Lebanon Hills Regional Park
Natural Resource Management Plan

October 2019

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1. EXECUTIVE SUMMARY

Located in northern Dakota County just 15 miles from downtown St. Paul and 22 miles from downtown Minneapolis, Lebanon Hills Regional Park (LHRP) is Dakota County's largest and oldest park at 1,869 acres and founded in 1967. LHRP is also the most visited park in the Dakota County park system, with over 600,000 visits in 2016.

Prior to the park being acquired, many years of degradation to the region's natural communities had occurred. Altering of wetlands, conversion of prairies to farmland, over-harvesting of timber, suppression of wildfires, introduction of exotic species, and more, attributed to a general decline in biodiversity, natural community resiliency, and ecosystem services such as clean water, nutrient cycling, and the building of healthy soils, that were provided by the ecosystem.

For the first three decades as a park, the County had generally approached natural resource management on a project-by-project basis, depending on a very small dedicated staff, a limited amount of general operating funds, and a few grants. Because of this, the quality of the park's plant communities and wildlife habitat slowly degraded. Despite setbacks, the County increased investment in natural resource management in 2013 by tripling the dedicated management staff. Between 2013 and 2016, the base operating budget also tripled, and the County received approximately $2.5 million in state grants to conduct natural resource management on 1,581 acres in four parks. Since these first grants, the park has been transformed through many ecological restoration projects and a systematic control of exotic invasive woody brush, especially European buckthorn and Tartarian honeysuckle, which had infested the park.

The list of past parks planning efforts includes the following: a Lebanon Hills Regional Park Natural Resources Management Plan (2000), the Dakota County 2030 Park System Plan (2008), the Lebanon Hills Regional Park Master Plans (2015, 2001, 1980), and the County Natural Resource Management System Plan (2017) for management of parks, greenways, and conservation easements over the next 20 years. This plan is consistent with previous plans but expands on details regarding natural resources of the park and their management.

The park provides significant recreational opportunities, including a children's play area, scenic views, a swimming beach, retreat center, and opportunities for nature observation, cross-country skiing, snowshoeing, camping, canoeing/kayaking/paddle-boarding, equipment rental, geocaching, ice skating on lakes, skate skiing, and sledding. The park also offers unique opportunities within the County park system for equestrian use, and mountain biking. In addition to providing these exceptional recreational opportunities for visitors, LHRP protects and conserves quality natural resources, including remnant native plant communities, diverse wildlife, rare plants and animals, and a variety of aquatic life in wetlands and lakes.

To further a focused, strategic, and comprehensive management approach towards Lebanon Hills Regional Park's natural resources, which also integrates past planning efforts, especially the 2015 master plan, Dakota County initiated development of a LHRP Natural Resources Management Plan in 2017. The plan aims to: (1) establish short-term (five-year) and long-term (20-year) visions for restoration and management of natural resources, (2) articulate goals and objectives, (3) identify challenges and opportunities, and (4) set forth priorities, procedures, recommendations, and cost estimates for specific activities and projects to enhance natural resources in the park in concert with visitor educational and recreational opportunities.

LHRP occurs on the St. Paul-Baldwin Plains and Moraines Subsection of the Minnesota DNR's Ecological Classification System, broadly formed from the end of the last glaciation some 12,000 years ago. Topography of the park is strongly influenced by glacial moraines, which are composed of irregular hills often with moderate to steep slopes. The low, depressional areas in this irregular topography feature a variety of wetland types, shallow lakes, and one deep lake (Holland Lake). Soils in the park are predominantly sandy loams and loamy sands, with some scattered very gravelly sand (on steeper Morainal slopes) and some organic mucks (associated with depressional wetlands). Vegetation of the park, prior to European settlement, consisted of oak woodlands and forests with quite a bit of oak savanna and open prairie mixed in. Today it has changed to a mix of oak forests, overgrown oak woodlands and afforested old fields. Wetlands are numerous and varied, with over 180 wetlands occurring throughout that are in various conditions, but many are in good condition. There are many lakes in the park, most being shallow, that contribute to a rich and habitat for plants and wildlife, as well as for recreational opportunities for park visitors. Wildlife in the park is varied also, with approximately 320 species from ten major taxa having been observed over the past 20 years. Several species of conservation concern have been observed in the park including Blanding's turtles, red-headed woodpeckers, spotted salamanders, smooth green snakes, and fishers. Regarding unique features, the park contains the only tamarack swamp in the county and the deepest lake in the county, Holland Lake. It also holds a handful of prairie remnants and some old-growth oak forests.

The park consists of three major segments, each divided by north-south roads (Pilot Knob and Johnny Cake Ridge Road). One challenge this presents is to find a way to protect wildlife from being killed on the roads, and to connect and buffer habitat that is fragmented and divided.

Another challenge is balancing recreation/facility needs with natural resource management needs. For instance, there are also approximately 58 miles of trails throughout the park, which although they provide great recreation opportunities for park visitors, they tend to fragment and divide wildlife habitat.

The natural resources management vision for LHRP (and for all Dakota County parks, greenways, and easements) is to manage water, vegetation, and wildlife to conserve and increase biodiversity, restore native habitats, improve public benefits, and achieve resilience and regionally outstanding quality, now and for future generations.

The following ten goals for LHRP, as articulated in this Natural Resources Management Plan, are:

1. Provide ecological services, restore ecosystem processes, and improve ecosystem resilience.
2. Maintain and continually enhance and increase the biodiversity and species evenness of native communities and visitor-use land cover areas.
3. Protect high priority natural features known to occur within the park.

4. Maintain and continually enhance the quality of natural communities throughout the park to promote and allow the fullest expression of these communities within the reasonable constraints of a Regional Park setting.
5. Protect core habitat throughout the park.
6. Protect the quality of surface water and groundwater resources.
7. Maintain and improve ecological connectivity within the park and the surrounding landscape.
8. Enhance visitor experience and environmental education associated with park natural and visitor use features.
9. Strike a balance between sustaining healthy natural communities in the park and providing a rich variety of nature-based recreation opportunities for park visitors.
10. Increase public involvement in natural resources planning, implementation, and stewardship, in the form of volunteerism and public engagement.

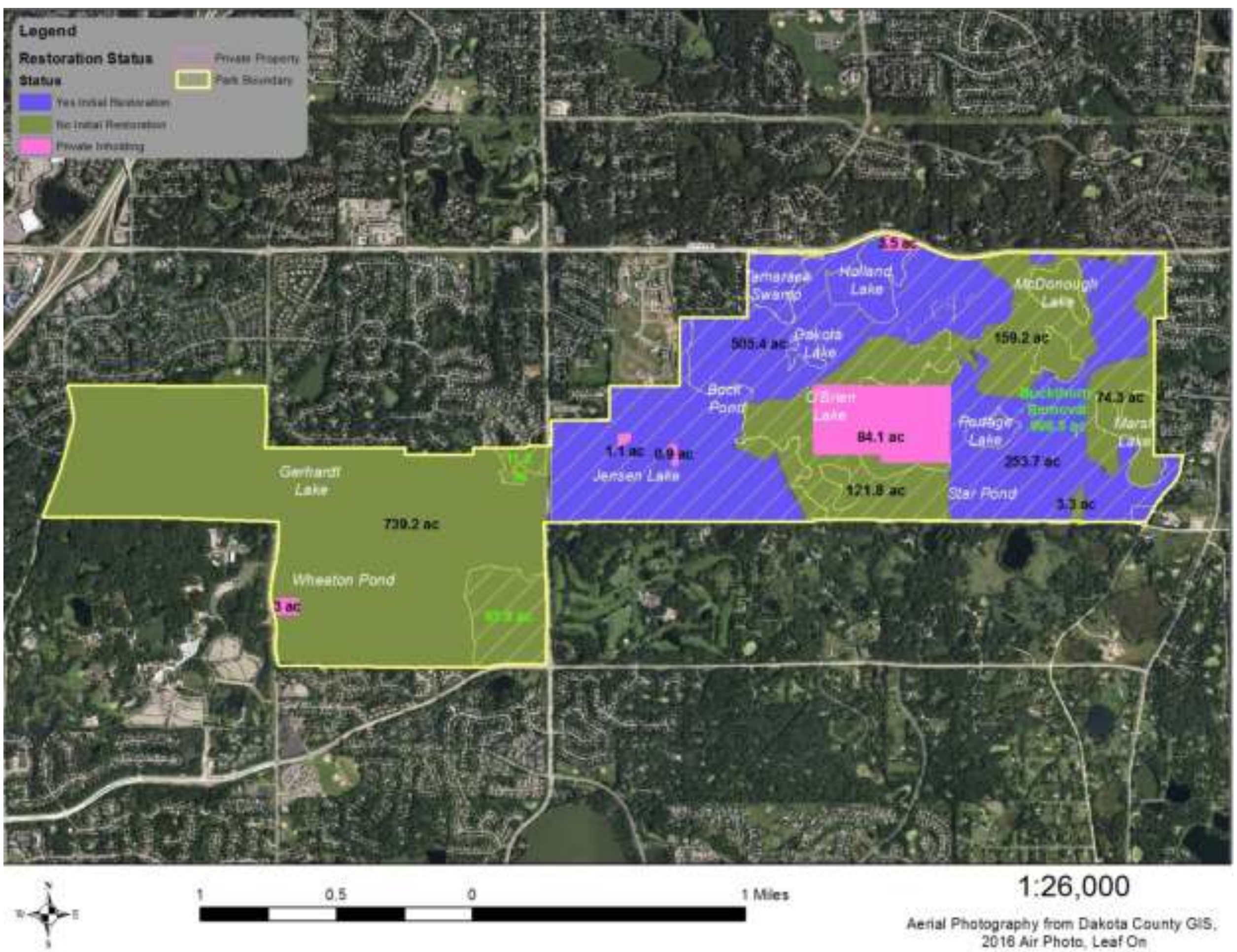


Figure ES-1. *Current status of ecological restoration in Lebanon Hills Regional Park. Blue areas have received an initial restoration (typically 3 to 5 years of work) but green areas have not. Hash-marked areas have undergone woody brush removal with County work crews.*

Dakota County has already made great strides towards the above goals by surveying and inventorying existing natural resources, implementing management and restoration activities (such as native plantings, invasive species control, and wetland, savanna, and forest restoration—see **Figure ES1**.), engaging the local community in the park through events and volunteer opportunities, and coordinating park planning with local and regional conservation, land use, and recreation planning efforts.

Some of the primary challenges identified for natural resources management at the park include altered natural systems, habitat fragmentation, the spread and proliferation of invasive, nonnative plant and animal species, pests and diseases, and potentially impactful recreation. However, the opportunities for enhancing the park's natural resources and nature-based recreation outweigh the challenges. LHRP management efforts benefit from having a large core area of habitat, remnant native plant communities, diverse wildlife, diverse aquatic resources, potential ecological connectivity through the County's greenway system, community support, public use and engagement, and a robust natural resources management program with dedicated staff and financial resources to implement management activities.

Several actions are recommended in this plan to address natural resource challenges at the park:

- Restore the entire park to appropriate native plant communities within 20-years' time (Figure ES2)
- Survey and monitor pre- and post-restoration activities.
- Select management and restoration tools that minimize negative impacts on wildlife.
- Prioritize management efforts on conserving and restoring remnant native plant communities and habitat for rare species and Species in Greatest Conservation Need.
- Focus management efforts on maintaining, buffering, and connecting large core habitat areas.
- Regularly engage in ongoing communications with inholding landowners regarding natural resources activities in the park and land protection options.
- Provide educational opportunities for residents in surrounding neighborhoods of the park to learn about natural resources and stewardship opportunities for both their property and the nearby park land.
- Engage in partnership opportunities for improving ecological connectivity (e.g., Greenway Collaborative, Dakota County Farmland and Natural Areas Program, private landowners) through ongoing staff involvement in communication and planning activities.
- Protect water resources within the park by protecting wetlands from stormwater runoff, sedimentation, and excessive nutrient loading by buffering wetlands and lakes with native vegetation and other means.
- Develop a wetland plan for all of the park's wetlands.
- Work with surrounding communities/agencies to identify opportunities to protect groundwater resources and hydrologic conditions within LHRP.

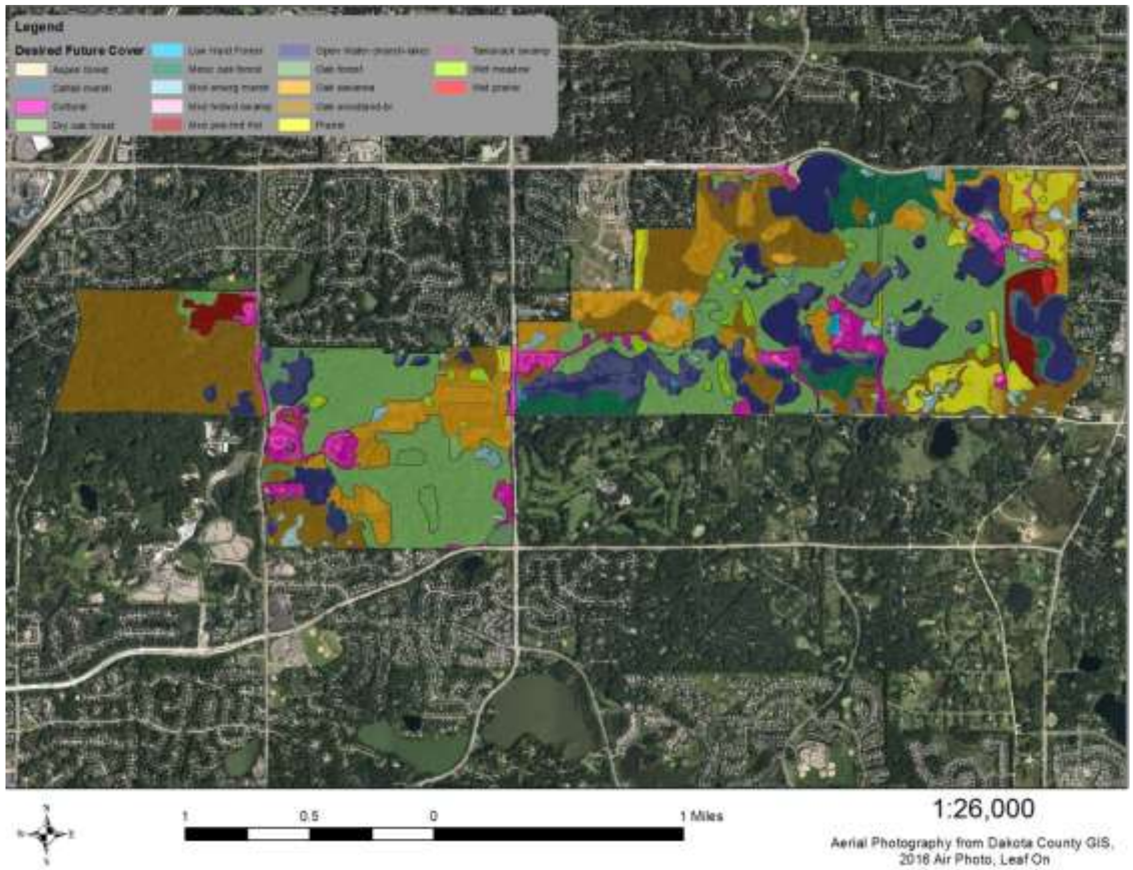


Figure ES-2. *Map showing "desired future cover types" for the park. Cover types primarily consist of native plant communities such as oak forest, oak woodland, savanna, prairie, and open water.*

- Partner with nearby landowners and local government units outside of park boundaries to improve the vegetation, water, and wildlife inside park boundaries.
- Control invasive species, strategically and with the lowest impact, throughout the park.
- Restore natural disturbances such as prescribed fire.
- Retain natural patterns and biological legacies in spite of high use and human disturbance.
- Foster ecological integrity by promoting multi-trophic food webs via the production of edible structures (e.g., nuts, berries, and shoots), providing habitat, and regulating nutrient flows.
- Manage to achieve a shifting patchwork of refugia.
- Manage to provide intermediate disturbance such as periodic fire (in fire dependent communities), which maximizes niches and bio-diversity.
- Manage restoration activities to achieve the following:
    - 1) The suppression of undesirable species,
    - 2) The release of desirable species, and
    - 3) The recovery of important processes historically imposed by keystone and other species that maintained desirable species biotic configurations/ecosystems.

- Identify keystone species and other important species that use the park's habitats, promote and conserve species that are already using the park, and consider reintroducing those that are not.
- Identify and protect core wildlife habitat areas throughout the park; determine how recreation can occur compatibly with core habitat quality.
- Promptly address erosion issues associated with steep slopes and trails.
- Coordinate management activities with other Departments to enhance educational and recreational opportunities compatible with protection of natural resources in the park.
- Plan and implement at least one collaborative project each year.
- Develop a strategy for maintaining ecologically and culturally compatible visual buffers between parks and surrounding landscape and identify priority areas for implementation.
- Develop strategies and priorities for maintaining culturally significant plantings and increasing biodiversity and functional attributes of them.
- Develop project scope and specifications for converting all old field areas to target native plant communities.
- Use adaptive management as a tool to help restore and manage the natural communities of the park.
- Regularly and systematically work with County Parks Planning, Capital Improvements Planning, and Transportation departments to protect and enhance natural resources during future building and development projects, review proposed projects that may impact resources within LHRP, and consult with project proposer(s) to avoid, minimize, or mitigate anticipated impacts; this may include pre- and post-project surveys and evaluations.
- Evaluate existing trail systems and other recreational uses and make recommendations for minimizing negative impacts to ecological quality; build upon past practices common to Minnesota; help design, plan, develop, and maintain trails that are physically, ecologically, and economically sustainable and that are visually appealing and enjoyable; and partner with Facilities Management staff to achieve common goals.
- Partner with County Visitor Services staff to mutually achieve Visitor Services Plan and Natural Resource goals.
- Strategically utilize volunteers to achieve restoration and management goals of the park.
- Develop and maintain an effective communication initiative to engage, motivate, and educate the public to the goals of natural resource management in the park.

A system for prioritizing restoration and management activities using project evaluation criteria is outlined in this plan to facilitate efficient and effective work planning and to guide funding proposals and budget allocations. Five-year and 20-year work plans are presented for the park's management units. The work plans include recommended acreages for desired future land cover types (e.g., woodland/forest/savanna, prairie, wet meadow, mixed pine-hardwood forest, lakes) and restoration cost estimates.

It is possible to restore the vegetation and plant communities of the entire park in 20 years, but it will take a consistent effort and dedication, which includes considerable external funding, primarily in the form of state grants, as well as County matching dollars and the ability to staff restoration project management. Cost estimates for restoring and managing the natural areas of the park were developed. Over the course of 20 years, it is estimated that restoration costs would range from approximately $4 million to $6 million. The Five-year plan is estimated to cost approximately $1.9 million for restoration.

Once restored, the land needs to be maintained. Maintenance costs are considerably lower than restoration costs (by a factor of about 10), but should be factored in. The cost to maintain all parkland vegetation for twenty years will be approximately $2.5 to $4 million and for the first five years it will cost approximately $350,000 to $700,000. Post-restoration enhancements, if pursued, will be an additional cost based on continued evaluation and adaptive management. Summing both restoration and maintenance costs together, the total cost for the park for the next twenty years is estimated to be between $6 and $9 million (see **Table ES-1**).

5-Yr Work Plan			*(years 1 through 5)*			
	Previously Restored Acres	Acres To Be Restored Yrs 1-5	Restore Cost	Enhance Cost	Maintain Cost	Sum Cost
East Segment, restored	600		$ -	$ -	$ 240,000	$ 240,000
East Segment		180	$ 900,000	$ -	$ 72,000	$ 972,000
Center Segment	-	100	$ 500,000	$ -	$ 40,000	$ 540,000
West Segment	-	100	$ 500,000	$ -	$ 40,000	$ 540,000
Total	**600**	**380**	**$ 1,900,000**	**$ -**	**$ 392,000**	**$ 2,292,000**
*Maintainence totals assume that all restored acres are in maintainence after five years.						
20-Yr Work Plan			*(years 6 through 20)*			
	Previously Restored Acres	Acres To Be Restored Yrs 6-20	Restore Cost	Enhance	Maintain Cost	Sum Cost
East Segment	780	189	$ 945,000	$ 200,000	$ 2,286,000	$ 3,431,000
Center Segment	100	261	$ 1,305,000	$ 50,000	$ 1,008,000	$ 2,363,000
West Segment	100	123	$ 615,000	$ 50,000	$ 468,000	$ 1,133,000
Total	**980**	**573**	**$ 2,865,000**	**$ 300,000**	**$ 3,762,000**	**$ 6,927,000**
	Restored Acres	Remaining Acres	Restore Cost	Enhance	Maintain Cost	Sum Cost
Sum Total	**1580**	**367**	**$ 4,765,000**	**$ 300,000**	**$ 4,154,000**	**$ 9,219,000**

Table ES-1. *Vegetation Management Cost Summary, Five- and Twenty-Year Work Plans.*

Regarding water resources management, the park has been evaluated and a plan for management was developed in the Lebanon Hills Regional Park Subwatershed Assessment in 2017-18. This thirty-year plan outlined thirteen projects to enact best management practices to reduce pollutant load to the lakes of the park. The total cost of all of these projects is approximately $3 million, but if implemented, will be phased over twenty years.

Regarding wildlife, many of the vegetation improvements and restoration greatly improve habitat for a wide variety of wildlife species that use the park. Additional projects over and above vegetation restoration are also planned for the park, and tend to focus on individual species, rather than the community in general. Species include common species to species of greatest conservation need, including badger, Blanding's turtle, red-headed woodpecker, rusty-patched bumblebee, red shouldered hawk, river otter, tiger salamander, oven bird, brown thrasher, monarch butterfly, leadplant moth, Dakota skipper, prairie skink, green snake, and plains pocket gopher, among many others. Furthermore, after evaluation of current literature and restoration potential for native communities in the park, staff developed a list of over 100 species that have a high potential to either occur in the park but have not been observed yet, or that have the potential of being restored to the park. Costs for special wildlife projects will vary depending on the specific project, but up to $300,000 has been identified by the NRMSP for the first five years.

LHRP is an exceptional oasis of quality natural resources and a preferred destination for recreational and educational opportunities in Dakota County and the greater Twin Cities Metropolitan Area. This plan will enable Dakota County to be well poised to achieve resilience and regionally outstanding quality at LHRP, now and for future generations.

2. INTRODUCTION

2.1. Precedent Planning Efforts

The *Dakota County 2030 Park System Plan* was approved by the Dakota County Board in 2008 and consists of the three main components: Great Places, Connected Places, and Protected Places. The current Lebanon Hills Regional Park (LHRP) Master Plan was completed in 2015. In 2010, Dakota County and several cities within the county (constituting the Dakota County Greenway Collaborative) adopted *The Greenway Guidebook*. In 2017, a Natural Resource Management System Plan (NRMSP) was approved by the County Board for all parks, greenways and County conservation easements. Also, in 2017, a Visitor Services Strategic Operations Plan (VSSOP) was completed for all parks and greenways. This plan, the LHRP Natural Resource Management Plan (NRMP), was developed with the goal of incorporating previous natural resource management efforts for LRHP, being consistent with the goals outlined in the Master Plan (2015) (LHRP MP) and the NRMSP (2017) and being compatible with the overall Park System Plan (2008) and the VSSOP (2017).

2.1.1. Dakota County 2030 Park System Plan (2008)

The 2008 Park System Plan (System Plan) provides an all-encompassing view that describes the existing status of Dakota County's Park System, a vision for the County's parks going forward, and a strategy for how to achieve this vision. The System Plan also identifies immediate priorities for the next 10 years and is organized into the following chapters: 1) System Overview, Research Findings, 2) System Vision for 2030, 3) Ten-Year Implementation Priorities, 4) Delivering the Vision, 5) Funding the Vision, and 6) Performance Measures.

2030 Park System Vision

This chapter describes a vision based on what citizens most wanted from County Parks. The vision as it applies to Lebanon Hills Regional Park is described below.

Great Places

The main points are: adding some paved walking and biking trails to link existing areas and lake loop trails, enhancing existing destinations (Visitor Center campus, picnic areas, trailheads, and camps), expanding four-season use, and strengthening resource stewardship.

Connected Places

The main points are: connecting a network of countywide greenways linking destinations and providing access to Dakota County Parks*.*

Protected Places

The main point is to manage resources in more sustainable ways*.*

Ten-Year Implementation Priorities

The 10-year priorities for implementing master plan projects included the following three recreational objectives for all County parks:

Objective 1: Provide **Popular Recreation Basics** at all parks including walking, biking, hiking, picnicking, fishing, programming, and events.

> *In addition to these basics, LHRP offers a children's play area, scenic views, and opportunities for nature observation, cross-country skiing, and snowshoeing. Cross-country skiing and hiking/walking amenities at LHRP are also signatures within the park system.*

Objective 2: Provide **Popular Opportunity-Based Recreation** using water features, terrain, and seasons, with a focus on areas with demonstrated popularity or need (e.g., canoe/kayak access points, cross-country skiing sites, and off-leash dog areas).

> *LHRP offers camping, canoeing/kayaking/paddle-boarding, equipment rental, geocaching, ice skating on lakes, skate skiing, sledding, a swimming beach, and a retreat center.*

Objective 3: Add or expand **Signature Use Recreation** to reflect each park's natural resources, location, and unique qualities.

> *LHRP has signature equestrian use, a high ropes adventure course, and mountain biking.*

Delivering the Vision

Described are broad implementation strategies and an overview of the care, maintenance, resource management, planning, programming, service delivery, and administration required to keep the park system operating. Policies, goals, and strategies discussed include building awareness and informing and engaging the public through targeted marketing efforts and by identifying needs, establishing expectations, and building capacity.

2.1.2. Natural Resource Management System Plan (2017) and Visitor Services Plan (2017)

The County recently developed a Natural Resource Management System Plan (NRMSP) to guide natural resource management in county parks, greenways, and conservation easements over the next 20 years. Combined with the Visitors Service Plan (VSP) (2017), near and long-term operations for the park system will be determined in the context of the existing or new master plan.

The process for developing the NRMSP consisted of four phases:

Phase I Scoping: Defined goals of the NRMSP and data used to complete the plan.

Phase II Research: Highlighted research completed to determine the type and condition of natural resources on County-owned lands and easements, including an inventory of measures needed to improve the health and condition of these lands.

Phase III Principles, Vision, and Preliminary Concepts: Described the vision for natural resource management and the principles used to guide the overall approach.

Phase IV Preferred Plan Option: Specified five- and 20-year priorities for managing natural resources in the system and provided natural resource management plan templates for individual parks, greenways, and easements.

Development of the NRMSP required an extensive review process, including public workshops, open houses, and public input to a dedicated NRMSP webpage on the County's website; it also required a Technical Advisory Committee comprised of private landowners, community leaders, State Agency staff, and members from academia, non-profit conservation organizations, and the Soil and Water Conservation District. The Plan was presented, in conjunction with the Visitor Services Plan, to the County Planning Commission and County Board at several points, including a Board workshop, and the County Board approved the NRMSP in May 2017.

The following tables summarize the initiatives for each of the major service areas for parks, vegetation, water, and wildlife, for the first five years of implementing the NRMSP.

Vegetation Management Activities in Parks	Acres	Estimated Cost
1. Control/manage most highly invasive species on all County lands	403	$869K
2. Restore/enhance important natural areas and high-use/educational areas	763*	$3.2M
3. Maintain all existing and newly restored areas (annually)	1,434	$2.9M
4. Stabilize invasive plant species control areas (every 5 years)	900	$728K
5. Collect baseline and trend data	4,000	$33K
6. Develop individual NRMPs for each park	-	$0 (in CIP)
7. Develop a new Private Sector Funding Program	-	$54K
TOTAL	**4,700** (3,500 managed and 1,200 not managed)	**$7.8M**

Table 1. *NRMSP Vegetation Management in Parks.*

Water Management Activities	Metric	Estimated Cost
1. Restore, enhance, and manage highest quality/most-used park waters via park projects	4 projects	$305K
2. Control the most harmful aquatic invasive species (AIS)	200 acres	$0 (already underway via external funds)

3. Work with partners to protect and manage areas outside of parks that benefit park waters	15 projects	$1.3M
4. Collect baseline and trend data (annually)	5 parks	$145K
5. Prevent new AIS from invading surface waters	300 acres	$0 (already underway via external funds)
SUBTOTAL		**$1.7M**

Table 2. *NRMSP Water Management in Parks.*

Wildlife Management Activities	Metric	Estimated Cost
1. Collect baseline and trend data (every other year)	6 parks	$489K
2. Work with partners outside of parks	5 sites	$323K
3. Focus on rare and endangered wildlife that are Group 1 species	3 to 5 species	$107K
4. Protect other important wildlife and improve populations	10 sites	$211K
5. Control problem wildlife	6 parks	$111K
SUBTOTAL		**$1.1M**

Table 3. *NRMSP Water Management in Parks.*

Wildlife Management Group	Definition and Implications for Management
Group I	**Park-specific or very local species.** Populations of individual species whose habitat and range are almost entirely within a park and hence can be managed and sustained inside a park. Butterflies, dragonflies, damselflies, some small mammals, and some reptiles and amphibians are in this group.
Group 2	**Local to regional species.** Populations of individual species that regularly use County parkland but, to persist long-term, must also use lands outside parks. Large mammals, many bird species, large reptiles and amphibians, many fish species, many aquatic macroinvertebrates, and freshwater mussels are in this group. Managing species in this group requires partnerships with others, often at a regional level.

Group 3	**Migratory.** Populations of individual species that use County park habitat in the spring and fall migration but do not breed there. Managing these species can occur at a continental scale, with some bird migrants travelling from southern South America to the Arctic tundra each year.

Table 4. *NRMSP Wildlife Management Groups.*

A provision of the NRMSP was to develop natural resource management plans (NRMPs) for each individual park in the County park system. Park NRMPs will deal with the details regarding the management of each park site, details that are very important but that are too specific for the higher-level management represented in the NRMSP. Thus, implementing the LHRP NRMP will fulfill the initiatives included in the Dakota County Parks NRMSP by planning and conducting invasive vegetation/AIS management, restoring native habitat and wildlife species, and maintaining quality native habitats that have been restored.

2.1.3. Previous Master Plans for Lebanon Hills Regional Park (1980, 2001)

The original Master plan was developed in 1980. It advocated a nature-based park management approach.

The Master plan was then updated in 2001. It emphasized providing a balance between visitor use and natural community impacts and the importance of a simplicity of the outdoor experience in the context of an ecologically healthy natural landscape.

2.1.4. Lebanon Hills Regional Park Master Plan (2015)

Key findings from the LHRP Master Plan are summarized here. The 2015 Lebanon Hills Regional Park builds upon the importance of natural resource protection and stewardship from previous park master plans.

<u>Recreation Elements</u>. Lebanon Hills provides for nine of the top ten activities in the Metropolitan Regional Park System. The main recreation elements in the park are picnicking, paved trails, accessible trails, equestrian use, camping, cross-country skiing, and programs/events.

Recreation improvements recommended from the Master Plan include the following:

- Goals (p. vii)
    - Update and complete unfinished elements from the 2001 Master Plan (trails, Camp Sacajawea, Campground, and trailheads)
    - Fill gaps in the most popular nature-based recreation activities (walking, bicycling, picnicking, beach enhancement, all-season use)
    - Improve existing recreation destinations (visitor center, trailheads, campground, and include site-based restoration with facility improvements)

- Build off existing development footprints to minimize impacts, when possible
- Facility Improvement Recommendations (pp. vii-ix)
    - Visitor Center
    - Holland Lake Trailhead
    - Jensen Lake Area
    - Southeast Trailhead
    - Campground
    - Camp Sacajawea
    - West Trailhead
- Trail Improvement Recommendations (pp. ix-xi)
    - Enhance existing trails
    - Improve accessibility and connectivity
    - Add popular recreation activities, without compromising existing trail networks
    - Protect and enhance natural resources
- Improvements for Further Study and Evaluation
    - Maintenance Facility Relocation (2023 CIP recommends relocation to the Northeast corner of the park)
    - Camp Sacajawea Location
    - Campground Road Improvement
    - Visitor Center Expansion
    - Lake Quality Management Study (completed 2017)
    - Natural Resources Management Plan (NRMSP completed in 2017, LHRP NRMP completed 2019)

<u>Cultural Resource Features</u>. A cultural resources inventory identified four historic sites within the park, three associated with property locations from an 1896 property plat map. Limited archaeological reconnaissance revealed intact materials at all four locations, with the probability that both historic and prehistoric materials are present within the Park. Because Native American prehistoric cultural resources are typically found near water, a 100-foot buffer is recommended to be added to waterway features when evaluating potential ground-disturbing activities.

<u>Natural Resources—Issues and Opportunities</u>. The plan identified four major issues for the park's natural systems:

1. **Long-term land use change, including farming and abandonment:** Removal of native vegetation and farming damaged park ecosystems through erosion, loss of soil fertility, and loss of the native seed bank. The biology, chemistry, and structure of park soils are degraded from their native state, limiting options for restoration.
2. **Removal of natural cycles,** such as naturally occurring fire, has allowed colonization by woody plants that convert open grasslands to shade-dominated successional woodlands.
3. **Disrupted natural systems:** Development around the park changed local hydrology and increased stormwater runoff into lakes and wetlands, which include chemicals, nutrients, and sediments.

4. **Invasive species** degrade ecosystems and prevent regeneration of native red oaks, the park's dominant native tree. As oaks decline, buckthorn and other species will dominate. Buckthorn is well-established and is the major threat. Exotic earthworms also impact the germination and growth of forest herbaceous plants.

Opportunities to address natural resources issues are increasing. With a re-organization of the Parks Department in 2013, a new natural resources management program was established which doubled staff, tripled funding toward stewardship, and leveraged contractor resources. This in-house capacity for land management and restoration is an exceptional opportunity to maintain and enhance natural resources in the park. The map below (**Figure 1**) illustrates some of the priority natural resource management areas identified in the 2015 LHRP Master Plan.

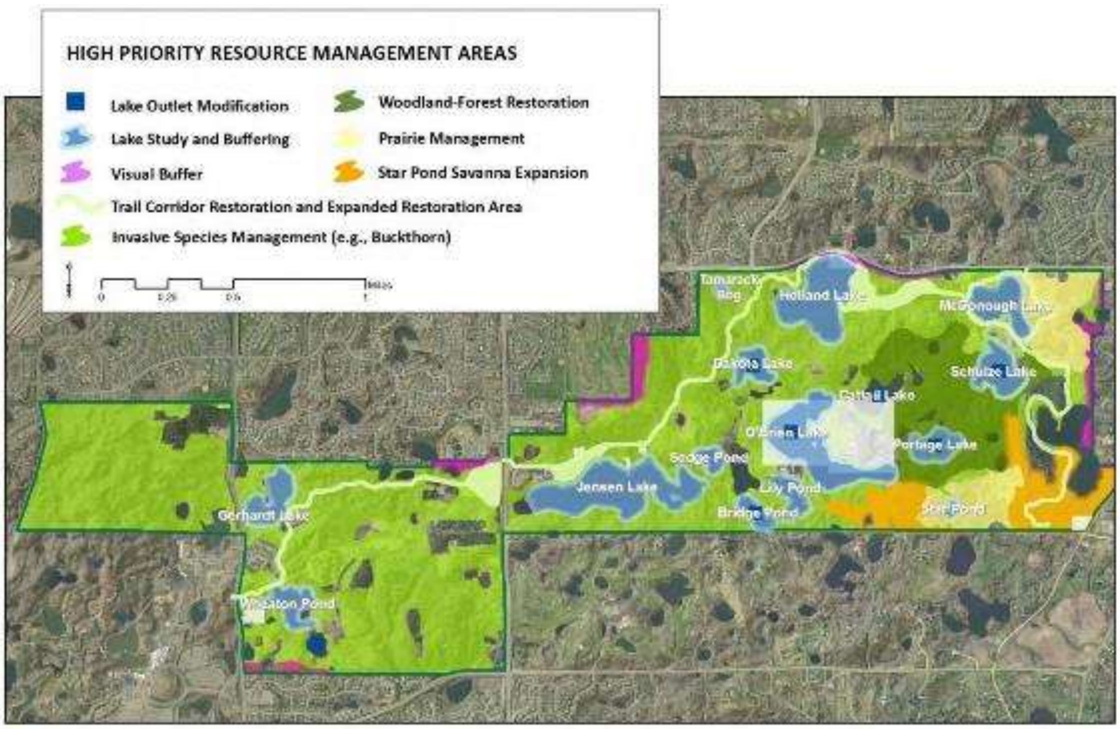


Figure 1. *Master Plan (2015) High Priority Natural Resource Management Areas.*

Implementation Plan. All components of the LHRP MP stress that it is essential for activities to protect and enhance natural resources in the park. Tier 1 and Tier 2 Priority Projects for implementation are included in the plan. Large-area natural resource stewardship projects include managing invasives species, managing existing restored prairies, expanding savanna restoration, lake restoration (outlets, shorelines, and associated wetland areas), stream restoration, management for rare species, and conifer plantation maintenance.

NOTE: The term "balance" has often been used to describe management approaches in parks, referring to the concept of "balance" between the natural and the built environments. In the past, it was common for governmental units to develop infrastructure that accommodated recreation as the primary focus of planning. In recent decades, however, there has been a movement towards an awareness of managing what has become a scarce resource. There has been increase in public opinion towards a more wholistic view of natural areas not primarily in terms of how they can serve humans, but rather, how they have intrinsic value to the myriad animals and plants that live there. A healthy ecosystem can and will produce benefits for people as well, such as cleaner air and water, notwithstanding the benefits of beauty and serenity so much sought after in the park experience. Individual development projects may have only small impacts to an ecosystem, but many such small projects may have large cumulative effects. This new Natural Resource Management Plan represents a shift toward natural resources restoration and management, and associated outreach and programming, to achieve the desired balance.

2.1.5. Lebanon Hills Regional Park Natural Resource Management Plan (2000)

Key findings from the plan are summarized here.

Vegetation. Seven natural resource types are described in the plan: savanna, woodland, forest, bluffland, floodplain, wetland, and versatile land. Essential activities included releasing native white oak tree species from competition with non-native trees (Siberian elm) and shrubs, keeping existing native prairie areas from woody encroachment, controlling invasive non-native species, and controlling the spread of oak wilt through removal of infected trees. The plan also includes considerations/limitations for active use of each natural resource type.

Surface Water. Essential activities to improve surface waters included installing water control structures at the outlets of major lakes and ponds and preventing stormwater from running directly from parking lots and other impervious surface areas into lakes, rivers, and creeks. No aquatic invasives species were noted in the plan.

Wildlife. Maintaining a wide variety of habitats for full life-cycle needs, amending cropland rental agreements to include hay/alfalfa, controlling deer populations, and controlling Canada goose populations through vegetation management were noted as essential and important activities for wildlife and park habitat management.

Implementation Plan. The management plan recommended an approach in which high priority, low cost projects are implemented in the short term, while supplemental funding is pursued for the remaining priorities and activities. Financing natural resource projects was presumably difficult due to Parks Department budget constraints and limited staff planning time available to incorporate projects into Capital Improvement Plans. At the time the plan was written, techniques were not yet developed for large scale restoration projects and Parks Department staffing was limited for even small-scale projects.

2.2. Regional Natural Resource Conservation Context

LHRP is in northern Dakota County within the St. Paul-Baldwin Plains Ecological Subsection. It is a critical component of local and regional networks of conservation land within the Twin Cities metropolitan area. The park lies within a Metro Conservation Corridor and includes pockets of land defined as having regional ecological significance. The park provides stepping stones of habitat within a 12-mile green corridor nearly connecting the Minnesota and Mississippi Rivers. The MN DNR has included the park in a Wildlife Action Network (MN DNR 2016) due to medium ranks for Species in Greatest Conservation Need.

Other conservation land within 10 miles of the park (**Figure 2**) includes Fort Snelling State Park, Scientific and Natural Areas (Pine Bend Bluffs in Rosemount, Grey Cloud Dunes just across the Mississippi River in Cottage Grove, and Savage Fen in Savage), and several Wildlife Management Areas (e.g., Spring Lake Islands, Vermillion Highlands, Vermillion River Bottoms). The Minnesota Zoo, Flint Hills Resources, numerous city parks, and Dakota County conservation easements conserve additional natural resources near LHRP.

The park is surrounded (**Figure 5**) by residential development which affects park visitation, limits park expansion, and provides challenges for natural resource management (especially prescribed fire activities).

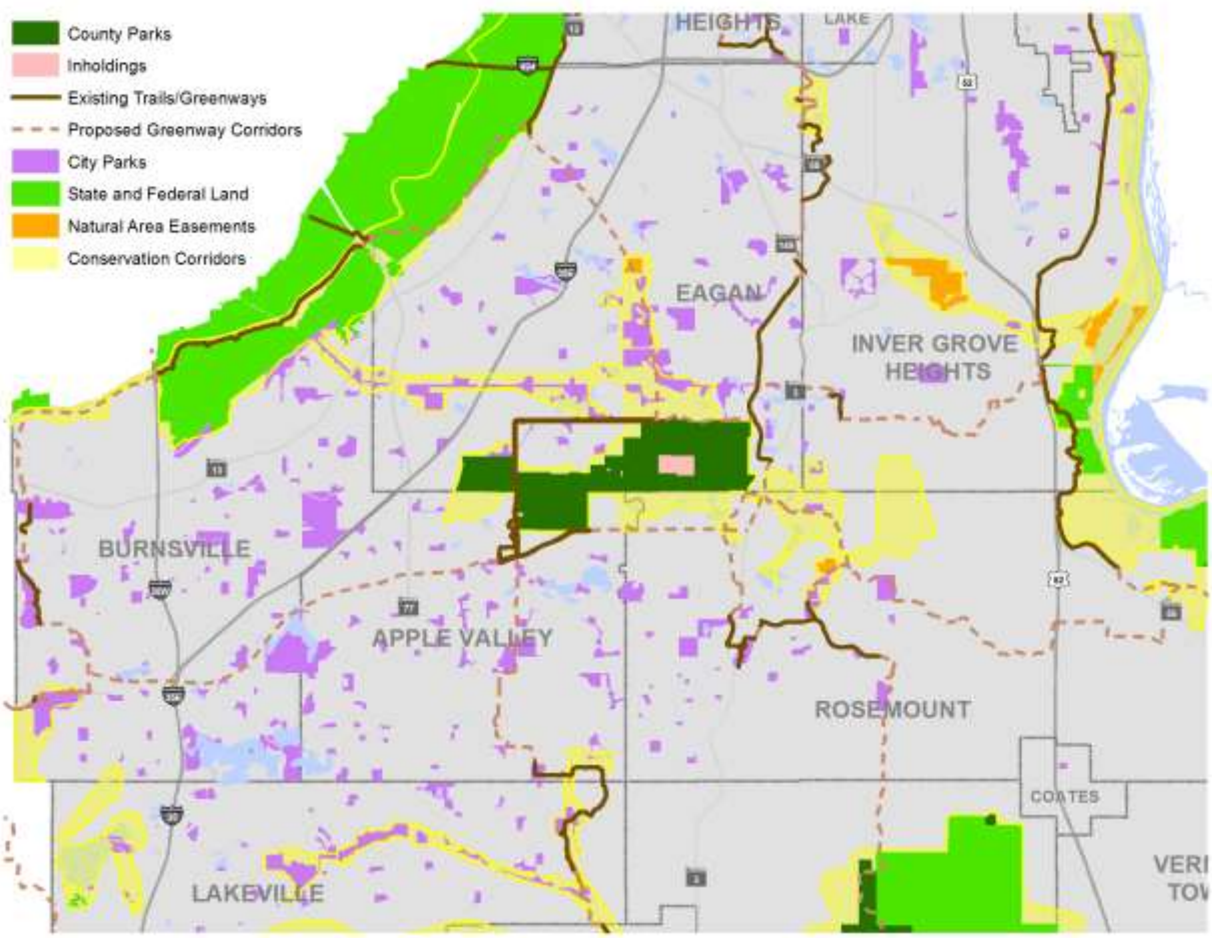


Figure 2. *Conservation Context Map. Note: the "Conservation Corridors" (yellow areas) are a refinement of the Metro Conservation Corridors developed by the MN DNR and refined by Dakota County staff as important for protection and natural resource management. Also note that many of the city parks contain active recreation that holds less natural resource value; exceptions are Patrick Eagan Park and Thomas Lake Park in Eagan, among others.*

2.3. Natural Resource Public Values

The natural world has a powerful influence on the lives of every person and has had for millennia. County residents in survey after survey express their desire to have nearby natural places that are out of the ordinary where they can be close to and even fully immersed in the natural world. For its residents, County parks can be an antidote to a fast-paced, technologically connected, buildings-and-road centered lifestyle.

2.4. The Main Problems Currently Facing the Park

The main problems currently facing the park's natural resources, and potential solutions, are listed below, summarized in bullet form. These issues will be explored in detail in the body of this report.

The main problems facing the park, and our natural communities and ecosystem in general are the following:

- Habitat and native plant community loss
- Habitat and native plant community fragmentation
- Loss, alteration, or suppression of ecosystem processes such as
    - Fire regimes
    - Grazing and browsing
    - Pollination
    - Hydrological regimes
    - Nutrient cycling
- Establishment of introduced, exotic species that have become invasive

The remedy to these problems is as follows:

- Increase the integrity of habitat and/or native plant community cover and quality
    - Protect
    - Connect
    - Buffer
- Restore or mimic lost or altered ecosystem processes
    - Prescribed burning
    - Conservation grazing/browsing or mowing

    - Historic hydrological regimes and increasing infiltration to groundwater
    - Nutrient cycling through reducing excess nutrients, increasing nutrient retention, and reconnecting nutrient pathways
- Remove or control the most prominent and disruptive invasive species
    - Uplands: European buckthorn, Tartarian honeysuckle, crown vetch, smooth brome
    - Lowlands: Reed canary grass, hybrid cattail, Eurasian water milfoil
- Re-introduce lost native species and foster/increase species with declining populations
- Use adaptive management as a tool to guide and assess the success of the restoration process
    - Monitor
    - Change as needed
    - Enhance as needed. Strategically:
        - Inter-seed into depauperate vegetation communities
        - Bolster key animal populations
        - Build soils,
        - Support targeted or missing habitat elements

How do we know this is working? With time, we should see the following:

- A significant increase of biodiversity
- A significant increase in species evenness
- A significant decrease in the cover and number of invasive species
- The stabilization or increase of at-risk native or important species
- Expansion of native plant community remnants
- Expansion of core habitat
- Increase in the quality of plant communities, locally and site-wide
- A significant increase in water quality
- An increase in groundwater replenishment and a concomitant decrease in surface water runoff
- Shorelines will increase in area and diversity
- Stream channels will reconnect with their floodplains
- Water will be retained more and conveyed less
- Wetlands will regain their functioning, not be lost, and be more diverse
- Soils will build and not be lost or eroded
- Organic matter will build in ecosystems and not be lost or reduced

Basically, all the aspects of a mature and well-functioning ecosystem should recover and be expressed.

All the parts need to work together for each of them to fully function. If one or multiple of the parts are non-functional, that will affect and diminish the other parts also. To quote the famous conservationist Aldo Leopold, "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" (Aldo Leopold, A Sand County

Almanac, 1949). Thus, due consideration and ecological assessment should be given for proposed changes to the park's management or environment, so that these changes do not result in significantly adverse impacts. For example, evaluating a proposed capital improvement and avoiding its being built into or through a rare plant remnant would be in keeping with the principle of ecological protection and connection for that remnant. Furthermore, consider cumulative effects. Singly, small intrusions or losses of habitat or ecosystem functioning or quality, may not seem to be a significant problem, but the accumulation of many small ones actually adds up to a large impairment to the system as a whole. Protecting and restoring the integrity of the natural communities and ecosystem is paramount for natural resource management success.

3. EXISTING NATURAL RESOURCES

3.1. Landscape Context

3.1.1. Location

Lebanon Hills Regional Park (LHRP) is located in the northern part of Dakota County. Lebanon Hills Regional Park is a large park surrounded by suburban development. It is Dakota County's largest park at 1,869 acres. LHRP straddles the borders of the cities of Apple Valley, Rosemount, and Eagan. Portions of the park are within Township 27N, Range 23W, Sections 26, 32-36, and Township 115N, Range 20W, Sections 11-14 (**Figure 3**). The park extends from Galaxie Avenue on the west side to Dodd Road on the east side and roughly from Cliff Road on the north side to 120th Street and McAndrews Road on the south. LHRP is located just 15 miles from downtown St. Paul and 22 miles from downtown Minneapolis.

Figure 3. *LHRP location and boundary (Source: Dakota County, LHRP Master Plan).*

3.1.2. Regional Natural Resources Context

LHRP occurs on the St. Paul-Baldwin Plains and Moraines Subsection of the Minnesota DNR's Ecological Classification System (**Figure 4**). This ecoregion consists of a Superior Lobe end moraine complex, St. Croix Moraine. LHRP occurs in the southern portion of this region, where it borders the Rosemount Outwash Plain to the south.

This subsection is small and continues into Wisconsin. Although it is topographically low in comparison to other areas in the state, the subsection is dominated by a large glacial moraine and areas of outwash plain. The subsection encompasses part of the seven-county metropolitan area and, as a result, is greatly affected by urban development. It is also dominated by a Superior lobe end-moraine complex comprising unstratified till. South of this moraine is a series of outwash plains, comprising stratified sands. There are some areas of loess plain (windblown silt deposition) over bedrock or till, in the southeastern portion of the subsection. Topography is rolling to hummocky on the moraine (steep, short complex slopes) and level to rolling on the outwash.

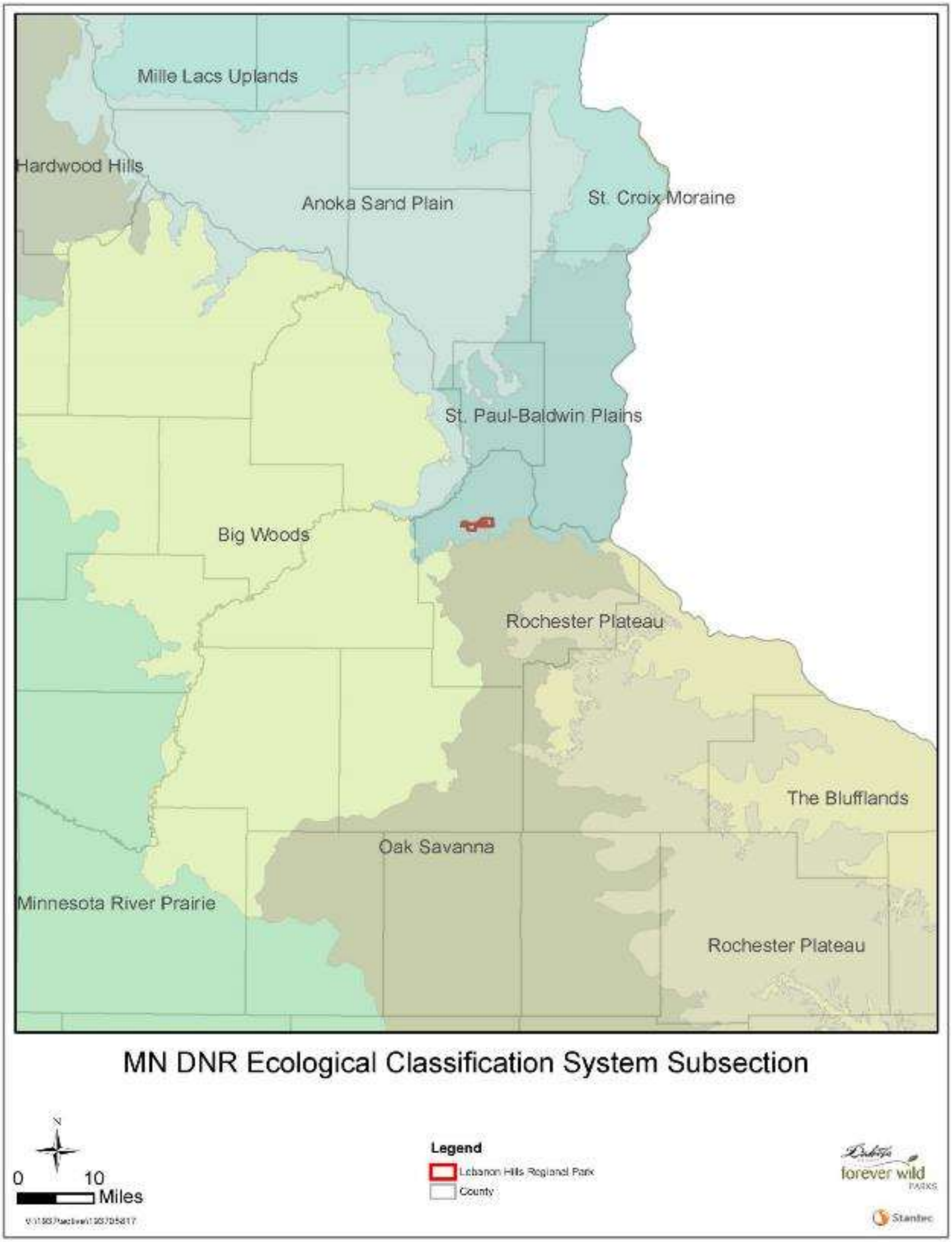


Figure 4. *Ecological Classification System Subsection map.*

3.1.3. Adjacent Land Use

The adjacency of agricultural, commercial, industrial, residential, open space, and other types of land use can affect vegetation, water, and wildlife management options and may present opportunities or barriers to enlarge existing habitat areas, create corridors for wildlife movement, and determine the characteristics of local surface water hydrology.

Development of areas immediately surrounding Lebanon Hills is nearly complete and consists largely of traditional suburban density residential development, with the exception of the Minnesota Zoo and large-lot rural residential areas southeast of the park in Rosemount. Agricultural and open land, shown in yellow on the map in **Figure 5**, still exists to the south and east of the park in Inver Grove Heights, Rosemount, and the rural townships. Some of this area is projected to transition to housing and other development by 2030.

Moreover, there are several private inholdings at LHRP. These include several individual residences and Camp Butwin, an 88-acre camp dedicated to providing nature experiences for children.

Substantial growth occurred between 2000 and 2010 in Lakeville, Farmington, and Rosemount, south of Lebanon Hills. Based on the 2010 Census, the geographic center of the County's population (centroid) has shifted from a location within Lebanon Hills in 2000 to south of the Jensen Lake area of the park.

There are a number of utilities that occur in or near the park (**Appendix K**), which have natural resource implications.

The natural resources within the park are affected by a number of physical conditions that influence their origin, current status, and future condition. These features include local geology, topography, and soils.

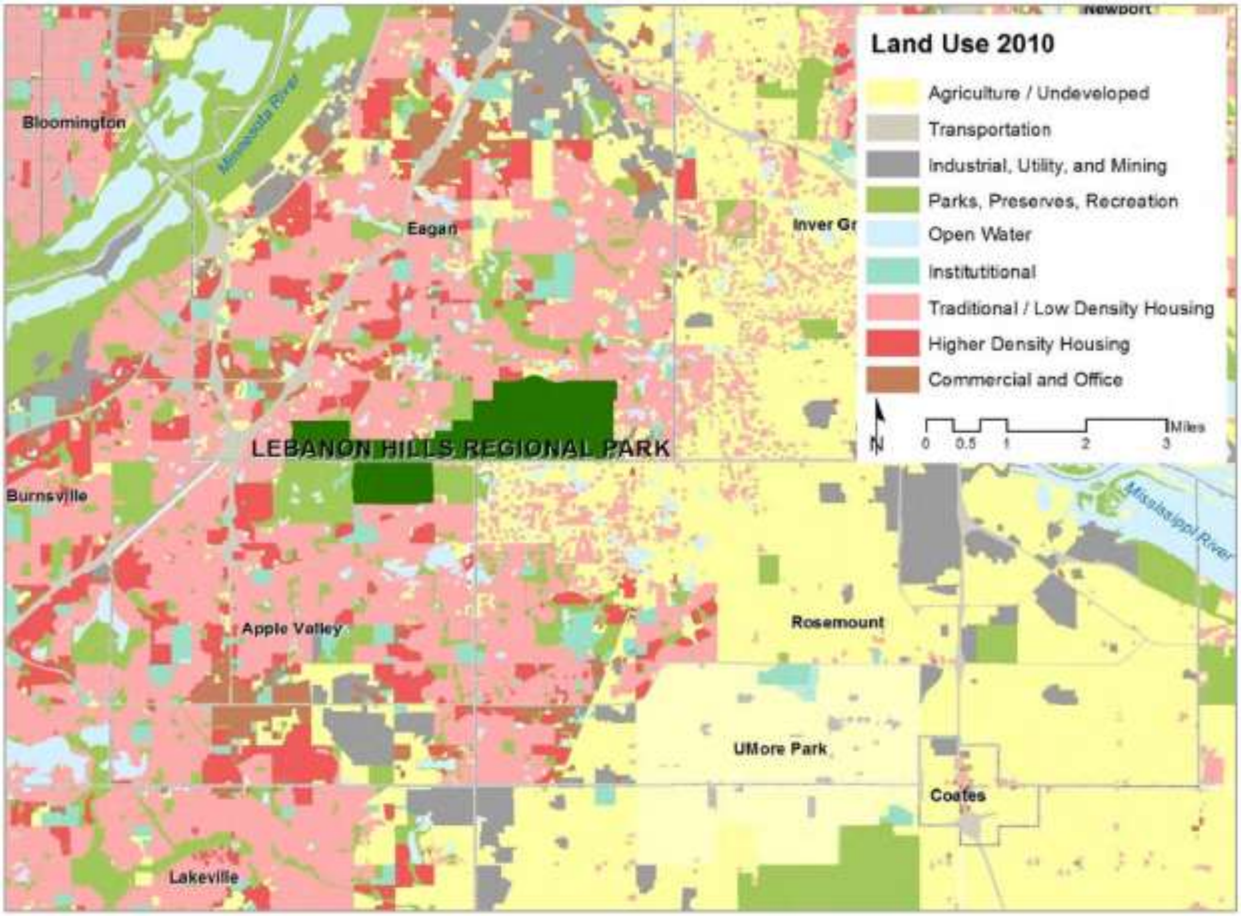


Figure 5. *Land Use (source: Dakota County).*

3.1.4. Geology

The bedrock geology in the western portion of the park is of Middle Ordovician origin that consists primarily of sandstone and limestone with shale components (**Figure 6**). The eastern portion of the park is Lower Ordovician which consists primarily of dolostone (dolomite) and limestone with sandstone components. The Ordovician period dates to 444 million years before present (BP). The Precambrian bedrock of the park is St. Croix Horst sandstones which date to 1,099 million years BP (**Figure 7**). These are soluble bedrocks consistent with Karst geology. The LHRP area has more than 100 feet of glacial deposits (deposited circa 12,000 years BP) on top of the bedrock and is considered Covered Karst, or Karst that is buried by younger sediment. With the bedrock geology lying under 100 feet of sediment, the effect on surface features is minimal and related primarily to drainage (see section 3.4.1 for more information on groundwater).

The surficial geology of LHRP consists of organic deposits on the eastern boundary and glacial lake sand and ice-contact stratified deposits along the northern and southern boundary of the park. The remainder of the park is till consisting mostly of sandy loam, unsorted sediment with pebbles, cobbles, and boulders. The effects of surficial deposits on vegetation communities, groundwater, and water bodies in this area will primarily depend on whether the deposits are sandy and well drained or clayey and poorly drained (see section 3.2.3 for more information on soils).

This surficial geology is conducive to develop and sustain the dry-mesic to dry oak forest, woodland, and prairie found in upland areas at LHRP (**Figure 8**). The irregular topography and small, closed watersheds have resulted in the development of wetlands and water bodies that tend to have good water quality and relatively fewer nutrients, which has helped sustain their quality.

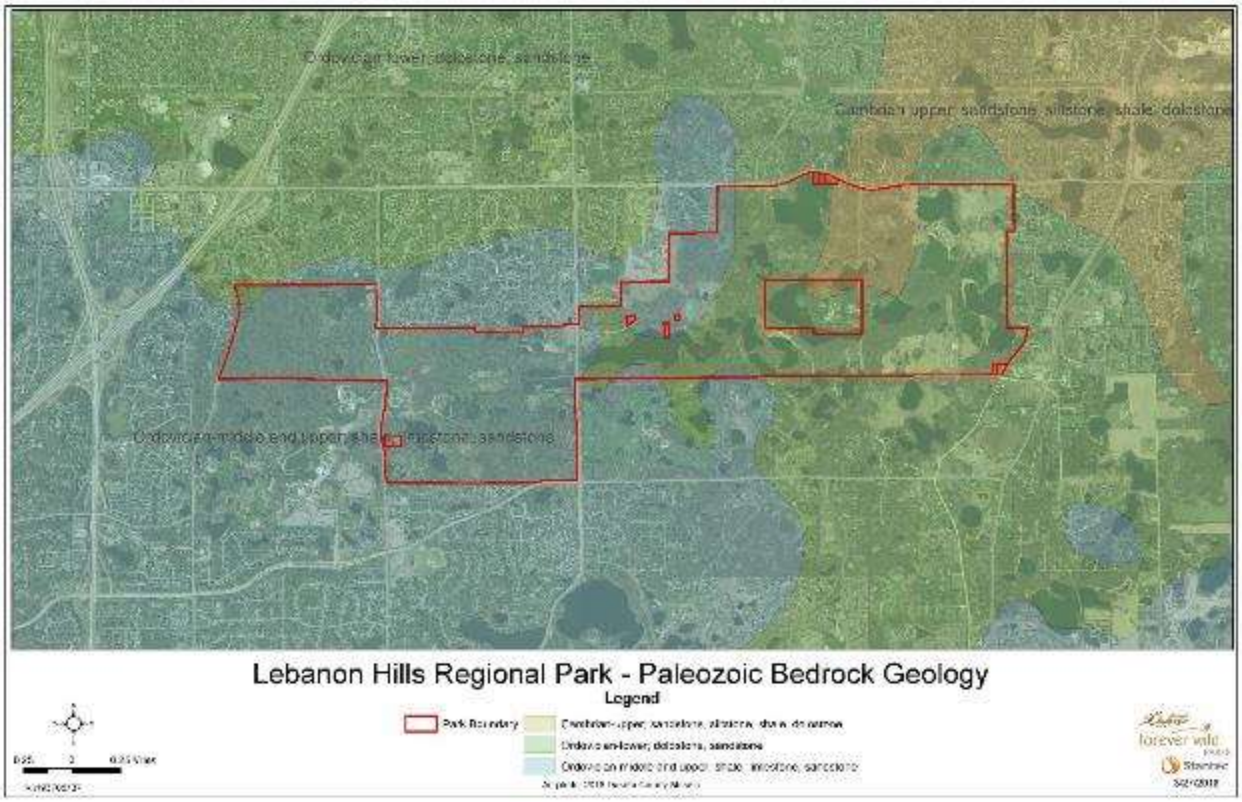


Figure 6. *Bedrock Geology.*

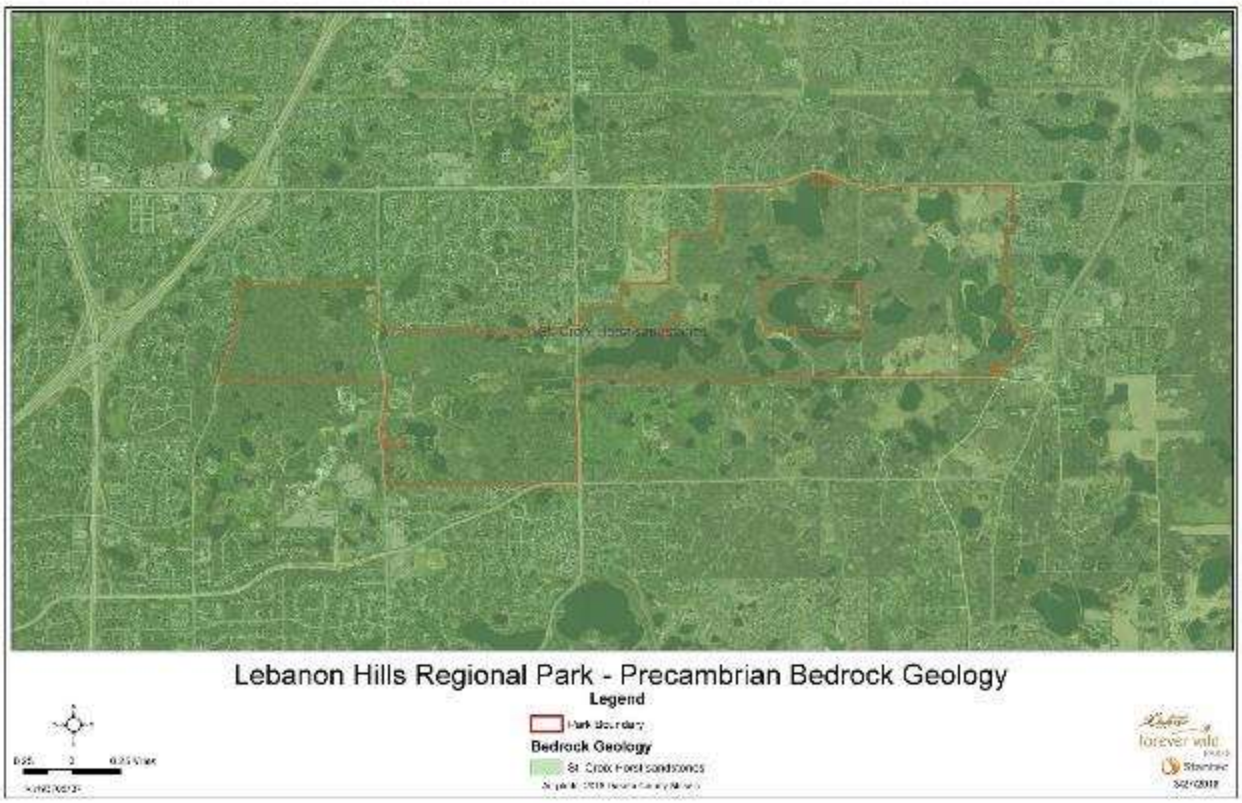


Figure 7. *Bedrock geology.*

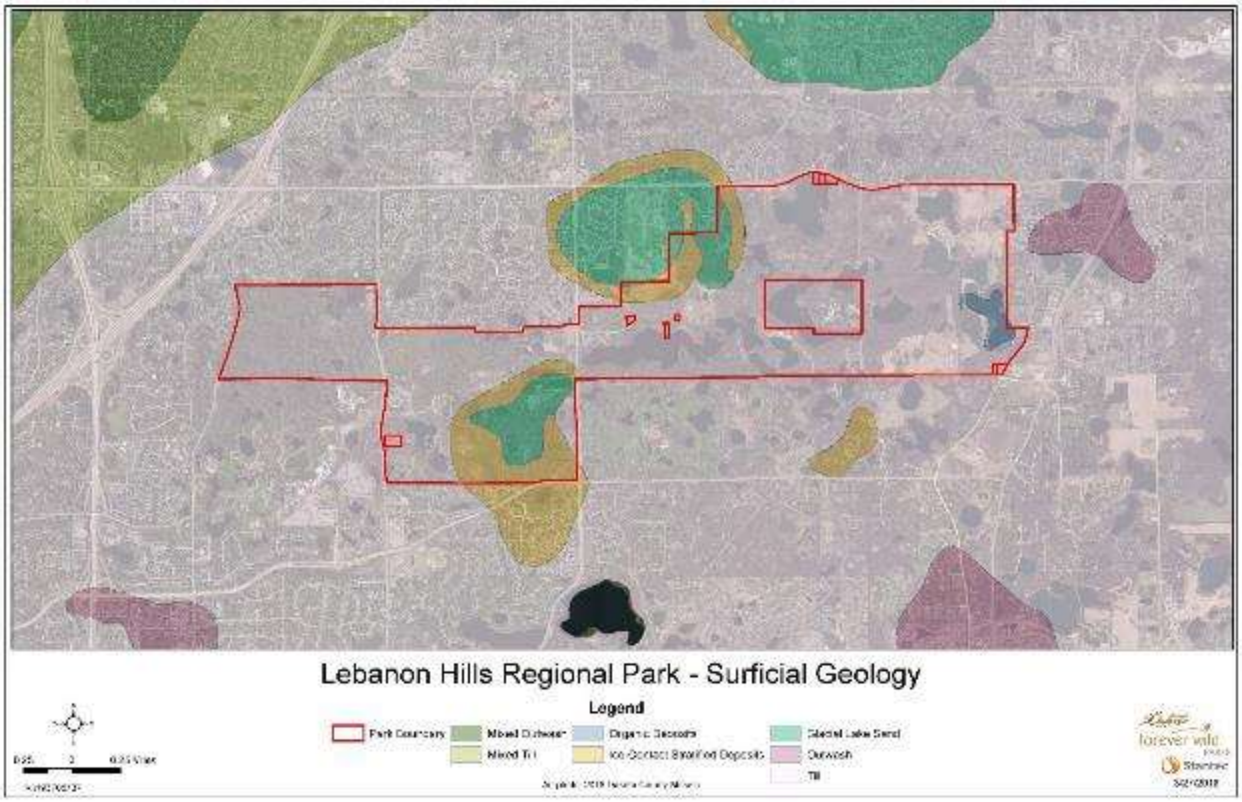


Figure 8. *Surficial geology.*

3.1.5. Topography

Topography and aspect (slope orientation relative to north, south, east, and west) are important factors in the development and formation of soil, soil erosion potential, and the type and stability of vegetation for a given location. The primary factors involved with topography, as it concerns natural features, are relief and variation. The difference from the highest to the lowest elevation is referred to as “relief”. The differences in contours from place to place across the landscape determine the amount of topographic variation. Taken together with variation in soil type, these factors help determine overall site heterogeneity. In general, greater heterogeneity within a site creates more complexity in vegetation and hydrologic features, which leads to greater biological diversity.

Aspect can have a strong influence on soil temperature and moisture. In the northern hemisphere, north- to east-facing slopes are often shaded or cooler, while south- to west-facing slopes are hotter and receive more solar radiation. Aspect can significantly influence the local climate (microclimate). Soil temperatures and soil moisture on south- to west-facing slopes are typically warmer and dryer than those on north- to east-facing slopes, due in part to the increased solar radiation and direction of the prevailing winds in the summer. Likewise, soils on north- to east-facing slopes tend to be cooler and wetter, due to diminished solar energy and late afternoon shading during the hottest part of the day.

The topography of LHRP is strongly influenced by glacial moraines, which are composed of irregular hills often with moderate to steep slopes (**Figure 9** and **Figure 10**). The low, depressional areas in this irregular topography feature a variety of wetland types, shallow lakes, and one deep lake (Holland Lake).

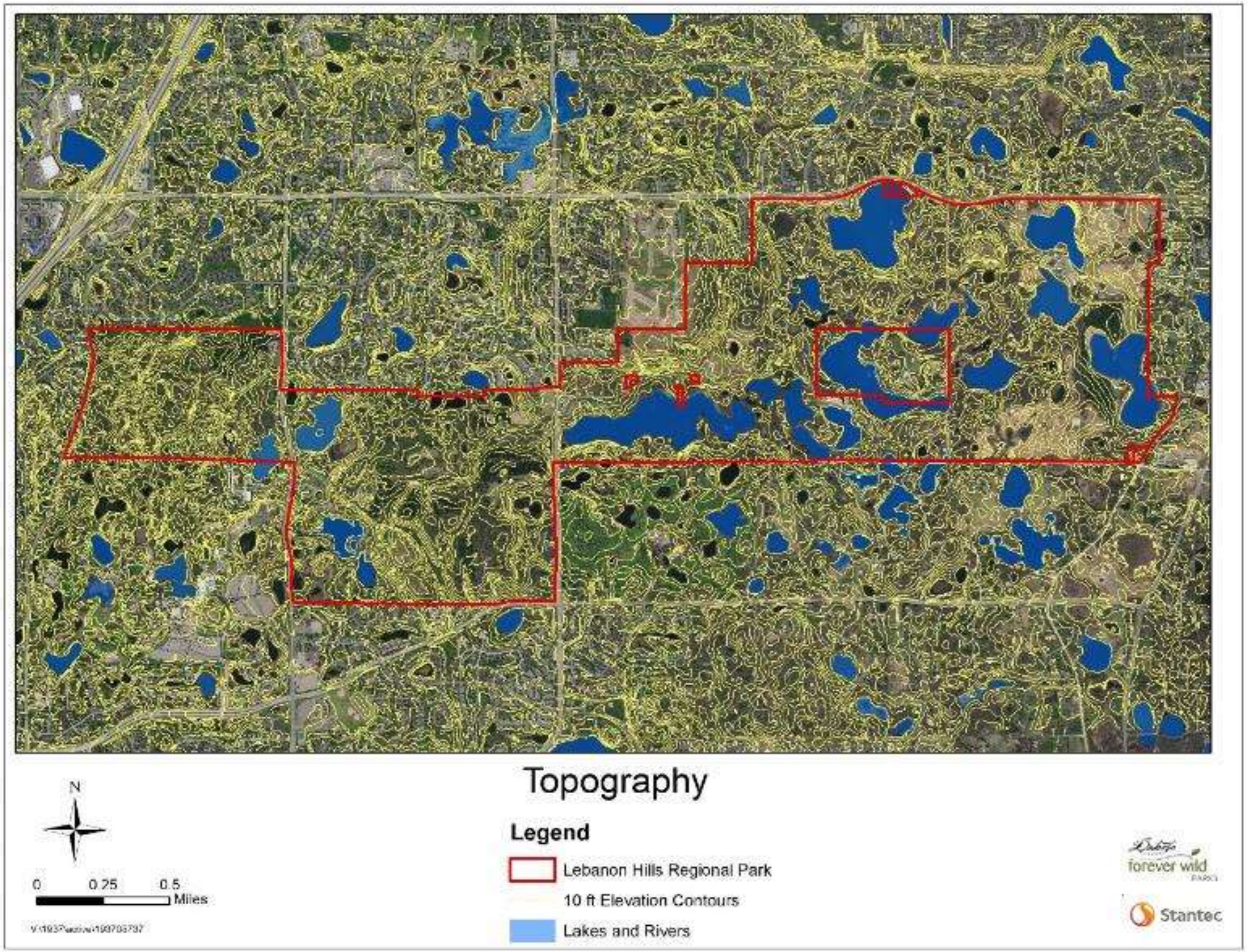


Figure 9. *Topography.*

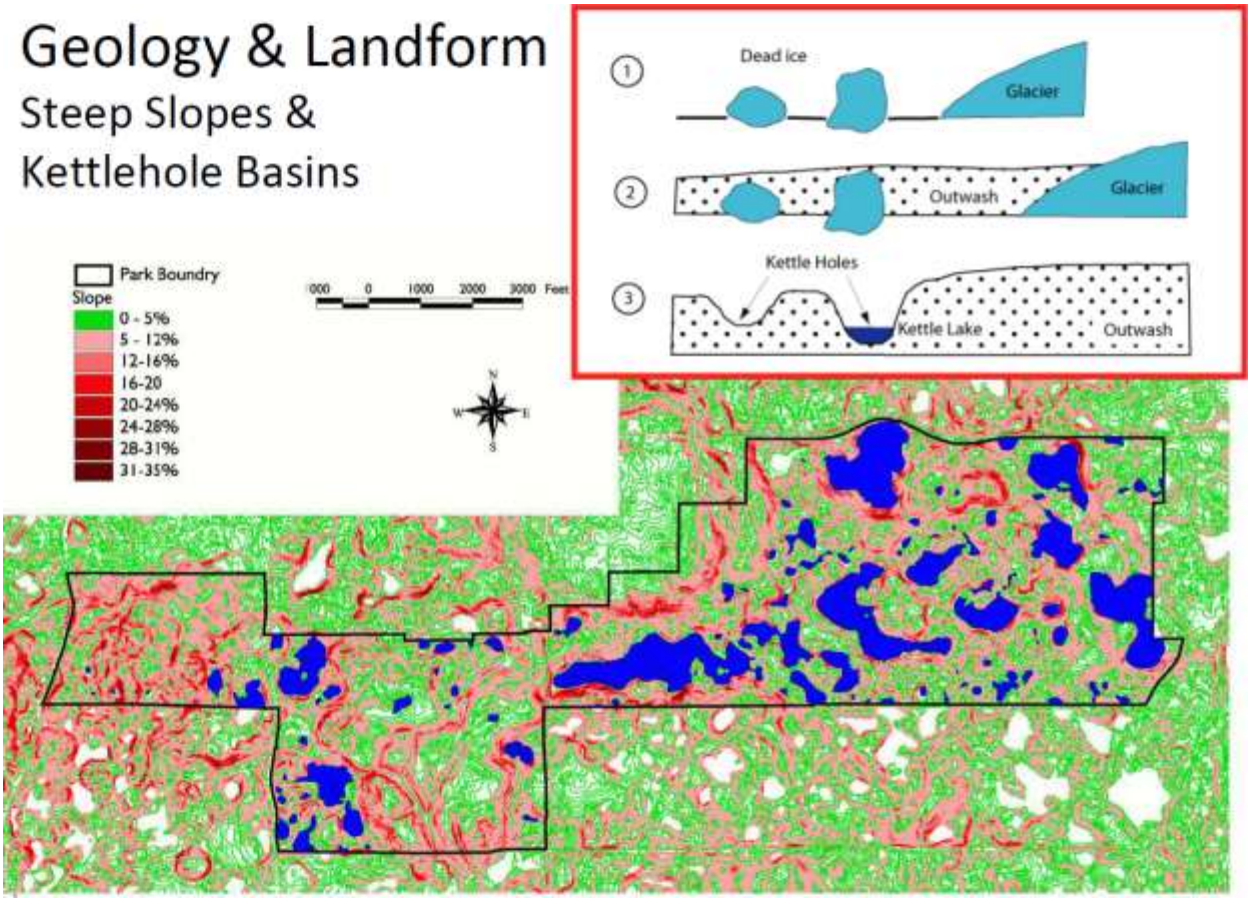


Figure 10. *Topography Lake Formation of Lebanon Hills Regional Park (Source: Dakota County).*

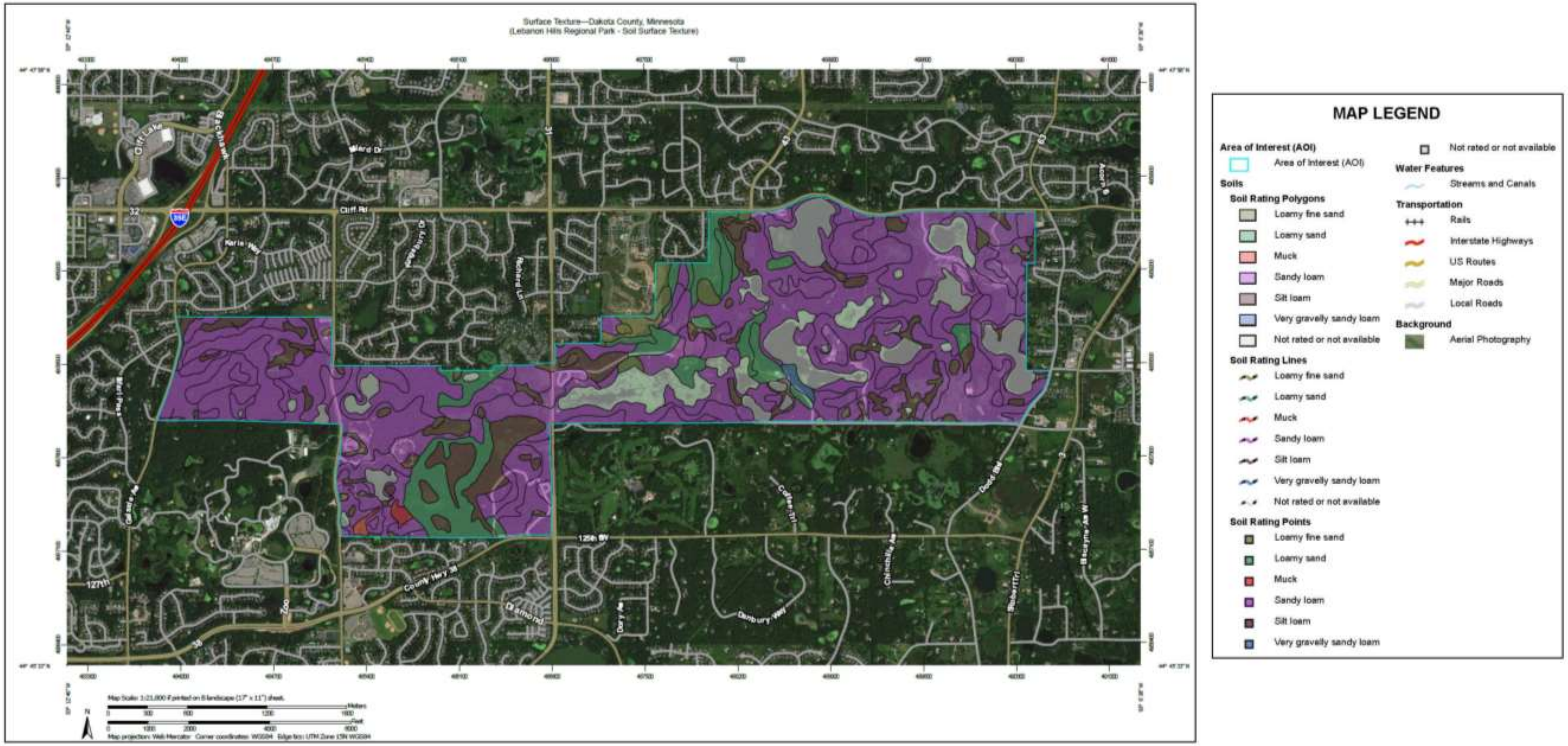
3.1.6. Soils

The "Soil Survey of Dakota County Minnesota," issued April 1983 and updated in May 1994, provides a generalized depiction and descriptions of soils found in the County. Soil formation is the result of the interaction of parent material (rock), climate, organisms, topographic position or slope, and time. Collectively, these factors help determine the dominant plant and animal communities, which in turn influences future soil development. Soil types can suggest the most appropriate use and management of the land.

The soils of LHRP are strongly influenced by the materials deposited by glacial activities. The most recent and influential glaciation occurred about 12,000 years ago during the Wisconsin period. Unlike glacial outwash plains that contain soil particles of similar size, moraine-derived soils contain particles that typically are not sorted by size and can have clay particles, silt, sand, gravel, rocks, and boulders all mixed together. Soils in upland areas generally are sandy loam to silt loam texture.

Sands, gravels, and cobbles are also common at the surface within LHRP, contributing to the vast majority of the soils in the park being classified as "well drained", with some areas being classified as “excessively drained” (**Figure 11** and **Figure 12**). Most park soils are mapped as the Kingsley-Mahtomedi-Spencer complex (up to 80 percent of the park), which can be sandy loam with variable underlying material, loamy sand underlain by gravelly sand, and silt loam underlain by silty clay loam. This soil group dries relatively quickly, has low nutrient levels, and erodes easily. These soil characteristics contribute to slow growth, disease susceptibility, and shorter lifespans for most native trees. These qualities also, especially on steep slopes, limit options for landscape restoration and re-establishing trees, although prairie and savanna communities would be well-suited. Small pockets of other soil types occur within the matrix of Kingsley-Mahtomedi-Spencer soils. Among other mapped soil groups, the park’s best agricultural soils (loams) are in its middle segment and the northeast corner of the west segment. The park’s hydric soils are associated with wetlands.

Lebanon Hills Regional Park – Soils Texture



Stantec

Dakota County forever wild PARKS

Figure 11. *LHRP Soil Texture map.*

Lebanon Hills Regional Park – Soils Drainage Class

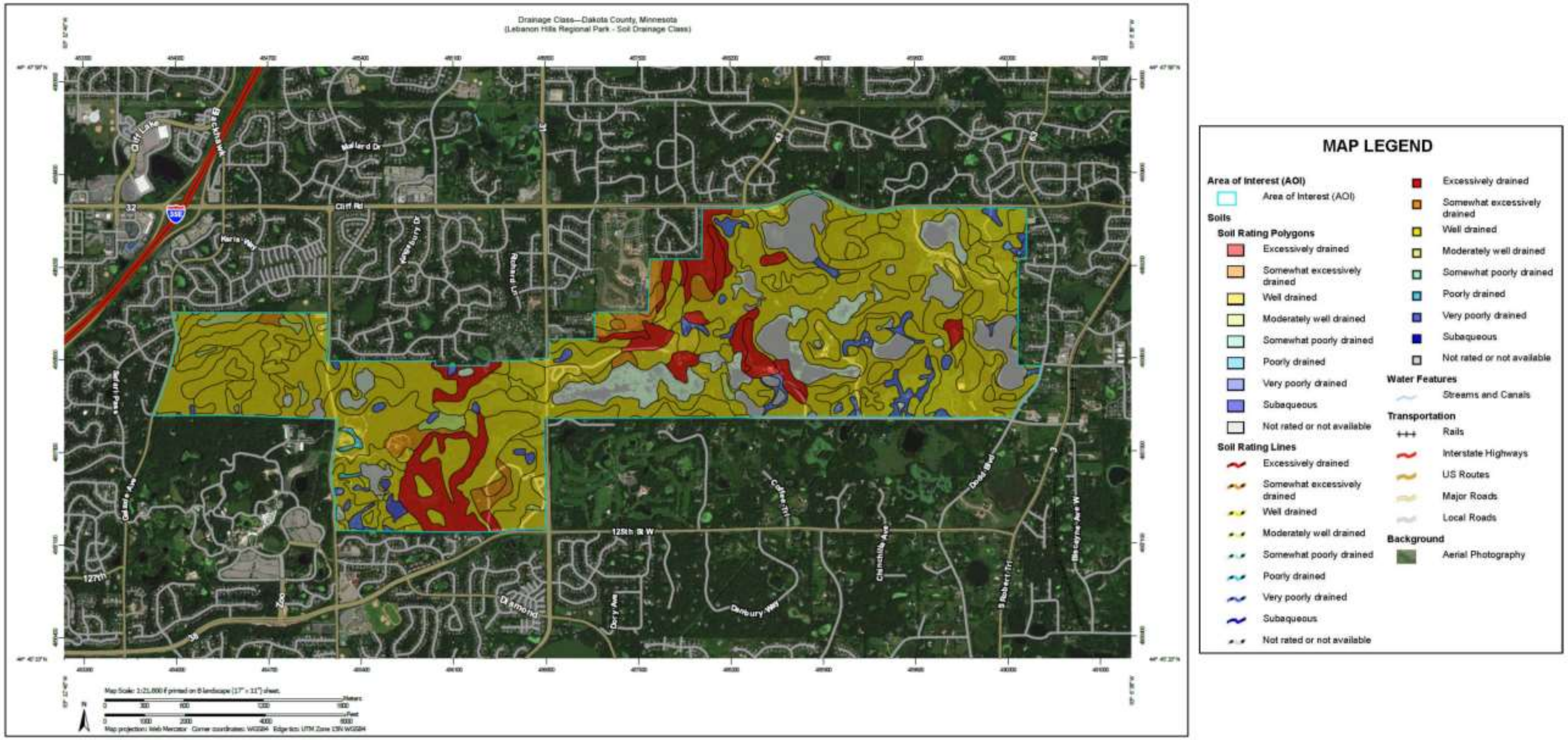


Figure 12. *LHRP Soil drainage class illustrating the predominance of well drained to excessively drained soils within the park.*

3.2. Vegetation

The vegetation growing in the park is determined by such factors as physical site conditions (topography, soils, and hydrology), historic and current land use, climate, invasive species, and wildlife. Vegetation is also affected by natural processes such as succession or natural events that create change and variation. Abrupt changes (disturbances), including wildfires, high winds, and floods, can quickly change the vegetative structure and composition. There is a spectrum of disturbance intensity from light, frequent events to catastrophic, uncommon events. The frequency and interval of different types of disturbances result in a myriad of potential vegetation types. After thousands of years, these dynamics influenced vegetation patterns and native plant communities prior to human settlement.

More recent activities associated with European settlement such as cultivation, draining of wetlands, pasturing, logging, mining, and urban development have created profound changes through disruptions of natural cycles and processes. Natural succession, the gradual change in structure and species composition, occurs as the vegetation changes in response to changes in light, water, nutrients, herbivory, predation, parasitism, and competition. Under natural conditions, succession tends to occur gradually over time and cause broadly predictable changes in the diversity and extent of vegetation communities and associated wildlife. The effects of disturbance and succession can vary widely. Different areas will be at varying successional stages due to diverse history, disturbance regimes, and time interval since the last major disturbance. These conditions interact with the environmental variability and genetic adaptations to create a mosaic of vegetation in various conditions across landscapes, including parks.

3.2.1. Historical Vegetation and Land Use

One major consideration for developing a comprehensive Natural Resource Management Plan (NRMP) is to understand the types of vegetation found on and around LHRP prior to European settlement. This information can be a helpful indicator of plants that may be found or thrive in the park. Fortunately, field notes on vegetation were taken during original territorial surveys during the 1840s–1860s and compiled into a valuable information source entitled “The Original Vegetation of Minnesota, compiled from U.S. General Land Office Survey Notes” (Notes) in 1974.

In general, the northern and western portions of the county consisted of hardwood forests among rolling hills and many lakes (**Figure 13**). American basswood, sugar maple, elm, paper birch, red oak, and an understory of shade-loving wildflowers made up the “Big Woods” in the soil-moist areas protected from fire. Bur, pin, and white oak, aspen, and black cherry were the dominant tree species in the drier areas. The southern part of the county consisted primarily of prairie and savanna, where, depending on soils, topography, and hydrology, tall grasses measuring as high as eight feet would have been the prominent vegetation type, with a diverse mix of other grasses and wildflowers (forbs). Shorter grasses and a wide variety of other forbs were found on sandy and gravelly areas and steeper slopes. Wet prairies were common on wetter soils where the water table was close to the surface. Wet meadows and marshes were present on soils that had standing water but that burned often enough to prevent trees and shrubs from becoming dominant. Near smaller rivers, prairie or savanna would often be found, even up to the water’s edge. Numerous wetlands once existed in the southwestern portion of the County, but only 12 to 15 percent remain today in Dakota County. Savannas with scattered oak trees formed transitional plant communities between grasslands and forests within the much larger transitional zone between the vast grasslands of the American West and the deciduous forests of Eastern America. Forested floodplains with cottonwood, silver maple, willow, and American elm were found in wider river valleys.

Figure 14 shows the predominant, pre-settlement plant communities of the park. The legend is interpreted from descriptions by Francis J. Marschner and his interpretation of records from the Public Land Survey from 1847 to 1855 in Dakota County. Government Land Office Survey work in the townships of LHRP occurred in 1853 and 1854. Descriptions below were modified from Marschner's Map by MN DNR as appropriate for southeastern Minnesota.

According to Marschner, the majority of vegetation in LHRP c.1855 can be broadly described as upland forest, characterized as being dominated by oak forest (bur oak, white oak, red oak, northern pin oak, elm). Given the current tree species composition and the records of bearing trees in the area, however, it is less likely that upland forests at LHRP would have been maple-basswood forest. A portion of the park was interpreted to be Aspen-Oak Land characterized by aspen, generally dense, and small in most areas, with scattered oaks and few elms, ash, and basswood. Aspen-Oak Land is considered to be a brushland and, in the absence of some type of regular disturbance (e.g., fire and/or wildlife grazing), would develop into oak and aspen forest.

It is important to note that because of the scale of Public Land Survey and the focus on surveying (rather than documenting vegetation), other plant community types such as tamarack swamp, emergent marsh, shallow lakes, smaller prairie openings, and similar inclusions would not have been documented, although they were certainly present.

Native American Use of Park Area

Early Prehistoric period settlement patterns are poorly known in the archeological area referred to as the "Central Lakes Deciduous" region, because evidence through artifacts is limited and consists for the most part of projectile points in surface collections. However, lakes and major rivers were apparently a focus of activity. Similarly, Early Middle Prehistoric period site location patterns are poorly known; they seem to primarily be associated with lakes and major rivers.

A major shift in subsistence-settlement pattern and technology occurred in the region during the Woodland period. Ceramics and building of burial mounds were adopted by about 200 B.C. The bow and arrow were adopted by ca. A.D. 500, and wild rice harvesting began to be intensified. As the broad-based hunting and gathering focus of the early Late Holocene was replaced by a more focal concentration on wild rice, habitation sites became larger, the human population may have increased dramatically in size, and people became less nomadic.

Although we do not have specific evidence of substantial historic use of LHRP by Native Americans, it is reasonable to assume that the area was probably used for periodic resource procurement forays. At the time of the establishment of Fort Snelling in 1821, Santee Dakota groups controlled the area that is now Dakota County. Although there is little information about the use of LHRP by Native Americans, it is well known that nearby sites were heavily used for camps and religious sites (e.g., Pike Island, Pilot Knob, and Pine Bend).

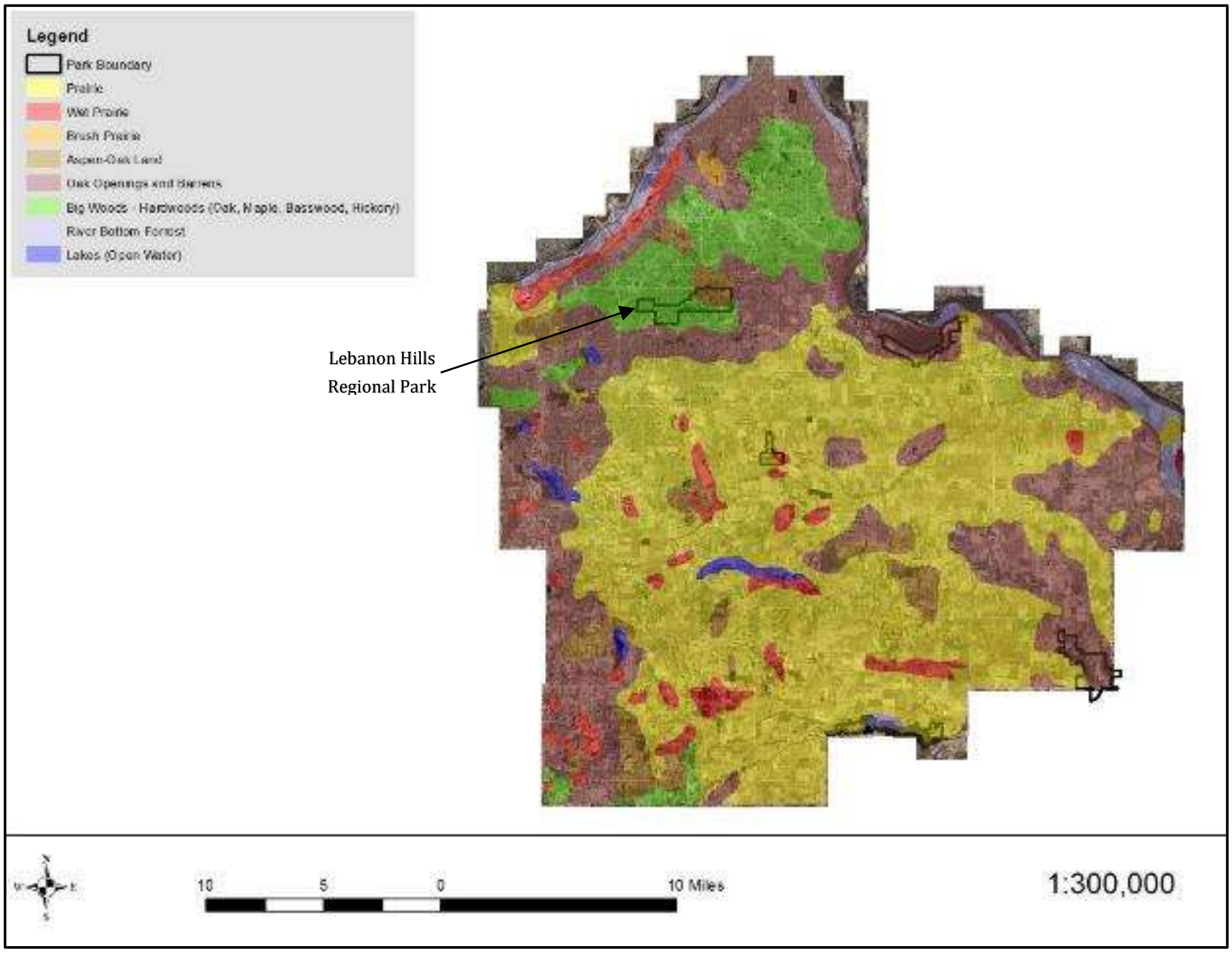


Figure 13. *Vegetation at the time of the 1847–1855 General Land Office Survey (Source: Dakota County).*

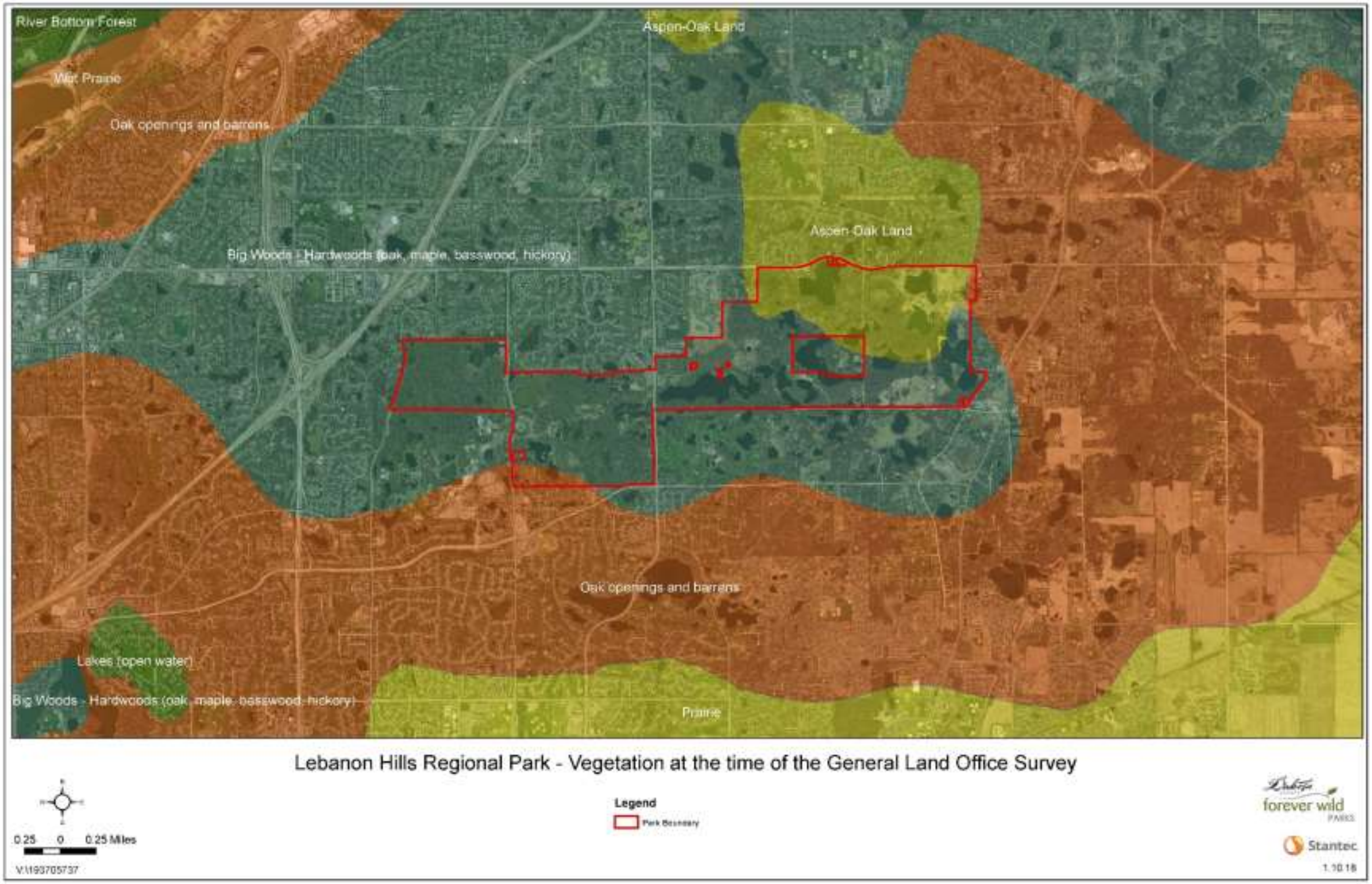


Figure 14. *Vegetation at LHRP at the time of the 1847–1855 General Land Office Survey.*

3.2.2. Land Cover and Land Use Trends

European settlement significantly changed the Dakota County landscape. Native prairies were plowed, forests and woodlands cut, wetlands drained, fires suppressed, wildlife species lost, and intense agricultural practices were introduced, including row cropping and livestock grazing. Since WWII, residential and commercial development has replaced much of the agricultural land cover in the northern half of the county. However, the southern half is predominantly open space dominated by agriculture.

Some of the best evidence of past land use is depicted in a progression of historical aerial photographs. **Figures 15, 16**, and **17** are historical aerial photos of the park and surrounding area starting from 1951 through 1997.

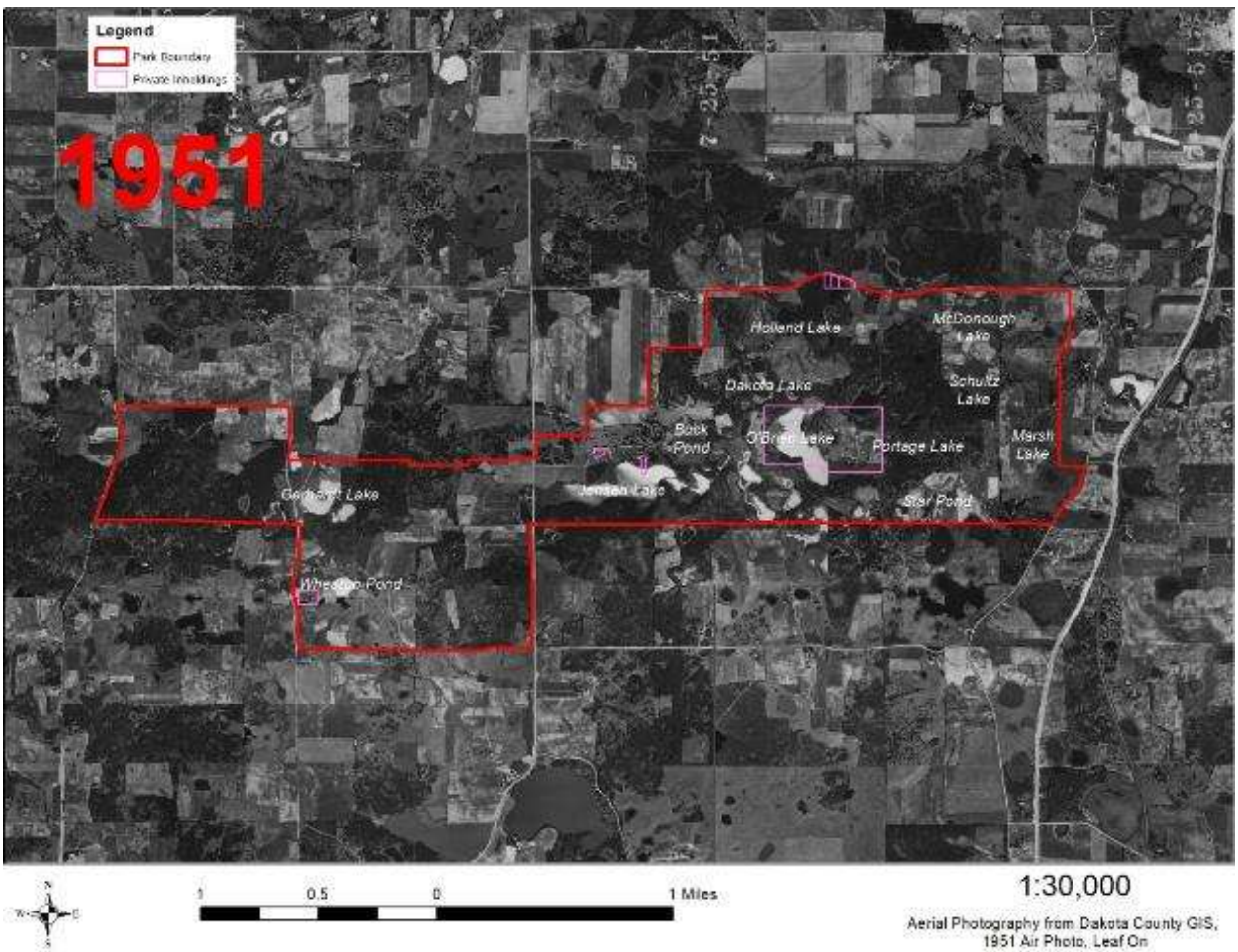


Figure 15. *Historic aerial photo from 1951 for LHRP.*

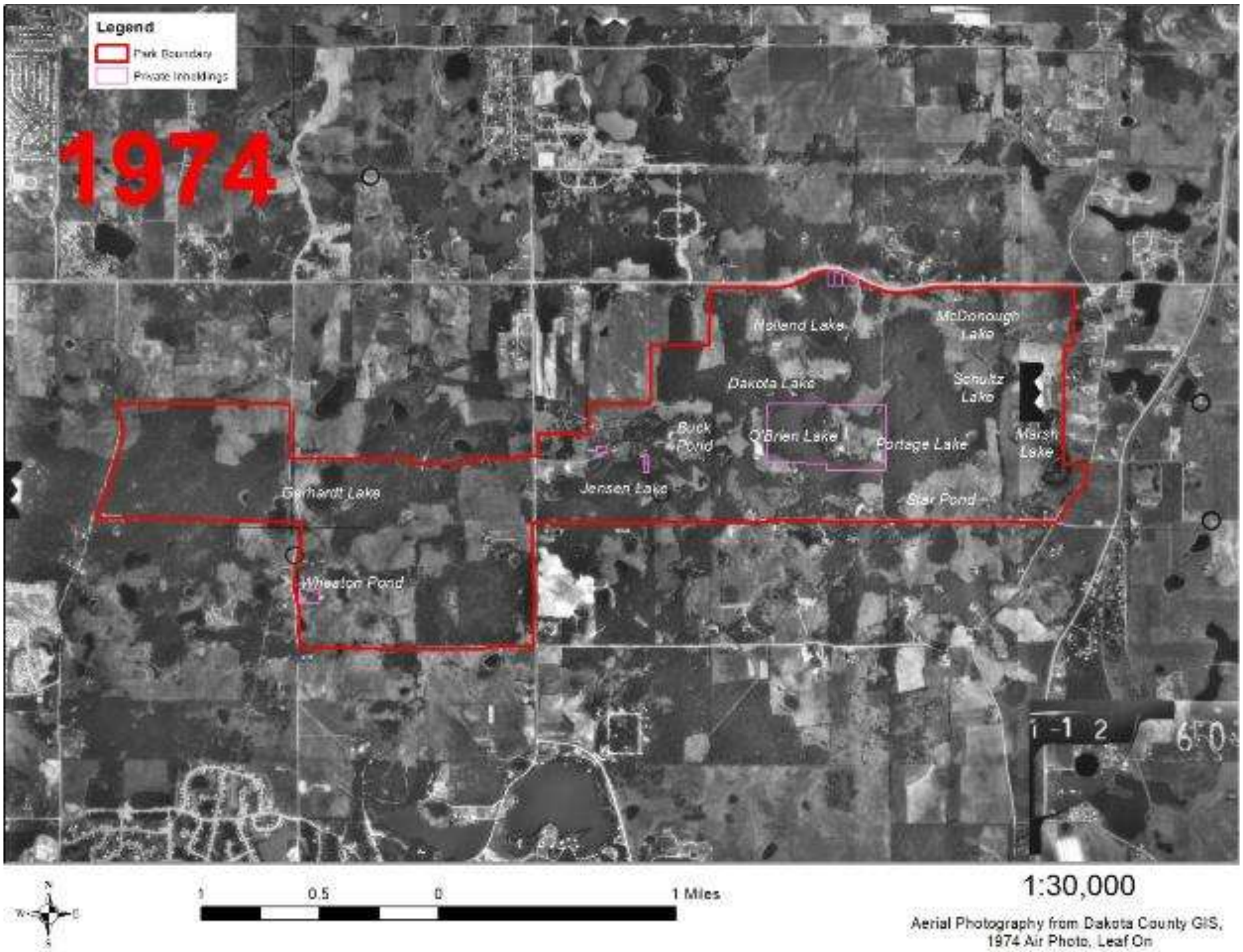


Figure 16. *Historic aerial photo from 1974 for LHRP.*

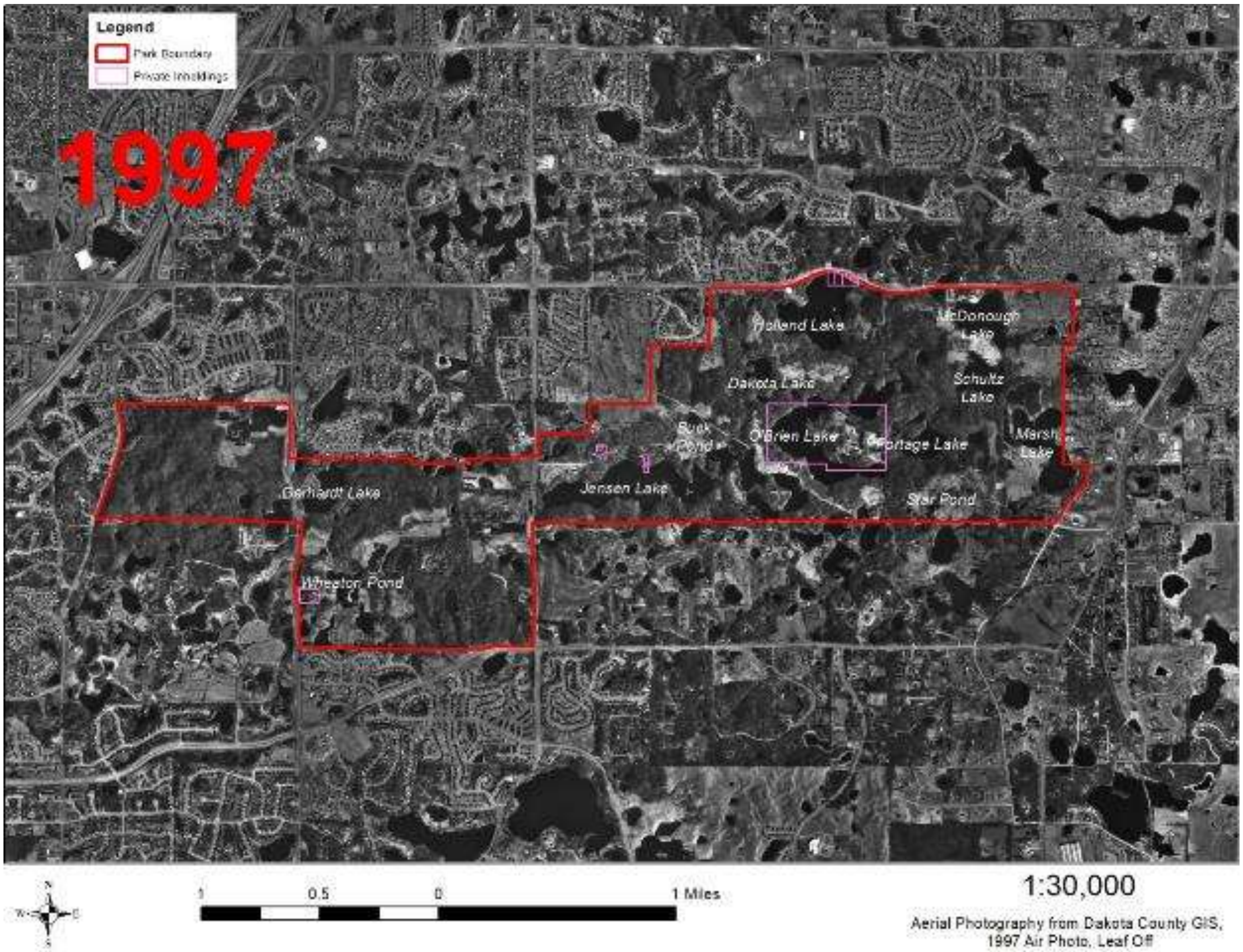


Figure 17. *Historic aerial photo from 1997 for LHRP.*

Upon closer examination of the photos, one can see that much of the park (about one-third of the area) was formerly in agricultural land use, either as crop fields, hay fields, or pasture. **Figure 18** helps illustrate this.

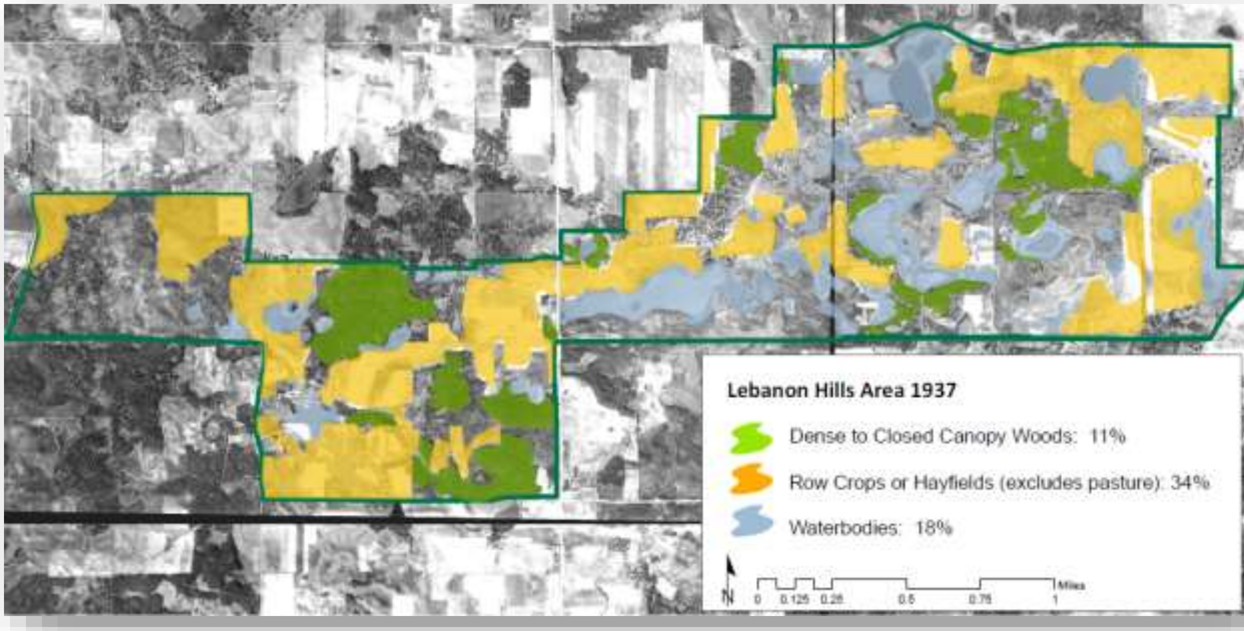


Figure 28. *Major land cover changes started with European settlement, as pioneers cleared forests, drained wetlands, and plowed prairies (the "agricultural era"). Row crops or hayfields (excluding pasture) in 1937 are highlighted in yellow and occupy about one-third of the area of the park (there would be more if pastures were included). Some of the lake beds in this photo are actually dry. Minnesota was in extended drought during the Dust Bowl era and after a heat wave in the summer of 1936, the shallow lakes dried up. Some of the lakes appear to be in cultivation or hay crops.*

The other big change that has occurred to the park land is the increase in the density and canopy cover of woodlands and forests. This is a result of fire suppression and the introduction of invasive shrub species such as common buckthorn and Tartarian honeysuckle. The county's native oak savannas, woodlands, and forests are fire-dependent systems and degrade without periodic ground fires.

Many small or relatively cryptic changes have occurred such as sedimentation in lakes, changing water levels in lakes and wetlands, and changes due to loss of key animal and plant species or disruption of ecosystem processes.

3.2.3. Land Cover Mapping and Assessment

Land cover within LHRP was updated in 2017–2018 using the Minnesota Land Cover Classification System (MLCCS) methodology. The original MLCCS mapping was conducted in the early 2000s, primarily by Dakota County Soil and Water Conservation District. Resources during the early surveys allowed primarily for mapping using aerial photo interpretation and by viewing areas from edge/distance. Below is a summary of the MLCCS methodology, followed by the results of the updated land cover mapping for LHRP (**Figure 19** and **Figure 20**).

MLCCS BACKGROUND

The MLCCS methodology, Version 5.4, was used to classify land cover within LHRP. A brief explanation of the method and its application to this project is provided below. The complete MLCCS methodology can be viewed and downloaded on the MN DNR website at the following address: *http://www.dnr.state.mn.us/mlccs/index.html* .

MLCCS provides a five-level, hierarchical system of land cover codes to describe natural and cultural land cover types. Natural land cover types include areas such as forests, prairies, wetlands, shrublands, and other similar areas. Cultural land cover types are areas that can be thought of as developed or substantially impacted by humans. These typically include paved (impervious) areas, agricultural fields, pastures and frequently manipulated grasslands, quarries, and others.

Progression through each of the five levels of the system represents an increased level of detail in land cover classification. In this framework, Level 1 is the least detailed and Level 5 is the most detailed. For the purposes of this project, all land cover within the park was classified to the greatest level of detail practical (Level 4 and Level 5 in most cases).

At the highest level, land cover is divided into either "natural/semi-natural" or "cultural" cover types. Below are explanations of the five different classification levels for the two major cover categories.

Natural/semi-natural

The natural/semi-natural classification system is a hybrid of the National Vegetation Classification System (NVCS) and the Minnesota Natural Heritage plant communities. The NVCS is used for the top three levels of the system, while the fourth and fifth levels rely on Minnesota Natural Heritage community types.

Level 1 - General growth patterns (e.g., forest, woodland, shrubland) (**Table 8**)
Level 2 - Plant types (e.g., deciduous, coniferous, grasslands, forbs)
Level 3 - Soil hydrology (e.g., upland, seasonally flooded, saturated)
Level 4 & Level 5 - Plant species composition (e.g., floodplain forest, rich fen sedge, jack pine barrens)

Cultural

The cultural classification system is designed to identify built-up/vegetation patterns and an area's imperviousness to water infiltration. Most other land inventory classification systems, such as the USGS Anderson system, employ land use terminology (e.g., urban, commercial, residential). This system distinguishes among land cover types at five levels.

Level 1 - Presence of built-up elements (i.e., built-up vs. cultivated land)
Level 2 - Dominant vegetation (e.g., trees, shrubs, herbaceous)
Level 3 - Plant type (e.g., deciduous, coniferous)

Level 4 - Percent of impervious surface or soil hydrology
Level 5 - Specific plant species

This cultural classification is unique in that it emphasizes vegetation land cover instead of land use, thus creating a land cover inventory especially useful for resource managers and planners.

Aerial Photo Interpretation and Remote Sensing *Error! Bookmark not defined.*

In October 2017, ecologists from Stantec began remote interpretation and preliminary review of existing cover type boundaries, using a variety of contemporary and historic aerial photographs to aid in interpretation of vegetation type and natural community structure.

Stantec staff then printed true-color, low-altitude aerial photographs for LHRP for use as base maps. These were printed at a scale to facilitate field survey work by an ecologist. Available electronic data layers such as the previous MLCCS polygons, National Wetlands Inventory, the Soil Survey, geopolitical boundaries, park boundaries, and DNR Natural Heritage (MCBS) data were also printed on these plotted photos.

Field Evaluation

In October 2017, field checking of land cover classifications began. During field review of areas, the previous five-digit MLCCS code assigned to any particular area/polygon was verified or modified, if necessary. In addition, other pertinent data was recorded using MLCCS Modifiers and Field Check Levels (see below). Modifications were also made to cover type polygon boundaries during the field survey portion of the project.

MLCCS Modifier Codes

Several 'classes' of MLCCS modifiers were assessed in the field while conducting the land cover classification of LHRP. These modifiers were assessed based on the methodology and definitions provided in the MLCCS training manual (Appendix B). Once assessed, the modifier values were entered into the GIS database for each land cover polygon.

Land Use Modifier

The M_2xx modifiers were developed to identify and describe land use. Seven categories of land use modifiers are available through MLCCS, of which four were used either wholly or partially in this inventory: 23x Transportation (roads and railroads), 24x Open Space Use, 25x Pavement, and 26x Farm modifiers. The primary land use modifier employed for the LHRP project was the 241 Park modifier.

Natural Community Quality Modifier (M_34x)

The M_34x modifier was developed as part of MLCCS methodology as a cursory method to assess the general natural quality of natural community and semi-natural land cover types. The natural plant community sites can be given a natural quality ranking, based on the DNR's Natural Heritage's Element Occurrence Ranking Guidelines. This modifier has four general categories: High Quality Natural Community (A), Good Quality Natural Community (B), Moderate Condition Natural Community (C), and Poor Condition Natural Community (D). However, the assessment method is based on general ecological variables and is applied in the same manner for all natural community types. The following is the description of the M_34x modifier from the MLCCS manual:

A = highest quality natural community, no disturbances and natural processes intact. Site must be visited entirely or partially to accurately assess its natural quality at this level (field level check = 3 or 4).

B = good quality natural community. Site has its natural processes intact but shows signs of past human impacts. Low levels of exotics. Site must be visited entirely or partially to accurately assess its natural quality at this level (field level check = 3 or 4).

C = moderate condition natural community with obvious past disturbance but is still clearly recognizable as a native community. Not dominated by weedy species in any layer. Minimally, the site must be visited from the edge to accurately assess its natural quality at this level (field level check = 2, 3, or 4).

D = poor condition of a natural community. Includes some natives but is dominated by non-natives and/or is widely disturbed and altered. Herbaceous communities may be assessed with this ranking from a distance (field level check = 1) if large masses of invasive species are present and the entire community is visible.

***NOTE**: DNR Ecologists weigh the herbaceous layer composition heavily in ranking a site. For example, in the case of a woodland community with good canopy structure and composition but poor ground layer structure and composition (which is the case in many parts of LHRP), it would probably be ranked a C. Nevertheless, such a woodland community is more readily "restorable" than one without intact canopy, in which case it would take hundreds of years to achieve a functional canopy.*

Invasive Species Modifiers (M_4xx)

The M_4xx modifiers represent invasive plant species occurring within land cover polygons. For the purpose of this project, the percent cover of each species of interest was estimated (rather than simply providing a presence/absence value as specified in the MLCCS training manual; see Appendix B). These species are important to track due to their invasive nature and potential threats to native plant communities and biological diversity of native habitats. The cover classes used to assess invasive species aerial cover (i.e., as viewed from above) are as follows:

Cover Class/Estimated Percent Cover for Invasive Species

Cover Class	Description
0	Unknown, or if field checked, plants not observed
1	Observed, unknown quality
2	1 to 5% coverage
3	6 to 25% coverage
4	26 to 50% coverage
5	51 to 75% coverage
6	76 to 100% coverage

Table 5. *MLCCS Percent Cover Classes*

The following is a list of invasive plant species and their associated modifier numbers that, if observed, were recorded for aerial coverage within land cover polygons at LHRP:

Modifier Number	Common Name	Scientific Name
M_402	Purple Loosestrife	*Lythrum salicaria*
M_406	Narrow-leaf Cattail	*Typha angustifolia*
M_408	Common Buckthorn	*Rhamnus cathartica*
M_412	Reed Canary Grass	*Phalaris arundinacea*
M_410	Tartarian Honeysuckle	*Lonicera [tatarica]*
M_411	Garlic Mustard	*Alliaria petiolata*
M_413	Smooth Brome	*Bromus inermis*
M_414	Spotted Knapweed	*Centaurea stoebe ssp. micranthos*
M_415	Exotic Thistle	*Cirsium* spp.
M_416	Siberian Elm	*Ulmus pumila*
M_417	Phragmites	*Phragmites australis*
M_418	Grecian Foxglove	*Digitalis lanata*
M_419	Amur Maple	*Acer ginnala*
M_420	Black Locust	*Robinia pseudoacacia*
M_421	Absinthe Sage	*Artemisia absinthium*

Table 6. *MLCCS Invasive Plant Species Modifiers*

Field-check Level

A field-check level modifier was assigned to all polygons. The field-check level indicates the degree to which an individual polygon was checked in the field during the land cover assessment. Most polygons were visited at least partially (field check levels 3 and 4), while cultural areas (20xxx and 10xxx codes) were viewed from the edge (field check level 2) or from a short distance (field check level 1). In rare cases, such as interior wetlands that were not accessible or where property access was denied, a site may have a field check level of 0 (not checked). The following is a list of field check modifier values and their associated descriptions:

Field Check Level	Description
4	Visited Entirely
3	Visited Partially
2	Viewed from Edge
1	Viewed from a Distance
0	Not Checked

Table 7. *MLCCS Field Check Levels*

Natural Community Quality Assessment

During the field checking of natural community land cover types, the project ecologist assessed the overall ecological quality of natural vegetation remnants using a standardized method developed by the MN DNR Natural Heritage Program. For the purposes of this project, certain minimum standard criteria that are part of this qualitative ranking methodology were not used. A specific example would be the minimum size (area) standard where the minimum threshold established by the DNR for most natural communities would prevent inclusion of many smaller natural areas that occur within the study area.

Search for Rare Plant Species

Where natural areas occur, particularly those of better quality, there is the potential for the occurrence of rare species. The MLCCS update was not intended to be a comprehensive floristic survey of LHRP and did not include targeted rare plant searches. However, Stantec ecologists remained alert to the possible presence of rare plants, especially in high quality natural communities. This being said, Dakota County natural resources staff systematically monitors the vegetation in the park every year, and occasionally new or rare species are found through this process. County staff documents and records information about species found, population locations, and other pertinent data. For instance, rare ferns (*Septridium* and *Botrychium* species) were found near Dakota Lake in 2017; County staff documented them and subsequently notified MN DNR staff who also documented them. Over time, County staff anticipates that the park vegetation will be better understood and more extensively described, to the benefit of management purposes and conservation efforts.

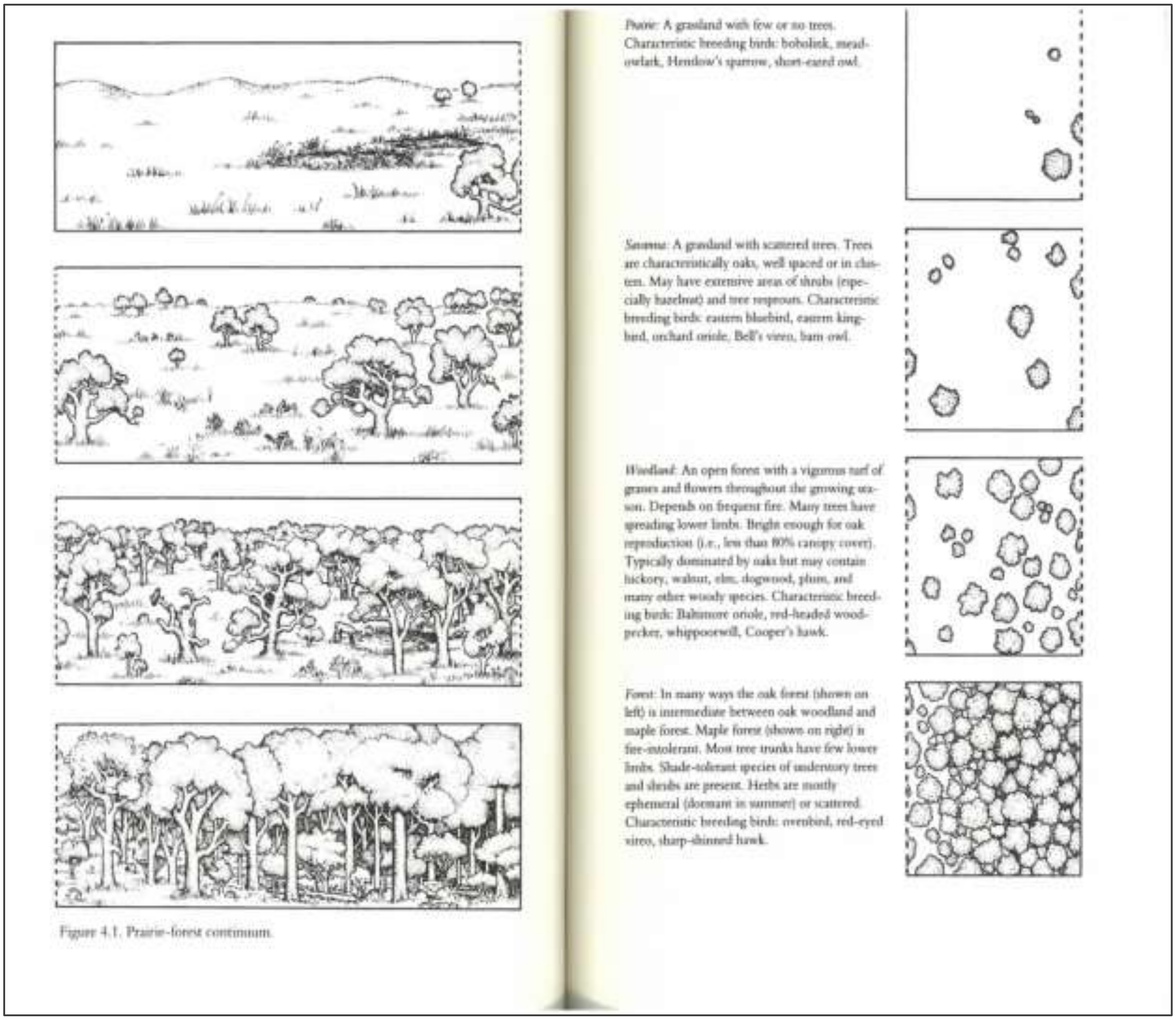
Land cover was classified to a minimum of Levels 4 and 5 for all of LHRP (1,960 acres). Seven of the nine Level 1 land cover codes were used to describe 540 individual land cover polygons within LHRP. The most significant updates that occurred from the previous (c.2002) land cover mapping effort included refining polygon boundaries, cover types, and adding additional detail about factors such as quality and invasive species cover.

3.2.4. Land Cover Results

GENERAL DESCRIPTION

Before describing in detail the types of vegetation on site and their quality, first a description of the land cover types and plant communities is in order. On a landscape scale, all communities/types are initially determined by abiotic factors such as hydrology, climate, and disturbance regime (such as fire occurrence/interval and plant-animal interactions like grazing and pollination), which determines what types of plants can survive in a given set of circumstances or region. For instance, 25 inches of precipitation per year in combination with cold winters and hot humid summers allows for a certain variety of plant communities to be possible in Minnesota. From this it can be seen that cover types and plant communities are dynamic—they are shaped by all of these large-scale factors.

Plant communities are primarily defined by a combination of two factors: composition and structure. They are *composed* of an assemblage of plant species that are typically associated with one another (e.g., oaks, grasses, and forbs in savannas and grasses and forbs in prairies). They are also *structured* such that spatial arrangements, patch densities, and cover proportions differ, independent of species composition (e.g., scattered trees (oaks) with brush/prairie understory for Woodland-Brushland and dense tree canopy with sparse shade-tolerant understory for forest). Considering the abiotic factors and the biotic factors together, with dispersal mechanisms, explains why and where a given plant community occurs on the landscape. And varying the intensity or frequency of one or more of the determining factors, such as fire or hydrology, will change the community, thus promoting succession from one type to another. For instance, withholding fire from a "prairie" community will lead to the succession of a "savanna" and then to a "woodland" and eventually to a "forest" community. This is called the prairie-forest continuum (**Figure 19**).



Prairie: A grassland with few or no trees. Characteristic breeding birds: bobolink, meadowlark, Henslow's sparrow, short-eared owl.

Savanna: A grassland with scattered trees. Trees are characteristically oaks, well spaced or in clusters. May have extensive areas of shrubs (especially hazelnut) and tree resprouts. Characteristic breeding birds: eastern bluebird, eastern kingbird, orchard oriole, Bell's vireo, barn owl.

Woodland: An open forest with a vigorous turf of grasses and flowers throughout the growing season. Depends on frequent fire. Many trees have spreading lower limbs. Bright enough for oak reproduction (i.e., less than 80% canopy cover). Typically dominated by oaks but may contain hickory, walnut, elm, dogwood, plum, and many other woody species. Characteristic breeding birds: Baltimore oriole, red-headed woodpecker, whippoorwill, Cooper's hawk.

Forest: In many ways the oak forest (shown on left) is intermediate between oak woodland and maple forest. Maple forest (shown on right) is fire-intolerant. Most tree trunks have few lower limbs. Shade-tolerant species of understory trees and shrubs are present. Herbs are mostly ephemeral (dormant in summer) or scattered. Characteristic breeding birds: ovenbird, red-eyed vireo, sharp-shinned hawk.

Figure 4.1. Prairie-forest continuum.

Figure 19. *Prairie-Forest Continuum. Top sketch fire frequency is high (2–5 years), second sketch is medium (3–7 years), third sketch is about every 9–10 years, and bottom sketch is infrequent (20 or more years). Frequent fire prevents trees and shrubs from dominating. From* The Tallgrass Restoration Handbook*, edited Stephen Packard and Cornelia F. Mutel. Copyright © 1997 Society of Ecological Restoration. Reproduced by permission of Island Press, Washington, D.C.*

Within each community or land cover type there is further variation across the site, as determined by factors such as topography, soil type, geology, and slope/aspect. This allows for micro-climates and micro-environments, for example differences in species composition on east/north-facing slopes vs. west/south-facing slopes. Greater differences in micro-environment and local environment tend to result in greater niche and species diversity, which is a key characteristic of a resilient and well-functioning ecosystem. Well-functioning ecosystems are beneficial to people, because they offer more secure services such as clean air, clean water, and healthy soil.

LEBANON HILLS AREA

The most common land cover type within LHRP is Dry Oak Forest (**Figures 20** and **22**). Other common cover types include open water (i.e., lakes), oak woodland, and (reconstructed) prairie. Less common, but of note, are several plant community types that have quality examples in LHRP and/or provide unique habitat. These include:

- Tamarack Swamp – west of Holland Lake, mapped by MCBS
- Mesic Oak Forest – south side of Jensen Lake, mapped by MCBS
- Wet Meadow, Floating Mat Subtype –various locations around LHRP
- Prairie remnants– scattered throughout the park, but notably four larger ones: 1) 0.25 miles north of Jensen Lake ("Rattlebox Prairie), 2) west side of Dakota Lake (porcupine prairie), 3) north of Wood Pond ("Roundtop Prairie"), and one in the Center Segment (no name).

Qualitative rankings for natural communities were generally good, with ranks that tended to fall in the B- to C-quality range (**Figure 21**). These included dry oak forest, particularly those in the eastern portion of the park that had been actively managed and/or had low levels of invasive shrubs.

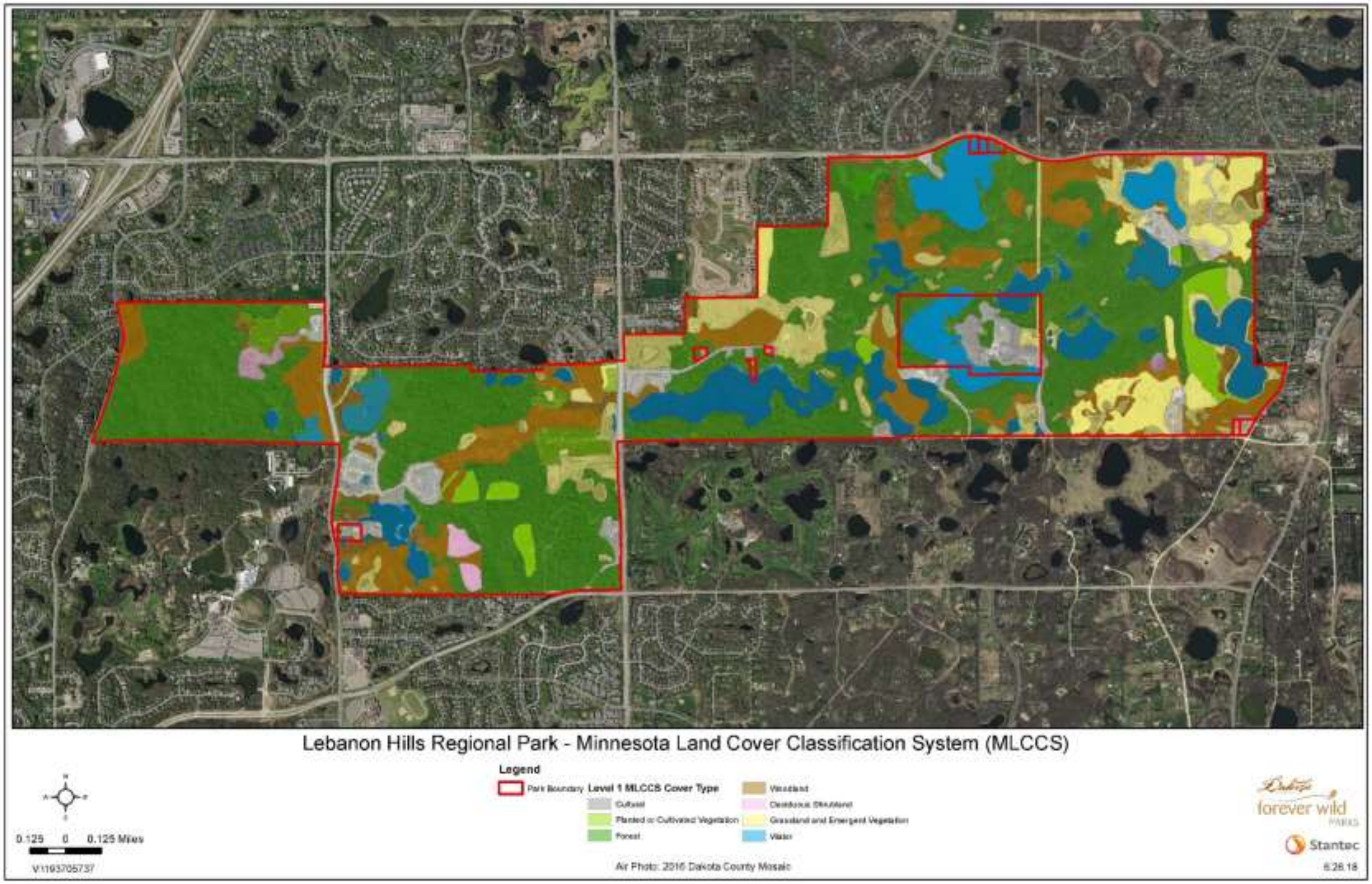


Figure 20. *MLCCS Level 1 cover type.*

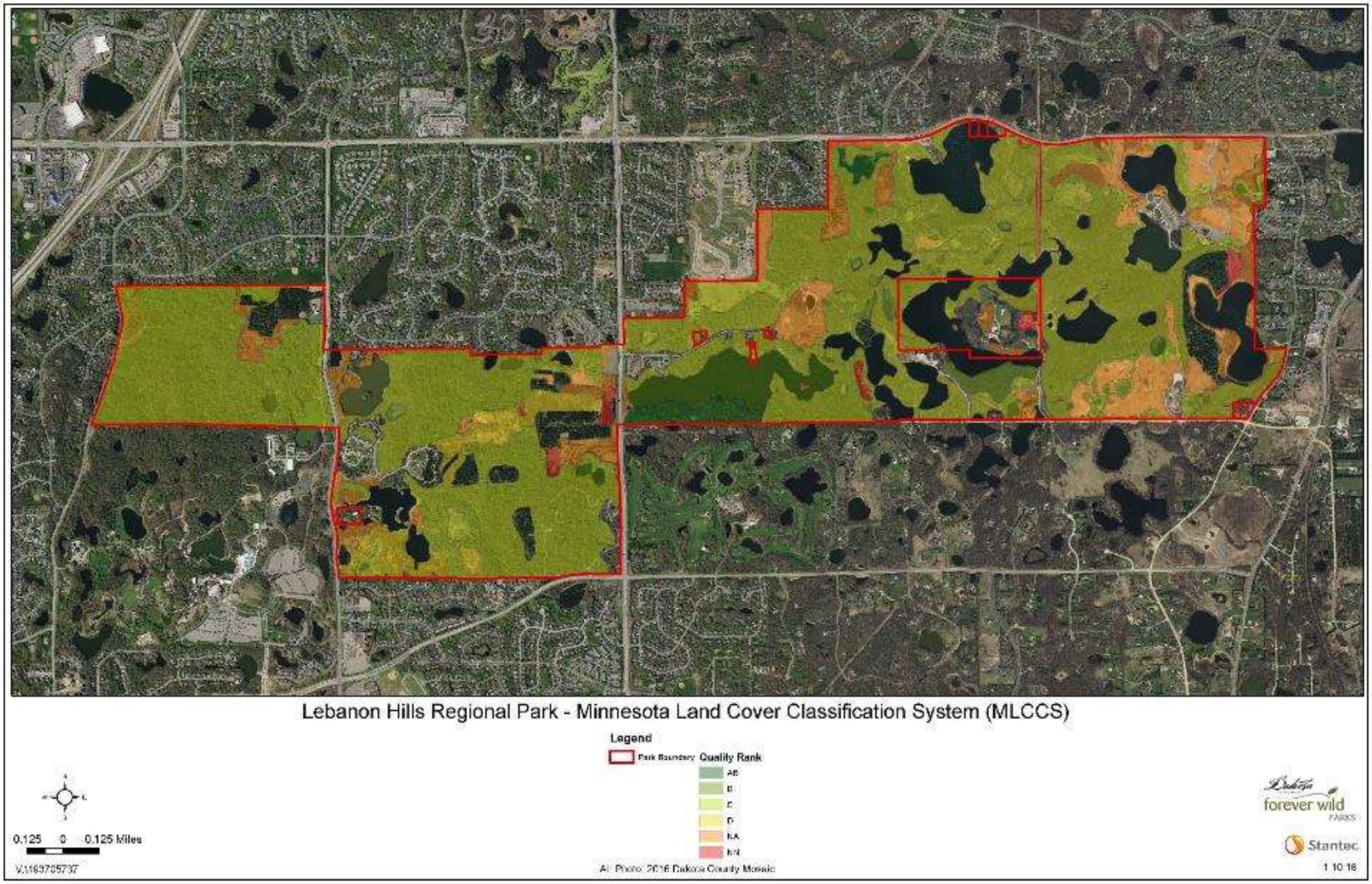


Figure 21. *MLCCS Qualitative Ranks for natural cover types.*

The most commonly observed invasive plant species was European buckthorn (*Rhamnus cathartica*), which was widespread in the park and symptomatic of the historic land use in the broader landscape of the Twin Cities region. Garlic mustard (*Alliaria petiolata*), an exotic forb, was most common in the western portions of the park, where it appeared to occur in patches and occasionally broad stands. The nonnative, invasives reed canary grass (*Phalaris arundinacea*) and hybrid cattail (*Typha x glauca*) were also common in some wetland areas; however, many wetlands were largely free of these.

Earthworms are also a significant and increasing invasive, nonnative species risk at LHRP and also within the broader landscape. Minnesota's hardwood forests, since the time of the last glaciation, have developed in the absence of earthworms. Without worms, fallen leaves decompose slowly, creating a spongy layer of organic "duff." This duff layer is the natural growing environment for native woodland wildflowers. It also provides habitat for ground-dwelling animals and overwintering habitat for rare species such as the rusty patched bumblebee and helps prevent soil erosion. Also, due to the activity of earthworms, fine soil particles more readily fill soil macropores and voids, which result in a net compaction of the soil at the surface, and ground surface elevations typically drop by six to 18 inches, exposing root collars of trees that were formerly covered with soil (the tree "gingivitis" syndrome). "Wormed" woodlands and forests feel harder when walked upon than non-wormed ones do—an indication of the hardening of the surface soil. See Great Lakes Worm Watch for more information (http://www.greatlakeswormwatch.org/).

Invading earthworms eat the leaves and are capable of eliminating the duff layer completely. Big trees survive, but many young seedlings perish, along with many ferns and wildflowers. Some species return after the initial invasion, but others disappear. In areas heavily infested by earthworms, soil erosion and leaching of nutrients may reduce the productivity of forests and ultimately degrade fish habitat.

MLCCS Level 1 Summary

MLCCS Code	Description	Number	Acres	Percent
10000	Artificial surfaces with <96% vegetation	30	131.1	6.7%
20000	Planted, maintained, or cultivated vegetation	11	80.8	4.1%
30000	Forest	37	869.0	44.3%
40000	Woodland	48	287.5	14.7%
50000	Shrubland	5	21.5	1.1%
60000	Herbaceous	101	323.4	16.5%
70000	Non-vascular	0	0.0	0.0%
80000	Sparse vegetation	0	0.0	0.0%
90000	Open Water	38	246.9	12.6%
	TOTAL	**540**	**1,960.2**	**100.0%**

Table 8. *MLCCS Level 1 Cover Types in LHRP*

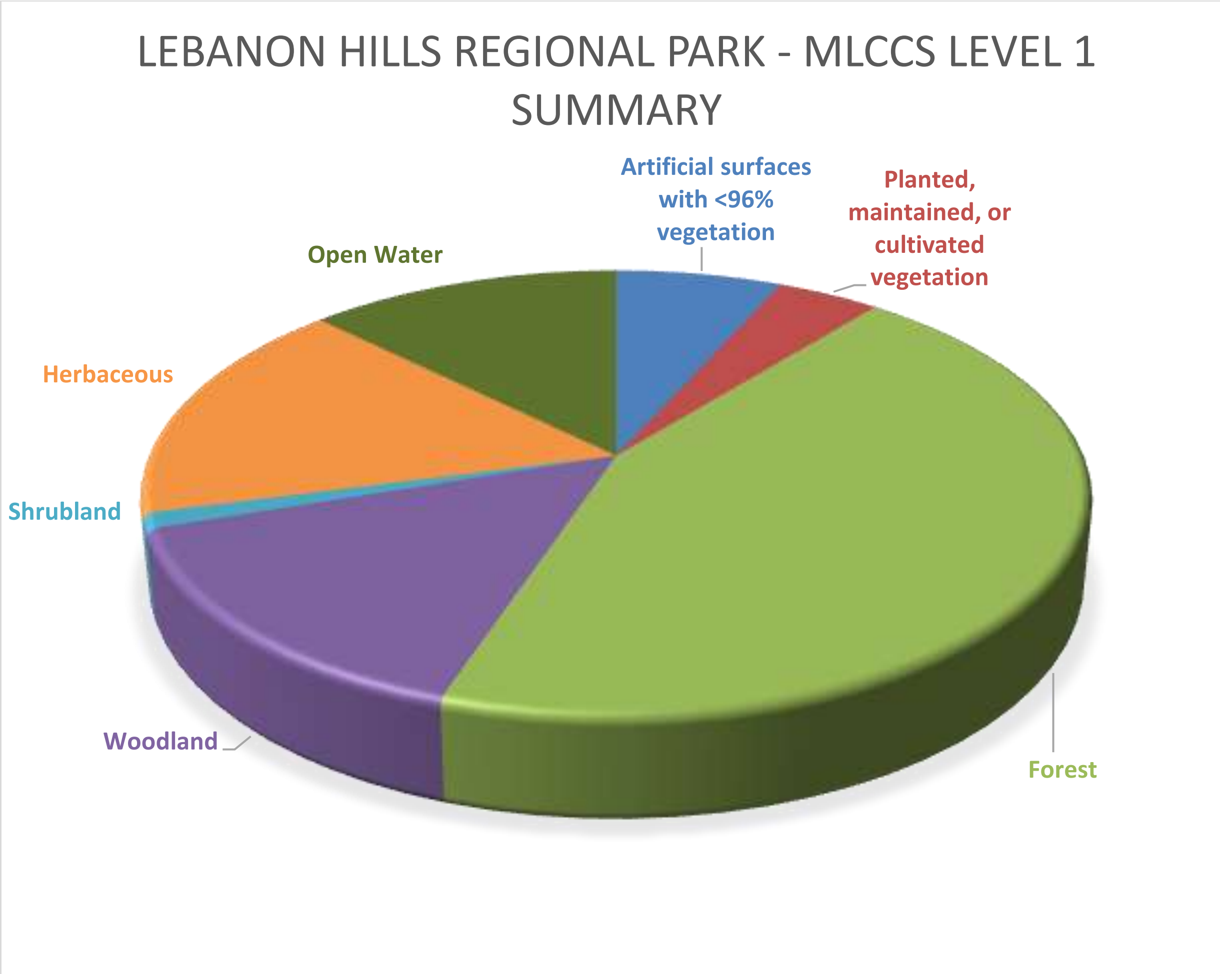


Figure 22. *LHRP Cover Type Summary.*

MLCCS LEVEL 5 SUMMARY FOR NATURAL AND SEMI-NATURAL COVER TYPES

MLCCS Code	Description	Polygon Number	Acres	Percent of LHRP
21110	Upland soils with planted, maintained, or cultivated coniferous trees	7	43.3	2.21%
21113	Red pine trees on upland soils	2	31.4	1.60%
21114	Coniferous trees on upland soils	1	4.1	0.21%
23212	Long grasses on upland soils	1	1.9	0.10%
31212	Tamarack swamp minerotrophic subtype	1	5.9	0.30%
32100	Upland deciduous forest	1	7.4	0.38%
32110	Oak forest	4	29.0	1.48%
32111	Oak forest red maple subtype	1	14.0	0.72%
32112	Oak forest mesic subtype	1	23.7	15.26%
32113	Oak forest dry subtype	14	744.3	37.97%
32160	Aspen forest	6	24.2	1.23%

MLCCS Code	Description	Polygon Number	Acres	Percent of LHRP
32170	Altered/non-native deciduous forest	5	17.0	0.87%
32220	Lowland hardwood forest	3	3.1	0.16%
32420	Mixed hardwood swamp - seasonally flooded	1	0.4	0.02%
42120	Oak woodland-brushland	27	233.8	11.93%
42130	Altered/non-native deciduous woodland	15	41.4	2.11%
43100	Upland mixed coniferous-deciduous woodland	4	7.1	0.36%
43110	Altered/non-native mixed woodland	2	5.2	0.27%
52111	Mesic brush-prairie sand-gravel subtype	2	9.5	0.48%
52120	Native dominated disturbed upland shrubland	1	8.8	0.45%
52120	Altered/non-native dominated upland shrubland	1	1.3	0.06%
52510	Wet meadow shrub - semi permanently flooded	1	1.9	0.10%
61110	Mesic prairie (planted)	12	79.3	4.05%
61213	Dry prairie sand-gravel subtype	1	2.2	0.11%
61220	Medium-tall grass altered/non-native dominated grassland	5	13.2	0.67%
61320	Wet meadow - temporarily flooded soils	2	1.3	0.06%
61330	Temporarily flooded altered/non-native dominated grassland	9	6.6	0.34%
61410	Wet prairie - saturated soils	1	0.4	0.02%
61420	Wet meadow	2	4.4	0.22%
61520	Mixed emergent marsh - seasonally flooded	21	11.2	0.57%
61530	Seasonally flooded altered/non-native dominated emergent vegetation	11	20.9	1.06%
61610	Cattail marsh - semi permanently flooded	2	2.9	0.15%
61620	Mixed emergent marsh	12	19.6	1.00%
61630	Semi permanently flooded altered/non-native dominated vegetation	1	0.7	0.04%
61641	Wet meadow floating mat subtype	4	4.5	0.23%
62120	Dry oak savanna	3	39.7	2.02%
62140	Grassland with sparse deciduous trees - altered/non-native dominated vegetation	8	41.2	2.10%
62220	Grassland with sparse conifer or mixed deciduous/coniferous trees - altered/non-native dominated	5	21.6	1.10%
64111	Water lily open marsh	2	53.7	2.74%
92100	Limnetic open water	3	90.5	4.62%
93220	Floating vascular vegetation	1	1.4	0.07%
93300	Palustrine open water	34	155.0	7.91%

Table 9. *MLCCS Level 5 Cover Types in LHRP.*

MLCCS DESCRIPTIONS OF PROMINENT COVER TYPES OBSERVED AT LHRP

Oak Forest - mesic/red maple subtype (MLCCS Codes 32110, 32112)

Within LHRP, six oak forest polygons were documented, totaling 66.7 acres. Of these, one red maple subtype oak forest totaling 14 acres was recorded, on the south side of Jensen Lake. This oak forest area was also mapped as high quality by the MCBS.

Because of the open canopy, the shrub layer is often very dense. American hazel dominates the shrub layer (but this is not the case for LHRP, where buckthorn dominates), which also often contains gray-bark dogwood, blueberries, and blackberries. Some of the more common ground layer species are the sedge (*Carex pensylvanica*), wild geranium (*Geranium maculatum*), Virginia creeper (*Parthenocissus inserta*), wild sarsaparilla (*Aralia nudicaulis*), and hog-peanut (*Amphicarpaea bracteata*). Commonly, at least some of the oak trees in the dry stands have multiple stems and thick, spreading lower branches, indicating that these trees grew up in a disturbed and more open setting. Minnesota public land survey records indicate, in fact, that many of these dry stands were oak savanna or oak woodland before European settlement and with fire suppression have succeeded to forest. Oak regeneration is rare in these stands now, as the oak species reproduce poorly under forest canopies. In the absence of fire, the relatively mesic or fire-sensitive species, such as bitternut hickory, basswood, and red maple, have been increasing in abundance in the community.

Northern red oaks, white oaks, or bur oaks dominate the canopy of more mesic stands of Oak Forest. These stands occur on sites that had fewer severe fires before European settlement than the sites on which Dry-Mixed Oak Forest occurs. These mesic stands most likely were always forest, rather than woodland or savanna. They have tall (>20 meters), straight, single-stemmed trees that lack spreading lower branches. Commonly, fire-sensitive tree species are present with the oaks in these stands, especially in the understory, which include basswood, green ash, bitternut hickory, big-toothed aspen, and butternut (occasionally). The shrub layer in mesic stands is typically sparser than in dry stands, and, correspondingly, the forb layer is denser and more diverse and there are more graminoid species. Like the drier stands, however, there is little oak regeneration, and most mesic Oak Forests appear to be succeeding to Maple-Basswood forest. Heavy selective logging of the oaks in mesic stands may accelerate this trend, producing young stands of Maple-Basswood Forest. The mesic stands often grade into drier stands of Maple-Basswood Forest but differ from them by having a somewhat denser shrub layer and herbs such as woodrush (*Luzula acuminata*) and pointed-leaved tick-trefoil (*Desmodium glutinosum*) in their understory.

Another variant of Oak Forest occurs in northeastern Minnesota, principally on ridgetops and upper slopes where the forest intermingles with bedrock outcrops. These forests contain northern red oak, bur oak, pin oak, and red maple. They originated mainly following the logging and burning of stands of Red Pine Forest in the 1800s and early 1900s. In general, most existing stands of Oak Forest have been disturbed by heavy grazing by domesticated livestock or selective cutting or have been fragmented by development. Natural stands of mesic Mixed Oak Forest are rare. Drier stands are more common, in part because, relative to the mesic forests, they occur on sites with soils less suitable for cultivation. Additionally, Dry Oak Forests may have increased in extent somewhat following fire suppression, succeeding from oak savanna and woodland. Disturbed (overgrazed) stands of oak forest commonly have dense subcanopies of prickly ash or of the exotic species common buckthorn and Tartarian honeysuckle, which have also now invaded many undisturbed stands. Disturbance through heavy grazing (by domesticated livestock) may also be partly responsible for the lack of regeneration in Oak Forests, especially in stands with heavy soils that compact readily with trampling.

Oak Forest is divided geographically into Southeast, Big Woods, Central, Northwest, and Northeast Sections. There are also three recognized subtypes (Dry, Mesic, and Red Maple), corresponding to the floristic and structural variation in the community described above.

Oak Forest, Dry Subtype (MLCCS Code 32113) (Figure 23)

A total of 14 dry oak forest (**Figure 20**) polygons were mapped at LHRP, totaling 744 acres. All of these were mapped as “C” (moderate) quality (**Figure 21**).

The driest stands of Oak Forest are dominated by northern pin oaks and white oaks, with black oaks, shagbark hickories, and sometimes bur oaks important in southeastern Minnesota. These stands occur on nutrient-poor, well-drained sandy soils on outwash plains, river terraces, and beach ridges. They have relatively open canopies, with between 70 and 80 percent cover. The canopy height is usually between 13 and 17 meters. Because of the open canopy, the shrub layer is often very dense. American hazel dominates the shrub layer (not the case in LHRP, where buckthorn dominates), which also often contains gray-bark dogwood, blueberries, and blackberries. Some of the more common ground layer species are the sedge (*Carex pensylvanica*), wild geranium (*Geranium maculatum*), Virginia creeper (*Parthenocissus inserta*), wild sarsaparilla (*Aralia nudicaulis*), and hog-peanut (*Amphicarpa bracteata*).

Commonly, at least some of the oak trees in the dry stands have multiple stems and thick, spreading lower branches, indicating that these trees grew up in a more open setting. Minnesota public land survey records indicate, in fact, that many of these dry stands were oak savanna or oak woodland before European settlement and with fire suppression have succeeded to forest. Oak regeneration is rare in these stands now, as the oak species reproduce poorly under shady forest canopies. In the absence of fire, relatively mesic or fire-sensitive species, such as bitternut hickory, basswood, and red maple, are increasing in abundance in the community.

Dry Oak Forests may have increased in extent somewhat following fire suppression, succeeding from oak savanna and woodland. Disturbed stands of oak forest commonly have dense subcanopies of prickly ash or of the exotic species common buckthorn and Tartarian honeysuckle, which have also now invaded many undisturbed stands (as is the case in LHRP).

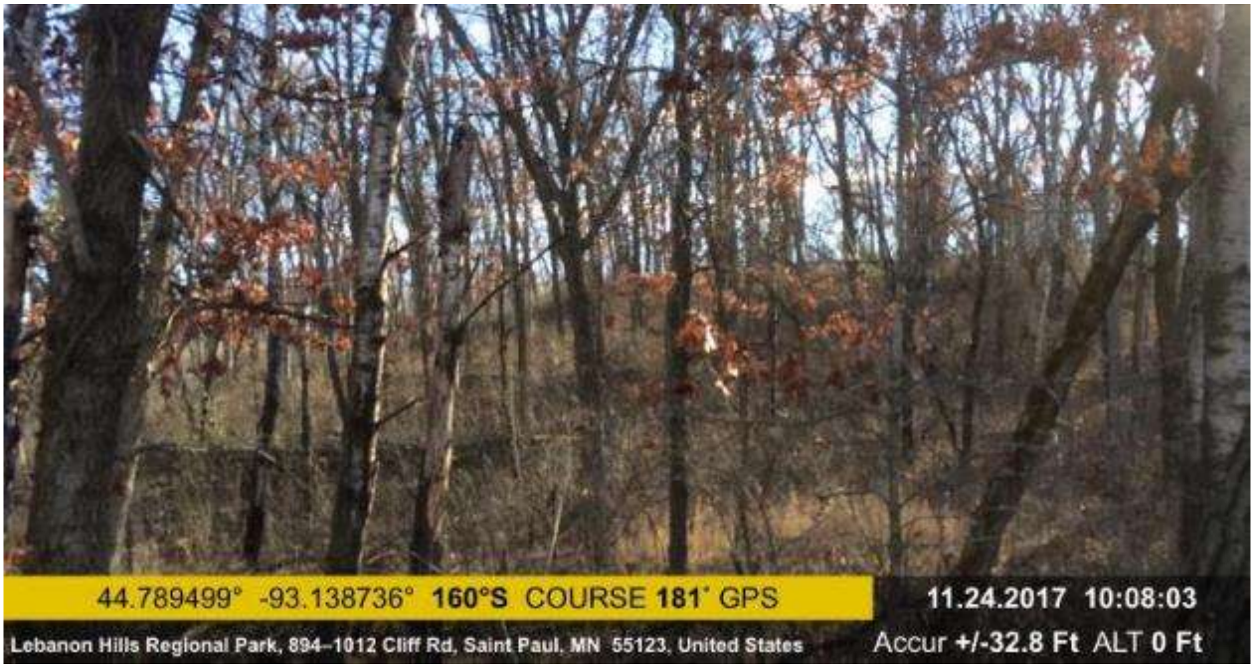


Figure 23. *An example of a dry oak forest at LHRP, dominated by northern pin oak and quaking aspen trees.*

Aspen Forest (MLCCS Code 32160)

There were six areas of aspen forest mapped at LHRP, totaling 24.2 acres.

Aspen Forest occurs throughout the deciduous forest-woodland zone of Minnesota, with isolated patches in the prairie zone. The community develops primarily on sites with wet, poorly drained soils and high water tables, although the water table is usually not high enough to affect the ground layer composition of the community or to cause peat accumulation.

The tree canopy most often is dominated by quaking aspens. Paper birches, balsam poplars, bur oaks, pin oaks, green ashes, or basswoods are minor canopy trees, although they may be abundant in the understory as seedlings and saplings. On low, poorly drained sites, balsam poplars are sometimes more abundant than quaking aspens in the tree canopy (but this is not the case at LHRP).

The understory of Aspen Forests tends to be brushy. American hazelnut is almost always abundant in the understory. Other shrubs vary in presence and abundance with soil moisture, which ranges from wet-mesic to dry. The groundlayer is composed mostly of forest herbs and grasses capable of surviving in the shade under the dense shrub layer. These species include wild sarsaparilla (*Aralia nudicaulis*), Canada mayflower (*Maianthemum canadense*), Pennsylvania sedge (*Carex pensylvanica)*, false melic grass (*Schizachne purpurascens*), and mountain rice-grass (*Oryzopsis asperifolia*).

Aspen Forest is an early-successional community. With prolonged absence of fire or other disturbances, Aspen Forests succeed to mid-successional forests composed of the minor canopy tree species listed above. An analysis of land survey records indicates that relatively pure stands of quaking aspen historically occurred on level terrain rather than on rough topography, suggesting that these stands were maintained by fire and windthrow. The aspen trees were present most commonly on somewhat poorly drained mineral soils, especially drumlin fields and other landforms with heavy soils, while paper birch, pin oak, and bur oak trees associated with the aspens were probably present on local areas of better drained soils.

Plots of aspen trees from early public land survey records show that aspen also occurred on areas of relict prairie soils within the deciduous forest-woodland zone. These sites are now mainly forested, but the land survey records indicate that the aspen trees previously were scattered widely enough on them to constitute woodland rather than forest. This is consistent with the surveyors' written descriptions of these sites, which state that they had relatively dense shrub layers dominated by American hazelnut and ground layers dominated by prairie forbs and graminoids. Aspen forests that occur on prairie soils and have prairie understories eventually may be recognized as a subtype of Aspen Forest or as a phase of Aspen Woodland, following further research and analysis of survey records.

WOODLANDS

Oak Woodland-Brushland (MLCCS Code 42120)

There were 27 oak woodland/brushland areas documented at LHRP totaling 233.8 acres. These were generally low quality due to encroachment/invasion by brush, high levels of past grazing (by domesticated livestock), the absence of periodic fires, and other factors.

Oak woodland-brushland occurs on dry to mesic sites throughout the deciduous forest-woodland zone and locally in the prairie zone near the ecotone between the prairie zone and the deciduous forest-woodland zone. Oak woodland is floristically and structurally intermediate between oak savanna and oak forest, with a patchy tree canopy and an understory dominated by shrubs and tree saplings.

The principal species in the tree canopy are bur oak, northern pin oak, white oak, and northern red oak. Aspens may form up to 70 percent of the tree canopy cover but are usually not more than 25 percent. The brush layer ranges in density from sparse (with 10–30 percent cover) to an impenetrable thicket. It is often especially dense in openings between clumps or groves of trees. Most of the floristic diversity in the community exists in the brush layer, which most commonly is composed of blackberries and raspberries (*Rubus* spp.), gooseberries (*Ribes* spp.), dogwoods (*Cornus* spp.), cherries (*Prunus* spp.), hazelnuts (*Corylus* spp.), prickly ashes (*Zanthoxylum americanum*), and sprouts of oak (*Quercus* spp.) and quaking aspen. Prairie vegetation, if present, occurs only in small openings in the tree or shrub canopy. Except in these scattered prairie openings, the herbaceous layer is sparse and floristically poor. It is usually composed of woodland species capable of surviving in the dense shade beneath the brush layer.

Oak woodland-brushland is a fire-maintained community. It is most common on rich sites where trees and shrubs grow well but where recurrent fires prevent the formation of true forest. Historically, Oak Woodland-Brushland was probably one of the most extensive community types in Minnesota, comprising much of the vegetation described as oak barrens, brushland, and thickets by the early surveyors. The fires that maintained oak woodland-brushland usually started on nearby prairies. Following the conversion of these prairies to agricultural land, oak woodland-brushland burned less frequently so rapidly succeeded to oak forest. Oak woodland-brushland is defined broadly enough here to also include communities in which the predominant cover is oak brush or oak-aspen brush (that originated following fire or limited human disturbance) instead of a well-developed tree canopy. There are four geographic sections of oak woodland-brushland in Minnesota. These sections may be modified in the future as more information becomes available.

In southeastern and central Minnesota, oak woodland-brushland is present on southwest-facing slopes on the blufflands and on outwash terraces of the Mississippi River and its tributaries. It generally occurs on more gentle slopes than bluff prairie or on lower slopes below bluff prairies. Bur oaks (*Quercus macrocarpa*) are common canopy dominants, and northern red oaks are common associates. Northern pin oaks, basswoods, and black cherries may also occur in the canopy. White oaks (*Quercus alba*) are rare, and aspens (*Populus tremuloides*) are absent. Chokecherries are common in the shrub layer, with shrub cover averaging 30–50 percent. On droughty sites with thin soils or steep slopes, these woodlands may persist even in the absence of fire.

In the Big Woods Section of Minnesota, oak woodlands are dominated by white oak (*Quercus alba*) in areas with coarse-textured soils, such as on kames or eskers, or in areas prone to occasional fires. Natural woodlands are now extremely rare in this section because of logging, over-grazing, and fire suppression.

UPLAND DECIDUOUS SHRUBLAND

Mesic Brush-prairie Sand-gravel Subtype (MLCCS Code 52111)

MN DNR Natural Heritage description: There is one recognized subtype, a Sand-Gravel Subtype which occurs locally on coarse-textured outwash deposits. Occurrences of the Sand-Gravel subtype are dry-mesic to mesic prairies in which porcupine grass (*Stipa spartea*) is the major grass species. Leadplant and (especially) prairie willow are important shrubs.

There were two occurrences of mesic brush-prairie documented at LHRP, totaling 9.5 acres. These occur on two hilltops in the center of LHRP. Historic air photos indicate that these areas may have been cropped in the past. If so, these areas were subsequently recolonized by native plants from surrounding savanna pasture (now closed dry oak forest).

Key-based definition of mesic brush prairie: Upland vegetation in far northwestern Minnesota with <10 percent tree cover, where the herbaceous layer is dominated by prairie species and where willows, cherries, hazel, bog birch, or shrubby cinquefoil are evenly distributed throughout the prairie, covering 30–50 percent of the area.

MN DNR Natural Heritage description: Mesic Brush-Prairie is the only type of Upland Brush- Prairie described by MN DNR Natural Heritage. Upland Brush-Prairies are open communities composed of various amounts of low brush in an herbaceous matrix of prairie species. The distributions of prairie grass and forb species in Upland Brush-Prairies correlate with changes in soil moisture along a gradient from wet-mesic to dry-mesic that parallels the moisture gradient-species distribution pattern present in mesic Upland Prairies. Upland Brush-Prairies differ from mesic Upland Prairies mainly by having many shrub species that do not occur in mesic Upland Prairies. Additionally, Upland Brush-Prairies frequently have significant numbers of small aspens, often with balsam poplars and, on drier sites, bur oak grubs and stunted trees.

Frequent fire is important in maintaining Upland Brush-Prairies, although there appears to be a threshold of fire frequency and intensity (see below) beyond which Upland Brush-Prairies are replaced on the landscape by brush-free prairie types. In the past, bison and elk activity may also have helped to maintain Brush-Prairie communities. Where they have not been otherwise tilled for cropland, most small remnants of Upland Brush-Prairie have succeeded to woodland because of suppression of wild fires. Although brushy areas are a common feature of prairie throughout the deciduous forest woodland zone, these areas usually are localized patches or thickets in depressions or in association with topographic and aquatic features that provide protection from fire. However, in the far northwestern part of the deciduous forest-woodland zone, brush is more uniformly distributed in the prairie (and species are present that are rarely or never present southward) and true Upland Brush-Prairie occurs.

On the pre-settlement landscape in northwestern Minnesota, Upland Brush-Prairie and the closely associated Wet Brush-Prairie were the predominant prairie types on the Glacial Lake Agassiz Interbeach Area, while just to the west on the Lake Agassiz Plain the prairies were mostly brush free. Southward within the Interbeach Area, brush prairies also gave way to standard prairie types, although Wet Brush-Prairie persisted farther southward than Upland Brush-Prairie. This suggests that a climatic gradient may have been important in causing the replacement of brush prairie, to the west and south, by brush-free prairie. That is, the cooler climate in the northwest reduced the frequency and severity of moisture stress and the intensity of fire so that, in general, brush would have a greater tendency to persist in prairie areas in the northwest. Superimposed on this climatic gradient, the Interbeach Area may have had a slight reduction in fire frequency, relative to the glacial lake plain to the west, because of its subtly greater relief and its edaphic heterogeneity. These differences may have been enough to tip the balance and prevent elimination of woody species from the prairies in the northern part of the Interbeach Area.

The major grasses of Mesic Brush-Prairie are big bluestem (*Andropogon gerardii*) and prairie dropseed (*Sporobolus heterolepis*) on all sites; little bluestem (*Schizachyrium scoparium*), junegrass (*Koeleria macrantha*), and porcupine grass (*Stipa spartea*) on drier sites; and bog reedgrass (*Calamagrostis inexpansa*), prairie cordgrass (*Spartina pectinata*), and mat muhly (*Muhlenbergia richardsonis*) on moister sites. Wheatgrass (*Agropyron trachycaulum*) is also generally common in the community; Indiangrass (*Sorghastrum nutans*) is present only occasionally. Mesic Brush-Prairie contains the usual forbs of Mesic Prairie and a few species more typical of woodland, including black snakeroot (*Sanicula marilandica*), carrion-flower (*Smilax lasioneura*), spreading dogbane (*Apocynum androsaemifolium*), and Pennsylvania sedge (*Carex pensylvanica)*. The brush layer within the community is generally less than 1.5 meters tall, with total cover ranging from 30 to 50 percent. The major shrub species present are slender willow, pussy willow, bog birch, and shrubby cinquefoil on wet-mesic sites; Bebb's willow on mesic to wet-mesic sites; hazel, Saskatoon, and chokecherry on dry-mesic and mesic sites; and prairie willow and leadplant on better-drained sandy sites. Sand cherry is present on most sites but is generally not abundant or important except on sandy sites. Quaking aspen suckers or small saplings often form dense thickets in the community; grubs and stunted trees of bur oak are common on dry sites. Scattered groves of larger aspen are also common, while larger oaks are present only occasionally.

Mesic Brush-Prairie generally occurs on somewhat poorly drained to well-drained, sandy clay loam to loamy fine sand soils. These soils form in lake-washed glacial till or in sandy lacustrine deposits (of variable thickness) over till. Mollisols predominate, but entisols are also common; most soils are strongly calcareous. On the landscape, Mesic Brush-Prairie occurs on nearly level terrain, often in a mosaic with Wet Brush-Prairie and brushy Wet Meadow. Distinguishing between Mesic Brush-Prairie and Wet Brush-Prairie may be difficult in these cases, as the two communities share many species. In some sandy areas, Mesic Brush-Prairie grades into typical Mesic Prairie. Brush and trees may actually be common in the Mesic Prairies in these areas but are more localized (in clumps and thickets) than in Mesic Brush-Prairie. On beach ridges and other dry, gravelly sites, Mesic Brush-Prairie grades into an oak scrub or savanna community. Where aspen cover increases, Mesic Brush-Prairie grades into Aspen Openings.

Mesic Brush-Prairie is a fire-dependent community. In the absence of fire, trees become more abundant in the community and it eventually succeeds to woodland. Examination of public land survey records from the late 1800s indicates that tree cover is now greater in most Mesic Brush-Prairies in Minnesota than it was in the past. If fires occur in the community only occasionally, they may actually advance succession to woodland by stimulating aspen root suckering and the production of more aspen shoots.

Mesic Brush-Prairie has a very restricted distribution; there are no geographic sections of the community, but it is very likely that it would have occurred in many areas of Dakota County.

FORESTED WETLANDS

Tamarack Swamp Minerotrophic Subtype (MLCCS Code 31212)

One tamarack swamp was documented at LHRP just west of Holland Lake, totaling 5.9 acres.

<u>MN DNR Natural Heritage description:</u> In minerotrophic wetlands in the deciduous forest woodland zone, the understory of the community commonly contains speckled alder, winterberry, blue-joint (*Calamagrostis canadensis*), broad-leaved cattail (*Typha latifolia*), and jewel-weed (*Impatiens capensis*).

<u>General description of Tamarack swamp (31210):</u> Saturated vegetation with >30 percent tree cover on <0.5m of peat with >50 percent tamaracks (>3m tall).

<u>MN DNR Natural Heritage description:</u> Tamarack Swamp is present throughout the deciduous forest-woodland and conifer-hardwood forest zones. It occurs on minerotrophic muck and shallow peat along rivers and in shallow lake basins and on nutrient-poor, mildly-acidic to acidic peat in ice-block basins (like that in LHRP) or large peatland systems. Tamarack is either the only canopy species or is mixed with black spruce, paper birch, yellow birch, white pine, black ash, American elm, or red maple. In northern Minnesota, tamarack may grow in association with alder, red-osier dogwood, willow species, and mountain fly honeysuckle.

Tussock sedge (*Carex stricta*) is common under relatively open stands of tamarack; cyperus-like sedge (*Carex pseudo-cyperus*) and black chokeberry (*Aronia melanocarpa*) are often present on tear-drop islands in large peatland complexes. In the absence of catastrophic disturbances, Tamarack Swamps may succeed Shrub Swamps, Rich Fens, Poor Fens, and possibly Hardwood Swamp Forests. Fire, flooding, and insect infestations (e.g., larch sawfly) often reverse this succession. Windthrow, disease, and selective cutting of tamaracks in dense stands help maintain tamarack cover by creating gaps in the canopy in which the very shade-intolerant tamarack seedlings and saplings are able to grow. Tamarack Swamp differs from Mixed Hardwood Swamp in part by having at least 50 percent of its canopy cover formed by tamarack. This may not be easy to determine (either from aerial photographs or in the field) because tamaracks are often slender and conical so may be numerous yet still contribute little to the total tree canopy cover. The same problem exists in Shrub Swamps where tamaracks occur as "spires" above the shrub layer. Tamarack Swamp differs from Bog communities in the pH of its surface waters and by having minerotrophic species that do not occur in true bogs (such as *Betula pumila, Carex leptalea, C. paupercula, C. tenuiflora, Lysimachia thrysiflora, Potentilla palustris*, *Salix pedicellaris,* and *Thuja occidentalis*).

WETLAND SHRUBLANDS

Willow Swamp (MLCCS Codes 52430, 52520)

Willow swamp is a minerotrophic wetland with a canopy of medium to tall (>1m) shrubs dominated by willows (especially pussy willow, slender willow, and Bebb's willow) and red-osier dogwood. There was one noted willow swamp at LHRP. Other shrubs, such as speckled alder, bog birch, poison sumac, and alder buckthorn, may be common in the tall shrub layer, although speckled alder is never the most abundant species present. Herbaceous species (especially graminoids) characteristic of wet meadow/fen communities are common in the more open occurrences of the community. However, in willow swamps, unlike wet meadow/fen communities, these graminoid-dominated patches are poorly separated from clumps of shrubs. The most common herbs are tussock sedge (*Carex stricta*), prairie sedge (*Carex prairea*), lake-bank sedge (*Carex lacustris*), broad-leaved cattail (*Typha latifolia*), blue-joint (*Calamagrostis canadensis*), northern marsh fern (*Thelypteris palustris*), and jewel-weed (*Impatiens capensis*).

Willow swamps dominated by bog birch are closely related to the shrub subtype of rich fen but have more minerotrophic indicator species (such as speckled alder [*Alnus rugosa,* holly [*Ilex verticillata*], jewel-weed [*Impatiens capensis*]*,* and horehound [*Lycopus uniflorus*]) than are present in Rich Fens. Following fire in conifer swamps or in the shrub subtype of rich fens, there may be initially a dense cover of willows (usually balsam willow and bog willow), but these stands are best classified as successional stages of conifer swamp or rich fen rather than as willow swamp. The dense groves of sand-bar willow or juvenile black willow that occur on sand bars along rivers are not considered shrub swamp communities but instead river beach communities because they occur on mineral rather than peat or muck substrates.

Willow swamp occurs on seasonally flooded soils with <30 percent tree cover and >50 percent cover by tall shrubs (not dwarf-shrubs), where <50 percent of the shrubs are alders and gaps are dominated by emergent species >1m tall.

HERBACEOUS WETLANDS

Cattail Marsh (MLCCS Codes 61510, 61610, 61710, 61810)

For the purposes of this project and according to DNR standards, cattails marshes do not include monotypic (i.e. single species) stands of cattail with very low species diversity (not even at a D-rank). Wetlands predominantly comprised of hybrid cattails (*Typha* spp.) or reed canary grass (*Phalaris arundinacea*) were considered non-native dominated herbaceous wetlands (MLCCS codes 61330, 61480, 61530, and 61630).

Cattail marsh is an emergent marsh dominated by cattails (including *Typha angustifolia*, *T. latifolia*, and their hybrids). It occurs most commonly along lake margins and in shallow basins, although it is sometimes also present in river backwaters. Lacustrine cattail marshes typically have a muck-bottom zone bordering the shoreline, where cattails are rooted in the bottom substrate, and a floating mat zone, where the roots do not contact the bottom but instead the plants grow suspended in a buoyant peaty mat. This community is generally tolerant of water inundation of 6 to 12 inches for most times of the year but can sustain 20 to 60 inches or higher, especially in marshes where the vegetation is rooted on floating mats. Water levels are fairly stable in settings supplied by significant groundwater inputs and variable where water is supplied predominantly by precipitation and surface runoff. If water-level drawdown occurs, it coincides with drought cycles and is not seasonal as in Wet Meadow/Carr communities. Associated species vary widely, but some of the most common ones are sedges of the genus *Carex* (*C. aquatilis*, *C. rostrata*, and *C. lanuginosa*), bulrushes (*Scirpus americanus*, *S. acutus*, and *S. heterochaetus*), and broad-leaved herbs such as northern marsh fern (*Thelypteris palustris*), swamp milkweed (*Asclepias incarnata*), jewel-weed (*Impatiens capensis*), broad-leaved arrowhead (*Sagittaria latifolia*), mad-dog skullcap (*Scutellaria lateriflora*), marsh skullcap (*Scutellaria galericulata*), and blue vervain (*Verbena hastata*).

Mixed Emergent Marsh (MLCCS Codes 61520, 61620)

A total of 35 mixed emergent marsh polygons were mapped at LHRP, totaling 33.6 acres. Mixed emergent marsh is a broad community type, encompassing all marshes dominated by species other than cattails. Bulrushes are the most common dominants, especially hard-stemmed bulrush (*Scirpus acutus*), river bulrush (*Scirpus fluviatilis*), softstem bulrush (*Scirpus validus*), *Scirpus americanus*, and *Scirpus heterochaetus*. Common reed grass (*Phragmites australis*), spike rushes (*Eleocharis* spp.), and (in some river backwaters) prairie cord grass (*Spartina pectinata*) are less common dominants.

In general, mixed emergent marsh tends to occur on harder pond, lake, or river bottoms than cattail marsh and is less likely to contain the forbs that grow on the floating peat mats present in many cattail marshes. Broad-leaved arrowhead (*Sagittaria latifolia*) and aquatic macrophytes are the most common non-graminoid associates. Many mixed emergent marsh species are sensitive to fertilizer run-off and other artificial disturbances, and disturbed mixed emergent marshes (especially in the Prairie Zone) tend to convert to cattail marshes or become strongly dominated by reed canary grass (*Phalaris arundinacea*) or common reed grass (*Phragmites australis*), species that increase in abundance with disturbance.

UPLAND GRASSLANDS

Mesic Prairie (MLCCS Code 61110 / No Remnant Acres; numerous reconstructions at LHRP)

No records of remnant mesic prairie were encountered at LHRP. However, 12 areas totaling 79.3 acres planted to native prairie plants were assigned the MLCCS code of mesic prairie with a "301 – planted" modifier. While the prairie reconstructions at LHRP (**Figure 24**) are less species-rich than remnant prairie, it is important to point out that they substantially mimic the habitat structure of historic prairies and will improve over time with management. No remnant mesic prairies were documented at LHRP. However, mesic brush prairie (prairie invaded by brush) was documented at LHRP and could one day be reclassified as remnant prairie with active management.

Mesic prairie is a dry-mesic to wet-mesic grassland that occurs mainly in the prairie zone in southern and western Minnesota and sporadically in the deciduous forest-woodland zone. Big bluestem (*Andropogon gerardii*), Indian grass (*Sorghastrum nutans*), and prairie drop seed (*Sporobolus heterolepis*) are the major native species on most sites, with little bluestem (*Schizachyrium scoparium*) and porcupine grass (*Stipa spartea*) important on drier sites and prairie cord grass (*Spartina pectinata*) and to a lesser degree switch grass (*Panicum virgatum*) more common on wetter sites.

Forb species composition varies with site moisture, although some forb species occur on almost all sites, moist or dry. Several low shrub or sub-shrub species are common on Upland Prairie; the most characteristic is leadplant (*Amorpha canescens*). Taller brush and trees are absent or scattered, however brush or woodland areas may be interspersed with prairie, usually in association with topographic and aquatic features that provide protection from fire.

The most important cause of variation in species composition in prairie communities is soil moisture. The local soil moisture regime is determined by slope, aspect, proximity to the water table, and soil texture. On a regional scale, variation in species composition is primarily caused by climatic variation (i.e., the westward decline in precipitation and northward decline in temperature in Minnesota).

Upland prairies occur on a range of landforms in the prairie zone, from nearly flat glacial lake plains to steep morainic slopes. In the deciduous forest-woodland zone, prairies occur on droughty, level outwash areas and steep south- and west-facing slopes. The pre-European settlement distribution of prairie was related to the interaction of local fire frequency with growth rates of woody species: where conditions were favorable for rapid growth, more frequent fires were necessary to maintain prairie over savanna, woodland, or forest. Fragmentation of upland prairie since European settlement and suppression has reduced fire frequency throughout the prairie and deciduous forest-woodland zones, and most prairie remnants have more brush and trees than were present in the past. The introduced grass Kentucky bluegrass (*Poa pratensis*) and smooth brome (*Bromus inermis*) are present at most sites; they are an indicator of the site's disturbance history.

Figure 24. *An example of a reconstructed prairie, "Star Pond Prairie", at southeastern LHRP.*

Forbs are abundant (but usually subdominant to grasses) and have high local diversity. Forb species-composition also varies locally with soil moisture. There is greater regional variation among forbs than among grasses. Common forb species include purple prairie-clover (*Petalostemon purpureum*), white prairie-clover (*P. candidum*), ground-plum (*Astragalus crassicarpus*), prairie-turnip (*Psoralea esculenta*), rough blazing-star (*Liatris aspera*), Canada goldenrod (*Solidago canadensis*), stiff goldenrod (*S. rigida*), Missouri goldenrod (*S. missouriensis*), prairie thistle (*Cirsium flodmanii*), smooth aster (*Aster laevis*), stiff sunflower (*Helianthus rigidus*), Maximilian sunflower (*H. maximiliani*), smooth rattlesnake-root (*Prenanthes racemosa*), white sage (*Artemisia ludoviciana*), wood lily (*Lilium philadelphicum*), white camas (*Zigadenus elegans*), heart-leaved alexanders (*Zizia aptera*), prairie larkspur (*Delphinium virescens*), downy phlox (*Phlox pilosa*), hoary puccoon (*Lithospermum canescens*), tall cinquefoil (*Potentilla arguta*), alum-root (*Heuchera richardsonii*), wood-betony (*Pedicularis canadensis*), northern bedstraw (*Galium boreale*), prairie bird-foot violet (*Viola pedatifida*), oval-leaved milkweed (*Asclepias ovalifolia*), and showy milkweed (*A. speciosa*). Purple coneflower (*Echinacea angustifolia*) is common on drier sites in the western part of the community's range. Leadplant, prairie rose, sand cherry, wolfberry, and prairie willow are common low-shrub or sub-shrub species. Fragrant false indigo is common on moister sites. Trees and taller brush often occur along the margins of wetlands adjacent to mesic prairies.

The soils in mesic prairie are predominantly mollisols with thick, dark mineral surface layers that have high base saturation. They range in texture and drainage from silty and somewhat poorly drained to sandy and somewhat excessively drained, with moderately well-drained to well-drained, loamy soils being most common. Mesic prairie can grade into wet prairie on moister sites and into the hill and sand-gravel subtypes of dry prairie on drier sites. Separation of mesic prairie from other prairie types is based primarily on landform or substrate characteristics rather than on species composition, as floristic boundaries between mesic prairie and other prairie types are not well defined.

Dry-mesic Prairie (no MLCCS Code – undifferentiated from mesic prairie 61110)

Despite the fact that the remnant dry-mesic prairie areas at LHRP are currently too small to map according to MLCCS mapping standards, there are a few locations around the park that can be characterized as dry-mesic prairie and worthy of resources to manage. These largely occur in areas that appear to have been hayed and/or cropped at one time and were recolonized from the surrounding area by prairie species. One good example of a dry-mesic prairie is the area referred to by Park staff as "rattlebox prairie" (**Figure 25**). MLCCS does not differentiate between mesic prairie and dry-mesic prairie, and the landscape position of the dry-mesic prairies at LHRP does not fit with the Dry Prairie landscape position/description; these areas should be considered mesic prairie remnant according to MLCCS.

Figure 25. *Rattlebox prairie is an example of dry-mesic prairie.*

Dry prairie (MLCCS Code 61210)

Key-based definition: Upland grassland dominated by prairie species, with <10 percent tree cover and <50 percent shrub cover, where the substrate is composed of sand or gravel (sometimes with a thin organic surface layer) or any texture on steep slopes (some examples may occur on sandy soils in temporarily flooded areas).

MN DNR Natural Heritage description: Dry Prairie is a type of Upland Prairie, which occurs primarily in the prairie zone, with scattered occurrences in the deciduous forest-woodland zone. It is dominated by grasses. Typically, little bluestem (*Schizachyrium scoparium*) and side oats grama (*Bouteloua curtipendula*) are the dominant grasses, but the tall grasses, big bluestem (*Andropogon gerardii*) and Indiangrass (*Sorghastrum nutans*), are major components on moist sites. Prairie dropseed (*Sporobolus heterolepis*) is common on both dry and moist sites. Forbs typically are abundant (but subdominant to the grasses) and may have high local diversity. Forb species composition varies with site moisture, although some forb species occur on almost all sites, moist or dry.

Several low shrub or sub-shrub species are common on Upland Prairie; the most characteristic is leadplant (*Amorpha canescens*). Taller brush and trees are absent or scattered, however brush or woodland areas may be interspersed with prairie, usually in association with topographic and aquatic features that provide protection from fire. The most important cause of variation in species composition in prairie communities is variation in soil moisture. The local soil moisture regime is determined by slope, aspect, proximity to the water table, and soil texture. On a regional scale, variation in species composition is primarily caused by climatic variation (i.e., the westward decline in precipitation and northward decline in temperature in Minnesota).

Upland Prairies occur on a range of landforms in the prairie zone, from nearly flat glacial lakeplains to steep morainic slopes. In the deciduous forest-woodland zone, prairies occur on droughty, level outwash areas and steep south- and west-facing slopes. The pre-European settlement distribution of prairie was related to the interaction of local fire frequency with growth rates of woody species: where conditions were favorable for rapid growth, more frequent fires were necessary to maintain prairie over savanna, woodland, or forest. Fragmentation of Upland Prairie since European settlement has reduced fire frequency throughout the prairie and deciduous forest-woodland zones, and most prairie remnants have more brush and trees than were present in the past.

Dry Prairie is a dry to dry-mesic herbaceous community dominated by grasses and sedges. It occurs throughout the prairie zone and sporadically in the deciduous forest-woodland zone. Dry Prairie has considerable variation in species composition, reflecting interactions among geography (namely climate), soils, and topography. In general, Dry Prairies have a greater component of Great Plains species than Mesic Prairies, especially in prairies in the western part of Minnesota. Big bluestem (*Andropogon gerardii*) is always present in the community and usually important, but it does not achieve the dominance it typically has in Mesic Prairie. Indiangrass (*Sorghastrum nutans*) is more limited in occurrence, generally appearing only where conditions approach mesic. Mid-height and short grasses and sedges are usually dominant in Dry Prairie. Among the more common are porcupine grass (*Stipa spartea*), little bluestem (*Schizachyrium scoparium*), side-oats grama (*Bouteloua curtipendula*), prairie Junegrass (*Koeleria macrantha*), and sun-loving sedge (*Carex heliophila*).

Forb variation within the community is more pronounced. Some widespread, characteristic species are dotted blazing star (*Liatris punctata*), pasque flower (*Pulsatilla nuttalliana*), prairie golden-aster (*Heterotheca villosa*), stiff sunflower (*Helianthus rigidus*), silky aster (*Aster sericeus*), green milkweed (*Asclepias viridiflora*), stiff goldenrod (*Solidago rigida*), gray goldenrod (*Solidago nemoralis*), Missouri goldenrod (*Solidago missouriensis*), and narrowleaved puccoon (*Lithospermum incisum*). Dry Prairies share many forb species with Mesic Prairies, including rough blazing star (*Liatris aspera*), buffalo-bean (*Astragalus crassicarpus*), tooth-leaved evening primrose (*Calylophus serrulatus*), silverleaf scurfpea (*Psoralea argophylla*), thimbleweed (*Anemone cylindrica*), Louisiana sagewort (*Artemisia ludoviciana*), prairie larkspur (*Delphinium virescens*), heartleaved alexanders (*Zizia aptera*), purple prairieclover (*Petalostemon purpureum*), hoary puccoon (*Lithospermum canescens*), prairie smoke (*Geum triflorum*), and wood lily (*Lilium philadelphicum*). Three sub-shrubs--leadplant (*Amorpha canescens*), prairie rose (*Rosa arkansana*), and wolfberry (*Symphoricarpos occidentalis*)--typical in Mesic Prairies are also generally present in Dry Prairie. Soil-encrusting lichens and the fern-ally rock-spikemoss (*Selaginella rupestris*) are often common in Dry Prairie. Brush, and sometimes trees, may be present in hollows and draws.

Bur oak (*Quercus macrocarpa*), chokecherry (*Prunus virginiana*), wild plum (*Prunus americana*), and smooth sumac (*Rhus glabra*) are the most widespread woody species. Other woody species more limited in distribution in the community are northern pin oak (*Quercus ellipsoidalis*), black oak (*Quercus velutina*), and hazel (*Corylus americana*). Dry Prairies are maintained by fire but require less frequent fires than mesic and wet prairies because the droughty conditions within Dry Prairies slow or prevent the growth of woody species. Dry Prairie occurs on a variety of landforms, including sand dune blankets of mid-Holocene origin, glacial lake beach ridges, outwash deposits, ice-contact features (kames, eskers [as in Lebanon Hills]), morainic hills, erosional slopes in glacial drift, and bedrock-cored bluffs. Soils range from nearly pure sand with little profile development, to mollisols, although the latter have a much thinner organic-rich surface horizon than the soils of Mesic Prairie. All overlie deep glacial drift except for those of the bedrock-cored bluffs, which are formed in a thin layer of loess or residuum. Soils are well drained to excessively drained. Depending upon the degree of slope, the slope aspect, and the soil composition, Dry Prairie intergrades with Mesic Prairie.

Dry Prairie, Hill Subtype (MLCCS Code 61210)

One 2.2-acre dry prairie was noted at LHRP.

<u>MN DNR Natural Heritage description:</u> The Hill Subtype occurs on steep terrain throughout the prairie zone as far north as Polk County and sporadically in the deciduous forest-woodland zone. Depending upon slope position, angle, and aspect, as well as soil type, conditions vary from dry to mesic, although drier conditions predominate. Of the Dry Prairie Subtypes, the Hill Subtype has the greatest overlap in species composition with Mesic Prairie and is richest in species. The major graminoids include those listed above for all Dry Prairies, plus prairie dropseed (*Sporobolus heterolepis*); Indian grass (*Sorghastrum nutans*) and big bluestem (*Andropogon gerardii*) are more important in the Hill Subtype than in other Dry Prairie subtypes. Less abundant but characteristic graminoids include Wilcox's panic grass (*Panicum wilcoxianum*) and plains muhly (*Muhlenbergia cuspidata*). Typical forbs other than those common to all Dry Prairie subtypes include purple coneflower (*Echinacea angustifolia*), aromatic aster (*Aster oblongifolius*), plains paintbrush (*Castilleja*

sessiliflora), small white beard-tongue (*Penstemon albidus*), locoweed (*Oxytropis lambertii*), and the milk-vetch (*Astragalus adsurgens*). The Hill Subtype occurs on erosional features in glacial till (e.g., valley side slopes) but also on steep slopes in disintegration moraine. Soils are mollisols but with shallower organic-rich surface horizons than in Mesic Prairie. Soil texture ranges from clay loam to sandy loam; cobbles and boulders are often common and gravelly inclusions may also be present. Soils are excessively drained to well-drained. Floristically, the boundary between the Hill Subtype of Dry Prairie and the dry-mesic phase of Mesic Prairie is particularly indistinct. They are best separated by topography. This subtype also grades into the hillier forms of the Sand-Gravel Subtype of Dry Prairie, as noted above. Heavily grazed occurrences of the Hill Subtype are often difficult to distinguish floristically from the Sand-Gravel Subtype. The Hill Subtype is present in the Southeast, Southwest, Central, and Northwest Sections of Dry Prairie.

Dry Oak Savanna (MLCCS Code 62120)

Three areas, totaling 39.7 acres, of dry oak savanna were mapped at LHRP. These were primarily located on slopes that were recently cleared of invasive brush, burned, and in some cases seeded (**Figure 26**).

<u>Key-based definition:</u> Upland vegetation with 10–70 percent cover by trees (of which <25 percent is conifer), where >30 percent of non-tree cover is herbaceous (prairie-dominated) and where oaks comprise >30 percent of the tree cover. The soil is composed of sand or gravel (sometimes with a thin organic surface layer) or any texture on steep slopes.

<u>MN DNR Natural Heritage description:</u> This dry to dry-mesic community is most common in the deciduous forest-woodland zone but also occurs sporadically throughout the prairie zone. The principal trees are bur oaks and northern pin oaks, but black oaks are also common in the southeast. Northwards, quaking aspens become more frequent in the community. The stature and spacing of trees is somewhat variable, reflecting differences in soils, topography, and climate, factors that strongly affect local droughtiness and fire frequency. Small, gnarly, open-grown trees are most common, although in moister spots, or in heavier soils, larger trees are sometimes more common. Tree spacing ranges from sparsely and evenly distributed to strongly clumped in moderately dense patches. Shrub cover is variable as well. The species composition of the shrub layer depends somewhat upon soil characteristics. Oak grubs and chokecherries are common on all soil types. On sandier soils, prairie willows (*Salix humilis*), New Jersey tea (*Ceanothus americanus*), American hazelnuts (*Corylus americana*), sand cherries (*Prunus pumila*), and juneberries (*Amelanchier* spp.) are usually present. Wolfberries (*Symphoricarpos occidentalis*) are commoner on heavier soils.

Dry Oak Savanna occurs on the same kinds of landforms as Dry Prairie, except for bedrock bluffs. Correspondingly, substrates range from excessively-drained to well-drained, sand to loam soils. The presence of savanna rather than prairie indicates a lower fire frequency or intensity (or both) than in prairie. Dry Oak Savanna requires less frequent fire than Mesic Savanna for maintenance. However, in the complete absence of fire, woodland will eventually replace Dry Oak Savanna. Wild grazing and browsing animals may also have had a role in the maintenance of Dry Oak Savanna. Because Dry Oak Savanna occurs on sites that are not as suitable for cultivation as Mesic Savanna sites; and, because succession in the absence of fire is not as rapid, more examples remain of Dry Oak Savanna than of Mesic Oak Savanna.

Figure 26. *An example of a restored dry savanna, following removal of invasive brush.*

Mesic Oak Savanna (MLCCS Code 62130 / no occurrences)

No mesic oak savannas were found within LHRP. Despite this, a description is given below for reference because it would have likely occurred in the vicinity of LHRP and Dakota County.

The characteristic trees of mesic oak savanna are bur oaks (*Quercus macrocarpa*) and, to a lesser extent, northern pin oaks (*Quercus ellipsoidalis*). Northward, quaking aspens were probably common in moister parts of mesic oak savannas. The stature and spacing of the oaks in the community probably varied considerably, primarily with differences in fire history, which were themselves related to differences in soils, landforms, and climate. Grubs and small, gnarly, open-grown trees were probably most common.

The distribution of trees ranged from evenly spaced to strongly clumped. Shrub cover, likewise, was probably quite variable. The shrub layer included chokecherries (*Prunus Virginian*), low June berries (*Amelanchier humilis*), gray-bark dogwoods (*Cornus racemosa*), wolfberries (*Symphoricarpos occidentalis*), and, on lighter soils, prairie willows (*Salix humilis*), New Jersey tea (*Ceanothus americanus*), and American hazelnut (*Corylus americana*). Leadplant (*Amorpha canescens*) was always present. The herbaceous vegetation was dominated by species typical of mesic prairie, but herbs typical of oak woodland and oak forest were probably present as well, especially beneath tree or shrub canopies.

Mesic oak savanna is rare throughout Minnesota. Historically, it occurred in the prairie and deciduous forest-woodland zones. Mesic oak savanna occurred on dry-mesic to mesic, gently undulating to moderately sloping sites. These sites were on glacial till or outwash, with soil texture ranging from clay loam to sandy loam. Mesic Oak Savanna generally occurred on sites where fire was frequent enough to prevent trees and shrubs from forming closed canopies, thereby permitting sun-loving prairie herbs to dominate the ground layer. However, fire frequencies were lower than in prairies on similar topography and soils. Native grazing and browsing animals may also have helped maintain the open character of mesic oak savanna. Within the deciduous forest-woodland zone, where landscape character reduced fire frequency on a large scale, mesic oak savanna often covered larger areas. With settlement and the suppression of prairie fires, savannas in the deciduous forest-woodland zone that escaped clearing and cultivation quickly succeeded to woodland unless heavily and continuously grazed. No high-quality examples are known to remain in Minnesota.

Rare Plants and Plants of Interest

As previously mentioned, the MLCCS update for the LHRP NRMP was not intended to be a comprehensive floristic survey and did not include targeted rare plant searches. However, the ecologists made an effort to identify rare plants and plants of local interest.

During the land cover mapping field survey, one previously undocumented rare plant was observed: white wild indigo (*Baptisia alba* var. *macrophylla*), listed as MN Special Concern. Additional plants of interest have been noted by Dakota County Parks staff, and others and are listed below (**Table 10** and **Figures 27** and **28**).

Scientific Name	***Common Name***	***State Status***	***Habitat Affinity***
Sceptridium multifidum	Leathery grape fern	Non-listed	Forest clearings, old fields
Sceptridium dissectum var. dissectum	Blunt-lobed grape fern	Non-listed	Mesic hardwood forest
Sceptridium oneidense	Blunt-lobed grape fern	Threatened	Mesic hardwood forest
Crotalaria sagitallis	Rattlebox	Special Concern	Prairie, savanna
Baptisia alba var. *macrophylla*	White wild indigo	Special Concern	Prairie, savanna
Goodyera pubescens	Rattlesnake plantain	Non-listed	Dry woodland
Liparis liliifolia	Lily-leaved twayblade	Non-listed	Woodlands, pine plantations

Table 10. *Rare plants and plants of interest found recently in LHRP.*

Photos of rare plants and plants of interest

Figure 27. *Blunt-lobed grape fern species (left to right):* Sceptridium multifidum*,* Sceptridium dissectum *var.* dissectum*, and* Sceptridium oneidense*.*

Figure 28*. Left to right: Rattlebox (*Crotalaria sagitallis*), rattlesnake plantain (*Goodyera pubescens*) (photo: Paul Bockenstedt), white wild indigo (*Baptisia alba *var.* macrophylla*), and lily-leaved twayblade (*Liparis liliifolia*) (photo: Richard Bonnet).*

There is a strong likelihood that rare species are still present, especially in high quality sites. It is also worth noting that some rare/uncommon plants tend to be found in specific types of transitional habitat that may appear to be disturbed. For instance, lily-leaved twayblade orchid tends to be found in dry woodland edges that have been recently colonized by brush and which were formerly old fields dominated by non-native, cool season pasture grasses. For this reason, species that are rare but capable of colonizing select disturbed habitats should also be taken into account when considering management strategies and potential park development projects (see **Table 11**). As such, we recommend project-specific rare plant evaluations be considered for proposed park capital improvements.

Examples of Potential Rare Plants at LHRP

Oak Forest:

Common Name	Scientific Name	Minnesota Status
Big tick-trefoil	*Desmodium cuspidatum*	Threatened
Stemless tick-trefoil	*Desmodium nudiflorum*	Threatened
Grape fern spp.	*Botrychium* spp.	Several spp. listed
One-flowered broomrape	*Orobanche uniflora*	Threatened
Wild Panax	*Panax quinquefolia*	Special Concern

Oak Savanna/Prairie:

Common Name	Scientific Name	Minnesota Status
Prairie milkweed	*Asclepias hirtella*	Threatened
Grape fern spp.	*Botrychium* spp.	Several spp. listed
Wild petunia	*Ruellia humilis*	Special Concern
Tall nut rush	*Scleria triglomerata*	Endangered

Wet Meadow:

Common Name	Scientific Name	Minnesota Status
Small white lady's slipper	*Cypripedium candidum*	Special Concern

Mixed Emergent and Cattail Marsh:

Common Name	Scientific Name	Minnesota Status
Water willow	*Decodon verticillatus*	Special Concern

Table 11. *Rare plants that have potential to occur in LHRP.*

3.3. Fungi

Until recently, not much was known about the diversity of fungi in LHRP. There have been groups interested in fungi that have explored the park, but no organized or official efforts to document the macro-(mushroom-producing) fungi until a "MycoBlitz" occurred in August 2018. The MycoBlitz recruited local expert Anna Gerenday of the Minnesota Mycoflora Project and Bell Museum, local members of the Minnesota Mycological Society and many volunteers to survey the area around the Visitor Center. Volunteers documented specimens using the *iNaturalist* application or through uploading photos and descriptions of their observations to the website *Mushroom Observer* (https://mushroomobserver.org). Unique specimens were collected and dried for further study, some of which were prepared for submission to the University of Minnesota Herbarium.

3.3.1. Taxa and Distribution

Resulting from this 2018 survey, approximately 55 distinct species were observed, of which at least 13 of these have no official record of being observed in Dakota County prior to the MycoBlitz (**Table 11a**).

The taxa found during the 2018 MycoBlitz fulfill multiple ecological roles in the forests and woodlands of Lebanon Hills. These observed fungi can be grouped into two broad categories: **mycorrhizal fungi** that form mutualistic associations providing nutrients to trees in exchange for plant-derived sugars, and **saprobic** fungi that degrade wood and other organic material. The mycorrhizal fungi are important for maintaining forest composition, as oaks in particular are dependent upon these fungi for nutrients and protection from drought. The absorptive capacity of mycorrhizal inoculated roots can be as much as three times the amount of non-innoculated ones. Mycorrhizal fungi can be **ectomycorrhizal**, such that the fungus grows and encapsulates the root tips of the tree, or they can penetrate the roots and form growths within the plant tissue in the case of **arbuscular mycorrhizal** fungi. The saprobic fungi observed can be further broken down into **white rot** or **brown rot** (wood-degrading) fungi, depending upon the molecules in the wood that they decompose, thus leaving the decomposing wood either a white or brown color from the residues that remain. Some wood degrading fungi grow on living trees where they degrade the interior wood, and their impact on the tree's physiology can sometimes be considered parasitic.

Scientific Name	Common Name	Ecological role	Dakota County Record
Amanita sp., Vaginatae group		ectomycorrhizal	
Artomyces pyxidatus	coral mushroom	saprobe	
Chlorociboria aeruginascens	little blue cup fungus	saprobe	X
Dadaeliopsis confragosa		white rot saprobe	
Ganoderma applanatum	artist's conk	white rot saprobe	
Gelatoporia dichroa		white rot saprobe	X

Gyroporus castaneus		ectomycorrhizal	X
Gyroporus cyanescens		ectomycorrhizal	X
Hydnum repandrum	hedgehog mushroom	ectomycorrhizal	X
Inocybe sp.		ectomycorrhizal	
Lactarius sp.		ectomycorrhizal	
Lactarius subserifluus		ectomycorrhizal	X
Laetiporus cincinnatus	chicken of the woods	brown rot saprobe	X
Lentinellus cochleatus		saprobe	X
Mycena cf. *haematopus*		saprobe	
Mycena leaiana		saprobe	
Panellus stipticus		saprobe	X
Pholiota cf. *albocrenulata*		saprobe	
Peziza sp.			
cf. *Peziza* sp.			
Rhodotus palmatus		saprobe	
Russula cf. *grata*		ectomycorrhizal	
cf. *Thelephora* sp.			
cf. *Tremellodendron* or *Lindneria*			X
Tremellodendron or *Thelephora*			X
Tremellodendron sp.			X
Scleroderma cf. *rhizopogon*		saprobe	X
Strobilurus or *Baeospora*		saprobe	

Table 11b. (Preliminary) Fungal taxa observed during the August 2018 MycoBlitz.

Although the emphasis of the MycoBlitz was on macrofungi that produce larger fruiting bodies, an extensive diversity of microscopic fungi is expected to be present in soils and on the surfaces of plants throughout the Park. Future studies could document these microscopic fungi through DNA-based sampling techniques.

3.3.1. Future Monitoring

Conducting a MycoBlitz annually is recommended. Focusing on the area near the Visitor Center would be a good strategy, as its location is most conducive to volunteer and citizen scientist involvement, at least for the first couple of years. Surveying other areas of the Park would be beneficial and could be done on a smaller scale with select volunteers and staff.

3.4. Forest Pathogens

3.4.1. Oak Wilt

Oak wilt is a non-native pathogen that is fatal to species of red (pin/black) and bur oaks and can often be fatal to white oak. The disease is common in east-central and southeast Minnesota and is widespread in the Twin Cities metropolitan area. LHRP has some areas that have been significantly impacted in the past by oak wilt and other areas that are currently being impacted. According to MN DNR foresters, the likelihood of successfully slowing oak wilt's expansion across the landscape is greatest at the edge of its geographical range, where it is found at low densities and where few landowners are impacted. LHRP identifies areas of oak wilt with the goal of removing dead/diseased trees. At this time, the MN DNR is generally discouraging the use of vibratory plowing in the Twin Cities region for oak wilt management but has not ruled it out. No active oak wilt management (i.e., vibratory plowing) is being conducted by Dakota County Parks at this time. But this could change, depending on the situation; for example, if oak wilt gets into bur and white oaks, it may warrant control action including vibratory plowing.

3.4.2. Emerald Ash Borer (EAB)

According to information on the MN DNR EAB website, this pathogen is native to eastern Asia and discovered in Detroit, Michigan, and Windsor, Ontario, in 2002. Indications are it may have been introduced to the Detroit/Windsor area as early 1990. EAB has been spread in ash firewood, nursery stock, and possibly other ash materials to a number of new areas. On May 14, 2009, emerald ash borer (EAB) was confirmed as present in the South Saint Anthony Park neighborhood in St. Paul. EAB is a serious invasive tree pest, and consequently quarantine has been placed to help slow the spread of EAB to other areas. Despite the quarantine, EAB has spread rapidly in the region. Although there were no new observations made for EAB during field work for the LHRP NRMP, the MN Department of Agriculture has mapped EAB at several locations immediately adjacent to and within LHRP (**Figure 29**). Although ash species are not a dominant tree species at LHRP, EAB still has the potential to significantly impact the overall species composition of forested upland and wetland areas at LHRP. The County adopted an Emerald Ash Borer Management Plan in 2017, which describes management options for the parks, including LHRP.

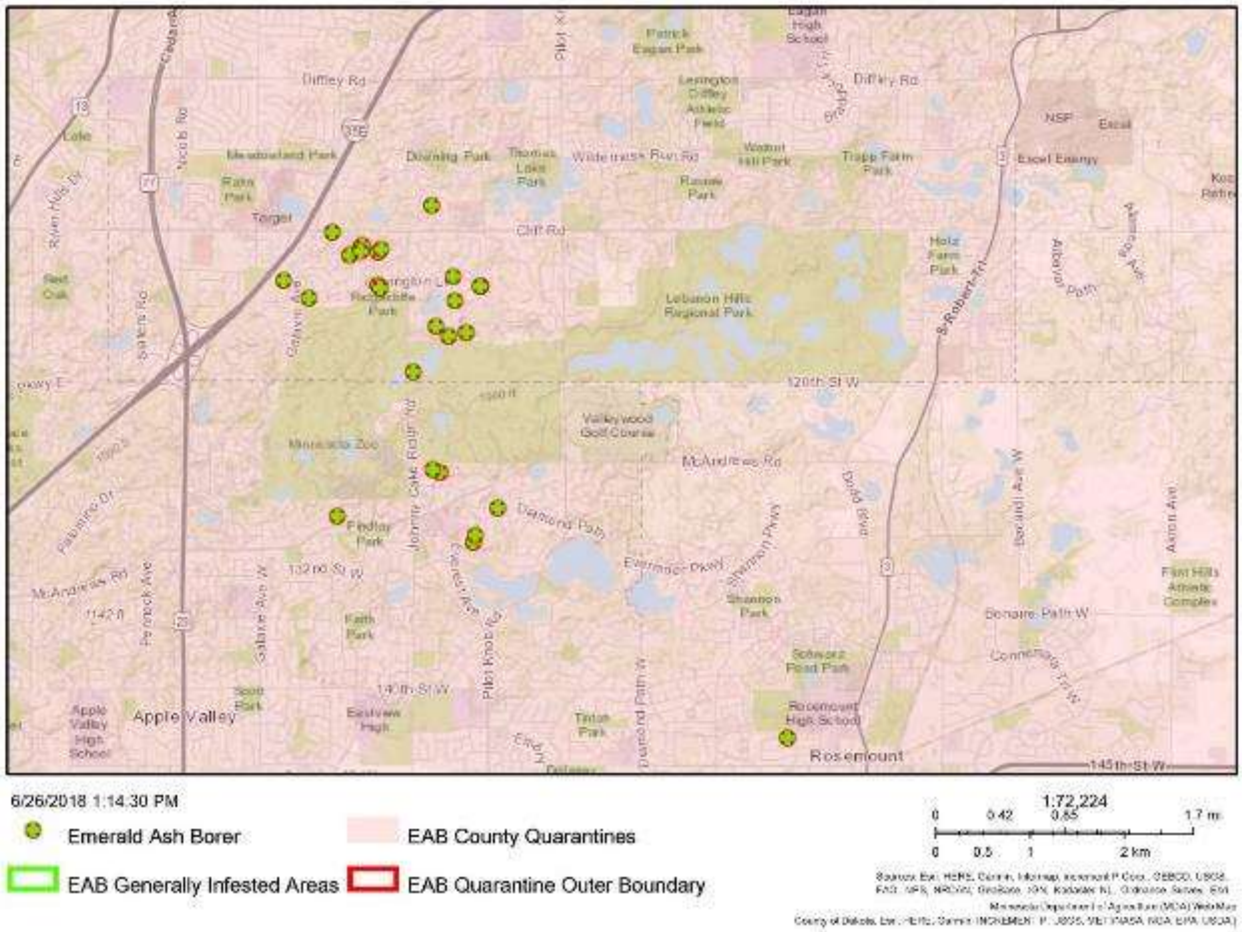


Figure 29. *Emerald Ash Borer infestations documented in/near LHRP (source: [MN DNR EAB Interactive Map]).*

3.5. Aquatic Resources

3.5.1. Groundwater and Aquifer Sensitivity

Groundwater accumulates below the surface of the land and is stored in complex, underground layers of sand, gravel, and porous rock. If groundwater exists in suitable quantity and quality, and can be tapped for human use, it is of great economic value. In the northern portion of the County where the glacial deposits tend to be deeper, groundwater is often extracted from drilled wells into sand and gravel deposits. In the southern part of the County where the layer of glacial deposits is shallower, most drilled wells extend into the porous bedrock. Throughout the County, most public water supplies are obtained from one of the deeper bedrock aquifers.

Due to its relative abundance, quality, and reasonable access, groundwater provides drinking water for the majority of County citizens, irrigation water for agricultural crops (especially on the sandier soils in the southeastern portion of the County), and process and cooling water for industrial and manufacturing companies. Although the amount of available groundwater appears to be stable, there is growing concern about the groundwater supply due to increased agricultural irrigation, suburban water use, and changing climate. Improved information on the role of groundwater to ecological systems like trout streams corroborates this. At the same time, much of the County's groundwater is "highly sensitive" to surface contamination, meaning that it takes only days or months for contaminants to reach the aquifer. Once an aquifer is polluted, it takes a long time for contaminants to either leave or be immobilized. It is very or prohibitively expensive to improve a polluted aquifer's quality to attain drinking water standards.

Given its importance and potential vulnerability, every effort should be made to prevent groundwater contamination, including from pesticide and herbicide use. Factors to consider during natural resource management activities are: 1) depth to groundwater and 2) the ability of the overlying geologic materials to protect the groundwater aquifer (deeper and less porous soils are best—thinner and more porous soils are worse).

One wetland near Cliff Road (Wetland #121), downstream from McDonough Lake, is the only known source of rapidly infiltrating surface water to recharge groundwater in the park. Any proposed chemical use or changes to this drainage area and their consequences should be carefully studied before application. Vegetation is an important defense in slowing and removing pollutants from runoff and maintaining healthy vegetative communities around all waterbodies in the park is important. Most waterbodies in the park have layers of clay that impede infiltration of lake water into groundwater.

Dakota County is within the Minnesota Metro Ground Water Province. The Metro Province is characterized by sand aquifers in thick (>100 feet) sandy and clayey glacial drift overlying Precambrian sandstone and Paleozoic sandstone, limestone, and dolostone aquifers. This area is underlain by sedimentary bedrock that has good aquifer properties. Dakota County, along with the southeastern third of MN, lies within bedrock aquifers consisting of thick, laterally extensive sequences of sandstone, limestone, and dolostone of sedimentary origin. In these aquifers, groundwater generally occurs in granular pare spaces, partings, joints, factures, and dissolution features, and is usually capable of yielding sufficient quantities of groundwater.

The central portion of the park lies within the Eagan South Drinking Water Supply Management Area. Drinking Water Supply Management Areas are approved surface and subsurface areas surrounding a public water supply well. The nearest groundwater monitoring stations are about half a mile south of the eastern portion of the park.

3.5.2. Surface Waters

One of the unique and attractive features of Dakota County is the amount and diversity of its surface waters. Major riverine systems, including the Mississippi, Minnesota, Cannon, and Vermillion Rivers create the borders or flow within the County. A number of creeks, streams, and brooks are found in the southern portion of the County. Numerous small lakes are found in the northern and western portions of the County as a result of previous glaciation. The two largest lakes, Crystal and Marion, are highly desirable for their scenic beauty and recreation. Different types of wetlands are scattered throughout the County, and several unique wetlands, known as fens, are found in the Minnesota River Valley. Two large reservoirs, Lake Byllesby and Spring Lake, were formed with the creation of dams.

Over time, most of these surface waters have been significantly degraded due to agricultural and municipal stormwater runoff. Entire wetland complexes that were important for filtering and retaining water and recharging the groundwater have been lost. Pollution often includes excess bacteria, sediment, and nutrients (especially nitrogen and phosphorous from fertilizer), causing lower levels of dissolved oxygen that limit reproduction and survival of fish populations and other aquatic organisms. Although state and federal regulations and voluntary efforts have improved water conditions, protection and management of natural areas, especially those adjacent to water bodies, are important strategies for achieving water quality goals.

Lakes

There are 13 named lakes within Lebanon Hills Regional Park: Beaver, Bridge, Cattail, Dakota, Gerhardt, Portage, Jensen, O'Brien, Marsh, McDonough, Holland, Schulze, and Wheaton (**Figure 30**). All lakes in LHRP are in the Lower Minnesota River Watershed and none are listed as impaired waters by the Minnesota Pollution Control Agency (MPCA). Shoreline erosion is not widespread in LHRP lakes; however, varying water levels in these lakes has impacted vegetation along some shorelines. These impacts can lead to shoreline erosion.

Trophic State Index (TSI) is a classification system used to evaluate the condition of a lake. Trophic classifications describe the nutrient levels existing in the lake, with higher values indicating more eutrophic conditions. In Minnesota, the MPCA evaluates TSI by measuring transparency, chlorophyll-a, and total phosphorus. These measurements lead to a TSI score. The MN DNR has developed a floristic quality index (FQI) to evaluate submerged aquatic vegetation community health. Floristic Quality Index evaluates the vegetation community. Low FQI scores indicate low quality, commonly dominated by invasive species, while high scores indicate a high-quality native plant community. Curlyleaf pondweed (CLP) (*Potamogeton crispus*) and Eurasian watermilfoil (EWM) (*Myriophyllum spicatum*) are prohibited aquatic invasive species that have been identified in LHRP lakes. The MN DNR has recognized Eurasian watermilfoil infestations in Dakota County lakes, and those lakes are listed as infested waters and should have posting indicating such. Lakes identified as having curlyleaf pondweed in LHRP were not included in the most recent (December 2017) MN DNR list of infested waters. LHRP will be treating curlyleaf pondweed and Eurasian watermilfoil and posting informational signs for the public. No invasive fish or invertebrate species have been identified in LHRP lakes to date. FQI impairment threshold limits have been developed based on deep and shallow lakes across Minnesota.

Tables 12 and **13** include statistics for the five largest lakes within LHRP. Additional descriptions for each lake are provided below.

Lak Name	Acres	Mean Depth (ft.)	Max Depth (ft.)	Trophic State Index	Floristic Quality Index
Jensen	54	3.6	8	56	19.4
O'Brien	33	5.9	10	49	17.7

Schultz (Schulze)	15	8.1	15	Not collected	14.4
McDonough	18	4.3	8	50	11.4
Holland	38	12.4	55	44	15.2

Table 12. *Data from the five largest lakes in LHRP.*

Lake levels vary throughout the park. This variation is influenced by several factors including subwatershed size, substrate type and porosity, percentage of impervious surface in the subwatershed, amount and type of vegetation, and fluvial morphology of the basin. The hydrology of the lake system in the park has been altered by installation of culverts, weirs, and other man-made control structures. Several lakes have their surface water levels being monitored on a regular basis. Some lakes have higher or lower levels than they have had historically, as indicated by aerial photography, and further investigation into causes and potential restorative measures should be conducted. One explanation of higher levels is buckthorn removal, since removal of vegetation in a watershed will increase the runoff, and there has been a great amount of woody stems, branches, and leaves removed via buckthorn control projects in the past five years. Furthermore, conducting wetland restoration should help stabilize lake levels, since wetlands help retain, infiltrate, and mitigate stormwater runoff, which help regulate lake levels and minimize rapid fluctuation.

Jensen Lake

Jensen Lake is the largest lake in LHRP at approximately 55 acres (MPCA) with a mean depth of 3.6 feet and maximum depth of eight feet; it is classified as a shallow lake. Jensen Lake's watershed is 416 acres. TSI data was collected between 2007 and 2016. Overall TSI for Jensen Lake is 56; this indicates a eutrophic, or nutrient rich, lake. The individual indicators *chlorophyll-a* and *total phosphorus* were both within the expected range of the ecoregion; *transparency* was higher than the expected range (MPCA). Overall, Jensen Lake is suitable for swimming with low algae levels (MPCA). Modeling suggests total phosphorus load is primarily from watershed runoff.

Jensen Lake is 100 percent littoral zone (depths less than 15 feet that allow light to penetrate to the lake bottom). Littoral area is important for vegetation growth, spawning habitat, and young fish habitat. A lack of deep-water habitat may limit fish diversity; however, shallow lakes are critical wildlife habitat. Submerged aquatic vegetation (SAV) surveys completed in 2016 produced an FQI score of 19.4, above the 17.8 impairment threshold for shallow lakes (Wenck) indicating a plant community with room for improvement but not considered impaired. No invasive species have been identified in Jensen Lake to date.

O'Brien Lake

O'Brien Lake is 33 acres with a mean depth of 5.9 feet and maximum depth of 10 feet; it is classified as a shallow lake. O'Brien Lake's watershed is 889 acres. TSI data was collected between 2007 and 2016. Overall TSI for O'Brien Lake is 49; this indicates a mesotrophic lake, borderline eutrophic. Individual indicators for *transparency* and *total phosphorus* were both within the expected range for the ecoregion, and chlorophyll-a was below the expected range (MPCA). Overall, O'Brien Lake is suitable for swimming with low algae levels (MPCA). Modelling suggests total phosphorus load is primarily from watershed runoff.

O'Brien Lake is 100 percent littoral zone. A lack of deep water may limit fish diversity; but, again, shallow lakes are critical wildlife habitat. Submerged aquatic vegetation surveys completed in 2016 produced an FQI score of 17.7, just below the 17.8 threshold for shallow lakes (Wenck), indicating an impaired plant community partially due to the presence of Eurasian watermilfoil in the lake.

Schultz (Schulze) Lake

Schultz Lake is 15 acres with a mean depth of 8.1 feet and maximum depth of 15 feet; it is classified as a shallow lake. Schulze Lake's watershed is 666 acres. Transparency data was collected between 2005 and 2014; *chlorophyll-a* and *total phosphorus* data was insufficient. The transparency score was 50, indicating a lake on the boundary of mesotrophic and eutrophic. Total phosphorus and chlorophyll-a data collected in 2017 were just below and within the expected range respectively (Wenck).

Schultz Lake is 100 percent littoral zone. A lack of deep water may limit fish diversity; however, shallow lakes are critical wildlife habitat. Submerged aquatic vegetation surveys completed in 2016 produced an FQI score of 14.4, below the 17.8 impairment threshold for shallow lakes (Wenck), indicating an impaired aquatic plant community likely due to the presence of Eurasian watermilfoil and curlyleaf pondweed in the lake.

McDonough Lake

McDonough Lake is 18 acres with a mean depth of 4.3 feet and maximum depth of eight feet; it is classified as a shallow lake. McDonough Lake's watershed is large at 2,163 acres. TSI data was collected between 2007 and 2016. Overall TSI for McDonough Lake is 50, indicating a lake on the boundary of mesotrophic and eutrophic. Individual indicators *transparency* and *total phosphorus* were within the expected range of the ecoregion; chlorophyll-a was below the expected range (MPCA). Overall, McDonough Lake is suitable for swimming with low algae levels (MPCA). Modelling suggests total phosphorus load is primarily from upstream lakes (Wenck).

McDonough Lake is 100 percent littoral zone. A lack of deep water may limit fish diversity; however, shallow lakes are critical wildlife habitat. Submerged aquatic vegetation surveys completed in 2016 produced an FQI score of 11.4, below the 17.8 impairment threshold for shallow lakes (Wenck). This is the lowest FQI score of the lakes in LHRP that have scores; the aquatic plant community is considered impaired. The presence of Eurasian Watermilfoil and Curlyleaf Pondweed in the lake are a factor in the low score.

MN DNR has conducted fisheries surveys and stocking on McDonough Lake; see section 3.5 for more information. Fish consumption advisories have been set for bluegill and bullhead in McDonough Lake. The website with the most up-to-date MN DNR fish consumption advisories can be found at http://www.dnr.state.mn.us/lakefind/index.html. Dakota County aerates the lake each winter to prevent winter fish kills.

Holland Lake

Holland Lake is 38 acres and is the deepest lake in the park (and in the county) with a mean depth of 12.4 feet and maximum depth of 55 feet; it is classified as a deep lake. Holland Lake's watershed is 157 acres. TSI data was collected between 2007 and 2016. Overall TSI for Holland Lake is 44, indicating a mesotrophic lake. Both *transparency* and *chlorophyll-a* were within range of mesotrophic lakes while total phosphorus was within range of eutrophic lakes (MPCA). Modelling suggests total phosphorus load is primarily from watershed runoff.

As determined from MN DNR data, Holland Lake is between 60 and 73 percent littoral zone; a mixture of shallow and deepwater habitat provides habitat diversity that is suitable for more species of fish than homogenous shallow lakes. Submerged aquatic vegetation surveys completed in 2016 produced a Floristic Quality Index (FQI) score of 15.2, below the 18.6 impairment threshold for deep lakes (Wenck), indicating an impaired plant community partially due to the presence of Eurasian watermilfoil and curlyleaf pondweed. MN DNR has conducted fisheries surveys on Holland Lake; see section 3.5 for more information.

The water quality of Holland Lake is currently considered good. Historically, Holland was considered to be the county's clearest lake. In the 1980s, however, during Eagan's boom years, the lake experienced a doubling of the amount of algae, probably driven by stormwater from a nearby housing development and degradation caused by overuse by humans (swimming and floating). After the building of Eagan's water treatment plant and the banning of swimming, water and habitat quality of the lake improved. Although not a direct solution for stormwater runoff issues, a healthy, vigorous, diverse shoreline vegetation buffer will help attenuate algal blooms by providing habitat for zooplankton that graze on algae.

Current lake levels are higher by about four feet than in the 1950s/60s, as indicated from historical aerial photography, and there are indications of fluctuating water levels during the last 20 years. Higher water levels make it more difficult to restore shoreline vegetation but not impossible. For example, emergent plantings will need to be taller to account for deeper water levels at the shoreline. Lowering lake water levels is something that should be explored. Nevertheless, density and diversity of emergent vegetation can be increased if properly planned and implemented. Transitional vegetation can be planted into areas that were formerly reed canary grass, and upland vegetation can be seeded.

The transitional zone is dominated by the exotic reed canary grass, which diminishes wildlife habitat value. The emergent zone is surprisingly non-diverse, consisting of only a handful of species: a few *Carex* sedges and native grasses and a couple of forbs, especially blueflag iris. The emergent and transitional zones comprise an approximately 10- to 20-foot wide strip around the entire shore of the lake. Restoring and enhancing the shoreline buffer will improve habitat for a variety of wildlife species such as fish. Adding more course woody debris at the water's edge and into the shallow shore areas would also give turtles more areas to bask in. Restoring areas of sparse vegetation in the nearby sandy soils of the upland lakeshore would provide nesting areas. Improving vegetation buffer should improve invertebrate habitat, which in turn would help animals that feed on them.

There are a number of places on steeper slopes where people have worn paths to gain access to the lake, which causes erosion and sedimentation into the lake. This could be prevented by planting shrubs and other plant material to discourage further usage of this type and to stabilize soils.

Gerhardt Lake

Gerhardt Lake is 13 acres and classified as a shallow lake. Transparency data was collected from 2007 to 2016; the data was above the expected range and indicated a hypereutrophic lake. Water quality sampling conducted in 2017 indicated the lake was not meeting current standards for *chlorophyll-a* and *Secchi depth*. Curlyleaf pondweed has been found in Gerhardt Lake. This lake could benefit from water quality improvements.

Other Lakes

The remaining lakes have little information available. Beaver Lake is 10 acres, and no invasive species are present. Bridge Lake is four acres, and Eurasian watermilfoil is present. Cattail Lake is 11 acres, and no invasive species are listed. Portage Lake is 11 acres; Eurasian watermilfoil is present, and 239 adult Bluegill were stocked in 2008. Marsh Lake is 32 acres, and curlyleaf pondweed has been identified. Wheaton Lake is nine acres and curlyleaf pondweed has been identified.

Parameter	Jensen	O'Brien	Schulze	McDonough	Holland
SAV Coverage [percent]	100%	98%	78%	97%	76%
CLP Coverage [percent]	0%	0%	26%	39%	24%
CLP Density [average]	NA	NA	1.0	1.1	1.8
EWM Coverage [percent]	0%	2%	52%	32%	48%
EWM Density [average]	NA	1.0	2.3	1.6	1.9
FQI Score	19.4	17.7	14.4	11.4	15.2
FQI Threshold	17.8	17.8	17.8	17.8	18.6
FQI Status	Above Threshold	Below Threshold	Below Threshold	Below Threshold	Below Threshold

Table 13. *Summary of 2016 submerged aquatic vegetation surveys for LHRP priority lakes (Wenck 2017).*

Streams

There are no named streams in LHRP. There are many channels that connect the various lakes; these channels are generally small (less than five feet wide) with low flows. During high flow events, fish and other aquatic organisms may use these channels to access habitat in other lakes. None of these channels have been identified as impaired. Some erosion problems have been identified along with undersized or poorly installed culverts along trails. Channel erosion can be caused by increases in runoff, destruction of the riparian area, sediment inputs, and undersized or improperly installed culverts.

Wetlands

Wetlands are described in the Land Cover Results Section (3.2.4) but are referenced here due to their protection under state and federal law. Wetlands may not be dredged, filled, or drained without a permit. However, vegetation can be altered or even completely removed (sometimes requiring a permit), especially for the purposes of ecological restoration and invasive plant management.

The National Wetlands Inventory (NWI) is a national assessment of wetland resources, conducted by the United States Fish and Wildlife Service between 1988 and 1992 within the state of Minnesota. The NWI survey was based strictly on aerial photography reconnaissance and interpretation and is therefore less accurate than the field-verified survey information collected for this project. However, the NWI coverage is useful in giving an estimate of the extent (i.e., approximate geographic location) and type (i.e., system, hydrologic regime, and predominant vegetation types) of wetlands within LHRP. **Figure 31** shows the NWI for LHRP, as well as highlighting the 32 wetlands that were included in the wetland Function and Values assessment for this project.

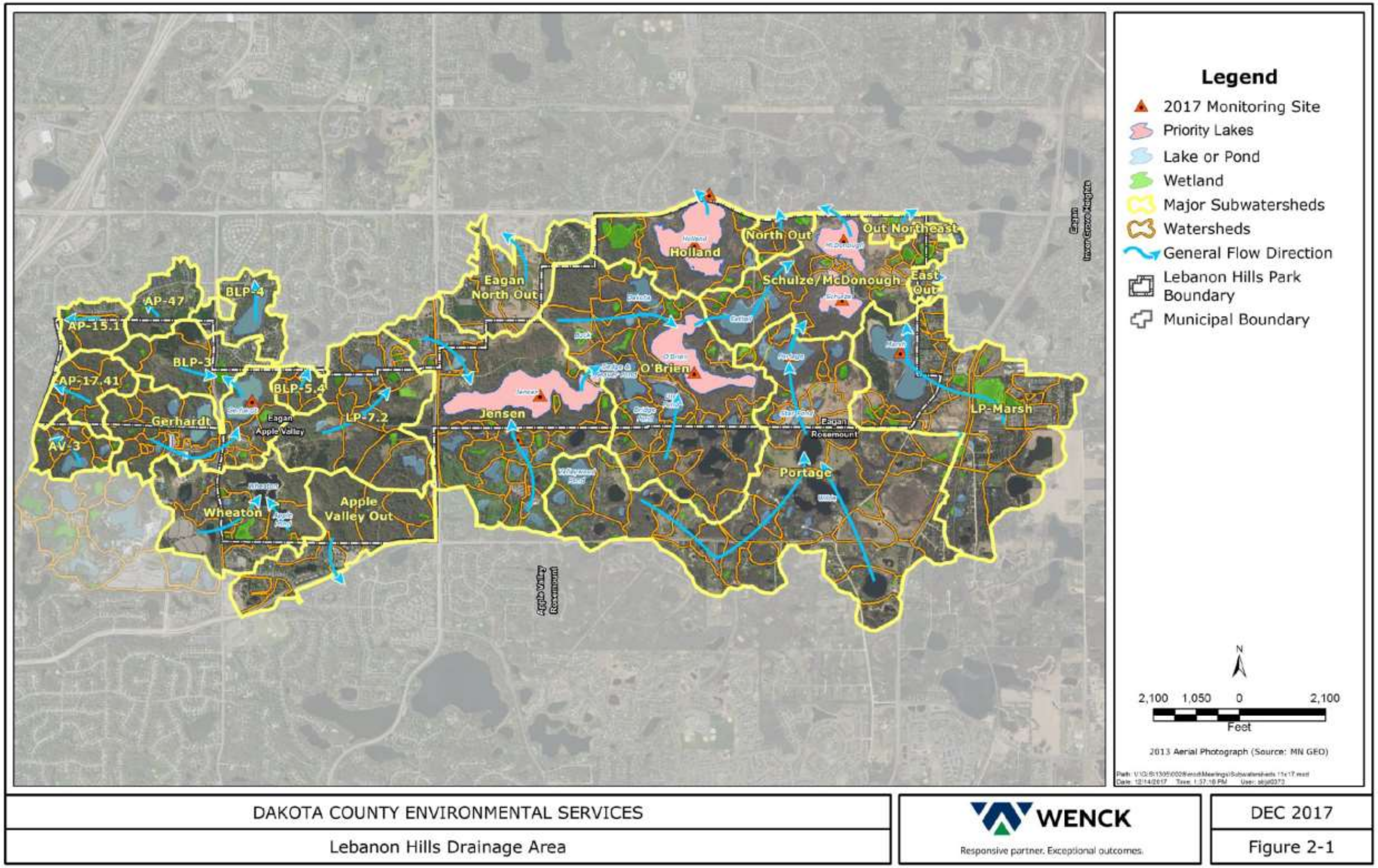


Figure 30. *Subwatersheds, lakes, and water resource features of Lebanon Hills Regional Park.*

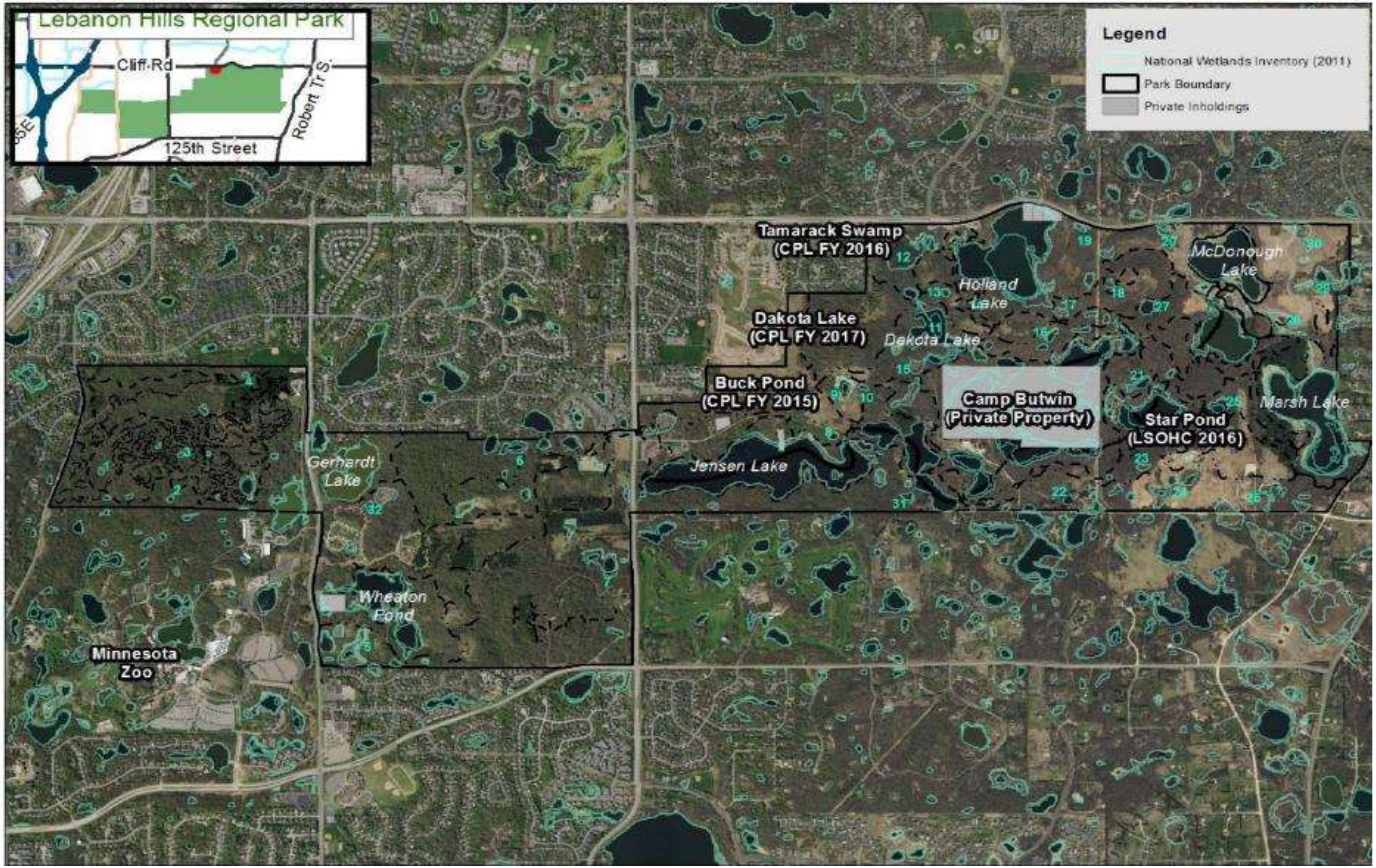


Figure 31. *National Wetlands Inventory. Wetlands evaluated using MnRAM noted by number.*

MnRAM Function and Values Assessment

A select set of 32 wetlands was chosen by Dakota County Parks Resource Managers for Function and Values Assessment using the Minnesota Routine Assessment Method (MnRAM). Stantec wetland scientists conducted assessment of the identified National Wetland Inventory (NWI) wetlands to provide baseline data on a representative set of wetlands at LHRP and to identify potential wetland restoration sites. The MnRAM field assessment was completed by Stantec in November 2017. Below is a summary of the methods and results for the MnRAM assessment effort.

MnRAM Purpose

The MnRAM was developed by the Board of Water and Soil Resources as a practical assessment tool to help make sound wetland management decisions for regulating wetland impacts. The MnRAM assesses wetlands based on the answers to 72 questions to determine how well the functions and values are performed within each wetland. Questions focus on vegetative diversity, hydrologic regime characteristics, flood prevention, water quality, and wildlife habitat.

Minnesota Routine Assessment Method of Evaluating Wetland Functions

The MnRAM evaluates the following functions/value characteristics:

Ecological Wetland Functions

- Vegetative Diversity/Integrity
- Hydrologic Regime
- Wetland Water Quality
- Wildlife Habitat Structure
- Fish Habitat
- Amphibian Habitat

Wetland Values

- Flood/Stormwater Attenuation
- Downstream Water Quality Protection
- Shoreline Protection
- Aesthetics/Recreation/Education/Cultural
- Commercial Uses
- Ground Water Interaction

Additional Evaluation Information

- Restoration Potential
- Sensitivity to Stormwater and Urban Development

Numeric scores are computed for each wetland function/value based on established formulas in the methodology. Those numeric scores are then converted to quality ratings (exceptional, high, medium, and low), which are entered into the Wetland Management Classification System to determine the management class.

Methods

Wetlands are valued for a wide range of functions they perform, such as improving water quality, flow rate reduction, and providing fish and wildlife habitat. Recently, wetland scientists have developed methods to assess the values of individual wetlands based on their ability to perform desired functions. The assessments evaluate characteristics such as plant community diversity and structure, connectivity to other habitat types, location within the watershed, and a wide range of other factors. The assessment is like a report card, which evaluates the wetland's functions and quality. It is important to note that the value and quality of different wetlands in a project area is relative. For example, a wetland found within Lebanon Hills Regional Park may not be considered to be of high quality compared to a wetland in northern Minnesota. However, in comparison with wetlands elsewhere in the park, the particular wetland may be highly valued for the functions it provides.

The MnRAM was used to assess the functions and values of the wetlands inventoried for this plan. The method was developed by the Minnesota Interagency Wetland Group as a field evaluation tool to assess the wetland function on a qualitative basis. It is intended to document the field observations and interpretations of professionals who have had training and experience in wetland science. This method is not intended to be a rigid procedure but rather an aid to complement trained observation and interpretive skills with additional qualitative evaluation.

Each identified wetland was assessed and assigned a rank reflecting the value of the functions it provides. Wetlands were ranked as Exceptional, High, Moderate, Low, or Not Applicable (N/A) for each functional value assessed. The summaries of the wetland rankings are presented in Appendix B of this report.

Prior to conducting the field assessments, preliminary information was compiled to answer the appropriate GIS questions. Base data used for this preparation included aerial imagery, web soil survey maps, LIDAR two-foot contour elevation maps, Minnesota Land Cover Classification System Inventory, National Wetland Inventory, Minnesota Department of Natural Resources (MN DNR) National Heritage Information System (NHIS) database of rare species and communities, MN DNR designated scientific and natural areas, county biological survey, drainage directions, trout streams, public parks, floodplain areas, and shore land management areas.

The MnRAM field assessments were conducted in November 2017. During the field visit, dominant vegetation species were recorded, and photographs were taken of each wetland assessed.

MnRAM RESULTS

A total of 32 wetlands covering 49.76 acres were assessed. The MnRAM assessed both wetland functions and wetland values. Wetland functions are inherent ecological aspects of the wetland in contrast to values, which are considered to be services that primarily benefit society. A summary of the wetland functions and value ratings is provided in Appendix D.

ECOLOGICAL WETLAND FUNCTIONS

Vegetative Diversity/Integrity

Over half of the assessed wetlands are rated low for vegetative diversity, which is common in an urban watershed. Most wetlands were lowered in quality by some presence of invasive species such as reed canary grass (*Phalaris arundinacea*), buckthorn (*Rhamnus cathartica*), and Eurasian milfoil (*Myriophyllum spicatum*). There are many areas that could be improved through invasive plant management as further discussed in the section below. Two wetlands were rated “high” in this category. These include LHRP-12 and LHRP-5, a 5.3-acre shrub-carr wetland and a 1.0-acre floating open bog wetland, respectively

Score	Exceptional	High	Moderate	Low	N/A
Number of wetlands	0	2	12	18	0

Table 14. *Vegetative Diversity Rankings for Sampled Wetlands in LHRP.*

Hydrologic Regime

All of the wetlands surveyed scored a high rating for the hydrologic regime characteristic. This is most likely due to natural outlet conditions across the park. Where outlets have been altered, they were placed at or above the wetland boundary, which preserves the hydrologic regime. No drainage tiles, ditching, or other obvious human-made signs of alteration to the hydrology were observed.

Score	Exceptional	High	Moderate	Low	N/A
Number of wetlands	0	32	0	0	0

Table 15. *Hydrologic Regime Rankings for Sampled Wetlands in LHRP.*

Wetland Water Quality

Most wetlands scored high or moderate for the wetland water quality characteristic. The moderate ratings were typically found at wetlands that were near roads or other impervious surfaces or had indicators that the wetland has been affected by nutrient loading or the presence of monotypic vegetation. Many areas that were rated moderate would have scored higher if monotypic vegetation (i.e., dense reed canary and nonnative cattail *Typha angustifolia/Typha x glauca* stands) were not present.

Score	Exceptional	High	Moderate	Low	N/A
Number of wetlands	1	16	15	0	0

Table 16. *Water Quality Rankings for Sampled Wetlands in LHRP.*

Wildlife Habitat Structure

Most wetlands scored high (16), followed closely by moderate (14). Two wetlands received an "exceptional" score in this category. This characteristic determines the value of wetland wildlife habitat in a general sense due to the wide range of specific habitat needs of individual species. Vegetative quality, outlet characteristics, upland use, upland buffer extent, condition, and diversity, as well as other factors, determine the score.

Score	Exceptional	High	Moderate	Low	N/A
Number of wetlands	2	16	14	0	0

Table 17. *Wildlife Habitat Structure Rankings for Sampled Wetlands in LHRP.*

Fish Habitat

Most wetlands scored high for this characteristic even though the likelihood of most of these wetlands supporting fish populations is relatively low. Due to the unique landscape of Lebanon Hills Regional Park, most wetlands occur in isolated basins which make it more difficult for fish to colonize and/or move between the many shallow open water communities that are characteristic of the park. Minimal stormwater runoff (sediment delivery) and low nutrient loads combined with surrounding land cover helped give many wetlands a boost to fish habitat that in reality are of poor quality to fish.

Score	Exceptional	High	Moderate	Low	N/A
Number of wetlands	0	13	8	0	11

Table 18. *Fish Habitat Structure Rankings for Sampled Wetlands in LHRP.*

Amphibian Habitat

Most wetlands scored high for the amphibian habitat quality characteristic. This characteristic is designed to look at the presence of suitable habitat for amphibian breeding and overwintering potential. This function determines the value of a wetland for amphibians in general, not based on specific species. Factors that influence this rating are a suitable hydroperiod for the wetland in early to mid-summer for favorable breeding habitat, as well as suitable conditions later in the season for overwintering. Large fluctuations of water during the overwintering period can cause mortality to reptiles and amphibians.

Score	Exceptional	High	Moderate	Low	N/A
Number of wetlands	0	24	4	0	4

Table 19. *Amphibian Habitat Structure Rankings for Sampled Wetlands in LHRP.*

WETLAND VALUES

Flood/Stormwater Attenuation

Most wetlands scored moderate for this characteristic due to the minimal amount of directed stormwater the park receives. Most wetlands within the park are in isolated basins which by nature do not retain floodwater from outside their immediate drainage area. This characteristic is designed to determine the value of the wetland in regard to helping to minimize downstream flooding and removing energy from stormwater. Soil types, land use, sediment delivery, abundance of wetlands and waterbodies in the subwatershed, and vegetation type affect the wetland's ability to provide flood storage and attenuation. A highly rated wetland will have unaltered or restricted outlands, undisturbed soils, and dense emergent vegetation without channels.

Score	Exceptional	High	Moderate	Low	N/A
Number of wetlands	0	4	28	0	0

Table 20. *Wetland Values Rankings for Sampled Wetlands in LHRP.*

Downstream Water Quality Protection

Most wetlands scored high for this characteristic due to the high quality of the surrounding land use, low sediment delivery, and the lack of directed stormwater inputs to wetlands within the park. This characteristic is designed to determine the value of the wetland as it relates to improving downstream water quality. The water quality is improved by capturing runoff sediments and by reducing the nutrient load in the water by vegetation uptake and residence time within the wetland.

Score	Exceptional	High	Moderate	Low	N/A
Number of wetlands	0	21	11	0	0

Table 21. *Downstream Water Quality Protection Rankings for Sampled Wetlands in LHRP.*

Shoreline Protection

The shoreline protection characteristic did not apply to most wetlands because they did not occur on the edge of a lake, stream, or deep-water habitat. This characteristic is designed to rate the function based on the wetland's opportunity to protect the shoreline. The wetland's width, vegetative cover, and resistance of the vegetation to erosive forces determine the wetland's ability to protect the shoreline.

Score	Exceptional	High	Moderate	Low	N/A
Number of wetlands	0	0	0	1	31

Table 22. *Shoreline Protection Rankings for Sampled Wetlands in LHRP.*

Aesthetics/Recreation/Education/Cultural

All wetlands surveyed scored exceptional for aesthetics/recreation/education/cultural due to their location within a public park with high visibility, proximity to population, and providing rare educational opportunities. Lebanon Hills is prized locally as the largest public park in Dakota County. The park contains miles of hiking, skiing, and equestrian trails, as well as water trails for canoers and kayakers.

Score	Exceptional	High	Moderate	Low	N/A
Number of wetlands	32	0	0	0	0

Table 23. *Cultural Rankings for Sampled Wetlands in LHRP.*

Commercial Uses

In contrast to the aesthetics/recreation/education/cultural characteristic, all of the wetlands surveyed scored not applicable for commercial uses due to the protected nature of the park. This characteristic assesses the nature of any commercially valuable use of the wetland and how it may be detrimental to wetland quality. The wetlands undergo sustainable uses, such as collection of botanicals, seeds, and fruit; however, these do not require modifying a natural wetland, are under the control and direction of the park, and are not for commercial use.

Score	Exceptional	High	Moderate	Low	N/A
Number of wetlands	0	0	0	0	32

Table 24. *Commercial Uses Rankings for Sampled Wetlands in LHRP.*

Groundwater Interaction

Most wetlands surveyed were classified as a combination of discharge and recharge wetlands. Recharge wetlands are considered to be a sensitive groundwater area because they contribute to the public water supply. The unique geomorphology and sandy soils of the park allow the many isolated shallow open water communities to contribute to the local groundwater supply by infiltrating water below the ground surface.

Score	Discharge	Recharge	Combination, Discharge, Recharge
Number of wetlands	1	9	22

Table 25. *Groundwater Interacting Types for Sampled Wetlands in LHRP.*

ADDITIONAL EVALUATION INFORMATION

Restoration Potential (hydrologic)

All of the wetlands surveyed were considered to be not applicable for restoration because the size and hydrology of the wetlands have not been historically altered. In this case, even if the wetlands had been altered, the opportunity to restore the wetlands does not exist due to the likelihood of flooding roads, golf courses, houses, and septic systems.

Score	Exceptional	High	Moderate	Low	N/A
Number of wetlands	0	0	0	0	32

Table 26. *Restoration Potential for Sampled Wetlands in LHRP.*

Sensitivity to Stormwater and Urban Development

The wetland sensitivity to stormwater input and urban development depends directly on the plant community type. Sedge meadows, open and coniferous bogs, calcareous fens, low prairies, coniferous swamps, lowland hardwood swamps, and seasonally flooded basins are always rated as exceptional. Shrub-carr, alder thickets, diverse fresh wet meadows dominated by native species, diverse shallow and deep marshes, and diverse shallow, open water communities are rated high. Floodplain forests, fresh wet meadows dominated by reed canary grass, shallow and deep marshes dominated by cattail, reed canary grass, giant reed (*Phragmites australis*), or purple loosestrife (*Lythrum salicaria*) and shallow, open water communities with moderate to low diversity are rated moderate. Gravel pits, cultivated hydric soils, and dredge/fill disposal sites are all classified as low.

Score	Exceptional	High	Moderate	Low	N/A
Number of wetlands	9	2	21	0	0

Table 27. *Sensitivity to Stormwater and Urban Development for Sampled Wetlands in LHRP.*

Summary

Many of the wetlands surveyed could have many of their functions and values improved through active vegetation management. Many of the wetlands assessed contained dense stands of reed canary grass and nonnative cattail, as well as a prevalence of buckthorn throughout portions of the park. Improving the vegetative quality by reducing invasive species would also increase the value to wildlife habitat and improve the overall park experience to the public. Because none of the evaluated wetlands appeared to have been hydrologically altered (i.e., drained), hydrologic restoration would not be the focus for restoration.

Wetlands with notable plant community type/quality include the three floating open bog communities which are uncommon for the region. In the northwestern portion of the park, LHRP-12, a five-acre shrub-carr wetland, was classified as exceptional for wildlife, which will likely improve over time following the restoration efforts in the area. Likewise, the MCBS-mapped tamarack swamp on the west side of Holland Lake is significant for Dakota County.

3.6. Wildlife

3.6.1. General Wildlife Habitat

With a heterogeneous landscape, diverse vegetation and an abundance of surface water, Dakota County historically had a highly diverse wildlife community. Several sub-ecoregions converged and intersected providing opportunities for the existence of a wide array of species endemic to different ecosystems, forming a diversity of wildlife habitats.

Historic Fauna of the County

In the 1800s, early explorers and settlers documented that bison grazed the prairie terraces near Fort Snelling, and nearly all of the early explorers from Radisson to Hennepin mentioned their abundance. Though elk were not considered common at the time of European settlement, Bison and elk were hunted to near extinction across their Midwestern range, including Dakota County. Agriculture eliminated habitat as well. White-tailed deer also suffered from hunting pressure but then began to thrive in the fragmented agricultural landscape once a hunting season was imposed and over-harvesting was controlled. Mountain lions, although present, were never common, but black bears were quite common in the first half of the 1800s.

Smaller mammals such as beaver, mink, and muskrat also existed in high numbers. However, over the course of two centuries of heavy trapping, these species' populations nearly crashed. Due to better regulation of trapping beginning in the 1930s, populations of beaver and other species rebounded.

As with the mammals, the County's diverse landscapes supported a wide array of resident and migratory bird species. Over one hundred species of birds nested in the County, and another hundred or more passed through in the spring and fall migrations. Large core habitat sustained many types of birds that are today uncommon or in decline, including forest interior birds, grassland birds, waterbirds and waterfowl, and raptors. The many species which once were common include upland sandpiper, loggerhead shrike, grasshopper sparrow, American bittern, red-shouldered hawk, red-headed woodpecker, bobolink, black tern, Virginia rail, and eastern towhee.

Populations of amphibians, fish, aquatic insects, and mollusks were once teeming in the County's rivers, streams, and wetlands. Overharvesting and pollution, plus large increases in impervious cover from buildings, roads, and parking lots, took a sharp toll on aquatic animal populations. In the case of trout, increased stormwater runoff near waterways has reduced levels of groundwater recharge, which in turn reduces the influx of cold groundwater to trout streams. Sediment from cropland, overgrazed pastures, and roads, together with excessive water from impervious cover and cropland, is a major cause of heavy sediment loads and bank erosion in streams, rivers, and ponds. The introduction of water quality rules at federal and state levels beginning in the 1970s reduced pollution from point sources like wastewater treatment plants and factory outfalls and, in recent decades, has provided a solid framework to quantify and limit non-point sources such as stormwater. This has and will continue to benefit aquatic wildlife.

Many other species have disappeared from the County or are in steep decline. Declining species have been identified by the Minnesota DNR, in the State Wildlife Action Plan, as Species of Greatest Conservation Need (SGCN). This topic will be discussed in the following sections (3.5.2 and 3.6).

Despite the dramatic changes to wildlife in the last 150 years, protected areas, such as the Minnesota Valley National Wildlife Refuge, several Scientific and Natural Areas, and the Gores Pool Aquatic Management Area (AMA), still provide the County with diverse though fragmented habitats—riverine wetlands, fens, seeps, floodplain forests, oak savannas, forest, and grasslands. Over 250 species of birds, including nesting bald eagles and peregrine falcons, some fifty species of mammals, and thirty species of reptiles and amphibians have been noted here.

3.6.2. Wildlife in the Park Today

Dakota County Parks staff, in coordination with others such as the MN DNR, has made recent efforts to assemble information from previously conducted wildlife surveys and studies as well as to conduct monitoring/surveys for key taxa of wildlife that can serve as indicators for the composition, function, and structure of various habitat types that currently occur or are being restored at LHRP (**Table 28**).

Taxa	Survey Method or Study	Current Management
White-tailed deer	Aerial counts, trail cameras	Deer hunt
Bats	Auditory Survey, Emergence Survey	Bat houses, habitat protection
Small mammals	Live trapping, trail cameras	Habitat protection
Bees	Bumble bee surveys, native bee surveys, pan traps	Habitat protection

Butterflies	Visual surveys	Habitat protection
Dragonflies	Visual Surveys	Habitat protection
Invasive insects	Various Inspections and surveys	Tree removals
Herptiles	Coverboards, trapping, tracking, visual surveys, road mortality, frog/toad call surveys	Habitat protection, nest protection
Birds	Breeding bird surveys, secretive marshbird surveys, auditory survey	Native community restoration and management

Table 28. *Key studies and monitoring that have been or are currently being conducted. For recommended future studies and monitoring see Section 7.1.2. Importantly, these various types of monitoring/surveys provide valuable feedback to resource managers, allowing them to practice Adaptive Management. This means that decisions about future management can be adjusted based on the best current information. Wildlife recently observed during the variety of studies/monitoring within LHRP are shown in **Appendix B**.*

3.6.3. Fisheries

The MN DNR has conducted fishery surveys and stocking on two lakes in LHRP; two additional lakes have also received stocked fish. Schultz (Shulze) Lake was stocked with 71 adult black crappies in 2008, and Portage Lake also received 239 adult bluegill in 2008.

Holland Lake was surveyed in 2013, 2007, 2001, 1995, 1990, 1985, 1980, and 1975. Because of the depth of Holland Lake, the DNR has attempted to create a two-story fishery that supports stocked trout in deeper cooler water and warm water species in the upper water column. During the last survey, Northern Pike were found well above the median level for abundance and at the median level for mean weight.

Bluegills were the most common species encountered during the survey. Both northern pike and bluegill growth rates were lower than the statewide average; this is likely due to a stunted population or a population, in which resources are lacking, creating poor growing conditions. A total of seven species of fish were sampled in 2013: black crappie, bluegill, green sunfish, hybrid sunfish, largemouth bass, northern pike, and pumpkinseed. Surplus rainbow trout and brown trout are periodically stocked in Holland Lake for a “put-and-take” winter fishery. But without stocking, these trout populations are not sustainable. Rainbow trout have been stocked in 2016, 2015, 2014, 2013, 2012, and 2011. Brown trout have been stocked in 2014, 2013, and 2009.

McDonough Lake has been surveyed once (2015) and was surveyed again in 2018. Four species of fish were sampled in 2015: black bullhead, bluegill, green sunfish, and pumpkinseed. All species were found in low abundance and found to be below-average size, except for good-sized Black Bullheads. Low abundance and below-average size may indicate a resource such as habitat or forage are limiting in the lake, while the healthy Black Bullhead population is common in winterkill lakes, which McDonough is prone to. Adult bluegill and black crappie have been stocked since 2008. Bluegill has been stocked in 2014, 2013, 2012, 2011, 2010, and 2008. Black crappie was stocked in 2012, 2011, 2010, and 2008.

3.6.4. At-Risk Wildlife Populations

"Tomorrow's Habitat for the Wild and Rare: An Action Plan for Minnesota Wildlife" (MN DNR 2006) defines Species in Greatest Conservation Need (SGCN) as those species whose populations are identified as being rare, declining, or vulnerable in Minnesota because they depend upon rare, declining, or vulnerable habitats. This also includes those species subject to other specific threats that make them vulnerable, such as overexploitation and invasive species. In addition, SGCN may also include those species that are experiencing significant decline in other parts of their range but have stable populations in Minnesota.

Dakota County Parks conducts its own monitoring of wildlife, as well as gathering information on wildlife sightings from other parties such as the MN DNR, USFWS, eBird, volunteer citizen-scientists, and others. The information on file with Dakota County Parks was used to compile the list below (**Table 29**) of known SGCN observations at Lebanon Hills Park.

Taxa	*Scientific Name*	*Common Name*	*State Status*	*Federal Status*	*Habitat Affinity*
Birds	*Aechmophorus occidentalis*	Western Grebe	NL		Marsh, shallow lake
Birds	*Anas acuta*	Northern Pintail	NL		Marsh, shallow lake
Birds	*Botaurus lentiginosus*	American Bittern	NL		Emergent marsh
Birds	*Buteo lineatus*	Red-shouldered Hawk	SPC		Terrace/floodplain forest
Birds	*Catharus fuscescens*	Veery	NL		Forest
Birds	*Chlidonias niger*	Black Tern	NL		Shallow lake
Birds	*Chondestes grammacus*	Lark Sparrow	NL		Open habitats
Birds	*Chordeiles minor*	Common Nighthawk	NL		Open habitats, woodlands
Birds	*Coccyzus americanus*	Yellow-billed Cuckoo	NL		Woodlands, shrublands
Birds	*Coccyzus erythropthalmus*	Black-billed Cuckoo	NL		Forest, shrubland
Birds	*Contopus cooperi*	Olive-sided Flycatcher	NL		Boreal/coniferous forests
Birds	*Empidonax virescens*	Acadian Flycatcher	SPC		Large forests with streams
Birds	*Gavia immer*	Common Loon	NL		Lakes
Birds	*Hylocichla mustelina*	Wood Thrush	NL		Woodland/brushland
Birds	*Leucophaeus pipixcan*	Franklin's Gull	SPC		Large prairie marshes

Taxa	*Scientific Name*	*Common Name*	*State Status*	*Federal Status*	*Habitat Affinity*
Birds	*Megaceryle alcyon*	Belted Kingfisher	NL		Shallow lake, streams
Birds	*Melanerpes erythrocephalus*	Red-headed Woodpecker	NL		Woodland, savanna
Birds	*Mergus merganser*	Common Merganser	NL		Marsh, shallow lake
Birds	*Nycticorax nycticorax*	Black-crowned Night-heron	NL		Marsh, shallow lake
Birds	*Oporornis agilis*	Connecticut Warbler	NL		Woodland, shrubland
Birds	*Pelecanus erythrorhynchos*	American White Pelican	SPC		Shallow lake, marsh
Birds	*Pipilo erythrophthalmus*	Eastern Towhee	NL		Woodland, forest
Birds	*Podiceps auritus*	Horned Grebe	END		Lakes, shallow lakes, deep wetlands
Birds	*Progne subis*	Purple Martin	SPC		Prairie, savanna, open water
Birds	*Protonotaria citrea*	Prothonotary Warbler	NL		Floodplain forest
Birds	*Rallus limicola*	Virginia Rail	NL		Marsh
Birds	*Scolopax minor*	American Woodcock	NL		Woodland
Birds	*Setophaga caerulescens*	Black-throated Blue Warbler	NL		Forest, understory, thickets
Birds	*Setophaga castanea*	Bay-breasted Warbler	NL		Northern spruce forests
Birds	*Setophaga cerulea*	Cerulean Warbler	SPC		Mature forest
Birds	*Setophaga tigrina*	Cape May Warbler	NL		Boreal forest
Birds	*Stelgidopteryx serripennis*	Northern Rough-winged Swallow	NL		Open water
Birds	*Toxostoma rufum*	Brown Thrasher	NL		Shrubland, woodland
Birds	*Troglodytes hiemalis*	Winter Wren	NL		Forest understory, thickets
Birds	*Vireo bellii*	Bell's Vireo	SPC		Woodland, brushland, old field
Birds	*Vermivora chrysoptera*	Golden-winged Warbler	NL		Shrub carr, wet brush prairie
Butterflies and moths	*Danaus plexippus*	Monarch	-	-	Grassland, woodland, forest
Reptiles	*Emydoidea blandingii*	Blanding's Turtle	THR		Shallow lakes, wetlands, open uplands
Mammals	*Eptesicus fuscus*	Big Brown Bat	SPC		Forest, savanna, prairie, wetland, lake
Mammals	*Myotis septentrionalis*	Northern Long-eared Bat	SPC	T	Forest, woodland, open water
Mammals	*Perimyotis subflavus*	Tri-colored Bat	SPC		Forest (further study needed)

Table 29. *List of Species in Greatest Conservation Need that have been observed at Lebanon Hills Regional Park*

There is an array of SGCNs that have potential to utilize LHRP as permanent residents or seasonally as migrants. Some of these may be utilizing the park currently but have gone undetected. Others may have the potential to utilize the park but are not present for a variety of potential reasons including factors such as the inability for a species to reach the park due to isolation from other suitable habitats in the region (lack of connectivity), lack of suitable population size to cause individuals to disperse and (re)colonize LHRP, or, if they are capable of reaching LHRP, they have simply not discovered that there is suitable habitat to be (re)colonized. See **Appendix B** for a list of potential species for the park, and also see the recommendations section for further information on management in the future.

3.7. Rare Natural Features

The Minnesota Department of Natural Resources' Natural Heritage Database was searched for rare natural feature records within the boundaries of the park. In addition, features recorded by parks staff, records listed on eBirder website, and observations by the Stantec ecologist during this project are also listed. The list (**Table 30**) is confined to species that utilize the park as either permanent residents or during their breeding season. Rare species that have been observed to utilize the park on a seasonal basis are listed in the SGCN section above. The search identified the following features:

Common Name	***Scientific name***	**State-listed**	**S Rank**	**G Rank**	**Year Documented Last recorded**
Animals					
Red-shouldered Hawk	*Buteo lineatus*	Special Concern	S3B, SNRN	G5	1988, 2018*
Acadian Flycatcher[1]	*Empidonax virescens*	Special Concern	S3B	G5	2005[1]
Blanding's Turtle	*Emydoidea blandingii*	Threatened	S2	G4	2018*
Wood Turtle^	*Glyptemys insculpta*	Threatened	S2	G3	2018^
Cerulean Warbler[1]	*Setophaga cerulea*	Special Concern	S3B	G4	2012[1]
Rusty Patched Bumble Bee	*Bombus affinis*	Not Listed, but Federally Endangered		G1	2018
High Quality Native Plant Communities					
Tamarack Swamp, Minerotrophic Subtype			SNR	GNR	1993*

Oak Forest (Southeast) Mesic Subtype			S2S3	DNR	1993*
Rare plants					
Lily-leaved Twayblade	*Liparis liliifolia*	Tracked, but Not Listed	SNR	G5	1993*
Rattlebox[1]	*Crotalaria sagittalis*	Special Concern	-	-	2017[1]
White Wild Indigo[2]	*Baptisia lactea*	Special Concern	S3	G5T4T5	2017[2]

Table 30. *State-, Federal-, and Global-listed species and high-quality Native Plant Communities at LHRP.*

**1988 record as recorded in NHIS Informatics database (data accessed July 2017). Was also heard in the park during the 2018 breeding season.*

^Observed at LHRP, but occurrence is likely due to an unauthorized release.

[1]Not recorded in NHIS Informatics database. Reported by County staff or citizen observers.

[2]Recorded during MLCCS update field inventory November 2017. Reported to MN DNR for accession into NHIS.

Each feature has potential obstacles to its persistence in the park as well as potential restoration and management measures to address the obstacles. Because research and information are ongoing for a number of these species, it is important for Dakota County Parks resource managers to keep up with the most current information by networking with local, state, and federal wildlife biologists and ecologists. **Appendix B** contains a list of wildlife species (some listed/rare) that County Natural Resource staff would expect to potentially observe in the park. Species were taken from the MN DNR SGCN List and then cross-referenced with the Rare Features Database to check if they have been located in Dakota County. If they had, but were not on the Confirmed Species list (Table B1), their habitat preference was checked to see whether or not they could be present in Lebanon Hills.

3.7.1. Biodiversity Significance

At the conclusion of work in a geographic region, Minnesota Biological Survey (MBS) ecologists assign a biodiversity significance rank to each survey site. These ranks are used to communicate the statewide native biological diversity significance of each site to natural resource professionals, state and local government officials, and the public. The biodiversity ranks help to guide conservation and management.

A site's biodiversity significance rank is based on the presence of rare species populations, the size and condition of native plant communities within the site, and the landscape context of the site (for example, whether the site is isolated in a landscape dominated by cropland or developed land or whether it is connected or close to other areas with intact native plant communities).

There are four biodiversity significance ranks:

1. "**Outstanding**" sites contain the best occurrences of the rarest species, the most outstanding examples of the rarest native plant communities, and/or the largest, and most ecologically intact or functional landscapes.
2. "**High**" sites contain very good quality occurrences of the rarest species, high-quality examples of rare native plant communities, and/or important functional landscapes.
3. "**Moderate**" sites contain occurrences of rare species, moderately disturbed native plant communities, and/or landscapes that have strong potential for recovery of native plant communities and characteristic ecological processes.
4. "**Below**" sites lack occurrences of rare species and natural features or do not meet MBS standards for outstanding, high, or moderate rank. These sites may include areas of conservation value at the local level, such as habitat for native plants and animals, corridors for animal movement, buffers surrounding higher-quality natural areas, areas with high potential for restoration of native habitat, or open space.

Two areas were mapped at LHRP by the Minnesota (DNR) Biological Survey as having biodiversity significance (**Figure 32**). These include an area mapped as a high-quality oak forest on the south side of Jensen Lake as well as a much broader area that supports a complex of dry oak forest, aspen forest, wetlands, and one MBS-mapped tamarack swamp extending from the west side of Holland Lake, through Cattail Lake and Portage Lake, wrapping around the south side of O'Brien Lake.

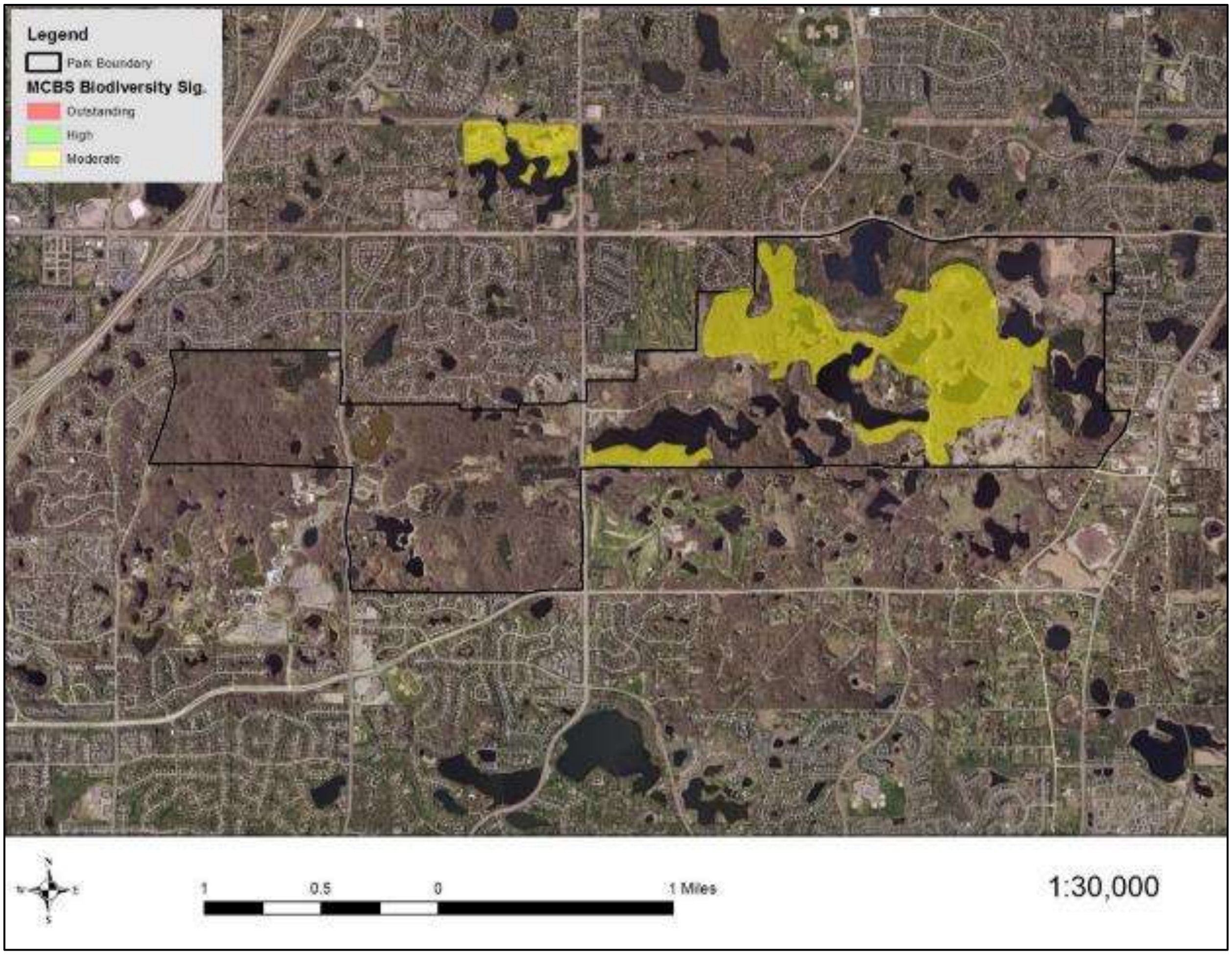


Figure 32. *Sites of Moderate Biodiversity Significance at LHRP (Dakota County Parks).*

4. NATURAL RESOURCES CHALLENGES AND OPPORTUNITIES

4.1. Challenges

During development of the LHRP NRMP challenges were identified by natural resources staff, as well as through stakeholder input and other means. The challenges identified are related to past or current land use practices as well as anticipated potential natural resources stressors and are listed below. Many of these issues are interrelated.

Altered natural systems. Past land use practices, recent changes in land use in the surrounding landscape, increased pressure from invasive species, and other factors have resulted in reduction in biodiversity, species composition, habitat structure and function, and ecosystem functions (for example, fire suppression in a fire-dependent community such as oak woodlands.

Reduced ecological connectivity. LHRP is only marginally connected to nearby native habitats resulting in no significant chance for most native plants and some species of wildlife moving between sites. Consider looking for opportunities to link habitats inside the park with those outside of the park, using the linkages identified in the Dakota County Parks, Lakes, Trails and Greenways Vision, 2030, such as Oak Pond Hills Park. Also consider exploring ways to connect the major segments of the park that have been divided by roads, such as land bridges, wildlife overpasses, and wildlife tunnels.

Climate change. Observational data and predictive models indicate that the climate in which LHRP occurs is in the process of changing and will be different in the coming decades. Managing natural resources in a rapidly shifting climate in a park that is ecologically isolated by development will pose special challenges.

Pests and diseases. There are a number of pests and pathogens that are known to occur within the park (e.g., oak wilt, earthworms, deer, raccoons, feral cats, cow birds) or are likely to arrive in the near future (e.g., emerald ash borer) that are capable of causing significant impacts to native species and native plant communities.

Habitat fragmentation. Habitat fragmentation has occurred related to past and current land use practices including housing developments, roads, trail and recreational facility development, edge effects, reduction of core habitat areas, and habitat connectivity.

Stormwater management/conveyance, including from adjacent properties. Water resources within LHRP are influenced to varying degrees by runoff from subwatersheds within and outside of the park. Water quantity and quality entering the park have a significant potential to negatively impact plant communities and animal populations.

Potentially impactful recreational activities or recreational improvements. LHRP serves over 800,000 users per year and the purpose is to provide natural resource recreation and protection. Planned recreation improvements have the potential to cause damage to natural system quality and function through loss and/or fragmentation of habitat, increased introduction and dispersal of invasive plants/species, increased potential for erosion, and other factors. These activities can also have a direct impact on animals by disrupting or destroying nests or the reproductive process. For example, when practical, new trails or other recreational elements should be designed and constructed such that:

1) Impacts to sensitive resources will first be **avoided**,
2) Impacts to sensitive resources, if they cannot be avoided, will be **minimized**,
3) If impacts cannot be minimized, they must be **restored, rehabilitated, or mitigated on site**, and
4) If impacts cannot be restored on site, then they will be restored, rehabilitated, or mitigated elsewhere within the park.

Invasive plants. There are several invasive plants that have exerted considerable pressure on native plant communities and aquatic systems at LHRP. The most significant of these include:

- European buckthorn (*Rhamnus cathartica*) is widespread in the park and has resulted in significant, widespread negative impacts.
- Garlic mustard (*Alliaria petiolata*) is locally abundant in some areas at LHRP.
- Japanese hedge parsley (*Torilis japonica*) is an emerging invasive plant that is becoming widely established in Dakota County and is present in portions of LHRP.
- Curly leaf pondweed (*Potamogeton crispus*) was identified in an Aquatic Invasive Species (AIS) survey in LHRP.
- Eurasian water milfoil (*Myriophyllum spicatum*) was documented in several waterbodies at LHRP during the AIS survey.
- Tatarian honeysuckle (*Lonicera tatarica*) and other nonnative honeysuckle shrubs are present at LHRP.
- Reed canary grass (*Phalaris arundinacea*) was historically introduced in the region for agricultural purposes. Its persistence and expansion is enabled by altered nutrients, hydrology, and other factors.
- Spotted knapweed (*Centaura stoebe*) is present in small amounts at LHRP.
- Hybrid cattail (*Typha x glauca, T. angustifolia*) is present in small amounts at LHRP, relative to many other areas in the region.
- Canada thistle (*Cirsium arvense*) is present in small amounts at LHRP.

Invasive animals. There are a few invasive animals that also have disrupted the natural communities of the park. The most significant of these include: earthworms, domesticated cats, and more.
These species need to be controlled throughout the park. There are many others that are problematic that also should be controlled (**Appendix A**). In addition, there are many other exotic species that have not yet been introduced but are near the park. Ongoing monitoring is needed to identify any new exotic species that gain a foothold in the park so that they may be eradicated swiftly before they become problematic.

Genetic isolation of flora and fauna populations. Genetic diversity is crucial for the long-term health of populations. Over time, populations, isolated by habitat fragmentation, suffer because they may experience reduced fitness and ultimately extirpation or local extinction. Because of land use changes in the vicinity, the habitats within the park and the species dependent on those habitats are becoming more and more isolated, putting those species at risk long-term. To avoid this situation or mitigate the effects of isolation, it is important to incorporate a regional landscape perspective to identify opportunities to provide connectivity to corridors and/or natural areas outside of Lebanon Hills Regional Park. The reintroduction of species or the importation of additional individuals of certain species could mitigate the effects of genetic isolation.

4.2. Opportunities

4.2.1. Opportunities

There are numerous opportunities to increase the ecological health and diversity of Lebanon Hills Regional Park. These opportunities, if pursued, can serve to lessen the effects of or eliminate the challenges presented above.

Core habitat area. LHRP has a relatively large area of core habitat compared to most parks situated in suburban areas. This enables the ability to plan, manage, and sustain gains in resource management with fewer negative outside pressures. Outside pressures can include such factors as spread of invasive species or contaminated surface water.

Community support. LHRP is an important resource for residents of Dakota County as well as many others from outside the county. Surveys and questionnaires regularly affirm that park users, as well as the community at large, place a high value on quality natural resources in County parks and open spaces. Likewise, support of citizens, elected officials, appointed individuals, and agencies has been demonstrated during the NRMSP process, and continued support will be a necessary component to sustaining efforts to restore and maintain quality natural communities at LHRP. Community members, who volunteer in the park, increase the resources available to improve the natural resources in the park.

Ecological connectivity. Although LHRP is somewhat isolated, due to land use in the area, it is connected to other habitat areas via Dakota County's Greenway system which is intended to help facilitate ecological connectivity between important habitat hubs throughout the County. These greenway connections have the potential to minimize or mitigate the relative isolation of the park but may not be wide enough for many species to utilize. Therefore, a more regional perspective is needed when planning for the long-term management of the natural resources within the park.

Remnant native plant communities and diverse wildlife. Despite being negatively impacted in a significant way by past land use (within the last 150 years), LHRP has a remarkable base of native plant communities with potential for significant improvement in quality. Similarly, LHRP supports a noteworthy number of uncommon species of wildlife, including State-listed species and numerous

Species in Greatest Conservation Need (see Section 3.5.3 for a list of SGCNs observed or probable to occur at LHRP).

Natural resources management program. Dakota County has chosen to support natural resources in its parks by dedicating staff time and financial resources to inventory, plan, and implement natural resources management. The natural resources and natural communities of LHRP have greatly benefited from these efforts and are poised to make even greater gains in resource richness and quality in the coming decades.

Public use and engagement. LHRP provides a remarkable number of opportunities for public appreciation of and education about natural resources. The park is by far the most visited/used site in Dakota County's Park system, for instance, with over 886,800 visits in 2017. This results in greater awareness and appreciation of natural resources and their management. The nature of the recreational provision is nature-based, and the quality of natural resources in the park improves the visitor's experience.

Reintroduction of appropriate native fauna and flora. A more resilient and sustainable ecosystem will have more biodiversity and niches for more organisms (see 5.2.2). The last 150 years has seen a steady degradation and loss of species diversity in Dakota County. Many of the species that have been lost were critical since they influenced other species and ecosystem processes. In some cases, the loss of one or a few of these keystone species can cause a "trophic cascade" where many other species that are dependent on this one or these few are lost. In an effort to improve this situation, re-introduction of select species would be beneficial and recommended.

The County should identify potential project partners to aid in reintroduction of select extirpated native species. Species-specific plans should be developed and reviewed with the DNR prior to implementing any reintroductions. Several factors should be considered before reintroduction is attempted, including adequate niches, competition from already established competitors, adequate food and cover resources, adequate space, and sufficient population numbers. As with genetic isolation, incorporating a regional landscape perspective to identify opportunities to provide connectivity to corridors and/or natural areas outside of Lebanon Hills Regional Park is also recommended to increase the success of species reintroduction.

The following are types of fauna no longer found in the park that could be potentially reintroduced back into the park: keystone and indicator species, top predators, and species that have populations in proximity to the park. Prior to any reintroduction project, a host of factors needs to be addressed. These include sources of the targeted animal, genetic isolation, habitat needs, and size of the animal's home range. For instance, one source indicates a badger's home range or territory is in the realm of three- or four-square miles; an animal with such a large home range may not stay within the park. On the other hand, a spotted salamander may live its life within 100 meters of its breeding pond. Some species to consider include bison, elk, prairie vole, spotted salamander, prairie chicken, red-headed woodpecker, lark sparrow, regal fritillary, Great Plains pocket gopher, 13-lined ground squirrel, plains pocket mouse, western harvest mouse, bull snake, ant species, dung beetles, pollinator species, grasshopper species, and cricket species.

The reintroduction of extirpated plant species to the park can be an important component of reestablishing diverse and resilient natural communities within the park. A large number of diverse plants within a community will provide the habitat needs for larger and more diverse group of animals. As in animal reintroduction projects, reintroducing plants to the park has its own set of considerations and guidelines. Care should be taken to understand the habitat requirements of any candidate species. Soil type, moisture and sun requirements, and necessary animal and/or plant symbiotic relationships are a few of these considerations. Other consideration would be whether it is known or highly probable that the candidate species was present within the park at one time, whether the conditions which supported it historically are present in the park today, and to identify the location or source of potential plants or seed. The ideal situation is to source the seed from plants historically and presently growing in the County. This may not always be possible; searching for species in a hierarchical concentric ring radiating out from Dakota County would be the next best approach. For instance, a seed source from Rice or Goodhue Counties would be preferable to seed sourced from Steele or Wabasha Counties.

Benefits of a contemporary master plan is a benefit for natural resource management. Since this is a park where multiple uses are necessary, the natural resources of the park must coexist with recreational elements of the park. To that end, the 2015 master plan shows generally what and generally where these elements will occur. When planning natural resource management, recreational elements must be considered, or conflicts may occur. The reverse also is valid, since recreational elements must consider where rare or sensitive resources occur, to avoid impacts to the resources. Since the majority of the park is impacted, in some way, there are also multiple opportunities to enhance both the recreational and ecologic features to accommodate public use and sustainable management.

Potential for restoring or landscaping visitor-use and social resource areas in the park. There are many recreational/cultural/social areas throughout the park that could potentially be made more “natural”. For instance, mowed turf areas around parking lots and picnic areas could be managed far less intensively. Making “bee lawns” by not spraying turf for weeds or modifying the heights of mower decks is an option. Planting “no-mow turf” is another option. Converting turfed areas to pollinator gardens or converting paved areas to rain gardens are other options. Another consideration is to plant masses of native forbs in and around landscape areas, along the sides of entrance/exit roads, and in other high-use areas.

5. NATURAL RESOURCE VISION AND GOALS

5.1. Vision for Lebanon Hills Regional Park

The Dakota County Parks Natural Resources Management System Plan describes its general parks vision in the following:

The water, vegetation, and wildlife of Dakota County parks, greenways, and easements will be managed to conserve biodiversity, restore native habitats, improve public benefits, and achieve resilience and regionally outstanding quality, now and for future generations.

5.2. LHRP Native Plant Communities Vision

The vision for native plant communities at LHRP is to utilize natural resource management tools that mimic historic processes and foster a mosaic of fire-dependent prairie, oak savanna, and dry oak forest plant communities in upland areas. Notable exceptions include mesic oak forest on the south side of Jensen Lake and on the north side of Portage Lake as well as wetland communities such as the minerotrophic tamarack swamp west of Holland Lake. Because of the soils, topography of the park, and anticipated use of tools such as fire, it is expected that the boundaries between fire-dependent community types may have a tendency to shift back and forth over the course of time.

LANDSCAPE CHANGES

Using work crews starting in 2014, the County has implemented a buckthorn and Tartarian honeysuckle removal project. Removal activities began on the east side of the park and moved methodically westward. The hatched areas on the map in **Figure 33,** with associated green text for acres, indicate the areas where buckthorn has been removed. To date, just under 1,000 acres of the park have been cleared of large buckthorn (greater than 1.25" diameter). In combination with state grant project areas, the entire East Segment of the park has been swept through at least once. In 2018, the Middle Segment was begun, starting with Camp Sacajawea and a small area in the northwest corner of the segment. Cut brush is stacked and burned. All stumps have been treated with herbicide to prevent re-sprouting. Follow-up treatment is planned for all areas that have had initial removal. This buckthorn removal project will continue and eventually cover the entire park.

The first phases of almost any upland restoration start with site-wide invasive brush removal. After that, sites are evaluated for recovery of native flora. If sites are not diverse enough or missing key components of the community, then supplemental seeding and/or planting is typically called for. In the case of LHRP, most woodland and forest areas will probably need some supplemental seeding. The key to, and most challenging part of, long-term restoration of these fire-dependent communities will be to establish a ground layer vegetation that will carry fire and to burn the sites on a regular basis and generally within the fire frequency intervals identified by NPC type in the *MN DNR Native Plant Community Guidebook* (2005). For instance, prairies are generally burned every two to five years, savannas every three to seven years, woodlands every 9 to 10 years, and dry forests every 20 years or so. Not only does fire promote native plants, but it also curtails the germination and growth of most woody plant species, including buckthorn and Tartarian honeysuckle. Fire frequencies will be adjusted by Parks resource managers based on feedback from monitoring and may include factors such as a need to more aggressively address brush levels and to lengthen intervals and/or modify burn units based on sensitive wildlife, water quality, and other factors. The overarching goal of this plan is to position the County to successfully restore its fire-dependent communities in about 50 years' time.

Wetland restorations usually start with controlling invasive plant species also, but are a little different that upland ones. The common trouble species are typically reed canary grass, hybrid cattail, non-native Phragmites, and glossy buckthorn, along with others.

DESIRED FUTURE COVER TYPES

As part of the process of developing the LHRP NRMP, Dakota County Parks staff, consultant, and others reviewed the existing cover types (MLCCS). This information was considered in the context of factors that include resource management tools and techniques likely to be employed, financial and physical resources available for restoration activities, and the overarching vision for native plant communities for LHRP, current ecological restoration best management practices, and others. The result is shown in the figure on the following page (which also includes Park Management Units).

Prevailing themes in choosing the Desired Future Cover Types include:

- Restoration of degraded natural areas to higher quality (e.g., degraded brush prairie to quality prairie).
- Converting areas currently dominated by nonnative vegetation to Native Plant Community types (e.g., converting nonnative grass-dominated areas to diverse native prairie).
- Restoring historic hydrologic and vegetative conditions to wetlands that were historically impacted by row crop farming practices (e.g., conducting sediment removal activities in silted-in wetlands and then restoring diverse native vegetation).
- Improving the quality of existing native plant communities (i.e., native species composition, structure, and function) through species enrichment, the reintroduction of historic processes, and others.
- Anticipating shifts in native plant community type through the reintroduction of historic processes and ongoing maintenance activities (e.g., oak woodland-brushland could be anticipated to convert to oak savanna over time with the application of prescribed fire).
- Naturalizing visitor-use areas and areas impacted by recreation facilities.

The Desired Future Cover Types, shown in **Table 34**, **Figures 38,** and **39**, represent groupings of several Native Plant Community (NPC) types into a single category. These more refined Native Plant Communities are described in the MN DNR's *Field Guide to the Native Plant Communities of Minnesota, The Easter Broadleaf Forest Province* publication. For the purposes of helping to provide a cross-reference to NPC types, a list of representative NPC types is provided below under the appropriate cover type shown on the Desired Future Cover Type maps.

Current MLCCS Cover Type	MLCCS Code	Desired Future Cover Type	MN DNR NPC Type	Acres
Oak forest dry subtype	32113	Dry oak forest	FDs37, MHs37	524.5
Oak forest dry subtype	32111	Oak woodland-brushland	FDs37	195.7
Oak forest	32110	Oak forest	MHs37, MHs38	21.5
Oak forest mesic subtype	32112	Mesic oak forest	MHs37, MHs38	90.8
Mixed pine-hardwood forest	33110	Mixed pine-hardwood forest	FDs27	86.6
Oak woodland-brushland	42120	Oak woodland-brushland	FDs37	234.5
Mesic oak savanna	62130	Mesic oak savanna	UPs24	116.9
Dry oak savanna	62120	Oak savanna	UPs14	85.4
Mesic prairie (planted)	61110	Prairie	UPs23	86.1
Wet prairie - saturated soils	61410	Wet prairie	WPs54	3.9
Aspen forest	32160	Aspen forest	FDs36	4.5
Lowland hardwood forest	32220	Terrace forest (lowland hardwood forest)	FFs59	12.8
Tamarack swamp minerotrophic subtype	31212	Tamarack swamp	FPs63	5.9
Wet meadow shrub - semi permanently flooded	52510	Wet meadow	WMn82	1.9
Wet meadow	61420	Wet meadow	WMn82	14.3
Wet meadow - temporarily flooded soils	61320	Wet meadow	WMn82	6.7
Wet meadow floating mat subtype	61641	Wet meadow	WMn82	4.5
Mixed emergent marsh	61620	Mixed emergent marsh	MRn83, MRn93	22.1
Mixed emergent marsh - seasonally flooded	61520	Mixed emergent marsh	MRn83, MRn93	18.7
Cattail marsh - seasonally flooded	61510	Cattail marsh	MRn83, MRn93	9.1
Cattail marsh - semi permanently flooded	61610	Cattail marsh	MRn83, MRn93	1.2
Water lily open marsh	64111	Open water (marsh/lake)	NA	1.6
Open Water (Marsh/Lake)	93300	Open water (marsh/lake)	NA	299.0

Table 32. *Current Cover Type and Desired Future (MN DNR NPC) Cover Types.*

A Note on Biotic Communities:

Scientists have long debated about how to characterize biotic communities. One view was that communities were analogous to the organism, such that each community is like an organ of the body, working together for a common purpose. In this view, community structure is defined by discrete, well-defined boundaries and most of the species tend to only associate with each other. This is called a "closed" community. An opposite view of community organization emerged that suggested the community, far from being a distinct unit like an organism, was merely a "fortuitous association of organisms" (Ricklefs, 1990) whose adaptation enabled them to live together under the particular physical and biological conditions that characterize a particular place. This is called an "open" community. Open communities have no natural boundaries; therefore, their limits are arbitrary with respect to the geographical and ecological distributions of their component species, which may extend their ranges independently into other associations. Today, most ecologists side with the open community model rather than the closed one. For the purposes of this plan, however, discreet community units were developed to help guide the restoration of the park. By no means are these community units meant to be discreet with sharp boundaries. Rather, for the most part, they should grade into each other, across a gradient of physical conditions such as temperature, moisture, salinity, light exposure, and space availability. Ultimately, most the edges and boundaries of community units should be soft and fuzzy, not hard and discreet.

The following is a description of each of the native plant communities that are targeted for Lebanon Hills, as taken from *The Field Guide to Native Plant Communities of Minnesota*. "Layers", in the vegetation sections, originate from physiognomic descriptions of vegetation structure and composition, based on height classes, which is a conventional way of describing vegetation.

MHs38—Southern Mesic Oak-Basswood Forest

"Mesic hardwood or, occasionally, hardwood-conifer forests. Present on wind-deposited silt on bedrock bluffs, on calcareous till on rolling till plains, and, rarely, on weakly calcareous till on stagnation moraines."

Vegetation Structure and Composition

"**Ground layer** cover is patchy to interrupted (25%-75%); important species include zigzag goldenrod, large-flowered bellwort, and Virginia waterleaf. Other common species include Clayton's sweet cicely, Virginia creeper, bloodroot, lopseed, common enchanter's nightshade, early meadow-rue, sarsaparilla, Pennsylvania sedge, and honewort."

"Shrub layer cover is patchy to interrupted (25-75%); common species include sugar maple, ironwood, prickly gooseberry, and chokecherry."

"Subcanopy cover is interrupted to continuous (50-100%); important species include ironwood, sugar maple, and basswood. Blue beech, American elm, red elm, and bitternut hickory are occasionally present."

"Canopy cover is interrupted to continuous (50-100%); the most common species are basswood, northern red oak, and sugar maple. Bur oak, green ash, or white oak can be abundant in some stands, and on rare occasions a supercanopy with abundant white pin is present."

Natural History

"In the past, catastrophic disturbances were rare in MHs38. An analysis of Public Land Survey records indicates that the rotation of catastrophic fires was in excess of 1,000 years, and the rotation of catastrophic windthrow was about 360 years. Events that resulted in partial loss of trees, especially light surface fires, were much more common, with an estimated rotation of about 35 years. Based on the historic composition and age structure of these forests, MHs38 had two growth stages separated by a period of transition.

- **0-35 years**—Young forests recovering from fire or wind, dominated by northern red oak mixed with basswood, American elm, and some quaking aspen.

- **35-75 years**—A transition period marked by the gradual decline of northern red oak and its replacement by sugar maple. Basswood, American elm, and ironwood increase during this period, and white oak becomes established.
- **> 75 years**—Mature forests of sugar maple mixed evenly with basswood, American elm, ironwood, northern red oak, and white oak.

Similar Native Plant Community Classes to MHs38

- **MHs37 Southern Dry-Mesic Oak Forest**

  MHs37 and MHs38 can be very similar, and the ranges of the two classes overlap in east-central and southeastern Minnesota. MHs37 usually occurs on drier sites than MHs38 and is much less likely to have abundant sugar maple in the canopy.

- **MHs39 Southern Mesic Maple-Basswood Forest**

  MHs39 and MHs38 are very similar, and the ranges of the two classes overlap strongly. The presence of species adapted to moist soils or dense shade—especially spring ephemerals such as Dutchman's breeches, cut-leaved toothwort, and white trout lily—and the presence of large patches of wood nettle help to differentiate MHs39 from MHs38.

- **MHs49 Southern Wet-Mesic Hardwood Forest**

  MHs49 can be somewhat similar to MHs38 but occurs on level wet-mesic sites on silty alluvium or glacial till and is more likely to have species adapted to high water tables or common on heavy moist soils.

NPC Types in Class

- MHs38a White Pine-Oak-Sugar Maple Forest
- MHs38b Basswood-Bur Oak-(Green Ash) Forest
- MHs38c Red Oak-Sugar Maple-Basswood-(Bitternut Hickory) Forest

Management actions and goals for restoration of Southern Mesic Oak-Basswood Forest include:

- Attempt to burn on a rotation of about 35 years. This may be difficult due to high moisture conditions and/or low amounts of cured fuel. Burning during periods of drought and on days when winds are relatively high may be the best strategy.
- Make canopy gaps to simulate partial loss of trees. Gaps should be large enough for light to reach the ground—at least 100 ft X 100 ft. Preferentially remove undesirable trees or trees such as boxelder or exotic species.
- Control woody and herbaceous invasive species

Mesic oak forest occurs sporadically in the eastern and segment of the park, in relatively fire-protected areas. The primary concern for restoration of this community is control of woody exotic species, increasing the diversity of the ground layer, and regenerating multiple age classes of canopy and subcanopy tree species. Special attention should be focused on the transitional boundary between forest and lakeshore, wetland, and dry-mesic oak forest, so that habitats do not fall into discrete zones. Many brush removal activities have already been underway in areas around Jensen Lake, Holland Lake, and south of O'Brien Lake.

MHs37—Southern Dry-Mesic Oak Forest

"Dry-mesic hardwood forests occurring most often on thin, wind-deposited silt on crests and upper slopes of bedrock bluffs and less often on hummocky stagnation moraines in calcareous, partially sorted drift."

Vegetation Structure and Composition

"**Ground layer** cover varies from patchy to continuous (25-100%). Important species include lady fern, pointed-leaved tic trefoil, Clayton's sweet cicely, enchanter's nightshade, wild geranium, hog peanut, and white snakeroot."

"**Shrub layer** cover is patchy to interrupted (25-75%); common species include northern red oak and black cherry saplings, chokecherry, American hazelnut, Missouri gooseberry, and pagoda dogwood."

"Subcanopy cover is patchy to interrupted (25-75%); important species include basswood, black cherry, northern red oak, white oak, and shagbark hickory."

"**Canopy** cover is interrupted to continuous (25-100%); the most common species are northern red oak, white oak, and basswood. Shagbark hickory is occasionally present in the Paleozoic Plateau", in far southeastern MN."

Natural History

"In the past, catastrophic disturbances were rare in MHs37. An analysis of Public Land Survey records indicates that the rotation of catastrophic fires was in excess of 1,000 years, and the rotation of catastrophic windthrow was about 390 years. Events that resulted in partial loss of trees, especially light surface fires, were much more common, with an estimated rotation of about 20 years. Based on the historic composition and age structure of these forests, MHs37 had two growth stages separated by a long period of transition:

- 0-55 years—Young forests recovering from fire or wind, dominated by northern red oak mixed with some white oak, basswood, and American elm.
- 55-95 years—A transition period marked by a gradual decline in northern red oak and increases in basswood, white oak, American elm, and ironwood.
- > 95 years—Mature forests consisting of mixed stands of white oak, basswood, northern red oak, and American elm."

Similar Native Plant Community Classes to MHs37

- **MHs38 Southern Mesic Oak-Basswood Forest**

  "MHs37 and MHs38 share many species and can be very similar. The ranges of the two classes overlap in east-central and southeastern Minnesota; MHs38 usually occurs on more mesic sites and is more likely to have abundant sugar maple in the canopy."

NPC Types in Class

- MHs37a Red Oak-White Oak Forest
- MHs37b Red Oak-White Oak-(Sugar Maple) Forest

Management actions and goals for restoration of Southern Dry-Mesic Oak Forest include:

- Attempt to burn on a rotation of about 20 years. This may be difficult due to high moisture conditions and/or low amounts of cured fuel. Burning during periods of drought and on days when winds are relatively high may be the best strategy.
- Make canopy gaps to simulate partial loss of trees. Gaps should be large enough for light to reach the ground—at least 100 ft X 100 ft. Preferentially remove undesirable trees or trees such as boxelder or exotic species.
- Control woody and herbaceous invasive species

Dry-mesic oak forest occurs throughout the core of the eastern and center segments of the park, and a little in the northeast corner of the western segment. The primary concern for restoration of this community is control of woody exotic species, increasing the diversity of the ground layer, and regenerating multiple age classes of canopy and subcanopy tree species. Oak wilt is common throughout the community, with several areas having been opened up widely, thus releasing the understory which is dominated by exotic buckthorn. Special attention should be focused on the transitional boundary between forest and woodland and savanna so that habitats do not fall into discrete zones. Many brush removal activities have already been underway in areas around Jensen Lake, Holland Lake, Dakota Lake, and .Portage Lake.

FDs37 – Southern Dry-Mesic Oak (Maple) Woodland

"Dry-mesic hardwood forests on undulating sand flats, hummocky moraines, and river bluffs. Present mostly on fine sand or sand-gravel soils. Often on south- or west-facing slopes but common also on flat to undulating sandy lake plains. Historically, fires were common in this community, and many stands are on sites occupied by brushlands 100–150 years ago."

Vegetation Structure and Composition

"**Ground-layer** cover is patchy to continuous (25–100%). Pointed-leaved tick trefoil, Clayton's sweet cicely, hog peanut, Canada mayflower, and wild geranium are commonly present. Pennsylvania sedge is the most abundant graminoid. Dewey's sedge and starry sedge may also be present."

"**Shrub-layer** cover is patchy to continuous (25–100%). Common species include black cherry, red maple, chokecherry, American hazelnut, gray dogwood, prickly ash, Virginia creeper, and poison ivy".

“**Subcanopy** cover is patchy to interrupted (25–75%). The most common species are black cherry, red maple, and bur oak.”
“**Canopy cover** is usually interrupted to continuous (50–100%)”. Bur oak and northern pin oak are the most common species. Northern red oak, white oak, and red maple are occasionally present. Older trees are often open-grown, indicating previously more open conditions on the site.”

Natural History
“In the past, fires were very common throughout the range of FDs37. An analysis of Public Land Survey records indicates that the rotation of catastrophic fires was about 110 years, and the rotation of mild surface fires about 10 years. The rotation of all fires combined is estimated to be 9 years. Windthrow was not common, with an estimated rotation exceeding 1,000 years. Based on the historic composition and age structure of these forests, FDs37 had two growth stages.

- 0–75 years—Young forests recovering from fire, dominated by bur oak with some northern red oak or white oak. Quaking aspen, northern pin oak, and black cherry are minor components.
- > 75 years—Mature forests dominated by a mixture of bur oak, white oak, northern pin oak, and some northern red oak, with minor amounts of American elm. (In the past, sites now occupied by FDs37 typically supported more open communities, including brush-prairie or savanna. Air photos from the 1930s show these sites to have scattered oaks rather than forest canopies. With suppression of wildfires since the mid-1800s, these sites have developed denser tree canopies and herbs typical of mesic forests have become common in the understory.”

The examples of FDs37 found in LHRP are best described by the mature forest growth stage.

Similar Native Plant Community Classes to FDs37

- **FDs36 Southern Dry-Mesic Oak-Aspen Forest**
  “FDs36 can be similar to FDs37, and the ranges of the two communities overlap in the central part of the Hardwood Hills Subsection in the MIM and adjacent parts of the RRV. FDs36 tends to occur on loamy rather than fine sand or sand-gravel soils.”
- MHs 37 Southern Dry-Mesic Oak Forest
  “MHs37 can be similar to FDs37 but is more likely to occur on loamy soils (at least in the upper soil layers) than on fine sand or sand-gravel soils. MHs37 occurs on sites less affected by fire in the recent past and therefore generally lacks the open-grown canopy trees often present in FDs37.”
- FDs27 Southern Dry-Mesic Pine-Oak Woodland
  “The range of FDs27 occasionally overlaps with FDs37 in the area around the Twin Cities, where it occurs on deep sands that accumulate along valley walls of tributaries to the Mississippi River. Indicator species of FDs27 are: flowering spurge, heart-leaved aster, downy rattlesnake plantain, bitternut hickory, eastern red cedar, white pine, white snakeroot, and black raspberry.”

Management actions and goals for restoration of southern dry-mesic oak (maple) woodland include:

- Restore the mild surface fire regime through a patchwork of prescribed burning (natural frequency rotation average 10 years)
- Clearcutting may mimic the effects of catastrophic fires (natural rotation was 110 years), which supports more open communities. Tree removal should target non-representative trees, such as box elder.
- Control woody and herbaceous invasive species

FDs27 – Southern Dry-Mesic Pine-Oak Woodland

"Dry-mesic (or dry) hardwood or pine-hardwood woodlands on sand deposits, primarily in the blufflands of southeastern Minnesota."

Vegetation Structure and Composition

"**Ground-layer** cover is variable, ranging from sparse to interrupted (5–75%), with prairie species often present. Important species include flowering spurge, pussytoes, harebell, elliptic shinleaf, white rattlesnakeroot, round-leaved hepatica, downy rattlesnake plantain, heart-leaved aster, and yarrow. Other common species include northern bedstraw, Clayton's sweet cicely, lopseed, columbine, hog peanut, white snakeroot, bracken and Pennsylvania sedge. The community provides important habitat for several rare sand-loving plants, especially Canada forked chickweed and marginal shield fern, and also rough-seeded fameflower, goat's rue, ebony spleenwort, and seaside three-awn grass."

"**Climbing plants** and **vines** are common but generally short. Common species include Virginia creeper and wild grape."

"**Shrub-layer** cover is mostly patchy to interrupted (25–75%). White pine, bitternut hickory, white oak, pin cherry, and eastern red cedar are important tree saplings, while ninebark, bush juniper, and black raspberry are important shrubs. Other common shrub-layer species include American hazelnut, prickly ash, black cherry, gray dogwood, and common poison ivy. Pipsissewa and leadplant are typical half-shrubs."

"**Subcanopy** is sparse to patchy (25–100% cover) and often poorly differentiated from the canopy. White pine, eastern red cedar, black cherry, black oak, and white oak are often present."

"**Canopy** cover is patchy to interrupted (25–75%). Canopy is typically dominated by one or more of the following: white pine, jack pine, white oak, and paper birch. Northern red oak, black cherry, quaking aspen, and basswood are occasional."

Landscape Setting and Soils

"**Sand Terraces and other sand deposits**—Uncommon. Present on deep sands that have accumulated on valley floors of tributary streams or rivers of the Mississippi River south of the Twin Cities metropolitan area. Most of the sands originate from stream dissection and disintegration of local sandstone, but a few stream bottoms have sands derived from glacial outwash and from stream dissection of glacial till above the sandstone bedrock. Because of the mantle of silty loess that covers the uplands of the Paleozoic Plateau Ecological Section (PPL), it is likely that fine sands were deposited in the area by wind as well. The sands are deposited in a variety of landforms including stream terraces, alluvial fans, ramps created by sand blown from valley floors onto adjacent slopes, and mixed deposits of sand and rocks (colluvium) at bases of sandstone outcrops. Although the bedrock from with sands are derived initially contained some carbonates, soils are poor and acidic. Soils tend to be uniformly sandy, lacking subsoil horizons or textural bands that can help to hold or perch snowmelt and rainfall. Soils are excessively drained. Soil-moisture regime is moderately dry. Mostly occurs in the Blufflands and the Rochester Plateau ecoregions of the PPL Section, but can occur very locally in the Oak Savanna subsection in the Minnesota & Iowa Morainal Section", which is where LHRP is located."

Natural History
"In the past, fires were very common throughout the range of FDs27. An analysis of Public Land Survey (PLS) records indicates that the rotation of catastrophic fires was about 135 years, and the rotation of mild surface fires about 15 years. The rotation of all fires combined is estimated to be 14 years. Windthrow was not reported in the surveyors' notes for this community. (The PLS data for this community are too limited to propose growth stages. Most (97%) of the bearing trees within the primary range of this community were oak trees. Bur oak was by far the most abundant, black oak was occasional, and northern pin oak and white oak were infrequent. The surveyors described this community mostly as scattered timber or oak openings. Jack pine and white pine are present in some modern stands; however, no pine bearing trees were reported by land surveyors.)"

Similar Native Plant Community Classes to FDs27

- **FDs38 Southern Dry-Mesic Oak-Hickory Woodland**
  "The ranges of FDs38 and FDs27 overlap in the Blufflands Subsection of the PPL, and both communities have prairie plants in the understory. FDs38 is much more common, occurring on silty soils on upper portions of south- to west-facing bluffs rather than on sandy soils."
- **FDs37 Southern Dry-Mesic Oak (Maple) Woodland**
  "FDs37 is similar to FDs27 but has not been documented as far south as the PPL. The ranges of the two classes may overlap in southern parts of the MIM, where minimal plant community surveys have been done."
- **UPs14 Southern Dry Savanna**
  "UPs14 can be similar to FDs27, especially occurrences on windblown sand (UPs14a). UPs14 often grades into FDs27 on areas of sand deposits with northerly aspects or without periodic fire, and the two classes share a number of prairie and woodland plants. UPs14 has a sparse to patchy canopy (5-25% cover), little woody vegetation in the understory, and more prairie species (especially grasses) and fewer woodland herbs in the ground layer. FDs27 has a patchy to interrupted canopy (25-75 cover), at least some woody understory vegetation present, and a ground layer dominated by woodland grasses and forbs with prairie species generally restricted to small canopy openings.

Management actions and goals for restoration of southern dry-mesic pine-oak woodland include:

- Survey for rare plants

- Restore the mild surface fire regime through a patchwork of prescribed burning (natural frequency rotation of about 15 years)
- Clearcutting may mimic the effects of catastrophic fires, which supports more open communities. Tree removal should target non-representative trees, such as box elder.
- Control woody and herbaceous invasive species

UPs24 – Southern Mesic Savanna

"Sparsely treed communities with tallgrass-dominated grouped layers on somewhat poorly drained to well-drained loam soils mainly formed in unsorted glacial till, sometimes in a thin loess layer over till, and locally in lacustrine sediments and outwash deposits. Present primarily on level to gently rolling sites. Drought stress is irregular in occurrence and usually not severe."

Vegetation Structure & Composition (There are no plot data for this class; description is based on inference from UPs23 and UPs14)
"**Graminoid cover** is interrupted to continuous (50-100%). Tallgrasses dominate, but several midheight grasses are also important. Big bluestem and Indian grass are the dominant tallgrasses, with prairie dropseed either codominant or subdominant component. On the drier end of the gradient, little bluestem, porcupine grass, and side-oats grama are important."
"Forb cover is sparse to patchy (5-50%). Forb species composition also responds to moisture. A number of species are common across the moisture gradient, including heart-leaved alexanders, heath aster, stiff and Canada goldenrods, purple and white prairie clovers, silverleaf scurfpea, stiff sunflower, white sage, northern bedstraw, and smooth blue aster. Maximillian's sunflower, tall meadow-rue, prairie phlox, and gray-headed coneflower are most common on the moister end of the gradient. Rough blazing star, Missouri and gray goldenrods, and bird's foot coreopsis are common in the drier end."
"**Climbing plants** and **vines** are a minor component. Virginia creeper is frequently present, and wild grape is occasionally present."
"Shrub layer is typically patchy (25-50% cover) and composed of low (<20 in) semi-shrubs, taller (up to 6ft) shrubs, and oak seedlings and saplings (<6 ft). The low semi-shrubs leadplant and prairie rose and poison ivy are generally common. Common taller shrubs are chokecherry, American hazelnut, smooth sumac, gray dogwood, wolfberry, low juneberry, and wild plum."
"Trees are scattered or in scattered clumps with total cover <70% and typically 25-50%." Bur oak is most common, but northern pin oak is also usually present.

Landscape Setting & Soils
"Historically, UPs24 occurred most commonly in low relief prairie landscapes on ground moraines and end moraines, and less commonly on lacustrine deposits and finer-textured outwash. Soils are somewhat poorly drained to well drained, mostly moderately permeable to permeable, fine- and medium-textured loams and loamy sands. Soils are mollisols, characterized by thick, dark, organic-enriched upper horizons with high base saturation and dominantly bivalent cations."
Natural History

“Savannas form where fire recurs frequently enough to prevent trees and shrubs from dominating, but where frequency and severity are low enough to allow fire-tolerant trees to become established and sometimes reach maturity. Historically, savannas occurred in physical proximity to prairies, but where features such as streams, lakes, and steep topography impeded the spread of fires, providing local amelioration of the prairie fire regime. All savannas are highly sensitive to fire suppression, quickly succeeding to woodland and eventually to forest, and the higher productivity of sites where UPs24 occurs makes it even more susceptible to succession than UPs14. UPs24 occupies sites where soil moisture availability remains high on average because of soil texture and composition, although the water table is below the rooting zone during the growing season except for brief periods. Before Euro-American settlement, grazing, browsing, and trampling by large ungulates were probably regular occurrences in UPs24. The contribution of this disturbance to the composition and structure of the vegetation is poorly understood, although confined grazing by domestic livestock can quickly destroy mesic savannas, promoting replacement of most of the native species by introduced ones. The fertile soils and gentle relief of UPs24 are ideal for row-crop agriculture, and almost all of the land that supported UPs24 has been converted to cropland; areas not converted have either been so heavily pastured that almost none of the native herbaceous flora survives, or they have become woodland or forest with fire suppression.”

Similar NPC’s

- **UPs23 Southern Mesic Prairie**
  “UPs23 has similar herbaceous composition to UPs24—although forbs may be more important relative to graminoids in UPs24 than in UPs23—but generally lacks trees, while UPs24 has at least sparse (> 10%) tree cover, dominated by bur oak. Because of partial shading in UPs24, cool-season graminoids may be more important relative to warm-season grasses than in UPs23. “
- **UPs14 Southern Dry Savanna**
  “Differences in the herbaceous flora between UPs14 and UPs24 are probably similar to the differences between UPs13 and UPs23. Shrub cover is probably greater in UPs24 than in UPs14—UPs24 might have more the appearance of a shrub thicket than that of a tree-studded prairie. Differences in substrate characteristics (predominantly sandy or gravelly outwash and lacustrine deposits versus predominantly loamy till) are sufficient in most cases to distinguish the two classes; classification uncertainty is likely only when UPs14 is on loamy slopes (UPs14c).”

Management actions and goals for restoration of southern mesic savanna include:

- Removal of all woody tree and shrub species, except Bur Oak, to open canopy and allow for oak regeneration and shade tolerant forb production.
- Reintroduction of fire in a shifting patchwork of prescribed burns every 3-5 years.
- Reintroduction of selected grazing to abate the encroachment of woody species.

Mesic savanna occurs in a patchwork of areas across Lebanon Hills, including North of Jensen Lake, South of Holland Lake, surrounding McDonough Lake, and in the central portion near Camp Sacagawea and east of the campgrounds. The primary concern for restoration of these areas is opening up the canopy, thinning the understory of buckthorn, honeysuckle, and other invasive woody shrubs, and removal of fire intolerant tree species. Frequent burning can help control the invasion of woody shrubs and trees. The addition of conservation grazing and browsing can be affective also. Special attention should be focused on the transitional boundary between forest and open grasslands so that habitats do not fall into discrete zones. Many thinning activities have already been underway in areas around Dakota Lake and Buck Pond.

UPs14 – Southern Dry Savanna

"Sparsely treed communities with grass-dominated herbaceous ground layers on nearly level to steeply sloping sites with droughty soils. Moderate growing season moisture deficits occur during most years and severe moisture deficits are frequent, especially during periodic regional droughts. Trees are open grown, typically small and gnarled."

Vegetation Structure and Composition

"**Graminoid cover** is patchy to continuous (25-100%). Mid-height grasses are most important, although tallgrass species are often important as well, especially where conditions tend toward mesic. Species composition varies with variation in soils and topography and is similar to that of UPs13. Little bluestem and porcupine grass are generally dominant; big bluestem and Indian grass are usually present and often common, more so than UPs13. Pennsylvania sedge, a woodland species, is often present."

"Forb cover is sparse to patchy (5-50%). Of characteristic forb, the most common are western ragweed, Virginia ground cherry, gray goldenrod, white sage, hairy and hoary puccoon, hoary frostweed, and starry false Solomon's seal. The fern ally rock spikemoss is usually common on sand substrates."

"Climbing Plants and vines are a minor component. Virginia creeper is frequently present, and wild grape is occasionally present."

"Shrub layer is typically patchy (25-50% cover) and composed of low (<20in) semi shrubs, taller (up to 6ft) shrubs, and oak seedlings and stunted (<6 ft) oak 'grubs'. Leadplant, prairie rose, and poison ivy are common low shrubs; chokecherry, American hazelnut, and smooth sumac are the most important tall shrubs."

Trees occur as scattered individuals or scattered small clumps (total cover <70%, typically 25-50%). Trees are usually <33 ft tall and frequently <16 ft with open growth form. Bur oak is most common, but northern pin oak is also usually present. Black oak is the major oak species on sandy sites in PPL, sometimes mixed with jack pine; in rare situations the latter is the dominant tree."

Landscape Setting & Soils

UPs14 occurs most frequently on terraces along the Mississippi River and on outwash and lacustrine deposits in the Anoka Sand Plain subsection. Soils are somewhat excessively to excessively drained, usually highly permeable, coarse-textured sandy loams or loamy sands, often with a substantial gravel fraction. Soil reaction ranges from circumneutral to slightly acidic. Soils are mainly entisols, with weak profile development, but sometimes are mollisols, with thick, dark, organic-enriched upper horizons, where the parent material includes a greater fraction of silt and clay."

Natural History

"**Savannas** form where fire recurs frequently enough to prevent trees and shrubs from dominating and shading out sun-loving herbaceous plants, but where frequency and severity are low enough to allow fire-tolerant trees to become established and sometimes reach maturity. Historically, savannas typically occurred in physical proximity to prairie, but where various factors provided some amelioration of the fire regime of the adjoining or surrounding prairie. These factors include streams, lakes, and steep topography, which limited the spread of fire and thus created conditions conducive to savanna formation in the prairie region. The very low productivity of sandy substrates as well as surface instability result in reduced fuel loads and thus fire intensity is lower in savannas than in typical prairies. All savannas are highly sensitive to fire suppression, quickly succeeding to woodland and eventually to forest in the absence of fire. Seedlings and saplings of a number of woodland trees are typically present in savannas today, reflecting reduced fire frequency and a general increase in these species in the landscape. Dry savannas are more resilient than mesic savannas because the xeric conditions and lower fertility of the soils inhibit tree and shrub growth and reproduction. These same factors also greatly influence herbaceous species composition, eliminating species not adapted to either frequent drought or low nutrient availability. On dune sands, blowout formation and migration produce dramatic local variation in species composition from sparse stands of pioneer species in bare, sterile sand to a relatively dense sod of grasses and forbs on long-stabilized, organically enriched sand. Before Euro-American settlement, browsing, grazing, and trampling by large ungulates were regular occurrences in dry savannas. The contribution of these activities to the composition and structure of the vegetation is not well understood, although it is known that confined grazing by domestic livestock can badly degrade dry savannas."

Similar NPC's

- **UPs24 Southern Mesic Savanna**
  "Scarcity of data for UPs24 makes comparison with UPs14 speculative. The tree canopy of UPs24 is probably dominated by bur oak, with northern pin oak less common. Trembling aspen is possibly a significant component, with white oak and basswood possibly minor components. The shrub layer is probably more developed than in UPs14. The herbaceous layer is similar to that of UPs23. Soils are loams that are finer textured than those of UPs14 and are always mollisols. UPs24 is present on level to gently sloping sites."
- **UPs13 Southern Dry Prairie**
  "UPs13 and UPs14 are quite similar in their herbaceous component: 'savanna is prairie with trees' is approximately true. Along with trees, shrubs are also typically more common in UPs14, and UPs14 is more likely to have woodland herbs such as Pennsylvania sedge and carrion flowers. By convention, total tree cover must exceed 10% for a site to be classified as UPs14 rather than UPs13."
- **FDs27 Southern Dry-Mesic Pine-Oak Woodland**
  "FDs27 can be similar to UPs14 but has greater tree cover, and there are several common species in the former rarely present in the latter. The shrub layer is also denser in FDs27, especially American hazelnut. Prairie rose and leadplant, important semi-shrubs in UPs14, are only occasional in FDs27. (The presence of leadplant in an occurrence of FDs27 strongly

suggests recent succession from UPs14.) The two classes differ most strikingly in their herbaceous composition. Little bluestem is occasional in FDs27, but the other prairie grasses common in UPs14 are rarely or never present in the former. Pennsylvania sedge, a minor presence in UPs14, is always present and often the dominant ground cover in FDs27. Similarly, most of the prairie forbs typical of UPs14 are uncommon to rare in FDs27, and a number of typical woodland forbs common in the latter rarely if ever occur in the former."

NPC Types in Class

- UPs14a Dry Barrens Oak Savanna (Southern)
- UPs14b Dry Sand-Gravel Oak Savanna (Southern)
- UPs14c Dry Hill Oak Savanna (Southern)

Management actions and goals for restoration of dry savanna include:

- Removal of all woody tree and shrub species, except Bur Oak, to open canopy and allow for oak regeneration and forb production
- Reintroduction of fire every 3-5 years in a dynamic rotational patchwork through prescribed burns.
- Reintroduction of selected grazing to abate the encroachment of woody species.

Dry savanna occurs in a patchwork of areas across Lebanon Hills, including north of Jensen Lake, south of Holland Lake, surrounding McDonough Lake, and in the central portion near Camp Sacagawea and east of the campgrounds. The primary concern for restoration of these areas is opening up the canopy, thinning the understory of buckthorn, honeysuckle, and other invasive woody shrubs, and removal of fire intolerant tree species. Frequent burning can help control the invasion of woody shrubs and trees. The addition of conservation grazing and browsing can be affective also. Special attention should be focused on the transitional boundary between forest and open grasslands so that habitats do not fall into discrete zones. Many thinning activities have already been underway in areas around Dakota Lake and Buck Pond.

UPs23 – Southern Mesic Prairie

"Grass-dominated but forb-rich herbaceous communities on somewhat poorly drained to well-drained loam soils mainly formed in unsorted glacial till, sometimes in a thin loess layer over till, and locally in lacustrine sediments and outwash deposits. Communities in this class occur primarily on level to gently rolling sites. Drought stress is irregular in occurrence and usually not severe."

Vegetation Composition and Structure

"**Graminoid** cover is usually continuous (75-100%). Tallgrasses dominate, but several midheight grasses are also important. Species composition is fairly uniform although relative abundances shift across the moisture gradient within the community. Big bluestem and Indian grass are the dominant tallgrasses, with prairie dropseed either codominant or subdominant component. On the drier end of the gradient, little bluestem, porcupine grass, and side-oats grama are important. On moister sites, switchgrass may be common, and prairie cordgrass is usually present. Leiberg's panic grass is distinctive, although usually minor in terms of cover."

"Forb cover is sparse to patchy (5-50%) Forb species composition also responds to moisture. A number of species are common across the moisture gradient, including heart-leaved alexanders, heath aster, stiff and Canada goldenrods, purple and white prairie clovers, silverleaf scurfpea, stiff sunflower, white sage, northern bedstraw, and smooth blue aster. Maximillian's sunflower, tall meadow-rue, prairie phlox, and gray-headed coneflower are most common on the moister end of the gradient. Rough blazing star, Missouri and gray goldenrods, and bird's foot coreopsis are common in the drier end. Rattlesnake master and compass plant are typical species in southeastern Minnesota but rare to absent in the community elsewhere. Narrow-leaved purple coneflower is common in the drier end of the gradient in the North-Central Glaciated Plains (CGP) but absent from the Eastern Broadleaf Forest province."

"Shrub layer is sparse (5-25% cover). The low semi-shrubs leadplant and prairie rose are generally common. Sparse patches of wolfberry are occasional. Gray dogwood, American hazelnut, and wild plum are rare."

Trees are absent except where fire suppression has allowed invasion by woody species."

Landscape Setting & Soils

The region of Minnesota in which UPs23 occurs is predominantly a low-relief landscape interrupted by local areas of greater relief associated with stagnation moraines and large erosional features created by glacial meltwaters. Historically, in the PPL, UPs23 was confined to the tops of broader interfluves. UPs23 typically occupies ground moraines and end moraines and smaller inclusions of outwash and lacustrine sediments. In southeastern and southwestern Minnesota, UPs23 occurs on older, loess-mantled ground moraines. Soils are somewhat poorly drained to well drained, mostly moderately permeable to permeable, fine- and medium-textured loams and loamy sands. Soils are mollisols, characterized by thick, dark, organic-enriched upper horizons with high base saturation and dominantly bivalent cations.

Natural History

"Ups23 is present on level to gently sloping sites where the water table is below the rooting zone except for brief periods during the growing season. Soil moisture availability remains high on average because of soil texture and composition. Recurrent fire is essential for the existence of Ups23, as environmental conditions are otherwise suitable for the growth of trees; where propagules are available, succession to forest occurs rapidly in the absence of fire. Fires also recycle nutrients bound up in litter and promote flowering and seed production. These events temporarily expose the soil surface and so probably play an important role in plant regeneration. Before Euro-American settlement, grazing and trampling by large ungulates were regular occurrences in Ups23. The contribution of this disturbance to the composition and structure of the vegetation is not well understood, although it is known that confined grazing by domestic livestock can quickly destroy mesic prairies, promoting the replacement of most native species by introduced ones. Episodic grazing probably enables the persistence of some native species that cannon otherwise reproduces in the dense canopy of tall grasses and orbs characteristic of Ups23; these would include shorter species and especially annual or biennial species. Spatial patchiness in grazing intensity is also thought to have influenced fire behavior, providing a shifting patchwork of refugia for fire sensitive animal species. The fertile soils and gentle relief of Ups23 are ideal for row-crop agriculture, and almost all of the land that supported this class has been converted to cropland."

Similar NPC's

- **UPs24 Southern Mesic Savanna**
  "Scarcity of data for UPs24 makes comparison with UPs23 speculative. The herbaceous component of the two classes is probably similar, although forbs possibly are more important relative to graminoids in UPs24 than in UPs23. UPs24 is distinguished by the presence of at least sparse (> 10%) tree cover, dominated by bur oak."
- **UPs13 Southern Dry Prairie**
  "The greater importance of midheight grasses relative to tallgrass species in UPs13 results in generally lower canopy height in UPs13 than in UPs23. UPs13 typically has sparser vegetation cover, with some bare soil exposed, often with terricolous lichens, while the soil surface is completely hidden in UPs23. There is little difference in species composition between drier examples of UPs23 and occurrences of UPs13 on loamier soils. Topography, soil characteristics, and relative abundances of species"
- **WPs54 Southern Wet Prairie**
  "WPs54 grades into UPs23 at the moist end of the moisture gradient in UPs23, without a distinct floristic boundary between the two classes. WPs54 is always present on level or slightly concave sites except in the unusual situation where groundwater seepage creates moist habitat. Prairie cordgrass is typically much more important in WPs54 than UPs23, as are sedges. Big bluestem is typically present, although its contribution to total cover is usually less than in UPs23, and it may be absent. Leadplant is present in most instances of UPs23 and rarely present in WPs54."

Management actions and goals for restoration of southern mesic prairie include:

- Frequent burns (2-3 years) in a shifting patchwork to allow for refugia to local fauna.
- Reintroduction of large grazers in a rotation to prevent soil compaction, over grazing, and floral trample.
- Removal of all woody tree species and thinning of woody shrubs to prevent savanna and forest succession.
- Interseed with a mix of forbs and native grasses to promote floral diversity.

Southern Mesic Prairie is targeted in Lebanon Hills in scattered patches mostly on the east side of the park near the equestrian lot and around the entrance drive of the park near the visitor center. This habitat type occurs in conjunction with savannas and is dependent on fire to prevent the succession into forest. Restoration concerns in Lebanon include maintaining a dynamic, undulating transition zone between the savannas and prairies to mimic fire and grazing patterns. Forb diversity can be increased within prairies through the introduction of grazers and interseeding.

WPs54 – Southern Wet Prairie

“Grass-dominated but forb-rich herbaceous communities on poorly drained to very poorly drained loam soils formed in lacustrine sediments, unsorted glacial till, or less frequently outwash deposits. Typically in slight depressions, sometimes on very gentle slopes. Flooded for brief periods at most; upper part of rooting zone is not saturated for most of growing season, but saturation usually persists in lower zone for much of season.”

Vegetation Composition and Structure

“**Graminoid** cover is usually continuous (75–100%). Tallgrasses dominate, but several midheight and low grasses and sedges are also important. Prairie cordgrass and big bluestem are the dominant tallgrasses; Indian grass and switchgrass are frequently important. Wooly sedge is often an important component, and rigid sedge and flattened spikerush are frequently present.”

“Forb cover is sparse to patchy (5–50%). Canada goldenrod and giant, sawtooth, or Nuttall’s sunflower are typically most common. Other common taller forbs are giant goldenrod, tall meadow rue, eastern panicled aster, and great blazing star (L. pycnostachya). Common midheight species are heath aster, clasping dogbane, Virginia mountain mint, and golden alexanders. Common strawberry, golden or false golden ragwort, and stemless blue violets are typically common in the lowest layer. Forb diversity and height decrease where soil salinity is elevated.”

Shrub layer is absent to sparse (0–25% cover).”

Landscape Setting & Soils

“WPs54 occurs predominantly in a low-relief landscape interrupted by areas of greater relief associated with stagnation moraines and large erosional features created by glacial meltwaters. WPs54 occupies plan or concave surfaces in shallow depressions and drainageways in ground moraines and end moraines and in smaller inclusions of outwash and lacustrine sediments. It occurs on older, loess-mantled ground moraines. Soils are poorly drained loams, most commonly fine textured, although coarser textured loams and even loamy sands also support WPs54 where the water table is persistently close to the surface. All soils are mollisols, characterized by thick, dark upper horizons with high base saturation and dominantly bivalent cations. The organic content is high to very high, but all wet prairie soils are considered mineral soils.”

Natural History

“Although WPs54 is characterized by wet-mesic or wet conditions, WPs54 is not as strongly influenced by wetland processes associated with inundation and soil saturation as Wet Meadow communities. Flooding episodes are brief following snowmelt and heavy rains. The water table typically remains within the rooting zone of most plants for several weeks during the growing season, but at least the upper part of the zone is not saturated for most of the season. In some situations on slopes, groundwater seepage maintains continuously moist but not saturated soil conditions. The dominant plant species in WPs54 lack the physiological and morphological adaptations to tolerate anoxic soil conditions that typify the plants of wetter communities. In western Minnesota, local areas of salt accumulation within wet sites favor species tolerant of salinity, including several species associated with droughty upland sites that can tolerate osmotically induced moisture stress. Recurrent fire is essential for the existence of WPs54, as environmental conditions are otherwise favorable for the development of forest. Fire also recycles nutrients bound up in litter and promotes flowering and seed production; fire temporarily opens up the soil surface and so probably plays an important role in plant regeneration. Before Euro-American settlement, grazing and trampling by large ungulates were presumably regular occurrences in WPs54, although it is possible that wet prairies were less favored than upland prairies. The contribution of this disturbance to the composition and structure of the vegetation is not well understood, although confined grazing by domestic livestock can quickly destroy wet prairies, promoting the replacement of most of the native species by introduced ones. Disturbance can be especially severe when soils are saturated. Episodic grazing probably allows for the persistence of some native species that cannot otherwise reproduce in the dense canopy of tall grasses and forbs of WPs54; these would include shorter-stature species and especially annual or biennial plants. Spatial patchiness in grazing intensity also influenced fire behavior, providing a shifting patchwork of refugia for fire-sensitive animal species."

Similar NPC's

- **UPs23 Southern Mesic Prairie**
  UPs23 grades into WPs54 at the moist WPs54 at the moist end of the moisture gradient in UPs23, without a distinct floristic boundary between the two classes. UPs23 typically occurs on drier sites, on perceptibly convex sites or slopes, but topographic differences between the classes are not always apparent. Big bluestem and prairie dropseed are more important in UJPs23 than in WPs54. Conversely, prairie cordgrass and mat muhly grass are much less important in UPs 23 than WPs54. Sedges are only a minor component of UPs23 but important in WPs54.
- **WMs83 Southern Seepage Meadow/Carr**
  "WPn83 can appear similar to WPs54 but occurs on organic and mineral soils where groundwater seepage maintains high soil moisture conditions, whereas WPs54 is always on mineral soils. Sedges dominate WMs83 whereas grasses dominate WPs54. The major prairie grasses of WPs54 are rare in WMs83, except prairie cordgrass, and it is not common. Cattails are frequently present in WMs83 but absent in WPs54."
- **WMs92 Southern Basin Wet Meadow/Carr**
  WPs54 and WMs92 occur in similar landscape settings, but soils in WPs54 are only briefly saturated in late spring, while soils in WMs92 are saturated throughout summer. As a result, WMs92 is more likely to have wetland species tolerant of long periods of inundation or saturated soils. WMs92 is usually strongly dominated by slough sedge or occasionally by lake sedge; whitetop is typically codominant or an important subdominant with slough sedge, while bluejoint is usually the major grass with lake sedge. Prairie cordgrass may be present in WMs92 but is much less common than in WPs54. The other typical prairie grasses of WPs54 are very rare in WMs92. All known occurrences of WMs92 are in the Prairie Parkland Province, but it may also occur in the Eastern Broadleaf Forest Province.
- **WMp73 Prairie Wet Meadow/Carr**
  WMp73 and WMp73 and WPs54 are nearly indistinguishable in topographic character, but WMp73 is subject to shallow flooding and soil saturation of longer duration than is WPs54. Prairie cordgrass and wooly sedge are major species in both, but narrow reedgrass and Sartwell's sedge are major species in WMp73 and minor components of WPs54. Tussock sedge is sometimes common in both. The upland prairie grasses that are common in WPs54

are absent from WMp73, and forb diversity is lower in the latter. WMp73 has been documented only in western Minnesota, in the North Central Glaciated Plains, the Red River Valley, and the Lake Agassiz Aspen Parklands.

NPC Types in Class

- WPs54a Wet Seepage Prairie (southern)
- WPs54b Wet Prairie (southern)
- WPs54c Wet Saline Prairie (southern)

Management actions and goals for restoration of southern wet prairie include:

- Frequent burns (2-3 years) in a shifting patchwork to allow for refugia for local fauna.
- Burn in conjunction with adjacent uplands to avoid developing distinct and hard edges.
- Reintroduction of large grazers in a sparse rotation to prevent soil compaction, over-grazing, and floral trample.
- Removal of all woody tree species and thinning of woody shrubs to prevent savanna and forest succession.

Wet Prairie occurs in one small section of Lebanon Hills on the eastern edge of the park, but is probably present at many more, small, undetected locations that are grading from wet meadow to an upland prairie community. Fire is crucial to maintain this community from the encroachment of woody species on either side. Wet soils can compact easily; grazing animals should not be allowed on wet soils to prevent soil compaction and major disruptions to the community.

WMn82—Northern Wet Meadow/Carr

"Open peatlands dominated by dense cover of broad-leaved graminoids or tall shrubs. Present on mineral to sapric peat soils in basins and along streams."

Vegetation Structure and Composition

"Moss cover most often is < 5% but can range to > 75%. Brown mosses are usually dominant, but Sphagnum can be dominant on some sites.

Graminoid layer consists of dense stands of mostly broad-leaved graminoids, including bluejoint, lake sedge, tussock sedge, and beaked sedge.

Forb cover is variable, with tufted loosestrife, marsh bellflower, marsh skullcap, and great water dock common, and small or three-cleft bedstraw, bulb-bearing water hemlock, northern bugleweed, linear-leaved, marsh, or down willow-her, water smartweed, and northern marsh fern occasional.

Shrub cover is variable. Tall shrubs such as willows, red-osier dogwood, and speckled alder can be dense, along with meadowsweet. Paper birch, black ash, red maple, American elm, and tamarack saplings are occasionally present in the shrub layer.

Trees taller than 16 ft (5m) are rarely present and if so, have low cover (< 25%)."

Landscape Setting and Soils

"WMn82 occurs in wetland basins on a variety of landforms. It is also associated with streams and drainageways, drained beaver ponds, shallow bays, and semifloating mats on lakes. Soils range from mineral or muck soil to sapric peat. Organic sediments are typically shallow but can be deep (> 15 inches) in basins filled by sedimentary peat."

Natural History
"WMn82 is subjected to moderate inundation following spring runoff and heavy rains, and periodic drawdowns during summer. Peak water levels are high enough and persistent enough to prevent trees (and often shrubs) from becoming established, although there may be little or no standing water much of the growing season. As a result of water level fluctuations, the surface substrate alternates between aerobic and anaerobic conditions. Any organic matter that may accumulate over time is usually oxidized during drawdowns following drought or is removed by fire. Where deep peat is present in the community, it likely was formed previously on the site by a peat-producing community—such as forested rich peatland—that was flooded by beaver activity and ultimately converted to a wet meadow. Deep peat may also develop from debris settling into basins with standing water, forming sedimentary peat. Because surface water in WMn82 is derived from runoff, stream flow, and groundwater sources, it has circumneutral pH (6.0-8.0) and high mineral nutrient content. Although mosses are typically sparse in WMn82 because of alternating flooding and drawdown, moss cover can be relatively high in settings where water levels have become stabilized. In these situations, it appears that Sphagnum can quickly invade the community, especially on floating mats that are completely above the water surface. The water chemistry in these sites can be rapidly converted by *Sphagnum* to rich fen and even poor fen conditions before characteristic wet meadow species, especially wide-leaved sedges, have been replaced by plants of rich or poor fen species such as narrow-leaved sedges. The process of succession of WMn82 to rich or poor fens is readily reversed by return of higher or more variable water levels, such as from beaver activity or variation in precipitation."

Similar Native Plant Community Classes

- **OPn81 Northern Shrub Shore Fen**
  "OPn81 often has abundant broad-leaved graminoids and can appear similar to occurrences of WMn82 with abundant speckled alder (WMn82a). OPn81 typically occurs on deep peat, often along lakeshores, and is more likely to have high cover of leatherleaf, bog birch, or sweet gale in addition to speckled alder. WMn82 commonly occurs on mineral soil or shallow peat and is often situated away from lakeshores; WMn82 is more likely to have abundant willows and red-osier dogwood in addition to speckled alder."
- **FPn73 Northern Rich Alder Swamp**
  "PFn73 may resemble occurrences of WMn82 that have significant amounts of speckled alder (WMn82a). FPn73 is typically associated with rich swamp forests—especially Northern Rich Spruce Swamp (Basin) (FPn62), Northern Cedar Swamp (FPn63), and Northern Rich Tamarack Swamp (Western Basin)(FPn82)—and is more likely to have tree > 6 ft (2m) tall, including paper birch, red maple, and balsam fir, and shade-tolerant swamp forest species in the ground layer."

NPC Types in Class

- WMn82a Willow-Dogwood Shrub Swamp
- WMn82b Sedge Meadow
  - WMn82b1 Bluejoint Subtype
  - WMn82b2 Tussock Sedge Subtype
  - WMn82b3 Beaked Sedge Subtype
  - WMn82b4 Lake Sedge Subtype

Management actions and goals for restoration of northern wet meadow/carr include:

- Restore hydrology to allow for periodic drawdowns in summer

- Allow to burn occasionally but not if deeper peat is present
- Control invasive species such as hybrid cattail, giant reed grass, or reed canary grass

There are over 180 wetlands in the park and many occurrences of this community class. The primary concern for restoration of this community is control of exotic herbaceous species such as reed canary grass. Special attention should be focused on the transitional boundaries so as not to develop hard edges between wet prairie, wet forest, and other community types—rather, they should grade into one another. Many brush removal activities have already been underway in areas around Jensen Lake, Holland Lake, and south of O'Brien Lake, but not much work has happened in the wetland zones yet.

WMn83—Southern Seepage Meadow/Carr

"Open wetlands dominated by a dense cover of hummock-forming broad-leaved sedges or tall shrubs. Present in areas of groundwater seepage along streams and drainage ways, on sloping terraces, and at bases of slopes."

Vegetation Structure and Composition

"**Moss** cover is typically absent, although brown mosses may be present.

Graminoid cover is interrupted to continuous (50-100%); typically dominated by tussock sedge or aquatic sedge with bluejoint, lake sedge, prairie sedge, woolly sedge, and fowl manna grass common. Hairy-fruited sedge is dominant on some sites.

Forb cover is variable (5-75%); common species include spotted Joe pye weed, great water dock, common boneset, marsh bellflower, red-stemmed aster, swamp milkweed, northern and cut-leaved bugleweeds, common marsh marigold, giant sunflower, and touch-me-nots.

Shrub cover is variable. Tall shrubs, if present, include red-osier dogwood, pussy willow, slender willow, and Bebb's willow."

Landscape Setting and Soils

"WMs83 is typically associated with groundwater seepage areas at bases of river terraces or beach ridges and on gentle slopes. It also can occur in level wetlands dissected by streams and rivers that may be fed by groundwater discharge. Surface water is derived primarily from groundwater sources and has neutral to basic pH, reflecting the surrounding calcareous till and bedrock substrate. Soils range from mineral or muck soil to sapric peat. Organic sediments range from very shallow to greater than 36 inches (100 cm) in depth."

Natural History

"WMs83 is associated with wetlands influenced by moving water, in contrast to the gravitational water of basins of other wet meadows. WMs83 may experience moderate inundation following spring runoff and heavy rains, and periodic drawdowns during summer or as a result of fluctuations in groundwater seepage. Water levels are high and persistent enough to prevent trees (and often shrubs) from becoming established, although standing water may be absent by the end of the growing season. Because of water level fluctuations, surface substrates alternate between aerobic and anaerobic conditions. Organic matter that accumulates over time on the substrate surface is usually oxidized during drought influenced drawdowns or is removed by fire during periods of severe drought. In basins where water flow becomes stabilized, accumulation of peat may cause succession of WMs83 to rich fen; otherwise, the constant inputs of minerals from groundwater flow that typically influence the community, along with warm climatic conditions and frequent drawdown, prevent succession of WMs83 to rich fen. Frequent fires in the surrounding landscape may be an important factor in reducing the presence of shrubs or accumulation of peat in the community. The lack of a distinct shade-tolerant flora in occurrences of WMs83 dominated by shrubs may be due to historically high fire frequency, which prevents shrubs from becoming established in any one place for very long. It is possible that shrub-dominated areas are more frequent now than in the past because of fire suppression over the past 100-150 years."

Similar Native Plant Community Classes

- **WMs92 Southern Basin Wet Meadow/Carr**

  "WMs92 occurs in small, shallow basins in far western and southern Minnesota and can be similar to WMs83. WMs92 is more likely to have slough sedge as a dominant graminoid and tends to occur in basins isolated from lateral water flow from streams or groundwater. WMs83 is more likely to have abundant willows and other shrubs and is present in basins influenced by water flow from streams or groundwater."

- **WMp73 Prairie Wet Meadow/Carr**

  "WMp73 occurs in small basins in the far western and southern parts of the state and can be similar to WMs83. WMp73, unlike WMs83, tends to occur in basins isolated from lateral water flow from streams or groundwater and generally has few if any shrubs."

- **WMn82 Northern Wet Meadow/Carr**

  "WMn82 and WMs83 can be similar when dominated by tussock sedge (WMn82b2 vs. WMs83a1) and their ranges overlap in the MIM. Unlike WMs83a1, WMn82b2 has not been recorded on sloping terraces or at bases of slopes where groundwater seepage is present."

- **OPp91 Prairie Rich Fen**

  "OPp91 is somewhat similar to WMs83 but is strongly dominated by narrow-leaved sedges that do not form tall hummocks and is more likely to have small shrubs such as sage-leaved willow rather than tall shrubs."

- **OPp93 Prairie Extremely Rich Fen**

  "OPp93 also occurs on sloping terraces and at bases of slopes with obvious, concentrated areas of seepage and can appear similar to WMs83. OPp93 is more likely to have visible areas of upwelling water and small shallow pools with marl deposits. WMs83 is often present on the outer margins of OPp93. OPp93 is more likely to have small shrubs such as sage-leaved willow and bog birch rather than tall shrubs and generally lacks sedge species that form tall hummocks."

- **WFs57 Southern Wet Ash Swamp**

"WFs57 can be similar to occurrences of WMs83 in groundwater seepage areas in forested wetlands (WFs57a vs. WMs83a3). In these settings, the two classes typically grade into one another and share many common wetland species including common marsh marigold, fowl manna grass, and interior sedge. WFs57 is generally present where seepage zones are small and the tree canopy is dense enough to favor shade-tolerant species in the understory such as jack-in-the-pulpit, wood nettle, and wild geranium. WMs83 is present where seepage zones create large enough openings in the canopy to favor shade-intolerant species in the understory such as tussock sedge, spotted Joe pye weed, and white turtlehead. WFs57 and WMs83 are most difficult to differentiate in seepage areas characterized by sparse cover of black ash trees."

NPC Types in Class

- WMs83a Seepage Meadow/Carr.
    - WMs83a1 Tussock Sedge Subtype
    - WMs83a2 Aquatic Sedge Subtype
    - WMs8a3 Impatiens Subtype

Management actions and goals for restoration of southern seepage meadow/carr include:

- Restore hydrology to allow for moving water
- Restore hydrology to allow for periodic drawdowns in summer
- Allow to burn occasionally (to reduce the presence of shrubs and reduce the accumulation of peat), especially if surrounding landscape has frequent fire, but not if deeper peat is present
- Control invasive species such as hybrid cattail, giant reed grass, or reed canary grass

There are a few seepage areas in the park where this community occurs. The primary concern for restoration of this community is control of exotic herbaceous species such as reed canary grass. Special attention should be focused on the transitional boundaries so as not to develop hard edges between wet prairie, wet forest, and other community types—rather, they should grade into one another. Many brush removal activities have already been underway in areas around Jensen Lake, Holland Lake, and south of O'Brien Lake, but not much work has happened in the wetland zones yet.

FPs63—Southern Rich Conifer Swamp

"Tamarack-dominated swamps on shallow to deep peat in basins on moraines and outwash plains. Occasionally on floating mats at edges of ponds."

Vegetation Structure and Composition

Moss layer is patchy to continuous (25-100% cover), often with Sphagnum-dominated hummocks and brown mosses dominant in hollows.

Graminoid layer has variable cover, with bristle-stalked sedge usually present, and fowl manna grass, bluejoint, and soft-leaved sedge frequently present. Prairie sedge is sometimes abundant in young, early successional stands.

Forb layer has 25-75% cover and usually includes dwarf raspberry, with common marsh marigold, northern marsh fern, touch-me-nots, tufted loosestrife, and starflower common.

Low-shrub and **vine** cover is variable, with Virginia creeper and poison ivy frequent, and red raspberry and wild grape occasional.

Tall-shrub layer is variable but frequently includes red-osier dogwood, with bog birch, swamp gooseberry, and willows common.

Understory trees commonly include tamarack, elms, and red maple.

Canopy is patchy to interrupted (25-75%) and dominated by tamarack. Deciduous trees such as paper birch are occasionally present.

Landscape Setting and Soils

FPs63 occurs in peat-filled basins on glacial moraines and outwash plains and appears to be associated with areas underlain by sandy substrates. FPs63 can also occur on floating mats at the edges of ponds. Soils are well-decomposed peat of variable depth. Surface water pH is circumneutral. Water table is at or near the surface, and hollows are often filled. FPs63 can occur in large contiguous sites > 100 acres (40 ha) in size but often is present in small patches, mixed with shrub or hardwood swamps.

Natural History

FPs63, like northern rich peatland (FPn) classes, occurs on peat substrates that are poor in nutrients but influenced by mineral rich groundwater that keeps the pH of surface water above 5.5. FPs63, however, occurs southwest of the zone of ideal climatic conditions for peat development, in an area where severe periodic droughts cause water table drawdown followed by drying and burning or decomposition of peat in many basins. As a result, unlike FPn classes, FPs63 is restricted to basins fed by groundwater flow that maintains sufficiently saturated conditions to promote peat development.

The sites where FPs63 typically occurs—small peat-filled basins—burned occasionally in the past during periods of severe drought, possibly from spread of fire from forests or woodlands on surrounding uplands or from nearby wet meadows. An analysis of Public Land Survey records indicates that the historic rotation of catastrophic fires in FPs63 was about 400 years. Because of structurally weak soils and shallow root systems, trees in the community are susceptible to windthrow, with a historic rotation for catastrophic windthrow of about 380 years. Small-scale disturbances resulting in partial mortality of the canopy were relatively common, with a rotation of about 40 years, and are presumed to have involved patchy windthrow of individual trees or small groups of trees. Levels of disturbance from windthrow in contemporary stands are consistent with historical records, with most modern stands having some evidence of recent windthrow.

Similar Native Plant Community Classes

- **FPn72 Northern Rich Tamarack Swamp (Eastern Basin)**

  "FPn72 is similar to FPs63 but occurs mainly to the north and east of FPs63 in the Laurentian Mixed Forest Province, with the ranges of the two classes overlapping along the southern edge of the WSU."

- **FPw63**

  "FPw63 is similar to FPs63 but occurs to the north in the LAP, with the ranges of the two classes possibly overlapping along the northern border of the MIM."

- **WFn53 Northern Wet Cedar Forest**

  Old forest stage of WFn53 can contain some tamarack, but they are not dominant, like they are in FPs63. WFn53 is found in the northeastern part of the state, and FPs63 is central part of the state.

- **FPn63 Northern Cedar Swamp**

  FPn63 is similar, but it is usually dominated by white cedar.

Management actions and goals for restoration of southern seepage meadow/carr include:

- Monitor water levels in the basin
- Remove and control exotic shrubs in the basin and surrounding uplands
- Control exotic forbs (e.g., mustards) and grasses (e.g., reed canary grass) in the basin and surrounding uplands via select spot-treatment and hand wicking
- Remove and control overabundant native shrubs in the basin and surrounding uplands to open up areas for tamarack regeneration
- Monitor vegetation and track tamarack regeneration and plant community structure and composition change over time.
- Monitor temperature and pH

There is one occurrence of this community in the park, located west of Holland Lake. It is one of the southern-most cases of this community in the state. A large restoration effort occurred here starting in 2016 and ending in 2019. Exotic buckthorn and honeysuckle were removed from the basin and surrounding uplands, and reed canary grass was controlled in the wetlands. Some plug planting and seeding occurred in the disturbed wetlands. The area really underwent a large transformation. Planned for the end of the project is the planting of small tamarack seedlings that were reared from seed collected on site.

MRn83—Northern Mixed Cattail Marsh

"Emergent marsh communities typically dominated by cattails. Present on floating mats along shorelines in lakes, ponds, and river backwaters or rooted in mineral soil in shallow wetland basins."

Vegetation Structure and Composition
"**Floating-leaved and submergent aquatic plant** cover is sparse, with species such as duckweed and greater duckweed frequent, and common bladderwort and common coontail occasionally present. Seasonally prolific, floating clones of the liverworts may be present, becoming stranded during water table drawdown.

Graminoid cover is variable, with lake sedge and bristly sedge commonly present.

Forb cover is strongly dominated by cattails, usually with >50% cover. Other common forbs include emergent species such as broad-leaved arrowhead, marsh skullcap, small or three-cleft bedstraw, and bur marigold and beggarticks.

Shrubs are absent or very sparse.

Notes: vegetation is often composed of dense stands of cattails interspersed with pools of open water. Associated species are highly variable."

Landscape Setting and Soils
"MRn83 occurs in shallow basins and depressions and along the shores of lakes, ponds, and river backwaters. Substrates range from muck or shallow well decomposed peat to floating peaty mats. Substrate surface is usually covered with plant litter, especially dead cattail stalks. MRn83 is often transitional between shallow aquatic communities and wet meadows."

Natural History
"MRn83 develops in areas where standing water is present most of the year, providing conditions favorable for hydrophytic plants. Occurrences of the community with plants rooted in muck or peat substrates may succeed to shallow aquatic communities if the water table rises for prolonged periods, or to wet meadows if the water table drops or if silt or sedimentary peat accumulation causes the substrate surface to become elevated above the water surface. Floating mats, which rise and fall with changes in water level, are presumably successionally stable but may be fragmented by strong winds or beaver activity. Variation in species composition observed in the class is likely due to differences in water depth, the permanence of standing water, and variation in substrate. Fires during severe droughts can remove accumulated peat in fens or wet meadows, effectively lowering the growing surface and creating the wetter conditions that favor marsh over fen or wet meadow vegetation."

Similar Native Plant Community Classes

- **MRn93 Northern Bulrush-Spikerush Marsh**

  "MRn93 can be similar to MRn83 but occurs in deeper water and is more affected by wave action. MRn93 is dominated by bulrushes and submergent aquatic species such as pondweeds and water milfoils, while MRn83 is dominated by cattails, with abundant sedges and forbs such as tufted loosestrife and great water dock."

- **MRp83 Prairie Mixed Cattail Marsh**

"MRp83 is very similar to MRn83 but occurs south and west of MRn83, in the Prairie Parkland Province."

- **MRu94 Lake Superior Coastal Marsh**

  "MRu94 is similar to MRn83 but is restricted to estuaries and embayments near the mouths of rivers flowing into Lake Superior, where seiches cause regular fluctuations in water level. MRu94 generally has higher species diversity, while MRn83 is more likely to be strongly dominated by cattails."

Management actions and goals for restoration of southern seepage meadow/carr include:

- Monitor water levels and document over time
- Burn rarely, and when it is done, do so in conjunction with surrounding uplands
- Monitor for hybrid cattail and giant reed grass and control if present; allow other, native species to fill in the space
- Monitor for and control exotic herbaceous species.

Since there are many lakes throughout the park, this community is common in the deeper lakeshore areas. The primary concern for restoration of this community is control of exotic herbaceous species such as hybrid cattail and giant reed grass (*Phragmites australis*). Special attention should be focused on the transitional boundaries so as not to develop hard edges between wet prairie, wet forest, and other community types—rather, they should grade into one another. Many brush removal activities have already been underway in areas around Jensen Lake, Holland Lake, and south of O'Brien Lake, but not much work has happened in the marshes or other wetlands yet.

MRn93—Northern Bulrush-Spikerush Marsh

"Emergent marsh communities, typically dominated by bulrushes or spikerushes. Present along lakeshore and stream borders."

Vegetation Structure and Composition

"**Floating-leaved** and **submergent aquatic plant** cover is variable, frequently with duckweed and infrequently with greater duckweed and pondweed.

Graminoid cover is variable, often consisting of dense, clonal, single-species patches interspersed with areas of open water. Community most often is dominated by bulrushes including soft stem bulrush and river bulrush, or by red-stalked spikerush, with lesser amounts of rice cut grass.

Forb cover is variable. Typical species include broad-leaved arrowhead, water smartweed, and bur reeds.

Shrubs are absent."

Landscape Setting and Soils

"MRn93 occurs in shallow water (typically 20-40 inches [50-100 cm] deep) along wave-washed and protected lakeshore and along stream borders. Substrates are usually mineral soil, sometimes held together by mats of plant roots. MRn93 appears to occur on permanently flooded sites but may be intermittently exposed during periods of low water."

Natural History

"MNn93 develops in settings where standing water is present most of the year, providing conditions favorable to hydrophytic plants. The community is most common along shorelines where exposure to waves hinders accumulation of peat and formation of floating mats. Variation in vegetation composition within the class is likely due to variation in water level, substrate, and exposure to wave action."

Similar Native Plant Community Classes

- **MRn83 Northern Mixed Cattail Marsh**

  "MRn83 is similar to MRn93 but occurs in shallow water on softer substrates more protected from wave action. MRn83 is dominated by cattails with abundant sedges and forbs such as marsh cinquefoil, northern bugleweed, and tufted loosestrife. MRn93 is dominated by bulrushes and submergent aquatic species such as pondweeds and water milfoil."

- **MRp93 Prairie Bulrush-Arrowhead Marsh**

  "MRp93 is similar to MRn93 but occurs south and west of MRn93, in the Prairie Parkland Province. There are too few detailed records available to identify species differences between the two classes."

NPC Types in Class

- MRn93a Bulrush Marsh (Northern)
- MRn93b Spikerush-Bur Reed Marsh (Northern)

Management actions and goals for restoration of southern seepage meadow/carr include:

- Monitor water levels and document over time
- Burn rarely, and when it is done, do so in conjunction with surrounding uplands
- Monitor for hybrid cattail and giant reed grass, and control if present; allow other, native species to fill in the space
- Monitor for and control exotic herbaceous species.

Since there are many lakes throughout the park, this community is common in the deeper lakeshore areas. The primary concern for restoration of this community is control of exotic herbaceous species such as hybrid cattail and giant reed grass (*Phragmites australis*). Special attention should be focused on the transitional boundaries so as not to develop hard edges between wet prairie, wet forest, and other community types—rather, they should grade into one another. Many brush removal activities have already been underway in areas around Jensen Lake, Holland Lake, and south of O'Brien Lake, but not much work has happened in the marshes or other wetlands yet.

FFs59—Southern Terrace Forest

Wet-mesic deciduous forests on silty or sandy alluvium on level, occasionally flooded sites along small streams to large rivers in the southern half of Minnesota.

Vegetation Structure and Composition

"**Ground layer** cover is mostly interrupted to continuous (50-100%); often with abundant wood nettle. Other typical species include Virginia waterleaf, spotted touch-me-knot, Tall coneflower, stinging nettle, cleavers, stemless blue violets, honewort, aniseroot, Virginia knotweed, Virginia bluebells, and eastern narrowleaf sedge. Reed canary grass is highly invasive on sites where the canopy has been opened by disturbance."

"**Climbing plants** and **vines** are sparse to patchy (5-50% cover); mostly present in lower strata; Virginia creeper and wild grape are typical."

"**Shrub layer** and **subcanopy** are sparse to patchy (5-50% cover); typical species include American elm, hackberry, boxelder, Missouri gooseberry, prickly ash, and chokecherry."

"**Canopy** is interrupted to continuous (50-100% cover). Species composition is variable, but American elm, green ash, hackberry, basswood, boxelder, silver maple, black ash, and cottonwood are often common."

Natural History

In the past, catastrophic disturbances were rare in FFs59. There are no references to fire in the Public Land Survey records, and the rotation of catastrophic windthrow was about 310 years. Events that result in partial loss of trees, especially flood damage (and possibly light surface fires), were much more common, with an estimated rotation of just 40 years. Based on the historic composition and age structure of these forests, FFs59 had three growth stages:

- 0-35 years—Young forests recovering from severe flooding or wind, often dominated by elm (most often American elm, but red elm was present as well). Basswood, willows, and green ash are also present.
- 35-155 years—Mature forests dominated by elm and ash, including American elm, red elm, green ash, and black ash. Basswood, bur oak, silver maple, hackberry, black walnut, and butternut are minor components. Willows are essentially absent during this stage.
- > 155 years—Old forests similar in composition to mature forests except walnuts, silver maple, and bur oak are more abundant, and basswood is mostly absent.

Similar Native Plant Community Classes

- **FFs68 Southern Floodplain Forest**

"FFs68 occurs along many of the same rivers as FFs59, and the two communities can grade into one another. FFs68 generally is present on sites that are inundated every spring (and sometimes following heavy rain) for several days to several weeks and have regular deposition of silt and sand, while FFn57 is present on sites—such as terraces and levees—that flood only occasionally and usually for just a few days at most. Recently deposited sediment, windrowed debris, and ice scars on trees are all useful evidence for distinguishing active floodplain sites from sites where terrace forests occur. The canopy of FFs68 is strongly dominated by silver maple, while FFs59 is more likely to have basswood, bur oak, swamp white oak, hackberry, black ash, or black walnut, with silver maple sometimes present but rarely dominant."

- **FFn57 Northern Terrace Forest**

  "FFn57 also occurs on terraces, levees, and other occasionally flooded sites along medium and large rivers. FFn57 is similar to FFs59 but is restricted to the southern half of the state. The ranges of the two communities overlap in east-central and west-central Minnesota."

- **MHs49 Southern Wet-Mesic Hardwood Forest**

  "MHs49 also occurs on silty alluvium on stream terraces but is more often restricted to narrow valleys along small streams in rugged, bedrock-controlled terrain. Both communities often have abundant spring ephemeral species such as false rue anemone."

- **WFs57 Southern Wet Ash Swamp**

  "WFs57 and FFs59 share much of their range, and both commonly occur on stream terraces, where they can grade into one another. Evidence of groundwater seepage, such as rivulets and saturated raised peat mound, is almost always present always present in WFs57 and absent from FFs59. The canopy of WFs57 is usually dominated by black ash and generally lacks other species common in FFs59 such as hackberry, silver maple, boxelder, swamp white oak, or cottonwood."

NPC Types in Class

- FFs59a Silver Maple-Green Ash-Cottonwood Terrace Forest
- FFs59b Swamp White Oak Terrace Forest
- FFs59c Elm-Ash-Basswood Terrace Forest

Management actions and goals for restoration of Southern Terrace Forest include:

- Evaluate to confirm the accuracy of the community identification. If not accurate, re-assign a more appropriate target community such as MHs38, WMs83, or WFs55, and adjust management goals.
- Attempt to burn on a rotation of about 40 years. This may be difficult due to high moisture conditions and/or low amounts of cured fuel. Burning during periods of drought and on days when winds are relatively high may be the best strategy.

- Make canopy gaps to simulate partial loss of trees. Gaps should be large enough for light to reach the ground—at least 100 ft X 100 ft. Preferentially remove undesirable trees or trees such as boxelder or exotic species.
- Control woody and herbaceous invasive species

This community occurs in many places scattered across the park. Since large rivers do not occur here, it is probable that many occurrences of this community may resemble a terrace forest but in fact may not be one. There are a few smaller streams in the park, however, and it is likely that the community occurs along them. It is easy to confuse a disturbed wet-mesic area, since very little remains of the native plant community. Further evaluation needs to be conducted to confirm appropriate communities and amend the map/plan. The primary concern for restoration of this community is control of woody exotic species, increasing the diversity of the ground layer, and regenerating appropriate species. Special attention should be focused on the transitional boundaries so as not to develop hard edges between them. Many brush removal activities have already been underway in areas around Jensen Lake, Holland Lake, and south of O'Brien Lake.

NOTE: The native plant communities shown in **Figure 34** have been drawn at a scale of approximately 1:3000 to 1:4000, in addition to being informed by ground truthing. At the time when work units are restored, or proposed to be restored, then they will need to be examined and checked for accuracy, and boundaries minorly adjusted to fit existing conditions including topography, slope aspect, soils, historical aerials, position of trails, etc., but no major changes should be necessary.

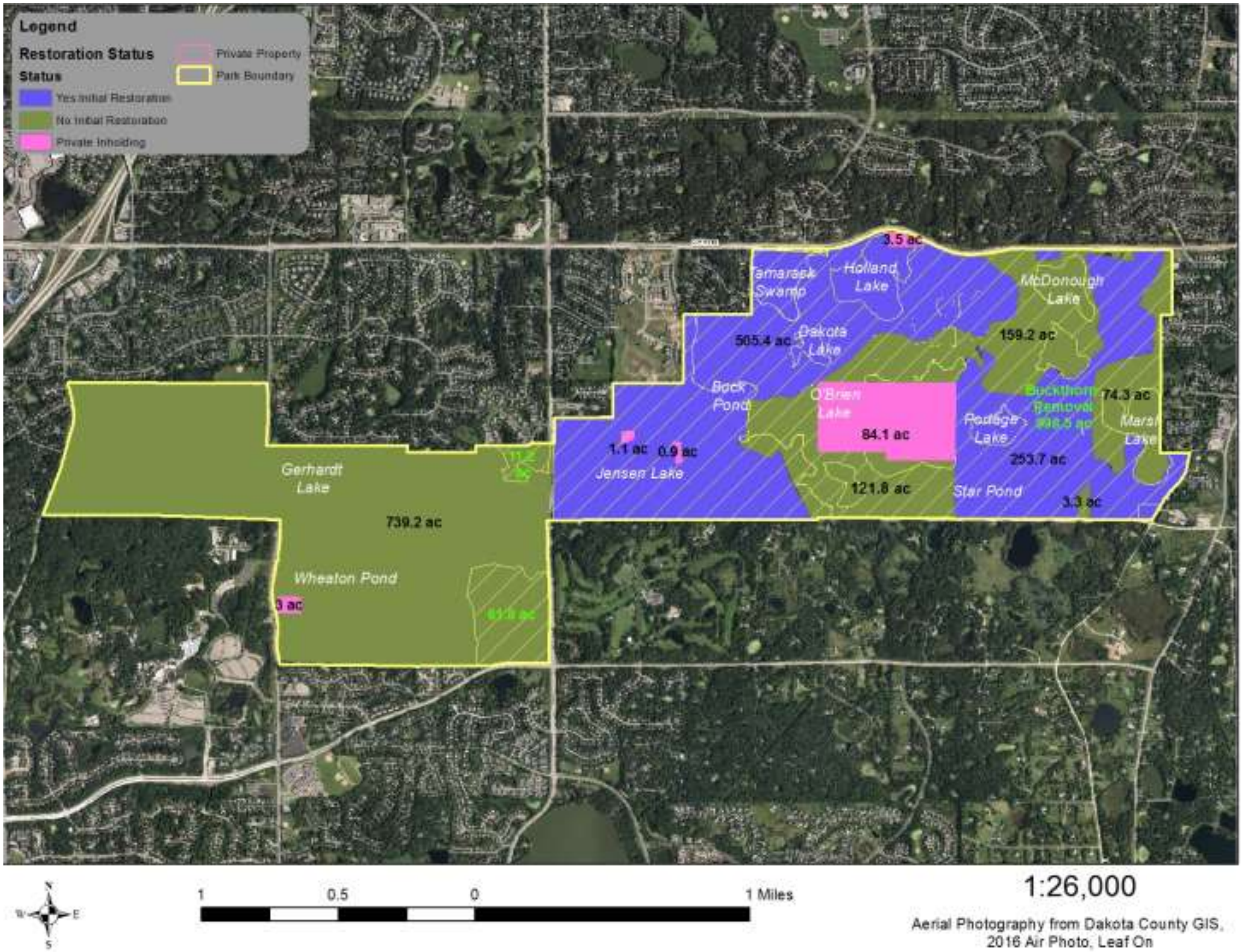


Figure 33. *Restoration Status of LHRP in 2018. Blue areas have started initial restoration under state grants. Green areas have not started initial restoration as of 2018. Hatched areas have been cleared of invasive woody brush as of 2018. Pink areas are private inholdings.*

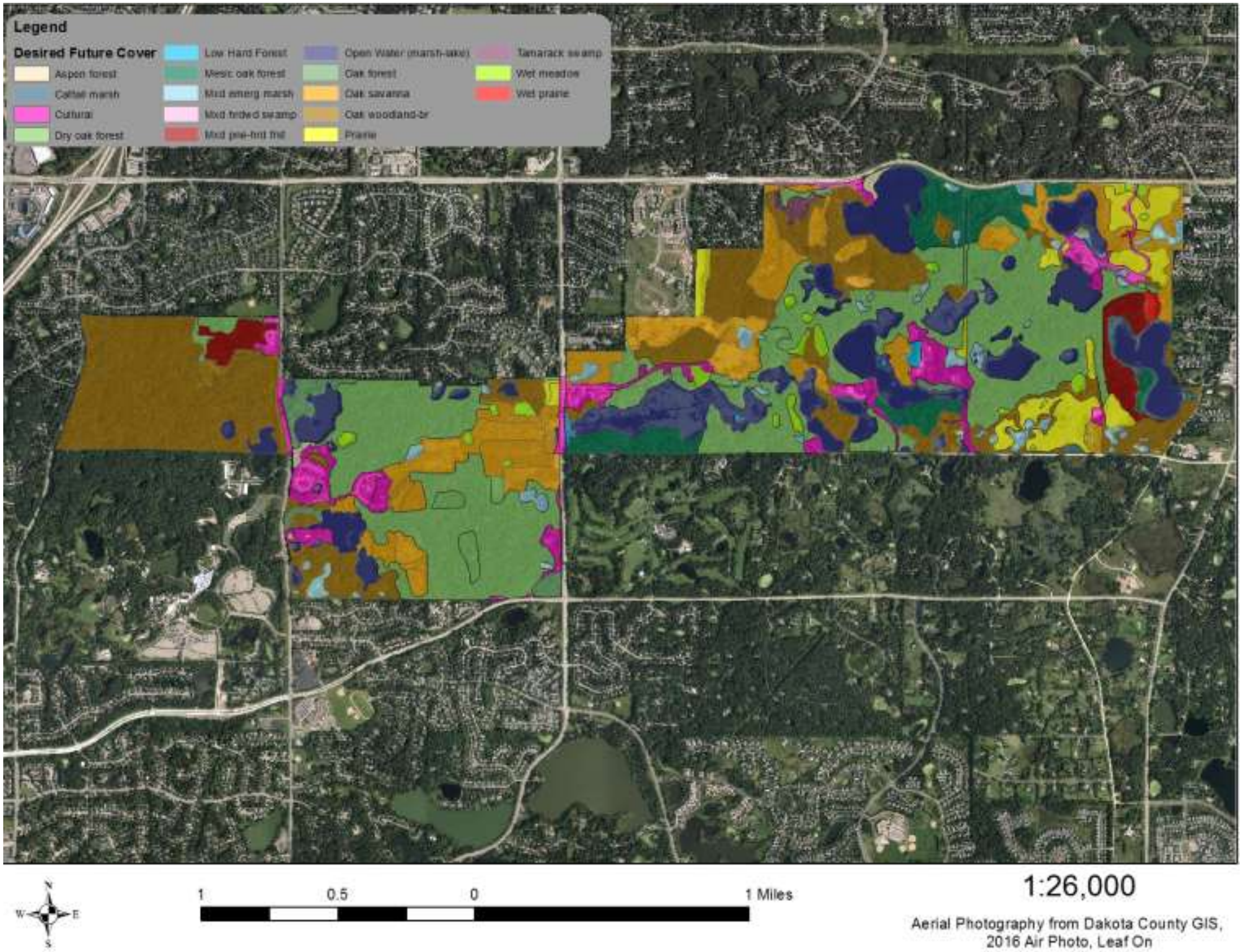


Figure 34. *Lebanon Hills Regional Park Desired Future Cover Type.*

5.3. Goals for Lebanon Hills Regional Park

Ecosystem-Level Management

An ecosystem is the interaction of all the living organisms, the physical/non-living parts, and the natural processes of a particular area. The animals, plants, fungi, bacteria, and protists utilize the non-living (soil, rock, water, air), which are impacted by the processes such as fire, wind, and flood, as well as others, to form a healthy ecosystem.

One consideration is to restore ecosystem processes in order to achieve a "mature" ecosystem. Maturation of ecosystems was described by E. P. Odum (1969) in terms of a whole system, as opposed to distinct communities and species. As described:

> "'immature' ecosystems are characterized, in general, by high production to biomass ratios; an excess of production over community respiration; simple, linear, grazing food chains; low species diversity; small organisms; simple life cycles; and open mineral cycles. In contrast, mature ecosystems, such as old growth forests and remnant prairies, tend to use all their production to maintain themselves and, therefore, have production-to-respiration ratios about equal to one and little, if any, net community production. Production may be lower than in immature systems, but the *quality* is better; that is, plant production tends to be high in fruits, flowers, tubers, and other materials that are rich in protein. Because of the large structural biomass of trees, the production-to-biomass ratio is small. Food chains are elaborate and detritus based, species diversity is high, the space is well organized into many different niches, organisms are larger than immature systems, and life cycles tend to be long and complex. Nutrient cycles are closed; nutrients are efficiently stored and recycled within the ecosystem."

Some ecosystem-level management goals to strive for are:

- *Foster ecological integrity by promoting multi-trophic food webs via the production of edible structures, providing habitat, and regulating nutrient flows*
- *Manage to achieve a shifting patchwork of refugia*
- *Manage to provide intermediate disturbance such as periodic fire (in fire dependent communities), which maximizes niches and bio-diversity*
- *Manage restoration activities to achieve the following: 1) the suppression of undesirable species, 2) the release of desirable species, and 3) the recovery of keystone processes historically imposed by keystone species that maintained desirable species biotic configurations/ecosystems*

Ecological Restoration

Ecological restoration is a long-term process. It takes time to restore ecosystems to their former functionality and diversity. And even under the best circumstances and human abilities, generally, this can only be approximated. It took many decades to degrade the ecosystem and biological communities on the property, so it will not be restored overnight. Many steps are typically involved in a successful restoration; even deciding when a restoration is complete/successful can be very difficult. Restoration should be viewed as a process and not as an end point. Natural communities are not in a static state but are dynamic and everchanging. Therefore the goal of restoration is not a distinct endpoint condition but the attempt to restore individual components and processes that mimic the native community and return it to a more natural dynamism.

The ultimate goal is to achieve and maintain a diverse natural community, though this will not always proceed in a linear fashion. Using the concept of *adaptive management* will be the key to continual progress at the site. Adaptive management (**Figure 35**) is a strategy commonly used by land managers, which integrates thought and action into the restoration process. It can be described as a strategy that uses evaluation, reflection, and communication and also incorporates learning into planning and management. It is set up like a feedback loop and looks like this: Plan/Design → Implement (Do) → Monitor → Evaluate (Learn) → Adjust and so forth. Thus, moving forward with restoration, each round of adaptive management refines and hones the process to better fit the conditions of the site. This strategy should be emphasized in the park.

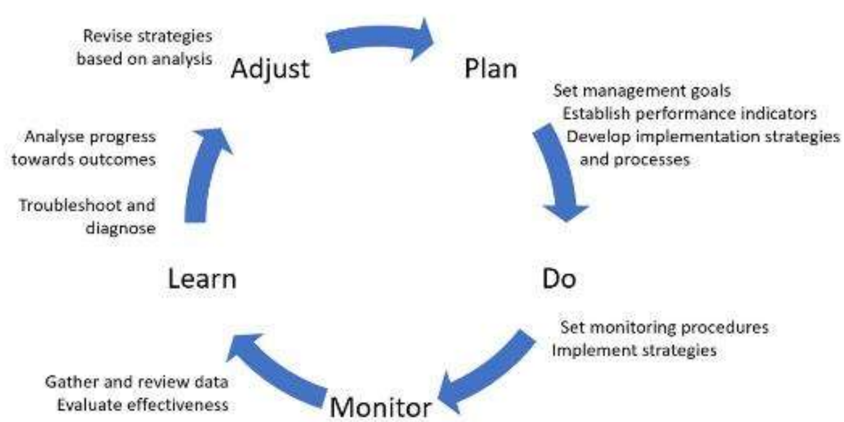


Figure 35. *Adaptive Management cycle ([Jones, G, 2005, 2009]).*

Natural Resource Management Goals

5.3.1. Goal 1: Provide ecological services and improve ecosystem resilience (as outlined in the master plan, 2015).

- *Increasing and maintaining biodiversity*
- *Purifying air and water*
- *Protecting stream and river channels and shores from erosion*
- *Mitigating drought and floods*
- *Dispersing seeds and storing native seed banks*
- *Cycling, moving, storing, and regulating nutrients*
- *Detoxifying and decomposing waste*
- *Conserving soils and renewing their fertility*
- *Hosting pollinator species*
- *Sequestering carbon*
- *Helping moderate weather extremes and their impacts*
- *Managing for mature ecosystems*
- *Restoring ecosystem-level processes*
    - *Natural disturbance*
    - *Historic hydrology*
    - *Hydrologic cycles*
    - *Seed dispersal*
    - *Pollination*
    - *Nutrient cycling*
- *Focusing on restoring food webs. Consider a variety of key pathways that help restore functional diversity, which in turn restores ecosystem function and the capacity of an ecosystem to provide ecosystem services.*

5.3.2. Goal 2: Restore ecosystem processes and maintain and continually enhance the biodiversity of native communities and cultural/visitor-use land cover areas.

<u>Native Community</u>

A native or natural community is an assemblage of plants, animals, and fungi that is more or less associated with each other and adapted to a set of site factors, such as shade, moisture availability, competition, and predation. Typically, many communities comprise an ecosystem. The richer and more diverse a community, the more vibrant and interactive it will be, thus increasing its resilience and resistance to perturbations from the greater environment.

<u>Native Community Objectives</u>:

- *Restore the natural areas in the park to appropriate native plant communities*.

- *Restore natural areas, being mindful of wildlife habitat requirements*.
- *Retain natural patterns and biological legacies in spite of high use and human disturbance.*
- *Use a "phased and stabilized" approach to restoration*. Phase the restoration, with high priority areas addressed first and low priority addressed last. Make sure to stabilize areas that are not being actively restored. To "stabilize" means not to fully restore an area, but not to let it to continue to degrade either. An example is to remove woody invasive plants on a periodic basis, such as every five years.
- *Select project-specific restoration and enhancement techniques that protect existing resources while promoting increased native plant community diversity and function*. For instance, applying prescribed fire at a time of year/season helps avoid or minimize potential risk to fire-sensitive, rare, or unique species of plants and wildlife. Other examples include interseeding, haying, mowing, herbicide applications, and conservation grazing, or a combination of them. Follow the latest science regarding methods and management. Limiting the use of herbicides and pesticides is a general goal, but their judicious use is not opposed. Strive to achieve "soft edges" between work units and land cover types (i.e., blend them together on their borders) in order to avoid "hard edges".
- *Use restoration methods that are based in scientific research and proven appropriate and effective.*
- *Monitor vegetation cover and wildlife for the entire park*. Develop a baseline for the parks vegetation and wildlife prior to and during the restoration process. Give special emphasis to pre- and post-work in restoration and enhancement project areas and adjust management activities as necessary to promote increases in species richness and diversity. Analyze monitoring data annually to detect trends. Periodically evaluate monitoring program and methods and adjust as needed. Consider expanding to monitor more and more species and populations.
- *Update the park's vegetation and wildlife inventory at five-year intervals in preparation for developing the next five-year work plan.*
- *Prevent the spread of invasive species using early detection (monitoring) and rapid response (control) measures.*
- *Control and prevent the spread of tree diseases and pests as much as is feasible*. Oak wilt is prevalent in the park, especially in the East Segment. Diseases should be monitored and controlled using early detection and rapid response methodology.
- *Review proposed private development projects that may impact resources within the park (e.g. cities, pipeline, power companies) and consult with project proposer(s) to avoid, minimize, or mitigate anticipated impacts.* The park should be better after the projects than before.
- *Ensure Natural Resources program staff participation in core planning teams for proposed park improvement projects.*

<u>Cultural/Visitor-Use Land Cover Objectives</u>:

- *Collaborate to increase the biodiversity, educational, recreation quality and aesthetic appeal for park visitors.* Focal areas as per the approved Master Plan vision
- *Identify environmental education opportunities associated with cultural land over areas and develop natural plantings that help provide opportunities and services.*
- *Plan and implement at least one collaborative project each year.*

- *Develop strategy for maintaining ecologically and culturally compatible visual buffers between the park and surrounding landscape and identify priority areas for implementation.*
- *Include project plans and specifications for creating and maintaining a buffer for all projects that involve restoration and enhancement activities along a park boundary.*
- *Develop strategies and priorities for maintaining culturally/visitor-use significant plantings and increasing biodiversity and functional attributes of them.* An example would be maintaining an existing conifer plantation.
- *Implement forest stand management and species diversity improvements in conifer plantation(s) as per **Figure 44** in Section VIII, "Management Recommendations*".
- *Create project plans and specifications for two to three high priority non-native dominated plant community conversions to native plant communities.*
- *Develop project plans for converting all old field areas to target native plant communities.*
- *Review proposed development projects that may impact resources within LHRP (from entities such as Dakota County Parks, cities, power companies) and consult with project proposer(s) to avoid, minimize, or mitigate anticipated impacts.* Evaluate proposed projects through the lens of the visitor experience to maximize the result for the visitor.
- *Evaluate existing trail system and make recommendations for minimizing negative impacts to ecological quality.* Collaborate with groups such as Facilities Management, Minnesota Off Road Cyclists, and Equestrians to improve both the ecological quality and aesthetic experience of the trails and along the trails.
- *Develop specifications for materials to be used for proposed development projects, such as erosion control and appropriate plant species for parking lots, rain gardens, landscaping, and trail border.*

5.3.3. Goal 3: Protect high priority natural features known to occur within the park.

High priority features are remnant native plant and animal communities, populations of rare and declining plant and animal species, hydrological features, or significant geological features.

Species of Conservation Interest and Concern Objectives:

- *Identify important specific habitat features and requirements for rare and declining plant and animal populations in project areas prior to implementing restoration and management activities.*
- *Identify indicator species of conservation concern (rare animal and plant species, SGCN, and species of local conservation interest) that park staff or volunteers can monitor on an annual basis and maintain monitoring observations in a georeferenced database.*
- *Develop additional and expand upon the rare species management recommendations the County is already developing.* Management should be focused on species of conservation interest and concern within the park and surrounding landscape.
- *Continue and expand wildlife surveys and monitoring throughout the park.*

5.3.4. Goal 4: Protect the quality of surface water and groundwater resources.

Surface Water Objectives:

- *Maintain and improve the water resources of the park.*
- *Implement surface water recommendations identified in the 2017 Subwatershed Assessment Study and identify those from the 2007 Barr Plan that have not yet been implemented.*
- *Incorporate vegetation management of wetlands and near-shore habitats for ponds in project grant proposals and specifications.*
- *Monitor conditions of stormwater pollution prevention structures on a regular basis and after major storm events.*
- *Assess the need for erosion control measures for all development, recreation, restoration, and enhancement activities and incorporate Best Management Practices in project specifications.*
- *Evaluate existing and future recreational facilities (including trail system) and make recommendations for minimizing negative impacts to water quality, including best management practices to reduce the impact of impermeable surfaces.*

Groundwater Objectives:

- *Incorporate herbicide application guidelines in all vegetation management activities to prevent groundwater contamination.*
- *Work with surrounding communities/agencies to identify opportunities to protect groundwater resources and promote groundwater recharge in a manner that is supportive of water resources and hydrologic conditions within LHRP.*

5.3.5. Goal 5: Maintain and improve ecological connectivity within the park and the surrounding landscape.

Ecological Connectivity Objectives:

- *Maintain ongoing communications with inholding landowners on natural resources management activities in the park and land protection options.*
- *Provide at least one educational opportunity per year for residents in surrounding neighborhoods to learn about natural resources and stewardship opportunities for their property and neighborhood.*
- *Engage in partnership opportunities for improving ecological connectivity in Dakota County (e.g., Greenway Collaborative, Dakota County Farmland and Natural Areas Program, private landowners) through ongoing staff involvement in communication and planning activities.*
- *Identify native plant community remnants and high-quality ecological areas or sensitive ecological areas.* Protect and connect these areas within the park via restoration projects, signage, education and outreach.
- *Identify wildlife core areas, key habitats, and corridors in and outside of the park.* Identify strategies to establish, improve, connect, or buffer key habitats, e.g., wildlife crossings, enhancing the greenway system for wildlife, and collaborating with adjacent landowners.
- *Connect disjunct plant communities to create larger core habitat.* Consider wildlife crossings over and/or under roads, land bridges, tunnels, and fencing to connect habitat pieces that are divided by roads.
- *Identify all inholdings in the park and, when they are on the market, purchase them as able.* Work with adjacent lands and inholdings, such as Camp Butwin, to help them permanently conserve and manage their natural lands in harmony with park land.

5.3.6. Goal 6: Enhance visitor experience and environmental education associated with park visitor-use features.

Figure 36 is from the master plan (2015) and highlights examples of natural resource management in visitor and recreational areas.

VISITOR AREA	SMALL-AREA RESTORATION PROJECT	ESTIMATED ACREAGE
Visitor Center	Deciduous tree planting	*To be determined*
	Woodland restoration, hill overlooking beach	4
	Prairie restoration, next to Visitor Center," learning prairies" for programs	5
	Wetland restoration connecting Schulze and McDonough lakes	1
Jensen Lake	Hillside restoration	5
	Meadow restoration	14
	Vegetation management between lake trail and north shore	12
	Evaluate iron filter phosphorous removal system in settling pond	*To be determined*
Holland Lake	Vegetation restoration for lake view enhancement	8
Campground	Woodland restoration on hillside overlooking RV loop	8
	Deciduous trees	*To be determined*
	Roadside vegetation buffer (coniferous trees and shrubs)	1
Visitor Center	Short grass prairie - open field	1
	Woodland restoration	9
West Trailhead	Meadow restoration southwest of trailhead	4
	Vegetation buffer along road frontage	1
Southeast Trailhead	Deciduous trees and around trailhead	*To be determined*

Figure 36. *Master Plan Restoration Projects (Source: Master Plan for Lebanon Hills Regional Park, 2015).*

<u>Visitor Experience and Environmental Education Objectives</u>:

- *Identify and scope projects that contribute to increasing biodiversity near high-use areas for visitor awareness of park natural resources and to increasing accessibility for interpretive signs and programs.*
- *Collaborate with internal stakeholders on ongoing development of website content, site signage, and printed materials for awareness and interpretation of the park's natural resources, management, and restoration activities.*

5.4. Significant Native Plant Community Drivers

There are a number of factors that drive the development and composition of plant communities over time. The drivers that are believed to be the most significant to influence restoring and maintaining native plant communities within LHRP are briefly described below. These are overarching factors that apply to all of the management units across LHRP.

Climate Change

In planning for the management of LHRP's natural resources over the next 50 years, it is essential that current and future climate change effects be considered. Although research and information in the field of climate change and our knowledge of impacts to ecosystems and plant and animal species will change as time goes on and more knowledge becomes available, it is wise to consider appropriate adaptation strategies for resource management objectives and actions. Climate change may have an even more profound impact at LHRP, given the park's relative lack of ecological connectivity to other reservoirs of biodiversity in the region.

The temperature in the Twin Cities region has increased by an average of one to two degrees Fahrenheit since the 1980s and is projected to rise another two to six degrees by 2050. This increase may lengthen the growing season. Annual average precipitation has been increasing and is expected to further increase. Precipitation is changing in both quantity and character, with an increasingly larger fraction of precipitation coming during fewer, but more intense rainfall events.

Increased rates of evapotranspiration are anticipated to outstrip modest increases in precipitation, resulting in drier landscapes. It is predicted that the climate in the Twin Cities region in 2060 could resemble that found today in eastern Nebraska. Significant climate impacts directly relevant to water/natural resources at LHRP can be expected to include:

- Increased (stress- and pathogen-induced) tree mortality
- Expansion of weedy/invasive species
- Lower water tables in peatlands

With significant changes in climate expected in the region, successful management of natural resources at LHRP will require adaptive management planning be employed in a manner that enables resilience of natural systems. Resistance, resilience, and facilitation actions are an important first step for effective climate change planning.

Invasive, Nonnative Species

Terrestrial nonnative species have increasingly expanded at LHRP over the course of decades and are a significant force in degrading the composition, structure, and function of native habitats at LHRP. The size of individual species populations and the extent to which individual species pose future threats to the park's natural systems vary by species.

By far the most significant terrestrial invasive plant issue at LHRP is common buckthorn (*Rhamnus cathartica*) which is dominant throughout most of the park and forms nearly continuous cover in the shrub layer.

Within wetland areas, the nonnatives reed canary grass (*Phalaris arundinacea*) and hybrid/narrowleaf cattail (*Typha x glauca*, *T. angustifolia*) are present in varying amounts in wetlands with a history of hydrologic disturbance, sedimentation, nutrient loading, and other factors.

Other species that are present in lesser amounts that still pose risks to native plant communities include:

- Glossy buckthorn (*Frangula alnus*) – present in relatively small amounts and primarily associated with wetland areas
- Japanese hedge parsley (*Torillis japonica*) – a highly invasive biennial that occurs in several locations in the park
- Garlic mustard (*Alliaria petiolata*) –present in varying amounts within the park but generally in low amounts compared to similar sites in the region; it is present in large numbers in relatively small areas within the park
- Honeysuckle (*Lonicera tatarica, L. bella, L. morrow, L. xylosteum*.) – present in relatively small numbers compared to common buckthorn but still present and a contributor to lower quality in woodland areas
- Leafy spurge (*Euphorbia esula*) - populations have remained small and localized in recent decades
- Canada thistle (*Cirsium arvense*) - relatively small populations within the park
- Spotted knapweed (*Centaurea stoebe*) - small populations on drier, sand-gravel soils
- Oriental bittersweet (*Celastrus orbiculatus*)
- Black locust (*Robinia pseudoacacia)*
- Siberian elm (*Ulmus pumila*)
- Common burdock (*Arctium minor)*
- Smooth brome grass (*Bromus inermis)*
- Bull thistle (*Cirsium vulgare)*
- Crown vetch (*Coronilla varia*)
- Quack grass (*Elytrigia repens)*
- Dame's rocket (*Hesperis matronalis)*
- Exotic mustards (*Brasicaria* family)
- Common toadflax (*Linaria vulgaris)*
- Bird's foot trefoil (*Lotus corniculatus)*
- Purple loosestrife (*Lytrhum salicaria)*
- Alfalfa (*Medicago sativa)*
- White sweet clover (*Melilotus alba)*
- Yellow sweet clover (*Melilotus officinalis)*
- Curly dock (*Rumex crispus)*
- Kentucky blue grass (*Poa pratensis)*

- Mullen (*Verbascum thapsus)*
- Foxtail grasses (*Setaria spp.)*
- Bittersweet nightshade (*Solanum dulcamara)*
- Amur maple (*Acer ginnala)*
- Norway maple (*Acer platanoides)*
- Autumn olive (*Eleagnus angustifolia*)
- Winged euonymus (*Euonymus alatus*)
- White mulberry (*Morus alba*)
- European mountain ash (*Sorbus aucuparia*)
- Queen Anne's lace (*Daucus carota)*
- Orchard grass (*Dactylis glomerata)*
- Barnyard grass (*Echinochloa muricata)*
- Wild parsnip (*Pastinaca sativa)*
- Common tansy (*Tanacetum vulgare)*
- Timothy (grass) (*Phleum pratense)*
- Siberian peashrub (*Caragana arborescens*)

Several invasive, nonnative plant species are not yet present in the park but are known to occur in areas near the park. A good source to check whether species have been reported in the park is EDDMaps (Early Detection and Distribution Mapping System, https://www.eddmaps.org/). The following is a list of plants that may or may not be in the park; and, if they are not, early detection and rapid response should be employed if they are detected.

- Russian olive (*Eleagnus angustifolium*)
- White poplar (*Populus alba*)
- Multiflora rose (*Rosa multiflora*)
- Amur cork tree (*Phelodendron amurense*)
- Soapwort (*Saponaria officinalis)*
- Common reed grass (*Phragmites australis*)

Aquatic invasive species observed within LHRP include curlyleaf pondweed (*Potamogeton crispus*) and Eurasian watermilfoil (*Myriophyllum spicatum*), both of which are described in greater detail in the AIS assessment report (2017). Purple loosestrife (*Lythrum salicaria*), zebra mussels (*Dreissena polymorpha),* and other invasive, nonnative aquatic plant and animal species could be transported to the park on trailered boats and equipment, bait containers, or other vectors. Common reed grass (*Phragmites australis*) is another aquatic exotic invasive herbaceous plant to watch out for.

LHRP is known to have several terrestrial nonnative, invasive animal species such as night crawlers (*Lumbricus terrestris*) and other worm species. Such worms degrade herbaceous plant communities, especially in the hardwoods. No complete assessment has been made in local reference hardwood communities to measure the impacts these nonnative worm populations have on native plant communities. Currently, there are no known widespread control methods for nonnative earthworms.

Invasive species prevention and management within the park focuses on locating occurrences of these species, preventing their spread, and disseminating information to park visitors regarding invasive species to help prevent introduction of new species. Invasive species and “Stop Aquatic Hitchhiker” signs are posted at all park boat access points, brochures are distributed to visitors at the park’s contact stations, park staff discuss invasive species prevention and management with visitors when opportunities arise, and visitors are encouraged to report questionable species to park personnel for identification. In addition, the concessionaires who operate the park’s boat and canoe rental are trained in aquatic invasive species identification and control and also provide information regarding invasive species to their customers.

In areas of active restoration, efforts should be made to regularly conduct invasive plant surveys and mapping (recommended minimum annual walking survey and annual or biennial mapping). Early detection of invasives should be conducted by Dakota County Park ecologists and volunteers, and early detection websites such as the invasives Early Detection & Distribution Mapping System should be monitored for new reports, especially for emerging invasives.

Historically Important Processes

As previously mentioned in the NRMP, historically, there were a variety of landscape-scale processes that were important for maintaining native plant communities in the region. Most notable of these were large grazers (e.g., elk, bison) and fire. While grazing may be considered in select instances, this tool is less likely to be applied on a broad scale at LHRP (should grazing be considered, a formal grazing plan should be developed for each unit/area where this tool is intended to be applied).

Prescribed fire, on the other hand, is a tool that can be feasibly applied on a regular and relatively widespread basis at LHRP. In the case of LHRP, fire can play an important part in reducing invasive brush levels and increasing native herbaceous species richness and total cover. Oak woodlands, savanna, and prairie are adapted to fire and depend on fire as well as other perturbations to sustain them. It is quite possible that during early phases of restoration some areas may benefit from the application of frequent prescribed fire (every one to four years).

Native Plant Species Richness

One of the most significant lingering results of land use during the last 150 years was the simplification of the plant species composition of the herbaceous layer (grasses, sedges, rushes, and forbs) at LHRP. The reduction in native plant species richness came, generally, at the expense of species of plants that tend to be intolerant of disturbance such as incompatible levels of historic grazing. Over time, LHRP has also become increasingly isolated from other remnant native plant communities, meaning the previously displaced native plant species have no practical way of recolonizing LHRP.

Restoring diverse, stable, and resilient plant communities at LHRP will depend on thoughtfully considering what species of plants would historically have been present that are currently missing from the park flora to make sound decisions about whether to reintroduce those species, as well as what source of ecotypic plant materials will be acceptable for such reintroduction efforts. Diversity (plant species richness in this case) imparts stability and, as such, is an important driver for the recovery of quality plant communities at LHRP

5.5. Sensitive Wildlife Populations

The overall intent to manage native vegetation at LHRP as a mosaic of habitats identified in the Desired Future Cover Type maps is generally compatible with sustaining a variety of both common and unique wildlife species. However, some groups of wildlife (e.g., insects) and some individual species deserve special consideration. As a result, resource managers should be aware of and follow Best Management Practices to avoid doing significant harm to species of wildlife that may be rare, unique, and/or sensitive to the (spatial and/or temporal) application of any particular resource management tool.

For instance, some species of habitat-obligate insects (e.g., prairie obligate butterflies) can be especially sensitive to fire that is applied across an entire habitat type during a period when they may be especially vulnerable. Resource management activities should be planned to allow for refugia for species of wildlife that may be restricted to small areas of habitat, are generally immobile, or are otherwise susceptible to increased mortality due to management activities. Likewise, Parks natural resources staff should be consulted during the planning, design, and construction of development projects in the park to minimize the risk of negatively impacting sensitive species of wildlife.

A specific example is Blanding's turtles, which are susceptible to mortality during periods when they travel to/from nesting sites including crossing roadways. Managing for Blanding's turtles should include taking into account factors such as when prescribed burns are conducted and working with local and County roadway managers to identify opportunities to make road infrastructure more compatible with sustaining Blanding's turtles (e.g., installing wildlife crossings as roads are maintained/upgraded). The Minnesota, Wisconsin, and Michigan DNRs all provide guidance on Best Management Practices for Blanding's turtles.

Minnesota DNR Blanding's turtle Fact Sheet
Wisconsin DNR Blanding's turtle Fact Sheet
Michigan DNR Blanding's turtle Fact Sheet

Refer to **Table 29** for a list of other sensitive species that are in the park.

Staff must manage for the native community while being mindful of individual species, especially the following: Species of Greatest Conservation Need, keystone species, umbrella species, Species of Local Conservation Interest, and priority features.

PARK MANAGEMENT UNITS

The Desired Future Cover Type map and other factors were utilized to develop Management Segments, Units, and Work Units within LHRP (**Figure 37**). The configuration of management Work Units is intended to reflect pragmatic ways of looking at the nexus of a variety of natural and cultural/visitor-use resource factors, including:

- Past land use
- Current condition of natural areas
- Water resources
- Recent ecological restoration activities
- Anticipated future ecological restoration activities
- Infrastructure within the park
- Current and future potential recreational/educational uses
- External factors/drivers

The evaluation resulted in LHRP being divided into three major Management Units or Segments (East, Center, and West). These larger units were then further divided into subunits, called Work Units, based on factors that drive water/natural resources at the scale of each unit.

Desired Future Cover Types (which could also be referred to as "Target Communities") at LHRP (**Figures 34**) were defined based on a variety of ecological and cultural features intended to facilitate sound and efficient resource management including trails/roads, water features, Native Plant Community Types, and topography. See the maps in **Figures 38** and **39**, for illustrations of the Target Native Plant Communities within the park management units.

Figure 37. *Lebanon Hills Regional Park Management Units.*

5.6. East Management Segment

5.6.1. Description

The East Management Segment at LHRP (**Figure 38**) is situated between Dodd Road on the east and Pilot Knob Road on the west. This segment is by far the largest segment in LHRP at approximately 1,200 of the park's 1,869 acres, representing nearly two-thirds of the land base of the park. Likewise, the East Management Segment has the most management work units within the park at thirteen. It includes the most private inholding parcels (10 parcels totaling approximately 95 acres).

Consistent with other areas of LHRP, soils are largely loam to sandy loam in upland areas that tend to be well drained (dry). The topography is moderately to sharply rolling with irregular, rounded hills and kettle-like depressions.

5.6.2. Recreation Elements and Facilities

The East Management Segment at LHRP supports a significant number of facilities:

- Lebanon Hills Visitor Center Campus
- Schulze Lake Beach
- Jensen Lake Picnic Shelter
- Holland Lake Picnic Area
- Southeast Equestrian Trailhead

This unit also hosts significant recreational activities for the park, including picnicking, hiking, cross-country skiing, horseback riding, environmental education, a beach, boating, and canoeing. While recreational activities within this segment of the park are largely compatible with sustaining water/natural resources, resource stressors may include trail erosion, spread of invasive, nonnative plants along trail corridors, and surface water runoff.

5.6.3. Plant Communities Summary

The East Management Segment is characterized by the abundance of lakes (and deep marshes), wetlands, oak-dominated woodlands and forests, remnant prairie, and one tamarack swamp. The East Management Segment also has the largest amount of reconstructed prairie (former crop ground) and one large pine plantation on the southeast side of the segment.

Substantial efforts have been made in recent years to initiate ecological restoration of remnant native plant communities (especially oak woodland, forest, and savanna and the tamarack swamp just west of Holland Lake.

A number of historically disturbed areas in the East Management Segment are characterized by a mix of plants that are capable of readily colonizing human-disturbed landscapes; most often these are altered, nonnative-dominated woodland areas. These areas are generally guided toward woodland and savanna. The conifer plantation (24 acres) on the southeast side of the East Management Segment is guided toward a long-term transition to pine-hardwood forest with the anticipated transition to a mix of oak-pine and then eventually to a fire-dependent oak-dominated system over the course of perhaps 50 to 100 years, depending on how this system responds to management activities and external forces such as shifts in temperature and precipitation patterns.

Although much of the land area in any particular unit will need active restoration, there are some areas that are in good or better condition and thought to require little in the way of initial restoration or even ongoing management. For instance, there are numerous wet meadows that are in good or very good condition; based on the minimal amount of outside influences on these areas it is anticipated that little or no restoration/management will be required in these areas.

In contrast, areas with significant nonnative infestation and/or areas that currently lack native species composition, lack desired three-dimensional structure, or have limited ecological functionality will require substantial amounts of effort to restore (e.g., nonnative-dominated woodlands, pine plantations, reed canary grass-dominated wetlands). **Table 33** summarizes anticipated restoration acres by desired future cover type.

SUMMARY EAST MANAGEMENT SEGMENT

Restoration Cover Type	**Acres**
Terrestrial woodland/forest/savanna*	1,104.2
Mixed pine-hardwood forest	23.6
Prairie	85.1
Wet meadow	15.7
Lake management	251.8
TOTAL	**1,339.4**

Table 33. *East Management Segment Desired Future Cover Type Summary*

5.6.4. Invasive Species

The East Management Segment includes a number of invasive, nonnative plant species of note. Below is a brief summary of the most prominent of these present in the East Segment of LHRP. In areas of active restoration, efforts should be made to regularly conduct invasive plant surveys and mapping (recommended minimum annual walking survey and annual or biennial mapping). Early detection of invasives should be conducted by Dakota County Park ecologists and volunteers, and early detection websites such as the invasives Early Detection & Distribution Mapping System should be monitored for new reports, especially for emerging invasives.

Woodland Decline

“Woodland decline” is a relatively recent phenomenon. It is the result of three primary factors: 1) exotic earthworm invasion coupled with 2) the invasion of exotic buckthorn and exotic honeysuckle coupled with 3) over-grazing/browsing. Species of large earthworms have not been native to the northern part of the U.S. since the last glaciation drove them southward over 10,000 years ago. During the last century, epigeic (litter dwelling), endogeic (soil dwelling), and anecic (deep burrowing) species of earthworms (Frelich and Holdsworth, 2002) have been introduced (primarily as cast-off bait from anglers). Since then, they have become established and are very widespread in our native woodlands and forests. These species move into new areas in waves, one species following another, with ultimately the largest worms, night-crawlers (*Lumbricus terrestris)*, invading and establishing. Recently, Asian jumping worms (*Amynthas agrestis, A. tokiensis)* are starting to invade Midwestern woodlands too. Where soils/systems have evolved without them, these earthworm species, contrary to popular opinion, are not good for the soil: they tunnel into the top layers of soil and ravenously consume large amounts of leaf litter. The result of their activities is a net soil compaction and a marked increase in the duff layer turnover rate (the time it takes for the litter layer to be decomposed and turn into humus). Thus, where there used to be several inches of light, fluffy duff layer in our native forests and woodlands, now there is only a trace or often none at all, with compacted, bare soil prevalent. This situation can then lead to detrimental impacts on surface water, due to increased erosion and nutrient runoff from affected areas into nearby lakes and streams.

The lack of duff layer and soil compaction have negative ramifications on native forb populations, especially spring ephemerals, which have evolved under conditions that provide thick, fluffy duff layers. Thin duff layers have another important repercussion: common buckthorn seeds readily germinate in bare soil and in a thin layer of duff. Thus, once buckthorn is introduced to an area that has been "wormed", it easily becomes established, which spells yet greater degradation to the woodland ecosystem. Once a few large seed-producing trees take hold in an area, a virtual carpet of buckthorn seedlings will radiate outward from each "mother plant", thus displacing or preventing native plants from re-establishing these areas. The berries of buckthorn (and exotic honeysuckles) are dispersed by birds throughout the woodland. Trees that offer perches for birds are typically choked with buckthorn plants growing under their crowns. Hence, buckthorn can rapidly come to dominate a vulnerable woodland or forest, in a matter of 30 to 50 years (a "blink of an eye" in terms of ecological time scales).

The third factor of the woodland decline is over-browsing/over-grazing. Areas that were pastured by cattle received heavy grazing pressure that was unknown previously. Native grazers would move around often and not concentrate on one plot of land for longs periods of time. This allowed for a very diverse forb layer to thrive. With the advent of cattle, introduced by Euro-Americans in the last century and a half, that grazing pattern changed since cattle will concentrate their grazing much longer and their impacts are much greater. Many of the native forbs simply cannot endure this new pressure.

Today, browsing, not grazing, probably has a greater impact on our woodlands, since the major browsers are deer. Deer populations have greatly increased over the last century due to both direct and indirect causes. The indirect cause is the vast amounts of agricultural land that has been created at the expense of native forest, woodland, savanna, and prairie. The direct cause is the active management for deer hunting by wildlife managers. It is well known that deer prefer "edge" habitat (areas of land with large amounts of long, linear forest/woodland edge) so they can use both the open areas to feed and the wooded areas for cover. Fragmentation of forests and managing for large gaps and lots with linear woodlands have greatly increased the "edge effect" in Minnesota. This, plus the elimination of large predators like the wolf, has resulted in an explosion in the deer population within the last 75 years. Deer, although they will eat them, do not prefer buckthorn or exotic honeysuckle—if given the choice they prefer many of the native forbs, shrubs, and tree seedlings. Therefore, this greatly increases the browsing pressure on the few natives that can survive earthworm and buckthorn invasions. One result that was noticed at this site is the lack of oak regeneration, typical of such woodlands.

Lastly, the lack of fire due to fire suppression, over the course of the last century and a half, has also negatively impacted the ecosystems of our native woodlands and savannas. Fire acts to kill small woody seedlings that might otherwise grow into mature trees and shrubs, thus keeping the understory of woodland and the ground layer of savannas open. Because of this, wildflowers, grasses, sedges, and ferns can thrive. When fires burned across the landscape (then often encouraged by Native Americans), a very diverse and varied herbaceous ground layer flourished under our woodlands and savannas, with hundreds of species occurring. Today, because of a lack of fire, woodlands have succeeded to forests and savannas to woodlands. Adding in the other three factors, earthworms, buckthorn, and deer, results in a degraded, vulnerable ecosystem, with only a few species remaining that can survive the onslaught.

The upshot of this discussion is that, due to several factors over the last 150 years, our woodlands and forests in Minnesota have undergone a transformation, one of vulnerability, degradation, and decline. The woodlands and forests of LHRP are typical of this situation. They have been invaded by earthworms, invaded by buckthorn, and over-browsed by livestock and deer. They have also been transformed by fire suppression. The bare soil and sedimentation accumulations at the bases of slopes are just one effect of this situation, which has developed over the course of the past 150 years and will not be easily reversed. However, with proper, well-timed management, restoration of LHRP woodlands is possible and likely (see Management Recommendations section below).

5.6.5. Wildlife

The East Management Segment supports the largest, most contiguous set of habitats at LHRP. As a result, it also supports the largest number of species that are State-listed, SGCN, or considered to be of local interest by Dakota County Parks staff. See **Table B1** in **Appendix B** and Segment 3.5.3 for species confirmed in the park.

Managing the natural areas at LHRP as a mosaic of identified habitats is generally beneficial to sustain a variety of wildlife. However, some of these species deserve special consideration, and resource managers should consult by-species Best Management Practices to avoid doing significant harm to species of wildlife that may be rare, unique, and/or sensitive to the (spatial and/or temporal) application of a particular resource management tool.

5.6.6. Water Resources

The East Management Segment supports the largest concentration of wetlands, lakes, and water resources within LHRP, including the broadest array of wetland types and fourteen water bodies ranging from deep marshes to shallow lakes to Holland Lake which has a depth of 60 feet.

Of the larger water bodies, five priority lakes in the park were studies in the LHRP Subwatershed Assessment Report (2017). These include Jensen, O'Brien, Schulze, McDonough, and Holland Lakes.

Below is a summary of the results and recommendations for each of the LHRP priority lakes, along with general recommendations.

Jensen Lake

- *Historic monitoring data for Jensen Lake indicates the lake is currently meeting State water quality standards and the 35 µg/L LHRP shallow lake TP target established for this study.*
- *Recent SAV surveys (2016) for Jensen Lake suggest the lake has a relatively abundant and diverse plant community and no observed AIS.*
- *Modeling results suggest TP loading to Jensen Lake is driven by watershed runoff (54%) followed by sediment (28%) and atmospheric (18%) inputs.*
- *This study set a TP load reduction goal of 10 percent (7 pounds per year) to ensure the lake continues to meet the LHRP shallow lake TP target.*
- *Based on historic monitoring data and model results, protection efforts for Jensen Lake should focus on reducing watershed TP loads, protecting the current SAV communities, and AIS prevention.*
- *Three potential BMPs were in the Jensen watershed (LHRP Subwatershed Assessment 2017), including two regional stormwater treatment practices (REG-5 and REG-6) and one trail crossing maintenance/repair project (3J). If all three of these projects were implemented, TP loading to Jensen Lake would be reduced by approximately eight pounds per year.*

O'Brien Lake

- *Historic monitoring data for O'Brien Lake indicates the lake has exceptional water quality and is currently meeting State water quality standards for TP, chlorophyll-a, and Secchi depth. With a historic average TP concentration of 22 µg/L, O'Brien Lake also currently meets the LHRP shallow lake TP target established for this study.*
- *Modeling results suggest TP loading to O'Brien Lake is driven by watershed runoff (49%) followed by inputs from upstream lakes and atmospheric deposition (both 21%) and the sediments (9%).*
- *This study set a TP load reduction goal of five percent (2 pounds per year) for O'Brien Lake.*
- *This goal is based on MPCA guidance for protecting lakes that currently meet State water quality standards.*
- *Based on historic monitoring data and model results, management efforts for O'Brien Lake should focus on reducing watershed TP loads and protecting/ enhancing water quality in upstream lakes (primarily Jensen).*

Additional Water Resource Recommendations in the Plan

- *Schulze, McDonough, and Holland Lakes currently have AIS that covers over 39 percent of the lakes' surface area. However, density of existing AIS in these lakes is relatively low, suggesting chemical treatments may not be necessary at this time. That said, FQI scores for four of the five priority lakes do not currently meet state thresholds.*
- *It is recommended that the County continue to perform annual SAV surveys to track trends/changes in AIS and general SAV community health over time and to reassess the need for treatments in the future.*

5.6.7. Management Work Units of the East Segment

There are fourteen subunits, or work units, and one private inholding within the East Management Segment of the park (**Table 34**).

Manage-ment Unit	Work Unit	Acres	Dominant Feature	Management/Restoration Overview
EAST	E-1	123	Buck Pond, Jensen North	Large work unit with a mosaic of relatively fire-dependent communities; roughly follows the boundaries of the Buck Pond Pond & Prairie project (2015-18) located north of Jensen Lake. *Oak Savanna: 50 acres* Spot treat exotics; Rx burn on a 2- to 7-year rotation (2 or 3 burn units). *Oak Forest (dry-mesic): 35 acres* Control exotic resprouts and seedlings; tend canopy gaps; Rx burn on a 20-year rotation (1 or 2 burn units). *Oak Woodland-Brushland: 18 acres* Control exotic resprouts and seedlings; burn on a 10-year rotation (1 burn unit). *Wet Meadow: 7 acres* Control herbaceous exotic species such as reed canary grass, exotic mustards, hybrid cattails; allow to drawdown occasionally; burn during periods of extreme drought. *Prairie (mesic): 7 acres* Spot treat exotics; Rx burn on a 2- to 5-year rotation. *Mixed Emergent Marsh: 5 acres* Control RCG and hybrid cattails; burn edges occasionally with surrounding units. *Cultural Areas: 13 acres* Remove invasive woody plants; control other exotic plant species; evaluate for hazard trees; replace hazard trees and dead trees to provide for shade—species selection from adjacent NPC; evaluate turf areas and naturalize some areas as possible to reduce turf; enhance open

Management Unit	Work Unit	Acres	Dominant Feature	Management/Restoration Overview
				areas with a variety of colorful forbs; tend raingardens.
EAST	E-2	62	Dakota Lake Area 2	*Oak Woodland-Brushland: 32 acres* May actually be more of a mosaic of woodland and savanna. Control exotic resprouts and seedlings; burn on a 10-year rotation (1 or 2 burn units). *Oak Savanna: 1 acre* Lump with oak savanna in E-3 to the east.
EAST	E-3	26	Tamarack Swamp	Roughly follows the boundary of the Tamarack Swamp Project (2016-19). *Rich Forested Conifer Swamp: 7 acres* Do not allow to burn, if possible, to protect tamarack trees. Occasional burns occurred historically, so if occasional burns occur, it's allowable. Spot treat exotic woody brush and undesirable native woody species; control herbaceous exotic plants; monitor for tamarack regeneration; monitor plant community response to restoration; monitor hydrology levels. *Oak Woodland-Brushland: 10 acres* Control exotic resprouts and seedlings; burn on a 10-year rotation (1 burn unit) that can be lumped with adjacent work unit E-4. *Oak Savanna: 5 acres* Spot treat exotics; Rx burn on a 2- to 7-year rotation (2 burn units) that can be lumped with adjacent work unit E-4. *Dry-Mesic Oak Forest: 4 acres* Conduct woodland burns on a 20-year rotation (1 burn unit); evaluate understory response; supplemental seed as necessary and/or canopy gaps. *Cultural/Visitor-Use Areas: 2 acres* Maintain fringes of the work unit; monitor for invasives.

Management Unit	Work Unit	Acres	Dominant Feature	Management/Restoration Overview
EAST	E-4	84	Dakota Lake Area 1	Roughly follows the boundary of the Dakota Lake 1 project (2017-20) plus the east side of Holland Lake. This work unit is a mosaic of oak woodland and oak savanna on the west and south side of Holland Lake, and oak forest on the east side of Holland. *Oak Woodland-Brushland: 36 acres* Control exotic resprouts and seedlings; burn on a 10-year rotation (3 or 4 burn units) that can be lumped with adjacent work units E-2 and E-11. *Oak Savanna: 32 acres* Control exotic resprouts and seedlings; burn on a 10 year rotation (2 burn units) that can be lumped with adjacent work units E-3 and E11. *Dry-Mesic Oak Forest: 2 acres* Two units. Conduct woodland burns on a 20-year rotation; lump with adjacent work units E-3 and E6; evaluate understory response; supplemental seed as necessary and/or canopy gaps. *Mesic Oak-Basswood Forest: 9 acres* Located east of Holland Lake; spot treat and control invasives; Rx burn on a rotation of 35 years that can be lumped with adjacent work unit E-6. *Oak-Aspen Forest: 3 acres* Remove and control invasive exotic brush; Rx burn on an 18-year rotation. *Cultural Areas: 2 acres* Maintain reconstructed areas on fringes of unit; monitor for invasives; maintain raingardens; consider converting portions of mowed turf to a bee lawn.
EAST	E-5	35		Tightly follows the open water of Holland Lake

Manage-ment Unit	Work Unit	Acres	Dominant Feature	Management/Restoration Overview
			Holland Lake	*Large Lake: 35 acres* Treat the littoral areas near shore together with the shoreland restoration project (2019-22). Continue to monitor water quality; monitor fish populations; monitor lake levels.
EAST	E-6	54	Round Top	*Mesic Oak Basswood Forest: 23 acres* Located in the north portion of work unit. Remove exotic brush; spot treat and control invasives; Rx burn on a rotation of 35 years (1 or 2 burn units) that can be lumped with adjacent work units E-5 and E-7. *Dry-Mesic Oak Forest: 19 acres* Located in the southern portion of work unit. Remove exotic brush; conduct woodland burns on a 20-year rotation (1 or 2 burn units); can be lumped with adjacent work units E-5 and E-10; evaluate understory response; supplement ally seed as necessary and/or canopy gaps. *Oak Woodland-Brushland: 3 acres* Remove exotic brush; control exotic resprouts and seedlings; burn on a 10 year rotation (1 burn unit). *Oak Savanna: 7 acres* Control exotic resprouts and seedlings; burn on a 10 year rotation (1 burn unit). *Mixed Emergent Marsh: 1 acre* At least two units. Control RCG and hybrid cattails; burn edges occasionally with surrounding units. *Wet Meadow: 1 acre* At least one unit. Control herbaceous exotic species such as reed canary grass, exotic mustards, hybrid cattails; allow to drawdown occasionally; burn during periods of extreme drought.

Manage-ment Unit	Work Unit	Acres	Dominant Feature	Management/Restoration Overview
EAST	E-7	142	Visitor Center, Schulze, McDonough Lakes	*Mesic Oak Basswood Forest: 15 acres* Located in the northwestern portion of work unit. Remove exotic brush; spot treat and control invasives; Rx burn on a rotation of 35 years (1 burn unit) that can be lumped with adjacent work unit E-6. *Oak Savanna, mesic and dry: 34 acres* Long narrow band surrounding McDonough Lake and adjoining to the eastern boundary. Transitionary between prairie and wetlands. Control exotic resprouts and seedlings; burn on a 10 year rotation (3 to 4 burn units). *Prairie, mesic: 33 acres* Spot treat exotics; Rx burn on a 2- to 5-year rotation; overseed with forbs to increase forb density and diversity. The Maintenance Shop will be relocating to the NE corner of this work unit. Native landscaping and raingardens should be installed to naturalize with surrounding plant communities. *Large Lakes: 31 acres* Restore the littoral and near shore areas. Continue to monitor water quality and dissolved oxygen levels; monitor fish populations; monitor lake levels. Control AIS. Educate and reach out to visitors regarding restoration and management efforts. *Mixed Emergent Marsh: 8 acres* At least 7 units. Control RCG and hybrid cattails; burn edges occasionally with surrounding units. *Oak Woodland-Brushland: 4 acres* Control exotic resprouts and seedlings; burn on a 10 year rotation (1 burn unit). *Lowland Hardwood Forest: 1 acre*

Manage-ment Unit	Work Unit	Acres	Dominant Feature	Management/Restoration Overview
				Two units. Control exotics; consider converting to either wet meadow or forested swamp. *Wet Prairie: 1 acre* At least two units. Control exotics; seed with wet prairie mix; spot treat exotics; Rx burn on a 2- to 5-year rotation that can be lumped with adjacent upland prairie. *Cultural/Visitor-Use Areas: 15 acres* Very large area. Contains the Visitor Center, three parking lots, driveway, picnic areas, sledding hill, swimming beach, canoe/kayak rental and more. Natural plantings were installed in fall of 2018; maintain these areas. Plant/seed forbs along road to make showier. Work with Visitor Services staff to enhance opportunities for visitors, students, and volunteers who frequent the work unit. Educate and reach out to visitors regarding restoration and management efforts.
EAST	E-8	71	Marsh Lake	*Mixed Pine-Hardwood Forest: 24 acres* Maintain long-term as a mixed pine-hardwood forest. Thin conifers, leaving best individuals for seed trees. Plant a diversity of understory species appropriate to the community. Burn on a 15-year rotation (1 or 2 units). Seed over black to increase diversity. *Large Lake: 27 acres* Restore the littoral and near shore areas of Marsh Lake. Continue to monitor water quality and dissolved oxygen levels; monitor fish populations; monitor lake levels. Control AIS. Consider stocking piscivorous game fish (work with DNR) to balance fish populations. Work with nearby neighborhood (outside of park) to install raingardens on their property that would reduce stormwater runoff into the lake.

Manage-ment Unit	Work Unit	Acres	Dominant Feature	Management/Restoration Overview
				Cattail Marsh: 9 acres Located around the perimeter of Marsh Lake. Control RCG and hybrid cattails; burn edges occasionally with surrounding units. *Oak Savanna: 4 acres* Located in northeastern corner of work unit. Control exotic resprouts and seedlings; burn on a 10 year rotation (1 burn unit); manage smoke from blowing on homes to the east (east-wind component). *Wet Prairie: 3 acres* This is one of the largest wet prairie units in the park. At one time, probably more of the area around Marsh Lake was wet prairie. Control exotics; evaluate for seed bank recovery; seed with wet prairie mix if necessary; spot treat exotics; Rx burn on a 2- to 5-year rotation that can be lumped with adjacent upland savanna unit. *Mesic Oak Forest: 4 acres* Located on the southwest side of Marsh Lake. Remove exotic brush; spot treat and control invasives; Rx burn on a rotation of 35 years (1 burn unit) *Dry-Mesic Oak Forest: 0.2 acres* Located in the far northern part of work unit, is a piece of a larger forest to the north and west in work unit E-10, so manage with E-10. Remove exotic brush; control exotic resprouts and seedlings; conduct woodland burns on a 20-year rotation; evaluate understory response; supplement ally seed as necessary and/or canopy gaps. *Oak Woodland-Brushland: 1 acre* Two units; located on east and southeast side of lake. Remove exotic brush; control exotic resprouts and seedlings; burn on a

Manage-ment Unit	Work Unit	Acres	Dominant Feature	Management/Restoration Overview
				10 year rotation (2 burn units); can be lumped with woodland to the south in work unit E-9.
EAST	E-9	133	Star Pond Area 1	Roughly follows the boundary of Star Pond 1 project (2016-21). Large diversity of community types. *Dry-Mesic Oak Forest: 30 acres* Located on north end of work unit, this is a small piece of larger forest to the north (work unit E-10). Manage with the larger forest in E-10. *Oak Woodland-Brushland: 35 acres* Located on the periphery of the restored prairie and in the southeastern portion of the work unit. Control exotic resprouts and seedlings; burn on a 10 year rotation (1 burn unit). *Prairie, mesic: 38 acres* One of the largest mesic prairie units in the park. Was restored in-house in the early 2000's. Much of this is probably wet prairie. Spot treat exotics; Rx burn on a 2- to 5-year rotation (3 or 4 burn units); overseed with forbs to increase forb density and diversity. *Oak Savanna: 3 acres* Transition between prairie and woodland. Control exotic resprouts and seedlings; burn on a 10 year rotation (1 burn unit; occasionally lump with prairie burns; be mindful of smoking out road to the south. *Wet Meadow: 3 acres* At least five units scattered throughout the work unit. Control herbaceous exotic species such as reed canary grass, exotic mustards, hybrid cattails; allow to drawdown occasionally; burn during periods of extreme drought. *Mixed Emergent Marsh: 9 acres*

Manage-ment Unit	Work Unit	Acres	Dominant Feature	Management/Restoration Overview
				Several units scattered throughout the work unit. Control RCG and hybrid cattails; burn edges occasionally with surrounding units. *Cultural/Visitor-Use Areas: 2 acres* Equestrian Parking Lot and Trailhead. Protect port-a-potty from fire by planting turf around it. Otherwise, bur right up to the edge of the parking lot. Install signage explaining prairie restoration and showing grantors. *Large Lakes: 12 acres* Portage Lake. Control exotics in littoral zone. Monitor using IBI. *Small Lakes: 2 acres* Lost Lake. Control exotics in littoral zone. Monitor using IBI. *Cattail Marsh: 3 acres* One large unit at the far south side of work unit. Control RCG and hybrid cattails taking care not to harm natives; burn edges occasionally with surrounding units.
EAST	E-10	107	Star Pond Area 2	Roughly follows the boundary of Star Pond 2 project (2018-23). *Dry-Mesic Oak Forest: 97 acres* Large tract of interior forest that more properly may be a mosaic of forest and woodland. Control exotic resprouts and seedlings; conduct woodland burns on a 20-year rotation (four burn units); evaluate understory response; supplementally seed as necessary and/or canopy gaps. *Small Lakes: 3 acres* There are a couple of small lakes scattered throughout the work unit. Control exotics in littoral zone. Monitor using IBI.

Manage-ment Unit	Work Unit	Acres	Dominant Feature	Management/Restoration Overview
				Mixed Emergent Marsh: 3 acres There are several marshes throughout the work unit. Control RCG and hybrid cattails taking care not to harm natives; burn edges occasionally with surrounding units. *Oak Woodland-Brushland: 4 acres* Occurs in the far south portion of the work unit. Is best managed with the rest of the cover type in work units E-9 and E-12. Remove exotic woody brush; control exotic resprouts and seedlings; burn on a 10 year rotation (1 burn unit).
EAST	E-11	46	Cattail Pond	Represents some of the most interior portions of the park. Manage cover types along with adjacent work units E-4, E-6, E-10, E-2, and Camp Butwin. *Dry-Mesic Oak Forest:22 acres* Represents the bulk of the work unit. Remove exotic brush; control exotic resprouts and seedlings; conduct woodland burns on a 20-year rotation (1 burn unit); evaluate understory response; supplementally seed as necessary and/or canopy gaps. *Oak Woodland-Brushland: 10 acres* Located in the northern border of the work unit and north of Cattail Lake. Remove exotic woody brush; control exotic resprouts and seedlings; burn on a 10 year rotation (2 burn units). *Large Lakes: 12 acres* Cattail Lake and a small portion of O'Brien Lake. Control exotics in littoral zone. Monitor using IBI. Monitor dissolved oxygen levels. Maintain canoe route by properly applying aquatic herbicides. *Mixed Emergent Marsh:2 acres* At least four units. Control RCG and hybrid cattails taking care not to harm

Manage-ment Unit	Work Unit	Acres	Dominant Feature	Management/Restoration Overview
				natives; burn edges occasionally with surrounding units.
EAST	E-12	123	O'Brien Lake, The Maintenance Shop, Buck Pond East	Much of this work unit is interior forest/woodland. It is a very diverse area with many different community types. The north part of the work unit transitions to drier conditions in the west, towards Buck Pond. An underground natural gas pipeline that is aligned diagonally NW-SW across the work unit will require special management. *Oak Woodland-Brushland: 26 acres* Two units. One occurs on an isthmus, bordered by open water on east and west. The other is in the center-north portion of the work unit; control exotic resprouts and seedlings; burn on a 10 year rotation (2 burn units). *Dry-Mesic Oak Forest: 26 acres* Perhaps a mosaic of forest and woodland would be a better characterization. Remove exotic brush; control exotic resprouts and seedlings; conduct woodland burns on a 20-year rotation (two to four burn units); evaluate understory response; supplementally seed as necessary and/or canopy gaps. *Mesic Oak Forest: 14 acres* Located on the south side of O'Brien Lake, this area would have been more protected from fire, and thus the different type of forest community. Remove exotic brush; spot treat and control invasives; Rx burn on a rotation of 35 years (1 burn unit). *Oak Savanna: 5 acres* Located on a sandy, southwest-facing slope, this area contains a small remnant prairie. Pine plantation could be removed and more prairie/savanna restored in its

Manage-ment Unit	Work Unit	Acres	Dominant Feature	Management/Restoration Overview
				place. Or at least, thin the pines heavily to create an open-grown pine woodland. Control exotic resprouts and seedlings; burn on a 10 year rotation (1 burn unit). *Large Lakes: 34 acres* Sedge, Beaver, Bridge, and Lily Ponds. Shallow lakes with much littoral zone. Control exotics in littoral zone. Monitor using IBI. Monitor dissolved oxygen levels. Maintain canoe route by properly applying aquatic herbicides. *Small Lakes: 3 acres* Occur primarily in the southeastern portion of the work unit. Control exotics in littoral zone. Monitor using IBI. *Wet Meadow: 4 acres* Several units. Control herbaceous exotic species such as reed canary grass, exotic mustards, hybrid cattails; allow to drawdown occasionally; burn during periods of extreme drought. *Mixed Emergent Marsh: 1 acre* Control RCG and hybrid cattails taking care not to harm natives; burn edges occasionally with surrounding units. *Cultural Areas: 10 acres* Maintenance Shop and Road is currently located here. Restoration of the north shore of Lily Pond is recommended. Wet meadow and wet prairie are the target communities. The Maintenance Shop will be relocated in the near future. The fate of the existing structures was not yet determined at the time of this document. The west side of the shop complex should be restored to oak savanna and oak woodland. Behind the shop complex should be restored to Dry-mesic oak forest. The loop road (unpaved) on the east side of the shop

Management Unit	Work Unit	Acres	Dominant Feature	Management/Restoration Overview
				complex may have to be cleaned up, then plowed and planted to oak forest, as well.
EAST	E-13	66	Mesic Oak Forest	Roughly follows the boundaries of the Buck Pond Forest & Woodland project (2015-18) located south of Jensen Lake. *Mesic Oak Forest: 24 acres* Located on the south and west side of Jensen Lake, this high-quality forest would have been more protected from fire, and thus the different type of forest community. Spot treat and control invasives; Rx burn on a rotation of 35 years (1 burn unit). *Dry-Mesic Oak Forest: 36 acres* Located on the south and east side of Jensen Lake, the topography and soils are more conducive to dry-mesic oak forest. Control exotic resprouts and seedlings; conduct woodland burns on a 20-year rotation; evaluate understory response; supplementally seed as necessary and/or canopy gaps. *Wet Meadow: 3 acres* Located on the eastern side of the work unit, there are a few wet meadows between the lake complexes of Jensen Lake to the west and the chain of ponds to the east. Control herbaceous exotic species such as reed canary grass, exotic mustards, hybrid cattails; seed if necessary; allow to drawdown occasionally; burn during periods of extreme drought. *Mixed Emergent Marsh: 1 acre* At least two units, located on the east side of the work unit. Control RCG and hybrid cattails taking care not to harm natives; burn edges occasionally with surrounding units. *Cultural/Visitor-Use Areas: 2 acres*

Manage-ment Unit	Work Unit	Acres	Dominant Feature	Management/Restoration Overview
				Former house site. Needs full blown restoration. Many exotics present from former development. Target plant community should be dry-mesic oak forest. Once restored, manage with adjacent community type to the west.
EAST	E-14	53	Jensen Lake	*Large Lakes: 52 acres* Jensen Lake. Shallow lake with much littoral zone. Control exotics in littoral zone. Restore shoreline around the lake. Control hybrid cattails and RCG. Monitor using IBI. Monitor dissolved oxygen levels. Monitor water quality and fish populations. Maintain canoe route by properly applying aquatic herbicides. *Lowland Hardwood Forest: 1 acre* Island on east end of lake. Consider transitioning to either wet meadow or forested swamp. Shallow lake with much littoral zone. Control exotics in littoral zone. Monitor using IBI. Monitor dissolved oxygen levels. Maintain canoe route by properly applying aquatic herbicides.
EAST	Private	84	Camp Butwin	Consider partnering with landowner to apply for external funding to restore the property to align with park management goals. *Dry-Mesic Oak Forest: 21 acres* Good quality interior forest. Remove exotic brush; control exotic resprouts and seedlings; conduct woodland burns on a 20-year rotation; evaluate understory response; supplementally seed as necessary and/or canopy gaps. *Cultural/Visitor-Use Areas: 23 acres* Camp Butwin, buildings, parking lots, and grounds. *Oak Savanna: 7 acres*

Manage-ment Unit	Work Unit	Acres	Dominant Feature	Management/Restoration Overview
				Control exotic resprouts and seedlings; burn on a 10 year rotation (1 burn unit; occasionally lump with prairie burns; be mindful of smoking out road to the south. *Lowland Hardwood Forest: 3 acres* Control invasives. Consider transitioning to wet meadow or forested swamp. *Large Lakes: 26 acres* O'Brien Lake. Attempt to help landowner manage the lake. Control exotics in littoral zone. Restore shoreline around the lake. Control hybrid cattails and RCG. Monitor using IBI. Monitor dissolved oxygen levels. Monitor water quality and fish populations. Maintain canoe route by properly applying aquatic herbicides. *Mixed Emergent Marsh: 2 acres* Control RCG and hybrid cattails taking care not to harm natives; burn edges occasionally with surrounding units. *Oak Forest: 2 acres* Located on the north side of O'Brien Lake, this area would have been more protected from fire, and thus the different type of forest community. Remove exotic brush; spot treat and control invasives; Rx burn on a rotation of 35 years (1 burn unit).
	TOTAL	***1,209***		

Table 34. *Summary of the Work Units in the East Management Unit of LHRP.*

With all work units, strive to lessen hard edges between them. Occasionally burn into adjacent units, remove and/or plant trees and shrubs, etc.

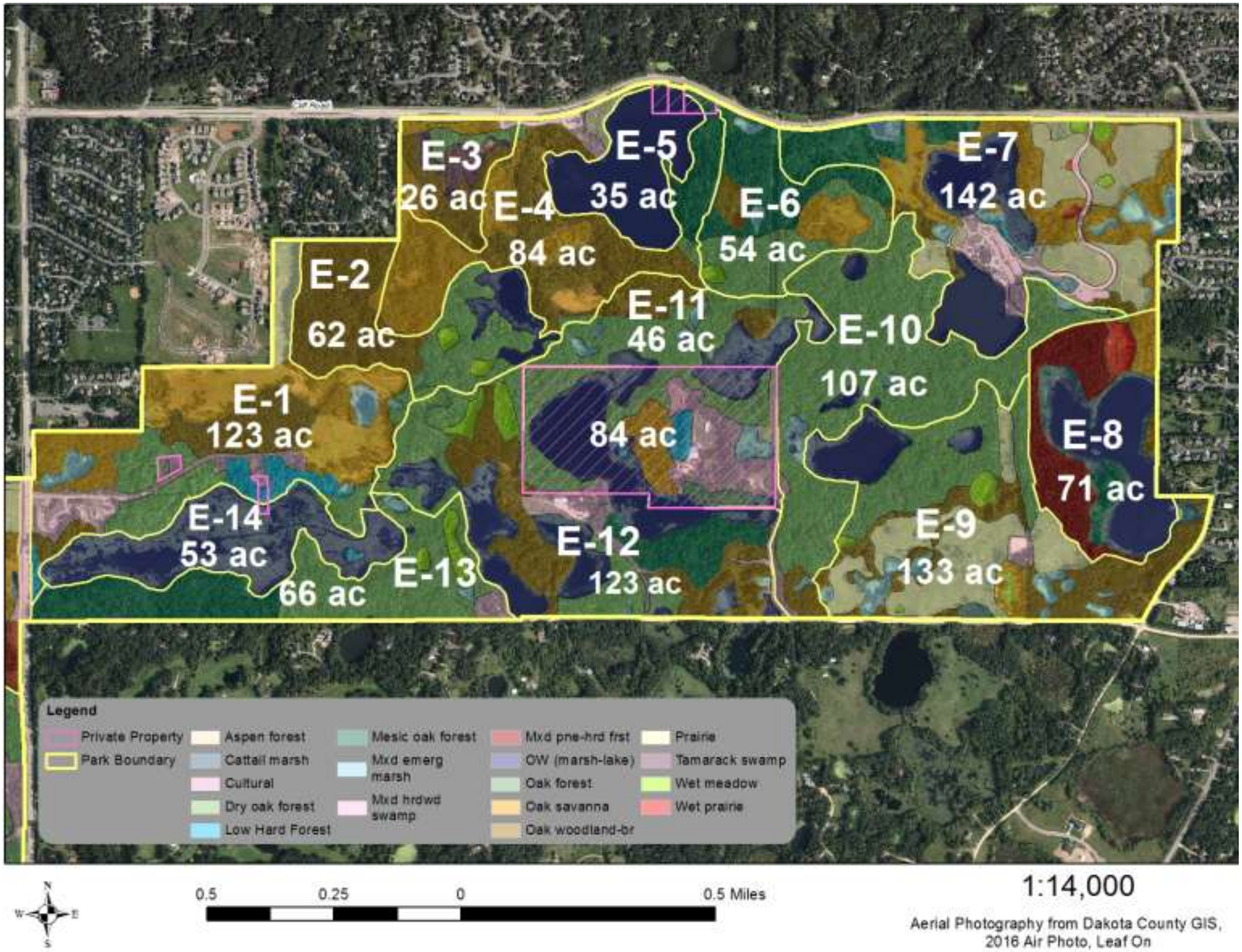


Figure 38. *East Lebanon Hills Regional Park Desired Future Cover Type and Management Subunits.*

5.7. Center Management Segment

5.7.1. Description

The Center Management Segment at LHRP (**Figure 39**) is situated between Pilot Knob Road on the east and Johnny Cake Ridge Road on the west. This segment encompasses approximately 507 of the park's 1,869 acres, representing approximately 27 percent of the land base of the park. The Center Management Segment has nine management work units that vary significantly in size from just under five acres up to 108 acres. The Center Management Segment has one private inholding parcel (three acres).

Soils in the Center Management Segment are largely well-drained loam to sandy loam in upland areas. The topography is moderately to sharply rolling with irregular topography and kettle-like depressions.

5.7.2. Recreation Elements and Facilities

The Center Management Segment includes two relatively large campgrounds and the Camp Sacajawea Retreat Center, and the Lebanon Hills Campground.

5.7.3. Plant Communities Summary

The Center Management Segment is characterized by a mix of oak-dominated woodlands and forests, two areas of remnant mesic (brush) prairie and numerous areas that were historically farmed and mostly characterized by species of disturbance-adapted plants. The area also includes one four-acre wetland that has been assigned to its own management Work Unit (C-3) based on the suspected likelihood that it had been significantly impacted by sedimentation from surrounding areas when they were farmed.

While much of the Center Management Segment shows significant signs of past disturbance, there are several opportunities to initiate ecological restoration of remnant native plant communities here. Notable among these are the two mesic (brush) prairies. While these areas are generally in poor qualitative state due to the level of invasive brush and young trees present, they offer important opportunities to restore a remnant system which also happens to support the state Special Concern plant species, white wild indigo.

This area has several conifer plantations in the Center Segment. Conifers are important for winter recreational use, so some conifer plantations throughout the park are guided to remain long-term, including one in the Center Segment. However, most conifer plantations have been guided toward a near-term conversion to more open prairie/oak savanna system or toward a long-term transition to pine-hardwood forest with the eventual anticipated transition to a fire-dependent oak-dominated system over the course of perhaps 50 to 100 years, depending on how this system responds to management activities and external forces such as shifts in temperature and precipitation patterns (**Figure 46**).

In contrast to the East Management Segment, the Center Management Segment wetlands show more signs of past disturbance, primarily through the level of invasive, nonnative vegetation (reed canary grass and/or nonnative cattail). There are numerous wet meadows that are in good or very good condition; based on the minimal amount of outside influences on these areas, it is anticipated that little or no restoration/management will be required.

The trails in this segment have not been modified to improve their sustainability. Many trails run directly up and down steep slopes, which accelerates erosion. All trails in this segment should be evaluated for sustainability and modified to reflect sustainable trail design and implementation (see MN DNR *Trail Planning, Design, and Development Guidelines, 2007).*

A substantial portion of the Center Management Segment is dominated and/or invaded by nonnative plant cover. As a result, this area will require substantial amounts of effort to fully restore (e.g., nonnative-invaded woodlands, remnant prairie, pine plantations, wetlands dominated by reed canary grass). Work crews should continue to sweep through this segment, generally heading from east to west, removing buckthorn and other large woody exotic shrubs, to stabilize ecological degradation caused by these invasive shrubs, which may take five to ten years. **Table 35** summarizes anticipated restoration acres by desired future cover type.

SUMMARY CENTER MANAGEMENT SEGMENT

Restoration Cover Type	**Acres**
Terrestrial woodland/forest/savanna	355.9
Prairie	3.2
Wet meadow	2.0
TOTAL	**356.5**

Table 35. *Center Management Segment Desired Future Cover Type Summary.*

5.7.4. Invasive Species

The Center Management Segment includes a number of invasive, nonnative plant species of note. In areas of active restoration, efforts should be made to regularly conduct invasive plant surveys and mapping (recommended minimum annual walking survey and annual or biennial mapping). Early detection of invasives should be conducted by Dakota County Park ecologists and volunteers, and early detection websites such as the invasives Early Detection & Distribution Mapping System should be monitored for new reports, especially for emerging invasives.

5.7.5. Wildlife

The Center Management Segment has been documented to support one State-listed species as well as the fisher (a mammal of forest habitats). A limited amount of surveys for wildlife have been conducted in this management segment area. As additional surveys and monitoring are conducted at LHRP, additional unique wildlife species may be documented.

The overall intent to manage native vegetation as a mosaic of habitats identified in the Desired Future Cover Type maps is generally compatible with sustaining a variety of both common and unique wildlife species. Some of these species deserve special consideration, and resource managers should consult by-species Best Management Practices to avoid doing significant harm to species of wildlife that may be rare, unique, and/or sensitive to the (spatial and/or temporal) application of a particular resource management tool.

5.7.6. Water Resources

The Center Management Segment supports numerous wetlands that range from saturated soils and temporarily flooded basins to emergent and deep marshes, including several moderate-quality (floating mat subtype) wet meadows. This management segment only has one lake: Gerhardt Lake on the northwest corner of the segment, adjacent to Johnny Cake Ridge Road.

The LHRP Subwatershed Assessment Report (2017) indicated the following for monitoring/ management for water bodies within the Center Management Segment area:

Gerhardt Lake is one lake in particular that should be targeted for more water quality monitoring and assessments. Water quality sampling was conducted on Gerhardt Lake in 2017 and results indicate the lake is currently not meeting State standards for chlorophyll-a and Secchi depth. Gerhardt Lake did meet State standards for TP in 2017, however it did not meet the 35 µg/L shallow target established for this study. This study identified two potential BMPs (one regional BMP and an alum treatment) to reduce TP loads to Gerhardt Lake.

5.7.7. Management Work-Units of the Center Management Segment

There are eight work units in the Center Management Segment. **Table 36** lists the Management Work Units of the Center Management Segment.

Manage-ment Segment	**Work Unit**	**Acres**	**Dominant Feature**	**Management/Restoration Overview**
CENTER	C-1	34	Gerhardt Lake	*Dry-Mesic Oak Forest: 17 acres* Remove exotic invasive shrubs; conduct woodland burns on a 20-year rotation (two burn units); evaluate understory response; supplemental seed as necessary and/or canopy gaps. *Wet Meadow: 1.8 acres* Control herbaceous exotic species such as reed canary grass, exotic mustards, hybrid cattails; allow to drawdown occasionally; burn during periods of extreme drought. *Wetlands: 3 acres* Control herbaceous exotic species such as reed canary grass, exotic mustards, hybrid cattails.

				Lakes:12 acres One large, several small. Control herbaceous exotic species such as reed canary grass, exotic mustards, hybrid cattails on lakeshore; evaluate littoral zones and supplement as necessary.
CENTER	C-2	87	Old Growth Oak Forest	*Dry-Mesic Oak Forest: 81acres* Remove exotic invasive shrubs; conduct woodland burns on a 20-year rotation (20-acre units); evaluate understory response; supplemental seed as necessary and/or canopy gaps. *Wetlands: 3 acres* Control herbaceous exotic species such as reed canary grass, exotic mustards, hybrid cattails. *Small Lakes: 3 acres* Control herbaceous exotic species such as reed canary grass, exotic mustards, hybrid cattails.
CENTER	C-3	20	Duck Pond	*Wetlands: 9 acres* Good candidate for wetland scrape; deposit spoils in nearby upland old field; allow seed bank recovery; supplemental seeding/plugging *Oak Woodland-Brushland: 3 acres* Remove exotic invasive shrubs; conduct woodland burns on a 10-year rotation (single unit); evaluate understory response; supplemental seed as necessary and/or canopy gaps. *Oak Savanna, mesic: 7 acres* Remove exotic woody brush; control herbaceous exotics; Rx burn on a 2- to 5-year rotation (single unit); seed as necessary. *Wet Meadow: 1 acre* Control herbaceous exotic species such as reed canary grass, exotic mustards, hybrid cattails; allow to drawdown occasionally; burn during periods of extreme drought. *Dry-Mesic Oak Forest:0.2 ac* Lump with C-6 Oak Forest.

CENTER	C-4	88	Conifer Plantations and Old Fields	*Mixed Pine-Hardwood Forest: 20 acres* Remove the northwest conifer stand promptly (within the next five years). Remove the majority of the Sothern conifer stand promptly (within next five years), but leave healthy conifers, as necessary, that are near trails or infrastructure. Burn on a 15-year rotation (1 or 2 units). Seed over black to increase diversity. Long-term community goal is oak savanna. *Oak Savanna: 20 acres* Remove exotic woody brush; control herbaceous exotics; Rx burn (7-acre units); seed as necessary. *Oak Woodland-Brushland: 11 acres* Remove exotic invasive shrubs; conduct woodland burns on a 10-year rotation; evaluate understory response; supplemental seed as necessary and/or canopy gaps. *Wet Meadow: 3 acres* Control herbaceous exotic species such as reed canary grass, exotic mustards, hybrid cattails (hand wick); allow to drawdown occasionally; burn during periods of extreme drought. Lump with C-3 wet meadow. *Mixed Emergent Marsh: 0.3 acres* Evaluate for species composition. Control exotic herbaceous species. Hand wick hybrid cattails. *Small Lake: 2 acres* Control herbaceous exotic species such as reed canary grass, exotic mustards, hybrid cattails (hand wick). *Mesic Prairie* Burn on a two- to five-year rotation; control exotic weed species (spot treat); overseed as necessary to increase diversity (seed onto the black following fire). Burn as a single unit

CENTER	C-5	96	Camp Sacajawea	*Dry-Mesic Oak Forest: 81acres* Remove exotic invasive shrubs; conduct woodland burns on a 20-year rotation (20-acre units); evaluate understory response; supplemental seed as necessary and/or canopy gaps. *Oak Forest: 5 acres* Same as Dry-Mesic Oak Forest. Large buckthorn has been removed; follow up on resprouts and seedlings; plant/seed to increase diversity; burn on a 20-year rotation (single unit or combine with adjacent). *Mixed Pine-Hardwood Forest: 6 acres* Manage long-term as conifer forest but increase diversity and sustainability of the forest community. Burn on a 15-year rotation (single unit); seed over black to increase diversity. *Mixed Emergent Marsh: 3 acres* Evaluate for species composition. Control exotic herbaceous species. Hand wick hybrid cattails. *Cultural/Visitor-Use: 5 acres* Manage invasives; plant forbs to increase diversity and aesthetic appeal.
CENTER	C-6	74	Savanna and Forest	*Mixed Pine-Hardwood Forest: 8 acres* Three conifer stands; remove the west stand promptly (within the next five years). Remove the majority of the other two stands promptly (within next five years), but leave healthy conifers, as necessary, that are near trails or infrastructure. Burn on a 15-year rotation (1 or 2 units). Seed over black to increase diversity. Long-term community goal is oak savanna. *Oak Savanna (mesic or dry): 16 acres* Two pieces that are part of larger cover type units that extend into adjacent subunits. Remove exotic woody brush; control herbaceous exotics; Rx burn on a 2- to 5- year rotation (7-acre units); seed as necessary.

				Oak Forest (Dry): 50 acres Represents the bulk of the subunit. Part of larger cover type units that extend into adjacent subunits. This NPC may more accurately turn out to be a mosaic of dry forest (MHs37) and dry woodland (FDs37), so use adaptive management to help determine that. Remove exotic invasive shrubs; conduct woodland burns on a 20-year rotation (20-acre units); evaluate understory response; supplemental seed as necessary and/or canopy gaps.
CENTER	C-7	74	Wheaton Pond	This subunit is a mix of several community types. *Oak Woodland-Brushland: 29 acres* Remove exotic invasive shrubs; conduct woodland burns on a 10-year rotation; evaluate understory response; supplemental seed as necessary and/or canopy gaps. Monitor area for turtles. *Shallow Lake: 20 acres* Six different lakes; two larger, including Wheaton Pond. Evaluate for hydrology fluctuations, both seasonal and historical. Evaluate lakeshore and littoral zones and restore as necessary. Control exotic plants such as RCG and exotic cattails. Monitor water quality. Consider phosphorous-locking treatment if warranted. *Emergent Marsh: 5 acres* Five different marshes; one large (in southwest part of subunit). Control exotic plants such as RCG and exotic cattails. *Oak Forest: 2.7 acres* Remove exotic invasive shrubs; conduct woodland burns on a 20-year rotation (20-acre units); evaluate understory response; supplemental seed as necessary and/or canopy gaps. *Oak Savanna: 5 acres* Two pieces; eastern one is part of a larger cover type unit that extends into adjacent subunits. Remove exotic woody brush; control herbaceous exotics; Rx burn on a

				2- to 5-year rotation (7-acre units); seed as necessary. *Mixed Hardwood Swamp: 0.4 acres* Located near the road in the western part of the cultural/visitor-use area. Control invasive species; monitor community response; assess stormwater runoff and hydrology level fluctuations. *Cultural/Visitor-Use: 5.5 acres* Canoe area. Mowed areas for canoers. Consider naturalizing to a more pollinator-friendly cover. Monitor area for turtles.
CENTER	C-8	31	Campground	*Cultural: 27 acres* Remove invasive woody plants; control other exotic plant species; evaluate for hazard trees; replace hazard trees and dead trees to provide for shade—species selection from MHs37 list; enhance open areas with a variety of colorful forbs. Burn the forest on a 20-year rotation, if possible. *Small Lake: 0.5 acre* This very small lake could be enhanced by restoring shoreline. *Oak Woodland-Brushland: 1.5 acres* This small woodland should have invasive woody brush removed and controlled; burn on a 10-year rotation, with surrounding woodlands in cultural/visitor-use area, if possible. *Oak-Aspen Forest: 1.5 acres* Remove and control invasive exotic brush; Rx burn on an 18-year rotation, with the rest of the cover type in subunit C-1 to the north.
	TOTAL	***504***		

Table 36. *Summary of the Subunits in the Center Management Unit of LHRP.*

5.8. West Management Segment

5.8.1. Description

The West Management Segment at LHRP (**Figure 39)** is situated between Johnny Cake Ridge Road on the east and Galaxie Avenue on the west. This segment encompasses approximately one eighth of the park of the land base (234 of LHRP's 1,869 acres). The West Management Segment has three management subunits, or work units, that are roughly delimited based on historic land use/disturbance (i.e., farming), tree planting, as well as the type/location of recreational amenities that occur. The West Management Segment has no private inholdings.

Soils in the West Management Segment are medium textured soils (e.g., sandy loam, loam) in upland areas. The topography is moderately to sharply rolling with irregular topography and some areas with significant amount of relief over short distances.

5.8.2. Recreation Elements and Facilities

The West Management Segment includes the West Trailhead, hiking trails, cross-country ski trails, and a significant amount of mountain bike trails. The mountain bike and hiking trails are designed to IMBA sustainability standards to minimize natural resource impacts using a single track Treadway. Ongoing maintenance by MORC further protects natural resources by management of erosion and establishing barriers and signage to route off-trail use.

If mountain bike trails become perennially unsustainable, then Dakota County Parks natural resources staff should work closely with County Visitor Services staff, Minnesota Off-Road Cyclists, and other cycling stakeholders to address the issue. Furthermore, continuing to use International Mountain Biking Association (IMBA) sustainable trail standards is recommended.

A paramount concern is the presence of a dense growth of exotic shrubs throughout the mountain bike trail system. Removal of exotic woody shrubs (European buckthorn and Tartarian honeysuckle) and replacement with native shrubs (such as juneberry or chokecherry—see table in **Appendix J** for the full list of recommended replacement species) is a primary goal for this area.

Some summer hiking and winter ski trails still run directly up and down steep slopes, which accelerates erosion. All trails in this segment should be evaluated for sustainability and modified to reflect sustainable trail design and implementation (see MN DNR *Trail Planning, Design, and Development Guidelines, 2007).*

5.8.3. Plant Communities Summary

The West Management Segment is characterized by oak-dominated woodlands and forest, as well as several areas on the northeast and northwest (Management Work Units W-1 and W-2) that were historically farmed and subsequently planted to nonnative vegetation and conifer trees. The West Management Segment has significant topography. Coupled with the generally light-textured soils comprised of large amounts of sand, the slopes in this management segment may be among the most susceptible to erosion within LHRP.

Management Work Unit W-1 has a large conifer plantation at the West Trailhead (**Figure 44**), with trees often overcrowded. This conifer plantation is guided toward a long-term management as a mixed pine-hardwood forest which includes forest stand improvements and thinning to promote uneven stand management and natural regeneration, and a reconstruction of a more diverse understory.

The West Management Segment has fewer wetlands and water bodies compared to the other two segments. They also show more signs of disturbance, primarily through the level of invasive, nonnative vegetation (reed canary grass and/or nonnative cattail) but also due to recreational features such as mountain bike trail boardwalks and corduroy crossing.

Among the three management segments, this area also generally has the poorest native plant species richness, the highest number of invasive plants, and highest total cover of invasive, nonnative vegetation. After completing the Center Segment, work crews should continue to sweep through this Western Segment, generally heading from east to west, removing buckthorn and other large woody exotic shrubs, to stabilize ecological degradation caused by these invasive shrubs, which may take five years. **Table 37** summarizes anticipated restoration acres by Desired Future cover type.

SUMMARY WEST MANAGEMENT SEGMENT

Restoration Cover Type	Acres
Terrestrial woodland/forest/savanna	207.5
Mixed pine-hardwood forest	15.4
TOTAL	**222.9**

Table 37. *West Management Segment Desired Future Cover Type Summary.*

5.8.4. Invasive Species

The West Management Segment is perhaps the most historically disturbed of the oak-dominated areas within LHRP. As a result, it has been colonized by a number of invasive, nonnative plant species of note. When active restoration activities are initiated in this area, efforts should be made to regularly conduct invasive plant surveys and mapping (recommended minimum annual walking survey and annual or biennial mapping). Early detection of invasives should be conducted by Dakota County Park ecologists and volunteers, and early detection websites such as the invasives Early Detection & Distribution Mapping System should be monitored for new reports, especially for emerging invasives.

5.8.5. Wildlife

The West Management Segment consists mostly of oak-dominated woodlands and forest and contains the least variety of plant communities of the three segments. Due to this, much of the wildlife that prefers prairies, savannas, and open woodlands will not inhabit this segment. To date, there have been limited wildlife surveys that have taken place in this segment of the park. Trail cameras have been installed, and bird surveys have taken place, but more are needed to sufficiently survey this segment.

5.8.6. Water

The West Management Segment supports numerous wetlands that range from saturated soils and temporarily flooded basins to temporarily flooded emergent marsh. There are two, open-water deep marshes on the southeast side of this segment including one that extends south onto Minnesota Zoo property. Among the three management segments at LHRP, this segment has fewer wetlands, which tend to be somewhat lower in quality compared to other areas (see MnRAM summary in Section 3.4.2)

.

5.8.7. Management Work Units of the West Management Segment

There are three work units in the West Management Segment. **Table 38** lists the Management Work Units of the West Management Segment.

Manage-ment Segment	**Work Unit**	**Acres**	**Dominant Feature**	**Management/Restoration Overview**
WEST	W-1	54	Steep Woodlands and Low Ponds	*Oak Woodland-Brushland: 54 acres* Remove exotic invasive shrubs; conduct woodland burns on a 10-year rotation; evaluate understory response; supplemental seed as necessary and/or canopy gaps. *Small Ponds* Control herbaceous exotic species such as reed canary grass, exotic mustards, hybrid cattails.
WEST	W-2	64	West Trailhead	*Oak Woodland-Brushland: 21 acres* Remove exotic invasive shrubs; conduct woodland burns on a 10-year rotation; evaluate understory response; supplemental seed as necessary and/or canopy gaps. *Mixed Pine-Hardwood Forest: 15 acres* Thin conifers; conduct Rx burns on a 15-year rotation; *Visitor Use Area (West Trailhead Area)* Maintain plantings and reconstructions surrounding facilities
WEST	W-3	116	Mountain Bike Trails, Dry Oak Woodlands	*Oak Woodland-Brushland: 110 acres* Remove exotic invasive shrubs; conduct woodland burns on a 10-year rotation; evaluate understory response; supplemental seed as necessary and/or canopy *Small Lakes*

				Control herbaceous exotic species such as reed canary grass, exotic mustards, hybrid cattails.
	TOTAL	***234***		

Table 38. *Summary of the Subunits in the West Management Unit of LHRP.*

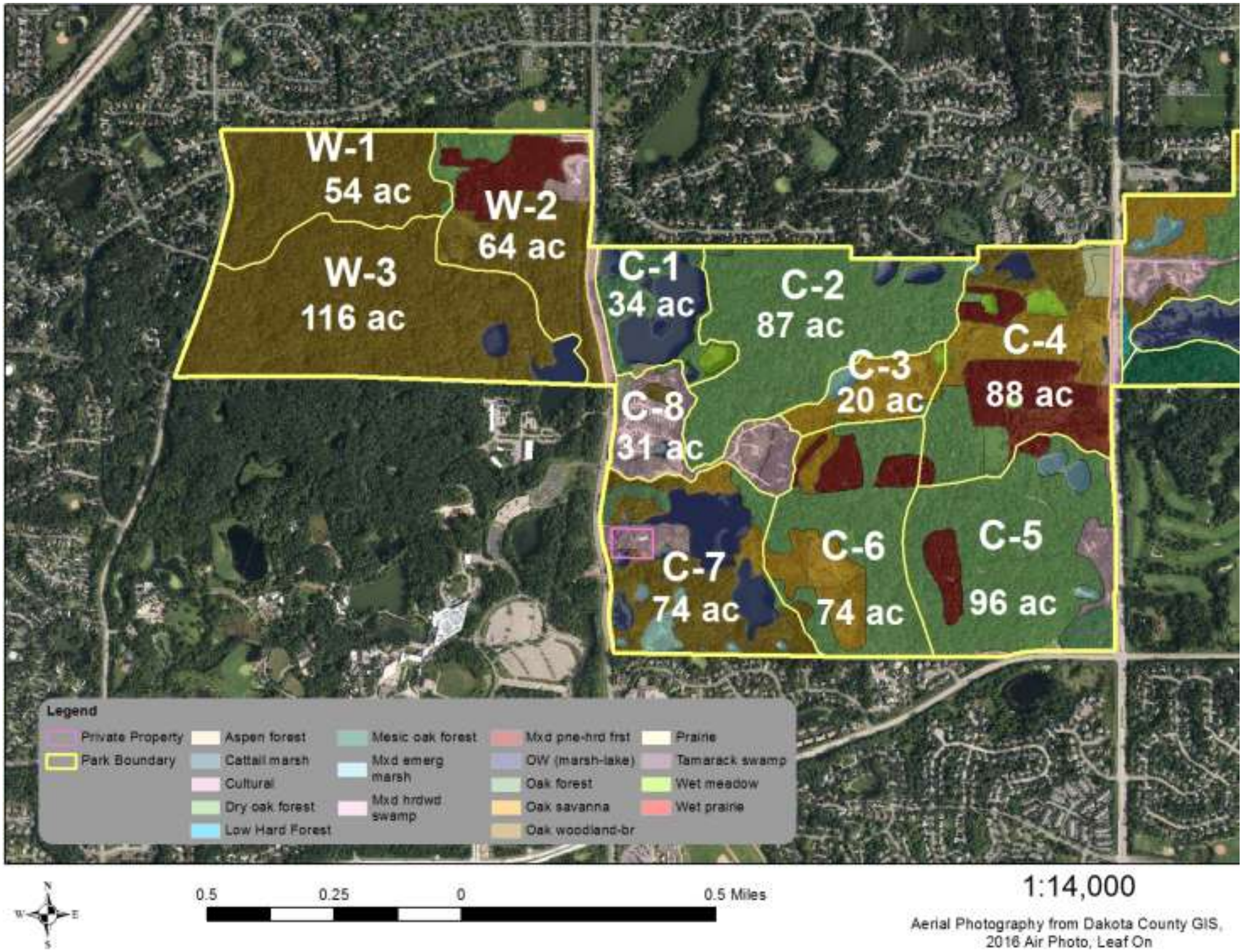


Figure 39. *Desired Future Cover Type and Management Work Units of the Center and Western Segments of Lebanon Hills Regional Park*

6. MONITORING AND REPORTING

6.1. Monitoring

Natural resource monitoring is a form of assessment that provides natural resource managers with information essential to making well-informed management decisions. Monitoring can play a vital role in the management of water/natural resources and provides the justification and knowledge needed for evaluating management actions (through Adaptive Management) and adjusting them, if necessary, to reach management objectives and sustainable land management goals more effectively and efficiently.

Monitoring can require significant resources. Therefore, it is important to carefully choose monitoring methods and levels of effort wisely. Monitoring should be designed to answer specific questions and provide actionable feedback to resource managers to help them effectively apply Adaptive Management principles. When a monitoring approach is established for a particular facet of water/natural resources, it is important to consistently monitor to avoid gaps in data.

Below are recommended monitoring methods for a number of water/natural resources areas.

6.1.1. Vegetation

General Vegetation Monitoring

General vegetation monitoring across LHRP and within each management unit should include at a minimum two walk-through vegetation surveys each year, conducted during the growing season. Information gathered during walk-through surveys should include at a minimum:

- Observed changes in overall plant community composition
- Significant changes in overall plant cover
- Changes in cover for desirable native plant species that tend to be indicators of improved quality in native plant communities
- By-species observations of invasive, nonnative plant cover, including evaluation of treatment efficacy and recommended next steps
- Photographs (general site or a set of photo-monitoring points) that illustrate:
    - Overall landscape cover
    - Invasive, nonnative plant cover
    - Results of on-the-ground management activities

Management and restoration activities monitoring should be done on a regular basis.

Photo Monitoring

Another monitoring activity that can be effective and requires little time is to take a geo-referenced picture from approximately the same location (a photo monitoring point) each year at approximately the same time of year (e.g., a picture [or series of pictures] taken from a trail intersection every year during the first week of July). Staff should be sure to take pictures from several locations; also, the more times pictures are taken throughout the year, the more beneficial the information will be.

Long-term and Project-specific Vegetation Monitoring

Although it can yield detailed data, quantitative vegetation monitoring can be exceptionally time-intensive. As an alternative to the approach of using fixed-location quantitative vegetation monitoring (e.g., plots or transects), Natural Resource staff recommends using an area-based approach utilizing the Floristic Qualitative Index (FQI) method.

The FQI has been developed and used for several regions throughout the United States to provide an objective assessment of the vegetation quality or biological integrity of plant communities. The FQI was first developed as a weighted average of the native plant species at a site by Floyd Swink and Gerould Wilhelm in 1979. It is based on a Coefficient of Conservatism (CC) score that is scaled from zero to 10 and is applied to each plant species in a local flora. The score reflects a species' tolerance to disturbance and specificity to a particular habitat type. Species adapted to disturbed areas are often not habitat specific and, as such, have a low CC score. In contrast, habitat-specific species are generally not tolerant to disturbances and, as such, have a high CC score. A group of experts on local plants agrees upon and assigns CC scores.

We recommend species lists and FQI scores be developed and revisited on a 10-year basis for each NPC within a particular management unit (e.g., brush prairie in the management segment between Johnny Cake Ridge Road and Pilot Knob Road or the Tamarack Swamp west of Holland Lake). For specific restoration projects, particularly those that are grant-funded, it is recommendable to utilize this system for pre- and post- management monitoring as a way to track changes in vegetation.

Minnesota (Pollution Control Agency) has developed Coefficients of Conservatism for wetland and wetland buffer plant species. However, no CCs have been developed for upland plant species in Minnesota. While there has been discussion among agencies about developing a set of CCs for the full flora of Minnesota, it does not currently exist. We believe that there is sufficient value in this system for Dakota County Parks to merit convening an expert panel to develop a set of CC values for Dakota County so the FQI methodology can be utilized.

Staff recommends, if possible, developing a customized FQI methodology that includes a by-species weighting based on the estimated occurrence of a particular species within the area of interest. The U.S. Geological Survey recently developed a weighted FQI methodology to include estimated percent cover for all plant species (native and nonnative) within a given area. The full USGS sampling protocol is available online at: https://pubs.usgs.gov/fs/2011/3044/pdf/FS11-3044.pdf. Staff recommends modifying the USGS approach to calculating FQI so that the formula is based on a cover class code rather than a percent cover score, with appropriate adjustments made in the FQI formula to derive a final FQI score for any particular sampling area. We recommend implementing such a modified FQI system on a 10-year basis for general vegetation monitoring with FQA values developed for each NPC type/management area.

Wetland Vegetation Monitoring

As part of the LHRP NRMP process, a number of wetlands were evaluated using MnRAM methodology, which included the Rapid FQA methodology developed by the MPCA. Parks staff may choose to continue utilizing this methodology to monitor vegetation in wetlands previously sampled with the potential for expanding to additional select wetlands throughout LHRP. The full methodology is available online at: https://www.pca.state.mn.us/sites/default/files/wq-bwm2-02b.pdf.

Aquatic Invasive Species

Blue Water Science conducted field surveys of AIS, evaluated existing conditions, and developed the *Aquatic Invasive Species Action Plan for Selected Dakota County Parks Lakes*, which was completed in 2017. The plan identifies areas of existing AIS and potential for growth of AIS plants and recommends detection, monitoring, and treatment strategies.

The two AIS that are known to occur at LHRP are curly leaf pondweed and Eurasian water milfoil. The report also notes that other AIS (e.g., zebra mussel, common carp, purple loosestrife, and flowering rush) were not known to occur at LHRP but should be monitored so that early detection and rapid response is possible, if detected. The text below is excerpted from the sections of the report that specifically outlined detection and monitoring of AIS:

> ***Curly Leaf Pondweed Scouting Activities:*** *Annual scouting activities can be used to delineate areas where curlyleaf pondweed (CLP) treatment is considered. Sediment characteristics indicate there is a potential for mostly light to moderate growth of CLP in Dakota County Parks lakes. If delineation occurs, it is recommended that all aquatic plants (including the natives) should be recorded within a delineated area containing curlyleaf pondweed. GPS mapping should be used to outline a treatment area. Areas of light growth do not need to be treated whereas areas of moderate to heavy growth are candidates for treatment.*

> ***Eurasian Water Milfoil Scouting Activities:*** *When observers are on the lake they could be looking for any EWM occurrences or any sign of existing heavy Eurasian milfoil growth. This scouting activity can occur at the time of curlyleaf scouting in May and June, but additional monitoring on the lake through the summer sampling season presents additional opportunities for a discovery.*

Figure 40. A zebra mussel plate sampler can be made from PVC materials. Ceramic tiles also make for good monitoring surfaces as well as pvc pipes (Blue Water Science).

Zebra Mussel Early Detection: *The zebra mussel is an aquatic invasive species that could be scouted in Dakota County Parks lakes. An active scouting program consists of volunteers using a plate sampler, pvc pipe, or ceramic tiles hung from docks to monitor the appearance of juveniles (**Figure 40**). Samplers should be checked monthly over the summer months.*

Common Carp Early Detection: *Carp are not present in Dakota County Parks lakes based on MN DNR fish survey records. If carp abundance increases, water clarity would likely decrease along with aquatic plant coverage. At this time, no carp management is necessary; rather, water quality and aquatic plant monitoring should be ongoing.*

The report went on to outline a framework for Early Detection and Rapid Response, including:

AIS Early Detection and Rapid Response Plans
At the end of 2016, curlyleaf pondweed was observed in 9 lakes and Eurasian watermilfoil was observed in 7 lakes [in Dakota County Parks]. No zebra mussels or common carp have been reported in any of the Dakota County Parks lakes.

Inspection and prevention programs are the foundation for aquatic invasive species (AIS) comprehensive management programs, and represent an important component of an AIS management program. However, there are other components to an AIS management program as well which include early detection, rapid response, and control. For new AIS, steps to consider for early detection, rapid response, and control components are summarized below.

AIS Early Detection Plan
Dakota County Parks website information and citizen reporting: *Create a tab on the Dakota County Parks website for a variety of AIS including zebra mussels, construct AIS identification pages to help lake users identify AIS. Designate a Dakota County Parks contact person, email address, and phone. Some AIS examples of early detection include installing a zebra mussel plate sampler at selected public accesses. Promote monthly lake user inspections. As lake buoys are removed after the boating season, inspect all buoys and report the presence or absence and lake location of any zebra mussels to the Dakota County Parks website.*

Enhanced early detection search programs: *Conduct a training session in June for volunteer searchers. Contract for monthly searches using scuba diving, snorkeling, and wading from July–October. If AIS, especially zebra mussels, are found, verify with MN DNR. Produce a press release and notify lake users.*

6.1.2. Wildlife

Fish Survey Plan

As part of the development of the LHRP NRMP, a Fish Sampling Plan was developed. The plan was intended to build on previous surveys conducted by the MN DNR between 1975 and 2015. Fish sampling survey efforts were recommended for the five major lakes in LHRP, including Holland, Jensen, O'Brien, McDonough, and Schulze. The survey methods developed for this project are designed to sample a representative portion of the fish population, capture a variety of species and sizes of fish in the Project lakes, and minimize the effects vegetation can have on survey results.

The five lakes are all relatively small in comparison to most MN DNR surveyed lakes and lack boat ramps or other access points suitable for larger, heavier boats. The methods and gear recommended in the survey plan are similar to MN DNR standard fish survey methodology, however they have been altered and adapted to the sampling challenges of the LHRP lakes. Level of effort and methods reflect the lake attributes and limited boat access. The index survey protocols repeat the sampling methods and timing constraints as previous MN DNR surveys. This approach of using a similar methodology will reduce sampling variability and allow for the monitoring of population trends over time. Survey design and methods are explained in more detail in the full survey plan report.

Insect Survey Plan

Insect populations can be an important biological indicator of habitat quality and serve as resource for plant and animal species that exist within an ecosystem. As part of the NRMP project, an Insect Survey Plan was developed (**Appendix G**) Dakota County Parks staff has conducted some limited insect surveys in LHRP. During the LHRP NRMP project, an insect survey plan was developed. Park staff wishes to implement insect monitoring as an assessment tool for evaluating insect populations within the park, primarily focusing on bees, day-flying *Lepidoptera*, and *Odonata* species.

The objectives of the insect survey plan are to:

- Develop an abundance and diversity baseline of relatively easy-to-identify, charismatic insect groups (bees, day-flying *Lepidoptera,* and *Odonata*) across the park.
- Measure the target insect populations as performance measures for adaptive management of ecosystem restoration efforts.

Lebanon Hills Regional Park staff wishes to begin widespread restoration efforts of oak forest, savanna, and prairie habitats located in the center and west portions of the park. A key recommendation in the insect survey plan is to conduct monitoring in areas slated for ecological restoration prior to restoration efforts to collect baseline data for insect and pollinators in these locations.

Baseline data and ongoing monitoring of insects will allow ecologists to identify spatial and temporal trends. Insect monitoring of select target species is intended to use standardized protocols including timed and fixed transects to collect data that can be compared from year to year.

In addition to the formal standardized sampling efforts, the insect survey plan also recommends gleaning species observations from local experts and enthusiasts by setting up an online project on a curated naturalist website, such as iNaturalist, www.inaturalist.org.

Herptile Survey Plan

During the process of developing the NRMP, a herptile survey plan was also developed (**Appendix F**). The purpose of completing herptile surveys is to build on existing data and the field survey work already completed by Dakota County Parks and others.

The intent of developing a standard set of survey protocols is to conduct herpetological surveys of reptiles and amphibians that help to gather baseline data that can be compared to subsequent surveys.

Objectives outlined in the plan include:

- Conduct amphibian and reptile presence/absence surveys at Lebanon Hills Regional Park.
- Determine amphibian and reptile species richness within Lebanon Hills Regional Park.
- Determine relative abundance of amphibian and reptile species to serve as a baseline to aid in determining long term population trends.
- Provide natural resource management recommendations to aid in future updates of the Natural Resources Management Plan for LHRP.

Recommended survey methods include:

- Visual encounter
- Road surveys*
- Visual encounter meander searches
- Coverboard surveys*
- Frog and toad call surveys*
- Aquatic trapping surveys
- Drift fence/pitfall/box surveys

*Currently using this method

Mammal Surveys

Mammals are very diverse in size and physical characteristics which means that many different survey methods must be utilized to study them. Small mammal traps have been used to survey for the small mammals, but larger mammals require other methods such as camera traps or aerial surveys for deer. Bats are another taxonomic order that requires unique survey methods.

Recommended survey methods include:

- Small mammal trapping*
- Aerial deer surveys*
- Camera traps*
- Auditory bat call surveys*
- Mist netting (bats)

*Currently using this method

Bird Surveys

Birds comprise the most extensive data that Dakota County has collected for LHRP. Most of this data has been collected from eBird, which is an online database of bird observations from the general public. This data is useful and will be utilized in the future, but it does not show which birds are breeding versus which ones are just passing through. Various other survey methods need to be used in order to gather this information.

Recommended survey methods:

- Breeding bird surveys*
- Secretive marsh bird surveys*
- Nest monitoring
- Mist netting

*Currently using this method

6.1.3. BioBlitz

According to Wikipedia, a 'BioBlitz' is "an intense period of biological surveying in an attempt to record all the living species within a designated area", and "groups of scientists, naturalists, and volunteers conduct an intensive field study over a continuous time period (usually 24 hours)". One of the benefits of conducting a BioBlitz is encouraging and engaging public participation. To this end, BioBlitzes are often held in parks or nature reserves close to cities. LHRP would be an ideal candidate for a BioBlitz.

It takes considerable effort to organize and coordinate a successful BioBlitz, such as contacting local experts and confirming their participation, recruiting volunteers, developing strategies and maps for surveying, and having a system to record and document all of the data and information that is produced. Although County staff does not currently have the capacity to do this, the potential exists for the future and should be planned for so that it can be implemented in the near term. Such a project may lend itself well for a temporary natural resource staff person to research and manage.

6.1.4. Lake/Water Resources Monitoring

A subwatershed assessment was complete in 2017 for LHRP (Wenck). The final report included a summary of past water quality sampling as well as recommendations for future activities related to water resources within and surrounding the park. Select information from sections of the report is excerpted below.

Intensive water quality sampling was conducted by Dakota County staff on each of the LHRP priority lakes in 2017. For each lake, surface samples were collected bi-weekly from June to late September and analyzed for [Total Phosphorous] TP, chlorophyll-a, Secchi depth, chloride, total suspended solids (TSS), nitrogen, temperature, and dissolved oxygen. In addition to the priority lakes, Portage, Marsh and Gerhardt Lakes were also sampled approximately one time per month from June through September in 2017. Prior to 2017, water quality sampling data for the lakes within LHRP is rather limited over the past 15 years. Water quality, including TP, chlorophyll-a and Secchi depth, was monitored on four lakes (Jensen, O'Brien, McDonough, and Holland) in 2007 and

2008. Additionally, Secchi depth measurements have been recorded periodically in Jensen, Schulze, McDonough, Holland, and Gerhardt Lakes.

The primary objectives of this study were to identify and prioritize targeted watershed management strategies for LHRP that are aimed at protecting and improving the water quality and ecological communities throughout the park. These objectives were accomplished through review of existing/historic water quality data and biologic assessments, development of water quality models to predict flow and nutrient (mainly TP) loading to the priority lakes, establishment of TP reduction goals for each priority lake, and, finally, identification of structural and in-lake BMPs to help meet the TP reduction goals and improve biotic communities. While the modeling and data collection for this study covered the entire LHRP system, the final analysis and reporting focused on five priority lakes in the park: Jensen, O'Brien, Schulze, McDonough, and Holland Lakes. Below is a summary of the results and recommendations for each of the LHRP priority lakes, along with general recommendations for other resources throughout the park.

Jensen Lake

- Historic monitoring data for Jensen Lake indicates the lake is currently meeting State water quality standards and the 35 μg/L LHRP shallow lake TP target established for this study.
- Recent SAV surveys (2016) for Jensen Lake suggest the lake has a relatively abundant and diverse plant community and no observed AIS.
- Modeling results suggest TP loading to Jensen Lake is driven by watershed runoff (54%) followed by sediment (28%) and atmospheric (18%) inputs.
- This study set a TP load reduction goal of 10 percent (7 pounds per year) to ensure the lake continues to meet the LHRP shallow lake TP target.
- Based on historic monitoring data and model results, protection efforts for Jensen Lake should focus on reducing watershed TP loads, protecting the current SAV communities, and AIS prevention.
- Three potential BMPs were [cited] in the Jensen watershed, including two regional stormwater treatment practices (REG-5 and REG-6) and one trail crossing maintenance/repair project (3J). If all three of these projects were implemented, TP loading to Jensen Lake would be reduced by approximately eight pounds per year.

O'Brien Lake

- Historic monitoring data for O'Brien Lake indicates the lake has exceptional water quality and is currently meeting State water quality standards for TP, chlorophyll-a, and Secchi depth. With a historic average TP concentration of 22 μg/L, O'Brien Lake also currently meets the LHRP shallow lake TP target established for this study.
- Modeling results suggest TP loading to O'Brien Lake is driven by watershed runoff (49%) followed by inputs from upstream lakes and atmospheric deposition (both 21%) and the sediments (9%).

- This study set a TP load reduction goal of 5% (2 pounds per year) for O'Brien Lake. This goal is based on MPCA guidance for protecting lakes that currently meet State water quality standards.
- Based on historic monitoring data and model results, management efforts for O'Brien Lake should focus on reducing watershed TP loads and protecting/enhancing water quality in upstream lakes (primarily Jensen).
- Two potential regional stormwater BMPs were [cited] in the O'Brien Lake watershed (REG-3 and REG-4). Both of these BMPs are large sand filters that would have the potential to remove approximately 10 pounds of TP per year.

Schulze Lake

The 2017 monitoring data for Schulze Lake indicates chlorophyll-a concentrations and Secchi depth are not currently meeting State water quality standards. The historic data for Schulze Lake suggests that Secchi depth has shown declining trends since the late 1990s. While average annual in-lake TP concentrations for Schulze Lake currently meet State standards, they do not meet the 35 μg/L LHRP shallow lake target established for this study.

Modeling results suggest TP loading to Schulze Lake is split between P-release from the lake's sediment (27%), model residual load (25%), upstream lakes (23%), watershed (16%), and atmospheric deposition (9%). The model residual load for Schulze Lake represents the additional load needed to calibrate the lake response model to monitored in-lake TP concentrations. This load could include TP inputs from one or several unknown sources such as rough fish and/or an imbalanced fishery, CLP senescence, or inputs from the public swimming beach.

Water quality in Portage Lake, which is the major upstream lake in the Schulze Lake watershed, is very good and currently meeting State water quality standards and the LHRP TP target. This study set a TP load reduction goal of 32 percent (14 pounds per year) in order for Schulze Lake to meet the 35 μg/L in-lake target concentration.

Based on historic monitoring data and model results, management efforts for Schulze Lake should focus on reducing internal P-release from the lake's sediments, watershed improvements, and identifying and addressing the source of the model residual load.

Three potential BMPs were sited in the Schulze watershed, including one regional stormwater treatment practice, one channel stabilization project, and an in-lake alum treatment.

- The regional stormwater treatment practice (REG-1) is located immediately downstream of Portage Lake. This practice would potentially reduce TP loads to Portage Lake by approximately 4 pounds per year.
- The channel stabilization project (1S) is a relatively cost-effective project and would potentially reduce TP loading in the Schulze Lake direct watershed by approximately 1.5 pounds per year.
- The proposed Alum treatment for Schulze Lake (AL-1) would provide a significant load reduction (11 pounds per year) and is the most cost-effective practice cited in the Schulze

Lake watershed. The alum treatment should help reduce algae levels, particularly nuisance algae blooms, which have become common in Schulze Lake during mid-late summer.

On September 6 and 7 of 2018, the County conducted a fish survey (see **Appendix E** for the full report) in Schulze Lake to determine the health of the fish community and to determine the impact that the fish have on water quality in the lake and other factors that may be influenced by the fish. Fyke and gill nets were used to catch fish in three littoral locations of the lake. Green sunfish dominated the catch in Schulze Lake and no piscivorous (fish-eating) species were captured in the nets. The fish community was comprised of moderately (green sunfish, hybrid sunfish) to highly low-oxygen-tolerant species (fathead minnow, black bullhead) (**Table 39**). Very few fish were observed at a size that is typically pursued by recreational fisherman.

Species	Mini-fyke 1	Mini-fyke 2	Mini-fyke 3	Gill Net 1	Total
Black Bullhead	1.4	0.8	--	0.1	2.4
Bluegill	1.6	1.0	1.3	--	3.9
Fathead Minnow	--	0.0	0.1	--	0.2
Green Sunfish	7.7	7.1	4.1	0.9	19.8
Golden Shiner	0.0	0.1	1.2	--	1.3
Hybrid Sunfish	0.7	1.4	1.0	--	3.2
Pumpkinseed Sunfish	0.8	0.1	0.8	--	1.7

Table 39. *Schulze Lake net catch summary reported as pounds per species.*

Monodominant fish communities and/or imbalanced fish communities in shallow lakes can lead to water quality impairments and habitat degradation. Monodominant and imbalanced community structures typically have an overabundance of planktivore/benthivore/omnivore specie(s) (i.e., green sunfish, black bullhead, fathead minnow). An overabundance of this trophic guild can directly or indirectly suppress the zooplankton and, in particular, large bodied zooplankton (i.e., Daphnia) (**Figure 41**). The large bodied zooplankton are exceptional filter feeders and can consume phytoplankton from the water column and help keep shallow lakes in a clear water state. Without healthy populations of zooplankton, phytoplankton levels (measured by chlorophyll-a) can increase and lead to a turbid water state. The turbid water state will likely persist until a shift in the community occurs to a more balanced fishery or a system with no fish.

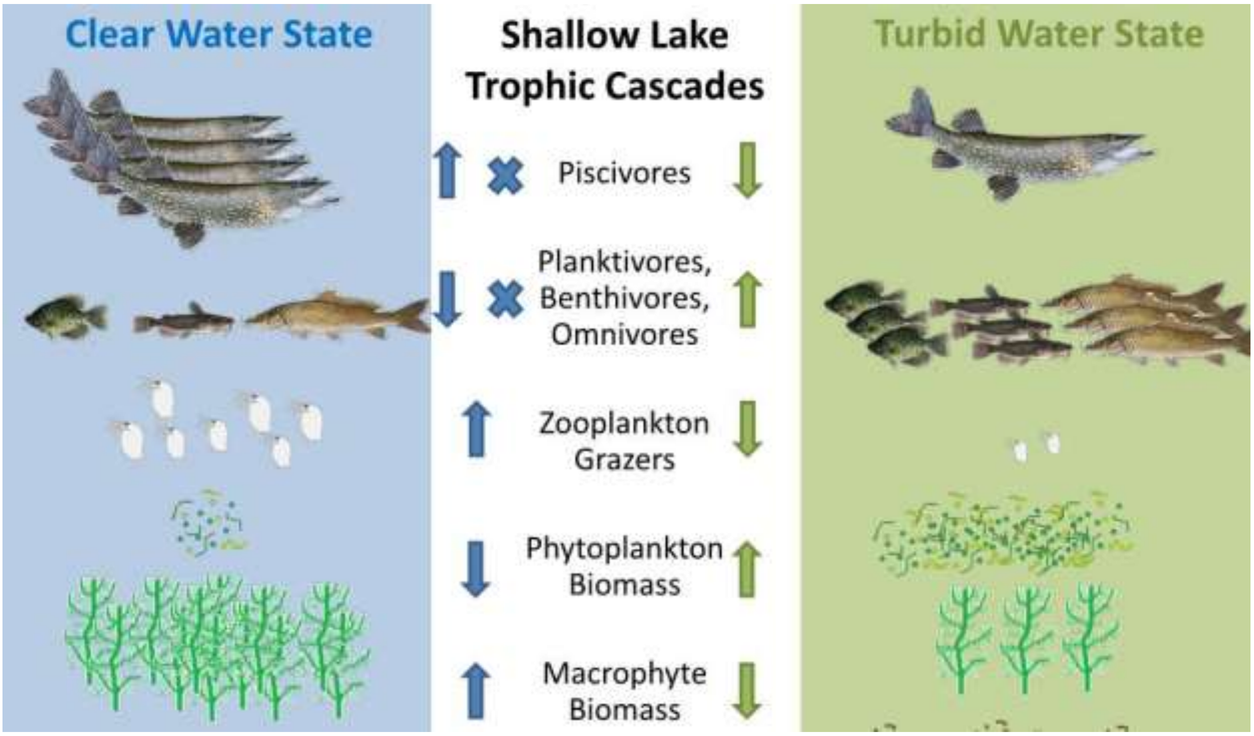


Figure 41. *Shallow lake trophic cascade schematic with relative abundance depicted by the number of fish in each trophic guild or by arrows next to the trophic guild.*

Schulze Lake has similar species as McDonough without as large of a green sunfish population. Schulze Lake also lacked any large piscivorous species (i.e. northern pike, largemouth bass) that may help reduce the foraging pressures of the planktivore/benthivore/omnivore species. Both systems appear to be highly productive shallow lake ecosystems that may face difficultly in establishing and sustaining balanced fisheries with piscivorous species. Upon retrieval of the mini-fyke nets in McDonough, nearly all the sunfishes were dead, suggesting a possible depletion in dissolved oxygen in the over-evening hours.

The mini-fyke nets were placed within large stands of coontail and lily pads, and it is likely that dissolved oxygen levels within these areas became depleted overnight while the lake was respiring. Once the fish were captured in the nets, they were unable to escape to deeper more oxygenated waters. All of the black bullheads captured in the same nets survived which, while interesting, is not surprising since they are a more stress tolerant species compared to green sunfish. These results suggest that dissolved oxygen may be a limiting factor for some fish species and sustained recruitment of piscivorous fish within McDonough Lake may be difficult without further management intervention (i.e., continuous aeration).

We did not observe any fish mortality in Schulze Lake. Schulze Lake is deeper compared to McDonough Lake and had a much smaller abundance of littoral vegetation; however, it is possible that the deeper areas of the lake were anoxic (i.e., oxygen levels <2.0 mg/L). If this area of the lake is anoxic it may create a stressful environment for all fish species. A non-direct fisheries concern to anoxia in a lake is the release of nutrients from benthic sediments that can lead to algae blooms and water quality concerns.

Recommendations include the following:

- Develop a sampling plan to gain more insight to the boom-bust nature of the fisheries in Schulze and McDonough Lakes and to better inform fisheries management plans.
- Develop fisheries management plans for each lake that align with the goals, objectives, and action items set forth in the Lebanon Hills Regional Park Masterplan, Lebanon Hills Natural Resource Management Plan, Lebanon Hills Regional Park Subwatershed Assessment Report, and staff interest. Schulze had observed populations of Eurasian watermilfoil, while McDonough did not. Efforts to inform the public and ensure this species is not moved into non-infested waters is critical.
- Optional: Sample the zooplankton community in each lake conjunction with routine water quality monitoring efforts to determine the presence and abundance of large bodied zooplankton (i.e., Daphnia).

McDonough Lake

Historic monitoring data for McDonough Lake indicates all three water quality parameters are currently meeting State water quality standards; however in-lake TP concentrations do not currently meet the 35 μg/L LHRP shallow lake target established for this study.

Modeling results suggest TP loading to Schulze Lake is driven primarily by inflow from upstream lakes (50%) followed by inputs from the direct watershed (23%), model residual load (16%), sediments (6%), and the atmosphere (5%). The model residual load for McDonough Lake could include TP inputs from one or several unknown sources such as rough fish and/or an imbalanced fishery or CLP senescence.

Three of the major lakes upstream of McDonough Lake, O'Brien, and Marsh, currently exhibit very good water quality and therefore are not likely negatively impacting water quality in McDonough Lake. As discussed above, water quality in Schulze Lake is poor and, due to its proximity to McDonough Lake, is likely having a significant impact on McDonough Lake.

This study set a TP load reduction goal of 25 percent (22 pounds per year) in order for McDonough Lake to meet the LHRP shallow lake target concentration. Based on historic monitoring data and model results, management efforts for McDonough Lake should focus on improving water quality in Schulze Lake, watershed improvements, and identifying and addressing the source of the model residual load. Two potential BMPs were [cited] in the McDonough watershed, including one regional stormwater treatment practice and one trail crossing maintenance/repair project (1M/4M). The regional stormwater practice, REG-2, is actually located in the Marsh Lake subwatershed and, if implemented, would potentially reduce TP loads to Marsh by approximately 16.4 pounds per year. This practice has the largest potential TP reduction of all the BMPs cited in the report and is relatively cost-effective. This project would help protect current water quality conditions in Marsh Lake while also benefitting McDonough Lake.

The following is a discussion of a fish survey (see **Appendix E** for the full report) that was conducted at McDonough Lake in September of 2018:

Green sunfish dominated the catch in McDonough with an estimated count of nearly 40,000 individuals captured in the three mini-fyke nets. No piscivorous species (i.e., northern pike, largemouth bass) were captured in the nets. The fish community was also comprised of moderately (green sunfish, hybrid sunfish) to highly tolerant species (black bullhead) (**Table 40**). Very few fish were observed at a size that is typically pursued by recreational fisherman, suggesting that recreational fishing opportunities are limited on McDonough.

Species	**Mini-fyke 1**	**Mini-fyke 2**	**Mini-fyke 3**	**Gill Net 1**	**Total**
Black Bullhead	12.3	1.2	0.8	0.6	14.9
Bluegill	0.8	0.6	0.6	0.0	2.0
Green Sunfish	15.0	112.4	4.4	--	131.8
Golden Shiner	0.0	0.3	0.1	--	0.4
Hybrid Sunfish	0.2	0.3	0.2	--	0.7
Pumpkinseed Sunfish	0.1	--	--	--	0.1

Table 40. *McDonough Lake net catch summary reported as pounds per species.*

The fish community in McDonough Lake was dominated by a large population of young-of-year (age 0-1) green sunfish. Though other fish species were observed, the over-abundance of green sunfish is concerning for water quality due to foraging on zooplankton and the release of phytoplankton from predation. Green sunfish themselves are not a species of direct concern for water quality (such as common carp, which can uproot vegetation); rather, it is their over-abundance that can indirectly contribute to water quality impairments. Additionally, no piscivore species were observed within McDonough which indicates green sunfish either have no predators within the lake or the abundance of predators is so small their ability to control the green sunfish populations is non-existent.

Recommendations

• Develop a sampling plan to gain more insight to the boom-bust nature of the fisheries in Schulze and McDonough Lakes and to better inform fisheries management plans.
• Develop fisheries management plans for each lake that align with the goals, objectives, and action items set forth in the Lebanon Hills Regional Park Masterplan, Lebanon Hills Natural Resource Management Plan, Lebanon Hills Regional Park Subwatershed Assessment Report, and staff interest.
• Schulze had observed populations of Eurasian watermilfoil, while McDonough did not. Efforts to inform public and ensure this species is not moved into non-infested waters is critical.

• Optional: Sample the zooplankton community in each lake conjunction with routine water quality monitoring efforts to determine the presence and abundance of large bodied zooplankton (i.e., Daphnia).

Holland Lake

Holland Lake is the only deep lake within LHRP and, due to its depth and small watershed to lake area ratio, has an extremely long residence time (~16 years). Historic monitoring data for Holland Lake indicates the lake has exceptional water quality and is currently meeting State water quality standards for all three parameters. With a historic average TP concentration of 18 µg/L, Holland Lake also currently meets the 20 µg/L TP target for deep lakes in LHRP established for this study. Recent SAV surveys (2016) for Holland Lake suggest the lake currently has two AIS, CLP, and EWM, at low to moderate densities throughout the lake.

Modeling results suggest TP loading to Holland Lake is driven by watershed runoff (54%) followed by atmospheric deposition (27%) and P-release from the lake's sediments (19%). This study set a TP load reduction goal of five percent (2 pounds per year) for Holland Lake. This goal is based on MPCA guidance for protecting lakes that currently meet State water quality standards.

Based on historic monitoring data and model results, management efforts for Holland Lake should focus on reducing watershed TP loads and managing AIS to promote native vegetation growth and a healthier submerged and shoreline aquatic vegetation community. One channel stabilization project (1S) was sited within the Holland Lake direct watershed. This project is a relatively cost-effective project and would potentially reduce TP loading to the lake by approximately 1.5 pounds per year.

Other Lakes and Water Resources in LHRP

This study focused on five priority lakes throughout LHRP. However, there are other lakes throughout the park that could be targeted for similar studies and improvement projects.

Gerhardt Lake is one lake in particular that should be targeted for more water quality monitoring and assessments. Water quality sampling was conducted on Gerhardt Lake in 2017, and results indicate the lake is currently not meeting State standards for chlorophyll-a and Secchi depth. Gerhardt Lake did meet State standards for TP in 2017; however it did not meet the 35 µg/L shallow target established for this study. This study identified two potential BMPs (one regional BMP and an alum treatment) to reduce TP loads to Gerhardt Lake.

The primary focus of this study was to assess and provide management recommendations for the priority lakes throughout LHRP. This study did not explicitly assess uplands (i.e., prairie and forest) and/or wetland features throughout the park system. Assessing, managing, protecting, and restoring these features to ensure they are in a healthy state will have a positive effect on the lakes and other resources throughout the park. Dakota County Parks is currently working on several upland restoration and improvement projects throughout the park, and it is recommended that these types of projects continue to be a high priority in the future.

Future Monitoring Recommendations

Currently, there is very limited water quality data for the lakes in LHRP. The 2017 monitoring data was extremely valuable for this study in developing the models and assessing the current state of the lakes in the park. It is highly recommended that the County continue to perform routine water quality sampling for the priority lakes within the park for at least three to five years. Collecting this data will provide a solid baseline dataset that can be used in the future to update models, determine long-term trends, evaluate potential BMPs, and track changes in water quality as BMPs are implemented.

It is recommended that fish surveys be conducted on the five priority lakes in LHRP, as well as Gerhardt Lake. The fish surveys should be performed using equipment (i.e., mini fyke nets) intended to sample shallow lake fish communities.

Schulze, McDonough, and Holland Lakes currently have AIS that covers over 39 percent of the lakes' surface area. However, density of existing AIS in these lakes is relatively low, suggesting chemical treatments may not be necessary at this time. That said, FQI scores for four of the five priority lakes do not currently meet state thresholds. It is recommended that the County continue to perform annual SAV surveys to track trends/changes in AIS and general SAV community health over time and to reassess the need for treatments in the future.

This study identified and sited eight potential regional stormwater BMPs. Load reduction estimates for these BMPs were generated and are based on modeled data, not monitored concentrations, and therefore it is highly recommended that the County collect at least one season's worth (minimum of 5 samples) of grab samples at each proposed BMP location prior to moving forward with any of the practices. The samples should be collected from the pond outlet (for filtration bench BMPs) or the channel itself (for filtration basin BMPs) during various flow conditions. Samples should be analyzed for TSS, TP, and ortho-phosphorus. Flow rates (if possible), temperature, and dissolved oxygen data should also be collected in conjunction with the water quality grab samples. Collecting this data will help verify modeling results and anticipated pollutant reduction loads which will further help BMP prioritization and feasibility of the proposed practices.

In all lakes, methods and materials to reduce sodium build up in the water and soil should be pursued. All staff applying road salt to trails and roads should receive best management practices training, including contractors that are hired to apply salt to park areas. Lakes should be sample periodically for sodium and chloride, both at the surface and at the bottom of lakes.

6.2. Reporting

Records should be kept of all management activities that have been conducted, including the timing, tools, and methods used (e.g., on September 15th, 20__, buckthorn was cut within six inches of the ground surface and promptly stump treated with a 20% solution of glyphosate; cut stems were allowed to fall in-place). Staff recommends that a Dakota County Parks Adaptive Management Spatial Database be developed that allows individual management activities to be recorded into a database that can be tied to a GIS-based mapping system.

7. NATURAL RESOURCES CONSERVATION, MANAGEMENT PRIORITIZATION, AND RECOMMENDATIONS

7.1. Management Prioritization

Prioritization System-Wide (excerpt from NRMSP, Section 11.6.1)

It is important that potential projects are evaluated individually to ensure that they are soundly conceived and designed, and that they are actually a high priority project. To this end, each potential project will be run through a set of criteria and scored. The criteria will be weighted according to their relative importance to achieving the goals of the NRMSP. Projects that receive a high score would receive the highest priority for funding and execution.

One method being considered is STAPLE-E, a typical bottom-up set of criteria. STAPLE-E considers the following in its scoring:
S = Social
T = Technical
A = Administrative
P = Political
L = Legal
E = Environmental
E = Economic

A bottom-up scoring system should be balanced by a top-down set of criteria. For example, no one park should receive the majority of funding, even if the needs of that park result in the identification of many important projects. This would help spread the restoration and management work more evenly among parks.

Other criteria, especially when pursuing grants, will be employed. For example, the DNR uses criteria for selecting candidate projects for Legacy grants. The County should evaluate projects being submitted for this funding using the DNR's criteria.

Lebanon Hills Regional Park is the County's largest and most-used park and should receive more consideration than other parks, such as ensuring that each year a project occurs there, even if it is a small one.

7.2. Conservation, Protection, and Management Prioritization of Natural Resources at Lebanon Hills Regional Park

Conservation, protection, and management activity prioritization for natural resources and management units is based on several factors. Typically, high priority features/units contain one or more of the following:

- **Quality, Diversity,** and **Integrity** of the pre-restoration area
- **Rare or uncommon features** such as:
    - Rare plant populations
    - Rare animal populations or observations
    - High quality native plant communities
    - Unusual or unique geologic features
- **Proximity** to areas previously or currently being actively restored (e.g., buckthorn removal, prescribed fire)
- Ability to provide **connectivity** for wildlife or vegetation or for rare or unique features
- **Important habitat** for declining wildlife species (e.g., hibernacula for snakes and bats, shoreland/mudflats for shore birds, prairie-wetland complexes for Blanding's turtles)
- Areas of **high public visibility** or **educational value**
- **Ecological Impact Value**—for example, areas that provide secondary benefits or important **buffer habitat**
- Groundwater infiltration/**sensitivity areas** (LHRP mapped as Low to Moderate by MGS)
- Areas with current or high potential for **erosion** (e.g., drainageways, trails)
- "**Restorability**"—high probability of the area being successfully restored, considering accessibility, effort necessary to do the project, disruptions that may occur, and site suitability for specific methods that would increase project success
- **Plan Consistency**—restoration is consistent with existing plans, including infrastructure improvements proposed in the Master Plan; proposed infrastructure projects will be evaluated through an environmental review process. Areas with higher chance of future development impacts, for example, would rank lower.
- **Sustainability**—long-term maintenance requirements
- **Urgency**—risk of losing natural features (such as rare species), with the degree of urgency based on anticipated timelines for losses (e.g., within 1 year, 5 years, 50 years)

A numeric scale may be developed to quantify the relative priority of a given site(s). For instance, **Table 41** has been developed as a draft restoration priority ranking scale.

Possible points (0-4)														
Weighting/multiplier	3	2	1	3	2	2	1	1	1	3				
Area/Site	Quality, Diversity, Integrity	Con-nectivity Potential, Adjacency to restored areas	High visibility, educa-tional, community interest	Rare Feature(s)	Restor-ability, accessibility, effort, disruption	Sustain-ability	Ecological Impact Value, Secondary Benefits, Buffering Potential	Site Sensitivity	Plan consistency	Urgency	TOTAL	Possible Points	Percent-age of Possible	Rank
Duck Pond Area	2	1	2	2	3	3	2	2	3	2				
Duck Pond with multiplier	**6**	**2**	**2**	**6**	**6**	**6**	**2**	**2**	**3**	**6**	**41**	**95**	**43%**	**3**
Cattail Pond Area	4	4	3	3	3	3	3	3	4	3				
Cattail Pond with multiplier	**12**	**8**	**3**	**9**	**6**	**6**	**3**	**3**	**4**	**9**	**63**	**95**	**66%**	**1**
Buck Pond Area	2	3	4	4	4	3	4	4	3	3				
Buck Pond with multiplier	**6**	**6**	**4**	**12**	**8**	**6**	**4**	**4**	**3**	**9**	**62**	**95**	**65%**	**2**

Table 41. *Example of Site Evaluation Ranking for Restoration Projects.*

Definitions For Assigning Point Values

Use the definitions/descriptions in **Table 42** to assign point values for each category.

Dakota County Numeric Rank	DNR Code	Dakota County Descriptor	Description
Quality, Diversity, Integrity			
4	A	Excellent	Occurrences have excellent ecological integrity. They have species composition, structure, and ecological processes typical of the natural or historic range of the community and have been little degraded by recent human activity or invasive species.
3	B	Good	Occurrences have good ecological integrity. They include plant communities with modest degradation or that were degraded in the past but have recovered and now have relatively natural composition and structure. B-rank occurrences normally will return to A-rank condition with protection or appropriate management.
2	C	Fair	Occurrences have fair ecological integrity. They show strong evidence of human-caused degradation but retain some characteristic species and have some potential for recovery with protection and management.
1	D	Poor	Occurrences have poor ecological integrity. The original composition and structure of the community have been severely altered by human-caused degradation or invasion by exotic species. They have little chance of recovery to their natural historic condition.
0	F	None	Occurrences are non-existent. The original composition and structure of the community has been lost. They have no chance of recovery to their natural condition without considerable input and effort.
Connectivity Potential, Adjacency to Restored Areas			
4	-	Excellent	High visibility area. Excellent and close-by educational opportunities. Strong community interest in area.
3	-	Good	Some high visibility sites in area. Good and not too distant educational opportunities. Good community interest.
2	-	Fair	A few high visibility sites in area. Some or distant educational opportunities. Some community interest or sporadic interest.

1	-	Poor	None to a few high visibility sites in area. Few or distant educational opportunities. Weak community interest.
0	-	None	No high visibility sites in area. No to few and distant educational opportunities. No to weak community interest.
Rare Feature(s)			
4	-	Excellent	Many rare features on site. Many observed in past.
3	-	Good	Several to some rare features recently observed on site. Some observed in past.
2	-	Fair	Some to few rare features recently observed on site. Some to few observed in past.
1	-	Poor	No rare features recently observed on site. Some observed in past.
0	-	None	No rare features recently observed on site. None observed in past.
Restorability, Accessibility, Effort, Disruption			
4	-	Excellent	Easily restorable; easy access; relatively low effort required; not very disruptive to visitors.
3	-	Good	Restorable; good access; moderate effort required; not terribly disruptive to visitors.
2	-	Fair	Moderately restorable; moderate access; moderate to high effort required; may be disruptive to visitors, but can be worked around.
1	-	Poor	Not very restorable; poor access; high effort required; potentially very disruptive to visitors and would be difficult to work around.
0	-	None	Not restorable; consider re-evaluating target plant community; extremely high effort required; potentially very disruptive to visitors and would be difficult to work around.
Sustainability			
4	-	Excellent	Highly sustainable; easy or routine maintenance required; no legacy invasives and non-native or impervious cover to control.
3	-	Good	Sustainable; moderate or routine maintenance required; few legacy invasives and non-native or impervious cover to control.
2	-	Fair	Moderately sustainable; difficult to moderate maintenance required; several legacy invasives and non-native or impervious cover to control.

1	-	Poor	Not very sustainable; difficult to maintain; many legacy invasives and nonnative or impervious cover to control.
0	-	None	Not sustainable; difficult to impossible to maintain; dominated by legacy invasives and nonnative cover or impervious cover.
Ecological Impact Value to surroundings, Secondary Benefits, Buffering Potential			
4	-	Excellent	Greatly positively impacts surrounding area or other features such as water quality. Significantly improves ecological functioning of site.
3	-	Good	Positively impacts surrounding area or other features such as water quality. Improves ecological functioning of site.
2	-	Fair	Moderately positively impacts surrounding area or other features such as water quality. Moderately improves ecological functioning of site.
1	-	Poor	Only slightly positively impacts surrounding area or other features such as water quality. Only slightly improves ecological functioning of site.
0	-	None	Does not positively impact surrounding area or other features such as water quality. Does not improve ecological functioning of site.
Site Sensitivity			
4	-	Extreme	Extremely sensitive site. For example, contains many steep slopes, many wetlands, many rare features, groundwater sensitivity, prime habitat, many nesting sites, and critical habitat elements.
3	-	High	Highly sensitive site. For example, contains many steep slopes, some wetlands, some rare features, groundwater sensitivity, prime habitat, many nesting sites, critical habitat elements.
2	-	Moderate	Moderately sensitive site. For example, contains some steep slopes, some wetlands, some rare features, some groundwater sensitivity, some prime habitat, some nesting sites, and some critical habitat elements.
1	-	Slight	Slightly sensitive site. For example, contains a few steep slopes, a few wetlands, a few to no rare features, no groundwater sensitivity, some prime habitat, a few nesting sites, some critical habitat elements.
0	-	Low	Low sensitive site. For example, contains few steep slopes, few wetlands, no rare features, no groundwater sensitivity, no prime habitat, few nesting sites, few critical habitat elements.

Plan Consistency			
4	-	Excellent	Very consistent with extant plans. No contradictions exist.
3	-	Good	Consistent with extant plans. Only one contradiction exists.
2	-	Fair	Fairly consistent with extant plans. A few contradictions exist.
1	-	Poor	Poorly consistent with extant plans. Several contradictions exist.
0	-	None	Not consistent with extant plans. Many contradictions exist.
Urgency			
4	-	Extremely Urgent	If nothing is done soon, species will be lost or character of the community will be significantly and irreversibly degraded. Requires action within 2 years.
3	-	Very Urgent	If nothing is done, species may be lost and community character may be significantly and irreversibly degraded. Requires action within 5 years.
2	-	Urgent	If nothing is done, species will be negatively affected, but probably not lost and community character will significantly degrade but not reversibly. Requires action within 10 years.
1	-	Mildly Urgent	If nothing is done, species will be negatively affected, but not lost and community character will be degraded but not reversibly. Requires action within 20 to 50 years.
0	-	Not Urgent	Not urgent. No action required.

Table 42. *Descriptions/Definitions for Levels and Categories for Prioritization Ranking.*

8.2.1. Conservation and Recommendations

This section describes specifics that help achieve the goals listed above. Each recommendation relates back to a goal. Included are occurrences of the following: high diversity areas, remnant natural communities, high priority features, and species of conservation interest. See the map in **Figure 42** for locations of some significant features. The County is continuing to survey and monitor the park, and, as new features are found, the list will be updated and further recommendations will be generated for each.

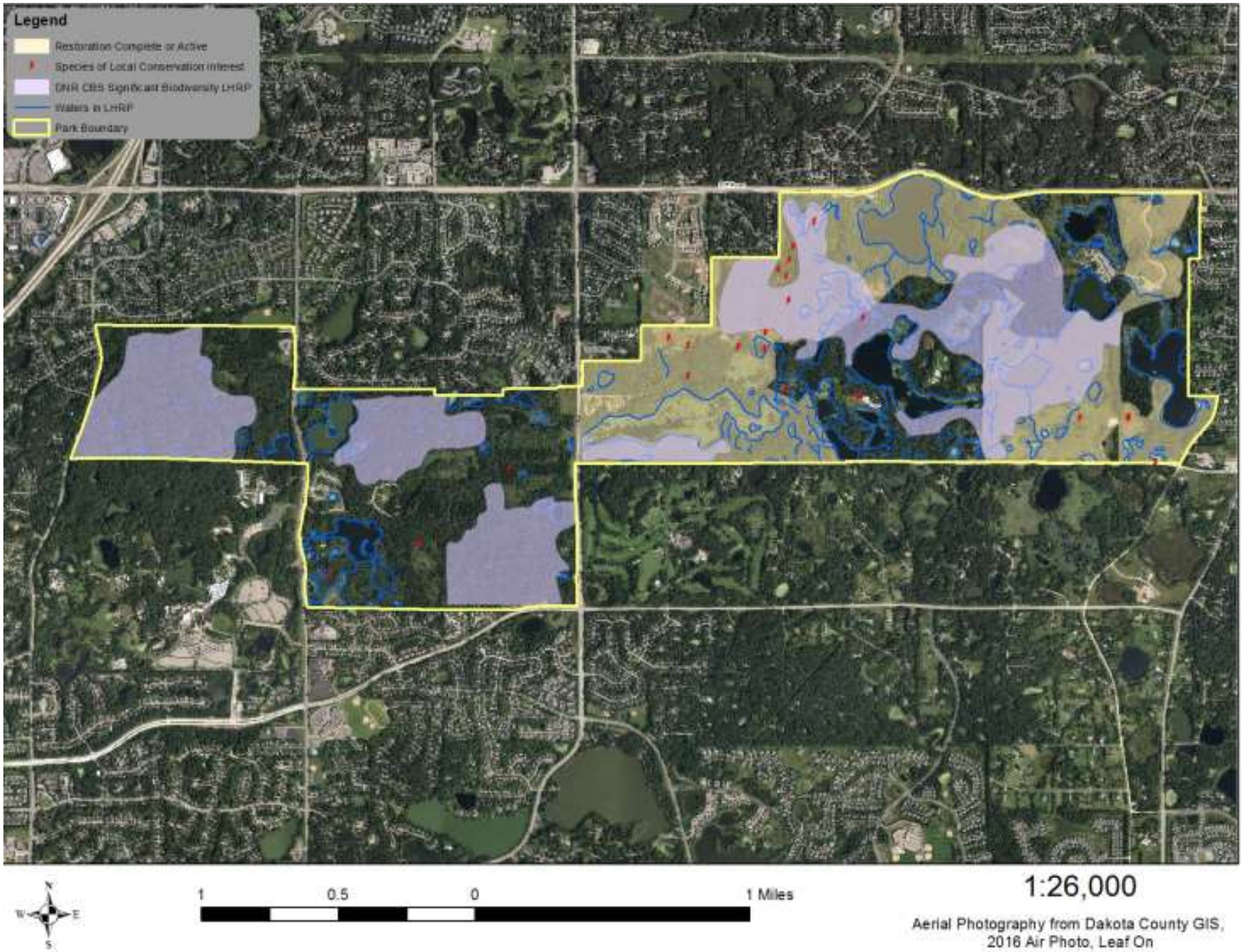


Figure 42. *Significant natural features and significant natural areas of LHRP.*

In general, when management (or other) activities are considered for the park, potential detrimental impacts to natural resources will be evaluated based on the following sequential criteria:

(1) Impacts must first be **avoided**, if possible.
(2) Impacts will be **minimized**.
(3) Impacts that cannot be avoided or minimized will be **restored, rehabilitated,** or **mitigated on site**.
(4) Lastly, if impacts cannot be mitigated through restoration activities at the impact site, then they will be restored, rehabilitated, or mitigated elsewhere within the park, if possible.

The ratio of area restored, rehabilitated, mitigated, or compensated to area impacted will depend on the value of the resource compromised and the severity of the impact. For example, if a high quality wetland is severely impacted, the restoration ratio could be as high as 10:1 (restore 10 times the amount of area that was impacted); but for an average wetland that was only mildly impacted, then the restoration ratio could be only 1:1.

Wildlife Habitat Relationships

Wildlife Habitat Relationships, WHR, is a concept introduced in the 1980's in California. It is used in landscape architecture and habitat design (Greco, S.E., 2016). It utilizes "ecological greenway design process which models species-specific life history information that links vegetation communities and their structure to individual wildlife species suitability models." Without incorporating WHR models for focal species in a design process to predict functionality for wildlife species of concern, is unlikely that a landscape will effectively function for them. By implementing a dual track design process, one track focused on natural systems and the other on cultural systems, GIS databases can be made and then combined with illustration software to create site analyses and phased master plans for each system. GIS can be used effectively to communicate phasing in an animated sequence. It is recommended that the County use this system, or one like it, in developing future master plans for LHRP and the greenways that connect to LHRP.

8.2.1.1 Remnant Prairies

Remnant prairies are plant communities composed of relatively high degree of biodiversity where most plant species are native. They are relatively intact plant communities or at least the major components of one. Generally speaking, they are prairies that were never plowed. They may have been grazed, in the recent past, but at least not to the extent that plant diversity is significantly low. No areas in the park have completely escaped impacts from people, so even areas we consider remnant are still somewhat degraded and deserve management attention. Most upland areas that were either 1) relatively flat, 2) not too rocky or sandy, or 3) accessible for farm equipment had been converted to some form of agricultural land use. Other marginal areas such as those that were intermittently or seasonally wet were sometimes turned into agricultural fields. Most remnant prairies, therefore, are either very remote, on steep slopes, or comprised of rocky/sandy soil and are relatively rare. As such, they deserve the highest degree of protection. Today they serve as important refugia for wildlife dependent on this rare community. They also can be used as a source of seeds and propagules for future prairie restoration in the park. In addition, they offer glimpses to visitors of what prairies were like historically. An example of a remnant prairie in the park is Rattlebox Prairie (**Figure 24**).

8.2.1.2 Wetlands

Although Dakota County has lost more than 85 percent of its wetlands since the time of statehood, over 180 wetlands occur in the LHRP, and many more, small, ephemeral wetlands (vernal pools) occur. The condition of these wetlands varies, but they all need to be conserved and protected. Many need to be restored. Examples include Tamarack Swamp, Duck Pond, Castle Wetland, Buck Pond, and Star Pond. Although wetlands are protected in the state of Minnesota from being dredged, drained, or filled (Wetland Conservation Act), they can still be impacted inadvertently from infrastructure development, such as sedimentation and pollutants from trails

In most cases, it is not sufficient to just protect the basin of a wetland or lake. Since wetlands take surface stormwater that drains from their surrounding watershed, it is recommended to protect as much of their upland watershed as possible. Restoring and managing a vigorous growth of native vegetation in a large buffer around each wetland and lake is advisable.

8.2.1.3 Lakes and Stream Channels

The lakes and stream channels in the park are significant resources requiring protection. Establishing and maintaining vigorous buffers of diverse native vegetation is important for healthy lakes and streams in the park. The 2017 Subwatershed Study and the 2002 Barr Engineering study provide guidance for management of lakes in the park. Implementation processes for water quality projects have been provided in both studies. Examples of projects include a Schulze Lake alum treatment, Holland Lake-Tamarack Swamp Channel restoration, McDonough and Jensen Lakes trail crossing maintenance repairs, and installation of iron-enhanced sand filtration (IESF) areas near Jensen, O'Brien, Portage, Marsh, Wheaton, and Gerhardt Lakes. Both studies recommend restoring native vegetation along lake shorelines and around wetlands. Native vegetation buffers not only improve water quality but also fish, amphibian, and invertebrate wildlife habitat in the watershed.

LAKE AND WETLAND PROTECTION PRIORITIES		
HIGH	MEDIUM	LOW
Bridge Pond	Dakota Lake	Cattail Lake
Gerhardt Lake	Jensen Lake	Marsh Lake
Holland Lake	McDonough Lake	
Lily Pond	Wetland 33	
Oak Pond	Wetland 34	
O'Brien Lake	Wetland 35	
Portage Lake		
Schulze Lake		
Sedge Pond		
Star Pond		
Tamarack Swamp		

Table 43. *Lake and Wetland Protection Priorities from 2015 Master Plan.*

The Barr Engineering study emphasized the importance of buckthorn removal and native vegetation restoration throughout the park for improved water quality as well. The dense growth habit of buckthorn reduces light to the ground, reducing or eliminating cover by herbaceous species. The resulting bare soil is susceptible to erosion and results in increased sediment flow into water bodies.

Lake and wetland protection priorities were included in the LHRP Master Plan (2015) (see **Table 43)**. The priorities were reviewed during development of the Subwatershed Assessment. In terms of this natural resources management plan, all of the lakes are considered high protection priorities.

8.2.1.4 Species in Greatest Conservation Need

Species in Greatest Conservation Need (SGCN) should be protected. **Tables 29** and **30** (pp. 89–90) contain lists of SGCN known to occur at the park or have been documented to occur in the past. Since these species are vulnerable and sensitive, information about where they are located within the park is not provided to the public. Information is still being gathered for the various SGCN in the park and will be continually updated to protect habitat for the species and focus or adjust management and development activities accordingly. For example, nesting sites have been identified for Blanding's turtle in an approximately 20-acre zone in the park. The County has taken steps to protect turtles and nests. If other Blanding's turtle nesting sites are discovered in the future, they should be mapped and added to a list for monitoring. If development activities or features are planned near a sensitive site, then the activities and/or development will be modified to ensure protection of the site.

8.2.1.5 Old Growth, Oak-dominated Savannas, Woodlands, and Forests

These communities are fire dependent. Oak savannas would have burned on a rotation frequency of about every two to eight years, oak woodlands about every seven to 10 years, and dry-mesic oak forest about every 10 to 20 years. Many woodlands and forests of the park contain old growth trees, especially oaks that are around 125 years old. Core Savanna/Woodland and Forest Areas that support old growth (typically oak) trees at LHRP have been identified via use of historical aerials and ground surveys (**Figure 42**). It is essential to protect, conserve, and restore core savanna/woodland and forest habitat, primarily since there is very little of it left in the region and large core areas provide better wildlife habitat for rare species.

Large and mature oaks are some of the most valuable resources we have in the park since they provide habitat for birds, nesting including several rare species like red-headed woodpeckers, habitat for insects, for mammals, and food for a plethora of animals that eat acorns. Mature oaks are important both dead and alive. The large dead or "over-mature" oaks often have punky wood and can contain cavities and cracks that birds and bats can utilize for their nests (birds) and summer roosts (bats). Thus, as a general rule, the harvesting of larger oaks—especially the white and bur oaks, will not occur. Occasionally, medium-sized red and pin oaks are removed, since they grow faster and have become overabundant in the park due to fire suppression—and many of them have died of oak wilt. The larger whites and burs are, for the most part, spaced relatively far apart and most of them are quite old. When exotic brush is removed (primarily buckthorn and Tatarian honeysuckle), as well as smaller trees and undesirable trees such as boxelder and silver maple, it allows more light to reach the ground and releases the plants that occur there, including oak seedlings. One of the long-term goals for the park is to increase oak regeneration, which this strategy should accomplish. So, unless they are a designated hazard, e.g., a tree with significant defects like large cracks or decay in the main stem or in the large branches, and it is next to a trail or a piece of infrastructure, the large oaks throughout the park will most likely remain standing.

Oak-dominated savannas, woodlands, and forests were once prominent in Dakota County and the regional landscape. These oak-dominated systems developed under native grazing and frequent fire and depend on maintenance through these activities (or others, such as haying that can mimic their effects). With the advent of fire suppression and removal of grazing (haying), these communities transitioned to closed forests with little or no oak regeneration. As a result, oak trees in these systems at LHRP are represented by an older age class generally dominated by bur and white oak that likely developed at or before the time of Euro-American settlement. These older trees are spatially arranged as scattered to patchy stands. Second growth of trees at LHRP is typically represented by denser stands of pin oak and aspen that developed much more recently. This has resulted in stands of oaks that are denser than they would have been, historically, as well as little or no oak regeneration.

Restoration of oak savannas and woodlands has become a focus of land managers for a myriad of reasons including conservation of native biodiversity, quality habitat for wildlife (especially species of conservation concern), diversification of habitats at the landscape scale, improving species richness of plants and animals, and restoration of ecosystem function. Oak savanna and oak forest also have significant aesthetic value for park visitors.

Restoration and maintenance of oak-dominated systems require active management. Fostering oak regeneration will be a critical factor in sustaining oak savanna and oak forest at LHRP. Reintroducing fire and integrating with silvicultural practices, herbaceous layer enrichment, and other activities will be essential to ensure that scenic oak savanna and oak forest are sustained into the future at LHRP.

Restoration ecology, and especially the restoration of oak-dominated systems, is a relatively young science. Management efforts to restore oak savannas and woodlands are often ahead of research. Monitoring and keeping up with the most current science will be essential for successfully employing adaptive management for oak habitat restoration at LHRP. To foster oak recruitment, appropriate tools will need to be utilized that allow gap reproduction of young oaks to enable development of the next generation of oaks in any particular area.

8.2.1.6 Steep Slopes and Areas of High Relief

As a result of the glacial landscape in which LHRP occurs, there are many irregularly shaped hills that include steep slopes. Scattered throughout the park, these areas deserve protection because of their high potential for soil erosion. Any slope of 25 percent or greater should be protected and monitored for erosion issues. **Figure 43** illustrates the distribution of steep slopes at LHRP. Areas shown in red and orange are slopes that are 25 percent or greater.

8.2.1.7 Restored Areas

Much of the park has already undergone the initial stages of restoration. Examples of restored areas include Tamarack Swamp, Buck Pond, Jensen Lake and Forest, Dakota Lake Savannas and

Woodlands, Star Pond Prairies, and Holland Lake Shoreline. **Figure 34** shows areas where restoration has been implemented in the park.

Most areas have been restored with state grant money and County matching funds, while some areas have been restored solely with County funding. Restored areas deserve high levels of protection to protect the investments that the County has made. Every effort should be made to minimize and avoid the most sensitive areas within any proposed development. Natural Resources staff members are currently consulted during the development planning process. The need for consultation with natural resources staff early in the process is key to best addressing potential issues and impacts to natural resources before the get too finalized. As reflecting current best management practices, a natural resource site evaluation should be conducted as part of the project scoping process to identify key natural resources to avoid and to serve as a baseline to compare post development evaluation.

10.2.1.8 Connectivity

Connectivity is important to join disparate and disjunct pieces together, to join fragments, and to help simulate core habitat. Much of the park has become fragmented due to past agricultural land use and current urban land use. The following is recommended to increase connectivity:

- Attempt to cluster restoration sites together to achieve a greater core habitat. When habitat is fragmented, attempt to connect via corridors or plan to restore land between fragments so that land pieces are joined together.
- Attempt to connect habitat pieces that are separated by barriers.
    - Roads. When habitat pieces are separated by roads, implement connectors such as wildlife crossings, tunnels, and landbridges.
        - County Roads in the vicinity of the park: before and during reconstruction, habitat connectivity should be examined and evaluated at that time (this would be the time to consider wildlife crossing structures and determine whether and how best to incorporate them into the road design and construction process).
        - Other roads: work with landowning entities (City, State) to evaluate factors such as habitat connectivity and best management practices.

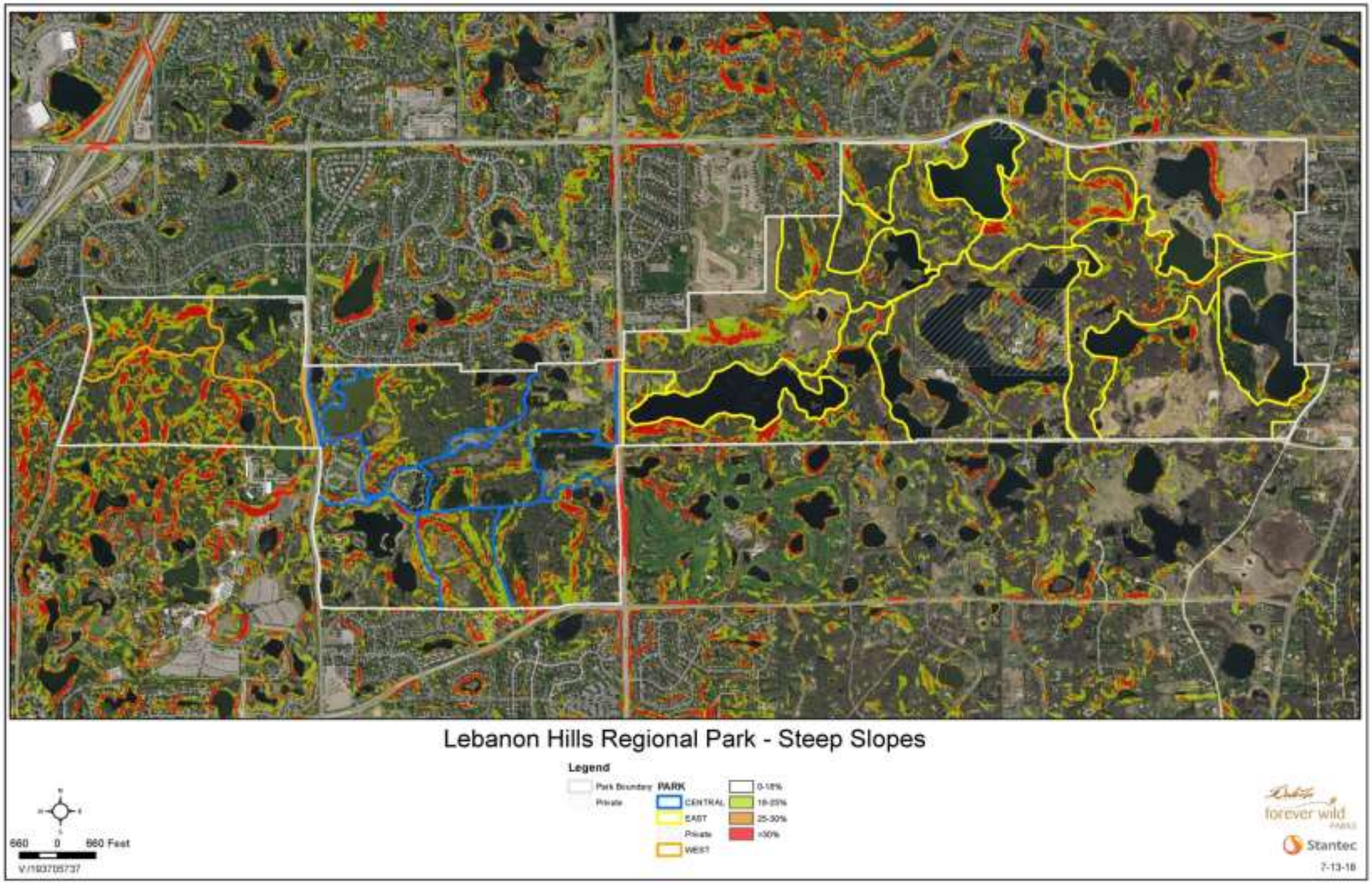


Figure 43. *Steep slopes in LHRP.*

8.2.1.9 High-Use and Significant Recreational Areas

Figure 45 shows high use areas for LHRP, as identified in the NRMSP. Natural Resources staff should partner and consult with Visitor Services staff to achieve common goals of both visitor services and natural resources

Recommendations are listed for the following areas:

- Visitor Center Area
    - Native plants. When planting within the visitor center campus, use native plants. Species chosen should have an educational and habitat purpose in addition to a specific landscaping purpose (shade for picnickers, screening of area roads/parking lots).
    - Restored prairie west of Schulze and mound west of Visitor Center. Maintain restored areas.
    - Beach and shoreline along Schulze Lake. Restore as much of the shoreline as possible, without detracting from the sand beach.
    - Fishing pier area on McDonough Lake. Work with MN DNR to achieve a more balanced fishery in the lake. There is a great lack of sizable fish in McDonough Lake, and the fishery is seriously out of balance. Steps should be taken to restore the fishery balance.
    - Woodland and non-restored prairie around McDonough.
        - Evaluate and restore turf areas that have not already been restored to an appropriate native grassland or pollinator-friendly community
        - Make restoration of the woodland around McDonough a priority. Restore/enhance within five years.
- Trails and Trail System
  Evaluate existing trail system (**Figure 44**) and make recommendations for minimizing negative impacts to ecological quality. Build upon past practices common to Minnesota. Help design, plan, develop, and maintain trails that are physically, ecologically, and economically sustainable, and that are visually appealing and enjoyable. Use the 2007 Minnesota DNR publication "Trail Planning, Design, and Development Guidelines" as a primary source for guiding trail planning, design, and development. Also, especially in the West Segment, use the International Mountain Bike Association (IMBA) as a resource (https://www.imba.com/). Partner with Facilities Management staff to achieve common goals.

- Proposed Capital Improvements Projects
    - Evaluate capital improvements using principles of avoid, minimize or mitigate natural resource impacts.
    - Natural resource data will be used to determine site selection and design process through environmental review.
    - Capital improvement projects should meet high standards for sustainability.

- New CIP projects will be designed per the Park Master and Natural Resource Management Plans. A “concentrated use-area” strategy is better suited for wildlife conservation and plant community diversity.
- Development projects should strive to leave Lebanon Hills in a better ecological state.

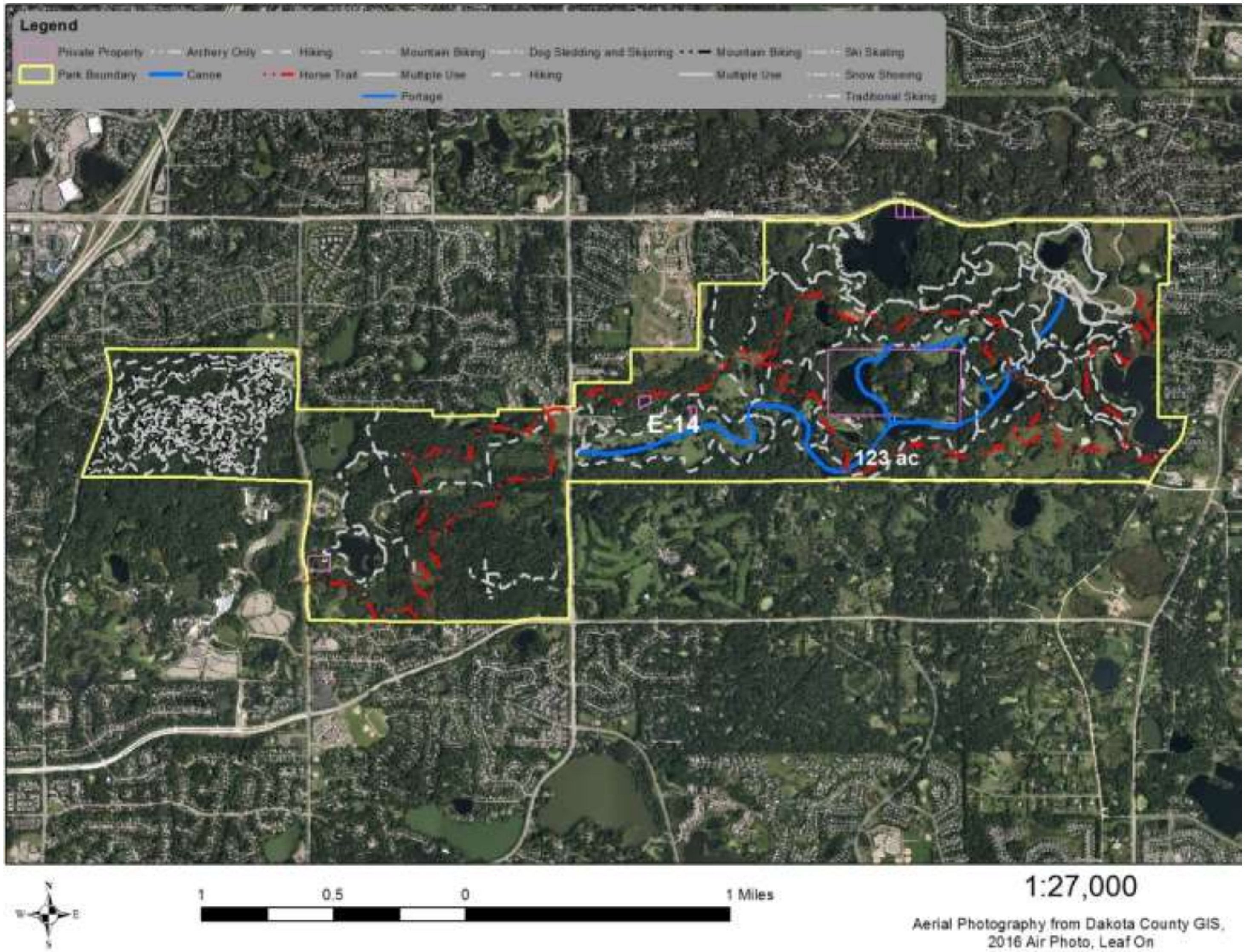


Figure 44. *Trails in LHRP.*

- Effects of Trails. Although essential recreational features, trails can serve to degrade natural areas in several ways, for instance by serving as conduits for invasive species, by fragmenting core habitat areas, by altering hydrology via culverts, and by encouraging usage in ecologically sensitive areas. While one trail may or may not have a detrimental impact on the ecological wellbeing of the ecosystem or park, cumulative impacts and distribution of many trails certainly will. Currently there are approximately 26 miles of hiking/snowshoeing/skiing trails, 11 miles of mountain bike trails (West Segment only), 10 miles of horse trails, and 1.6 miles of paved trails (East Segment only) for a total of approximately 58 miles of trails in the park. Another way of looking at it, approximately 30 acres of soft-surface trails occur in the park, which consists of about 1.6% of the park (**Figure 44**).
- Additional trails per the Master plan should be evaluated for ecological impacts. If and when more trails are designed strive to reduce their footprint and impacts by following sustainable trail best management practices. In the Center Segment, evaluate existing trails for sustainability; produce a trail plan and design for new trails that is more sustainable.
- Mountain Bike Trails. Located in the west segment of the park (**Figure 44**), currently, these trails are maintained and monitored by Work with Minnesota Off-Road Cyclists (MORC) and Dakota County Facilities Management. Work with MORC and Facilities Management staff to improve the ecological quality of the mountain bike trails in the western segment of the park.
  - Replace buckthorn and other non-native woody plant species with species of shrubs or herbaceous plants that are native to the park ecoregion and will also function to help screen and frame the mountain bike trails as necessary.
  - Work with MORC to further reduce erosion and all other ecologically deleterious impacts of the mountain bike trails. Use the 2006 DNR Trail Guidelines and IMBA as a guide.
  - Apply for state grant funding to achieve these initiatives
- Hiking Trails. Evaluate hiking trails, especially in the Center Segment, for sustainability. Implement best management practices as necessary.
- Effects of Impervious Surfaces. Impervious surfaces are defined as the surfaces that prohibit infiltration of water from the land surface into the underlying soil. Impervious surfaces such as roofs, parking lots, and roads result in many deleterious effects to natural resources, including an increase in the frequency and intensity of downstream runoff, a decrease in water infiltration and groundwater recharge, a decrease in surface water quality, a reduction in base flow to streams, lakes, and wetlands, an increase in flood frequency, an increase in the transport of non-point source pollution, and an altering of urban heat fluxes. For example, it has been found that if more than 10 percent of a watershed is impervious, stream quality starts to degrade, such as reduced channel stability and loss of diversity (Schueler 1994; Arnold 1996; Chithra 2015). In fact, imperviousness "is one of the few variables that

can be explicitly quantified, managed, and controlled at each stage of land development."

- Recommend limiting impervious surfaces in the park and watersheds of the park to no more than 10% of the total area of the watershed. Currently, approximately 4% of the park is occupied by impervious surfaces.
- Local impacts to subwatersheds will be heavier in those where impervious cover is high (more than 10%), so special focus should be given to those subwatersheds.
- Recommend working with all adjacent landowners to increase infiltration of their stormwater that flows to the park. Encouraging the installation of raingardens on all of the properties in the adjacent neighborhoods that flow to the park would be very beneficial. For example, working with Dakota County SWCD to accomplish 10% of private residences annually for 10 years would accomplish the goal.
- If watersheds cannot be limited to 10% impervious cover, then they should be limited to at least 25% impervious cover. The key resource objective for these watersheds is to mitigate impacts to the greatest extent possible, using effective best management practices.

- Equestrian Trailhead Area and Equestrian Trails. Located in the center and east segments of the park (**Figure 44**), these trails should be integrated into the park. The following are recommendations for horse trails:
  - Study and evaluate the equestrian trail system to identify ecological impacts of the trails; make recommendations based on the outcomes of the study/evaluation.
  - Meet and work with equestrians that use the trails in the park and with Dakota County Visitor Services staff and Facilities Management staff. Identify and define interests, issues, opportunities, and goals. Develop a consensus and implement best management practices and objectives to achieve common goals.
- Holland Lake Trailhead
  - <u>Fishing Pier on Holland Lake</u>. As part of the Holland Lake Shoreline Restoration project, evaluate and improve the ecological quality of the fishing pier area.
- Jensen Lake Trailhead
  - Enhance this trailhead using native plants. Reduce turf where possible.
- Camp Sacajawea: Woodland and Surrounding Trail Loop
  - Continue, where buckthorn removal left off, restoring this area. Control buckthorn seedlings and resprouts, seed/plant native plants, spot treat exotic weeds, burn and graze on rotation.
  - Install interpretive signs.
- Wheaton Pond Area
  - Work with Visitor Services staff to identify common goals that reduce impacts to natural resources of the area.
  - Restore the shoreline of Wheaton Pond.
  - Install interpretive signs in the area.
- School of Environmental Studies (SES)

- Partner and work with SES to improve the park resources and achieve common goals of both the park and SES.
    - Focus on the area in the park across from the school.
    - Develop and implement volunteer events with SES for the park improvement such as planting or tending native plants to enhance plant communities and improve wildlife habitat.
- West Trailhead Skills Park
    - Evaluate the nearby pine stand, except in areas adjacent to trails or infrastructure as appropriate.
    - Grade the naturalized plantings in the trailhead into the surrounding natural area to achieve a seamless look.
    - Install interpretive signs to help educate and inform visitors about the natural resources of the area.

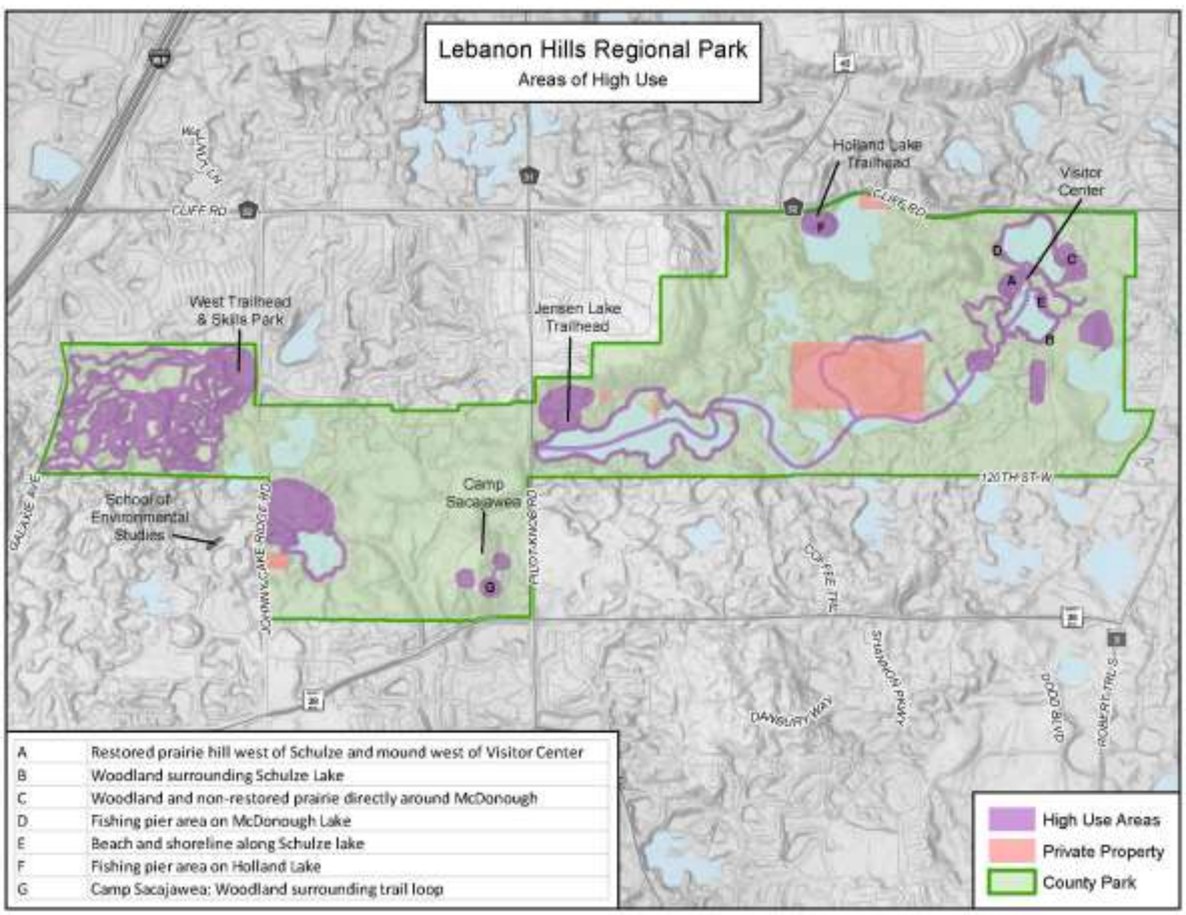


Figure 45. *High Use Areas of LHRP.*

- Conifer Plantations.

Pines, spruces, and firs, although native to the state of Minnesota, are not native to LHRP. Numerous conifers occur in the parks, but they were all planted. The majority of conifer planting occurred about 50 to 75 years ago. This was typical of the time period, since managing for native plant communities was not often considered then. The conifer plantations that are found in the park were often planted in old fields but sometimes were planted into native oak woodlands and savannas, displacing these native communities.

In terms of vigor and vitality, the red pine species does not do well in this part of the state (personal communication with DNR Regional Forester, December 2017). White pine and jack pine do better here. Jack pine is probably the best choice of pine, since it tends to grow in more open canopied stands, allowing for a greater diversity of species in the understory. Scotch pine is non-native. Blue spruce is not native to Minnesota and is subject to a host of disease and insect problems. White spruce is native to Minnesota, but not to this area, and does better than blue spruce. Firs, balsam, and others are also native to Minnesota but not to this area. In general, conifers were planted closely in rows in plantations and tend to get crowded quickly. With no harvesting, self-thinning occurs, where out-competed trees die. Most trees lose their lower branches. Regeneration of new pines can occur, but generally does not due to lack of light in the understory. The diversity of the shady understory is usually very low in plantations, consisting of a few shade tolerant weeds and fast growing species such as boxelder and green ash. Conversely, on the margins of plantations, where light conditions are high, conifers will proliferate, expanding into nearby open landscapes, which is at odds with prairie and savanna management.

Consider removing pines throughout the park. Recognizing the value that some park visitors place on evergreens, a plan has been developed with a differential management strategy (**Figure 46**) as follows:

- Class 1. Remove the conifer stand promptly (within the next five years).
- Class 2. Remove the majority of the conifer stand promptly, but leave healthy conifers, as necessary, that are near trails or infrastructure.
- Class 3. Manage long-term as conifer forest but increase diversity and sustainability of the forest community.

This plan would need to be evaluated by Visitor Services for visitor experience value prior to implementation.

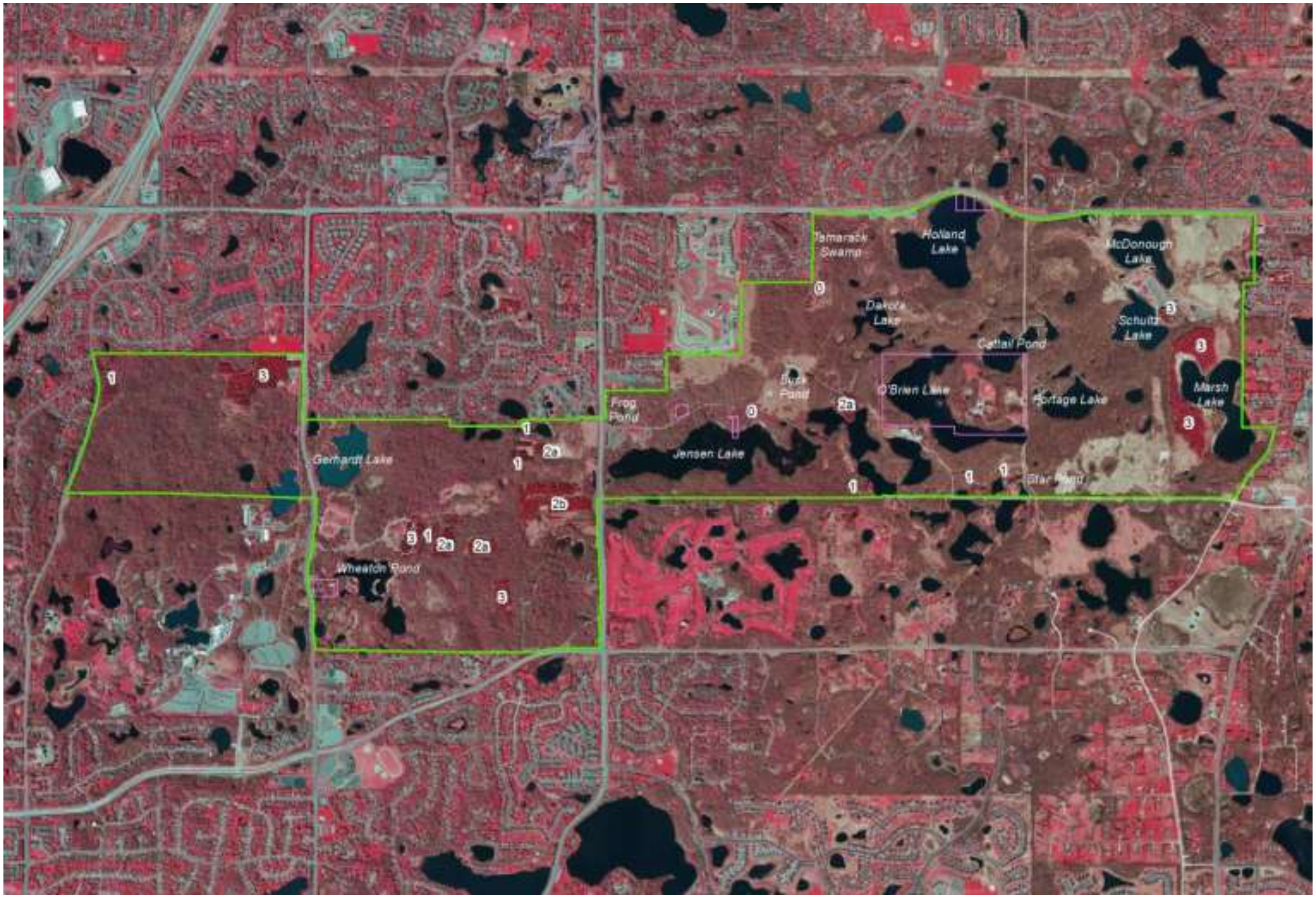


Figure 46. *Proposed Management of Conifer Plantations. 1 = remove promptly, 2 = remove promptly except around trails or infrastructure as necessary, and 3 = manage long-term as conifer forest but increase diversity and sustainability of the forest community.*

- Old Fields
  The numerous areas throughout the park that were once old fields (**Figure 18)** should be restored to native plant communities. This is easiest when fields are just coming out of production and have been planted in soy beans the year prior to restoration. However, none of the former agricultural fields throughout the park are in or just coming out of production, so that window of opportunity has past. Nevertheless, lumping old field restoration with other restoration can be done, but it may take longer to achieve a diverse landscape, depending on what the target community is. For instance, if the target community is woodland, then it will take many years for trees to mature. Prairie tends to establish quicker, but a diverse and evenly distributed one can take as long to develop as a mature woodland.

- Restoration Methods and Specifications
  - Specifications
    In development of project Request for Bids documents, staff includes many specifications for restoration and management of natural resources in the parks, but listing them here is not warranted. However, underscoring the importance of some items deserves attention, since oftentimes these items are overlooked for parking lots, raingardens, landscaping, trail borders, and projects.
    - Use only natural fiber erosion control blanket. Blanket with plastic strands is not to be used in the park. Regarding natural fiber products, it is preferable to use wider mesh than smaller mesh. A good choice is "Geo-jute", or equivalent, as recommended by Prairie Moon Nursery in Winona, MN.
    - Use species native to Dakota County; their seed source should be located within 150 miles of the County (**Figure C1** in **Appendix C**).
    - If deviating from recommendations, consult natural resources staff.
    - Include two years of establishment management for native planting areas.

8.2.1.10 Methods and Strategies

- Methods and Strategies

  Use methodologies and strategies that will achieve the restoration goals (see Section 5.2). Consider the following:

  - Burning. Mix up the timing, frequency, season, and size of prescribed burns to avoid too much repetition which tends to favor one set of species or factors and reduce diversity. Consider conducting summer prescribed burns, since they have been shown to be more effective in reducing woody resprouting. Burn no more than ¼ to 1/3 of any landcover type in any given year. Break up larger fire dependent areas into burn units to provide for refugia for sensitive fauna, especially insects. Time burns to avoid sensitive impacting wildlife species such as ground nesting birds and herptiles. In general, burn more frequently in the first years following restoration and then settle into a more regular rotation frequency that is typical of the given community (e.g., burn FDs37 on a 10-year rotation). Use adaptive management and monitoring of biota and woody resprouts to tailor fire management details to the site.

- Edges. Run fire into adjacent burn units to avoid developing "hard edges"—distinct differences in cover types between two adjacent but different areas, like woodland and prairie with a line of trees against a grassland. Another method to soften edges is to selectively remove trees on the "wooded" side of an edge and/or to plant fire resistant trees into the "grassland" side of an edge.
- Conservation Grazing. Use "conservation grazing" to simulate the grazing that has been lost from former grazing and browsing species like elk and bison that formerly grazed/browsed prairies, savannas, and woodlands. Conservation grazing typically uses meat goats (not milk goats) but can also use other species such as bison, long-horned steers, sheep, and pigs.
- Haying. "Haying" is a method that is used when fire and/or grazing cannot be used on a landscape. With haying, the area is mowed and then the cut tops are removed from the land surface (raked off, collected, and disposed of). Leaving dead cut tops is harmful to prairie plants because the dead tops smother prairie plants.
- Forestry Mower. Forestry mowing is used when woody stems are so abundant that hand cutting becomes very time consuming and costly. Forestry mowing is an effective way of controlling areas with a high density of woody stems and that are not too large. Following up with a broadcast herbicide to control resprouts and seedlings is usually what occurs, but this can be very damaging to native plants, so timing and application rates are very important. Do not use broadcast herbicide if the area supports native plants greater than about 33 percent of the overall plant diversity. In such cases, spot treating is necessary, even if it is costlier.
- Combine Methods to Achieve Restoration Goals. Using several methods in combination is typically more effective than using just one alone. The timing and application of methods can be tricky and will need to be adjusted to achieve the best results. Use adaptive management as an adjustment tool.
- Burn Piles. Stack and burn: make piles in openings where heat will not damage standing tree trunks or branches. Never make brush piles on existing native prairie, or good quality woodland. Avoid steep slopes. Seek disturbed areas, nonnative vegetation or stumps of cut brush/trees. Minimize number of burn piles. Ideally, brush will be stacked and burned at the same time as cutting if feasible. Otherwise, burn piles in winter. Brush can also be hauled to edges, chipped, and removed. Chip can alternatively be blown onto site as long as depth does not exceed two inches.
- Pollinators. When designing seed mixes and when managing fire dependent communities, proceed with pollinator habitat in mind. As a general rule, enhance the seed mixes with pollinator species, balancing them with just enough tall grasses that will be necessary to provide fuel for future fires but not so much that pollinators are sparse.

- Targeted Plant Communities and Seed Mixes. Consider community types when designing seed mixes. For prairie, avoid targeting too much tallgrass prairie. Instead, target shortgrass and dry prairie when possible. When targeting tallgrass prairie, attempt to limit the amount of tall grasses such as big bluestem, Indiangrass, and switchgrass, since they can readily dominate an area to the detriment of diversity and habitat value. Sandy, gravelly soils will be better drained and thus drier, therefore calling for a shorter, more xeric seed mix. Many of the rarer animal species actually depend on "short-grass prairie" (e.g., little bluestem, sideoats grama, hairy grama, poverty oat grass, junegrass, sand reed grass, etc.) as opposed to tallgrass prairie, in this subregion. Tall grasses should not be absent, but rather they should only be sparsely represented compared to the shorter grasses.
- Management Philosophy. When planting or planning for restoration and management, as a general rule, *manage for the community, while keeping individual species in mind*. In other words, manage such that the heterogeneity, diversity, and microclimates of an area are maximized, so that the overall habitat offers enough for a full complement of species (as many species as can be supported), but at the same time also consider individual species needs, for instance planting enough prairie violets for regal fritillary butterflies to survive.
- External Funding. Pursue grant funding on a regular basis, especially for initial restoration work. The NRMSP recommends an 80 percent external funding level for restoration-type work and a 10 percent external funding level for maintenance-type work.
- Chemical Use. Reduce or limit chemical use whenever possible, as much as practicable, throughout the park

8. WORK PLANS (FIVE-YEAR AND 20-YEAR)

8.1. Vegetation Management, Five-Year Work Plans, All Management Segments.

These are cost estimates. Costs will vary depending on the details of the site and current bids/prices.

Management Unit	Total Acres	Acres not yet restored	Cost for Total Acres	Cost for acres not yet restored
East	1,480	529	$ 6,144,624.00	$ 1,487,090.00
Center	361	361	-	$ 1,800,423.00
West	223	223	-	$ 1,083,631.00
Total				**$ 4,371,144.00**

Table 44. *Five-Year Work Plan, All Segments.*

8.2. Vegetation Management, East Management Segment, Estimates.

Desired Future Cover Type	MLCCS Update	ACRES
Aspen forest	Aspen forest	2.5
Cattail marsh	Cattail marsh - seasonally flooded	9.1
Dry oak forest	Oak forest dry subtype	15.9
Low Hard Forest	Lowland hardwood forest	0.8
Oak forest	Oak forest	2.0
Mxd emerg marsh	Mixed emergent marsh - seasonally flooded	0.3
Mxd pne-hrd frst	Mixed pine-hardwood forest	23.6
Oak savanna	Dry oak savanna	21.7
Oak woodland-br	Oak forest dry subtype	139.1
OW (marsh-lake)	Open Water (Marsh/Lake)	36.5
Prairie	Mesic prairie	2.7
Tamarack swamp	Tamarack swamp minerotrophic subtype	5.9
Wet meadow	Wet meadow floating mat subtype	0.8
Wet prairie	Wet prairie - saturated soils	0.2
	TOTAL	

Table 45. *Vegetation Management in East Segment.*

SUMMARY EAST MANAGEMENT UNIT					
Restoration Cover Type	**Total Acres**	**Acres not yet restored**	**Avg. cost/ac.**	**Cost for Total Acres**	**Cost for acres not yet restored**
Terrestrial woodland/forest/savanna	1,104.2	249.15	$5,000	$5,521,000	$1,245,750
Mixed Pine-hardwood forest	23.6	23.6	$4,000	$94,487	$94,400
Prairie	85.1	0	$4,000	$340,437	$0
Wet meadow	15.7	5.26	$4,000	$62,800	$21,040
Lake Management	251.8	251.8	$500	$125,900	$125,900
TOTAL	**1,480.4**	**529.81**		**$6,144,624**	**$1,487,090**

Table 46. *Summary of Vegetation Management and Cost Estimates for the East Segment.*

8.3. Vegetation Management, West Management Segment, Estimates.

Desired Future Cover Type	MLCCS Update	ACRES	SUMMARY	
Cultural	NA	5.1		
Dry oak forest	Oak forest dry subtype	2.5		
Dry oak forest	Oak forest dry subtype	4.9	7.3	
Mixed pine-hardwood forest	Mixed pine-hardwood forest	15.4	15.4	
Oak woodland-brushland	Oak woodland-brushland	8.8		
Oak woodland-brushland	Oak woodland-brushland	10.3		
Oak woodland-brushland	Oak woodland-brushland	21.0		
Oak woodland-brushland	Oak forest dry subtype	160.1	200.2	
OW (marsh-lake)	Open Water (Marsh/Lake)	1.9		
OW (marsh-lake)	Open Water (Marsh/Lake)	4.3	6.2	
	TOTAL	**229.1**	229.1	
	SUMMARY WEST MANAGEMENT UNIT			
	Restoration Cover Type	**Acres**	**Avg. cost/ac.**	**Cost**
	Terrestrial woodland/forest/savanna	207.5	$5,000	$1,037,491
	Mixed Pine-hardwood forest	15.4	$3,000	$46,140
	TOTAL	**222.9**		**$1,083,631**

Table 47. *Vegetation Management Cost Estimates for the West Segment.*

8.4. Vegetation Management, Center Management Segment, Estimates.

Desired Future Cover Type	MLCCS Update	ACRES		
Aspen forest	Aspen forest	2.0	2.0	
Dry oak forest	Oak forest dry subtype	134.1	225.1	
Mxd emerg marsh	Mixed emergent marsh	1.7	11.2	
Mixed hardwood swamp	Mixed hardwood swamp - seasonally flooded	0.4	0.4	
Mixed pine-hardwood forest	Mixed pine-hardwood forest	5.9	46.6	
Oak forest	Oak forest	2.8	19.6	
Oak savanna	Mesic oak savanna	33.3	62.7	
Oak woodland-brushland	Oak woodland-brushland	11.0	46.5	
OW (marsh-lake)	Open Water (Marsh/Lake)	5.4	42.6	
Prairie	Mesic (brush) prairie	1.9	3.2	
Wet meadow	Wet meadow - temporarily flooded soils	2.0	5.8	
	TOTAL	**513.1**	465.7	
	SUMMARY CENTRAL MANAGEMENT UNIT			
	Restoration Cover Type	**Acres**	**Avg. cost/ac.**	**Cost**
	Terrestrial woodland/forest/savanna	355.9	$5,000	$1,779,430
	Prairie	3.2	$4,000	$12,800
	Wet meadow	2.0	$4,000	$8,192
	TOTAL			**$1,800,423**

Table 48. *Vegetation Management Cost Estimates for the Center Segment.*

8.5. Vegetation Management Segments and Work Unit Estimates.

5-Yr Work Plans		*(Years 1 through 5)*					
East Segment		Restore		Enhance	Maintain		Sum
Units	Acres	Cost/ac	Total Cost		Cost/ac	Total Cost	
E-1	123	$ -	$ -		$ 400	$ 49,200	
E-2	62	$ -	$ -		$ 400	$ 24,800	
E-3	26	$ -	$ -		$ 400	$ 10,400	
E-4	84	$ -	$ -		$ 400	$ 33,600	
E-5	35	$ 500	$ 17,500		$ 100	$ 3,500	
E-6	54				$ 400	$ 21,600	
E-7	142	$ 2,500	$ 355,000		$ 400	$ 56,800	
E-8	71	$ 6,000	$ 426,000		$ 400	$ 28,400	
E-9	133	$ -	$ -		$ 400	$ 53,200	
E-10	107	$ -	$ -		$ 400	$ 42,800	
E-11	46	$ 5,000	$ 230,000		$ 400	$ 18,400	
E-12	123	$ 5,000	$ 615,000		$ 400	$ 49,200	
E-13	66	$ -	$ -		$ 400	$ 26,400	
E-14	53	$ 500	$ 26,500		$ 100	$ 5,300	
Butwin	84	$ 5,000	$ 420,000		$ 400	$ 33,600	
Subtotal	1,209		$2,090,000	$ 200,000		$ 457,200	$ 2,747,200
Center Segment		Restore		Enhance	Maintain		Sum
Units	Acres	Cost/ac	Total Cost		Cost/ac	Total Cost	
C-1	34	$ 5,000	$ 170,000		$ 400	$ 13,600	
C-2	87	$ 5,000	$ 435,000		$ 400	$ 34,800	
C-3	20	$ 10,000	$ 200,000		$ 400	$ 8,000	
C-4	88	$ 5,000	$ 440,000		$ 400	$ 35,200	
C-5	96	$ 5,000	$ 480,000		$ 400	$ 38,400	
C-6	74	$ 5,000	$ 370,000		$ 400	$ 29,600	
C-7	74	$ 5,000	$ 370,000		$ 400	$ 29,600	
C-8	31	$ 5,000	$ 155,000		$ 400	$ 12,400	
Subtotal	504		$2,620,000	$ 50,000		$ 201,600	$ 2,871,600
West Segment		Restore		Enhance	Maintain		Sum
Units	Acres	Cost/ac	Total Cost		Cost/ac	Total Cost	
W-1	54	$ 5,000	$ 270,000		$ 400	$ 21,600	
W-2	64	$ 5,000	$ 320,000		$ 400	$ 25,600	
W-3	116	$ 7,000	$ 812,000		$ 400	$ 46,400	
Subtotal	234		$1,402,000	$ 50,000		$ 93,600	$ 1,545,600
Total	1,947		$6,112,000			$ 752,400	$ 7,164,400

Table 49. *Vegetation Management Cost Estimates per work unit.*

NOTE: If a cell in the "restore" column is blank, it has already undergone or is currently undergoing initial restoration and henceforth requires only enhancement and/or maintenance.

8.6. Vegetation Management, Five- and 20-Year Work Plans.

5-Yr Work Plan		*(years 1 through 5)*			
	Previously Restored Acres	Acres To Be Restored Yrs 1-5	Restore Cost	Enhance Cost	Maintain Cost	Sum Cost
East Segment, restored	600		$ -	$ -	$ 240,000	$ 240,000
East Segment		180	$ 900,000	$ -	$ 72,000	$ 972,000
Center Segment	-	100	$ 500,000	$ -	$ 40,000	$ 540,000
West Segment	-	100	$ 500,000	$ -	$ 40,000	$ 540,000
Total	**600**	**380**	**$ 1,900,000**	**$ -**	**$ 392,000**	**$ 2,292,000**

*Maintainence totals assume that all restored acres are in maintainence after five years.

20-Yr Work Plan			*(years 6 through 20)*			
	Previously Restored Acres	Acres To Be Restored Yrs 6-20	Restore Cost	Enhance	Maintain Cost	Sum Cost
East Segment	780	189	$ 945,000	$ 200,000	$ 2,286,000	$ 3,431,000
Center Segment	100	261	$ 1,305,000	$ 50,000	$ 1,008,000	$ 2,363,000
West Segment	100	123	$ 615,000	$ 50,000	$ 468,000	$ 1,133,000
Total	**980**	**573**	**$ 2,865,000**	**$ 300,000**	**$ 3,762,000**	**$ 6,927,000**

	Restored Acres	Remaining Acres	Restore Cost	Enhance	Maintain Cost	Sum Cost
Sum Total	**1580**	**367**	**$ 4,765,000**	**$ 300,000**	**$ 4,154,000**	**$ 9,219,000**

Table 50. *Vegetation Management Cost Summary, Five- and Twenty-Year Work Plans.*

These are estimates. The allocation of restoration funding per segment/unit may vary depending on circumstances. The order and ranking of what areas or work units are restored can vary depending on several factors. Generally, the prioritization criteria (Section 7.2) will be used to help guide this process. Alternate methods can be used or can modify the criteria. For example, restoring all of the East Segment first might be a good approach, since the highest quality communities are located there (according to the Minnesota County Biological Survey). However, since too much disturbance concentrated in one area can be difficult to bear in terms of visitor services, it may be best to mix up areas/segments, for instance, restore a unit in the East Segment, then one in the Center, then one in the West, etc. Also consider that other units from other county parks also need attention, which will influence the pace and order of units in LHRP.

An alternate method is to base the projected restoration on past performance. The County has restored, or is in the process of restoring, approximately 500 acres of land since 2015. This comes out to about 100 acres per year. The cost of restoring these 500 acres was approximately $1.7 million, or about $3400/acre. At the same rate, therefore, to restore the remaining 953 acres would cost about $3.24 million. This is less than the other estimates, and the reason for this is primarily because of utilizing work crews for initial removal of buckthorn and other woody invasives. So, the value of using work crews for initial buckthorn removal is approximately $1,000-$1,600 per acre.

Restoring approximately 50 to 100 acres per year seems to be a reasonable pace, ecologically. It is best to proceed with caution with ecosystem management, since there are so many variables and so much uncertainty about how pieces of the system will react and respond. There is a proverb in restoration ecology that says, "when you don't know, go slow!" This is good advice.

This work plan is primarily dependent on grant/external funding and secondarily dependent on County funding and competition from restoration needs of other County parks. County staff has been successful getting state grants to fund restoration work in the past and anticipates further success, but that is not a given. For instance, most of the areas that the County restored early on, have been the highest quality areas; and, as restoration proceeds, lesser quality areas may not be as attractive to grant funders. The NRMSP sets an expectation of restoration work being approximately 80 percent funded by external funds. Implementation will proceed as projected, but the rate of restoration may be slowed depending on whether the County is able to continue to receive external grant funding. If external funding falls short, other sources of funding may have to be considered. Five- and 20-Year Work Plans: Water Resources

Water resources management is going to be based on the Subwatershed Assessment for Lebanon Hills Regional Park 2017. The following are five- and twenty-year work plans:

Five-Year Water Resources Work Plan

- Conduct further evaluation of potential projects as recommended, before projects are implements.

BMP ID	Lake Subwater-shed	BMP Type	Annual TP Load [lbs/yr]	TP Reduction [lbs/yr]	Construction Cost	Life Cycle Cost [30 yrs]	Life Cycle Cost per pound of TP Removed
REG-1	Schulze	IESF Filtration Area	28.9	4.1	$102,000	$306,000	$2,488
REG-5	Jensen	IESF Filtration Area	3.2	1.8	$165,000	$360,000	$6,623
1M/4M	McDonough	Trail Crossing Maintenance/Repairs	NA	NA	$33,144	$45,144	NA
3J	Jensen	Trail Crossing Maintenance/Repairs	NA	NA	$20,400	$32,400	NA
5H-6H	Holland	Channel Stabilization	1	1	$36,360	$48,360	$1,612

1S	Schulze	Channel Stabilization	1.5	1.5	$48,720	$60,720	$1,349
AL-1	Schulze	Alum Treatment	12	11	$40,627	$40,627	$107
AL-2	Gerhardt	Alum Treatment	9.8	8.8	$45,000	$45,000	$170
TOTAL					**$491,251**		

Table 51. *Water Resources Cost Estimates for LHRP for the next five years*

*Twenty-Year Water Resources Work Plan**

BMP ID	Lake Subwater-shed	BMP Type	Annual TP Load [lbs/yr]	TP Reduction [lbs/yr]	Construction Cost	Life Cycle Cost [30 yrs]	Life Cycle Cost per pound of TP Removed
REG-2	LP-Marsh	IESF Filtration Benches	27.9	16.4	$645,000	$1,585,000	$3,226
REG-3	O'Brien	IESF Filtration Area	7.3	4.1	$190,000	$530,000	$4,328
REG-4	O'Brien	Sand Filtration Area	9	5.5	$415,000	$760,000	$4,640
REG-6	Jensen	Lift Station IESF Filtration Area	10.1	5.8	$600,000	$1,035,000	$5,931
REG-7	Wheaton	IESF Filtration Bench	6.3	3.7	$180,000	$485,000	$4,425
REG-8	Gerhardt	IESF Filtration Bench and Pond	10.7	7	$305,000	$770,000	$3,678
TOTAL					**$2,335,000**		

Table 52. *Water Resources Cost Estimates for LHRP for the next 20 years.*

*The table shows 20-year maintenance costs but implementation/construction of the BMPs is not necessarily stretched out over 20 years. Parks can be as aggressive or conservative as it chooses to implement these projects. Also, not every project must be implemented. Rather, these are potential options to address water quality issues and more often to protect existing good water quality.

Other components of the Water Resource Work Plan are:

- Monitor all the major water bodies in LHRP at a cost of $6,000 annually.
- Develop a Wetland Plan for all the wetlands in the park. This would include studying, evaluating, and identifying restoration and management needs and estimating implementation costs for the next 20 years. The cost of such a plan will need to be determined but could be as much as $20,000. External cost share may be available, but sources need to be identified.

8.7. Five- and 20-Year Work Plans: Wildlife

Inherently, wildlife habitat is closely intertwined with vegetation; wildlife depends on vegetation for cover, nesting, and food. Conversely, plants depend on animals for dispersal, to scarify seed covers, and for pollination, as examples, and thus depend on wildlife. Therefore, general improvements to vegetation will generally benefit wildlife. More focused wildlife management, however, should be conducted, so that a greater number of species can benefit. Each species has different habitat requirements, and these requirements should be given consideration during vegetation management. For example, grassland birds require large tracts of land that are relatively free of trees and tall woody vegetation, since predators and cow birds can more readily prey upon them if too many perch sites are available. Bison need large areas of land to roam, or else their social groups will become stressed. Certain warblers need a mix of open and shrub/carr habitats to be successful throughout their varied life cycles. Fishers and badgers need a large territory to range in to be successful. Monarch butterflies need adequate amounts of milkweed stems to be successful. In general, many of the species that are in decline or rare need either specialized habitat elements or a type of habitat that has been lost or has become rare, for example, red-headed woodpeckers and Blanding's turtles with savanna and ovenbird with woodlands.

Managing for the community, i.e., managing for a general plant community type is what is typically done, and what is recommended here; but staff must also be mindful of the specific conservation requirements of rare and declining species, so that species diversity is maximized. To that end, the list of species in **Appendix B** contains many potential species to be considered for wildlife projects in the next five and 20 years for Lebanon Hills Regional Park.

To attain this goal, continuous monitoring and adjusting of management methods is required to achieve this goal. Also, some special management efforts may be required, such as 1) developing a protocol for animal species reintroductions that considers all aspects of the subject, such as the potential unintended negative consequences of introducing a particular species and 2) developing a file for each of the target species that enables a full understanding of the species and their life cycles, gathers literature on them, and compiles data.

The NRMSP described a timeline and a cost associated with wildlife management that includes collecting baseline and trend data, working with partners outside of parks, focusing on rare and endangered wildlife, protecting other important wildlife, and controlling problem wildlife. This had a cost of 1.1 million for the entire parks system for the first five years, which means that for LHRP approximately $300,000 would be allocated in the first five years for wildlife management. The costs for specific projects will be determined when they are identified and implemented. Some grant money can be used to enhance the vegetation for specific wildlife habitat improvement needs.

9. REFERENCES

Albert, D. 1995. *Regional Landscape Ecosystems of Michigan, Minnesota, and Wisconsin: A Working Map and Classification* (Fourth Revision: July 1994). General Technical Report NC-178. North Central Forest Experiment Station. U.S. Department of Agriculture. 250 pp.

Arnold, Chester L. Jr., C. James Gibbons. Spring 1996. *Impervious Surface Coverage: The Emergence of a Key Environmental Indicator.* American Planning Association. The Journal of American Planning Association, ABI/INFORM Global, P. 243.

Baughman, Melvin J., Alvin A. Alm, A. Scott Reed, Thomas G., Eiber, and Charles R. Blinn. 1993. *Woodland Stewardship: A Practical Guide for Midwestern Landowners.* University of Minnesota Extension Service, Minnesota Department of Natural Resources, Forest Stewardship program, and the College of Natural Resources of the University of Minnesota. Univeristy of Minnesota Extension Service Distribution Center, 405 Coffey Hall, 1420 Eckles Avenue, St. Paul, MN 551108-6068.

Blue Water Science. 2017. Aquatic Invasive Species Action Plan for Selected Dakota County Parks Lakes. Dakota County, MN.

Blue Water Science. 2016. Aquatic Invasive Species Surveys and Suitability Assessments for Selected Dakota County Park Lakes, Dakota County, MN.

Brooks, Kenneth N., Peter F. Foliot, Hans M. Gregersen, Leonard F. DeBano. 2003, 1997, 1991. *Hydrology And The Management Of Watersheds.* Iowa State University Press, A Blackwell Publishing Company, 2121 State Street Avenue, Ames, Iowa, 50014.

Chithra S.V., Dr. M.V. Harindranathan Nair, Amaranth A, Anjana N.S. May 2015. School of Environmental Studies, Cochin University of Science and Technology, Kochi, Kerala, India. *Impacts of Impervious Surfaces on the Environment.* International Journal of Engineering Science Invention, Volume 4 Issue 5, pp. 27-31.

Cleland, D.T, Avers, P.E., McNab, W.H., Jensen, M.E., Bailey, R.G., King, T., Russell, W.E. 1997. *National Hierarchical Framework of Ecological Units*. Published in, Boyce, M.S. and A. Haney, eds. 1997. Ecosystem Management Applications for Sustainable Forest and Wildlife Resources. Yale University Press, New Haven, CT. pp 181-200.

Dakota County, Dakota County Office of Planning, HKG, AES, Barr Engineering, 2015, Master Plan for Lebanon Hills Regional Park. Dakota County, MN

Dakota County, Applied Ecological Services, Fortin Consulting, and SRF Consulting. 2017. Natural Resource Management System Plan for Dakota County Parks, Greenways and Conservation Easements. Dakota County, MN

Foth, Henry D. 1958, 1965, 1972, 1978, 1984, 1990. *Fundamentals Of Soil Science.* University of Michigan. John Wiley & Sons, Inc..

Frelich, Lee E., and Andrew Holdsworth. 2002. *Exotic Earthworms in Minnesota Hardwood Forests: an investigation of earthworm distribution, understory plant communities, and forest floor dynamics in* *northern hardwood forests*. Department of Forest Resources, University of Minnesota, 1530 Cleveland Ave. N., Saint Paul, MN 55108.

Jones, G. 2009. The adaptive management system for the Tasmanian Wilderness World Heritage Area—linking management planning with effectiveness evaluation. Chapter 13 *in* Allan, C. and Stankey, G. (eds), *Adaptive Environmental Management. A Practitioners Guide.* Co-published by Springer and CSIRO Publishing, 351p, ISBN 978-1-4020-9631-0. Dordrecht The Netherlands, and Collingwood Australia. [*Author's copy. Publication available at* www.springerlink.com.]

McComas, Steve. 2003. *Lake and Pond Management Guidebook.* CRC Press LLC, 2000 N.W. Corporate Blvd., Boca Raton, Florida 33431.

Mitsch, William. J., and James G. Gosselink. 2000. *Wetlands* (third ed.), John Wiley & Sons, Inc., New York, New York.

Odum, E. P. 1969. The Strategy of Ecosystem Development. Science 164:262-270.

Packard, Stephen and Cornelia F. Mutel (edited by). 1997, 2005. *The Tallgrass Restoration Handbook: For Prairies, Savannas, And Woodlands.* Society for Ecological Restoration International. Island Press, 1718 Connecticut Ave., NW, Suite 300, Washington , DC 20009.

Ricklefs, Robert E. 1973, 1979, 1990. *Ecology*. Third edition. W.H. Freeman and Company, United States.

Schueler T.R. 1994. *The Importance of Impervious Surfaces.* Watershed Protection Techniques, Vol. 1, No. 3, pp. 100-111.

State of Minnesota, Department of Natural Resources (MN DNR). 2005. Field Guide to the Native Plant Communities of Minnesota: The Broadleaf Forest Provinces. Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program. MNDNR. St. Paul, MN.

State of Minnesota, Department of Natural Resources, 2004. Minnesota, Minnesota Land Cover Classification User Manual, Version 5.4. MN DNR Central Region, St. Paul, Minnesota.

State of Minnesota, Department of Natural Resources, 2014, 2017 Biotics (NHIS). Natural Heritage Information System. Minnesota DNR. Division of Ecological and Water Services.

State of Minnesota, Department of Natural Resources, 2006. Tomorrow's Habitat for the Wild and Rare: An Action Plan for Minnesota Wildlife, Comprehensive Wildlife Conservation Strategy. Division of Ecological and Water Services, Minnesota Department of Natural Resources.

State of Minnesota, Department of Natural Resources, 2016. Minnesota's Wildlife Action Plan 2015-2025. Division of Ecological and Water Resources, Minnesota Department of Natural Resources.

State of Minnesota, Department of Natural Resources, 2018. Rare Species Guide, accessed March 2018.

State of Minnesota, Department of Natural Resources, Division of Fish and Wildlife, Section of Fisheries (Schlagenhaft, T). 1993. Manual of instructions for lake survey. Special Publication No. 147.

State of Minnesota, Minnesota Pollution Control Agency (MPCA). 2014. Rapid Floristic Quality Assessment Manual. wq-bwm2-02b. Minnesota Pollution Control Agency, St. Paul, MN.

State of Minnesota, Department of Natural Resources, Minnesota Biological Survey, Minnesota DNR, Division of Ecological Resources, 2016, Native Plant Communities GIS Layer., accessed 2015-18.

State of Minnesota, Department of Natural Resources, 2011, Minnesota Prairie Conservation Plan. Minnesota Prairie Plan Working Group, "Prairie Plan". Minneapolis, MN. 55 pp.

State of Minnesota, Department of Natural Resources, 2007. "Trail Planning, Design, and Development Guidelines." Trails & Waterways Division, 500 Lafayette Road, St. Paul, MN 55155-4052. 306 pages.

USDA Web Soil Survey, accessed January 2018.

USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions. 3 vols.* Charles Scribner's Sons, New York. Vol. 2: 263.

Wenck. 2017. Lebanon Hills Regional Park Subwatershed Assessment Report. Dakota County, MN

https://en.wikipedia.org/wiki/BioBlitz

10. APPENDICES

10.1. Appendix A. Plant Species Inventory (including Invasives) of LHRP

Table A-1. *Dominant Flora and Invasive Species with Native Status (N), Physiognomy (P), and Rarity (R)*

Species	Common Name	N	P	R
Acer ginnala	amur maple	I	D	
Acer negundo	box elder	N	D	
Acer platanoides	Norway maple	I	D	
Acer rubrum	red maple	N	D	
Acer saccharinum	silver maple	N	D	
Acer saccharum	sugar maple	N	D	
Achillea millefolium	common yarrow	U	H	
Actaea rubra	red baneberry	N	H	
Adiantum pedatum	maidenhair fern	N	H	
Agastache foeniculum	blue giant hyssop	N	H	
Agastache scrophulariaefolia	purple giant hyssop	N	H	
Ageratina altissima	white snakeroot	N	H	
Agrostis gigantea	redtop	I	G	
Agrostis scabra	rough bentgrass	N	G	
Alisma subcordatum	heart-leaved water plantain	N	H	
Alisma triviale	common water plantain	N	H	
Alliaria petiolata	garlic mustard	I	H	
Allium canadense	wild garlic	N	H	
Allium cernuum	nodding wild onion	N	H	SC
Allium stellatum	prairie wild onion	N	H	
Allium tricoccum	wild leek	N	H	
Alnus incana	speckled alder	N	D	
Ambrosia artemisiifolia	common ragweed	N	H	
Ambrosia psilostachya	western ragweed	N	H	
Ambrosia trifida	great ragweed	N	H	
Amorpha canescens	leadplant	N	D	
Amorpha fruticosa	false indigo	N	D	
Amphicarpaea bracteata	hog peanut	N	H	
Anaphalis margaritacea	pearly everlasting	N	H	
Andropogon gerardii	big bluestem	N	G	
Anemone canadensis	Canada anemone	N	H	
Anemone cylindrica	long-headed thimbleweed	N	H	
Anemone nemorosa	wood anemone	N	H	
Anemone patens	pasqueflower	N	H	
Anemone quinquefolia	wood anemone	N	H	
Anemone virginiana	tall thimbleweed	N	H	
Antennaria neglecta	field pussytoes	N	H	

Legend

Native Status: N = Native, I = Invasive, U = Undetermined

Physiognomy: B = broadleaf evergreen, D = broadleaf deciduous, E = needleleaf evergreen, G = graminoid, H = forb, L = lichens and moss, C = climber, K = stem succulent, X = epiphyte, F = floating aquatic, S = submerged aquatic

Rarity: E = Endangered, T = Threatened, SC = Special Concern, W = Watch List, H = Historical

Species	Common Name	N	P	R
Antennaria plantaginifolia	plantain-leaved pussytoes	N	H	
Apocynum androsaemifolium	spreading dogbane	N	H	
Apocynum cannabinum	American hemp	N	H	
Apocynum sibiricum	clasping dogbane	N	H	
Aquilegia canadensis	columbine	N	H	
Arabis pycnocarpa	hairy rock cress	N	H	
Aralia nudicaulis	wild sarsaparilla	N	H	
Aralia racemosa	American spikenard	N	H	
Arisaema triphyllum	Jack-in-the-pulpit	N	H	
Artemisia ludoviciana	white sage	N	H	
Asarum canadense	wild ginger	N	H	
Asclepias exaltata	poke milkweed	N	H	
Asclepias incarnata	swamp milkweed	N	H	
Asclepias incarnata	swamp milkweed	N	H	
Asclepias ovalifolia	oval-leaved milkweed	N	H	
Asclepias sullivantii	sullivant's milkweed	N	H	T
Asclepias syriaca	common milkweed	N	H	
Asclepias tuberosa	butterflyweed	N	H	
Asclepias verticillata	whorled milkweed	N	H	
Astragalus canadensis	Canada milk-vetch	N	H	
Astragalus crassicarpus	ground plum	N	H	
Athyrium angustum	Northern Lady Fern	N	H	
Athyrium filix-femina	lady fern	N	H	
Baptisia alba	white wild indigo	N	H	

Species	Common Name	N	P	R
Baptisia bracteata	plains wild indigo	N	H	
Baptisia leucantha	largeleaf wild indigo	N	H	
Barbarea vulgaris	yellow rocket	I	H	
Berberis thunbergii	Japanese barberry	I	D	
Berteroa incana	hoary alyssum	I	H	
Betula nigra	river birch	N	D	
Betula papyrifera	paper birch	N	D	
Betula pumila	bog birch	N	D	
Bidens cernua	nodding bur marigold	N	H	
Bidens connata	swamp beggarticks	N	H	
Bidens vulgata	common beggarticks	N	H	
Blephilia hirsuta	Hairy Wood Mint	N	H	
Boehmeria cylindrica	false nettle	N	H	
Bolboschoenus fluviatilis	river bulrush	N	G	
Boltonia asteroides	false aster	N	H	
Botrychium dissectum	dissected grapefern	N	H	
Botrychium virginianum	rattlesnake fern	N	H	
Bouteloua curtipendula	side-oats grama	N	G	
Bouteloua gracilis	blue grama	N	G	
Brickellia eupatorioides	false boneset	N	H	
Bromus ciliatus	fringed brome	N	G	
Bromus inermis	smooth brome	I	G	
Bromus kalmii	kalm's brome	N	G	
Bromus pubescens	hairy brome	N	G	
Bromus tectorum	cheatgrass	I	G	

Legend

Native Status: N = Native, I = Invasive, U = Undetermined

Physiognomy: B = broadleaf evergreen, D = broadleaf deciduous, E = needleleaf evergreen, G = graminoid, H = forb, L = lichens and moss, C = climber, K = stem succulent, X = epiphyte, F = floating aquatic, S = submerged aquatic

Rarity: E = Endangered, T = Threatened, SC = Special Concern, W = Watch List, H = Historical

Species	Common Name	N	P	R
Cacalia atriplicifolia	great Indian plantain	N	H	
Cacalia plantaginea	tuberous Indian plantain	N	H	
Calamagrostis canadensis	bluejoint	N	G	
Caltha palustris	common marsh marigold	N	H	
Campanula americana	tall bellflower	N	H	
Campanula rotundifolia	harebell	N	H	
Campanulastrum americanum	tall bellflower	N	H	
Cannabis sativa	marijuana	I	H	
Carex atherodes	slough sedge	N	G	
Carex bebbii	Bebb's sedge	N	G	
Carex bicknellii	Bicknell's sedge	N	G	
Carex blanda	charming sedge	N	G	
Carex brevior	plains oval sedge	N	G	
Carex comosa	bristly sedge	N	G	
Carex gravida	heavy sedge	N	G	
Carex lacustris	lake sedge	N	G	
Carex molesta	troublesome sedge	N	G	
Carex pellita	woolly sedge	N	G	
Carex pensylvanica	Pennsylvania sedge	N	G	
Carex rosea	starry sedge	N	G	
Carex scoparia	pointed broom sedge	N	G	
Carex sprengelii	Sprengel's sedge	N	G	
Carex stipata	awl-fruited sedge	N	G	

Species	Common Name	N	P	R
Carex stricta	tussock sedge	N	G	
Carex tenera	quill sedge	N	G	
Carex vulpinoidea	fox sedge	N	G	
Carya cordiformis	bitternut hickory	N	D	
Caulophyllum thalictroides	blue cohosh	N	H	
Ceanothus americanus	New Jersey Tea	N	H	
Celtis occidentalis	hackberry	N	D	
Centaurea stoebe	spotted knapweed	N	H	
Cerastium arvense	field chickweed	N	H	
Ceratophyllum demersum	common coontail	N	H,S	
Chamaecrista fasciculata	partridge pea	N	H	
Chelone glabra	white turtlehead	N	H	
Chenopodium album	white lamb's quarters	I	H	
Chrysopsis villosa	hairy false goldenaster	N	H	
Cicuta bulbifera	bulb-bearing water hemlock	N	H	
Circaea alpina	Small Enchanter's-Nightshade	N	H	
Circaea canadensis	Broad-Leaf Enchanter's-Nightshade	N	H	
Circaea lutetiana	common enchanter's nightshade	N	H	
Cirsium arvense	Canada thistle	I	H	
Cirsium discolor	field thistle	N	H	

Legend

Native Status: N = Native, I = Invasive, U = Undetermined

Physiognomy: B = broadleaf evergreen, D = broadleaf deciduous, E = needleleaf evergreen, G = graminoid, H = forb, L = lichens and moss, C = climber, K = stem succulent, X = epiphyte, F = floating aquatic, S = submerged aquatic

Rarity: E = Endangered, T = Threatened, SC = Special Concern, W = Watch List, H = Historical

Species	Common Name	N	P	R
Cirsium muticum	swamp thistle	N	H	
Cirsium vulgare	bull thistle	I	H	
Clematis virginiana	virgin's bower	N	C	
Comandra umbellata	bastard toadflax	N	H	
Conyza canadensis	horseweed	N	H	
Corallorhiza odontorhiza	autumn coralroot	N	H	
Coreopsis lanceolata	lanceleaf tickseed	I	H	
Coreopsis palmata	bird's foot coreopsis	N	H	
Coreopsis tripteris	tall coreopsis	N	H	
Cornus alba	Red Osier	N	D	
Cornus obliqua	Silky Dogwood	N	D	
Cornus racemosa	gray dogwood	N	D	
Cornus rugosa	Round-leaved Dogwood	N	D	
Corylus americana	American hazelnut	N	D	
Crepis tectorum	yellow hawk's beard	I	H	
Crotalaria sagittalis	rattlebox	N	H	SC
Cryptotaenia canadensis	honewort	N	H	
Cyperus esculentus	yellow nutsedge	I	G	
Dalea candida	white prairie clover	N	H	
Dalea purpurea	purple prairie clover	N	H	
Delphinium virescens	Carolina larkspur	N	H	
Desmanthus illinoensis	prairie mimosa	N	H	SC
Desmodium canadense	Canada tick trefoil	N	H	
Desmodium glutinosum	pointed-leaved tick trefoil	N	H	

Species	Common Name	N	P	R
Diarrhena americana	obvate beakgrain	N	G	
Dichanthelium oligosanthes	Scribner's panic grass	N	G	
Diervilla lonicera	bush honeysuckle	N	D	
Digitaria cognata	fall witch grass	N	G	
Doellingeria umbellata	flat-topped aster	N	H	
Dryopteris carthusiana	spinulose shield fern	N	H	
Dryopteris cristata	crested fern	N	H	
Dulichium arundinaceum	three-way sedge	N	G	
Echinacea angustifolia	narrow-leaved purple coneflower	N	H	
Echinacea pallida	pale purple coneflower	N	H	
Echinacea pallida var. angustifolia	pale purple coneflower	N	H	
Echinacea purpurea	eastern purple coneflower	N	H	
Echinochloa crus-galli	cockspur barnyard grass	I	G	
Echinocystis lobata	Wild Cucumber	N	H	
Eleocharis obtusa	blunt spikerush	N	G	
Eleocharis palustris	marsh spikerush	N	G	
Elodea canadensis	Canadian elodea	N	H,S	
Elymus canadensis	Canada wild rye	N	G	
Elymus hystrix	bottlebrush grass	N	G	
Elymus repens	quackgrass	I	G	
Elymus trachycaulus	slender wheatgrass	N	G	

Legend

Native Status: N = Native, I = Invasive, U = Undetermined

Physiognomy: B = broadleaf evergreen, D = broadleaf deciduous, E = needleleaf evergreen, G = graminoid, H = forb, L = lichens and moss, C = climber, K = stem succulent, X = epiphyte, F = floating aquatic, S = submerged aquatic

Rarity: E = Endangered, T = Threatened, SC = Special Concern, W = Watch List, H = Historical

Species	Common Name	N	P	R
Elymus villosus	downy wild rye	N	G	
Elymus virginicus	Virginia wildrye	N	G	
Enemion biternatum	false rue anemone	N	H	
Epilobium coloratum	purple-leaved willow herb	N	H	
Equisetum arvense	field horsetail	N	H	
Equisetum fluviatile	water horsetail	N	H	
Equisetum palustre	marsh horsetail	N	H	
Eragrostis spectabilis	purple lovegrass	N	G	
Erechtites hieraciifolius	pilewort	N	H	
Erigeron annuus	annual fleabane	N	H	
Erigeron strigosus	daisy fleabane	N	H	
Eriochloa villosa	hairy cupgrass	I	G	
Eryngium yuccifolium	rattlesnake master	N	H	SC
Eupatorium maculatum	Joe Pye Weed	N	H	
Eupatorium perfoliatum	common boneset	N	H	
Eupatorium purpureum	sweet Joe-Pye weed	N	H	
Euphorbia corollata	flowering spurge	N	H	
Euthamia graminifolia	grass-leaved goldenrod	N	H	
Euthemia graminifolia	Grass Leaved Goldenrod	N	H	
Eutrochium maculatum	spotted Joe pye	N	H	
Eutrochium purpureum	sweet-scented Joe pye	N	H	
Fallopia convolvulus	black-bindweed	I	H	
Fragaria vesca	woodland strawberry	N	H	

Species	Common Name	N	P	R
Fragaria virginiana	common strawberry	N	H	
Frangula alnus	glossy buckthorn	I	D	
Fraxinus nigra	black ash	N	D	
Fraxinus pennsylvanica	green ash	N	D	
Galeopsis tetrahit	hemp nettle	I	H	
Galium aparine	cleavers	N	H	
Galium asprellum	rough bedstraw	N	H	
Galium boreale	northern bedstraw	N	H	
Galium triflorum	sweet-scented bedstraw	N	H	
Gentiana andrewsii	bottle gentian	N	H	
Gentiana flavida	yellowish gentian	N	H	
Gentiana puberulenta	downy gentian	N	H	
Gentianella quinquefolia	stiff gentian	N	H	
Geranium maculatum	wild geranium	N	H	
Geum aleppicum	yellow avens	N	H	
Geum canadense	white avens	N	H	
Geum macrophyllum	large-leaf avens	N	H	
Geum rivale	Water Avens	N	H	
Geum triflorum	prairie smoke	N	H	
Glechoma hederacea	creeping charlie	I	H	
Glyceria canadensis	Rattlesnake Grass	N	G	
Glyceria grandis	American Manna Grass	N	G	
Glyceria striata	fowl manna grass	N	G	
Glycyrrhiza lepidota	wild licorice	N	H	

Legend

Native Status: N = Native, I = Invasive, U = Undetermined

Physiognomy: B = broadleaf evergreen, D = broadleaf deciduous, E = needleleaf evergreen, G = graminoid, H = forb, L = lichens and moss, C = climber, K = stem succulent, X = epiphyte, F = floating aquatic, S = submerged aquatic

Rarity: E = Endangered, T = Threatened, SC = Special Concern, W = Watch List, H = Historical

Species	Common Name	N	P	R
Goodyera pubescens	downy rattlesnake plantain	N	H	
Hedeoma hispida	mock pennyroyal	N	H	
Helenium autumnale	autumn sneezeweed	N	H	
Helianthus divaricatus	woodland sunflower	N	H	
Helianthus maximilliani	maximillani sunflower	N	H	
Helianthus occidentalis	western sunflower	N	H	
Helianthus pauciflorus	stiff sunflower	N	H	
Helianthus strumosus	woodland sunflower	N	H	
Helianthus tuberosus	jerusalem artichoke	N	H	
Heliopsis helianthoides	ox-eye	N	H	
Hemerocallis fulva	fulvous daylily	I	H	
Heracleum lanatum	cow parsnip	N	H	
Hesperis matronalis	dame's rocket	I	H	
Hesperostipa spartea	porcupine grass	N	G	
Heterotheca villosa	hairy golden aster	N	H	
Heuchera richardsonii	alumroot	N	H	
Hierochloe ordorata	Sweet Grass	N	G	
Hydrophyllum virginianum	Virginia waterleaf	N	H	
Hylodesmum glutinosum	pointed-leaved tick-trefoil	N	H	
Hypericum punctatum	spotted St. John's wort	N	H	
Hypericum pyramidatum	great St. Johnswort	N	H	
Hypoxis hirsuta	yellow star-grass	N	H	
Ilex verticillata	winterberry	N	D	

Species	Common Name	N	P	R
Impatiens capensis	spotted touch-me-not	N	H	
Impatiens pallida	pale touch-me-not	N	H	
Iris veriscolor	Blue Flag Iris	N	H	
Iris versicolor	northern blue flag	N	H	
Juglans cinerea	butternut	N	D	E
Juglans nigra	black walnut	N	D	
Juncus arcticus	baltic rush	N	G	
Juncus effusus	soft rush	N	G	
Juncus interior	inland rush	N	G	
Juncus tenuis	path rush	N	G	
Juncus torreyi	Torrey's Rush	N	H	
Juniperus virginiana	eastern red cedar	N	B	
Koeleria macrantha	junegrass	N	G	
Lactuca biennis	tall blue lettuce	N	H	
Lactuca canadensis	Canada wild lettuce	N	H	
Lactuca serriola	prickly lettuce	I	H	
Laportea canadensis	woodnettle	N	H	
Larix laricina	tamarack	N	E	
Lathyrus palustris	marsh vetchling	N	H	
Lathyrus venosus	veiny pea	N	H	
Leersia oryzoides	rice cut grass	N	G	
Leersia virginica	white grass	N	G	
Lemna minor	lesser duckweed	N	F,H	
Lemna trisulca	star duckweed	N	F,H	
Leonurus cardiaca	common motherwort	I	H	

Legend

Native Status: N = Native, I = Invasive, U = Undetermined

Physiognomy: B = broadleaf evergreen, D = broadleaf deciduous, E = needleleaf evergreen, G = graminoid, H = forb, L = lichens and moss, C = climber, K = stem succulent, X = epiphyte, F = floating aquatic, S = submerged aquatic

Rarity: E = Endangered, T = Threatened, SC = Special Concern, W = Watch List, H = Historical

Species	Common Name	N	P	R
Leonurus sibiricus	motherwort	I	H	
Lespedeza capitata	round-headed bush clover	N	H	
Lespedeza leptostachya	prairie bush clover	N	H	T
Lespedeza virginica	slender bush clover	N	H	
Liatris aspera	rough blazing star	N	H	
Liatris cylindrica	cylindric blazing star	N	H	
Liatris ligulistylis	northern plains blazing star	N	H	
Liatris punctata	dotted blazing star	N	H	
Liatris pycnostachya	great blazing star	N	H	
Liatris scariosa	northern blazing star	N	H	
Linaria vulgaris	butter-and-eggs	I	H	
Liparis liliifolia	lily-leaved twayblade	N	H	
Lobelia siphilitica	great lobelia	N	H	
Lobelia spicata	pale-spiked lobelia	N	H	
Lonicera dioica	wild honeysuckle	N	C	
Lonicera tatarica	tartarian honeysuckle	I	D	
Lotus corniculatus	bird's-foot trefoil	I	H	
Lupinus perennis	wild lupine	N	H	
Lycopus uniflorus	northern bugleweed	N	H	
Lysimachia ciliata	fringed loosestrife	N	H	
Lysimachia thyrsiflora	tufted loosestrife	N	H	
Lythrum salicaria	purple loosestrife	I	H	
Maianthemum canadense	Canada mayflower	N	H	

Species	Common Name	N	P	R
Maianthemum racemosum	common false Solomon's seal	N	H	
Matteuccia struthiopteris	ostrich fern	N	H	
Medicago lupulina	black medick	I	H	
Melilotus alba	white sweet clover	I	H	
Melilotus albus	white sweetclover	I	H	
Melilotus officinalis	yellow sweet clover	I	H	
Menispermum canadense	Canada moonseed	N	C	
Mentha arvensis	common mint	N	H	
Menyanthes trifoliata	buckbean	N	H	
Micranthes pensylvanica	swamp saxifrage	N	H	
Mimulus ringens	blue monkey flower	N	H	
Monarda fistulosa	wild bergamot	N	H	
Monotropa uniflora	Indian pipe	N	H	
Muhlenbergia cuspidata	Plains muhly	N	G	
Muhlenbergia glomerata	clustered muhly grass	N	G	
Muhlenbergia mexicana	Mexican muhly grass	N	G	
Muhlenbergia racemosa	marsh muhly grass	N	G	
Myosoton aquaticum	giant chickweed	I	H	
Myriophyllum sibiricum	northern water milfoil	N	H,S	
Myriophyllum spicatum	Eurasian water milfoil	I	H,S	
Nabalus albus	white rattlesnakeroot	N	H	
Nelumbo lutea	American lotus	N	H	
Nepeta cataria	catnip	I	H	

Legend

Native Status: N = Native, I = Invasive, U = Undetermined

Physiognomy: B = broadleaf evergreen, D = broadleaf deciduous, E = needleleaf evergreen, G = graminoid, H = forb, L = lichens and moss, C = climber, K = stem succulent, X = epiphyte, F = floating aquatic, S = submerged aquatic

Rarity: E = Endangered, T = Threatened, SC = Special Concern, W = Watch List, H = Historical

Species	Common Name	N	P	R
Nuphar variegata	bullhead pond-lily	N	F,H	
Nymphaea odorata	American white waterlily	N	F,H	
Oenothera biennis	common evening primrose	N	H	
Oenothera gaura	biennial beeblossom	N	H	
Onoclea sensibilis	sensitive fern	N	H	
Onosmodium molle	false gromwell	N	H	
Osmorhiza claytonii	Clayton's sweet cicely	N	H	
Osmorhiza longistylis	aniseroot	N	H	
Osmunda claytoniana	interrupted fern	N	H	
Ostrya virginiana	ironwood	N	D	
Panicum capillare	witch grass	N	G	
Panicum virgatum	switchgrass	N	G	
Parenthesis quinquefolia	virginia creeper	N	C	
Parthenium integrifolium	wild quinine	N	H	E
Parthenocissus insersta	woodbine	N	C	
Parthenocissus inserta	Thicket-Creeper	N	C	
Pascopyrum smithii	western wheatgrass	N	G	
Pastinaca sativa	wild parsnip	I	H	
Pedicularis canadensis	wood betony	N	H	
Pedicularis lanceolata	swamp lousewort	N	H	
Pediomelum esculentum	prairie turnip	N	H	
Penstemon calycosus	calico beardtoungue	N	H	
Penstemon cobaea	showy beardtoungue	N	H	
Penstemon digitalis	foxglove beard tongue	I	H	W

Species	Common Name	N	P	R
Penstemon gracilis	slender beard tongue	N	H	
Penstemon grandiflorus	large-flowered beard tongue	N	H	
Penthorum sedoides	ditch stonecrop	N	H	
Peritoma serrulata	spider-flower	I	H	
Persicaria amphibia	water smartweed	N	F,H	
Persicaria lapathifolia	nodding smartweed	N	H	
Persicaria maculosa	lady's thumb	I	H	
Persicaria pensylvanica	Pennsylvania smartweed	N	H	
Persicaria sagittata	arrow-leaved tearthumb	N	H	
Phalaris arundinacea	reed canary grass	I	G	
Phleum pratense	timothy	I	G	
Phlox pilosa	prairie phlox	N	H	
Phryma leptostachya	lopseed	N	H	
Physalis virginiana	Virginia ground cherry	N	H	
Physostegia virginiana	obedient plant	N	H	
Pilea pumila	dwarf clearweed	N	H	
Pinus strobus	white pine	N	E	
Plantago major	common plantain	I	H	
Plantago rugelii	Rugel's plantain	N	H	
Poa palustris	fowl bluegrass	N	G	
Poa pratensis	Kentucky bluegrass	I	G	
Polemonium reptans	spreading Jacob's-ladder	N	H	
Polygonatum biflorum	giant Solomon's seal	N	H	

Legend

Native Status: N = Native, I = Invasive, U = Undetermined

Physiognomy: B = broadleaf evergreen, D = broadleaf deciduous, E = needleleaf evergreen, G = graminoid, H = forb, L = lichens and moss, C = climber, K = stem succulent, X = epiphyte, F = floating aquatic, S = submerged aquatic

Rarity: E = Endangered, T = Threatened, SC = Special Concern, W = Watch List, H = Historical

Species	Common Name	N	P	R
Polygonatum pubescens	hairy solomon's seal	N	H	
Populus deltoides	cottonwood	N	D	
Populus grandidentata	big-toothed aspen	N	D	
Populus tremuloides	quaking aspen	N	D	
Porteranthus stipulatus	bowman's root	N	H	
Potamogeton amplifolius	large-leaved pondweed	N	F,H,S	
Potamogeton natans	floating pondweed	N	F,H,S	
Potamogeton zosteriformis	Flat-Stem Pondweed	N	F,H	
Potentilla argentea	silver cinquefoil	N	H	
Potentilla arguta	prairie cinquefoil	N	H	
Potentilla norvegica	rough cinquefoil	N	H	
Potentilla recta	sulphur cinquefoil	N	H	
Potentilla simplex	common cinquefoil	N	H	
Prenanthes alba	white rattlesnakeroot	N	H	
Prenanthes racemosa	smooth rattlesnakeroot	N	H	
Prunella vulgaris	heal-all	I	H	
Prunus americana	wild plum	N	D	
Prunus serotina	black cherry	N	D	
Prunus setotina	black cherry	N	D	
Prunus virginiana	chokecherry	N	D	
Pseudognaphalium obtusifolium	sweet everlasting	N	H	
Pycnanthemum pilosum	hairy mountain mint	N	H	

Species	Common Name	N	P	R
Pycnanthemum tenuifolium	narrowleaf mountain mint	N	H	
Pycnanthemum virginianum	Virginia mountain mint	N	H	
Pyrola elliptica	elliptic shinleaf	N	H	
Quercus alba	white oak	N	D	
Quercus ellipsoidalis	northern pin oak	N	D	
Quercus macrocarpa	bur oak	N	D	
Quercus rubra	northern red oak	N	D	
Ranunculus abortivus	kidney-leaved buttercup	N	H	
Ranunculus acris	tall buttercup	I	H	
Ranunculus scelatus	cursed crowfoot	N	H	
Ranunculus sceleratus	cursed crowfoot	N	H	
Ratibida columnifera	prairie coneflower	N	H	
Ratibida pinnata	gray-headed coneflower	N	H	
Rhamnus cathartica	European Buckthorn	I	H	
Rhus glabra	smooth sumac	N	D	
Rhus typhina	staghorn sumac	N	D	
Ribes americanum	wild black currant	N	D	
Ribes cynosbati	prickly gooseberry	N	D	
Ribes missouriense	Missouri gooseberry	N	D	
Rosa arkansana	prairie rose	N	H	
Rosa blanda	smooth wild rose	N	H	
Rosa rugosa	rugosa rose	I	H	
Rubus allegheniensis	Allegheny blackberry	N	D	

Legend

Native Status: N = Native, I = Invasive, U = Undetermined

Physiognomy: B = broadleaf evergreen, D = broadleaf deciduous, E = needleleaf evergreen, G = graminoid, H = forb, L = lichens and moss, C = climber, K = stem succulent, X = epiphyte, F = floating aquatic, S = submerged aquatic

Rarity: E = Endangered, T = Threatened, SC = Special Concern, W = Watch List, H = Historical

Species	Common Name	N	P	R
Rubus idaeus	Common Red Raspberry	N	H	
Rubus ideaus	wild red raspberry	N	H	
Rubus occidentalis	black raspberry	N	H	
Rubus pubescens	dwarf raspberry	N	H	
Rudbeckia hirta	black-eyed susan	N	H	
Rudbeckia laciniata	tall coneflower	N	H	
Rudbeckia subtomentosa	sweet coneflower	N	H	
Rudbeckia triloba	three-leaved coneflower	N	H	
Rumex acetosella	common sheep sorrel	I	H	
Rumex altissimus	tall water dock	N	H	
Rumex britannica	great water dock	N	H	
Rumex crispus	curly dock	I	H	
Sagittaria latifolia	broad-leaved arrowhead	N	H	
Sagittaria rigida	sessile-fruited arrowhead	N	H,S	
Salix amygdaloides	peach-leaved willow	N	D	
Salix bebbiana	Bebb's willow	N	D	
Salix candida	sage-leaved willow	N	D	
Salix discolor	pussy willow	N	D	
Salix interior	sandbar willow	N	D	
Salix nigra	black willow	N	D	
Salix petiolaris	slender willow	N	D	
Sambucus canadensis	common elder	N	D	
Sambucus nigra	Black Elder	N	D	

Species	Common Name	N	P	R
Sambucus racemosa	red-berried elder	N	D	
Sanguinaria canadensis	bloodroot	N	H	
Schizachne purpurascens	false melic grass	N	G	
Schizachyrium scoparium	little bluestem	N	G	
Schoenoplectus acutus	hardstem bulrush	N	G	
Schoenoplectus pungens	Three-square Bulrush	N	H	
Schoenoplectus tabernaemontani	soft stem bulrush	N	G	
Scirpus atrovirens	dark green bulrush	N	G	
Scirpus cyperinus	woolgrass	N	G	
Scirpus fluviatilis	river bulrush	N	G	
Scirpus pungens	common threesquare	N	G	
Scirpus validus	soft-stemmed bulrush	N	G	
Scirpus validus (tabernaemontani)	Soft-stem Bulrush	N	H	
Scrophularia lanceolata	lance-leaved figwort	N	H	
Scutellaria galericulata	marsh skullcap	N	H	
Scutellaria lateriflora	mad dog skullcap	N	H	
Securigera varia	purple crownvetch	I	H	
Setaria faberi	giant foxtail	I	G	
Setaria pumila	yellow foxtail	I	G	
Setaria viridis	green foxtail	I	G	
Sicyos angulatus	One-Seed Burr-Cucumber	N	H	
Silene latifolia	white campion	I	H	
Silene stellata	starry campion	N	H	

Legend

Native Status: N = Native, I = Invasive, U = Undetermined

Physiognomy: B = broadleaf evergreen, D = broadleaf deciduous, E = needleleaf evergreen, G = graminoid, H = forb, L = lichens and moss, C = climber, K = stem succulent, X = epiphyte, F = floating aquatic, S = submerged aquatic

Rarity: E = Endangered, T = Threatened, SC = Special Concern, W = Watch List, H = Historical

Species	Common Name	N	P	R
Silphium integrifolium	rosinweed	N	H	
Silphium laciniatum	compass plant	N	H	
Silphium perfoliatum	cup plant	N	H	
Sisyrinchium campestre	field blue-eyed grass	N	H	
Sium suave	water parsnip	N	H	
Smilax tamnoides	greenbrier	N	C	
Solanum dulcamara	bittersweet nightshade	I	H	
Solidago canadensis	Canadian Goldenrod	N	H	
Solidago flexicaulis	zigzag goldenrod	N	H	
Solidago gigantea	giant goldenrod	N	H	
Solidago missouriensis	Missouri goldenrod	N	H	
Solidago nemoralis	gray goldenrod	N	H	
Solidago ohioensis	Ohio goldenrod	N	H	
Solidago ptarmicoides	upland white aster	N	H	
Solidago riddellii	Riddell's goldenrod	N	H	
Solidago rigida	stiff goldenrod	N	H	
Solidago speciosa	showy goldenrod	N	H	
Sonchus arvensis	field sow thistle	I	H	
Sorbus americana	american mountain-ash	N	H	
Sorghastrum nutans	Indian grass	N	G	
Sparganium eurycarpum	giant bur-reed	N	H	
Spartina pectinata	prairie cordgrass	N	G	
Spiraea alba	white meadowsweet	N	D	
Spiraea tomentosa	Steeplebush	N	D	

Species	Common Name	N	P	R
Spirodela polyrhiza	Common Duckweed	N	H	
Spirodela polyrrhiza	greater duckweed	N	F,H	
Sporobolus compositus	rough dropseed	N	G	
Sporobolus cryptandrus	sand dropseed	N	G	
Sporobolus heterolepis	prairie dropseed	N	G	
Stellaria longifolia	long-leaved chickweed	N	H	
Stuckenia pectinata	sago pondweed	N	H,S	
Symphyotrichum drummondii	Drummond's aster	N	H	
Symphyotrichum ericoides	heath aster	N	H	
Symphyotrichum laeve	smooth blue aster	N	H	
Symphyotrichum lanceolatum	panicled aster	N	H	
Symphyotrichum lateriflorum	side-flowering aster	N	H	
Symphyotrichum novae-angliae	New England aster	N	H	
Symphyotrichum ontarionis	Ontario aster	N	H	
Symphyotrichum oolentangiense	skyblue aster	N	H	
Symphyotrichum pilosus	frost aster	N	H	
Symphyotrichum puniceum	red-stemmed aster	N	H	
Symphyotrichum puniceus	Red-stemmed Aster	N	H	
Symphyotrichum urophyllum	arrowleaf aster	N	H	

Legend

Native Status: N = Native, I = Invasive, U = Undetermined

Physiognomy: B = broadleaf evergreen, D = broadleaf deciduous, E = needleleaf evergreen, G = graminoid, H = forb, L = lichens and moss, C = climber, K = stem succulent, X = epiphyte, F = floating aquatic, S = submerged aquatic

Rarity: E = Endangered, T = Threatened, SC = Special Concern, W = Watch List, H = Historical

Species	Common Name	N	P	R
Taraxacum officinale	common dandelion	I	H	
Teucrium canadense	germander	N	H	
Thalictrum dasycarpum	tall meadow-rue	N	H	
Thalictrum dioicum	early meadow-rue	N	H	
Thalictrum thalictroides	rue anemone	N	H	
Thelypteris palustris	northern marsh fern	N	H	
Torilis japonica	Japanese hedge parsley	I	H	
Toxicodendron radicans	eastern poison ivy	N	D	
Toxicodendron rydbergii	western poison ivy	N	D	
Tradescantia bracteata	bracted spiderwort	N	H	
Tradescantia occidentalis	western spiderwort	N	H	
Tradescantia ohiensis	Ohio spiderwort	N	H	
Tragopogon dubius	yellow goat's beard	I	H	
Tridens flavus	purpletop tridens	N	G	
Trifolium hybridum	alsike clover	I	H	
Trifolium pratense	red clover	I	H	
Trifolium repens	white clover	I	H	
Trillium cernuum	nodding trillium	N	H	
Triosteum perfoliatum	late horse gentian	N	H	
Typha angustifolia	narrow-leaved cattail	I	H	
Typha latifolia	broad-leaved cattail	N	H	
Typha X glauca	Hybrid Cat-tail	I	H	
Ulmus americana	American elm	N	D	
Ulmus pumila	Siberian elm	I	D	

Species	Common Name	N	P	R
Urtica dioica	stinging nettle	N	H	
Utricularia macrorhiza	Greater Bladderwort	N	H,S	
Utricularia vulgaris	common bladderwort	N	H,S	
Uvularia grandiflora	large-flowered bellwort	N	H	
Uvularia sessilifolia	pale bellwort	N	H	
Vaccinium angustifolium	lowbush blueberry	N	D	
Verbascum thapsus	common mullein	I	H	
Verbena hastata	blue vervain	N	H	
Verbena stricta	hoary vervain	N	H	
Verbena urticifolia	white vervain	N	H	
Verbesina helianthoides	yellow crownbeard	N	H	
Vernonia fasciculata	bunched ironweed	N	H	
Veronicastrum virginicum	Culver's root	N	H	
Viburnum lentago	nannyberry	N	D	
Viburnum opulus	European cranberrybush	U	D	
Viburnum rafinesqueanum	downy arrowwood	N	D	
Vicia americana	American vetch	N	H	
Vicia villosa	hairy vetch	I	H	
Viola pedatifida	bearded birdfoot violet	N	H	
Viola pubescens	downy yellow violet	N	H	
Vitis riparia	riverbank grape	N	C	
Wolffia columbiana	Columbian Watermeal	N	H,F	

Legend

Native Status: N = Native, I = Invasive, U = Undetermined

Physiognomy: B = broadleaf evergreen, D = broadleaf deciduous, E = needleleaf evergreen, G = graminoid, H = forb, L = lichens and moss, C = climber, K = stem succulent, X = epiphyte, F = floating aquatic, S = submerged aquatic

Rarity: E = Endangered, T = Threatened, SC = Special Concern, W = Watch List, H = Historical

Species	Common Name	N	P	R
Zanthoxylum americanum	prickly ash	N	D	
Zizania aquatica	annual wildrice	N	G	W
Zizia aptera	heart-leaved alexanders	N	H	

Species	Common Name	N	P	R
Zizia aurea	golden alexanders	N	H	

Legend

Native Status: N = Native, I = Invasive, U = Undetermined

Physiognomy: B = broadleaf evergreen, D = broadleaf deciduous, E = needleleaf evergreen, G = graminoid, H = forb, L = lichens and moss, C = climber, K = stem succulent, X = epiphyte, F = floating aquatic, S = submerged aquatic

Rarity: E = Endangered, T = Threatened, SC = Special Concern, W = Watch List, H = Historical

10.2. Appendix B. Wildlife Species Inventory (including invasives)

Wildlife Observations/Indications

Table B1. *Confirmed Wildlife Species Observed in LHRP*

Fauna Type	Species (Invasives Italic)	*Scientific Name*	State Status	Federal Status	SGCN Status	Evidence in Park (*confirmed breeding)	Nature Serve Rank	Most Recent Observation	Source	SGCN Criteria (stressors and life-history traits)(Source: DNR Species of Greatest Conservation Need list)
Amphibian	Tiger Salamander	*Ambystoma tigrinum*	NL	NL	NL	Yes	G5	2018 Field Season	Coverboard Surveys	
Amphibian	American Toad	*Anaxyrus americanus, Bufo americanus*	NL	NL	NL	Yes	G5	2018 Field Season	NAAMP, Turtle Visual Surveys, Frog Call Surveys	
Amphibian	Cope's Gray Treefrog	*Hyla chrysoscelis*	NL	NL	NL	Yes	G5	2018 Field Season	NAAMP, Frog Call Surveys	
Amphibian	Eastern Gray Treefrog	*Hyla versicolor*	NL	NL	NL	Yes	G5	2018 Field Season	NAAMP, Frog Call Surveys	
Amphibian	Green frog	*Lithobates clamitans*	NL	NL	NL	Yes	G5	2018 Field Season	Frog Call Surveys	
Amphibian	Northern Leopard Frog	*Lithobates pipiens, Rana pipiens*	NL	NL	NL	Yes	G5	2018 Field Season	NAAMP, Turtle Visual Surveys, Frog Call Surveys	
Amphibian	Mink Frog	*Lithobates septentrionalis*	NL	NL	NL	Yes	G5	2003 Field Season	NAAMP	
Amphibian	Wood Frog	*Lithobates sylvaticu, Rana sylvatica*	NL	NL	NL	Yes	G5	2018 Field Season	NAAMP, Frog Call Surveys	
Amphibian	Spring Peeper	*Pseudacris crucifer*	NL	NL	NL	Yes	G5	2018 Field Season	NAAMP, Frog Call Surveys	
Amphibian	Boreal Chorus Frog	*Pseudacris maculata*	NL	NL	NL	Yes	G5	2018 Field Season	NAAMP, Frog Call Surveys	

Amphibian	Western Chorus Frog	*Pseudacris triseriata*	NL	NL	NL	Yes	G5	2018 Field Season	Frog Call Surveys, Frog Call Surveys	
Avian	Common Redpoll	*Acanthis flammea*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Cooper's Hawk	*Accipiter cooperii*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Sharp-Shinned Hawk	*Accipiter striatus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Spotted Sandpiper	*Actitis macularius*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Northern Saw-Whet Owl	*Aegolius acadicus*	NL	NL	NL	Yes	G5	2018 Field Season	Trail Camera Survey, eBird	
Avian	Red-Winged Blackbird	*Agelaius phoeniceus*	NL	NL	NL	Yes*	G5	2018 Field Season	Marshbird Survey, Breeding Bird Survey, eBird, Turtle Visual Surveys	
Avian	Wood Duck	*Aix sponsa*	NL	NL	NL	Yes*	G5	2018 Field Season	Marshbird Survey, Trail Camera Survey, eBird	
Avian	Northern Pintail	*Anas acuta*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	statistically valid decline documented
Avian	Green-Winged Teal	*Anas crecca*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Mallard	*Anas platyrhynchos*	NL	NL	NL	Yes*	G5	2018 Field Season	Marshbird Survey, Trail Camera Survey, eBird, Turtle Visual Surveys	

Avian	Greater White-Fronted Goose	*Anser albifrons*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Sandhill Crane	*Antigone canadensis*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Ruby-Throated Hummingbird	*Archilochus colubris*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Great Egret	*Ardea alba*	NL	NL	NL	Yes	G5	2017	Marshbird Survey, Trail Camera Survey, Turtle Visual Surveys	
Avian	Great Blue Heron	*Ardea herodias*	NL	NL	NL	Yes	G5	2018 Field Season	Marshbird Survey, eBird	
Avian	Lesser Scaup	*Aythya affinis*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	statistically valid decline documented
Avian	Redhead	*Aythya americana*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Ring-Necked Duck	*Aythya collaris*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Canvasback	*Aythya valisineria*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Cedar Waxwing	*Bombycilla cedrorum*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Ruffed Grouse	*Bonasa umbellus*	NL	NL	NL	Yes	G5	1988	Tom A. Tustison Bird Survey	
Avian	American Bittern	*Botaurus lentiginosus*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	statistically valid decline documented

Avian	Canada Goose	*Branta canadensis*	NL	NL	NL	Yes*	G5	2018 Field Season	Marshbird Survey, Trail Camera Survey, Breeding Bird Survey, eBird	
Avian	Cackling Goose	*Branta hutchinsii*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Snowy Owl	*Bubo scandiacus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Great Horned Owl	*Bubo virginianus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Bufflehead	*Bucephala albeola*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Common Goldeneye	*Bucephala clangula*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Red-Tailed Hawk	*Buteo jamaicensis*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Rough-Legged Hawk	*Buteo lagopus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Red-Shouldered Hawk	*Buteo lineatus*	SPC	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	habitat degradation; habitat fragmentation; requires large home ranges/multiple habitats
Avian	Broad-Winged Hawk	*Buteo platypterus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Swainson's Hawk	*Buteo swainsoni*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	rare, vulnerable/declining habitat
Avian	Green Heron	*Butorides virescens*	NL	NL	NL	Yes*	G5	2018 Field Season	Marshbird Survey, eBird,	

									Turtle Visual Surveys	
Avian	Canada Warbler	*Cardellina canadensis*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Wilson's Warbler	*Cardellina pusilla*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Northern Cardinal	*Cardinalis cardinalis*	NL	NL	NL	Yes*	G5	2018 Field Season	Marshbird Survey, Breeding Bird Survey, eBird	
Avian	Turkey Vulture	*Cathartes aura*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Veery	*Catharus fuscescens*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	statistically valid decline documented; Minnesota population represents significant portion of their North American breeding or wintering population
Avian	Hermit Thrush	*Catharus guttatus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Gray-Cheeked Thrush	*Catharus minimus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Swainson's Thrush	*Catharus ustulatus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Brown Creeper	*Certhia americana*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Chimney Swift	*Chaetura pelagica*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	statistically valid decline documented
Avian	Killdeer	*Charadrius vociferus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	

Avian	Black Tern	*Chlidonias niger*	NL	NL	Yes	Yes	G4G5	Pulled from ebird on 12/3/2018	eBird	statistically valid decline documented; rare, vulnerable/declining habitat
Avian	Common Nighthawk	*Chordeiles minor*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	extensive surveys indicate a decline of unknown cause
Avian	Bonaparte's Gull	*Chroicocephalus philadelphia*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Northern Harrier	*Circus hudsonius*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	rare, vulnerable/declining habitat; habitat loss; depend on large habitat
Avian	Marsh Wren	*Cistothorus palustris*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Sedge Wren	*Cistothorus platensis*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	Minnesota population represents significant portion of their North American breeding or wintering population
Avian	Yellow-Billed Cuckoo	*Coccyzus americanus*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	statistically valid decline documented
Avian	Black-Billed Cuckoo	*Coccyzus erythrop-thalmus*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	statistically valid decline documented; depend on ecological process no longer within NRV
Avian	Northern Flicker	*Colaptes auratus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Rock Pigeon	*Columba livia*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Olive-Sided Flycatcher	*Contopus cooperi*	NL	NL	Yes	Yes	G4	Pulled from ebird on 12/3/2018	eBird	statistically valid decline documented
Avian	Eastern Wood-Pewee	*Contopus virens*	NL	NL	NL	Yes*	G5	2018 Field Season	Breeding Bird Survey, eBird	

Avian	American Crow	*Corvus brachyrhynchos*	NL	NL	NL	Yes*	G5	2018 Field Season	Marshbird Survey, Trail Camera Survey, Breeding Bird Survey, eBird	
Avian	Blue Jay	*Cyanocitta cristata*	NL	NL	NL	Yes*	G5	2018 Field Season	Marshbird Survey, Trail Camera Survey, Breeding Bird Survey, eBird	
Avian	Trumpeter Swan	*Cygnus buccinator*	SPC	NL	Yes	Yes	G4	Pulled from ebird on 12/3/2018	eBird	Minnesota population represents significant portion of their North American breeding or wintering population
Avian	Tundra Swan	*Cygnus columbianus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Bobolink	*Dolichonyx oryzivorus*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	statistically valid decline documented; rare, vulnerable/declining habitat; habitat loss; Minnesota population represents significant portion of their North American breeding or wintering population
Avian	Pileated Woodpecker	*Dryocopus pileatus*	NL	NL	NL	Yes	G5	2018 Field Season	Marshbird Survey, eBird	
Avian	Gray Catbird	*Dumetella carolinensis*	NL	NL	NL	Yes*	G5	2018 Field Season	Breeding Bird Survey, eBird	
Avian	Alder Flycatcher	*Empidonax alnorum*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Yellow-Bellied Flycatcher	*Empidonax flaviventris*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Least Flycatcher	*Empidonax minimus*	NL	NL	NL	Yes*	G5	2018 Field Season	Breeding Bird Survey, eBird	

Avian	Willow Flycatcher	*Empidonax traillii*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Acadian Flycatcher	*Empidonax virescens*	SPC	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	rare, vulnerable/declining habitat; habitat degradation
Avian	Rusty Blackbird	*Euphagus carolinus*	NL	NL	NL	Yes	G4	Pulled from ebird on 12/3/2018	eBird	
Avian	Brewer's Blackbird	*Euphagus cyanocephalus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Merlin	*Falco columbarius*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Peregrine Falcon	*Falco peregrinus*	SPC	NL	Yes	Yes	G4	Pulled from ebird on 12/3/2018	eBird	statistically valid decline documented; limited ability to recover (low reproductive rate)
Avian	American Kestrel	*Falco sparverius*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	statistically valid decline documented
Avian	American Coot	*Fulica americana*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Common Loon	*Gavia immer*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	contaminants
Avian	Kentucky Warbler	*Geothlypis formosa*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Mourning Warbler	*Geothlypis philadelphia*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Common Yellowthroat	*Geothlypis trichas*	NL	NL	NL	Yes*	G5	2018 Field Season	Marshbird Survey, Breeding Bird Survey, eBird	

Avian	House Finch	*Haemorhous mexicanus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Purple Finch	*Haemorhous purpureus*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	statistically valid decline documented
Avian	Bald Eagle	*Haliaeetus leucocephalus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Barn Swallow	*Hirundo rustica*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Caspian Tern	*Hydroprogne caspia*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Wood Thrush	*Hylocichla mustelina*	NL	NL	Yes	Yes*	G4	2018 Field Season	Breeding Bird Survey, eBird	habitat loss; habitat degradation
Avian	Yellow-breasted Chat	*Icteria virens*	NL	NL	NL	Yes	G5	2001	Tom A. Tustison Bird Survey	
Avian	Baltimore Oriole	*Icterus galbula*	NL	NL	NL	Yes*	G5	2018 Field Season	Breeding Bird Survey, eBird	
Avian	Orchard Oriole	*Icterus spurius*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Dark-Eyed Junco	*Junco hyemalis*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Northern Shrike	*Lanius borealis*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Herring Gull	*Larus argentatus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Ring-Billed Gull	*Larus delawarensis*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	

Avian	Franklin's Gull	*Leucophaeus pipixcan*	SPC	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	habitat loss; aggregate their populations
Avian	Hooded Merganser	*Lophodytes cucullatus*	NL	NL	NL	Yes	G5	2018 Field Season	Marshbird Survey, eBird	
Avian	Red Crossbill	*Loxia curvirostra*	NL	NL	NL	Yes	G5	1988	Tom A. Tustison Bird Survey	
Avian	Gadwall	*Mareca strepera*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Belted Kingfisher	*Megaceryle alcyon*	NL	NL	Yes	Yes	G5	2018 Field Season	eBird, Turtle Visual Surveys	statistically valid decline documented
Avian	Red-Bellied Woodpecker	*Melanerpes carolinus*	NL	NL	NL	Yes	G5	2018 Field Season	Breeding Bird Survey, eBird	
Avian	Red-Headed Woodpecker	*Melanerpes erythrocephalus*	NL	NL	Yes	Yes	G5	2018 Field Season	Marshbird Survey, eBird	statistically valid decline documented
Avian	Wild Turkey	*Meleagris gallopavo*	NL	NL	NL	Yes*	G5	2018 Field Season	Marshbird Survey, Trail Camera Survey, Breeding Bird Survey, eBird	
Avian	Swamp Sparrow	*Melospiza georgiana*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Lincoln's Sparrow	*Melospiza lincolnii*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Song Sparrow	*Melospiza melodia*	NL	NL	NL	Yes*	G5	2018 Field Season	Marshbird Survey, Breeding Bird Survey, eBird	
Avian	Common Merganser	*Mergus merganser*	NL	NL	Yes	Yes	G5	2018 Field Season	Marshbird Survey, eBird	migrating populations congregating in Minnesota represent a significant portion of the North American population

Avian	Red-Breasted Merganser	*Mergus serrator*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Black-And-White Warbler	*Mniotilta varia*	NL	NL	NL	Yes*	G5	2018 Field Season	Breeding Bird Survey, eBird	
Avian	Brown-Headed Cowbird	*Molothrus ater*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Great Crested Flycatcher	*Myiarchus crinitus*	NL	NL	NL	Yes*	G5	2018 Field Season	Breeding Bird Survey, eBird	
Avian	Black-Crowned Night-Heron	*Nycticorax nycticorax*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	rare, vulnerable/declining habitat; aggregate their populations
Avian	Connecticut Warbler	*Oporornis agilis*	NL	NL	Yes	Yes	G4G5	Pulled from ebird on 12/3/2018	eBird	statistically valid decline documented; habitat loss; habitat fragmentation
Avian	Orange-Crowned Warbler	*Oreothlypis celata*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Tennessee Warbler	*Oreothlypis peregrina*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Nashville Warbler	*Oreothlypis ruficapilla*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Ruddy Duck	*Oxyura jamaicensis*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Osprey	*Pandion haliaetus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Northern Waterthrush	*Parkesia noveboracensis*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	House Sparrow	*Passer domesticus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	

Avian	Savannah Sparrow	*Passerculus sandwichensis*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Fox Sparrow	*Passerella iliaca*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Indigo Bunting	*Passerina cyanea*	NL	NL	NL	Yes*	G5	2018 Field Season	Breeding Bird Survey, eBird, Turtle Visual Surveys	
Avian	American White Pelican	*Pelecanus erythrorhynchos*	SPC	NL	Yes	Yes	G4	Pulled from ebird on 12/3/2018	eBird	Minnesota population represents significant portion of their North American breeding or wintering population; aggregate their populations
Avian	Cliff Swallow	*Petrochelidon pyrrhonota*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Double-Crested Cormorant	*Phalacrocorax auritus*	NL	NL	NL	Yes	G5	2018 Field Season	Marshbird Survey, eBird	
Avian	Ring-Necked Pheasant	*Phasianus colchicus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Rose-Breasted Grosbeak	*Pheucticus ludovicianus*	NL	NL	NL	Yes*	G5	2018 Field Season	Breeding Bird Survey, eBird	
Avian	Downy Woodpecker	*Picoides pubescens*	NL	NL	NL	Yes*	G5	2018 Field Season	Marshbird Survey, Breeding Bird Survey, eBird	
Avian	Hairy Woodpecker	*Picoides villosus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Eastern Towhee	*Pipilo erythrophthalmus*	NL	NL	Yes	Yes*	G5	2018 Field Season	Marshbird Survey, Breeding Bird Survey, eBird	statistically valid decline documented; depend on ecological process no longer within NRV
Avian	Scarlet Tanager	*Piranga olivacea*	NL	NL	NL	Yes*	G5	2018 Field Season	Breeding Bird Survey, eBird	

Avian	Summer Tanager	*Piranga rubra*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Horned Grebe	*Podiceps auritus*	END	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	rare, vulnerable/declining habitat; habitat loss
Avian	Pied-Billed Grebe	*Podilymbus podiceps*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Black-Capped Chickadee	*Poecile atricapillus*	NL	NL	NL	Yes*	G5	2018 Field Season	Marshbird Survey, Breeding Bird Survey, eBird, Turtle Visual Surveys	
Avian	Blue-Gray Gnatcatcher	*Polioptila caerulea*	NL	NL	NL	Yes*	G5	2018 Field Season	Breeding Bird Survey, eBird	
Avian	Vesper Sparrow	*Pooecetes gramineus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Sora	*Porzana carolina*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Purple Martin	*Progne subis*	SPC	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	statistically valid decline documented; contaminants; aggregate their populations
Avian	Prothonotary Warbler	*Protonotaria citrea*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	habitat loss; habitat degradation; invasive species
Avian	Common Grackle	*Quiscalus quiscula*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Virginia Rail	*Rallus limicola*	NL	NL	Yes	Yes	G5	2018 Field Season	Marshbird Survey, eBird	rare, vulnerable/declining habitat
Avian	Ruby-Crowned Kinglet	*Regulus calendula*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	

Avian	Golden-Crowned Kinglet	*Regulus satrapa*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Bank Swallow	*Riparia riparia*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Eastern Phoebe	*Sayornis phoebe*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	American Woodcock	*Scolopax minor*	NL	NL	Yes	Yes	G5	2018 Field Season	Marshbird Survey, eBird	statistically valid decline documented
Avian	Ovenbird	*Seiurus aurocapilla*	NL	NL	NL	Yes*	G5	2018 Field Season	Breeding Bird Survey, eBird	
Avian	Northern Parula	*Setophaga americana*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Black-Throated Blue Warbler	*Setophaga caerulescens*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	rare, vulnerable/declining habitat; habitat fragmentation
Avian	Bay-Breasted Warbler	*Setophaga castanea*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	habitat loss; need special resources (narrow thermal preferences)
Avian	Cerulean Warbler	*Setophaga cerulea*	SPC	NL	Yes	Yes	G4	Pulled from ebird on 12/3/2018	eBird	rare, vulnerable/declining habitat; habitat degradation
Avian	Hooded Warbler	*Setophaga citrina*	SPC	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	habitat loss; highly localized/restricted distribution
Avian	Yellow-Rumped Warbler	*Setophaga coronata*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Blackburnian Warbler	*Setophaga fusca*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Magnolia Warbler	*Setophaga magnolia*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	

Avian	Palm Warbler	*Setophaga palmarum*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Chestnut-Sided Warbler	*Setophaga pensylvanica*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Yellow Warbler	*Setophaga petechia*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Pine Warbler	*Setophaga pinus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	American Redstart	*Setophaga ruticilla*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Blackpoll Warbler	*Setophaga striata*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Cape May Warbler	*Setophaga tigrina*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	habitat loss; need special resources (narrow thermal preferences)
Avian	Black-Throated Green Warbler	*Setophaga virens*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Eastern Bluebird	*Sialia sialis*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Red-Breasted Nuthatch	*Sitta canadensis*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	White-Breasted Nuthatch	*Sitta carolinensis*	NL	NL	NL	Yes*	G5	2018 Field Season	Breeding Bird Survey, eBird	
Avian	Northern Shoveler	*Spatula clypeata*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Blue-Winged Teal	*Spatula discors*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	

Avian	Yellow-Bellied Sapsucker	*Sphyrapicus varius*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Pine Siskin	*Spinus pinus*	NL	NL	NL	Yes	G5	1998	Tom A. Tustison Bird Survey	
Avian	American Goldfinch	*Spinus tristis*	NL	NL	NL	Yes*	G5	2018 Field Season	Marshbird Survey, Breeding Bird Survey, ebird	
Avian	Dickcissel	*Spiza americana*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	statistically valid decline documented
Avian	Clay-Colored Sparrow	*Spizella pallida*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Chipping Sparrow	*Spizella passerina*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Field Sparrow	*Spizella pusilla*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	statistically valid decline documented; rare, vulnerable/declining habitat
Avian	American Tree Sparrow	*Spizelloides arborea*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Northern Rough-Winged Swallow	*Stelgidopteryx serripennis*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	statistically valid decline documented
Avian	Forster's Tern	*Sterna forsteri*	SPC	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	rare, vulnerable/declining habitat; habitat loss; aggregate their populations
Avian	Eurasian Collared-Dove	*Streptopelia decaocto*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Barred Owl	*Strix varia*	NL	NL	NL	Yes	G5	2018 Field Season	Trail Camera Survey, eBird	
Avian	Eastern Meadowlark	*Sturnella magna*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	rare, vulnerable/declining habitat; habitat loss

Avian	European Starling	*Sturnus vulgaris*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Tree Swallow	*Tachycineta bicolor*	NL	NL	NL	Yes	G5	2018 Field Season	Marshbird Survey, eBird	
Avian	Brown Thrasher	*Toxostoma rufum*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	statistically valid decline documented
Avian	Solitary Sandpiper	*Tringa solitaria*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	House Wren	*Troglodytes aedon*	NL	NL	NL	Yes*	G5	2018 Field Season	Breeding Bird Survey, eBird	
Avian	Winter Wren	*Troglodytes hiemalis*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	habitat loss
Avian	American Robin	*Turdus migratorius*	NL	NL	NL	Yes*	G5	2018 Field Season	Marshbird Survey, Breeding Bird Survey, eBird	
Avian	Eastern Kingbird	*Tyrannus tyrannus*	NL	NL	NL	Yes	G5	2018 Field Season	Marshbird Survey, eBird	
Avian	Golden-Winged Warbler	*Vermivora chrysoptera*	NL	NL	Yes	Yes	G4	Pulled from ebird on 12/3/2018	eBird	Minnesota population represents significant portion of their North American breeding or wintering population; populations in Minnesota stable but have declined or are declining in a substantial part of range
Avian	Blue-Winged Warbler	*Vermivora cyanoptera*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Bell's Vireo	*Vireo bellii*	SPC	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	rare, vulnerable/declining habitat; extensive surveys indicate a decline of unknown cause
Avian	Yellow-Throated Vireo	*Vireo flavifrons*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	

Avian	Warbling Vireo	*Vireo gilvus*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Red-Eyed Vireo	*Vireo olivaceus*	NL	NL	NL	Yes*	G5	2018 Field Season	Breeding Bird Survey, eBird	
Avian	Philadelphia Vireo	*Vireo philadelphicus*	NL	NL	Yes	Yes	G5	Pulled from ebird on 12/3/2018	eBird	rare, vulnerable/declining habitat; extensive surveys indicate a decline of unknown cause
Avian	Blue-Headed Vireo	*Vireo solitarius*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Mourning Dove	*Zenaida macroura*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	White-Throated Sparrow	*Zonotrichia albicollis*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	White-Crowned Sparrow	*Zonotrichia leucophrys*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Avian	Harris's Sparrow	*Zonotrichia querula*	NL	NL	NL	Yes	G5	Pulled from ebird on 12/3/2018	eBird	
Bees	Honey Bee	*Apis mellifera*	NL	NL	NL	Yes	GNR	2018 Field Season	Bumble Bee Surveys	
Bees	Black and Gold Bumblebee	*Bombus auricomus*	NL	NL	NL	Yes	G4G5	2018 Field Season	Bumble Bee Surveys	
Bees	Two-spotted bumble bee	*Bombus bimaculatus*	NL	NL	NL	Yes	G5	2018 Field Season	Bumble Bee Surveys	
Bees	Brown-belted bumblebee	*Bombus griseocollis*	NL	NL	NL	Yes	G5	2017 Field Season	Bumble Bee Surveys	
Bees	Red-belted Bumblebee	*Bombus rufocinctus*	NL	NL	NL	Yes	G4G5	2017 Field Season	Bumble Bee Surveys	
Bees	Half-black bumble bee	*Bombus vagans*	NL	NL	NL	Yes	G5	2018 Field Season	Bumble Bee Surveys	
Bees	Common eastern bumble bee	*Bomus impatiens*	NL	NL	NL	Yes	G5	2018 Field Season	Bumble Bee Surveys	

Bees	(A bee)	*Nomada ruficornis*	NL	NL	NL	Yes	NA	2018 Field Season	Bumble Bee Surveys	
Fish	Black Bullhead	*Ameiurus melas*	NL	NL	NL	Yes	G5	2018 Field Season	Fish Surveys, DNR Fishing in the Neighborhood Program, DNR Surveys	
Fish	Yellow Bullhead	*Ameiurus natalis*	NL	NL	NL	Yes	G5	Data Taken from DNR Website in 2018	DNR Fishing in the Neighborhood Program, DNR Surveys	
Fish	white sucker	*Catostomus commersonii*	NL	NL	NL	Yes	G5	Data Taken from DNR Website in 2018	DNR Fishing in the Neighborhood Program, DNR Surveys	
Fish	Northern Pike	*Esox lucius*	NL	NL	NL	Yes	G5	2018 Field Season	DNR Fishing in the Neighborhood Program, DNR Surveys	
Fish	Green Sunfish	*Lepomis cyanellus*	NL	NL	NL	Yes	G5	2018 Field Season	Fish Surveys, DNR Fishing in the Neighborhood Program, DNR Surveys	
Fish	Pumpkinseed Sunfish	*Lepomis gibbosus*	NL	NL	NL	Yes	G5	2018 Field Season	Fish Surveys, DNR Fishing in the Neighborhood Program, DNR Surveys	
Fish	Bluegill	*Lepomis macrochirus*	NL	NL	NL	Yes	G5	2018 Field Season	Fish Surveys, DNR Fishing in the Neighborhood Program, DNR Surveys	

Fish	Hybrid Sunfish	*Lepomis spp*	NL	NL	NL	Yes	G5	2018 Field Season	Fish Surveys, DNR Fishing in the Neighborhood Program, DNR Surveys	
Fish	largemouth bass	*Micropterus salmoides*	NL	NL	NL	Yes	G5	Data Taken from DNR Website in 2018	DNR Fishing in the Neighborhood Program, DNR Surveys	
Fish	Golden Shiner	*Notemigonus crysoleucas*	NL	NL	NL	Yes	G5	2018 Field Season	Fish Surveys, DNR Fishing in the Neighborhood Program, DNR Surveys	
Fish	rainbow trout	*Oncorhynchus mykiss*	NL	NL	NL	Yes	G5	Data Taken from DNR Website in 2018	DNR Fishing in the Neighborhood Program, DNR Surveys	
Fish	Fathead Minnow	*Pimephales promelas*	NL	NL	NL	Yes	G5	2018 Field Season	Fish Surveys	
Fish	white crappie	*Pomoxis annularis*	NL	NL	NL	Yes	G5	Data Taken from DNR Website in 2018	DNR Fishing in the Neighborhood Program, DNR Surveys	
Fish	black crappie	*Pomoxis nigromaculatus*	NL	NL	NL	Yes	G5	2014	DNR Fishing in the Neighborhood Program, DNR Surveys	
Fish	brown trout	*Salmo trutta*	NL	NL	NL	Yes	G5	Data Taken from DNR Website in 2018	DNR Fishing in the Neighborhood Program, DNR Surveys	

Fish	walleye	*Sander vitreus*	NL	NL	NL	Yes	G5	Data Taken from DNR Website in 2018	DNR Fishing in the Neighborhood Program, DNR Surveys	
Insect	Least Skipper	*Ancyloxypha numitor*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Hackberry Emperor	*Asterocampa celtis*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Spring Azure	*Celastrina ladon*	NL	NL	NL	Yes	G4G5	2016	John Shier Butterfly Data	
Insect	Common Wood Satyr	*Ceryonis pegala*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Common Ringlet	*Coenonympha tullia*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Orange Sulphur	*Colias eurytheme*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Clouded Sulphur	*Colias philodice*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Eastern Tailed-Blue	*Cupido comyntas*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Northern Pearly Eye	*Enodia anthedon*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Silver-Spotted Skipper	*Epargyreus clarus*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Common Buckeye	*Junonia coenia*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Viceroy	*Limenitis archippus*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Red Spotted Purple	*Limenitis arthemis*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Little Wood Satyr	*Megisto cymela*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Mourning Cloak	*Nymphalis antiopa*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	

Insect	Tiger Swallowtail	*Papilio glaucus*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Black Swallowtail	*Papilio polyxenes*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Pearl Crescent	*Phyciodes tharos*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Cabbage White	*Pieris rapae*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Hobomok Skipper	*Poanes hobomok*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Peck's Skipper	*Polites peckius*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Question Mark	*Polygonia interrogationis*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Gray Comma	*Polygonia progne*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Little Glassywing	*Pompeius verna*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Great Spangled Fritillary	*Speyeria cybele*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	European Skipper	*Thymelicus lineola*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Red Admiral	*Vanessa atalanta*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Painted Lady	*Vanessa cardui*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	American Lady	*Vanessa virginiensis*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Insect	Azure	*#N/A*	NL	NL	NL	Yes	G5	2016	John Shier Butterfly Data	
Invertebrate	A species of leach	Erpobdella punctata	NL	NL	NL	Yes	G5	2018 Field Season	WHEP	
Invertebrate	A species of leach	haemopis grandis	NL	NL	NL	Yes	GNR	2018 Field Season	WHEP	

Invertebrate	A species of leach	Leptocerus americanus	NL	NL	NL	Yes	GNR	2018 Field Season	WHEP	
Lepidoptera	Monarch	*Danaus plexippus*	NL	NL	Yes	Yes	G4	2018 Field Season	John Shier Butterfly Data, Turtle Visual Surveys	statistically valid decline documented; rare, vul-nerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; need special resources (host species); Minnesota population represents significant portion of their North American breeding or wintering population
Mammal	Northern Short Tailed Shrew	*Blarina brevicauda*	NL	NL	NL	Yes	G5	2011 Field Season	Mosquito Control Trapping	
Mammal	Coyote	*Canis latrans*	NL	NL	NL	Yes	G5	2018 Field Season	Trail Cameras	
Mammal	Virginia Opossum	*Didelphis virginiana*	NL	NL	NL	Yes	G5	2018 Field Season	Trail Camera Surveys	
Mammal	Fisher	*Martes pennanti*	NL	NL	NL	Yes	G5	2018 Field Season	Trail Camera Surveys	
Mammal	Meadow Vole	*Microtus pennsylvanicus*	NL	NL	NL	Yes	G5	2018 Field Season	Small Mammal Trapping	
Mammal	Southern Red Backed Vole	*Myodes (Clethrionomys) gapperi*	NL	NL	NL	Yes	G5	2017 Field Season	Mosquito Control Trapping	
Mammal	American Mink	*Neovison vison*	NL	NL	NL	Yes	G5	2018 Field Season	Trail Camera Surveys, Turtle Visual Surveys	
Mammal	White-Tailed Deer	*Odocoileus virginianus*	NL	NL	NL	Yes	G5	2018 Field Season	Trail Camera Surveys, Turtle Visual Surveys, Heicopter Surveys	
Mammal	Muskrat	*Ondatra zibethicus*	NL	NL	NL	Yes	G5	2018 Field Season	Trail Camera Surveys, Turtle Visual Surveys	

Mammal	White-Footed Mouse	*Peromyscus leucopus*	NL	NL	NL	Yes	G5	2018 Field Season	Small Mammal Trapping, Mosquito Control Trapping	
Mammal	Deer Mouse	*Peromyscus maniculatus*	NL	NL	NL	Yes	G5	2018 Field Season	Small Mammal Trapping	
Mammal	Common Raccoon	*Procyon lotor*	NL	NL	NL	Yes	G5	2018 Field Season	Trail Camera Surveys	
Mammal	Eastern Gray Squirrel	*Sciurus carolinensis*	NL	NL	NL	Yes	G5	2018 Field Season	Trail Camera Surveys	
Mammal	Pygmy Shrew	*Sorex hoyi*	NL	NL	NL	Yes	G5	2017 Field Season	Small Mammal Trapping, Mosquito Control Trapping	
Mammal	Eastern Cottontail	*Sylvilagus floridanus*	NL	NL	NL	Yes	G5	2018 Field Season	Trail Camera Surveys	
Mammal	American Red Squirrel	*Tamiasciurus hudsonicus*	NL	NL	NL	Yes	G5	2018 Field Season	Trail Camera Surveys	
Mammal	Eastern Chipmunk	*Tamius striatus*	NL	NL	NL	Yes	G5	2018 Field Season	Mosquito Control Trapping	
Mammal	Gray Fox	*Urocyon cinereoargenteus*	NL	NL	NL	Yes	G5	2016 Field Season	Trail Camera Surveys	
Mammal	Meadow Jumping Mouse	*Zapus hudsonius*	NL	NL	NL	Yes	G5	2018 Field Season	Small Mammal Trapping, Mosquito Control Trapping	
Odonata	Common Green Darner	*Anax junius*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Horned Clubtail	*Arigomphus cornutus*	NL	NL	NL	Yes	G4	2018 Field Season	Dragonfly Surveys	

Odonata	Halloween Pennant	*Celithemis eponina*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Marsh Bluet	*Enallagma ebrium*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Hagen's Bluet	*Enallagma hageni*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Eastern Forktail	*Ischnura verticalis*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Chalk-Fronted Corporal	*Ladona julia*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Spotted Spreadwing	*Lestes congener*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Northern Spreadwing	*Lestes disjunctus*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Amber-Winged Spreadwing	*Lestes eurinus*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Slender Spreadwing	*Lestes rectangularis*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Lyre-Tipped Spreadwing	*Lestes unguiculatus*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Dot-Tailed Whiteface	*Leucorrhinia intacta*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Widow Skimmer	*Libellula luctuosa*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Twelve-Spotted Skimmer	*Libellula pulchella*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Four-Spotted Skimmer	*Libellula quadrimaculata*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Sedge Sprite	*Nehalennia irene*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Blue Dasher	*Pachydiplax longipennis*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Eastern Amberwing	*Perithemis tenera*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	

Odonata	White-Faced Meadowhawk	*Sympetrum obtrusum*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Autumn Meadowhawk	*Sympetrum vicinum*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Boreal Bluet	*Enallagma boreale*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Sweetflag Spreadwing	*Lestes forcipatus*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Odonata	Black Saddlebags	*Tramea lacerata*	NL	NL	NL	Yes	G5	2018 Field Season	Dragonfly Surveys	
Reptile	Snapping Turtle	*Chelydra serpentina*	NL	NL	NL	Yes	G5	2018 Field Season	Turtle Surveys	
Reptile	Painted Turtle	*Chrysemys picta*	NL	NL	NL	Yes	G5	2018 Field Season	Turtle Surveys	
Reptile	Blanding's Turtle	*Emydoidea blandingii*	THR	NL	Yes	Yes	G4	2018 Field Season	Turtle Surveys	rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; requires large home ranges/multiple habitats; depend on large habitat; limited ability to recover (low reproductive rate)
Reptile	Milk Snake	*Lamptopeltis triangulum*	NL	NL	NL	Yes	G5	2017 Field Season	Coverboard Surveys	
Reptile	Smooth Green Snake	*Opheodrys vernalis*	NL	NL	Yes	Yes	G5	2017 Field Season	Coverboard Surveys	habitat loss; habitat degradation; habitat fragmentation; contaminants
Reptile	Prairie Skink	*Plestiodon septentrionalis*	NL	NL	NL	Yes	G5	2018 Field Season	Coverboard Surveys	
Reptile	Red-bellied Snake	*Storeria occipitomaculata*	NL	NL	NL	Yes	G5	2018 Field Season	Coverboard Surveys	
Reptile	Common Garter Snake	*Thamnophis sirtalis*	NL	NL	NL	Yes	G5	2018 Field Season	Coverboard Surveys, Turtle Visual Surveys	
			NL	Not Listed						
			SPC	Special Concern						
			THR	Threatened						

			END	Endangered					

Table B2. *Expected Wildlife Species for LHRP*

Fauna Type	Species (Invasives in italics)	*Scientific Name*	State Status	Federal Status	SGCN Status	Expected in Park?	Nature Serve Rank	SGCN Criteria (stressors and life-history traits) (Source: DNR Species in Greatest Conservation Need list)
Amphibian	Pickerel Frog	*Lithobates palustris*	NL	NL	Yes	Yes	G5	Rare, vulnerable/declining habitat; habitat loss; habitat degradation; requires large home ranges/multiple habitats; highly localized/restricted distribution; aggregate their populations
Amphibian	Mudpuppy	*Necturus maculosus*	SPC	NL	Yes	Yes	G5	Habitat degradation; habitat fragmentation; over-exploitation; disease
Amphibian	Eastern Newt	*Notophthalmus viridescens*	NL	NL	Yes	Yes	G5	Rare, vulnerable/declining habitat; habitat degradation; habitat fragmentation; requires large home ranges/multiple habitats
Avian	Loggerhead Shrike	*Lanius ludovicianus*	END	NL	Yes	Yes	G4	Rare, vulnerable/declining habitat; extensive surveys indicate a decline of unknown cause
Bees	Rusty Patched Bumble Bee	*Bombus affinis*	NL	NL	Yes	Yes	G1	Extensive surveys indicate a decline of unknown cause
Bees	Ashton Cuckoo Bumble Bee	*Bombus bohemicus*	NL	NL	Yes	Yes	G4	Need special resources (host species)
Bees	Golden Northern Bumble Bee or Yellow Bumble Bee	*Bombus fervidus*	NL	NL	Yes	Yes	G5	Extensive surveys indicate a decline of unknown cause
Bees	American Bumble Bee	*Bombus pensylvanicus*	NL	NL	Yes	Yes	G3G4	Extensive surveys indicate a decline of unknown cause
Bees	Yellowbanded Bumble Bee	*Bombus terricola*	NL	NL	Yes	Yes	G3G4	Extensive surveys indicate a decline of unknown cause
Fish	Pirate Perch	*Aphredoderus sayanus*	SPC	NL	Yes	Possible	G5	Habitat degradation; highly localized/restricted distribution
Fish	Mississippi Silvery Minnow	*Hybognathus nuchalis*	SPC	NL	Yes	Possible	G5	Habitat fragmentation; depend on ecological process no longer within NRV; highly localized/restricted distribution
Fish	Warmouth	*Lepomis gulosus*	SPC	NL	Yes	Possible	G5	Habitat degradation; highly localized/restricted distribution
Fish	Pugnose Shiner	*Notropis anogenus*	THR	NL	Yes	Possible	G3	Habitat loss; habitat degradation
Fish	Weed Shiner	*Notropis texanus*	NL	NL	Yes	Possible	G5	Highly localized/restricted distribution
Fish	Pugnose Minnow	*Opsopoeodus emiliae*	NL	NL	Yes	Possible	G5	Habitat degradation; habitat fragmentation; populations in Minnesota stable but have declined or are declining in a substantial part of range

Insecta	Common Wood-Nymph	*Cercyonis pegala*	NL	NL	No	Yes	G5	
Insecta	Elm Sawfly	*Cimbex americana*	NL	NL	No	Yes	GNR	
Insecta	Racket-tailed Emerald	*Dorocordulia libera*	NL	NL	No	Yes	G5	
Insecta	Eastern Pondhawk	*Erythemis simplicicollis*	NL	NL	No	Yes	G5	
Insecta	Milkweed Tussock Moth	*Euchaetes egle*	NL	NL	No	Yes	G5	
Insecta	Silvery Blue	*Glaucopsyche lygdamus*	NL	NL	No	Yes	G5T5	
Insecta	Banded Tussock Moth	*Halysidota tessellaris*	NL	NL	No	Yes	G5	
Insecta	Asian Lady Beetle	*Harmonia axyridis*	NL	NL	No	Yes	GNR	
Insecta	Northern Pearly-eye	*Lethe anthedon*	NL	NL	No	Yes	G5	
Insecta	False Milkweed Bug	*Lygaeus turcicus*	NL	NL	No	Yes	GNR	
Insecta	Large Yellow Underwing	*Noctua pronuba*	NL	NL	No	Yes	GNR	
Insecta	Eastern Giant Swallowtail	*Papilio cresphontes*	NL	NL	No	Yes	G5	
Insecta	Eastern Tiger Swallowtail	*Papilio glaucus*	NL	NL	No	Yes	G5	
Insecta	Eastern Comma	*Polygonia comma*	NL	NL	No	Yes	G5	
Insecta	Japanese Beetle	*Popillia japonica*	NL	NL	No	Yes	GNR	
Insecta	Margined Calligrapher	*Toxomerus marginatus*	NL	NL	No	Yes	G5	
Jumping spiders	A Species Of Jumping Spider	*Habronattus calcaratus maddisoni*	SPC	NL	Yes	Possible	GNR	State listed; no additional criteria identified
Jumping spiders	A Species Of Jumping Spider	*Habronattus texanus*	SPC	NL	Yes	Possible	GNR	Rare, vulnerable/declining habitat; highly localized/restricted distribution
Jumping spiders	A Species Of Jumping Spider	*Habronattus viridipes*	SPC	NL	Yes	Possible	GNR	Rare, vulnerable/declining habitat; highly localized/restricted distribution
Jumping spiders	A Species Of Jumping Spider	*Marpissa formosa*	SPC	NL	Yes	Possible	GNR	Highly localized/restricted distribution
Jumping spiders	A Species Of Jumping Spider	*Paradamoetas fontana*	SPC	NL	Yes	Possible	GNR	Habitat loss; highly localized/restricted distribution
Jumping spiders	A Species Of Jumping Spider	*Pelegrina arizonensis*	SPC	NL	Yes	Possible	GNR	Rare, vulnerable/declining habitat; habitat degradation; need special resources (host species); depend on ecological process no longer within NRV; highly localized/restricted distribution

Jumping spiders	A Species Of Jumping Spider	*Phidippus apacheanus*	SPC	NL	Yes	Possible	GNR	Rare, vulnerable/declining habitat; habitat loss; habitat degradation; highly localized/restricted distribution
Jumping spiders	A Species Of Jumping Spider	*Phidippus pius*	SPC	NL	Yes	Possible	GNR	Rare, vulnerable/declining habitat; habitat loss; habitat degradation; highly localized/restricted distribution
Jumping spiders	A Species Of Jumping Spider	*Sassacus papenhoei*	SPC	NL	Yes	Possible	GNR	Rare, vulnerable/declining habitat; highly localized/restricted distribution
Jumping spiders	A Species Of Jumping Spider	*Tutelina formicaria*	THR	NL	Yes	Possible	GNR	Rare, vulnerable/declining habitat; need special resources (host species); highly localized/restricted distribution
Lepidoptera	Arogos Skipper	*Atrytone arogos iowa*	SPC	NL	Yes	Yes	G3T3	Rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation
Lepidoptera	Blazing Star Clear-Wing Moth	*Carmenta anthracipennis*	NL	NL	Yes	Possible	GNR	Rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; need special resources (host species)
Lepidoptera	Abbreviated Underwing	*Catocala abbreviatella*	SPC	NL	Yes	Possible	G4	Rare, vulnerable/declining habitat; habitat fragmentation; need special resources (host species)
Lepidoptera	Whitney's Underwing	*Catocala whitneyi*	SPC	NL	Yes	Yes	G3G4	Rare, vulnerable/declining habitat; need special resources (host species)
Lepidoptera	Mottled Dusky Wing	*Erynnis martialis*	NL	NL	Yes	Possible	G3	Rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; depend on large habitat; need special resources (host species); depend on ecological process no longer within NRV
Lepidoptera	Large Marble	*Euchloe ausonides*	NL	NL	Yes	Possible	G5	depend on large habitat; need special resources (host species, narrow thermal preferences); depend on ecological process no longer within NRV; highly localized/restricted distribution
Lepidoptera	Two-Spotted Skipper	*Euphyes binacula illinois*	NL	NL	Yes	Possible	GNR	Rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; depend on large habitat; need special resources (host species); depend on ecological process no longer within NRV
Lepidoptera	Leonard's Skipper	*Hesperia leonardus*	SPC	NL	Yes	Yes	G5	rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation
Lepidoptera	Ottoe Skipper	*Hesperia ottoe*	END	NL	Yes	Possible	G3G4	Rare, vulnerable/declining habitat; habitat degradation; need special resources (host species); depend on ecological process no longer within NRV; highly localized/restricted distribution
Lepidoptera	Nabokov's Blue	*Plebejus idas nabokovi*	SPC	NL	Yes	Possible	G5TU	Rare, vulnerable/declining habitat; habitat degradation; need special resources (host species); depend on ecological process no longer within NRV; highly localized/restricted distribution
Lepidoptera	Juanita Sphinx Moth	*Proserpina juanita*	NL	NL	Yes	Possible	GNR	Rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; depend on large

								habitat; need special resources (host species); depend on ecological process no longer within NRV
Lepidoptera	Leadplant Flower Moth	*Schinia lucens*	SPC	NL	Yes	Yes	GNR	Rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; need special resources (host species)
Lepidoptera	Regal Fritillary	*Speyeria idalia*	SPC	NL	Yes	Yes	G3	Rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; depend on large habitat; need special resources (host species); depend on ecological process no longer within NRV
Mammal	American Beaver	*Castor canadensis*	NL	NL	No	Yes	G5	
Mammal	Big Brown Bat	*Eptesicus fuscus*	SPC	NL	Yes	Yes	G5	Disease; need special resources (narrow thermal preferences); limited ability to recover (low reproductive rate); aggregate their populations
Mammal	Silver-Haired Bat	*Lasionycteris noctivagans*	NL	NL	Yes	Yes	G3G4	Habitat fragmentation; limited ability to recover (low reproductive rate)
Mammal	Red Bat	*Lasiurus borealis*	NL	NL	Yes	Yes	G3G4	Habitat fragmentation; limited ability to recover (low reproductive rate)
Mammal	Hoary Bat	*Lasiurus cinereus*	NL	NL	Yes	Yes	G3G4	Habitat fragmentation; limited ability to recover (low reproductive rate)
Mammal	White-Tailed Jack-Rabbit	*Lepus townsendii*	NL	NL	Yes	Possible	G5	Statistically valid decline documented; extensive surveys indicate a decline of unknown cause
Mammal	North American river otter	*Lontra canadensis*	NL	NL	No	Yes	G5	
Mammal	Groundhog	*Marmota monax*	NL	NL	No	Yes	G5	
Mammal	Striped Skunk	*Mephitis mephitis*	NL	NL	No	Yes	G5	
Mammal	Least Weasel	*Mustela nivalis*	SPC	NL	Yes	Possible	G5	Highly localized/restricted distribution
Mammal	Little Brown Myotis	*Myotis lucifugus*	SPC	NL	Yes	Yes	G3	Disease; need special resources (narrow thermal preferences); limited ability to recover (low reproductive rate); aggregate their populations
Mammal	Northern Long-Eared Bat	*Myotis septentrionalis*	SPC	THR	Yes	Yes	G1G2	Disease; need special resources (narrow thermal preferences); limited ability to recover (low reproductive rate); aggregate their populations
Mammal	Tri-Colored Bat	*Perimyotis subflavus*	SPC	NL	Yes	Yes	G2G3	Disease; need special resources (narrow thermal preferences); limited ability to recover (low reproductive rate); aggregate their populations
Mammal	Plains Pocket Mouse	*Perognathus flavescens*	SPC	NL	Yes	Yes	G5	Highly localized/restricted distribution
Mammal	Franklin's Ground Squirrel	*Poliocitellus franklinii*	NL	NL	Yes	Yes	G5	Populations in Minnesota stable, but have declined or are declining in a substantial part of range

Mammal	Western Harvest Mouse	*Reithrodontomys megalotis*	SPC	NL	Yes	Yes	G5	State listed; no additional criteria identified
Mammal	Thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*	NL	NL	No	Yes	G5	
Mammal	American Badger	*Taxidea taxus*	NL	NL	Yes	Yes	G5	Habitat loss; habitat fragmentation
Mammal	Red Fox	*Vulpes vulpes*	NL	NL	No	Yes	G5	
Mussels	Mucket	*Actinonaias ligamentina*	THR	NL	Yes	Possible	G5	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants
Mussels	Elktoe	*Alasmidonta marginata*	THR	NL	Yes	Possible	G4	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; need special resources (host species); highly localized/restricted distribution
Mussels	Rock Pocketbook	*Arcidens confragosus*	END	NL	Yes	Possible	G4	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants
Mussels	Spectaclecase	*Cumberlandia mono-donta*	END	END	Yes	Possible	G3	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; limited ability to recover (low dispersal ability); highly localized/restricted distribution; aggregate their populations; Minnesota population represents significant portion of their North American breeding or wintering population
Mussels	Purple Wartyback	*Cyclonaias tuberculata*	END	NL	Yes	Possible	G5	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; need special resources (host species)
Mussels	Butterfly	*Ellipsaria lineolata*	THR	NL	Yes	Possible	G4G5	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; need special resources (host species)
Mussels	Elephant-Ear	*Elliptio crassidens*	END	NL	Yes	Possible	G5	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; need special resources (host species)
Mussels	Spike	*Elliptio dilatata*	THR	NL	Yes	Possible	G5	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants
Mussels	Snuffbox	*Epioblasma triquetra*	END	END	Yes	Possible	G3	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; need special resources (host species); Minnesota population represents significant portion of their North American breeding or wintering population

Mussels	Higgins Eye	*Lampsilis higginsii*	END	END	Yes	Possible	G1G2	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants
Mussels	Yellow Sandshell	*Lampsilis teres*	END	NL	Yes	Possible	G5	Statistically valid decline documented; invasive species; contaminants; need special resources (host species); extensive surveys indicate a decline of unknown cause
Mussels	Creek Heelsplitter	*Lasmigona compressa*	SPC	NL	Yes	Possible	G5	Habitat degradation; contaminants
Mussels	Fluted-Shell	*Lasmigona costata*	THR	NL	Yes	Possible	G5	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants
Mussels	Black Sandshell	*Ligumia recta*	SPC	NL	Yes	Possible	G4G5	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants
Mussels	Washboard	*Megalonaias nervosa*	END	NL	Yes	Possible	G5	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; over-exploitation; invasive species; contaminants
Mussels	Hickorynut	*Obovaria olivaria*	NL	NL	Yes	Possible	G4	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; need special resources (host species)
Mussels	Sheepnose	*Plethobasus cyphyus*	END	END	Yes	Possible	G3	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants
Mussels	Round Pigtoe	*Pleurobema sintoxia*	SPC	NL	Yes	Possible	G4G5	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants
Mussels	Winged Mapleleaf	*Quadrula fragosa*	END	END	Yes	Possible	G1	Statistically valid decline documented; Habitat loss; Habitat degradation; Habitat fragmentation; Invasive species; Contaminants; Need special resources (host species); MN population represents significant portion of their N. Am. breeding or wintering pop.
Mussels	Monkeyface	*Quadrula metanevra*	THR	NL	Yes	Possible	G4	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants
Mussels	Wartyback	*Quadrula nodulata*	THR	NL	Yes	Possible	G4	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; Minnesota population represents significant portion of their North American breeding or wintering population
Mussels	Salamander Mussel	*Simpsonaias ambigua*	END	NL	Yes	Possible	G3	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; need special resources (host species); limited

								ability to recover (low dispersal ability); highly localized/restricted distribution; highly localized/restricted distribution; aggregate their populations
Mussels	Pistolgrip	*Tritogonia verrucosa*	END	NL	Yes	Possible	G4G5	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; need special resources (host species)
Mussels	Fawnsfoot	*Truncilla donaciformis*	THR	NL	Yes	Possible	G5	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; need special resources (host species); extensive surveys indicate a decline of unknown cause
Mussels	Ellipse	*Venustaconcha ellipsiformis*	THR	NL	Yes	Possible	G4	Statistically valid decline documented; habitat loss; habitat degradation; habitat fragmentation; invasive species; contaminants; limited ability to recover (low dispersal ability)
Odonata	Blue-Eyed Darner	*Rhionaeschna multicolor*	NL	NL	Yes	Possible	G5	Habitat loss
Odonata	Plains Emerald	*Somatochlora ensigera*	NL	NL	Yes	Possible	G4	Habitat loss; habitat degradation
Odonata	Brush-Tipped Em-Erald	*Somatochlora walshii*	NL	NL	Yes	Possible	G5	Rare, vulnerable/declining habitat; need special resources (narrow thermal preferences)
Odonata	Zebra Clubtail	*Stylurus scudderi*	NL	NL	Yes	Possible	G5	Habitat degradation
Reptile	North American Racer	*Coluber constrictor*	SPC	NL	Yes	Possible	G5	Rare, vulnerable/declining habitat; habitat loss; highly localized/restricted distribution; aggregate their populations
Reptile	Northern Ring-Necked Snake	*Diadophis punctatus edwardsii (*northern subspecies)	NL	NL	Yes	Possible	G5T5	Highly localized/restricted distribution
Reptile	Wood Turtle	*Glyptemys insculpta*	THR	NL	Yes	Yes	G3	Statistically valid decline documented; rare, vul-nerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; requires large home ranges/multiple habitats; depend on large habitat; limited ability to recover (low reproductive rate); aggregate their populations
Reptile	Plains Hog-Nosed Snake	*Heterodon nasicus*	SPC	NL	Yes	Yes	G5	Rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; overexploitation
Reptile	Eastern Hog-Nosed Snake	*Heterodon platirhinos*	NL	NL	Yes	Yes	G5	Rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation
Reptile	Gophersnake	*Pituophis catenifer*	SPC	NL	Yes	Yes	G5	Rare, vulnerable/declining habitat; habitat loss; habitat degradation; habitat fragmentation; overexploitation; deliberate killing; requires large home ranges/multiple habitats; depend on large habitat
Reptile	Brown Snake	*Storeria dekayi*	NL	NL	No	Yes	G5	
Reptile	Plains Garter Snake	*Thamnophis radix*	NL	NL	No	Yes	G5	

KEY:

NL	**Not Listed**
SPC	**Special Concern**
THR	**Threatened**
END	**Endangered**

For the Expected Species list, species were taken from the MN DNR SGCN List and then cross referenced with the Rare Features Database to check if they have been located in Dakota County. If they had, but were not on the Confirmed Species list, their habitat preference was checked to see whether or not it could be present in Lebanon Hills. Some common species were also added to this list because the county does not have official records, but are sure to be seen in the park.

SGCN Criteria was taken from DNR Species of Greatest Conservation Need list

10.3. Appendix C. Acceptable Source Origin of Native Seed for LHRP

Native seed source origin should be from within circle shown below. Some allowance may be made to accommodate facilitation of more southerly species into the county to respond to climate change.

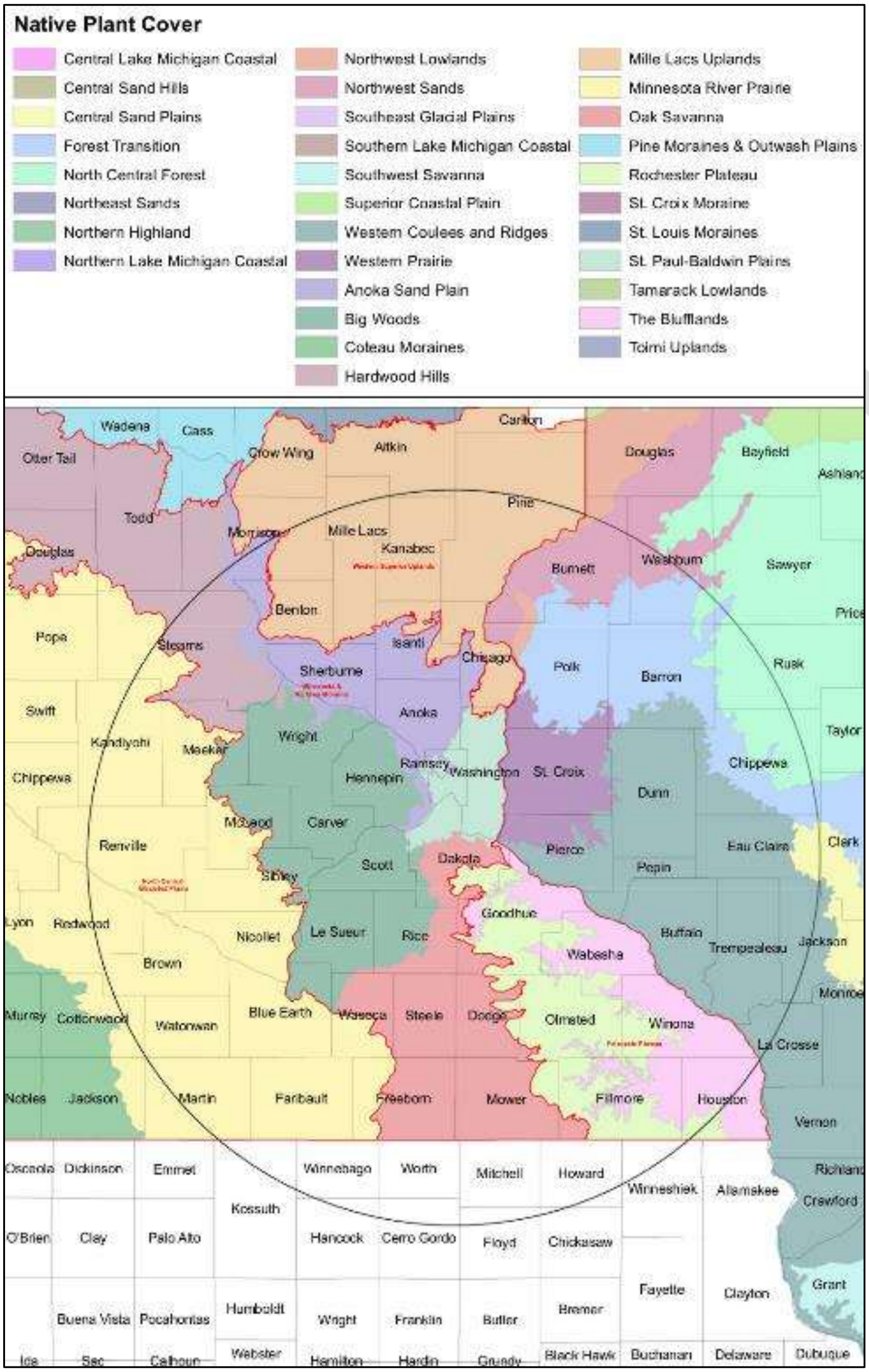


Figure C1. *Zone of acceptance for native seed origin for plantings within County parks.*

10.4. Appendix D. Summary of MN RAM Wetland Function and Value Ratings for LHRP Wetlands

Table D-1 - Wetland Survey Summary

Table D-2. *Functional Assessment Summary*

NAME	Hydro Geomorphology	Hydro-logic Regime	Flood Storm-water Attenuat-ion	Down-stream Water Quality Protectio n	Wetland Water Quality	Shore-line Protect-ion	Wildlife Habitat Structure	Fish Habitat	Amph-ibian Habitat	Aesthetics Recreation Education Cultural	Ground Water Interact-ion	Resto-ration Potent -ial	Sensitivity to Storm-water & Urban Develop-ment	Additional Stormwater Needs
LHRP-1	Depressional/Isolate d (no discernable inlets or outlets)	High	Moderate	High	High	NA	Moderate	NA	NA	Exceptional	Recharge	NA	Exceptional	High
LHRP-2	Depressional/Isolate d (no discernable inlets or outlets)	High	Moderate	High	High	NA	Moderate	NA	High	Exceptional	Recharge	NA	Exceptional	High
LHRP-3	Depressional/Isolate d (no discernable inlets or outlets)	High	Moderate	High	High	NA	High	NA	NA	Exceptional	Recharge	NA	Exceptional	NA
LHRP-4	Depressional/Isolate d (no discernable inlets or outlets)	High	Moderate	High	High	NA	High	NA	NA	Exceptional	Recharge	NA	Exceptional	High
LHRP-5	Depressional/Tributa ry (outlet but no perennial inlet or drainage entering from upstream subwatershed)	High	Moderate	High	High	NA	High	High	High	Exceptional	Combinat-ion Discharge, Recharge	NA	Moderate	High
LHRP-6	Depressional/Isolate d (no discernable inlets or outlets)	High	Moderate	Moderate	Exception al	Low	Exceptiona l	High	High	Exceptional	Combinat-ion Discharge, Recharge	NA	Moderate	Exceptional
LHRP-7	Depressional/Isolate d (no discernable inlets or outlets)	High	High	Moderate	High	NA	High	High	High	Exceptional	Combinat-ion Discharge, Recharge	NA	Moderate	High

NAME	Hydro Geomorphology	Hydro-logic Regime	Flood Storm-water Attenuat-ion	Down-stream Water Quality Protectio n	Wetland Water Quality	Shore-line Protect-ion	Wildlife Habitat Structure	Fish Habitat	Amph-ibian Habitat	Aesthetics Recreation Education Cultural	Ground Water Interact-ion	Resto-ration Potent -ial	Sensitivity to Storm-water & Urban Develop-ment	Additional Stormwater Needs
LHRP-8	Depressional/Isolate d (no discernable inlets or outlets)	High	Moderate	High	High	NA	Moderate	High	High	Exceptional	Combinat-ion Discharge, Recharge	NA	Moderate	High
LHRP-9	Depressional/Isolate d (no discernable inlets or outlets)	High	Moderate	High	High	NA	High	High	High	Exceptional	Combinat-ion Discharge, Recharge	NA	Moderate	High
LHRP-10	Depressional/Isolate d (no discernable inlets or outlets)	High	Moderate	High	Moderate	NA	High	Moderat e	High	Exceptional	Combinat-ion Discharge, Recharge	NA	Moderate	Moderate
LHRP-15	Depressional/Tributa ry (outlet but no perennial inlet or drainage entering from upstream subwatershed)	High	Moderate	Moderate	High	NA	High	High	High	Exceptional	Combinat-ion Discharge, Recharge	NA	Exceptional	High
LHRP-13	Depressional/Isolate d (no discernable inlets or outlets)	High	Moderate	High	High	NA	High	NA	High	Exceptional	Recharge	NA	Exceptional	High
LHRP-14	Depressional/Isolate d (no discernable inlets or outlets)	High	Moderate	High	High	NA	High	High	High	Exceptional	Recharge	NA	Moderate	High
LHRP-12	Depressional/Flow-through (apparent inlet and outlet),	High	High	High	High	NA	Exceptiona l	NA	High	Exceptional	Discharge	NA	High	High
LHRP-11	Depressional/Isolate d (no discernable inlets or outlets)	High	Moderate	High	High	NA	High	High	High	Exceptional	Combinat-ion Discharge, Recharge	NA	Moderate	High
LHRP-16	Depressional/Isolate d (no discernable inlets or outlets)	High	Moderate	High	Moderate	Not Applica ble	Moderate	Moderat e	High	Exceptional	Combinat-ion Discharge, Recharge	NA	Moderate	Moderate
LHRP-17	Depressional/Tributa ry (outlet but no perennial inlet or drainage entering	High	Moderate	Moderate	High	NA	High	NA	High	Exceptional	Combinat-ion Discharge, Recharge	NA	Exceptional	High

NAME	Hydro Geomorphology	Hydro-logic Regime	Flood Storm-water Attenuat-ion	Down-stream Water Quality Protectio n	Wetland Water Quality	Shore-line Protect-ion	Wildlife Habitat Structure	Fish Habitat	Amph-ibian Habitat	Aesthetics Recreation Education Cultural	Ground Water Interact-ion	Resto-ration Potent -ial	Sensitivity to Storm-water & Urban Develop-ment	Additional Stormwater Needs
	from upstream subwatershed)													
LHRP-18	Depressional/Isolated (no discernable inlets or outlets)	High	Moderate	High	Moderate	NA	High	NA	High	Exceptional	Recharge	NA	Moderate	Moderate
LHRP-19	Depressional/Isolated (no discernable inlets or outlets)	High	High	Moderate	Moderate	NA	Moderate	Moderate	Moderate	Exceptional	Recharge	NA	Moderate	Moderate
LHRP-20	Depressional/Isolated (no discernable inlets or outlets)	High	Moderate	Moderate	Moderate	NA	Moderate	Moderate	Moderate	Exceptional	Recharge	NA	Moderate	Moderate
LHRP-21	Depressional/Isolated (no discernable inlets or outlets)	High	Moderate	High	Moderate	NA	Moderate	Moderate	High	Exceptional	Combinat-ion Discharge, Recharge	NA	Moderate	Moderate
LHRP-22	Depressional/Isolated (no discernable inlets or outlets)	High	Moderate	High	Moderate	NA	Moderate	High	High	Exceptional	Combinat-ion Discharge, Recharge	NA	Moderate	Moderate
LHRP-23	Depressional/Tributary (outlet but no perennial inlet or drainage entering from upstream subwatershed)	High	Moderate	Moderate	High	NA	High	High	High	Exceptional	Combinat-ion Discharge, Recharge	NA	Exceptional	High
LHRP-24	Depressional/Flow-through (apparent inlet and outlet),	High	Moderate	High	Moderate	NA	High	High	Moderate	Exceptional	Combinat-ion Discharge, Recharge	NA	Moderate	Moderate
LHRP-25	Depressional/Isolated (no discernable inlets or outlets)	High	Moderate	High	High	NA	Moderate	High	High	Exceptional	Combinat-ion Discharge, Recharge	NA	Moderate	High
LHRP-26	Depressional/Isolated (no discernable inlets or outlets)	High	Moderate	High	Moderate	NA	Moderate	Moderate	High	Exceptional	Combinat-ion Discharge, Recharge	NA	Moderate	Moderate

NAME	Hydro Geomorphology	Hydro-logic Regime	Flood Storm-water Attenuat-ion	Down-stream Water Quality Protectio n	Wetland Water Quality	Shore-line Protect-ion	Wildlife Habitat Structure	Fish Habitat	Amph-ibian Habitat	Aesthetics Recreation Education Cultural	Ground Water Interact-ion	Resto-ration Potent -ial	Sensitivity to Storm-water & Urban Develop-ment	Additional Stormwater Needs
LHRP-27	Depressional/Flow-through (apparent inlet and outlet),	High	Moderate	Moderate	Moderate	NA	Moderate	High	Moderat e	Exceptional	Combinat-ion Discharge, Recharge	NA	Moderate	Moderate
LHRP-28	Depressional/Isolate d (no discernable inlets or outlets)	High	Moderate	High	Moderate	NA	Moderate	Moderat e	High	Exceptional	Combinat-ion Discharge, Recharge	NA	Moderate	Moderate
LHRP-29	Depressional/Flow-through (apparent inlet and outlet),	High	Moderate	Moderate	Moderate	NA	Moderate	Moderat e	High	Exceptional	Combinat-ion Discharge, Recharge	NA	Moderate	Moderate
LHRP-30	Depressional/Isolate d (no discernable inlets or outlets)	High	Moderate	Moderate	Moderate	NA	High	NA	NA	Exceptional	Combinat-ion Discharge, Recharge	NA	High	Moderate
LHRP-31	Depressional/Isolate d (no discernable inlets or outlets)	High	High	High	Moderate	NA	Moderate	NA	High	Exceptional	Combinat-ion Discharge, Recharge	NA	Exceptional	Moderate
LHRP-32	Depressional/Isolate d (no discernable inlets or outlets)	High	Moderate	Moderate	Moderate	NA	High	NA	High	Exceptional	Combinat-ion Discharge, Recharge	NA	Moderate	Moderate

10.5. Appendix E. Fish Survey 2018 Results

Wenck Associates was contracted by Dakota County (the County) to perform shallow lake fisheries assessments on Schulze and McDonough Lakes within Lebanon Hills Regional Park, Eagan, Minnesota. Survey efforts were conducted on September 5th and concluded on September 7th, 2018. In addition to conducting the fisheries assessment, Wenck staff demonstrated and trained Dakota County staff on the nets and techniques to perform shallow lake fisheries assessments.

Methods

Fish communities are sampled using various techniques and equipment to target specific aspects of the fish community. Mini-fyke net and gill net assessments are typically implemented on shallow lake ecosystems (max depth < 15 feet) using net dimensions and sampling techniques described in Herwig *et al.* 2010. Mini-fyke nets contain a lead net perpendicular to shore with a series of hoops and funnels at the end of the net that direct and entrap fish. The gill net catches fish via gill entanglement consist of multi-sized mesh panels.

For these assessments, three mini-fyke nets and one gill net were set on McDonough Lake (9/5-9/6) and Schulze Lake (9/6-9/7) to tangle/entrap fish over a 12-24 hour period. Mini-fyke nets contain a lead net perpendicular to shore with a series of hoops and funnels at the end of the net that direct and entrap fish. The gill net catches fish via gill entanglement and consist of multi-sized mesh panels. The gill nets are typically set along the deepest oxic contour within the basin (Figure 1). All fish captured in the nets were identified, sorted and weighed for total biomass.

Figure E1. *Deployed mini-fyke net (left) and deployment of a gill net (right).*

Results

McDonough Lake

Nets were set in McDonough Lake (Figure 1) the morning of September 5th and revisited the morning of September 6th.

Figure E2: *Net locations on McDonough Lake, September 2018.*

Green sunfish dominated the catch in McDonough with an estimated count of nearly 40,000 individuals captured in the three mini-fyke nets (Figure 2). No piscivorous species (i.e. northern pike, largemouth bass) were captured in the nets. The fish community was also comprised of moderately (green sunfish, hybrid sunfish) to highly tolerant species (black bullhead); (Table 1). Very few fish were observed at a size that is typically pursued by recreational fisherman, suggesting that recreational fishing opportunities are limited on McDonough.

Table E1: *McDonough Lake net catch summary reported as pounds per species.*

	McDonough				
Species	**Mini-fyke 1**	**Mini-fyke 2**	**Mini-fyke 3**	**Gill Net 1**	**Total**
Black Bullhead	12.3	1.2	0.8	0.6	14.9
Bluegill	0.8	0.6	0.6	0.0	2.0
Green Sunfish	15.0	112.4	4.4	--	131.8
Golden Shiner	0.0	0.3	0.1	--	0.4
Hybrid Sunfish	0.2	0.3	0.2	--	0.7
Pumpkinseed Sunfish	0.1	--	--	--	0.1

Schulze Lake

Nets were set in Schulze Lake (Figure 2) the afternoon of September 6th and revisited the morning of September 7th.

Figure E3: *Net locations on Schulze Lake, September 2018.*

Similar to McDonough Lake, green sunfish dominated the catch in Schulze Lake and no piscivorous species were captured in the nets. The fish community was comprised of moderately (green sunfish, hybrid sunfish) to highly tolerant species (fathead minnow, black bullhead); (Table 2). Very few fish were observed at a size that is typically pursued by recreational fisherman.

Table E2: *Schulze Lake net catch summary reported as pounds per species.*

	Schulze				
Species	Mini-fyke 1	Mini-fyke 2	Mini-fyke 3	Gill Net 1	Total
Black Bullhead	1.4	0.8	--	0.1	2.4
Bluegill	1.6	1.0	1.3	--	3.9
Fathead Minnow	--	0.0	0.1	--	0.2

Green Sunfish	7.7	7.1	4.1	0.9	19.8
Golden Shiner	0.0	0.1	1.2	--	1.3
Hybrid Sunfish	0.7	1.4	1.0	--	3.2
Pumpkinseed Sunfish	0.8	0.1	0.8	--	1.7

Discussion

Monodominant fish communities and/or imbalanced fish communities in shallow lakes can lead to water quality impairments and habitat degradation. Monodominant and imbalanced community structures typically have an overabundance of planktivore/benthivore/omnivore specie(s) (i.e. green sunfish/ black bullhead/ fathead minnow). An overabundance of this trophic guild can directly or indirectly suppress the zooplankton and in particular, large bodied zooplankton (i.e. Daphnia); (Figure 3). The large bodied zooplankton are exceptional filter feeders and can consume phytoplankton from the water column and help keep shallow lakes in a clear water state. Without healthy populations of zooplankton, phytoplankton levels (measured by chlorophyll-a) can increase and lead to a turbid water state. The turbid water state will likely persist until a shift in the community occurs to a more balanced fishery or a system with no fish.

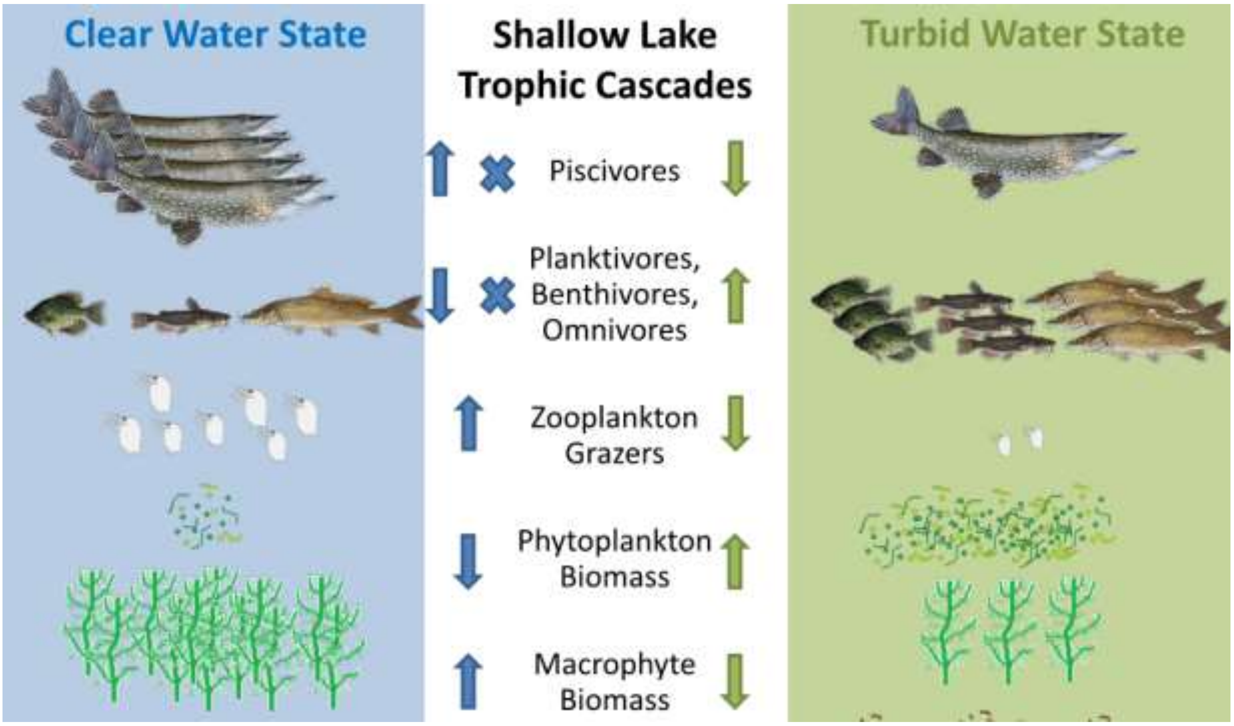


Figure E4. *Shallow lake trophic cascade schematic with relative abundance depicted by the number of fish in each trophic guild or by arrows next to the trophic guild.*

The fish community in McDonough Lake was dominated by a large population of young-of-year (age 0-1) green sunfish. Though other fish species were observed, the over-abundance of green sunfish is concerning for water quality due to foraging on zooplankton and the release of phytoplankton from predation. Green sunfish themselves are not a species of direct concern for water quality (such as common carp, which can uproot vegetation), rather, it is their over-abundance that can indirectly contribute to water quality impairments. Additionally, no piscivore species were observed within McDonough which indicates green sunfish either have no predators within the lake or the abundance of predators is so small their ability to control the green sunfish populations is non-existent.

Schulze Lake has similar species as McDonough without as large of a green sunfish population. Schulze Lake also lacked any large piscivorous species (i.e. northern pike, largemouth bass) that may help reduce the foraging pressures of the planktivore/benthivore/omnivore species.

Both systems appear to be highly productive shallow lake ecosystems that may face difficultly in establishing and sustaining balanced fisheries with piscivorous species. Upon retrieval of the mini-fyke nets in McDonough, nearly all the sunfishes were dead, suggesting a possible depletion in dissolved oxygen in the over evening hours.

The mini-fyke nets were placed within large stands of coontail and lily pads and it is likely that dissolved oxygen levels within these areas became depleted overnight while the lake was respiring. Once the fish were captured in the nets, they were unable to escape to deeper more oxygenated waters. All the black bullheads captured in the same nets survived which, while interesting, is not surprising since they are a more stress tolerant species compared to green sunfish. These results suggest that dissolved oxygen may be a limiting factor for some fish species and sustained recruitment of piscivorous fish within McDonough Lake may be difficult without further management intervention (i.e. continuous aeration).

We did not observe any fish mortality in Schulze Lake. Schulze Lake is deeper compared to McDonough Lake and had a much smaller abundance of littoral vegetation; however, it is possible that the deeper areas of the lake were anoxic (i.e. oxygen levels <2.0 mg/L). If this area of the lake is anoxic it may create a stressful environment for all fish species. A non-direct fisheries concern to anoxia in a lake is the release of nutrients from benthic sediments that can lead to algae blooms and water quality concerns.

Recommendations

- Develop a sampling plan to gain more insight to the boom-bust nature of the fisheries in Schulze and McDonough Lakes and to better inform fisheries management plans.
- Develop fisheries management plans for each lake that align with the goals, objectives, and action items set forth in the Lebanon Hills Regional Park Masterplan, Lebanon Hills Natural Resource Management Plan, Lebanon Hills Regional Park Subwatershed Assessment Report, and staff interest.
- Schulze had observed populations of Eurasian watermilfoil, while McDonough did not. Efforts to inform public and ensure this species is not moved into non-infested waters is critical.
- Optional: Sample the zooplankton community in each lake conjunction with routine water quality monitoring efforts to determine the presence and abundance of large bodied zooplankton (i.e. Daphnia).

References

Hanson, M.A., Herwig, B.R., Zimmer, K.D., and N. Hansel-Welch. 2016. Rehabilitation of shallow lakes: time to adjust expectations? Hydrobiologia DOI 10.1007/s10750-016-2865-9.

Herwig, B.R., Zimmer, K.D., Hanson, M.A., Konsti, M.L., Younk, J.A., Wright, R.W., Vaughn, S.R., and M.D. Haustein. 2010. Factors influencing fish distribution in shallow lakes in prairie and prairie-parkland regions of Minnesota, USA. Wetlands 30: 609-619.

Zimmer, K.D., Hanson, M.A., Herwig, B.R., and M.L. Konsti. 2009. Threshold and stability of alternative regimes in shallow prairie-parkland lakes of Central North America. Ecosystems 12: 843-852.

Photos

Photo 1*: Sorted 1-gallon bucket full of green sunfish on McDonough Lake.*

Photo 2: *Sorted caulderon of black bullhead on McDonough Lake.*

Photo 3: *Golden shiner observed in McDonough Lake.*

Photo 4: *Sorted bluegill sunfish on McDonough Lake.*

Photo 5: *Hybrid sunfish observed on McDonough Lake.*

Photo 6: *Retrieving a mini-fyke net from Schulze Lake.*

Photo 7: *Sunfish species (Left to right): Bluegill, Pumpkinseed, Green sunfishes.*

Photo 8: Fathead minnows observed on Schulze Lake.

10.6. Appendix F. Herptile Survey Protocol

Lebanon Hills Herpetological Survey Plan

Dakota County, Minnesota

December 19, 2018

Prepared for:

Lebanon Hills Regional Park
860 Cliff Road
Eagan, MN 55123Lebanon Hills Regional Park
860 Cliff Road
Eagan, MN 55123Lebanon Hills Regional Park
860 Cliff Road
Eagan, MN 55123

Prepared by:

Herpetological Survey Plan

Herpetology is the study of amphibians (e.g., frogs, toads, salamanders, newts) and reptiles (e.g., snakes, lizards, turtles, tortoises). Amphibians and reptiles are important components of ecosystems and provide numerous ecosystem services. Recently, decreases in herpetological diversity and a growing list of declining populations suggest a worldwide crisis (Blaustein et al. 1994). Amphibians and reptiles are experiencing significant population declines in North America, with habitat loss and fragmentation the largest threats to both groups. Efforts to collect baseline data about occurrence, distribution, and status of populations are relatively well advanced for amphibians; however, less information is known about reptiles, for which recent data suggests are as threatened as frogs and toads (Gibbons et al. 2000). Important habitat for amphibians and reptiles rarely receives sufficient attention from conservation agencies and nonprofit organizations (Sutherland and deMaynadier 2012).

In Minnesota, over 50 species of reptiles and amphibians can be found, including 22 species of frogs, toads, and salamanders, 17 species of snakes, 11 species of turtles, and 3 lizard species. However, many amphibian and reptile species are experiencing population declines due to habitat loss and habitat fragmentation throughout the state. This survey plan outlines several protocols for assessing reptile and amphibian populations at Lebanon Hills Regional Park in Dakota County, Minnesota.

Purpose/Objectives

The purpose of the survey is to complete a baseline herpetological survey of reptiles and amphibians at Lebanon Hills Regional Park with the following objectives:

1. Conduct amphibian and reptile presence/absence surveys at Lebanon Hills Regional Park;

2. Determine amphibian and reptile species richness within Lebanon Hills Regional Park;

3. Determine relative abundance of amphibian and reptile species to serve as a baseline to aid in determining long term population trends; and,

4. Provide natural resource management recommendations to aid in future updates of the Natural Resources Management Plan for Lebanon Hills Regional Park.

Survey Protocols

Visual Encounter Survey Protocols

Road Survey

Major roads and transportation arteries near the park may see increased use as rural development continues and populations near the park rise. Roads and highways fragment habitat and can lead to high wildlife mortality rates for species that traverse short or long distances across the landscape. Reptiles and amphibians are especially vulnerable to road mortality due to their movement between various habitats and preference to sun themselves on warm surfaces, such as roads. The road surveys will be completed to document mortality occurrences at and near the park.

Equipment

- Clipboards
- Datasheets
- Maps and survey route locations
- Vehicle with strobe
- High-visibility safety vests
- Shovel
- GPS or iPad
- Herpetofauna identification guides

Methods

Surveys will consist of driving the length of the predetermined routes to observe road mortalities. For safety purposes, this must be completed with two people. One person will drive, and the other person will observe and record. The driver will start at the beginning of the road and drive the designated survey route while the observer will record any instances of road mortality. Some roads may have high traffic volume, thus requiring the surveyors to drive in both directions to adequately and safely observe all mortalities. Some high mortality areas between lakes and wetlands that have been identified in previous surveys will be walked in order to obtain more in-depth data.

When a mortality is found, the observer will instruct the driver to stop and pull over at a safe point to identify the species and collect data. This will be repeated until the team has completed the designated route. Any instances of live and/or injured amphibians or reptiles should be recorded. Live individuals found basking or crossing the road should be safely moved from the road. The animal should be moved to the side of the road in the direction in which it was facing. Each instance of road mortality should be recorded on the datasheet (see Attachment A), including the specific location. If safe to do so, the carcass should be photographed, removed from the road, and discarded in the adjacent vegetation. In some cases, terrain surrounding the road may require one person to act as a spotter as roadkill is inspected and removed from the road. It is mandatory to wear high visibility vests and drive a vehicle with a strobe during this survey. If walking along the road is necessary, observers should walk against traffic.

Road surveys should be completed once per week from April 1 – September 30 (30 total surveys). Start and end dates may need to be adjusted according to weather conditions, as spring emergence and fall torpor/hibernation timing are weather dependent. Weather conditions during the survey events should not be a limiting factor, unless heavy rain or fog cause dangerous work conditions.

Generally, surveys should be completed near the end of rush hour traffic times to ensure safety and to avoid missing any road mortalities. Snakes are most active near roadways in the early morning or in the evening, while basking on roads and shoulders. Frogs and toads are most active after sunset.

Visual Encounter Meander Searches

Visual encounter meander searches (VES) are time-constrained methods in which surveyors sample for species richness and abundance within a survey area. VES surveys take into account the time that is spent surveying and the number of surveyors. They can be used for both inventory and monitoring of amphibians and reptiles and are particularly useful for detecting rare species that seldom can be trapped. Using a combination of VES with other surveying techniques can produce more thorough species compositions within the sampled area.

Equipment

- Clipboard
- Datasheets
- Thermometer
- Binoculars
- Maps and survey locations
- GPS/iPad
- Camera
- Snake hook
- Dip net
- Herpetofauna identification guides

Methods

VES simply consist of one or more observers randomly or systematically walking around the survey site looking for amphibians and reptiles. Each sampling site should be surveyed for a total of four person-hours per site visit, which may be broken up between multiple observers (e.g., 2 hours with 2 observers). Searches within the survey area should focus on locations with the best amphibian and reptile habitat characteristics (i.e., those areas most likely to yield amphibian and reptile observations). For example, areas with numerous rocks and logs should be searched before searching areas without this type of habitat. Searching should include flipping rocks and logs to identify and record individuals in the area. Care must be taken to move rocks and logs back to their original position to minimize disturbance. Wetlands may be waded at a reasonable depth (up to 0.5 meter [20 inches]) to search for amphibian egg masses, larvae, and amplexed (i.e., mating) frogs and toads. Long-handled dipnets may be used, when necessary.

In order to identify suitable habitat (e.g., wetlands, ponds, lakes, large streams) for visual (i.e., basking) turtle surveys, Google Earth, National Wetlands Inventory (NWI) data, park maps, other GIS data layers, or locations of known records may be used. Permanent circular survey plots (400-meter [0.25 mile] radius), centered on or immediately adjacent to suitable turtle habitat should be established. Prior to conducting the survey, visit the survey plot to make sure the location is accessible and to identify areas for additional trapping surveys. Visual assessments should last 10 minutes within each survey plot, and all turtles observed within the plot should be recorded, as well as any habitat characteristics and weather conditions at the time of the survey (see Attachment A). Binoculars should be used to scan basking sites, the water surface, and the shore, followed by scanning the water for any swimming turtles or individuals resurfacing after the surveyor's initial arrival. The number of basking turtles should be recounted at the end of the 10-minute survey period. Dakota County has previously used volunteers to conduct these surveys and will continue to utilize them in the future.

Coverboard Survey Protocol

The use of coverboards for reptile and amphibian surveys is an efficient survey method for assessing the presence of species at a site. The coverboard provides favorable habitat conditions for reptiles and amphibians, thus allowing them to congregate in one area and be surveyed.

Equipment

- Plywood (3' x 4' x 1/2") or corrugated sheet metal
- Weed whip
- Datasheets
- Camera
- Scale
- Measuring tape
- Snake hook
- Herpetofauna identification guides
- Clipboard with pencils
- Thermometer
- Gloves

Methods

Vegetation should be trimmed at each cover board location using a weed whip to expose the ground surface, allowing the board to lay flat on the ground with minimal debris underneath. Boards should be placed randomly around the study site in suitable habitat and should be labeled with Dakota County Parks Survey and permit numbers if applicable. The best time to place coverboards is early spring after snow melt; ideally the coverboards should be left in place for multiple seasons.

To check the coverboards, lift the board, observe if any species are present, and if necessary capture the individual for identification. Any animals handled should be released at the capture site. Observations should be recorded on the datasheet found in Attachment A. Take photos and make note of any unique markings to aid in identification of the individual. See Section 1.5 for assistance in identifying the sex of reptiles and amphibians. If no animals are present, return the coverboard to its original placement and return again another day. Complete a datasheet for all visits regardless of whether any amphibians or reptiles are found during the survey event.

Frog & Toad Call Survey Protocol

Auditory surveys are useful tools for estimating anuran (i.e., frog and toad) species richness and relative abundance. Males tend to be conspicuous during the breeding season when they utilize mating calls to attract females, and calls are species-specific. During the breeding season, listening stations can be randomly or selectively assigned along a breeding site (e.g., wetland, stream, lake) to identify species presence and determine their relative abundance. Auditory surveys are a non-invasive way to sample a large area.

Equipment

- Clipboard
- Datasheets
- Audio recorder
- Camera
- Thermometer
- GPS/iPad
- Map and survey locations

Methods

Auditory surveys should follow the North American Amphibian Monitoring Program (NAAMP) protocol (https://www.usgs.gov/centers/pwrc/science/north-american-amphibian-monitoring-program). Following this protocol standardizes surveys and allows for comparison between surveys. The surveyor shall establish frog call point count locations throughout the park, located approximately 0.25 mile (400 meters) apart when possible. Locations should be chosen near potential breeding wetlands. The amphibian calling index is ranked on a scale of 1 through 3. A ranking of 1 is for calls where individuals can be counted (space between calls). A ranking of 2 is for calls where individuals can still be distinguished, but there is some overlapping of calls. A ranking of 3 is for a full chorus of calls, where the calls are constant, continuous, and overlapping. All calls should be ranked, and the ranking recorded on the datasheet (see Appendix A).

Surveys shall be conducted three times at each survey location, utilizing the air temperature criteria of the 3-run system for NAAMP surveys. Survey 1 should be conducted between April 15th–April 30th when the air temperature is at a minimum of 50°F (10°C), Survey 2 conducted between May 20th–June 5th at a minimum air temperature of 60°F (16°C), and Survey 3 should be conducted between June 25th–July 10th at a minimum air temperature of 70°F (21°C). Each point will be surveyed for at least 5 minutes, and the amphibian calling index will be used to record each species that is heard. Warm, cloudy evenings with little or no wind (<8 miles per hour [3.6 meters per second]) and high humidity are ideal. Rare or unusual calls should be verified by tape recording, testimony of two experienced observers, or a photograph if the individual calling can be located and photographed.

Aquatic Trapping Survey Protocol

When utilizing aquatic traps for surveys, the effort should focus on the time of year when the target species are most likely to be active and sampling a variety of habitats to increase the likelihood of species detection. Turtles should be surveyed between June 1st and August 15th and larval amphibians should be surveyed between May 15th and July 1st. Aquatic traps may have a low capture rate, so for successful inventories, a higher intensity sampling may be necessary (i.e., more trap-nights spread across the season). Aquatic trapping should utilize:

- Small aquatic funnel traps – These are traps that can be used to target amphibians, specifically salamanders that may breed in ephemeral pools.

- Hoop-nets – These are large funnel traps used primarily for trapping highly aquatic carnivorous turtles, although with leads they can be useful for trapping any aquatic turtles.

See Figure 1 for drawings of these two types of aquatic traps.

Equipment

- Clipboard
- Datasheets
- Thermometer
- Maps and survey locations
- GPS/iPad
- Camera
- Traps
- Waders
- Flagging tape/string
- Floats
- 3-edge file
- Scale
- Measuring tape
- Herpetofauna identification guides
- Gloves

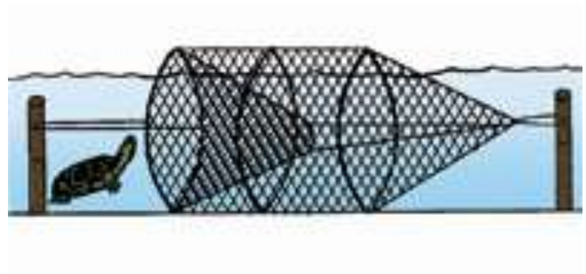
Methods

Funnel and hoop-net traps can be handmade or purchased from a supplier (Figure 1). For example, modified fyke nets, as described by Legler (1960), can be used as hoop-net traps to target aquatic turtles. Small aquatic funnel traps targeting amphibians, such as salamanders, can include commercially-available minnow traps or handmade traps resembling the same general design with tapered entrance holes on each end and a holding chamber in the middle. An example of a commercial trap supplier can be found at the following link (http://www.memphisnet.net/category/traps).

Small aquatic funnel traps targeting amphibians should be placed flush with the bottom substrate in water depths ranging from the minimum depth required to submerge the entrance holes to a maximum of 1 meter (3.3 feet). All traps must be set with the tops above the water line, allowing adult amphibians to reach the surface for air. Traps should be labeled with Dakota County Parks Survey and permit numbers if applicable and marked with floats or flagging tape/string tied to nearby vegetation. If traps are located in flowing water or near depth gradients, they should be secured in place. With respect to trap placement, surveyors should try to place traps in a variety of wetland habitat types to survey for all potential species (Adams et al. 1997). Areas with vegetation, sticks, stems, and branches provide cover and objects for egg attachment and should be targeted as opposed to large sections of open water with little to no cover. Results from previous studies indicate that glow sticks added to traps can improve the capture success of larval amphibians (Grayson and Roe 2007, Bennett et al. 2012). Traps should be checked a minimum of once per day, and all captures should be recorded on the datasheet (Attachment A).

For larger hoop-nets targeting turtles, traps may be baited with fresh fish, sardines, or other suitable bait placed in screened baitholders suspended from the top of the trap. All traps must be set with the tops above the water line, allowing turtles to reach the surface for air. Traps should be labeled with Dakota County Parks Survey and permit numbers if applicable. In order to avoid drowning turtles, traps should be checked within 24 to 48 hours and if water levels rise to a level that submerges the trap, they should be checked within 18-24 hours. All captures should be recorded on the datasheet with information pertaining to the species, sex, mark (if marking individuals), size, age class (juvenile/adult), and location of capture. Turtles may be given a unique permanent marking by notching the marginal scutes with a 3-edge file or scissors/fingernail clippers (see Section 1.5).

Figure F1 – Examples of commercially available funnel traps (left) and hoop-net traps (right) for amphibian and reptile surveys. Product photos from Memphis Net & Twine (http://www.memphisnet.net/).



Drift Fence/Pitfall/Box Survey Protocol

Drift fences allow for the capture of amphibians and reptiles during seasonal movements associated with travel to and from breeding or overwintering sites. Ponds and wetlands can be targeted in early spring (March and April) as amphibians congregate to breed. Warm spring rains trigger movement patterns in amphibians from hibernacula to breeding pools and can be used as a guideline for drift fence and pitfall trap installation. The same fences and pitfalls can be used in summer (June and July) to target turtles as they emerge from aquatic environments to lay eggs in adjacent uplands. The fence acts as a barrier to animal movement, directing them towards the traps located along the drift fence.

Equipment

- Clipboard
- Datasheets
- Thermometer
- Maps and survey locations
- GPS/iPad
- Camera
- Drift fence
- Bucket (below ground) or box (aboveground) traps
- Garden spade
- Sledge hammer
- Brush removal equipment to clear space for the fence
- Tape measure
- Short stakes
- Staples and staple gun
- Knife/snips to cut fencing material
- Other materials necessary for fence/trap installation
- Scale
- Measuring tape
- Herpetofauna identification guides

- Scissors/fingernail clippers
- 3-edge file

Methods

Each drift fence and pitfall/box setup should consist of approximately 100 feet (30 meters) of window screen or other drift fence material buried 6 inches (15 centimeters) below ground and extending 12-14 inches (30-36 centimeters) above ground. Wetland characteristics (e.g. water table, historic flood levels, and ephemeral or permanent water body) can be used to determine the distance drift fences are placed from the wetland. Fences should be placed as close as possible to the wetland but far enough away to avoid holding back water during flooding or allowing pitfalls to fill up with water. Drift fence should be labeled with Dakota County Parks Survey and permit numbers if applicable. Four pitfall/box traps should be spaced more or less evenly along the length of the fence so that animals attempting to cross the fence are forced to fall in (Christiansen and VanDeWalle 2000; Figure 2). Depending on the method chosen, pitfall buckets should be buried below the ground surface directly along the drift fence, or box traps should be placed directly next to the drift fence material. When not in operation, pitfalls or box trap entrances should be securely covered to avoid capture of any animals. When activated, traps should be checked multiple times a day to limit mortality of captured animals. Depending on environmental conditions (e.g. extreme heat or sustained precipitation) pitfall traps may need to be closed for extended periods of time. Each trap location should be recorded with a handheld GPS device and given a unique label. All captured animals should be recorded on the datasheet (see Appendix A), and all pertinent information should also be noted.

Figure F2 – General depiction of drift fence and pitfalls (with flip-top lids) setup (from Christiansen and VanDeWalle 2000).

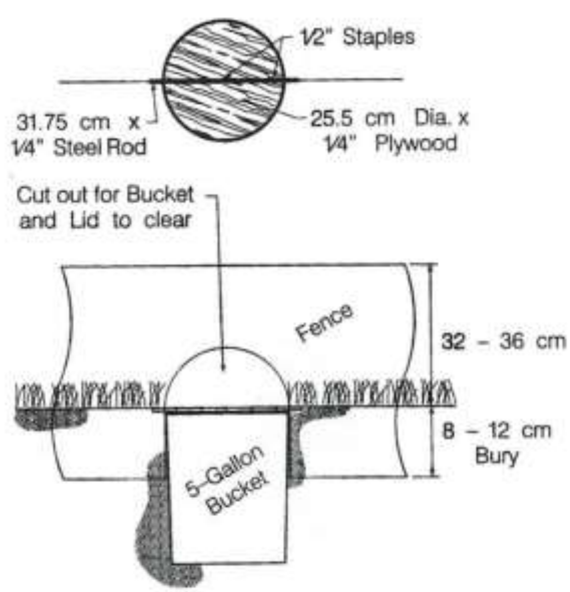


Figure F3 – Photographs of drift fence and box trap setup, the method utilized by the Minnesota Department of Natural Resources (MN DNR). Photos courtesy of Jeff LeClere, MN DNR.

Timing, Frequency, and level of effort of Surveys

Spring Surveys (March 15 – April 15)

Target species are salamanders, early calling anurans (frogs and toads), and turtles. Specific surveys include:

- Small aquatic funnel trapping – Minimum level of effort of 10 traps/night for 3 calendar nights (30 trap nights) per survey location.
- Frog call surveys – Minimum of 5 frog call point count locations spaced approximately 0.25 mile apart when possible. Each point surveyed for 5 minutes.
- VES targeting salamanders and anurans (e.g., log flipping, dip netting) – Minimum of 20 person hours.
- VES targeting turtles – Visual turtle surveys should be completed three times during the later spring season at each survey location. If using volunteers, surveys can be performed once per week at each point.
- Cover boards – Set up a minimum of 20 boards per survey location. Check boards approximately once per week.

- Road cruising – As appropriate (e.g., at night, after a rain, to and from survey locations, etc.).
- Drift fence/pitfalls – Install drift fence and pitfalls in early spring. Operate for two weeks, checking traps a minimum of twice per day. Disable traps until next round of trapping during the summer survey period.

Summer Surveys (May 15 – June 15)

Target species are salamanders, anurans, snakes, and turtles. Specific surveys include:

- Small aquatic funnel trapping – Minimum level of effort 10 traps/night for 3 calendar nights (30 trap nights) per survey location.
- Frog call surveys – Minimum of 5 frog call point count locations spaced approximately 0.25 mile apart when possible. Each point surveyed for 5 minutes. A minimum of three survey events per site.
- VES targeting salamanders, anurans, snakes and lizards (e.g., walking survey, log flipping, dip netting) – Minimum of 20 hours.
- VES targeting turtles – Visual turtle surveys should be completed three times during the spring season at each survey location.
- Turtle aquatic trapping – Minimum level of effort 5 traps/night for 3 calendar nights (15 trap nights) per survey location.
- Cover boards – Minimum of 20 boards per survey location. Check boards approximately once per week.
- Road cruising – As appropriate (e.g., at night, after a rain, to and from survey locations, etc.).
- Drift fence/pitfalls – Operate for two weeks, checking traps a minimum of twice per day. Disable traps until next round of trapping during fall survey period.

Late Summer/Fall Surveys (August 15 – September 15)

Target species are salamanders, frogs, turtles, snakes, and lizards. Time to be focused on species that were not previously detected but would be expected to be present at the site. Specific tasks include, as needed:

- Frog call surveys – As necessary to confirm species not previously detected.
- Turtle aquatic trapping - Minimum level of effort 5 traps/night for 3 calendar nights (15 trap nights) per survey location.
- VES targeting species not detected previously (e.g., cover board flipping, log flipping, basking survey) – Minimum 20 hours per survey location.
- Road cruising - As appropriate (e.g., at night, after a rain, to and from survey locations, etc.).
- Cover boards – Check boards approximately once per week. Remove boards at the end of the season.

- Drift fence/pitfalls – Operate for two weeks, checking traps a minimum of twice per day. Remove drift fence and traps at the end of the survey period.

Survey Metrics and Objectives

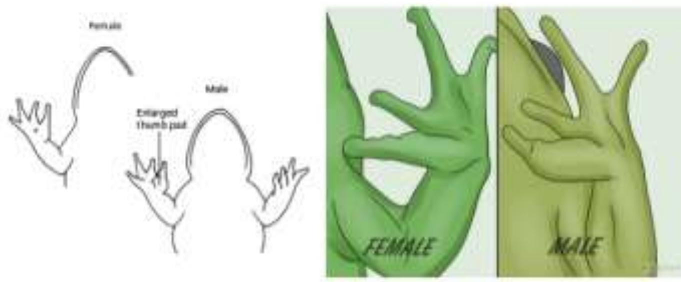
Table F2 – Metrics collected by survey type and objective.

Survey Type		Survey Objective and Metrics		
		Presence/Absence	**Species Richness**	**Relative Abundance**
Visual Encounter	**Road Surveys**	Presence/Absence	Number of species per survey route	Average number of individual species per survey route per survey
	Visual Encounter Meander Surveys	Presence/Absence	Number of species per survey area	Average number of individuals per species per survey area per survey
	Coverboards	Presence/Absence	Number of species per survey area	Average number of individuals per species per coverboard per visit
Frog Call Surveys		Presence/Absence	Number of species per survey point	Call index by species
Aquatic Trapping		Presence/Absence	Number of species per survey area	Average number of individuals per species per trap night
Drift Fence/Pitfall/Box		Presence/Absence	Number of species per survey area	Average number of individuals per species per trap night

Additional Information

Amphibian Sex Identification

Figure F4 – Sex identification of frogs.



The sex of a frog may be determined externally by examining the **thumb pads** on the front feet. The thumb pads of males are enlarged at the base as in the drawing on the right.

Figure F5 – Sex identification of salamanders.

Reptile Sex Identification

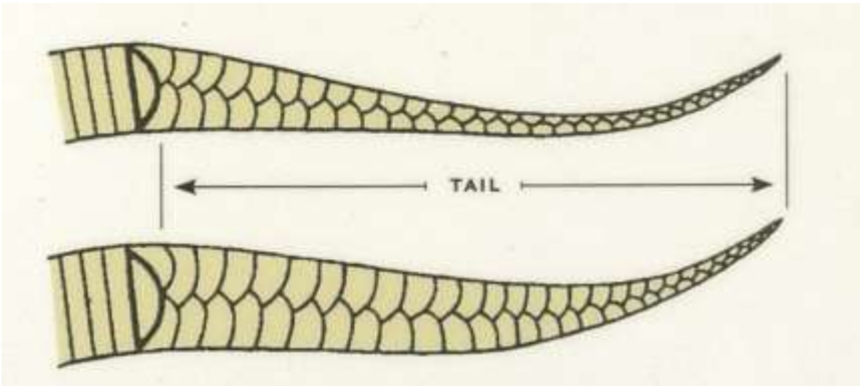
<u>Snakes</u>

- In some species, males have longer tails and more subcaudal scales (i.e. scales on the underside of the tail) than females (check field guides).
- Popping – "Popping" refers to reverting the hemipenis (male sex organ) out in male snakes so they are visible outside the tail. Pressure is applied with your finger firmly but gently on the snake below their vent where the hemipenis would come out. If done correctly, then a hemipenis will pop out. This can usually only be done on smaller snakes, and it can cause a lot of trauma if done incorrectly. This is not the preferred

method of determining the sex of a snake because it is difficult to do and should only be attempted by someone experienced in the technique.

- Probing – Probing a snake involves inserting a thin metal rod (called a snake probe) into the vent (cloacal opening) of the snake while they are awake. The special probe can be inserted further in males since they have a hemipenis on either side of the vent. This should only be attempted by someone experienced in this technique as it can harm the snake if done incorrectly.

Figure F6 – Measuring tail length in snakes (Powell et al. 2016).

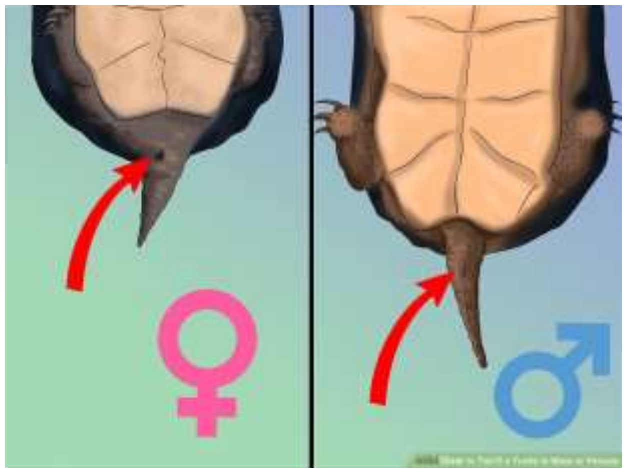


Tail of female (above) tapers from anal plate, tail of male is stout at base. Tail begins where anal plate ends.

Turtles

- Male – concave plastron (i.e., underside of shell), long claws on front legs, longer thicker tail, cloaca located beyond edge of carapace (i.e., upper side of shell).
- Female – flat plastron, short claws on front legs, short tail, anal opening located beneath carapace.

Figure F7 – Position of cloacal opening in male and female turtles.



https://www.wikihow.com/Tell-If-a-Turtle-Is-Male-or-Female

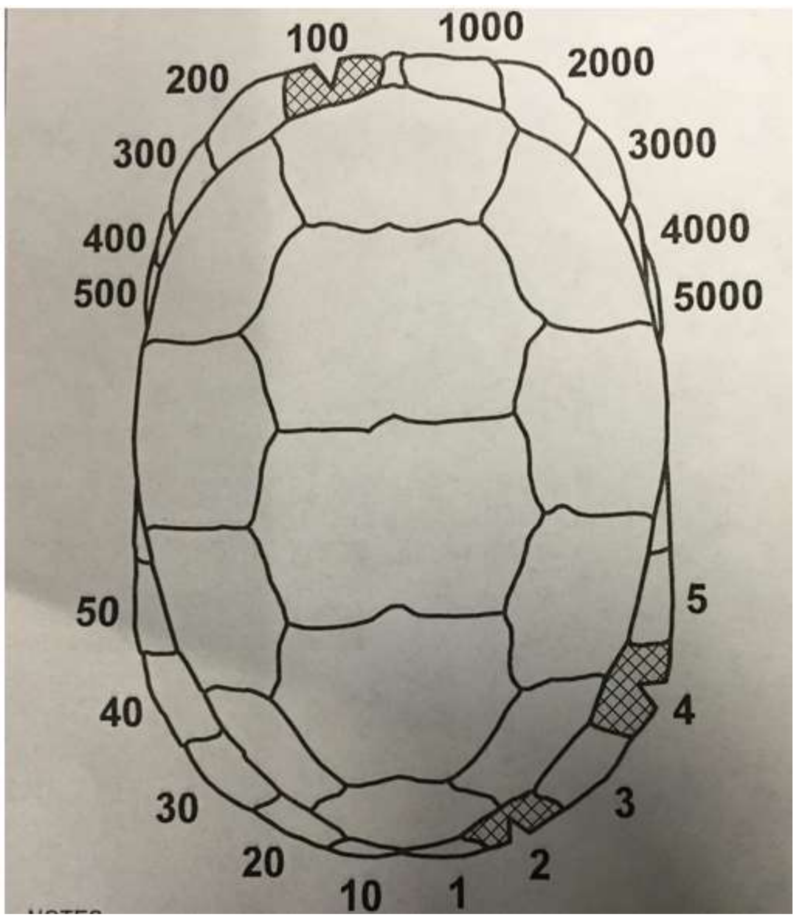
Figure F8 – Claw length on front feet of male and female turtles.

https://www.wikihow.com/Tell-If-a-Turtle-Is-Male-or-Female

Individual Turtle Marking

Marginal scutes on the carapace of turtles with boney shells (i.e., not softshells or juvenile turtles whose shells have not ossified) can be marked by notching with a triangular metal file. Each turtle can be given a unique set of notches, beginning with “101” for the first turtle and continuing sequentially (e.g. 102, 103, and etc.). For example, if a turtle is being marked as 124, it would be marked at the scute labeled 100, 20, and 4 (Figure 9). According to Hildebrand and Hatsel (1926), these notches are permanent if made when the shell is ossified and tend to fade away in juveniles over time. Therefore, on a re-capture, notches might be touched-up with the metal file. This technique allows future identification of individual turtles and population estimates.

Figure F9 – Notching system for unique permanent marking of marginal scutes on captured turtles.



https://www.researchgate.net/publication/318298509_Effectiveness_of_Head-starting_as_a_Management_Tool_for_Establishing_a_Viable_Population_of_Blanding's_Turtles

References

Adams, M.J., K.O. Richter, and W.P. Leonard. 1997. Surveying and monitoring amphibians using aquatic funnel traps. In *Sampling Amphibians in Lentic Habitats: Methods and Approaches for the Pacific Northwest*. U.S. Geological Survey. Society for Northwestern Vertebrate Biology, Olympia, WA.

Blaustein, A.R., Wake, D.B. & Sousa, W.P. 1994. Amphibian Declines: Judging stability, persistence, and susceptibility of populations to local and global extinctions source. Conservation Biology 8: 60-71.

Bennett, S.H., J.L. Waldron, and S.M. Welch. 2012. Light bait improves capture success of aquatic funnel-trap sampling for larval amphibians. Southeast Naturalist.11:49-58.

Christiansen, J.L. and T.J. VanDeWalle. 2000. Effectiveness of three trap types in drift fence surveys. Herpetol. Rev. 31(3):158-160.

Gibbons, J.W., Scott, D.E., Ryan, T.J., Buhlmann, K.A., Tuberville, T.D., Metts, B.S., Greene, J.L., Mills, T., Leiden, Y., Poppy, S. & Winne, C.T. 2000. The global decline of reptiles and amphibians. Bioscience 50: 653-666.

Grayson, Kristine L., and Andrew W. Roe. Glow sticks as effective bait for capturing aquatic amphibians in funnel traps. *Herpetological Review* 38, no.2 (2007):168-170.

Hildebrand, S. F., and C. Hatsel. 1926. Diamond-back terrapin culture at Beaufort, N.C. U.S.Bur.Fish.Econ.Circ. 60:1-20.

Legler, J. M. 1960. A simple and inexpensive device for trapping aquatic turtles. Utah Acad. Proc.37:63-66.

Powell, R., R. Conant, and J.T. Collins. 2016. Peterson Field Guide to Reptiles and Amphibians of Eastern and Central North America. 4th Edition. Houghton Mifflin Harcourt.

Suthernland, R. and deMaynadier, P. 2012. Model criteria and implementation guidance for a priority amphibian and reptile conservation area (PARCA) system in the USA. Partners in Amphibian and Reptile Conservation, Technical Publication PARCA-1. 28 pp.

Attachment A: SURVEY DATASHEETS

10.7. Appendix G. Pollinator Survey Protocol

Stantec

Lebanon Hills Regional Park

Insect Survey Plan

July 3, 2018

Prepared for:

Dakota County Parks

Prepared by:

Jessica Jaworski

Stantec

Introduction

Lebanon Hills Regional Park (LHRP) is an 1,869-acre park surrounded by urban residential development in Dakota County, Minnesota (Figure 1). The park is located within the metropolitan area of the Twin Cities and experiences heavy recreational use. Park staff actively manage LHRP for recreational use as well as to implement best management practices for the habitat structures that encompass the park. Lebanon Hills Regional Park's terrestrial plant communities are primarily comprised of dry-mesic to dry oak forest, woodland, savanna, and prairie (large prairie reconstructions and several remnants). The park also supports abundant water resources, including numerous wetlands and wetland types that range from temporarily saturated meadows to seasonally flooded marshes, and lakes. These varied habitats have the potential to support a significant richness in species and abundant populations of insects.

Insect populations can be an important biological indicator of habitat quality and serve as resource for plant and animal species that exist within an ecosystem (Jordan et al. 2016). Dakota County wishes to implement insect monitoring as an assessment tool for evaluating insect populations within the park primarily focusing on bees, day-flying Lepidoptera and Odonata species (Figure 2).

The objectives of this insect survey plan are to:

1. Develop an abundance and diversity baseline of relatively easy to identify, charismatic insect groups (bees, day-flying *Lepidoptera*, and *Odonata*) across the park.
2. Measure the target insect populations as performance measures for adaptive management of ecosystem restoration efforts.

Dakota County staff wishes to begin widespread restoration efforts of oak forest, savanna, and prairie habitats located in the central and west portions of the park. Prior to restoration efforts in these locations, staff would like to collect baseline data for insect and pollinators as there is a lack of previous sampling efforts in these locations. In order to develop baseline data and evaluate trends spatially and temporally, insect monitoring of the target species must use standardized protocols that include species count data per unit time. This insect survey plan proposes the implementation of timed and fixed transects (Debinski et al. 2000, Joradan et al. 2006, and Ward et al. 2014) to collect data that can be compared from year to year.

In addition to the formal standardized sampling efforts, we recommend collecting species observations from local experts and enthusiasts by setting up an online project on a curated naturalist website, such as iNaturalist, www.inaturalist.org.

Bee Monitoring

Declines in insect pollinator populations such as bees have been increasingly documented (Ward et al. 2014, Williams and Osborne 2009). The conservation of native bee populations and pollinator habitat can enhance the diversity and overall fitness of ecosystems (Williams 2009). Native bee monitoring is suggested for the prairie and savanna habitats within the Park (Figure 2), as well as areas targeted for restoration (as determined in LHRP NRMP and during regular project/work planning). The primary goal is to develop long term data for the existing open habitats, and to track trends in bee populations in areas that are being or will be actively restored. This insect survey plan is based on protocols for bee monitoring and assessing pollinator habitat as outlined in the Xerces Society Upper Midwest Citizen Science native bee monitoring protocol (Jordan et al. 2016).

Previous Efforts

Bees have been previously monitored in 2017 and 2018, using transects in the eastern end of the Park. Data was collected for four 180 meter transects in 2017 using the Xerces Society Upper Midwest Citizen Science Native Bee Monitoring Protocol. Surveying in 2018 included continued monitoring at these four transects, and additional meander surveys for bumblebees through the Minnesota Bumble Bee Atlas program, under the direction of Elaine Evans, University of Minnesota Bee Lab.

Protocol Design

Sampling Methods

The primary objective is to establish permanent transects and timed walks looking at floral visitors. Transects will be evenly spaced throughout project areas intended for bee monitoring with a length of 180 meters (Jordan et al. 2016). A single transect in the middle of the project area will be used in areas less than two acres in size and two to three transects that are 100 feet apart will be used in areas larger than two acres for a total transect length of 180 meters (Jordan et al. 2016). All transects will be identified via GPS unit or on aerial photos prior to sampling efforts.

Sampling Sites

Sampling sites will include prairie and savanna habitat within LHRP. All sampling sites will be identified on transect maps prior to sampling efforts. Efforts will be focused on both higher and lower quality habitat to provide the greatest sampling effort within prairie and savanna habitats.

Sampling Intensity

Sampling intensity will include a single transect 180 meters long. All transects will be conducted by trained staff or volunteers.

Sampling frequency and timing

Bee surveys will be conducted a minimum of three times per season, ideally monthly, to capture the peak colony sizes for common bumble bee species (Jordan et al. 2016). Surveys should be conducted May through September, approximately 30 days apart.

Surveys should ideally take place in warm, sunny weather conditions, between 10 am and 6 pm (Jordan et al. 2016). Wind speeds should ideally be less than 10 mph, and the sky should not be so overcast that you cannot see your shadow. Air temp should be above 60 degrees.

Field Implementation

Field Sampling

We recommend bee monitoring sampling efforts be completed with one to two observers. At a minimum, data sheets should include location, time, date, and weather conditions. Observers should be provided with a map (Figure 2) or GPS unit indicating transect locations. Transects should be walked at a pace of approximately 3 meters per minute (Jordan et al. 2016).

Additional Field Data Collection

In the comment section of the data sheet additional information such as important site information (rare, threatened, or endangered species), dominant blooming flowers as well as flowers attracting pollinator species (Ward et al. 2014) can be recorded.

Butterfly (Day-flying Lepidoptera) Monitoring

Butterflies are a charismatic, easily identifiable, and day flying indicator species for insect populations (Quinn and Danielson 2009). Approximately 21% of the 760 species of butterflies exist in Minnesota (Huber 1981, Quinn and Danielson 2009). Butterfly monitoring is suggested for all existing major Native Plant Community habitat types within the Park (Figure 2), particularly areas targeted for restoration. The primary goal is to develop long term data for the existing habitats, and to track trends in butterfly populations in the restoration areas. This insect survey plan will use protocols for butterfly monitoring and assessing pollinator habitat as outlined by the national park protocol (Debinski et al. 2000).

Previous Efforts

County staff is unaware of any formal butterfly monitoring efforts at Lebanon Hills. Local experts and enthusiasts, including the local North American Butterfly Association ("NABA") have documented observations online (iNaturalist and elsewhere).

Protocol design

Capacity Building

In the first year of butterfly monitoring, it is recommended to do exploratory work to prepare for formal ongoing transect sampling (Debinski et al. 2000). Steps include:

- Develop capacity for butterfly identification, obtain sampling equipment and train volunteers.
- Reach out to local experts and enthusiasts (NABA, Andy Birkey) who have done work in and near the park.

- Develop a checklist of species in representative habitats at the park and describe habitats. Determine which species are habitat generalists and specialists (ecological guild) for future tracking of restoration project progress.
- Field test transect sampling methods in different habitats to refine transect width and placement.
- Develop approximate time periods for 3 flight periods.
- Determine if there are any rare species that merit dedicated survey effort at particular times.
- Set up butterfly feeders near the staff offices and visitor center and invite public participation to document species online.

Sampling Methods

This sampling protocol is a fixed-route timed transect covering each habitat type in the park (Figure 2), as well as recently restored areas. This protocol follows the National Park Service Protocol developed for prairie and savanna habitat in National Parks in the greater Midwest area (Debinski et al. 2000). Protocols and transect lengths (50m long and 5 m wide) outlined by Debinski et al. 2000 will be used for these surveys. Transects will be evenly spaced throughout project areas designated as butterfly monitoring locations, and all transects will be identified via GPS unit or on aerial photos prior to sampling efforts.

Sampling Sites

Sampling sites will be within each habitat type within LHRP. All sampling sites will be identified on transect maps prior to sampling efforts. Efforts will be focused on both higher and lower quality habitat to provide the greatest sampling effort within all habitat types. Please refer to the attached map for proposed transects (Figure 2). Transects will be at least 50 m apart and contain a 50 m distance from the habitat edge.

Sampling Intensity

Sampling intensity will include at least 6 total transects that are 50 m long and 5 m wide (Debinski et al. 2000). All transects will be conducted by trained staff or volunteers.

Sampling frequency and timing

A total of three surveys per season will be conducted to capture the flights of butterfly species present within LHRP, including:

- Spring emergents
- Early summer and first brood bivoltine emergents
- Late summer univoltine and second brood bivoltine emergents

The timing of the surveys will need to be developed based off the species lists developed in the first year of species inventory.

The following table represents approximate flight time periods for three flights based on sampling protocols outlined by Debinski et al. 2000 and temporal sampling windows presented in Table 2, Debinski et al. 2000. We recommend using these approximate flight time periods to capture flights of butterflies present within LHRP.

May 5 to May 20	June 10 to July 25	August 5 to August 26

Field Implementation

Field Sampling

Butterfly monitoring sampling efforts will be completed with one to two observers. A data sheet that includes location, time, date and weather conditions will be used. Observers should be provided with a map (Figure 2) or GPS unit indicating transect locations. Transects will be walked at a pace of 10 feet per minute (Jordan et al. 2016).

Additional Field Data Collection

In the comment section of the data sheet additional information such as important site information (rare, threatened, or endangered species), dominant blooming flowers as well as flowers attracting pollinator species (Ward et al. 2014) can be recorded.

Odonata Monitoring

Odonata species such as dragonflies and damselflies serve many key roles in an aquatic ecosystem. They have important influences on nutrient cycles, primary production, decomposition and translocation of allocthonous materials. They are also important food sources for fish, amphibians and birds. One of the additional key roles these organisms play within an aquatic ecosystem is as a valuable indicator of water quality, and ultimately the quality of wetlands, lakes and streams.

Previous Efforts

Formal Odonata monitoring is commencing in 2018 as a citizen science effort. The monitoring presented in this document can be applied to all lake, wetland and stream ecosystems present within he Park.

Protocol Design

Sampling Methods

The survey methods provided below focus on the capture of juvenile (nymphs and exuviae) and adult Odonata. These methods will also indirectly capture other macroinvertebrate species. It will be important to document the other macroinvertebrate species captured during the Odonata sampling. This additional data set can be used to further document the aquatic insect community and provide additional insight into the water quality of the lakes and wetlands in the Park.

Several key reference materials and sampling guidelines were used to develop this protocol. These references should be consulted prior to any sampling event. These resources provide additional information on sampling techniques, identification resources (including iOS and Android Apps), water quality sampling and data sheet examples. Links to these websites, documents and identification keys are provided below:

Minnesota Pollution Control Agency, Biological Monitoring Protocols - https://www.pca.state.mn.us/water/biological-monitoring-water-minnesota

Minnesota Wetland Health Evaluation Program (WHEP) - http://www.mnwhep.org/id28.html

Wisconsin Odonata Survey - http://wiatri.net/inventory/odonata/survey/index.cfm

Odonata Central - https://www.odonatacentral.org/index.php/PageAction.get/name/HomePage

iPhone or Android Apps for Odonata Identification:

Dragonfly ID App - https://appadvice.com/app/dragonfly-and-damselfly-field-guide-and-id-app/1011910922

Aquabugs App - https://itunes.apple.com/us/app/aqua-bugs/id1088808991?mt=8

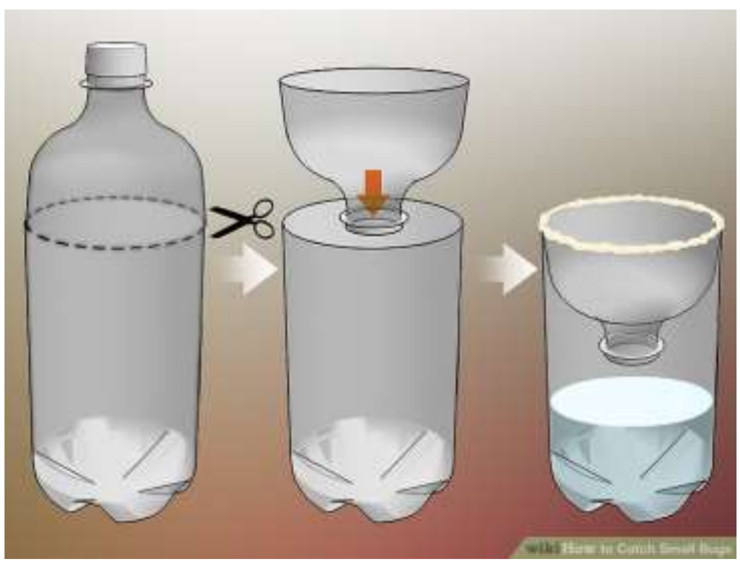
JUVENILE ODONATA (NYMPHS AND EXUVIAE) SAMPLING

The juvenile Odonata community residing in the wetlands and nearshore lake areas associated with the Park will be surveyed utilizing qualitative sampling protocols (Hilsenhoff 1998, Lillie 2000, Lillie et al. 2003). Survey methods provided herein can also be applied to any streams present in the park, however, the focus of this survey protocol will be on lake shoreland zones and wetlands.

Shoreline and wetland transects should be roughly 100 feet long and be located based on varying habitat types such as vegetation (emergent, submerged and floating leaf), woody debris, substrate changes (muck, mud, sand and rocks) and shoreline canopy cover. In general, 3-5 transects should be sampled within each wetland and/or waterbody. Each transect should be marked in the field (lath/flagging) and surveyed utilizing a handheld GPS unit or similar device. This will allow for the easy re-location of these transects during subsequent sampling events. Water quality data should also be collected; and should include a minimum of water temperature, pH, conductivity, turbidity and dissolved oxygen (DO). Transect habitat and water quality data should be documented on a field sampling summary data sheet.

Direct juvenile Odonata and macroinvertebrate sampling will be completed with a D-Frame aquatic kick net. The nets will be jabbed into various types of wetland/shoreline vegetation, debris (sticks, trees and log jams) and rocky substrates. Direct sampling will be done until at least 100-150 organisms have been collected. Collected organisms along with debris will be placed in a 500 to 1,000mL HDPE plastic bottle with a 70-80% ethanol solution (mixed with tap water). Transect location, date, time and other pertinent sampling information will be written in permanent ink on the bottles. Odonata and other macroinvertebrates will be identified to the genus level.

Indirect sampling will be completed using macroinvertebrate bottle traps set in vegetation and woody debris in water no deeper than 12-16". The bottle traps can be constructed utilizing a clear 1L plastic soda or water bottle. These traps can also be made using a 1-quart glass mason jar, a clear plastic funnel, one rubber band and two large paper clips. The Plastic bottle trap construction is as follows:



Bottle traps are submerged until filled with water and then placed on the bed of the wetland or shoreland zone. The traps should be placed in vegetation or within woody debris and marked with a lath and flag or pin-flag. Up to 5 traps per 100 yard transect should be used. Traps are left in the water for 24 hours and then removed and the contents emptied into a sorting pan. All organisms captured can be field identified and released or placed in a 500 to 1,000mL HDPE plastic bottle with a 70-80% ethanol solution (mixed with tap water).

ADULT ODONATA SAMPLING

Adult Odonata should be sampled via meander surveys along 100-200' transects located in habitats ranging from wetlands, shorelines, upland prairies and even mowed lawns. These transects should be located within 100' of a wetland or lake. A 12" to 15" diameter insect net is used to capture adults flying or to net them while resting on vegetation. Adults should be identified and released, however individuals may be placed in a 500 to 1,000mL HDPE plastic bottle with a cotton ball soaked in ethyl alcohol for later identification.

Sampling Intensity

As stated above, a total of three to five 100-foot shoreline or wetland transects should be sampled within each wetland or waterbody. Transects will be developed within portions of the shoreline with varying cover types including emergent and submergent vegetation, small woody debris and fallen trees. Meander surveys for adults will be performed along 100' transects located in varying habitat types adjacent to wetland, waterways and waterbodies.

Sampling Frequency and Timing

Surveying should be completed within two time periods to capture the emergence of different species of Odonata and other macroinvertebrates:

- Late May to mid-June
- Mid-August to early September.

Field Implementation

Field Sampling

Sampling as described in section 4.2.1 above will be by wading in shoreline and wetland areas and by meander surveys for adults. Kick net samples for juvenile Odonata and macroinvertebrates can be performed at any time during the day, however adult Odonata sampling should be performed during midday hours. This scheduled will take advantage of the greatest activity period for adult Odonata. Sampling crews will be comprised of two to three individuals.

Additional field data collection

Water quality data should be collected during each sampling event at one location along each transect. Water quality parameters that should be collected include water temperature, pH, dissolved oxygen (DO), conductivity and turbidity. Additionally, documentation of habitat within each transect will be completed. Habitat Information collected will include, but are not limited to:

- vegetative community (comprehensive list of emergent, submergent, wetland and shoreline plant species, percent cover, invasive species and tree and shrub species)
- shoreline substrate types
- water clarity
- shoreline erosion

- other habitat information

Future Considerations

Moth light trapping could be added in the future as a passive sampling method; however, there are many more moth species than butterflies, and expert help would be needed for identification.

References

Beadle, D. and S. Leckie. 2012. Peterson Field Guide to Moths of Northeastern North America, First Edition. Houghton Mifflin Harcourt Publishing Company, New York.

Brock, J.P. and K. Kaufman. 2003. Butterflies of North America. Houghton Mifflin Company, New York.

Debinski, D., S. Mahady, W. M. Rizzo, and G. D. Willson. 2000. Butterfly monitoring protocol for four prairie parks. Final report to the Great Plains Prairie Cluster Long-term Ecological Monitoring Program, National Park Service, Wilson's Creek National Battlefield, Republic, Missouri. 47 pp.

Hilsenhoff, W.L. 1988. Rapid field assessment of organic pollution with a family-level biotic index. Journal of the North American Benthological Society 7:65-68.

Huber, Ronald L. 1981. Checklist of Minnesota Butterflies. James Ford Bell Museum of Natural History, University of Minnesota. Minneapolis, MN.

Jordan, S.F., Lee-Mader, E., Vaughn, M. 2016. Upper Midwest Citizen Science Monitoring Guide Native Bees. Portland, Or: The Xerces Society for Invertebrate Conservation.

Lillie, R.A., S.W. Szczytko and M.A. Miller. 2003. Macroinvertebrate Data Interpretation Guidance Manual. Wisconsin Department of Natural Resources, Madison, WI.

Lillie, R.A. 2000. Development of a Biological Index and Classification System for Wisconsin Wetlands using Macroinvertebrates and Plants. Wisconsin Department of Natural Resources, Monona, WI.

Quinn, E.M., R. Danielson. 2009. A Survey of Lepidoptera in Three Priority Areas of the Minnesota State Parks System. MNDNR Division of Parks and Trails.

Sogaard, J. 2009. Moths and Caterpillars of the North Woods. Kollath+Stensaas Publishing, Duluth, MN.

U.S. Fish and Wildlife Service. 2003. Final Recovery Plan for the Karner Blue Butterfly (*Lycaeides melissa samuelis*). U.S. Fish and Wildlife Service, Fort Snelling, Minnesota.273 pp.

Ward, K., D. Cariveau, E. May, M. Roswell, M. Vaughan, N. Williams, R. Winfree, R. Isaacs, and K. Gill. 2014. Streamlined Bee Monitoring Protocol for Assessing Pollinator Habitat. 16 pp. Portland, OR: The Xerces Society for Invertebrate Conservation.

Williams, P.H., Osborne, J.L. 2009. Bumblebee Vulnerability and Conservation Worldwide. Apidologie 40, 367-387.

Figure 1 -Land Cover in vicinity of Lebanon Hills Regional Park

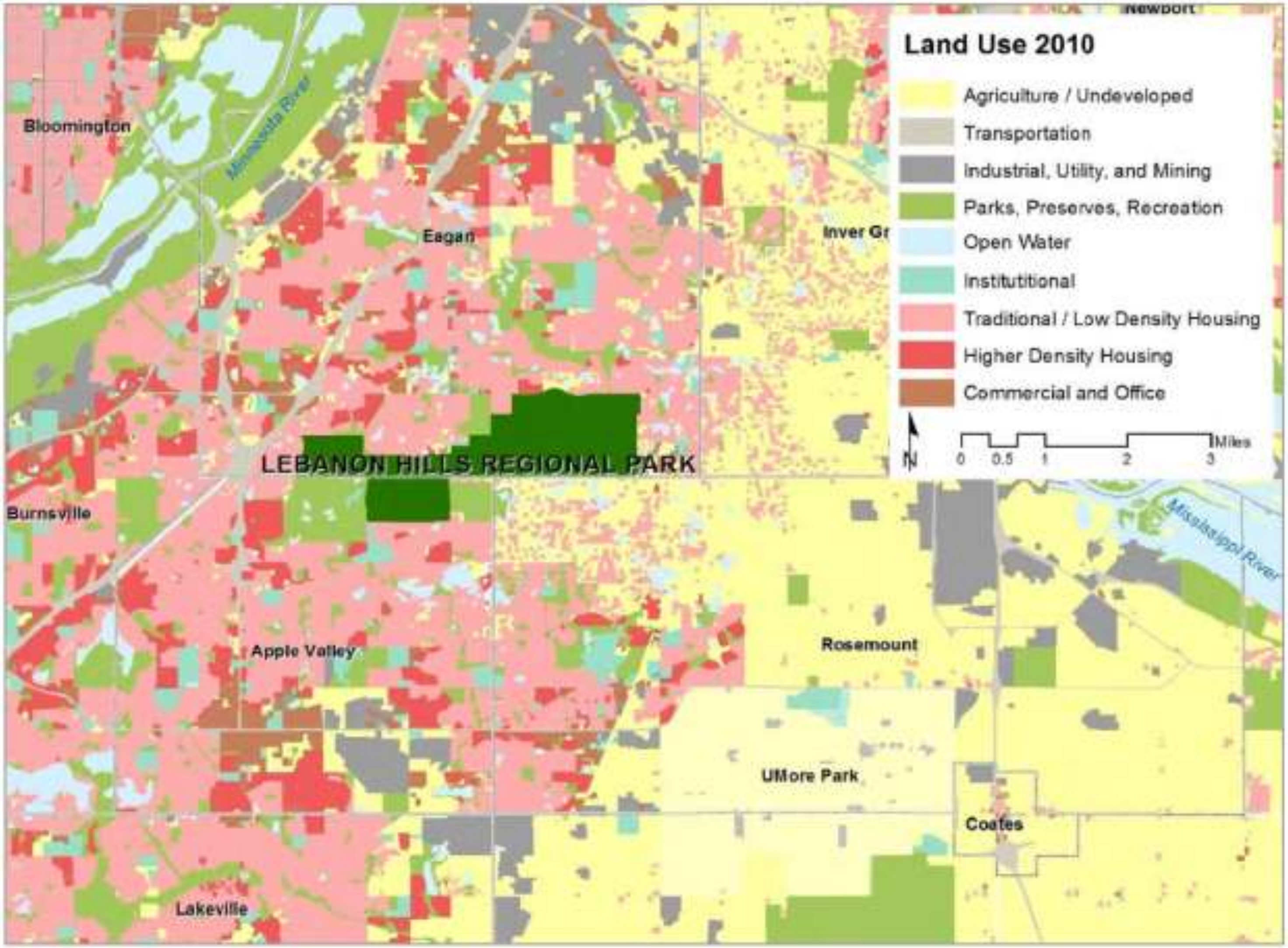
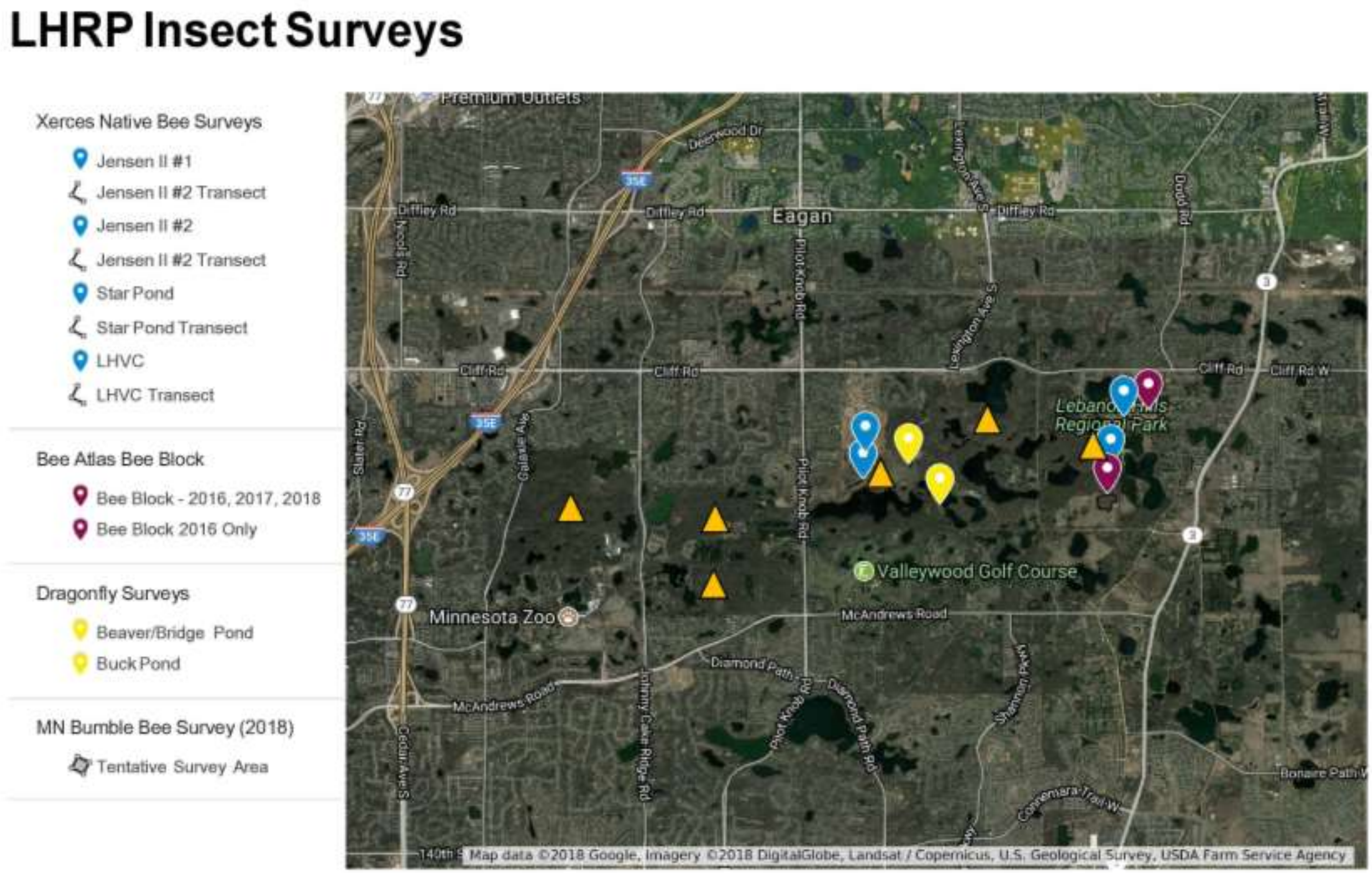


Figure 2 - Recommended Transect and Survey locations



Butterfly Sampling Protocol - May 30, 2018
Effects of grazing versus fire for prairie management

Introduction:

Two butterfly sampling methods are described below: a transect walk and an observation walk. The transect walk is based on a modification of the "Pollard Walk" (Pollard 1977; Pollard and Yates 1993). Pollard walk methods have been widely used to answer questions of butterfly abundance, community composition, species richness, dominance and diversity (for examples, see Murphy and Weiss 1988; Swengel 1996; Thomas 2005; Swengel and Swengel 2013), and are here used to assess butterfly presence and relative abundance in Minnesota's tallgrass prairie. The observational walk is used to supplement species presence data and compile more complete species lists for each survey site.

Field Materials:

GPS, spare batteries
Flags
Flagging tape
Kill jars
Ethyl acetate for kill jars
Watch or cell phone (for start and end time)
Wind gauge
Thermometer
Data sheets
Stopwatch (to time walk)
Arial net
CO2 dispenser
Extra CO_2 cartridges
Clear centrifuge "sleep" tubes (ca. 4cm diameter, with two holes drilled in cap)
Digital camera/phone for photographing difficult to ID individuals
Butterfly identification guides/sheets
Glassine envelopes
Pencils 2

Transect walk protocol:

- Prior to visiting each field site, generate random points within each site using ArcMap. Delineate 400 meters of transects on maps prior to sampling and run transects parallel to any elevation gradient; if none exists, use a random numbers table to select a compass bearing. The 400 m can be one transect or split between many transects depending on site size, shape, and prairie type. Divide the 400 m transect(s) proportionally between the represented prairie types (wet, mesic, dry) at each site. If multiple transects are required, they should be no less than 20 m apart, to avoid counting redundancy. Start transects 10 m from the edge of the site to minimize edge effects.
- Download GPS points for transects within each site onto GPS unit from computer or laptop prior to going into the field.
- Charge kill jars with ethyl acetate to prepare to collect any difficult to identify/voucher specimens.
- Before surveying, use GPS unit to locate and mark 400m of transects with flags or flagging tape.
- Record start time (from watch or phone), wind speed (from wind gauge), temperature (from thermometer), and percent cloud cover (eye estimate) on datasheet. Record end time when finished surveying transect. Surveys should be confined, when possible, between 0930 h and 1830 h when temperatures are above 18^{o} C, sustained winds are less than 17 km/h, and cloud cover is <50%.
- Start stopwatch and walk the transect at a steady pace of approx. 10m/min, identifying and recording each butterfly seen within a 5-5 m box to the front (2.5m on either side) (Shepherd and Debinski 2005; Davis et al. 2007; Vogel et al. 2007; Davis et al. 2008; Kadlec et al. 2012). Butterfly activity can be recorded if of interest. The stopwatch should be stopped to process and record individuals, and total survey time on the clock should be 40 minutes. An aerial net can be used to catch and to identify butterflies, or the following methods can be used:
  - The CO_2 method: net the butterfly, place in a sleep tube and give a light pulse of CO_2 to knock it out, then identify or photograph butterfly for later identification. Butterflies should be removed from sleep tube as soon as they have ceased moving to prevent any harm and identified or photographed in hand. Recovery takes 30 seconds to a few minutes, after which butterfly will fly away.
  - Collection: Butterflies can be collected for further identification in lab or as voucher specimens. Place each butterfly into its own glassine envelope with unique number (initials + polygon ID + transect number), time of capture and % open sky, and place the envelope in a kill jar charged with ethyl acetate. Keep collected butterflies in a freezer until you are ready to process them.

Observational walk protocol:

- An observer-directed opportunistic walk is useful for documenting species not seen during the course of the transect walk. This data should not be used for relative abundance, but it can be a good way to detect additional species present at a site, including rare species.
- Survey time can vary based on site size, shape, and habitat quality, but should always be recorded as a measure of effort. A minimum survey time of 30 minutes for small sites is a good place to start. Record start and end time, wind speed, temperature, and percent cloud cover. Record each additional butterfly species seen and add to the species list for each site.
- Identification methods are the same as those mentioned above. Place any collected butterflies in freezer until you are ready to process them.

References:

Davis, J. D., Debinski, D. M., Danielson, B. J. (2007) Local and landscape effects on the butterfly community in fragmented Midwest USA prairie habitats. Landscape Ecology 22:1341-1354.
Davis, J. D., Hendrix, S. D., Debinski, D. M., Hemsley, C. J. (2008) Butterfly, bee and forb community composition and cross-taxon incongruence in tallgrass prairie fragments. J Insect Conserv. 12:69-79.
Kadlec, T., Tropek, R., Konvicka, M. (2012) Timed surveys and transect walks as comparable methods for monitoring butterflies in small plots. J Insect Conserv. 16:275–280.
Murphy, D. D., Weiss, S. B. (1988) A Long-Term Monitoring Plan for a Threatened Butterfly. Conservation Biology 2: 367-374.
Pollard, E. (1977) A method for assessing changes in the abundance of butterflies. Biol. Conserv. 12:115–134.
Pollard, E., Yates, T. J. (1993) Monitoring butterflies for ecology and conservation. The British butterfly monitoring scheme. Institute of Terrestrial ecology and joint nature conservation committee. Chapman and Hall, London, United Kingdom.
Shepherd, S., Debinski, D. M. (2005) Evaluation of isolated and integrated prairie reconstructions as habitat for prairie butterflies. Biol. Conserv. 126:51-61.
Swengel, A.B. (1996) Effects of fire and hay management on abundance of prairie butterflies. Biol. Conserv. 76:73–85.
Swengel A. B., Swengel, S. R. (2013) Decline of *Hesperia ottoe* (Lepidoptera: Hesperiidae) in Northern Tallgrass Prairie Preserves. Insects 4:663-682.
Vogel, J.A., Debinski, D.M., Koford, R.R., Miller, J.R. (2007) Butterfly responses to prairie restoration through fire and grazing. Biol. Conserv. 140:78–90.

BUTTERFLY CHECKLIST (Following two pages)

Lebanon Hills Regional Park – Insect Survey Plan

	Common Name	***Scientific Name***	**Generalist**	**Prairie**	**Forest**	**Wetland**	**Comments**
	Abbott's sphinx	*Sphecodina abbottii*			x		
	Acadian Hairstreak	*Satyrium acadica*				x	
	Achemon sphinx	*Eumorpha achemon*			x		
	American Copper	*Lycaena phlaeas*	x				Often found in disturbed areas
	American Dagger Moth	*Acronicta americana*			x		
	American Lady	*Vanessa virginiensis*	x				
	Aphrodite Fritillary	*Speyeria aphrodite*	x				
	Artichoke Plume Moth	*Platyptilia carduidactyla*	x				
	Astyanax' Red-spotted Purple	*Limenitis arthemis astyanax*		x	x		
	Baltimore Checkerspot	*Euphydryas phaeton*				x	Larval host plant: *Chelone glabra*
	Banded Hairstreak	*Satyrium calanus*			x		
	Banded Tussock Moth or Pale Tiger Moth	*Halysidota tessellaris*			x		
	Barred Itame	*Macaria subcessaria*			x	x	
	Beautiful Wood-nymph	*Eudryas grata*		x	x		
	Black Dash	*Euphyes conspicua*				x	
	Black Swallowtail	*Papilio polyxenes*		x			
	Black Witch	*Ascalapha odorata*	x				
	Black-banded Brocade	*Oligia modica*			x	x	
	Bold-feathered Grass Moth	*Herpetogramma pertextalis*	x	x	x	x	
	Branded Skipper	*Hesperia comma Common*		x			
	Broad-winged Skipper	*Poanes viator*				x	
	Bronze Copper	*Lycaena hyllus*				x	
	Cabbage White	*Pieris rapae*		x	x		
	Cecropia silkmoth	*Hyalophora cecropia*			x		
	Celery Looper Moth	*Anagrapha falcifera*	x	x			
	Checkered White	*Pontia protodice*	x				
	Chestnut-marked Pondweed Moth	*Parapoynx badiusalis*				x	
	Chickweed Geometer	*Haematopis grataria*		x			
	Clouded Sulphur	*Colias philodice*	x	x			
	Common Buckeye	*Junonia coenia*	x				
	Common Checkered-Skipper	*Pyrgus communis*	x				
	Common Idia Moth	*Idia aemula*			x	x	
	Common Sootywing	*Pholisora catullus*	x	x			
	Common Wood-Nymph	*Cercyonis pegala*	x	x	x	x	
	Confused Eusarca	*Eusarca confusaria*		x			
	Copper Underwing	*Amphipyra pyramidoides*			x		
	Coral Hairstreak	*Satyrium titus*	x	x	x		
	Dainty Sulphur	*Nathalis iole*		x			
	Delaware Skipper	*Anatrytone logan*	x	x		x	
	Delicate Cycnia or Dogbane Tiger Moth	*Cycnia tenera*		x			
	Dion Skipper	*Euphyes dion*				x	
	Double-lined Prominent	*Lochmaeus bilineata*			x		
	Dreamy Duskywing	*Erynnis icelus*			x	x	
	Dun Skipper	*Euphyes vestris*	x	x	x	x	
	Early Zanclognatha Moth	*Zanclognatha cruralis*			x		
	Eastern Comma	*Polygonia comma*			x	x	
	Eastern Tailed-Blue	*Cupido comyntas*		x			
	Edwards' Hairstreak	*Satyrium edwardsii*			x		
	Elder Shoot Borer Moth	*Achatodes zeae*	x		x		
	European Skipper	*Thymelicus lineola*		x			
	Eyed Brown	*Satyrodes eurydice*				x	
	False Crocus Geometer	*Xanthotype urticaria*		x	x		
	Five-spotted hawkmoth	*Manduca quinquemaculata*	x				predominately found in agriculture fields
	Forage Looper Moth	*Caenurgina erechtea*		x			
	Giant Swallowtail	*Papilio cresphontes*	x	x	x	x	
	Gray Comma	*Polygonia progne*			x		
	Gray Copper	*Lycaena dione*		x		x	
	Great ash sphinx	*Sphinx chersis*			x		
	Great Spangled Fritillary	*Speyeria cybele*	x	x	x	x	
	Hackberry Emperor	*Asterocampa celtis*			x	x	
	Hobomok Skipper	*Poanes hobomok*	x	x	x	x	
	Hummingbird Clearwing	*Hemaris thysbe*	x	x	x	x	
	Juniper Hairstreak	*Callophrys gryneus*			x		
	Large Lace-border	*Scopula limboundata*	x				
	Large Maple Spanworm Moth	*Prochoerodes lineola*			x		
	Least Skipper	*Ancyloxypha numitor*				x	
	Leconte's Haploa	*Haploa lecontei*			x		
	Leonard's Skipper	*Hesperia leonardus*		x			
	Little Glassywing	*Pompeius verna*			x	x	
	Little Wood-Satyr	*Megisto cymela*		x	x		
	Little Yellow	*Pyrisitia lisa*		x			
	Long Dash	*Polites mystic*		x		x	
	Maple Spanworm	*Ennomos magnaria*			x		
	Maple Zale	*Zale galbanata*			x	x	
	Meadow Fritillary	*Boloria bellona*				x	
	Mexican Yellow	*Eurema mexicana*		x			
	Milbert's Tortoiseshell	*Aglais milberti*			x	x	

Lebanon Hills Regional Park – Insect Survey Plan

	Common Name	*Scientific Name*	Generalist	Prairie	Forest	Wetland	Comments
	Milkweed Tussock Moth or Milkweed Tiger Moth	*Euchaetes egle*		x			
	Modest sphinx	*Pachysphinx modesta*				x	
	Monarch	*Danaus plexippus*	x	x	x	x	Where milkweed is present
	Mottled Duskywing	*Erynnis martialis*			x		
	Mourning Cloak	*Nymphalis antiopa*	x	x	x	x	
	Mulberry Wing	*Poanes massasoit*				x	
	Nevada buckmoth	*Hemileuca nevadensis*				x	
	Northern Broken-Dash	*Wallengrenia egeremet*		x			
	Northern Burdock Borer Moth	*Papaipema arctivorens*		x			
	Northern Cloudywing	*Thorybes pylades*		x			
	Northern Crescent	*Phyciodes cocyta*		x			
	Northern Pearly-eye	*Enodia anthedon*			x		
	Orange Sulphur	*Colias eurytheme*		x			
	Orange-tipped oakworm moth	*Anisota senatoria*			x		
	Painted Lady	*Vanessa cardui*	x	x			
	Pandorus Sphinx	*Eumorpha pandorus*			x		
	Pearl Crescent	*Phyciodes tharos*	x	x	x		
	Pearly Wood-nymph	*Eudryas unio*				x	
	Peck's Skipper	*Polites peckius*		x		x	
	Pepper and Salt Geometer	*Biston betularia*			x	x	
	Pink-barred Pseudeustrotia	*Pseudeustrotia carneola*	x				
	Pink-edged Sulphur	*Colias interior*			x	x	Larval hostplant: blueberry
	Polyphemus moth	*Antheraea polyphemus*			x		
	Question Mark	*Polygonia interrogationis*			x		
	Red Admiral	*Vanessa atalanta*	x	x	x		
	Red-spotted Purple or White Admiral	*Limenitis arthemis*			x		
	Regal Fritillary	*Speyeria idalia*		x			Potential restoration to park
	Ruby Tiger Moth	*Phragmatobia fuliginosa*	x	x			
	Sachem	*Atalopedes campestris*	x	x			
	Salt Marsh Moth or Acrea Moth	*Estigmene acrea*	x		x		
	Silver-bordered Fritillary	*Boloria selene*				x	
	Silver-spotted Skipper	*Epargyreus clarus*		x			
	Silvery Checkerspot	*Chlosyne nycteis*			x	x	
	Southern Cloudywing	*Thorybes bathyllus*	x	x			
	Spiny oakworm moth	*Anisota stigma*			x		
	Spring Azure	*Celastrina ladon*	x	x	x		
	Spurge hawkmoth	*Hyles euphorbiae*	x	x			Introduced from Europe to control leafy spurge
	Striped Hairstreak	*Satyrium liparops*			x		
	Summer Azure	*Celastrina neglecta*	x	x	x		
	Tawny Emperor	*Asterocampa clyton*			x		
	Tawny-edged Skipper	*Polites themistocles*	x	x			
	The Bruce Spanworm	*Operophtera bruceata*			x		
	The Infant	*Archiearis infans*			x		
	Tiger Swallowtail	*Papilio glaucus Eastern*			x		
	Two-spotted Skipper	*Euphyes bimacula*				x	
	Ultronia Underwing	*Catocala ultronia*			x		
	Unarmed Wainscot	*Leucania inermis*	x				Larval host plant: nonnative orchard grass
	Unexpected Cycnia*	*Cycnia inopinatus**		x			Larval host plant: *Asclepias* (milkweed) species
	Unicorn Caterpillar Moth	*Schizura unicornis*			x		
	Variegated Fritillary	*Euptoieta claudia*	x	x			
	Viceroy	*Limenitis archippus*			x	x	
	Virgin Tiger Moth	*Grammia virgo*	x	x			
	Virginia Ctenucha	*Ctenucha virginica*				x	
	Virginian Tiger Moth or Yellow Woolybear Moth	*Spilosoma virginica*			x		
	White Admiral or Red-spotted Purple	*Limenitis arthemis arthemis*			x		
	White-dotted Prominent	*Nadata gibbosa*			x		
	White-lined Sphinx	*Hyles lineata*	x	x	x		
	White-marked Tussock Moth	*Orgyia leucostigma*			x		
	Yellow-headed Cutworm Moth	*Apamea amputatrix*	x	x	x		
	Zebra Caterpillar Moth	*Melanchra picta*	x		x		
	Giant Eucosma Moth	*Eucosma giganteana**		X			restricted to cup plant as host plant

	highlighted are moth species

*habitat information unavailable

Lebanon Hills Regional Park Butterfly Monitoring Supplies and Instructions

Field Monitoring Supplies Checklist:

☐ Field Maps
☐ Butterfly Species Checklist
☐ Butterfly ID Field Guides
☐ Data Sheets
☐ GPS
☐ Wind Gauge
☐ Stop watch, wrist watch or phone to record time
☐ Pencils/Pens
☐ Clipboard
☐ Measuring Tape
☐ Marker flagging/tape
☐ Camera
☐ PPE (I.e. Field clothes, water, sunscreen, first aid kit, etc.)

Butterfly Monitoring Data Sheet and Instructions

Lebanon Hills Regional Park Butterfly Monitoring Data Sheet Date______________

Observer________________________________ Transect Location/ID______________________Transect Sample # (for repeat visits on 1 day) _________

Habitat Type____ Start time__________ End Time__________

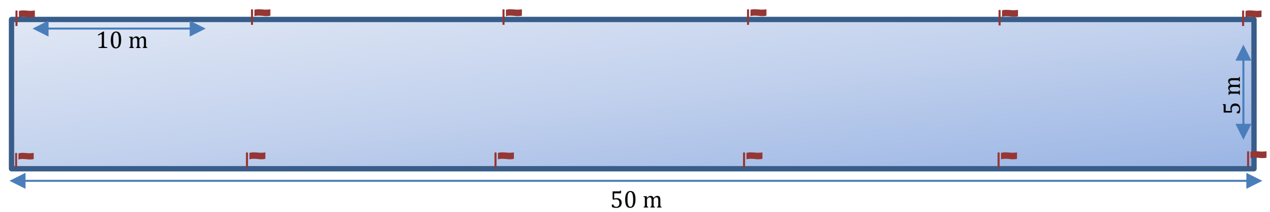
Temp (°F) _____ Wind Speed (mph)_____ Wind Direction (i.e. NW, E) ____ Sky condition (i.e. clear, cloudy, overcast)_________ Cloud Cover (%)_______

Species Name	Common Name	Number of Individuals	Comments

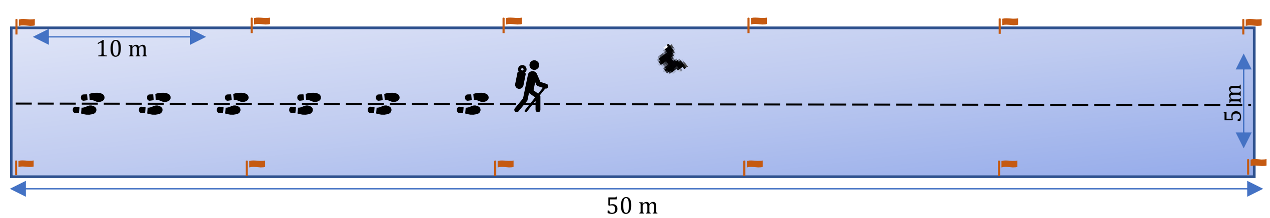
Additional Field Observations/Comments:

Instructions for Butterfly Monitoring Data Sheet, as outlined by Debinski *et al*. 2000 Protocol

Prior to sampling: A day before sampling is to occur, place a marker flag at the start of the transect at each boundary edge of the 5-meter width transect and proceed to flag every 10 meters along the total transect length**.** Take time to look over field maps or aerial images to become familiar with transect locations.



During sampling: Be sure to fill out the data sheet with supplementary information (i.e. date, observer, weather, start time) before walking transect. Walk down the middle of the transect at a pace of approximately 3 meters (10 ft) per minute. At this pace, you should spend a little over 3 minutes between flagged 10-meter intervals. Use a timer (i.e. stopwatch, wrist watch, phone) to keep track of your pace. The observer can stop their timer when additional time is needed to capture and identify individuals or when a large number of individuals is encountered. Identify all butterflies you encounter along the transect and record the numbers of individuals observed on the data sheet. When possible, record species names. Individuals that can't be identified in flight can be captured using a standard butterfly net and identified. If you can't make a positive ID of a butterfly, record the individual as an "unknown." The observer can also take a picture of the "unknown" to confirm identify later. The observer should take detailed field notes to accurately record pictures taken. Record end time when finished walking transect and record any additional observations or comments (i.e. rare/endangered species, plant community data). Repeat the transect walk as necessary (typically six times during a sample visit); allow a minimum of 15 minutes to elapse between transect counts. For repeat transect walks, record your visit number in the supplementary information at the top of the data sheet (i.e. visit #1, 2, 3, etc.).



10.8. Appendix H. Fish Survey Protocol

Lebanon Hills Fisheries Survey Plan

The following plan is designed for lakes in Lebanon Hills Regional Park.

December 20, 2018

Prepared for:

Dakota County

Prepared by:

Anna Varian

Fisheries Survey

The five largest lakes in the Lebanon Hill Regional Park (LHRP) are Jensen, Holland, O'Brien, McDonough, and Schulze (Schulze) (the Project). Jensen, Holland and Shultz lakes are shallow with abundant vegetation. McDonough Lake is the only deep lake in LHRP with extensive areas of vegetation in the littoral zone. A brief survey history of each lake is provided below:

<u>Holland Lake</u>

Holland Lake is surveyed every 12 years by the DNR and stocked with rainbow and brown trout. Aeration of the lake began in 2012. Largemouth bass were first detected in Holland Lake during the DNR's 2013 survey. Species caught during the last survey include: black crappie, bluegill, hybrid sunfish, largemouth Bass, northern pike, pumpkinseed, and green sunfish. DNR surveys have been conducted in 1975, 1980, 1985, 1990, 1995, 2001, 2007, and 2013.

<u>Jensen Lake</u>

Jensen Lake has no history of fish surveys.

<u>O'Brien Lake</u>

O'Brien Lake was surveyed in 2015 with seines and multiple minnow species were found.

<u>McDonough Lake</u>

McDonough Lake was first surveyed by the DNR in 2015 and will be surveyed every 5 years. McDonough is managed by Fishing In the Neighborhood and is stocked with bluegill and black crappie. Aeration of the lake began in 2012. Species caught during the 2015 survey include: black bullhead, bluegill, green sunfish, and pumpkinseed.

<u>Schulze Lake</u>

Schulze Lake was also surveyed in 2015 with seines, species found include: black bullhead, green sunfish, pumpkinseed, and multiple minnow species.

Sampling Methodology

The survey methods developed for this project are designed to sample a representative portion of the fish population, capture a variety of species and sizes of fish in the Project lakes, and minimize the effects vegetation can have on survey results. The five Project lakes are all relatively small in comparison to most MN DNR surveyed lakes and lack boat ramps or other access points suitable for larger, heavier boats. The methods and gear used in this survey plan are similar to MN DNR standard fish survey methodology, however they have been altered and adapted to the sampling challenges of the LHRP lakes (Schlagenhaft 1993). Level of effort and methods reflect the lake attributes and limited boat access. The index survey protocols provided here repeat the same sampling methods and timing constraints as previous MN DNR surveys. This will reduce sampling variability and allow for the monitoring of population trends throughout time. Survey design and methods are explained in more detail in the section below.

Permitting

A MN DNR permit is required for the proposed sampling work. This application will be developed and submitted prior to the start of sampling. Applicable sampling permit applications are available on the MN DNR website and will be submitted to the appropriate regional fisheries resource office.

Survey Design and Methods

A successful index survey requires standardized gear and methods to reduce variability between sampling periods. Sampling stations, effort, and time of year must remain consistent from year to year. Fish behavior, travel and feeding patterns and location related to specific habitat types, change seasonally and with age. Consistent, repeatable sampling protocols will help reduce any sampling bias.

Spring (May to early June) sampling is recommended for LHRP lakes to reduce the effects thick vegetation can have on capture efficiency. Water surface temperatures should be between 55 and 70° Fahrenheit. The MN DNR's previous index surveys of McDonough and Holland Lakes occurred in July, surveying McDonough and Holland in the spring rather than July will yield different results and the surveys will not be directly comparable. McDonough Lake has only been surveyed by the DNR once and starting a new baseline survey in the spring will not set back the history of data far and will likely yield better catch efficiencies. Holland Lake has been sampled several times by the DNR in July, the survey history dates back to 1975, continuing surveys in July will allow the data to be comparable.

MN DNR Fisheries Special Publication 147, Manual of Instructions for Lake Survey (Schlagenhaft 1993) and any subsequent editions should be used as a reference for sampling procedures.

All survey locations should be chosen carefully during the initial survey and the same location should be used in following years. Additionally, initial survey dates should be chosen during a time period that crew workload can accommodate in following year. GPS location, description of site, water depth, and photos are recommended to help ensure nets are set in the same location survey to survey. Areas of dense vegetation and steep lake bottom contours will be avoided.

Recommend surveying each lake every five years (or more often) to monitor fish population status. If management or maintenance practices of any of the lakes change (i.e. aeration, new stocking, etc.) multiple surveys should be conducted before and after to track any changes in fish populations due to the change. Additionally, the discovery of an invasive fish species may also prompt additional surveys.

Gear Description

Setting and pulling trap nets, gillnets, and seines will require a crew of two or more people and a boat.

Trap Nets

Standard MN DNR trap nets are 3' tall by 6' wide with a 40-foot lead with ¾ in mesh, lead lines can vary slightly. Trap nets should be set perpendicular to shore with the end of the net fully submerged. Shallow water may hinder the entire net from being submerged; however, the throat, or funnel in which the fish swim through, must be submerged to operate properly. Trap nets should be set in less than 8 feet of water, if there is a steep drop off the net can be set at an angle. A line and stake or tree can be used to tie the lead end to shore while an anchor and float will be necessary for the end of the net. Trap nets should be set for approximately 24 hours in the same location on two consecutive nights (but checked daily). Trap nets should be set to sample a variety of habitats (consider vegetation, shoreline and depth contours, bottom substrate, and shoreline land use). See Schlagenhaft (1993) for details on how to properly set a trap net.

Gillnets

Standard MN DNR gillnets are 250 feet long, 6 feet tall, with 5 different mesh sizes. Each net contains 50 feet of 3/4", 1", 1 ¼", 1 ½", and 2" bar mesh made of monofilament. Gillnetting is the recommended method to catch fish in off shore areas. Gillnets should be set in water deep enough to completely submerge the net and should be pulled tight to fish effectively. A wooden bridle attached to each end of the net with an anchor and float are necessary to set and retrieve the net. Gillnets should be set overnight and pulled the next day. See Schlagenhaft (1993) for details on how to properly set a trap net. Gillnets should be set for approximately 24 hours.

Gillnets usually cause mortality for most or all fish captured, disposal of fish should be planned ahead of survey; burial, compost or disposal in a remote area is recommended. Disposal of fish carcasses in small shallow lakes is not recommended.

Seines

A standard MN DNR seine is 5' deep, 50' long with ¼" mesh bag. A smaller seine may be more efficient if obstacles such as vegetation, rocky bottoms, and woody debris are expected. Seining targets smaller fish that would not be captured in a trap net or gillnet. Two seining methods are recommended; seining parallel to shore or perpendicular to shore. Seining parallel to shore is recommended over perpendicular; however, if obstacles limit parallel seining then perpendicular can be used. A parallel seine pull should be 100 linear feet along the shoreline, a perpendicular seine pull should be up to 100 feet if practical. A minimum of 3 stations are recommended.

Boat electrofishing

Boat electrofishing of shoreline habitat is recommended to effectively sample bass; however, given the difficulty of launching a boat electrofishing unit without a boat ramp, it is recommended that this survey method be used if boat launch improvements are made or a small portable boat electrofishing unit if available. If this opportunity arises the standard netting survey should also be conducted in the same year.

Boat electrofishing surveys should be conducted at night in either the spring or fall when water temperatures are between 55 and 70^{o}F. Lakes in LHRP are small enough that the entire shoreline should be sampled.

Minnow traps

Minnow traps are an optional survey method. Setting and retrieval are simple and quick, they should be set in shallow (less than 4 feet) water in a variety of habitats. Setting minnow traps throughout the summer can be a useful method to monitor for aquatic invasive species (AIS) and monitor natural reproduction of AIS if discovered.

Aquatic Invasive Species

To reduce the chance of transporting Aquatic Invasive Species (AIS) between lakes, it is recommended that all gear be cleaned of any coarse debris and dried, preferably in the sun for a week before using in another body of water. Using bleach to clean nets is not recommended due to its corrosive nature, but may be used on boats, holding tanks, measuring boards etc.

Lake Specific Recommendations

Lake	**Trap Net Sets**	**Gillnet Sets**	**Seines**
Holland	8	1	4
Jensen	8*	1	4
McDonough	4	Not recommended	3
O'Brien	8*	1	4
Schulze	4	Not recommended	3

*See recommendations below.

All lakes should be surveyed on a five-year (or less) rotation. Initial surveys may require additional net sets to determine the best location for future surveys. Trap nets should be set for 24 hours in the same location on two consecutive nights (but checked daily).

Holland Lake

Surveys in Holland Lake can be carried out in the spring to compare to other LHRP lakes and/or in July in order to compare to previous DNR surveys. Previous MN DNR sampling data on Holland Lake indicates bluegill, largemouth bass, and northern pike have below average growth. Aging structures of these species should be collected during every survey to monitor changes in growth patterns. Largemouth bass where only recently discovered in the lake and the population may still be growing and changing the food web. Holland Lake is the first priority for boat electrofishing if the opportunity arises. If changes in growth are not seen as the Largemouth Bass population stabilizes a diet, habitat, and/or creel survey may be needed to determine the cause of slow growth in this lake and management options should be discussed with the DNR. If gill net mortality is higher than a comfortable level gill netting can be reduced to short sets of one hour a few times during the day. Evaluate to see what effect trout are having on the fishery as a whole.

Jensen Lake

A bathymetry survey and creation of a contour map for Jensen Lake prior to the initial survey will be helpful in identifying net set locations. Jensen Lake has no history of fish surveys, additional netting during the initial survey may help determine which species are residing in the lake. Aging structures from all gamefish should be collected to determine growth. If game fish are not found in Jensen Lake, trap netting efforts can be reduced. A dissolved oxygen profile collected during winter months will also provide insight as to which species will survive in the lake. If gill net mortality is higher than a comfortable level gill netting can be eliminated or reduced to short sets of one hour a few times during the day.

McDonough Lake

McDonough Lake is stocked with bluegills and black crappie, these species should be aged to monitor and evaluate growth, and success of stocking. The DNR identified vegetation as a limiting factor to trap netting efficiency during their July survey, conducting index netting in the spring preceding heavy vegetation growth may reduce this factor but survey results will not be comparable. Work with DNR to stock with bass, which are the best option for establishing a predatory fish populations in this shallow, weedy lake, which will help keep the smaller fish species' populations in check.

O'Brien Lake

O'Brien has little history of fish surveys, additional netting during the initial survey may help determine which species are residing in the lake. If game fish are not found in O'Brien Lake, trap netting efforts can be reduced. If gill net mortality is higher than a comfortable level gill netting can be eliminated or reduced to short sets of one hour a few times during the day. A dissolved oxygen profile collected during winter months will also provide insight as to which species will survive in the lake.

Schulze Lake

Very little surveying has been conducted in Schulze Lake, additional netting during the initial survey may help determine which species are residing in the lake. Aging structures from all gamefish should be collected to determine growth. A dissolved oxygen profile collected during winter months will also provide insight as to which species will survive in the lake.

Data Analysis

At a minimum a summary of the survey and catch should be written up for each survey on each lake. The survey report should include information on survey components such as: dates, water temperature, crew, gear used, and a section discussing any issues with the survey or future recommendations. Additionally, a summary of the catch should be included in the report including: species caught, catch per unit effort (number of each species caught in each net), average length and weight, and a length frequency distribution. If fish are aged, a length at age should be reported. The report should compare these results with previous years.

References

Schlagenhaft, T. 1993. Manual of instructions for lake survey. Minnesota Department of Natural Resources Division of Fish and Wildlife, Section of Fisheries. Special Publication No. 147. Available: https://www.dnr.state.mn.us/publications/fisheries/special_reports.html

Field Procedures

Data collection

The following appendices will assist in preparation for field work. See Appendix B for a list of gear to bring with during sampling, Appendix C for lake maps, and Appendix D for data sheets.

"Write in the rain" paper is recommended for collecting data, and all datasheets should be scanned immediately after returning from the field.

Fish Sampling

All fish captured should be identified, counted and examined for external parasites, signs of disease or deformities. Length measurements should be collected to the nearest mm and weight to the nearest gram. Scales collected for age structure determination should be placed in an envelope marked with the fish species and a unique fish ID number.

Individual lengths and weights should be collected from all game species. If large numbers of fish are encountered a minimum of 5 fish of each game species from each 10 mm length group up to 300 mm and 10 fish from each 25 mm group for all fish over 300 mm should be weighed. Collecting individual weights on a portion of the catch eliminates the need for bulk weights. Subsampling reduces the amount of time required to process catch when large numbers of fish are collected but can introduce bias. Subsampling should be used for non-game fish and if large numbers of panfish are collected in each net (>25-50). When appropriate, a random sample of 25-50 non-game or panfish should be measured per net and the rest of the fish counted. Consider collecting individual data on a larger number a fish early during the survey to ensure enough data is collected in case catch rates in remaining locations are low.

Age structure should be collected from game fish species of interest to examine growth. Length, weight, and if possible, sex should be collected from all fish an aging structure is collected from in order to determine length at age. Scales can be collected with a knife by pressing the blade perpendicular to the fish and scraping in a rearward motion, slide the scales off the knife directly into a scale envelope. Scales from bass, perch and sunfish should be collected in the area behind the pectoral fin and below the lateral line, scales from pike should be taken from nape of the neck. Aging northern pike is more accurate with the cleithrum but this requires mortality and should be collected on dead specimens. It's important to record as much information relating to the fish on the scale envelope (length, weight, lake, etc.) in case data is lost. Scales should be collected from 5 individuals from each 10 mm length group. Reading aging structures should be conducted by a trained individual.

Identification of fish can be difficult. The Wisconsin Fish Identification Database found here: http://www.seagrant.wisc.edu/home/Default.aspx?tabid=604 is a great source, they also have a mobile app.

Gear List

Setting Nets

Nets

Data sheets

Thermometer

GPS

Depth finder

Anchors: at least one per trap net and two per gillnet

Floats: at least one per trap net and two per gillnet

Stakes for tying down trap nets

Pulling Nets

Data sheets

Camera

Measuring board

Small dip nets

Scale

GPS

Thermometer

Knife

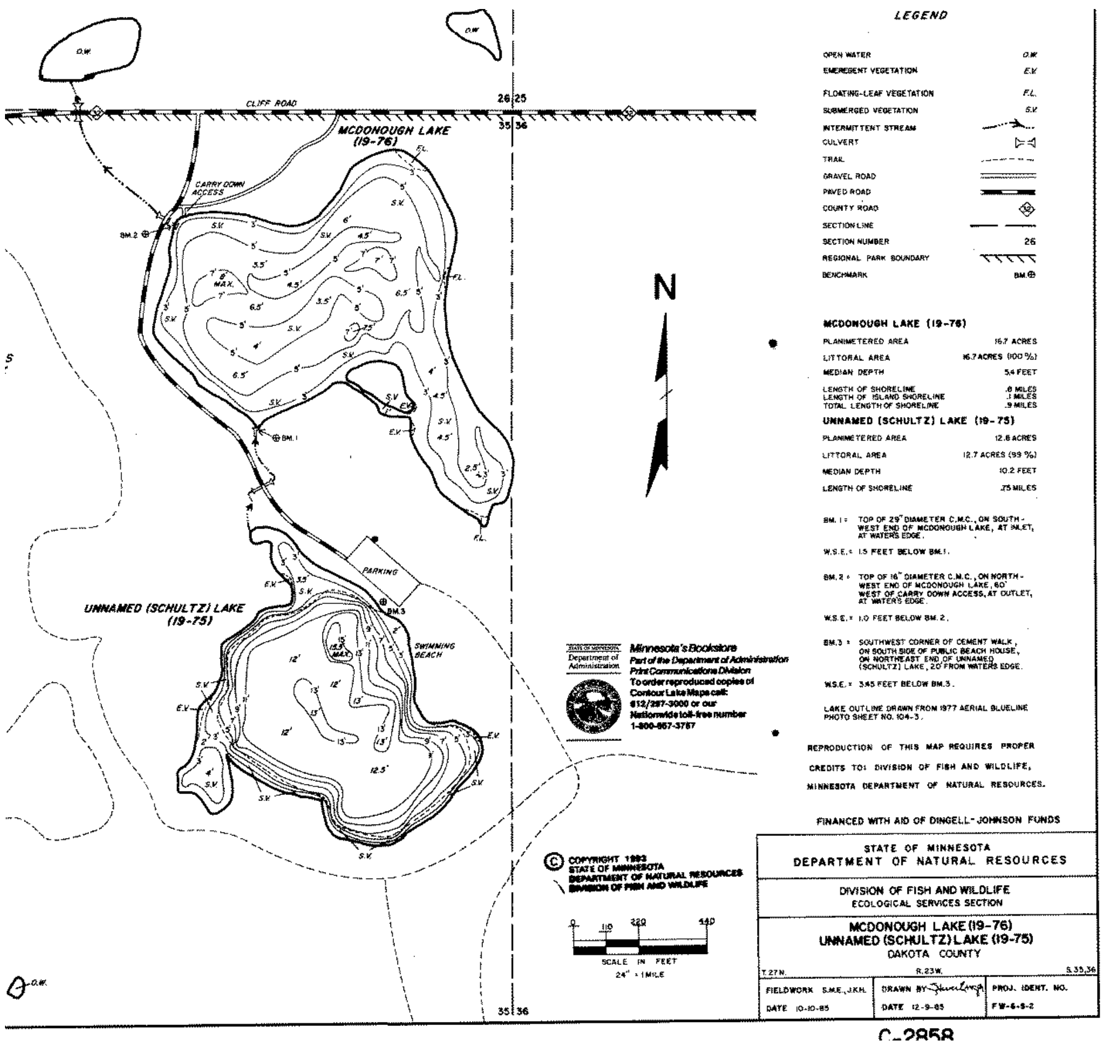
Holding tanks

Scale envelopes

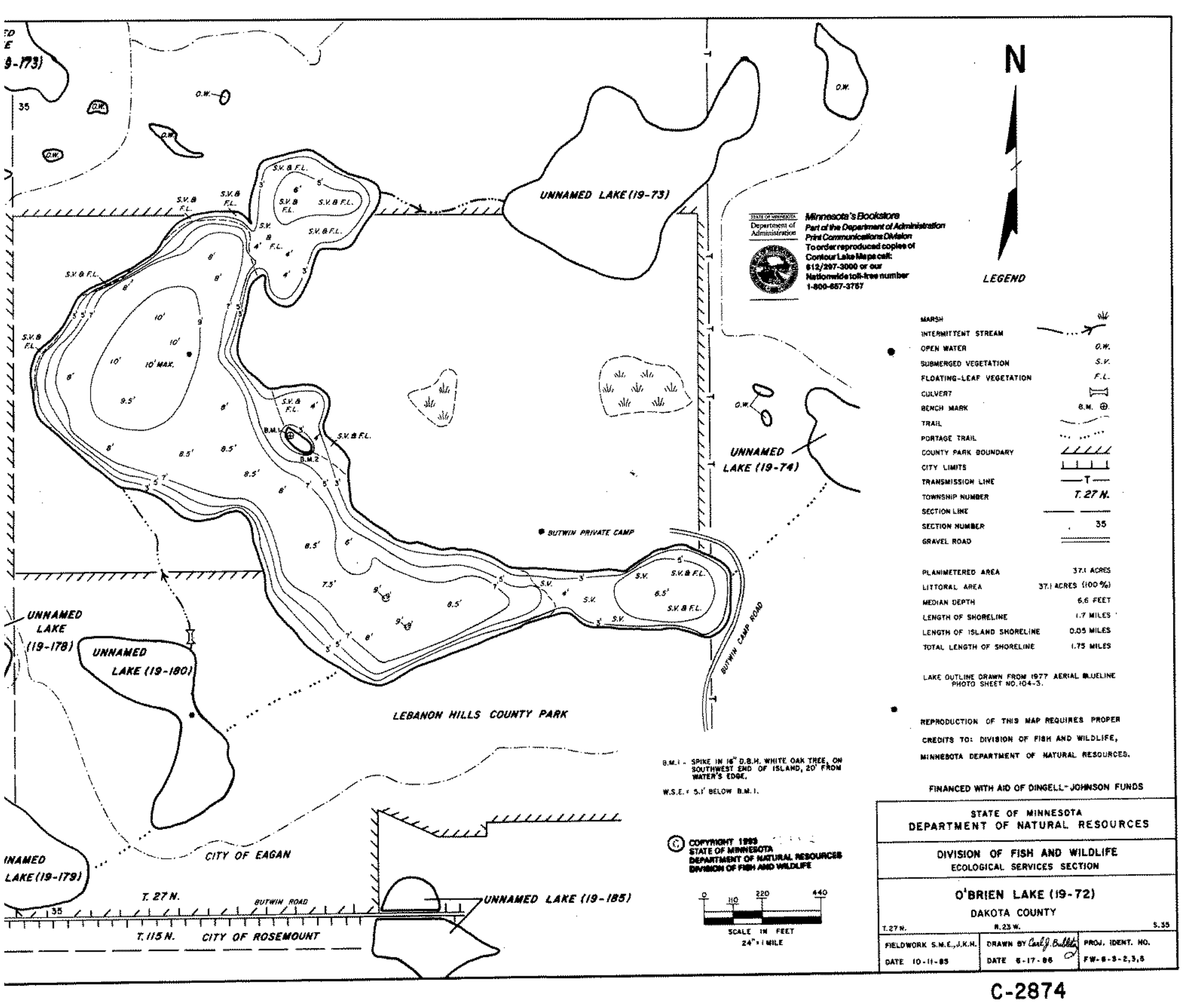
Taxonomic key

Lake Maps

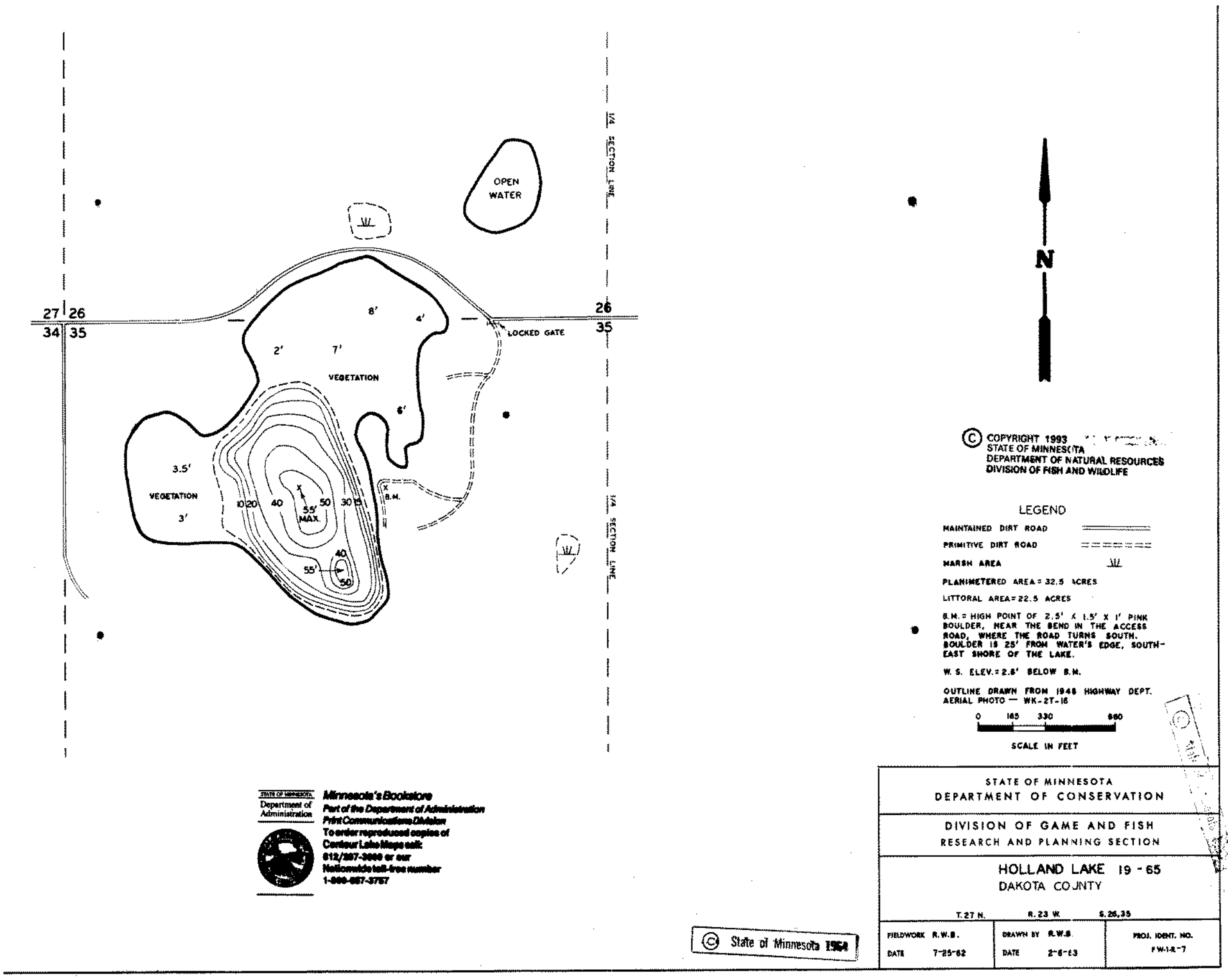
McDonough and Schulze



O'Brien



Holland


OPEN WATER
27 26
34 35
26
35
LOCKED GATE
1/4 SECTION LINE
8'
4'
2'
7'
VEGETATION
6'
3.5'
VEGETATION
3'
10 20 40
55' MAX
50 30 15
B.M.
40
55'
50
N
© COPYRIGHT 1993
STATE OF MINNESOTA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISH AND WILDLIFE
LEGEND
MAINTAINED DIRT ROAD
PRIMITIVE DIRT ROAD
MARSH AREA
PLANIMETERED AREA = 32.5 ACRES
LITTORAL AREA = 22.5 ACRES
B.M. = HIGH POINT OF 2.5' X 1.5' X 1' PINK BOULDER, NEAR THE BEND IN THE ACCESS ROAD, WHERE THE ROAD TURNS SOUTH. BOULDER IS 25' FROM WATER'S EDGE, SOUTH-EAST SHORE OF THE LAKE.
W. S. ELEV. = 2.8' BELOW B.M.
OUTLINE DRAWN FROM 1948 HIGHWAY DEPT. AERIAL PHOTO — WK-2T-18
0 165 330 660
SCALE IN FEET
STATE OF MINNESOTA
DEPARTMENT OF CONSERVATION
DIVISION OF GAME AND FISH
RESEARCH AND PLANNING SECTION
HOLLAND LAKE 19 - 65
DAKOTA COUNTY
T. 27 N. R. 23 W. S. 26,35
FIELDWORK R.W.B. DATE 7-25-62
DRAWN BY R.W.B. DATE 2-6-63
PROJ. IDENT. NO. FW-1-R-7
Minnesota's Bookstore
Part of the Department of Administration
Print Communications Division
To order reproduced copies of Contour Lake Maps call:
612/297-3000 or our
Nationwide toll-free number
1-800-657-3757
© State of Minnesota 1964

10.9. Appendix I. Public Engagement and Summary of Plan Outreach and Public Comments

This is a description of the public engagement process that occurred for this plan and a summary of the comments from meetings (public, planning commission, and county board) regarding it.

Level of Engagement: Level 1, Inform and Listen

Used primarily to explain, educate, or gather information, this level of engagement is used when priorities and decisions are still being shaped. Can explain the issue, while gathering information to understand perspectives and ideas of citizens.

Stakeholders: Wilderness in the City, City of Eagan, City of Apple Valley, City of Rosemount, Valleywood Golf Course, Adjacent homeowners, Minnesota Off Road Cyclists, Equestrians, Hastings Environmental Protectors, Camp Butwin, Minnesota Zoo, Neighborhood schools, MN DNR, Lower Minnesota River Watershed Organization, Park Users, Dakota County Staff,

Impact Type: Type 3, High impact, local geographic area

Engagement Methods: face-to-face interviews, open houses, neighborhood meetings, website information, webinars, Planning Commission meetings, County Board meetings (PDC).

Public Engagement Schedule

Stakeholder Group(s)	Meeting Date	Location	Notes
Public	January 16, 2018	Visitor Center	Open House and Presentation
Dakota County Planning Commission	January 26, 2018	WSC	Planning Commission Meeting
Dakota County Board	February 13, 2018	NSC	PDC meeting
Implementing Agencies	March 6, 2018	ADC	Webinar/Skype meeting
Nonprofits and Volunteers	March 13, 2018	LHRP Visitor Center	Open House and Presentation

Park Neighbors and Adjacent Property Owners	March 20, 2018	School of Environmental Studies, Lobby	Open House and Presentation
Dakota County Businesses	April 12, 2018	Wings Financial Credit Union, Eagan, MN	“Coffee Break” open social meeting
Park User Groups	April 18, 2018	LHRP Visitor Center	Open House and Presentation
Dakota County Staff	April 25, 2018	WSC	Roundtable Discussion
Public	July 16, 2018	School of Environmental Sciences, Lobby	Open House and Presentation
Dakota County Planning Commission	July 26, 2018	WSC	Planning Commission meeting
County Board	August 14, 2018	WSC	PDC meeting
Final Review and Approval	February-July 2019		

Summary of Open House, Tuesday, January 16, 2017

There were approximately 25 people in attendance at the meeting. Many were natural resource volunteers from the Wilderness in the City nonprofit organization. Three County Board Commissioners were in attendance (Commissioner Egan, Commissioner Atkins, and Commissioner Slavik), and also one Planning Commissioner (Commissioner Graham).

The first half hour was open house style, where attendees were invited to browse and comment on posters illustrating the preliminary findings of the project, including the landform, vegetation, water resources, and wildlife of the park and surrounding area. Staff and the consultant were on hand to answer questions and to talk with the public. At 6:30, staff and the consultant provided a presentation and responded to public comments and questions. Generally, the project and associated work to date was positive and supported by attendees.

Written Comments

- The mower seems to be scalping the trail edges (where it's not flat but at an angle) – I'm concerned especially where it has moss. Not only along trail of Holland Lake, but it's especially bad each year (for 3 years) there.
- Stakeholders: MORC (mountain bikers), trail runners, equestrian users, Eagan Core Greenway, WITC.
- Erosion and streams near trails.
- Have AIS "stop, drain, dry" stickers available and even on boats (canoes & kayaks) for rent at park.
- Conduct a study on how many boats from outside the park com into the park in order to assess AIS risk.
- Star Pond work needs to clear out all the cut & fallen trees & brush left behind that both clogs & obliterates views of water bodies & streams most notably along Discovery Trail between Visitors Ctr and A-Frame. These are trees cut and just left because they aren't blocking the trail, but it is unsightly and looks like a job left undone. Secondly, we need, in recognition of the amount of water bodies unique to Lebanon, that salt cannot be used on paved trails and that we should exercise caution—addressing hikers that winter hiking at your own risk—salt would pollute (permanently), would allow for daytime melt but then refreeze at night, making matters worse. And it's a park—NOT A SIDEWALK.

Verbal Comments/Questions

Question: Who are the stakeholders that are being approached for the stakeholder meetings?

Response: several including Wilderness in the City, MORC, nearby schools, neighborhood organizations, hikers, equestrians, skiers, Dakota County staff, etc.

Comment/Question: There are some specific areas that I have seen erosion problems in the park. Shouldn't these be located and addressed?

Response: Yes, they should. Please let us know and we'll investigate them. Also, the worst erosion areas were identified during a process in the Subwatershed Study, but more can be assessed, as we find out about them.

Question: What's being done to follow up on buckthorn (BT) control in certain areas of the park like the north end? Seems like nothing has been done in several years after cutting of large-diameter shrubs.

Response: We plan on following up on all areas that were previously cut. We have a Vegetation Management contract now that includes all of these areas and they will be addressed by either brush cutting, forestry mowing, or herbicide applications. Ultimately, we would like to restore the natural community and establish a good amount of fuel-bearing plants in the ground layer that can carry a running ground fire, which will allow us to use fire as a management tool to control BT resprouts and seedlings and whips. Native grasses, sedges, and forbs will compete with BT and help "turn the tide" of buckthorn dominance of the site, thus enabling us to escape the seemingly perpetual cycle of cutting, regrowth, and cutting again.

Question: How do you propose to manage the middle and western sections of the park? Right now, they are covered with BT, and it will only get worse and do more damage to the native plant community. Shouldn't something be done sooner than later, to prevent even more degradation?

Response: Yes it should, but we need a solid plan to guide us on how and what to tackle when. That is what we are hoping to get from this plan: a set of priority areas and actions, and a work plan with action steps and estimated costs outlined.

Question: What is being done to prevent new invasive species from entering the parks? Shouldn't signage or boot cleaners or something of the like be installed?

Response: Yes it should be and is called for in the Parks AIS Plan. Signage should also be installed at various entrance points to the park and along trails. Boot cleaners don't really work that well, because people don't always use them. They can't be installed at all points where people enter, although they do provide good reminders to people that they should be cleaning invasive species off of their boots and equipment before entering the park.

Summary of Open House, July 16, 2018

Comments:

- Buckthorn removal re-establishment is there somewhere to see where and when management is taking place? It was mentioned that it would be good to post updates and a "look ahead" on the grant websites.
- One attendee commented that the plan seemed really comprehensive and she couldn't think of anything that was missing. She really appreciated the efforts made for public involvement and outreach.
- Regarding lake and stream management, is there anything in the plan regarding inlets into the park from outside sources? Thinking about sedimentation, water quality monitoring, etc.
- It would be great to have public education about restoration taking place in the park, showing what it will look like afterwards, benefits to restoration, etc. (in visitor center or sandwich displays)
- What are we doing about other invasives besides JHP and garlic mustard? After we remove those, plants like crown vetch, burdock, and plantain start to come up everywhere. Also mentioned how trail mowing opens up spots for more invasives.
    - One person mentioned trying to foster a healthy ecosystem instead of managing every single species on an individual species
    - Early detection, rapid response, and adaptive management were all brought up as strategies to include in NRMP
- Volunteers liked the idea of adopting an area of a mark to manage for all invasive species instead of spreading efforts throughout the entire park—Seems like it is difficult to see progress when it is so spread out, and it seems odd to pass by all other invasives when you are only looking for one specific plant.
- NRMP could include working with volunteers

Staff Question: Do you understand, or need clarification regarding the NRMP?

Public Response: I am under the impression that the public doesn't need to fully understand the entirety of the document, which should be left to the experts

Staff Question: Is there anything presented so far that doesn't make sense?

Public Response 1: It would be helpful to know the big picture, since we are heavy users of the park

Public Response 2: It would be helpful to have more signage in the park – and keep them updated

Public Question: Do you get pushback from park users when they see ongoing management?

Staff Response: Of course – whenever we remove trees. We assure them that we have a plan for the park and we are trying to restore native plant communities, which is the highest and most appropriate use for the park.

Public Question: What would you like to see in the park, in terms of plant community restoration?

Staff Response: Many factors are required when making decisions. For example: soils, slope, mosaic of natural communities… We want to use adaptive management to sustain the communities to make it easier to maintain into the future.

Public Question: What is the health of Jensen lake?

Staff Response: 20ft deep to 10ft deep (due to sedimentation), which is based on neighbor report. All lakes will transition – for example Empire Lake: how do we define it. Holland Lake – Abundance of predators can drive the system.

Public Question: Because of the number of lakes, is there less turnover of water?

Response: Park lakes are relatively isolated = good. This protects the lakes in the parks from outside contamination. Water does circulate, through the ground and overland, but in many places, it is regulated by a system of weirs, culverts, and also pumping stations.

Public Question: Is run-off from Pilot Knob causing issues in Jensen Lake?

Staff Response: We have been thinking about filtering water entering the lake from the south, with an iron-enhanced filter system, however this recommendation was given by engineers and needs to be incorporated into the park's ecosystem, holistically.

Public Question: What happens when Jensen Lake is no longer a lake?

Staff Response: Over about 100 or more years the regional ecosystem has been exacerbated by anthropogenic disturbance, which has increased sedimentation rates. Rates of sedimentation will decrease over time however, for example Lake Pepin – MN River is the biggest contributor of sediment. Natural erosion and prime agricultural land exposes soil which cause this. If agriculture were to cease in the MN River watershed, the problem would alleviate. Same goes for any surface watershed, as with Lebanon Hills. Most of the lakes of the park are quite shallow, and eventually they will succeed to drier communities, but this will take many decades or centuries.

Public Question: Are there problematic wildlife besides deer?

Staff Response: Anything out of balance can become a problem, which we've seen through management over the past approximately 100 years. For example: raccoons, Canada geese, etc. In order to manage nuisance wildlife, we have to treat the causes, not just the symptoms.

Public Question: Do you think EAB will be a problem?

Staff Response: We have inventoried all of our ash trees. One management technique is to find large individuals and inject them, but this will be focused on large trees near trails or structures. We may still need to remove a certain percentage that potentially could be hazardous, near trails and structures. Since we know that less than 1% will have resistance, we don't want to remove all of the ash trees. A good option for trees in remote and natural areas of the park is to release bio-control to help keep the beetle's population in control. Injection and removal of trees in remote natural areas will not be a management option.

Staff Question: Are the any final comments/concerns?

Public Response: None

Summary of Stakeholder Meeting for Neighbors of the Park, March 20, 2019, at the School of Environmental Studies

Lebanon Hills Regional Park stakeholders were presented with detailed information about Phase I of the NRMP development (the findings), ecological background information of the park and current restoration projects that are happening within the park. Natural Resources Staff provided information about the planned restoration work and the scientific basis for those plans. After this presentation, which also included information about the geologic and ecological history of what is now Dakota County, stakeholders were free to comment and ask questions.

Some questions or comments were directly related to the current management plan of LHRP, including restoration projects that began in the last couple of years.

- I live near the Dakota Lake I project, and there was a ton of noise in the last year. I have no clue what the noise came from or why there was so much.
    - A Natural Resource (NR) staff person informed the stakeholder that "the worst is over" and talked about the specific activities happening at that site, including about the machinery that was used to remove invasive shrubs.
- Will accessibility be addressed in this management plan?
    - The Master Plan might address accessibility, but the Natural Resources Management Plan for Lebanon Hills Regional Park does not. The NR staff could not speak to infrastructure changes related to accessibility.
- Will there be goats at LHRP in the future?
    - Goats used for grazing and managing weeds/invasive species are not a part of the management plan for LHRP at this point, but we are considering them for future

projects. Currently, we are using goats at Miesville Ravine Regional Park to help restore woodland and savanna.

- There was a pile of cut buckthorn stacked near the boundary of my property and the park for a long time. I was planning on mentioning that at this meeting, but the pile was finally burned.
- One stakeholder asked whether a specific pond ("Marsh Pond", "Oak Pond") and other natural areas outside of the park boundaries will be addressed in the NRMP, citing that surrounding areas are important to consider for restoration as well.
    - Those particular areas adjacent to but outside of LHRP boundaries will be mentioned in the plan, but not analyzed in depth. NR staff agreed that connectivity and restoration of more wildlife habitat is important.
- How does the management plan fit with expected effects of climate change?
    - Much of the restoration work planned for LHRP will transform degraded areas into oak savannas and prairies. These are native plant communities of the region, and as drier plant communities, will align with future drying conditions caused by climate change (the "savannafication" of Minnesota).

Other questions related to habitat restoration, ecology, and wildlife in general.

- Are you doing research on how noise impacts wildlife?
    - Dakota County NR is not currently doing research on this topic, but it is likely that others have done research and that those findings are available on the internet.
- I'm concerned about oak wilt in the park. It is in my yard, too.
    - NR staff is not currently addressing oak wilt as a main priority, but we are aware of the threat. Joe said that many years ago much effort occurred to control oak wilt, but it was not very effective. Therefore, control efforts were discontinued. Since red oaks have become over-abundant in the park, their loss due to oak wilt is not a critical concern. However, when oak wilt ramps up and spore loads are high, the risk to white and bur oaks elevates, which is a concern. Therefore, we need to review our policy on oak wilt control and address this concern—so there will be a section in the plan that addresses this.
- Do prescribed burns affect tick populations?
    - Yes, burning decreases tick populations, both directly through fire mortality, and indirectly by reducing rodent populations that are hosts for ticks. Burning is a regular component of our management plans because it is a natural part of many plant communities and is necessary for successful restoration in many cases. It also has added benefits like reducing tick populations!
- How do I find out about volunteer opportunities?
    - There is information on our website, and a Volunteer Coordinator to contact with inquiries.
- What do I do with the buckthorn in my yard or in the park adjacent to my yard?
    - Person actually was asking if it's legal to remove buckthorn from park property adjacent to her yard. It is not, but if staff is contacted, we can discuss the issue with you and arrive at a solution.

- There is a new development being proposed on the east side of Marsh Lake which will generate lots of potentially untreated stormwater that will runoff directly into Marsh Lake. What can be done about this?
    - Let's talk. Staff would like to investigate this further. We can discuss with the City.

Written Comments

1. I would like to have a guided tour of a restoration project
2. I would like to have a "life in the lakes" seminar
3. I would like to have a seminar on native plants, their importance to insects and the entire food web; and what is harmful to native plants and insects
4. I would like to have a seminar on "City Ordinance"
5. I would like to have a seminar on invasives—they are very aggressive and hard to keep up with
6. Need someone to remove the buckthorn, please.
7. Concerned that communication about burns isn't timely enough. Don't remember getting a postcard—look on the Park webpage.
8. Want a better agenda for this meeting with more detail. Thought it was an open house
9. Post presentation online.
10. We appreciated the presentation and now we understand why those gorgeous balsam firs and spruce were cut down. It would have been helpful to have had this presentation before all of this happened…maybe next time, tell us why first. Thank you.

Comments Sent to Project Manager

"I have been going to Jensen Lake for decades over the past decade or so the trails are in very poor condition due to the large volume of people walking in all weather conditions. Tree roots are getting exposed due to muddy conditions on trail and rain wash. This is a complicated issue people want year round access. But the number of people creates trenches. To upgrade the entire loop with fill could be done, but then cost is taking money from other areas. The shores need to get the excessive downed trees cleaned up this year please.

There are still two homes left on Carriage Rd a couple of weeks ago you tore down a home. What are the Counties plans personally I would like to see a couple more rentable shelters built back there where the foundations are already at."

Dakota County Planning Commission

Advisory Committee Meeting Minutes

Date: March 28, 2019

Time: 7:00 p.m. to 9:00 p.m.

Members Present				Staff Present		Others Present
Mike Greco	☒	Barry Graham	☒	Kurt Chatfield	☐	
Jerry Rich	☒	Ramraj Singh	☒	Jessica Johnson	☒	
Timothy Tabor	☒	Christopher Ross	☒	Steve Sullivan	☒	
Lori Hansen	☒	Nate Reitz	☒	Joe Morneau	☒	
Jill Smith	☒	Jim Guttmann	☒	Joe Walton	☒	
Greg Oxley	☒	Tony Nelson	☒	Tom Lewanski	☒	
Amy Hunting	☒	Donald Post	☒			

Meeting Called to Order
Time: 7:01 p.m.
By: Chair Hansen

Audience items not on the agenda

Comments/Notes: No one came forward.

Approval of agenda

Motion by: Commissioner Singh

Second: Commissioner Hunting

Vote: Unanimously approved with a note that the next meeting date needs to be corrected to April 25, 2019.

Approval of minutes (from February 28, 2019 meeting)

Motion by: Commissioner Reitz

Second: Commissioner Guttmann

Vote: Unanimously approved with corrections.

Item # 1: Lebanon Hills Regional Park Draft Natural Resource Management Plan **Action / Information**

Comments/Notes: Tom Lewanski, Natural Resources Manager, presented the Planning Commission with a review of the draft Lebanon Hills Natural Resource Management Plan (Plan), including the goals, challenges, and opportunities highlighted in the Plan. Joe Walton, Natural Resource Senior Ecologist, provided an overview of the restoration status, natural features, and management units within Lebanon Hills Regional Park and how they will be address in the Plan. The recreation and natural resource management, vegetation resources management, wildlife resource management, and water resources management recommendations and work plans included in the Plan were also presented.

Questions and comments by Commissioners along with responses from staff (italics):

- Staff was complimented on the thoroughness of the draft plan.
- The Executive Summary states over 10 miles of trails. The number should reflect over 50-miles of trails.
- The legend on page 207 needs to be revised and names cleaned up.
- Has staff looked into the use of citizens or volunteers to help keep costs down for surveys? *Yes, staff utilizes volunteers as well as the work crews within the park.*
- Are there any metrics that can be used against the plan to measure our progress to date? *Staff measures both the qualitative and quantitative aspects of restoration activities in the parks. Staff tracks the acres being restored and monitor all project sites with fixed monitoring plots to measure changes over time. Wildlife and vegetation surveys help track the quality of the plantings and wildlife restoration projects.*
- What does staff see as the most urgent challenge within the park? *Addressing the exotic invasive species (ex. buckthorn), and increasing the diversity of the natural communities in the park is a high priority.*
- A Commissioner suggested that, after five years, staff should provide a write-up of the progress to compare against the five-year goals, and then continue to have a progress report every five years.

- In the Table of Contents, the missions and goals are listed as number five when it should be at the top of the list.
- Will staff be collaborating with the Minnesota Zoo as a part of this Plan, similar to the work with Camp Butwin? *Some of the bumble bee surveys took place on their property, and staff is working with the Zoo to explore how the County and Zoo can work together.*
- How would staff manage getting buy-in from the surrounding community for best practices? *One example of what could happen is the work that is happening with Great River Energy as they place transmission lines in the park. Staff has been able to work with their pollinator team and create ways to improve pollinator corridors. Other potential ideas include working with neighbors to install rain gardens, and holding neighborhood meetings to help educate residents on other ways they can help the ecosystem.*
- What would be a key area to connect or bridge areas for ecological corridors? *The greenway system is a way to build that connectivity, and working with local units of government within their parks is a way this could be accomplished. An example that is noted in the Plan is installing 'turtle tunnels' which would create a connection for turtles through the ecosystem.*
- Are the 58-miles of trails we have in the park excessive, and do they create more of a blockage to those wildlife corridors? Is there wildlife of any size that can exist in the park that isn't frightened by the activity on the trails? *The mountain bike trails have demonstrated a sustainable approach with use of the International Mountain Bike Association sustainable standards. They have created maintained trails that prevent erosion and water quality problems.*
- It's important to keep in mind that the Plan should start with the basics and build on them to make it understandable for a general audience. Summaries could be used to address this and help speak to many different audiences.
- What is the price tag on building the Plan? *$50,000*
- What is the price tag on finishing the projects at the end of the twenty years? *The vegetation work plans amount to approximately $9 million.*
- Where is the money coming from? *Approximately 80% is coming from state grants, and when restoration begins County funding will take over.*
- Met Council funding may not be as available in future as it is now.

Motion to recommend to the Physical Development Committee of the Whole (and County Board) release of the draft Lebanon Hills Regional Park Natural Resource Management Plan for public review and comment.

Motion by: Commissioner Oxley

Second: Commissioner Greco

Vote: Unanimously approved.

10.9.1. Comments that Resulted from the 45-day Public Comment period (April-June, 2019)

1. Wilderness in the City

DATE: June 10, 2019

TO: Mr. Joseph Walton, Senior Ecologist, Dakota County Parks via email: joseph.walton@co.dakota.mn.us

FROM: Holly Jenkins on behalf of Board of Directors, Wilderness in the City via email: hollyj@wildernessinthecity.org

RE: Lebanon Hills Draft Natural Resource

Management Plan Dear Mr. Walton,

Thank you for the opportunity to comment on the draft Natural Resource Management Plan (NRMP) for Lebanon Hills Regional Park.

The draft plan does an excellent job of detailing a wealth of information and thoughtful recommendations for Lebanon Hills to reach its greatest potential with a diversity of healthy habitats. These habitats encourage a variety of species to inhabit Lebanon Hills, and create a more aesthetically pleasing and unique environment for park visitors, unlike what is available in more intensively developed parks.

We are appreciative of the steps Dakota County has already taken by surveying and inventorying existing natural resources, implementing management and restoration activities, and engaging the local community in the park through events and volunteer opportunities.

While we are pleased to support the goals and recommendations established in the draft NRMP, certain language in the plan is vague resulting in concerns over the long-term ecological health of the park. To help assure successful implementation of the plan with minimal conflict in years ahead, we suggest the following edits and additional points of clarification for the NRMP.

Suggested Edits for the NRMP

Delete language (page 1):

~~Despite the inclusion of natural resource management as an important part of each park master plan, the 2008 recession severely slowed implementation of natural resource management on County lands when providing other urgent County services became a higher priority. Municipalities across the County also cut back on natural resource~~

~~spending at this time. Because of this, the quality of the park's plant communities and wildlife habitat slowly degraded. Despite setbacks,~~ The County increased investment in natural resource management in 2013 by tripling the dedicated management staff.

Rationale: Toward the goal for increased accountability, past actions should not be misinterpreted.

- The statement implies the quality of natural resources degraded because the 2008 recession required a reallocation of funds from the parks natural resources program to other urgent county services.
- This is not entirely true as there are funding sources for parks and natural resources which cannot be re- allocated to other urgent county services, including funds from the 2008 Legacy Amendment, a conservation amendment.
- The County decided to allocate more than 85% of its parks and trails legacy appropriations for regional trail development instead of toward the goals for natural resources management program as prioritized by the then current 2001 LHRP Master Plan.
- "The delivery of regional trails was prioritized to realize the benefit of approved Federal Transportation construction grants totaling $5.8M. .... The five year funding target for Metro Council derived Park and Trail Legacy funds remains unchanged at about $5,820,000.The target is allocated to greenway/regional trails (87%) and natural resource program funding (13%). " ~ *2013 Parks CIP*
- Had these funds gone toward restoration within Forever Wild parks, rather than toward new built infrastructure, natural resources throughout LHRP would be in much better shape today.
- Going forward, we urge the County to allocate at least 50 percent of parks and trails legacy dollars to natural resource restoration projects which will improve Lebanon Hills and other parks, and meet the expectations of voters.

Insert language (page 1):

"The list of past park planning efforts includes the following: a Lebanon Hills Regional Park Natural Resources Management Plan (2000), the Dakota County 2030 Park System Plan (2008), the Lebanon Hills Regional Park Master Plans (2015, *2001, 1980*), and the County Natural Resource Management System Plan (2017) for management of parks, greenways, and conservation easements over the next 20 years."

Rationale: This section fails to acknowledge the 1980 or 2001 Lebanon Hills Master Plans and therefore misrepresents the public's investment in past planning efforts.

- Lebanon Hills has a well documented history prior to the 2015 Master Plan showing the long-held vision and public support to preserve the park as a high-quality natural destination.
- The 2015 Master Plan presumes to build from those previous plans—not disregard them, and therefore a complete record of previous master plans should be provided.

Revise and Insert language in Section 5.6, page 153:

5.6. Preserve Zone / East Segment Management:

"The Preserve Zone encompasses the largest area of the park and offers the most extensive overall ecological diversity. The area is characterized by a cross-section of all of the major plant communities, ecotonal areas, and pond/lake system that are found within the park. Given its ecological diversity relatively rugged terrain, and large land mass, this area of the park is best suited for a strong focus on outdoor education, interpretive programs, and a variety of natural trail experiences.

Although the remainder of the park is perhaps less ecologically diverse, it does not diminish its value as natural open space that is worthy of the same level of protection as that of the Preserve Zone. Throughout the park, restraint toward expanding the existing development areas is essential."

Rationale: The "East" section of the park was defined in the 2001 master plan as the *Preserve Zone*; this important concept should be respected, not disregarded. Given the context of this NRMP, it is valid to incorporate this relevant language.

Revise language on Page 217:

Additional Trails ~~per the Master Plan~~ should be evaluated for ecological impacts. If and when more trails are ~~installed~~ deemed necessary, strive to reduce their footprint and impacts as much as possible by following sustainable trail best management practices and environmentally-friendly surfaces. In the Center Segment, evaluate existing trails for sustainability; produce a trail plan and design for new trails that is more sustainable. If additional segments of trails are deemed necessary, equal distances of existing trail segments should then be removed from the system and restored. The long-term goal is to remain at, or decrease, current mileage of trails.

Rationale: A net increase in trail mileage will further degrade the park and challenge the successful restoration of LHRP. Currently there are approximately 58 miles of trails throughout the park. Trails provide great recreation opportunities for park visitors, and that has been well accommodated. Trails also fragment and divide wildlife habitat, yet that has not been given due consideration.

Insert/Edit language on Page 214

Proposed Capital Improvement Projects

- Showing due restraint for expanding the development footprint will allow the public to enjoy the park without compromising its inherent natural qualities—therefore, only those facilities necessary to support nature-based recreation and education should be considered.
- ~~If new~~ Natural resource data ~~has been collected since the 2015 master plan was adopted that indicates significant natural resource impact, this data~~ will be used ~~during the~~ to determine site selection and design process.
- Capital improvement projects that are deemed necessary should meet the highest standards for sustainability resulting in an improved, rather than diminished, natural setting.
- New CIP projects, ~~as per the approved master plan~~ will ~~tend to expand~~ occur ~~upon~~ in already existing use areas to limit potential for development creep. Thus, new use-area locations within the park should be avoided. ~~an infrequent occurrence~~. This "concentrated use-area" strategy is better suited for wildlife conservation, plant community diversity, and visitor experience.

Rationale: One of the largest threats to the beloved natural character of Lebanon Hills is expanded capital development, yet the existing language in the NRMP is very weak with regard to recommendations for capital improvements, ongoing management, and natural resource staff authority. The suggestions listed above are a starting point—the bare minimum—of what should be included in this section in order to assure that natural resources are at the forefront of decision making.

Edit page 202:

"Plan Consistency—restoration is consistent with existing plans, including infrastructure improvements proposed in the Master Plan; ~~projects with many future development impacts, for example, would rank lower.~~ Proposed infrastructure projects will be viewed through a natural resource lens to help assure impacts will be avoided.

Rationale: *"Projects with many future development impacts" should not take place within the boundaries of Lebanon Hills.* Preserving the highest remaining natural areas in the region was the basis for 1974 legislation which established the metropolitan regional parks system. These special places provide nature-based opportunities, crucial habitat for wildlife, and help to mitigate the impacts of climate change for now and future generations. More than ever, our communities benefit from natural areas, and they should not be diminished.

Edit page 231:

"The NRMSP sets an expectation of restoration work being approximately 80 percent funded by external funds. ~~Implementation will proceed as projected, but the rate may be slowed depending on whether or not the County is able to receive external grant funding.~~ If external funding falls short, the existing Dakota County Environmental Legacy Fund (ELF) and the Parks and Trails Legacy Fund will provide reliable funding sources. Thus, implementation of the NRMP can proceed as projected without needing to increases property taxes or user fees.

Rationale: Ongoing neglect to the natural resource base of Lebanon Hills is contrary to public priorities, and delayed implementation of the NRMP will result in higher costs in the future. The County has readily available funds through their Parks and Trails Legacy appropriations which alone could provide full funding for implementation of the NRMP. In years ahead, the cost to restore and manage land is minimal compared to the cost for capital development and associated ongoing maintenance expenses.

Key Points Needing Additional Clarification

"Balancing" recreation and natural resource management

(ie: page 3, Goal #9 states "Balance natural resources management with public recreation and outdoor education needs")

Historically, natural resources have been compromised in pursuit of "balancing" with recreation—in fact, many agree that management of the park has been unbalanced with respect to the natural environment. Now, the NRMP offers a critical shift. As it is implemented, decisions for future built amenities should allow natural resource management to take precedence.

- Lebanon Hills provides an abundance of recreational opportunities, including: a children's play area, a swimming beach, retreat center and facility rental, cross-country skiing, snowshoeing, camping, canoeing/kayaking/paddle-boarding, equipment rental, geo-caching, ice skating, sledding, equestrian use, mountain biking, hiking, trail running, swimming, picnicking, fishing–and more.
- Infrastructure to accommodate recreation has been the primary focus of planning and funding for decades, while management of natural resources has been neglected.
- The focus now must shift toward natural resource restoration and management, outreach and programming to achieve desired "balance."
- After the park is restored and the public has an opportunity to experience Lebanon Hills in an ecologically healthy state–only then should discussions for additional recreation development be considered.

Increase the decision-making authority of Natural Resources Staff

The plan appropriately allows Natural Resources (NR) staff to work with other departments to minimize impact of development projects. It falls short, however, in that it prescribes NR staff to identify how a project can have the least impact—essentially giving a green light to all projects despite potential impacts.

- Instead*, NR staff together with outside ecological consultants must have authority to recommend against projects*, not just determine how to make them least impactful—because sometimes *least impactful* allows extensive construction and diminished habitat.
- NR staff must be included throughout the planning process for capital development, providing natural resource data and alternative proposals, when necessary, to avoid impacts.
- Development projects, when deemed appropriate, should always leave Lebanon Hills in a better ecological state—never diminished.

Clarify "Public Vision" for LHRP

Chapter 2 of the NRMP plan references the 2030 Park System Plan as it relates to Lebanon Hills as: *"This chapter describes a vision based on what citizens most wanted from County Parks. The vision as it applies to LHRP is... Adding some paved walking and biking trails to link existing areas and lake loop trails, enhancing existing destinations, expanding four-season use, and strengthening resource stewardship."*

Additional background:

- The 2030 Parks System Plan was created by staff and consultants and envisioned Lebanon Hills as the *hub of the greenway bike network*.
- This *hub vision* swayed far from the 2001 Master Plan which by comparison was created with citizens, had broad public support, and prioritized the natural environment.
- To achieve this new "hub" vision, a Lebanon Hills master plan update was required.
- The update, a contentious two-year process, resulted in the 2015 Lebanon Hills Master Plan update which was overwhelmingly opposed by the public.

LONG-HELD VISION for LEBANON HILLS

- The original 1980 Master Plan stated "it is the intention of this report to advocate total design that will cause as little damage to the ecology of the area as possible. *Extra effort should be made to design all manmade facilities in the park to be as unobtrusive as possible to avoid adulteration of the natural beauty of the area.*
- The 2001 Master Plan vision is "to provide a balance between human use of the park and its ecological preservation and protection. *This vision reflects the simplicity of the outdoor experience being sought in the context of an ecologically healthy natural landscape."*
- *The unique, natural character of Lebanon Hills remains part of the public's vision today* based on findings from County surveys and public comments received from the 2015 Master Plan.

Public Engagement will be Crucial as Plans are Implemented in Years Ahead

As the NRMP, the 2015 Master Plan and the 2017 Visitor Services Plan are implemented in years ahead, it is crucial that the public have meaningful opportunity to participate in the process before decisions are made.

- The 2015 Master Plan serves as a concept; as it is implemented details will make a significant difference.
- There is no advisory body for Dakota County which focuses solely on parks and natural resources during the implementation phase of master plans to help ensure details adhere to public priorities.
- Meaningful public engagement throughout implementation of these plans will help to (1) ensure balance of all pertinent park services, (2) be mindful of fiscal constraints, and (3) help prevent built recreation amenities from continuing to be prioritized over natural resource management.

In conclusion, a 1994 letter to Dakota County from the DNR stated "Lebanon Hills is a significant natural resource in Dakota County because it is the last remaining large habitat of this type in northern Dakota County. It is elevated in importance each time development takes place in the surrounding area and the rest of the county." Clearly, Lebanon Hills level of importance has grown significantly since those words were delivered.

We are grateful for the efforts put forth in this Natural Resources Management Plan—a blueprint and exciting glimpse of the park's true potential—and look forward to continuing our efforts with the County to support Lebanon Hills as a top destination in the metro area.

2. Comments from Individuals

1. Maryann Passe, Eagan, MN

DATE: June 10, 2019

TO: Joe Walton, Senior Ecologist, Dakota County Parks
CC: Dakota County Board of Commissioners

RE: Lebanon Hills Draft Natural Resources Management Plan (NRMP)

I am so appreciative of the decision by Dakota County to undertake this effort and the expertise of Joe Walton, Tom Lewanski and the other natural resource staff for their professional and thorough execution and production of this proposal.

My greatest concern for this plan is Dakota County's schizophrenic management of Lebanon Hills Regional Park. On the one hand every effort is made to claim available funding to invest in the park - which has and continues to be (based on funding requests) primarily to expand built infrastructure in the park. On the other hand, excellent natural resource staff have been hired, natural resource restoration projects undertaken, and this plan developed.

I see no clear vision for the management of Lebanon Hills Park. In many, many ways the park's Master Plan, Park Visitors Plan, and this Natural resource Management Plan are in direct conflict with each other. And, all plans are written so vaguely that Dakota County decision makers can go in any direction at any time without "literally" being in conflict with any of their conflicting plans.

In the past, from my observations of county management of Lebanon Hills, I see only a lack of vision, a lack of understanding of the *gem of urban nature* that we have in Dakota County, and, in so many ways, a disregard for the public's repeated response of desiring natural resource preservation being at the top of their priority list. Yet, here the county has developed this natural resource plan that is a blueprint for the vision that should drive every decision regarding Lebanon Hills to be *Forever Wild.*

I sincerely ask the county to put some strength into this plan:

- Add precise wording that specifically prioritizes natural resource preservation whenever park projects are considered.
- Add wording that specifically empowers Natural Resource staff with decision-making in *all* consideration of projects of *any* kind in the park.
- Add wording to declare the natural resource staff as the visionary leaders of the park in charge of protecting and enhancing the natural resource treasures in Lebanon Hills over all other considerations.

Doing this does not mean there can be no projects or development within the park. It means that ***all projects and development must be undertaken through the lens of natural resource restoration and preservation***.

- YES enhance accessibility.
- YES increase visitors.
- YES add programming.

But every trail, every amenity, every project must be envisioned, planned, funded, and implemented in the name of the best Dakota County can do for Lebanon Hills natural resources.

This document is an incredible opportunity to take Lebanon Hills to its full potential as an amazing urban natural oasis. A park that so many, many other urban communities would be desperate to offer their citizens. The county's natural resource staff are some of the best in the Twin Cities - the county administrator was wise to hire them. But this document needs teeth and I am sure the Natural Resource staff knows exactly where and what wording needs to be added to get Lebanon Hills to this potential.

I encourage County management to take this opportunity, have the courage to declare natural resource prioritization as your direction, trust your incredible natural resource staff, and let them lead Lebanon Hills Park management for the next five-to-ten years. The results will be amazing and your foresight in prioritizing, restoring, and preserving Lebanon Hills natural resources will be something our community and our children will appreciate, and cities near and far will envy.

Regards,

Maryann Passe

1249 Balsam Trail E

Eagan, MN 55123

2. Mary T'Kach, Inver Grove Heights, MN

June 9, 2019

Mr. Joe Walton
Project Manager, Lebanon Hills Natural Resources Management Plan
Dakota County Western Service Center
14955 Galaxie Avenue
Apple Valley, MN 55033
Email address: joseph.walton@co.dakota.mn.us

Dear Mr. Walton:

Dakota County has a unique opportunity to restore and preserve an incredibly valuable community asset known as Lebanon Hills Regional Park however under the current proposed Natural Resources Management Plan (NMRP) for this park, too much is left to chance. Restoring and protecting the native ecosystems of this land is paramount to protecting this unique natural resource.

As a thirty-plus year resident of the county I watched the park face one development project after the other (paths, buildings, parking lots, even pipelines). Each project was a "minor" development with good intentions. Unfortunately, all these smaller good intentions have had huge unintended negative consequences and created an ecological mess. It's time to put the natural areas of Lebanon Hills Regional Park back to their pre-development condition and forgo additional development or extensive remodeling of existing buildings and parking lots until the natural areas of the park have been fully restored. This may seem unsuitable to park planners and development staff, however until funds are adequately prioritized for restoration of native ecosystems, the integrity of the park will continue to be compromised and the full NRMP cannot be realized.

I support the NRMP which emphasizes restoration and ongoing management of natural resources throughout Lebanon Hills, but the plan falls short because it does not include language that requires natural resource management to take precedent over capital development projects. I would like to see language in the NMRP that absolutely prioritizes putting restoration and protection of native ecosystems and natural resources at the core of all decision-making for Lebanon Hills Regional Park and for the Forever Wild Parks System.

This type of work will take a commitment to funding and therefore I encourage the county to use the Parks and Trails Legacy Fund, the Environmental Legacy Fund and other sources such as federal and state grants. Perhaps another land conservation/restoration type bond referendum is needed.

We have a moral responsibility to restore and protect a unique natural resource for today and for the future. I urge the board and staff to not step away from this responsibility and unique opportunity.

Sincerely,

Mary T'Kach
7848 Babcock Trail
Inver Grove Heights, MN 55077

Cc: Commissioner Joe Atkins

3. Mike Fedde, Eagan, MN

Good Afternoon,

I have the following comments on the Lebanon Hills Draft Natural Resources Management Plan (NRMP):

1. The plan should cover all of the nearly 2000 acres of Lebanon Hills. As a long time resident and visitor to Lebanon Hills I have noted that all of the park has deteriorated markedly from the state existing when I first encountered the park in the 70's. Buckthorn is the main problem. (Actually all park acreage needs work – otherwise we should turn the parks over to something like the Nature Conservancy along with the budget)
2. The hiking trails in LH are also very eroded, the newer ones as well. The crushed limestone fixes are ineffective and don't last past the next heavy rainstorm. This is putting silt in the bottom lands – additional silt.
3. No noticeable effort at controlling invasives occurred before 2013. Recession was not the cause of neglect as this has been the habit up to that point. We are doing good things today.

4. The priority of Legacy funds needs to be restoration and control of invasives. Until very recently the Legacy money was being spent on development, sometimes grandiose and unneeded.
5. Development projects need to be compatible with preserving the ecological goals of the public.
6. Almost all present recreation in the park requires ecological management be it swimming, fishing, hiking, skiing, birdwatching, and so on. The only major investment that is not ecological is the RV campground. This is paid for by the taxpayers and used by visitors many of whom are 6 months and a day tax avoiders. For the most part the campground is a country unto itself with respect to the park. They don't stray far from their vehicles.

In summary I am very happy that there is a project to address invasives and restore the park to a natural and native space. I think most users are glad to see the restoration progress in recent years. Forever Wild is a slogan for Dakota County Parks and was a good recognition of what the public and taxpayers want when adopted. Unfortunately the slogan was only marketing for a long stretch but is being made part of the ethos of the land management as shown by the natural resources plan.

Thanks for the opportunity to comment.

Mike Fedde, 1662 Norwood Dr, Eagan

4. W. Barry Graham, Eagan, MN

Date: June 10, 2019

TO: Joe Walton, Project Manager, joseph.walton@co.dakota.mn.us

RE: Comments on the Lebanon Hills draft Natural Resources Management Plan

The draft NRMP for Lebanon Hills Regional Park is an excellent document that will provide essential information for decision makers as future investments are made to this unique natural resource treasure located in close proximity to the majority of Dakota County residents. I am in support of the draft as written, with a number of important caveats:

- In the past, the balance between built, recreational developments and natural resource management and restoration activities has been tilted toward building "new stuff" which threatens the quality of the natural environment and creates an ongoing requirement to maintain and repair these developments. For a period of time, at least ten years, the County should forgo building "new stuff" in Lebanon Hills and should continue to implement the natural resource restoration projects that are described in the NRMP.
- When, in the future, built projects are proposed for Lebanon Hills, the County's Natural Resource staff should have a much stronger voice, if not a veto power, in the decision-making process. In recent years, the County has wisely assembled an extremely skilled

and dedicated Natural Resource staff. The County Board, as well as the County's administrative staff, must listen to and allow the recommendations of the County's Natural Resource staff to be at the forefront of decision making!

- The residents of Dakota County have overwhelmingly stated that they value the quality of the natural environment that Lebanon Hills provides. They want it to be maintained as a natural oasis near the center of population in the county. We are fortunate to enjoy an abundance of municipal parks that provide intensive recreational uses. We are most fortunate that Lebanon Hills provides opportunities to enjoy, relax and restore the sense of calm that the quality of the natural environment offers to the current and future generations of the county.

Thank you for opportunity to comment on the NRMP and for producing such a comprehensive plan! Please listen to the comments and concerns of the residents of the county before initiating built projects that detract from the natural environment of Lebanon Hills.

Sincerely,

W. Barry Graham
4670 Parkridge Drive
Eagan, Minnesota 55123

5. Paul Mandell, Inver Grove Heights, MN

June 6, 2019

To: Joe Walton, Dakota County Parks

From: Paul Mandell

8320 Cleadis Ave., Inver Grove Heights, MN 55076

RE: LEBANON HILLS PARK NATURAL RESOURCES M. AGE:MENT PLAN

CommentPeriod

I am someone who served on the Citizens Task Force for the 2001 Lebanon Hills Master Plan but saw little in the way of improvements. I was then even more dismayed when in 2013, the County's new Lebanon Hills Master Plan showed a significant shift in focus from the natural to construction of many amenities already found in the surrounding local parks, with high capital costs and mere guestimates for the costly maintenance tails. This would come to the detriment of natural resources restoration budgets that had already suffered from the 2008 recession. I am convinced that it is these natural resources that underlie both the popularity and regional significance of this park. Worse yet, despite the nearly unanimous opposition from the public over two comment periods, the County leaders remained committed to the six-mile long, all-season, paved bike thoroughfare, a far cry from the passive connector trail recommended in the 2001 plan to serve those within the park. The argument for the trail continued to come down to resolving accessibility for those with disabilities or limited mobility, as well as families with small kids; despite the fact that if built as a bike transportation link using federal monies, the design would follow standards deemed appropriate for travel at twenty miles per hour, hardly a system conducive to those with limited mobility or small kids.

After the County's vote, we were led to believe that this paved trail would be carefully studied for its' environmental impacts once the Natural Resources Management Plan was done; and that any negative impacts would then be addressed via either mitigation or a redesign. The only concession the County Board made to the public outcry was to allow for the greenway, intended for those commuters or serious bikers merely looking to get from one part of the county to another, to be re-routed around the park. However, they kept the six-mile long paved trail bisecting the entire length of the park, now dubbed the "connector trail".

While I applaud the depth of scientific analysis throughout the draft LHP Natural Resources Management Plan (NRMP), with examination of the water systems, vegetation, wildlife and even micro-systems, I find it almost incredulous that so little is said about the paved trail. While the NRMP raises concerns regarding the already excessive number of trails bisecting the park, some already so degraded that they pose a threat to the very health of the area, the Plan barely touches on the 'connector trail'. Nor does it address the implications of servicing the trail in winter with plowing and the use of sand, salt or other chemicals, through a park strewn with water bodies, many of which are already seriously degraded due to human activity. The Plan does little to dispel the fears of many that the proposed, six-mile long paved trail is a threat to the very life of the park.

I do want to be clear in expressing my appreciation for the depth with which the Plan examined most of the issues, despite its failure to do so for the biggest looming threat of all, the paved trail, especially if built using federal dollars and built to federal standards. I find many of the conclusions in the Plan to be excellent and well based in their analysis, and really appreciate the financial analysis which, for nearly the first time, put forth real numbers and very serious concerns about the level of funding needed to actually make headway toward permanent restoration of the entire park. While all know that construction capital costs will always be higher than the proper and comprehensive restoration of the natural resources in the park, it has only been since the public outcry repeatedly cited the on-going degradation of the park as their top three priorities for Lebanon Hills that the County Board has begun to at least start putting serious money into the natural resources of the entire system. That said, their commitment comes up shy of what is needed in just Lebanon Hills if they are ever to get ahead of things.

It would be my hope that the Plan would create a consensus around commensurate commitments from the County Board in doubling down with Parks and Trails Legacy Funds and far more out of the County Environmental legacy Fund (ELF) for the restoration of the natural environment at an accelerated and dramatically increased level, focused on taking care of what we have before incurring more costs through new redundant facilities that could be perceived as 'extras'.

With the Greenway now routed around the park, given the concerns for excessive trails, as reported in the Plan I would also hope that County Board might re-examine the need for the bikeway and look instead toward an accessible trail connecting one of the trailheads to a few key features in the park for a comparable but more easily accessed loop trail, matching the success of the new McDonough Lake loop trail.

In the end, the County needs to commit far more financial resources toward a complete and total restoration of the park in order to get ahead of the current and persistent level of degradation evidenced throughout most of the park, if necessary putting things like the unpopular bike trail on permanent hold while focusing on restoration of the park. Only then will the many visitors continue to come to Lebanon Hills, able to appreciate the unique attributes our County's flagship park offers.

If I had to make one comprehensive statement on the overall Management Plan, it would be that the Plan reads like it can't be critical or call into question anything in the most recent Lebanon Hills Master Plan—even though that Master Plan strayed from the earlier 2001 Master Plan and, as environmental assessment occurs, I would expect the Management Plan to give a serious impact analysis of all plans.

6. Linda Quammen

Hi Tom,

It was good talking to you about the Lebanon Hills Park Master Plan on Friday night.

I'm glad that the county is addressing some of the very real problems of our regional parks.

As a longtime Dakota County Natural Resources volunteer and resident (30+ years), I've enjoyed Lebanon Hills Regional Park in all weathers and seasons, hiking, skiing, snowshoeing, botanizing and just sitting looking out at one of the lakes or prairies. I love having such a beautiful, wild area for rest and relaxation within a few miles of my home and I count myself lucky.

Over the years, especially the past 5-7, I've seen the park change due to many stresses. The most harmful to the park, and the most difficult, but important, to solve are the invasive plants (and animals) that are beginning to overrun and destroy natural plant communities and ecosystems.

Restoring the park is a wonderful goal that I wholeheartedly agree with. I'm glad to see the removal of buckthorn, probably the most noticeable change of the first 3 years of the park restoration. However, I'm growing concerned that "restoration" may mean something very different to me than to Dakota County. At the meeting there was a slide showing that 600 acres have been "restored" (if I recall correctly). I can't point to any spot in the park, other than Buck Pond, that I would call "restored", though. Certainly, some restoration activities have been taken, like forestry mowing of buckthorn. But I hope that those areas, having been mowed, aren't considered "restored." In fact, most look worse, due to resprouting after 2-3 years, than before. I don't think they can, under anyone's definition, be considered restored (and so, moved along the timeline to "maintenance.")

And other invasives are just as destructive as buckthorn, if less noticeable to most people. Crownvetch, Burdock, non-native Plantain, Reed Canary grass, Queen Anne's Lace, Ground ivy, Barnyard and other grasses are infiltrating and taking over everywhere in the park. We have been fighting off Garlic Mustard and trying to reduce Japanese Hedge Parsley with some success but the host of invasives that are not being addressed, as far as I can see, seem destined to take over everything, including any territory ceded by buckthorn, under the current plan. How does the county plan to address these non-buckthorn invasives?

Sincerely,

Linda Quammen

7. Thor Westra

Joe,

Nice to meet you last Friday.

Comments / Notes, in no particular order or preference.

1. Restoration is challenging work that needs upfront and continued investment and the plan accounts for that approach. Without continued investment, restoration will take much longer or be impossible.
2. Controlling the deer will be important. Maybe there are creative ways to both keep hunting, and to further control deer. For example, let hunters shoot the "big bucks", and use sharpshooters to cull females. Don’t make it an either/or decision. Hunters hate it when sharpshooters kill big bucks that the hunters were willing to pay to pursue.
3. Studying the progress of the restoration and using the park as a research "lab", of sorts, could benefit other parks or even large landholders who want to combat invasives, etc. So, my point is that the park could be a good resource to try new techniques and innovate. I think the County's experience could be useful to influence future legislation and/or future investments from public officials to combat invasives. (I would like to see a law that requires landowners to remove all buckthorn, but that is probably a dream and unrealistic.)

4. I like the park having cultural use areas. Expansion of those areas could help with growing demand, HOWEVER, the park is a unique, semi-wild tract of land in an urban area, which deserves its own place and the LH Plan looks to make that wild place continue, and that is good. What we don't need is 1600 acres of picnic tables and swimming beach, etc.
5. Growth on the mountain bike area has been very attractive, and it will be difficult to make that area "wild" again given current and expected future use. I bike, so I like that part of the park. I think that the invasives need to be addressed and maintained but I don't know that this part of the park can be a true "wild" area again with the intensive use by bikers.
6. Use fire, instead of chemicals, wherever responsible and possible to assist with restoration, and maintenance.

Joe, thanks for you work on the park and the plan. It is a big and important job.

Thor

8. Pat Cummens, Eagan, MN

Dear Joe,
Thank you for the presentation updating us on the natural resource restoration plans underway at Lebanon Hills Park and the overview of the Natural Resources Management Plan (NRMP). I commend Dakota County on the acknowledgment of the importance of the value and nature resources of LHRP and the recent restoration efforts and encourage the long-term commitment to this effort. It goes without saying that without a long term commitment to this effort, it is simply a wasted investment. The natural resource management plan is good and an important guide for future activities. I like the way the areas are broken into manageable management units that can be matched up with grant and other funds as they become available. My, concern about the plan is that the principals and activities outlined in the plan will not find their way into county policies and abided by and instead will be over-ridden by misguided plans and desire for prioritizing physical development over restoration.

The role, positioning and influence of the natural resource plan must be strengthened and considered a higher priority in determining appropriate future development activities. In other words, the potential impact of any planned development must be a evaluated and that information must inform the decision whether a development project should go forward. The way it stands now, development decisions are made outside of this lens, and instead the staff is restricted to trying to do their best to minimize the impact of already approved development on the natural resources. This is approach is backwards, particularly in a park like Lebanon Hills, there the draw is to the unique natural environment, a rare treasure in a growing urban area.

Therefore, the natural resource management plan and the experience and insight of the staff of the natural resources team at the county must be elevated to influence development decisions. It is imperative that they not just have a seat at the table and do the best they can to minimize negative impact on the natural resources of the park. They must have a voice and the natural resource management plan and county policies must be updated to institutionalize and clearly define the priority role natural resource restoration and preservation play in the decision making process for development projects.

Sincerely,

Pat Cummens, Eagan MN

9. Kevin Grass, Burnsville, MN

Hi Joseph;

I have lived in Dakota County since Cedar Ave was a dirt road into what is now called Apple Valley. Bicyclists are way too intrusive to allow any farther into the park. The State's and County's idea for a GREEN TRAIL idea is absurdity. The moving of white lines on the side of the roads to make the shoulders wider for bicyclist is dangerous, there now is not room for two semi's to meet. That's all on the County when not if an accident happens. The dirt trails around the lakes and ponds are awesome, the paved loop gives the wheelchairs a chance to enjoy.

Keep technology out just manage the woods and the land please.

Thank you

Kevin Grass

13615 Oakland Dr.

Burnsville, MN.

6514341636

10. Linda Knutson, Eagan, MN

For over 20 years I have been enjoying the natural habitat and scenery at Lebanon Hills park. It is peaceful and restorative to the soul, mind, and body. I see wildlife often as I walk or ski through the park. I love that the ground is dirt and I can run and walk on it without my knees aching as they do on concrete or asphalt. I love that there is a place like this in the middle of the cities to get away from manmade materials and get close up with God made materials.

In addition to providing Nature-based recreation and education, Lebanon Hills offers habitat for a wide variety of wildlife species that use the park, including species of greatest conservation need — badger, Blanding's turtle, red-headed woodpecker, rusty-patched bumblebee, red shouldered hawk, river otter, tiger salamander, oven bird, brown thrasher, monarch butterfly, leadplant moth, Dakota Skipper, prairie skink, green snake, and plains pocket gopher, among many others. In addition, staff developed a list of over 100 species that have potential to either occur in the park, but have not been observed yet, or have the potential of being restored to the park.

- The natural resources management vision for LHRP is to manage water, vegetation, and wildlife to conserve and increase biodiversity, restore native habitats, improve public benefits, and achieve resilience and regionally outstanding quality, now and for future generations.
- The draft Plan develops approaches to set a course for sustainable native plant communities within the park, which is critical toward preserving the unique natural character of Lebanon Hills.
- I strongly support efforts to help Lebanon Hills achieve its full potential as an exceptional oasis of high-quality natural resources to benefit now and future generations of people and wildlife.
- Thank you!

Linda Knutson

1257 Dunberry Lane

Eagan, MN 55123

11. Barb Zeches, Eagan, MN

I am a frequent visitor to Lebanon Hills Park and I want you to know that as for the future of the park we need to continue the restoration that has been taking place as the number one priority. As I walk, run and ski in the park I can see how healthy it is becoming where work has been done to remove buckthorn, replant native plants and ensuring water quality. Please continue in that direction. We need to keep this Park natural and wild for future generations to enjoy. The last thing we need is spending money on pavement and buildings.

Having this Park in the Twin Cities is amazing. Please do not ruin it!

Barb Zeches

4526 Oak Chase Way, Eagan

12. Jim Jenkins, Apple Valley, MN

Mr. Joseph Walton, Project Manager

Mr. Walton,

I am very happy that the current draft plan has placed an emphasis on maintaining the natural resources for this unique park going forward.

I was a Stakeholder representative as part of a group of individuals with specific interests in the development of a revised Master Plan in 2001. The Dakota County Commissioners chose this group to work with an experienced outside coordinator to update the original Master Plan which was approved by the County Board.

This effort included the input from all of the Stakeholders and resulted in a document that wasn't perfect, but a reasonable compromise for all involved. We worked together and were proud of the results.

The language emphasized the overarching importance of developing and restoring the natural environment that made this Park unique from most other parks. It acknowledged that most trails and areas were to remain natural and would not be suitable for everyone. Again, we were pleased with the results and proud we could assist in developing a plan which documented in detail and "spirit" how this particular park was unique from others.

Within two years, I discovered that a design consultant had been retained by the county to revise the Master Plan and suddenly there were proposals for much "hard surface" and building development, including outdoor music and entertainment areas, etc. I was very disturbed that this Master Plan could be violated so easily and ignore the major principals that were agreed upon. As the years have gone buy I have seen major movements and funding toward the built environment. Often I have seen these proposals move rapidly forward even after user surveys have clearly supported maintaining the emphasis on restoring the natural environment.

So, I have concluded that the County has "followed the money" and that they have emphasized the built environment because that money is more available and easier to obtain. Thus the proportion of funds for hard development has far exceeded the funds for natural restoration. Also, it was very difficult for the average person to review the funding in a transparent manner. It is difficult to identify the amount really spent on the natural environment.

Therefore if we are to have confidence in this latest emphasis on the natural environment versus hard surface / built environment, I believe we must have a transparent way to review the budget in advance to assure that the number one priority for obtaining funds and expenditures for using the funds will be on Natural Resources.

I live near the park and have enjoyed it for over 30 years. I hope this NRMP can move forward in this positive direction.

Respectfully Submitted,

Jim Jenkins

12105 Gantry Lane

Apple Valley, MN 55124

13. Brad Blackett, Apple Valley, MN

I am writing from my North Woods haven, a family cabin handed down to me that sits on the Shores of Lake Superior. I have periodic cell coverage here. I am not sure you will get my comments in time.

There is something to be said about what we hand down to the generations. If development continues to encroach upon our natural areas soon there won't be anything left.

Perhaps not in our life time but certainly seems to be the case of our societies insatiable appetite to build bigger and better as well as consume everything in the name of progress.

We are losing our senses. If something else needs to be built then buy the extra land and place the development there.

Say what. There is no more land of natural quality to build that user convenience ... then you have just proven my point. We do not have enough natural areas as it is.

For future generations we must manage, and regenerate what we have already harmed ... not the opposite by over developing engineered roads, parking lots, bike trails, shelters - you name it.

Efforts should be made to inventory, evaluate every acre of Dakota Park land and assess how much has been already harmed.

I believe for every acre converted to development an equal or better resource should be obtained and protected, by purchasing additional lands.

Enacting a moratorium on further capital improvements in Lebanon Hills Regional Park would be a first step. If it takes Metropolitan Council to suspend further "Park Improvement Funding" to be implemented then so be it.

Enough development, focus on the future, fund the restoration and regenerative efforts to higher levels and provide additional resources and effort to make that happen system wide.

Brad Blackett, 457 Reflection Rd, Apple Valley, MN 55124.

14. Mary and Robert Kanuit, Dakota County

To whom it may concern:

I am writing to voice my opposition to the continuing Drama surrounding LHRP. This has been an ongoing assault on the Environment of our precious LHRP. I believe the County Commissioners and the Parks dept. have hijacked the when process. They have disregarded what the people want. That was proven about 3-4 years ago when the Commissioners decided to fast track a new "Master Plan of THEIR liking without so much as a public commenting period, which of course was forced upon them by the people. The people spoke. 96% of the people rejected the new Master Plan as being too aggressive. Well it is. Why do we need all this fake educational stuff in the park?? Isn't the whole idea of being a Park is that people experience it in it's natural state? In my opinion they have ruined this Park already. The more they draft plans the more unnatural it becomes.

Then there's the loss of very important habitat. That speaks for itself. Then there's upkeep which I'm sure will end up being paid by the very people opposing this. Btw, what's the point of a public commenting period if your just going to ignore the opposition, which is exactly what happened last time. I have no confidence in our Commissioners to do the right thing. Which IS to listen to the people!!!!!!! I cannot stress this enough. Remember you all work for us, We The People, and don't forget that. So obviously my vote on anything besides 25% Stewardship of this Park is a big fat NO on more unnatural spaces period. Also what ever happened to that original Stewardship of 25%? Its now down to 1% of your pie chart. What's up with that? The people have spoken over and over. Why won't anyone listen?

Sincerely,

Mary and Robert Kanuit

Dakota County Taxpayers 24 years.

Do we have a say?

15. Barry Johnson, Apple Valley, MN

Joe,

I'm not sending you any canned message. This one is straight from me.

Over the last few weeks I did some bushwhack hiking in Lebanon Hills. I stumbled into large areas where - to my surprise and joy - buckthorn had been cleared. Wow, so this is what the park looked like decades ago!

Better managing the natural resources of the park is so much more important that putting down asphalt trails/roads, constructing new buildings, or adding and expanding parking lots.

I hope that the parks natural resources take precedent over more capital projects.

Barry Johnson

13064 Eveleth Ave

Apple Valley MN

16. Jill Danner, St. Paul, MN

Good Day Mr Walton,

I understand the ecology at Lebanon is being looked at. I missed the notice about the meeting on Friday night.

I support keeping Lebanon natural and representative of the natural environment that should be there. I support hiking trails, canoe and horse trails.

I do not support bike trails. I would support a mile long looped trail that was handicap accessible but not a trail that runs through the entire park. I do have a husband that is disabled and I would never push him through the entire park.

I hope more environmentally correct development continues that supports current usage. It is my favorite place to ride my horse.

Jill Danner

791 Ottawa Ave

St Paul, MN 55107

17. Laura Hedlund

Date: June 6, 2019

TO: Joe Walton, Project Manager, joseph.walton@co.dakota.mn.us

RE: Comment for Lebanon Hills draft Natural Resources Management Plan

I appreciate the focus on the Natural Resources Master Plan for Lebanon Hills Regional Park and I encourage Dakota County to complete the plan and allow Lebanon Hills to achieve its potential as an exceptional oasis of quality natural resources.

To minimize potential conflicts with successfully implementing this NRMP, I urge the county to:

• Suspend development of new built amenities—especially the controversial 6-mile asphalt bicycle route through the park.

• Fully fund the plan by pursuing grants and also using existing sources of conservation funds, including the Parks and Trails Legacy Fund and the Dakota County Environmental Legacy Fund (ELF).

• Continue planning the regional bike network around Lebanon Hills as approved in the Central Greenway Connectivity Plan.

• Explore innovative ways to connect land and all people.

• Gather information about how the walking on asphalt differs from walking on natural paths in terms of physical and mental health

• Gather information about the health consequences of asphalt including: the average cancer rates of people who work with asphalt, etc

• Gather information about the impact of asphalt trails on the Rusty Patch Bumblebee, other pollinators as well as other small creatures.

• Study how the complex microbiome of Lebanon Hills Regional Hills would be impacted by asphalt trail.

• Study impacts on water.

• Look at a map of Dakota County – how much land has been "developed?" How many opportunities are there to walk on asphalt? How many opportunities for natural trails?

• As all life is connected, how we relate natural world is a matter of choice. Given the natural complexities of the soil, we deny our children their birthright when we offer asphalt trails versus natural trails.

Sincerely,

Laura Hedlund

1364 Wilderness Run Dr

Eagan, Minnesota 55123

Dakota County Park and Advisory Committee 1998 to 2004

18. Patrice Callahan, Teacher at the School of Environmental Studies

Lebanon Hills Regional Park is near and dear to my heart. When my children were growing up we often ran over to the park to hike or swim. On long summer days we would spend hours wandering around the myriad of trails. Later, my grandchildren experienced their first camping trip at Lebanon Hills Regional Park campground. We spent the weekend hiking, swimming, paddling and camping before heading back to work on Monday. This beautiful natural wonderland right here in Apple Valley is an amazing opportunity to staycation! Over the years we have noticed the buckthorn taking over large swatches of Lebanon Hills and we are happy that the management plan continues to address removal of this and other invasive species in the park. We are especially excited to see the planned return of the beautiful open oak savanna. Thank you for your hard work and dedication to this urban wilderness!

19. Patricia Ryan, Eagan, MN

Dear Mr Walton,

Lebanon Hills is a beautiful more wild appearing park, unique in that way, compared with all other parks in Dakota County. I encourage Dakota County to complete the NRMP plan and allow Lebanon Hills to achieve its potential as an exceptional oasis of quality natural resources.

I do not want it to look like the spoiled Spring Lake Park which Dakota County decided to "develop" recently from the lovely piece of land from which it was formed.

In that light:

- Do not build the controversial 6-mile asphalt bicycle route through the park.
- Fund future plans by pursuing grants and also using existing sources of conservation funds, including the Parks and Trails Legacy Fund and the Dakota County Environmental Legacy Fund (ELF).
- Route the regional bike network **around** Lebanon Hills as approved in the Central Greenway Connectivity Plan.
- I am a nurse and understand accessibility and the accessibility laws. Accessibility is a "fluid" issue and does not mean that every mobility challenged person needs to have access to every park! I fully support the county providing accessibility in a manner

that does not take away from the NRMP, which will then provide **all** visitors the opportunity to experience the park's beautiful and healthy natural environment.

Sincerely,

Patricia Ryan

1590 Mallard Vw

Eagan, MN 55122

20. Jean Oberle

I am pleased to support the Lebanon Hills NRMP. Language that prioritizes natural resources in decision making needs to be included in the final version in order to strengthen the plan.

Sincerely,

Jean Oberle

21. Anne LaGoo, Hastings, MN

While this is a draft letter - I support it 100%. I regularly use Lebanon Hills equestrian trails and do not support additional building or development of this park.

I am pleased to support the NRMP which emphasizes the vital importance of restoration and ongoing management of natural resources throughout Lebanon Hills, which is consistent with public priorities for this park.

The plan falls short, however, of including language that would allow natural resource management to take precedent over capital development projects, which compromises the parks natural resource base and threatens successful implementation of the NRMP. <u>Language, therefore, must be included in the plan which prescribes that management of Lebanon Hills and the Forever Wild Parks System will put natural resources at the forefront of decision making.</u>

Further, to minimize potential conflicts and to allow the park to realize its potential, I urge the county to:

- Take care of what we have, but suspend new development or expansion of built amenities until Dakota County's natural resource staff and outside ecology professionals deem the park to be in a healthy ecological state—only then can the impacts of capital development projects truly be known.

- Fully fund the NRMP by pursuing grants, and also using existing sources of conservation funds, including the Parks and Trails Legacy Fund and the Dakota County Environmental Legacy Fund (ELF).

The NRMP sets into motion a vital shift from what we've historically seen, and I urge Dakota County to complete the plan and allow Lebanon Hills Regional Park to achieve its potential as an exceptional oasis of quality natural resources.

Sincerely,

Anne LaGoo

102 Riverdale Dr

Hastings, MN 55033

22. Jean Hewitt, Eagan, MN

Mr Walton,

I am happy to learn of the NRMP and support the plan which emphasizes the vital importance of restoration and ongoing management of natural resources throughout Lebanon Hills. This is consistent with the general public priorities for this park beautiful, natural park.

I feel the plan falls short in that it does not include language that would allow natural resource management to take precedent over capital development projects. I am not in favor of the capital development, which compromises the parks natural resource base and threatens successful implementation of the NRMP. <u>Language, therefore, must be included in the plan which prescribes that management of Lebanon Hills and the Forever Wild Parks System will put natural resources at the forefront of decision making. (and NOT capital development).</u>

Further, to minimize potential conflicts and to allow the park to realize its potential, I urge the county to:

- Take care of what we have.
- Suspend new development or expansion of built amenities until Dakota County's natural resource staff and outside ecology professionals deem the park to be in a healthy ecological state. Only then can the impacts of capital development projects truly be known.
- Fully fund the NRMP by pursuing grants and also using existing sources of conservation funds, including the Parks and Trails Legacy Fund and the Dakota County Environmental Legacy Fund (ELF).

The NRMP sets into motion a vital shift from what we've historically seen, and I urge Dakota County to complete the plan and allow Lebanon Hills Regional Park to achieve its potential as an exceptional oasis of quality natural resources.

Sincerely,

Jean Hewitt
4860 Wellington Ct
Eagan, MN 55122

23. Bruce Goff

I live right across the street from Lebanon Hills and run or walk my dog almost every day in the park. I am pleased to support the NRMP which emphasizes the vital importance of restoration and ongoing management of natural resources throughout Lebanon Hills, which is consistent with public priorities for this park.

The plan falls short, however, of including language that would allow natural resource management to take precedent over capital development projects, which compromises the parks natural resource base and threatens successful implementation of the NRMP. Language, therefore, must be included in the plan which prescribes that management of Lebanon Hills and the Forever Wild Parks System will put natural resources at the forefront of decision making.

Further, to minimize potential conflicts and to allow the park to realize its potential, I urge the county to:

- Take care of what we have, but suspend new development or expansion of built amenities until Dakota County's natural resource staff and outside ecology professionals deem the park to be in a healthy ecological state—only then can the impacts of capital development projects truly be known.
- Fully fund the NRMP by pursuing grants, and also using existing sources of conservation funds, including the Parks and Trails Legacy Fund and the Dakota County Environmental Legacy Fund (ELF).

The NRMP sets into motion a vital shift from what we've historically seen, and I urge Dakota County to complete the plan and allow Lebanon Hills Regional Park to achieve its potential as an exceptional oasis of quality natural resources.

Bruce Goff

24. Bernard Friel, Mendota Heights, MN

Dear Mr. Walton

I write to support the NRMP which emphasizes the vital importance of restoration and ongoing management of natural resources throughout Lebanon Hills, which is consistent with public priorities for this park.

The NRMP sets into motion a vital shift from what we've historically seen, and I encourage Dakota County to complete the plan and allow Lebanon Hills to achieve its potential as an exceptional oasis of quality natural resources.

To minimize potential conflicts with successfully implementing this NRMP, I urge the county to:

- Suspend development of new built amenities—especially the controversial 6-mile asphalt bicycle route through the park—until the county natural resource staff and outside ecology professionals deem the park to be in a healthy ecological state. Only then can the true impacts of that and other construction projects be realized.
- Fully fund the plan by pursuing grants and also using existing sources of conservation funds, including the Parks and Trails Legacy Fund and the Dakota County Environmental Legacy Fund (ELF).
- Continue planning the regional bike network around Lebanon Hills as approved in the Central Greenway Connectivity Plan.
- Revisit opportunities to increase accessibility for mobility challenged visitors within the park using the best practices for sustainable design. I fully support the county providing accessibility in a manner that does not take away from the NRMP, which will then provide **all** visitors the opportunity to experience the park's beautiful and healthy natural environment.

Sincerely,
Bernard P. Friel

750 Mohican Lane

Mendota Heights, MN 55120

(651) 454-3655

25. Mary Wierschem

Yikes, the changing and destroying of Lebanon hills just doesn't stop. Its incomprehensible why this park can't be left alone. Forever wild is a joke.

26. Robert Chase, Roseville, MN

Dear Mr. Walton,

I am pleased to support the NRMP which emphasizes the vital importance of restoration and ongoing management of natural resources throughout Lebanon Hills, which is consistent with public priorities for this park.

The plan falls short, however, of including language that would allow natural resource management to take precedent over capital development projects, which compromises the parks natural resource base and threatens successful implementation of the NRMP. Language, therefore, must be included in the plan which prescribes that management of Lebanon Hills and the Forever Wild Parks System will put natural resources at the forefront of decision making.

Further, to minimize potential conflicts and to allow the park to realize its potential, I urge the county to:

- Take care of what we have, but suspend new development or expansion of built amenities until Dakota County's natural resource staff and outside ecology professionals deem the park to be in a healthy ecological state—only then can the impacts of capital development projects truly be known.
- Fully fund the NRMP by pursuing grants, and also using existing sources of conservation funds, including the Parks and Trails Legacy Fund and the Dakota County Environmental Legacy Fund (ELF).

The NRMP sets into motion a vital shift from what we've historically seen, and I urge Dakota County to complete the plan and allow Lebanon Hills Regional Park to achieve its potential as an exceptional oasis of quality natural resources.

I appreciate all your efforts to keep our park as close to "wild" as you can.

Sincerely,

Robert Chase

2558 Beacon Street

Roseville, MN 55113

WE DO NOT INHERIT THE EARTH FROM OUR ANCESTORS,

WE BORROW IT FROM OUR CHILDREN. Native American Proverb

27. Pat Stevesand

Mr. Walton,

Please ensure more resources are used to improving the natural state of this park as opposed to capital development.

The current plan falls short of including language that would allow natural resource management to take precedent over capital development projects, which compromises the parks natural resource base and threatens successful implementation of the NRMP.

Language, therefore, must be included in the plan which prescribes that management of Lebanon Hills and the Forever Wild Parks System will put natural resources at the forefront of decision making.

Thank you for keeping this jewel, a jewel, and not simply another less than valuable park.

Pat Stevesand

28. Suzanne Savanick Hansen, South St. Paul, MN

Date: June 7, 2019

TO: Joe Walton, Project Manager, joseph.walton@co.dakota.mn.us

RE: Comment for Lebanon Hills draft Natural Resources Management Plan

I grew up skiing in Lebanon Hills park and am pleased to support the NRMP which emphasizes the vital importance of restoration and ongoing management of natural resources throughout Lebanon Hills, which is consistent with public priorities for this park.

The plan falls short, however, of including language that would allow natural resource management to take precedent over capital development projects, which compromises the parks natural resource base and threatens successful implementation of the NRMP. <u>Language, therefore, must be included in the plan which prescribes that management of Lebanon Hills and the Forever Wild Parks System will put natural resources at the forefront of decision making.</u>

Further, to minimize potential conflicts and to allow the park to realize its potential, I urge the county to:

- Take care of what we have, but suspend new development or expansion of built amenities until Dakota County's natural resource staff and outside ecology professionals deem the

park to be in a healthy ecological state—only then can the impacts of capital development projects truly be known.
- Fully fund the NRMP by pursuing grants, and also using existing sources of conservation funds, including the Parks and Trails Legacy Fund and the Dakota County Environmental Legacy Fund (ELF).

The NRMP sets into motion a vital shift from what we've historically seen, and I urge Dakota County to complete the plan and allow Lebanon Hills Regional Park to achieve its potential as an exceptional oasis of quality natural resources.

Sincerely,

Suzanne Savanick Hansen
1007 15th Ave N
South St. Paul MN 55075

29. Jim Brudney

Date: June 7, 2019

TO: Joe Walton, Project Manager, joseph.walton@co.dakota.mn.us

RE: Comment for Lebanon Hills draft Natural Resources Management Plan

I am pleased to support the NRMP which emphasizes the vital importance of restoration and ongoing management of natural resources throughout Lebanon Hills, which is consistent with public priorities for this park.

The plan falls short, however, of including language that would allow natural resource management to take precedent over capital development projects, which compromises the parks natural resource base and threatens successful implementation of the NRMP. Language, therefore, must be included in the plan which prescribes that management of Lebanon Hills and the Forever Wild Parks System will put natural resources at the forefront of decision making.

Further, to minimize potential conflicts and to allow the park to realize its potential, I urge the county to:

- Take care of what we have, but suspend new development or expansion of built amenities until Dakota County's natural resource staff and outside ecology professionals deem the park to be in a healthy ecological state—only then can the impacts of capital development projects truly be known.
- Fully fund the NRMP by pursuing grants, and also using existing sources of conservation funds, including the Parks and Trails Legacy Fund and the Dakota County Environmental Legacy Fund (ELF).

The NRMP sets into motion a vital shift from what we've historically seen, and I urge Dakota County to complete the plan and allow Lebanon Hills Regional Park to achieve its potential as an exceptional oasis of quality natural resources.

Sincerely,

Jim Brudney

Concerned Citizen Formerly of South Minneapolis
Frequent visitor to Lebanon Hills during visits to TC.

30. Shannen Espelien, Savage, MN

Date: June 7, 2019

To Whom it May Concern,

I am pleased to support the NRMP which emphasizes the vital importance of restoration and ongoing management of natural resources throughout Lebanon Hills, which is consistent with public priorities for this park.

The plan falls short, however, of including language that would allow natural resource management to take precedent over capital development projects, which compromises the parks natural resource base and threatens successful implementation of the NRMP. Language, therefore, must be included in the plan which prescribes that management of Lebanon Hills and the Forever Wild Parks System will put natural resources at the forefront of decision making.

****Personal note:** In our Twin Cities community, we are very fortunate to have many picnic and play spaces for children and structures to support the needs of the families that are served. What is becoming less prevalent are natural spaces that support the creatures that are native to the area and the plant species that thrive natively as well.

As time goes on, we find that more natural spaces are being removed to make way for areas that are more manicured and structured by humans, but unless we sustain the ecosystem as best we can, we will ruin the outdoor spaces that we hold dear and the structures we build will have less use as being outdoors will not bring the joy it currently does.

There are numerous studies about the health and wellness benefits of natural outdoor spaces, even one done in a hospital that patients heal faster when they can see natural spaces from the window of their hospital room. In our time where health costs are increasing and wellness measures across the board are decreasing, we can not afford to take out what is naturally pleasing and healing to humans to make way for manicured and concrete structures. Even something built with sustainability in mind that cuts down the natural habitat of the ecosystem around us is not working toward the wellness of the community as a whole.

Further, to minimize potential conflicts and to allow the park to realize its potential, I urge the county to:

- Take care of what we have, but suspend new development or expansion of built amenities until Dakota County's natural resource staff and outside ecology professionals deem the park to be in a healthy ecological state—only then can the impacts of capital development projects truly be known.
- Fully fund the NRMP by pursuing grants, and also using existing sources of conservation funds, including the Parks and Trails Legacy Fund and the Dakota County Environmental Legacy Fund (ELF).

The NRMP sets into motion a vital shift from what we've historically seen, and I urge Dakota County to complete the plan and allow Lebanon Hills Regional Park to achieve its potential as an exceptional oasis of quality natural resources.

Sincerely,

Shannen Espelien

4457 River Bend Pl

Savage, MN 55378

31. Chris Erickson, Lakeville, MN

Date: June 7, 2019

TO: Joe Walton, Project Manager, joseph.walton@co.dakota.mn.us

RE: Comment for Lebanon Hills draft Natural Resources Management Plan

I am pleased to support the NRMP which emphasizes the vital importance of restoration and ongoing management of natural resources throughout Lebanon Hills, which is consistent with public priorities for this park.

The plan falls short, however, of including language that would allow natural resource management to take precedent over capital development projects, which compromises the parks natural resource base and threatens successful implementation of the NRMP. Language, therefore, must be included in the plan which prescribes that management of Lebanon Hills and the Forever Wild Parks System will put natural resources at the forefront of decision making.

Further, to minimize potential conflicts and to allow the park to realize its potential, I urge the county to:

- Take care of what we have, but suspend new development or expansion of built amenities until Dakota County's natural resource staff and outside ecology professionals deem the park to be in a healthy ecological state—only then can the impacts of capital development projects truly be known.
- Fully fund the NRMP by pursuing grants, and also using existing sources of conservation funds, including the Parks and Trails Legacy Fund and the Dakota County Environmental Legacy Fund (ELF).

The NRMP sets into motion a vital shift from what we've historically seen, and I urge Dakota County to complete the plan and allow Lebanon Hills Regional Park to achieve its potential as an exceptional oasis of quality natural resources.

Sincerely,

Chris Erickson
18971 Inlet Road
Lakeville, MN 55044

32. Sue Schedin, Beldenville, WI

Hi Joseph,

I am pleased to support the NRMP which emphasizes the vital importance of restoration and ongoing management of natural resources throughout Lebanon Hills, which is consistent with public priorities for this park.

The plan falls short, however, of including language that would allow natural resource management to take precedent over capital development projects, which compromises the parks natural resource base and threatens successful implementation of the NRMP. Language, therefore, must be included in the plan which prescribes that management of Lebanon Hills and the Forever Wild Parks System will put natural resources at the forefront of decision making.

Further, to minimize potential conflicts and to allow the park to realize its potential, I urge the county to:

- • Take care of what we have, but suspend new development or expansion of built amenities until Dakota County's natural resource staff and outside ecology professionals deem the park to be in a healthy ecological state—only then can the impacts of capital development projects truly be known.
- • Fully fund the NRMP by pursuing grants, and also using existing sources of conservation funds, including the Parks and Trails Legacy Fund and the Dakota County Environmental Legacy Fund (ELF).

The NRMP sets into motion a vital shift from what we've historically seen, and I urge Dakota County to complete the plan and allow Lebanon Hills Regional Park to achieve its potential as an exceptional oasis of quality natural resources.

I am a frequent visitor on the equestrian trails at Lebanon and, therefore, I support the park's potential as an exceptional oasis of quality natural resources.

Thank you!

Sue Schedin
W5329 County Rd. N
Beldenville, WI 54003

33. Gary Sheets

Date: June 7, 2019

TO: Joe Walton, Project Manager, joseph.walton@co.dakota.mn.us

RE: Comment for Lebanon Hills draft Natural Resources Management Plan

I am pleased to support the NRMP which emphasizes the vital importance of restoration and ongoing management of natural resources throughout Lebanon Hills, which is consistent with public priorities for this park.

The plan falls short, however, of including language that would allow natural resource management to take precedent over capital development projects, which compromises the parks natural resource base and threatens successful implementation of the NRMP. Language, therefore, must be included in the plan which prescribes that management of Lebanon Hills and the Forever Wild Parks System will put natural resources at the forefront of decision making.

Further, to minimize potential conflicts and to allow the park to realize its potential, I urge the county to:

- Take care of what we have, but suspend new development or expansion of built amenities until Dakota County's natural resource staff and outside ecology professionals deem the park to be in a healthy ecological state—only then can the impacts of capital development projects truly be known.
- Fully fund the NRMP by pursuing grants, and also using existing sources of conservation funds, including the Parks and Trails Legacy Fund and the Dakota County Environmental Legacy Fund (ELF).

The NRMP sets into motion a vital shift from what we've historically seen, and I urge Dakota County to complete the plan and allow Lebanon Hills Regional Park to achieve its potential as an exceptional oasis of quality natural resources.

34. Valorie Jackson, Eagan, MN

Date: June 7, 2019

TO: Joe Walton, Project Manager, joseph.walton@co.dakota.mn.us
RE: Comment for Lebanon Hills draft Natural Resources Management Plan

I am pleased to support the NRMP which emphasizes the vital importance of restoration and ongoing management of natural resources throughout Lebanon Hills, which is consistent with public priorities for this park.

The NRMP sets into motion a vital shift from what we've historically seen, and I encourage Dakota County to complete the plan and allow Lebanon Hills to achieve its potential as an exceptional oasis of quality natural resources.

To minimize potential conflicts with successfully implementing this NRMP, I urge the county to:

- Suspend development of new built amenities—especially the controversial 6-mile asphalt bicycle route through the park—until the county natural resource staff and outside ecology professionals deem the park to be in a healthy ecological state. Only then can the true impacts of that and other construction projects be realized.

- Fully fund the plan by pursuing grants and also using existing sources of conservation funds, including the Parks and Trails Legacy Fund and the Dakota County Environmental Legacy Fund (ELF).

- Continue planning the regional bike network around Lebanon Hills as approved in the Central Greenway Connectivity Plan.

- Revisit opportunities to increase accessibility for mobility challenged visitors within the park using the best practices for sustainable design. I fully support the county providing accessibility in a manner that does not take away from the NRMP, which will then provide all visitors the opportunity to experience the park's beautiful and healthy natural environment.

Sincerely,

Valorie Jackson
549 Hawthorne Woods Drive
Eagan, MN 55123

35. Peggy Pasillas, Inver Grove Heights, MN

I am pleased to support the NRMP which emphasizes the vital importance of restoration and ongoing management of natural resources throughout Lebanon Hills, which is consistent with public priorities for this park.

The NRMP sets into motion a vital shift from what we've historically seen, and I encourage Dakota County to complete the plan and allow Lebanon Hills to achieve its potential as an exceptional oasis of quality natural resources.

To minimize potential conflicts with successfully implementing this NRMP, I urge the county to:

- Suspend development of new built amenities—especially the controversial 6-mile asphalt bicycle route through the park—until the county natural resource staff and outside ecology professionals deem the park to be in a healthy ecological state. Only then can the true impacts of that and other construction projects be realized.
- Fully fund the plan by pursuing grants and also using existing sources of conservation funds, including the Parks and Trails Legacy Fund and the Dakota County Environmental Legacy Fund (ELF).
- Continue planning the regional bike network **around** Lebanon Hills as approved in the Central Greenway Connectivity Plan.
- Revisit opportunities to increase accessibility for mobility challenged visitors within the park using the best practices for sustainable design. I fully support the county providing accessibility in a manner that does not take away from the NRMP, which will then provide **all** visitors the opportunity to experience the park's beautiful and healthy natural environment.

Thank you for your consideration.

Peggy Pasillas

9928 Rich Valley Blvd

Inver Grove Heights, MN 55077

36. Jason Bass, Rosemount, MN

Date: June 7, 2019

TO: Joe Walton, Project Manager, joseph.walton@co.dakota.mn.us

RE: Comment for Lebanon Hills draft Natural Resources Management Plan

I am pleased to support the NRMP which emphasizes the vital importance of restoration and ongoing management of natural resources throughout Lebanon Hills, which is consistent with public priorities for this park.

The NRMP sets into motion a vital shift from what we've historically seen, and I encourage Dakota County to complete the plan and allow Lebanon Hills to achieve its potential as an exceptional oasis of quality natural resources.

To minimize potential conflicts with successfully implementing this NRMP, I urge the county to:

- Suspend development of new built amenities—especially the controversial 6-mile asphalt bicycle route through the park—until the county natural resource staff and outside ecology professionals deem the park to be in a healthy ecological state. Only then can the true impacts of that and other construction projects be realized.
- Fully fund the plan by pursuing grants and also using existing sources of conservation funds, including the Parks and Trails Legacy Fund and the Dakota County Environmental Legacy Fund (ELF).
- Continue planning the regional bike network around Lebanon Hills as approved in the Central Greenway Connectivity Plan.
- Revisit opportunities to increase accessibility for mobility challenged visitors within the park using the best practices for sustainable design. I fully support the county providing accessibility in a manner that does not take away from the NRMP, which will then provide **all** visitors the opportunity to experience the park's beautiful and healthy natural environment.

Sincerely,

Jason Bass
14802 Del.Delmar Ct
Rosemount, Mn

37. Brent Beal, Rosemount, MN

Date: June 7, 2019
TO: Joe Walton, Project Manager, joseph.walton@co.dakota.mn.us
RE: Comment for Lebanon Hills draft Natural Resources Management Plan
I am pleased to support the NRMP which emphasizes the vital importance of restoration and ongoing management of natural resources throughout Lebanon Hills, which is consistent with public priorities for this park.
The NRMP sets into motion a vital shift from what we've historically seen, and I encourage Dakota County to complete the plan and allow Lebanon Hills to achieve its potential as an exceptional oasis of quality natural resources.
To minimize potential conflicts with successfully implementing this NRMP, I urge the county to:

- • Suspend development of new built amenities—especially the controversial 6-mile asphalt bicycle route through the park—until the county natural resource staff and outside ecology professionals deem the park to be in a healthy ecological state. Only then can the true impacts of that and other construction projects be realized.
- • Fully fund the plan by pursuing grants and also using existing sources of conservation funds, including the Parks and Trails Legacy Fund and the Dakota County Environmental Legacy Fund (ELF).
- • Continue planning the regional bike network around Lebanon Hills as approved in the Central Greenway Connectivity Plan.
- • Revisit opportunities to increase accessibility for mobility challenged visitors within the park using the best practices for sustainable design. I fully support the county providing accessibility in a manner that does not take away from the NRMP, which will then provide **all** visitors the opportunity to experience the park's beautiful and healthy natural environment.

Sincerely,
Brent Beal
15555 Dapple Circle
Rosemount, MN 55068

38. Leslie Pilgrim, Mendota Heights, MN

Date: June 7, 2019

TO: Joe Walton, Project Manager, joseph.walton@co.dakota.mn.us

RE: Comment for Lebanon Hills draft Natural Resources Management Plan

I am pleased to support the NRMP which emphasizes the vital importance of restoration and ongoing management of natural resources throughout Lebanon Hills, which is consistent with public priorities for this park.

The NRMP sets into motion a vital shift from what we've historically seen, and I encourage Dakota County to complete the plan and allow Lebanon Hills to achieve its potential as an exceptional oasis of quality natural resources.

To minimize potential conflicts with successfully implementing this NRMP, I urge the county to:

- Suspend development of new built amenities—especially the controversial 6-mile asphalt bicycle route through the park—until the county natural resource staff and outside ecology professionals deem the park to be in a healthy ecological state. Only then can the true impacts of that and other construction projects be realized.
- Fully fund the plan by pursuing grants and also using existing sources of conservation funds, including the Parks and Trails Legacy Fund and the Dakota County Environmental Legacy Fund (ELF).
- Continue planning the regional bike network around Lebanon Hills as approved in the Central Greenway Connectivity Plan.
- Revisit opportunities to increase accessibility for mobility challenged visitors within the park using the best practices for sustainable design. I fully support the county providing accessibility in a manner that does not take away from the NRMP, which will then provide all visitors the opportunity to experience the park's beautiful and healthy natural environment.

Sincerely,

Leslie Pilgrim

Mendota Heights/Dakota County

10.10 Appendix J. Suggested Native Shrubs for Replacing Common Buckthorn

DRY UPLAND

Common Name	Scientific Name	Height	Light	Wildlife Value	Comments
Gray dogwood	*Cornus racemosa*	9 ft	Sun/shade	Very high	Used by 40 some species of wildlife. Spreads
American hazelnut	*Corylus americana*	6-12 ft	Sun/part shade	Highly valued by mammals (mice, deer, etc.) and birds (blue jays, turkeys, etc.)	Spreads, but slowly; forms very deep roots
Beaked hazelnut	*Corylus cornuta*	6-12 ft	Sun/shade	High	Spreads, but slowly. More northern range than American hazelnut.
Eastern red cedar	*Juniperus virginiana*	20 ft	Sun	High	Aggressive colonizer. Invades prairies in absence of fire. Important for bird cover during winter and during the heat of summer.
Pin cherry	*Prunus pensylvanica*	10-30 ft	Sun	Excellent	Used by 81 species of wildlife
Smooth rose or Prairie rose	*Rosa blanda, Rosa arkansana*	4-6 ft	Sun/part shade	High: birds, mammals.	Low shrub that blends well with prairie forbs. Rose hips ripe in late summer and fall. Flowers favorite of Japanese beetles.
New Jersey tea	*Ceanothus americanus*	2-3 ft	Full sun	High: butterflies and hummingbirds	Beautiful patches of shrubs in prairie setting
Silver buffaloberry	*Shepherdia argentea*	8-10 ft	Full sun	High: birds	Thicket-forming in prairies; silvery green foliage; red berries in late summer
Wolfberry	*Symphoricarpos occidentalis*	2-4 ft	Full sun	High: birds	Thicket forming in prairie; small pinkish flowers; white berries in late summer
Coralberry	*Symphoricarpos orbiculatus*	2 ft	Full sun	High: birds	Low shrub; thicket forming in prairie; small white flowers; red berries in late summer. Northern part of its range in MN.
Leadplant	*Amorpha canescens*	2 ft	Full sun	High: pollinators	Slow growing, low, hemi-shrub; develops extensive root system
Prairie willow	*Salix humilis*	3 ft	Full sum	Moderate: pollinators	Willow spp that grows in the dry prairie. Very low growing shrub with dense foliage.

DRY-MESIC UPLAND

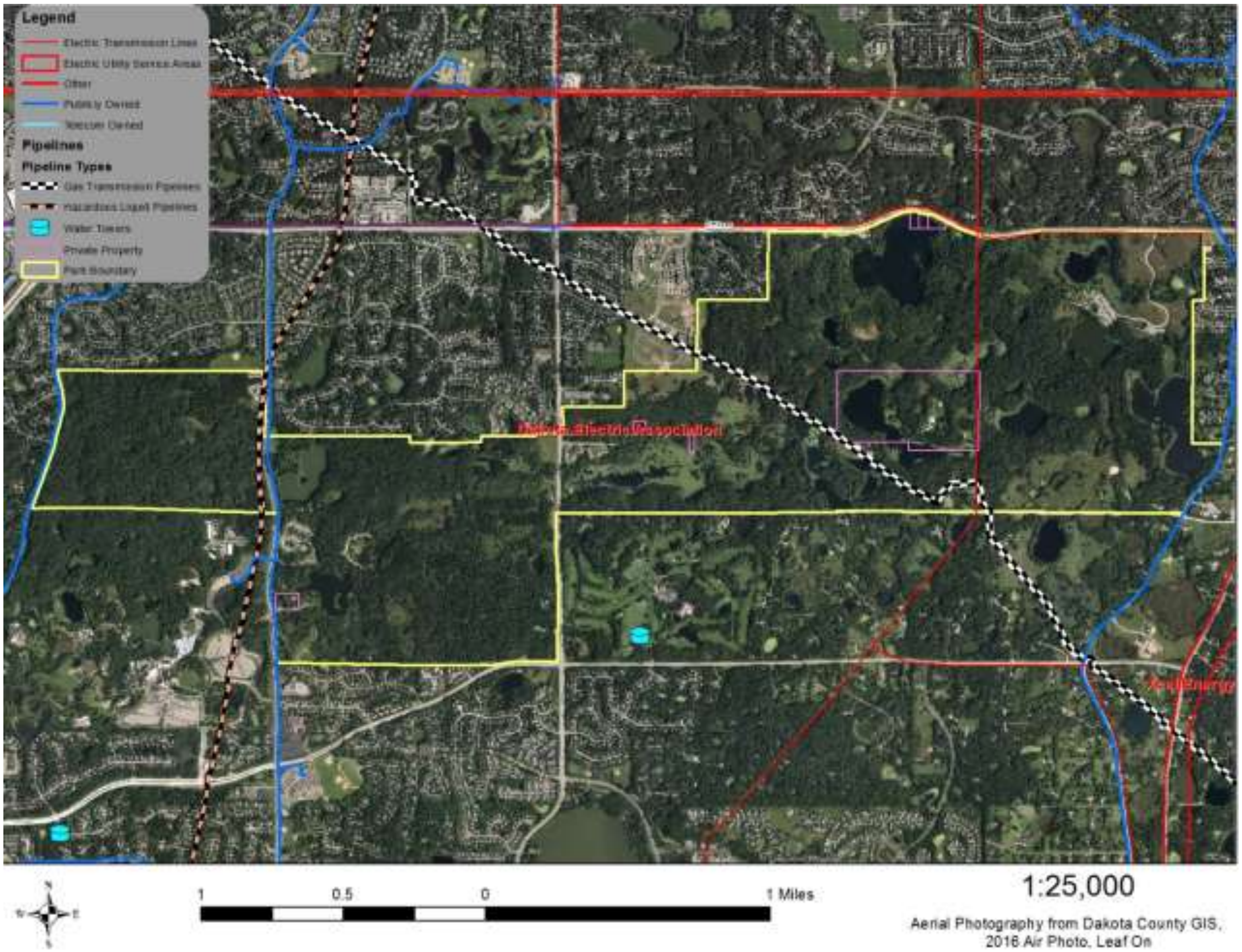
Common Name	Scientific Name	Height	Light	Wildlife Value	Comments
Allegheny serviceberry	*Amelanchier laevis*	15-25 ft	Sun/part shade	High	Edible fruits. White flowers in spring.
Eastern wahoo	*Euonymus atropurpurea*	6-20 ft	Sun/shade		Cultivars are common; native wild type is uncommon. Attractive scarlet-red foliage and purple fruit. Spreads.
American plum	*Prunus americana*	20-35 ft	Sun	High	Fruits edible; ripe in summer. Forms thickets.
Wafer ash	*Ptelea trifoliata*	10-15 ft	Sun to shade	Larval host for swallowtail butterfly	Foliage more open form in shade, dense in sun.
Choke cherry	*Prunus virginiana*	20-30 ft	Sun/part shade	Excellent	Common woodland and forest understory shrub.
Smooth rose	*Rosa blanda*	4-6 ft	Sun/part shade	High: birds, mammals.	Rose hips ripe in late summer and fall. Flowers favorite of Japanese beetles.
Red-berried elder	*Sambucus pubens*	6-12 ft	Shade	Very high	Excellent massing plant, fast growing.
Bladdernut	*Staphylea trifolia*	8-15 ft	Shade		Tolerates many soil conditions, disease resistant
Highbush cranberry	*Viburnum trilobum*	6-12 ft	Sun to shade	High -Birds eat fruits.	Foliage more open form in shade, dense in sun.
Arrowwood viburnum	*Viburnum rafinesquianum*	5-8 ft	Part shade, shade	High	Pretty foliage; straight stems; grows in understory of woodlands, forests.
Round-leaved dogwood	*Cornus rugosa*	8-12 ft	Part sun/shade	Butterflies use flowers. Birds eat berries	Dense, flat-topped clusters of creamy-white flowers in June, followed by light-blue berries on red stems in August. Prefers sandy soil.
Black-berried elder	*Sambucus canadensis*	10-12 ft	Sun/part shade	High value: bird food	Cluster of white flowers; dark blue berries in late summer.
Common ninebark	*Physocarpus opulifolius*	8-10 ft	Full sun	Bird food	Dense growth habit
Bush honeysuckle, northern	*Diervilla Lonicera*	3 ft	Partial sun, shade	Bee favorite	Spreads by rhizomes

FLOOD TOLERANT

Common Name	Scientific Name	Height	Light	Wildlife Value	Comments
Black chokeberry	*Aronia melanocarpa*	5-8 ft	Sun/shade	Bird food	
Pagoda dogwood	*Cornus alternifolia*	15-20 ft	Sun/shade	Birds	Especially lovely as an ornamental shrub. Flat clusters of white flowers and blue-black fruits. Cool, moist, slightly acidic soils are best.
Nannyberry	*Viburnum lentago*	16-20 ft	Sun/part shade	High	Dense foliage. Fruit are dark blue drupes that hang from branches. Good for wetland edges.
False Indigo	*Amorpha fruticosa*	8-10 ft	Sun/part shade	Butterflies	Attractive flower; forms open, loose canopy, compatible with grasses, sedges, and fobs. Great lakeshore stabilizer.
Buttonbush	*Cephalanthus occidentalis*	6-12 ft	Full sun	Birds, butterflies	Round flower head; fragrant; showy.
Silky dogwood	*Cornus amomum*	6-12 ft	Full sun	Bird food	Blue fruit; reddish-purple bark
Red twig dogwood	*Cornus sericea*	6-12 ft	Sun/part shade	Bird food	Red twigs, greenish-white fruit
Witch hazel	*Hamamelis virginiana*	20-30 ft	Sun or shade	Late-season pollinators	Unique, spider-shaped yellow flowers that bloom late in the year.
St. John's Wort	*Hypericum kalmianum*	2-3 ft	Sun/part shade	Pollinators	Masses of yellow flowers in summer
Winterberry	*Ilex verticillata*	6-8 ft	Sun/lt shade	Bird food	Showy, small, scarlet-colored fruit in fall and winter.
Black Currant	*Ribes americanum*	3-6 ft	Sun/lt shade	High value: birds and mammals	White flowers; black-purple fruit, edible
Pussy willow	*Salix discolor*	20 ft	Full sun	Soil stabilizer	Showy catkins; ornamental
Slender willow	*Salix petiolaris*	25 ft	Full sun	Good cover for birds	Forms loose thickets; still allows enough light for dense ground layer growth.
Red willow	*Salix sericea*	6-8 ft	Full sun	Bird food	Upright, rounded form; reddish-brown twigs
American elder	*Sambucus canadensis*	8-10 ft	Full sun	High value: bird food	Very tolerant of soil conditions; blue-black fruit in late summer; edible.

Red elderberry	*Sambucus pubens*	8-10 ft	Sun/part shade	High value: bird food	Red berries in May/June; not edible by people, but birds love them.
Meadowsweet	*Spirea alba*	3-6 ft	Full sun	Bird food	Of wet meadows. Erect branching; white flower spikes in July.
Highbush cranberry	*Viburnum trilobum*	6-12 ft	Sun/part shade	High value: bird food	Upright, arching habit; white flat-topped flower clusters; red fruit persists until spring; red color to foliage in autumn. Verify native species, since cultivars are common.
Golden currant	*Ribes aureum*	3-6 ft	Sun/Pt shade	High: berries for birds	White flowers; gold-colored fruit, edible

10.11 Appendix K. Utilities Map



This is a map of the current utilities that occur in or near the park. This is important to consider since damage, repair, or removal, or construction of new utilities may greatly affect the resources of the park. For example, the gas transmission pipeline (owned by Northern Natural Gas) was reconstructed in 2016-2019 which had implications for vegetation, soil, wetlands, etc. Careful planning and implementation of utilities projects is necessary to reduce impacts to the park.