presented to the City of Duluth's Natural Resources Commission on December 4, 2024 to discuss the project outcomes and next steps. The Natural Resources Commission passed a resolution indicating their support for broader implementation of green infrastructure across the city to promote overall environmental quality, and to recommend the planning commission commit to reviewing the recommendations and advance changes as appropriate. As such, project leads from the Natural Resources Research Institute and Minnesota Sea Grant are committed to supporting the City of Duluth in their next steps to move recommendations of their choosing through the planning and public processes. Please let us know how we can best be of service.

B. Midway Township's Green Infrastructure Code Audit Summary of Findings

September 11, 2024

Overview:

In the spring of 2023, the Code Audits & Community-Government Partnerships: Facilitating Pathways to Resilience with Green Infrastructure in Minnesota Communities, hereafter Code Audit, Team met on multiple occasions with the Midway Planning Commission as a whole, as well as with Grant Forsyth individually, to discuss Midway's priorities regarding surface water protection, flood mitigation, and township ordinances. Based on those discussions, we were able to develop a work plan to guide our collaboration over the course of the Code Audit Project.

What you already had:

We heard from you that you had already adopted a construction erosion control ordinance (aka Haul and Fill ordinance, aka Ordinance #200) in 2013, as well as a related 2021 Zoning Amendment, which incorporated the provisions of the Haul and Fill Ordinance into Midway's existing Zoning Ordinance.

What you asked for:

1) Digitize Ordinance #200 and #203.
2) Propose updates and improvements that will help to preserve Midway's rural character, prevent property damage due to flooding, and preserve the quality of Midway's streams, wetlands, and other surface waters.
3) Develop materials to support the preservation of collectively held knowledge, such as processes and procedures for inspecting construction sites.

What we drafted and why:

- Ordinance #200, "Haul and Fill Ordinance": Recommended updates to Ordinance #200 are summarized in Table 1.

Table 1. Recommended Updates to Ordinance #200

Ordinance #200: Haul/Fill or Land Disturbance - Recommended Updates	
Section 1.d.	"Land disturbing activities" added to current list of actions that have the potential to increase erosion and stormwater runoff, thus requiring review
Section 3.b.	"Applicants shall use sufficient erosion control practices to ensure no sediment reaches streams…[or] is tracked onto public roadways."
Section 3.c.	"the Township may enforce this Ordinance #200"
Section 4.c.	"Open ground" must be "seeded and mulched within 7 days."
Section 6	Haul/Fill or Land Disturbance Permit required for any land disturbance of 2,000 sq ft or more; projects in E-1 district already require review under 13.16.

Section 6.a.	Erosion/sediment controls must be in place before permitted land disturbance activity begins.
Section 6.b.	Specimen trees must be marked and protected with ribbon or fencing.
Section 6.c.	Limits of land disturbance must be marked with ribbon or fencing prior to activity.
Section 6.d.	No stockpiling in wetland or stream buffers, or on property lines
Section 6.e.	Areas intended for landscaping, septic system leach fields, and future stormwater management systems must be marked with ribbon or fencing prior to construction activity.

- Zoning Ordinance: If the recommended updates to Ordinance #200 are adopted, updates to the Zoning Ordinance will be necessary to ensure consistency. The zoning updates that would be necessary in that case are outlined in Table 2.

Table 2. Recommended updates to the Zoning Ordinance

Ordinance #98-5: Zoning - Recommended Updates	
Section 13.16.	Specifies which permit is required for different activities
Section 13.16.a.	Within E-1 district, disturbance of more than 500 sq ft of land surface area requires a Haul/Fill or Land Disturbance Permit.
Section 13.16.c.	Septic systems and driveways do not require permits under this section; their construction is authorized by the Septic System or Driveway Permit.
Section 13.161.	Zoning administrator may refer permit applications in the E-1 district to the Planning Commission for additional review. This replaces previous language specifying thresholds for referral.
Section 13.164.i.	Erosion/sediment controls must be in place before permitted land disturbance activity begins
Section 13.164.j.	Specimen trees must be marked and protected with ribbon or fencing.
Section 13.164.k.	Limits of land disturbance must be marked with ribbon or fencing prior to activity.
Section 13.164.l.	No stockpiling in wetland or stream buffers, or on property lines
Section 13.164.m.	Areas intended for landscaping, septic system leach fields, and future stormwater management systems must be marked with ribbon or fencing prior to construction activity.
Section 13.18	Zoning Administrator may refer applications to Planning Commission if substantial impacts could occur; otherwise, administrative approvals are authorized.

- Haul /Fill or Land Disturbance Permit Application: In order to administer the updated Ordinance #200, a permit application form has also been drafted. (See Attachment E).

If adopted, what would these updates accomplish?

Adopting the new haul and fill ordinance would, fundamentally, re-affirm the township's stated intention to regulate and enforce these activities within the township's boundaries. The updates to the 2013 ordinance would not affect property rights or impose new permitting requirements; rather, they clarify what was implied by the original ordinance, and add clear, objective standards for (1) which activities are regulated, and (2) which specific actions should be taken to reduce erosion, protect areas such as new septic system leach fields, and prevent sedimentation in Midway's streams and wetlands.

Supplemental Outreach/Supporting Materials Include:

- Shoreland Area Mailer: Other communities participating in this project prioritized shoreland area regulation. While we were working on their shoreland area tasks, we decided to create a short shoreland/wetland regulation explainer tailored to Midway township. This was developed to be mailed to lakeshore property owners.

- Flow Path Mapping: Our team provided the Planning Commission and Midway's staff with an overview and example of surface water flow path mapping completed for the City of Bayfield, Wisconsin (see image below). Flow path mapping shows how water travels across the land, based on topography plus the locations and positions of storm drains, buildings, and roads. There was a lot of enthusiasm for finding a way to create flow path mapping for Midway, since this map would have many uses for landowner outreach, public works, flood prevention and mitigation, and generally understanding why flooding or erosion are happening in certain locations. Our team engaged the Minnesota Lake Superior Coastal Program, and they reserved approximately $19,000 of their budget to create a flow path map for Midway township. To confirm map accuracy and retrieve necessary data layers, we are also working with Tim Beaster at South St. Louis Soil and Water Conservation District (SWCD), Bri Speldrich with Minnesota Department of Natural Resources (MN DNR), and Jeff Jasperson with Minnesota Pollution Control Agency (MPCA). Coastal Program staff, led by Clinton Little, are currently starting the mapping work, and hope to have a draft product available for review in spring or summer 2025.

C. DUWAC's Green Infrastructure Code Audit: Summary of Findings

December 2024

Things that are looking good

- **Snow storage:** Some LGUs have standards requiring provisions for requiring applicants to identify snow storage areas and take water quality protection measures.
- **Erosion control:** Some LGUs require erosion control measures for land disturbances of less than 1 acre.

Things that could use some work

- **Snow storage:** Most snow storage provisions are generic and do not provide specific direction on where snow storage should not occur (i.e., in bioretention/biofiltration facilities, sensitive natural areas, or other areas where damage would result).
- **Parking lot landscaping:** Requirements, if they exist, are minimal. Most LGUs have no specific landscaping requirements for development sites or specifically for parking areas.
- **Parking lot ratios:** The minimum parking ratios in most of the LGUs are outdated, and require far more parking than is recommended in up-to-date parking standards.
- **Surface water and wetland buffers:** We found no mention of standards requiring establishment of buffers for surface waters or wetlands in any of the LGUs.
- **Shoreland regulations:** There is some inconsistency among LGUs in understanding and applying Minnesota Shoreland Management regulations. These inconsistencies arise in the context of land development and enforcement of local zoning ordinances. This issue principally concerns coordination among and between townships, counties, and the state.

Comments

- **Erosion control:** In Hermantown, construction and other land disturbing activities of 500 square feet or more must employ erosion control measures at a lower threshold than MPCA's minimum. This is good news for watershed protection and for preventing costly damage during storm events!
- **Parking lot landscaping:** Most DUWAC communities have no specific landscaping requirements. Those that do have only minimal standards, without specific minimums for planting. This is an area of opportunity. When updating codes to include landscaping requirements, standards should be designed to ensure landscaping features will also serve as stormwater management features.
- **Parking lot ratios:** The Institute of Transportation Engineers' recommended parking ratios take into account employee parking in addition to client and customer needs. Many of the DUWAC LGUs require employee parking in addition to a minimum parking ratio. There is no need to require additional parking stalls for employees on top of ITE's recommended number of stalls. Every additional parking space adds 18,690 gallons of runoff in a 1" rainfall and costs the developer more than $10,000 in surface construction costs.
- When standards for site improvements such as landscaping, erosion control, and snow storage are vague or subjective, as is the case in many of the LGUs, the review process may be less likely to achieve good outcomes and may be uncertain for applicants. Having explicit standards helps applicants and Planning Commissions identify the right components to include in a site plan, saving time and confusion in the review process.

Recommendations

Water quality and review processes would benefit from the implementation of updated codes in the DUWAC LGUs. Specific actions are recommended, including:

- An application process that requires a straightforward permit for land disturbing activities affecting 500 ft2 or more of surface area would be a beneficial standard and procedure in any LGU that does not currently have this requirement in its codes. A simple process would include a checklist for demarcating limits of construction; ensuring stockpiles will not wash onto neighboring properties, into surface waters, or into storm drains; and using basic erosion control practices such as covering stockpiles and providing downstream protection. This provides an important opportunity to educate property owners on methods that will protect the quality of soil and vegetation on their own properties as well as preventing damage to surface waters, wetlands, and neighboring lands.
- Requirements to show snow storage on site plans, with provisions that ensure snow storage is not located in a stormwater facility or vegetated area that would be damaged if used as a storage area, is recommended in those LGUs that do not currently include this as an element of a site plan application. Asking applicants to show where snow storage will be located also helps ensure that storage will not conflict with neighboring properties or the public right of way.
- Updating landscaping standards to include basic minimum landscaping for off-street parking lots, non-residential and multi-family residential development sites, and buffers between land uses. Ensuring some minimum standard for landscaping in these areas is essential for reducing water and pollutant runoff and urban heat island effects. LGUs and permit applicants would benefit from updated standards that provide for minimum planting areas; appropriate standards for trees, plants, and ground cover in planting areas; and options to co-design these areas as stormwater management features.
- Updating parking ratios, and associated land use categories, to reflect (and facilitate permitting of) contemporary land uses and land use patterns. Having clear, relevant standards for parking that require an appropriate amount of area is a “business friendly” strategy that reduces both the applicants’ cost (of building excess parking spaces), and the amount of polluted, heated runoff reaching surface waters and storm drains. Alignment with Institute for Transportation Engineering (ITE) standards, which reflect current research on land uses and travel patterns, is recommended to ensure that there is sound engineering analysis data underlying any changes. In addition, LGUs should consider including specific guidance on the approval of shared parking among uses (e.g., multiple tenants in a shopping center) and allowances for off-street parking in order to further maximize the efficiency of existing and new parking areas.
- Update codes to require demarcation and planting of a permanently vegetated buffer along the perimeter of wetlands and other surface waters. The water quality, sediment reduction, habitat, and urban heat-reducing benefits of effectively demarcated and well-vegetated buffers are well documented. While buffer widths may need to vary in existing or planned urban areas, a 30’ width has been demonstrated to be an effective width for reducing the impacts of overland flow from developed surfaces. Requiring a defined boundary, made of sturdy plantings, landscape boulders, or fencing, is especially important to maintain the quality and function of a vegetated buffer over time. Buffer requirements also should prevent further establishment of turfgrass lawns or new impervious areas within the buffer, except where pathways, public utilities, or other crossings are needed.
- Continued conversations among and between townships, their respective county agencies, and the state (MN DNR), regarding enforcement of Shoreland Area regulations, would be very

beneficial. Clarification of state and county roles and associated regulatory standards would support better enforcement and would improve the effectiveness, clarity, and understanding of permitting standards.