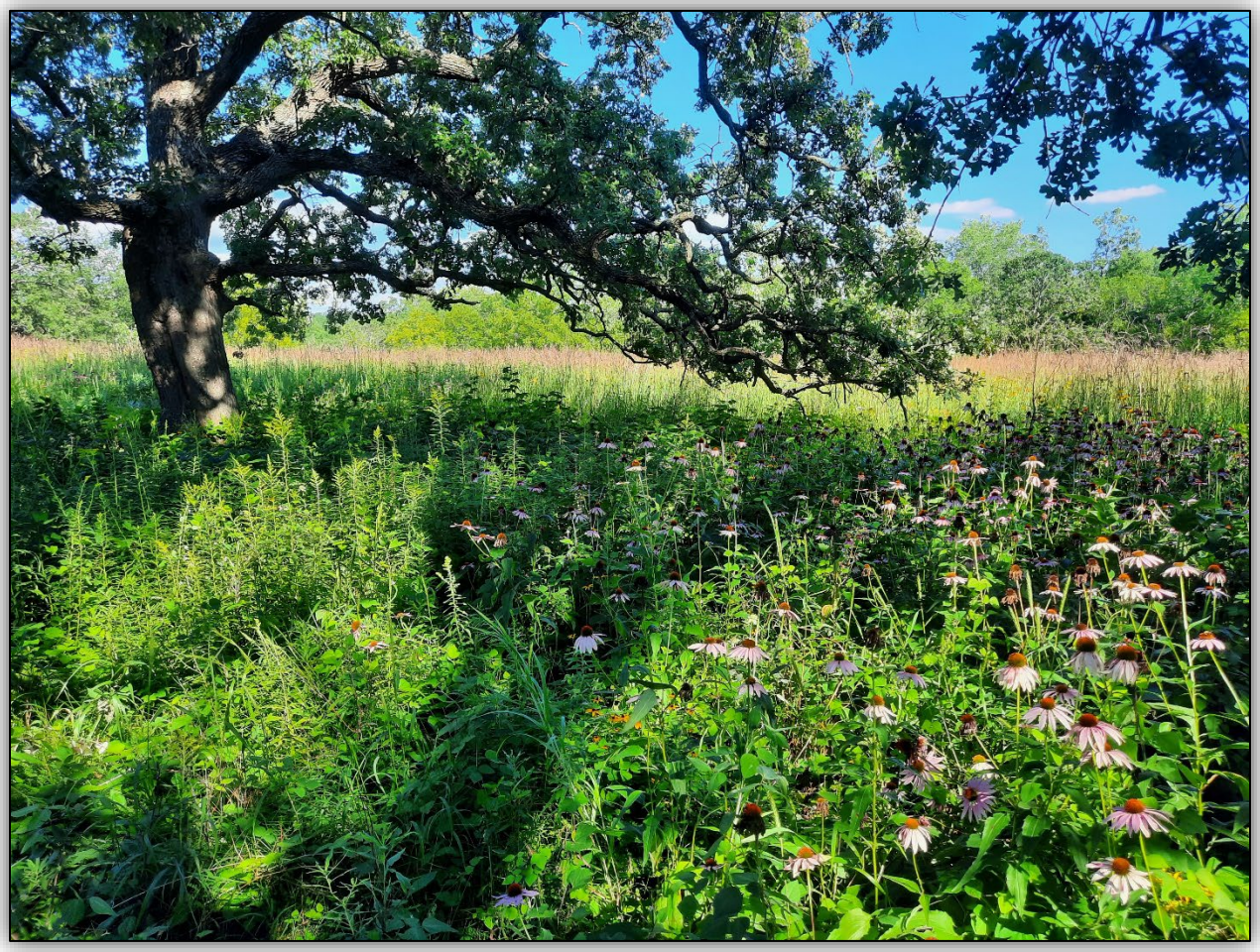
CITY OF ROCHESTER

NATURAL AREAS MANAGEMENT PLAN



JANUARY 6, 2023

PREPARED FOR:
CITY OF ROCHESTER

ROCHESTER PARKS & RECREATION
GO. PLAY. EXPLORE.

PREPARED BY:
RESOURCE ENVIRONMENTAL SOLUTIONS &
SRF CONSULTING GROUP

res
SRF

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CITY OF ROCHESTER
NATURAL AREAS MANAGEMENT PLAN

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LAND ACKNOWLEDGEMENT

"*We collectively acknowledge that the City of Rochester is located on the traditional, ancestral, and contemporary lands of Native/Indigenous people - Dakota/Sioux, Anishinaabe, Ojibway and Winnebago people. This land holds great historical, spiritual, and personal significance for the Native/Indigenous nations and peoples of this region.*"

Resource Environmental Solutions (RES) gratefully acknowledges the direction and generous contribution of the City of Rochester, specifically:

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EXECUTIVE SUMMARY

The City of Rochester is fortunate to have thousands of acres of natural areas throughout the community, including forests, savannas, prairies, wetlands, lakes, and flowing waters. The City recognizes the importance of these natural areas and how their protection (and easy and equitable access to them) is fundamental to sustainable development, human health, and overall quality of life.

In April 2022, the City retained Resource Environmental Solutions (formerly Applied Ecological Services, Inc.) and SRF Consulting Group, Inc. to develop this Natural Areas Management Plan. This plan is focused on system-wide ecologically-based planning but can be used for individual parks and specific natural areas. It provides a framework for protecting the City's valued natural areas, as well as opportunities for enhancing, expanding, and connecting these important natural resources. It is the foundation for accurate cost estimates to implement restoration and management plans citywide. Lastly, implementation of the plan will enhance biodiversity, increase human enjoyment of natural areas, and put natural areas on a trajectory towards long-term ecological health and resilience.

Information was gathered and reviewed, including previous City plans and a variety of natural resources mapping data. RES conducted field assessments of many of the City's natural areas, focusing on plant communities and indicators of ecological health. The City's existing Natural Resources Program was evaluated in terms of current staffing, funding, practices, and initiatives. A Community & Public Engagement Plan was developed specifically for this Natural Areas Management Plan. Through online promotion, public meetings, pop-up/intercept events, a City-wide survey, and stakeholder engagement, the City learned about how the community engages with natural areas, and how people would like to advance conservation objectives within the City.

This work enabled the City to develop a vision, planning principles, goals, and milestones to guide and evaluate the development and implementation of this Natural Areas Management Plan. With consideration of the City's natural areas, their existing condition, ecological stressors, conservation biology principles, and conservation planning practices, recommendations were developed to help the City of Rochester advance its Natural Areas Program. These recommendations include regional-scale opportunities, priority projects within the City's natural areas, and multiple phased implementation scenarios, which vary on available funding and related resources.

By using an ecosystem approach to restoration and management and by practicing adaptive management, the City is well-poised to implement the recommendations of this Natural Areas Management Plan. Implementation will result in increased restoration and management of natural areas in the City's parks and flood control lands, which will improve Rochester's natural areas, and over time will raise the region to a higher level of ecological health and resilience, to the benefit of all residents and visitors.

1. INTRODUCTION

1.1 Project Background & Purpose

The City of Rochester is fortunate to have thousands of acres of natural areas throughout the community, including forests, savannas, prairies, wetlands, lakes, and flowing waters. Long ago, these natural features (including the South Fork Zumbro River, its tributaries, and dramatic karst topography) attracted people to settle in the area. Over many generations, Rochester has evolved into a burgeoning city and Destination Medical Center (DMC), ranked as one of the best places to live in the United States—in part due to its natural areas and integrated parks and trails. Rochester's Comprehensive Plan (City of Rochester 2018) and Parks and Recreation System Plan (City of Rochester et al 2016) recognize the importance of the City's natural areas, and how their protection (and easy and equitable access to them) is fundamental to sustainable development, human health, and overall quality of life. Public feedback solicited during the development of those plans indicated interest in improved management and expansion of the City's natural areas.

While these earlier plans draw attention to the importance of the City's natural areas, their focus was not on strategies to achieve long-term protection, management, and expansion. Such goals can only be achieved through thoughtful investigation, consideration of public/stakeholder input, and proactive planning and budgeting. Goals presented in the Parks and Recreation System Plan included creating a Natural Resources Inventory and development of Natural Resource Management Plans for designated areas—both of which are advanced by this Natural Areas Management Plan (NAMP). This plan provides a much more targeted and detailed inventory and assessment of the City's natural areas, describes myriad opportunities for improvement, identifies priority projects, and lays out a year-by-year roadmap to help plan and budget for the conservation, restoration and management of the City's natural areas.

Natural Areas + Sustainability

Natural areas provide a link between people and their environment; a fact that is becoming increasingly important to communities across the nation. There are many opportunities for Rochester's parks and recreation system to connect people to nature while positively impacting the ecosystem.

- Expanding **nature-based programming, outreach, and educational opportunities** will spread the word about the value of natural resources.
- Moving forward, areas of natural value should be **preserved from development**, especially those that offer connections between existing parks and other destinations.
- Incorporating sustainable and innovative design and maintenance practices will make Rochester a **model for sustainability**.

Source: Comprehensive Plan (City of Rochester 2018)

In April 2022, the City retained Resource Environmental Solutions (RES, formerly Applied Ecological Services, Inc., AES) and SRF Consulting Group, Inc. (SRF) to develop this NAMP. This NRMP is focused on system-wide ecologically-based planning but can be used for individual parks and specific natural areas. It provides a framework for protecting the City's valued natural areas, as well as opportunities for enhancing, expanding, and connecting these important natural resources. It is the foundation for accurate cost estimates to implement restoration and management plans citywide. Lastly,

implementation of the plan will enhance biodiversity, increase human enjoyment of natural areas, and put natural areas on a trajectory towards long-term ecological health and resilience. Significant deliverables in addition to this plan include geographic information system (GIS) mapping of natural areas and georeferenced field photographs of representative areas. A glossary of technical terms and acronyms is provided in Appendix A.

1.2 The Importance of Natural Areas and Their Management

1.2.1 The Importance of Natural Resources

For millennia, the Rochester region consisted of a rich mosaic of natural landscapes. Sunlight, air, water, bedrock and minerals, soils, vegetation, and animals—that is, ecosystems—interacted in complex ways, producing an abundance of some plants and animals favored by the overall condition of the landscape, while others were more specialized and rare. Prairie grasses, bison, prairie chicken, and other huntable wildlife were abundant, while certain species of plants, insects and fish were uncommon, restricted by their habitat requirements.

Native Americans inhabited the Rochester region for several thousand years, taking advantage of game animals and other wildlife, edible plants, and an abundant water supply. Despite periodic droughts and severe winters, they did not exhaust natural resources and, in fact, managed them using fire and other practices, such as cropping of domesticated plants and seeding of wild plant species for specialized uses.

European settlers who came to the region in the mid-1800s found an open landscape dominated by prairies, savannas, and wet meadows, with forests in areas protected from fire (e.g., often in floodplains and on steep slopes). Over time, settlement, conversion of prairies and forests to crop fields, and industry changed the landscape. Natural resources are limited and can be lost if over-used or managed poorly, as clearly demonstrated by the local extinction of bison, elk, and prairie chicken.

Healthy Natural Resources Benefit People

Natural resources in a healthy condition support a community's economy and well-being by cleaning the water and air, reducing air temperature, building soil and preventing erosion, providing green spaces for rejuvenation and recreation, and enlivening the surroundings with a variety of animal and plant life. Since the 1850s these "ecosystem services" have been damaged by incompatible styles of development and use. This NAMP is a tool to restore these lost benefits of a healthy environment.

Much of the Rochester region has now been transformed by development—agricultural fields, pastures, homes, roads, parking lots, commercial buildings, and recreational fields. The City of Rochester's parklands and flood control lands comprise over 5,000 acres (including open water), with the vast majority of that parkland consisting of natural areas. Of these natural areas, only a portion represents the original landscape of the 1850s — and even these areas have been degraded by fragmentation, invasive species, nearby development, and other factors.

Modern societies tend to place value on natural resources based on how useful they are. Timber for lumber, limestone for gravel, cropland soils, groundwater, and surface water have an extrinsic or monetary value. On the other hand, some argue that all species have a basic right to exist—they have intrinsic value. The conservationist Aldo Leopold, the first professor of wildlife biology in the country,

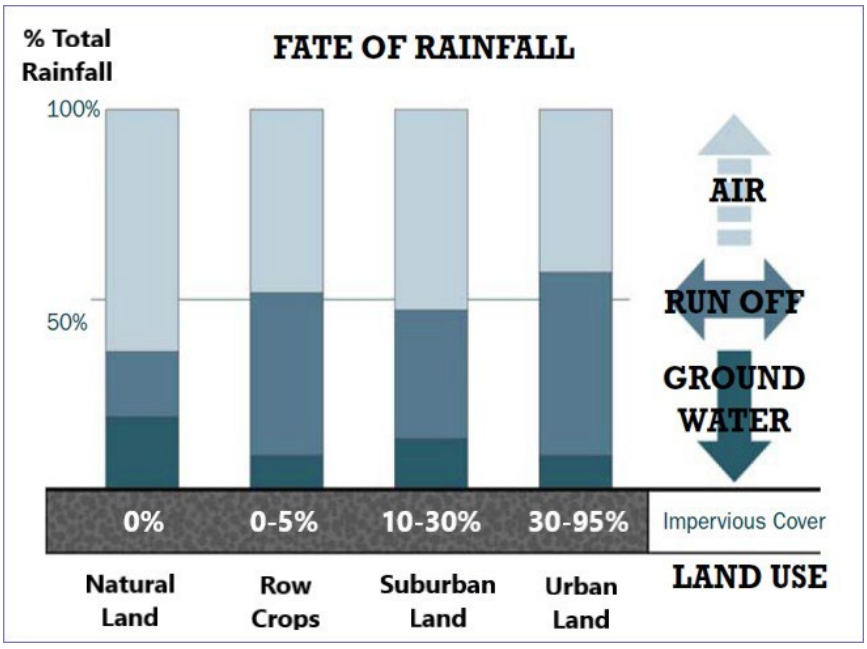
talked about a land ethic in which people saw themselves as part of the ecology and felt a responsibility to treat it well. Two of his most used quotes from his best-known book, *A Sand County Almanac*, are:

> *A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.*
>
> *We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect.*

While far from a new concept, the idea that nature has intrinsic value continues to gain support as people have experiences in park natural areas or through travel, by visiting museums and zoo exhibits, or simply by watching television programs about nature.

Part of a species' and ecosystem's intrinsic value is also due to the growing realization that healthy ecosystems support healthy human societies and economies. It has become clear through research, for instance, that preserving a certain amount of natural vegetation and soil reduces downstream flooding. Figure 1 supports this concept, as natural land is shown to absorb into the ground and release into the air the majority of rainwater, while urban land sheds most rain water, increasing potential floodwaters and their management. In another example, homeowners and businesses consistently rate proximity to a park as highly desirable (Crompton 2001), which typically generates higher demand for buildings near open space—and higher property values.

Figure 1. Natural vs. Developed Land Runoff



Natural land sheds two-thirds to one-half the runoff that developed land sheds, and sends more into groundwater.

Ecosystem Services

Natural areas are vital to city residents and park visitors for several reasons besides the economic value they provide. Wetlands and forested areas along rivers and streams help reduce downstream flooding (a major threat in the Rochester region), and prairies, savannas, and forests on the landscape absorb huge quantities of rainfall, which in turn reduces the amount of runoff and eroded sediment that reaches a watershed's streams and lakes. Natural areas also absorb and store carbon from the air, helping to reduce greenhouse gasses. Schools, organizations and families use natural areas to learn about the natural world; this is especially important for young children who otherwise spend more time making virtual connections indoors. Natural areas simply make urban life better because citizens and visitors can stroll, bike, take in the scenery, or simply relax in a natural setting.

Scientists call the benefits that natural resources provide "ecosystem services". Ecosystem services save people money over the long term. A milestone scientific study completed in 2005, called the Millennium Ecosystem Assessment, summarized the state of ecosystem services worldwide (Hassan et al. 2005). Since then, dozens of scientific papers have been published demonstrating the financial savings of healthy ecosystems. For instance, if people were to pay to purify air and water, build soil, or to regenerate forest trees and wild fish and game, the cost would be in the hundreds of millions of dollars annually for a City like Rochester. Building flood control infrastructure or rebuilding after flood would be much more costly without floodplains and the natural capacity of watersheds to absorb and regulate the water moving through them. The main ecosystem services are summarized in Figure 2.

Figure 2. Ecosystem Services

Source: Metro Vancouver Regional Planning (2018)

Besides supporting and regulating the human environment, the City of Rochester's park system serves recreation and tourism as well as contributes to resident well-being. Research in the last 20 years has demonstrated a strong link between time spent in or near nature with better physical and mental health. Viewing nature out a window can improve test scores in school children or elevate moods in adults. Of course, people love to fish, hike, bike, ski, picnic, camp, and celebrate with family in natural areas. Sometimes just sitting still in nature, or within sight of nature, can nourish the spirit and reduce stress.

Natural resources create a sense of place that attracts people and businesses and convinces them to remain in the area. Healthy ecosystems not only signal that ecosystem services are operating, but that society and the economy are being supported and enriched. By protecting and managing the City's natural resources, ecosystem services will persist and improve.

1.2.2 Ecological Restoration & Management

Definition. Ecological restoration is the art and science of improving the health and resilience of natural environments by stabilizing and enhancing species diversity and natural processes. Restoration ecologists use scientific knowledge of how ecologically healthy plant communities and ecosystems are composed and operate in order to describe current ecological conditions and lay out programs to create positive changes in damaged ecosystems and plant communities. After restoration to a better condition, ecosystems, plant communities, and wildlife still need to be watched and managed, though at a lower per-acre cost than managing turf or traditional landscaping.

Restoring and Managing Natural Resources is a Good Idea

The art and science of improving ecosystem health and resilience is being used by the City to support pollinators and wildlife, reduce management costs and environmental damage from incompatible past land use, and lay the groundwork for adaptation to ongoing and future climate change. It is not an attempt to restore conditions of 1850, but rather to work with existing conditions and set ecosystems on a trajectory towards a higher level of ecosystem health and resilience despite future environmental change.

Importance of Native Vegetation. Re-establishing and enhancing native vegetation—adapted to the local environment and growing in the region–is fundamental for ecological restoration and the conservation of biodiversity. Benefits of native vegetation include:

- Providing high-quality habitat for native wildlife, including many pollinators
    - Nutritious food (berries, pollen, nectar)
    - Nesting and overwintering habitat (full life-cycle needs)
- Requiring no irrigation once established
- Requiring no fertilizers or pesticides
- More resilient than many non-native or cultivated varieties due to drought- and pest-resistance and suitability for the local climate and soils

While restoring native plant communities has the greatest effect on large tracts of native forests, savannas, and prairie plantings, native plantings for small restorations, rain gardens, and butterfly gardens also create habitat and deliver ecosystem services. This small restoration approach offers myriad opportunities for public and private lands. For example, small native plantings are suitable for residential

lots, in boulevards, along rights-of-way, and on small areas of public property. Strategically placed, they can be buffers for, and connectors between, nearby natural areas.

Benefits of Ecological Restoration. Ecological restoration helps people directly by improving ecosystem services, including flood and erosion control, soil building, and pollinator resources. It also benefits plant and animal species that are uncommon or declining, species that need high quality or large habitats, and species that respond poorly to intensive human use. The Minnesota Department of Natural Resources (MNDNR) County Biological Survey identified numerous Sites of Biodiversity Significance and native plant communities within the City limits (MNDNR 2022 and Appendix B), and Minnesota's Wildlife Action Plan (MNDNR 2016) identifies many Species of Greatest Conservation Need found within the City (see Appendix A for a glossary of technical terms). These species need well-managed and sometimes large habitats to stop their decline.

The City has completed several ecological restoration projects, including invasive vegetation removal and restoration and management (i.e., prescribed burning) of prairies. This NAMP will help expand the City's restoration and management efforts, prevent further species declines, and may increase the population size of some native species.

Limits of Ecological Restoration. Ecological restoration creates healthy and resilient ecosystems, often in developed and disturbed landscapes. The composition, structure, and function of restored ecosystems aim to be like those of original ecosystems, but of course cannot in the short-term (or perhaps ever) fully replicate those original ecosystems that persisted for thousands of years. However, restored ecosystems have more native plant and animal species, higher levels of infiltration and carbon storage, and greater ability to change as the environment changes, compared to turf, cropland, and cultural ecosystems.

Restored ecosystems need to be managed to keep them in good working order, just as cultural land must be. The ecosystems of 170 years ago also were "managed" by fire, grazing and burrowing animals, flooding, and other natural disturbances. Landscape-scale and local changes often prevent the full re-creation of original natural conditions. Historical ecological conditions give us insights into what is possible at a given site, but no more. In the end, however, the goals of a restoration project dictates the level of effort and the conditions that result.

Importance of Adaptive Management. Restoration and management plans need to be flexible. Restoration programs are often not implemented exactly according to plan because the timing of funding may not align with field operations, the response of ecosystems to restoration may dictate adjustments in techniques, and the basic management needs of an ecosystem may change in response to new threats and conditions. New scientific findings and insights also may change restoration plans and management practices. For these reasons, restoration and management plans should be viewed as a starting point in a process of restoring biodiversity and natural processes in natural areas, subject to amendment as conditions and information change.

The most successful restoration programs use regular monitoring and reporting as feedback on the program's effectiveness. Monitoring also generates information to justify changes in the restoration and management program. Adaptive management is an approach to structured decision making in the face of uncertainty, with an aim to reducing uncertainty over time by using a cycle of planning, implementation, monitoring, evaluation, adjustment, and further implementation (Figure 3). Adaptive management is used in the best restoration programs, begins with the initial restoration work, and continues indefinitely as natural areas are managed over time.

Adaptive Management

The City will use adaptive management—a cycle of planning, implementation, evaluation, and adjustment—to make decisions despite uncertainty, with the aim of reducing uncertainty with each implementation cycle.

Figure 3. Adaptive Management Framework

Source: Conservation Measures Partnership (2022)

1.2.3 What Happens When Natural Resources Are Not Managed?

Some people believe that nature has been around a very long time and can take care of itself. Others think that more important issues and problems face us and that managing natural resources does not merit the expense. While these are valid views, they are not the whole story.

Studies over the last half century clearly demonstrate that, without management—i.e., "ecological stewardship"—natural resources change in ways that are not always beneficial to people or supportive of

ecosystem services (Alstad et al. 2016, Le Maitre al. 1996, Leach and Givnish 1996). A common problem in many unmanaged forests and woodlands in the region is invasion by non-native Common buckthorn (*Rhamnus cathartica*) and Asian honeysuckles (*Lonicera* spp.). When these shrubs invade natural areas, a cascade of negative effects follows. Oak regeneration is suppressed, native shrubs decline, soil chemistry and composition change, and ground vegetation is shaded—leading to the loss of soil-anchoring plants and excessive erosion. Flower resources for pollinators are eliminated, reducing the amount and variety of food for other wildlife, and further depressing wildlife populations.

Large, ecologically complex natural areas may resist these trends, but without proper management quality declines over time. This is especially true in small and scattered natural areas, which is the situation in many Rochester parks. With some level of consistent management, the situation can be stabilized and even improved. For example, removing invasive buckthorn and honeysuckle from woodland slopes preserves the soil and seedbank, and prevents sediment from reaching water bodies. This NAMP identifies and prioritizes the management actions that the City can take to improve the health and resilience of its natural areas and the resulting ecosystem services and recreational benefits.

1.2.4 Integrated Pest Management (IPM) & Herbicide Minimization

Integrated Pest Management is an ecosystem-based approach that uses a combination of practices that minimize risk to beneficial insects and organisms, wildlife, humans, and the environment. Pesticides and herbicides are used only after monitoring indicates they are necessary and applied with the goal of removing only the target pest or species.

Restored native species dominance in all vegetation layers of a plant community often requires use of herbicides. If native dominance can be restored without herbicides, spot-treatment may still be appropriate to eliminate colonies of the most problematic species. Some can be managed with mowing or hand-pulling, but in most cases targeted herbicide treatment is the best means of control.

The public is increasingly concerned about herbicides and other pesticides used on public land. City staff may be contacted for information in response to restoration and management involving herbicides. A consistent message should be conveyed to the public by City staff who receive inquiries about herbicides:

- The City minimizes herbicide use by taking an ecosystem approach and following Integrated Pest Management (IPM) practices. The City has implemented a Pesticide Free Parks Policy. Twelve parks have been identified in the policy where no registered chemicals are allowed to be used. On all other park locations the City allows use of herbicides with the lowest toxicity to achieve restoration goals.
- Herbicide application on City-managed lands is applied at the lowest effective concentration.
- Recommended safety precautions are followed by herbicide applicators, and signage is installed as appropriate to inform the public of herbicide use and appropriate exclusion intervals following application.

The amount of herbicide applied for ecological restoration and management is at levels far below that used in agricultural fields. Moreover, the herbicide is often precisely applied to small areas, such as a cut stump or individual thistle clump. Preference is given to sponge- or wick-application or low-pressure

nozzle to minimize drift and spillage. Restoration professionals prefer to use broadcast herbicide application as a tool of last resort, in order to remove a dominant invasive plant in a vegetation layer that is resistant to other approaches.

1.3 Rochester's Natural Resources Program

The City of Rochester currently lacks a formal Natural Resources Program. However, over recent decades, the City has been actively managing natural areas, working with partners and volunteers, and providing education and outreach regarding conservation opportunities within the City.

1.3.1 Ecological Restoration & Management

The City of Rochester does not aspire to restore its natural areas to pristine, pre-settlement conditions, but rather to remove invasives and restore the diversity and structure of naturally occurring plant communities. To accomplish this, the primary ecological restoration and management activities conducted by the City are prescribed burning and invasive vegetation control.

Prairies within the City's natural areas (e.g., Essex Park, Quarry Hill Park) are burned intermittently, based on observation of thatch accumulation. Burns are conducted by a professional contractor and/or with fire department assistance.

Invasive buckthorn and honeysuckle removal (i.e., brushing) has been implemented in many of the City's most infested natural areas (e.g., Quarry Hill Park, Zumbro South Park). City-funded brushing projects typically involve forestry mowing followed by 2-3 years of follow-up herbicide spraying of resprouts and seedlings. Goats have also been used to browse forestry mowed areas. Brushing is typically conducted by professional contractors at a cost of approximately $10,000/year. Considerable brushing has occurred at Indian Heights by the work of volunteers, and there is also a strong volunteer group at Quarry Hill Park that controls invasive vegetation.

The City has also received grants for control of a variety of invasive plant species, with most of that work conducted by Master Naturalists and other volunteers. The web-based, crowd-sourced Early Detection and Distribution Mapping System (EDDMapS 2022) is used by the City to report and track invasive species found in its parklands, primarily in flood control lands. Table 1 summarizes the City's recent or ongoing natural resources management throughout its parklands and reservoir sites.

A recent park referendum added $50,000/year to the City's base $10,000/year natural resources management budget, so the City will have a budget of $60,000/year through 2027. Currently there is no formal volunteer program managed by the City, and it is recognized that recruiting, overseeing, and retaining quality volunteers is a challenge that requires an investment. Interest has been expressed in retaining a Volunteer Coordinator and formalizing such a program with an emphasis on natural areas management. Quarry Hill Nature Center has a robust volunteer program that regularly conducts projects within that park, and the City Forestry Department has a cohort of volunteers consisting of Citizen Pruners and Neighborhood Tree Watch members.

Table 1. Rochester's Ongoing Natural Resources Management Activities

Park/Location	Acres Under Management	Prairie Mgmt	Brushing	Wild Parsnip Mgmt	Garlic Mustard Mgmt	Tree Removals	Tree Plantings	Wildlife Mgmt*
Bear Creek Park/Trail	40.0		X			X	X	X
Cascade Lake	35.5	X						
Century Hills	0.1	X						
Essex	29.1	X					X	X
Foster Arend	40.7							X
Gamehaven Park/Reservoir	230	X		X				X
Hadley Creek Golf Course	108.2							X
Homestead	4.4	X						
Indian Heights	15.0		X					X
KR-3	62.0	X		X				X
KR-6	77.0	X		X				X
KR-7	61.0	X		X				X
Mayowood Trail	NA					X		
McQuillan	34.0		X					X
Natural Areas in South	NA					X		
Natural Areas in North	NA					X		
Northern Heights	66.0							X
Northern Hills Prairie	6.1	X						
Plummer House	1.5		X		X			
Prairie Crossing	8.5		X					
Quarry Hill	31.0		X		X		X	X
Ridgeview Manor	0.5	X						
Riverview West	0.5	X						
Schmidt	7.5	X						
Silver Creek Reservoir	32.0			X		X		X
Silver Lake Park/Buffer	8.5	X						X
Sunny Slopes (Skyline Dr)	0.3	X						
Thompson Mill Race	0.5	X						
Willow Creek Reservoir	14.0	X		X				X
Zumbro North	NA							X
Zumbro South	4.5	X	X			X		X
Total	***918.4***							

* Beaver are managed throughout park system.
NA = Not Applicable

1.3.2 Education & Outreach

Public education and outreach is a critical component of any Natural Resources Program. This is especially important in a City such as Rochester where much of the City's natural areas exist on private land, making public-private partnerships critical to achievement of the City's natural resource and conservation goals. The City of Rochester's education and outreach work has focused on protection of water resources; however, several of those practices also create habitat for native plants and wildlife and provide other conservation benefits beyond water protection. The City's website provides the following links, which describe the different practices and provide information on cost-share opportunities and additional technical resources:

- Traditional Landscaping Best Practices
  - What is traditional landscaping?
  - Irrigation and Rain Barrels
  - Lawn Chemical Use
- Native Plants
- Rain Gardens
- Planting Trees
- Perennial Ground Cover and Habitat Restoration
- Low Maintenance Turf
- Pollinator Friendly Lawns
- Shoreline Stabilization
- No Mow May
- Natural Landscape Permit
- Volunteering and Friends of Forestry

The City's Park and Recreation System Plan (2016) presented several goals for expanding nature-based programming, outreach, and education about natural areas. Some of these goals include:

1. Provide interpretive information about natural resources/habitat in environmental and regional parks, as well as at key features in other park components (i.e., Silver Lake).
2. Improve education/marketing of the value of natural areas.
3. Support Quarry Hill Nature Center as the community hub for environmental education, nature-based programming, and natural area stewardship.
4. Work with the Friends of Quarry Hill to implement the development and natural resource recommendations from the 2015 Quarry Hill Master Plan and their strategic plan.
5. Explore/support nature-based programming provided by Quarry Hill Nature Center at satellite locations across the city.

1.4 City Data, Plans and Policies

Existing plans and data were reviewed and used to assist with our understanding of City precedents, plant community mapping, classification, and quality assessment. RES compiled and reviewed numerous plans and datasets, including:

Existing Related Plans

- City of Rochester Parks and Recreation – Planning Survey 2021 – Summary of Results (City of Rochester 2021)

- Planning 2 Succeed - Rochester Comprehensive Plan 2040 (City of Rochester 2018)
- Rochester Parks and Recreation System Plan (City of Rochester et al 2016)
- Resident Canada Goose Management Plan (City of Rochester 2021)
- Comprehensive Surface Water Management Plan (in progress to be finished in 2023)

Geographic Information System (GIS) Data

- City limits of Rochester
- City park boundaries
- City bike paths
- MNDNR lands and other parcel data
- Original Vegetation of Minnesota (Marschner 1974)
- MN Conservation Explorer (MNDNR 2022)
- MNDNR County Biological Survey data (Sites of Biodiversity Significance and Native Plant Communities, 1997)
- MNDNR Public Waters Delineations
- MNDNR National Wetlands Inventory (NWI) Southern Minnesota Update (2017)
- City of Rochester fens
- City of Rochester tree inventory
- City of Rochester woodland assessments
- Early Detection and Distribution Mapping System (EDDMapS)
- FEMA Floodplains and Floodways
- Decorah edge
- Critical natural areas (including public and private open space, parklands, flood control, and stormwater management areas)
- Minnesota Land Cover Classification System (MLCCS) data (MNDNR 2004)
- University of Minnesota Land Cover (2016)
- SSURGO soils mapping (including hydric soils)
- Elevation data from LiDAR (2017)
- Aerial photography (historical and recent)

Other Reports/Data

- City of Rochester Woodland Assessment (City of Rochester 2020)
- Field Guide to the Native Plant Communities of Minnesota: The Eastern Broadleaf Forest Province (MNDNR 2005)
- MNDNR Natural Community Element Occurrence Ranking Guidelines (MNDNR 2001)

Review of the above plans, data, and other reports provided a sound foundation to understand the City's natural resources and previous work that should inform this NAMP. Of note, the City's assessment of many of its woodlands (City of Rochester 2020) found the most dominant tree species to be boxelder (*Acer negundo*, a native species, but one typically associated with disturbed landscapes). Invasive vegetation (mostly common buckthorn (*Rhamnus cathartica*) and non-native honeysuckles

(*Lonicera* spp.) was found in 86% of surveyed locations. These two facts suggest the majority of the City's woodlands represent degraded or second-growth forests as opposed to natural forest and woodland communities.

Also of note, the Comprehensive Plan (City of Rochester 2018) presents the following goals for the City's natural areas:

1. *Improve Access to Natural Areas*
2. *Preserve Areas of Natural Value*
3. *Expand Nature-Based Programming, Outreach, and Education about Natural Areas*

Item 2 above includes the goal to,

> "*Create a Natural Resources Inventory that identifies, designates, and categorizes natural areas managed by Parks & Recreation by size, quality, and habitat type. Use the Natural Resources Inventory to develop Natural Resource Management Plans for designated areas. Prioritize the development of plans for environmental parks, linear parks, reservoirs, regional parks, and community parks*."

This NAMP represents a Park System-wide Natural Resources Inventory and provides a system-wide understanding of Rochester's Park natural areas to guide the identification and prioritization of restoration and management efforts as well as facilitate the development of more specific Management Briefs or Natural Resource Management Plans for specific Park natural areas.

1.5 Vision, Principles & Goals for Rochester's Natural Areas

The City of Rochester recognizes the important role that natural resources play in their city. Natural areas are valued deeply by the community—they provide an enjoyable and interactive experience for residents and visitors, for example, an outdoor classroom for students of all ages, and a home for a surprising variety of plants and wildlife.

Effective planning is often facilitated by development of an aspirational vision statement, establishing principles, and outlining goals.

1.5.1 Vision

Through discussions with City staff, the City of Rochester developed the following vision for its natural areas:

> *To secure and capitalize on the many benefits natural areas provide to residents and visitors, the City of Rochester will protect, improve, maintain, and expand healthy ecosystems in its natural areas throughout the City and support private landowners in doing the same.*

1.5.2 Principles

Ecologically-based planning principles are guideposts, used to define how a project should unfold. Based on discussions with City staff and feedback from the public and Stakeholder Committee, these planning principles were established for natural areas restoration and management within Rochester:

Overall

- Understand the historical and current conditions of natural areas to describe a future ecological path for natural resources management.
- Design within the limits of existing soils, hydrology, and vegetation conditions.
- Protect and better connect sensitive natural resources in order to foster resilient and biodiverse natural areas within the City limits.
- Create attractive and resilient plant communities that can be managed economically.
- Tell the ecological story of the City's natural areas to inspire people through its restoration.
- Bring people into the City's natural areas while protecting biodiversity and ecosystem resilience.
- Provide all City residents and visitors with an equitable opportunity to access and experience natural areas within the City's park system.
- Use indicators and monitoring to document trends in natural resources and determine the success of restoration and management efforts.

Vegetation

- Protect and restore the City's ecologically important natural areas and plant communities to prevent their disappearance or degradation.
- Maintain and enhance common natural areas.
- Promote a natural variety of native flowering plants across the growing season.
- Control invasive or aggressive native plants that reduce biodiversity and ecological resilience.
- Establish vegetative structure that requires the least effort to maintain.

Wildlife

- Protect, improve, and restore habitat for all wildlife—especially rare and uncommon species.
- Create the largest, roundest habitats for area-sensitive wildlife species (round habitats tend to be higher quality because they resist negative edge effects from adjacent land uses; see Section 4.1 for further details.)
- Design to reduce wildlife-damaging edge effects from adjacent properties.
- Install special habitat features (nest boxes, basking logs, etc.).
- Identify and seek to make connections to similar habitats on nearby conservation lands.
- Manage nuisance wildlife species (e.g., white-tailed deer, geese) using appropriate methods.

Soil & Hydrology

- Preserve and restore healthy, stable soils and natural hydrology by using a watershed management approach and identifying and stabilizing unstable slopes.
- Use vegetative stabilization and a natural ecosystems approach before resorting to more hard-armored and engineered solutions, or consider integrating both into bioengineered solutions.
- Protect downstream and neighboring properties from floods and water damage.
- Use a series of natural features (e.g., rain gardens, prairies, wetlands), arranged in stormwater treatment trains, to reduce runoff at its source and manage runoff from impervious cover.
- Design and implement soil and hydrology solutions in the most cost-effective way possible.

Human Use

- Identify a conservation concept for natural areas—cores, transitions, and high impact areas.
- Prioritize restoration and management activities based on criteria that match the City's goals (e.g., make equitable investments in natural areas throughout the community and within established budgets).
- Improve management of natural areas by defining management units and access points.
- Detect problems early by regular monitoring.
- Recruit organizations, experts and volunteers to help maintain and monitor natural areas.
- Protect cultural resources (e.g., artifacts and historical structures).

1.5.3 Goals & Milestones

Through discussions with City staff, the public, and other stakeholders, the following goals were developed for the City of Rochester's Natural Resources Program:

1. Improve the ecological health of natural areas by decreasing invasive species.
2. Increase the abundance of plants native to the region.
3. Improve forest structure.
4. Use restoration and management practices that provide the highest impact for lowest cost.
5. Ensure restoration and management efforts are distributed equitably across the City (i.e., throughout the City's four quadrants).
6. Prioritize restoration and management projects for strategic implementation.

More specific milestones were established for the initial implementation of this NAMP (i.e., first five years). These milestones are:

1. Ensure the continued or perpetual management required to sustain or enhance existing/ongoing ecological restoration projects in the City.
2. Increase the acres of natural areas under management as funding allows.
3. Implement a demonstration project in a high-visibility location within three years.
4. Improve/formalize the City's volunteer recruitment and organization program.
5. Plan and execute at least one public volunteer event and/or celebration of the City's natural areas.

In summary, to achieve the City's conservation goals, its Natural Resources Program will require additional resources. This NAMP will help identify the Program's most needed resources. These may include additional City staff, increased City budget allocation, more external funds from sources such as grants, and increased partner collaborations and volunteer engagement.

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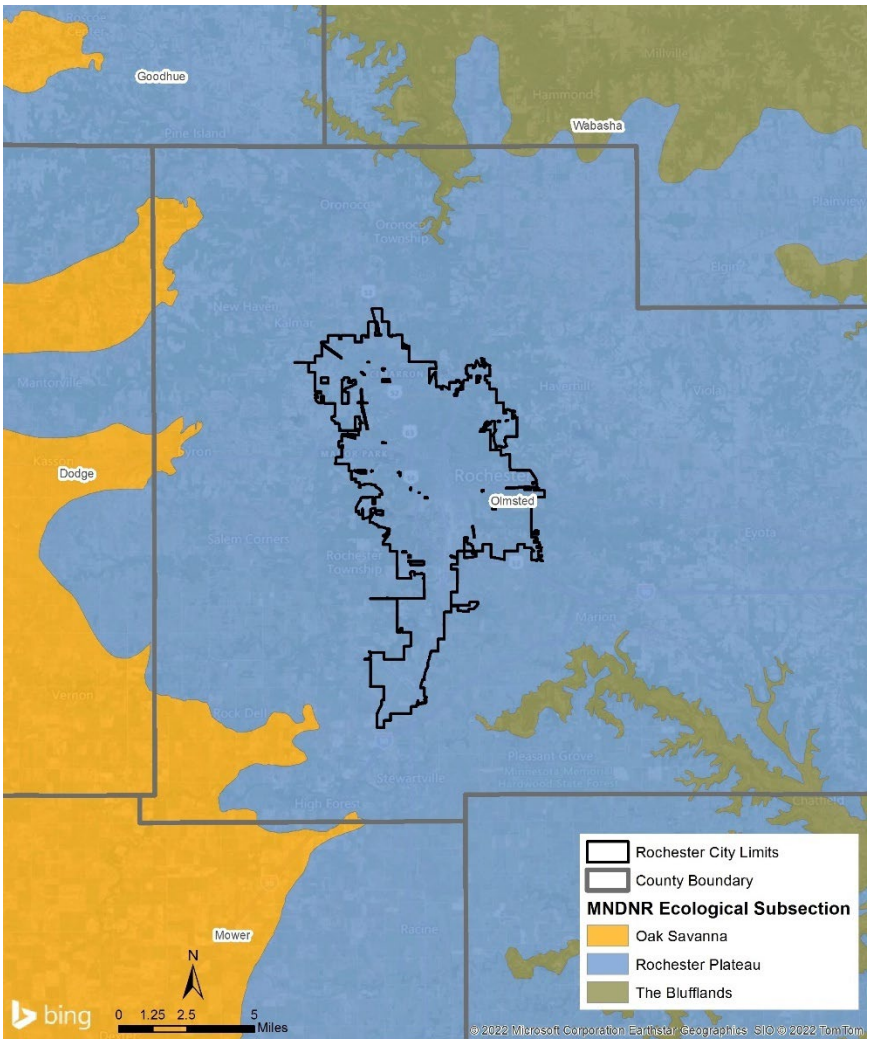
2 ECOLOGY OF ROCHESTER

2.1 Natural Resources Findings

The natural history and current conditions of region provide a necessary foundation for natural resources management. The City of Rochester is located near the center of Olmsted County in southern Minnesota (Figure 4).

Figure 4. Regional & Ecological Context of Rochester



2.1.1 Ecological Context & Overview

Rochester lies in the northwestern portion of the Driftless Area, comprised of southeastern Minnesota, southwestern Wisconsin, northeastern Iowa, and northwestern Illinois. The Driftless Area was not covered by the last ice age and lacks the characteristic glacial deposits known as drift. Consequently, the landscape is characterized by deeply carved river valleys, karst geology, and steep hills. Large exposures of bedrock are common in steep ravines and are primarily composed of dolomite, limestone, and sandstone with Cambrian sandstone, shale, and dolomite exposed along the valley walls of the Mississippi

River. Soils in the region are dominated by loess (fine sediments deposited by the wind) of variable thickness.

According the MNDNR Ecological Classification System (ECS), the City of Rochester lies within the Rochester Plateau Subsection within the Paleozoic Plateau Section within the Eastern Broadleaf Forest Province (MNDNR 2022, Figure 4). A brief description of the subsection follows.

> **Rochester Plateau.** Soils are typically silty with a thin layer of topsoil formed in forests from deposits of loess. Loess thickness varies, ranging from 30 feet on ridgetops to under a foot on valley walls. The region was originally covered with a mosaic of savanna, prairie, brush prairie, aspen-oak land, and river bottom forest. Drier upper slopes and ridgetops supported tallgrass prairie and oak savanna, while brush prairie was found on more mesic sites. Moister slopes supported oak forest. Areas of tallgrass prairie tended to be relatively narrow but extended uninterrupted over long distances.

For thousands of years prior to the arrival of Europeans, Native Americans were living on the land that would later become known as Minnesota. Native Americans altered the natural landscape through repeated use of fire, clearing brush from forest understories and creating prairie and oak savanna. They established villages, trails, and plots for crops in choice locations. During the mid-to-late 1600s, Euro-Americans arrived first as French missionaries and fur traders. Later in the 1700s and 1800s, British and American traders and explorers arrived, dramatically altering the environment and social landscape through settlement, fur trade, warfare, and treaties. Rochester's landscapes were influenced by these past land uses and practices, and they continue to evolve due to changes in use, management, wildlife, and climate. This rich history lives on in Rochester's natural areas such as in Indian Heights Park, which is recognized as a Dakota burial site (Indian Heights Park Master Plan, 2017).

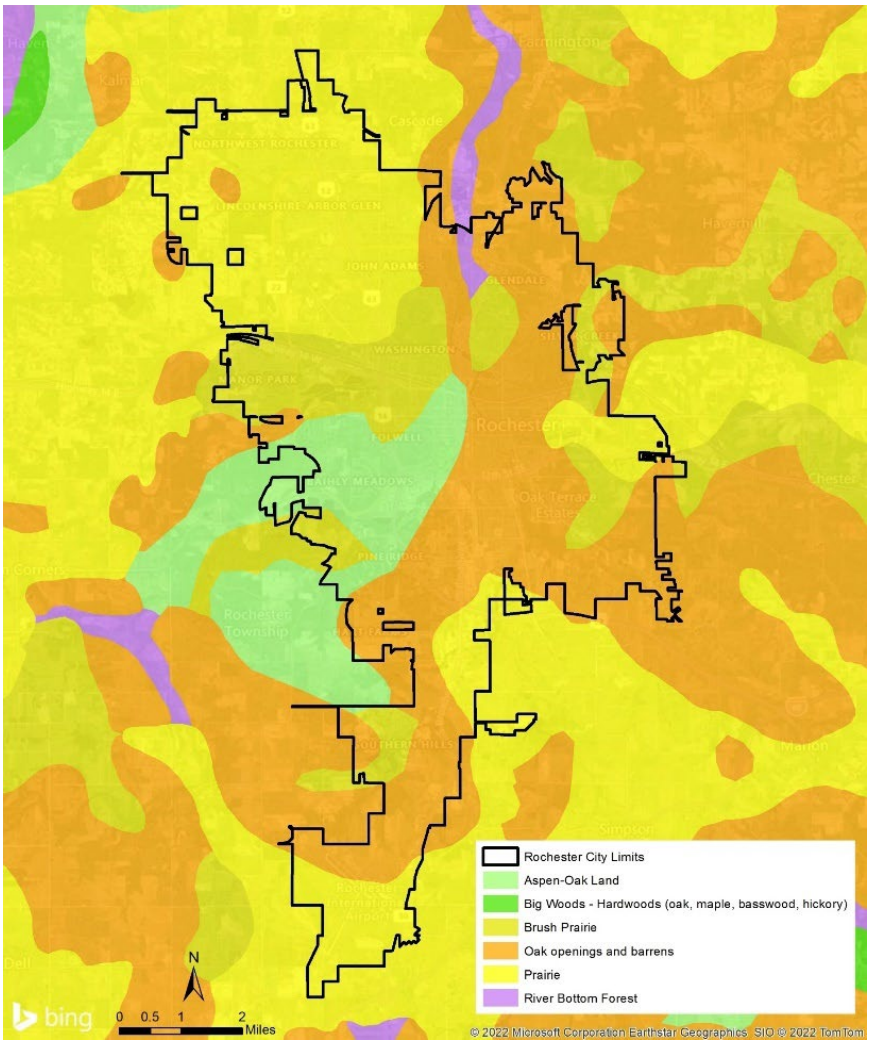
2.1.2 Land Cover & Plant Communities

Land cover includes relatively natural, usually vegetated, areas or habitats (e.g., forests, prairies, old fields, wetlands, water bodies) and more altered cultural areas (e.g., turf, impervious surfaces). Land cover mapping is usually employed to assess and manage natural resources.

Pre-European Settlement Vegetation

According to vegetation mapping by Marschner (1974), prior to European settlement (early 1800s), the City of Rochester was dominated by Prairie and Oak Openings and Barrens; areas of Brush Prairie and Aspen-Oak Land were also mapped (Figure 5). The landscape was dominated by sun-loving prairie species —some beneath scattered trees (mostly oak) and scattered shrub copses—with areas of aspen woodland containing shade-tolerant plant species. River Bottom Forest of elm, ash, silver maple, and cottonwood was mapped along the South Fork Zumbro River in the northern portion of the City.

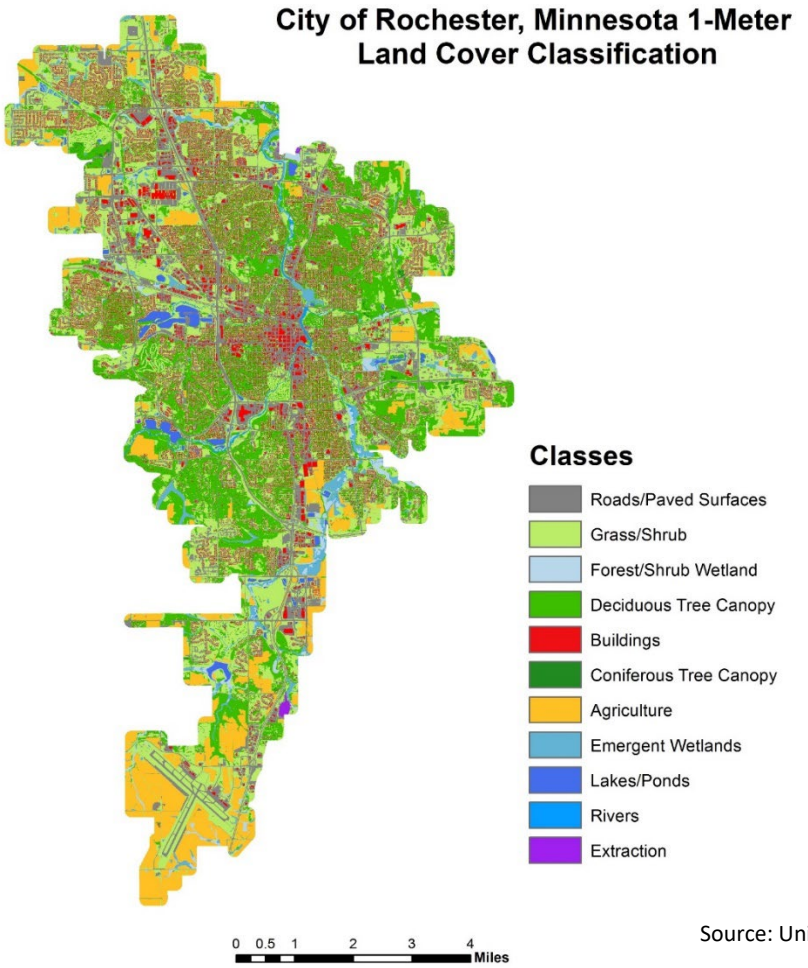
Figure 5. Pre-European Settlement Vegetation of Rochester



Recent Land Cover and Use

Since European settlement, much of the City has been developed to various degrees, including agricultural conversion and urban areas. In the early 2000s, Olmsted County staff used the Minnesota Land Cover Classification System (MLCCS; MNDNR 2004) to map land cover in the region. MLCCS is designed as a detailed classification system with many applications; however, the Olmsted County data used a coarse level of classification. In 2016, the University of Minnesota used aerial imagery and remote sensing techniques to create a more current and detailed land cover map of the City (Figure 6). Impervious surfaces (e.g., buildings, roads, parking lots), shown as red and gray, are concentrated in the City's most developed urban areas. However, the City's urban tree canopy is evident, as indicated by the extensive "Deciduous Tree Canopy" shown as medium green in much of the City's urban and suburban areas.

Figure 6. Land Cover of Rochester

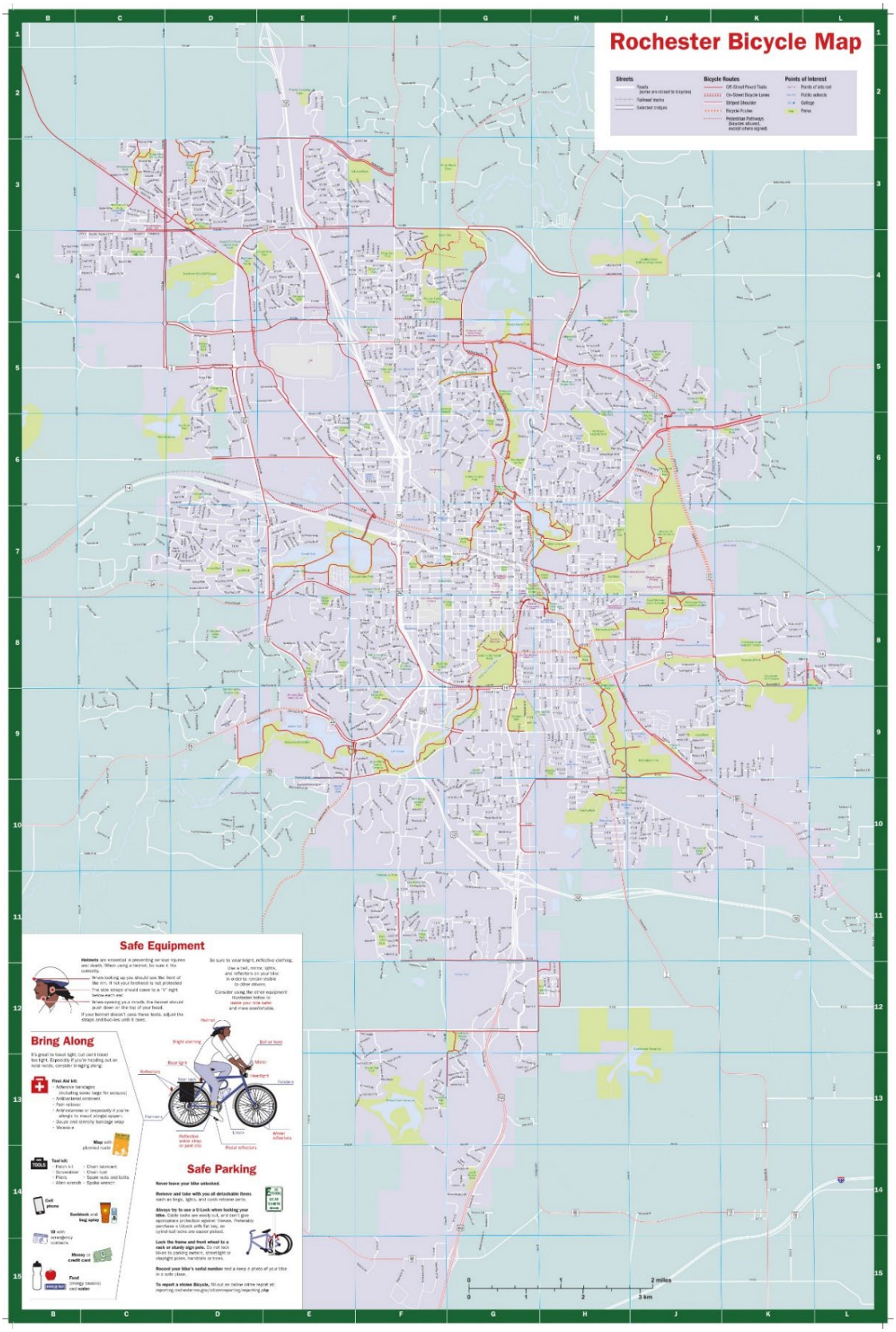


Source: University of Minnesota (2016)

Rochester has a robust park and trail system (Figure 7). The City's parklands and flood control lands comprise over 5,000 acres (including open water), with the vast majority of that parkland consisting of natural areas. Of these natural areas, only a portion represents the original landscape of the 1850s — and even these areas have been degraded by fragmentation, invasive species, nearby development, and other factors.

City parks are organized into nine classifications (Mini Neighborhood, Community, Regional, Athletic Complex, Special Use, Environmental, Linear, and Golf), depending on their use, service area, size, and facilities. Detailed information about the City's park system can be found in the Rochester Parks and Recreation System Plan (City of Rochester et al 2016). In addition, the City owns and manages six reservoirs (which are used as parkland), several of which are outside the City limits.

Figure 7. City of Rochester Parks and Trails



Natural Areas & Sensitive Natural Features Mapping

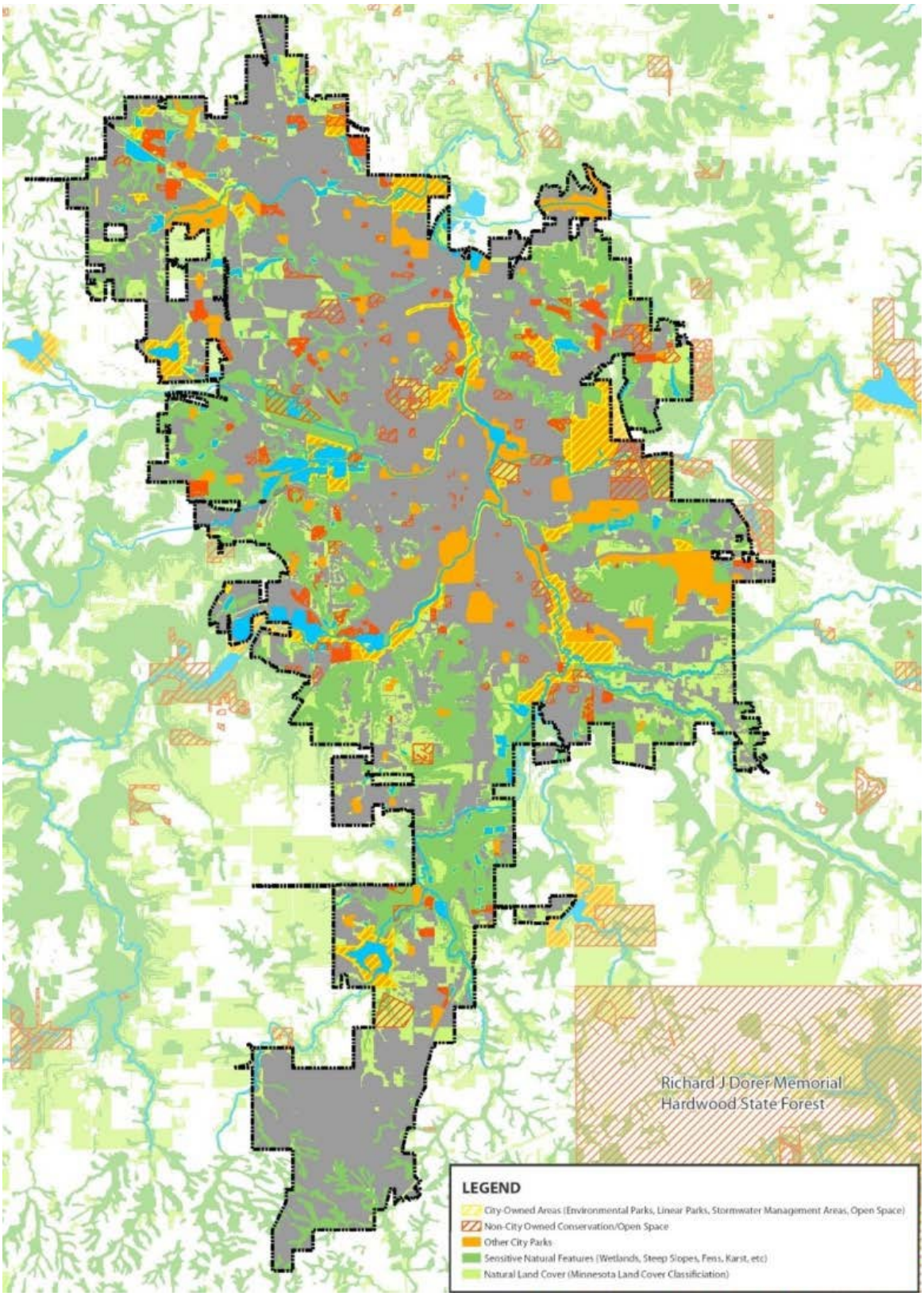
In 1997, the MNDNR County Biological Survey (CBS) mapped Sites of Biodiversity Significance and native plant communities in Olmsted County (MNDNR 1997). Sites of Biodiversity Significance (SBS) identified in Rochester were limited to nine locations in the southern portion and along the eastern edge of the City, with an additional site just east of the City (associated with Gamehaven Reservoir). Three of these sites were mapped but classified as "Below" the CBS threshold of an SBS site (based on size and ecological quality). The remaining sites were classified as "Moderate" quality (six locations) and "High" quality (one location), and the mapping identified native plant communities present in five of the SBS sites.

As part of the City's Park and Recreation System Plan (City of Rochester et al 2016) a "Preservation Areas" map was developed (Figure 8). This figure conveys many of the City's parks, non-city conservation lands, and sensitive natural resources such as:

- Steep slopes (>18%) – susceptible to erosion
- Fens, wetlands and hydric soils – of which fens and wetlands are protected
- Decorah edge – areas of groundwater discharge and recharge, often containing diverse wetlands
- Karst features – surficial expressions of carbonate bedrock characterized by cracks, crevices, and cavities

Many of these data layers are considered in this NAMP's conservation opportunities section (Section 5.1).

Figure 8. City of Rochester Preservation Areas (City of Rochester et al 2016)



RES Vegetation Mapping

Using MLCCS data, current aerial imagery, and field assessments of select natural areas within the City (see Section 5.2 for a description of areas assessed), RES ecologists updated and refined land cover mapping of City natural areas. The classification developed by RES is detailed enough for guiding general management and costing exercises, yet simple enough to effectively communicate with natural resource managers and the public. The classification focuses on natural and semi-natural plant communities (Table 2). ("Natural/semi-natural" plant communities include native plant communities and altered natural areas that are not routinely managed, such as second-growth forests and old fields). The classification is arranged in a hierarchy, and lower organizational levels that provide more detail are indented. For instance, the first level separates dry from wet soils (upland versus lowland communities). The second level separates communities by the dominant form of the vegetation. At the third and fourth levels, additional information is brought into the classification, such as the dominant plant species or a unique feature of the habitat.

Table 2. Natural/Semi-Natural Vegetation Classification for Rochester

PLANT COMMUNITIES	DEFINING CHARACTERISTICS
Upland Communities	**High, dry ground**
Forest/Woodland	**50-100% tree canopy**
Mature Forest/Woodland	**Large native trees**
Dry-Mesic Forest/Woodland (1)	Often oaks; fire-dependent
Mesic Forest (2)	Often maples, basswood, walnut
Altered Forest/Woodland (3)	**Often box elder, green ash, elms**
Savanna/Brushland	**5-50% tree canopy**
Savanna (4)	Tree dominated, but <50% canopy cover
Shrub/Scrub (5)	Shrub dominated, sometimes with trees
Grassland	**<5% tree canopy**
Prairie (6)	Native plants typically dominate
Non-Native Grassland (7)	Little native plant cover or diversity
Lowland Communities	**Low areas, including wetlands**
Lowland Forest/Woodland	**50-100% tree canopy**
Lowland Forest/Woodland (8)	Forests in floodplains or near water
Lowland Savanna/Brushland	**5-50% tree canopy**
Lowland Savanna (9)	Low/wet areas with scattered trees
Lowland Shrub/Scrub (10)	Shrub-dominated (often willows, dogwoods)
Lowland Herbaceous	**<5% tree canopy**
Herbaceous Wetland (11)	Often wetland grasses, sedges, cattails
Open Water (12)	**May have submerged or floating vegetation**

Application of this vegetation classification system for select natural areas within the City is shown in Figure 9. Table 3 and Figure 10 summarize mapped natural areas in terms of each plant community's acreage, percentage of assessed natural areas, and range of ecological quality (discussed further in Section 2.1.3).

Figure 9. Natural/Semi-Natural Vegetation of Assessed Natural Areas in Rochester

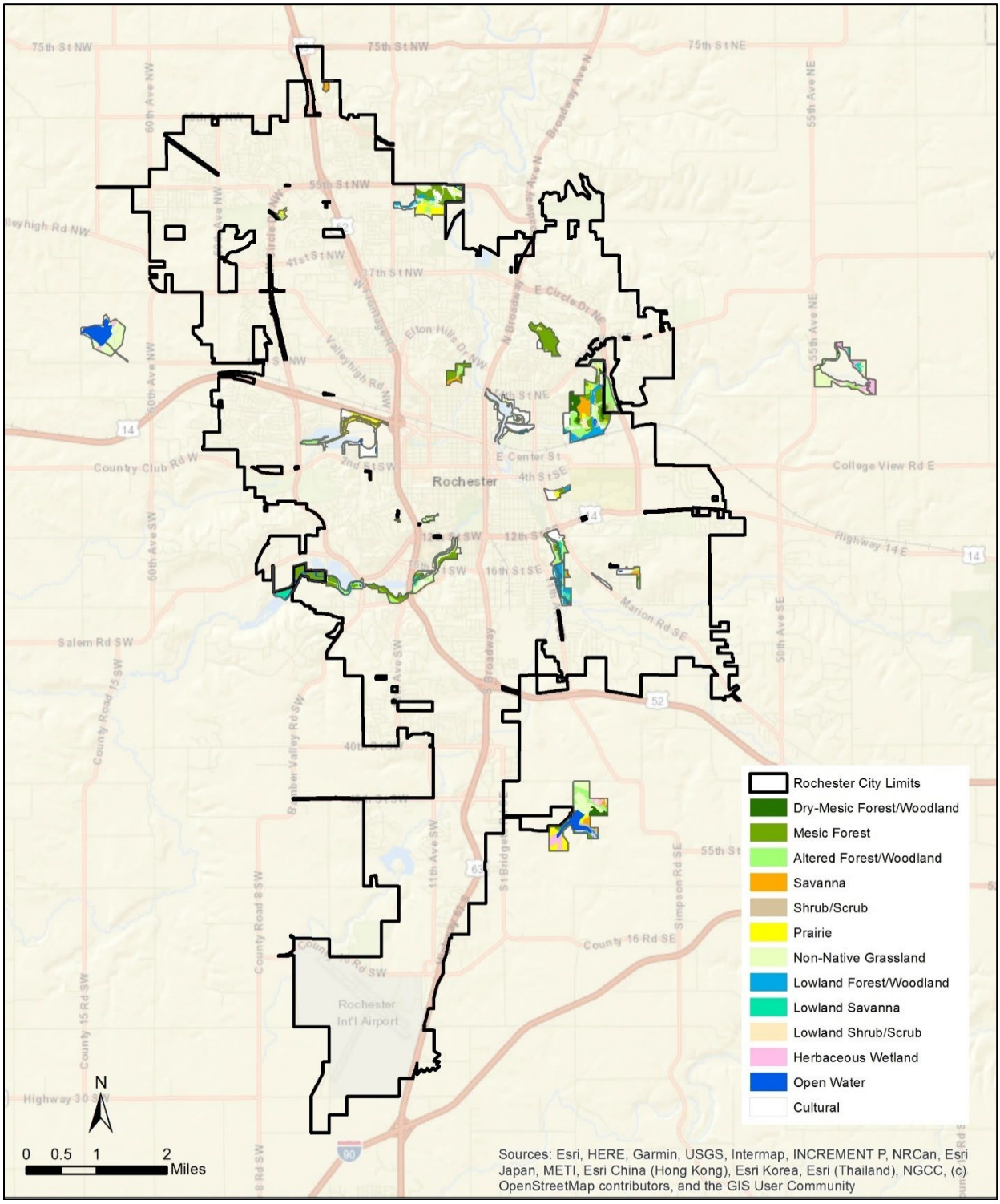


Table 3. Natural/Semi-Natural Vegetation of Assessed Natural Areas in Rochester

PLANT COMMUNITIES[1]	ASSESSED NATURAL AREAS ACRES	PERCENT OF ASSESSED NATURAL AREAS	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**1047.4**	**73.3%**	**B - NN**
Forest/Woodland	**553.4**	**38.7%**	**BC - NN**
Mature Forest/Woodland	**361.2**	**25.3%**	**BC - D**
Dry-Mesic Forest/Woodland (1)	53.5	3.7%	C - D
Mesic Forest (2)	307.7	21.5%	BC - D
Altered Forest/Woodland (3)	**192.2**	**13.5%**	**NN**
Savanna/Brushland	**94.1**	**6.6%**	**B - NN**
Savanna (4)	61.8	4.3%	B - NN
Shrub/Scrub (5)	32.3	2.3%	BC - NN
Grassland	**399.9**	**28.0%**	**B - NN**
Prairie (6)	124.5	8.7%	B - D
Non-Native Grassland (7)	275.4	19.3%	NN
Lowland Communities	**381.2**	**26.7%**	**BC - NN**
Lowland Forest/Woodland	**114.4**	**8.0%**	**C - D**
Lowland Forest/Woodland (8)	114.4	8.0%	**C - D**
Lowland Savanna/Brushland	**68.0**	**4.8%**	**BC - NN**
Lowland Savanna (9)	34.9	2.4%	BC - D
Lowland Shrub/Scrub (10)	33.0	2.3%	C - NN
Lowland Herbaceous	**83.3**	**5.8%**	**BC - NN**
Herbaceous Wetland (11)	83.3	5.8%	BC - NN
Open Water (12)	**115.5**	**8.1%**	**NA**
Totals	***1428.6***	***100%***	

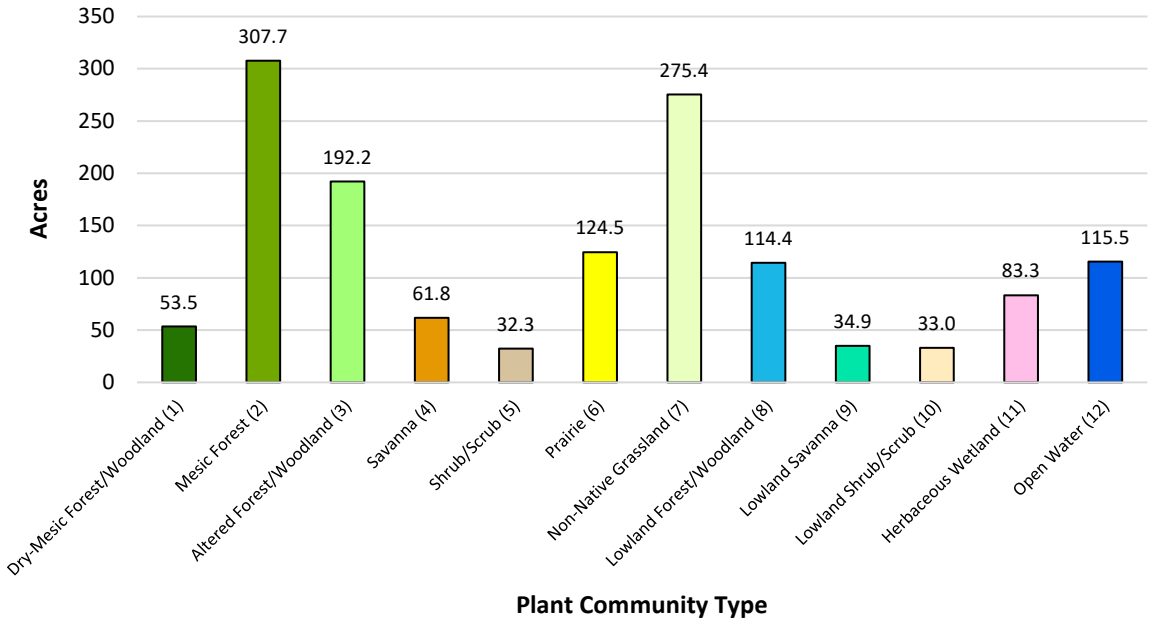
[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.1.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate quality; D = Poor quality; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

The City's assessed natural areas are dominated by upland forest/woodland plant communities (39% of the assessed areas) followed by upland grasslands (28%). Upland savannas, brushlands, and shrublands constitute 7% of assessed areas, and lowland plant communities and open water occupy 27% of the assessed areas.

Much of the City's wooded areas are closed canopy forests, derived from overgrown savannas and second-growth forests now dominated by boxelder, elms, and green ash. These forests provide fewer ecosystem services than native forests. The once prevalent and characteristic natural savannas and brushlands of the city now occupy approximately 4% of the assessed areas. Although the typical savanna structure of scattered and grouped canopy trees, with few saplings and shrubs beneath, can be seen at picnic areas of any park and in front yards of many homes, these cultural land covers do not provide the ecosystem services of native oak savannas.

Figure 10. Natural/Semi-Natural Vegetation of Assessed Natural Areas in Rochester



The following descriptions of natural and semi-natural vegetation types are based on RES' 2022 field observations. Acreages provided after each plant community name represent the acres of each plant community assessed within the City.

1. Dry-Mesic Forest/Woodland (53.5 acres)

Summary

A well-drained, forested plant community of oaks and other tree species on higher ground and slopes.

Characteristic Plant Species

- Bur oak (*Quercus macrocarpa*)
- Northern pin oak (*Q. ellipsoidalis*)
- White oak (*Q. alba*)
- Red oak (*Q. rubra*)
- Black cherry (*Prunus serotina*)
- Big-toothed and Quaking aspen (*Populus grandidentata, P. tremuloides*)
- Woodbine (*Parthenocissus inserta*)

Other Plant Community Characteristics

- Tree canopy typically has scattered openings, where direct sunlight dapples the forest floor.
- Compared to Mesic Forest, Dry-Mesic Forest/Woodland may be more susceptible to invasion by Common buckthorn (*Rhamnus cathartica*) and invasive honeysuckles (*Lonicera tatarica, L. x bella*, etc.).
- Generally falls within the "Fire-Dependent Forest/Woodland System" of the Minnesota Native Plant Community Classification (MNDNR 2005).

Soil and Slopes

- Often occurs in well- to moderately well-drained soils.
- Often found on south- or west-facing slopes but can also occur on relatively flat landscape settings.

Historical Conditions

- Historically burned relatively frequently (approximately once every 10 years), resulting in more of a savanna structure.
- Low-intensity surface fires were important for maintaining plant community structure and species composition. Without fire, sun-dependent species disappear, reducing the variety of plants and insects in the community.

Dry-Mesic Forest/Woodland, in western portion of Quarry Hill Park.

2. Mesic Forest (307.7 acres)

Summary

A moist, forested plant community of sugar maple, basswood, oaks, and other tree species typically on level ground, northerly-facing slopes, and lower slopes.

Characteristic Plant Species

- Sugar maple (*Acer saccharum*)
- Basswood (*Tilia americana*)
- Red and Bur oaks (*Quercus rubra, Q. macrocarpa*)
- Hackberry (*Celtis occidentalis*)
- American elm (*Ulmus americana*)
- Ironwood (*Ostrya virginiana*)
- Woodbine (*Parthenocissus inserta*)
- Wild ginger (*Asarum canadense*)

Other Plant Community Characteristics

- Tree canopy closure often is nearly 100 percent, which limits or excludes shrub and ground layer vegetation that requires direct sunlight.
- Invasive Common buckthorn (*Rhamnus cathartica*) and non-native honeysuckles (*Lonicera* spp.) are often present, but typically less abundant than in Dry-Mesic Forest/Woodland.
- Invasive Garlic mustard (*Alliaria petiolata*) is a problem in some of Rochester's Mesic Forests, especially those in low-lying or moist areas.
- Generally falls within the "Mesic Hardwood Forest System" of the Minnesota Native Plant Community Classification (MNDNR 2005), and includes mesic oak forests as well as maple-basswood forests.

Soil and Slopes

- Often occurs in moderately well-drained soils.
- Often found on north- or east-facing slopes, but can also occur on relatively flat landscape settings.

Historical Conditions

- Historically, burned rarely (approximately once every 20-50 years).
- Tends to become dense stands of maple in the natural process of forest succession. Individual tree death or blowdowns of several trees maintained tree canopy diversity if species other than maple were growing beneath the gap created in the forest canopy.
- Researchers have shown that non-native, invasive earthworms (including "jumping worms") harm Minnesota forests, particularly Mesic Forest. Earthworms reduce forest duff, increase erosion, and change soil structure in a way that prevents the regeneration of many native herbaceous plants and trees. It is likely that most, if not all, of Rochester's Mesic Forest stands contain some invasive earthworms.

Mesic Forest, in western portion of Zumbro South Park.

3. Altered Forest/Woodland (192.2 acres)

Summary

A forested plant community on formerly cropped, pastured, or disturbed land, dominated by light-seeded trees and shrubs, most of which originate in lowland settings.

Characteristic Plant Species

- Box elder (*Acer negundo*)
- Green ash (*Fraxinus pennsylvanica*)
- American and Slippery elm (*Ulmus americana, U. rubra*)
- Siberian elm (*Ulmus pumila*) – invasive non-native
- Eastern cottonwood (*Populus deltoides*)
- Quaking aspen (*Populus tremuloides*)
- Planted conifers (e.g., *Pinus* spp.)
- Gray dogwood (*Cornus racemosa*)
- Common buckthorn (*Rhamnus cathartica*) – invasive non-native
- Non-native honeysuckles (*Lonicera tatarica, L. x bella*, etc.) - invasive non-native

Other Plant Community Characteristics

- Some areas contain planted trees of native and non-native deciduous and coniferous species.
- Invasive plants are common, including Common buckthorn, non-native honeysuckles, Garlic mustard (*Alliaria petiolata*), Motherwort (*Leonurus cardiaca*), and Common burdock (*Arctium minus*).
- Often mapped in MLCCS as “Boxelder – Green ash forest”.
- Not considered a natural community.

Soil and Slopes

- Occurs in a broad range of soils and slope positions.

Historical Conditions

- Often formerly disturbed areas that were colonized by pioneering species of bottomlands, which have light, highly mobile seeds (see Characteristic Plant Species above); these trees may range in age from young to mature.

Altered Forest/Woodland, in northeast portion of Indian Heights Park.

4. Savanna (61.8 acres)

Summary

A relatively open plant community where oaks, other trees, and shrubs cover less than half the ground, which is blanketed by sun-requiring and shade-tolerant plants. The term "Savanna" as used in this classification does not necessarily mean a high quality native community, such as an intact oak savanna with native groundcover. Rather, Savanna here means a community has the physical structure of a savanna, with 10-50 percent canopy cover, consisting mostly of trees, and a shrubby or herbaceous ground layer. Ecological quality ranks discussed later in this plan can be used to differentiate savannas with oaks and a native ground layer versus savannas comprised of species not characteristic of historical, species-rich savannas.

Characteristic Plant Species

- Bur oak (*Quercus macrocarpa*)
- Northern pin oak (*Q. ellipsoidalis*)
- Black cherry (*Prunus serotina*)
- American plum (*Prunus americana*)
- Chokecherry (*P. virginiana*)
- Pennsylvania sedge (*Carex pennsylvanica*)
- Black walnut *(Juglans nigra)*

Other Plant Community Characteristics

- Savanna is used to describe landscapes with less canopy cover than forests and woodlands (typically <50 percent canopy cover), and where the woody (i.e., tree and shrub) vegetation is dominated by trees as opposed to shrubs.
- The broken tree canopy allows sunlight to reach the ground layer, often supporting substantial herbaceous vegetation where shrubs and colonizing trees are not dominant.
- Many of the grand, arching oaks seen in some of Rochester's parks originated in savannas, and often still present the look of a natural savanna even though the ground layer is mowed or composed of non-native plants.
- Common buckthorn and invasive honeysuckles are invasive shrubs that dominate the understory of many Savannas.
- Falls within the "Upland Prairie System" of the Minnesota Native Plant Community Classification (MNDNR 2005).

Soil and Slopes

- Occurs in a broad range of soil types and slope positions.

Historical Conditions

- Historically, Savannas experienced frequent fires (approximately once every 2-4 years). However, where canopy cover approached 50 percent, these fires (carried by oak leaves) were not severe, with flame lengths only a few feet in height. Where trees covered only 10 percent of the ground, fires were like those in prairies, with much longer flame lengths due to the abundance of dry ground layer vegetation as fuel. While shrubs and seedlings were often killed

by these fires, they re-sprouted from rootstocks. Fire-tolerant trees such as the thick-barked bur oak and trees that grew rapidly from root masses (called “grubs”), such as northern pin oak, were usually able to reach a size that survived the surface fires. Fire helped maintain an open and patchy vegetation structure in the community, with some areas in full sun and others in partial shade.

- Variety of tree canopy cover and different amounts of light promoted a diversity of flowering shrubs, grasses, and wildflowers, combining forest and prairie flora, and made these habitats productive and able to support a wide range of wildlife.
- Attractive to people because of their park-like quality.

Savanna, in western portion of Quarry Hill Park.

5. Shrub/Scrub (32.3 acres)

Summary

An upland plant community where shrubs and scrubby trees cover up to half the ground.

Characteristic Plant Species

- Smooth and Staghorn sumac (*Rhus glabra, R. typhina*)
- Common buckthorn (*Rhamnus cathartica*) – invasive non-native
- Invasive honeysuckles (primarily *Lonicera tatarica, L. morrowii, L. x bella*) – invasive non-native
- Eastern red cedar (*Juniperus virginiana*) – potentially aggressive native
- Siberian elm (*Ulmus pumila*) – invasive non-native
- Gray dogwood (*Cornus racemosa*)
- Smooth brome (*Bromus inermis*) – invasive non-native
- Canada goldenrod (*Solidago canadensis*) – potentially aggressive native

Other Plant Community Characteristics

- Like Savanna, Shrub/Scrub describes landscapes with less canopy cover than forests and woodlands (<50 percent cover); however, the woody vegetation is primarily shrubs and not trees.
- Generally not considered a natural community; however, prior to 1850, Shrub/Scrub communities on high ground were common and supported a wide array of native plants and animals.

Soil and Slopes

- Occurs in a broad range of soils and slope positions.

Historical Conditions

- Most are former grassland areas that became overgrown with shrubs and scattered trees.
- If previously farmed or heavily grazed, ground layer often consists of non-native plants, similar to those of Non-Native Grasslands.

Upland Shrub/Scrub, in eastern portion of Joyce Park.

6. Prairie (124.5 acres)

Summary

A plant community of native grasses with a large variety of sunlight-dependent wildflowers that grow in different combinations based on soil moisture.

Characteristic Plant Species

- Big bluestem (*Andropogon gerardii*)
- Indian grass (*Sorghastrum nutans*)
- Switch grass (*Panicum virgatum*)
- Little bluestem (*Schizachyrium scoparium*)
- Gray-headed coneflower (*Ratibida pinnata*)
- Black-eyed Susan (*Rudbeckia hirta*)
- Stiff goldenrod (*Oligoneuron rigidum*)
- Common oxeye (*Heliopsis helianthoides*)
- Eastern purple coneflower (*Echinacea purpurea*)
- Purple prairie clover (*Dalea purpurea*)
- Bergamot (*Monarda fistulosa*)

Other Plant Community Characteristics

- Herbaceous plant community, often dominated by grasses.
- Common invasive species include Smooth brome (*Bromus inermis*) and Canada thistle (*Cirsium arvense*) in uplands, and reed canary grass (*Phalaris arundinacea*) in lowland areas.
- Falls within the "Upland Prairie System" or "Wetland Prairie System" of the Minnesota Native Plant Community Classification (MNDNR 2005).

Soil and Slopes

- Occurs in a broad range of soils and slope positions: dry prairie is often on sandy soils and/or south- or west-facing slopes, often the hottest, driest locations in the region; moist or mesic prairie is found in a variety of settings, but never excessively dry or wet; wet prairie grows in low, flat areas with shallow groundwater or seepage.

Historical Conditions

- Historically burned frequently (return intervals less than 5 years). A return interval of less than 4 years is recommended to prevent leaf litter accumulation, which changes soil conditions in favor of many invasive plants which were not present in Minnesota 170 years ago.

Prairie, in southern portion of Essex Park.

7. Non-Native Grassland (275.4 acres)

Summary

A plant community dominated by non-native, often invasive grasses, and often supporting few wildflower species.

Characteristic Plant Species

- Smooth brome (*Bromus inermis*) – invasive non-native
- Kentucky bluegrass (*Poa pratensis*) – invasive non-native
- Wild parsnip (*Pastinaca sativa*) – invasive non-native
- Yellow and White sweet clover (*Melilotus officinalis, M. alba*) – invasive non-native
- Ground clovers (primarily *Trifolium repens, T. pratense*) – invasive non-native
- Canada goldenrod (*Solidago canadensis*) – potentially aggressive native
- Reed canary grass (*Phalaris arundinacea*) – invasive non-native

Other Plant Community Characteristics

- Dominated by non-native herbaceous vegetation that is often not mowed or maintained; may be hayed intermittently.
- Not considered a natural community.

Soil and Slopes

- Occurs in a broad range of soils and slope positions.

Historical Conditions

- Often previously farmed or grazed.

Non-Native Grassland, in northern portion of Gamehaven Reservoir.

8. Lowland Forest/Woodland (114.4 acres)

Summary

A low-lying, sometimes wet/flooded, forested plant community of elm, ash, maple, cottonwood, and other trees and shrubs.

Characteristic Plant Species

- Eastern cottonwood (*Populus deltoides*)
- Silver maple (*Acer saccharinum*)
- Black willow (*Salix nigra*) and hybrids
- Box elder (*Acer negundo*)
- American and Slippery elm (*Ulmus americana, U. rubra*)
- Green ash (*Fraxinus pennsylvanica*)
- Common hackberry (*Celtis occidentalis*)
- Black walnut (*Juglans nigra*)
- Stinging nettle (*Urtica dioica*)
- Wood nettle (*Laportea canadensis*)
- Enchanter's nightshade (*Circaea lutetiana*)
- Garlic mustard (*Alliaria petiolata*) – invasive non-native
- Spotted touch-me-not (*Impatiens capensis*)
- Common buckthorn *(Rhamnus cathartica)* – invasive non-native
- Clearweed *(Pilea pumila)*

Other Plant Community Characteristics

- Low-lying woodlands that experience flooding, shallow water tables, or very moist conditions due to solar aspect (e.g., in ravines or on north- or east-facing slopes).
- Remnant or restored native Lowland Forest often falls within the "Floodplain Forest System" or "Wet Forest System" of the Minnesota Native Plant Community Classification (MNDNR 2005).

Soil and Slopes

- Occurs in low-lying areas including basins, floodplains, drainageways, and on lower slopes.
- Floodplains usually have mineral soil; swamps typically have organic, mucky soils.

Historical Conditions

- Some Lowland Forests still experience unaltered hydrology and resemble historical forests, but others have changed due to hydrological alterations (e.g., dams, levees).

Lowland Forest/Woodland, in southern portion of Bear Creek Park.

9. Lowland Savanna (34.9 acres)

Summary

Lowland Savannas are relatively open plant communities where walnuts, other trees, and shrubs cover less than half the ground, which is blanketed by sun-requiring and shade-tolerant plants. The term "Savanna" as used in this classification does not necessarily mean a high quality native community with native groundcover. Rather, Savanna here means a community has the physical structure of a savanna, with 10-50 percent canopy cover, consisting mostly of trees, and a shrubby or herbaceous ground layer. Ecological quality ranks discussed later in this plan can be used to differentiate Lowland Savannas consisting of native vegetation versus Lowland Savannas comprised of species not characteristic of historical, species-rich savannas.

Characteristic Plant Species

- Black walnut *(Juglans nigra)*
- Bur oak (*Quercus macrocarpa*)
- American and Slippery elm (*Ulmus americana, U. rubra*)
- Green ash (*Fraxinus pennsylvanica*)
- Silver maple (*Acer saccharinum*)
- Common hackberry (*Celtis occidentalis*)
- Eastern cottonwood (*Populus deltoides*)
- Cut-leaf coneflower (Rudbeckia laciniata)
- Germander (*Teucrium canadense*)

Other Plant Community Characteristics

- Lowland Savanna is used to describe landscapes with less canopy cover than forests and woodlands (typically <50 percent canopy cover), and where the woody (i.e., tree and shrub) vegetation is dominated by trees as opposed to shrubs.
- The broken tree canopy allows sunlight to reach the ground layer, often supporting substantial herbaceous vegetation where shrubs and colonizing trees are not dominant.
- Common buckthorn and invasive honeysuckles are invasive shrubs that dominate the understory of many Lowland Savannas.

Soil and Slopes

- Occurs primarily in low-lying areas, such as floodplains.

Historical Conditions

- Historically, Lowland Savannas experienced occasional fires, which along with flooding and windthrow, helped maintain an open and patchy vegetation structure in the community, with some areas in full sun and others in partial shade.
- Variety of tree canopy cover and different amounts of light promoted a diversity of flowering shrubs, grasses, and wildflowers, combining forest and prairie flora, and made these habitats productive and able to support a wide range of wildlife.
- Attractive to people because of their park-like quality.

Lowland Savanna, restoration site in western portion of Zumbro South Park.

10. Lowland Shrub/Scrub (33.0 acres)

Summary

A plant community on moist, occasionally flooded soils, where shrubs and scrubby trees cover up to half the ground.

Characteristic Plant Species

- Black willow *(Salix nigra*) and hybrids
- Willow shrubs (*Salix* spp.)
- Red-osier dogwood (*Cornus stolonifera*)
- Glossy buckthorn (*Frangula alnus*) – invasive non-native
- Wild black currant (*Ribes americanum*)
- Narrow-leaved and Blue cattail hybrid (*Typha angustifolia, T. x glauca*) – invasive non-native
- Reed canary grass (*Phalaris arundinacea*) – invasive non-native
- Sedges (*Carex* spp.)
- Spotted touch-me-not (*Impatiens capensis*)

Other Plant Community Characteristics

- Shrub-dominated community, often wetland.
- Often contains highly invasive Reed canary grass, which can completely dominate the ground layer.
- Remnant or restored native Lowland Shrub/Scrub falls within the "Wet Meadow/Carr System" of the Minnesota Native Plant Community Classification (MNDNR 2005).

Soil and Slopes

- Occurs in saturated or groundwater-fed soils, usually in shallow, inundated depressions.

Historical Conditions

- Some Lowland Shrub/Scrub areas represent historical conditions, while others developed after woody plants invaded Wet Meadows following drainage and the cessation of haying or grazing or due to fire suppression.

Lowland Shrub/Scrub, in Quarry Hill Park.

11. Herbaceous Wetland (83.3 acres)

Summary

A plant community on moist, occasionally flooded soils or standing water. Vegetation dominated by grasses and sedges with scattered wildflowers.

Characteristic Plant Species

- Reed canary grass (*Phalaris arundinacea*) – invasive non-native
- Sedges (*Carex* spp.)
- Canada bluejoint grass (*Calamagrostis canadensis*)
- Manna grasses (*Glyceria* spp.)
- Swamp milkweed (*Asclepias incarnata*)
- Spotted Joe-pye weed (*Eutrochium maculatum*)
- Purple loosestrife (*Lythrum salicaria*) – invasive non-native
- Blue flag iris (*Iris versicolor*)
- Beggar ticks (*Bidens* spp.)
- Narrow-leaved and Blue cattail hybrid (*Typha angustifolia, T. x glauca*) – invasive non-native
- Broad-leaved cattail (*Typha latifolia*)

Other Plant Community Characteristics

- Most in the Rochester area are dominated by invasive cattails and/or reed canary grass. These species often spread throughout a wetland, reducing vegetation diversity and habitat value.
- Remnant or restored native Herbaceous Wetlands typically fall within the "Wet Meadow/Carr System" or "Marsh System" of the Minnesota Native Plant Community Classification (MNDNR 2005).

Soil and Slopes

- Occurs in depressions and at edges of marshes, lakes, ponds, and some streams and rivers.
- Found in saturated soils to shallow water.

Historical Conditions

- Invasion by cattails, reed canary grass, and other aggressive species have resulted in the dramatic degradation of these types of wetlands throughout the Upper Midwest. Hydrological regimes were dynamic but predictable historically. With the current shunting of excessive runoff from roads, pavement, and rooftops, these wetlands now experience water level fluctuations out of the normal range that the historical vegetation can tolerate. Both Narrow-leaved cattail (*Typha angustifolia*, an invasive, non-native species) and Blue cattail (*T. x glauca*, the invasive hybrid between Narrow-leaved cattail and native Broad-leaved cattail, *T. latifolia*) grow well with this overly-dynamic flooding regime. These two aggressive cattail species, as well as invasive reed canary grass, also use the higher phosphorus concentrations in most Marshes that receive runoff and develop into dense stands, smothering native vegetation and simplifying the habitat.

Herbaceous Wetland, in southeast portion of Silver Creek Reservoir.

12. Open Water (115.5 acres)

Summary

Areas of deep water that may contain floating-leaved or submergent vegetation.

Characteristic Plant Species

- Yellow water lily (*Nuphar variegata*)
- White water lily (*Nymphaea odorata*)
- American lotus (*Nelumbo lutea*)
- Eurasian watermilfoil (*Myriophyllum spicatum*) – invasive non-native
- Curly-leaf pondweed (*Potamogeton crispus*) – invasive non-native
- Coontail (*Ceratophyllum demersum*)
- Pondweeds (*Potamogeton* spp.)
- Lesser duckweed (*Lemna minor*)

Other Plant Community Characteristics

While not a focus of this study, Open Water areas often contain a variety of floating and/or submerged aquatic plants. Aquatic habitats in Rochester are affected by urban stormwater runoff and aquatic invasive species (AIS), including plants such as Eurasian watermilfoil and Curly-leaf pondweed, and non-native animals, such as Common carp (*Cyprinus carpio*).

Soil and Slopes

- Lakes, ponds, and reservoirs with mineral or organic sediment.

Historical Conditions

- Many Open Water areas represent historical conditions (e.g., natural lakes, rivers, and open water wetlands), while some represent dammed river segments, constructed stormwater ponds, or flood control reservoirs.

Open Water, in Cascade Lake Park.

2.1.3 Ecological Quality

An integral component of this NAMP is the assignment of an ecological quality rank to the City's priority natural areas. This rank estimates the relative health of a specific plant community. The criteria for assigning a rank are:

- Diversity of native species
- Level of disturbance
- Presence of invasive species
- Structural and spatial diversity (i.e., vegetation layers and plant variety across the natural area)
- Connectivity with other plant communities versus adjacency to turf or active use areas
- Degree of erosion due to processes such as excessive runoff or foot traffic
- Other negative management or use impacts

Departments of Natural Resources across the country have adopted a standardized ecological ranking system used by State Natural Heritage Programs when conducting inventories of natural areas. In Minnesota, this system was refined by the MNDNR as the Natural Community Element Occurrence Ranking Guidelines (MNDNR 2001). This robust (91-page) methodology provides definitions and criteria for assigning an ecological quality rank to any given native plant community in Minnesota. For more general application of ecological quality ranks, MLCCS (version 5.4) adopted a simplified version of the MNDNR's system, whereby more general guidelines are provided to help the user assign an appropriate quality rank. Based on the ecological criteria described above, it was decided that the MLCCS ecological quality ranking system would be modified slightly for use in the City of Rochester (see box below).

Often, a mapped plant community may be somewhat heterogeneous and contain characteristics of multiple quality ranks. For instance, a moderate quality forest (C rank) may have dense patches of invasive buckthorn (justifying a D rank). In this case, it would be acceptable to assign multiple ranks to this single plant community (i.e., CD). It is best to limit the number of ranks to two "adjacent" ranks, and if this does not accurately characterize the plant community's quality, the plant community (polygon) is typically split and each portion assigned its appropriate quality rank.

Ecological Quality Ranks

A = Highest quality natural community. Has no disturbances, and natural processes intact.

B = Good quality natural community. Has its natural processes intact, but shows signs of past human impacts. Low levels of non-native or invasive plants.

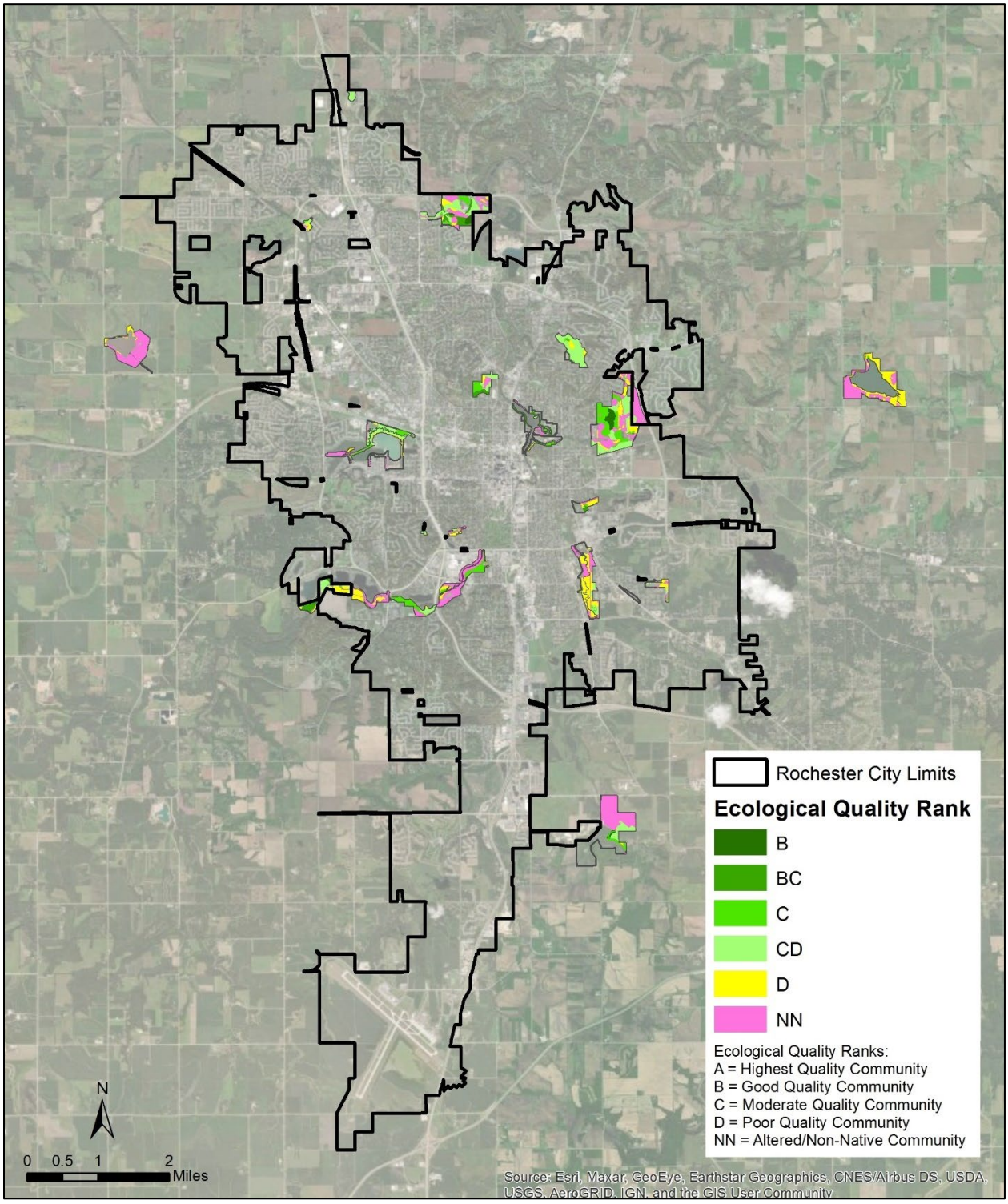
C = Moderate quality natural community. Has obvious past disturbance, but still clearly recognizable as a native community. Typically not dominated by weedy species in any layer.

D = Poor quality natural community. Includes some native plant species, but is dominated by non-natives and/or is widely disturbed and altered.

NN = Altered / non-native plant community. These semi-natural communities (e.g., Altered Forest/Woodland, which includes green ash/box elder forests) do not receive a natural quality rank.

Plant communities visited during RES's field assessment were assigned a quality rank. Figure 11 illustrates quality ranked plant communities within the City.

Figure 11. Quality Ranks of Assessed Natural Communities in Rochester



2.1.4 Water Resources

While not the focus of this NAMP, surface waters are an important natural feature in the City of Rochester. The South Fork of the Zumbro River and several of its tributaries (including Willow, Cascade, Badger Run, Bear, and Silver Creeks) represent the City's natural flowing waters, some of which have been dammed to create artificial lakes (e.g., Silver and Cascade Lakes). These surface waters provide significant recreational value and amenities for City residents and the metro region, as well as aquatic habitat for many species of fish, amphibians, birds, and aquatic insects and clams.

The green-tinted waters of Augusta Lake speak to the need for watershed planning and BMP implementation.

The City's urban downtown and surrounding suburban development patterns generate excessive surface water runoff from roads, parking lots, roofs, and turf. This larger than natural volume of water and its associated "non-point source" pollution alters the normal pattern of water level variation, degrades water quality, erodes streambanks and shores, and causes flooding—all of which impact City infrastructure, decrease aesthetics and recreation opportunities, and degrade aquatic, wetland, and lowland habitats.

Most of these water resources issues are best addressed at a watershed scale. While it is difficult for the City to influence watershed-scale impacts associated with the rivers and creeks that originate outside the City limits, meaningful actions can be taken to address local sources of runoff and pollution, helping to protect the City's lakes, wetlands, and streams. Stormwater improvement projects are beyond the scope of this NAMP, but there are many opportunities for partnering with water management organizations, Olmsted County, institutions (e.g., schools, churches), homeowner associations, and private landowners to implement green infrastructure and stormwater best management practices (BMPs) to better protect the City's wetlands and aquatic resources, if not improve them. As defined in the City's comprehensive plan (City of Rochester 2018), " "Green infrastructure" is a strategically planned network of natural areas and open spaces, such as fields, wetlands, river corridors, and forests, to provide flood protection, cleaner air and water, habitat, and aesthetic appeal. It uses vegetation, soils, and other natural elements to treat stormwater at its source while delivering environmental, social, and economic benefits." Green infrastructure includes urban forests and green streets as well as a variety of stormwater BMPs such as natural buffers around water bodies, rain gardens, vegetated swales, infiltration basins, and stormwater wetlands. The City's stormwater management ordinance (Code 1965, § 146A.01-18, Title 6 Chapter 6-4) references the use of BMPs to protect water resources. In addition, City ordinances could be augmented to require more stringent stormwater management practices.

The City is currently working with watershed management agencies, businesses, and residents to address stormwater management. The City could expand its coordination with partners in order to increase the adoption of stormwater BMPs near creeks and other surface waters. Some of the public outreach

opportunities listed in Section 1.3.2 address water resources, and there are additional opportunities for education and engagement in protecting these important aquatic habitats and amenities.

2.1.5 Wildlife

Wildlife surveys were not conducted for this NAMP. Based on available data (e.g., eBird), City staff, local birders' reports, and the consultant team's ecological assessment field work within the park system, there appears to be a moderate variety and abundance of wildlife using the City's natural areas. However, many of these species are considered "generalists." Generalists persist and even thrive in cities, suburbs, farmland, and degraded natural areas. Generalists do not have narrow habitat and dietary needs that can only be satisfied by high quality or large natural areas; this allows them to build up large populations using resources inadvertently supplied by people. While not problems in themselves, an abundance of generalists indicates that natural areas are lower in quality, smaller, and more isolated than natural areas where generalists are not as common. By contrast, "specialists" are species with specific needs, such as a particular habitat feature, preferred food, or conditions for raising offspring. (Species that need large areas are included here.) Specialists are less common than generalists, more often found in larger, higher quality habitats. They are more sensitive to environmental change and are often classified as Species of Greatest Conservation Need (see below). As natural areas are improved, connected, and shielded from the damaging effects of adjacent land uses, specialist species will appear and increase in abundance. Specialists are therefore a good indicator of the success of restoration and conservation efforts.

Typical Species by Habitat

Several dozen common wildlife species probably occur in the City's natural areas (Table 4). Many use several habitats, and many other bird species migrate through the City in spring and fall.

Table 4. Typical Wildlife in Rochester's Natural Areas

Plant Communities	Mammals	Birds	Reptiles & Amphibians	Other
Upland Communities				
Forest/Woodland	White-tailed deer, Raccoon, Opossum Red fox, Woodchuck, Gray squirrel, E. chipmunk	Warblers, Vireos, Black-capped chickadee, Woodpeckers, Owls, Cooper's hawk, Sharp-shinned hawk, Wild turkey, Blue jay, Northern cardinal	Garter snake, Tree frog	
Savanna/Brushland	Coyote, White-footed mouse, Short-tailed shrew	American robin, Brown thrasher, Field sparrow, Song sparrow, American crow, European starling, Gray catbird, Common grackle	Garter snake	
Prairie	Woodchuck, Ground squirrel, Meadow vole, Red fox, Striped skunk, Eastern cottontail	American goldfinch, Dark-eyed junco, Flycatchers, Eastern bluebird, Indigo bunting, Red-tailed hawk	American toad, Garter snake	Monarch butterfly
Non-Native Grassland	Gray squirrel, Ground squirrel	Canada goose		Grasshoppers
Lowland Communities				
Lowland Forest/Woodland & Savanna/Brushland	Raccoon	Bald eagle, Osprey	Tree frogs	
Herbaceous Wetland (e.g., Wet Meadow & Marsh)	Muskrat, Mink, Short-tailed weasel	Killdeer, Red-winged blackbird, Yellow warbler, Common yellowthroat	Leopard frog, W. chorus frog	Dragonflies, Damselflies
Open Water	Beaver, Otter	Belted kingfisher, Great blue heron, Swallows, Pied-billed grebe, Mallard, Wood duck, Blue-winged teal, Hooded merganser, Spotted sandpiper, Canada goose	Snapping turtle, Softshell turtle, W. painted turtle, Green frog	Sunfishes, Bass, Northern pike, Carp

More detailed observations of birds in Rochester can be found by zooming in on the City using eBird (https://ebird.org/hotspots?env.minX=-97.238983&env.minY=43.502103&env.maxX=-89.499961&env.maxY=49.383296&yr=all&m=).

Species of Greatest Conservation Need

Species of Greatest Conservation Need (SGCN) is a wildlife classification for regional conservation purposes; many of these species are classified as specialists, which are commonly found in higher quality or large core habitats. SGCN include state-listed species and non-listed species that are regionally rare or in decline, often as a result of habitat loss. While most are not yet endangered, they may become so in the future unless people become aware of and manage for them.

Minnesota's Wildlife Action Plan (MNDNR 2016) presents a statewide analysis of SGCN and wildlife conservation issues. The plan identifies 346 SGCN in the state, many of which were formerly common species driven to rarity by land use changes during the past 150 years.

The City of Rochester contains habitat used by many SGCN, and some of the City was scored as "Medium-High" in the statewide "Wildlife Action Network" analysis (MNDNR 2016); however, the City does not contain any "Conservation Focus Areas". Through implementation of this NAMP, the City's natural habitats will be restored, expanded, and better connected to benefit these species. Increases in SGCN over time will indicate that restoration and management efforts are succeeding.

Nuisance Wildlife

A variety of wildlife species in good numbers usually indicate that habitats are diverse and in good condition. However, large numbers of some animals can be considered a nuisance. Managing nuisance wildlife populations is the most common method to address these concerns. After determining that an animal species or an individual animal is a problem, then population control is likely the best path forward. This is most commonly accomplished by culling, which may be achieved by hunting, trapping, and/or egg addling (coating eggs with oil to make them unviable). These practices must be conducted in compliance with wildlife management regulations under the U.S. Fish & Wildlife Service (for federally-protected wildlife species) and/or the MNDNR (state-listed animals and some additional species).

Other management strategies focus on altering the habitat that attracts nuisance wildlife. For instance, fencing can reduce grazing and browsing by deer, or planting tall vegetation around water will discourage use by geese. Unpalatable plantings can also deter grazing. Plants such as Butterfly milkweed (*Asclepias tuberosa*), Columbine (*Aquilegia canadensis*), Prairie coreopsis (*Coreopsis palmata*), evening primrose (*Oenothera biennis*), native thistles (e.g., *Cirsium discolor*), beardtongues (e.g., *Penstemon digitalis*), purple coneflowers (e.g., *Echinacea angustifolia*), and Wild ginger (*Asarum canadense*) are generally avoided by deer. Native plants are generally less desirable and less of an attractant than ornamental plants. Lastly, creating suitable habitat for nuisance wildlife away from areas where they pose health, safety, and ecological challenges can reduce grazing and browsing impacts on native vegetation. Alfalfa fields, for example, planted near forest and woodland can provide sustenance for deer and reduce their grazing on forest herbs in late winter and early spring, when highly nutritious vegetation is sparse.

The most prominent nuisance wildlife species in the City of Rochester and current management strategies follow.

- **White-tailed deer**. These charismatic animals can adversely impact natural areas and restoration projects by browsing native herbaceous and woody plants, preventing the regeneration of the tree canopy, and suppressing reproduction of many species of ground layer plants. The City has a program in place to control deer populations; however, browsing by deer continues to stress and degrade some of the City's native plant communities.
- **Canada goose**. Often abundant in turf grass areas near water bodies, Canada geese add nutrients and bacteria in their droppings to surface waters. The City has a draft goose management program to address this wildlife nuisance (City of Rochester 2021). Canada geese in Rochester congreate primarily in Silver Lake Park (one of the City's Priority Natural Areas). Population estimates reached 40,000 geese in the early 2000's during migration season (September through May) in Silver Lake alone, and nest and egg counts in 2021 suggest this is

the largest population of geese in the City. Cascade Lake (another Priority Natural Area) sustains a smaller population of Canada geese. Canada goose mangaement strategies adopted by the City of Rochester Parks and Recreation Department include education, signage, data collection, habitat modification, and continued control in high conflict areas by following humane wildlife management protocols.

- **Beaver**. These large rodents can cause upstream flooding (through dam construction), and they may cut down trees that people value, including those in restoration plantings. On the other hand, rodents are the base of many food chains, and beaver dams historically created wet meadow and marsh habitat, which is relatively uncommon in Rochester.
- **Pocket Gopher.** These burrowing rodents can compromise the integrity of banks, dams, and levees; therefore, they are controlled on the levees associated with City reservoirs.

2.1.6 Rare Natural Features

The rarest species in a region, state or nation speak to the vulnerability of some animal groups to extinction, such as freshwater mussels, and to the potential loss of unique members of the web of life. They are, moreover, bellwethers of humanity's effect on the natural world—diminishing as the scale of the human enterprise expands. For some animal and plant groups in the Midwest, up to half of that group's biodiversity is extinct or threatened with extinction. Rare species constitute a significant part of a region's biodiversity, without question.

It is valuable, therefore, to identify the rare species and habitats that exist or existed as this information can shape conservation priorities, projects, and strategies. Understanding the rare plants and animals in the City's natural areas can guide the siting and design of restoration projects to best protect and meet each species' particular needs. Several federal- and state-tracked rare and uncommon natural features exist, used to exist, or may exist in Rochester. Some are protected by regulation; however, many are not formally protected, underscoring the importance of proactive and voluntary efforts to conserve biodiversity.

Federally-Tracked Natural Features

The U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) website is used to identify federally-tracked species in a project area. A query of IPaC (USFWS 2022) for the City of Rochester plus a 3-mile radius indicated that five federally-listed species may potentially be affected by activities within the City of Rochester (Table 5).

The Rusty patched bumble bee (federally-endangered) has been documented in the City of Rochester. Source: USFWS

Table 5. Federally-Listed and Candidate Species Potentially Affected by Activities in Rochester

Common & Scientific Name	Federal Status & Recovery Plan Status	Habitat	Presence in City of Rochester	Potential for Positive Effect With City Action
Rusty patched bumble bee (*Bombus affinis*)	Endangered (Plan begun 2018)	Historically occupied grasslands and tallgrass prairies.	Confirmed.	Very high potential to improve habitat by expanding and improving prairies.
Northern long-eared bat (*Myotis septentrionalis*)	Threatened (Plan not started)	Roosts and forages in upland forests and woods; hibernates in caves and mines; autumn swarming occurs in surrounding wooded areas.	Possibly roosting and foraging in City's larger forests; a survey has not been done; hibernacula not known to occur in County.	After a survey to confirm presence, roosting and foraging habitat could be improved in quality and expanded.
Leedy's roseroot (*Rhodiola integrifolia ssp. leedyi)*	Threatened (Plan began 1988)	Shallow ledges of north-facing dolomite cliffsides.	A population may persist on Root River tributaries.	Little can be done to directly enhance protection of cliff-faces.
Prairie bush-clover (*Lespedeza leptostachya*)	Threatened (Plan began 1988)	Found only in the tallgrass prairie region.	May exist in prairie areas.	Potential to improve habitat by expanding and improving prairies.
Monarch Butterfly (*Danaus plexippus*)	Candidate	Prairies, fields, and parks where milkweed is common.	Confirmed.	Very high potential to improve habitat by expanding and improving prairies.

Of the five federally-listed or candidate species, the Rusty patched bumble bee (endangered) has been documented in the City of Rochester, and Northern long-eared bat (threatened) may also use City parks and other natural areas. Per species range maps (Minnesota Wildflowers 2022), there are herbarium records of Leedy's roseroot in Olmstead County, and there are MNDNR reports of Prairie bush-clover in the county, but no records are currently available. While global populations are decreasing dramatically, the candidate species Monarch butterfly is moderately common in Rochester. As RES did not conduct special surveys, other rare plants or wildlife could not be confirmed as present or absent in the City. Three of these species are most likely to be influenced by activities in the City of Rochester: Rusty patched bumble bee, Northern long-eared bat, and Monarch butterfly.

Rusty patched bumble bee. This federally-endangered insect's habitat requirements include food (nectar and pollen from flowers), nesting sites (underground and abandoned rodent cavities or clumps of grasses above ground), and overwintering sites for queens (undisturbed soil). This species has been documented in the City, and it may use additional restored prairies and other grasslands within the City. Impacts and threats to Rusty patched bumble bee are:

- Habitat loss and degradation, e.g. loss of native prairie
- Intensive farming and associated loss of crop diversity, hedgerows, and pastures
- Disease and pesticides

- Global climate change, which can lead to increased disease and loss of habitat elements at the critical time

Rusty patched bumble bee can be protected by:

- Removing/controlling invasive vegetation
- Installing diverse native flowering plants
- Preserving native landscape areas, where lack of mowing and soil disturbance will provide potential habitat
- Avoiding use of pesticides and chemical fertilizers

Northern long-eared bat. This federally-threatened mammal is a medium-sized bat with long ears that uses forested areas for summer roosting. Its range includes the entire Upper Midwest, including Minnesota. This bat species overwinters in caves and mines with constant temperatures, high humidity, and no air currents. This species may travel over 100 miles between summer and winter habitat, but journeys of 50 miles are more common. The Northern long-eared bat has shown a preference for upland forests but also may use lowland forests with mid-sized streams. These ecosystems are present in the City of Rochester.

Survey techniques to determine the presence or absence of the Northern long-eared bat should follow the USFWS survey guidelines for Indiana bat (USFWS 2019). USFWS management guidelines (USFWS 2016) recommend that tree-cutting in suitable habitat should not occur from April 1 through September 30, with the pup-rearing season (June 1 through July 31) being critical, especially in the white-nose syndrome zone, discussed below. This federal guidance (USFWS 2016) suggests that tree clearing, even for ecological restoration, should occur from early October through March (with June 1 through July 31 being the most sensitive period due to pup rearing). Fortunately, this is the typical period for tree removal in ecological restoration projects, and this timing also avoids harming nesting migratory birds. Impacts and threats to the Northern long-eared bat (and other bat species) are:

- White-nose syndrome, a severe and immediate threat to this and other cave-hibernating bat species. White-nose syndrome is a fungus that kills hibernating bats in North America. It is a major concern for bat conservation because it kills all or nearly all bats using overwintering caves, mines, and other “hibernacula.” It has spread rapidly across the U.S. since its discovery in New York state in 2006, and it has been confirmed in Olmstead County (White Nose Syndrome Response Team 2018).
- Impacts to hibernacula where they spend the winter, such as access changes, microclimate changes, and human disturbances
- Loss or degradation of summer forest habitat and/or roost trees
- Wind farm operations (turbines can kill bats)

The Northern long-eared bat can be protected by:

- Not removing potential roost trees
- Not removing trees within 150 feet of a known roost tree when young bats are with mothers at the roost; this “non-volant pup” phase is June 1 through July 31

Monarch butterfly. This federal candidate insect's habitat requirements include first and foremost the presence of milkweeds — the sole host plant species of monarch larvae. Adult monarchs use diverse nectar sources for food. Nectar plants are a key component of ideal habitat for monarchs and other pollinators. The monarch requires an assemblage of native wildflowers which bloom throughout the growing season. Summer-blooming nectar sources (blooming approximately June 2 - August 15) are essential in the breeding range of the species, which includes Rochester. Threats and impacts to the monarch butterfly include:

- Breeding and overwintering habitat loss from urbanization and intensive farming
- Climate change, which alters breeding range and migratory patterns
- Use of pesticides — including toxic neonicotinoids and herbicides

Monarch butterflies can be protected by:

- Establishing and maintaining habitat which includes ample milkweed and other native nectar sources throughout the growing season
- Avoiding untimely mowing and pesticide applications
- Removing/controlling invasive vegetation

Other Rare Species and Habitats

In addition to federally-tracked listed species, the USFWS tracks critical habitats, migratory bird species of particular concern, wildlife refuges, and fish hatcheries. The IPaC report identified 18 migratory bird species of particular concern that potentially occur in the City of Rochester (Table 6). No critical habitats, wildlife refuges, or fish hatcheries were identified in the City.

Table 6. Potential Migratory Bird Species of Concern in Rochester (USFWS 2022)

Common Name	Scientific Name	Level of Concern	Breeding Season
American golden-plover	*Pluvialis dominica*	BCC Rangewide (CON)	Breeds Elsewhere
Bald eagle	*Haliaeetus leucocephalus*	Non-BCC Vulnerable	Dec 1 to Aug 31
Black-billed cuckoo	*Coccyzus erythropthalmus*	BCC Rangewide (CON)	May 15 to Oct 10
Bobolink	*Dolichonyx oryzivorus*	BCC Rangewide (CON)	May 20 to Jul 31
Cerulean warbler	*Dendroica cerulea*	BCC Rangewide (CON)	Apr 22 to Jul 20
Chimney swift	*Chaetur pelagica*	BCC Rangewide (CON)	March 10 to Aug 31
Eastern whip-poor-will	*Antrostomus vociferus*	Bcc Rangewide (CON)	May 1 to Aug 10
Golden eagle	*Aquila chrysaetos*	Non-BCC Vulnerable	Breeds Elsewhere
Henslow's sparrow	*Ammodramus henslowii*	BCC Rangewide (CON)	May 1 to Aug 31
Hudsonian godwit	*Limosa haemastica*	BCC Rangewide (CON)	Breeds Elsewhere
Lesser yellowlegs	*Tringa flavipes*	BCC Rangewide (CON)	Breeds Elsewhere
Prothonotary warbler	*Protonotaria citrea*	BCC Rangewide (CON)	Apr 1 to Jul 31
Red-head woodpecker	*Melanerpes erythrocephalus*	BCC Rangewide (CON)	May 10 to Sep 10
Ruddy turnstone	*Arenaria interpres morinella*	BCC-BCR	Breeds Elsewhere
Rusty blackbird	*Euphagus carolinus*	BCC Rangewide (CON)	Breeds Elsewhere
Short-billed dowitcher	*Limnodromus griseus*	BCC Rangewide (CON)	Breeds Elsewhere
Upland sandpiper	*Bartramia longicauda*	BCC-BCR	May 1 to Aug 31
Wood thrush	*Hylocichla mustelina*	BCC Rangewide (CON)	May 10 to Aug 31

BCC-BCR = Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
BCC Rangewide (CON) = Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska

The Bald Eagle was removed from the federal list of threatened and endangered species in 2007, but it is still protected under the Bald and Golden Eagle Protection Act of 1940. Bald eagles have been known to nest within the City of Rochester, but not on City parkland.

State-Tracked Natural Features

The MNDNR's Natural Heritage Program recently developed the MN Conservation Explorer – an online tool for facilitating conservation of the state's natural resources. This tool was used to query the MNDNR's various spatial databases for the City of Rochester plus a 3-mile radius. The search identified:

- 37 Sites of Biodiversity Significance,
- 67 mapped native plant communities,
- 11 calcareous fens (including Joyce Park Fen),
- no old growth stands,
- no Prairie Conservation Plan sites,
- one Important Bird Area ("Blufflands-Root River" located on the very southeast edge of the search area),
- no Lakes of Biological Significance, and

- one large Rusty Patched Bumble Bee High Potential Zone (encompassing much of the City).

Appendix B provides a more detailed summary of these findings, and these data can be publicly-accessed and explored further using the online MN Conservation Explorer: (https://mce.dnr.state.mn.us/content/explore).

2.2 Ecological Stressors

2.2.1 Habitat Loss, Fragmentation, and Edge Effects

Land conversion for development (e.g., buildings, parking lots, roads, yards, athletic fields) and for agricultural production (e.g., crop fields, pasture) results in loss and degradation of habitat for native plants and wildlife. Much of Rochester has been significantly altered for agricultural production or is already built out, such that the remaining natural areas are essential for maintaining the already-reduced ecosystem functioning in the City. However, even remaining habitats have been severely degraded due to removal of natural disturbance regimes, invasive species, fragmentation, and edge effects. These concepts are addressed further in the following sections.

2.2.2 Disrupted Natural Disturbance Regimes

The mid-1800s plant communities of Rochester were sustained by natural disturbances—fires of various frequencies and intensity sustained prairies, savannas, some wetlands, and even some woodlands. Natural flooding and water level changes helped sustain healthy and diverse wetland communities. Occasional straight-line winds and tornadoes caused massive windthrows, helping sustain forest and woodland diversity. Herds of bison and elk consumed and trampled grasses and forbs of prairies, savannas, and woodlands, adding carbon to the soil and recycling nutrients for new vegetation growth.

Changes in natural disturbance regimes since the mid-1800s have markedly changed the plant communities and wildlife populations of Rochester. Given that the region was dominated by fire-dependent prairie and oak savanna, the elimination of fire on most of the City's landscape was significant. It led to colonization and dense growth of trees and shrubs in grasslands, savannas and woodlands. The effect of fire suppression is well documented and generally results (within a few decades) in the loss of hundreds of native prairie and savanna plant and animal species. In addition, many non-native and invasive species more easily establish and spread, as they did not evolve with frequent fire and are protected by fire suppression.

The hydrology of the region also was dramatically altered through river dams, channelization of streams, drainage of wetlands, expansion of impervious surfaces and larger amounts of stormwater runoff, compounded by climate change and more frequent severe storm events. These alterations changed natural flooding regimes that formerly supported Rochester's lowland and aquatic ecosystems. The resulting "flashier" streams and wetlands that now experience a larger hydrological "bounce"; that is, a small rainfall now produces a rapid and large rise in water levels in rivers, lakes, streams and wetlands, whereas in a naturally vegetated watershed a small rainfall would produce no or little rise in water levels. Flashiness and hydrological bounce cause bank and bed erosion in watercourses, remove vegetation at

the water's edge, add silt and phosphorus that causes algae growth, and generally degrade habitat and water quality.

The loss of large and periodically abundant grazers and browsers from the landscape also affected these plant communities, which evolved under periods of short-term, intense grazing and trampling, followed by periods with little disturbance. By contrast, the hundred years of season-long or continuous grazing by cows and sheep after 1850 was a new type of grazing regime that eliminated most native species from pastures and woodlands and replaced those with Eurasian forage grasses and forbs.

2.2.3 Nutrient Enrichment

High levels of the nutrients phosphorus and nitrogen are well documented in urban water bodies. Increased impervious surfaces and connection of these areas with curb, gutter, and storm sewers leads to more runoff, sediment, and pollutants reaching surface waters. Elevated nutrients contribute to algae growth in water bodies—including cyanobacteria, which can be harmful or fatal to pets and even people. Nutrient-rich, or "eutrophic", waters tend to have low clarity and poorer quality habitat, with fewer native aquatic species. Several invasive plants, like Narrow-leaved cattail (*Typha angustifolia*), hybrid cattail (*Typha* x *glauca*), and Reed canary grass (*Phalaris arundinacea*) thrive in nutrient-rich waters, outcompeting native plants and reducing plant and animal diversity.

Nutrient enrichment and ecosystem effects have also been documented in terrestrial landscapes. Atmospheric deposition of soil particles and nitrogen across vast regions, for instance, raises nutrient levels in upland soils, causing changes in plant communities and biogeochemical processes in the soil. Nutrient enrichment of the soil encourages invasive vegetation to become established and spread, degrading natural areas.

2.2.4 Invasive Species

Invasive Plants

The City of Rochester is no different than every other city in the United States regarding invasive plant species: removing them from natural areas is a primary management activity, and one that must be followed up with perpetual control. Natural areas in the City have been dramatically and negatively affected by the presence of many invasive plant species.

People's disturbance and alteration of landscapes often lead to conditions that are poor for the native plant community (e.g., excessive shade, bare soil, nutrient enrichment) and in turn favor invasive species. These aggressive species then establish and often thrive in these disturbed habitats, crowding out the already stressed native plants and animals. Invasive species typically have the following characteristics:

- Tolerant of a variety of environmental conditions.
- Grow and reproduce rapidly, with good seed dispersion.
- Able to utilize an overabundance of certain resources, such as nutrients, food, water, and (for plants) sunlight, and turn that into rapid growth and population expansion. Lack natural enemies or effective competitors.
- Some are allelopathic (i.e., they release chemicals that inhibit growth of other species).

Invasive plants suppress native plant growth and abundance, degrade wildlife habitat, and lessen the resilience of ecosystems during recovery from disturbances and environmental change. Invasive plant species that pose the greatest threat to Rochester's natural areas are listed in Table 7.

Table 7. Invasive Plant Species of Rochester

Common Name	Scientific Name	Level of Infestation in Rochester Natural Areas[1]	Ecological Effect if Uncontrolled[2]
Common buckthorn	*Rhamnus cathartica*	Major	Major
Non-native honeysuckles	*Lonicera tatarica, L. x bella*, etc.	Moderate	Major
Invasive cattails	*Typha angustifolia*, *T. x glauca*	Major	Major
Reed canary grass	*Phalaris arundinacea*	Major	Major
Siberian elm	*Ulmus pumila*	Moderate	Moderate
Wild Parsnip	*Pastinaca sativa*	Moderate	Moderate
Leafy spurge	*Euphorbia virgata*	Moderate	Moderate
Garlic mustard	*Alliaria petiolata*	Moderate	Moderate
Purple loosestrife	*Lythrum salicaria*	Moderate	Moderate
Spotted knapweed	*Centaurea stoebe*	Low	Moderate
Crown Vetch	*Securigera varia*	Low	Moderate
Common burdock	*Arctium minus*	Low	Moderate
Black locust	*Robinia pseudoacacia*	Low	Moderate

[1] Infestation: Major - common to abundant in most of its preferred habitats; Moderate - present in most of its preferred habitats, but with low cover; Low - occasionally encountered, or large but few populations exist; Minor - rarely encountered, usually in small populations.
[2] Effect: Major - significantly alters vegetation structure and plant diversity, prevents regeneration of native plants; Moderate - noticeably affects vegetation structure and plant diversity, but some native plant regeneration occurs; Low - a noticeable member of the vegetation structure and diversity, but normal ecological processes are operating; Minor - vegetation structure, native plant diversity, and normal ecological processes are largely unaffected

Even some native plant species such as Box elder (*Acer negundo*), Green ash (*Fraxinus pennsylvanica*), Eastern red cedar (*Juniperus virginiana*), and Canada goldenrod (*Solidago canadensis*) can be invasive and aggressive in certain settings.

While buckthorn (and to a lesser degree, invasive honeysuckle) removal has been underway in many of Rochester's parks over the past two decades, these invasive shrubs continue to spread and degrade natural areas, limiting their ability to regenerate the normal number of plant species and degrading the habitat for wildlife. The density of buckthorn is a significant strain on the ability of oaks—one of the City's naturally-dominant trees—to regenerate. Losing the food resources of oaks has the potential to reduce the variety and abundance of species dependent on them: migrating songbirds, certain other birds, many moths and insect species, and the plants that grow in the filtered light beneath oak canopies.

Wild parsnip (*Pastinaca sativa*), a major invasive in several of the City's reservoir sites, is managed by bailing as this species is forming seed. This approach of intermittently removing the plant and seed source shows promise over burning, which appears to promote aggressive regrowth of this invasive plant.

Ongoing control of invasive vegetation is needed to counter new invasions by wind-blown and bird-dispersed seeds, persistent seed banks (i.e., weed seeds in the soil that germinate over several to many years), and adjacent private properties harboring invasive plants.

Normal park and public right-of-way maintenance, such as turf mowing and roadside maintenance, together with ecological restoration and management, may accidentally introduce or spread invasive species. Appendix C provides guidelines developed by the MNDNR to avoid the introduction or spread of invasive species during maintenance and management activities.

Invasive Animals

Invasive animals can also have adverse effects on natural areas. These species migrated into the region or were introduced accidentally or intentionally by human transport and may exist on private properties adjacent to City natural areas. Some invasive animals (e.g., invasive earthworms) cannot be removed or controlled cost-effectively. In these cases, managing the effects of an invasive species, rather than trying to eradicate it, is the best course of action. The main invasive animals that may affect the City's natural areas include:

- Emerald ash borer (EAB). Since this invasive animal is most destructive to trees, it is discussed under Section 2.2.5 below.
- Invasive earthworms. Present in City forests, these non-native, invasive animals, were introduced in part as discarded fishing bait. These earthworms aggressively consume organic matter on the surface of and in the soil, altering soil structure and composition, changing the amount and variety of plants living on the forest floor, and producing unknown effects on the regeneration of the future forest tree canopy. "Jumping worms", a new addition to the list of invasive earthworms in Minnesota, have been documented in Rochester.

2.2.5 Diseases of Native Vegetation

Diseases can also have adverse effects on native vegetation, and in turn, natural areas. Sometimes these occur as natural components of an ecosystem, but as with invasive animals, others have migrated into the region by accident and may live on private land next to City parkland. The main pests and diseases that may affect Rochester's natural areas include:

- **Emerald ash borer (EAB).** This invasive insect is widespread in the City of Rochester and without continued management, it will have a devastating effect on the many ash trees growing throughout the region. The damage to ash trees is done during the beetle's larval stage. The larvae feed on the tissue layer under the bark of ash trees, interrupting the flow of water and nutrients. The tree will eventually die when larval damage is significant.
- **Oak wilt.** This deadly disease of oaks is caused by an invasive fungus (Ceratocystis fagacearum) that is spread by sap beetles, and can then travel between trees through roots that have grown together, called root grafts. Present in the City, this disease warrants special management of oak trees, especially species in the highly susceptible red oak group.

Emerald Ash Borer

The Emerald Ash Borer (EAB) is a small beetle that infests and kills ash trees. EAB was first detected in Minnesota in 2009, and since then it has killed thousands of ash trees. The City of Rochester has an active ash treatment and removal program to protect healthy trees replace those that are low quality.

- **Dutch elm disease.** This usually lethal disease of native elms is caused by an invasive fungus (Ophiostoma novo-ulmi) that can travel between trees through root grafts and is spread by elm bark beetles. This disease is present in the City, warranting special management of native elm trees or the planting of disease-resistant varieties. Elm seedlings and saplings are still abundant, despite the fungus, but generally become infected and die at 15-20 years of age.

2.2.6 Climate Change

The City of Rochester's Office of Energy and Sustainability developed a community-wide Climate Action Plan (CAP) to provide a framework for sustainable projects and actions, which was endorsed by the City Council in 2017. The CAP (City of Rochester 2017) has a goal of reducing greenhouse gas emissions by 40% from 2010 levels by 2030. To achieve these goals, the CAP outlines 35 implementation actions across five focus areas. One of these focus areas, Land Use, includes greenhouse gas reduction strategies such as "finding opportunities to improve land use practices to help the City better manage the impacts of climate change". The CAP does not include specific mitigation strategies for this focus area because direct land use related greenhouse gas emissions were not measured as part of the CAP baseline inventory. However, the Land Use focus area includes Parks and Open Space Planning, which will attempt to "manage and maintain City and County parks and other natural lands in ways that maximize carbon storage and increase resilience to climate change."

Climate change predictions include:

- More days over 90°
- Increased wind
- More intense but less frequent storm events
- Less snow cover with higher average winter temperatures

Preparation for climate change begins with:

- Capturing stormwater where it falls
- Appropriately shading buildings and pavement
- Monitoring changes in forests and wetlands

According to Minnesota's Wildlife Action Plan 2015-2025 (MNDNR 2016), we are already experiencing the early effects of climate change in Minnesota—including higher temperatures, especially in winter and at night, and more severe precipitation events. These changes are likely to influence species and ecosystems by altering fundamental interactions with other species and the physical environment, potentially creating a cascade of impacts (Staudinger, et al. 2012).

The Wildlife Action Plan states with high confidence that climate change in Minnesota will result in a shorter frost season, longer growing season, earlier lake ice-outs, fewer days with snow cover, the persistence of new invasive and pathogenic species, and more intense, widespread, and damaging flash-flooding (MNDNR 2016). The Wildlife Action Plan (citing Galatowitsch et al. 2009) reports the following predicted changes for upland plant communities:

Forests (in the Prairie-Forest Border, including Rochester)

Insect damage, larger blowdown areas, droughts, and fire are expected to interact, resulting in many forests, particularly on marginal soils, becoming savannas. Invasive species, including earthworms, may limit the establishment and growth of native tree seedlings and other understory plants.

Deciduous forests within the prairie-forest border are severely fragmented by agriculture and urban/suburban land use. Should fragmentation increase and further shrink forest patches and increase

edge effects, the ability of some plant and animal species to adapt to climate change may become limited. Reasons for this include greater predation on wildlife, the spread of invasive species, and competition from other native species that prefer forest edges.

Prairies & Grasslands

The small size and isolation of prairies increase their vulnerability to climate change. Already subject to inbreeding and species extirpations due to small populations, scarce pollinators, and random events, mesic and wet prairie communities are most vulnerable. Wet prairies and meadows will become small due to tree and shrub expansion, and uncommon wet-prairie species will likely be lost. In some cases, prescribed burns, conservation grazing focused on resilience, and adding seed of plants that withstand a new climate may be needed to maintain or restore the City's prairies.

Responsible, effective natural resources management should heed these climate change predictions to ensure that natural areas will be functional and resilient in the face of environmental change in the coming decades. Section 4.3.5 addresses climate considerations for natural resources management.

2.3 Summary of Findings

This section summarizes the results of our inventory, assessment, and analysis of the City of Rochester's natural resources and its existing Natural Resources and volunteer program.

2.3.1 City of Rochester Natural Resources Program

- While the City has been engaged in a number of restoration and management projects through the years (mostly burning prairies and removing invasive shrubs), Rochester lacks a formal Natural Resources Program and has no staff dedicated to the regular management of natural areas.
- As of 2022, the City's natural resources budget is $60,000/year through 2027.
- While volunteers conduct much of the restoration and management work within the City's natural areas, their engagement is limited due to insufficient resources for recruitment, organizing, and oversight.
- The City's education and outreach program for natural resources has focused on residential landscaping practices and protection of water resources.

2.3.2 Rochester's Current Ecological Conditions

- The City of Rochester lies within the Driftless Area of Minnesota in a region formerly dominated by prairies and savannas.
- The City's parklands and flood control lands comprise over 5,000 acres (including open water), with the vast majority of that parkland consisting of natural areas.
- Many of the City's natural areas lie along the South Fork of the Zumbro River, its tributaries, or are associated with reservoirs or other flood control projects. Protection of the City's water resources and aquatic habitats will often be most effective when viewing challenges and solutions at a watershed scale.
- The native forests, savannas, and prairies that once dominated the Rochester region are now rare, and most are severely degraded.

- Of the 1,429 acres of natural areas assessed within the City, the most abundant plant communities were Mesic Forests (308 acres) and Non-native Grasslands (275 acres).
- Invasive plants are one of the greatest threats to the City's natural areas because they displace native species, which leads to lower diversity of native plants and wildlife, less pollinator nectar and pollen, lower fruit and seed production, reduction in native tree regeneration in forests, and soil erosion on slopes.
- Lack of regular natural disturbances (in particular fire) for many decades has significantly reduced the area of former prairie and savanna where those habitats had escaped destruction.
- The most abundant wildlife species in the City appear to be generalists (i.e., adapted to human-altered landscapes), based on field assessment and consultation with City staff.
- Federally-listed and state-listed animals (including multiple records of the federally-endangered Rusty patched bumble bee) have been recorded in the City.
- Twenty-four potential migratory bird species of concern were identified in the Rochester area, and the City has many passionate birders, making bird conservation an important consideration in this NAMP.
- While limited in the more dense and urban areas of Rochester, opportunities exist to increase the size, quality, and connectivity between natural areas through ecological restoration and management.
- Historical land uses (e.g., grading/filling/dumping, cropping, grazing) have resulted in habitat loss, fragmentation, and edge effects. Other ecological stressors include disrupted natural disturbance regimes (e.g., fire), invasive species, diseases of native species, climate change, and other factors. Together these stressors have compromised all of the City's natural areas, necessitating strategic intervention and long-term management if these natural areas and their ecosystem services are to be restored and sustained.

3. COMMUNITY & PUBLIC ENGAGEMENT PLAN (CPEP)

3.1 CPEP Methods

The consultant team, in coordination with City of Rochester staff, developed and implemented a Community & Public Engagement Plan (CPEP). This plan was implemented during 2022, over the course of the Rochester NAMP project. Diversity, equity and inclusion were important considerations for designing and implementing public engagement. The team worked with the City's Director of Communications and with the Director of Diversity, Equity and Inclusion on the design of the engagement plan and in identifying locations for events and methods for disseminating information to the community.

The project team used five main methods for connecting with community groups, stakeholders, and the public.

Online Promotions. The project team sent out promotions via email, social media, and through press releases to local news outlets to promote upcoming public events and the online survey.

Public Meetings. Two public meetings were held during the project process. Public Meeting #1, held early in the project, introduced attendees to the City staff and consultant team and summarized project goals, scope, the public engagement process, conservation concepts and planning approach, analysis completed to date, and upcoming analysis to be completed. In addition, the team facilitated discussion and gathered feedback on community needs, concerns, and aspirations for the Rochester NAMP. Public Meeting #2, held during development of the draft plan, provided attendees with an introduction to the project team and summarized the project scope, public engagement findings, field assessment findings, potential natural area improvements, an outline of the NAMP document. In addition, City staff and consultants received feedback, facilitated discussion, and answered questions from community members.

Pop-Ups/Intercepts. Two pop-up/intercept events were held in June 2022 to promote the NAMP project and gather feedback from the community. These pop-ups were held at the Rochester Recreation Center and Quarry Hill Nature Center.

Survey (PolCo). A PolCo survey was created to gather more specific feedback from the Rochester community about how they currently use natural areas and what they want to see from natural areas in the future.

Stakeholder Committee. A Stakeholder Committee was developed with representatives from key community organizations and interest groups, including:

- Olmsted County Parks
- Olmsted County Soil & Water Conservation District
- Rochester Diversity Council
- Community Resource Mobilization Coalition
- UMN Extension
- RCTC Environmental Science Program
- Minnesota Master Naturalist Program
- Audubon Society
- The Prairie Enthusiasts

- SE MN Center for Independent Living
- Community at-large

A Stakeholder Meeting was convened in July 2022, where seven City staff, four consultants, and 14 attending stakeholders introduced themselves and shared their aspirations for the NAMP. Stakeholders then learned about the project, process, and preliminary findings. Questions were posed and natural areas topics were discussed, including the greatest needs/issues/concerns/challenges, biggest opportunities, if anything was missing from our approach, and if there were any other issues the NAMP team should be aware of as we proceeded with the project. Suggestions from the stakeholders included consideration of Rochester's future climate when planning restoration and management activities, additional engagement of community members in volunteer activities in natural areas, recognition of the need for more volunteer organizing and support, and acknowledgement of the City's natural areas as indigenous lands — and celebrating them as such.

3.2 CPEP Findings

Comments were gathered through the PolCo survey, public meetings, and the pop-ups. 179 people completed the PolCo survey, answering 25 questions and providing more than 200 individual comments. Another 250 comments were gathered from the 75 people that participated in the pop-ups and the 37 attendees that participated in the public meetings.

Key themes from the survey and other public input include:

- The most popular City-owned natural areas include: Quarry Hill, Silver Lake, Cascade Lake, Plummer House, Essex, Bear Creek, Zumbro South, and Indian Heights.
- The most popular activities at City-owned natural areas include: walking/hiking, running, relaxing in nature, helping with invasive species management, and outdoor activities with children.
- Some of the greatest concerns regarding natural areas are: protecting natural areas from development, protecting pollinators, providing wildlife habitat, loss of native plant diversity, planning for climate resiliency, and invasive plant species.
- There is a desire for more ecological restoration, nature education, and community events and festivals.
- Respondents feel that natural areas would be visited more frequently with enhanced educational programing on natural areas, increased trail connections, and improved land management.
- The majority of commenters asked that the city consider investing more effort in habitat restoration and family-friendly programming or other natural area activities.

4. ECOLOGICAL RESTORATION, MANAGEMENT & CONSERVATION

4.1 Conservation Planning

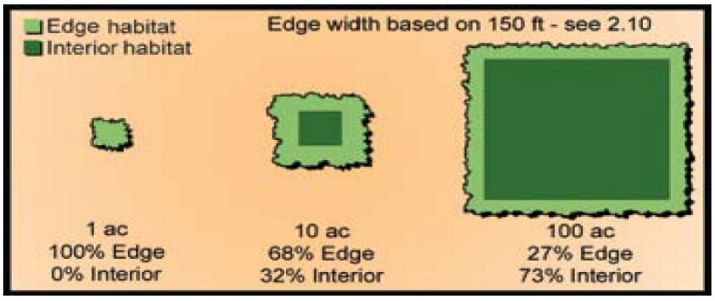
Conservation planning is an important tool for conserving biodiversity and ecosystem services in a given geographic area. Based on principles of landscape ecology, conservation biology, and population biology, existing land cover, vegetation, water features, and other environmental factors are assessed with the intent of identifying, protecting, and connecting natural habitats for the benefit of healthy, diverse, and sustainable communities of native plants and animals. Conservation planning concepts and their application to the City of Rochester are discussed in the following sections.

Natural Area Core Habitats, Transitions & Connections

As mentioned in Section 2.1.5, generalist wildlife species (crows, starlings, raccoons, etc.) are animals that are common and can tolerate and even thrive in altered and developed lands and waters where habitat fragmentation and degradation have occurred. These species are typically not a focus of conservation since their populations are usually stable or increasing. In contrast, specialist wildlife species are often rare or have declining populations due to special habitat needs. Many specialist wildlife species require large, diverse and high-quality habitat blocks to sustain their numbers. These areas are called *natural area core habitats*. Protecting and managing core habitats in the City will improve the likelihood that uncommon and declining animal species will persist, including Species of Greatest Conservation Need (discussed in Section 2.1.5).

The effects of natural areas being converted to developed lands (e.g., buildings, parking lots, roads), with resulting habitat loss, are well documented. Less obvious are the effects of increasing the amount of habitat *edge*. Smaller, narrower habitats have more edge than larger, rounder ones (Figure 12).

Figure 12. Natural Area Core/Interior Habitats and Edge Habitats

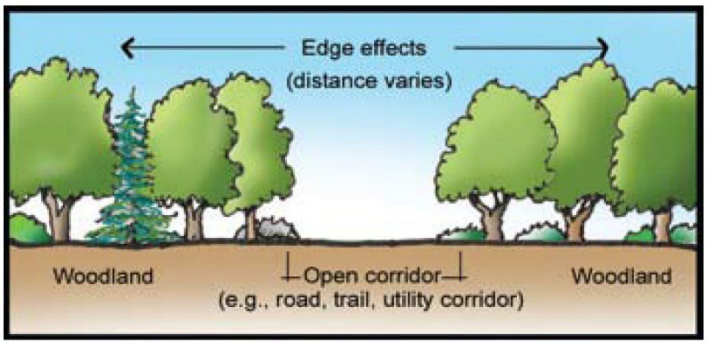


Source: Bentrup (2008)

More *edge* and less *interior* habitat pose significant threats to wildlife that need core habitat. A variety of scientific papers and other sources have documented how edge effects penetrate into adjacent natural habitat. For instance, birds and other wildlife can be flushed by people walking on trails up to a distance of 150 feet away. Mid-sized predators (raccoon and feral house cats) will travel several hundred feet into forests and grasslands to prey on birds, small mammals and other wildlife. Invasive plants move from edges where they grow into interior areas. Traffic noise, warm and dry air, dust from gravel roads,

pesticide drift, and many other damaging influences enter wildlife habitat from these edges (Figure 13). Enlarging existing habitats and eliminating encroachments helps reduce edge effects, as does planting designs and management. Even cultural landscapes along the edges of core habitats can be designed and maintained as natural vegetative screens or buffers. These screens and buffers, ideally consisting of native vegetation, create *natural area transitions*, which further reduce edge effects and improve core habitats.

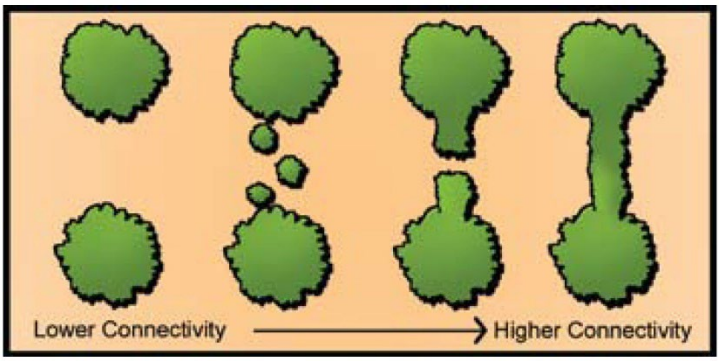
Figure 13. Edge Effects from Development and Disturbance



Source: Bentrup (2008)

Connecting core habitats (Figure 14) allows wildlife to retreat to different, more favorable areas, without being exposed to the hazards of travel. Generally speaking, only the largest natural areas will support the City's most sensitive vertebrate species. Some of these species require corridors of several hundred to thousands of feet in width to move among large habitat cores. It is more practical in developed and farmed landscapes to consider core habitats of 200 to 2,000 acres, with 200-foot to 2,000-foot wide corridors connecting large cores. Larger habitat areas and connections also benefit many types of smaller animals. On the other hand, small habitat areas can sustain many invertebrate species which have small home ranges. Native vegetation can also benefit from connectivity as seed dispersal can be facilitated; however, this becomes a problem when invasive plants take advantage of these connections. Due to these variables, greenways (an important method of increasing connectivity) should be designed and managed thoughtfully to maximize ecological benefits and minimize adverse effects.

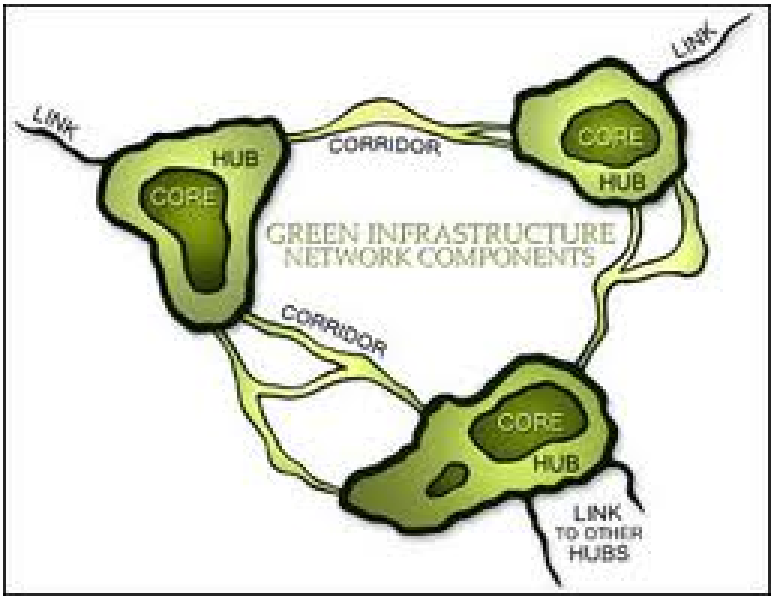
Figure 14. Gradients of Ecological Connectivity



Source: Bentrup (2008)

The concepts of core habitats, edge effects, transitions, and connectivity can be used to help conserve—and even improve—the City's full spectrum of biodiversity. Protecting, connecting and restoring large areas of natural vegetation to minimize fragmentation and edge effects (i.e., creating "green infrastructure", Figure 15) will address the habitat needs of many native plant and animal species, including sensitive and uncommon species. During development of the City's Comprehensive Plan (City of Rochester 2018), one of the priorities identified was to utilize natural areas as green corridors to enhance connections within the City's park system and to connect to natural areas outside of Rochester's boundaries. These concepts are applied to Rochester in greater detail in Section 5.1.

Figure 15. Core Habitats, Transitional Buffers & Corridors on the Landscape



Source: Chicago Wilderness Green Infrastructure Vision (2012)

4.2 Ecosystem Approach to Restoration & Management

Successful ecological restoration and management requires the correct execution of a series of tasks, each of which should be customized to the site's unique environmental conditions to meet project goals. This NAMP provides general management recommendations for different types of native plant communities; however site-specific restoration and management prescriptions require an understanding of site-specific goals, resources, budget, and other factors.

For restoration and management planning, RES recommends an "ecosystem approach". In brief, this approach entails first using less expensive, more natural methods to restore natural processes and appropriate vegetation structure and composition to an ecosystem. This often consists of replacing dominant invasive vegetation with native species that are dominant in the target plant community. Prescribed fire and physical removal of undesirable vegetation typically follow. This is then followed by other tasks, such as targeted use of herbicides and other interventions to set the plant community on a trajectory toward greater ecological health and resilience.

An Ecosystem Approach Uses Nature's Own Processes to Restore Ecosystem Health

In an ecosystem approach, managers use their understanding of past and current ecosystem processes, structure and composition to design and implement restoration and management tasks that are lower cost and more consistent with the ecosystem's own internal processes of repair and rejuvenation. When combined with adaptive management and monitoring, an ecosystem approach can be more effective in the long term than conventional approaches to ecological restoration and management.

The variability of plant communities, including species composition, structure, land use history, and soils, and the variety of restoration and management goals, present a complex challenge for natural resource managers. The following framework can help managers develop efficient, effective, and appropriate restoration and management prescriptions for natural areas.

1. **Understand the starting ecosystem.** Rarely intact, an inherited ecosystem is more commonly a degraded natural community, a cultural landscape of cropland, pasture, or turf, or a novel ecosystem—that is, an apparently stable plant community, such as an old field or a forest dominated by non-native trees, that originated from cultural practices.
    a. Gather baseline data and complete a natural resources inventory and assessment in the field, including an early restoration concept based on observed conditions in an ecosystem management framework.
2. **Define conservation and restoration goals** for the land or plant community, including specifying target plant communities. Goals should lead to self-perpetuation, limited human management of ecosystems, and long-term resilience despite environmental change and unexpected stressors.
    b. Consider the type and level of **ecosystem services** being restored in light of expected land use, species and habitats targeted for protection, and other desired outcomes.
    c. Consider the **achievable ecological quality.** Is it realistic to expect an A-quality plant community, or is BC-quality acceptable?

d. Consider **short-term and long-term costs.** For instance, though generally cheaper than most management techniques, is it cost-effective (and appropriate) to manage a particular site with fire considering its natural disturbance regime and constraints?
e. Consider **schedule and milestones.** Define the time over which the goals will be realized and define steps along the way that represent significant interim accomplishments.

3. **Develop and implement restoration and management prescriptions, including the appropriate tasks and sequence,** to set the ecosystems and target plant communities on a trajectory towards ecological health, integrity, and resilience.
    a. **Ensure adequate resources** to implement the restoration work and perpetual management thereafter.
    b. **Restore processes** that can be used cheaply and extensively to restore vegetation structures, such as prescribed fire, flood regimes, canopy closure, other processes (grazing, burrowing), the addition of legacy materials, etc.
    c. **Restore structure** by using or mimicking natural processes, physical removals (e.g., brushing) and/or native plantings, biocontrol agents, etc. Use management mowing, spot herbicide application sparingly, and broadcast herbicide applications as a last resort, with the goal of restoring dominance by native plants suited to local climate, soil, and setting.
    d. **Introduce species diversity** as necessary to support restoration of native dominance in vegetation layers, enhance ecological functions such as pollinator community support, and resilience against climate change that favors southern species and disfavors northern ones. Native seeding and live-planting are typically required if native seed banks and root reserves are exhausted.
    e. **Continue short-term management** (e.g., management mow, spot spray)
4. **Practice adaptive management** (i.e., implement, monitor, report, learn, and adjust as warranted).
5. **Accept long time frames,** requiring patience and persistence to achieve long-term goals.

4.3 Restoration & Management Plans

This NAMP summarizes the City's existing natural resources at a high level, lays out a vision for natural resource management, and facilitates strategic, system-wide planning and program administration. The City has been restoring and managing select natural areas over recent decades; however, this work has sometimes been conducted without consideration of systemwide prioritization, landscape setting, and the resources necessary for long-term management. To fully advance the work laid out in this NAMP, more detailed, site-specific plans should be developed, often referred to Natural Resources Management Plans, or NRMPs. These plans provide refinement of natural resources data and more detailed, site-specific recommendations and prioritization of specific restoration projects within the site. Each year, the City should consider and budget for natural resource planning – especially in its parks in advance of scheduled master planning efforts. NRMPs can vary in terms of content and detail, but Appendix D presents a general outline of such a plan.

4.3.1 Target Native Plant Communities

Proposed native plant communities are those largely self-sustaining ecological combinations of species that are expected to develop at a site following the implementation of ecological restoration and management activities. Given the current degraded condition of most of the City's natural areas, we recommend that, over time, all native or semi-natural plant communities be enhanced to establish more ecologically healthy conditions. In addition, underutilized turf areas in parklands should undergo conversion to lower maintenance native plant communities, such as prairie or savanna.

For example, existing Mesic Forest will remain as such, but would be enhanced by removal of invasive species, selective thinning of aggressive native trees and shrubs, and limited plantings. This would diversify the canopy, understory, and ground layer vegetation and improve wildlife habitat, including habitat for pollinators. Complete replacement of vegetation could occur where natural resource conservation calls for turf grass to be replaced by native prairie or savanna grasses and wildflowers under trees.

Native plant species lists appropriate for restoring or enhancing the City's specific plant community types can be derived from MNDNR's *Native Plant Communities of Minnesota – The Eastern Broadleaf Forest Province* (MNDNR 2005) and native seed mixes are available from the Minnesota Board of Water and Soil Resources (BWSR).

Converting Turf to Prairie Makes Sense for Good Reason

Converting little-used turf areas to native prairie is one technique to elevate ecosystem services. Compared with regular mowing of lawns, maintenance of prairie represents a significant reduction in time, effort, and cost. At the same time, prairie generates huge increases in the land's capacity to absorb greenhouse gases, infiltrate groundwater, and support wildlife and pollinators compared to turf grass.

Whenever possible, native plant materials (seed and live plants) used in ecological restorations should have a genetic source-origin from within 200 miles of the project area, preferably not far to the north (due to ongoing and projected climate change patterns). In addition, only native, wild-type species should be used, not cultivars and horticultural varieties. While local ecotype seeds and plants are highly recommended, some species are not always available in today's market. Substitutions for specified seed and plant materials may be necessary if materials are not available or prices for some species too high. Every effort should be made to substitute unavailable species with those that match the ecological purpose of unavailable species. Appendix E of this plan addresses the restoration and management tasks needed to establish healthier native plant communities in the City's natural areas.

4.3.2 Wildlife Management

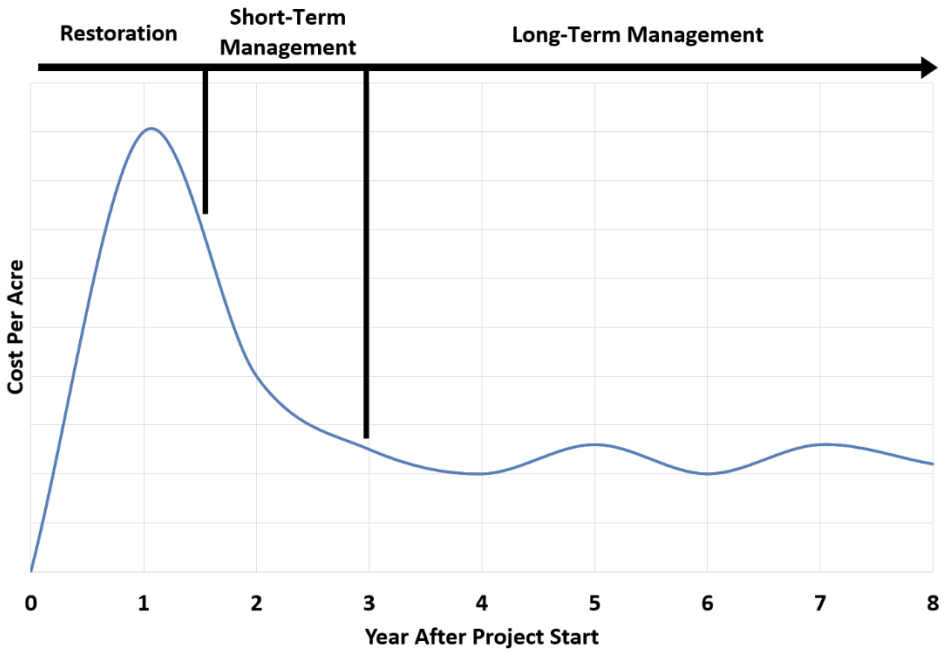
Management of problematic wildlife species is an important component of natural areas management. These species were either absent or much less abundant during pre-European settlement times, or they interact with natural areas in ways inconsistent with healthy, sustainable native communities. Several of these species interfere with early restoration projects, such as browsing on or otherwise damaging newly planted native vegetation. The primary wildlife species of concern in Rochester are addressed in Section 2.1.5, above. Those sections also provide the City's current management practices to control problematic wildlife.

4.3.3 Restoration & Management Phases & Tasks

Initial Restoration and Short-Term Management Phase

Ecological restoration has short- and long-term management phases. The initial restoration and short-term management phase is typically labor-intensive and costly compared to long-term management. The initial effort usually lasts about three years and requires a significant investment to prepare for and begin establishing the proposed native plant communities. Tasks often include: re-introducing natural disturbances (e.g., fire); re-establishing natural hydrological cycles in aquatic systems; using biocontrol, physical methods, and chemicals (e.g., herbicides) to control invasive plant species; and seeding and planting native vegetation. Appendix E describes restoration and management tasks in greater detail. The length of time before transitioning to long-term management depends on the site's initial quality, weather conditions, how the site responds to restoration activities, the size of the site, and factors unique to the site. Figure 16 shows the relatively high cost of initial restoration work, the somewhat reduced cost during establishment management, and the lowest annual cost in long-term management.

Figure 16. Generalized Cost of Restoration and Management Over Time



It is usual to refer to planting a new prairie or wetland as "restoration," whereas "enhancement" is used to describe activities where natural conditions already exist and less effort is needed to improve the natural resources. Enhancement, for instance, might entail removing invasive shrubs and overseeding native woodland plants in an existing native woodland or forest.

Restoration sequence in a woodland: left: degraded, center: restoration, right: short-term management

Long-Term Management Phase

After the restoration and short-term management phase, the process shifts to a lower-cost, but equally important, long-term management phase. Scheduling a monitoring visit and management activities every year protects the restoration investment and ensures that the plant community and ecosystems continue on a trajectory towards greater ecological health.

Long-term management tasks often are to:

- Maintain disturbances (e.g., fire) that perpetuate a diverse, resilient plant community
- Selectively remove or treat invasive plants (e.g., precise spot-application of herbicide)
- Re-seed disturbed or poorly developing areas
- Re-plant woody plants that have died.

Most North American ecosystems need some type of disturbance that removes dead plant material, stimulates blooming of plant species, and opens up microhabitats for plants and animals to perpetuate themselves. Controlled or prescribed burns are a common tool used that mimic natural fire regimes in prairies, savannas, wetlands, and some forests and woodlands. Harvesting hay from prairies, which mimics fire and, to a lesser extent, grazing, can also be effective. Long-term management task descriptions are included in Appendix E.

The Importance of Stewardship

While initial restoration and short-term management typically require more effort and higher cost per acre, long term stewardship will protect this investment in perpetuity with less effort and at lower cost per acre.

4.3.4 Management Units

At an individual site scale, ecological restoration and management is often conducted in a given area or "management unit." Small sites may be treated as a single management unit, but larger sites are often subdivided to facilitate implementation of restoration/management tasks in areas with similar management needs and proposed uses. Management units are also used to phase projects over time, often necessitated by annual budgets, or to provide refuges for invertebrates during and after prescribed fires. Management units often consist of a single plant community type (like forest), but they may contain a variety of plant communities. Management unit boundaries are typically delineated along existing roads/trails, plant community edges, watercourses, or topographic breaks. Management units have not been delineated in this NAMP, but many of the City's smaller natural areas could be managed easily as a single unit. Defining management units in larger parks should be done after more detailed site-specific plans (e.g., NRMPs) are completed.

Restoration and short-term management tasks generally include site preparation, brushing and thinning (in wooded communities), weed control, native seeding and planting, and ecological monitoring and reporting. Table 8 illustrates a schedule for a typical restoration project that requires significant site preparation followed by initial management. Laying out restoration tasks for an individual management unit requires a detailed scope, often with a different schedule. The schedule below does not address long-term management. Management briefs are a useful tool to better define and guide implementation of restoration and management tasks within a management unit.

Table 8. Generalized Restoration & Short-Term Mgmt. Schedule for a Management Unit

Task	Description/Subtask	Year 1				Year 2				Year 3			
		Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Site Preparation	Re-establish historical hydrology and/or disturbance regimes (e.g., fire); broadcast herbicide, till, spot herbicide and/or mow	■	■	■									
Invasive Tree & Shrub Removal/Thinning	Cut & stump treat invasive woody plants				■								
	Remove or selectively thin aggressive native woody plants				■								
Invasive Herbaceous Vegetation/Weed Control	Prescribed dormant-season burn; site preparation burn can be late Summer, Fall or Spring		■	■		■							
	Spot herbicide and/or spot mow					■	■			■	■		
	Foliar herbicide the invasive woody re-growth							■				■	
Seeding & Planting After Weed Control	Install native seed								■	■			
	Install live woody plants (dormant)							■		■			
	Install live herbaceous plants									■			
Ecological Monitoring & Reporting	Assess/document site; prepare year-end summary report	■	■	■	■	■	■	■	■	■	■	■	■

4.3.5 Climate Change Resilience

Projected changes in climate (see Section 2.2.6) are forcing natural resource managers to adjust restoration and management prescriptions. Although the broad patterns of climate change can be predicted—more rainfall in larger storms, warmer nighttime temperatures, reduced snow cover—coping strategies must be broad. Changing the list of trees to plant in response to shifting plant hardiness zones is obvious. The City of Rochester Forestry Division follows University of Minnesota Extension guidance regarding tree planting, using species native to Minnesota as well as species from zones further south to evaluate their performance as the climate warms over time. Less obvious and more challenging are

managing aquatic and wetland ecosystems for changes in rainfall, anticipating future diseases, pests, and invasive species arriving with warmer temperatures, and even the timing of prescribed burns and herbicide applications.

As the specifics of climate change come into focus, the City can adapt its ecosystem approach. The National Fish, Wildlife and Plants Climate Adaptation Strategy (National Fish, Wildlife and Plants Climate Adaptation Partnership 2012) offers general guidance on how to insulate a region, municipality, or natural area against negative effects of climate change.

- Conserve habitats for healthy fish, wildlife, and plant populations and ecosystem functions.
- Manage species and habitats to protect ecosystem processes and functions and put in place sustainable cultural, subsistence, recreational, and commercial uses.
- Increase capacity in staffing and budgets for effective management and adaptation to change.
- Support adaptive management by integrating monitoring observations and decision support tools across departments and organizations.
- Increase and share knowledge about impacts and responses of fish, wildlife, and plants.
- Increase awareness of and motivate actions to safeguard fish, wildlife, and plants.
- Reduce non-climate stressors, such as invasive species, to help fish, wildlife, plants and ecosystems adapt.

The City already has implemented some of these strategies by controlling invasive species and restoring natural areas on City property. The following recommendations should be considered as the City continues to expand its Natural Resources Program:

- With snowless winters and often dry conditions, it may be possible to conduct dormant season burns in winter months rather than in fall and early spring. This could expand the burning window, which has shrunk due to frequent red flag warnings (no burning) issued by the MNDNR during historically preferred burn windows.
- In the next two to three decades, before the significant climate changes predicted by mid-century take hold, remove the threat posed by the most damaging invasive species—buckthorn, honeysuckle, Smooth brome grass, Reed canary grass, invasive cattails, Giant reed, and others.
- For seed and live plants, use genetic material from farther south to pre-adapt the City's ecosystems to a new climate. Countering this is research that suggests local genetic material has the potential to accommodate predicted climate change. This strategy requires more research, which is ongoing in the state and elsewhere.
- Predict the trajectory of the City's ecosystems based on evidence from past and current ecosystem structure, process, and known pathways of plant succession. Use this knowledge to revise restoration and management traditional prescriptions.

5 ADVANCING ROCHESTER'S NATURAL AREAS PROGRAM

5.1 Regional/City-wide Conservation Opportunities

Ecological systems and many wildlife populations operate at large spatial scales. Therefore, it is important to take a step back and look at the big picture when assessing conservation opportunities. Based on RES' review of existing ecological data, our field assessments of the City's priority natural areas in 2022, and consideration of conservation planning and landscape ecology principles, we developed a Conservation Concept for the City of Rochester (Figure 17).

Data used to develop the Conservation Concept included:

- Natural or Semi-natural Land Covers (from MLCCS land cover mapping)
- Priority Natural Areas (identified by City of Rochester)
- Higher Quality Natural Areas within City's Priority Natural Areas (based on RES' field assessments)
- Mapped native plant communities (MNDNR data)
- Mapped Sites of Biodiversity Significance (MNDNR data)
- Fens
- National Wetlands Inventory (NWI)
- Decorah Edge
- 100-Yr Floodplain
- Critical Natural Areas (developed by others), including public and private open space, parklands, flood control, and stormwater management areas
- Streams

Each data layer is represented graphically as a transparent green layer; the more overlapping layers create darker green patches (indicating more natural features present in such locations). Considering these and related data, conceptual greenways (yellow corridors) were developed, using variable width lines (generally reflective of the level of constriction in that section of greenway). Many of the areas shown in green have some level of protection due to their classification (e.g., wetlands, MNDNR Public Waters) or land ownership (City or other public entity); however, many green areas exist on private lands and have no protection from disturbance or alteration. Figure 18 uses dark gray masking to illustrate natural features that may have some level of protection; therefore, any green (and to a lesser degree, yellow) areas that are not masked by dark gray may present priority opportunities for conservation (either through acquisition, conservation easement, ecological buffering, cost-share, or other protection/partnership with landowners).

A Good Conservation Concept is the Foundation for Ecosystem Health

Just managing the vegetation inside a natural area won't stop the past harm to ecosystems and biodiversity. To do that, natural areas need to be part of a larger Conservation Concept. It takes many years of discussion, policy change, and steady work to implement this tool, but incrementally it does these things:

- Builds a system of large core habitats, with transitional areas that buffer edge effects from adjacent incompatible land uses, which damage the interior conditions of natural areas.
- Creates meaningful natural connections among core habitats so that plants and animals can move between cores and survive inbreeding and catastrophic disturbances to any one core.

Figure 17. Conservation Concept for City of Rochester

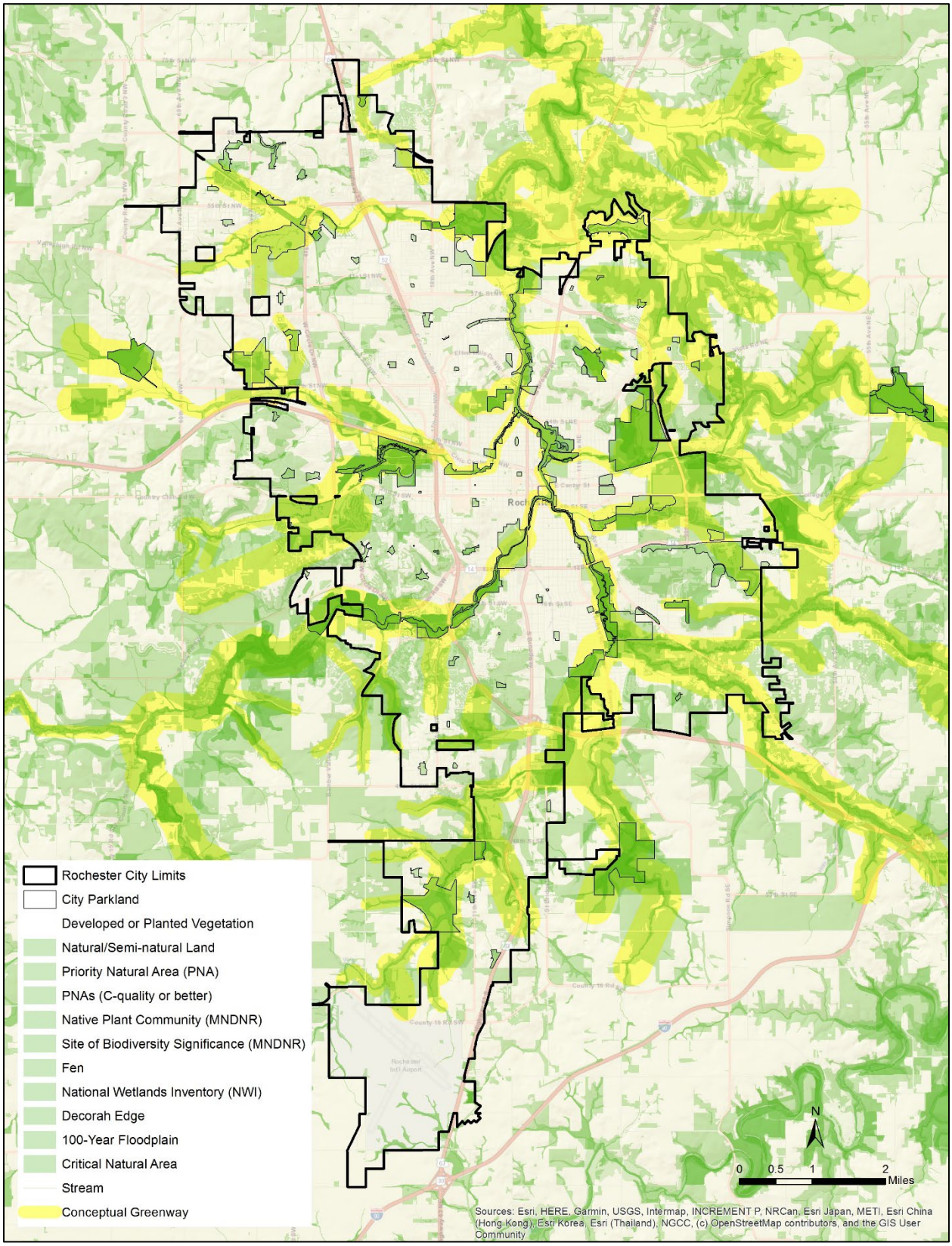
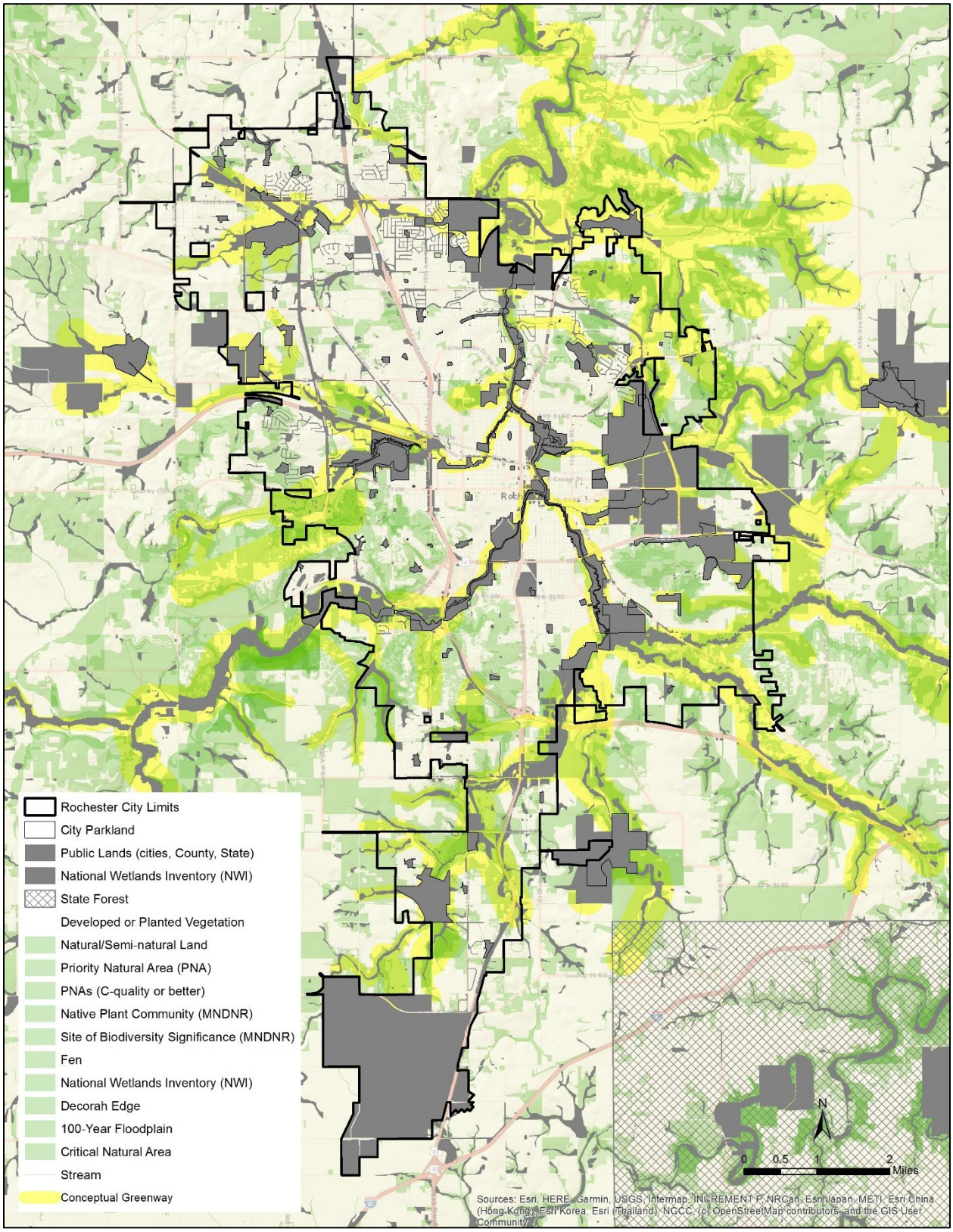


Figure 18. Potential Protection of Areas Identified in Conservation Concept



Since many opportunities exist for the City to expand, enhance, buffer, and connect its natural areas, these figures help to identify where such investments might be most effective. Working with private landowners and/or acquiring land or conservation easements can facilitate removal and management of invasive vegetation, expansion of smaller natural areas into core habitats, and/or widening of narrow greenways for improved habitat connectivity and resilience.

5.2 City Priority Natural Areas & Select Reservoir Sites

The City of Rochester contains over 100 City-owned and managed parks, as well as flood control lands along waterways and six reservoirs located outside the City limits. Many of these areas (totaling over 5,000 acres) consist of, or are dominated by, recreational fields and other cultural land covers (e.g., turf). Through review of existing data and discussions with the public, City staff, and stakeholders, 15 natural areas within the City were identified as Priority Natural Areas (PNAs), providing the greatest opportunities for ecological restoration and management. In addition, three reservoir sites (located outside the City limits) were identified as warranting attention in this NAMP. While all of the City's natural resources are considered in this NAMP, these 18 sites received focused attention, including field-assessment by RES ecologists. The PNAs and select reservoir sites are shown in Figure 19 and summarized in Table 9.

Figure 19. Rochester's Priority Natural Areas & Select Reservoir Sites

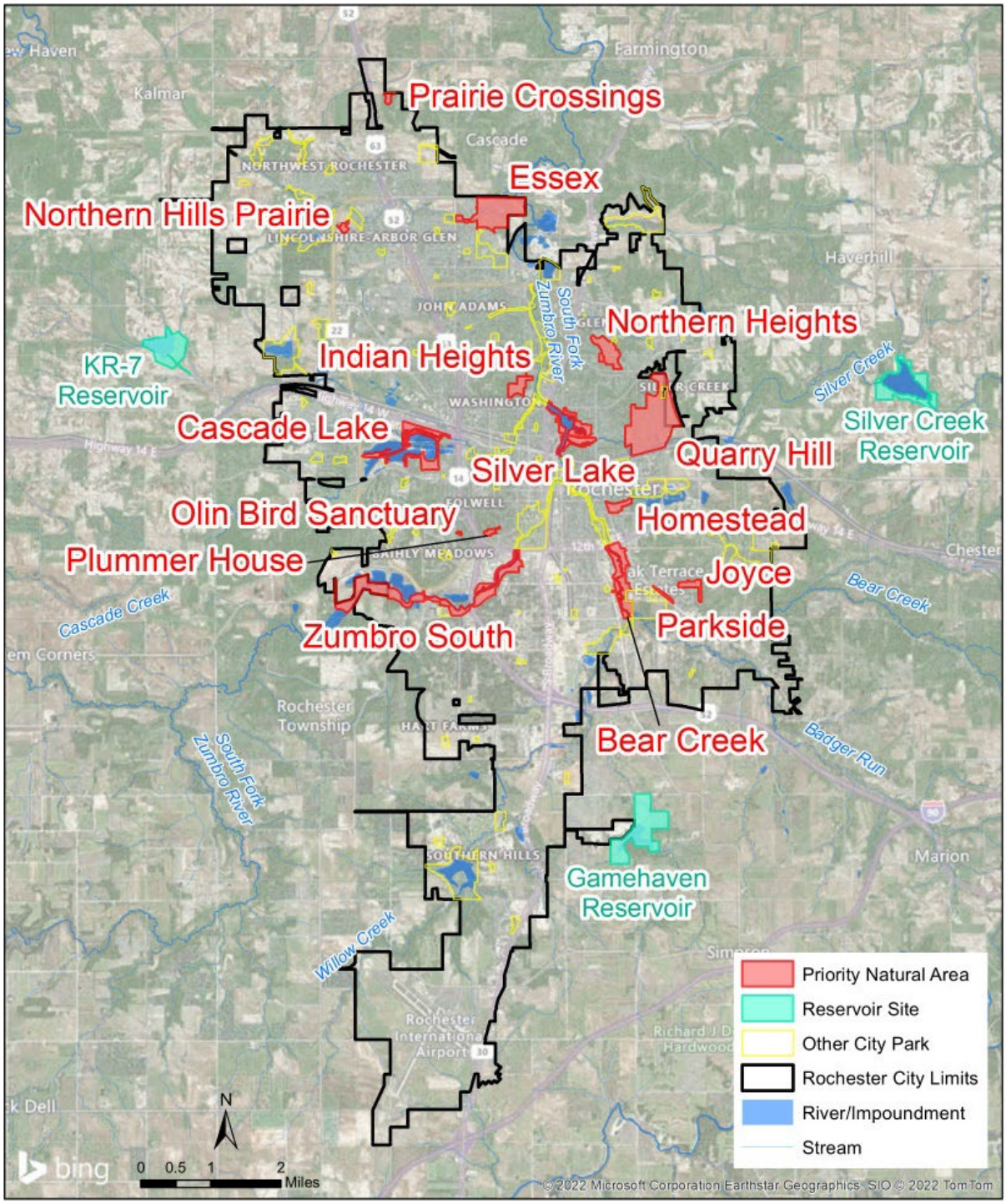


Table 9. Rochester's Priority Natural Areas & Select Reservoir Sites

Site Name	Quadrant of City	Total Acres of Site	Natural Acres (including open water)	Percent of Site in Natural Vegetation (including open water)
Bear Creek Park	SE	110.0	85.5	78%
Cascade Lake Park	NW	99.4	55.8	56%
Essex Park	NW	172.5	141.6	82%
Gamehaven Reservoir	SE	230.3	228.5	99%
Homestead Park	SE	24.4	12.7	52%
Indian Heights Park	NW	36.6	36.6	100%
Joyce Park	SE	23.6	14.3	61%
KR-7 Reservoir	NW	132.9	128.9	97%
Northern Heights Park	NE	66.1	59.8	90%
Northern Hills Prairie	NW	8.9	8.6	97%
Olin Bird Sanctuary	SW	1.3	1.3	98%
Parkside Park	SE	6.8	0.0	0%
Plummer House Park	SW	8.6	6.0	70%
Prairie Crossing Park	NW	8.5	8.5	100%
Quarry Hill Park	NE	318.2	292.5	92%
Silver Creek Reservoir	NE	113.4	113.1	100%
Silver Lake Park	NE	78.0	16.2	21%
Zumbro South Park	SW	229.3	218.5	95%
Totals		***1668.8***	***1428.4***	***NA***

As with most of the region's natural areas, reintroduction of natural disturbance regimes and removal and control of invasive vegetation are the greatest conservation needs at these PNAs. Suppression of ground fires, hydrologic alteration, and loss of large grazing animals such as bison have led to shifts in ecosystem structure, composition, and function. Dominance by invasive plants depresses biodiversity and interrupts the normal regenerative processes of native ecosystems, such as tree germination and growth in forests. A well-designed ecosystem management program, using proven restoration and management practices, can address these issues, reverse the degradation that has occurred, and bring these natural areas to a higher level of ecological function and resilience in the face of environmental change. Each PNA is described below.

Bear Creek Park

Overview. Bear Creek Park consists of approximately 110 acres in the southeast quadrant of the City (Figure 19). The park contains several amenities (e.g., ballfield, playground, ice rink), and the trail system is heavily used by the community. Of the parkland, approximately 86 acres support natural and semi-natural plant communities and open water habitats, most of which are altered or of poor ecological quality (Figure 20). The following table and figure (histogram) further characterize the site's natural/semi-natural vegetation and open water habitats.

Figure 20. Bear Creek Park Land Cover

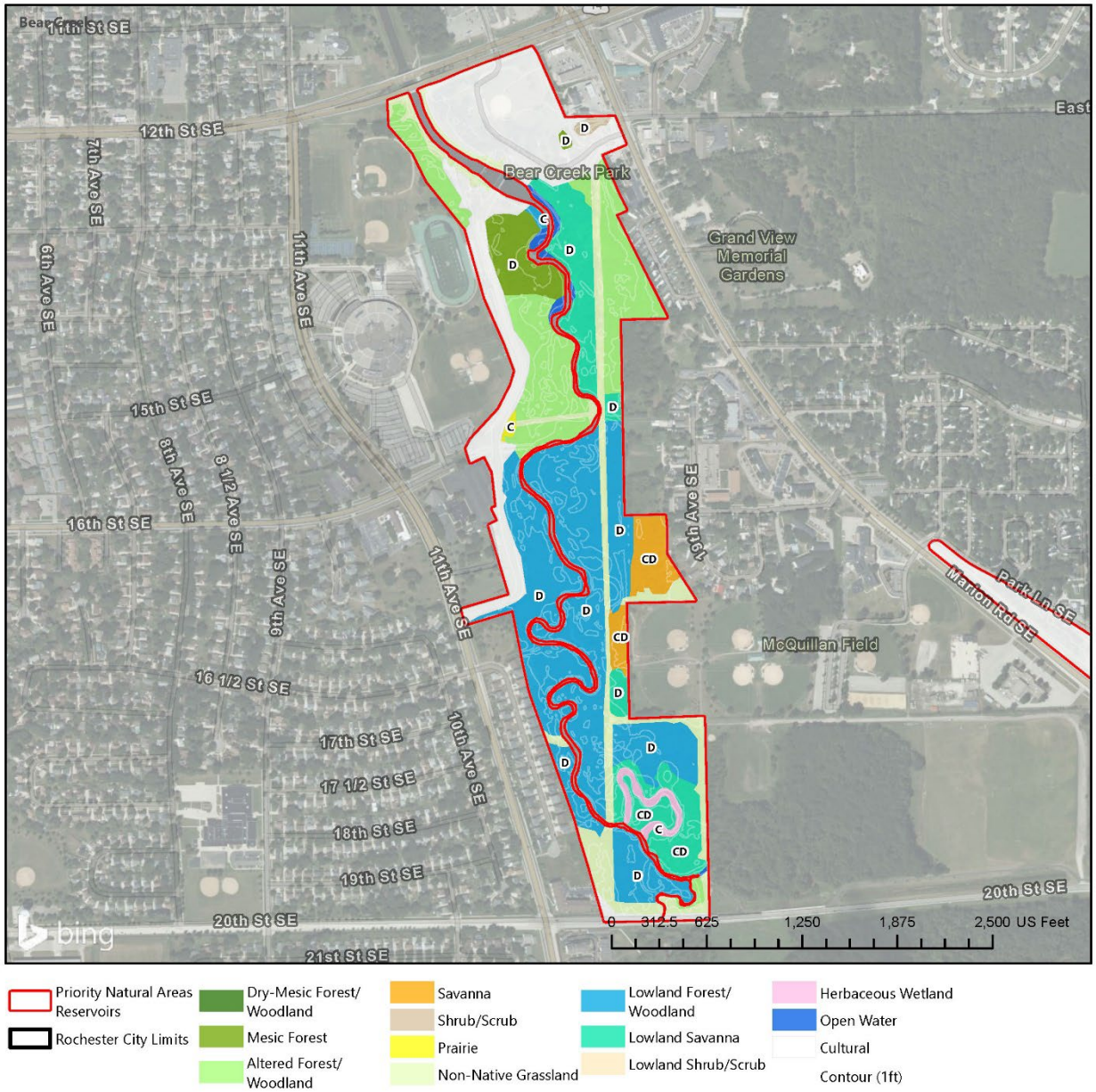


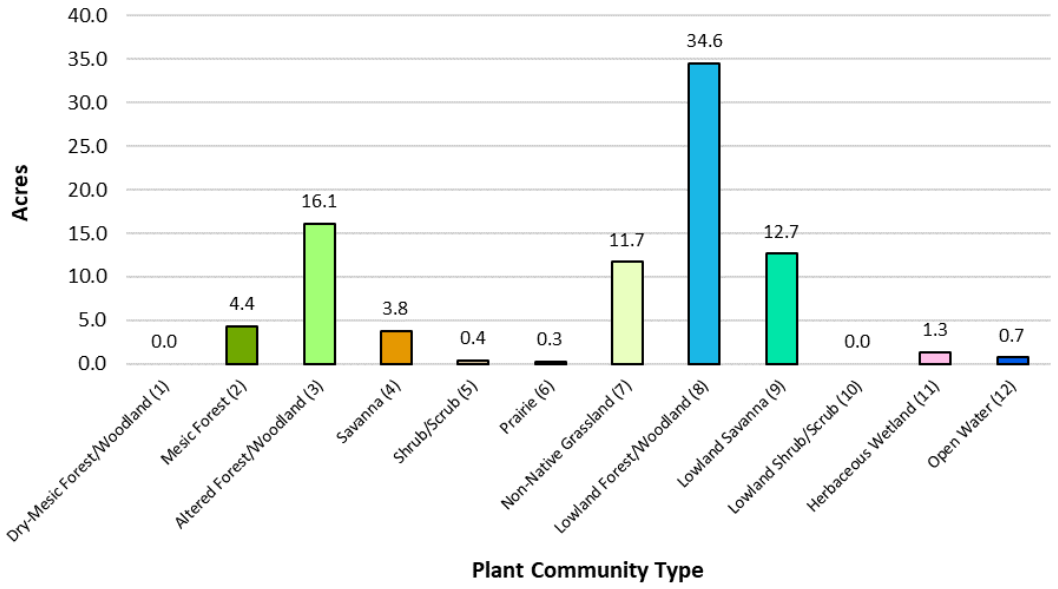
Table 10. Natural/Semi-Natural Vegetation of Bear Creek Park

PLANT COMMUNITIES[1]	NATURAL AREA ACRES	PERCENT OF TOTAL NATURAL AREA ACRES	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**36.6**	**42.6%**	**C - NN**
Forest/Woodland	**20.5**	**23.8%**	**D - NN**
Mature Forest/Woodland	**4.4**	**5.1%**	**D**
Dry-Mesic Forest/Woodland (1)	0.0	0.0%	NA
Mesic Forest (2)	4.4	5.1%	D
Altered Forest/Woodland (3)	**16.1**	**18.7%**	**NN**
Savanna/Brushland	**4.2**	**4.9%**	**CD - D**
Savanna (4)	3.8	4.4%	CD
Shrub/Scrub (5)	0.4	0.5%	D
Grassland	**12.0**	**13.9%**	**C - NN**
Prairie (6)	0.3	0.3%	C
Non-Native Grassland (7)	11.7	13.6%	NN
Lowland Communities	**49.3**	**57.4%**	**C - D**
Lowland Forest/Woodland	**34.6**	**40.2%**	**C - D**
Lowland Forest/Woodland (8)	34.6	40.2%	C - D
Lowland Savanna/Brushland	**12.7**	**14.7%**	**CD - D**
Lowland Savanna (9)	12.7	14.7%	CD - D
Lowland Shrub/Scrub (10)	0.0	0.0%	NA
Lowland Herbaceous	**1.3**	**1.5%**	**C**
Herbaceous Wetland (11)	1.3	1.5%	C
Open Water (12)	**0.7**	**0.9%**	**NA**
Totals	***85.9***	***100%***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.1.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate quality; D = Poor quality; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Figure 21. Natural/Semi-Natural Vegetation of Bear Creek Park



Natural Characteristics. Bear Creek Park is notable for supporting 65 acres of Lowland Forest/Woodland and Altered Forest/Woodland communities (Table 10 and Figure 21). Although in a degraded condition, the extensive stand of forested habitat along a major riparian corridor in the City make the site an important location with a potential for great conservation value.

Past Natural Area Management. Ecological restoration and management work has included removal of invasive shrubs by forestry mowing and goat grazing, ash tree removal, tree and shrub planting, and bow hunting to reduce deer density.

Challenges & Opportunities. Altered/non-native plant communities occupy approximately one-third of the park's natural areas. The generally poor quality of the park's native plant communities is driven largely by the abundance of invasive plants (mostly common buckthorn, honeysuckle, and garlic mustard) and by the low diversity of the tree canopy. As a result, the park provides habitat for fewer native plant and animal species than would be expected in a more intact and diverse riparian forest. Low-diversity plant communities are less resilient to environmental change, which can lead to further degradation and reduced ecosystem services.

This park presents opportunities for restoration and enhancement of a large tract of native forest, woodland, and savanna, primarily in a lowland/riparian setting. Continued and accelerated removal of non-native shrubs and other invasive vegetation, coupled with native replacement plantings, will improve the quality, ecosystem services, and resilience of this park. Restoration and management efforts in this park should be focused first on managing areas where restoration has begun, but then expand work into the park's adjacent and/or higher quality natural areas.

Park expansion and connection opportunities exist to the north and south of this site along the Bear Creek riparian corridor; City-owned Slatterly Park lies to the north of Bear Creek Park, City-owned McQuillan Field (including a large stand of forest) lies adjacent to the east of the site, and south of 20th Street SE lies City-owned Jean & Carl Frank Canine Park.

Cascade Lake Park

Overview. Cascade Lake Park consists of approximately 99 acres in the northwest quadrant of the City (Figure 19). Cascade Lake, a former sand quarry and now-impounded portion of Cascade Creek, is not included in the park boundary. The park contains several amenities (e.g., playground, public art), and the trail system is heavily used by the community. Of the parkland, approximately 56 acres support natural and semi-natural plant communities and open water habitats, some of which is altered and most of which are of moderate to poor ecological quality (Figure 22). The following table and figure (histogram) further characterize the site's natural/semi-natural vegetation and open water habitats.

Figure 22. Cascade Lake Park Land Cover

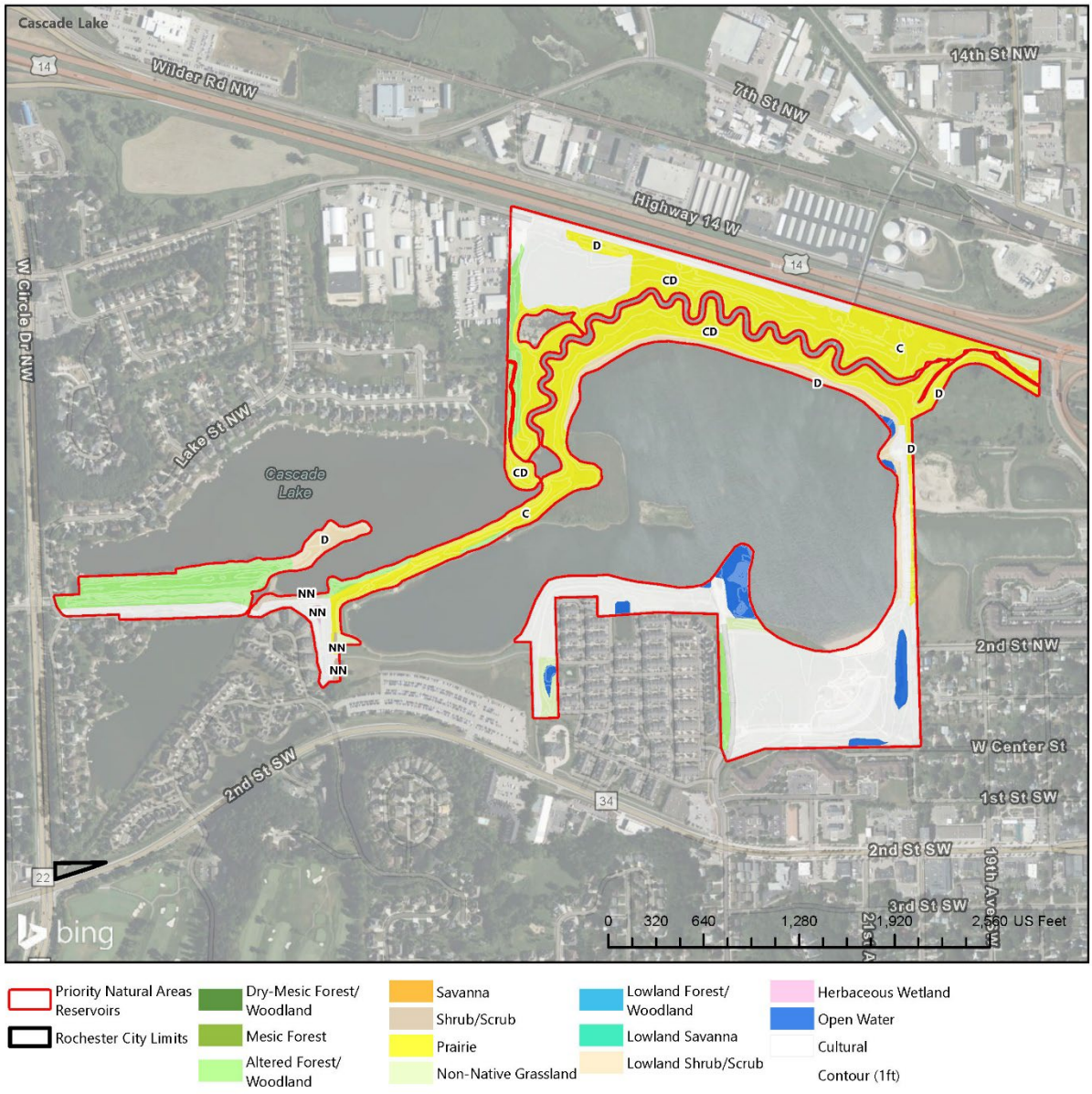


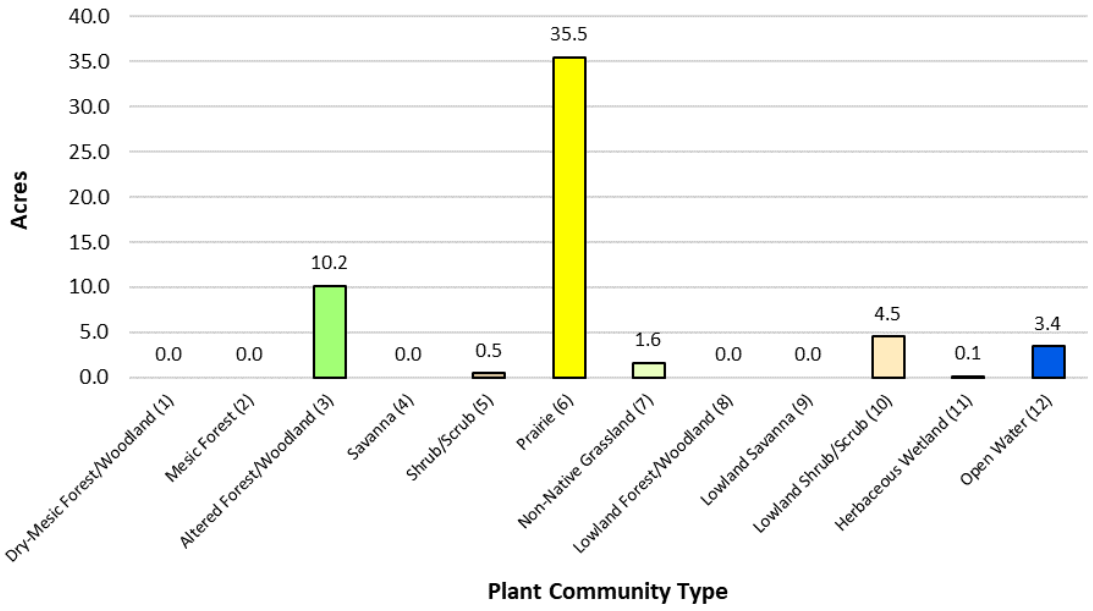
Table 11. Natural/Semi-Natural Vegetation of Cascade Lake Park

PLANT COMMUNITIES[1]	NATURAL AREA ACRES	PERCENT OF TOTAL NATURAL AREA ACRES	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**47.8**	**85.6%**	**C - NN**
Forest/Woodland	**10.2**	**18.2%**	**NN**
Mature Forest/Woodland	**0.0**	**0.0%**	**NA**
Dry-Mesic Forest/Woodland (1)	0.0	0.0%	NA
Mesic Forest (2)	0.0	0.0%	NA
Altered Forest/Woodland (3)	**10.2**	**18.2%**	**NN**
Savanna/Brushland	**0.5**	**0.8%**	**NN**
Savanna (4)	0.0	0.0%	NA
Shrub/Scrub (5)	0.5	0.8%	NN
Grassland	**37.1**	**66.5%**	**C - NN**
Prairie (6)	35.5	63.6%	C - D
Non-Native Grassland (7)	1.6	2.9%	NN
Lowland Communities	**8.0**	**14.4%**	**D - NN**
Lowland Forest/Woodland	**0.0**	**0.0%**	**NA**
Lowland Forest/Woodland (8)	0.0	0.0%	NA
Lowland Savanna/Brushland	**4.5**	**8.1%**	**D**
Lowland Savanna (9)	0.0	0.0%	NA
Lowland Shrub/Scrub (10)	4.5	8.1%	D
Lowland Herbaceous	**0.1**	**0.2%**	**NN**
Herbaceous Wetland (11)	0.1	0.2%	NN
Open Water (12)	**3.4**	**6.1%**	**NA**
Totals	***55.8***	***100%***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.1.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate quality; D = Poor quality; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Figure 23. Natural/Semi-Natural Vegetation of Cascade Lake Park



Natural Characteristics. Cascade Lake Park is notable for supporting over 35 acres of planted Prairie (Table 11 and Figure 23). Although in a moderate to poor condition, this extensive stand of Prairie in one of the City's most popular parks make the site an important habitat for prairie-dependent wildlife, including many species of birds and pollinators. The lake, shoreline, and restored, meandering channel provides habitat for a diversity of riparian, wetland, and aquatic species, including waterfowl.

Past Natural Area Management. Ecological restoration and management work has included establishment of the site's prairies, ongoing prairie management (mostly prescribed burning), and construction of the re-meandered channel where water leaves the lake and flows eastward toward the South Fork Zumbro River.

Challenges & Opportunities. Altered/non-native plant communities occupy approximately 20% of the park's natural areas. The moderate to poor quality of this park's native plant communities is driven largely by the presence of invasive plants (mostly reed canary grass, crown vetch, and native sandbar willow and cottonwood). As a result, the park provides habitat for fewer native plant and animal species than would be expected in a more intact and diverse prairie. Low-diversity plant communities are less resilient to environmental change, which can lead to further degradation and reduced ecosystem services.

This park presents opportunities for enhancement of the site's prairies and wetlands, as well as restoration of Altered Forest/Woodland. Continued management of invasive vegetation (including prescribed burning and removal of dense stands of sandbar willow along the lake's shoreline), coupled with native enhancement plantings, will improve the quality, ecosystem services, and resilience of this park. Restoration and management efforts in this park should be focused first on managing areas where restoration has begun (i.e., the prairies), but then expand work into the park's adjacent and other natural areas. The park is surrounded mostly by intensely developed land, limiting expansion and connection opportunities.

Essex Park

Overview. Essex Park consists of approximately 173 acres in the northwest quadrant of the City (Figure 19). The park contains several amenities (e.g., playgrounds), and the trail system is heavily used by the community. Of the parkland, approximately 142 acres support natural and semi-natural plant communities and open water habitats. Most of the park's natural areas are of moderate to poor ecological quality; however, some of the park's natural areas were good or good-to-moderate quality (Figure 24). The following table and figure (histogram) further characterize the site's natural/semi-natural vegetation and open water habitats.

Figure 24. Essex Park Land Cover

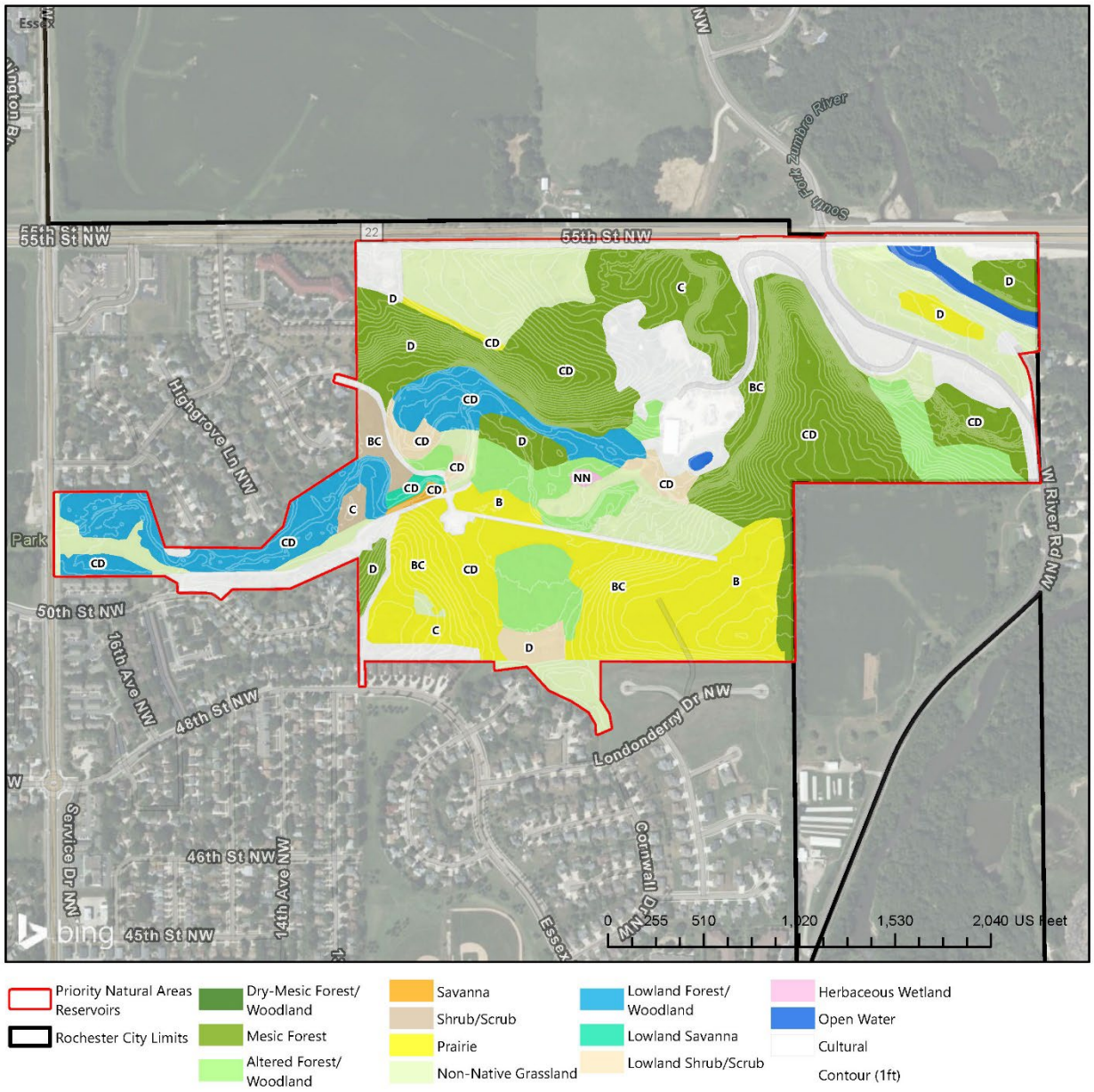


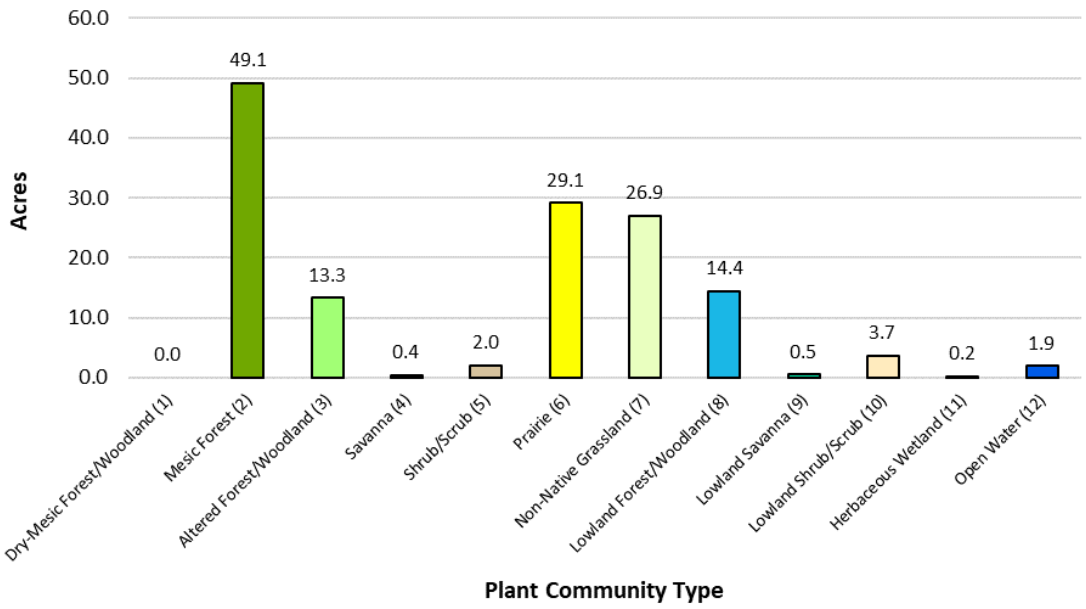
Table 12. Natural/Semi-Natural Vegetation of Essex Park

PLANT COMMUNITIES[1]	NATURAL AREA ACRES	PERCENT OF TOTAL NATURAL AREA ACRES	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**120.8**	**85.4%**	**B - NN**
Forest/Woodland	**62.3**	**44.0%**	**BC - NN**
Mature Forest/Woodland	**49.1**	**34.7%**	**BC - D**
Dry-Mesic Forest/Woodland (1)	0.0	0.0%	NA
Mesic Forest (2)	49.1	34.7%	BC - D
Altered Forest/Woodland (3)	**13.3**	**9.4%**	**NN**
Savanna/Brushland	**2.4**	**1.7%**	**BC - D**
Savanna (4)	0.4	0.3%	CD
Shrub/Scrub (5)	2.0	1.4%	BC - D
Grassland	**56.1**	**39.6%**	**B - NN**
Prairie (6)	29.1	20.6%	B - D
Non-Native Grassland (7)	26.9	19.0%	NN
Lowland Communities	**20.7**	**14.6%**	**CD - NN**
Lowland Forest/Woodland	**14.4**	**10.2%**	**CD**
Lowland Forest/Woodland (8)	14.4	10.2%	CD
Lowland Savanna/Brushland	**4.2**	**2.9%**	**CD - D**
Lowland Savanna (9)	0.5	0.4%	CD
Lowland Shrub/Scrub (10)	3.7	2.6%	CD - D
Lowland Herbaceous	**0.2**	**0.2%**	**NN**
Herbaceous Wetland (11)	0.2	0.2%	NN
Open Water (12)	**1.9**	**1.3%**	**NA**
Totals	***141.6***	***100%***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.1.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate quality; D = Poor quality; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Figure 25. Natural/Semi-Natural Vegetation of Essex Park



Natural Characteristics. Essex Park is notable for supporting over 49 acres of Mesic Forest and over 29 acres of planted Prairie (Table 12 and Figure 25). Although most of the Mesic Forest is in a moderate to poor condition, these relatively large wooded tracks represent important forest habitat with high potential for restoration. Most of the park's significant acreage of Prairie ranges from good to moderate quality; the presence of these extensive stands of native grassland in one of the City's most popular parks make the site an important habitat for prairie-dependent wildlife, including many species of birds and pollinators.

Past Natural Area Management. Ecological restoration and management work has included establishment of the site's prairies, ongoing prairie management (mostly prescribed burning), removal of ash trees, diverse plantings of native trees, and bow hunting to reduce deer density.

Challenges & Opportunities. Altered/non-native plant communities occupy approximately 28% of the park's natural areas. The moderate to poor quality of most of this park's native plant communities is driven largely by the presence of invasive plants (e.g., common buckthorn, garlic mustard). As a result, the park provides habitat for fewer native plant and animal species than would be expected in a more intact and diverse prairie. Low-diversity plant communities are less resilient to environmental change, which can lead to further degradation and reduced ecosystem services.

This park presents opportunities for continued enhancement of the site's Prairie, enhancement of Mesic Forest, and restoration of Altered Forest/Woodland and Non-native Grassland. Continued management of invasive vegetation (including prescribed burning of the Prairie and removal of invasive brush in park forests/woodlands), coupled with native enhancement plantings, will improve the quality, ecosystem services, and resilience of this park. Restoration and management efforts in this park should be focused first on managing areas where restoration has begun (i.e., the prairies), but then expand work into the park's adjacent and other natural areas.

Park expansion and connection opportunities exist to the west (City-owned Kings Run Park) and to the east along the South Fork Zumbro River riparian corridor.

Gamehaven Reservoir

Overview. Gamehaven Reservoir (one of the City's flood control projects) consists of approximately 230 acres located east and southeast of the City's new 160-acre Gamehaven Park. In 2021, a championship disc golf course was constructed at the reservoir site. While located outside the City limits, the reservoir site is most-closely associated with the southeast quadrant of the City (Figure 19). Almost all of Gamehaven Reservoir supports a variety of natural and semi-natural plant communities and open water habitats, most of which are altered or of moderate to poor ecological quality (Figure 26). The following table and figure (histogram) further characterize the site's natural/semi-natural vegetation and open water habitats.

Figure 26. Gamehaven Reservoir Land Cover

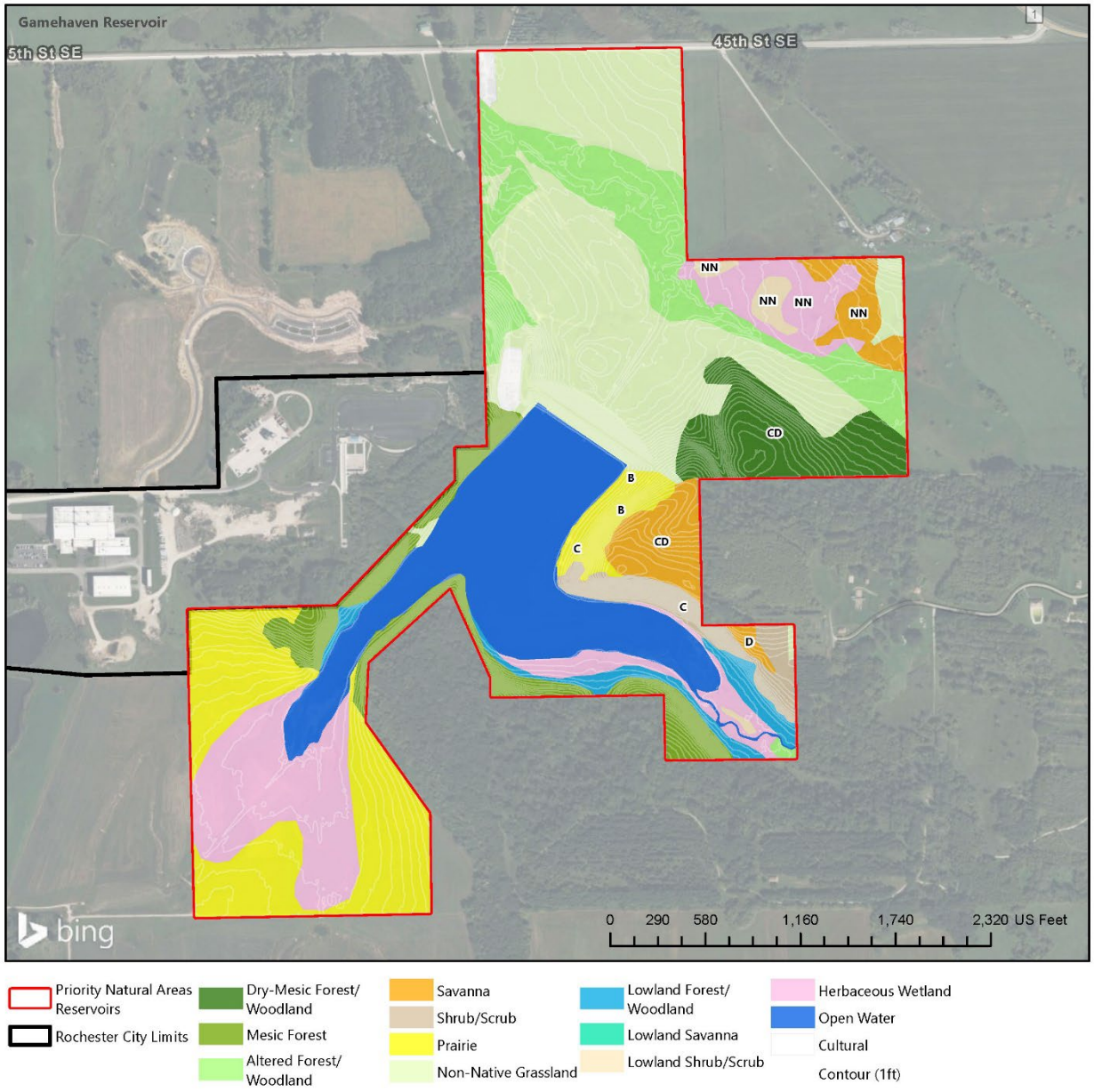


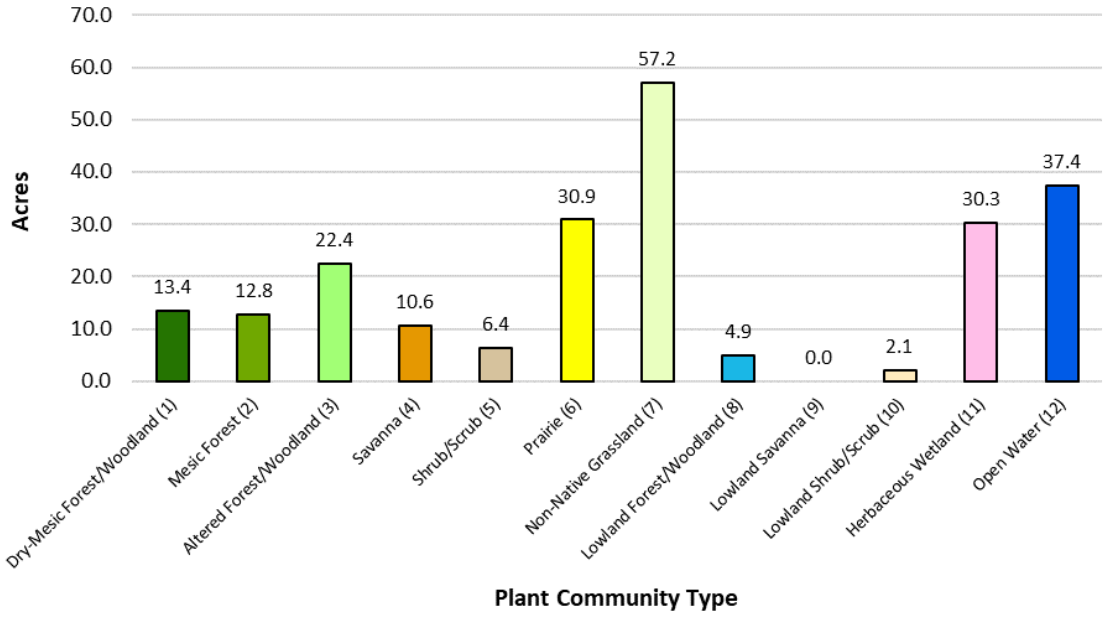
Table 13. Natural/Semi-Natural Vegetation of Gamehaven Reservoir

PLANT COMMUNITIES[1]	NATURAL AREA ACRES	PERCENT OF TOTAL NATURAL AREA ACRES	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**153.8**	**67.3%**	**B - NN**
Forest/Woodland	**48.7**	**21.3%**	**CD - NN**
Mature Forest/Woodland	**26.3**	**11.5%**	**CD**
Dry-Mesic Forest/Woodland (1)	13.4	5.9%	CD
Mesic Forest (2)	12.8	5.6%	NA
Altered Forest/Woodland (3)	**22.4**	**9.8%**	**NN**
Savanna/Brushland	**17.0**	**7.5%**	**C - NN**
Savanna (4)	10.6	4.7%	CD - NN
Shrub/Scrub (5)	6.4	2.8%	C
Grassland	**88.1**	**38.5%**	**B - NN**
Prairie (6)	30.9	13.5%	B - C
Non-Native Grassland (7)	57.2	25.0%	NN
Lowland Communities	**74.7**	**32.7%**	**NN**
Lowland Forest/Woodland	**4.9**	**2.1%**	**NA**
Lowland Forest/Woodland (8)	4.9	2.1%	NA
Lowland Savanna/Brushland	**2.1**	**0.9%**	**NN**
Lowland Savanna (9)	0.0	0.0%	NA
Lowland Shrub/Scrub (10)	2.1	0.9%	NN
Lowland Herbaceous	**30.3**	**13.3%**	**NN**
Herbaceous Wetland (11)	30.3	13.3%	NN
Open Water (12)	**37.4**	**16.4%**	**NA**
Totals	***228.5***	***100%***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.1.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate quality; D = Poor quality; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Figure 27. Natural/Semi-Natural Vegetation of Gamehaven Reservoir



Natural Characteristics. Gamehaven Reservoir is notable for being one of the largest natural areas owned by the City. It supports a diversity of habitats, including a variety of forests/woodlands, savanna, native and non-native grasslands, wetlands, and the open water reservoir (Table 13 and Figure 27). Of the 18 natural areas assessed as part of this NAMP, Gamehaven Reservoir was the only site identified by the MNDNR as a Site of Biodiversity Significance and as containing native plant communities. These more intact natural areas consist of forest/woodland along the site's southern boundary and remnant prairie, which extends into the east-central portion of the site (Figure 26). This remnant prairie represents one of the highest quality native plant communities assessed as part of this NAMP. Many of the site's other natural areas are non-native plant communities or in moderate to poor condition; however, the southern and southwest portions of the site were not field assessed.

Past Natural Area Management. Ecological restoration and management work has included establishment of a wetland/prairie complex in the southwest portion of the site, ongoing prairie management (mostly prescribed burning), wild parsnip management (mowing and/or haying the site's Non-native Grassland), bow hunting to reduce deer density, and removal of gophers that could compromise the integrity of the reservoir dam.

Challenges & Opportunities. Altered/non-native plant communities occupy over 40% of the site's non-aquatic natural areas. The moderate to poor quality of this site's native plant communities is driven largely by the presence of invasive plants (e.g., black locust, common buckthorn, wild parsnip, smooth brome). As a result, the park provides habitat for fewer native plant and animal species than would be expected in a more intact and diverse prairie. Low-diversity plant communities are less resilient to environmental change, which can lead to further degradation and reduced ecosystem services.

This park presents opportunities for protecting the remnant Prairie, restoring the site's woodlands and forests, converting Non-native Grassland to Prairie, and creating a large-scale, complex mosaic of high quality native plant communities. In particular, the remnant Prairie should be managed to minimize impacts from disc golf. Recommendations include:

1. Minimize regular mowing.
2. Minimize foot traffic.
3. Conduct annual monitoring to assess vegetation, invasive species, erosion, or damage from park users; implement remedial actions promptly, as necessary.
4. Conduct prescribed, rotational burning so that each unit is burned every 4-6 years.
5. Restore adjacent natural areas (e.g., Savanna to east and Shrub/Scrub to south) to buffer the Prairie from invasive vegetation and provide a higher quality habitat complex.

The wetland and prairie restoration project in the southwest portion of the site warrants continued management to ensure its successful establishment, as does Gamehaven Park's newly planted prairie acreage to the west. Expanding restoration and management of the remainder of the site will improve the quality, ecosystem services, and resilience of this important natural area. As alluded to above, restoration and management efforts at this site should be focused first on managing areas where restoration has begun and then expand work into the site's adjacent and other natural areas.

Park expansion and connection opportunities exist around most of the reservoir site and new City park perimeter due to the predominantly agricultural lands in the area. A Boy Scout camp (including a large tract of forest, which is part of the MNDNR-mapped Site of Biodiversity Significance and native plant community) lies adjacent to the south of the reservoir site.

Homestead Park

Overview. Homestead Park consists of approximately 24 acres in the southeast quadrant of the City (Figure 19). The park contains amenities (e.g., ballfield), and the trail system is heavily used by local residents. Of the parkland, approximately 13 acres support natural and semi-natural plant communities, much of which is altered or of poor ecological quality (Figure 28). The following table and figure (histogram) further characterize the site's natural/semi-natural vegetation and open water habitats.

Figure 28. Homestead Park Land Cover

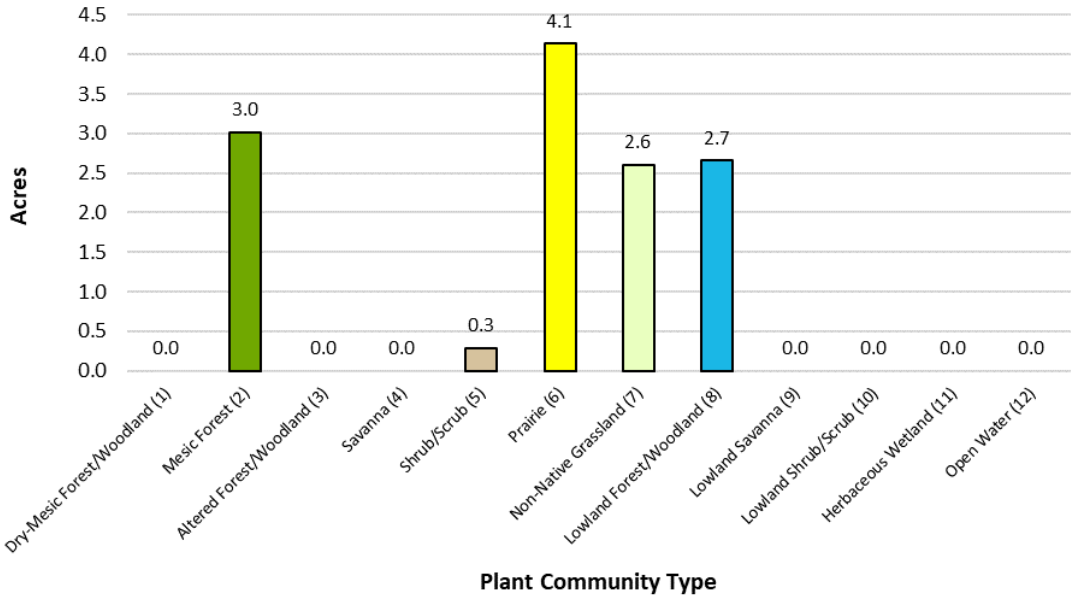
Table 14. Natural/Semi-Natural Vegetation of Homestead Park

PLANT COMMUNITIES[1]	NATURAL AREA ACRES	PERCENT OF TOTAL NATURAL AREA ACRES	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**10.0**	**79.1%**	**BC - NN**
Forest/Woodland	**3.0**	**23.8%**	**D**
Mature Forest/Woodland	**3.0**	**23.8%**	**D**
Dry-Mesic Forest/Woodland (1)	0.0	0.0%	NA
Mesic Forest (2)	3.0	23.8%	D
Altered Forest/Woodland (3)	**0.0**	**0.0%**	**NA**
Savanna/Brushland	**0.3**	**2.2%**	**NN**
Savanna (4)	0.0	0.0%	NA
Shrub/Scrub (5)	0.3	2.2%	NN
Grassland	**6.7**	**53.0%**	**BC - NN**
Prairie (6)	4.1	32.6%	BC - D
Non-Native Grassland (7)	2.6	20.5%	NN
Lowland Communities	**2.7**	**20.9%**	**D**
Lowland Forest/Woodland	**2.7**	**20.9%**	**D**
Lowland Forest/Woodland (8)	2.7	20.9%	D
Lowland Savanna/Brushland	**0.0**	**0.0%**	**NA**
Lowland Savanna (9)	0.0	0.0%	NA
Lowland Shrub/Scrub (10)	0.0	0.0%	NA
Lowland Herbaceous	**0.0**	**0.0%**	**NA**
Herbaceous Wetland (11)	0.0	0.0%	NA
Open Water (12)	**0.0**	**0.0%**	**NA**
Totals	***12.7***	***100%***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.1.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate quality; D = Poor quality; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Figure 29. Natural/Semi-Natural Vegetation of Homestead Park



Natural Characteristics. Homestead Park's most notable natural features are a 4-acre planted Prairie (mostly good-to-moderate quality) and a stand of degraded Mesic Forest and Lowland Forest/Woodland (Table 14 and Figure 29). The Prairie represents an patch of habitat for birds and pollinators, and despite its degraded condition, the forest/woodland provides habitat for some native wildlife. A drainage swale of Non-native Grassland runs along most of the park's north edge.

Past Natural Area Management. Ecological restoration and management work has included establishment of the site's Prairie and its ongoing management (mostly prescribed burning).

Challenges & Opportunities. Altered/non-native plant communities occupy approximately 20% of the park's natural areas. The moderate to poor quality of most of this park's native plant communities is driven largely by the presence of invasive plants (e.g., reed canary grass, common buckthorn). As a result, the park provides habitat for fewer native plant and animal species than would be expected in a more intact and diverse prairie. Low-diversity plant communities are less resilient to environmental change, which can lead to further degradation and reduced ecosystem services.

This park presents opportunities for continued enhancement and management of the site's Prairie (primarily through prescribed burning), enhancement of Mesic Forest and Lowland Forest/Woodland (primarily through the removal of invasive species and planting of diverse native vegetation), and conversion of the Non-native Grassland swale to Prairie. These actions will improve the quality, ecosystem services, and resilience of this park. Restoration and management efforts in this park should be focused first on managing areas where restoration has begun (i.e., the Prairie), but then expand work into the park's adjacent and other natural areas. Park expansion and connection opportunities exist to the east, where a complex of lowland forest and wetlands lies adjacent to the site.

Indian Heights Park

Overview. Indian Heights Park consists of approximately 37 acres in the northwest quadrant of the City (Figure 19). The park's trails are used regularly by local residents. The entirety of this park supports natural and semi-natural plant communities, much of which is altered or of poor ecological quality, but some of which is good to moderate quality (Figure 30). A significant portion of the site consists of an abandoned quarry. The following table and figure (histogram) further characterize the site's natural/semi-natural vegetation and open water habitats.

Figure 30. Indian Heights Park Land Cover

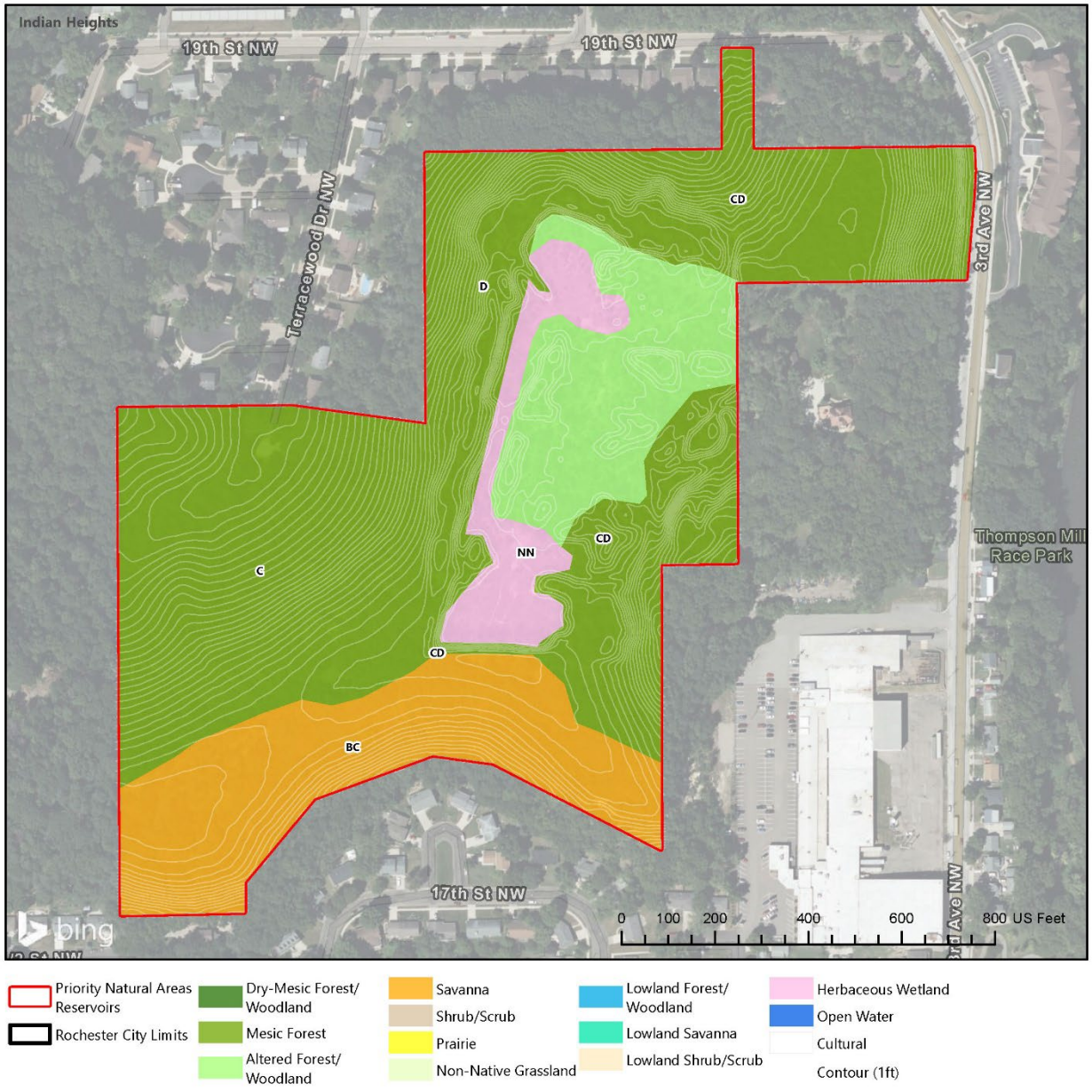


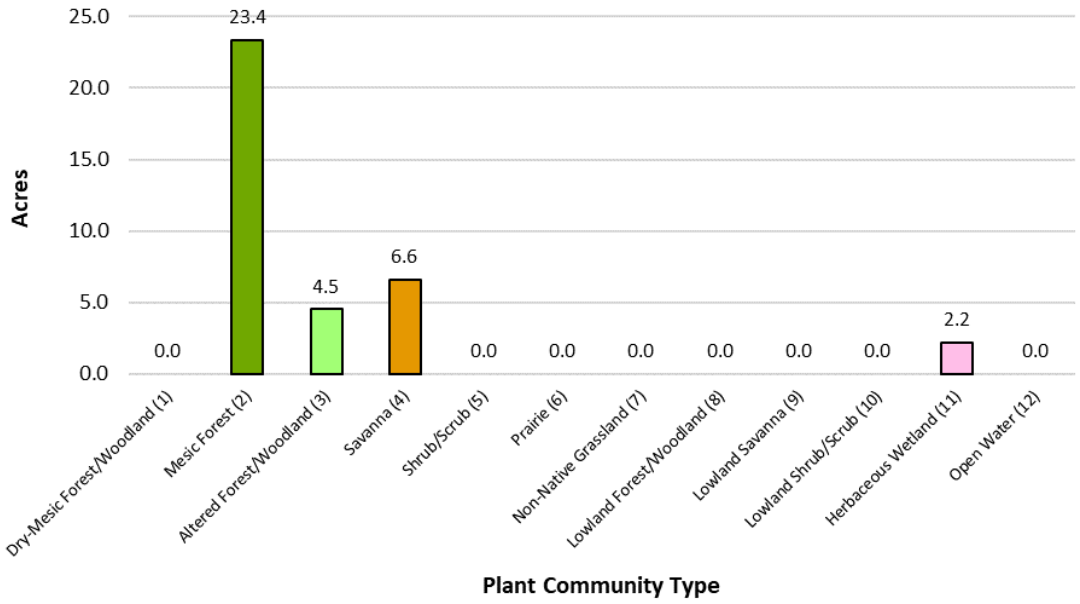
Table 15. Natural/Semi-Natural Vegetation of Indian Heights Park

PLANT COMMUNITIES[1]	NATURAL AREA ACRES	PERCENT OF TOTAL NATURAL AREA ACRES	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**34.5**	**94.1%**	**BC - NN**
Forest/Woodland	**27.9**	**76.1%**	**C - NN**
Mature Forest/Woodland	**23.4**	**63.7%**	**C - D**
Dry-Mesic Forest/Woodland (1)	0.0	0.0%	NA
Mesic Forest (2)	23.4	63.7%	C - D
Altered Forest/Woodland (3)	**4.5**	**12.3%**	**NN**
Savanna/Brushland	**6.6**	**18.0%**	**BC**
Savanna (4)	6.6	18.0%	BC
Shrub/Scrub (5)	0.0	0.0%	NA
Grassland	**0.0**	**0.0%**	**NA**
Prairie (6)	0.0	0.0%	NA
Non-Native Grassland (7)	0.0	0.0%	NA
Lowland Communities	**2.2**	**5.9%**	**NN**
Lowland Forest/Woodland	**0.0**	**0.0%**	**NA**
Lowland Forest/Woodland (8)	0.0	0.0%	NA
Lowland Savanna/Brushland	**0.0**	**0.0%**	**NA**
Lowland Savanna (9)	0.0	0.0%	NA
Lowland Shrub/Scrub (10)	0.0	0.0%	NA
Lowland Herbaceous	**2.2**	**5.9%**	**NN**
Herbaceous Wetland (11)	2.2	5.9%	NN
Open Water (12)	**0.0**	**0.0%**	**NA**
Totals	***36.6***	***100%***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.1.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate quality; D = Poor quality; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Figure 31. Natural/Semi-Natural Vegetation of Indian Heights Park



Natural Characteristics. Indian Heights Park is notable for supporting a 6.6-acre restored Savanna and a relatively large tract of Mesic Forest (Table 15 and Figure 31). The restored Savanna (dominated by mature bur oak and black walnut) is largely the result of the dedicated "Friends of Indian Heights Park" (https://www.foih.org/), which has been removing invasive buckthorn and organizing other conservation projects at the site over the past decade. Although most of the Mesic Forest is in a moderate to poor condition, this relatively large wooded track represents important forest habitat with high potential for restoration. The former quarry site consists primarily of Altered Forest/Woodland and Herbaceous Wetland, which, while representative of disturbed conditions, contains an interesting assemblage of plant communities.

Past Natural Area Management. Ecological restoration and management work has included removal of invasive brush (mostly from the Savanna area) and bow hunting to reduce deer density.

Challenges & Opportunities. Altered/non-native plant communities occupy approximately 18% of the park's natural areas. The moderate to poor quality of most of this park's native plant communities is driven largely by the presence of invasive plants (e.g., common buckthorn, non-native honeysuckle, reed canary grass). As a result, the park provides habitat for fewer native plant and animal species than would be expected in a more intact and diverse prairie. Low-diversity plant communities are less resilient to environmental change, which can lead to further degradation and reduced ecosystem services.

This park presents opportunities for continued enhancement and management of the site's Savanna (e.g., prescribed burning, native plantings), enhancement of Mesic Forest (primarily through the removal of invasive species and planting of diverse native vegetation), and conversion of the disturbed quarry areas to more diverse native plant communities. These actions will improve the quality, ecosystem services, and resilience of this park. Restoration and management efforts in this park should be focused first on managing areas where restoration has begun (i.e., the Savanna), but then expand work into the park's adjacent and other natural areas. Park expansion and connection opportunities exist to the west where a stand of forest lies adjacent to the site, and the South Fork Zumbro River lies nearby to the east of the park.

Joyce Park

Overview. Joyce Park consists of approximately 24 acres in the southeast quadrant of the City (Figure 19). The park contains amenities (e.g., playground, pond), and the trail system is heavily used by local residents. Of the parkland, approximately 14 acres support a variety of natural and semi-natural plant communities and open water habitats, most of which are altered or of moderate to poor ecological quality (Figure 32). The following table and figure (histogram) further characterize the site's natural/semi-natural vegetation and open water habitats.

Figure 32. Joyce Park Land Cover

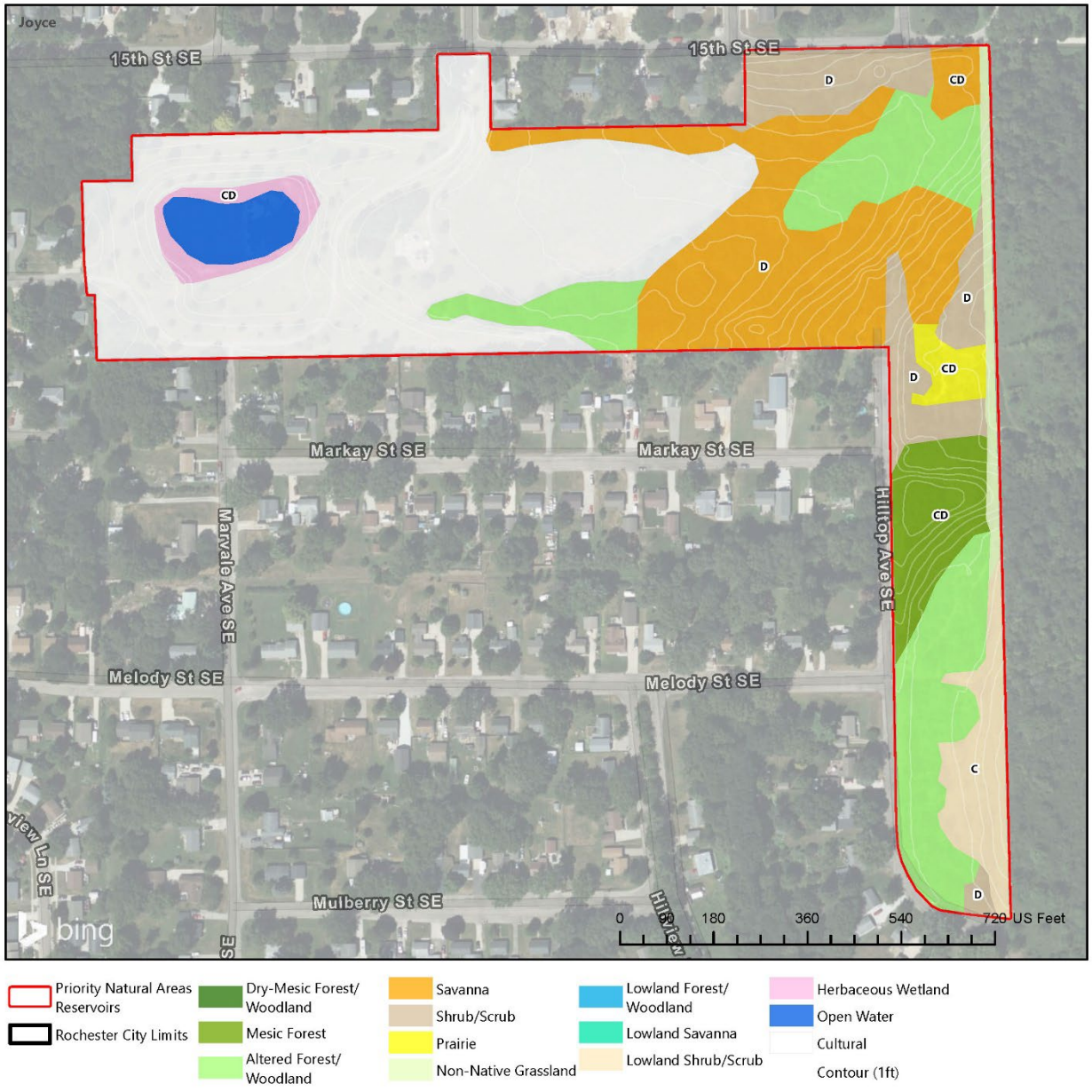


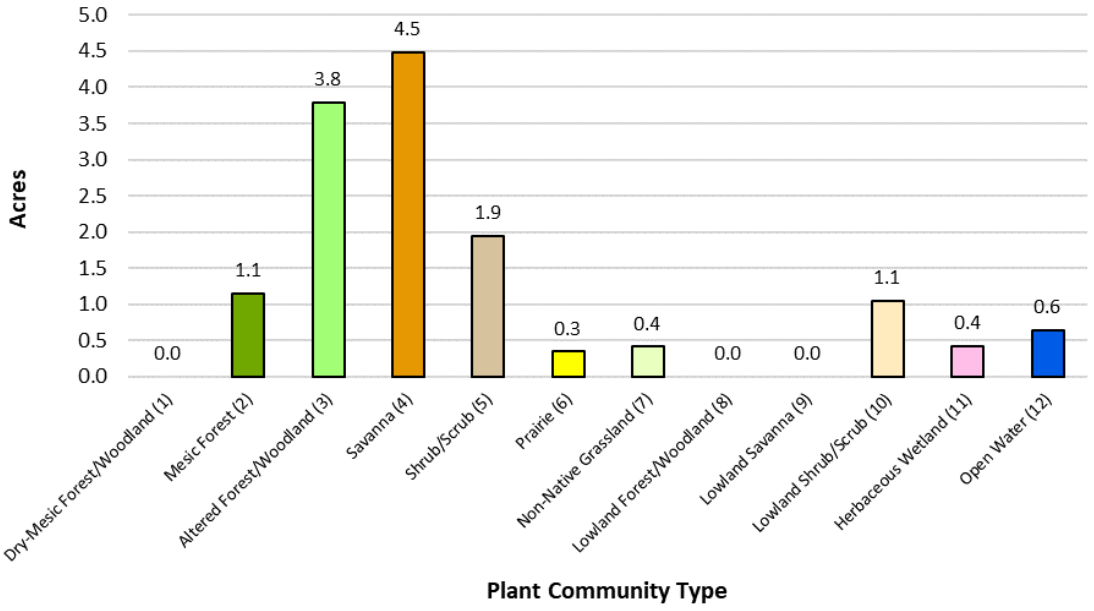
Table 16. Natural/Semi-Natural Vegetation of Joyce Park

PLANT COMMUNITIES[1]	NATURAL AREA ACRES	PERCENT OF TOTAL NATURAL AREA ACRES	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**12.1**	**85.2%**	**CD - NN**
Forest/Woodland	**4.9**	**34.7%**	**CD - NN**
Mature Forest/Woodland	**1.1**	**8.1%**	**CD**
Dry-Mesic Forest/Woodland (1)	0.0	0.0%	NA
Mesic Forest (2)	1.1	8.1%	CD
Altered Forest/Woodland (3)	**3.8**	**26.6%**	**NN**
Savanna/Brushland	**6.4**	**45.2%**	**CD - D**
Savanna (4)	4.5	31.5%	CD - D
Shrub/Scrub (5)	1.9	13.7%	D
Grassland	**0.8**	**5.3%**	**CD - NN**
Prairie (6)	0.3	2.4%	CD
Non-Native Grassland (7)	0.4	2.9%	NN
Lowland Communities	**2.1**	**14.8%**	**C - CD**
Lowland Forest/Woodland	**0.0**	**0.0%**	**NA**
Lowland Forest/Woodland (8)	0.0	0.0%	NA
Lowland Savanna/Brushland	**1.1**	**7.4%**	**C**
Lowland Savanna (9)	0.0	0.0%	NA
Lowland Shrub/Scrub (10)	1.1	7.4%	C
Lowland Herbaceous	**0.4**	**2.9%**	**CD**
Herbaceous Wetland (11)	0.4	2.9%	CD
Open Water (12)	**0.6**	**4.5%**	**NA**
Totals	***14.2***	***100%***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.1.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate quality; D = Poor quality; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Figure 33. Natural/Semi-Natural Vegetation of Joyce Park



Natural Characteristics. Joyce Park is notable for supporting a 4.5-acre black walnut Savanna as well as a diversity of other natural and semi-natural woodlands and shrublands (Table 16 and Figure 33). Although most of the park's natural areas are in a moderate to poor condition, the complex of habitats provides the opportunity to support a diversity of native plant communities and wildlife. A seepage wetland (associated with the Decorah Edge) exists in the southeast portion of the park; this area contains a diversity of native wet prairie and wetland plants. An area containing mesic prairie plants exists in the east-central portion of the site, and a small pond is located in the western portion of the site.

Past Natural Area Management. To date, ecological restoration and management work has not occurred at this park.

Challenges & Opportunities. Altered/non-native plant communities occupy approximately 30% of the park's natural areas. The moderate to poor quality of this park's native plant communities is driven largely by the presence of invasive plants (e.g., Siberian elm, common buckthorn, non-native honeysuckle, invasive cattail). As a result, the park provides habitat for fewer native plant and animal species than would be expected in a more intact and diverse prairie. Low-diversity plant communities are less resilient to environmental change, which can lead to further degradation and reduced ecosystem services.

This park presents several opportunities for restoration and management of the site's natural areas. A prairie buffer could be established around the park's pond to provide water quality protection and important riparian habitat. The site's wooded areas, seepage wetlands, and degraded Prairie could be enhanced, primarily through the removal of invasive species and planting of diverse native vegetation. These actions will improve the quality, ecosystem services, and resilience of this park. Due to the lack of investment in this neighborhood park's natural areas, restoration and management efforts should be focused first on the prairie buffer around the pond, due to the high-visibility of the area. Restoration and management should then expand into the park's nearby wooded areas, prairie, and seepage wetland. Park expansion and connection opportunities exist to the west, where a large tract of undeveloped land (forests and fields) lies adjacent to the site.

KR-7 Reservoir

Overview. KR-7 Reservoir (one of the City's flood control projects) consists of approximately 133 acres. While located outside the City limits, the reservoir site is most-closely associated with the northwest quadrant of the City (Figure 19). Almost all of KR-7 Reservoir supports natural and semi-natural plant communities and open water habitats, most of which are altered or of poor ecological quality (Figure 34). The following table and figure (histogram) further characterize the site's natural/semi-natural vegetation and open water habitats.

Figure 34. KR-7 Reservoir Land Cover

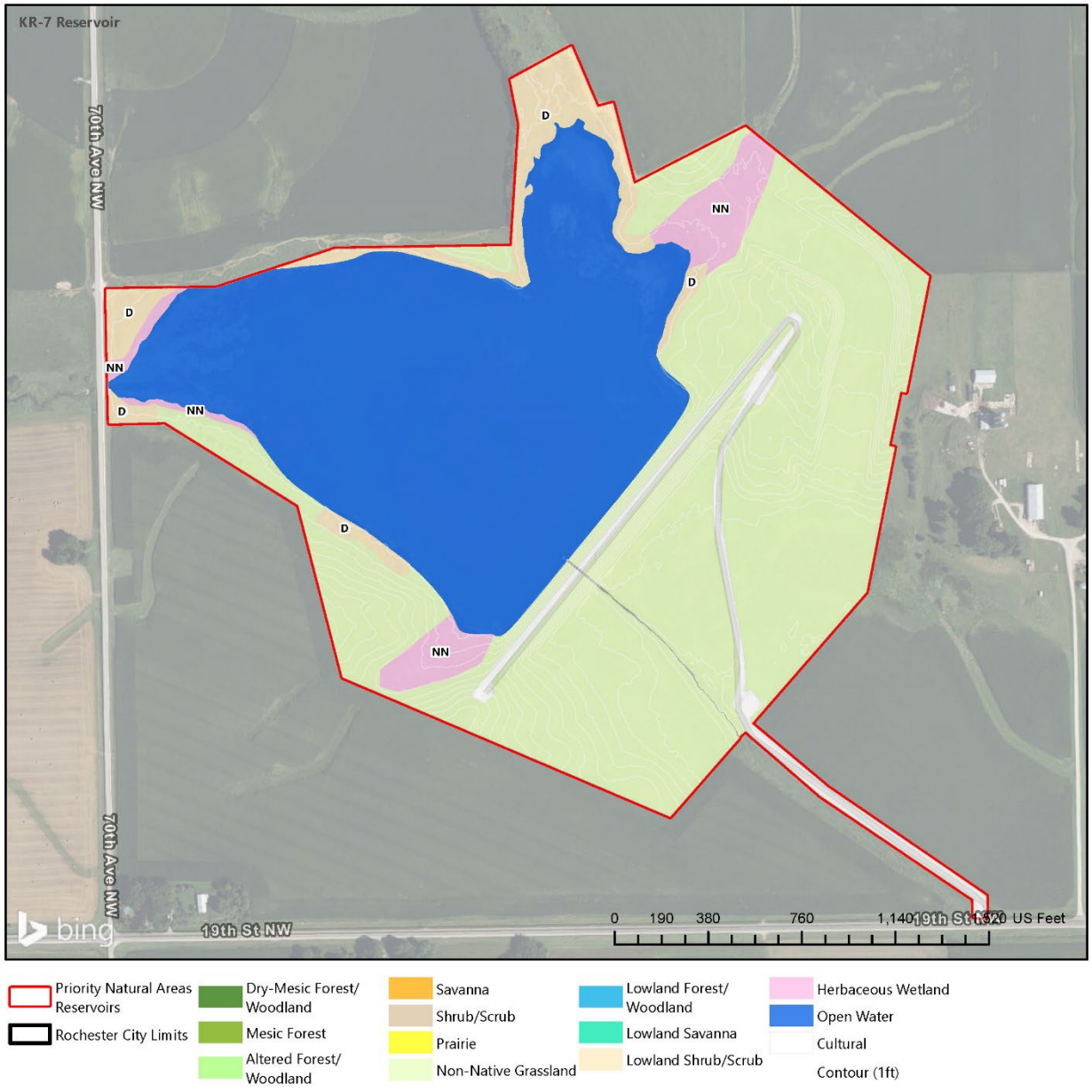


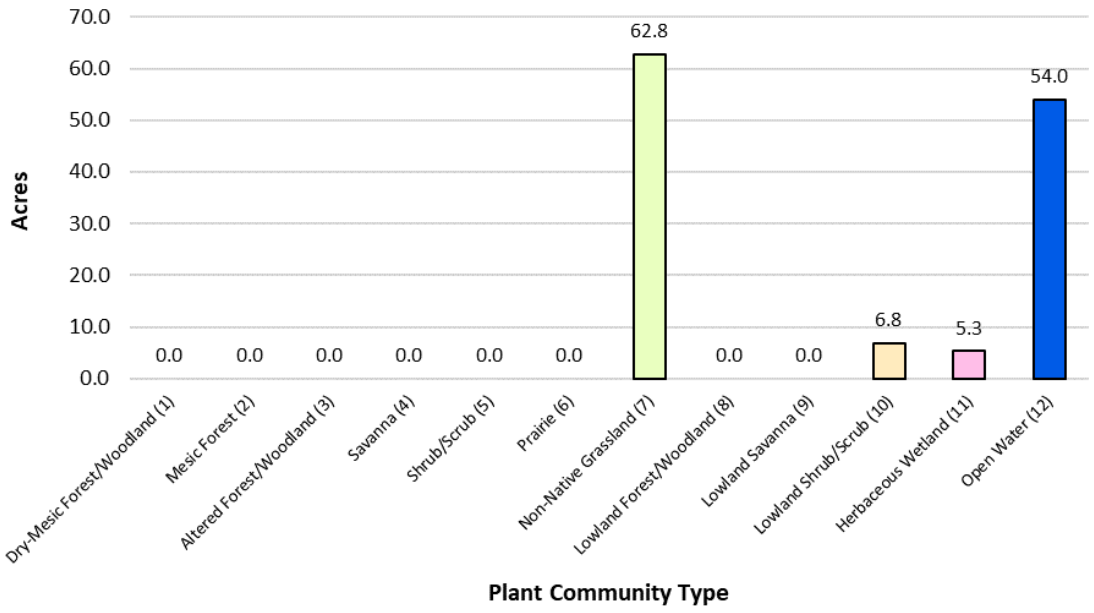
Table 17. Natural/Semi-Natural Vegetation of KR-7 Reservoir

PLANT COMMUNITIES[1]	NATURAL AREA ACRES	PERCENT OF TOTAL NATURAL AREA ACRES	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**62.8**	**48.7%**	**NN**
Forest/Woodland	**0.0**	**0.0%**	**NA**
Mature Forest/Woodland	**0.0**	**0.0%**	**NA**
Dry-Mesic Forest/Woodland (1)	0.0	0.0%	NA
Mesic Forest (2)	0.0	0.0%	NA
Altered Forest/Woodland (3)	**0.0**	**0.0%**	**NA**
Savanna/Brushland	**0.0**	**0.0%**	**NA**
Savanna (4)	0.0	0.0%	NA
Shrub/Scrub (5)	0.0	0.0%	NA
Grassland	**62.8**	**48.7%**	**NN**
Prairie (6)	0.0	0.0%	NA
Non-Native Grassland (7)	62.8	48.7%	NN
Lowland Communities	**66.1**	**51.3%**	**D - NN**
Lowland Forest/Woodland	**0.0**	**0.0%**	**NA**
Lowland Forest/Woodland (8)	0.0	0.0%	NA
Lowland Savanna/Brushland	**6.8**	**5.3%**	**D**
Lowland Savanna (9)	0.0	0.0%	NA
Lowland Shrub/Scrub (10)	6.8	5.3%	D
Lowland Herbaceous	**5.3**	**4.1%**	**NN**
Herbaceous Wetland (11)	5.3	4.1%	NN
Open Water (12)	**54.0**	**41.9%**	**NA**
Totals	***128.9***	***100%***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.1.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate quality; D = Poor quality; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Figure 35. Natural/Semi-Natural Vegetation of KR-7 Reservoir



Natural Characteristics. KR-7 Reservoir is notable for being a large natural area owned by the City. The majority of the site consists of Non-native Grassland, and most of the remainder consists of the open water reservoir itself (Table 17 and Figure 35). Although little of the site represents native plant communities, these altered and degraded areas do provide habitat for some generalist wildlife species.

Past Natural Area Management. Ecological restoration and management work has included prescribed burning, mowing, herbicide applications and haying to control wild parsnip and other unwanted vegetation, and removal of gophers that could compromise the integrity of the reservoir dam and in accordance with U.S. Army Corps of Engineers management goals.

Challenges & Opportunities. Altered/non-native plant communities occupy approximately 84% of the site's non-aquatic natural areas. The poor quality of this site's native plant communities is driven largely by the presence of invasive plants (e.g., reed canary grass, invasive cattail). As a result, the site provides habitat for far fewer native plant and animal species than would be expected in a more intact and diverse prairie/wetland complex. Low-diversity plant communities are less resilient to environmental change, which can lead to further degradation and reduced ecosystem services.

This site presents opportunities for restoration and management of the site's natural areas. Converting the site's Non-native Grassland to Prairie and its degraded Herbaceous Wetland to native wet prairie/wet meadow will improve the quality, ecosystem services, and resilience of this site. Restoration and management efforts should be focused first on restoration of Prairie, as this process is relatively straight forward and would provide a large tract of habitat that would benefit a diversity of birds and pollinators. Restoration and management should then expand into the site's adjacent wetland areas. Park expansion and connection opportunities exist around most of the site perimeter due to the predominantly agricultural lands in the area.

Northern Heights Park

Overview. Northern Heights Park consists of approximately 66 acres in the southeast quadrant of the City (Figure 19). The park contains amenities (e.g., ballfield), and the trail system is used regularly by local residents. Of the parkland, approximately 60 acres support natural and semi-natural plant communities, which are altered or of moderate-to-poor and poor ecological quality (Figure 36). The following table and figure (histogram) further characterize the site's natural/semi-natural vegetation and open water habitats.

Figure 36. Northern Heights Park Land Cover

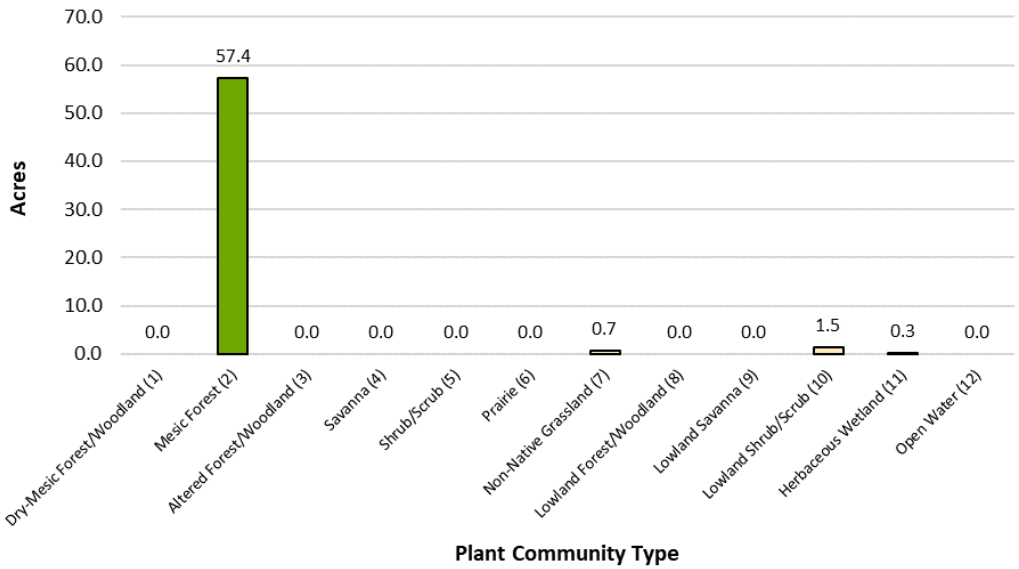
Table 18. Natural/Semi-Natural Vegetation of Northern Heights Park

PLANT COMMUNITIES[1]	NATURAL AREA ACRES	PERCENT OF TOTAL NATURAL AREA ACRES	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**58.0**	**97.1%**	**CD - D**
Forest/Woodland	**57.4**	**95.9%**	**CD - D**
Mature Forest/Woodland	**57.4**	**95.9%**	**CD - D**
Dry-Mesic Forest/Woodland (1)	0.0	0.0%	NA
Mesic Forest (2)	57.4	95.9%	CD - D
Altered Forest/Woodland (3)	**0.0**	**0.0%**	**NA**
Savanna/Brushland	**0.0**	**0.0%**	**NA**
Savanna (4)	0.0	0.0%	NA
Shrub/Scrub (5)	0.0	0.0%	NA
Grassland	**0.7**	**1.1%**	**NN**
Prairie (6)	0.0	0.0%	NA
Non-Native Grassland (7)	0.7	1.1%	NN
Lowland Communities	**1.8**	**2.9%**	**BC - C**
Lowland Forest/Woodland	**0.0**	**0.0%**	**NA**
Lowland Forest/Woodland (8)	0.0	0.0%	NA
Lowland Savanna/Brushland	**1.5**	**2.4%**	**C**
Lowland Savanna (9)	0.0	0.0%	NA
Lowland Shrub/Scrub (10)	1.5	2.4%	C
Lowland Herbaceous	**0.3**	**0.5%**	**BC**
Herbaceous Wetland (11)	0.3	0.5%	BC
Open Water (12)	**0.0**	**0.0%**	**NA**
Totals	***59.8***	***100%***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.1.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate quality; D = Poor quality; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Figure 37. Natural/Semi-Natural Vegetation of Northern Heights Park



Natural Characteristics. Northern Heights Park is notable for supporting over 57 acres of Mesic Forest (Table 18 and Figure 37). Although the forest is significantly degraded, this relatively large wooded track represents important forest habitat with high potential for restoration. A wet meadow (associated with the Decorah Edge) exists in the northern portion of the park. This wetland contains a diversity of native wetland plants; however it is being invaded by common buckthorn and native sandbar willow (mapped as Lowland Shrub/Scrub in Figure 36). Several smaller springs and seepages (also associated with the Decorah Edge) exist in the south-central portion of the park, some of which flow northward into ravines.

Past Natural Area Management. Ecological restoration and management work has included bow hunting to reduce deer density.

Challenges & Opportunities. The moderate-to-poor and poor quality of this park's native plant communities is driven largely by the presence of invasive plants (e.g., non-native honeysuckle, common buckthorn, garlic mustard). As a result, the park provides habitat for fewer native plant and animal species than would be expected in a more intact and diverse prairie. Low-diversity plant communities are less resilient to environmental change, which can lead to further degradation and reduced ecosystem services.

This park presents opportunities for protection and enhancement of the site's uncommon wet meadow and restoration and management of the site's large Mesic Forest (primarily through the removal of invasive species and planting of diverse native vegetation). These actions will improve the quality, ecosystem services, and resilience of this park. Restoration and management efforts in this park should be focused first on protecting the wet meadow (currently experiencing woody invasion) and then expanding work into adjacent natural areas. Park expansion and connection opportunities exist to the northwest (a tract of undeveloped fields and wetlands) and forest lands east of the park.

Northern Hills Prairie

Overview. Northern Hills Prairie consists of approximately 9 acres in the northwest quadrant of the City (Figure 19). The park's trail system is used by local residents and staff from nearby businesses, and Douglas State Trail lies adjacent to the west of the site. Almost the entirety of the parkland supports natural and semi-natural plant communities, most of which are of moderate to poor ecological quality (Figure 38). The following table and figure (histogram) further characterize the site's natural/semi-natural vegetation and open water habitats.

Figure 38. Northern Hills Prairie Land Cover

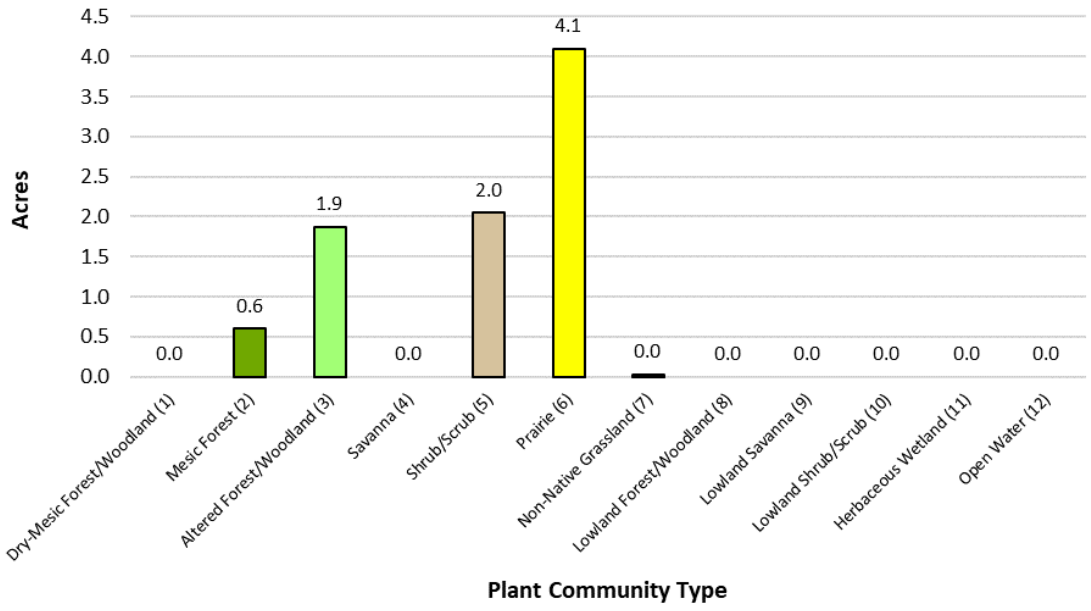
Table 19. Natural/Semi-Natural Vegetation of Northern Hills Prairie

PLANT COMMUNITIES[1]	NATURAL AREA ACRES	PERCENT OF TOTAL NATURAL AREA ACRES	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**8.6**	**100.0%**	**C - NN**
Forest/Woodland	**2.5**	**28.6%**	**CD - NN**
Mature Forest/Woodland	**0.6**	**6.9%**	**CD**
Dry-Mesic Forest/Woodland (1)	0.0	0.0%	NA
Mesic Forest (2)	0.6	6.9%	CD
Altered Forest/Woodland (3)	**1.9**	**21.6%**	**NN**
Savanna/Brushland	**2.0**	**23.7%**	**D**
Savanna (4)	0.0	0.0%	NA
Shrub/Scrub (5)	2.0	23.7%	D
Grassland	**4.1**	**47.7%**	**C - NN**
Prairie (6)	4.1	47.4%	C - D
Non-Native Grassland (7)	0.0	0.3%	NN
Lowland Communities	**0.0**	**0.0%**	**NA**
Lowland Forest/Woodland	**0.0**	**0.0%**	**NA**
Lowland Forest/Woodland (8)	0.0	0.0%	NA
Lowland Savanna/Brushland	**0.0**	**0.0%**	**NA**
Lowland Savanna (9)	0.0	0.0%	NA
Lowland Shrub/Scrub (10)	0.0	0.0%	NA
Lowland Herbaceous	**0.0**	**0.0%**	**NA**
Herbaceous Wetland (11)	0.0	0.0%	NA
Open Water (12)	**0.0**	**0.0%**	**NA**
Totals	***8.6***	***100%***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.1.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate quality; D = Poor quality; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Figure 39. Natural/Semi-Natural Vegetation of Northern Heights Park



Natural Characteristics. Northern Hills Prairie Park is notable for its approximately 6-acre planted prairie, some of which has become overgrown with shrubs (Table 19 and Figure 39). The Prairie represents a patch of habitat for birds and pollinators, and despite its degraded condition, the adjacent forest/woodland provides habitat for native plants and wildlife.

Past Natural Area Management. Ecological restoration and management work has included establishment of the site's Prairie and its ongoing management (mostly prescribed burning).

Challenges & Opportunities. Altered/non-native plant communities occupy approximately 22% of the park's natural areas. The Prairie's moderate to poor quality is driven largely by areas of relatively low diversity, the presence of invasive plants (e.g., Canada thistle, curly dock, reed canary grass), and woody invasion by native trees and shrubs (mostly gray dogwood and smooth sumac). The Altered Forest/Woodland contains significant cover by invasive buckthorn and non-native honeysuckle; however, the patch of Mesic Forest contains a number of mature bur oak and black cherry. Due to these factors, the park provides habitat for fewer native plant and animal species than would be expected in a more intact and diverse assemblage of native plant communities. Low-diversity plant communities are less resilient to environmental change, which can lead to further degradation and reduced ecosystem services.

This park presents opportunities for accelerated management of the site's Prairie (primarily through prescribed burning), and enhancement of the site's forest/woodland areas (primarily through the removal of invasive species and planting of diverse native vegetation). These actions will improve the quality, ecosystem services, and resilience of this park. Restoration and management efforts in this park should be focused first on managing areas where restoration has begun (i.e., the Prairie), but then expand work into the park's adjacent and other natural areas. The park is surrounded mostly by developed land, limiting expansion and connection opportunities.

Olin Bird Sanctuary

Overview. Olin Bird Sanctuary consists of approximately 1.3 acres in the southwest quadrant of the City (Figure 19). There are no amenities or formal trails associated with this park, which is the smallest natural area assessed in this NAMP. The entirety of the park supports natural and semi-natural plant communities, which are of moderate-to-poor and poor ecological quality (Figure 40). The following table and figure (histogram) further characterize the site's natural/semi-natural vegetation and open water habitats.

Figure 40. Olin Bird Sanctuary Land Cover

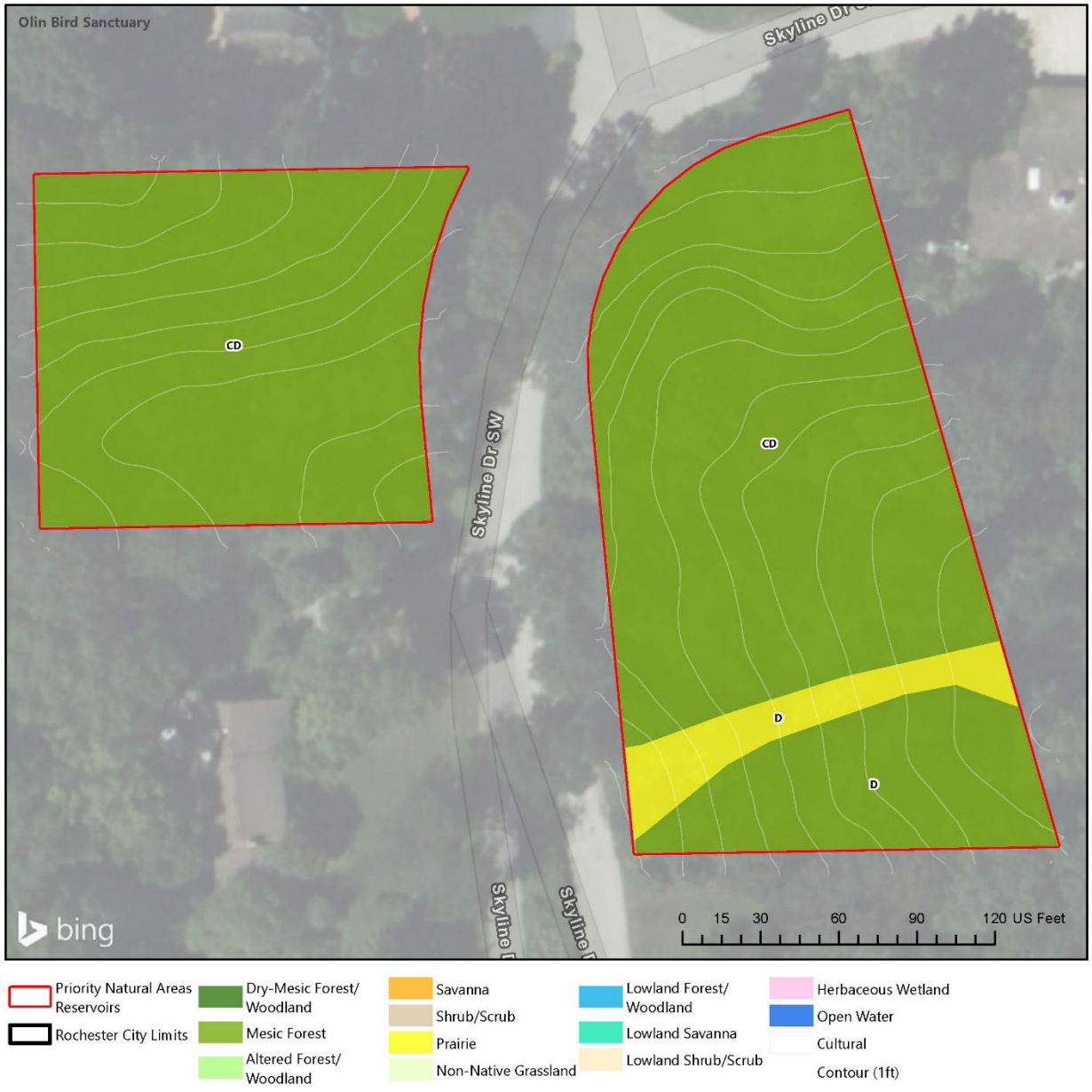


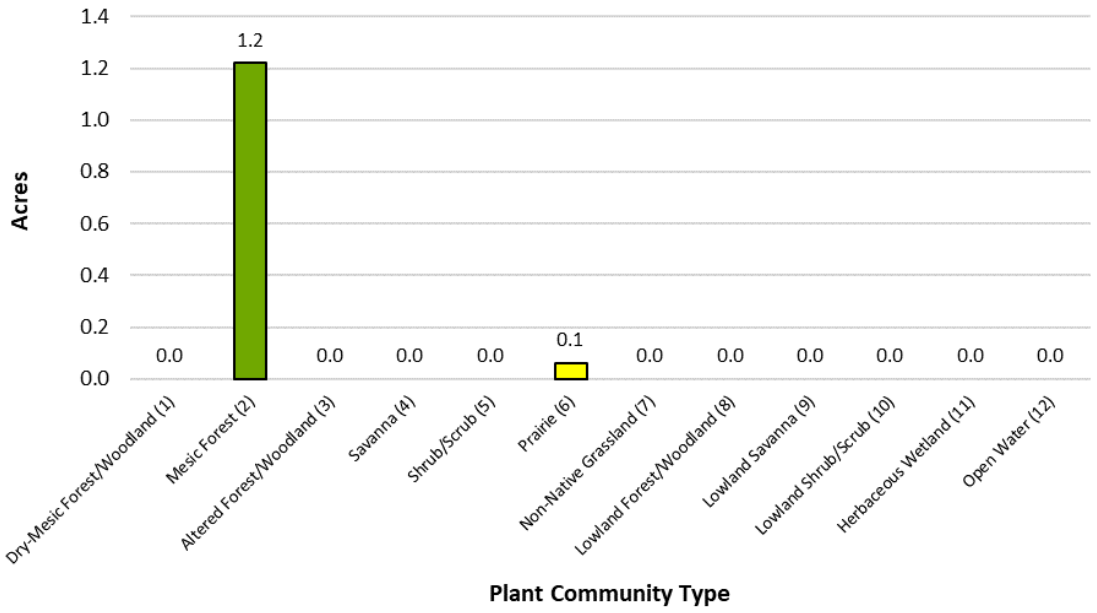
Table 20. Natural/Semi-Natural Vegetation of Olin Bird Sanctuary

PLANT COMMUNITIES[1]	NATURAL AREA ACRES	PERCENT OF TOTAL NATURAL AREA ACRES	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**1.3**	**100.0%**	**CD - D**
Forest/Woodland	**1.2**	**95.2%**	**CD - D**
Mature Forest/Woodland	**1.2**	**95.2%**	**CD - D**
Dry-Mesic Forest/Woodland (1)	0.0	0.0%	NA
Mesic Forest (2)	1.2	95.2%	CD - D
Altered Forest/Woodland (3)	**0.0**	**0.0%**	**NA**
Savanna/Brushland	**0.0**	**0.0%**	**NA**
Savanna (4)	0.0	0.0%	NA
Shrub/Scrub (5)	0.0	0.0%	NA
Grassland	**0.1**	**4.8%**	**D**
Prairie (6)	0.1	4.8%	D
Non-Native Grassland (7)	0.0	0.0%	NA
Lowland Communities	**0.0**	**0.0%**	**NA**
Lowland Forest/Woodland	**0.0**	**0.0%**	**NA**
Lowland Forest/Woodland (8)	0.0	0.0%	NA
Lowland Savanna/Brushland	**0.0**	**0.0%**	**NA**
Lowland Savanna (9)	0.0	0.0%	NA
Lowland Shrub/Scrub (10)	0.0	0.0%	NA
Lowland Herbaceous	**0.0**	**0.0%**	**NA**
Herbaceous Wetland (11)	0.0	0.0%	NA
Open Water (12)	**0.0**	**0.0%**	**NA**
Totals	***1.3***	***100%***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.1.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate quality; D = Poor quality; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Figure 41. Natural/Semi-Natural Vegetation of Olin Bird Sanctuary



Natural Characteristics. Olin Bird Sanctuary consists of two discontinuous stands of Mesic Forest, one of which contains a strip of planted prairie vegetation (Table 20 and Figure 41). Most of the forest is moderate-to-poor quality, and the prairie strip consists almost exclusively of planted wildflowers. These moderately degraded native plant communities provide small habitats for native plants, birds, and pollinators.

Past Natural Area Management. Ecological restoration and management work has included planting of the site's Prairie strip.

Challenges & Opportunities. The small size and generally degraded or low-diversity condition of the park's forest and prairie provide limited ecosystem services such as wildlife habitat. The Mesic Forest's moderate-to-poor and poor quality is driven largely by the presence of invasive plants (e.g., Norway maple, common buckthorn, non-native honeysuckle, dame's rocket, burdock, garlic mustard), and the Prairie had very low species diversity. Due to these factors, the park provides habitat for fewer native plant and animal species than would be expected in a more intact and diverse assemblage of native plant communities. Low-diversity plant communities are less resilient to environmental change, which can lead to further degradation and reduced ecosystem services.

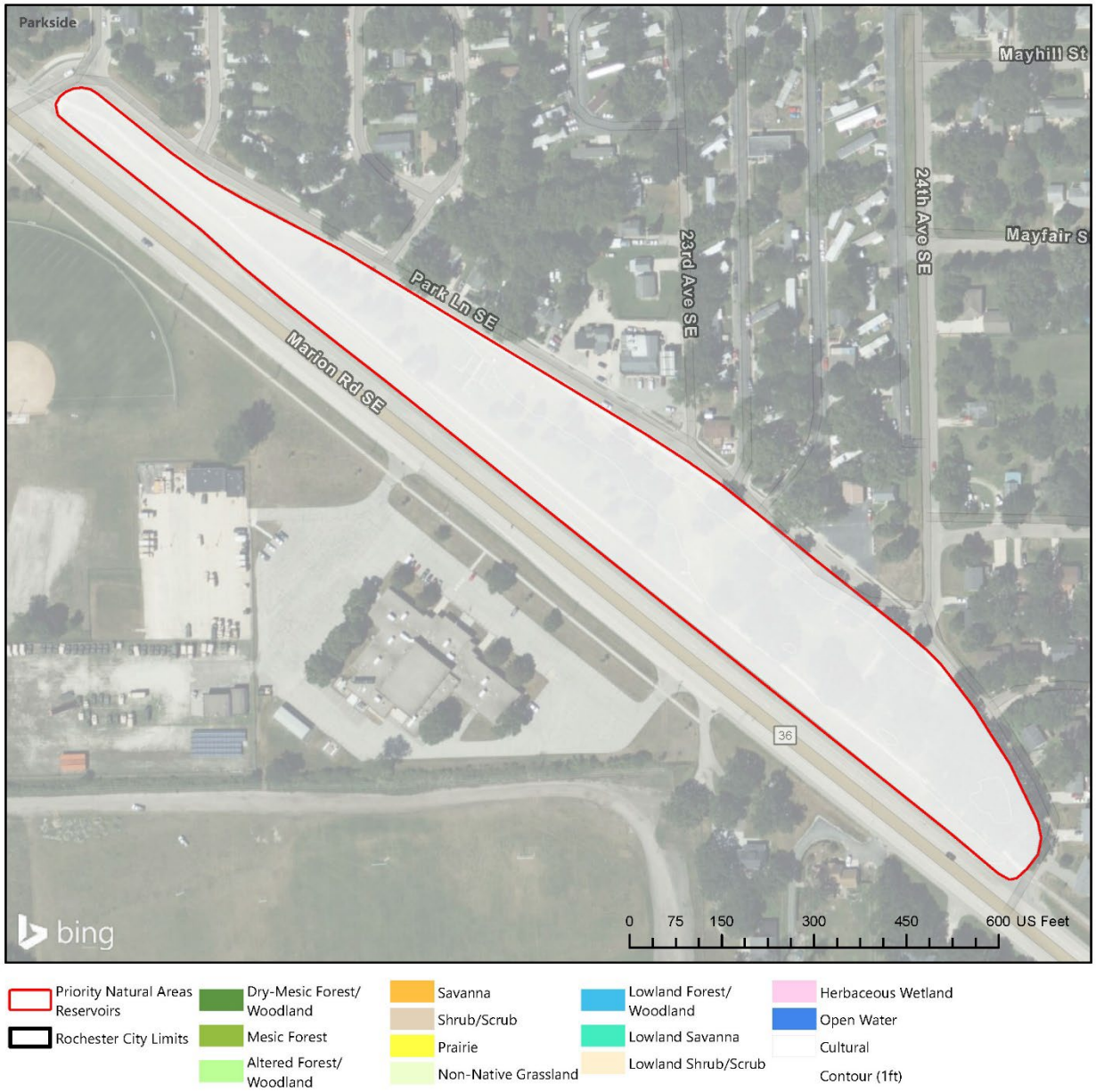
This park presents opportunities for enhancement of the site's Mesic Forest (primarily through the removal of invasive species and planting of diverse native vegetation) and diversification of the site's Prairie (primarily through prescribed burning and overseeding). These actions will improve the quality, ecosystem services, and resilience of this park. Restoration and management efforts in this park should be focused first on managing areas where restoration has begun (i.e., the Prairie), but then expand work into the park's adjacent forests.

The park is surrounded mostly by large-lot residential properties, limiting expansion and connection opportunities. However, restoration and other conservation practices in the adjacent privately-owned forests would benefit the ecological health of this small City park.

Parkside Park

Overview. Parkside Park consists of approximately 6.8 acres in the southeast quadrant of the City (Figure 19). This is the second-smallest natural area assessed in this NAMP. The entire park contains maintained turf, with the exception of a small area of community gardens near the center of the park. In addition to numerous planted conifers, a stand of mature bur oaks exists in the southeast portion of the site. Due to the absence of natural or semi-natural plant communities (Figure 42), no acreage table or histogram of natural areas is provided.

Figure 42. Parkside Park Land Cover



Natural Characteristics. Parkside Park lacks natural or semi-natural vegetation. However, the stand of mature bur oaks is an impressive feature of the site.

Past Natural Area Management. To date, no ecological restoration and management work has been conducted at the park.

Challenges & Opportunities. This park contains significant areas of underutilized turf. Converting some of these areas to native prairie and savanna would reduce the need for regular mowing and provide important and attractive native pollinator habitat. Restoration and management efforts in this park should consist of establishing prairie and savanna vegetation beneath the stand of mature oaks in the southeast portion of the park, and then expand similar conversions into adjacent and nearby underutilized turf areas within the park.

The park is surrounded mostly by developed land, limiting expansion and connection opportunities. City-owned McQuillan Field lies to the west of the site, across Marion Road SE.

Plummer House

Overview. Plummer House, known primarily for its buildings and gardens, consists of approximately 9 acres in the southwest quadrant of the City (Figure 19). The park is visited regularly by the community. Of the parkland, approximately 6 acres support natural and semi-natural plant communities, most of which are of poor ecological quality (Figure 43). The following table and figure (histogram) further characterize the site's natural/semi-natural vegetation and open water habitats.

Figure 43. Plummer House Land Cover

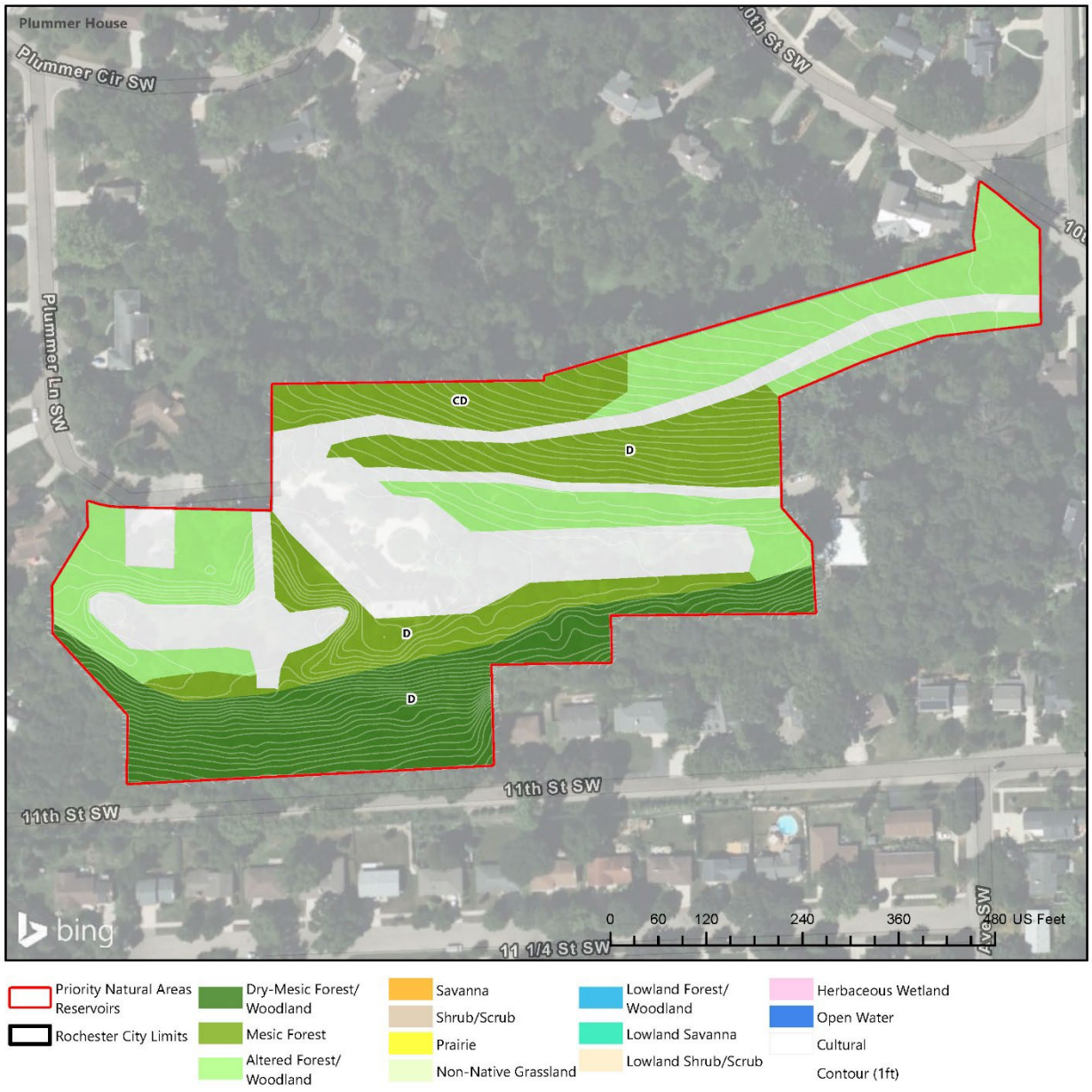


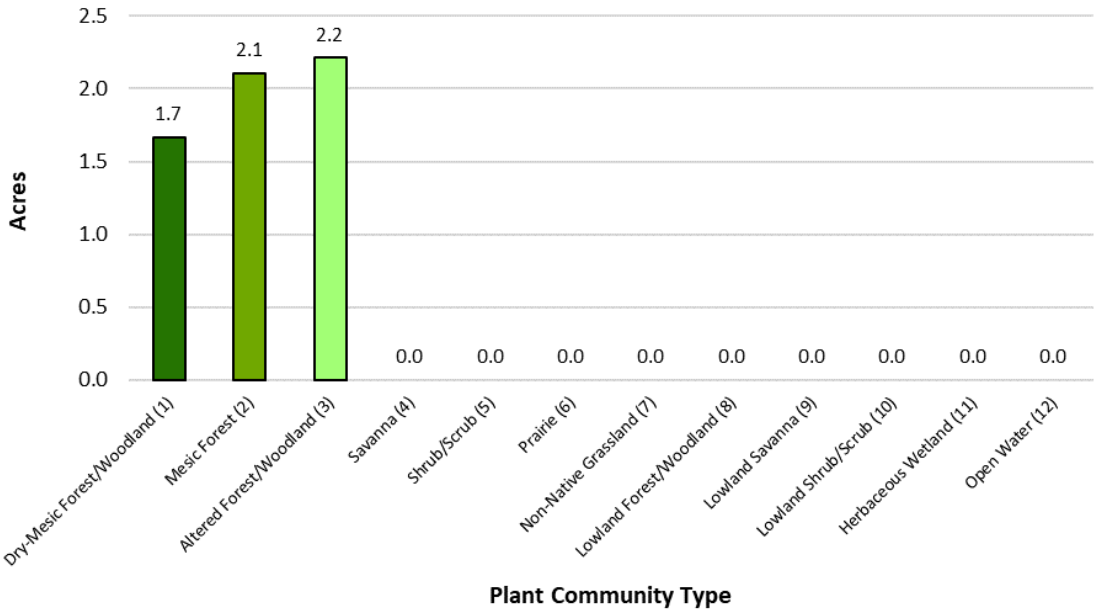
Table 21. Natural/Semi-Natural Vegetation of Plummer House

PLANT COMMUNITIES[1]	NATURAL AREA ACRES	PERCENT OF TOTAL NATURAL AREA ACRES	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**6.0**	**100.0%**	**CD - NN**
Forest/Woodland	**6.0**	**100.0%**	**CD - NN**
Mature Forest/Woodland	**3.8**	**63.0%**	**CD - D**
Dry-Mesic Forest/Woodland (1)	1.7	27.8%	D
Mesic Forest (2)	2.1	35.2%	CD - D
Altered Forest/Woodland (3)	**2.2**	**37.0%**	**NN**
Savanna/Brushland	**0.0**	**0.0%**	**NA**
Savanna (4)	0.0	0.0%	NA
Shrub/Scrub (5)	0.0	0.0%	NA
Grassland	**0.0**	**0.0%**	**NA**
Prairie (6)	0.0	0.0%	NA
Non-Native Grassland (7)	0.0	0.0%	NA
Lowland Communities	**0.0**	**0.0%**	**NA**
Lowland Forest/Woodland	**0.0**	**0.0%**	**NA**
Lowland Forest/Woodland (8)	0.0	0.0%	NA
Lowland Savanna/Brushland	**0.0**	**0.0%**	**NA**
Lowland Savanna (9)	0.0	0.0%	NA
Lowland Shrub/Scrub (10)	0.0	0.0%	NA
Lowland Herbaceous	**0.0**	**0.0%**	**NA**
Herbaceous Wetland (11)	0.0	0.0%	NA
Open Water (12)	**0.0**	**0.0%**	**NA**
Totals	***6.0***	***100%***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.1.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate quality; D = Poor quality; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Figure 44. Natural/Semi-Natural Vegetation of Plummer House



Natural Characteristics. Plummer House is notable for supporting 6 acres of various forest types (Table 21 and Figure 44). Although these forests are altered or significantly degraded, this wooded track represents an opportunity to improve the ecological health of a high-visibility forest.

Past Natural Area Management. Ecological restoration and management work has included removal of invasive shrubs and pulling of garlic mustard by volunteers.

Challenges & Opportunities. Altered/non-native plant communities occupy over one-third of the park's natural areas. The generally poor quality of this park's native plant communities is driven largely by the presence of invasive plants (e.g., Norway maple, Amur maple, common buckthorn, non-native honeysuckle, garlic mustard); however, the park's many trails, driveways, and cultural landscapes fragment the already small stand of forest and woodland. As a result, the park provides habitat for fewer native plant and animal species than would be expected in a more intact and diverse prairie. Low-diversity plant communities are less resilient to environmental change, which can lead to further degradation and reduced ecosystem services.

This park presents an opportunity for continued and expanded restoration and management of this complex of forest types. This would consist primarily of removing invasive species and planting diverse native vegetation. The park's Dry-Mesic Forest/Woodland (along the southern edge of the site) is situated on a steep, south-facing slope, which over time may allow for restoration of a fire-dependent oak woodland or savanna. These actions will improve the quality, ecosystem services, and resilience of this park. Restoration and management efforts in this park should be focused first on areas where previous removals have been conducted by volunteers and then expanded into adjacent natural areas.

The park is surrounded mostly by large-lot residential properties, limiting expansion and connection opportunities. However, restoration and other conservation practices in the adjacent privately-owned forests would benefit the ecology of this small City park.

Prairie Crossing Park

Overview. Prairie Crossing Park consists of approximately 8.5 acres in the northwest quadrant of the City (Figure 19). This relatively new park has recently undergone brush removal, native seeding, and installation of a woodchip trail, used by local residents. The entirety of the park supports natural and semi-natural plant communities, which are of moderate-to-poor ecological quality due to the relatively young condition of the restoration (Figure 45). The following table and figure (histogram) further characterize the site's natural/semi-natural vegetation and open water habitats.

Figure 45. Prairie Crossing Park Land Cover

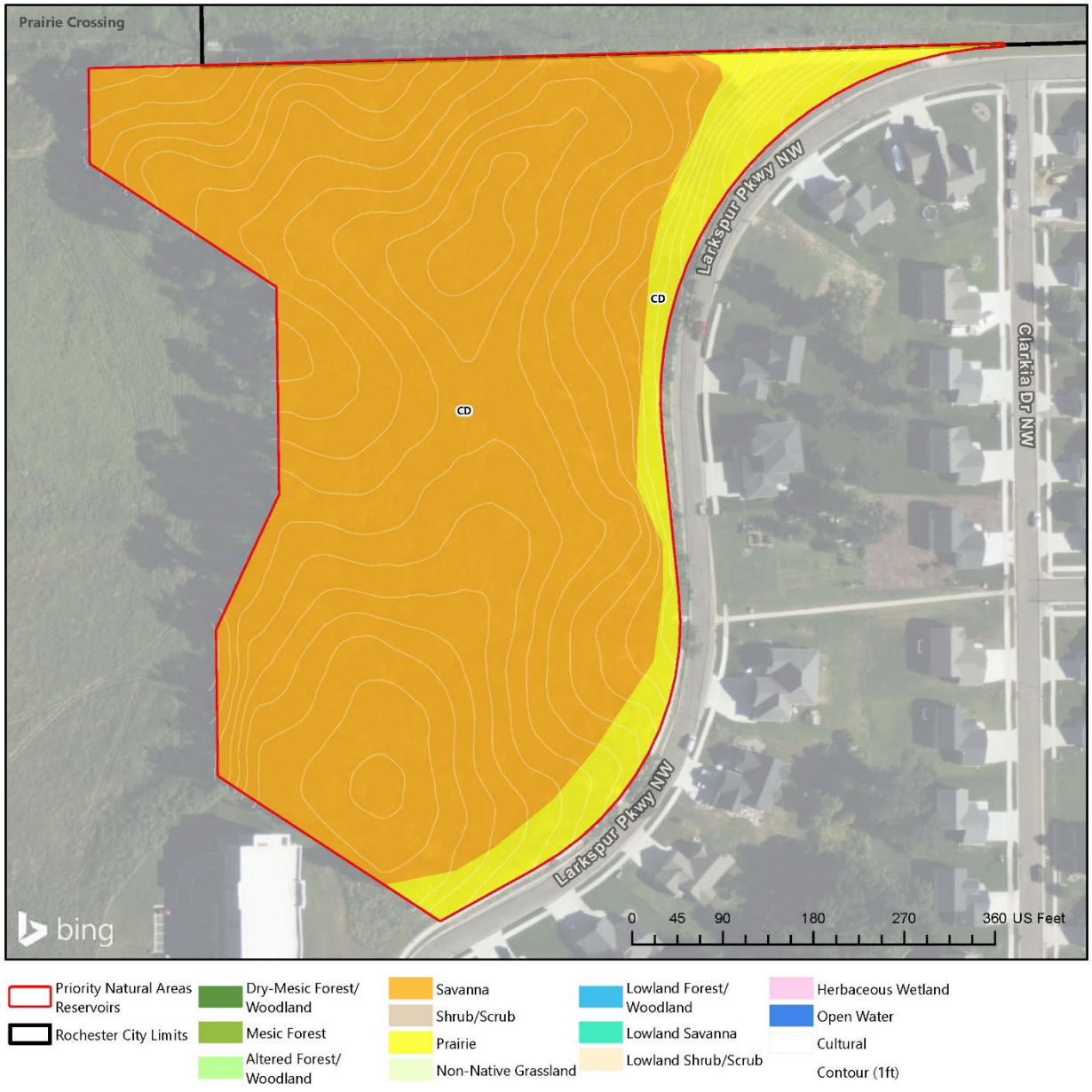


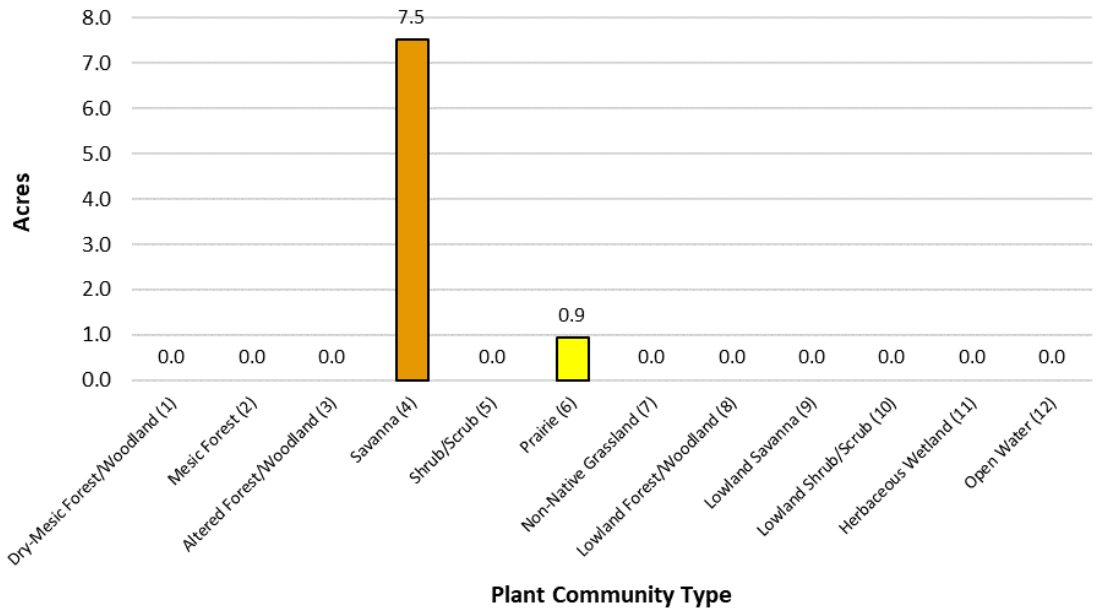
Table 22. Natural/Semi-Natural Vegetation of Prairie Crossing Park

PLANT COMMUNITIES[1]	NATURAL AREA ACRES	PERCENT OF TOTAL NATURAL AREA ACRES	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**8.5**	**100.0%**	**CD**
Forest/Woodland	**0.0**	**0.0%**	**NA**
Mature Forest/Woodland	**0.0**	**0.0%**	**NA**
Dry-Mesic Forest/Woodland (1)	0.0	0.0%	NA
Mesic Forest (2)	0.0	0.0%	NA
Altered Forest/Woodland (3)	**0.0**	**0.0%**	**NA**
Savanna/Brushland	**7.5**	**88.9%**	**CD**
Savanna (4)	7.5	88.9%	CD
Shrub/Scrub (5)	0.0	0.0%	NA
Grassland	**0.9**	**11.1%**	**CD**
Prairie (6)	0.9	11.1%	CD
Non-Native Grassland (7)	0.0	0.0%	NA
Lowland Communities	**0.0**	**0.0%**	**NA**
Lowland Forest/Woodland	**0.0**	**0.0%**	**NA**
Lowland Forest/Woodland (8)	0.0	0.0%	NA
Lowland Savanna/Brushland	**0.0**	**0.0%**	**NA**
Lowland Savanna (9)	0.0	0.0%	NA
Lowland Shrub/Scrub (10)	0.0	0.0%	NA
Lowland Herbaceous	**0.0**	**0.0%**	**NA**
Herbaceous Wetland (11)	0.0	0.0%	NA
Open Water (12)	**0.0**	**0.0%**	**NA**
Totals	***8.5***	***100%***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.1.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate quality; D = Poor quality; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Figure 46. Natural/Semi-Natural Vegetation of Prairie Crossing Park



Natural Characteristics. Prairie Crossing Park is notable for the restoration of over 8 acres of Savanna and adjacent Prairie (Table 22 and Figure 46). Although the Savanna and Prairie are ranked as only moderate-to-poor quality, this is because it is a young restoration. With ongoing management, this site has good potential for becoming a high-quality Savanna/Prairie complex.

Past Natural Area Management. Ecological restoration and management work has included removal of non-savanna tree species, removal of dead standing trees, forestry mowing, overseeding, and spot spraying of invasive vegetation.

Challenges & Opportunities. The moderate-to-poor quality of this park's native plant communities is driven largely by the presence of invasive plants (e.g., common buckthorn seedlings and saplings, Canada thistle, burdock, garlic mustard). As a result, the park provides habitat for fewer native plant and animal species than would be expected in a more intact and diverse prairie. Low-diversity plant communities are less resilient to environmental change, which can lead to further degradation and reduced ecosystem services.

While initial restoration work has been completed at this park, ongoing management (primarily the removal of invasive species) and continued planting of diverse native vegetation will be critical over the coming years. These actions will improve the quality, ecosystem services, and resilience of this park. Park expansion and connection opportunities exist north (forest) and west (undeveloped fields and wetlands) of the park.

Quarry Hill Park

Overview. Quarry Hill Park consists of approximately 318 acres in the northeast quadrant of the City (Figure 19). This is the largest City-owned natural area in Rochester and the location of the popular Quarry Hill Nature Center. The park has ballfields on its western edge, and its extensive trail system is heavily used by the community. Of the parkland, approximately 293 acres support natural and semi-natural plant communities and open water habitats, which range from good to poor ecological quality (Figure 47). The following table and figure (histogram) further characterize the site's natural/semi-natural vegetation and open water habitats.

Figure 47. Quarry Hill Park Land Cover

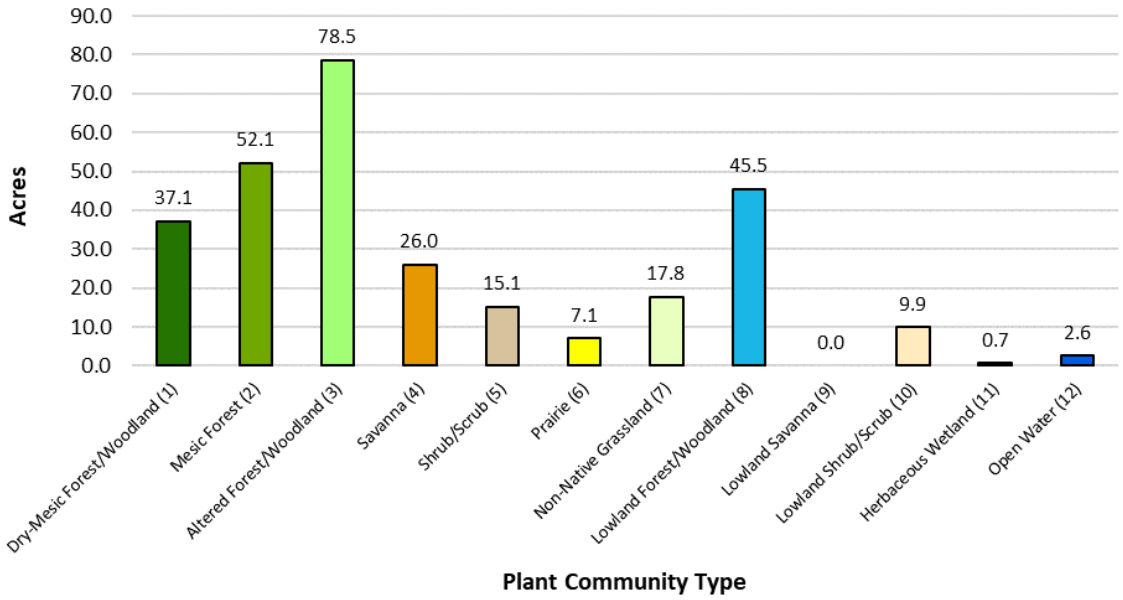
Table 23. Natural/Semi-Natural Vegetation of Quarry Hill Park

PLANT COMMUNITIES[1]	NATURAL AREA ACRES	PERCENT OF TOTAL NATURAL AREA ACRES	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**233.7**	**79.9%**	**B - NN**
Forest/Woodland	**167.7**	**57.3%**	**C- NN**
Mature Forest/Woodland	**89.2**	**30.5%**	**C - D**
Dry-Mesic Forest/Woodland (1)	37.1	12.7%	C - D
Mesic Forest (2)	52.1	17.8%	C - D
Altered Forest/Woodland (3)	**78.5**	**26.9%**	**NN**
Savanna/Brushland	**41.1**	**14.0%**	**B - NN**
Savanna (4)	26.0	8.9%	B - C
Shrub/Scrub (5)	15.1	5.2%	C - NN
Grassland	**24.9**	**8.5%**	**B - NN**
Prairie (6)	7.1	2.4%	B - CD
Non-Native Grassland (7)	17.8	6.1%	NN
Lowland Communities	**58.8**	**20.1%**	**C - NN**
Lowland Forest/Woodland	**45.5**	**15.6%**	**C - D**
Lowland Forest/Woodland (8)	45.5	15.6%	C - D
Lowland Savanna/Brushland	**9.9**	**3.4%**	**C - D**
Lowland Savanna (9)	0.0	0.0%	NA
Lowland Shrub/Scrub (10)	9.9	3.4%	C - D
Lowland Herbaceous	**0.7**	**0.2%**	**C - NN**
Herbaceous Wetland (11)	0.7	0.2%	C - NN
Open Water (12)	**2.6**	**0.9%**	**NA**
Totals	***292.4***	***100%***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.1.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate quality; D = Poor quality; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Figure 48. Natural/Semi-Natural Vegetation of Quarry Hill Park



Natural Characteristics. Quarry Hill Park is notable for its large acreage of a diverse mosaic of natural areas with an extensive trail network (Table 23 and Figure 48). The majority of the park is forested, but there is a significant Savanna restoration in the west-central portion of the site, and there are several smaller Prairie restorations as well as a remnant goat prairie. Although most of the forests are altered or ranked as moderate or poor quality, they represent a large complex of forest habitats. The Savanna and most of the Prairies range from good to moderate quality. The former quarry, located in the southwestern portion of the park, consists of an interesting assemblage of upland and lowland plant communities.

Past Natural Area Management. Ecological restoration and management work (much of which has been conducted by the Friends of Quarry Hill, Master Naturalists and the Weed Warrior volunteers) has included forestry mowing and goat browsing in the Savanna, control of garlic mustard, tree plantings, goose management, and bow hunting to reduce deer density.

Challenges & Opportunities. Altered/non-native plant communities occupy over one-third of the park's natural areas. The moderate to poor quality of many of this park's native plant communities is driven largely by the presence of invasive plants (e.g., common buckthorn, non-native honeysuckle, garlic mustard, reed canary grass). As a result, the park provides habitat for fewer native plant and animal species than would be expected in a more intact and diverse prairie. Low-diversity plant communities are less resilient to environmental change, which can lead to further degradation and reduced ecosystem services.

While significant restoration and management work has been conducted at this park, many portions of the park have not undergone any such efforts. Ongoing management of ongoing restoration sites (primarily the control of invasive species) and expansion of restoration work will improve the quality, ecosystem services, and resilience of this park. Restoration and management efforts in this park should be focused first on areas where previous restoration has been conducted and then expanded into adjacent and higher quality natural areas.

The park is surrounded mostly by residential properties, limiting expansion and connection opportunities. However, the Silver Creek riparian corridor runs along the southern portion of the park, including a broad expanse of undeveloped fields and wetlands to the west.

Silver Creek Reservoir

Overview. Silver Creek Reservoir (one of the City's flood control projects) consists of approximately 113 acres; the reservoir's open water is not included in the site. While located outside the City limits, the reservoir site is most-closely associated with the northeast quadrant of the City (Figure 19). Almost all of Silver Creek Reservoir supports natural and semi-natural plant communities, most of which are altered or of poor ecological quality (Figure 49). The following table and figure (histogram) further characterize the site's natural/semi-natural vegetation and open water habitats.

Figure 49. Silver Creek Reservoir Land Cover

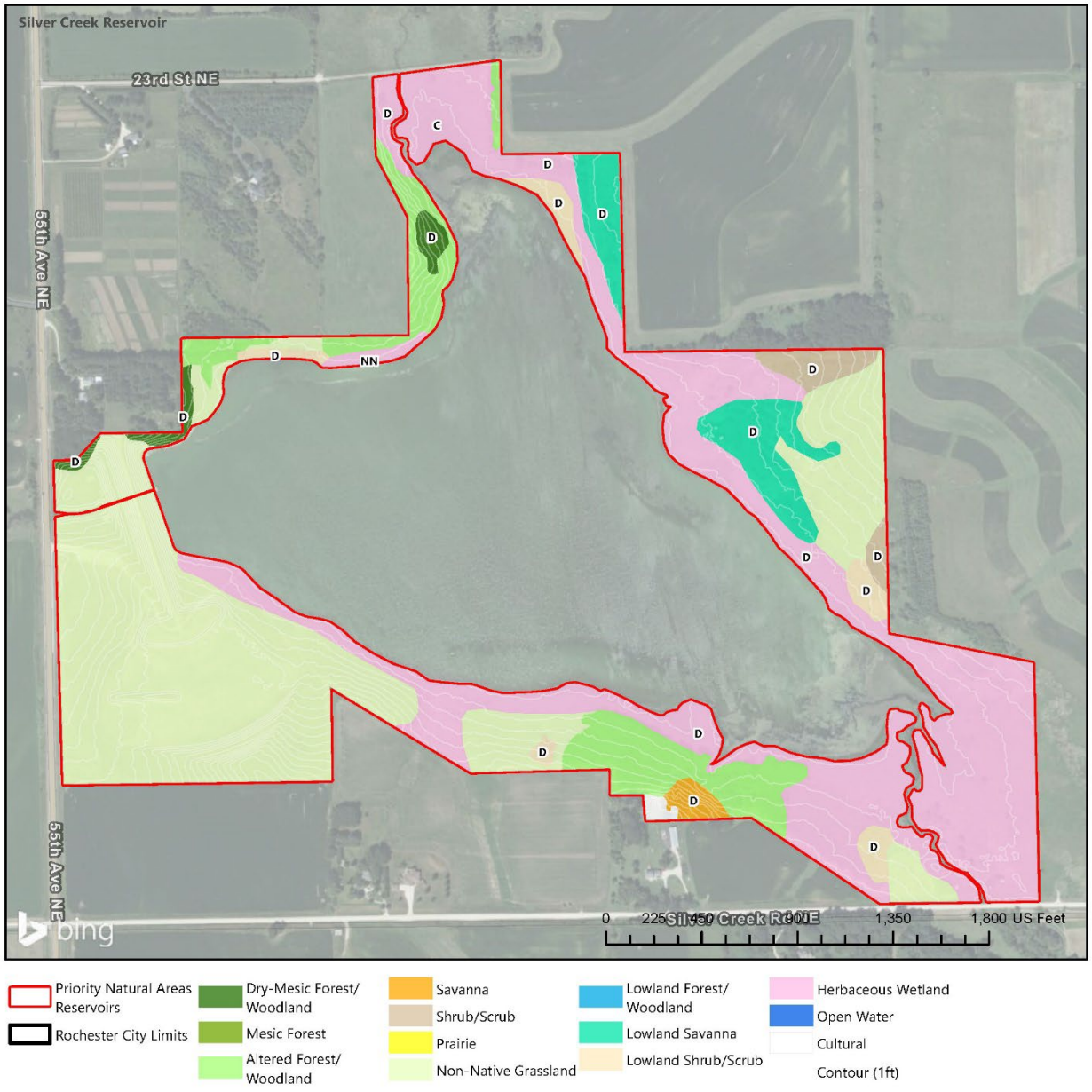


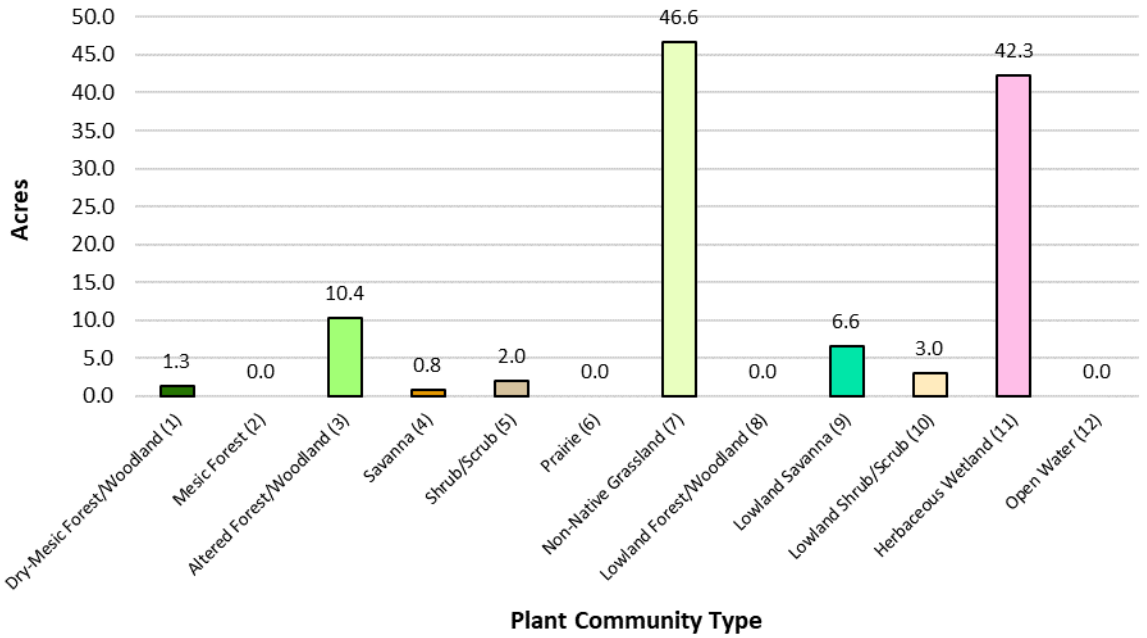
Table 24. Natural/Semi-Natural Vegetation of Silver Creek Reservoir

PLANT COMMUNITIES[1]	NATURAL AREA ACRES	PERCENT OF TOTAL NATURAL AREA ACRES	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**61.2**	**54.1%**	**D - NN**
Forest/Woodland	**11.7**	**10.3%**	**D - NN**
Mature Forest/Woodland	**1.3**	**1.2%**	**D**
Dry-Mesic Forest/Woodland (1)	1.3	1.2%	D
Mesic Forest (2)	0.0	0.0%	NA
Altered Forest/Woodland (3)	**10.4**	**9.2%**	**NN**
Savanna/Brushland	**2.9**	**2.5%**	**D**
Savanna (4)	0.8	0.7%	D
Shrub/Scrub (5)	2.0	1.8%	D
Grassland	**46.6**	**41.2%**	**NN**
Prairie (6)	0.0	0.0%	NA
Non-Native Grassland (7)	46.6	41.2%	NN
Lowland Communities	**51.9**	**45.9%**	**C - NN**
Lowland Forest/Woodland	**0.0**	**0.0%**	**NA**
Lowland Forest/Woodland (8)	0.0	0.0%	NA
Lowland Savanna/Brushland	**9.5**	**8.4%**	**D**
Lowland Savanna (9)	6.6	5.8%	D
Lowland Shrub/Scrub (10)	3.0	2.6%	D
Lowland Herbaceous	**42.3**	**37.4%**	**C - NN**
Herbaceous Wetland (11)	42.3	37.4%	C - NN
Open Water (12)	**0.0**	**0.0%**	**NA**
Totals	***113.1***	***100%***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.1.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate quality; D = Poor quality; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Figure 50. Natural/Semi-Natural Vegetation of Silver Creek Reservoir



Natural Characteristics. Silver Creek Reservoir is notable large areas of Non-native Grassland and Herbaceous Wetland (Table 24 and Figure 50). Although these plant communities are altered and/or degraded, they do provide habitat for native plant and wildlife species.

Past Natural Area Management. Ecological restoration and management work has included control of wild parsnip and removal of gophers that could compromise the integrity of the reservoir dam.

Challenges & Opportunities. Altered/non-native plant communities occupy half of the site. The poor quality of this site's native plant communities is driven largely by the presence of invasive plants (e.g., common buckthorn, non-native honeysuckle, wild parsnip, reed canary grass, invasive cattail). As a result, the site provides habitat for far fewer native plant and animal species than would be expected in a more intact and diverse prairie/wetland complex. Low-diversity plant communities are less resilient to environmental change, which can lead to further degradation and reduced ecosystem services.

This site presents opportunities for restoration and management of the site's natural areas. Converting the site's Non-native Grassland to Prairie and its degraded Herbaceous Wetland to native wet prairie/wet meadow will improve the quality, ecosystem services, and resilience of this site. Restoration and management efforts should be focused first on restoration of Prairie, as this process is relatively straight forward and would provide a large tract of habitat that would benefit a diversity of birds and pollinators. Restoration and management should then expand into the site's adjacent wetland and wooded areas. Park expansion and connection opportunities exist around most of the site perimeter due to the predominantly agricultural lands in the area.

Silver Lake Park

Overview. Silver Lake Park consists of approximately 78 acres in the northeast quadrant of the City (Figure 19). Silver Lake, an impounded portion of Silver Creek, is not included in the park boundary. Of the parkland, approximately 16 acres support natural and semi-natural plant communities, most of which are of good-to-moderate and moderate ecological quality (Figure 51). The following table and figure (histogram) further characterize the site's natural/semi-natural vegetation and open water habitats.

Figure 51. Silver Lake Park Land Cover

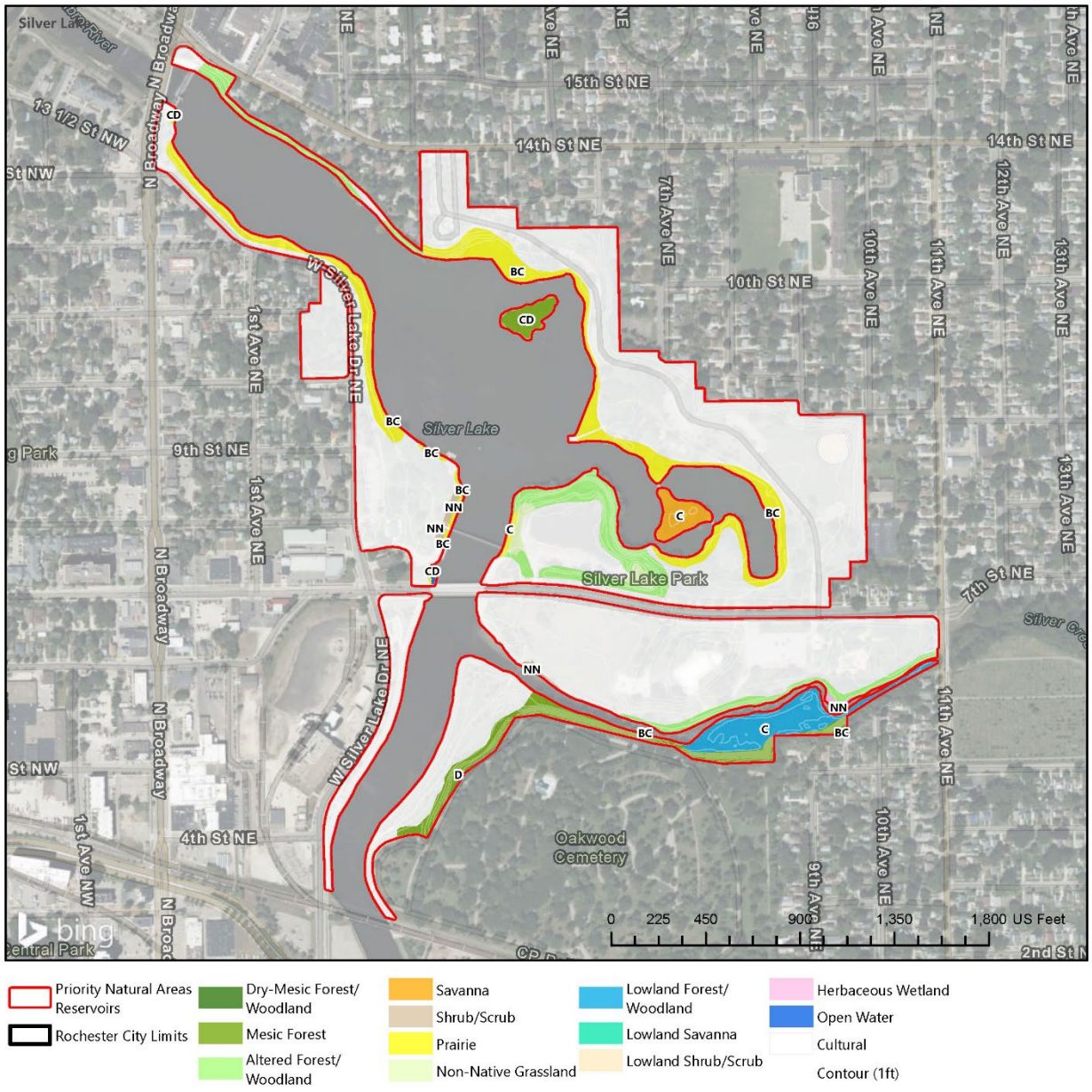


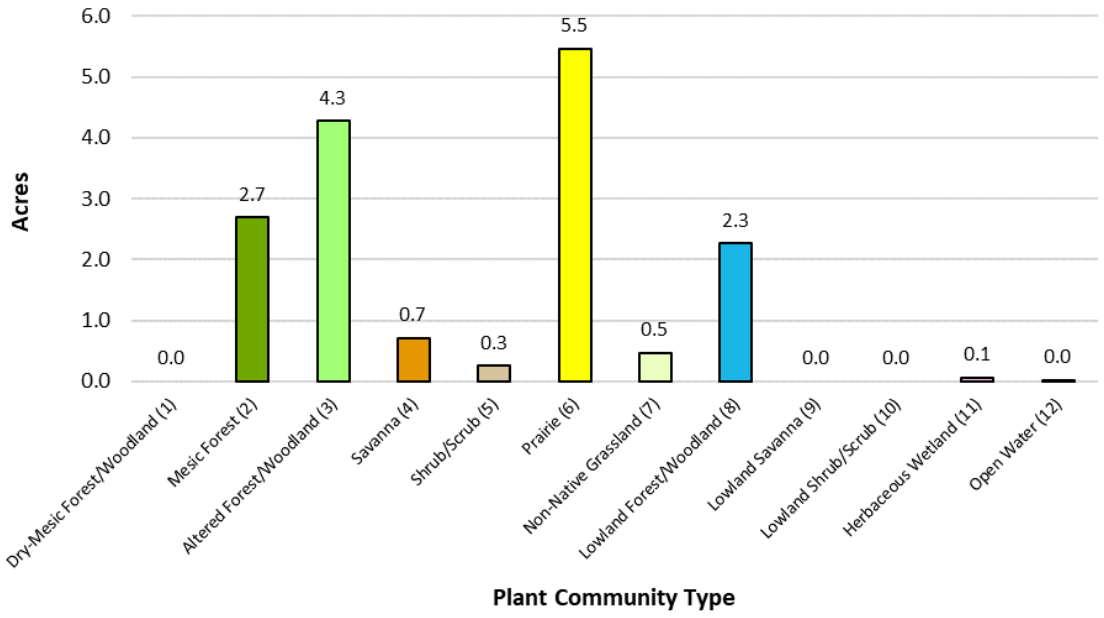
Table 25. Natural/Semi-Natural Vegetation of Silver Lake Park

PLANT COMMUNITIES[1]	NATURAL AREA ACRES	PERCENT OF TOTAL NATURAL AREA ACRES	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**13.9**	**85.5%**	**BC - NN**
Forest/Woodland	**7.0**	**43.0%**	**BC - NN**
Mature Forest/Woodland	**2.7**	**16.6%**	**BC - D**
Dry-Mesic Forest/Woodland (1)	0.0	0.0%	NA
Mesic Forest (2)	2.7	16.6%	BC - D
Altered Forest/Woodland (3)	**4.3**	**26.4%**	**NN**
Savanna/Brushland	**1.0**	**5.9%**	**C - NN**
Savanna (4)	0.7	4.4%	C
Shrub/Scrub (5)	0.3	1.6%	NN
Grassland	**5.9**	**36.6%**	**BC - NN**
Prairie (6)	5.5	33.7%	BC - CD
Non-Native Grassland (7)	0.5	2.9%	NN
Lowland Communities	**2.3**	**14.5%**	**C - NN**
Lowland Forest/Woodland	**2.3**	**14.0%**	**C**
Lowland Forest/Woodland (8)	2.3	14.0%	C
Lowland Savanna/Brushland	**0.0**	**0.0%**	**NA**
Lowland Savanna (9)	0.0	0.0%	NA
Lowland Shrub/Scrub (10)	0.0	0.0%	NA
Lowland Herbaceous	**0.1**	**0.4%**	**NN**
Herbaceous Wetland (11)	0.1	0.4%	NN
Open Water (12)	**0.0**	**0.1%**	**NA**
Totals	***16.2***	***100%***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.1.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate quality; D = Poor quality; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Figure 52. Natural/Semi-Natural Vegetation of Silver Lake Park



Natural Characteristics. Silver Lake Park is notable for supporting over 5 acres of Prairie planted as a natural buffer around the lakeshore (Table 25 and Figure 52). Although only a narrow strip, this good-to-moderate quality stand of Prairie in one of the City's most popular parks provides important habitat for prairie-dependent wildlife, including many species of birds and pollinators. A narrow strip of good-to-moderate quality Mesic Forest exists along the park's southern boundary. The lake, natural shoreline, tributary, and adjacent forests and woodlands all provide habitat for a diversity of riparian, wetland, and aquatic species, including waterfowl.

Past Natural Area Management. Ecological restoration and management work has included mowing of the site's prairies (prescribed fire has not been used due to the park's urban location) and goose management.

Challenges & Opportunities. Altered/non-native plant communities occupy approximately 30% of the park's natural areas. The good-to-moderate to poor quality of this park's native plant communities is driven largely by the presence of invasive plants (Siberian elm, common buckthorn, invasive honeysuckle, reed canary grass) and the narrow, highly fragmented nature of these habitats. As a result, the park provides habitat for fewer native plant and animal species than would be expected in a more intact and diverse prairie. Low-diversity plant communities are less resilient to environmental change, which can lead to further degradation and reduced ecosystem services.

This park presents opportunities for enhancement of the site's prairies and forest/woodlands. Continued management of the lakeshore Prairie, coupled with invasive vegetation removals and native enhancement plantings, will improve the quality, ecosystem services, and resilience of this park. Restoration and management efforts in this park should be focused first on managing areas where restoration has begun (i.e., the prairies), but then expand work into the park's adjacent and other natural areas. The park is surrounded mostly by intensely developed land, limiting expansion and connection opportunities; however, restoration plantings and other conservation practices in Oakwood Cemetery (south of the park) would benefit the ecological health of Silver Lake Park.

Zumbro South Park

Overview. Zumbro South Park consists of approximately 229 acres in the southwest quadrant of the City (Figure 19). Of the parkland, approximately 219 acres support natural and semi-natural plant communities and open water habitats, most of which are of moderate to poor ecological quality (Figure 53). The following table and figure (histogram) further characterize the site's natural/semi-natural vegetation and open water habitats.

Figure 53. Zumbro South Park Land Cover

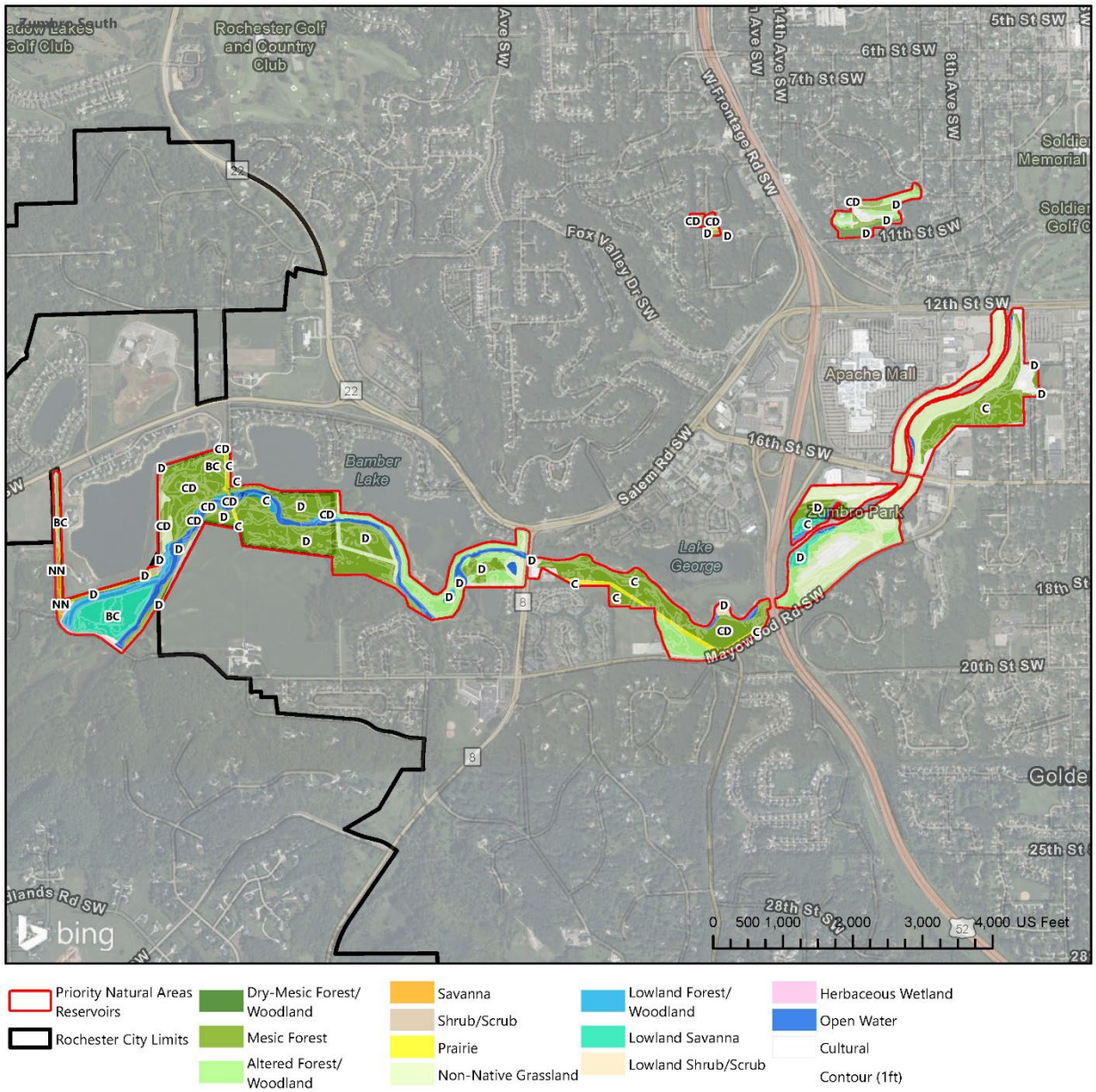


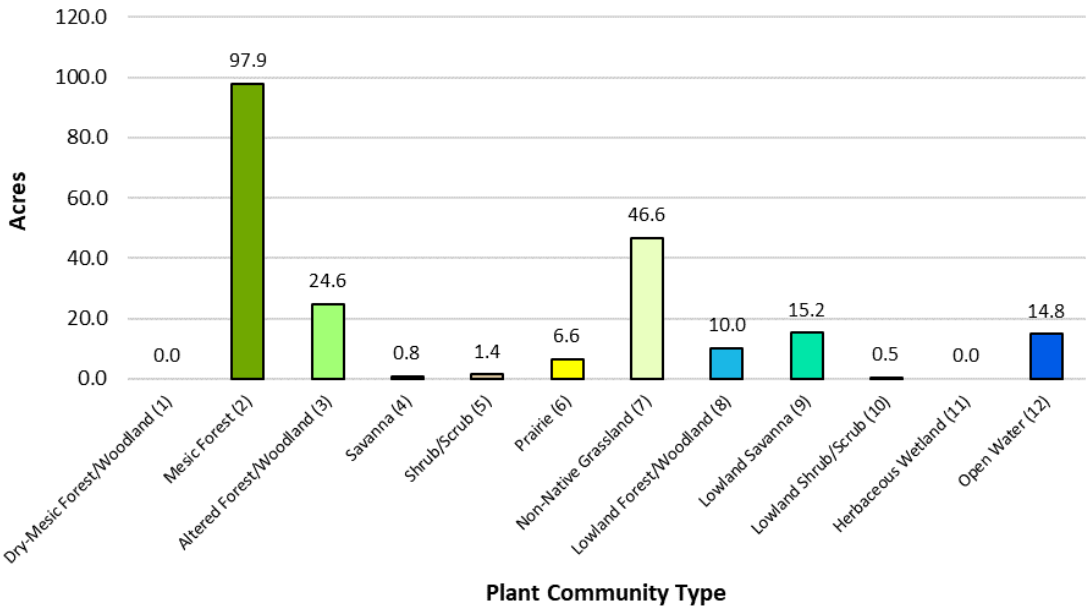
Table 26. Natural/Semi-Natural Vegetation of Zumbro South Park

PLANT COMMUNITIES[1]	NATURAL AREA ACRES	PERCENT OF TOTAL NATURAL AREA ACRES	ECOLOGICAL QUALITY RANKS[2]
Upland Communities	**177.9**	**81.4%**	**BC - NN**
Forest/Woodland	**122.5**	**56.1%**	**BC - NN**
Mature Forest/Woodland	**97.9**	**44.8%**	**BC - D**
Dry-Mesic Forest/Woodland (1)	0.0	0.0%	NA
Mesic Forest (2)	97.9	44.8%	BC - D
Altered Forest/Woodland (3)	**24.6**	**11.3%**	**NN**
Savanna/Brushland	**2.2**	**1.0%**	**D - NN**
Savanna (4)	0.8	0.4%	NN
Shrub/Scrub (5)	1.4	0.6%	D - NN
Grassland	**53.2**	**24.3%**	**BC - NN**
Prairie (6)	6.6	3.0%	BC - D
Non-Native Grassland (7)	46.6	21.3%	NN
Lowland Communities	**40.6**	**18.6%**	**BC - D**
Lowland Forest/Woodland	**10.0**	**4.6%**	**C - D**
Lowland Forest/Woodland (8)	10.0	4.6%	C - D
Lowland Savanna/Brushland	**15.7**	**7.2%**	**BC - D**
Lowland Savanna (9)	15.2	7.0%	BC - D
Lowland Shrub/Scrub (10)	0.5	0.2%	D
Lowland Herbaceous	**0.0**	**0.0%**	**NA**
Herbaceous Wetland (11)	0.0	0.0%	NA
Open Water (12)	**14.8**	**6.8%**	**NA**
Totals	***218.5***	***100%***	

[1] See Table 2 for brief descriptions of plant community types

[2] See Section 2.1.3 for Ecological Quality Rank discussion; A = Highest quality; B = Good quality; C = Moderate quality; D = Poor quality; combinations of letters (e.g., BC) represent a mosaic of quality ranks; NN = Not a natural community; NA = Not applicable

Figure 54. Natural/Semi-Natural Vegetation of Zumbro South Park



Natural Characteristics. Zumbro South Park is notable for supporting almost 100 acres of Mesic Forest (Table 26 and Figure 54). Although most is moderately degraded, the extensive stand of forested habitat along a major riparian corridor in the City make the site an important location with a potential for great conservation value.

Past Natural Area Management. Ecological restoration and management work has included establishment of Prairie (mostly along rights-of-way), removal and control of invasive shrubs by forestry mowing and goat grazing, and bow hunting to reduce deer density.

Challenges & Opportunities. Altered/non-native plant communities occupy over one-third of the park's natural areas (not including Open Water). The moderate to poor quality of the majority of the park's native plant communities is driven largely by the abundance of invasive plants (e.g., common buckthorn, non-native honeysuckle, reed canary grass, and creeping Charlie). As a result, the park provides habitat for fewer native plant and animal species than would be expected in a more intact and diverse riparian forest. Low-diversity plant communities are less resilient to environmental change, which can lead to further degradation and reduced ecosystem services.

This park presents opportunities for continued restoration and enhancement of a large tract of native forest, as well as conversion of extensive Non-native Grassland to Prairie or other native plant community. Continued and accelerated removal of non-native shrubs and other invasive vegetation, coupled with native replacement plantings, will improve the quality, ecosystem services, and resilience of this park. Restoration and management efforts in this park should be focused first on managing areas where restoration has begun, but then expand work into the park's adjacent and/or higher quality natural areas.

Park expansion and connection opportunities exist around much of this park. The South Fork Zumbro River riparian corridor extends west of the park, and to the northeast lies City-owned Soldiers Field Golf Course and Memorial Field. City-owned John Withers Sports Complex lies to the south of the park. While limited, these adjacent sports-related public lands present opportunities for restoration and enhancement that would benefit Zumbro South Park.

5.3 Priority Projects

Section 1.3 presents ongoing natural areas restoration and management activities performed by the City and its partners and volunteers. Those areas warrant continued support because financial and volunteer resources have already been allocated to them and perpetual stewardship is required to protect those investments. However, the City and community would like to expand the City's Natural Resources Program to include new restoration and management projects. Section 5.2 identifies the City's 18 PNAs and select reservoir sites, which represent the best areas to advance the City's Natural Resources Program.

The goals of this NAMP will take many years to achieve, due to the time required for ecological restoration and management as well as the limits of the City's resources. Therefore, priorities need to be established to schedule actions in a strategic and efficient manner. Prioritization can be based on a variety of considerations, including location considerations (e.g., managing areas of previous investment, protection of high-quality plant communities), cultural considerations (e.g., safety issues, equity issues, and educational programs and opportunities), and specific types of actions (e.g., control of a particular invasive species or group of species).

Based on existing data, RES' field assessment, restoration potential, previous investments, visibility, feasibility, and discussions with the public, stakeholders, and City staff, the following eight Priority Projects were identified.

Table 27. Rochester's New Priority Projects

Priority Project	Context	Acres	Primary Management Needs
Gamehaven Park	New City park	40	Ash removals/burning
Prairie Crossing	Young savanna restoration	8.5	Prescribed burning
Northern Heights	Natural park area	58	Invasive species removal
Joyce Park (prairie)	Naturalization of existing park	1	Establish prairie around storm pond
Joyce Park (seepage wetland)	Improvement of existing park	1	Manage invasive vegetation
Valley High Dr NW Prairie	Natural park area	12.5	Establish prairie
Parkside Park	Naturalization of existing park	3	Establish prairie/savanna
Joyce Park (forest)	Improvement of existing park	12	Forest stand improvement

Priority Projects represent discrete restoration and management projects (located primarily within the City's PNAs) that represent areas where initial investments have already been made, new park acquisitions, higher quality natural areas, areas with high restoration potential, and/or underserved neighborhoods that have not received significant natural areas investments.

5.4 How Work Gets Done

Implementation of the City's priority restoration and management projects will require additional planning and capacity. In addition to City funds, ecological work can be advanced by using volunteers, hiring professional ecological contractors, and engaging partners.

Volunteers

Many benefits can arise from engaging volunteers in City's Natural Resources Program:

- The public learns about natural resources, increasing their awareness and appreciation of natural areas and the natural world.
- Valuable data can be collected for baseline and trend monitoring.
- Cost-savings through volunteer labor and in-kind match for grants.
- Building community and appreciation of City parks.

Natural resources volunteers typically conduct physical work (e.g., planting, seeding, removing invasive species). Additionally, volunteers can be used effectively for monitoring and research (e.g., field observations, data collection, and data analysis). Volunteer monitoring/research advances knowledge and builds public support for natural resource programs. Some volunteer activities require oversight, typically provided by City staff, trained volunteers, and/or partners. Currently, the City of Rochester does not have an organized volunteer program, limiting its ability to recruit, train, oversee, and maintain volunteers. Staffing investments are necessary to operate a safe, effective, and sustainable volunteer program.

Volunteers can assist in a variety of tasks, and with additional training and oversight they can effectively accomplish tasks. Some volunteer tasks may be one-time events, and other tasks may be repeated over time by dedicated volunteer stewards. Table 28 presents how the City of Rochester envisions conducting various restoration tasks, with a focus on how volunteers can assist.

Table 28. Using City Staff, Volunteers & Private Contractors for Ecological Tasks

Restoration Tasks	City Staff	Volunteers			Professional Ecological Contractor
		Generally Appropriate	*Appropriate With Training & Supervision*	*Not Appropriate*	
Collect native seed			X		X
Hand-broadcasting native seed			X		X
Machine-broadcast/drill native seed	X			X	X
Install live trees, shrubs, herbaceous plugs	X		X		X
Hand-pull invasive plants			X		X
Drag & clear-cut brush	X	X			X
Hand-cut brush	X		X		X
Machine-cut brush	X			X	X
Apply herbicide	X		X		X
Conduct prescribed burns	X			X	X
Stabilize slopes, streambanks, lakeshores	X		X		X
Mow or hay by hand	X		X		X
Mow or hay by tractor, etc.	X				X
Construct best practices for water management	X		X		X
Conduct simple ecological monitoring	X		Adults primarily (young people can assist)		X
Conduct ecological monitoring for permit compliance & technical standards	X		X		X

Ecological Contractors

Private, professional ecological contractors have staff, equipment, and experience to efficiently implement natural resource restoration and management projects. Unlike non-profits and government, however, their overhead costs must be included in their prices in order to remain viable businesses. When used, qualified ecological contractors should meet the following criteria:

- Firm has local project experience in the past five years providing the specific ecological restoration and management tasks required for the project.
- On-site field supervisor(s) overseeing project implementation communicates effectively through verbal and written communication and are present on site or available at all times during work. Field supervisor(s) should have a minimum of five years' experience conducting ecological restoration and vegetation management in the region.

- Proper training and certifications for restoration and management activities with inherent risks, such as use of heavy equipment, herbicides, chainsaws, and prescribed fire.
- Positive references from past clients.
- Sufficient bonding for the work being performed.

While professional contractors are typically more expensive than using in-house resources and volunteers, qualified contractors should be expected to complete high-quality work efficiently and meet performance standards under their guarantee. Bidding documents and specifications should state required qualifications for contractors (such as those listed above), project schedules, and performance standards that ensure the City's goals are met for the project. Solicitation, assessment, and selection of bids, as well as contractor oversight and contract administration takes expertise and time and need to follow appropriate procurement and purchasing procedures.

Partnerships

As with volunteers, partnerships provide opportunities to foster relationships with partner organizations and the community. However, developing and sustaining partnerships requires dedicated staff time. The City of Rochester has partnered with the following entities on natural resource-related projects or initiatives.

- Minnesota Department of Natural Resources (MNDNR)
- Minnesota Department of Transportation (Mn/DOT)
- Olmsted County (Parks Department, Soil & Water Conservation District, Youth Commission)
- Conservation Corps of Minnesota & Iowa
- University of Minnesota
- Prairie Enthusiasts
- Audubon Society
- Master Gardeners, Master Tree Stewards, Minnesota Water Stewards, and Master Naturalists
- Rotary Club of Rochester
- Friends of Indian Heights Park
- Friends of Silver Lake Park
- R-Neighbors
- Neighborhood associations

Quarry Hill Park, one of the City's most treasured and enjoyed natural areas, is managed cooperatively through a partnership including Friends of Quarry Hill Nature Center, the City of Rochester, Rochester Public Schools, and many other organizations in the community and region. Many volunteers also spend countless hours helping to manage this valued community asset. The City will continue this longstanding partnership, as well as explore other partnering opportunities (e.g., Rochester Garden & Flower Club) to advance its Natural Resources Program.

It is recommended that the City establish agreements or contracts with partner organizations to help implement ecological restoration and management projects, especially long-term management. Such agreements ensure that all parties are clear on expectations and responsibilities, which reduces the likelihood of miscommunication or lack of follow-through.

5.5 Cost of Natural Areas Restoration & Management

Natural areas restoration and management requires an investment. This NAMP will help the City understand implementation costs and focus limited resources by presenting real-world unit costs, such as dollar per acre to carry out a prescribed burn in a savanna. Many variables influence unit costs. The size of an area being restored, the existing site conditions, access and slope issues all can affect cost. For planning purposes, it is useful to understand unit costs in general. Table 29 provides unit costs for the most common restoration and short-term management tasks, assuming a professional ecological contracting firm does the work. Appendix E describes most of these tasks, including long-term management.

Table 29. Unit Costs for Ecological Restoration & Management

Task	Unit	Unit Cost Range
Invasive/Aggressive Tree & Shrub Removal Tasks		
Tree removal (size, access, and disposal method influence cost)	each	$180-$600
Brushing (non-steep slopes; cut and stump treat)	acre	$1,500-$3,500
Brushing (steep slopes; cut and stump treat)	acre	$3,000-$6,000
Brushing (forestry mower)	acre	$800-$2,000
Brushing (goat browsing)	acre	$3,000-$4,000
Foliar spray young woody brush	acre	$200-400
Invasive/Aggressive Herbaceous Species Removal Tasks		
Broadcast herbicide	acre/trip	$175-300
Spot herbicide	acre/trip	$200-400
Mowing	acre/trip	$150-350
Conservation haying	acre/trip	$350-$1,000
Prescribed burn (minimum 3 acres)	acre	$300-700
Tilling	acre	$150-350
Native Seeding & Planting Tasks		
Native seed (material only)	acre	$200-$1,100
Native seeding (no-till drill, labor only)	acre	$200-500
Native seeding (hand-broadcast, labor only)	acre	$300-600
Straw mulch (spread and crimp)	acre	$600-900
Installed live herbaceous plant plug	each	$3-7
Installed shrub (2-gallon pot)	each	$25-40
Installed shrub (5-gallon pot)	each	$50-75
Installed tree (10-gallon pot)	each	$150-250
Installed tree (2” ball & burlap)	each	$300-600

Costs can often be reduced by using City staff and equipment, partners, youth workers and volunteers; however, some tasks are best conducted by trained/licensed professionals (see Table 28 above). Use of volunteers or youth workers typically requires training, and contractors, seasonal staff, youth and volunteers all require oversight. Close supervision of all steps (including contract development, material acquisition, installation, and management) is prudent to ensure work is done properly and restoration

goals are achieved. Training and oversight requires time and/or expertise, which can add to overall implementation costs.

Unit costs can be multiplied by acres needing restoration and management in order to arrive at a total estimated cost for ecological restoration and management. Considering the plant community acreages of the 18 PNAs and reservoir sites inventoried and assessed as part of this NAMP (Table 3, but not including Open Water), their ecological quality, and estimated unit costs, it would cost over $8 million for professional contractors to conduct all restoration and management tasks warranted over the first three years to bring the areas to a greater level of ecological health. This total, system-wide estimated cost is substantial, but it results from the acreage of City-owned natural areas, their generally degraded ecological condition, and the need for significant restoration and management efforts. This anticipated cost, however, is not out of line with other municipalities having similar land holdings. It is clear that the City's existing natural resources budget, staff, and equipment limit what can be done in a given year. Therefore, it is necessary to prioritize projects and phase them over many years.

In addition to the initial restoration and short-term management costs presented above, the City also needs to plan and budget for long-term management in perpetuity. This means that new restoration projects should be initiated only as aggressively as there are funds or other resources to complete the project and manage the project in perpetuity as well as continue to maintain all previously restored natural areas. Variations in the type and size of plant community, ecological quality, type and intensity of stressors, site-specific management techniques and goals, and other factors all influence the effort required to maintain restored natural areas. As a general rule of thumb, the City should assume annual long-term management costs of $200 to $400 for each acre of natural area. For comparison, actively maintained turf requires approximately $750 to $1,000 per acre per year.

5.6 Phased Implementation Plan

Implementation of this NAMP will include continued stewardship of areas that have already been restored or managed as well as phasing in new Priority Projects that will advance the City's Natural Resources Program goals. Based on the condition and needs of ongoing projects, opinions of probable cost were developed for continued management. In addition, opinions of probable cost were developed for Priority Projects (Table 27), anticipating the restoration and management tasks needed (described in Section 4.2 and Appendix E), and assigning average unit costs for each task (similar to those found in Table 29).

Working closely with City staff, an "optimal" five-year implementation scenario was developed that ensures comprehensive management of 13 ongoing restoration projects (not including projects funded by the City's flood control budget) and comprehensively initiates all eight New Priority Projects identified in this NAMP (Section 5.3) totaling 181 acres under management. This approach would require approximately $160K the first year, with generally decreasing costs each subsequent year over the following four years to approximately $100K in year five. The total five-year expenditure would be approximately $685K, assuming a two percent annual inflation rate (Table 30).

Table 30. Five-Year Phasing of Rochester Projects (Optimal Scenario)

Scenario: Optimal - All ongoing restoration projects managed comprehensively; all New Priority Projects initiated comprehensively; 2% annual inflation

Prioritized Projects	Natural Area Investments (ac)	Total Resto/ Mgmt Cost (over 5 yrs, without inflation) - BUDGET	Year 2023	2024	2025	2026	2027	Total Cost (with inflation)
Ongoing Projects								
Century Hills	0.1	$ 1,000	$ 204	$ 208	$ 212	$ 216	$ 221	**$ 1,062**
Essex Park	29.1	$ 54,440	$ 11,106	$ 11,328	$ 11,554	$ 11,786	$ 12,021	**$ 57,795**
Homestead	4.4	$ 13,053	$ 2,663	$ 2,716	$ 2,770	$ 2,826	$ 2,882	**$ 13,858**
Indian Heights Park	15.0	$ 42,000	$ 8,568	$ 8,739	$ 8,914	$ 9,092	$ 9,274	**$ 44,588**
Northern Hills Prairie	6.1	$ 20,537	$ 4,189	$ 4,273	$ 4,359	$ 4,446	$ 4,535	**$ 21,802**
Plummer House	1.5	$ 3,750	$ 765	$ 780	$ 796	$ 812	$ 828	**$ 3,981**
Prairie Crossing	8.5	$ 22,383	$ 4,566	$ 4,658	$ 4,751	$ 4,846	$ 4,943	**$ 23,763**
Quarry Hill Park	31.0	$ 68,733	$ 14,022	$ 14,302	$ 14,588	$ 14,880	$ 15,177	**$ 72,969**
Ridgeview Manor	0.5	$ 3,350	$ 683	$ 697	$ 711	$ 725	$ 740	**$ 3,556**
Riverview West	0.5	$ 3,350	$ 683	$ 697	$ 711	$ 725	$ 740	**$ 3,556**
Schmidt	7.5	$ 19,750	$ 4,029	$ 4,110	$ 4,192	$ 4,276	$ 4,361	**$ 20,967**
Silver Lake Park/Buffer	8.5	$ 22,383	$ 4,566	$ 4,658	$ 4,751	$ 4,846	$ 4,943	**$ 23,763**
Sunny Slopes (Skyline Dr)	0.3	$ 10,763	$ 2,196	$ 2,239	$ 2,284	$ 2,330	$ 2,377	**$ 11,426**
New Priority Projects								
Gamehaven Park	25.0	$ 93,750	$ 19,125	$ 29,261	$ 19,898	$ 20,296	$ 10,351	**$ 98,930**
Prairie Crossing	8.5	$ 38,250	$ 11,705	$ 7,959	$ 8,118	$ 8,281	$ 4,223	**$ 40,286**
Northern Heights	5.0	$ 30,750	$ 9,410	$ 6,398	$ 6,526	$ 6,657	$ 3,395	**$ 32,386**
Joyce Park (prairie)	1.0	$ 7,650	$ 2,341	$ 1,592	$ 1,624	$ 1,656	$ 845	**$ 8,057**
Joyce Park (seepage wetland)	1.0	$ 7,800	$ 2,387	$ 1,623	$ 1,655	$ 1,689	$ 861	**$ 8,215**
Valley High Dr NW prairie	12.5	$ 68,750	$ 21,038	$ 14,306	$ 14,592	$ 14,883	$ 7,591	**$ 72,409**
Parkside Park	3.0	$ 19,050	$ 5,829	$ 3,964	$ 4,043	$ 4,124	$ 2,103	**$ 20,064**
Joyce Park (forest)	12.0	$ 96,600	$ 29,560	$ 20,101	$ 20,503	$ 20,913	$ 10,665	**$ 101,741**
Totals	**181.0**	**$ 648,093**	**$ 159,634**	**$ 144,609**	**$ 137,552**	**$ 140,303**	**$ 103,075**	**$ 685,173**

A second, "budget", five-year implementation scenario was developed that limits spending to within the City's current annual Natural Resources budget of $60K. This approach requires that City staff address all management needs of seven of the City's ongoing projects, the remaining six ongoing projects would be managed in a more limited fashion, and New Priority Projects would be simplified (i.e., less expensive) and would be initiated as the annual funding cap allows. This approach would enable initiation of six of the seven new projects, bring 155 acres under (more limited) management, and the total five-year expenditure would be approximately $294K, assuming a two percent annual inflation rate (Table 31).

Table 31. Five-Year Phasing of Rochester Projects (Budget Scenario)

Scenario: Budget - Subset of ongoing restoration projects receive limited management; New Priority Projects simplified and initiated to keep annual cost <$60K; 2% annual inflation

Prioritized Projects	Natural Area Investments (ac)	Total Resto/ Mgmt Cost (over 5 yrs, without inflation)	Year 2023	2024	2025	2026	2027	Total Cost (with inflation)
Ongoing Projects								
Essex Park	29.1	$ 24,250	$ 4,947	$ 5,046	$ 5,147	$ 5,250	$ 5,355	**$ 25,744**
Homestead	4.4	$ 7,333	$ 1,496	$ 1,526	$ 1,556	$ 1,588	$ 1,619	**$ 7,785**
Indian Heights Park	15.0	$ 13,500	$ 2,754	$ 2,809	$ 2,865	$ 2,923	$ 2,981	**$ 14,332**
Northern Hills Prairie	6.1	$ 15,047	$ 3,070	$ 3,131	$ 3,194	$ 3,257	$ 3,323	**$ 15,974**
Quarry Hill Park	31.0	$ 40,833	$ 8,330	$ 8,497	$ 8,667	$ 8,840	$ 9,017	**$ 43,350**
Schmidt	7.5	$ 10,000	$ 2,040	$ 2,081	$ 2,122	$ 2,165	$ 2,208	**$ 10,616**
Silver Lake Park/Buffer	8.5	$ 7,650	$ 1,561	$ 1,592	$ 1,624	$ 1,656	$ 1,689	**$ 8,121**
New Priority Projects								
Gamehaven Park	25.0	$ 40,000	$ 8,160	$ 12,485	$ 8,490	$ 8,659	$ 4,416	**$ 42,210**
Prairie Crossing	8.5	$ 35,700	$ 10,924	$ 7,428	$ 7,577	$ 7,729	$ 3,942	**$ 37,600**
Northern Heights	5.0	$ 32,250	$ 9,869	$ 6,711	$ 6,845	$ 6,982	$ 3,561	**$ 33,966**
Joyce Park (prairie)	1.0	$ 7,550	$ 2,310	$ 1,571	$ 1,602	$ 1,634	$ 834	**$ 7,952**
Joyce Park (seepage wetland)	1.0	$ 7,800	$ 2,387	$ 812	$ 1,655	$ 1,689	$ 1,722	**$ 8,265**
Valley High Dr NW prairie	12.5	$ 70,000		$ 7,283	$ 7,428	$ 7,577	$ 15,457	**$ 37,745**
Parkside Park	3.0	$ 18,150						
Totals	**157.6**	**$ 330,063**	**$ 57,847**	**$ 60,970**	**$ 58,773**	**$ 59,948**	**$ 56,123**	**$ 293,661**

Many assumptions are embedded in these opinions of probable cost and, therefore, these costs should be viewed as preliminary, with details worked out in refined restoration plans, annual budgets, and Capital Improvement Plans. However, it is apparent that the City's existing annual Natural Resources budget is insufficient to provide comprehensive stewardship for ongoing projects as well as fully implement its top priority projects. Therefore, the City should consider what natural areas management burden they can sustain with in-house staff and equipment over the long-term, what tasks may be more appropriate for professional contractors to conduct, and how the City may better leverage partners, grants, and volunteers to achieve its natural resources goals.

Budgeting for Success

This NAMP:

- Identifies a need of over $8M for the first few years of ecological restoration and management if all 18 City-owned natural areas assessed for this plan were addressed.
- Concludes that the City's existing annual Natural Resources budget is insufficient to provide continued stewardship for ongoing projects as well as fully implement its top priority projects.
- Provides a framework for identifying, prioritizing, costing, and planning restoration and management projects in a way that will not overextend the City's ability to care for previous natural areas investments.

The City's natural areas, and the many residents and visitors that appreciate them, would benefit from increased internal funding and leveraging other resources (e.g., partners, grants, volunteers). The good news is that over time, as the number of acres under long-term management increases, the per-acre cost of management decreases, allowing for the initiation of new restoration projects, which ultimately will be brought into long-term management. During the initial five-year implementation plan, progress should be monitored, and during 2027 (in time for City budgeting) a subsequent five-year implementation plan should be developed for 2028-2032.

The City can continue this implementation model into the coming decades by identifying and prioritizing projects, estimating costs, securing funds, and implementing work in a sustainable fashion using City-allocated and other available resources. In this way, the City's Natural Resources Program will grow and mature, resulting in a healthier, lower maintenance, and more resilient system of natural areas.

Budgeting for the Long Haul

While grants, partners, and volunteers may provide financial and labor support for *initial* restoration and short-term management of projects, these resources may not be available in the *long term*. To protect its initial restoration investment, the City would need to augment its annual budget for the natural resources program and ensure that stewardship of natural areas can continue in perpetuity.

5.7 Education & Outreach

This NAMP provides foundational concepts, planning principles, and recommendations for advancing the City of Rochester's Natural Resources Program. Successful implementation of this plan will be accomplished only with the engagement of the Rochester community. Numerous opportunities exist to share this information with the public and encourage their appreciation of, and engagement with, the City's natural areas.

- Publicize and share this NAMP so that residents and partners can better understand and appreciate Rochester's natural areas, the City's goals, and opportunities for protection and improvement.
- Formalize the City's volunteer program (e.g., hire a dedicated Volunteer Coordinator) to better leverage the community's interest, energy, and skills in managing natural areas.
- Organize volunteer opportunities and celebrations associated with natural area projects. This may include kick-off events for new restoration projects or celebrations for ongoing or completed projects.
- Many communities have collected valuable data by sponsoring a "bioblitz", typically a 24-hour period when professionals and volunteers document all living species within a given area, such as a public park. A bioblitz helps to gather important baseline and ongoing monitoring data on plants and animals in a specific area (e.g., a park), while also engaging people in discovery of the natural world and scientific research in the company of experts.

All these opportunities should be considered and offered through a lens sensitive to historically underrepresented or marginalized communities. The City's Diversity, Equity and Inclusion Director and Diversity Council should be engaged in the planning and execution of this outreach effort.

5.8 How Work Gets Funded

Securing financial resources – both for initial restoration efforts and long-term management – is critical to the long-term success of any management plan. Funding typically comes from internal budgets and external sources such as grants and partners.

The Limits of Grant Funding

Many grants can be used only for initial restoration and short-term management. Perpetual management of natural areas usually depends on funding from sources other than grants.

The City's Park and Recreation System Plan (2016) identifies the best sources of funding for natural resources *planning* to be the City's general fund, possibly augmented by partner funding. The System Plan identifies natural resources *management* as best funded by a park bond referendum, likely augmented by a combination of the general fund and grants, and possibly partnerships, donations, and utility fees. Partnerships (potentially providing financial assistance) are addressed in Section 5.4 above.

To augment City budgets and partner and donor contributions, the following grant programs may provide funds to help implement this plan. However, additional staffing time and expertise will be required to pursue and administer such funds, if awarded.

State Programs

- **Clean Water, Land and Legacy Amendment (funded by State sales tax)**
    - **Outdoor Heritage Fund/Lessard-Sams Conservation Partners Legacy Grants**. Thirty-three percent of the sales tax revenue from the Clean Water, Land and Legacy amendment is distributed to the Outdoor Heritage Fund. Those funds, administered by the MNDNR, "may be spent only to restore, protect, and enhance wetlands, prairies, forest and habitat for fish, game, and wildlife."
      Information: https://www.legacy.mn.gov/outdoor-heritage-fund

      The Conservation Partners Legacy (CPL) Grant Program funds conservation projects under the Outdoor Heritage Fund.
      Information: https://www.dnr.state.mn.us/grants/habitat/cpl/index.html
    - **Clean Water Fund.** Thirty-three percent of the sales tax revenue from the Clean Water, Land and Legacy amendment is allocated to the Clean Water Fund. Those funds, administered by the Minnesota Pollution Control Agency, may only be spent to protect, enhance, and restore water quality in lakes, rivers, and streams and to protect groundwater from degradation. At least five percent of the Clean Water Fund must be spent to protect drinking water sources.
      Information: https://www.legacy.mn.gov/clean-water-fund
    - **Parks & Trails Fund.** The Parks and Trails Fund receives 14.25 percent of the sales tax revenue resulting from the Clean Water, Land and Legacy amendment. Those funds, administered by the Greater Minnesota Regional Parks and Trails Commission, may only be spent to support parks and trails of regional or statewide significance.
      Information: https://www.legacy.mn.gov/parks-trails-fund
- **Environment & Natural Resource Trust Fund**. The Environment and Natural Resources Trust Fund (ENRTF) was established following voter approval of a constitutional amendment in 1988. The money in the Trust Fund is generated by the Minnesota State Lottery, and the Legislative-Citizen Commission on Minnesota Resources (LCCMR) makes funding recommendations to the Minnesota Legislature. The Trust Fund holds assets that can be appropriated, "for the public purpose of protection, conservation, preservation, and enhancement of the state's air, water, land, fish, wildlife, and other natural resources."
  Information: https://www.legacy.mn.gov/environment-natural-resources-trust-fund

County Programs

- **Olmsted County SWCD Programs**. Olmsted County Soil and Water Conservation District (SWCD) staff help connect citizens, developers, and local government with the educational, technical, and financial support needed to put proven and innovative stormwater management and conservation practices on the land. Many types of non-agricultural and agricultural conservation practices to improve and protect water quality can qualify for program assistance, including landscaping for clean water, prairie restoration, cover crops, grassed waterways,

terraces, water and sediment control basins, and grade stabilization structures. Specific SWCD programs include:

- Olmsted Soil Health Program
- AgBMP Loan Program
- State Cost Share Program
- Minnesota Buffer Initiative on Public Waters
- MN CREP & RIM
- Stream & River Sampling
- Funding for the Environment in Minnesota

Information: https://www.olmstedcounty.gov/residents/soil-water-resources/soil-and-water-conservation-district#state-costshareprogram2

National Fish and Wildlife Foundation (NFWF)

- **Five Star and Urban Waters Restoration Grant.** This partnership grant focuses on water quality issues in priority watersheds, such as erosion due to unstable streambanks, pollution from stormwater runoff, and degraded shorelines caused by development. More information is available at: https://www.nfwf.org/programs/five-star-and-urban-waters-restoration-grant-program
- **Monarch Butterfly and Pollinators Conservation Fund.** A recently initiated program to protect and increase habitat for monarch butterflies on the breeding grounds and along their migration routes, and to educate people about this incredible species. More information is available at: https://www.nfwf.org/programs/monarch-butterfly-and-pollinators-conservation-fund
- **Resilient Communities Program.** Designed to prepare for future environmental challenges by enhancing community capacity to plan and implement resiliency projects and improve the protections afforded by natural ecosystems by investing in green infrastructure and other measures. Information: https://www.nfwf.org/programs/resilient-communities-program

Foundations, Non-Profits & Private Philanthropy

- **Minnesota Council of Foundations.** A useful resource to identify foundations that may be interested in supporting natural areas projects. Information: https://mcf.org/
- Non-profits and the many private organizations that are active and well-known in the Rochester community that may be interested in supporting natural areas projects.

5.9 NAMP Updates

This NAMP represents an important foundational step in advancing the management of Rochester's natural resources. As with most planning documents, NAMPs warrant regular updating as the program is implemented, successes (and failures) are tracked, and changing circumstances warrant different

strategies. This is no different from practicing adaptive management, whereby a plan is implemented, progress monitored, and changes are made based on achievement of desired outcomes. For this reason, this NAMP should be consulted regularly to assess its effectiveness at achieving the City's goals, and a comprehensive NAMP update should be conducted at least every ten years. These regular updates represent a relatively small investment that ensures the best practices and strategies are being used for successful, cost-effective achievement of conservation goals.

6 NEXT STEPS

Next steps the City of Rochester can take to implement this NAMP are:

- Communicate staffing and funding needs to decision makers, including City Council and staff.
- Incorporate the principles, goals, and recommendations of this NAMP into the City's operating procedures, including but not limited to:
  - Protect the City's rare natural features (Section 2.1.6).
  - Advance discussions with strategic partners and landowners to strengthen protection and restoration of natural areas and enhanced ecological connectivity (Sections 2.2.1 and 4.1).
  - Use an ecosystem approach to natural resources management (Section 4.2).
  - Increase the management of invasive plants (Section 2.2.4).
  - Implement climate resilience practices (Section 4.3.5).
- Increase community engagement and effectively use volunteer labor (Sections 5.4 and 5.7).
- Collaborate with and secure commitments from partner organizations and private landowners (Section 5.4).
- Secure grant funds and/or other funding/support to implement the five-year phasing plan (Sections 5.6 and 5.8).
- Hold a celebration of progress and initial success.

This NAMP will enable the City of Rochester (helped by volunteers, partners, and professional contractors) to carry out prioritized natural resources projects over the coming decades. Results will be evaluated and reported annually, staff will adapt the plan to meet changing circumstances, and residents and City leadership will be kept informed. In this way, healthy ecosystems and wildlife populations will be passed on to future generations for the enjoyment of all and the benefit of nature. One can envision that the restoration and management of natural areas in the City's parks and flood control lands will improve other natural open space in Rochester, and over time will raise the region to a higher level of ecological health and resilience, to the benefit of all residents and visitors.

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Appendix A. Glossary & Acronyms

Adaptive Management	Structured decision making in the face of uncertainty, with an aim to reducing uncertainty over time by a cycle of implementation, monitoring, evaluation, and adjustment.
Biocontrol	The use of natural enemies to reduce invasive species populations.
Biodiversity	The variety of life in a particular habitat or ecosystem, including plants and animals.
Decorah Edge	A geologic feature that naturally filters and provides about half of Olmsted County's drinking water. Associated with some of the state's most diverse wetlands.
Ecological Enhancement	Improving an existing natural area, such as adding more native flower species to a prairie or removing an undesirable tree like Boxelder from an oak forest.
Ecological Restoration	As a general term, improving the natural environment by stabilizing and enhancing biodiversity, resilience, and ecosystem services. In contrast to Ecological Enhancement, Ecological Restoration typically refers to converting a non-natural area (e.g., turf grass or cropland) to a native plant community (e.g., prairie or wetland).
Ecological Stewardship	Refers to responsible use and protection of the natural environment through conservation and sustainable practices.
Ecosystem Approach	An approach to land and water management that considers all interacting factors in an ecosystem and designs management techniques that replicate, at the lowest practical cost, the ecological structures and processes that enable ecosystems to adapt to changing conditions.
Ecosystem Services	The natural outputs of healthy ecosystems that benefit people—air and water purification, flood control, groundwater recharge, fish and wildlife production, soil building, recreation, food and fiber production, and spiritual renewal and recreational pleasure. Ecosystem services are worth trillions of dollars annually worldwide.
Edge Effects	The (usually negative) impacts that altered or developed land have on adjacent natural habitats (e.g., increased noise, microclimate changes, increased predation). Smaller, narrower habitats are more impacted by edge effects than larger, rounder ones.
Generalist Wildlife Species	Animal species that can live in many different types of environments and have a varied diet and broad habitat requirements.
Geographic Information System	(GIS) A computer-based mapping system designed to capture, store, manipulate, analyze, manage, and present spatial or geographic data.
Habitat Fragmentation	Habitat fragmentation is the process by which habitat loss results in the division of large, continuous habitats into smaller, more isolated remnants.
Integrated Pest Management	(IPM) Integrated Pest Management is an ecosystem-based approach that uses a combination of practices that minimize risk to beneficial insects and organisms, wildlife, humans, and the environment. Pesticides and herbicides are used only after monitoring indicates they are necessary and applied with the goal of removing only the target pest or species.

Invasive Species	Aggressive species whose introduction does or is likely to cause economic or environmental harm or harm to human health.
Karst	Area of carbonate bedrock, characterized by abundant cracks, crevices and cavities formed by dissolving minerals. Karst areas often contain sinkholes and are very susceptible to groundwater pollution.
Mesic	Moist, typically referring to soil conditions (as opposed to dry or wet).
Native Plants	Plants indigenous to a given area in geologic time. This includes plants that have developed, occur naturally, or existed for many years in an area.
Natural Area	Areas consisting of natural and/or semi-natural vegetation and not intensively managed for human use.
Natural Areas Management Plan	(NAMP) A system-wide plan that provides in inventory and assessment of an areas' multiple, discontinuous natural areas and provides guidance for their restoration and management.
Natural Resources Management Plan	(NRMP) A site-specific plan that provides a detailed inventory and assessment of a site's plant communities and provides specific guidance for their restoration and management.
Non-invasive Species	Species that are not likely to cause economic or environmental harm.
Specialist Wildlife Species	Animal species that have specific environmental needs related to habitat, diet or another environmental factor, without which they cannot sustain their populations.
Species of Greatest Conservation Need	(SGCN) Wildlife species, including state-listed and non-listed species, that are regionally rare or in decline, often as a result of habitat loss.
Spot Herbicide Application	Using targeted application methods (e.g., backpack sprayer with wand or sponge) to apply herbicide to undesirable vegetation, such as invasive plants.
Watershed Management	An approach to water and other natural resources management that considers the entire drainage area or catchment.

Appendix B. MN Conservation Explorer (MNDNR 2022)

Conservation Planning Report: Rochester NAMP (City plus 3-mi. radius)

This document is intended for planning purposes only for the area of interest defined by the user. The report identifies ecologically significant areas documented within the defined area of interest plus any additional search distance indicated below. These ecologically significant areas can be viewed in the Explore Tab of the Minnesota Conservation Explorer. Please visit MN Geospatial Commons for downloadable GIS data.

This document does not meet the criteria for a Natural Heritage Review. If a Natural Heritage Review is needed, please define an Area of Interest in the Explore Tab and click on the Natural Heritage Review option.

This document does not include known occurrences of state-listed or federally listed species.

MBS Sites of Biodiversity Significance

Search distance = 330 feet

Minnesota Biological Survey (MBS) Sites of Biodiversity Significance are areas with varying levels of native biodiversity that may contain high quality native plant communities, rare plants, rare animals, and/or animal aggregations. A Biodiversity Significance Rank is assigned on the basis of the number of rare species, the quality of the native plant communities, size of the site, and context within the landscape. MBS Sites are ranked Outstanding, High, or Moderate. Areas ranked as Below were found to be disturbed and are retained in the layer as negative data. These areas do not meet the minimum biodiversity threshold for statewide significance but may have conservation value at the local level as habitat for native plants and animals, corridors for animal movements, buffers surrounding higher quality natural areas, or as areas with high potential for restoration of native habitat. The DNR recommends avoidance of MBS Sites of Biodiversity Significance ranked High or Outstanding.

Wetlands within MBS Sites of Outstanding or High Biodiversity Significance may be considered Rare Natural Communities under the Wetland Conservation Act. For technical guidance on Rare Natural Communities, please visit WCA Program Guidance and Information.

For more information please visit MBS Sites of Biodiversity Significance.

The following MBS Sites of Biodiversity Significance are within the search area:

MBS Site Name	Biodiversity Significance	Status
AIRPORT WETLAND	High	final
BEAR CREEK FLOODPLAIN	Below	final
CASCADE 1	Moderate	final
CHESTER WOODS	Outstanding	final
EASTSIDE WMA	Moderate	final
FUGLE'S MILL	High	final
GAMEHAVEN BOYSCOUT RANCH	Moderate	final
GORDON W. YEAGER WMA	Moderate	final
HIGH FOREST 3	Moderate	final
HIGH FOREST 17	Below	final
HIGH FOREST 22	Below	final
HIGH FOREST 35	Moderate	final
ISAAC WALTON WETLAND	Below	final

MBS Site Name	Biodiversity Significance	Status
KALMAR 4	Moderate	final
KALMAR 9	High	final
KALMAR 10 NW	Moderate	final
KALMAR 10 SE	Moderate	final
KELLER WMA	Moderate	final
LAWLER'S PRAIRIE	Moderate	final
MARION 1	Below	final
MARION 30	High	final
MAYOWOOD	High	final
MEADOW CROSSING	Moderate	final
NEW HAVEN 35	Below	final
ORONOCO 16	Moderate	final
ORONOCO 23	Moderate	final
ORONOCO 35	Moderate	final
ORONOCO PRAIRIE	Outstanding	final
QUARRY HILL PARK	Below	final
ROCHESTER 6	Below	final
ROCHESTER 16, 21 WOODS	Moderate	final
ROCHESTER 22	Moderate	final
ROCHESTER 24	Moderate	final
ROCHESTER 31	Moderate	final
ROCK DELL 12	Moderate	final
SALEM 25	Moderate	final
SCHUMANN WMA	Below	final

DNR Native Plant Communities

Search distance = 330 feet

A native plant community is a group of native plants that interact with each other and with their environment in ways not greatly altered by modern human activity or by introduced organisms. These groups of native plant species form recognizable units, such as oak savannas, pine forests, or marshes, that tend to repeat over space and time. Native plant communities are classified and described by considering vegetation, hydrology, landforms, soils, and natural disturbance regimes.

DNR Native Plant Community types and subtypes are given a Conservation Status Rank that reflects the relative rarity and endangerment of the community type in Minnesota. Conservation Status Ranks range from S1 (critically imperiled) to S5 (secure, common, widespread, and abundant). Native plant communities with a Conservation Status Rank of S1 through S3 are considered rare in the state. The DNR recommends avoidance of rare native plant communities.

Wetland native plant communities with a conservation status rank of S1 through S3 may also be considered Rare Natural Communities under the Wetland Conservation Act. For technical guidance on Rare Natural Communities, please visit WCA Program Guidance and Information.

DNR Native Plant Communities may be given a Condition Rank that reflects the degree of ecological integrity of a specific occurrence of a native plant community. The Condition Rank is based on species composition, vegetation structure, ecological processes and functions, level of human disturbance, presence of exotic species, and other factors. Condition Ranks range from A-rank (excellent ecological integrity) to D-rank (poor ecological integrity. A Condition Rank of NR means Not Ranked and a Condition Rank of MULTI mean multiple ranks are present because the record is a native plant community complex.

For more information please visit Minnesota's Native Plant Communities.

The following DNR Native Plant Communities are within the search area:

MBS Site Name	PC Code	Native Plant Community Classification	Conservation Status Rank	Number of Communities
AIRPORT WETLAND	OPp93c	Calcareous Fen (Southeastern)	S1	1
AIRPORT WETLAND	WMs83a1	Seepage Meadow/Carr, Tussock Sedge Subtype	S3	1
CHESTER WOODS	FDs27c	Black Oak - White Oak Woodland (Sand)	S2	2
CHESTER WOODS	FDs38a	Oak - Shagbark Hickory Woodland	S3	1
CHESTER WOODS	FFs59c	Elm - Ash - Basswood Terrace Forest	S2	1
CHESTER WOODS	MHs37a	Red Oak - White Oak Forest	S3	1
CHESTER WOODS	MHs49	Southern Wet-Mesic Hardwood Forest	(S2, S3)	1
CHESTER WOODS	UPs13a	Dry Barrens Prairie (Southern)	S1S2	4
CHESTER WOODS	UPs13c	Dry Bedrock Bluff Prairie (Southern)	S3	2
CHESTER WOODS	UPs14a2	Dry Barrens Oak Savanna (Southern), Oak Subtype	S1S2	1
EASTSIDE WMA	WMn82b	Sedge Meadow	S4 or S5	2
FUGLE'S MILL	FFs59c	Elm - Ash - Basswood Terrace Forest	S2	1
FUGLE'S MILL	MHs38a	White Pine - Oak - Sugar Maple Forest	S3	1
FUGLE'S MILL	MHs39a	Sugar Maple - Basswood - (Bitternut Hickory) Forest	S2	3
GAMEHAVEN BOYSCOUT RANCH	UPs13c	Dry Bedrock Bluff Prairie (Southern)	S3	2
GORDON W. YEAGER WMA	MHs37a	Red Oak - White Oak Forest	S3	1
GORDON W. YEAGER WMA	MHs37b	Red Oak - White Oak - (Sugar Maple) Forest	S4	1
HIGH FOREST 35	OPp93c	Calcareous Fen (Southeastern)	S1	1
KALMAR 4	FDs38a	Oak - Shagbark Hickory Woodland	S3	1
KALMAR 4	MHs37a	Red Oak - White Oak Forest	S3	1
KALMAR 4	MHs37b	Red Oak - White Oak - (Sugar Maple) Forest	S4	1
KALMAR 9	MHs37	Southern Dry-Mesic Oak Forest	(S3, S4)	1
KALMAR 9	MHs37b	Red Oak - White Oak - (Sugar Maple) Forest	S4	1
KALMAR 9	MHs38c	Red Oak - Sugar Maple - Basswood - (Bitternut Hickory) Forest	S3	1
KALMAR 9	MHs39a	Sugar Maple - Basswood - (Bitternut Hickory) Forest	S2	1
KALMAR 9	MHs39b	Sugar Maple - Basswood - Red Oak - (Blue Beech) Forest	S3	1
KALMAR 9	MHs49	Southern Wet-Mesic Hardwood Forest	(S2, S3)	3
KALMAR 10 NW	FFs59c	Elm - Ash - Basswood Terrace Forest	S2	1
KALMAR 10 NW	MHs37	Southern Dry-Mesic Oak Forest	(S3, S4)	1
KALMAR 10 NW	MHs39	Southern Mesic Maple-Basswood Forest	(S2, S3)	2
KALMAR 10 SE	MHs37a	Red Oak - White Oak Forest	S3	1
KALMAR 10 SE	MHs39b	Sugar Maple - Basswood - Red Oak - (Blue Beech) Forest	S3	1
KELLER WMA	FDs38a	Oak - Shagbark Hickory Woodland	S3	1
KELLER WMA	FFs59c	Elm - Ash - Basswood Terrace Forest	S2	1
KELLER WMA	MHs37a	Red Oak - White Oak Forest	S3	1
KELLER WMA	UPs13c	Dry Bedrock Bluff Prairie (Southern)	S3	1
LAWLER'S PRAIRIE	UPs13c	Dry Bedrock Bluff Prairie (Southern)	S3	1
MARION 30	OPp93c	Calcareous Fen (Southeastern)	S1	1
MARION 30	WPs54a	Wet Seepage Prairie (Southern)	S1	3
MAYOWOOD	FFs59c	Elm - Ash - Basswood Terrace Forest	S2	3
MAYOWOOD	MHs37	Southern Dry-Mesic Oak Forest	(S3, S4)	1
MAYOWOOD	MHs37a	Red Oak - White Oak Forest	S3	1

MBS Site Name	NPC Code	Native Plant Community Classification	Conservation Status Rank	Number of Communities
MAYOWOOD	MHs39b	Sugar Maple - Basswood - Red Oak - (Blue Beech) Forest	S3	1
MEADOW CROSSING	FDs38a	Oak - Shagbark Hickory Woodland	S3	1
MEADOW CROSSING	FFs59c	Elm - Ash - Basswood Terrace Forest	S2	2
MEADOW CROSSING	MHs37	Southern Dry-Mesic Oak Forest	(S3, S4)	3
MEADOW CROSSING	MHs49	Southern Wet-Mesic Hardwood Forest	(S2, S3)	2
MEADOW CROSSING	UPs13c	Dry Bedrock Bluff Prairie (Southern)	S3	5
ORONOCO 16	UPs13c	Dry Bedrock Bluff Prairie (Southern)	S3	1
ORONOCO 23	FFs59c	Elm - Ash - Basswood Terrace Forest	S2	5
ORONOCO 23	MHs37a	Red Oak - White Oak Forest	S3	2
ORONOCO 23	UPs13c	Dry Bedrock Bluff Prairie (Southern)	S3	1
ORONOCO 35	FDs38a	Oak - Shagbark Hickory Woodland	S3	1
ORONOCO 35	FFs59c	Elm - Ash - Basswood Terrace Forest	S2	1
ORONOCO 35	MHs37a	Red Oak - White Oak Forest	S3	2
ORONOCO 35	MHs39	Southern Mesic Maple-Basswood Forest	(S2, S3)	1
ORONOCO 35	MHs49	Southern Wet-Mesic Hardwood Forest	(S2, S3)	1
ORONOCO PRAIRIE	UPs13b	Dry Sand - Gravel Prairie (Southern)	S2	1
ORONOCO PRAIRIE	UPs13c	Dry Bedrock Bluff Prairie (Southern)	S3	6
ROCHESTER 16, 21 WOODS	MHs37	Southern Dry-Mesic Oak Forest	(S3, S4)	1
ROCHESTER 16, 21 WOODS	MHs49	Southern Wet-Mesic Hardwood Forest	(S2, S3)	1
ROCHESTER 16, 21 WOODS	UPs13c	Dry Bedrock Bluff Prairie (Southern)	S3	1
ROCHESTER 24	WMn82b	Sedge Meadow	S4 or S5	1
ROCHESTER 31	UPs13c	Dry Bedrock Bluff Prairie (Southern)	S3	2
SALEM 25	FFs59c	Elm - Ash - Basswood Terrace Forest	S2	2
Not Within MBS Site	FDs36	Southern Dry-Mesic Oak-Aspen Forest	(S3S4)	1
Not Within MBS Site	FFs59	Southern Terrace Forest	(S1, S2, S3)	1

Calcareous Fens

Search distance = 5 miles

A calcareous fen is a rare and distinctive peat-accumulating wetland that is legally protected in Minnesota under the Wetland Conservation Act. Many of the unique characteristics of calcareous fens result from the upwelling of groundwater through calcareous substrates. Because of this dependence on groundwater hydrology, calcareous fens can be affected by nearby activities or even those several miles away. For more information regarding calcareous fens, please see the Calcareous Fen Fact Sheet or review the List of Known Calcareous Fens.

The following Calcareous Fens are within the search area:

Fen Site Name	Fen ID	TRS
Haverhill 19	46597	107N013W - 19
High Forest 15	8275	105N014W - 15
High Forest 35	8276	105N014W - 35
Joyce Park Fen	46590	106N013W - 8
Marion 30	8274	106N013W - 30
Marion 8	46591	106N013W - 8
Nelson Fen WMA	13727	105N015W - 16
Rochester 23	46596	106N014W - 23
Rock Dell 23 Fens	8278	105N015W - 23

Fen Site Name	Fen ID	TRS
Rock Dell 23 Fens	20563	105N015W - 23
Rock Dell 23 Fens	46082	105N015W - 23

DNR Old Growth Stands

Search distance = 330 feet

Old-growth forests are natural forests that have developed over a long period of time, generally at least 120 years, without experiencing severe, stand-replacing disturbances such as fires, windstorms, or logging. Old-growth forests are a unique, nearly vanished piece of Minnesota's history and ecology; less than 4% of Minnesota's old-growth forests remain. The DNR recommends avoidance of all DNR Old Growth Stands. The following DNR Old Growth Stands have been documented within the search area.

SEARCH RESULTS: No features were found within the search area.

MN Prairie Conservation Plan

Search distance = 330 feet

The Minnesota Prairie Conservation Plan, a twenty-five year strategy for accelerating prairie conservation in the state, identifies Core Areas, Corridors, and Corridor Complexes as areas to focus conservation efforts. The Plan's strategies include protection, enhancement, and restoration of grassland and wetland habitat. To meet the Plan's goals, approaches within Core Areas will need to include restoration and approaches within Corridors will need to include conservation of grassland habitat which can provide stepping stones between larger Core Areas.

SEARCH RESULTS: No features were found within the search area.

Important Bird Areas

Search distance = 1 mile

Important Bird Areas, identified by Audubon Minnesota in partnership with the DNR, are part of an international conservation effort aimed at conserving globally important bird habitats. They are voluntary and non-regulatory, but the designation demonstrates the significant ecological value of the area.

The following Important Birds Areas are within the search area:

- Blufflands-Root River

Lakes of Biological Significance

Search distance = 330 feet

Lakes of Biological Significance are high quality lakes as determined by the aquatic plant, fish, bird, or amphibian communities present within the lake. To be included in this layer, a lake only needs to meet the criteria for one of these four community types. The lake is assigned a biological significance of Outstanding, High, or Moderate based on the community with the highest quality.

SEARCH RESULTS: No features were found within the search area.

USFWS Regulatory Layers

To ensure compliance with federal law, conduct a federal regulatory review using the U.S. Fish and Wildlife Service's (USFWS) online Information for Planning and Consultation (IPaC) tool. This report is not a substitution for a Section 7 review.

For informational purposes only, this tool currently checks the following USFWS Regulatory Layers:

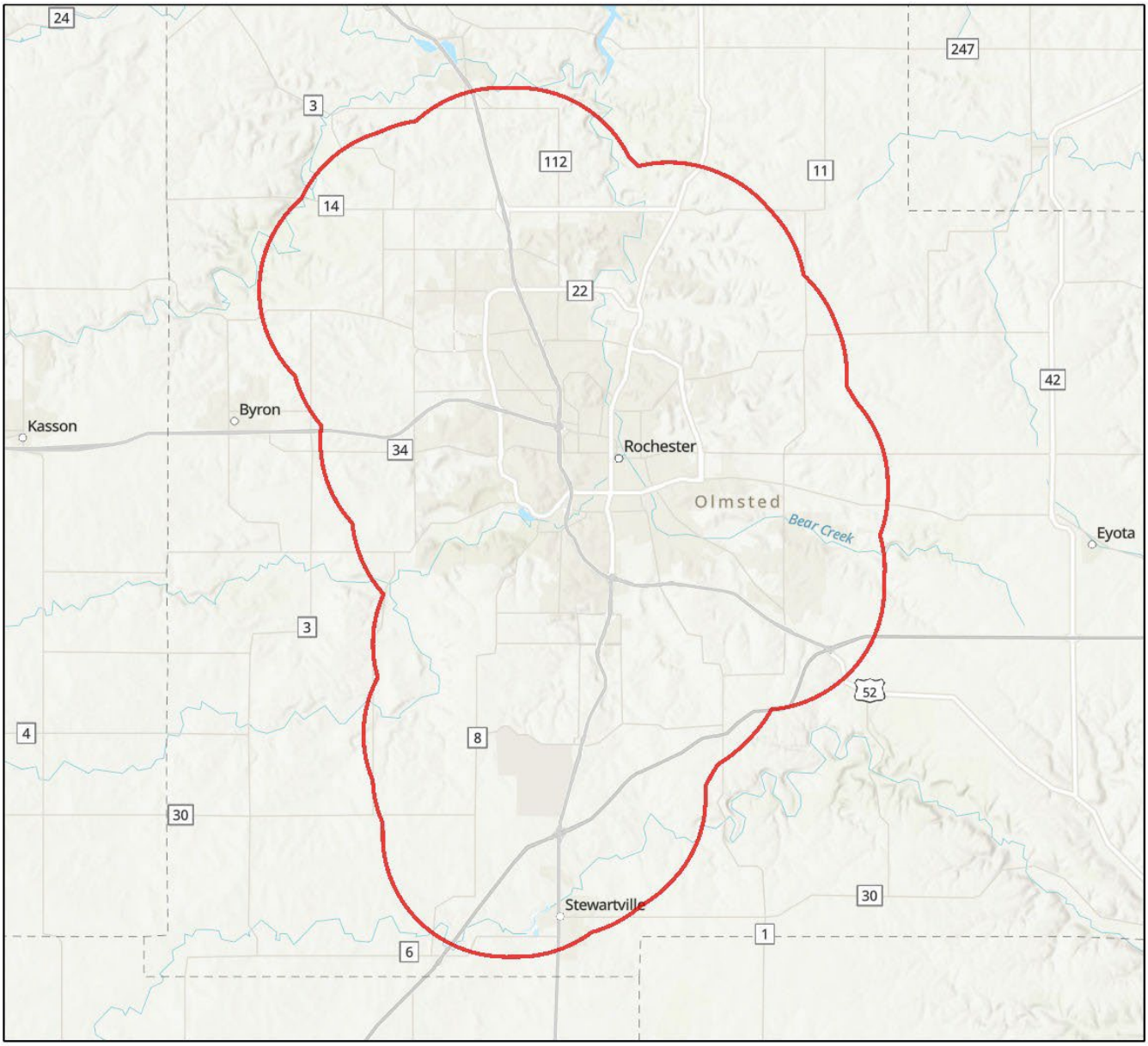
Rusty Patched Bumblebee High Potential Zones: (*search distance = 0; within area of interest only*) The rusty patched bumble bee (*Bombus affinis*), federally listed as endangered, is likely to be present in suitable habitat within the high potential zones. From April through October this species uses underground nests in upland grasslands, shrublands, and forest edges, and forages where nectar and pollen are available. From October through April the species overwinters under tree litter in upland forests and woodlands. The rusty patched bumble bee may be impacted by a variety of land management activities including, but not limited to, prescribed fire, tree-removal, haying, grazing, herbicide use, pesticide use, land-clearing, soil disturbance or compaction, or use of non-native bees. The USFWS RPBB guidance provides guidance on avoiding impacts to rusty patched bumble bee and a key for determining if actions are likely to affect the species; the determination key can be found in the appendix. Please visit the USFWS Rusty Patched Bumble Bee Map for the most current locations of High Potential Zones.

The following USFWS Regulatory Species are within the search area:

- Rusty Patched Bumble Bee High Potential Zone

Rochester NAMP (City plus 3-mi. radius)

Conservation Planning Map



N
W E
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0 1.5 3 6 9 12 Miles

Area of Interest

Size (acres): 142,350.59

County(s): Olmsted

Esri, CGIAR, USGS
Esri, HERE, Garmin, FAO, NOAA, USGS, EPA
Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS

Appendix C. Practices to Avoid Introducing & Moving Invasive Species (MNDNR)

It is the MNDNR's policy to limit the introduction of invasive species onto MNDNR managed lands and waters, limit their rate of geographical spread, and reduce their impact on high value resources.

The movement of equipment, organisms, and organic and inorganic material are potential pathways for the introduction or spread of invasive species. Each of these pathways should be considered and addressed to reduce risk associated with invasive species movement.

General Procedures for Intentional Movement of Equipment

1. Before arriving at a work site, inspect for and remove all visible plants, seeds, mud, soil, and animals from equipment.
2. Before leaving a work site, inspect for and remove all visible plants, seeds, mud, soil and animals from equipment.
3. After working on infested waters or waters known to harbor pathogens of concern, clean and dry equipment prior to using in locations not known to be infested with species or pathogens present at the last location visited.

Specific Procedures: Vehicles and Heavy Equipment

4. When possible maintain separate equipment to use on uninfested sites.
5. If working on multiple sites, work in uninfested sites before infested sites and clean equipment after use.
6. When working within a site with invasive species work in uninfested areas before infested areas and clean equipment after use.
7. Avoid entering site under wet conditions to minimize rutting and other soil disturbances.
8. Minimize area of soil disturbance with equipment.
9. Minimize number of access points to site.
10. When creating roads and trails minimize area of vegetation and soil disturbance.
11. Survey site before management treatment and treat or avoid moving equipment through existing patches of invasive species.
12. Conduct post management treatment monitoring and treat any responding invasive species.
13. Inspect all gear and remove vegetation, soil, and organisms prior to arriving and leaving site.
14. On sites that are known to be infested with species such as garlic mustard, spotted knapweed, leafy spurge, etc. (species with small seed that can collect on cloth material) wash clothing after work is complete.
15. Carry boot brush in or on all vehicles and clean boots and clothing (in a controlled area) when leaving any site.
16. Use brush to clean gear and equipment such as chainsaws to remove loose soil and plant materials.
17. Avoid parking in patches of invasive species. When unavoidable, clean vehicle of all visible evidence of soil and vegetation when leaving site.
18. Brush off (hand remove) plants, seeds, mud, soil and animals from vehicles, including wheel wells, tracks, hums, blades, grills, etc.
19. Power spray equipment after hand removal if necessary to remove aquatic plant remnants (particularly curly-leaf pondweed, Eurasian watermilfoil, flowering rush, and purple loosestrife) and earthworms.

General Procedures for Intentional Movement of Organisms, Organic and Inorganic Material (including water, fish, plants, mulch, soil, gravel, rock)

1. Do not plant or introduce prohibited or regulated invasive species or other listed invasive species.
2. Do not transport water from infested waters, except by permit. When you must use water from an infested waters, do not drain this water or water that has come in contact with organisms from the

infested waters, where it can run into another basin, river, or drain system that does not go to a treatment facility.

3. Use only mulch, soil, gravel, etc. that is invasive species-free or has a very low likelihood of having invasive species.
4. Do not transplant organisms or plant material from any waters with known populations of invasive aquatic invertebrates
5. Do not move soil, dredge material, or raw wood projects that may harbor invasive species from infested sites.

Specific Procedures: Re-vegetation (Aquatic and Terrestrial Plants)

1. Do not plant or introduce prohibited or regulated invasive species or other listed invasive species.
2. Inspect transplanted vegetation for signs of invasive species that may be attached to the vegetation and remove (i.e., other plant material and animals, etc.)
3. Re-vegetate with native species.
4. Preserve existing native vegetation. Peel topsoil that contains natives away from the work zone, stockpile and then replace it at the end of construction. This can help re-establish native species quickly.
5. If stockpiled invasive free topsoil isn't adequate for post-construction landscaping, and black dirt, sand or gravel must be purchased, purchase invasive species (i.e., worm) free material.
6. Purchase certified weed-free mulch.
7. Inspect outside of storage containers and materials for visible presence of invasive species.
8. If possible, use seeding material, plants, fill, straw, gravel, and mulch that are certified as uninfested.
9. Monitor areas where materials are added for evidence of invasive species germination.
10. When possible minimize the use of outside materials.

Procedures to Minimize the Risk of Increasing the Dominance of Invasive Species on Site

1. Survey site before burning and treat or avoid moving through patches of invasive species before burn is conducted.
2. Avoid entering site under wet conditions to minimize rutting and other soil disturbances.
3. Conduct post-treatment monitoring and treat any invasive species (such as resprouts and germination).

Site Planning and Management

Construction activities that disturb the soil surface can expose dormant invasive species seed banks and create a growth medium that favors invasive plants. Landscaping can also introduce invasive plant species, as can maintenance activities such as mowing, grading, and stormwater pond maintenance.

Exercise site-level management to minimize the introduction, spread, and impact of invasive species. Site-level management shall include planning, implementation and evaluation procedures that reduce the risk of introduction, spread, and impact of invasive species. Procedures include identification of invasive species, monitoring for invasive species, developing strategies and actions to minimize spread and impact, implementing management actions, and evaluating success.

References

Minnesota Department of Natural Resources Operational Order #113, Invasive Species, May 31, 2007.
Minnesota Department of Natural Resources Invasive Species Operational Handbook, May 31, 2007.
Minnesota Department of Natural Resources Standard Protocols for Invasive Species Prevention on Terrestrial Sites (Draft).

Appendix D. Example Outline of a Park Natural Resources Management Plan (NRMP)

1. EXECUTIVE SUMMARY

2. INTRODUCTION

- 2.1. Precedent Planning Efforts
- 2.2. Regional Natural Resources Conservation Context
- 2.3. Natural Resources Public Values

3. EXISTING NATURAL RESOURCES

- 3.1. Landscape Context
  - 3.1.1. Location
  - 3.1.2. Regional Ecological Context
  - 3.1.3. Adjacent Land Uses
- 3.2. Physical Conditions
  - 3.2.1. Geology
  - 3.2.2. Topography
  - 3.2.3. Soils
- 3.3. Vegetation
  - 3.3.1. Historical Vegetation and Land Use
  - 3.3.2. Land Cover and Use Trends
  - 3.3.3. Land Cover Mapping and Assessment
- 3.4. Aquatic Resources
  - 3.4.1. Surface Waters
  - 3.4.2. Groundwater and Aquifer Sensitivity
- 3.5. Wildlife
  - 3.5.1. General Wildlife Habitat
  - 3.5.2. Wildlife in the Park Today
  - 3.5.3. At Risk Wildlife Populations
- 3.6. Rare Natural Features

4. NATURAL RESOURCES ISSUES AND OPPORTUNITIES

- 4.1. Issues
  - 4.1.1. Issue 1…
- 4.2. Opportunities
  - 4.2.1. Opportunity 1…

5. NATURAL RESOURCE VISION AND GOALS

- 5.1. Vision for Park Name
- 5.2. Goals for Park Name
  - 5.2.1. Goal 1

Appendix E. Ecological Restoration & Management Tasks

As discussed in Section 4.3.3, ecological restoration and management requires execution of a series of tasks, each of which should be customized to the site's unique environmental conditions to meet project goals. Restoration and short-term management tasks for natural areas are discussed below; some of the tasks below also apply to long-term management.

Hydrological Restoration

Natural Hydrology. In natural settings of the Midwest and Great Lakes Region, wetlands and associated streams, ponds, and lakes experienced gradual rises and falls in water level after large storms and spring snowmelt. Small storms rarely caused surface and groundwater levels to rise. Evapotranspiration from the land and vegetation gradually drew down water and groundwater levels from early summer into fall. (The groundwater table that is visible in wetlands, streams, ponds and many lakes rises and falls even more slowing than surface water levels.) Rochester's Decorah Edge geologic features, fed by infiltration and shallow groundwater, are expressed on the surface as seeps and springs—some of which are diverse wetland plant communities. Groundwater recharge is also significant in this Decorah Edge areas.

Altered Hydrology and Vegetation Effects. Native plants and animals were well-adapted to the formerly gradual changes in water and groundwater level. Ditching, tiling, and other drainage systems, as well as land clearing and impervious surfaces, have deranged the natural hydrological regime in the majority of wetlands, streams, ponds, and lakes of the region. Damming (e.g., Rochester's Silver Lake and flood control reservoirs) and road-building also alter hydrology by impounding water uphill and drying the downhill landscape. These changes in hydrology alter the plant and animal communities of hydrologically-dependent ecosystems by favoring certain species well-adapted to either a static hydrological regime (such as above dams) or artificially dynamic hydrological regime, such as below drained agricultural and developed landscapes. Development above the Decorah Edge often decreases natural infiltration, resulting in reduced seepage and springs that support historical wetlands. Dominance by a few species often results from these circumstances, along with the loss of plant and insect biodiversity, and shifts in the abundance of bird, amphibian, and small mammal densities.

Restoring Hydrology. In hydrologically-deranged wetland and related systems, the first restoration task is to identify where ditches, tiles, undersized road culverts, impervious surfaces, berms and dikes exist on a site in order to remove or adjust them to restore a more natural hydrological regime. A second task is to identify locations outside the site (usually upstream or upslope) that have a disproportional effect on the hydrology of the site. The first task is a common part of restoration, while the second requires taking a watershed approach that often involves multiple parties, considerable expense, and longer time frames.

In developed areas, a watershed approach usually entails identifying the most cost-effective opportunities to slow and infiltrate runoff before it reaches receiving waters. By integrating smaller, dispersed infiltration and detention projects into developed (or developing) areas, especially near parking lots and roads where storm sewers are often installed, more natural hydrology (and healthier aquatic ecosystems) can be achieved. At a smaller scale, private landowners can do many things on their own property to

better manage runoff (e.g., redirect roof downspouts to lawn rather than a driveway, or install a rain garden).

Prescribed Burning

Prescribed burning is an important and cost-effective ecological restoration and management tool – and one that is appropriate for fire-dependent communities such as: pine, pine-oak, and oak forests; oak and oak-pine savanna; prairie; wet meadow; and marsh. The City of Rochester contains fire-dependent forests, woodlands, savannas and other native plant communities that benefit from periodic fire. These plant communities are often most cost-effectively managed with well-planned and well-executed prescribed burns. The many benefits of fire in these communities has been well documented.

Burning Prairies and Other Herbaceous-Dominated Plant Communities. The City's prairie and more open savanna habitats should be burned approximately every three years, but this depends on the rate of woody plant invasion and the accumulation rate of fine fuel. More frequent burning may be needed to control woody plant growth, or less frequent if the litter layer accumulates slowly (such as in dry prairies). The frequency of burning other herbaceous plant communities depends on their historical fire regime and management goals (e.g., abundance of invasive vegetation). Creating multiple burn units, each capturing the landscape's heterogeneity, preserves refugia for wildlife negatively affected by fire. For instance, invertebrates (including pollinators such as the Rusty patched bumble bee) are protected by not burning an entire plant community at once, usually recolonizing the burned patch from refugia (i.e., nearby habitat areas spared from burning) in the next year or two. The USDA/NRCS recommends that most prescribed burning be done in the early spring before grassland birds nest. However, late-summer and fall burns also avoid the prime nesting season (USDA/NRCS 1999). Due to these potential adverse wildlife impacts, burning small native restorations with little or no nearby refugia might be at odds with the City's restoration objectives.

Burning Fire-Dependent Woody Plant Communities. Fire-dependent forests and woodlands (including more dense savannas) may have sufficient oak or pine leaf litter to carry a low-intensity surface fire, generally with flame lengths only up to two to three feet. These surface fires help remove excess leaf litter and organic duff, control invasive plants not adapted to fire, and stimulate the growth of a diverse assemblage of native plants. (The fire research at Minnesota's Cedar Creek Ecosystem Science Reserve demonstrates this clearly for savannas.)

For routine management, the City's fire-dependent forests and woodlands should be burned every five to ten years, depending on their species composition, available fuel, ecological quality, and restoration and management needs. More frequent burns, even annually, may be beneficial for killing invasive vegetation (e.g., buckthorn) and preparing a site for restoration. However, burning these areas can be challenging if fine fuel is sparse. Legacy materials (downed woody debris and snags) must be addressed before or after a burn. In closed-canopied forests, especially with a woody understory, dense shade often suppresses invasive plants, making prescribed burning less important as a management tool.

Challenges of Using Prescribed Fire. Prescribed burning can be challenging in a developed setting. Park users, neighboring residences and businesses, traffic on roads, and air quality all need to be considered

when developing a thorough and safe burn plan. Prior to burning, the City of Rochester or its appointed contractor should secure the necessary permissions, notify the community, and take appropriate precautions to protect public safety and health, infrastructure, and vegetation that is not intended to be burned. Due to fixed costs associated with mowing fire breaks, notifications, mobilization, and burn coordination and execution, small burns of less than a dozen or so acres are much more expensive on a per-acre basis than larger ones.

Biocontrol

Biocontrol uses natural enemies to reduce invasive species populations. Several approved biocontrol agents are available to control invasive species in the City (Table D1), but the most problematic ones—buckthorn, invasive honeysuckles, reed canary grass, invasive cattail—have none.

Table D1. Potential Biocontrol Options for City of Rochester

Community	Plant Species	Biocontrol Agent	Mechanism	Application	References
Forests & Woodlands	Garlic mustard (*Alliaria petiolata*)	A root-crown mining weevil (*Ceutorhychus scrobicollis*)	*Adult Stage*: Herbivory of foliage. *Larval Stage*: Mine petioles and root crowns in winter and early spring.	Biocontrol agent not available in the U.S. but is being tested.	Becker et al. 2020
Upland Grasslands	Leafy spurge (*Euphorbia esula*)	Leafy spurge beetle (*Aphthona lacertosa*)	*Adult Stage*: Herbivory on foliage, then lay eggs at the base of plant. *Larval Stage*: Eggs hatch, larvae feed on roots over winter until pupation and emergence as adults the next summer.	Exists in City; recommend experimental release first.	Chandler et al. 2012
		Black dot Leafy spurge flea Beetle (*Aphthona nigriscutis*)			
	Spotted knapweed (*Centaurea stoebe*)	Seedhead weevils (*Larinus minutus* and *L. obtusus*)	*Adult stage*: Herbivory of foliage. *Larval stage*: Consume developing spotted knapweed seed.	Exists in City; recommend experimental release first.	Chandler 2021
		A root-boring weevil (*Cyphocleonus achates*)	*Larval Stage*: Develop in roots, consuming starch reservoir and physically damaging roots.		
Wetlands	Purple loosestrife (*Lythrum salicaria, L. virgatum*)	Black-margined loosestrife beetle (*Galerucella calmariensis*)	*Adult Stage*: Herbivory of foliage. *Larval Stage*: First instar larvae feed concealed in leaf or flower bud; later instars feed on aboveground plant parts.	Exists in City; recommend experimental release first.	MNDNR 2021
		Purple loosestrife leaf beetle (*Galerucella pusilla*)			
		Loosestrife root weevil *(Hylobius transversovittatus)*	*Adult Stage*: Herbivory of foliage. *Larval Stage*: Feed in roots.		

Invasive Tree & Shrub Removal

As part of an ecosystem approach, removing invasive woody vegetation often dramatically accelerates the ecological restoration process. Common buckthorn (*Rhamnus cathartica*) and non-native

honeysuckles (e.g., *Lonicera morrowii, L. x bella, L. tatarica*) are primary targets in Rochester since they can dominate forest understories, and Siberian elm (*Ulmus pumila*) and Black locust (*Robinia pseudoacacia*) trees, saplings, and seedlings can also be abundant. In addition, some native trees and shrubs—Boxelder (*Acer negundo*), Green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), Eastern red cedar (*Juniperus virginiana*), and Chokecherry (*Prunus virginiana*)—behave as invasive species in native plant communities damaged by past poor management. In these cases, selectively or completely removing them from a forest understory may help to accelerate the restoration process; however, aggressive removal of native species should occur only after thorough assessment of the plant community and consideration of conservation goals. Once aggressive shrub and understory species are under control, soil-anchoring native ground layer vegetation and native trees and shrubs can be planted to stabilize soils and compete with the invasives. Planting nut- and berry-producing trees and shrubs should be a priority as these important source of wildlife food are usually missing or scarce in damaged forest ecosystems.

If resources are limited, invasive vegetation management should focus on removing invasives from the highest quality areas or areas with the rarest natural features. These are experiencing early invasions that are easier to control than dense infestations.

Removing invasive woody vegetation typically includes the following tasks.

- **Native Plant Protection.** Protect desirable native woody and herbaceous vegetation by various means. Avoid: forestry mowing, goat grazing, heavy equipment use, and broadcast herbiciding. Where native vegetation is sparse in one or more layers of a plant community, these indiscriminate methods can be used.
- **Slope Protection and Safety.** Steep slopes may make mechanized woody plant removal very difficult. Hand cutting with workers in safety harnesses is a better choice. Leaving roots intact in the soil (i.e., not using a Weed Wrench) will reduce erosion potential. Goat grazing may be effective on steep slopes, but has disadvantages discussed below.
- **Soil Protection.** Woody plant removal should be done when the ground is frozen to minimize rutting and damage to plant roots.
- **Hand-Pulling.** Where feasible on relatively flat, stable soils, hand-pull seedlings and young invasive shrubs of up to 2" diameter near the base. This can be done with a Weed Wrench or similar tool. If control can be executed over several years, buckthorn may be removed from sites with sandy, mucky, or other loose soil by cutting the stem at a height of 3 feet. These stems may "sucker" or re-sprout but can then be re-cut and/or extracted through leverage or tools after a year or two, avoiding the use of chemicals. Physical removal of the root mass disturbs soil and can promote weed seeds in the soil to germinate; therefore, this practice should be used only after considering site conditions, the likelihood of weed seed growth, and potential for erosion.
- **Hand-Cutting or Killing in Place.** When other methods are not feasible, invasive woody plants should be cut and stump-treated with an approved contact herbicide. This is a commonly used technique as it accommodates most situations, but disposing of material can add significant costs (see below). If a less expensive method is desired, invasive woody plants can receive a

basal bark application of herbicide and left standing after dying where appropriate. Herbicides should be appropriate to the task and methods should be used that minimize damage to native vegetation or soil biota. Unwanted trees can be killed and left to die standing in place by girdling (i.e., severing the bark, cambium, and sometimes the sapwood in a ring extending entirely around the trunk of the tree).

- **Goat Browsing.** Goats have been used at some restoration sites to browse and reduce invasive woody vegetation. Goats defoliate and stress small shrubs and trees, woody plant seedlings, and the low-hanging branches of taller plants, but cannot control mature shrubs. Moreover, browsing may not kill the browsed plant, allowing it to regrow. Because mature invasive shrubs are found in many of the City's forests, goats are often not a suitable tool by themselves. Other disadvantages are that goats browse native woody species and require the installation and management of electric fencing and other infrastructure. For these reasons, goats should be used only at appropriate sites, under close supervision, and with other brush control methods.
- **Forestry Mowing.** Mechanized forestry mowing is often used for large areas of invasive woody plants, but may have the disadvantages of removing and damaging desirable native vegetation, causing soil erosion, and compacting soil. Forestry mowing also leaves uneven/shredded stump-cuts, making herbicide application challenging. For this reason, resprouts are common, requiring foliar application of herbicide (see below) or use of goats for follow-up browsing. For large areas dominated by invasive woody plants and lacking native woody plants, mechanical forestry may be appropriate.
- **Understory Thinning.** Where past poor management has allowed early-seral trees to colonize the forest understory, a deep shade develops. Selective thinning of these trees can accelerate the restoration process. A continuous forest canopy should be maintained in most forests, as this reduces the invasion and growth of buckthorn and honeysuckle. Thinning the understory and creating canopy gaps, however, allows more sunlight to reach the ground, helps the growth of mid- to late-seral species (e.g., red oak), and stimulates the spread of native ground layer plants.
- **Woody Material Disposal.** Cut material is typically hauled off site, chipped and thin-spread on the site, or stacked into brush piles for wildlife habitat or burning (in approved locations). Care should be taken to not spread invasive plant seeds and berries during removal. Handling and transporting cut material should follow all state and federal recommendations to prevent the movement of pests, such as Emerald ash borer and Gypsy moth. If many large trees are being cut, these should be moved out of the way to maintain travel routes for material disposal. Where there are fewer large trees being removed, the boles can be bucked, chopped and thin-spread, and the trunks left on the ground as wildlife habitat. If generating a commercial product such as biomass for energy or stream bioengineering material, understory thinning can be done with lower material removal costs.
- **Treating Resprouts and Seedlings.** To control woody brush resprouts and seedlings (and encourage growth of ground layer vegetation, including woodland grasses that can help carry

ground fires for management), "critical period cuts" can be effective. Conducted in July (when woody plants have expended much of their root resources on growth for the year), cutting brush at ground level will encourage resprouting later in the season, which uses up the plants limited resources at a time when it typically would be storing up reserves in its roots for the winter and following year. Goat browsing can also be a useful method for managing resprouts and seedlings; however, the cautions noted above should be considered. Use of prescribed fire the spring following a critical period cut can be particularly effective at killing the seedlings and resprouts. Goat browsing and prescribed fire are methods that eliminate the need for herbicide application, helping to protect native, non-target vegetation.

When a critical period cut or goat browsing is not feasible or appropriate, treat invasive woody vegetation seedlings and resprouts with approved foliar herbicide in the growing season after cutting, preferably late summer or early fall, to avoid collateral damage to native ground layer vegetation. Due to the seedbank in well-established stands of buckthorn and honeysuckle, treating seedlings may take up to seven years after the mature individuals are removed.

Invasive Herbaceous Vegetation Control

- **Competition by Native Plants.** As invasive plants create a seedbank which produces seedlings for years, expanding the cover of native vegetation is the most effective way in the long term to compete with and suppress the germination and growth of invasive plant seedlings.
- **Native Plant Protection.** Protect desirable native vegetation by avoiding native plants with equipment and herbicides. Select the right herbicide and apply at the proper time with the proper method to minimize drift and drip. Properly use prescribed burning. Use a broadleaf-specific herbicide when protecting native grasses, sedges, and graminoids, and a grass-specific herbicide when protecting native forbs.
- **Multi-Pronged Approach.** Employ an Integrated Pest Management (IPM) approach by combining manual pulling where erosion is not a concern, spot-application of herbicide, spot-mowing, and prescribed burning—the combination determined by the vulnerabilities of the invasive plants being controlled.
- **Broadcast Herbicide Treatment.** Two or three herbicide treatments are usually required to control certain perennial weeds, for example: Smooth brome (*Bromus inermis*), Kentucky bluegrass (*Poa pratensis*), and Canada thistle (*Cirsium arvense*). Spot-herbicide treatment after initial removal is usually needed in these situations. Broadcast herbicide applications should be used as a last resort.

Herbaceous Vegetation Installation

- **Native Seedbank Assessment.** Following initial removal of invasive woody and herbaceous species, it is often beneficial to wait and see if the native seedbank germinates. If in the first year it does not respond sufficiently in variety or coverage, native seeding should be initiated.

- **Native Seeding.** Seeding is less expensive than installing live plants, but requires more time to establish, often up to three years. Always use native seed of the local ecotype, originating within 150-200 miles of the site. Seeding a native grassy cover crop will rapidly stabilize soils and create a competitive environment for invasive seedlings emerging from the seedbank. A native grass seeding also provides fine fuel to carry a prescribed burn, if that is a restoration and management action. Diversity can be increased by seeding forb species after the graminoids are established, usually by drilling seed after a burn or mowing. Volunteers can collect native seed and hand sow it in sparse or low diversity areas. The ground layer vegetation will help stabilize soils, prevent new invasion by invasive and weedy plants, and restore the ecological composition, structure, and function of the area being restored.
- **Live Plugs.** Live plant plugs ("plugging") produces an immediate effect but is relatively expensive. An intermediate approach is to add plugs to a native seeding area, either to increase diversity of species that do not establish well from seed, or to create an impressive floral display, such as in high visibility areas.

Tree & Shrub Installation

- **Planting Trees and Shrubs.** Native woody plantings are used to replace or compete with invasive or early-seral native woody plants, setting the plant community on a trajectory to a more resilient condition. In restoration projects, plant material typically consists of whips, bare root stock or small saplings. Using smaller material is less expensive than larger material and usually results in better establishment over time. As guided by restoration goals and plant community targets, install ecologically appropriate and local ecotype native trees and shrubs. Appropriate native species can be selected from the MNDNR species list for each target plant community (MNDNR 2005). Protection from deer and rodent browsing may be necessary.
- **Direct Seeding.** Direct seeding of harvested acorns, walnuts, hickory nuts, butternut, and seeds of elm and maple is a low-cost but slow method to establish woody plants; however, it may be effective in certain areas.
- **Timing of Planting.** It is often best to not install woody vegetation in the first year or two of restoration and management due to the extensive invasive plant removal occurring. Native trees and shrubs can be added after invasive vegetation is sufficiently under control.

Conifer Plantation Thinning and Restoration

City of Rochester parkland contains conifer plantings and plantations (e.g., Quarry Hill Park). While often consisting of native species (e.g., White and red pine, *Pinus strobus* and *P. resinosa*), these plantings and plantations represent altered, low-diversity plant communities. Converting conifer plantations to healthier, more diverse and resilient native plant communities is often best accomplished by selective thinning of conifers over several years, accompanied by interplanting appropriate native trees and seeding and/or live plantings other native species. Local conditions (e.g., soils, moisture regime) will help

determine an appropriate target plant community and which species are most appropriate for the particular location. Tree plantings typically require browse protection from White-tailed deer, rabbits, and rodents.

Turf to Native Vegetation Conversion

Many of Rochester's parks and other public parcels contain turf lawn; most of these are actively used, justifying this vegetation cover. To increase habitat for pollinators and other native species, to improve other ecosystem services, and to reduce long-term maintenance costs, underutilized turf areas can be converted to native prairie or savanna ground layer vegetation. Native prairie is typically maintained by prescribed burning once every few years. Compared with regular mowing of turf lawns, maintenance of prairie represents a significant reduction in time, effort, and cost when compared with conventional lawns. Even considering prairie installation costs by seeding, these native plant communities have lower cumulative costs than lawns within a couple years.

The conversion of herbaceous vegetation from turf grass to prairie/savanna grasses, sedges, and wildflowers involves the following.

- **Native Plant Protection.** Protect desirable vegetation, especially mature native trees, by marking a perimeter around them in which turf removal methods are carefully applied.
- **Turf Removal without Herbicide.** Black plastic laid on the turf in summer will kill turf. However, this process requires large amounts of plastic sheeting, the plastic must be installed as to not cause runoff and erosion problems, it may require several months to eliminate turf, and soil-dwelling biota will also be killed. Sod-cutting is another turf removal method; however, this procedure also removes topsoil from the site, which requires transport and disposal and may leave site soils less conducive to revegetation.
- **Turf Removal with Herbicide.** Use approved broadcast herbicide to kill existing lawn and other undesired vegetation. A minimum of two herbicide treatments is often required to control turf species and achieve performance standards. Mowing or burning vegetation prior to or in between treatments may improve turf removal.
- **Native Seeding.** Once turf species are removed satisfactorily, seed with local ecotype native seed. Seeding is less expensive than installing live plant plugs, however seeding requires more time for establishment, and some prairie and savanna species are slow to develop.
- **Live Plugs.** Some species are best installed as live plants. If rapid establishment and additional species diversity is desired, enhancement plugging can be conducted in select areas, such as along roads and paths, or near buildings, signage, and other site amenities.

Slope & Seep Stabilization

Rochester's parks and flood control lands include areas with steep slopes. Many of these steep slopes experience erosion due to a combination of factors:

- Dense shade (by overstocked canopies or invasive shrubs) inhibits the growth of soil-anchoring ground layer vegetation.
- Runoff flowing down steep slopes causes sheet erosion that displaces topsoil, inhibiting the growth of soil-anchoring vegetation.
- Concentrated runoff (e.g., from impervious surfaces at the top of slopes) flows down steep slopes with highly erosive energy that causes rill and ravine erosion.
- Steep slopes and other landforms (e.g., Decorah Edge) are subject to seeps and springs, which saturate soil. Such soils lack integrity, which can lead to mass-wasting.
- Digging and other disturbance by people.

Assessment, and potential stabilization, of these features requires close attention to all contributing factors. If stabilization interventions appear warranted, a holistic approach should be used to develop a design that has a high probability of success, minimizes risks, and controls costs.

Diseased Tree Removals

Tree disease management in natural areas is conducted by the City of Rochester to control oak wilt, Dutch elm disease, and emerald ash borer inside of a 100-foot buffer of all adjacent developed parcels. As trees are removed from forests, appropriate native species (see MNDNR 2005) may be planted in canopy gaps by City staff, partners, or volunteers. Tree species selection should consider climate change (Section 2.2.6).

Ecological Monitoring & Reporting

Monitor natural areas' response to restoration/enhancement activities so management activities are adjusted accordingly. Monitoring the restoration and management activities at a site will help define the best management schedule and techniques. Monitoring can range from rapid and simple assessments to quantitative surveys with detailed reporting. Sharing monitoring results with the public can provide greater transparency, encourage the community's appreciation of natural areas, and increase the commitment to long-term stewardship.

As City staff and budgets allow, we recommend the following monitoring protocols for Rochester's natural areas.

1. **Priority Natural Areas** (larger intact natural areas and other natural communities with a quality rank of BC or better).
    a. A qualified ecologist should conduct a baseline field assessment of each plant community in the area, documenting vegetation species present and percent cover of each species. Notes should include invasive species, other stressors, erosion features, rare species observations, etc.
    b. A walkabout survey (i.e., qualitative assessment documenting conditions, presence of invasives, other environmental concerns, etc.) should be conducted annually by a

qualified ecologist. Any concerns should be conveyed to the City Forester, and interventions should be scheduled promptly.

2. **Active Restoration Areas**
    a. Prior to initiating restoration activities, a qualified ecologist should inspect the entire project area confirming existing conditions and validating restoration goals are appropriate. Notes should include invasive species, other stressors, erosion features, rare species observations, etc.
    b. Prior to installing native seed/plants, a qualified ecologist should inspect the entire project area confirming site preparation was done properly before installation of plant materials.
    c. During restoration activities, a qualified ecologist should oversee contractors, volunteers, and other personnel at a frequency pursuant to their skill levels. Any concerns should be conveyed to the City Forester.
3. **Other Natural Areas**
    a. Conduct walkabout surveys as time and resources allow and report issues to the City Forester.