Stormwater Utility Vegetation Management Plan

City of Madison Engineering Division

January 2025

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Executive Summary

The City of Madison Stormwater Utility (SWU) manages over 1,500 acres of regional ponds, greenways, wetlands and open space dedicated for stormwater management. Excluding water, these areas amount to approximately 1,300 acres of vegetation on SWU land.

Prior to 2003, vegetation management on SWU property was the responsibility of the Parks Division. Starting in 2003, the SWU took over vegetation maintenance of SWU property, and from 2003 to 2024 the approach to vegetation management changed significantly. These changes include managing for greater native plant establishment, improving strategies for native ecosystem biodiversity, reducing turf areas and frequency of mowing, increasing management of invasive species, improving strategies for maintaining vegetation for emergency access, and other changes to both improve resilience related to stormwater functions.

This plan provides a framework for Madison residents and policy makers to understand the types of vegetation on these lands and their role as part of the larger regional stormwater system. This plan also identifies the approach to annual maintenance based on existing resources and sets forth a level of service that can be applied citywide as part of a larger goal to improve SWU vegetation both for stormwater function but also for multiple ecosystem services.

This plan does not address specific site construction projects, or larger strategies for green infrastructure. It is a policy specific to the resources and goals of managing vegetation to serve the stormwater utility's primary functions.

Development of this plan included researching public perceptions and expert opinions on topics related to stormwater vegetation including water resources, ecology, forestry, stormwater engineering, conservation, entomology, wildlife habitat, invasive species, fluvial geomorphology, sustainability, carbon storage and heat islands. This front-end engagement identified multiple opinions and varied perspectives of vegetation management. Engagement outcomes identified in this plan are summarized from the more detailed Public Engagement Summary, Volunteer Expert Technical Response Summary, Focus Group Workshop Summary, and Consultant Vegetation Management Recommendations. This plan also incorporates recommendations from the Wisconsin Initiative on Climate Change Impacts.

The results of this engagement identified that there is no simple solution to citywide SWU vegetation management. There are differing opinions on priorities, perceptions, and strategies to address the compounding impacts of climate and non-climate stressors on vegetation.

The goals and strategies recommended in this plan recognize these complexities and provide an adaptive approach to vegetation management within existing resources, while outlining core services and needs for stormwater priorities. They include strategies that the SWU is currently implementing, along with future goals – some which would require additional resources.

This plan provides an adaptive approach for managing SWU property to reduce flood and storm impacts, improve water quality, create equitable levels of service, increase resiliency to climate change, create healthy ecosystems and habitat, prioritize areas for urban canopy, and use technology to inventory, assess and monitor vegetation within SWU land.

1 Introduction

This chapter is divided into three sections:

- Purpose
- Brief History of Stormwater Utility Land
- Plan Development Process

Purpose

The purpose of the City of Madison's Stormwater Vegetation Management Plan (SVMP) is to create a framework for vegetation management practices and goals. It identifies systemwide goals and strategies within existing resources to provide a vegetation management framework. This plan also identifies future opportunities to ensure a resilient stormwater system responsive to increasing environmental pressures.

Photo of native plants at Saturn Drive stormwater utility pond.
[PD 7342-003]

The City of Madison Stormwater Utility (SWU), a part of the Engineering Division, includes approximately 1,500 acres of land dedicated for stormwater management. The SWU is responsible for managing the vegetation on this land as part of the City's connected stormwater infrastructure. This infrastructure is crucial to reducing flooding, ensuring public safety, improving water quality and recharging groundwater. It also supports multiple ecosystem services that provide the foundation for a green and resilient city.

Vegetation is increasingly recognized as an integral part to developing a sustainable city. It plays an important role in addressing a variety of environmental pressures including species loss (biodiversity loss), waterway pollution, increasing temperatures, poor air quality, depleting aquifers, excessive nutrient loading, and soil degradation, as well as general habitat loss.

The climate and environmental challenges we face today are complex. There is no simple solution to address the often-competing priorities required to develop a resilient, sustainable city while accounting for a myriad of current and future environmental impacts.

This plan reflects the complexity and variety of these environmental pressures. It recognizes the importance of vegetation as green infrastructure to improve water quality, reduce erosion, and provide flood storage. It also recognizes the importance of multiple ecosystem services, systems that do not achieve just one goal, but can address the many competing priorities that require a solution in the face of climate change.

As a stormwater utility, the primary objective of this plan is to ensure that vegetation on these lands perform their primary stormwater management functions.

While the larger stormwater infrastructure system includes private and public lands, this plan is specific to property owned by the City of Madison SWU. The goals identified in this plan serve as a mechanism to inform larger efforts including the future private stormwater maintenance agreements, agreements between agencies, and long-term stormwater vegetation goals across both public and private land.

This is a big picture plan. It does not address individual sites. This is not a plan for specific construction or reconstruction projects, which typically have their own public engagement processes and influencing priorities. Additionally, this plan does not include lands managed by Madison Parks or other City, county, or state agencies.

Brief History of Stormwater Utility Land

The majority of Dane County is within the Wisconsin Department of Natural Resources (WDNR) defined Southeast Glacial Plains Ecological Landscape. Within the City of Madison proper, the pre-European settlement landscape included oak savanna, prairie, wet meadows and emergent marshes. Oak woodland and maple-basswood forest (in what is now the Village of Maple Bluff) existed in locations not easily reached by fire (Wisconsin Department of Natural Resources, 2015).

Fire maintained the historic ecological landscapes of Madison, including wetlands, which experienced fire during dry times. Fire was the primary disturbance regime that shaped these ecosystems—creating opportunities for new plants and animals to establish themselves, leading to a highly biodiverse landscape.

As land was deprived of fire, developed, or farmed, the typical ecological cycles that maintained the remaining native ecosystems were disrupted. Wetland ecosystems were greatly disturbed by runoff from additional impermeable surfaces as development expanded. This additional runoff carried urban pollutants including sediment and phosphorus to alter aquatic ecology. The cessation of frequent fire in developed areas caused remnant upland natural communities to shift toward more closed-canopy woodlands. Invasive species introductions increased with development, further altering the composition and function of these historical ecosystems.

Aerial view of Isthmus looking west towards State Capitol Building in 1930. Wisconsin State Historical Society image 31351

In Madison today, few areas resemble the landscape prior to European settlement. The natural hydrology of the Madison area was further altered through historic stormwater development and regulatory requirements for stormwater management.

In Madison, as in virtually all United States cities prior to the 1970s, stormwater was piped directly to wetlands and waterways. Madison enacted its first stormwater management ordinance in 1983. Previously, there were no stormwater ordinances or requirements associated with development. As Madison largely developed from the Capitol outward, little to no green stormwater infrastructure was included in the areas.

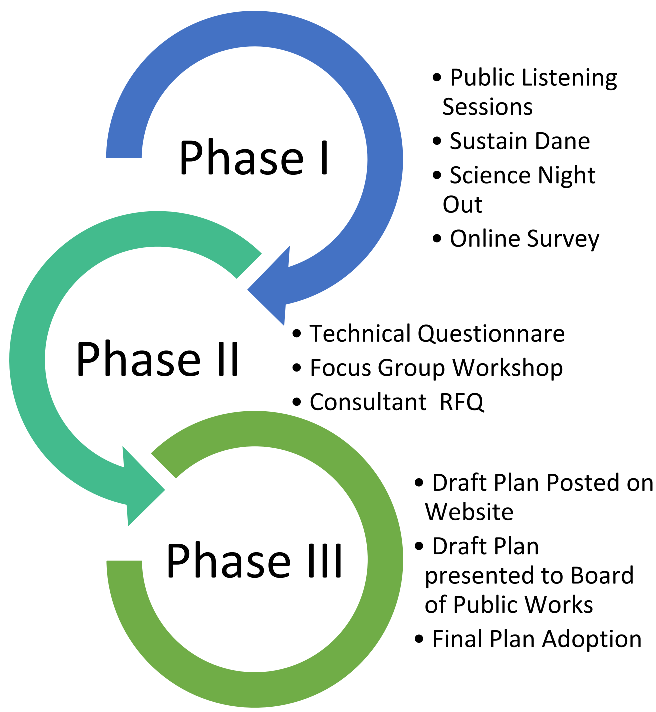
Concrete cunette within City of Madison stormwater utility greenway.
GR 2869-016

After the enactment of stormwater regulations, open drainage ways became the preferred conveyance method for watersheds larger than 150 acres. These open drainageways were constructed, seeded with turf grass, and mowed. In areas with relatively flat topography (like the southwest side of Madison), cunettes (also known as concrete channels) were installed due to their ability to rapidly convey water and drain dry, minimizing erosion and mosquito habitat in areas that often-had minimal longitudinal slope along the channel. As the natural hydrology was altered by surrounding development, streambanks were increasingly riprapped to prevent erosion and stabilize the channel from both vertical and horizontal movement. Below is a synopsis of major changes in policies or practices that impacted stormwater management land growth and vegetation.

- Prior to the 1970s, stormwater management primarily consisted of digging farm ditches, piping intermittent streams, and installing pipes that would be considered significantly undersized by today's standards.
- In the 1970s, stormwater management developed to include concrete cunettes, turfgrass, and rock streambanks.
- The first stormwater ordinance was adopted in Madison in 1983. Chapter 37 of the Madison General Ordinances (MGO) has been updated multiple times, most recently in 2020.
- In the 1990s, the Engineering Division began requiring new and reconstructed ponds and greenways be planted with native prairie and wetland species. Native plants were becoming known for their ability to improve infiltration and water quality, withstand fluctuating water levels and provide wildlife habitat.
- Prior to 2003, vegetation maintenance on the stormwater system was limited to mowing. Maintenance was delegated to Madison Parks, which also had thousands of acres of parkland to mow in the same short field season. During this period, pond and greenway mowing was not prioritized. As these areas went unmanaged, they increasingly became dominated by easily adaptable and aggressive trees and shrubs—often invasive species.
- In 2003, the Engineering Division assumed routine maintenance responsibilities for their stormwater lands. The Division initiated a program to remove invasive trees and shrubs to provide maintenance access.

- In 2012, the Engineering Division began a pilot project to compare the cost effectiveness of selectively mowing prairie-vegetated ponds and greenways. The "Selective Prairie Management Program" (SPM) restricted mowing to patches of invasive or undesirable plants, while the rest of the corridor was left unmowed—allowing native plants to compete more effectively. This pilot proved to be successful both in terms of cost effectiveness and, from the perspective of species management, by preserving the prairies and achieving better weed control.
- From 2018 to present, two full-time and two seasonal positions focused on ecological restoration were added to the Engineering Division staff to improve the success of native plant establishment within ponds and greenways.
- In 2023, the Engineering Division began drafting the Stormwater Utility Vegetation Management plan to provide a transparent framework on vegetation management goals within stormwater utility lands.

Plan Development Process



Development of this plan incorporated a variety of components to address the intersecting social, financial, natural resource, and public health impacts related to stormwater vegetation management.

Throughout the plan's development, updates on each phase of the process were presented to the Board of Public Works.

Phase I: Public Engagement (October 2023 – February 2024)

Phase I included hosting three public engagement listening sessions, staffing information booths at community events, and an online survey.

This phase also included evaluating citywide land management strategies using the City of Madison's Racial Equity and Social Justice (RESJ) Comprehensive Toolkit and with assistance from City of Madison and Dane County staff involved in land management policies. Participants in the RESJ Toolkit analysis also comprised members of an internal Advisory Group. The Advisory Group reviewed the public engagement processes and outcomes and included staff from Madison Parks, Forestry, Engineering, Dane County, and faculty emeritus from the University of Wisconsin.

Phase II: Technical Experts (May 2024 – September 2024)

Phase II included obtaining input from a wide range of technical experts through a technical questionnaire, focus group workshop, and consultant recommendations for specific stormwater issues.

Phase III: Plan Development, Review and Approval (September 2024 – January 2025)

Phase III included plan development. The final draft plan was posted online for public comment and presentation and acceptance by the Board of Public Works at for their review.

2 Engagement

This section summarizes the findings of the public and technical expert engagement process.

- Public engagement: three public listening sessions, onsite tabling at two community events, and an online survey.
- Technical expertise through a technical questionnaire, focus group workshop, and consultant recommendations.

Public Engagement

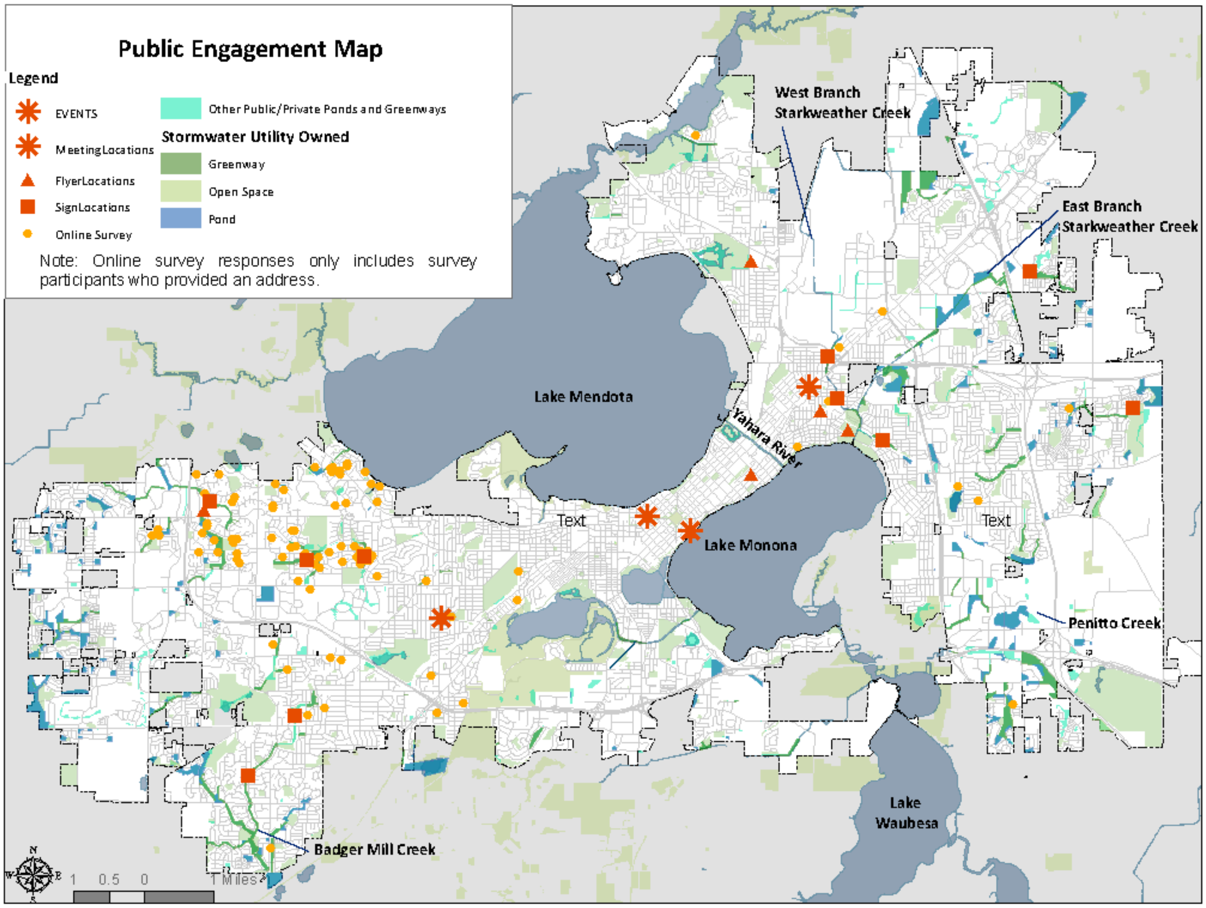
Development of the plan included front-end engagement with the public to identify larger issues, community perceptions, and priorities related to vegetation management. The City implemented three different public engagement strategies: public listening sessions, onsite tabling at two community events, and an online survey.

- Three public listening sessions in November 2023.
- An onsite-staffed information table at the Wisconsin Science Festival/Night Market on October 19, 2023, and the Sustain Dane Annual Event on November 3, 2023.
- An online survey (January-February 2024).

Each engagement strategy had unique results, reflective of the type of engagement and participating audience. A detailed description of the results from each engagement strategy can be found in the Public Engagement Summary Report.

Photo of public listening session on November 20, 2023.

Public Engagement Locations Map



Top Concerns and Takeaways from Public Engagement

The list below highlights key points and unique perspectives from each engagement strategy. It is not exhaustive of all the comments and concerns received in the public engagement process, nor are the items listed in any order.

- **Environmental values, but differing opinions on best solutions.**
  Engagement identified strong priorities towards environmental concerns and values. Technical knowledge related to these issues varied, and public comments included competing priorities, such as both keeping non-native ecosystem vegetation in urban woodlots and restoring native ecosystems as the best ways to provide habitat and improve biodiversity.
- **Vegetation and ecosystem management is a technical and complex topic.**
  Many people recognized that native plants are beneficial, but fewer fully understand the subtleties of native plant community interactions that support biodiversity, wildlife, and pollinators. For example, Wisconsin Science Festival participants unanimously identified that the City should invest in restoring native prairies, wetlands and woodlands. However, the third most preferred image for vegetation preferences was an image of a buckthorn monoculture, an aggressive non-native shrub

well known for its ability to disrupt woodland ecosystems and negatively impact birds that feed on the berries.

- **Types of engagement strategies yielded different results.**
  Public Listening Sessions, Wisconsin Science Festival and Sustain Dane Event Takeaways:
  - Participants selected images of an oak savanna and wetland for “preferred vegetation” category.
  - These three engagement strategies were attended by people with backgrounds in ecological restoration/native plants (both formal and informal).
    - Many of these meeting attendees were in favor of the existing direction of the SWU—which has shifted management towards ecological restoration of native plant communities.
    - They expressed concerns about not enough existing staff and volunteer resources to manage these areas.
    - They sought additional opportunities to volunteer and assist with technical expertise required for ecological restoration.
  - Vegetation maintenance should prioritize the area most vulnerable to erosion and flood damage.

  Online Survey Takeaways:
  - Many open-ended comments related to trees, which was not a significant topic at other engagement events. This may reflect recent larger reconstruction and planning projects on the west side related to tree removals. The online survey includes a higher representation of those who live on the west side based on addresses provided.
  - Top concerns included impacts of vegetation management on the loss of biodiversity (66.67%), wildlife habitat and impacts (65.82%), bird habitat and impacts (66.5%), and pollinators (63.92%).
  - Topics with the highest “not concerned” ratings included sequestering carbon in soils and vegetation (17.37%), herbicide use on stormwater land (16.93%), and vegetation and heat islands (14.89%).

Technical Expert Engagement

As part of this plan development, the SWU solicited technical expertise through three methods: a technical questionnaire, a focus group workshop, and consultant review and recommendations of specific stormwater issues.

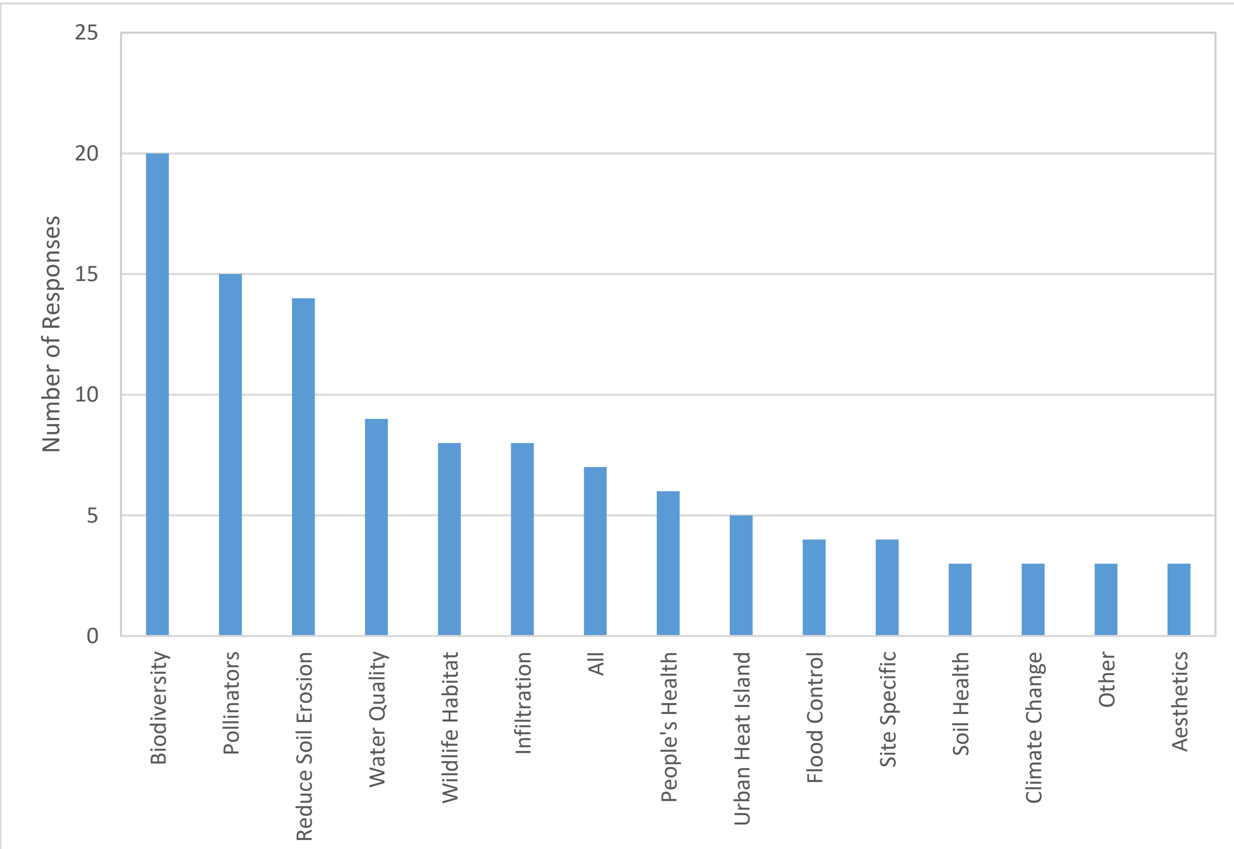
This approach reached out to approximately 180 academics and professionals in the fields of stormwater engineering, lake and water quality, soil science, climate, urban heat islands, entomology, wildlife ecology, forestry, ecology, land conservation, and other related fields. Participation by these technical experts was voluntary.

The reports listed below provide a general summary of the feedback received from each strategy. They are intended to identify large, broad themes and key findings. Each specific response includes nuances that are important to consider.

Technical Expert Questionnaire

Approximately 40 experts provided responses to the technical questions. Questions catered to specific areas of expertise. Volunteer responses varied in depth and position, and responses were variable across fields of study. A full report of these responses can be found in the [Volunteer Expert Technical Response Summary].

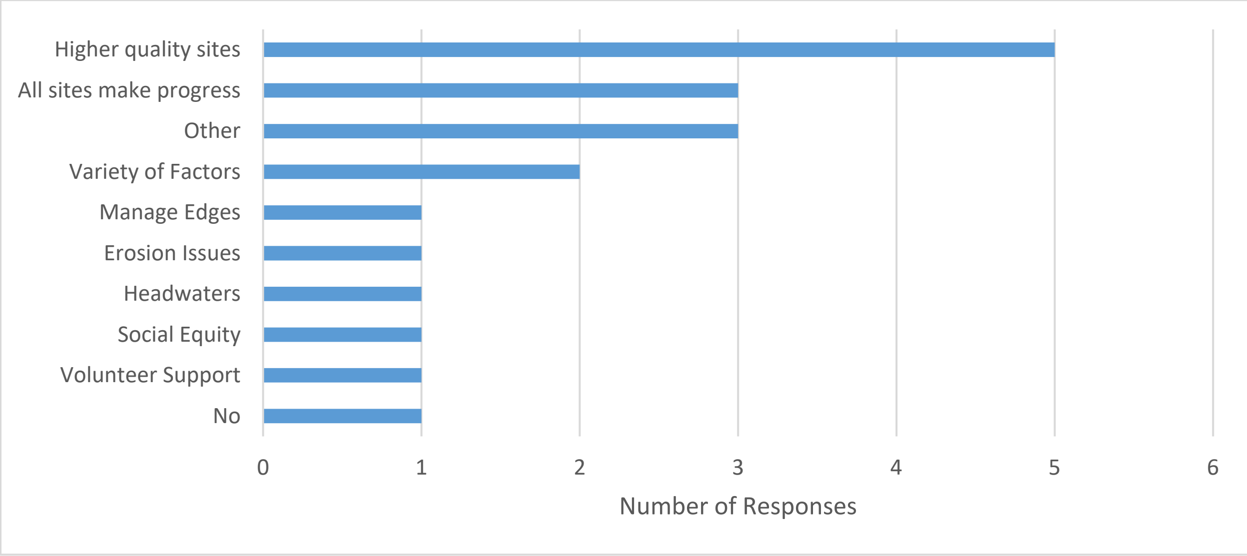
Graph: Technical Expert Question – What top ecosystem services should the stormwater utility vegetation provide?



Focus Group Workshop

Approximately 20 experts expressed interest in and attended a focus group workshop to discuss land management strategies. A full report of this workshop can be found in the [Focus Group Workshop Summary].

Graph: Focus Group Workshop – Would you prioritize specific ecosystems or locations? Or generally try to improve all sites?



Consultant Perspectives on Public Concerns and Vegetation Management

As part of plan development, the City issued a request for quotes for consultants to review top public concerns and identify how these concerns could be addressed as part of a citywide vegetation plan. Consultants included Heartland Ecological Group, Quercus Land Stewardship Services, and Inter-Fluve River Restoration and Water Resources. Recommendations from these consultants were specific to an example property reflective of typical SWU land. Management strategies were diverse and reflect the variety of perspectives in vegetation management. The full reports can be found in the Consultant Vegetation Management Recommendations.

Consensus amongst vegetation management proposals from all three companies included:

- Strategies to focus on removing existing invasive species
- Strategies to increase native species diversity

Both objectives are current primary goals of the SWU management practices.

The following page includes a comparison of the larger takeaways and recommendations across each submittal.

Table: Comparison of Public Concern Takeaways and Recommendations amongst [Consultant Vegetation Recommendations]

Consultant and Example Site	Consultant Public Concerns Addressed by Recommendations	Recommendations
Heartland Ecological Group Sister Oak Ponds (PD 1452-033)	• Impacts to biodiversity and habitat for pollinators, birds, and other wildlife. • Public values native and biodiverse landscapes for aesthetics, resiliency to flooding and erosion, and for benefits to other ecosystem services such as pollinator habitat • Interest in volunteering at these properties and would like to learn more about restoration techniques and methods	• Control cattail and woody vegetation • No opportunities to plant woody species at this location • Increase native species diversity by installing native wetland emergent plants and supplementing with native seed • Utilize prescribed burning as a management tool • Conduct neighborhood outreach for volunteers • Control other invasive herbaceous plants • Enhance turtle and frog habitat • Consider habitat corridors and connectivity to other SWU and public lands
Quercus Land Stewardship Services Sister Oak Ponds (PD 1452-033) North Pennito Creek Greenway (GR 7052-005) Hanson Road Wetland (PD 6417-002)	• Lack of larger public understanding /education on native ecosystems, wetlands, and their function on stormwater land • Interest in volunteering • Concern about wildlife habitat and impacts, biodiversity and species extinction, Invasive plants • Concerns about herbicide use on stormwater land vegetation and heat islands, flooding, water quality and types of vegetation, sequestering carbon in soils and vegetation	• Increase prescribed fire by reintroducing natural fire regime • Keep herbaceous and woody species control to less than 5% cover of entire acreage • Engage residents in the long-term management of the site • Monitor for the adaptive management of stated strategies • Inter-seeding with native plant species
Inter-fluve Wooded Greenway North Pennito Creek Greenway (GR 7052-005)	• Concerns about improving habitat for wildlife, climate change impacts, biodiversity Impacts, and preserving tree canopy	• Each site is unique and must be uniquely assessed • Limit impacts on forest canopy • Maintain a diverse assemblage of plants • Remove invasive plants • Monitor maintenance strategies to focus on controlling invasive shrubs, forbs, and grasses • Consider idea of novel ecosystem management

Top Takeaways from Technical Expert Engagement

Responses varied and often conflicted, showcasing an overarching theme of the complexity of the environmental issues and understanding.

The list below highlights key points and unique perspectives received. It is not exhaustive of all the comments and concerns collected, nor are items listed in any order. Detailed information can be found in the Volunteer Technical Response Summary , Focus Group Workshop Summary, and Consultant Vegetation Management Recommendations.

- **Priorities and solutions differ amongst technical experts.** Like many highly technical scientific fields, there are diverse opinions on solutions, best practices, and priorities related to vegetation. These varying opinions can be seen in the responses to almost every technical question including use of pesticides, accommodating migration shift, the tolerance of specific invasive species, and specific mowing practices. For example, experts in ecological restoration and conservation may prioritize native ecosystems, whereas experts in urban forestry may prioritize urban forest diversity including non-native species.

- **Resiliency is complex and often has competing solutions.** Vegetation systems can rarely meet all the ecological/environmental/social solutions for resiliency. The term resiliency often oversimplifies the complex interaction of soils, hydrology, carbon storage, biodiversity, invasive species, pollinator habitat, climate change, and the increasingly complex ways that vegetation impacts these variables.

Bumble bee on a sawtooth sunflower at a Mansion Hill Pond.
PD 2165-002

- **Native plants provide stormwater benefits, which in turn provide lake and water quality benefits.** Experts in various fields noted the benefits native plants provide to stormwater management including reducing soil erosion, increasing infiltration, and reducing water velocity. Native plants, typically understood as having deep root systems, were consistently identified to reduce soil erosion. There were differences in opinions about types of native plants (woody vegetation versus herbaceous vegetation) as the best options, but general agreement on the importance of native plants being present.

- **Top ecosystem concerns include promoting biodiversity, reducing soil erosion, and addressing pollinator impacts.** Most technical question respondents recognized that the top three ecosystem services that stormwater vegetation should provide include biodiversity, pollinators, and reducing soil erosion, but this was noted as not a "one size fits all" approach.

- **Prioritize ecological restoration on sites that are existing high-quality ecosystems, oak woodlands, or new restorations.** With limited resources, many suggested to focus on restoring new ponds, oak dominated ecosystems, or focusing integrated pest management on existing highly biodiverse sites.

Stormwater utility greenway dominated by invasive reed canary grass.
GR 2879-036

- **Reed canary grass is a top ecosystem threat, but there are multiple other species.** Reed canary grass was identified as the invasive species most likely to impact habitat and biodiversity. It is also recognized as incredibly prevalent and time and resource-intensive to eradicate. Reed canary grass is a particular challenge to stormwater property since it thrives in moist soils and frequently flooded areas.

- **Invasive species management is an important goal on public lands.** To some degree, all respondents agreed that invasive species management on public lands is an important goal. However, there was less agreement amongst experts about removing aggressive native species as part of ecological restoration goals, which is discussed further throughout this report.

- **Integrated Pest Management (IPM) should include prescribed burning, mowing, and sparing use of herbicides.** Ecologists and land managers almost unanimously agreed that fire is an important tool for land management, and that herbicide is a necessary tool of integrated pest management. Fire was noted to have practical limitations in urban landscapes but should be appropriately incorporated based on

Prescribed burn at pollinator planting.

resources. Most respondents acknowledged that herbicide use should be limited and geared towards specific situations, but it is necessary for eradication of some species and for management with limited staff. However, some respondents cautioned against using pesticides, specifically neonicotinoids because of their impacts to pollinators. Note, that the SWU does not use neonicotinoid pesticides or plant any species treated with neonicotinoids.

- **Native plants in urban areas contribute to supporting pollinators and other species, but they are not a guarantee that all species will benefit from urban native plantings.** Responses generally indicated that native plantings in urban areas provide beneficial insect habitat but impacts to larger wildlife populations might be limited. Responses varied and included strong support for urban areas to improve pollinator habitat including endangered species. However, respondents also indicated that larger tracts of preserved habitat in rural areas are more beneficial to larger wildlife.

Monarch butterfly on native plants at Grassman Pond.
PD 3046-006

- **Adjacent land use should play a role in the management of SWU land.** Responses had vast differences in opinions on removing native species; however, many of them shared values that removing aggressive natives or other nonnative trees should be based on larger management goals and resources. For SWU land, this is an important consideration with limited resources. The use of more resource-intensive management techniques like prescribed fire is limited based on the type of plants present.

- **Timing and method of mowing in herbaceous communities is site specific.** Respondents with backgrounds in conservation land management had varied opinions on mowing herbaceous ecosystems for management. Most responses favored mowing but noted some concerns with a general approach compared to specific spot mowing, dependent on the specific site.

- **Differing ideas related to assisted migration for climate change related ecosystem shifts.** Assisted migration as part of SWU land management includes encouraging establishment, typically of species native to North America, but also of native floras south of our region. Such species were typically not historically present in pre-European settlement within public lands. The goal of assisted migration is in part to proactively address warming climates and potential species migration. Most of the respondents were skeptical about this management strategy as a goal within stormwater management, but some cited potential benefits and examples.

3 Stormwater Utility Land Classification

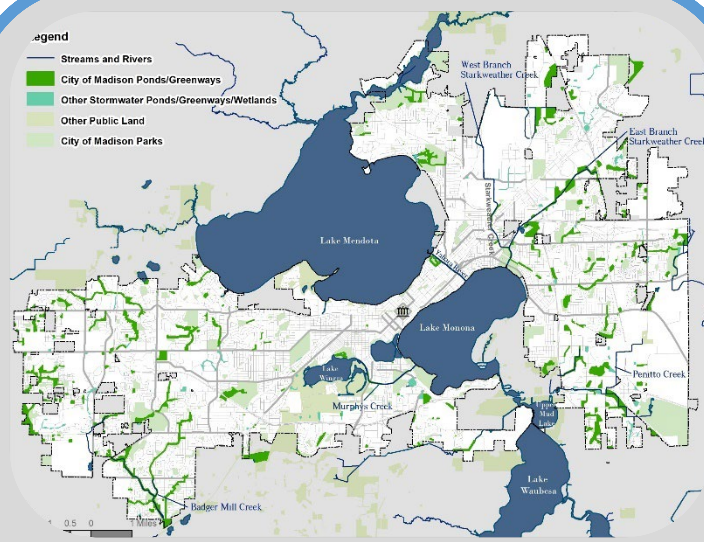
This chapter is divided into three sections:

- Infrastructure Background
- Regulatory Background
- Stormwater Land Categories

Infrastructure Background

City of Madison SWU land consists of infrastructure designed to convey, infiltrate or store stormwater (sometimes all three). These systems of ponds, greenways, and wetlands comprise the backbone of the SWU's water quality and flood management network, especially in areas developed from the late 1970s to the present.

The existing SWU network has developed throughout the City's establishment, is reflective of city structure, as well as engineering design standards and stormwater requirements at the time of development. This network includes public and private property improvements, improvements within public drainage easements, parkland, and road right of way. This larger network includes stormwater facilities with differing roles and requirements based on land dedications, property type, deed restrictions, maintenance agreements, primary function or historical maintenance in cases where there are no agreements in place.



Thumbnail Image of [Interactive Online Map of Ponds and Greenways]

The SWU maintains approximately 1,500 acres of stormwater utility dedicated property. This includes regional ponds, greenways, wetlands and open space and limited other features. The categories below are historical classifications used to describe the general function and track assets for a variety of monitoring and operational purposes. These lands are not inclusive of the City of Madison's larger stormwater management network, which includes both private and public lands and stormwater pipes and structures. This number is an estimation and continually increases as new properties are dedicated to the SWU through the subdivision process and as the City accepts newly constructed stormwater ponds.

There are often dozens of ponds, greenways and other stormwater infrastructure in various stages of construction and vegetation establishment by developers as part of contractual development agreements. Per these private development agreements, the SWU takes over maintenance of these areas once they meet their ecological restoration requirements, adding several new ponds and greenways to maintain each year.

Additionally, the SWU maintains over 80 acres of vegetation on non-stormwater utility owned property and assists in the maintenance of approximately 250 acres on other city agency property. These areas include raingardens and bioretention basins, various native plantings installed by volunteers along bike paths, native garden demonstration beds, pollinator plantings and other native plantings. The SWU also maintains stormwater functions of some ponds and greenways within parkland, including removing downed trees or special projects, such as the native restoration along part of Castle Creek at Warner Park.

Each land classification type below includes a variety of stormwater best management practices including grassed swales, permeable pavers, biofilters, regenerative conveyance swales, soil amendments, bio swales, urban canopy, native plantings, rain gardens, vegetation buffers and other green infrastructure.

Table: Stormwater Land Classification by Type and Acreage

Stormwater Land Classification Type[1]	Total Approximate Acreage (including water)
Greenways	616
Open Space	38
Ponds	923
Wet Ponds	482
Wetlands	212
Dry Ponds	102
Infiltration Basins	60
Undesigned	48
Bioretention	9
Total	**1,578**

Regulatory Background

Vegetation maintenance within SWU lands is part of larger regulatory requirements and laws that regulate stormwater and water quality management. These include the following:

- Wisconsin Department of Natural Resources (WDNR) Municipal Separate Storm Sewer System (MS4) Permit. The permit requires the City to conduct various stormwater management programs, which include reducing stormwater pollution originating from its existing upstream storm sewer system. The goal of the municipal stormwater discharge permit program is to reduce adverse impacts to water quality in our lakes and streams from urban sources of stormwater runoff. The City of Madison along with 22 other local municipalities is part of the Madison Area Municipal Stormwater

[1] Acreages includes properties owned by the SWU as dedicated stormwater outlots regardless of construction status, including water.

Partnership that collectively shares a WDNR Individual MS4 Permit under the Wisconsin Pollutant Discharge Elimination Program to discharge stormwater to waters of the.

- Rock River Total Maximum Daily Load (TMDL). Several watersheds within the City of Madison are part of the Rock River TMDL, which sets a maximum of total suspended solids and total phosphorus the City can discharge into waters of the state. These requirements set a much higher treatment required than the MS4 goals and include additional standards for agricultural land and the sewerage district.
- Madison General Ordinances Chapter 37. Development requirements for public stormwater facilities are set forth by requirements in MGO Chapter 37, which regulates erosion and stormwater runoff and impacts to regional water sources, health, safety, property, general welfare, and the enjoyment and use of natural resources.

This plan does not address the specific regulatory stormwater flood control or water quality requirements identified in the MS4 permit, Rock River TMDL and City of Madison ordinance.

The City of Madison SWU infrastructure within our greenspace network is a significant component of our compliance methodology. The function of vegetation within the greenspace network contributes to the functioning of the infrastructure.

Stormwater Land Categories

Greenways

Greenways are defined in the City of Madison General Ordinances as open areas of land with the primary purpose to carry storm water on the ground surface in lieu of an enclosed storm sewer. Greenways may serve multiple purposes in addition to their principal use for storm drainage, including vehicular and/or pedestrian access, sanitary sewers, water mains, storm sewers, storm water retention basins, park development and other related uses.

Wooded greenway at Sycamore Stoughton Greenway.
GR 6435-002

Greenways typically convey stormwater away from developed or flood-prone areas towards stormwater storage infrastructure. A greenway may also infiltrate stormwater; the degree to which it does is related to the channel material. Greenways include a variety of methods to conduct water, including concrete cunettes, riprap channels and fully vegetated channels.

Vegetation within greenways includes a variety of ecosystem types and varying biodiversity.

Some shorelines are classified as greenways because they are dedicated parcels owned by the SWU along a riparian corridor. These areas are predominantly along Starkweather and Wingra Creek and the vegetation along these areas is unique to riparian corridors.

Wet and Dry Ponds

The City of Madison has both dry ponds (sometimes referred to as detention) and wet ponds (sometimes referred to as retention). Dry ponds hold water only temporarily, filling up when it rains and infiltrating or releasing the water slowly downstream in the hours following rain. These dry ponds are not as efficient at reducing sediment, and provide limited wetland emergent vegetation, but often have more sedge meadow vegetation. Dry ponds were primarily constructed prior to the WDNR technical standard 1001 for effective performance standards to meet NR 151 requirements for post construction stormwater management or in areas restricted from constructing wet ponds by FAA rules, due to proximity to the airport. Many of these dry ponds were converted to wet detention ponds to meet this standard in the 1990s.

Native plants in summer at Sister Oak Pond wet detention pond.
PD 1452-033

Dry ponds are not as effective at reducing sediment, and typically do not provide significant wetland emergent vegetation. If these areas are managed as turf grass, they may be used as recreational areas during dry periods.

Wet ponds have year-round permanent ponds of water designed to "collect, detain, treat, and release stormwater runoff." (NR 1001). These wet ponds improve water quality by allowing particulates to settle out via gravity within the water column. They also reduce peak stormwater flow discharge rates and, in some cases, provide additional flood storage. These ponds are designed in accordance with WDNR stormwater construction technical standards required to meet MS4 permit requirements for reducing total suspended solids and phosphorous, as part of the federal and state regulations to restore the impaired Rock River through the Rock River Total Maximum Daily Loads (TMDL). Nineteen of Madison's twenty watersheds fall into the Rock River TMDL regulatory zone. The City of Madison has approximately 300 wet ponds on SWU land and even more that are part of the greater stormwater drainage system.

These wet and dry ponds are connected to other features of the drainage system by culverts, underground storm pipe systems and surface channels.

The SWU wet and dry ponds are typically seeded with native plant seed mixes. Older ponds, prior to current day design regulations, may have a variety of vegetation. Upland areas around ponds may consist of mesic prairie mixed with dry-tolerant, shorter prairie species, perhaps with scattered native shrubs and the occasional tree. Detention basins may be fully vegetated with wet prairie species or wetland shrub species able to tolerate extended periods of both standing water and drawdown.

Shorelines of detention basins may support shoreline emergent aquatic vegetation such as rushes, pickerelweed and arrowhead. Vegetation within these ponds provides opportunities to improve biodiversity and habitat related to wetland and wet mesic species. Wet ponds can include native wetland vegetation that requires a consistent water elevation. Unfortunately, these ponds also often include monocultures of invasive wetland species characteristic of urban wetlands that collect water from large watersheds.

View through vegetation of Southwest Blackhawk Pond wet pond. PD 1748-035

Bioretention Basins and Infiltration Systems

Both bioretention basins and infiltration systems are designed to infiltrate stormwater into the ground within small drainage areas.

Bioretention basins are designed to meet stormwater requirements in Wisconsin DNR Technical Standard 1004 to "enhance stormwater infiltration, reduce discharge of stormwater pollutants to surface and ground water, decrease peak flow rates and volumes, preserve base flow rates in streams, and reduce temperature impacts of stormwater runoff." They include additional soil amendments and an underdrain. Bioretention basins are required to be planted with native plant plugs typically spaced one foot on center.

Managed Meadow in fall at infiltration basin at Gingergrass at Gilded Cider. GR 1659-056

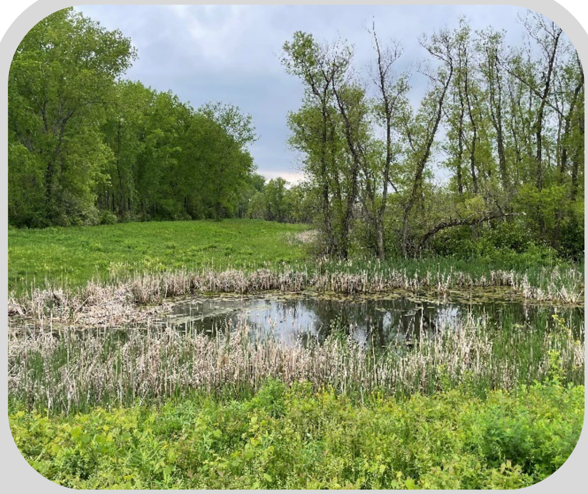
Infiltration systems are designed to "reduce stormwater pollutants, increase discharge to groundwater, decrease runoff peak flow rates and volumes, preserve base flow in streams and reduce temperature impacts of runoff." The City of Madison requires infiltration systems be seeded with native plants, although this requirement is not part of WDNR Technical Standard 1003.

Rain gardens are similar to bioretention basins and infiltration systems but are much smaller in scale. Typically, rain gardens are on park or private property and treat only "clean" areas with low or little sediment such as rooftops. The SWU designs and installs rain gardens in the public right-of-way as part of the Terrace Rain Garden program, but long-term vegetation maintenance of these is the responsibility of the property owner.

Rain gardens are typically planted with the same type of native vegetation as bioretention and infiltration basins.

Wetlands

Wetlands as a land classification include large, protected areas. Within the stormwater utility system, these ecological corridors are primarily comprised of undeveloped land with saturated soils. Wetlands provide numerous ecological benefits and provide natural phosphorus sinks, groundwater recharges, flood mitigation, thermal mitigation and a reduction of peak flows. This plan does not include all delineated wetlands or Wisconsin Wetland Indicators identified by the Wisconsin Department of Natural Resources since many of these overlap with other types of land.



View of wetland at Edna Taylor Marsh Greenway.
GR 6857-007

Wetlands are protected from development by the Wisconsin Department of Natural Resources. Typically, these only become City of Madison SWU property when they are restricted from development. Many wetlands in urban watersheds follow statewide wetland trends of being predominately dominated by reed canary grass.

Wetlands include areas of identified Federal Emergency Management Agency (FEMA) floodplains acquired for flood protection and storage, improving water quality and reducing erosion.

Open Space

Some stormwater land is undesigned and doesn't fit within any specific stormwater function category. These include hillsides, areas that were intended for development that did not occur, or other areas that serve as open space not specific to stormwater function. Some sites may have remnant native ecosystems of high value, but many of these areas have been dramatically altered by urbanization and may no longer have great ecological functionality or biodiversity.

4 Existing Vegetation Management

This chapter is divided into two sections:

- Vegetation Maintenance Tiers
- Vegetation Type General Classifications

Vegetation Maintenance Tiers

In the past five years, the SWU has maintained lands based on vegetation maintenance tiers. Vegetation maintenance tiers describe the levels of services using vegetation as a primary indicator of ecosystem health and considers the diversity and cover of native plants; connectivity of site to other high quality natural areas; the species and cover of invasive plants; susceptibility to future infestation by invasive plants and the site history of vegetation maintenance. Other factors in ranking sites include the likelihood of future reconstruction; demographics of the surrounding area and visibility/interest to the public; and a variety of other factors laid out in the definitions below.

Sites are ranked from one to three with tier one sites being those with the most biodiversity and presumed ecosystem functionality, and tier three sites being those with lowest biodiversity and presumed ecosystem functionality across all land cover types and stormwater function.

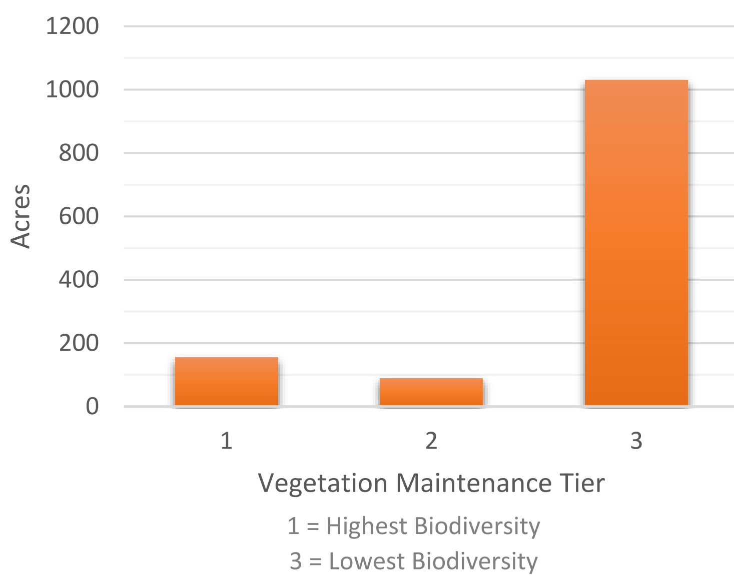
Vegetation management through this tiered system prioritizes resources to maintain existing native communities, while slowly increasing the biodiversity, reducing invasive species and increasing the tier level of SWU lands. Strategies identified in Chapter Seven build on this approach to improve SWU vegetation citywide.

This system incorporates the Madison Parks Division's adopted Land Management Plan for Tier Structure for Managed Meadows and applies the same principles across a variety of different vegetation classifications found within stormwater properties (e.g., Tier 3 Woods or Tier 3 Mixed Meadow and Woodlands).

Tier quantities described in this plan are a snapshot in time. Vegetation tiers may change depending on efforts to restore native species or new invasive species establishment.

The tier system is not all inclusive for all maintenance activities and strategies, but rather provides a baseline framework to help communicate maintenance routines and service levels based on the type of existing vegetation.

Graph: Vegetation Maintenance Tiers by Acreage



Tree plantings are eligible at each tier level. Tree plantings are implemented as part of both reconstruction projects and general operations. The Engineering Division does not equipment to install large trees, so it typically works with Madison Parks or organizations such as the Urban Tree Alliance on larger tree installations not associated with a capital project. **Across all tiers, requests for tree pruning and removals are currently only performed when there is a hazard to private property structure, to designated maintenance or public paths, or storm infrastructure. This work is performed by SWU staff, Forestry staff, or a private arborist depending on site conditions and access. This work will only occur when there is reasonable access to remove the tree.**

Saturn Drive Pond: a tier 1 wet detention pond.
PD 7341-001

Tier 1

These sites are characterized by their great diversity of native species and receive the highest level of maintenance for ecological restoration. These sites are primarily bioretention basins or infiltration systems, newly restored ponds, and greenways with vegetation most closely resembling a native ecosystem. Tier 1 sites are characterized by majority native plant cover, high diversity of native plant species, low invasive plant presence, and great potential for supporting species specialists that require native plants.

Level of Service

- Each site receives a maintenance visit **at least twice** during the growing season; this includes targeted invasive species control at this visit overseen by conservation staff.
- Supplemental native seeding **or plug planting** as needed.
- Supplemental native tree or shrub plantings based on Chapter Seven strategies to address urban canopy disparities, downstream flooding and oak regeneration and the appropriate vegetation type and management practice.
- These sites are **burned on a maintenance cycle of three to seven years** if site conditions, and species composition allows.
- Each site will receive spot brush cutting of woody invasives every three years, alternating prescribed burn years.
- Each site receives a **flora survey once every three to five years**.
- Hybrid non-native cattails and reed canary grass are typically managed in these areas if they are new populations or impede stormwater flow contributing to flooding.

Tier 2

These sites are mostly ponds, greenways, wetlands and open space with some native vegetation, but with a lower cover or diversity of native plants than Tier 1 sites. These sites receive a medium level of maintenance. Tier 2 sites may also face greater threats of infestation or have a higher cover of invasive non-native plants. A typical example is Dondee retention pond (PD 6751-024) where native wetland species are supported in the basin and some upland forbs and grasses grow among non-native cool season grasses in the upland areas. Many of the Tier 2 sites are managed with the goal to transition to Tier 1 sites, which can be managed long term with prescribed burning rotations rather than mowing.

Tier 2 savanna restoration part of North Door Creek Greenway. GR 7641-013

Level of Service

- Each site receives a maintenance visit **at least once** during the growing season, which includes targeted invasive species control overseen by conservation staff. This may include mowing.
- These sites **may be inter-seeded** with highly competitive and conservative native species in the fall/winter, or plug planted during the growing season in spring/fall.
- These sites **are only burned in cases where that activity could promote additional native species within existing resources** (e.g., this would not include burning lawn, where establishing natives would require significant work).
- Supplemental native tree or shrub plantings based on Chapter Seven strategies to address urban canopy disparities, downstream flooding and oak regeneration and the appropriate vegetation type and management practice.
- These sites receive a **flora survey once every five to ten years.**
- Hybrid non-native cattails and reed canary grass may be managed in these areas if they impede stormwater flow contributing to flooding.

Tier 3

Large swaths of the stormwater system fall into the Tier 3 rank. These sites are characterized by low native plant diversity, with a majority covered by non-native or invasive vegetation, and few ecosystem services. Maintenance on these sites varies but accessible sites are typically mowed once a year. Tier 3 sites may not be mowed if they are wooded, too wet or have limited access (primarily due to topography). The number of inputs needed to increase native plant diversity on these sites is high, so efforts to capitalize on the vegetation already present must be low input. Because so much of Madison's stormwater system is in this condition, not all areas are able to be mowed at optimal times for vegetation maintenance or habitat purposes (such as nesting habitat for ducks or red-winged blackbirds), though the low mowing pressure can still make these sites valuable to wildlife. Tier 3 sites receive a lower level of management, primarily mowing, to preserve existing native or non-native flowers and reduce the spread of existing or new invasive species. This category includes over 500 acres of land that is unmowable due to topography, access, wet conditions, or woods. Most of the unmowable areas are either too wet or wetland (>250 acres) or are wooded (>200 acres).

Reed canary grass monoculture on a tier 3 greenway at Glacier Crossing Pond.
[PD 2677-023]

Level of Service

- Each site is inspected for mowing accessibility each year and **mowed annually** if accessible by commercial-grade mowers that can cover large areas efficiently.
- These sites **may be inter-seeded** with highly competitive native species particularly if a disturbance (either natural or man-made) exposes soil. Species that pose health hazards, such as wild parsnip or poison ivy, may be controlled via targeted mowing or other means.
- A small percentage of Tier 3 areas are turf, and these are mowed four times a year.
- Supplemental native tree or shrub plantings based on Chapter 7 Strategies to address urban canopy disparities, downstream flooding and oak regeneration and the appropriate vegetation type and management practice.
- Hybrid non-native cattails and reed canary grass are rarely managed and frequently found in these areas. They are only removed if they impede stormwater flow contributing to flooding.

Targeted Tier Management Areas

These are transitional areas within each tier that have specific management practices. These tiers can exist within any combination of Tier levels and additional targeted Tier Management Areas.

Tier a – Transitional Area due to Minimal Existing Invasives

These areas have less native plant biodiversity than the tier above but have minimal patches of existing invasive species that are easily controlled. With temporary increased management, these areas can achieve more ecological diversity and move to a higher tier. In turn, this would lower long-term maintenance specifically in areas that can be maintained through prescribed burns. These areas are more intensely managed than other land within that tier, with the goal that they can transition to Tier 1 or 2 areas within the next year or two.

Tier b – Targeted Areas due to Species of Concern

These are areas that have invasive species of concern and are specifically managed for control and removal of the following species:

- Japanese knotweed (*Polygonum cuspidatum*)
- Tree of heaven (*Ailanthus altissima*)
- Purple loosestrife (*Lythrum salicaria*)
- Wild chervil (*Anthriscus sylvestris*)
- Porcelain berry (*Ampelopsis brevipedunculata*)
- Water celery (*Oenanthe javanica*)
- Poison hemlock (Conium maculatum)

Vegetation Type General Classifications

Vegetation is categorized into general vegetation types and then within each type, a vegetation tier based on biodiversity and native/invasive species. This classification applies to approximately 1,300 acres of vegetation managed on SWU property. Not included in these descriptions are lands that are acquired but not yet designed, developed or leased agricultural lands. The quantities listed below are approximate.

Managed meadow native plants at Upper Badger Mill Creek South Regional Basin. PD 2779-032

Turf Areas

There are approximately 30 acres of SWU property that have been historically mowed to turf by City Engineering staff four times a year. Some of these include agreements with other agencies and specific case scenarios. The City of Madison does not enter into new agreements for new turf areas. However, Madison General Ordinances allow for adjacent property owners to mow greenways and ponds unless posted for no mowing. Given this, in some locations where native ecosystem establishment is not practical or currently underway, property owners are allowed to mow ponds and greenways. These areas are then typically maintained by property owners as turf moving forward.

Managed Meadows

There are approximately 850 acres of managed meadows on SWU property. These areas are primarily mixed herbaceous vegetation in non-wooded, non-turf areas that may also support native wetland or prairie species but are not considered fully restored ecosystems. The level of biodiversity and general maintenance is determined by the tier level. Tier 1 areas are typically highly restored ecological restorations dominated by native species, whereas Tier 3 areas are dominated by invasive species. Long term vegetation objectives for managed meadows mirror those adopted by the Parks Land Management Plan and include:

- increasing the quality and diversity of native pollinator species,
- providing winter habitat (cover) for insects and small mammals,
- providing effective, long-term control of invasive plant populations,
- limiting the growth of woody species to maintain open space dominated by herbaceous species,
- providing areas that maximize infiltration of precipitation and reduce runoff.

The above objectives are ideal; however, management is limited based on available resources and site characteristics. Many managed meadows within SWU greenways cannot be managed to these goals without a larger construction project that leverages funding for ecological establishment. Additionally, some monocultures of reed canary grass and hybrid cattails that occur in managed meadows cannot be sustainably managed to these goals, since they would require significant resources both to eliminate these species and to continue to maintain them as biodiverse communities. Strategies for prioritizing these goals are found in Chapter 7.

Urban Woodlands

There are approximately 300 acres of urban woodlands on SWU property. These include urban forests of mixed species dominated by woody non-herbaceous species. At the time of this plan, native woodland communities have not yet been distinguished and include wooded wetlands and floodplains. Development of a GIS-based catalog is a goal of this vegetation management plan. Long term vegetation objectives for woodlands mirror those adopted by the Madison Parks Land Management Plan and include:

- promoting survival of canopy dominant oak and desirable sub-canopy trees by thinning and reducing competition in overcrowded stands,
- ensuring the retention of oak as a species component in oak dominated woodlands,
- ensuring regeneration, particularly of oaks in stands with closed canopies by removing invasive shrub understories,
- removing invasive and non-native plant species,
- conducting prescribed burns where possible in stands containing oak or hickory,
- retaining a diverse native shrub component understory,
- restoring and maintaining a native herbaceous ground layer,
- retaining standing dead trees for wildlife habitat where safe and practical,
- retaining downed woody debris for wildlife habitat where possible.

Unfortunately, available resources limit management to many of these urban woodland long term objectives. Historically, they are met only as part of a stormwater infrastructure reconstruction project that includes capital resources to leverage vegetation management. Strategies for prioritizing these goals are found in Chapter 7.

Mixed meadow and woodland at Mendota Spring Harbor (Kenosha) Greenway. GR 3353-057

Mixed Meadow and Woodland

There are approximately 70 acres of mixed meadow and woodland areas. These are communities of both herbaceous and woody vegetation.

Native Ecosystem Communities

These sites are high quality, high biodiversity, very low invasive species, native ecosystems that have been re-established and/or preserved, and are part of the native ecosystems described in the Wisconsin Department of Natural Resources Southeast Glacial Plains Ecological Landscape. Almost all Native Community sites are Tier 1 or Tier 2. In native ecosystems, specific management strategies and planting reflects plants representative of these ecosystems. Native Ecological communities may include forests, savannas, shrub communities, herbaceous communities and other miscellaneous natural communities and terrestrial habitats. Staff goals include monitoring and inventorying more detailed vegetation as defined in Community Descriptions of historic native ecosystems of the Southeast Glacial Plains Ecological Landscape. At the time of this plan, a catalog of native plant communities does not exist but are contained within the existing categories of Managed Meadow, Urban Woodlands and Mixed Meadow and Woodland. Development of this GIS-based catalog is a goal of this vegetation management plan.

Undesigned

There are approximately 30 acres of land that are not designed. These include lands that are subdivided but not yet constructed, agricultural leases, and other property not yet developed. These do not receive any maintenance until the associated stormwater features (e.g. pond, biofiltration basin, etc.) are constructed.

Table: Maintenance Tier Classifications and Minimum Expected Levels of Service

MANAGED MEADOWS	Tier 1	Tier 2	Tier 3
Conservation Maintenance Visit (weeding, spot mowing)	2x year	1x per year	As time allows
Burn Frequency	1x, every 5-7 years	1x, every 5-7 years (only sites not annually mowed)	None
Invasive Brush Removal	1x, every 3 years	1x, every 3 years	None
Planting	Supplemental native trees, shrubs, plugs or seed	Supplemental native trees, shrubs, plugs or seed	Supplemental native trees, shrubs, plugs or seed
Floral Survey Frequency	1x, every 3-5 years	1x, every 5-10 years	None
Annual Mow	None	Yes - Accessible areas only (for sites that are not on prescribed burn schedule)	Yes (Accessible areas only)
URBAN WOODLANDS	Tier 1	Tier 2	Tier 3
Conservation Maintenance Visit (weeding, spot mowing)	2x year	1x per year	As time allows
Burn Frequency	As possible	May be burned if close to being upgraded to a tier 1	None
Invasive Brush Removal	1x, every 3 years	1x, every 3 years	None
Planting	Supplemental native trees, shrubs, plugs or seed	Supplemental native trees, shrubs, plugs or seed	Supplemental native shrubs or seed
Floral Survey Frequency	1x, every 3-5 years	1x, every 5-10 years	None
Annual Mow	None	Yes - Accessible areas only (for sites that are not on prescribed burn schedule)	Yes (Accessible areas only)
MIXED MEADOWS AND WOODLAND	Tier 1	Tier 2	Tier 3
Conservation Maintenance Visit (weeding, spot mowing)	2x year	1x per year	As time allows
Burn Frequency	As possible	May be burned if close to being upgraded to tier 1	None
Invasive Brush Removal	1x, every 3 years	1x, every 3 years	None
Planting	Supplemental native trees, shrubs, plugs or seed	Supplemental native trees, shrubs, plugs or seed	Supplemental native trees, shrubs, plugs or seed
Floral Survey Frequency	1x, every 3-5 years	1x, every 5-10 years	None
Annual Mow	None	Yes - Accessible areas only (for sites that are not on prescribed burn schedule)	Yes (Accessible areas only)
TURF	Tier 1	Tier 2	Tier 3
Mow	Turf is only considered Tier 3 because of the lack of biodiversity.		Mow four times per year
NATIVE COMMUNITIES			
Identification of specific, sensitive native communities is ongoing. Management strategies will likely mirror Tier levels but may include additional resources to protect and enhance the community. A goal of the SWU is to map and identify these communities and determine additional resources required for long term management (e.g., treating increasing non-climate and climate impacts on oak woodlands).			

5 Resources

This chapter is divided into two sections:

- SWU Staff
- Funding

Specific to this plan are the resources and responsibilities for management of dedicated land owned by the SWU. Resources for vegetation management of these properties is funded by the SWU's portion of the municipal services bill.

Stormwater Utility Staff

SWU staff have multiple responsibilities, including the management and maintenance of the SWU properties. Maintenance of our system is limited by existing staff and funding resources and is leveraged through community partnerships, development requirements, volunteers, and private ecological restoration contracts.

Approximately 1,500 acres of land are owned and managed by the SWU. Staff also assist with vegetation maintenance on an additional 330 acres of ponds and greenways. These lands are owned by other public agencies and divisions (Madison Parks, MMSD, Dane County, City of Madison Streets & Recycling, City of Madison Water Utility, City of Madison Closed Landfills), as well as on private lands over which the SWU has a public easement.

Management on SWU land is completed by both the stormwater conservation staff and general stormwater Operations Staff.

Stormwater Conservation Staff

The conservation staff became integral to managing SWU lands in 2018. In 2018, the SWU hired the first Stormwater Vegetation Coordinator, followed by a full-time Conservation Technician in 2021. These two full-time staff are responsible for management of all stormwater utility land, in addition to other initiatives mentioned throughout this plan.

Today's SWU conservation staff include:

- (1) Stormwater Vegetation Coordinator
- (1) Conservation Technician
- (2) Seasonal Summer Hourly Conservation Trainee

Stormwater Conservation Staff conducting prescribed burn at rain garden.

Land management responsibilities include, but are not limited to:

- Managing vegetation on SWU property
  - Spot mowing, hand weeding, prescribed burning, brush clearing, herbicide application, etc.
  - Collecting native plant seeds for use on SWU property
  - Growing native plants for use on SWU property
  - Seeding and planting plugs, shrubs and small trees, as well as watering
- Inventory, inspection and assessment of SWU property
- Installing Spring and Fall terrace rain gardens with street reconstruction projects
- Inspecting, assigning and overseeing work performed by Operation Fresh Start and private contractors
- Reviewing, coordinating, and inspecting new ecological restorations and plantings as part of new construction for private development stormwater properties or Public Works green infrastructure development

Over 50% of SWU conservation staff time is spent on manual weed control, native planting, and collecting and processing native seed to use throughout the system.

In 2023, this work included:

- Planting approximately 14,000 native plugs
- Planting 245 native trees or shrubs
- Performing 15 prescribed burns
- Conducting 35 flora surveys
- Collecting and processing 338 lbs. of native seed from 154 native species ($65,000 value if purchased)
- Spending 381 hours on manual weed control (digging, hand pulling, brush mowing)

General Operations Staff

The Engineering General Operations department (Ops) provides additional non conservation staff that perform operational vegetation maintenance tasks as part of their other duties. Vegetation specific duties performed by Ops staff include large scale mowing (not species specific) and tree and brush removals. Other primary duties of Ops staff assigned to work on stormwater vegetation include storm/sanitary repairs, MI-TE Madison Infrastructure Training Engineering, inlet cleaning, debris removal from City storm structures and snow removal.

Today's SWU Ops staff include:

- (1) Public Works Foreperson
- (5) Operations Field Staff

> From 2019 to 2023 there have been 332 work orders to remove brush/downed trees that were blocking drainage channels in ponds or greenways.

This staff conducts the larger scale mowing in vegetation management areas designated Tier 3. As described in Chapter 4, Tier 3 lands are not yet managed for higher biodiversity and/or ecological restoration. These areas include approximately 170 locations (350 acres) mowed once annually, 15 locations (35 acres) mowed twice annually, 15 locations (24 acres) mowed every other year, and less than 20 acres of turf areas mowed four times a year. The remaining approximately 600 acres in Tier 3 cannot be mowed primarily due to wet conditions and woodland vegetation.

Funding

SWU land management is funded primarily through the SWU municipal services bill that property owners receive each month. The monthly service bill is approximately $12.53/single family household and funds the entire SWU operations and capital projects. In addition to funding through the SWU municipal services bill, the SWU seeks additional revenue through grant opportunities for operational expenses. Since 2019, the SWU has received two grants totaling $45,000 from the Wisconsin Department of Natural Resources (WDNR) to monitor and manage new Invasive Species.

As the City continues to expand, the amount of land managed by the SWU also grows each year. These areas include new publicly dedicated stormwater ponds and greenways, as well as redevelopment that requires new public stormwater infrastructure to meet existing ordinance requirements.

The annual budget for landscaping equipment and supplies (plants, seed, plant support materials) as part of general annual operations in 2024 was $19,000. The annual budget for landscaping consultant services as part of general annual operations in 2024 was $70,000. This amount has varied between $40,000 and $70,000 (2024 budget) since 2018.

> Since 2019, the SWU has received two grants from the Wisconsin Department of Natural Resources to monitor and manage new invasive species totaling $45,000.

Anticipated Growth

SWU land has grown significantly in the past few years in conjunction with new subdivision development. Since the Stormwater Vegetation Coordinator position was created in 2018, over 80 new ponds and greenways have been dedicated accounting for approximately 470 acres of additional land to be managed. This growth is anticipated to continue through infill, new development, and intergovernmental agreements with the Town of Burke, Blooming Grove, and Middleton.

New Development

Existing Adopted Neighborhood Development Plans include approximately 2,470 acres of current undeveloped land that is proposed as future "parks and open space," which include lands designated for stormwater purposes within City of Madison limits.

Additionally, the Adopted Comprehensive Plan identifies a total of 5,330 acres of new land designated as "parks and open space" which includes lands designated for dedication of parkland or stormwater as part of Adopted Neighborhood Plans and land to be incorporated into the City of Madison limits with future agreements.

Redevelopment

Within existing developed areas, redevelopment construction often needs to dedicate or implement stormwater management infrastructure to meet increased ordinance requirements. As these areas develop, this often means installing and/or dedicating new publicly maintained and owned stormwater bioretention basins, typically smaller than larger ponds or greenways, but more numerous and highly visible small plantings of live plants within street terraces or the right of way.

Reconstruction of Existing Ponds and Greenways

When ponds and greenways are reconstructed to improve flood capacity, storage, or water quality, these improvements typically increase the level of vegetation management from pre-construction conditions. All pond and greenway reconstruction projects include establishment of native vegetation, typically including trees, shrubs, live native grasses and forbs, along with native seed. Most of these projects reconstruct ponds and greenways that previously underwent very little to no maintenance, thus transferring maintenance responsibilities from a potential annual mow to multiple site visits/treatments per year. Since 2018, nine previously unmaintained ponds and greenways were reconstructed and moved up to a Tier 1 management level due to increased native plant diversity and improved ecological functionality. Tier 1 sites are the most resources intensive designations in the first few years of ecological establishment.

Increasing Climate Challenges

The Wisconsin Initiative on Climate Change 2021 Assessment Report predicts that Wisconsin's future will continue to be warmer, have increased rain and snow, and experience more frequent extreme rain events. The SWU is already experiencing these impacts. Engineering staff have increased their efforts to water plants in warmer temperatures, grow efforts to respond to increased stresses on trees related to heat, drought, and disease vectors; as well as expand requirements for contractors establishing new vegetation on engineering property to mitigate climate impacts. This is in addition to increased work by general operations staff for debris clearing, storm damage, and structure clearing.

Additionally, as Madison continues to aspire to grow sustainably, the SWU is increasing its investment into native vegetation and ecological solutions to climate change impacts at the local level. This includes increasing native plantings within terrace plantings, promoting terrace rain gardens with applicable new street reconstruction projects, requiring stricter vegetation standards for new developer constructed public ponds and greenways, and working with volunteers to address the increasing community interest in local native vegetation management as part of the solution to stormwater runoff.

6 Vegetation Management Considerations

Solutions and goals of vegetation management are complex. Vegetation communities impact wildlife habitat, pollinators, global food production, genetic biodiversity, nutrient runoff, soil erosion, carbon storage, air quality, stormwater runoff, aquifer recharge, aquatic habitat and water quality.

The relationships between plants, soils, nutrients, and wildlife have formed over 410 million years but have been most drastically altered within the 20th and 21st century.

In Dane County, the pre-European ecological landscape was minimally impacted for thousands of years. Today, these thousand year old ecosystems are primarily gone, and ecosystems like oak openings, some of the rarest plant communities in the Upper Midwest, are listed by the Wisconsin's Natural Heritage Working List as both globally and state critically imperiled with a very high risk of extinction. Other historical communities of wet prairie, mesic prairie, and oak woodlands are listed as critically impaired within the State of Wisconsin.

While vegetation assemblages have changed, so too have the social and global impacts and public perspectives surrounding vegetation. Vegetation is increasingly looked at as part of a solution to a variety of environmental issues including biodiversity loss, soil loss, urban heat impacts, carbon sequestration, groundwater infiltration, and ecosystem support. Vegetation as a solution to larger environmental issues is complex, and the options for managing vegetation or sites to address one or all of these issues often has competing priorities.

Future Climate Change Impacts

The Wisconsin Initiative on Climate Change 2021 Assessment Report predicts that Wisconsin's future will continue to be warmer, have increased rain and snow, and more frequent extreme rain events. The Wisconsin Initiative on Climate Change Impacts (WICCI) Plants and Natural Communities Working Group identified 10 specific climate change issues and their impacts to plants and natural communities as part of the Governor's Task Force on Climate Change.

Table: Wisconsin Initiative on Climate Change Impacts Plants and Natural Communities Working Group List of 10 Specific Climate Change Issues on Plants and Natural Communities

1 **More Intense and Frequent Heavy Rainfall**
Extreme storms cause erosion that can damage soils and vegetation, as well as infrastructure such as roads, bridges, culverts, and trails. Extreme rainfall events also carry significant amounts of nutrients and sediment to wetlands and waterbodies. These can diminish culturally important plants such as wild rice and encourage growth and dispersal of harmful or invasive plants such as blue-green algae and Eurasian water-milfoil. For more about this topic, see this issue brief: Reducing the Impacts of Extreme Precipitation to Benefit Both Natural and Human Communities (pdf).

2 **Wetter Overall Climate, Especially During Winter and Spring**
Prescribed burning opportunities may change due to a changing climate. Diminished prescribed fire in fire dependent ecosystems can reduce numbers and productivity of important native species,

including some that hold cultural importance to tribes, like blueberries, as well as diminish ecosystem integrity, making them less resilient to climate change.

3 **More Summer Droughts and Longer Periods Between Rain Events**
Increased evapotranspiration can lead to drying of soils and lower groundwater, causing drying of wetlands and changes in their composition, quality, structure and function. Upland forest tree species composition may also shift in response to warmer conditions.

4 **Warming Temperatures Combined with Increased Atmospheric Carbon Dioxide**
Non-native invasive species benefit from warming temperatures and carbon dioxide enrichment.

5 **Warming Temperatures, Including More Extreme Summer Heat**
Native plants that are at the southern edge of their range or that have restricted ranges or habitats may disappear from Wisconsin. This is especially true for boreal species and natural communities.

6 **Milder Winters with Less Snow**
Tree regeneration is increasingly inhibited by deer as higher deer numbers survive milder winters and woody stems are more accessible with shallower snow. Tree roots are also more vulnerable to frost damage when they lack insulating snow cover.

7 **Winter Precipitation Increasingly Falling as Rain and Freezing Rain**
Rain falling on frozen ground can transport manure spread on fields and road salt to waterways and wetlands, causing harm to wetland plants and encouraging growth of invasives.

8 **Great Lakes Changes, Including Increased Extreme Storms, Rapid/Extreme Water Level Changes, and Increased Wave Action**
These can cause shoreline erosion, slumping, increasing freeze-thaw cycles, and drought. Near-shore coastal wetlands are experiencing increasing deposition of sediment. Also, increased armoring of shorelines in response to climate change can result in loss of important wetlands and other shoreline habitats.

9 **Multiple Climate Stressors, Often Combined with Other Existing Stressors**
Climate change amplifies existing non-climate stressors (habitat loss and fragmentation, invasive species, lack of fire, excessive deer browse, and nutrient runoff) to the point where once-diverse habitats are simplified, associated wildlife species diminish or disappear, important ecosystem services are lessened (like water filtration and pollinator sources), and sustainable harvests of desirable species are limited. To learn more, see this issue brief: Habitat Restoration Can Reduce Adverse Impacts of Multiple Climate Stressors (pdf).

10 **Increasing Atmospheric Carbon Dioxide**
Natural communities such as forests, grasslands and wetlands, particularly peatlands, can mitigate climate change by sequestering carbon.

These issues are specifically concerning to stormwater management property that will be most impacted by changing precipitation rates. Strategies to address these issues are included more in depth in the Issue-Impact-Strategy Table of Recommendations for the Governor’s Climate Change Task Force.

Other City of Madison Plans Related to Vegetation

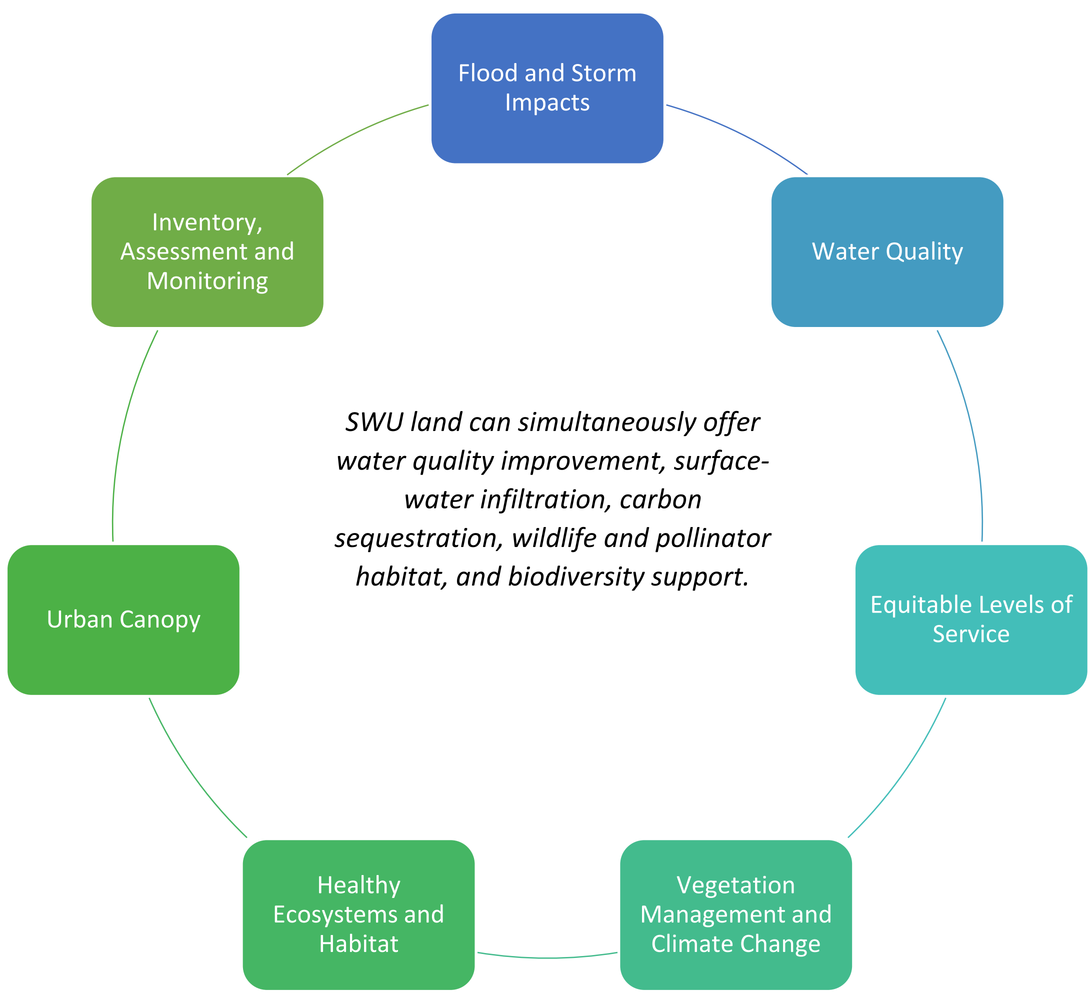
There are several adopted big picture, citywide planning documents that include strategy recommendations related to vegetation management for stormwater function. These include the City of Madison Pollinator Task Force Report, the Climate Forward Agenda, the Urban Forestry Task Force Report, and the City of Madison Sustainability Plan.

7 Goals and Strategies

This chapter outlines goals and strategies of the SWU's Vegetation Management Plan. This plan includes strategies that reflect public input and the values of our community, along with the guidance received from various experts in related fields. The strategies also consider existing resources that aim to provide a sustainable vision for SWU's ponds and greenway vegetation. Existing and future efforts are identified within each strategy. Strategies identified for the future may require additional resources.

These goals provide a framework for citywide SWU vegetation management. They do not address individual sites. This is not a plan for new construction or reconstruction projects. New construction and reconstruction projects typically have their own public engagement process and goals. This plan does not include lands managed by Madison Parks or other City, county, or state agencies.

This framework is separated into seven categories and includes larger goals, as well as strategies to achieve each goal. Though discussed separately, the goals and strategies within each category are interconnected to long-term, sustainable vegetation management within City resources and priorities.



Flood and Storm Impacts

A primary function of the SWU is to manage vegetation within watersheds to reduce flood impacts. This includes reducing flooding to property, structures, streets and emergency access, as well as increasing infiltration to reduce downstream flooding and impacts to water quality. This is increasingly important with forecasted climate projections.

According to the Wisconsin Initiative on Climate Change Impacts (WICCI), Wisconsin has become both wetter – annual precipitation has increased 17 percent – and more likely to experience very extreme precipitation events. These extreme events are already occurring. In August 2018, 11.63 inches of rain fell over 24 hours in Middleton, immediately west of the City of Madison. This event and the series of storms that followed flooded roads, paths, homes, medical facilities, businesses and caused millions of dollars in damage. Increasing extreme storms like these concern Madison residents. The majority of responses in the public engagement process said that vegetation maintenance should be prioritized based on the greatest threat to stormwater issues.

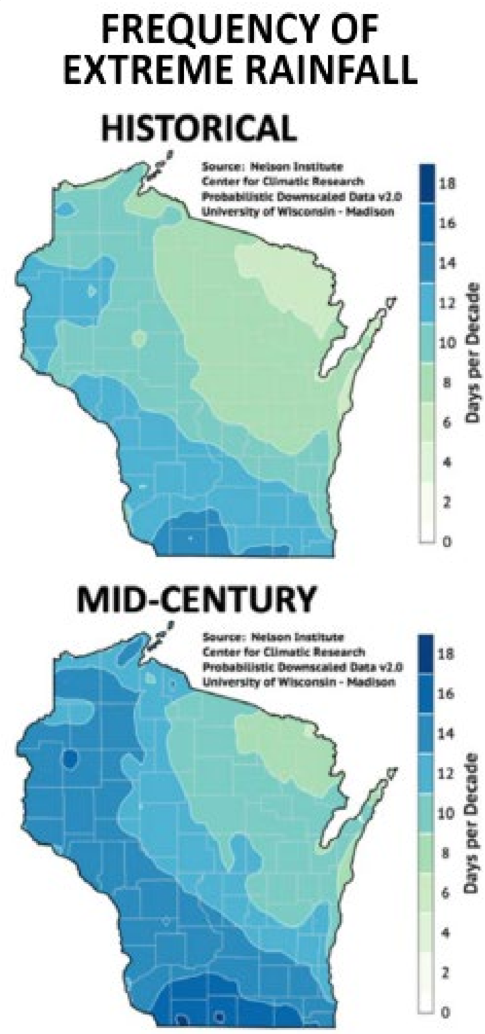


Figure 10: Extreme precipitation events will occur more frequently through the coming century. Shown here is the frequency of days with 2 or more inches of precipitation in a 24hr period.

Wisconsin Initiative on Climate Change Impacts (2021).

Goals

1. Ensure vegetation does not obstruct stormwater conveyance in ponds and greenways that are prone to flooding adjacent structures, roads, and bike paths. Conveyance restrictions and the resulting backwater can increase flooding.
2. Reduce runoff by maintaining bioretention basins and infiltration systems with native plants to increase infiltration during storm events and reduce downstream flood velocity.
3. Ensure access to ponds and greenways for preventative and emergency maintenance to stormwater infrastructure to prevent backups, overflow or other flooding related to vegetation clogging or blocked inlets pipes, outlets, and other infrastructure. Ensure access for other utilities such as sanitary sewer infrastructure and overhead utilities that are located within greenways.

4. Manage vegetation to enhance water storage and infiltration in the upper watershed or headwater of a channel at locations where there is no risk of structure, street, or other flood impacts.
5. Prioritize vegetation management for emergency access in areas at risk of flooding and locations of vulnerable populations that may not be able to leave their residence if flooded. (Ongoing)

Flood waters from 2018 storm almost overtopping culvert at greenway.
GR 2472-008

Strategies

- Identify locations to increase shrub and tree canopy, where doing so can decrease downstream flooding. (Future)
- Remove accessible dead, diseased, damaged and felled trees that block channels, block storm inlets, or are at risk of causing structure damage to private properties and utilities to reduce storm event damage. Maintain access around these areas so that adjacent trees do not need to be felled for emergency repairs. Felled and dead trees that are not accessible, cannot be easily removed and are not proactively removed. (Ongoing)
- Remove vegetation that clogs inlets and blocks channels and replace with flood tolerant native species that pose minimal risk to blocking channels and clogging inlets. (Ongoing)
- Mow vegetation along existing access routes at least once per year to ensure access to conveyance routes, structures, pipes, and other utilities. In areas where these have overgrown due to lack of maintenance, evaluate options for selective brush and tree removal that provides emergency access while minimizing impacts to vegetation. (Ongoing)

Since 1950, the southern two-thirds of Wisconsin has experienced the biggest increase in precipitation.

Roads, bridges, culverts, and stormwater structures not built for the increasing volume and intensity of precipitation are contributing to damaging floods and increasing health risks. (WICCI Climate Change Fact Sheet, n.d.)

Water Quality

Nutrient runoff through soil loss is the leading contributor to decreased water quality. Within Dane County, phosphorous runoff from agricultural land is the primary contributor to nutrient runoff. Additional contributors to runoff include pollution contributions through sediment loss within ponds and greenways. The WICCI Water Resources Working Group identifies Impacts of and Adaptation Strategies for Climate Change on Wisconsin's Water Resources, which has helped guide the vegetation management plan goals and strategies.

View through vegetation of Southwest Blackhawk Pond wet detention pond. PD 1748-035

"Stream flooding associated with large storms is also a concern, causing damage to infrastructure, habitat loss, and risks to human health. The fast-flowing water during floods increases erosion and can also cause deep channels to form that intensify the flow of stormwater. These channels further reduce flood storage, degrade water quality, and increase downstream flooding." (WICCI, 2021)

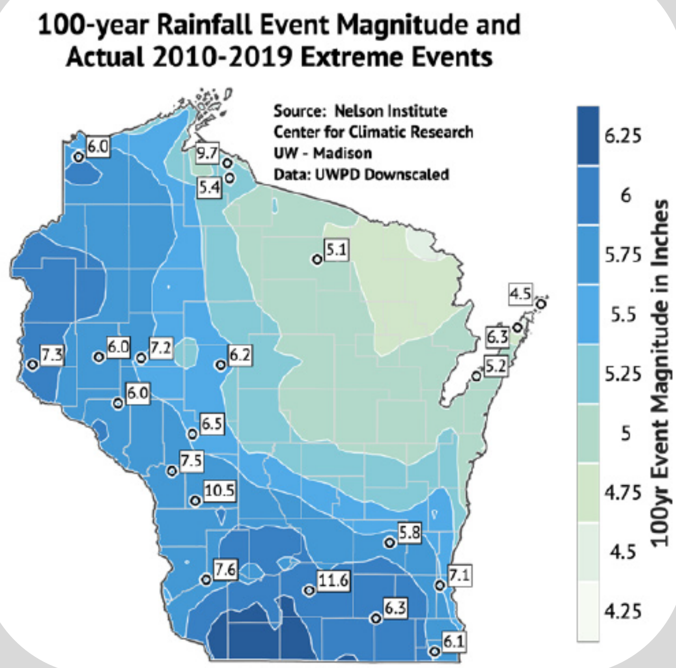
Goals

1. Maintain vegetation within ponds and greenways to reduce potential erosion while maintaining goals and compliance of the MS4 permit and Madison Area Stormwater Partnership to reduce phosphorous loads within the Rock River Total Maximum Daily Load (TMDL).
2. Protect and restore lake and streambanks, floodplains, wetlands, and groundwater recharge areas.
3. Manage vegetation to increase infiltration.

Strategies

- Minimize areas of mowed turf within SWU maintained by private homeowners and areas maintained by the SWU. Compared to other vegetation types, mowed turf requires higher levels of routine maintenance, provides less infiltration and is less effective at managing nutrient and sediment runoff. (Ongoing)
- Manage vegetation within watersheds to slow sediment and water movement within tributaries where structure, street, and bike path flooding is not likely. Vegetation is only one contributing factor to bank stabilization. (Ongoing and Future)
- Continue annual greenway inspections for MS4 permit compliance and reduce the number of greenways that have existing erosive slopes by vegetating areas that are bare and actively eroding. Vegetate urban channels that are not part of a larger reconstruction project based on the results from annual greenway inspections and as operating budgets allow. (Ongoing)

- In newly constructed or reconstructed greenways, ensure that resources are available for long-term maintenance to meet vegetation goals to stabilize pond and greenway banks. (Ongoing and Future)
- Minimize soil disturbance from vehicles and operations related to vegetation management practices to the greatest extent possible to reduce the potential for spreading invasive plants and protect topsoil resources. (Ongoing)
- Develop shoreline ratings system and monitor SWU public shorelines to track erosion. (Future)
- In greenways that border riparian waterfronts, stabilize shorelines with nature-based solutions based on the ecosystem services of native wetlands, wetland emergent and shrub-carr communities where possible. (Ongoing)



Wisconsin Initiative on Climate Change Impacts (2021).

Wisconsin is experiencing more extreme rainfall events. The shading in this figure shows the magnitude of the "100 year" rain event in Wisconsin, ranging from 4.25 to 6.25 inches. In the years 2010-2019, Wisconsin experienced at least 21 rainfall events that exceeded the 100-year event in locations indicated by the circled and labeled amounts. (WICCI Report, 2021)

Equitable Levels of Service

The SWU maintains a geographic database system of all vegetation within stormwater utility property. Citywide vegetation management includes a minimum level of service for each location based on the vegetation management tiers described in Chapter 4.

This system prioritizes invasive species management based on existing biodiversity and available resources while gradually improving areas of lower biodiversity. In 2024, the SWU implemented GIS-centric asset management software Cityworks® to better organize and understand levels of service across the city, as well as to monitor and inventory native and invasive species, and implement early detection and rapid response for invasive species.

Processing native seed collected by staff for overseeding stormwater utility ponds and greenways.

Goals

1. Maintain levels of service to provide transparent communication on what residents should anticipate for vegetation maintenance in stormwater properties.
2. Ensure staff time is equitably distributed across communities per recommendations by the Racial Equity and Social Justice Tool presented to the Board of Public Works.
3. Prioritize invasive removal maintenance in existing highly biodiverse, sensitive and threatened ecosystems.
4. Provide site specific management in in transitional areas and in targeted areas for species of concern.

Strategies

- Implement levels of service identified in Chapter 4 based on identified biodiversity tier and targeted areas. (Ongoing)
- Maintain a baseline annual mowing on all Tier 3 mowable properties to reduce new populations of invasive species and maintain emergency access. (Ongoing)
- Increase fire-tolerant areas to decrease pesticide use, mowing, and brush removal which will allow staff to focus on increasing biodiversity in lower tiers. (Ongoing)
- Allocate resources equitably to ensure that communities of color and low-income populations are not disproportionately impacted by low quality public landscapes. Use Cityworks® to better understand City demographics compared to City resources. (Started in 2024)
- Develop a volunteer policy that can assist with vegetation management with consideration to unintended consequences of vegetation management in areas with and without volunteers. (Future)
- Increase signage and access on stormwater utility land to increase awareness and access of public land and work with volunteer groups to help make areas more attractive for use. (Future)

Vegetation Management and Climate Change

Throughout the public engagement process Madison residents and volunteers expressed concerns about climate change related biodiversity, wildlife habitat and impacts, pollinators and tree impacts.

The climate and environmental challenges we face today are complex. There is not one simple solution to address the multifaceted and often-conflicting priorities related to increasing climate impacts. However, vegetation plays an important role in many of these issues.

Management practices to best address climate change impacts and vegetation varied in responses from the technical subject experts surveyed. These varied responses provide opportunities for adaptive management practices required to address many climate change impacts.

Staff monitoring Starkweather Creek for invasive Oenanthe javanica (water celery) as part of WDNR Grant.

According to the WICCI 2021 Assessment Report, "all seasons and regions of Wisconsin are getting warmer and wetter, but winters are warming more rapidly than summers and nighttime low temperatures are warming faster than daytime high temperatures. Wisconsin's winter, nighttime temperatures have warmed by four to seven degrees Fahrenheit since 1950. In contrast, summer, daytime temperatures have only warmed by about one degree since 1950." Seasonally, our winters will warm more than our summers, but frequency of extreme heat days (above 90° F) will increase.

Goals

1. Develop strategies for adaptive vegetation management in response to climate change stressors.
2. Identify future climate change impacts to existing vegetation.
3. Incorporate applicable general strategies from the Wisconsin Initiative on Climate Change Impacts (WICCI) Plants and Natural Communities Working Group Issue – Impact Strategy Table of Recommendations for Governor's Climate Change Task Force.

Strategies

- Coordinate with other agencies and researchers to understand and address the effects of climate change. (Ongoing)
- Coordinate with the WDNR, private consultants, other agencies and municipalities to evaluate options for increased vectors and stressors on urban canopy that are likely to increase with climate change. (Ongoing)
- Increase the number of native species in plantings and plant species that are predicted to be climate change "winners." (Ongoing and Future)
- Partner with Dane County, the University of Wisconsin, and other agencies on increasing monitoring and awareness of carbon sequestration. (Future)

- Continue to monitor vegetation management practices and latest research in the complexities of vegetation, ecosystems and carbon, and carbon dynamics in relation to prescribed fire. (Ongoing)
- Incorporate recommendations of the Wisconsin Initiative on Climate Change Impacts (WICCI) Plants and Natural Communities Working Group Issue – Impact Strategy Table of Recommendations for Governor's Climate Change Task Force including:
    - increasing prescribed fire (Ongoing),
    - planting drought tolerant prairie species along banks and shorelines (Ongoing),
    - promoting diverse oak age classes (Ongoing),
    - developing seed banks for native plants vulnerable to climate change (Ongoing),
    - incorporating science guided transformation of natural communities that may lose key species or characteristics due to climate change. (Future)

- Wisconsin's average daily temperature has become three degrees Fahrenheit warmer since the 1950's.
- The last two decades have been the warmest on record, and the past decade has been the wettest.
- Wisconsin has become wetter – average precipitation has increased 17 percent since 1950.
- Warming is happening fastest in the winter and at night.
- Southern Wisconsin has experienced the highest increase in precipitation in the state.
- Very extreme precipitations events will increase in the future.
- Extreme events are already causing immense impacts across the state, and the frequency of those will generally increase.

(WICCI Report, 2021)

Healthy Ecosystems and Habitat

Healthy biodiverse ecosystems play an important role in providing multiple ecosystem services that mitigate climate impacts. The value of healthy native ecosystems was identified through both the public engagement process and in the responses from the volunteer experts. Invasive plant management is a key component for maintaining a healthy biodiverse native ecosystem.
71% of the public listening session attendees thought that restoring native ecosystems on SWU land was "extremely valuable." This mirrored online survey top concerns of biodiversity loss and species extinction, bird impacts, wildlife impacts, and impacts to pollinator habitat. Additionally, respondents felt that new shifts towards an ecology-based direction of land management was working well.

Whitetail ridge whorled milkweed wasp at Whitetail Ridge Detention Pond.
PD 5622-036

WICCI suggests that the most climate resilient landscapes are highly biodiverse, and that healthy and diverse habitats can better absorb the stresses of a rapidly changing climate. Within stormwater management areas, biodiverse natural communities that can tolerate these conditions and provide a natural climate resiliency.

However, the extent to which native ecosystems are restored, which species are managed, the site-specific goals, and the tolerance for non-native species is much more complex and limited to available resources. This remains a varied opinions across experts.

Goals

1. Maintain vegetation to promote biodiversity, prioritizing new ecological restorations, remnant oak habitat, areas of special status, and natural plant communities.
2. Incorporate recommendations and implement at the local level strategies from the Wisconsin Initiative on Climate Change Impacts WICCI Plants and Natural Communities Team Brief to improve climate resiliency including restoration and monitoring of native habitats, safe implementation of prescribed fire, control of early detection and NR40 invasive species.
3. Protect and encourage habitat for keystone species.
4. Prioritize native habitat on new stormwater facilities where possible to provide essential wetland habitat, water quality, and infiltration services.

Strategies

- Plant or sow missing or underrepresented plant families or pollinator-friendly species. (Ongoing)
- Ensure that developer agreements for new ponds and greenways include requirements for better native plant establishment and long-term establishment goals. (New requirements implemented in 2024)
- Continue to maintain vegetation database that classifies biodiversity and ecological threats. (Ongoing)
- Avoid disturbing populations of desirable herbaceous or shrub woodland or savanna species during routine maintenance. (Ongoing)
- Identify, protect, and preserve special status plants and natural plant communities. (Future)
- Leave dead standing trees and naturally felled trees for wildlife habitat if they are not in areas where they will pose a hazard to people or property or will not cause stormwater drainage issues. (Ongoing)
- Prohibit planting of invasive plants or cultivars on SWU land. (Ongoing)
- Identify and establish "no mow" areas within Tier 1 and Tier 2 SWU land should not be mowed or planted by individual adjacent property owners as part of ecological restoration goals (Ongoing and Future).

Biocage as part of partnership with the WDNR on loosestrife beetles for biocontrol of invasive purple loosestrife as part of integrated pest management.

- Remove select invasive species that outcompete native species as part of ecological restoration efforts. (Ongoing)
- On sites dominated by monocultures or predominately invasive nonnative species, improve native biodiversity by minimizing the spread of existing invasive species, seeking opportunities and pockets for establishment of native species within larger site, and seek opportunities to slowly increase biodiversity on existing monoculture sites through collaboration with community partners and volunteers. (Ongoing and Future)
- Use Integrated Pest Management (IPM) to manage vegetation through primarily mechanical methods, followed by mowing, then by prescribed fire, lastly by herbicide application for species that are not well-controlled through other mechanisms, and update IPM practices in accordance with the Integrated Pest Management Task Force. (Ongoing and Future)
- Control herbaceous invasive species with high potential to disrupt ecological restoration and follow the Wisconsin Department of Natural Resources Chapter 40 Classification and Control Legislature on Prohibited Invasive Species (control is required) and Restricted Invasive Species (control is recommended). (Ongoing)
- Coordinate with the WDNR to fund treatment of new invasive species.

Urban Canopy

Urban canopy is an integral function of a citywide approach to climate change impacts. Through the engagement process concerns on a variety of urban canopy issues were raised. This includes the increasing stresses on oak trees, the relationship to urban canopy and climate change, and larger City initiatives on urban canopy issues. Within the City of Madison, the SWU performs only select work on trees. The SWU relies on partners with other City agencies, volunteers, and contractors for tree plantings, storm tree removals, and pest management. Management of the larger urban forest is looked at holistically and recommendations are included in the Urban Forestry Tast Force Report, and reinforced in the City of Madison Sustainability Plan.

Spongy moth caterpillar
In 2023, a combination of environmental factors created opportune conditions for the caterpillar/moth. This invasive insect is very destructive to trees. Those environmental factors came at a time when there was a population spike in this pest. Every 10 to 15 years there is a boom in the spongy moth population.

Goal

1. Prioritize and implement recommendations applicable to SWU property from the Urban Forestry Task Force Report.

Strategies

- Work with other agencies, volunteers, and contractors to leverage resources for tree treatments, plantings, prunings, and hazard tree removals based on available resources. For example, in 2023 and 2024 the Engineering Division and other City agencies worked together to implement a strategy for Spongy Moth Outbreak. (Ongoing and Future)
- Coordinate with other agencies to continue to provide information on tree health and resources. The roles of private landowners and urban forestry canopy health is critical. The 2021 WICCI Assessment Report also identifies that "most urban trees grow in privately-owned residential areas (69 percent) and that surveys have shown people value tree canopy". (Ongoing)
- Coordinate with other City agencies to develop policies and procedures to reduce the spread of tree diseases and pests that considers impacts on specific sites and equitable use of resources.
- Perform tree inventories and incorporate recommendations identified in other sections of this framework including applicable recommendations in the Climate Change Impacts (WICCI) Plants and Natural Communities Working Group Issue – Impact Strategy Table of Recommendations for Governor's Climate Change Task Force and WICCI Plants and Natural Communities Team Brief. (Ongoing)
- Identify locations to increase shrub and tree canopy, where doing so can decrease downstream flooding and prioritize areas based on urban canopy disparities in neighborhoods and communities. (Ongoing and Future)

- Ensure regeneration of the urban forest, particularly groves in certain locations, and oaks as a species component of woodlands in general. (Future)
- Increase the quality and diversity of tree species in the urban forest as a whole to improve disease resistance and habitat for native pollinator species, birds, and other wildlife. Native trees are preferred but consider other species where ecological appropriate. (Ongoing)
- Promote urban canopy growth that can tolerate fluctuating urban hydrology and fire-adapted management, including as part of larger citywide implementation of heat resilience strategies in urban heat islands and populations sensitive to heat. (Ongoing)
- Notify the public when any tree trimming, pruning or removal of trees are on public land or within public right of way in accordance with Administrative Procedure Memorandum 6-2. (Ongoing)

Inventory, Assessment, and Monitoring

"Climate change impacts of warmer winters, extreme weather events, summer droughts, and longer growing season are stressing forest ecosystems, increasing the risk of outbreaks of new pests and disease" (WICCI, 2021). They are also "amplifying non-climate stressors to the point where diverse native habitats are simplified, and associated wildlife species are diminished or disappearing, and species extinction rates are accelerating". Inventorying, assessment, and monitoring stormwater utility vegetation is a critical management tool to better understand and address these impacts.

Canoe inspection of shoreline vegetation at Starkweather Creek by City SWU staff.

Goals

1. Track, monitor, and evaluate stormwater vegetation for biodiversity, ecosystem composition, native, and invasive plant populations.
2. Monitor and assess stormwater areas for bare soil and native planting/seeding opportunities to comply with MS4 compliance to improve water quality.
3. Monitor and assess ecological establishment in response to areas impacted by climate change, such as areas impacted by spongy moth, oak wilt, or other climate and non-climate-stressors.

Strategies

- Perform monitoring and assessment with formal flora surveys conducted at intervals identified in Chapter Four. (Future)
- Monitor and identify private property mowing or planting invasive species on public SWU in areas that are environmentally sensitive area, Tier 1 or Tier 2 areas with higher goals for establishing native ecosystems (Ongoing and Future).
- Protect Wisconsin wildlife and support climate-vulnerable species by identifying, and monitoring citizen science contributions through platforms such as iNaturalist, invasive species tracking platform EDD Maps and the Wisconsin DNR Bumble Bee Brigade. (Ongoing)
- Perform pond and greenway inspections using Cityworks® every five years as part of MS4 compliance and include site photos to leverage annual tracking of vegetation along these environmental corridors. (Ongoing)
- Identify areas of bare soil and erosion for reseeding or replanting. (Future)
- Coordinate with Dane County, Capitol Area Regional Planning Commission, Madison Parks and City Forestry to monitor localized impacts of climate change. (Ongoing)
- Investigate and monitor efforts of science-guided transformation of natural communities that may lose key species or characteristics due to climate change. (Future)