Whitetail Woods Regional Park

Natural Resource Management Plan

October 20, 2020

Dakota County Parks – Natural Resources

Dakota County
forever wild
PARKS

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1. EXECUTIVE SUMMARY

Whitetail Woods Regional Park, a relatively new park in the Dakota County Park System, is a 459-acre site located in Empire Township in the center of the County. The park is part of the Vermillion Highlands open space collaboration between the County, MN DNR, and the University of Minnesota (UMORE Park), which together total nearly 5,000 acres of contiguous open space. The park was founded in 2008, as a single purchase, and a Master Plan was developed in 2010-2012. Surrounded by agricultural land and a wildlife management area to the south, aggregate mines to the west, and a growing urban area to the north and northwest, and southwest (Farmington, Lakeville, and Empire Township), the park represents sort of an oasis of recreational and ecological land for the area.

Major portions of the park were rated as having moderate to high ecological biodiversity significance by the County Biological Survey of the Minnesota DNR in the 1990's. There are several rare plants and animals that are found in the park, and just outside of the park, including Blanding's turtles, hairy valerian, and a high quality wet meadow.

The geologic history of the region shows that the bedrock was formed hundreds of millions of years ago, when the whole area was part of a great, shallow, inland sea. Limestone deposits over the ages formed the structure for what is now the major aquifer for the Twin Cities metro area, the Prairie du Chien formation. There are relatively little recent deposits over the Prairie du Chien, in this vicinity of the County, which makes the groundwater highly sensitive to contamination. Unfortunately, the recent past contributed much pollution to the aquifer, when a munitions factory was built near the present day park in the 1940's. Also, aquifer contamination from nitrate fertilizer and pesticides is well-documented. Aquifer recharge areas like the wetlands of the park and surrounding areas, are what cools the water and makes trout habitat possible in the Vermillion River.

Natural features of the park include the soils, topography, water resources, and vegetation. The soils are comprised primarily of four regions; *i*) the northern dissected till plain, *ii*) the middle loess-mantled highlands, *iii*) the southwestern highlands, and *iv*) the lowland regions that developed on alluvial sediments. Soils develop over time in association with the plants and animals that grew in them. The highlands soils of the park were, until recently, associated with prairie, savanna, and oak woodlands, and the lowland regions were associated with shallow and deep water wetlands. Some areas of the park consist of pure sand and gravel, while others are mantled by loess, a wind-blown silt that accumulated from glacial times. The lowland soils are rich in organic matter and are dark in color and mucky.

Topography of the park is quite variable, with steeper lobes or moraines on the east side of the lake, and knolls on the southwest side of the lake. The uplands to the north of the lake are gently rolling and not too steep. The wetlands are broad, flat, and low.

Many changes in land use have occurred since Presettlement times (early 19th century). Agriculture and mining are the major factors, and they have all acted to degrade the integrity of the natural communities here. Vast areas of native grasslands were plowed, and many other areas were pastured and overgrazed by domestic livestock. Mining stripped the land of vegetation and greatly altered water flow and drainage patterns. Also, in the 1960's, an earthen dam was constructed across the

wetlands, by the private landowner, which forever changed the character of the wetland—it impounded water on the north/upstream side of the dam and made conditions much drier on its south/downstream side. Streams were ditched, from the present day park southwards, which also changed hydrology of the wetlands.

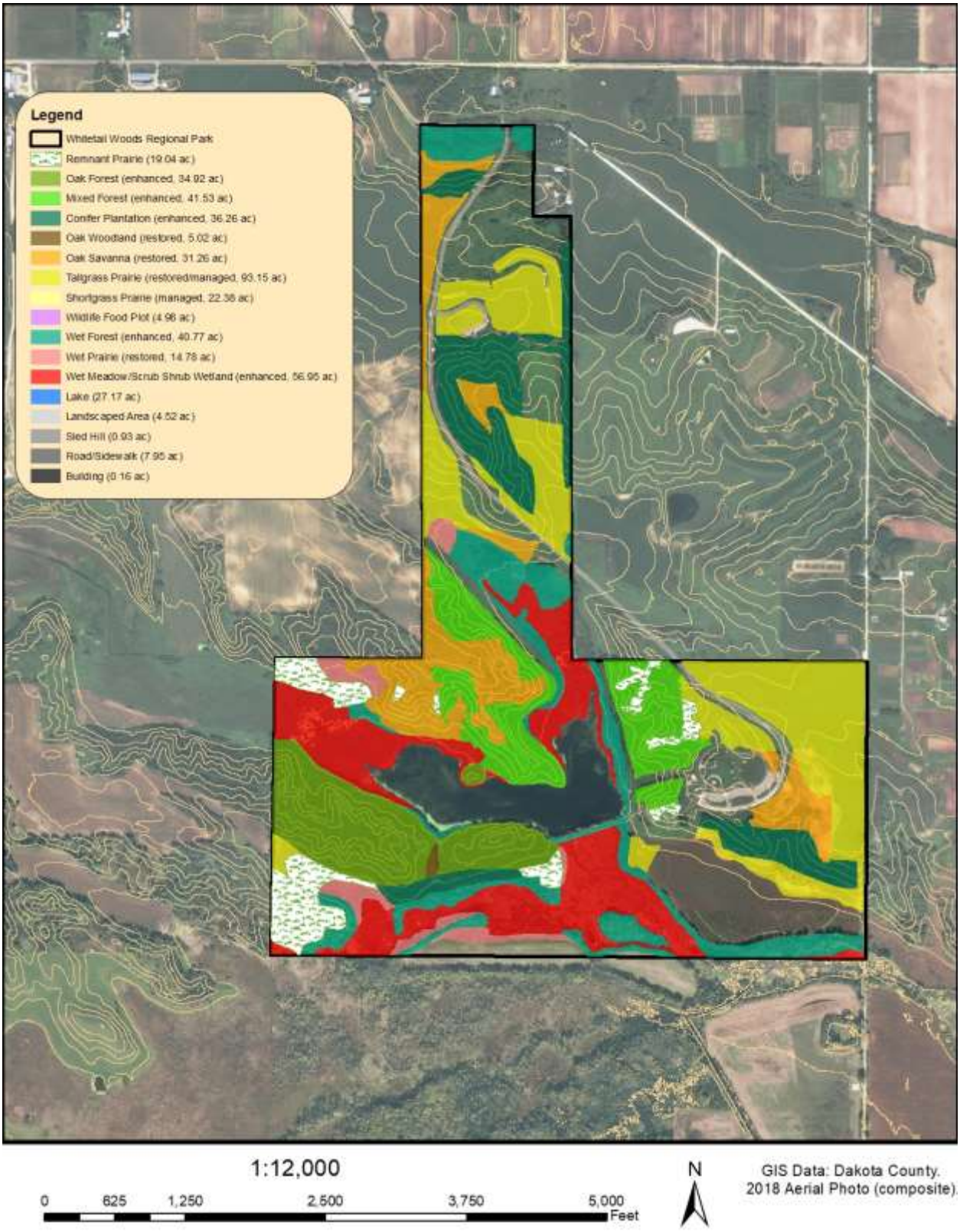
As a result of the impacts, the natural communities suffered. Many species were driven out, and many others were overhunted and driven out of the area. When top predators disappear from the scene, it can cause a "trophic cascade" that has ripple effects all down the food chain. When keystone species like bison are lost, it has large repercussions for the grasslands that they help maintain.

The County has been doing much to restore and replenish the land to some of its former condition. A large state grant was obtained in 2015 that has helped transform the natural communities of the park, removing invasive plant species such as buckthorn and reed canary grass, and replanting many species that were lost. The purpose of this Natural Resource Management Plan is to organize the management of the park to maximize restorative power and to keep the park's restoration trajectory on track. If the plan is followed, the ecosystem of the park and the surrounding area will benefit, and so will the people that use the park.

The vision for managing natural resources in Whitetail Woods Regional Park is: *the water, vegetation, and wildlife will be managed to conserve biodiversity, restore native habitats, improve public benefits, and achieve resilience and regionally outstanding quality, now and for future generations.*

The major goals of this plan are the following:

1. Manage and conserve biodiversity
2. Restore ecosystem processes and native habitats
3. Achieve ecological resilience and provide ecological services
4. Achieve regionally outstanding quality
5. Enhance visitor experience and environmental education
6. Integrate with Master Plan elements
7. Develop target plant communities that are appropriate for the site
8. Develop a 5- and 20-year work plan identifying priorities, recommended tasks, and estimates of costs
9. Use adaptive management as a way to guide and manage moving forward



Target plant communities and work units for Whitetail Woods Regional Park.

The work plan lays out the major priorities and tasks for management moving forward into the next five to twenty years. If enacted, the work plan calls for over 400 acres of the park to be enhanced over the next twenty years at a maximum cost of nearly $700,000. External grant funding will be sought for restoration and enhancement projects. Using in-house crews would decrease this cost. These costs reflect all the potential enhancements identified for the park. Actual enhancements will be based on yearly work plans for the entire park system and external funding. Ongoing maintenance will cost just over $180,000 for the next ten to twenty years, which will be covered primarily by County funding. Water resources tasks include water quality monitoring, Empire Lake restoration, and wetland restoration, with costs estimated around $170,000 for the first five years of the plan. External grant funding will be sought for water projects. For wildlife resources, approximately $180,000 was identified in the Natural Resources Management System Plan that would be allocated in the first five years for wildlife projects. The costs for specific wildlife 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.

The NRMP will be reviewed and updated every five years or as needed to maintain its relevancy.

2. INTRODUCTION

2.1. Precedent Planning Efforts

The Dakota County *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 *Whitetail Woods Regional Park Master Plan* was completed in 2012. 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 *Whitetail Woods Regional Park Natural Resource Management Plan* was developed with the goal of incorporating previous natural resource management efforts for Whitetail Woods Regional Park, being consistent with the goals outlined in the NRMSP and being compatible with the overall *Park System Plan* and the VSSOP.

2.1.1. Dakota County 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 ten 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 Whitetail Woods Regional Park is described below:

1. Great Places
2. Connected Places
3. Protected Places

Ten-Year Implementation Priorities

The ten-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.

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).

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

Delivering the Vision

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

2.1.2. Natural Resource Management System Plan (2017)

In 2017, the County 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* (VSSOP) (2018), 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 twenty-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; and a Technical Advisory Committee comprised of members from academia, non-profit conservation organizations, private landowners, community leaders, Soil and Water Conservation District, and State Agency staff. The Plan was presented to the County Planning Commission and County Board at several points, and the County Board approved the NRMSP in May 2017.

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

System-Wide Vegetation Management Activities	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. Vegetation Resources Management from the NRMSP, 2017.

System-Wide Water Resource 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. Water Resources Management from the NRMSP, 2017.

System-Wide 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. Wildlife Resources Management from the NRMSP, 2017.

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. Wildlife Management Groups from the NRMSP, 2017.

Whitetail Woods Regional Park NRMP will fulfill the above initiative and management activities for the five-year NRMSP work plan (see Section 10.2, below)

2.1.3. Whitetail Woods Regional Park Master Plan (2012)

The 2012 Master Plan provided guidance on the development (Figure 1), maintenance, and operations of Whitetail Woods Regional Park in Empire Township. Plan content is based on the eleven requirements for master plan content listed in the Metropolitan Council's 2030 Regional Parks Policy Plan: 1) boundaries and acquisition costs, 2) stewardship plan, 3) demand forecast, 4) development concept, 5) conflicts, 6) public services, 7) operations, 8) citizen participation, 9) public awareness, 10) accessibility, and 11) natural resources.

- Geology, soils, and slopes, etc., were described, however, this information was used to identify potential development, not for managing the vegetation, wildlife, and water resources for their intrinsic values. Vegetation was described, cover types were classified, and quality rankings were designated
- Archaeological resources were described and areas with potential to find artifacts in the park were identified.
- Land use history was described from 1680's to present
- Demographic trends were explained and use projections for the future were anticipated. By 2030, it was predicted that the park would serve roughly 500,000 visitors a year.
- Opportunities identified were collaboration with Vermillion Highlands and connections to future development to the north and west.
- Issues identified were long term mining would continue for decades that posed challenges in connecting with surrounding communities in the future, road access from the west will need to be developed, and environmental cleanup of Vermillion Highlands will hamper the full recreational potential of the regional park.
- Potential conflicts identified were adjacent hunting uses, adjacent shooting range, and adjacent future mining.
- Proposed park projects and visitor amenities effects on natural resources (proposed or new infrastructure and modified programs) are the following:
    - Gateway Entrance
    - Off Leash Dog Area
    - Gateway Trailhead
    - Agriculture and Food Plantings
    - Art and Activities
    - Landscaping to frame and screen views
    - Stormwater management and wetland replacement for loss due to construction
    - Energy production such as wind and solar
    - Parking—to integrate small pull-off parking strategically along the entrance road
    - Picnic shelters scattered outside the main shelter for additional 100 visitors
    - Interim visitor center/equipment rental facility
    - Observation tower from the park's highest points
    - "Green" architecture
    - Terraced perennial food production
    - Camper cabins in conifers

    - Play area and nature trails
    - Vegetation –thin the conifers and plant deciduous trees, shrubs, and groundcover over time.
    - Fire hazard mitigation
    - Group camping
    - Performance area
    - Small ceremony space for weddings, baptisms, etc.
    - Disc golf course
    - Landscaping and integrated food—plant native and perennial food trees and shrubs as buffers
    - Water play
    - Community Commons
    - Nature-related art area
    - Visitor Center
    - Outdoor learning and play area
    - Kayak/canoe landing
    - Southwest overlooks
    - Trails
    - Boardwalks
- Natural Resources
    - Restoration areas—
        - three areas designated Restoration Areas
        - nine areas designated Protection and Maintenance Areas
        - six areas designated Production Areas (wood fiber, energy plantings, food production collaborations—"Arboretum")
    - Soil Resource Stewardship
    - Temporary cover options for cultivated land
    - Active and passive water harvesting
    - Use of wetlands and lake
- Cultural Resources
    - Historic Sites
    - Archaeological sites
    - Cemeteries
- Park Boundary and Acquisition
- Maintenance and Operations
- Partnership and Volunteerism
- Public Safety and Enforcement
- Public Outreach and Awareness
- Capital Improvement

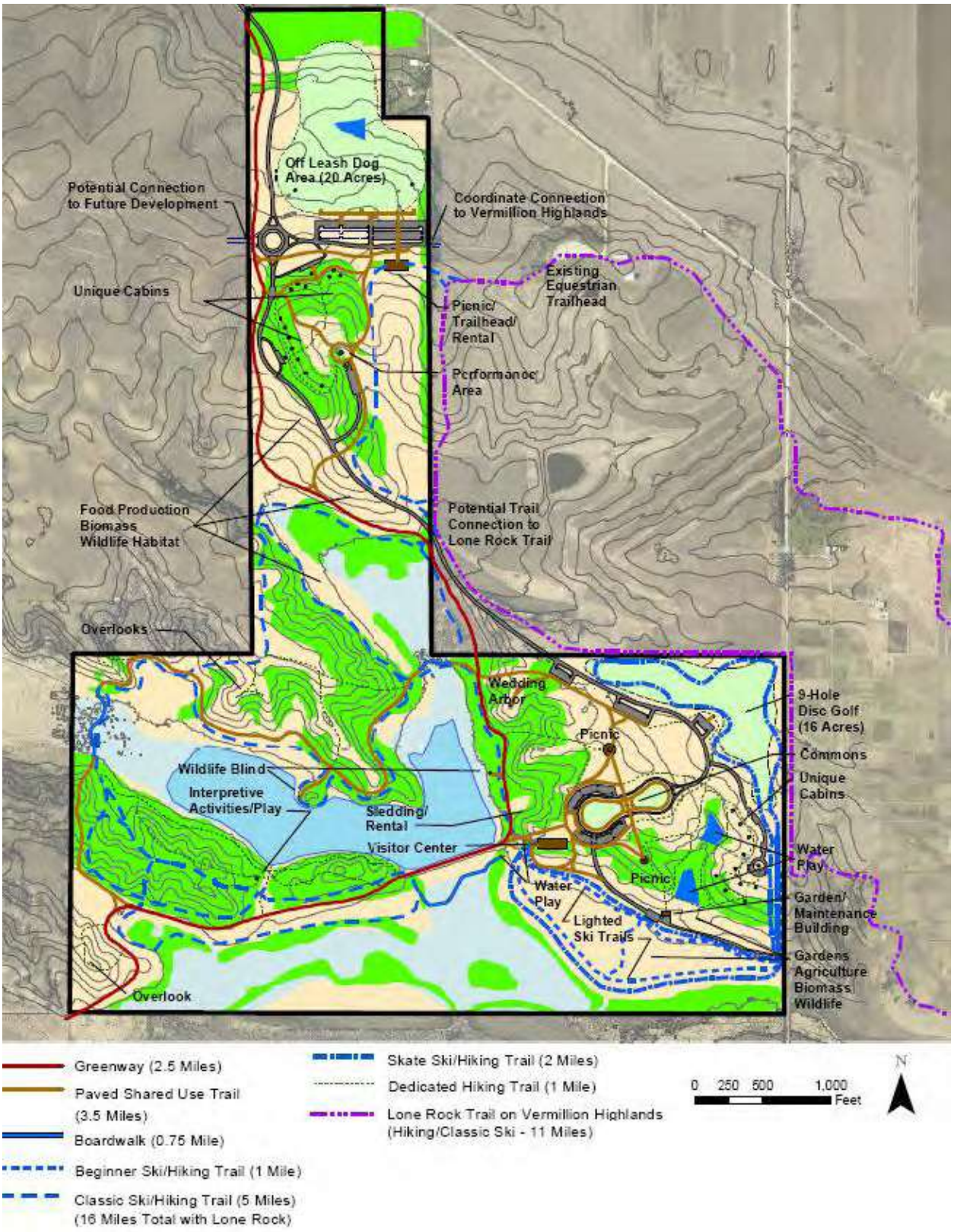


Figure 1. Development Master Plan (from the 2012 Master Plan for WWRP).

2.2. Regional Natural Resource Conservation Context

Whitetail Woods Regional Park, located in the center of the County, is a key piece of land for the conservation of wildlife in the County. Being surrounded by other natural area land, in a matrix of agricultural, mining, and developing urban land uses makes it an important refuge for plants and animals that live and migrate through the County. Additional details are provided in Section 3, below.

Dakota County's Greenway plans include a regional greenway from Lebanon Hills Regional Park to the Vermillion River, traveling through UMore Park and the Whitetail Woods Regional Park. With representatives from the MDNR and Empire Township, the County explored alternative routes for the greenway segment that will connect the park to the Vermillion River. MDNR worked with landowners to provide greenway access. Empire Township has expressed interest in local trail connections when the area west of the regional park develops.

Natural resource management in the Vermillion Highlands WMA and the Vermillion River AMA has been occurring for decades. Some of the primary management efforts include the following:

- Re-meandering of a previously ditched section of the Vermillion River to re-establish natural river channel sinuosity
- Integration of stream habitat and bank stabilization improvements, including toe wood banks, root wads, hammerhead pools, and lunker structures
- Riparian vegetation improvement and management
- Restored over 500 acres of native prairie
- Invasive species control (primarily buckthorn)
- Food plot management for overwintering wildlife
- Wood duck box placement and upkeep

2.3. Natural Resource Public Values

The natural world is a powerful influence in the lives of every person, and has been 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.

Public surveys of County residents have consistently shown strong support for the idea of nature-based parks, viewing of wildlife and native vegetation, and clean water. In keeping with this attitude, it is important to manage the natural resources of the park so that these values and priorities come to fruition (Dakota County Resident Survey, 2019).

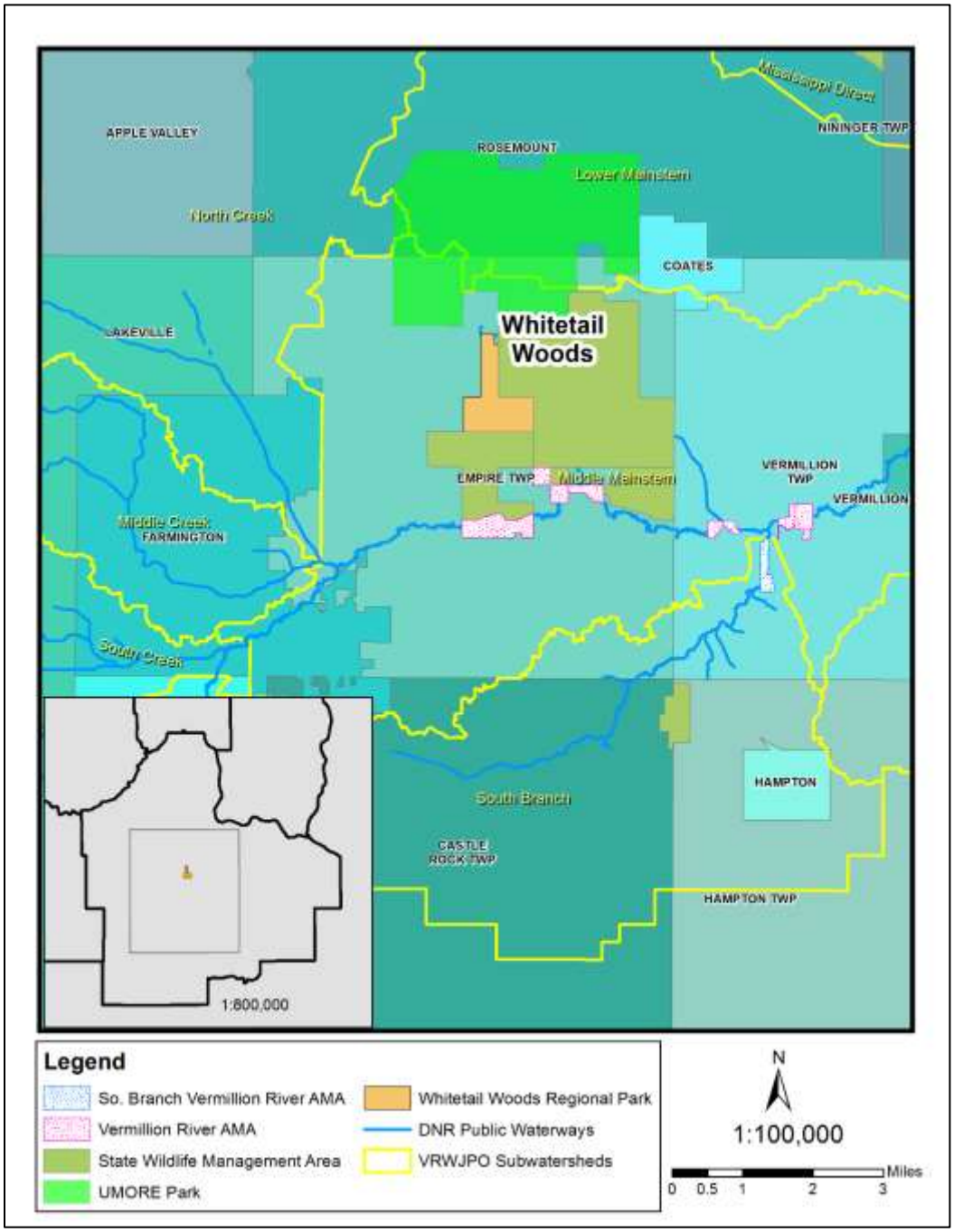
3. NATURAL HISTORY AND CURRENT CONDITIONS

3.1. Landscape Context

3.1.1. Location

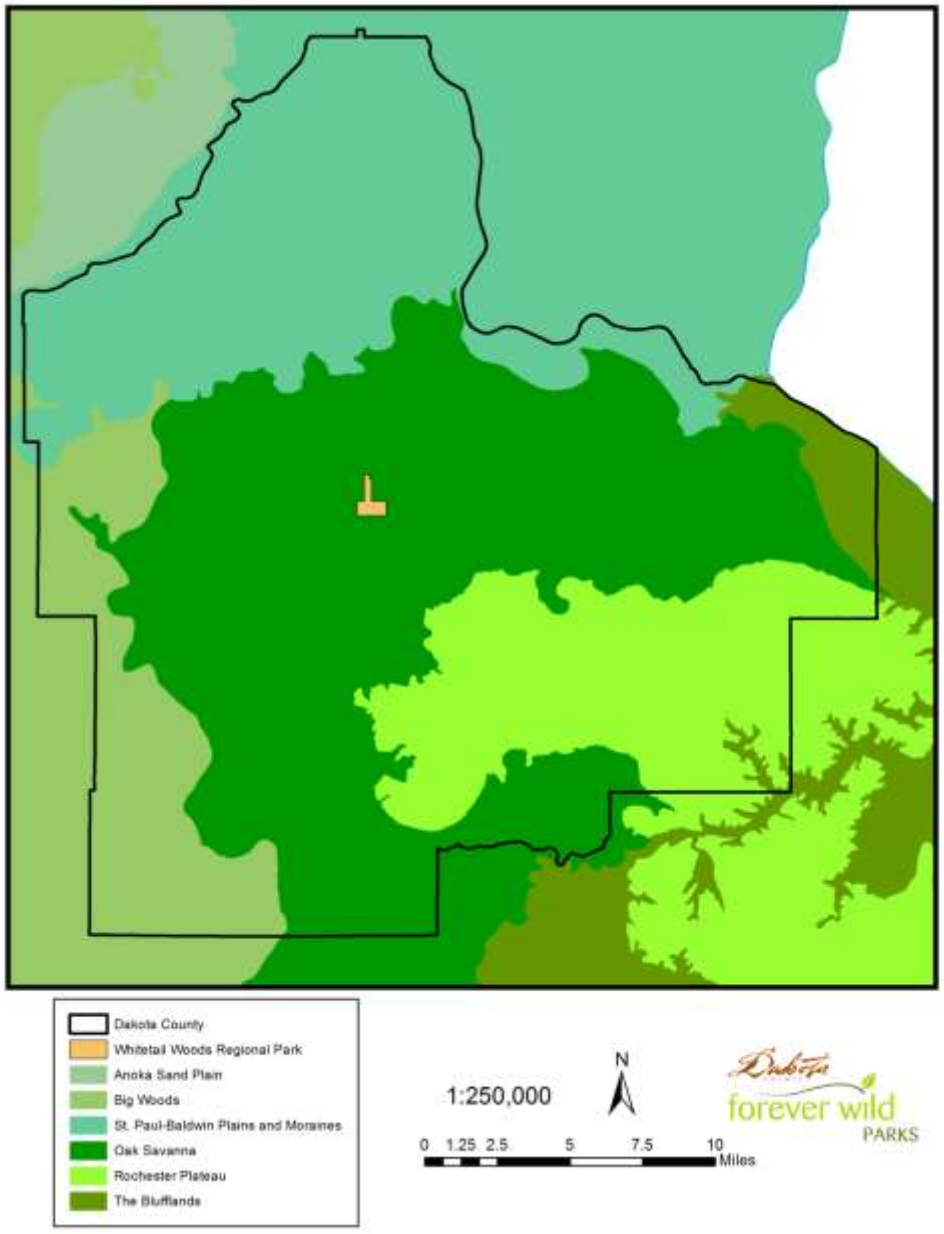
Whitetail Woods Regional Park is a 459-acre park located within Empire Township in Dakota County south of 170th Street West on Station Trail (within Sections 10 and 15, T114 R19) (Figure 2). The Park lies within the Middle Mainstem sub-watershed of the Vermillion River. The Park is adjacent to the 4,772-acre University of Minnesota Outreach, Research and Education (UMore) Park, which comprises a multitude of land uses including experimental agricultural plots, conservation lands, and the relics of an abandoned WWII-era munitions plant. The eastern and southern boundaries of the Park are shared with the 2,838-acre Vermillion Highlands Research Recreation and Wildlife Management Area, which is jointly managed by the DNR and the Regents of the University of Minnesota. The Vermillion River Aquatic Management Area is contained within parcels of this greater WMA and is located further to the south on the banks of the Vermillion River. While the Vermillion Highlands area has mixed agricultural and conservation-based land use, it contributes to a larger aggregation of open space public lands that protect and support the habitat needs of wildlife found in the Park and the surrounding area.

Figure 2. Regional Context of Whitetail Woods Regional Park.



3.1.2. Regional Natural Resources Context

Figure 3. Ecological Subsections of Dakota County.



There are four ecological provinces in Minnesota (prairie parkland, eastern broadleaf forest, Laurentian mixed forest, and tallgrass aspen parkland), ten sections within the provinces, and 26 subsections (Figure 3). Whitetail Woods Regional Park is situated within the Eastern Broadleaf Forest Ecological Province, the Minnesota and Northeast Iowa Morainal Ecological Section, and the northern part of the Oak Savannah Ecological Subsection. The Oak Savanna subsection historically consisted largely of gently rolling hills with bur oak savanna being the primary vegetation community, but with areas of tallgrass prairie and maple-basswood forest also being common. Bur

oak savanna consisted of mesic to dry tallgrass prairie with an occasional and interspersed canopy of fire-resistant trees such as bur oaks. Fire was a key disturbance that maintained the open structure of these savannahs and kept wooded vegetation from encroaching and succeeding to forests. Wetlands were once plentiful throughout the subsection and provided critical habitat for wildlife. The patchy nature of this Subsection supported a variety of habitat types, depending upon fire frequency and topography, including but not limited to dry sand-gravel prairies, mesic tallgrass prairies, dry and mesic oak savannahs and brushlands, wet prairie, and fire-dependent oak woodlands.

Today most of the subsection is farmed, putting increasing pressure on the ecosystem which has led to further wetland deterioration, water quality concerns, sediment loading in streams, habitat fragmentation, and herbicide drift issues. Residential development from the Twin Cities has accelerated in the past 30 years, and stresses natural communities in the northern part of the subsection.

There are over 90 species of Greatest Conservation Need (SGCN) in the subsection, spanning eight taxonomic groups. The greatest factors affecting SGCN vulnerability and decline are habitat loss and habitat degradation. Other factors include invasive species competition, pollution, exploitation from people, disease, and food source limitations (*Tomorrow's Habitat for the Wild and Rare*, MN DNR, 2006). Key habitats in the Subsection are 1) oak savanna, 2) prairie, 3) wetland-nonforest, 4) grassland, and 5) river-headwater-to-large. Management goals developed by the DNR are the following: 1) maintain, enhance, and protect the key habitats by managing invasive species, using prescribed fire and other practices, 2) encouraging restoration efforts, 3) providing technical assistance and protection opportunities to interested individuals and organizations, 4) surveying SGCN populations, assessing the amount and quality of key habitats and mapping their locations, and 5) better understanding the life histories of SGCN to improve their conservation and management. See below in Rare Natural Features, Section 3.6, for more information.

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 to enlarge existing habitat areas, create corridors for wildlife movement, and determine the characteristics of local surface water hydrology.

Agriculture is the dominant land use immediately outside the Park's boundaries, both on private lands to the west and within the Rosemount Agricultural Experiment Station portion of UMore Park to the north and east (Figure 1). While there are differences in the cropping and tillage practices in these areas, tillage does create the potential for sediment runoff within the Park boundaries during precipitation events. The private landholdings to the west are slated for sand and gravel mining in the future, which will affect the hydrological conditions in the Park. The conservation areas within the Vermillion Highlands complex and WMA lands work to complement the natural areas in Whitetail Woods Regional Park in terms of creating an ecologically contiguous region. There is ongoing interest

in coordinating natural resource management activities across jurisdictional boundaries in these natural areas. Also, about ½ mile to the east of the park is located the Dakota County Gun Club.

3.2. Physical Conditions

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.

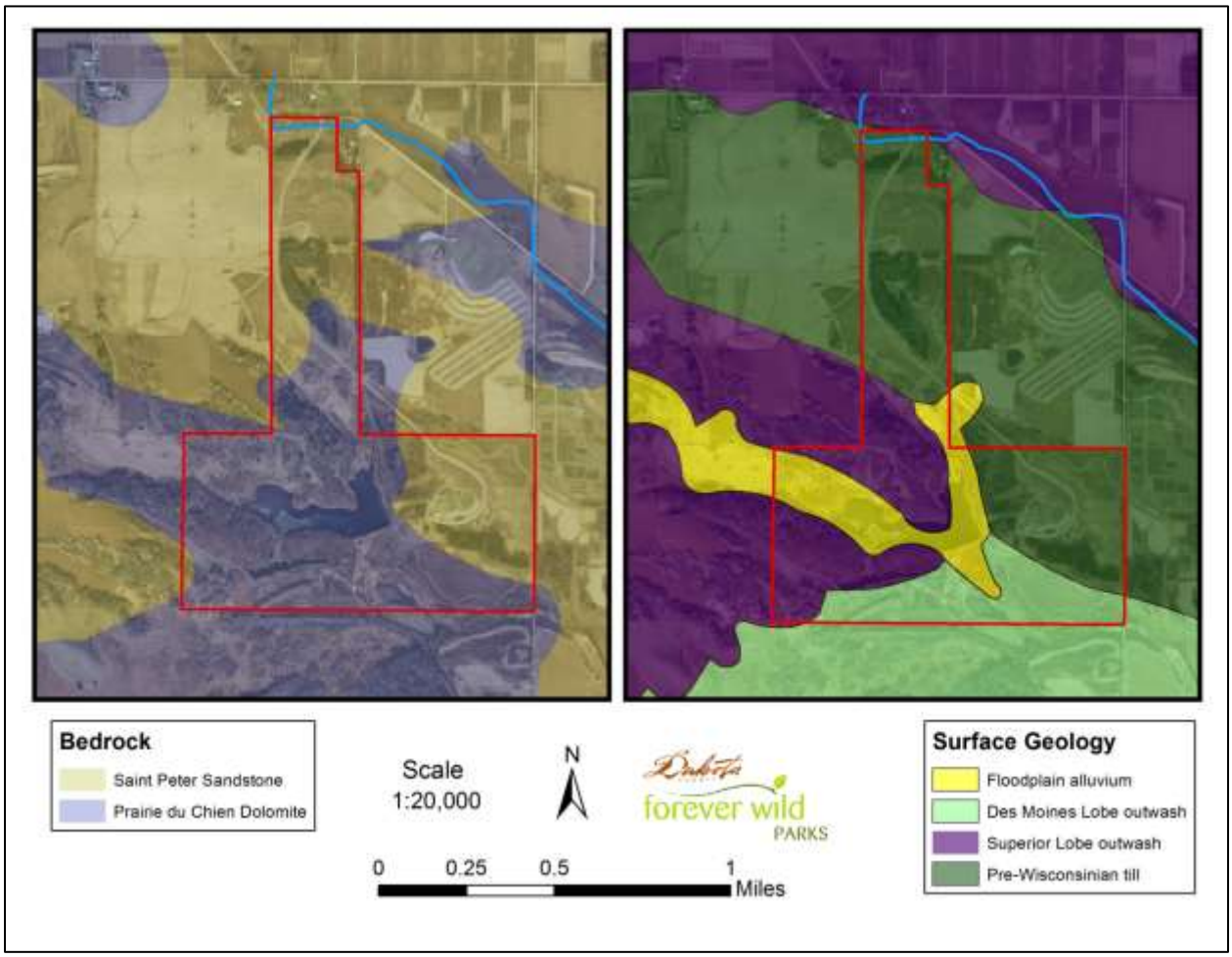
3.2.1. Geology

The geological make-up of bedrock underlying Whitetail Woods Regional Park consists of sedimentary layers deposited during the Ordovician period roughly 480 to 440 million years ago (MYA) when this region of the continent was overlain by shallow inland seas (Figure 4). The Saint Peter Sandstone formation was deposited during the Upper Ordovician and consists primarily of fine to medium-sized quartz sand and has the capacity to act as an aquifer when submerged below the water table. This sandstone formation gave rise to interesting surface features where this soft rock substrate was overlain by limestone caps that slow its erosion, such as the Lone Rock formation in the adjoining Vermillion Highlands, Chimney Rock to the east and Castle Rock to the south.

The Saint Peter Sandstone stratum lies above dolomite and limestone formations of the older Prairie du Chien Group of the Lower Ordovician, and accordingly, these latter strata form the bedrock of the lower-elevation regions of the Park. The fine- to very fine-grained Shakopee Dolomite that makes up the majority of the Prairie du Chien Group in this region is important as an aquifer for groundwater storage. The dolomite minerals in this limestone impart a high buffering capacity to groundwater that favors certain calciphilic (calcium-loving) plants in groundwater seepage areas. For example, the rare plant edible valerian (*Valeriana edulis* var. *ciliata*) is on the MN Threatened Species list and has been documented within a mile of the park boundary. These plants are used in part as indicator plants for calcareous fen plant communities, which rely on calcium-rich groundwater seepages for their persistence (MN DNR, 2016), although no calcareous fens were found in the park.

Both of these bedrock strata contribute to the temperature regulation and suitability of the nearby Vermillion River as trout habitat, owing to their capacity to store and cool groundwater.

Figure 4. Bedrock and Surface Geology of Whitetail Woods Regional Park.



The surficial geology of Whitetail Woods Regional Park region is a result of the past 2 million years of glacial activity in this area, spanning multiple periods that altered the landscape with the successive advance and retreat of glaciers throughout the Quaternary Period.

The parent material of soils in the northern region of the Park are the result of multiple older pre-Wisconsinan-era glacial tills, and this higher-elevation region likely consisted of a larger complex of highlands that persisted through subsequent glaciation events. Nicknamed 'old gray till' in early soil surveys (Winchell 1888), this material was transported from the northwest near Hudson Bay in Canada before or during the Illinoian glaciation (190,000 years ago) and underwent subsequent deposition of windblown silt (loess) (Balaban & Hobbs, 1990). This till has loam to clay loam textures that developed into well-drained to poorly drained soils on summits and side slopes (See Section 3.2.3 below).

The more recent Late Wisconsin Glaciation occurred between 50,000-10,000 years ago and deposited till from the Superior and Des Moines lobes to the north and west of the park. The Rosemount Outwash Plain was a result of glacial meltwater from the Superior lobe, which redistributed material from the St. Croix Terminal Moraine at least five miles north and distributed it throughout what is now the Vermillion River watershed in central Dakota County. These sand and

gravel deposits that are overlain by loess comprise the highlands of the western section of the park, and this parent material resulted in well-drained soils (below).

The most recent glaciation from the Des Moines lobe advanced along the western border of Dakota County. The outwash from the retreat of this lobe bisected previous material laid upon the Rosemount Outwash Plain and deposited sand and gravel along a valley train that is now occupied by the mainstem of the Vermillion River and its major tributaries. This outwash resulted in deposits of sorted loams in the lowlands on the southern edge of the Park that are relatively poorly drained (below).

Alluvial deposits from current drainages tend to be composed of less permeable materials with higher fractions of silt and clay. These drainages, as well as the lowland areas of Des Moines outwash, have developed into wetlands due to the topological and poorly-drained nature of these parent materials.

3.2.2. 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- and 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 drier 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.

Figure 5. Topography of Whitetail Woods Regional Park.

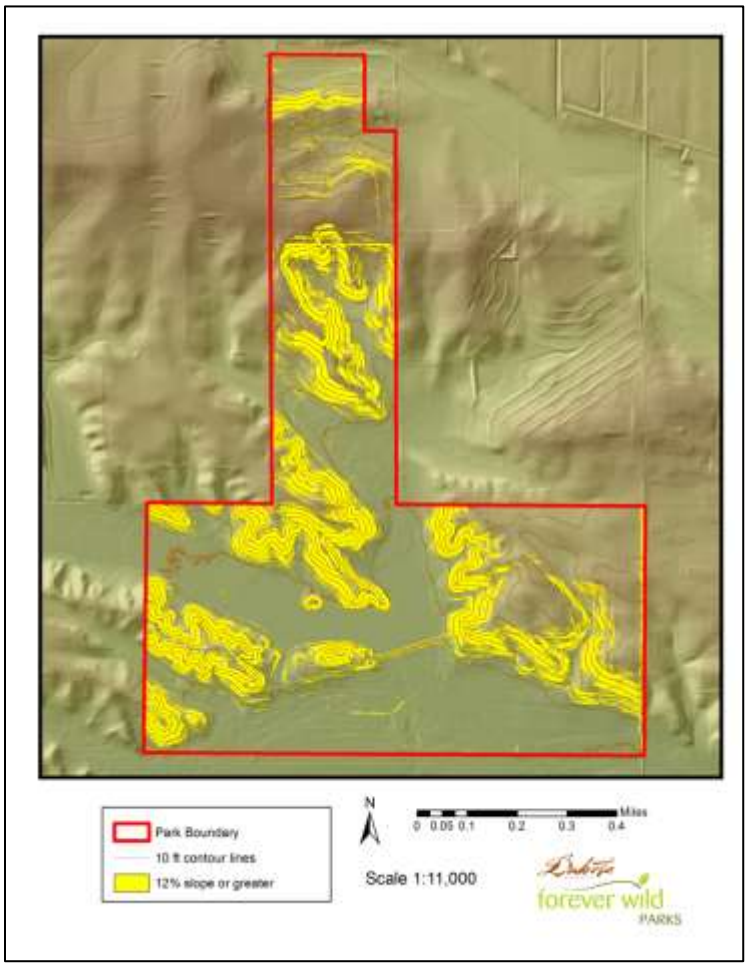


Figure 4 displays the topographical relief of Whitetail Park and the surrounding area. The higher regions of the Park that are the result of old glacial till (north) or glacial outwash (southeast and west) are dissected by lower-elevation drainages in the middle and southern portions of the park.

Steep slopes with grades greater than 12% are found along the transitional margins of the higher elevation areas in the Park. Many of these hills have an orientation that exposes south- and west-facing aspects, resulting in predominantly drier conditions in most of the transitional elevations of the Park. The ridge running northwest to southeast that bisects the upper-middle portion of the Park exhibits northeast aspects that are predominantly forested and that contain conifer plantations. These areas would likely support more mesic plant communities that would succeed to forest in the absence of more regular disturbance regimes such as periodic fire.

Other northerly aspects occur on the hills south and west of Empire Lake, but these topological considerations that might contribute to cooler, wetter conditions are outweighed by the excessively drained Hawick or Salida sandy loam soils at these sites (below).

Another concern regarding these steeper slopes is their susceptibility to erosion. Again, consideration of the particular soils is relevant, as soils with higher potential for surface runoff and lower permeability are more susceptible to erosion. Within Whitetail Woods Regional Park, the

areas most susceptible to erosion are those with slopes between 12-25%, confined to regions with the aforementioned Hawick series (units 611D and 611E), as well as those of the Timula-Bold complex (963D2) (Figure 5).

3.2.3. 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, 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 units/types suggest the most appropriate use and management of the land.

The soils within Whitetail Woods Regional Park have all developed within the last Wisconsin glaciation 10,000 years ago and are thus considered geologically young. These soils still exhibit some of the chemical and physical properties of the parent material, in that soluble materials haven't had much time to leach down through the soil profile, such as the Timula and Bold Complex soils, where organic matter accumulation and horizon development is relatively nascent. A map of the following soil units and their properties can be found in Figure 5 and Table 1, respectively.

The major soil units in the Park can be broken up into four regions; *i*) the northern dissected till plain, *ii*) the middle loess-mantled highlands, *iii*) the southwestern highlands, and *iv*) the lowland regions that developed on alluvial sediments.

i) The northern region of the park developed on loess depositions upon the pre-Wisconsinan-era calcareous 'old gray till.' Here, the Ostrander loam soils formed in association with Klinger silt loam, Maxfield silty clay loam, Garwin silty loam and Colo silty clay loam. All four soils are types of mollisols that developed with prairie vegetation. These soils form a sequence of well drained to poorly drained soils as they trend from high to low elevation, beginning with the upland Ostrander series to the somewhat poorly drained Klinger series on side slopes, to the alluvial drainageways occupied by the poorly drained Maxfield, Garwin and Colo series. Loess depositions increase in depth downslope, and the degree of permeability decreases concordantly with this trend in smaller particle size, leading to poorer drainage characteristics. Ostrander soils developed on uplands of surficial loam underlain by calcareous glacial till, and the Maxfield series has developed at the heads of drainageways on these uplands. The Garwin and Colo series soils occupy concave depressional areas that form drainageways from the upslope Maxfield and Ostrander soils. The landscape position of the Maxfield, Garwin, and Colo soils has exposed them to greater levels of water, which has led to their characterization as Typic Endoaquolls due to the development of darker surface layers, higher organic content and a dull grayish subsoil color with varying degrees of mottling. Colo soils typically have a thicker mollic epipedon than the adjacent but upslope Garwin series and experience periodic flooding, which would support the establishment of sedge meadow and wetland plant species.

ii) The highlands within the middle portions of the Park are dominated by the Timula and Bold series soils are mapped together as a complex. The Timula and lighter-colored Bold soils are silt loams, and their classification as Typic Eutrudepts (Timula) or Udorthents (Bold) indicate that these Inceptisols and Entisols, respectively, haven't differentiated into distinct horizons, likely due to recent erosion given their relatively steep slopes (6 to 18 % grade). The Port Byron and Tallula series that occupy hill crests and uplands to the east have thicker and darker surface layers than the Timula and Bold series due to the organic matter accumulation characteristic of prairie vegetation (i.e., mollic epipedons), and are thus classified as Typic Hapludolls, or mollisols that receive sufficient rainfall to keep these soils moist throughout most of the year. All four of these well drained silty loam soils are typically adjacent to one another, as they all developed on the thick layers of loess that were deposited on the uplands in this region.

iii) The glacial outwash plains resulting from the retreat of the Superior Lobe developed into upland Wadena loams and Estherville sandy loams covering hill crests, with Hawick sandy loams or loamy sands occupying steep side-slopes and Salida sandy loams occur on gravelly convex areas at the base of these slopes. While the hilltop soils are Typic Hapludolls, the side slope soils are Entic Hapludolls that have less soil development due to their capacity for erosion. All of these soils are well drained to excessively drained due to higher levels of sand and gravel, indicating that these areas are drier and would support vegetation that would thrive under a periodic fire regime.

iv) The flat lower elevation region along the southern border of the Park is a result of the outwash plain from the Des Moines Lobe, which is contiguous with the gently sloping valley of the Vermillion River and its tributaries to the south and east. The other low regions consist of alluvial sediments that follow the eastward and southward drainage pattern in the Park. The prominent soils on these alluvial sediments are the poorly to very poorly drained Mayer loam, Mayer silt loam, Colo silt loam, Kato silty clay loam, and the well-drained Lindstrom silt loam. The Mayer, Colo and Kato series soils are Endoaquolls, indicating that they experience periodic saturation. These soils are positioned downslope of the drier Lindstrom and Terril units, which are Cumulic Hapludolls that contains a thicker organic horizon and less saturation than the Endoaquolls. The Cylinder silt loam occupies terraces below the Timula-Bold hillslopes and is positioned slightly upslope of the Mayer series. Most of these soil units are currently covered by degraded sedge meadows or monotypic stands of reed canary grass, but historically they likely supported sedge meadows in the wettest regions to wet and mesic prairies in drier upland Terril and Lindstrom units.

Figure 6. Soils of Whitetail Woods Regional Park.

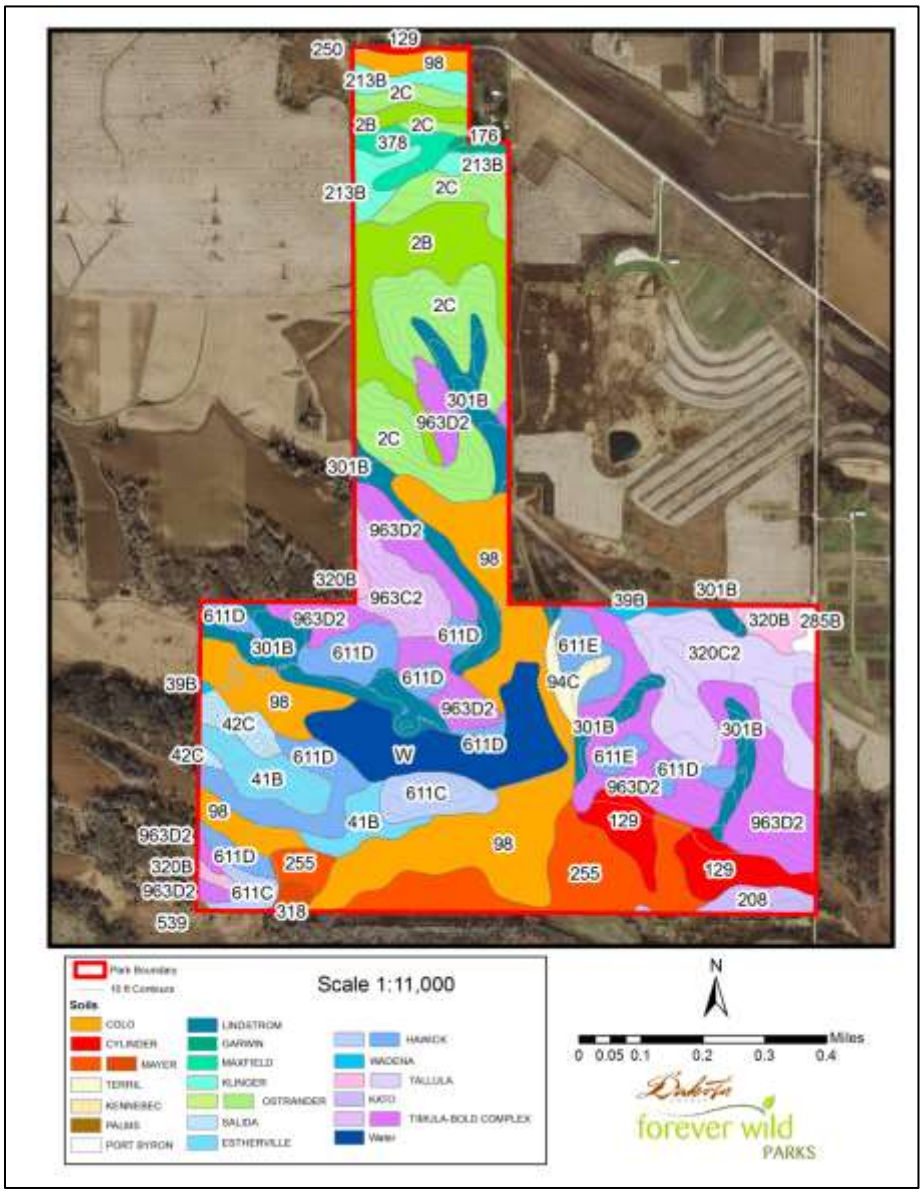


Table 5. Soil Unit Properties.

Soil Unit	Description	Percent Slope	Acres	Taxon	Drainage
	TOTAL ACRES		**458.4**		
98	Colo silty clay loam	0 to 2	69.0	Fine-silty, mixed, superactive, mesic Cumulic Endoaquolls	Poorly drained
963D2	Timula-Bold complex	12 to 18	62.1	Bold: Coarse-silty, mixed, superactive, calcareous, mesic Typic Udorthents	Well drained
2C	Ostrander loam	6 to 12	45.5	Fine-loamy, mixed, superactive, mesic Typic Hapludolls	Well drained
301B	Lindstrom silt loam	2 to 6	38.5	Fine-silty, mixed, superactive, mesic Cumulic Hapludolls	Well drained
255	Mayer silt loam	0 to 2	30.7	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, calcareous, mesic Typic Endoaquolls	Poorly to very poorly drained
611D	Hawick sandy loam	12 to 25	30.0	Sandy, mixed, mesic Entic Hapludolls	Excessively drained
320C2	Tallula silt loam	6 to 12	28.9	Coarse-silty, mixed, superactive, mesic Typic Hapludolls	Well drained
2B	Ostrander loam	1 to 6	26.8	Fine-loamy, mixed, superactive, mesic Typic Hapludolls	Well drained
129	Cylinder loam	0 to 5	16.3	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, mesic Aquic Hapludolls	Somewhat poorly drained
41B	Estherville sandy loam	2 to 6	14.8	Sandy, mixed, mesic Typic Hapludolls	Somewhat excessively drained
611C	Hawick coarse sandy loam	6 to 12	10.9	Sandy, mixed, mesic Entic Hapludolls	Excessively drained
963C2	Timula-Bold complex	6 to 12	10.7	Timula: Coarse-silty, mixed, superactive, mesic Typic Eutrudepts	Well drained
213B	Klinger silty clay loam	1 to 4	10.5	Fine-silty, mixed, superactive, mesic Aquic Hapludolls	Somewhat poorly drained
611E	Hawick loamy sand	18 to 25	8.5	Sandy, mixed, mesic Entic Hapludolls	Excessively drained
320B	Tallula silt loam	2 to 6	5.6	Coarse-silty, mixed, superactive, mesic Typic Hapludolls	Well drained
378	Maxfield silty clay loam	0 to 2	5.4	Fine-silty, mixed, superactive, mesic Typic Endoaquolls	Poorly drained
42C	Salida gravelly coarse sandy loam	2 to 12	4.9	Sandy-skeletal, mixed, mesic Entic Hapludolls	Excessively drained
208	Kato silty clay loam	0 to 2	4.8	Fine-silty over sandy or sandy-skeletal, mixed, superactive, mesic Typic Endoaquolls	Poorly to very poorly drained
94C	Terril loam	4 to 12	3.6	Fine-loamy, mixed, superactive, mesic Cumulic Hapludolls	Moderately well drained
39B	Wadena loam	2 to 6	1.9	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, mesic Typic Hapludolls	Well drained
318	Mayer loam, swales	0 to 2	1.6	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, calcareous, mesic Typic Endoaquolls	Poorly to very poorly drained

285B	Port Byron silt loam	2 to 6	1.4	Fine-silty, mixed, superactive, mesic Typic Hapludolls	Well drained
176	Garwin silt loam	0 to 2	1.2	Fine-silty, mixed, superactive, mesic Typic Endoaquolls	Poorly drained
539	Palms muck	0 to 6	0.2	Loamy, mixed, euic, mesic Terric Haplosaprists	Very poorly drained
W	Water		24.6		

3.3. Vegetation

The vegetation found 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 disturbance results in a myriad of potential vegetation types. After thousands of years, these dynamics influenced vegetation patterns and native plant communities prior to human occupation. Native Americans profoundly influenced vegetation types and patterns by using fire as a tool to make the land more appealing to wild game. More recent activities associated with European settlement such as cultivation, draining, pasturing, logging, mining, and 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 plasticity to create a mosaic of vegetation in various conditions across landscapes, including parks.

3.3.1. 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 Whitetail Woods Regional Park 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. American basswood, sugar maple, elm, red oak, and an understory of

shade-loving wildflowers made up the "Big Woods" in the moist areas protected from fire. Bur 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 gravel 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. A large number of wetlands once existed in the southwestern portion of the County with only 12 to 15 percent remaining. 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.

Public Land Survey Data

The original Public Land Survey was done for Dakota County in the 1850's and 1860's. Information from the "notes" sections of the survey has been used to reconstruct what the Presettlement vegetation would have been at the time (Marschner's Map) (Figure 6). At each quarter section a "bearing tree" was located, and usually it was identified, to the best of the surveyor's ability. If no tree was available, as was the case with prairie, then often a pile of rocks was used. Figure 8 shows bearing tree data from the original land survey.

Figure 7 shows the predominant, pre-settlement (c. 1850's) plant communities of the park. Figure 8 shows the "Bearing Tree" data. It can be seen from the map in Figure 7 that each point within WWRP was called "prairie" and most of the points surrounding the park were also called "prairie". This does not mean that no trees occurred in the region, as is the case of the woodlands of what is today the park, but, for the most part, very few trees were to be found in this region at the time just before settlement.

The term "prairie" was a general one that described areas dominated by grasslands and herbaceous vegetation. There are many different types of prairie, including wet prairie, dry prairie, and mesic prairie, as well as many subtypes such as dry barrens prairie, hill prairie, and sand gravel prairie. The types of prairie that would probably have occurred at Whitetail Woods park at the time of pre-settlement would have most likely been a mix of dry prairie, mesic prairie, and wet prairie. In addition, there most likely would have been some areas of savanna, which are dominated by grasses and forbs but that contain a few scattered groups of scrubby oaks, such as bur and pin oaks. Wet prairie would have been quite extensive in the vicinity of the future park, as seen from the occurrence of hydric and poorly drained soils. A description of native plant communities, including dry and wet prairie, will be given later in this document.

Figure 7. Pre-Settlement Vegetation Near WWRP.

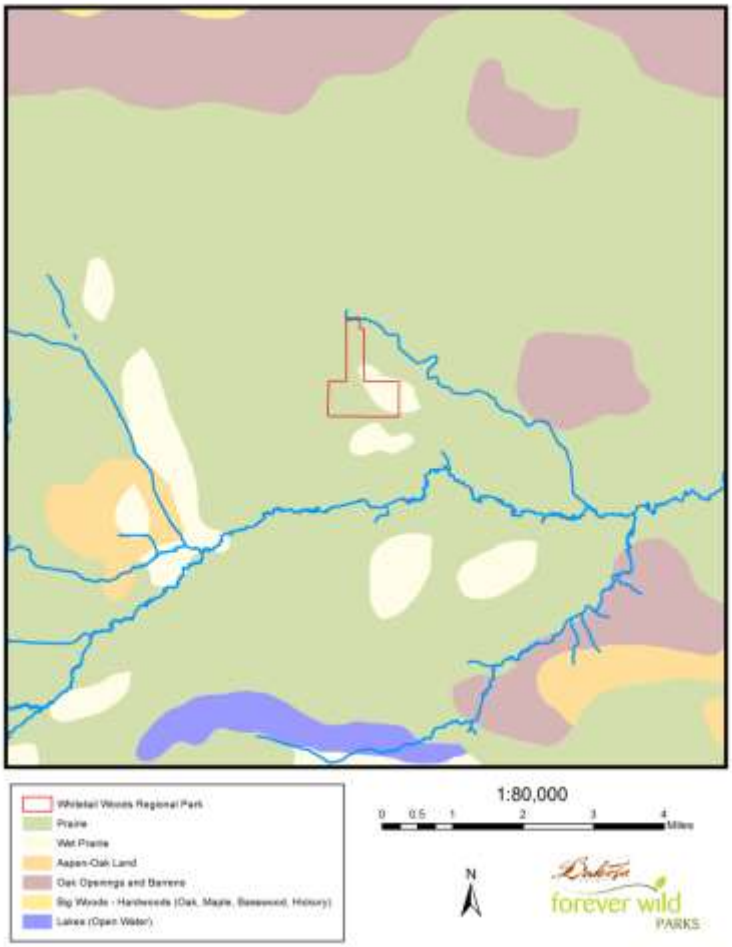
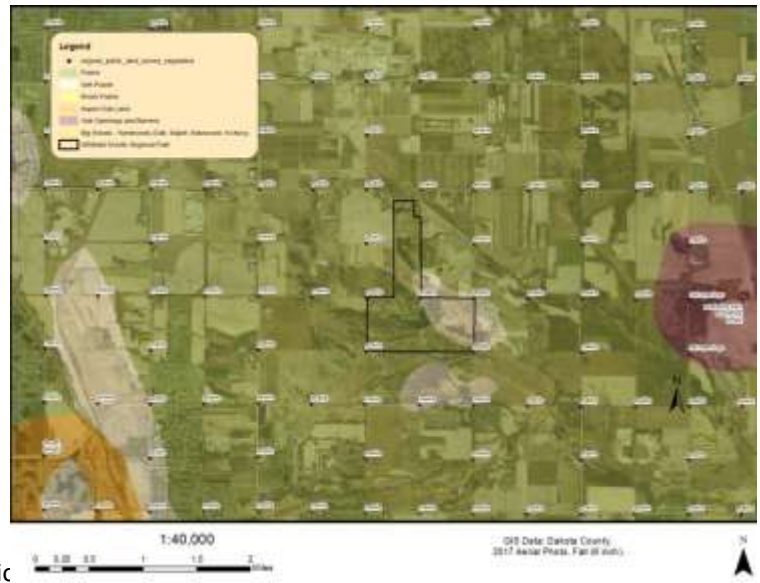


Figure 8. Bearing Tree data from the notes of the original land survey of Dakota County.



Whitetail Woods Regic

3.3.2. Land Cover and Use Trends

European settlement significantly changed the Dakota County landscape. Native prairies were plowed, forests and woodlands cut, wetlands drained, fires suppressed, 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.

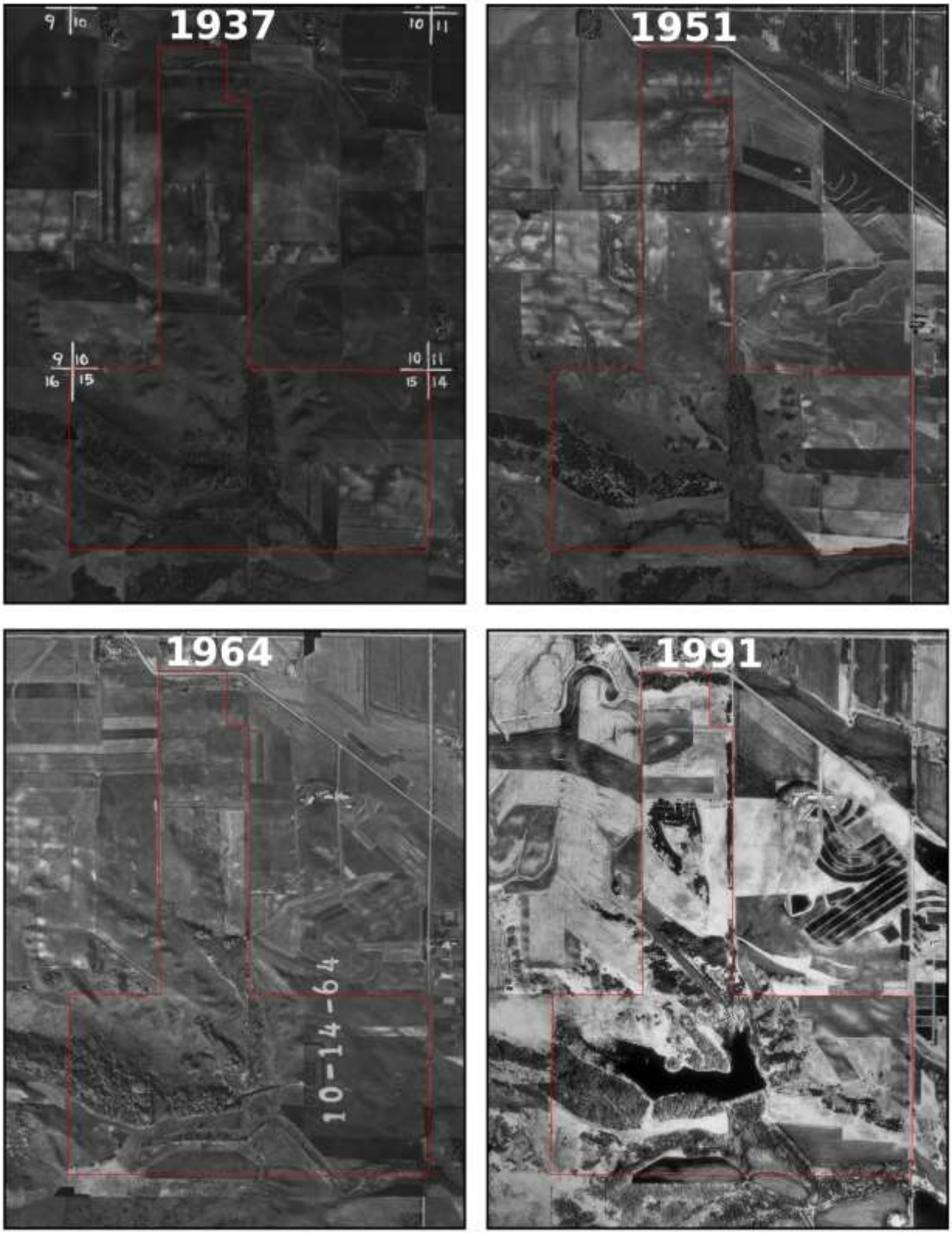
Some of the best evidence of past land use is depicted in a progression of historical aerial photographs. Figure 9 exhibits historical aerial photos of the park and surrounding area starting from 1937 through 2017. Primary impressions and a summary of interpretations from these photos are the following:

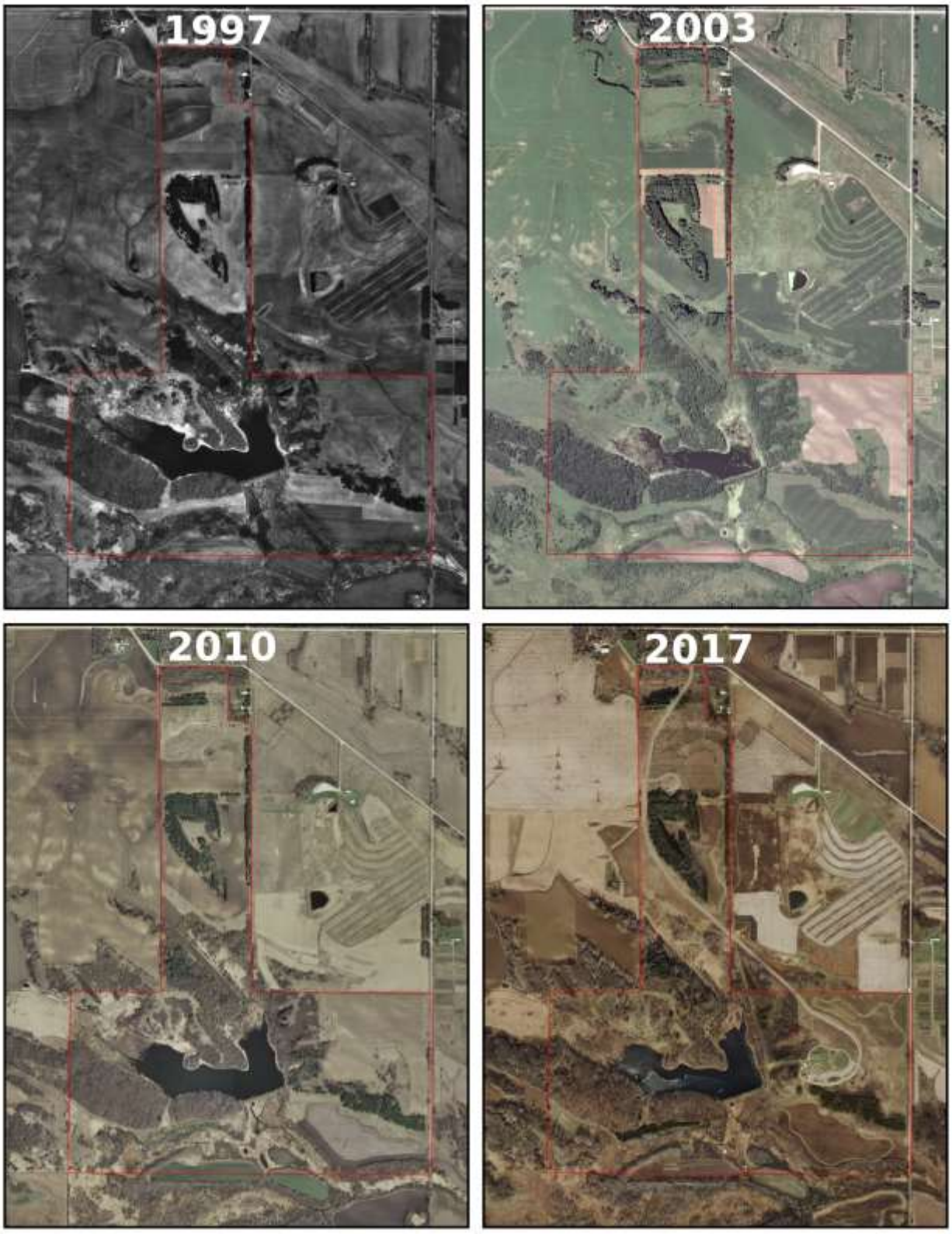
- **Empire Dam**. Dam installation from the 1960's (Figure 9A) resulted in significant hydrological impacts and changes of the site; creating an impounded area north of the dam and a dry area south of the dam; wetlands north of the dam became flooded, and south of the dam became dried out. Today a shallow lake or deep marsh exists north of the dam and south of the dam is a shrub-carr wetland. Although this situation caused some drastic changes to occur, and displaced many species in the process, it also favored some species, such as Blanding's turtle, by making deeper water for them to overwintering in.
- **Wetlands**. Wetlands throughout the park have been impacted by disruptive land use practices. For example, the wetlands just west of the park property-- were farmed in the 1990's, causing significant impacts and changes to the wetland hydrology and species composition here. As a result, today, these wetlands on private property just west of the park are mostly a monoculture of the exotic invasive grass, reed canary grass (*Phalaris arundinacea*), while the park side still contains a relatively diverse community of wetland vegetation, but with pockets of reed canary grass (RCG). This example underscores the resiliency of intact native plant communities (on the park side of the wetland) even in the face of highly disruptive land use activities (on the private side of the wetland), but also highlights the problematic nature of invasive species at this site—RCG will continue to be a problem as long as it's propagules enter the park from disrupted wetlands outside of the park.
- **Upland Prairie/Savanna**. Much of the upland grassland dominated communities such as prairie and oak savanna was converted to agricultural land use post-settlement. This can be seen in the aerial photos showing up as rectangular areas with plow or hay rows inside of them. Due to 150 years of agriculture land use, these areas have basically no native seed bank remaining, and thus will be more difficult to restore. An example of such an areas is the upland to the north of Empire Lake, which was farmed for 100-plus years prior to the area becoming a park. Without intensive restoration management and activities occurring here for several years, this area will be dominated by invasive exotic weeds such as bull thistle, early seral (successional) native species such as boxelder, and grazing-increasers (unpalatable or thorny plants avoided by cattle) such as old-field goldenrod, for decades.
- **Prairie Remnants**. A few remnant prairies can be seen on the aerial photos. These areas, dominated by herbaceous plants, show up as light-colored areas representing open areas. A

few remnant prairies have managed to survive relatively unscathed to this date. No area within the park has completely avoided disruptive impacts, however

- **Woodlands**. The woodlands of the park area (see area south of today's Empire Lake) were previously much more open, with more grassland vegetation and fewer trees and shrubs. Compare the 1937 aerials with the current ones. A gradual increase in woody plant cover has occurred over the last 80 years.
- **Former Agricultural Lands**. The narrower piece of park land jutting out of the north side of the park, sometimes referred to as "the stovepipe" was mostly plowed for crop fields. Likewise, was the eastern third of the southern body of the park ("the stove") and strip on the far southern end of the park. Therefore, today these areas contain lower quality plant communities than the rest of the park does.
- **Pine Plantations**. The numerous pine plantations that are scattered throughout the park did not exist, pre-1964. Most of them were planted in the 1970's for erosion control and economic purposes, both which do not make ecologic sense for the park today. A common misconception is that these pines stands are remnant, which is not the case. Conversely, the remnant prairie, savanna, and woodland communities date back thousands of years. Managing pine stands makes management of the surrounding communities more difficult, since prairie and savanna have very different requirements. Pines tend to encroach into nearby prairies unless managed very closely. However, since these pines seem to be important to many visitors, strategic management of these stands will be a feature of this plan.
- **Park Purchased by County**. The parkland was purchased by the County in 2008. Initial Capital Improvements were implemented starting 2012.
- **Ecological Restoration**. Recently, the park has undergone ecological restoration. In 2013, a large old field in the southeast portion of the park was restored to tallgrass prairie as seen in aerial photos from 2010 and 2017). In 2015, the County received a large grant from the state of Minnesota, Lessard-Sams Outdoor Heritage Council (LSOHC) and restored the 470 total acres representing the majority of the park's upland and some of the wetlands. () Restoration efforts can be seen when comparing the 2017 aerial photo to previous years' photos.

Figure 9. Aerial Photos 1937-2017.




1997
2003
2010
2017

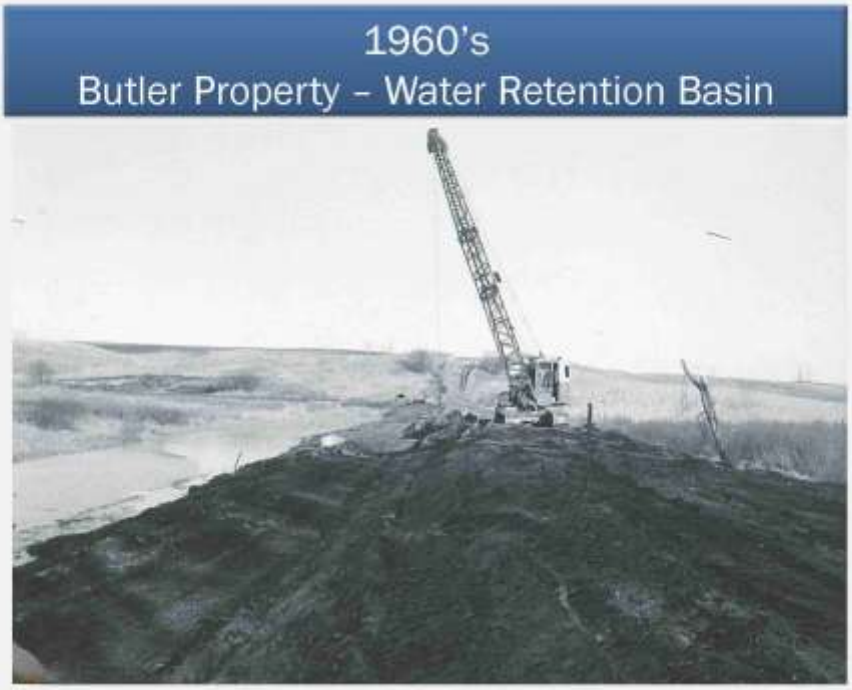


Figure 9A. 1960's aerial photo of the construction of the berm that formed "Empire Lake". This view is looking eastward. Note how open the landscape was in the background, what is now the east side of the park. Also note the wetland vegetation that still existed on the north side of the berm.

3.3.3. Land Cover Mapping and Assessment

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, plant-animal interactions like grazing and pollination, etc.), 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 defined and described by a combination of two things: 1) composition and 2) structure. They are *composed* of an assemblage of plant species that are typically associated with one another, for example, oaks and grasses/forbs in savannas, and grasses and forbs in prairies. They are also *structured* such that spatial arrangements, patch densities, and cover proportions, independent of species composition, are important, for example 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 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 more and more woody plants and the succession of a "savanna", and then a "woodland", and eventually to a "forest" community. The reverse is also true—more fire will lead to a more open community. This is what has been called the prairie-forest continuum.

Within each community or land cover type, there is further variation across the site, as determined by topography, soil type, geology, etc. This allows for microclimates and environments at a smaller scale, 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 all, including people, because they offer more secure services such as clean air, clean water, and healthy soil, which we all depend on to survive.

Mining

Mining for sand and gravel is planned to occur adjacent to the park on the west side of the "stovepipe". Currently the landowner is leasing the land out for farming, but if and when this land is mined, it could greatly impact the park, both ecologically by reducing habitat size and recreationally by having

a disruptive activity close by to visitors. The draft Land Conservation Plan includes this area in the Vermillion Highlands Preliminary Conservation Focus Area, so in the future, there may be an option for purchasing the land or obtaining a permanent conservation easement on this land.

Invasives Management

The property was acquired by the County as a regional park in 2008 as a single land purchase. There was little if any invasives management prior to that time; actually none until 2012, when the Master Plan was completed. A couple old fields were reconstructed to native prairie in the early years of the park. In 2014, the County was awarded a large state grant from Lessard-Sams Outdoor Heritage Council which was also matched by a substantial amount of County dollars and in-kind (total project was just over $1 million). Invasive species control and management started in earnest, as part of the grant project, in the fall of 2015. The grant ended on June 30,2019, at which point the bulk of the park's natural resources go into "maintenance mode", meaning rotational burning and/or grazing, spot treatment of invasive weeds, and ongoing monitoring and responding to immediate emerging management issues. Continual ecological enhancements can and should be made to the park, over time, however.

The biggest invasive plant species management concerns lie with the following species: common buckthorn (*Rhamnus cathartica*), Tartarian honeysuckle (*Lonicera tatarica*), reed canary grass (*Phalaris arundinacea*), smooth brome (*Bromus inermis*), cheat grass (*Bromus tectorum*), and spotted knapweed (*Centaurea maculosa*). As part of the grant, contractors have been hired to aggressively control these invasive, exotic plants. County Natural Resource staff monitors the park for new and existing invasive species. Since the grant expired, the County will continue to monitor and also hire contractors to control invasive species.

One of the best ways to control many invasive species is to burn fire dependent communities, such as oak woodland, oak savanna, and prairie that occur in the park. Another good method is to use grazing and/or browsing by goats and possibly sheep or long-horned steers. Other methods are spot treating with herbicides, using propane torches, mowing, haying, and using bio-controls. All of these methods will be utilized by the County.

Recreation

See the 2012 Master Plan for all planned facilities and activities for the park.

WWRP is currently located in a rural setting, but in the not so distant future will be most likely surrounded by urban and suburban land use. Thus, the number of visitors is expected to increase over the years. Today, visitorship is around 100,000 people per year (https://metrocouncil.org/Parks/Services/Parks-Research/Regional-Park-System-Annual-Use-Estimates.aspx). Current usage focuses on the Picnic Shelter and parking lot area. So far, parking and day use is adequate for the size of the park and the parking lot, but this may change in the future. Currently, there are a few soft surface trails throughout the park, and a newly paved regional trail that traverses the park latitudinally and a newly paved loop around Empire Lake. Hiking trails are a

highlight of the park. WWRP was recently voted by City Pages Magazine as the "best hike" in the Twin Cities.

Camper Cabins are located at the middle of the park in a pine plantation, and they are very popular. They sell out a full year in advance. The cabins are going to be expanded, and natural resource planning and management will be a part of the design and location process.

A Dog Park was sited for the park. Plans are to make this a unique dog park where hunting dogs can be trained. This area was deliberately kept out of the LSOHC grant project area. Some prairie seeding was done at the Dog Park site (in 2016), but if more restoration work is to be done there in the future, then it will have to be paid for by the County—not paid for by a grant.

A Disc Golf course was also planned for in the Master Plan. In the early and mid-2000's, disc golfing was in vogue, and it remains popular today, but several venues (e.g., City of Rosemount, City of Hastings) currently exist that did not before, . The area was seeded with a prairie mix in 2016, in the interim.

Impacts of recreation on natural resources can be damaging to the resource. Sensitive areas should be protected, and trail design implemented in such a way as to limit impacts to plants, animals, and water resources. Use of signage is very helpful. A signage plan is being developed by Dakota County and should be implemented at WWRP. An example of how to sensitively build a trail in a wetland is by using a boardwalk. But even boardwalks can be impactful, since they block sunlight from reaching plants directly under and adjacent to the boardwalk. Boardwalks should be built such that they do not do too much damage (e.g., using a grated surface that will allow light to penetrate) to the wetland and still allow access to the wetlands by people. Recent boardwalk construction (2020) over the wetland at the far west side of the park has incorporated such a grate, made of aluminum alloy, which will allow 55% of light to reach the ground under the structure.

Raingardens have been built near the parking lot and picnic shelter. They are working well to treat the stormwater from these impervious surfaces. Maintenance is performed by Natural Resources staff annually.

One issue regarding visitors and programming in the park is "bugs" . Due to the abundant wetlands in the park, there are many mosquitos and flies. Although good for birds and plants, insects can be pests for people, especially at dusk and after dark. Currently there are no indoor facilities at the park, so really nowhere to get away from the bugs. Metro Mosquito Control treats mosquito larvae in the spring, in the park, but does not do any adult mosquito control. WWRP is adjacent to MN DNR Wildlife Management Area (WMA), which does not treat mosquitoes. Other solutions may need to be explored for controlling insect pests that do not involve pesticides, such as installing bat houses, etc.

3.3.4. Existing Vegetation

Most of the park site was in some form of agricultural land use in the recent past (see section on aerial photos, 3.3.2, above), although there are a few small remnant prairies scattered throughout the property (Figure 19). There is evidence of this all over the park, including a plethora of annual and

biennial weeds (evidence of loss of native plant cover), patches of thorny shrubs such as European buckthorn and *Rubus* species, and unpalatable vegetation such as goldenrod and white snakeroot (evidence of heavy grazing). The wetlands and woodlands have been impacted by altered hydrology, fire suppression, and invasive species introduction, but with the advent of the restoration work that started in 2015, the situation is improving. Much work needs to be continued for success to be achieved, however. Figure 19 shows the extent of vegetation restoration and management in the park.

Figure 10. Large bur oaks on the north side of Empire Lake

Mixed Forest

Old fields that have become afforested, or old woodlots that were over-harvested. They have become dominated by weedy species in the ground and shrub layer and by medium-sized to young boxelder, ash, and black walnut in the canopy, but some areas contain mature bur oaks (Figure 10). Historically, these cover types were probably open woodlands or savanna.

Oak Forest

Forest or overgrown woodlands dominated by white, norther pin, and bur oak, with some aspen clones, black cherry, hackberry, and other tree species. These forests are more likely overgrown woodlands, and after grazing pressure was lost, woody vegetation has grown in. Overgrazing by domestic cattle probably occurred in these woodlands that may have driven down the ground layer diversity. High deer population density is a problem today, and can curtail oak regeneration. Canopy oaks are large and old, and thus provide the structure for mature forest and woodland (Figure 11). Very few small oaks are present in the shrub and ground layers. Shrub layer was recently dominated by buckthorn but now has been released (post 2015-2019) and now is dominated by raspberry and gooseberry (brambles). Ground layer cover is interrupted, and its diversity is patchy, being dominated by brambles. Burning helps regenerate ground layer diversity by suppressing brambles and other woody vegetation growth which reduces competition for light and nutrients to herbaceous plants. Areas that have been recently burned have shown great recovery and have a higher species richness such as abundant blood root and blue cohosh.

Figure 11. Mature red oak that was released from being smothered by buckthorn. Note the long, lateral branches that are low on the stem—an indication of open-grown conditions.

Wet Forest

Located along the drier margins of streams and ditches. Was recently dominated by buckthorn in many places, but willow is common in the shrub layer canopy. Now most of the buckthorn has been removed. Currently, the shrub layer is sparse and dominated by willow, brambles, gooseberry, and deciduous tree seedlings and whips (Figure 12). Ground layer was dominated by reed canary grass and small buckthorn, but has the potential to recover nicely. Like the "wet meadow-scrub shrub wetland" cover type, the lowland margins of these wet forest cover types are transitional areas between wetlands and woodlands and contain a mix of both of these community types. An eagle's nest was formerly located in the southern wet forest, but is now defunct.

Figure 12. Mix of wetland and woodland species on east side of Empire Lake.

Conifer Plantation

Several conifer plantations occur on the property. These were planted in the 1970's and 80's. They consist of blue and black spruce, red and white and scotch pine, and uncommonly, jack pine. The conifer plantations have cultural value, such as providing a unique setting for the camper cabins, and select, designated stands are slated to remain. However, other than red cedar, conifers are not native to this area and most of them are slated to be transitioned to more appropriate native plant communities such as oak woodland or savanna, over a period of 5 to 40 years.

Degraded Woodland

Located in the north part of the park, this cover type was a woodland that had not been burned for many years and contained a high density of young woody stems. The understory was depauperate, also.

Degraded Mosaic

Located on afforested old fields, this cover type represented a mix of non-native dominated grasslands and woodlands. Common species include smooth brome, boxelder, green ash, and a mix of planted conifers.

Old Field

These were old fields that were recently abandoned and were dominated by a mix of non-native and native annuals and perennials found commonly in ag fields like exotic thistles, burdock, cocklebur, rhizomatous goldenrods, and velvet leaf. Some woody plants were starting to pioneer into the old field.

Crop Field

Still in agricultural production when the restoration began in 2015.

Young Prairie

Prairie that was planted soon after the park was purchased by the County. It is still in the process of succession and maturation. Seed lists are provided in Appendix F.

New Prairie

Prairie that was very recently planted. Some areas received seed that was of non-local ecotype. Seed lists are provided in Appendix F. Photo-monitoring can help document the progression of the prairie over time (Figures 13-15)

Figure 13. Prairie that was just seeded that same year photo was taken in 2015. Located east of the parking lot.

Figure 14. Same view from the same spot in 2016.

Figure 15. Same view from the same spot in 2019.

Remnant Prairie

Small pieces of a formerly larger prairie that covered much of the upland areas of central and southern Dakota County. Today, most of these remnants are relegated to the ends and steeper sides of glacial moraines (unconsolidated glacial till deposits) on the east side of the lake, up on slopes, and, on the west side of the park, at the tops of small knolls and hills (Figure 16). Many native prairie species were present including Indian turnip, prairie phlox, leadplant, little bluestem and much more. All of these remnants would be considered "Dry Hill Prairie" (UPs13), except for one "Sand-Gravel Prairie" (UPs13b) that is located on a west-facing slope between the sledding hill and the paved path that connects the parking lot and the Regional Trail by the Earthen Berm.

Figure 16. Remnant prairie near Picnic Shelter. Photo taken in early fall.

Degraded Shrub Wetland

Wetlands dominated by shrubs, primarily willows. Herbaceous plants abound, too, but shrubs are very abundant. Although degraded, has the potential to recover from the seed bank if reed canary grass is controlled and light is exposed to the ground for germination.

Degraded Graminoid Wetland

Wetlands dominated primarily by grasses, including non-native reed canary grass and native Canada bluejoint (Figure 17). Many other species were present, but there were fewer shrubs in these areas than in the Degraded Shrub Wetlands. Although degraded, has the potential to recover from the seed bank if reed canary grass is controlled and light is exposed to the ground for germination.

Figure 17. View of the wetland, from the boardwalk looking to the northeast.

Wet Meadow/Scrub-Shrub Wetland

Wetlands dominated by sedges and short shrubs. Willows are common. So are equisetum. Some of the most diverse plant communities on the site occur in this cover type, for instance by the boardwalk (Figure 18). Like the "wet forest", the upland margins of these wet meadow cover types are transitional areas between wetlands and woodlands and contain a mix of both of these community types. On the east side of the lake, for example, can be found woodland forbs such as wild geranium and black snakeroot growing along with a variety of wetland sedges and other wetland plants like bugleweed.

Figure 18. View just off boardwalk. Diverse wet meadow community with sedges, horsetails, swamp lousewort, green orchids, white turtlehead, bottle gentian, Michigan lily, and more.

Lake

Empire Lake, an impounded, former deep-water marsh. Dominated by coontail, but also present were pondweeds, American lotus, and other native submerged aquatic vegetation (SAV). Has the potential to be planted with a variety of SAV and emergent vegetation. Consider suitability for wild rice.

Wildlife Food Plot

Located at the far southern end of the property, this old field is planted as a food plot for game and wildlife each year by the DNR. It is the northern edge of a much larger plot extending south into DNR land. It is basically inaccessible from the park.

Landscape/Roadside/Building Areas

Recreation elements and infrastructure. Raingardens were planted to a variety of native plants. Turf areas have the potential to be enhanced with native and non-invasive cultivars, which would increase the habitat value for insects and birds.

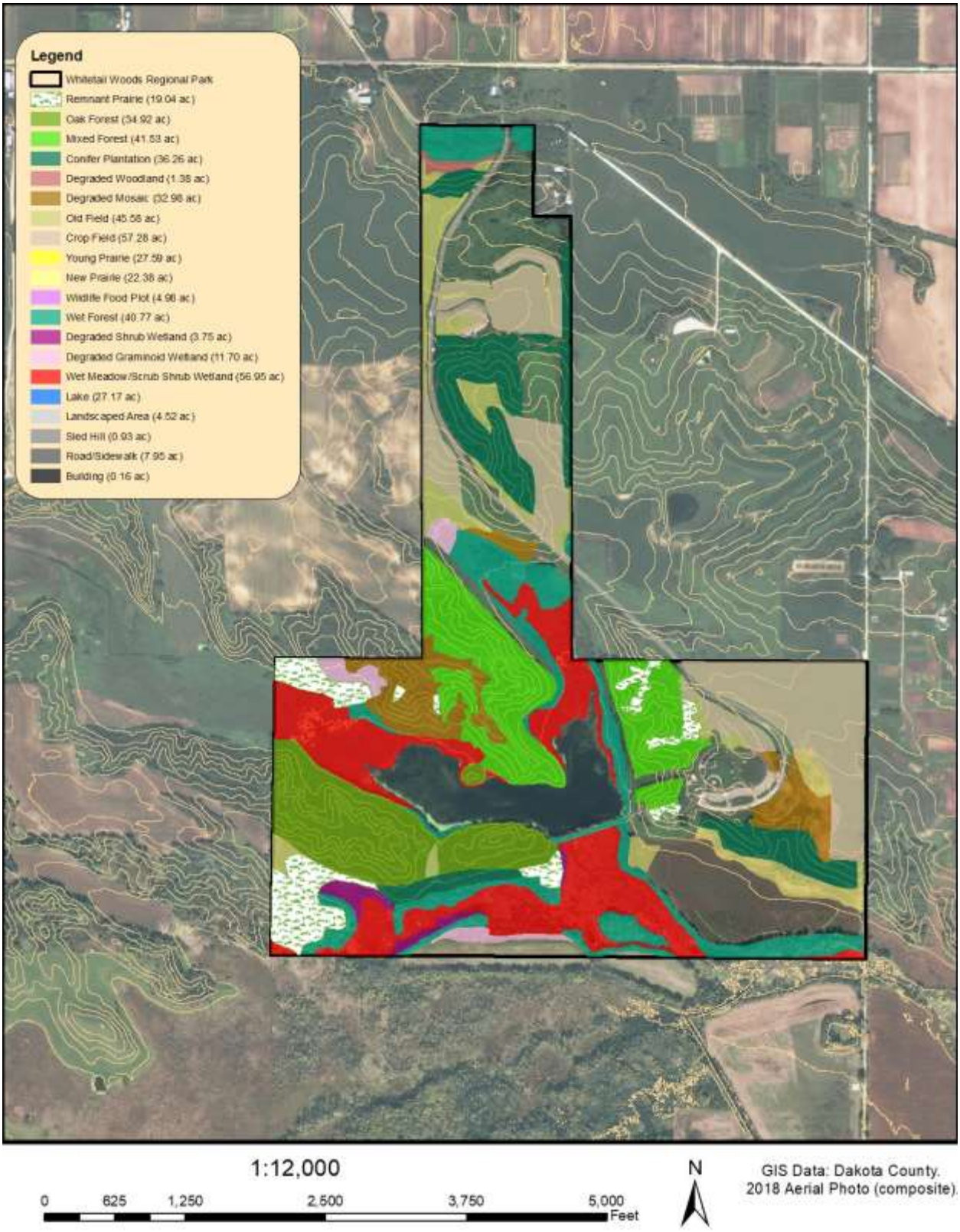


Figure 19. Existing Land Cover, including prairie remnants, at Whitetail Woods Regional Park.

3.4. Aquatic Resources

3.4.1. 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 fertilizer and pesticide 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). In the vicinity of WWRP, sensitivity to groundwater contamination is considered "high" and "moderate" (Figure 20). The bulk of the area of the park is in the "high" groundwater sensitivity zone, while the northern stem and northeastern corner is in the "moderate" zone. The recreational focus areas, for the most part, were placed in the proper place, in terms of groundwater sensitivity, since the parking lot and shelter are in the northeast corner, and much of the road is in the northern stem. The parking area and Shelter actually come into the "high" zone on their east sides, but only a little bit. Areas such as the Camper Cabins, the Nature Play area, and the rest of the paved regional trail, which are located in the "high" sensitivity zones should be addressed with practices such as raingardens, filter strips, etc.

Groundwater continually seeps into the wetlands located west of Empire Lake, as the bases of the steeper slopes. The obligate seepage plant, marsh marigold, occurs here. Because of this groundwater input, the water never freezes at the western end of the park. It also keeps the water temperatures cooler in the summer. Movement is generally from northeast to southwest, towards the Vermillion River.

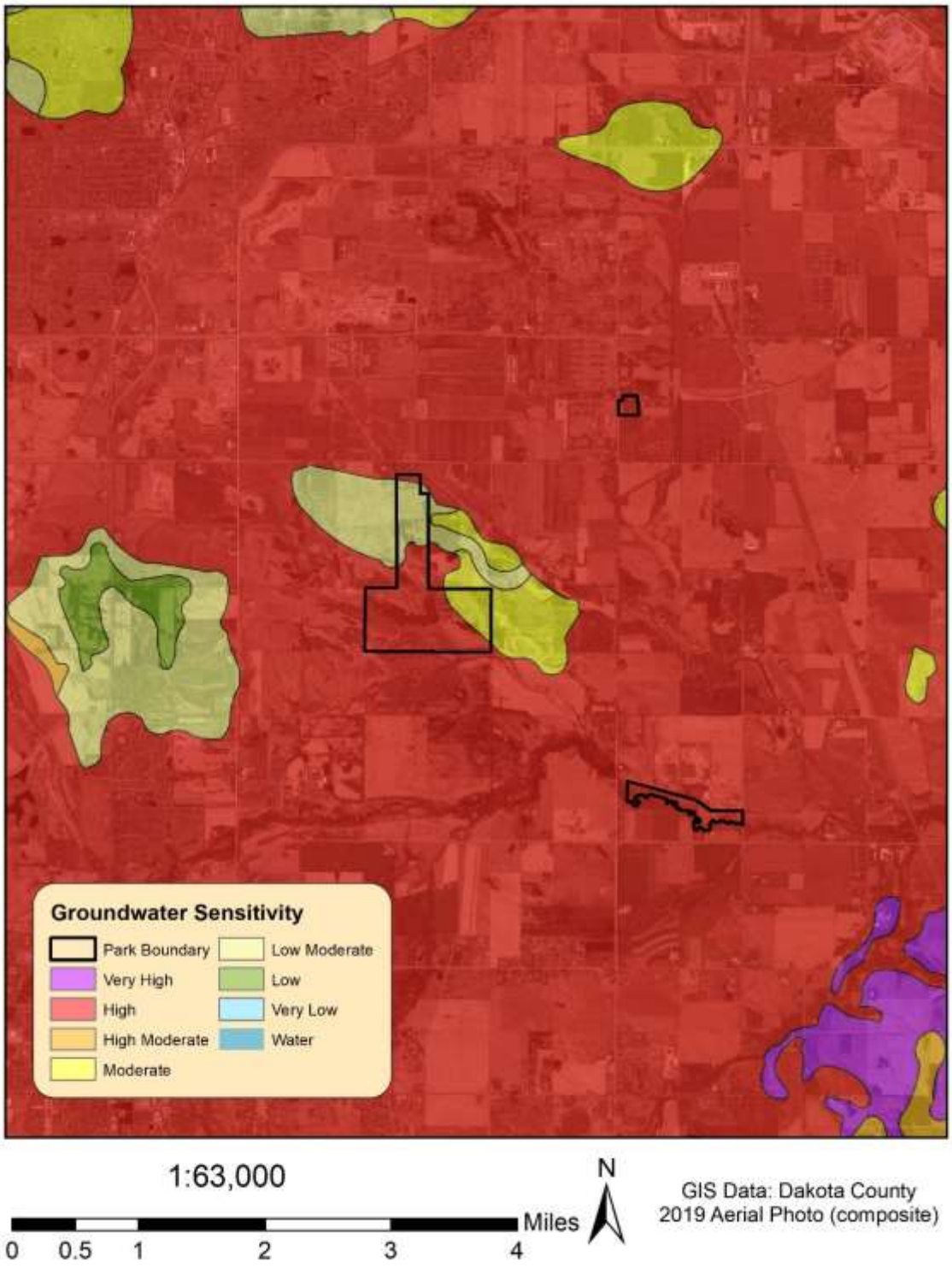


Figure 20. Sensitivity to Groundwater Contamination Map.

3.4.2. Off-Site Pollution of Groundwater from Surface Waters

Pre-World War II Waste Disposal

Land adjacent to and nearby the park, on its north and east sides, was occupied by the former Gopher Ordnance Works (GOW) during 1943-45, a munitions factory owned by the Federal Government. We now know that this area was within a "high sensitivity zone" for groundwater contamination, but back then, it may not have been known. Prior to the 1942 acquisition and subsequent 1943-1945 construction and operation of GOW by the former U.S. War Department, the approximately 8,800-acre area was comprised of family farms involved in dairy, domesticated meat, and crop production. Post-Depression era farm waste generation and disposal practices were usually isolated and private (so-called "farm dumps"), and biodegradable wastes (household and manure) were often incinerated, used as feed (e.g., feed for hogs), or land-applied. Locations of the farmsteads abutting the future 160th Street are identified on pre-World War II aerial photographs (e.g., 1937) as wooded shelterbelts, and any dumps would have been near the farmsteads in natural or artificial, shallow depressions. Some of these former farmsteads were subsequently used by both GOW and Rosemount Research Center (RRC)/Agricultural Research Station (AES) and may still exist today.

In this area, deep, dug wells were uncommon as groundwater is 60 to 100 feet below the ground surface. However, in scattered areas where perched groundwater may have existed because of silty, clayey lenses in the outwash, some wells may have been dug. Typically, they would be constructed with wood, stone, brick, or concrete block and usually 3 to 4 feet in diameter. When shallow, dug wells became dry and were abandoned (hence, the term "dry wells"), some were converted to cesspools for sewage disposal.

Cisterns (underground water reservoirs), both water well and rainwater types, were common on farmsteads in areas of droughty soils and deeper groundwater, such as this area especially after the mid-1930's "Dustbowl" drought. Constructed of stone, wood, concrete, brick, and metal, the cisterns were located near or under windmill wells that stored water pumped during windy weather and near homes and barns to catch rainwater diverted from roofs and gutters. When abandoned, the cisterns were usually not collapsed or filled and may now pose a subsidence or collapse hazard if present, although to date, none have been found on park property. Some abandoned cisterns may have been converted into septic tanks or cesspools for sewage disposal.

Sewage from the households, and sometimes dairy farm waste, in this area was commonly disposed by cesspools—deep, non-watertight, rectangular or cylindrical in-ground vaults. The cesspools were ordinarily abandoned. Consequently, significant, underground void spaces may still exist and may be subject to unexpected subsidence or collapse.

World War II Era: Gopher Ordnance Works

The World War II ammunition manufacturing facility, known as the U.S. Army Gopher Ordnance Works (GOW) (Figure 29, page 71), was built in 1944. It was primarily sited, built, and operated to produce smokeless gunpowder for munitions for rifles and cannons. According to facility records, part of the Plant was operational for seven to eight months in 1945 producing 29 million pounds of smokeless gunpowder. On the west side of GOW, Plant B was nearing completion in August 1945, but the power plant was incomplete and reportedly was not used.

The physical and chemical operations planned were elaborate and being constructed at an immense scale. Sulfuric and nitric acids and other chemicals were produced in bulk at the facility from raw materials. Aniline was brought in by tank car for the manufacture of diphenylamine. Large quantities of solvents, including alcohol, acetone, and ether, were stored in aboveground tanks, used in gunpowder manufacturing, and partially recovered for reuse. The wastes generated from chemical and munitions manufacturing were considerable. Disposal methods included burning and burial in dumps; underground detention and infiltration in tanks, sumps, and cesspools; acid wastewater neutralization, surface wastewater discharge and infiltration into ditches, impoundments, sanitary sewers, laminex and woodbox sewers; air discharge in stacks and fugitive emissions, solvent/chemical volatization; and on-site spills, leaks and other discards.

Transfer and storage of raw materials occurred on site, that could still be a problem today. Some substances to be aware of are creosote, asbestos, and gunpowder. The only GOW hazardous waste burn site located to date is immediately north of the former US Naval Satellite Observatory facility (NAVSOC) Detachment Bravo site [recently replaced by the Army National Guard (RIATEN)]. Also, some of the solvents recovered utilized granular activated carbon, but their final disposal or reuse is unknown. Finally, rumors persist among some former GOW employees that a number of railroad box cars full of wastes were derailed and disposed in natural depressions and borrow pits adjacent to the rail lines.

Given the flow rates and the northeasterly direction, away from the present day park, of the shallow groundwater in the surficial Quaternary deposits (primarily Rosemount outwash) and shallow Ordovician bedrock (Prairie du Chien dolostone), contaminants would have traversed the distance from release source to receptor in less than 30 years. This is based on average contaminant retardation rates of the more mobile contaminants, e.g., volatile organic compounds. However, delayed releases from sources and less mobile contaminants, i.e., metals and recalcitrant chemicals with lower solubilities and longer retardation rates in groundwater, could extend that transit time to 50 years or more and may be so dilute so as to be marginally detectable. The latter contaminants are more likely to represent a contact hazard at and near the source when exposed, whereas weathering and biodegradation may largely dissipate the more mobile contaminants.

University of Minnesota RRC and AES

In 1946 and again in 1947, the University of Minnesota proposed to take over approximately 8,000 acres of the former GOW for agricultural research. Quit claim deeds were filed later in 1947, and the University of Minnesota eventually divided up the property between the Rosemount Research Center (RRC) and the Agricultural Research Station (AES), and other remaining attributes became University property. Because the promised restoration of land to the former farmers, who were evicted by the US Government in 1942, never occurred, the local citizens' resentment of the federal government was projected to the University. This animosity was still present more than two generations later, as it became clear in the early 1984 complaint investigations by Dakota County Public Health Department staff that led to the RRC/AES being listed on the Superfund.

There followed many years of marginal use of a few of the former GOW facilities, primarily for a variety of University agricultural research projects. Open land was returned to farming, primarily for University test plots (e.g., municipal sewage sludge land application, crop hybridization, and plant pathology and genetic resistance studies), as well as leases to area farmers for cash crops. In the 1950's, the University began leasing former GOW buildings, structures, and land to businesses and individuals for a variety of non-agricultural purposes. A number of these former tenants, as well as the University itself, was responsible for significant solid and hazardous waste disposal in the ensuing years. Some of this was revealed in the University's July 1984 response to the Superfund's RFI (Request for Information) which detailed disposals of a wide array of chemical, biological, and physical wastes from many campuses, as well as some wastes from former/current tenants and some State agencies. However, poor recordkeeping and limited oversight prevailed leaving many more questions than answers.

In particular, a few University tenants' businesses were examined more closely because of the seriousness of the alleged disposals and releases. The copper salvaging operations conducted by Porter Electric, George's Used Equipment, and US Transformer came under close scrutiny as copper windings from transformer cores were recovered by first dumping the transformer oil and then burning off the wire insulation. This generated a number of hazardous waste streams including lead, PCB's, and other recalcitrants, disposed on-site or at other locations. The disposal of laboratory chemicals and other hazardous wastes primarily at the RRC East 160th Street Dumps was presumed to be the source of the groundwater contamination plume characterized by seven chlorinated volatile organic compounds although no intensive investigation of the source was ever undertaken. A few other sites (GOW Process Wastewater Lagoon, AES East 155th Street Dumps, RRC East 170th Street Dump, and RRC Wastewater Oxidation Pond) received limited investigations under Superfund but no remedial actions. Other alleged and known disposals and releases by RRC tenants and the University faced limited reviews but no investigations.

A number of these known and alleged, but so far uninvestigated, waste disposal sites are located in or near the proposed Highway 46 corridors. Once listed under Superfund, the Minnesota Environmental Response and Liability Act prohibits any and all actions by local governments until a

site is delisted for whatever reason. This is required to facilitate the timely and efficacious investigation, mitigation, and resolution of Superfund sites unencumbered by local issues and pressures. The RRC/AES sites have been listed on Superfund for 14 years and are now finally poised for complete delisting.

3.4.3. 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 run-off. 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 limits 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, is an important strategy for achieving water quality goals.

The lake and wetlands of Whitetail Woods Park are located in a subwatershed called Empire Lake Watershed that is just shy of 4,000 acres in size. This subwatershed is part of the larger Vermillion River Watershed that is over 233,000 acres in size. The Vermillion River Watershed is managed by the Vermillion River Watershed Joint Powers Organization (VRWJPO). One of the primary risks to the Vermillion River is loss of groundwater recharge when runoff from rooftops and pavement is sent directly to storm sewers and surface waters, which short-circuits the natural flow of water in the watershed and starves the stream of its steady, cold, groundwater. The natural areas of Whitetail Woods Park help recharge the Vermillion River with clean groundwater.

In the Empire Lake Watershed, surface water flows generally from the northwest to the southeast. Land us is primarily agricultural, with some areas of sand-gravel mining. The City of Farmington is nearby. Whitetail Woods Regional Park is located at the downstream or “down-watershed” end of the watershed, so therefore does not have much control of what impacts the water of the park.

Empire Lake

Empire Lake is only fifty-some years old. It is a reservoir made by impounding the overland flow of wetlands by an earthen dam or berm located at the southern end of the park. The berm was built in

1965 by the previous landowner (private) and designed by the Soil Conservation Service, probably for the purpose of watering cattle, according to the former landowners who built the berm. The berm was recently (2018-19) stabilized to accommodate park land use. The berm currently has a weight rating of 20,000 lb., unless high water is experienced, in which case traffic is prohibited. There is a paved trail on top of the berm, since it is part of the Vermillion Highlands Regional Greenway. The primary effect of the berm was to make the upflow side wetter and the downflow side drier. Upflow side is a large, shallow lake, or deep marsh, approximately 30 acres in size and only five feet deep. It is located entirely inside the park. A new control structure regulates flow from the marsh to a tributary of the Vermillion River. This is either all open or all closed, with no "in between", so it cannot be easily controlled. Water should never be drawn in the winter months, due to risking fish, turtle, and frog kills. Monitoring in 2009 to 2011 rated the marsh as eutrophic. Sometimes, however, the water clarity makes the bottom visible. In one year's study, the invertebrate animal diversity and abundance was moderate, and vegetation diversity and native cover excellent. Although the deep marsh is surrounded by woodland and grassland, upstream agricultural areas send runoff into it via two small, unnamed tributaries, probably affecting its water quality. But perhaps even more of a contributor to runoff is from internal loading from nutrients contained in the sediments that were transported to the lake in the recent past from farmland erosion. The extensive restoration work that is occurring throughout the park will improve ground cover and more effectively filter runoff.

Figure 21. Nelumbo lutea, American lotus.

Figure 22. East end of Empire Lake.

Aquatic vegetation was surveyed in 2018 for this plan. Seven points, scattered across the lake, were sampled. The results showed that water quality Secchi depth varied from 0.5 m to 1.5 m; temperature in August at the surface varied from 24.1-29.2 degrees C, at 1m depth varied from 24.4-28.2 C, and at 1.5 m depth was 27.4 C; dissolved oxygen (mg/L) varied from 5.63 – 9.03 at the surface and from 8.17 to 0.24 at 1 m depth. This data shows that the lake, even though very shallow, still stratifies during the summer months, at least on the east end, far enough away from the inputs and mixing of seeping groundwater at the west end. The lake was almost entirely covered by some sort of vegetation (Figure 22). There were some areas of the lake that were open at the surface, but most of it had vegetation erupting or coming to the surface. The vegetation of the

lake consisted of both floating-leaved and submerged vegetation. The floating leaved vegetation was composed of the following species: filamentous algae, common duckweed, large duckweed, forked duckweed, watermeal, and American lotus (one large colony at the east end of the lake) (Figure 21). Submerged vegetation consisted of the following: coontail, northern watermilfoil, flat-stem pondweed, sago pondweed, common waterweed, and curlyleaf pondweed, with coontail being by far the dominant species (80-100 percent cover on all sample points).

There was no to little evidence of shoreline erosion at the time of the survey in 2018. With the work done to the berm in 2018-19, erosion is a concern on the north side of the berm at the water line, since there is not vegetation established there. It is recommended to plant native aquatic plants along the toe of the slope of the north side of the berm to prevent soil erosion.

Aquatic habitats in Empire Lake are suitable for a variety of wildlife species, including turtles, small fish, waterfowl, amphibians, and mammals. See Tables 6 and 7 in the Wildlife Section (3.5), below, for more details.

Streams and Ditches

Small streams and flowages were present on the 1937 aerial photographs (Figure 9, pp. 30-31). These streams were fed from flowages that were probably heavily influenced by groundwater, although they were also affected by agriculture. The direction of flow is southeast. There were a number of streams, historically, in the location of the park and adjacent to it, but many of them have been channelized to form ditches . Today, the straightness of the ditches is still present. Ditches emanate from the south side of the wetland complex located south of the dam, and flow eastward and southward, towards the Vermillion River.

There is a stream on the north side Empire Lake (south and parallel to the “Bowling Alley” tree planting area) that flows towards the southeast. The origin of this stream is from agricultural runoff from an adjacent ag field to northwest of the park. If runoff from this field were reduced, the stream may dry up, although there is probably a component of base flow (groundwater), too. Streams that originate from agricultural fields are a potential source of inputs of nutrients to Empire Lake, and should be managed to prevent excessive nutrient delivery to the lake. Management would include installing native vegetation to buffer streams. SWCD potentially could work with adjacent landowners to install buffers along their streams and convert their ditches to “two-stage ditches” to reduce sedimentation and nutrient loading to streams. The quality of the streams for fish and macroinvertebrates is good in areas of groundwater upwelling, and fair to poor in areas of sedimentation. There are small fish in these streams/ditches—the same species that occur in Empire Lake, namely green sunfish, black bullhead, hybrid sunfish, bluegill, crappie, and largemouth bass. It’s possible that northern pike may get into these streams from the Vermillion River, when water levels are high during wet years, since pike tend to be pioneers. Considering the makeup of this fish community, it doesn't seem like there are any real piscivore predator species besides the largemouth bass. A fish stocking/management program could be considered as this could have a positive impact on the fish community and water quality in the lake.

Streambank erosion is not prevalent in Whitetail Woods, due to the slow and steady nature of groundwater-fed streams. Spring meltwater can cause some flooding, and some erosion, but it is generally not an issue.

Wetlands

Wetlands are described in the Land Cover Section (3.3.3), 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 purpose of ecological restoration and invasive plant management.

Whitetail Woods is Dakota County's "wetland park", with a large part of the park having shallow inundation due to groundwater and surface water flow and therefore wetlands and wetland vegetation (Figure 23).

Prior to the 1960's, when the damn was installed, the area that now occupies Empire Lake was a vast wetland with a large diversity of wetland plants. Today, there are still significant areas of wetland in the park, adjacent to and surrounding the lake.

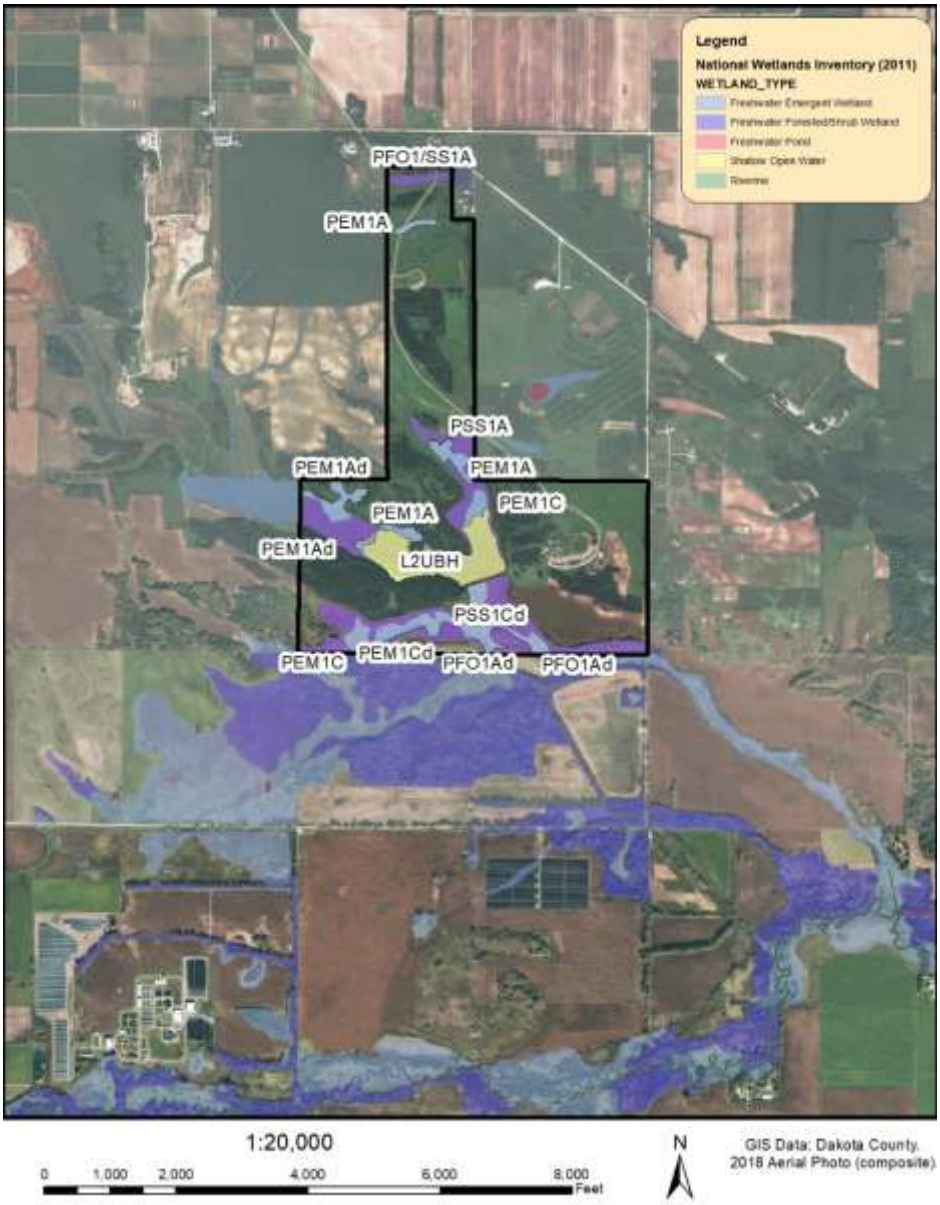


Figure 23. National Wetland Inventory map.

Five wetland types are common in the park: freshwater emergent, freshwater forested/shrub, freshwater pond, shallow open water, and riverine.

3.5. Wildlife

3.5.1. 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 teaming 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.

3.5.2. Wildlife in the Park Today

Today many different species of wildlife can still be found occupying Whitetail Woods and its different habitats. White-tail deer, Raccoons, Virginia Opossum, Coyotes, Gray and Red Squirrels, American Robins, Blue Jays, American Crows, and White-breasted Nuthatches are all abundant across many of the park's habitats.

In the prairies, where grasses like Indiangrass, big bluestem, and little bluestem take root, and forbs such as goldenrods and blazing stars grow, American badger, garter snakes, prairie skinks, birds such field sparrows, vesper sparrows, eastern kingbirds and northern harriers, and small mammals including the 13 lined ground squirrels will be found. The abundance of pollinators here is impressive, with many species of bees, dragonflies, butterflies and moths present.

Continuing out of the prairie, you may walk into the Woodland and Savanna-Brushland habitats, which are composed of varying degrees of hardwood tree cover and herbaceous understory. These habitats are home to many different bird species including Ovenbirds, Downy, Hairy and Pileated Woodpeckers, Sharp-shinned Hawks, Orchard Orioles, Yellow Warblers. You may hear amphibians such as Gray and Cope's Treefrog and American Toads or find reptiles such as garter snakes.

Eventually the brushland openings will give way to the thicker deciduous and mixed forest habitats. These are made up of maples, oaks, basswoods, blue cohosh, goldenrods, trilliums and spring ephemerals such as dutchman's breeches and bloodroot. Here are found warbling vireos, cerulean warblers, least flycatchers, big and little brown bats, white-tailed deer, red fox, coyotes, and small mammals.

Moving through the floodplain forests, wet forest and swamp habitats, among the silver maples, cottonwoods, black willows, jewelweed and wood nettle, species that are more adapted to the wet environment, such as wood ducks, great blue herons, great egrets, least flycatchers, many species of dragonflies, mink, and bat species such as the little brown bat and big brown bat can be found.

In the wet meadow and emergent marshes, water tolerant plants such as red-osier dogwood, willows, bull rush or cattail, forbs such as Michigan lily, ironweed and marsh marigold support many types of wildlife including northern leopard frogs, green frogs, secretive marsh birds such as Sora and Virginia rail, songbirds such as sedge wrens, marsh wrens and red-winged blackbirds, mink, muskrat, otter and beaver.

Finally, in the lakes, ponds, rivers and streams of Whitetail Woods, where water is more permanent, and vegetation is primarily submerged, which help support fish species such as sunfish, crappie, and bullhead. Also commonly present are snapping, painted, and Blanding's turtles, frog species such as northern leopard and green frogs, muskrat, otter, beaver, waterfowl, shorebirds, bald eagles and osprey, and many dragonfly species.

Birds (Include ecological niche, importance to park, habitat requirements/indicators, etc.)

Trumpeter Swan – Trumpeter Swans are North America's largest waterfowl species that were once listed as federally endangered due to overhunting and habitat loss, but thanks to captive breeding and reintroduction efforts in the 1960s, they have seen a considerable increase in population numbers. Trumpeter Swans tend to nest on the tops of beaver or muskrat lodges or will build up smaller hummocks in wetlands. Presence of Trumpeter Swans indicate that lakes and marshes have a relatively healthy population of aquatic vegetation. They were recorded during our 2019 Breeding Bird Surveys.

Wood Duck – Wood Ducks are cavity nesters and need mature trees within a mile of water to build nests in, therefore they require somewhat mature forests. Their numbers had huge declines in the 19th century due to overhunting and loss of habitat but have since rebounded thanks to habitat restoration and the assistance of artificially constructed nest boxes. They are dabbler ducks, meaning they need shallow waters no deeper than 6 to 9 inches to reach the bottom of the waterbody to forage for aquatic plants and invertebrates. Wood Ducks were recorded during the Whitetail Woods Breeding Bird Survey in 2019.

Osprey – Osprey were one of the many species highly affected by DDT in the 1960's that have since rebounded dramatically. They feed almost exclusively on fish and will build their nest within a half mile of a water body. They prefer to nest in the tallest structure near the waterbody, and will utilize many different structures, including manmade structures such as utility towers. With the loss of many old growth trees due to development, land managers have begun erecting nest towers to invite Osprey back into the ecosystems, which they have benefited greatly from. In fact, an osprey tower was erected in the fall of 2019 at a high point north of the lake (Figure 24).

Figure 24. Installed osprey tower.

Bald Eagle – Bald Eagles were nearly wiped out in the 1960s due to herbicide and lead poisoning but have since rebounded spectacularly to be removed from the Endangered Species List. Bald Eagles will occupy large old growth trees to build their nests in and prefer to be near large water bodies. They will mainly prey on fish but will also prey on mammals and birds such as rabbits, raccoons, or waterfowl. They have been observed nesting in and near Whitetail Woods in recent years.

Pileated Woodpecker – Pileated Woodpeckers prefer mature tree stands of all types, and presence of them helps recycle dead standing trees to make room for new canopy growth. They assist in the

decay and recycling of dead trees through the excavation of carpenter ants and other insects from trunks and limbs. The cavities they create can be reused for other cavity dwelling species.

Sora – Sora have been spotted or heard in Whitetail Woods in each of the past four years of our marshbird surveys. These secretive birds prefer to nest in stands of cattails and bulrush but will also utilize wet meadows with tall vegetation. They mainly feed on seeds and insects. Since they are so secretive, they are a species that if not monitored could be lost without realizing until years later. Their nests and chicks are predated on by snakes, coyotes, foxes, and sometimes larger marshbirds such as herons and egrets.

Virginia Rail – Virginia Rails were first documented during our marshbird surveys in 2019. They mainly inhabit shallow waters and feed on insects, aquatic invertebrates, and seeds. They often occupy the same ecological niche and habitats as Sora and are equally secretive. Their main nest and chick predators are snakes, raccoons, muskrats, mink, and striped skunks.

Passerines

Field Sparrow – Field sparrows require savanna habitats with sparsely populated trees and little human interactions. They have experienced widespread habitat loss in past years due to conversion of old fields to agriculture or human development, or to habitat succession due to fire suppression. They feed on a mix of grass seeds and insects. Because of their foraging patterns, they act as seed dispersers in prairie and savanna habitats

Ovenbird – Ovenbirds occupy deciduous and mixed forests with ample leaf litter and dead wood where they forage primarily for insects. They prefer large areas of unbroken closed-canopy forests with sparse understories. Their domelike nests, situated on the ground, are frequently predated on by snakes and rodents such as chipmunks and squirrels.

Orchard Oriole – Orchard Orioles can be found in riparian zones along creeks, marshes and lakeshores along forest edges. They act as pollinators for some flower species, they distribute seeds of fruit they feed on and act as predators to many insect species. They have seen declines in numbers in recent years due to a combination of pesticide use and human development.

Mammals

Beaver – Beavers are nature's first land manager and "ecosystem engineers", actively thinning woody plant encroachment on wetlands and diverting riparian areas and wetlands to fit their needs. It makes sense that humans have butted heads with their methods and plans for as long as we have been around, since they often are at odds with ours. But for aquatic systems, they are quite beneficial. Their active damming can create new pools and bodies of water which creates habitats for fish and turtle species, and their dens and lodges are often shared by other species including muskrats. In addition, the dams slow the flow of water which collects suspended sediments over time which helps filter water.

Figure 25. Installing beaver pond leveler.

At the far east end of the Empire Lake wetland complex, near the park boundary and the boardwalk, was located a beaver dam and lodge. This dam/lodge has been in place for many years, as evidenced from historical aerial photos. Because high water levels may jeopardize the boardwalk and the adjacent high quality wet meadow community, a "Clemson beaver pond leveler" (https://files.dnr.state.mn.us/assistance/backyard/privatelandhabitat/clemson_beaver_pond_leveler.pdf) was installed in February 2020 that allows the pond to drain in a way that does not stress out the beavers (Figure 25). It is the sound and feel of moving/trickling water that triggers beavers to repair their dams, and this apparatus is very quiet and outlets water 20-30 feet downstream from the dam/lodge so should not trigger them. It is still experimental, but staff is hoping this will be a good solution to be able to keep the beavers here without damaging park infrastructure and other features.

Muskrat – Mostly present in wetlands and slow-moving riparian areas, muskrat will eat the roots and shoots of aquatic vegetation and stimulate native plant growth. They will often dig up mud and vegetative material to build a nest mound or burrow. Their rapid reproductivity also supports larger predators in the wetland ecosystems such as mink, fox, coyote, and raptors.

Badger –Badger are strong earth movers with large front claws for digging dens and burrows. Their abandoned dens are often used by other species such as Red Fox and Striped Skunks and also work to create soil disturbances for new grassland species regeneration. They prey primarily on small mammals, reptiles, and

Figure 26. American badger caught on trail camera at WWRP.

ground nesting birds found in prairies. Badgers have been recorded, via trail cameras monitored by NR staff, in the prairies at Whitetail Woods in 2018 (Figure 26).

Striped Skunk – Skunks are insectivores or opportunistic omnivores that will feed on everything from insects, carrion, or small mammals, to plant mater. They will often dig dens to raise kits but will just as readily reuse dens created by other animals. They can occupy a number of different habitats including prairies, woodlands, forests and wetlands. Since they are nocturnal, they are generally more prevalent than people think.

Big Brown Bat – The Big Brown Bat populations in North America have seen drastic declines recently due to White-nose syndrome, a fungus that covers the body of bats during hibernation. Historically these bats have hibernated in hollow trees, caves and rock ledge openings, but since settlement, they have utilized human structures. They are insectivores, eating as much as a third of their body weight each a night and can act as a very efficient controller of insect populations. It is likely that they are present in Whitetail Woods, but we have not confirmed this through surveys yet.

Little Brown Bat – Little Brown Bat populations in North America have recently been devastated by White-nose syndrome, a fungus that will cover their bodies during hibernation and cause them to awaken prematurely and use up stored energy resources before the spring. They feed on insects in midflight using their echolocation to find insects over water, wooded areas and open fields. They are considered major controllers of insect populations near their roosting sites. It is likely that we have a population of Little Brown Bats in Whitetail Woods, but we have not surveyed the area yet.

Mice – Whitetail Woods likely has a number of mouse species including White-footed mice, Deer mice, and Meadow Jumping mice. Mouse species are an important source in moving mycorrhizal fungi through environments. These fungi form symbiotic relationships with many plant species, growing on the root systems to facilitate increased absorption of nutrients. In addition, these different mouse species provide a food source to many predator species in the park.

13-lined ground squirrel – Play an important role in prairies as nutrient recyclers and prey for many other species. Their burrowing activities help aerate and move soil and seeds through a prairie. Healthy populations indicate presence of larger predators in prairies, such as raptors, fox, coyote, badger, and snakes. If predators are removed from the ecosystem, they can quickly overpopulate and cause damage.

Grey squirrel – The gray squirrel is ubiquitous in Dakota County Parks and a great example of how the species has thrived with human development. Their natural role as tree planters for nut bearing trees can go somewhat unnoticed to the casual observer but are useful for forest regeneration in the long term. In addition, healthy populations help sustain other wildlife predators including raptors, red fox, coyotes, and more.

Red squirrel – Red Squirrels mainly inhabit conifer stands and feed on conifer cones and seeds but will also feed on bird eggs, nuts, berries, and other small mammals. Their predators include virtually every animal larger than them, including raptors, minks, coyotes, foxes, and weasels. Since Red Squirrels are generally not known to be a great plains species, their presence in the park can be attributed to the planted conifer stands.

Whitetail Deer – The namesake of the park whitetail deer are present in the park today. County Natural Resource staff monitor populations periodically and perform deer counts. Between 2007 and 2019, counts in the park have ranged from 0 to 41 deer. Since Whitetail Woods is part of a larger complex of deer habitat, it is difficult to gather good information on deer populations by just looking at the park alone. In 2013, the MN DNR performed a 17-square mile survey that included all of the Vermillion Complex which includes Vermillion Highlands, Vermillion WMA, UMORE property, and Whitetail Woods. During this survey they counted 41 deer in Whitetail Woods and 242 deer overall for a density of 14 deer per square mile. The density goal for deer is 10-15 animals per square mile, so this is within that goal. In 2018, DC staff counted zero deer in the park but there were 45 deer just west of the park.

Deer management in the form of hunting has been happening in this area by private landowners for many years. After the WMA was formed by the DNR, managed hunts were utilized to offer recreational opportunities and control deer populations in the area. Since the County purchased the park in 2008, deer management has not occurred in the park. Discussions have been had with the DNR about deer hunting opportunities in the park and will be discussed further in future years.

Reptiles

Blanding's Turtle –The presence of Blanding's Turtles indicates healthy waterbodies. They prefer wetlands with adjacent upland prairies or sparsely vegetated areas, and sandy soils. They are very long lived, with individuals living up to 80 years old. They take about 14 years to reach sexual maturity, which makes their populations vulnerable to major environmental changes such as urban development, habitat fragmentation, and use of chemicals. Because they will travel over a kilometer to find suitable nesting habitat, where they are bound to encounter and crossroads, vehicle mortality is a major threat to their populations. Another threat, as with many turtles, is nest predation, since many predators eat turtle eggs. Interestingly, since during the first 24 hours their eggs strong-smelling, if they can be protected at that time, the success of reproduction greatly increases. They are currently present in the park and park staff have been tracking their movement patterns and nesting locations since 2016 (Figure 27).

Figure 27. Female Blanding's turtle with attached GPS/VHF transmitter.

Snapping Turtle –Snapping Turtles were once listed as a special concern species in Minnesota prior to 2013 due to commercial turtle harvest, habitat loss, and pollution. Since changes were made to harvest permits, they have been delisted. Snapping turtles are a long-lived species, living to over 100 years, and not reaching sexual maturity until 15-20 years. They are abundant in Empire Lake.

Painted Turtle – Painted Turtles are the most common turtle found in Dakota County parks, including Whitetail Woods.

Prairie Skink – Prairie skinks are reptiles and insectivores that prefer upland grasslands and stream banks with sandy soil. They often burrow underground or underneath logs and other debris for cover and hibernate under the frost line. They have been described as "snakes with legs", which comes close to the mark. Their feeding, along with other insectivores, helps control insect populations that may otherwise become overabundant. Their main predators include raptors, ground squirrels, and raccoons.

Amphibians

Frogs – Six species of frogs are present in Whitetail Woods, including the Wood frog, Green Frog, Northern Leopard Frog, Western Chorus Frog, Gray Tree frog, Cope's Gray Tree frog, and perhaps pickerel frog. Frogs primarily occupy wetlands, but also forested areas, and help control invertebrate populations as well as act as prey for larger predators. We have observed mustelids eating frogs during the winter, when other prey is scarce. Frog larva (tadpoles) and adults can be sensitive to water quality and therefore function as important indicators of wetland health.

Eastern Tiger Salamander – These are probably present in Whitetail Woods, although they have not been observed in surveys yet. They prefer fishless ephemeral pools and wetlands for reproduction. Since Empire Lake contains fish, this lake may not be suitable habitat for salamanders, but there are other wetlands in the park that may be fine. They spend their winters under rocks and logs in upland and wooded areas. Interestingly, salamanders can be cannibalistic, eating their own siblings, a behavior that evolved because of the fact that the ephemeral pools in which they live tend to dry up and shrink during the course of the spring and summer, leaving less and less room for them. Many salamander species were formerly common in the region but are scarce today because of habitat loss and pollution.

Fish

Although fish have not been surveyed in Empire Lake, several species float to shore following fish kill events. Fish in the lake are small. The species that have been observed are the following: green sunfish, hybrid sunfish, bluegill, crappie, black bullhead, and largemouth bass. Occasionally, northern pike, and other fish, may come upstream from the Vermillion River, during wet years, but they are not common in the lake. Frogs occur abundantly in the lake, at the shallow margins and in the wetland shores, which means that fish do not venture into those areas. Thus far, common or invasive carp have not been observed in the park.

Insects

Lepidopterans – Butterflies, skippers, and moths are excellent species-specific pollinators that occupy various habitat niches. Many species have evolved special relationships with specific plants ("host" plants) that they must feed on ("obligate") in the larval stage. Adults will often nectar upon and lay their eggs on these host plants. A famous example is monarch butterflies and milkweed, but many other exist, such as regal fritillary and prairie violets, Dakota skipper and blazing stars, Baltimore checkerspot and turtlehead plants. (Incidentally, Whitetail Woods Park is the only park in the County park system to have a healthy population of turtleheads [*Chelone glabra*], and in turn, a viable population of Baltimore checkerspots.) Sometimes, though, adults will nectar on a variety of different flowering plants—they can either specialists, utilizing a very specific plant or plants, or

they can be generalists, utilizing many different plants. As with many other insect species, habitat loss and loss of biodiversity, due primarily to land use changes and pesticide usage, have caused lepidopteran populations to decrease and even to crash. Formal lepidopteran surveys have not been conducted in Whitetail Woods as of this writing.

Bombus – Dakota County has recorded four species of bumble bees in Whitetail Woods since beginning surveys in 2017. *Bombus griseocollis, B. impatiens, B. borealis*, and *B. bimaculatus* have all been present and are important pollinators for many different species of flowering plants across the park (but are also the most common bumble bee species in some of our other parks, too). Bumble bees have been experiencing population declines in recent years due to a number of different factors primarily including habitat loss and pesticide use, but also from introduced mites. Whitetail Woods provides much needed habitat relative to its surrounding landscape dominated by agricultural land use.

Odonates – Dragonflies act as an important predator in both the air and the water throughout their lifespan. In the larval stage they live in the water where they will feed on many different aquatic invertebrates, and then upon emerging from the water, they are voracious feeders on many types of flies, including mosquitoes. In addition to providing some insect control, they also are preyed on by many bird species and provide an important food source for nesting, fledging, and migrating birds. Dakota County has not done comprehensive surveys to identify all species present in Whitetail Woods, but their presence is known.

Coleopterans – This insect group, which includes all beetles, is the largest group of insects in the world, encompassing almost 40% of all known insects. Coleopterans can be found in many different niches in the environment, ranging from aquatic to sandy environments. Many types of beetles act as indicators of aquatic health and are a food source for many different predators.

Pests

Emerald Ash Borer – EAB, a beetle that originated in eastern Russia and Northern China, was inadvertently introduced to North America in 2002. It targets all species of ash trees found in North America and can kill trees in as little as three years via its voracious boring activity. It bores underneath the bark, which destroys the vascular tissue of trees. This beetle can fly up to a half mile to find a new host tree. Dead trees along trails can pose hazards, but dead trees away from trails and roads pose no hazards. To date, EAB has not been found in Whitetail Woods park, but it is expected to invade eventually. Please refer to the County's "Emerald Ash Borer Management Plan" that was written in 2018, for more information and management strategies.

Japanese Beetle – These are an invasive species introduced to North America in 1916 and first found in Minnesota in 1968. Today, they are prevalent throughout the metro area. They prefer habitat with a mix of turf and perennials, so suburbia is ideal. They overwinter in the ground in turf where they feed on the roots of turfgrass. Then they emerge from the ground in June or July and feed on the leaves of more than 300 different plants. Most mature plants can tolerate the feedings, but young plants can be killed from high densities of beetles.

Elm Bark Beetle – These beetles will bore holes into the bark to lay eggs where their larva will eventually feed on the tree. There are both native and non-native species present in Minnesota, and

both facilitate the spread of the fungal pathogen Dutch Elm Disease, which can then spread to other nearby elms through root grafts. Elm Bark Beetles are attracted to trees already infected with Dutch Elm Disease and can help increase the spread of the disease to other areas as they search for food.

Picnic Beetles – These small beetles are known vectors of the oak wilt fungus, which kills oak trees. Attracted to the scent of freshly wounded oaks, this beetle can spread the fungus overland, from tree to tree, since it carries fungal spores in its body. Oak wilt does occur in the park, so this is a concern. The best way to prevent the spread of the disease is to protect oaks from getting wounded. Wounding of trees happens most when construction activity occurs nearby, but it can also happen naturally, during storms and high winds. Trees should be inspected periodically, to prevent the spread of the disease.

3.5.3. At Risk Wildlife Populations

The following table lists "at-risk" wildlife species, or species of greatest conservation need (SGCN) in the park.

Table 6. At-Risk Wildlife Species

Species list	Evidence of species using the park	Potential for species to use the park	Potential barriers to the species using the park
Blanding's turtle (*Emydoidea blandingii*)	During wildlife surveys in the past 3 years, 12 turtles of varying age have been captured and released.		
Regal fritillary (*Speyeria idalia*)	No evidence	With increased tall grass prairie management, the fritillary could possibly be reintroduced.	Loss of prairie habitat to development and agriculture. Ill-timed burns.
Northern harrier	Observed by Breeding Bird Survey (BBS*) volunteer		
Dickcissel	Sighted in large numbers in restored prairies		
Eastern fox snake	No data to verify presence.		

Western harvest mouse	No data to verify presence.		
American black duck	Observed by BBS volunteer		
Northern pintail	Observed by BBS volunteer		
Lesser scaup	No evidence		
American bittern	No evidence, however, it has been seen outside the park.		
Least bittern	No evidence	Habitat requirements have been met (marshes dominated by cattails).	This species may not tolerate certain park improvements.
Black-crowned night-heron	Has been observed in the park		
Bald eagle	Observed numerous times perched on the edge of Empire Lake		
Virginia rail	No evidence	High potential	
Sandhill crane	Observed by BBS volunteer	With increased tall grass prairie management this species would frequent the park.	
Upland sandpiper	No evidence, however, it has been seen outside the park.	Habitat requirements are met, but species may need to be reintroduced.	Nest predation.
Black-billed cuckoo	Observed by BBS volunteer		
Common nighthawk	Observed by BBS volunteer		

Red-headed woodpecker	Observed by BBS volunteer	Dead snag requirements	This species requires specific nesting habitat.
Least flycatcher	Observed by BBS volunteer	Habitat requirements have been met.	
Willow flycatcher	Observed by BBS volunteer	Habitat requirements have been met.	Habitat fragmentation
Northern rough-winged swallow	Observed by BBS volunteer		
Bobolink	Observed by BBS volunteer		
Tricolored bat	No data to verify presence.		
Northern long-eared bat	No data to verify presence.		
Prairie vole	No data to verify presence.	Habitat requirements have been met.	This species may need to be reintroduced.
Least weasel	No data to verify presence.	Habitat requirements have been met.	Competition from other species, and predation. Habitat and prey loss.
Leadplant flower moth	No data to verify presence.	Habitat requirements have been met.	
Iowa skipper	No data to verify presence.		
Whitney's underwing	No data to verify presence.		
Baltimore checker spot	Has been observed in the park (larval and adult stages)		
Wood turtle	No evidence of park use.		Fragmentation of habitat.
Common five-lined skink	No data to verify presence.	Some requirements have been met, but it may not be	Lack of south-facing, rocky outcrops.

		reasonable to expect this species to be in the park.	

**BBS = breeding bird survey

3.6. Rare Natural Features

The Minnesota Department of Natural Resources' Natural Heritage Database was searched for rare natural feature records within one mile of the boundaries of the park. This search identified the following rare natural features:

Table 7. Rare Natural Features. Observed within one mile of Park boundary.

Taxon	*Scientific Name*	*Common Name*	*State Status*	*Federal Status*	*Last Observed*
Birds	*Virio bellii*	*Bell's Vireo*	*SPC*	*none*	*2012*
Birds	*Lanius ludovicianus*	*Loggerhead Shrike*	*END*	*none*	*2012*
Reptiles	*Emydoidea blandingii*	*Blanding's turtle*	*THR*	*none*	*2018*
Plants	*Valeriana edulis var. ciliata*	*edible valerian*	*THR*	*none*	*1992*
Plants	*Phlox maculata*	*wild sweet William*	*SPC*	*none*	*1992*

SPC = Species of Special Concern; THR = Threatened Species; END = Endangered Species

Habitat loss, degradation, and fragmentation are the biggest threats to the rare species identified in Table 7. The Oak Savanna Ecological Subsection consisted of a patchwork quilt of adjacent but different habitat types, including oak savanna, prairie, and wetlands. Whitetail Woods Regional Park contains all of these habitat types within a relatively small (460 acre) footprint, highlighting its significance in supporting these declining populations.

The ranges for the avian species identified in Tables 6 and 7 are greatest of all the rare taxa, and thus they are not restricted to the Park, such that the downward trends in their populations are indicative of their sensitivity to continued habitat destruction in the greater area. Bell's Vireos are mid-distance migratory birds that nest in shrublands that include species such as prickly ash (Zanthoxylum americanum), American wild plum (Prunus americana) and American hazelnut (Corylus americana), within close proximity to riparian corridors and grasslands (Robbins 1991). Vireos also face parasitism from Brown-headed cowbirds, causing nest abandonment and decreases in brood size.

Loggerhead shrikes are experiencing a sharp decline nationwide (Rosenberg et al., 2016) and have similar habitat needs for scattered shrubs adjacent to open grasslands, where they nest primarily in

red cedar (Juniperus virginiana), plum (P. americana), hawthorn (*Crataegus* spp.) and other small trees (Brooks 1988). The latter two shrubs also contribute to the Shrike's life history in a peculiar way; these birds will impale their prey upon thorns prior to consuming them. Together, landscape modifications that remove shrubland mosaics coupled with high rates of cowbird parasitism within agricultural zones are the greatest threats facing these rare bird populations. Ecological restoration practices that control woody encroachment with fire to promote scattered shrublands adjacent to diverse prairies and riparian corridors would enhance the habitat suitability for these species.

Blanding's turtles face many threats to their populations, including habitat loss and fragmentation, predation, and road mortality. Blanding's turtles are long lived, and they don't reach sexual maturity until after 12 years. These turtles breed during spring and early summer in wetlands where there are abundant food sources of invertebrates and small amphibians (Oldfield and Moriarty 1994) . Females choose nesting sites in sandy upland areas with sparse vegetation up to a mile away from their resident marshes (Piepgras and Lang 2000). Turtle nests are generally raided by predators to a high degree, and Blanding's turtles have been documented to experience nest predation rates as high as 93% (Congdon et al., 1983). For those nests that survive, the hatchlings that emerge in August and September must face hazards such as predation and road mortality as they seek shelter in wetland habitats. Their low reproduction and high predation rates limit the degree to which their populations can rebound from disturbance. Priorities for assisting Blanding's turtle recovery include restorations of wetland habitats adjacent to suitable nesting sites, turtle nest protection, and transportation planning that allows for safe turtle crossings separated from vehicle traffic.

The rare plants found in proximity of Whitetail Woods Regional Park were both historically abundant, but the wet meadows they occupied have largely been lost to development and agriculture or have been degraded by the introduction of invasive species. **Edible valerian** (*Valeriana edulis* var. *ciliata*) is a State Threatened species found in calcareous fens and in wet meadows to wet-mesic prairies that have developed in calcareous soils, and is largely confined to prairie remnants and railroad rights-of-way. Because this plant reproduces only by seed, it is dependent upon pollinators that have been in decline due to habitat fragmentation. **Wild sweet William** (Phlox maculata) is a State Species of Special Concern which can be found in similar habitats and is also dependent upon insects for pollination. These plants face fierce competition from invasive reed canary grass, such that removal of RCG is a prime consideration in the restoration and maintenance of wet meadows and prairies. Fortunately, remnant plant material for these species is becoming more readily available in the native plant nursery trade, and these species can be included in restoration plantings to increase their numbers.

4. VISION

4.1. Vision for Whitetail Woods 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.*

The vision for the park from the *2012 WWRP Master Plan* is the following:

> *Whitetail Woods Regional Park is a healthy mosaic of natural and community spaces that restore the human spirit, where people can gather, celebrate, and be inspired. Outstanding recreation and learning experiences heighten awareness and appreciation of our relationship with nature.*
>
> *Strong partnerships with Empire Township, the University of Minnesota, and Minnesota Department of Natural Resources on adjacent public lands expand boundaries of all areas, with the park as a welcoming gathering place for visitors.*

Similarly, the park master plan is part of the larger Vermillion Highlands Concept Plan that says:

> *The approved Vermillion Highlands Concept Master Plan defines preferred uses and use intensity throughout the Modified WMA. High intensity uses are focused in the northwestern corner of Modified WMA, next to the new Regional Park and future development in UMore Park. Low intensity uses that support habitat restoration and wildlife management goals predominate east and south. General zones of emphasis for agricultural research, wildlife management, and park-based recreation.*

These visions will be echoed for Whitetail Woods Regional Park. Those elements unique to the park that may influence the vision for managing its natural resources will be addressed in the goals section that follows.

5. ISSUES

During development of the WWRP 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. In some instances, recommendations are made in this section.

5.1. Altered Natural Systems and Ecosystem Disruptions.

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). Other issues are life cycles have become more and more simple vs. complex. And there is a general loss of mutual symbiotic interspecies relationships across the ecosystem.

5.2. Loss of Ecological Integrity and Reduced Ecological Connectivity.

WWRP is relatively well-connected to nearby native habitats resulting in the possibility of 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. Also consider exploring ways to connect the major segments of the park that have been divided by roads, wildlife overpasses, and wildlife tunnels.

5.3. Climate Change.

Observational data and predictive models indicate that the climate in which WWRP 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.

5.4. 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. Pesticide and herbicide use should be used judiciously to prevent unnecessary impacts to natural communities, especially pollinators.

5.5. Habitat Fragmentation.

Habitat fragmentation has occurred related to past and current land use practices including agriculture over more than a century, mining, housing developments, and development of roads, and to a lesser extent of trails and recreational facilities. Edge effects, reduction of core habitat areas, and loss of habitat connectivity are effects of land uses that negatively impact wildlife habitat.

5.6. Stormwater Management/Conveyance, Including from Adjacent Properties.

Water resources within WWRP 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. Erosion is a concern where areas have lost vegetative cover. Alteration of natural water bodies is a large issue at this park, for example Empire Lake and altered wetlands and stream flowages. Impervious cover in the watershed can negatively affect water quality and quantity (**Figure 28**).

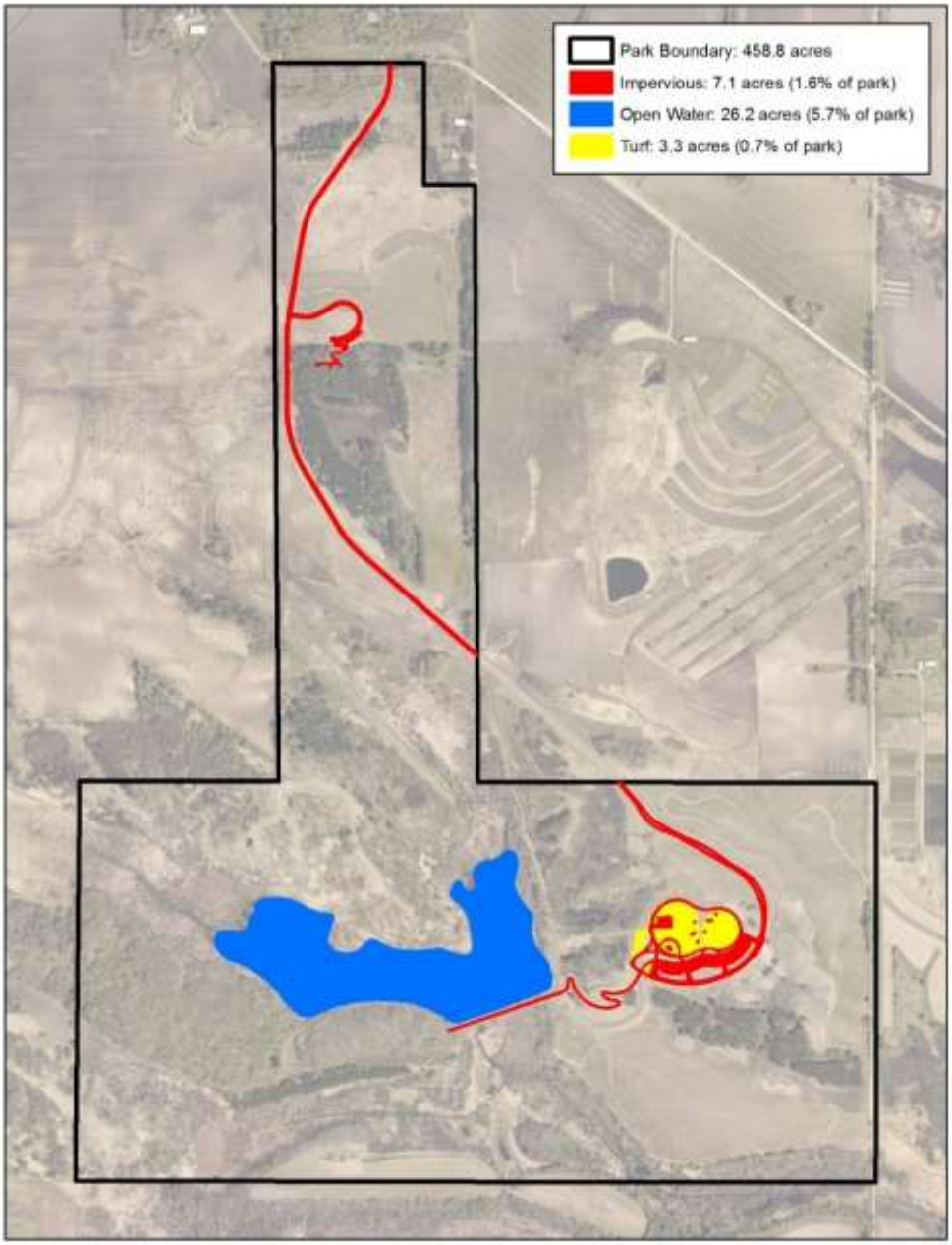


Figure 28. Open water, turf, and impervious surfaces in WWRP.

5.7. Potentially Impactful Recreational Activities or Recreational Improvements.

WWRP serves over 80,000 users per year and the purpose is to provide natural resource recreation for the region that includes several growing cities and at the same time to provide protection of these resources. The area was formerly intensively farmed. It is part of a larger 4,000-acre natural area where recreational facilities were slated to occur primarily, and the intent was to leave the majority of the natural areas and habitat only minimally impacted. Planned recreation improvements should be done in an environmentally sensitive way. They 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. Buildings, improvements, small structures, utilities, septic systems, roads, parking areas, paths, trails, and fences all have an impact on the natural resources. Recreational issues such as harvesting of timber, berries, or fruit; agricultural crops motorized vehicles; signs; recreational activities can all affect the resources, too.

Whether these impacts are direct or indirect, there can be significant effects. 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.

How much mitigation is required and costs to the County will vary depending on the species, its habitat needs, and the magnitude of effect the proposed project has on the priority feature and/or habitat. Mitigation plans will need to be developed with Dakota County Natural Resource staff.

5.8. 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 Whitetail Woods Regional Park. The reintroduction of species or the importation of additional individuals of certain species could mitigate the effects of genetic isolation.

5.9. Adjacent Land Effects

Effects can stem from residential, commercial, or industrial activities nearby the park, both past and current, such as sand/gravel mining, alteration of topography (that currently occurs to the west of the park, and soil and water contamination (that occurred north and east of the park). Also, to the west of the park, towards the north side of the park, if gravel or development were to occur, it could negatively impact the park. To the south of the park is DNR land, but to the west of the park and between that and the Vermillion River there is also a private property. To the north and east of the park is U of MN land (UMORE Park). To the north of the park is U of MN land and also some smaller private properties.

Legacy of Contamination

A big issue from adjacent land is soil and water contamination. There are several episodes of contamination that occurred on adjacent land, in the recent past, near what is today Whitetail Woods Park. Groundwater flow mostly carries soluble contaminants away from the park. Testing for contaminants is recommended, just in case. A responsible party should be identified moving forward, for example, County Parks, Groundwater Unit, or other. Windborne contamination may be a concern and options should be explored to minimize it. The following is a summary of contamination on or near the park.

Munitions Production Facility

The first was the former Gopher Ordnance Works, circa 1945, which was located just to the northeast of what is the park today (Figure 29) (also see Section 3.4.2, above) . This was commissioned by the federal government during World War II to manufacture gun powder and other munitions for the war. Many toxic chemicals were used on this site that entered the groundwater. There is a "groundwater divide" that occurs such that groundwater northeast of "Patrol Road/Station Trail" flows north and east towards the Mississippi River, and that south and west flows towards the Vermillion River. This divide provides some protection from groundwater contamination to the park. Also, external pipes had been insulated with asbestos, which later contaminated surface soils once the munitions plant was decommissioned and torn down after the war.

UMore Park

Once the University of Minnesota took over ownership of the former Gopher Ordnance Works, more contamination occurred. Lab chemicals were dumped on the site. Also, bio-solids were sprayed onto the surface of the soil as part of an experiment to deal with solid waste, and some of these were toxic.

Private Land Contamination

Not unlike the rest of the parks, private landowners also dumped trash and junk in private dumps on theirs properties, which was a common practice until the 1970's and 1980's. In addition, one landowner, near the park, collected old transformers that leaked out toxic PCB's into the soil and groundwater. A comprehensive testing program should be implemented to test for contaminated soil and water on the park property.

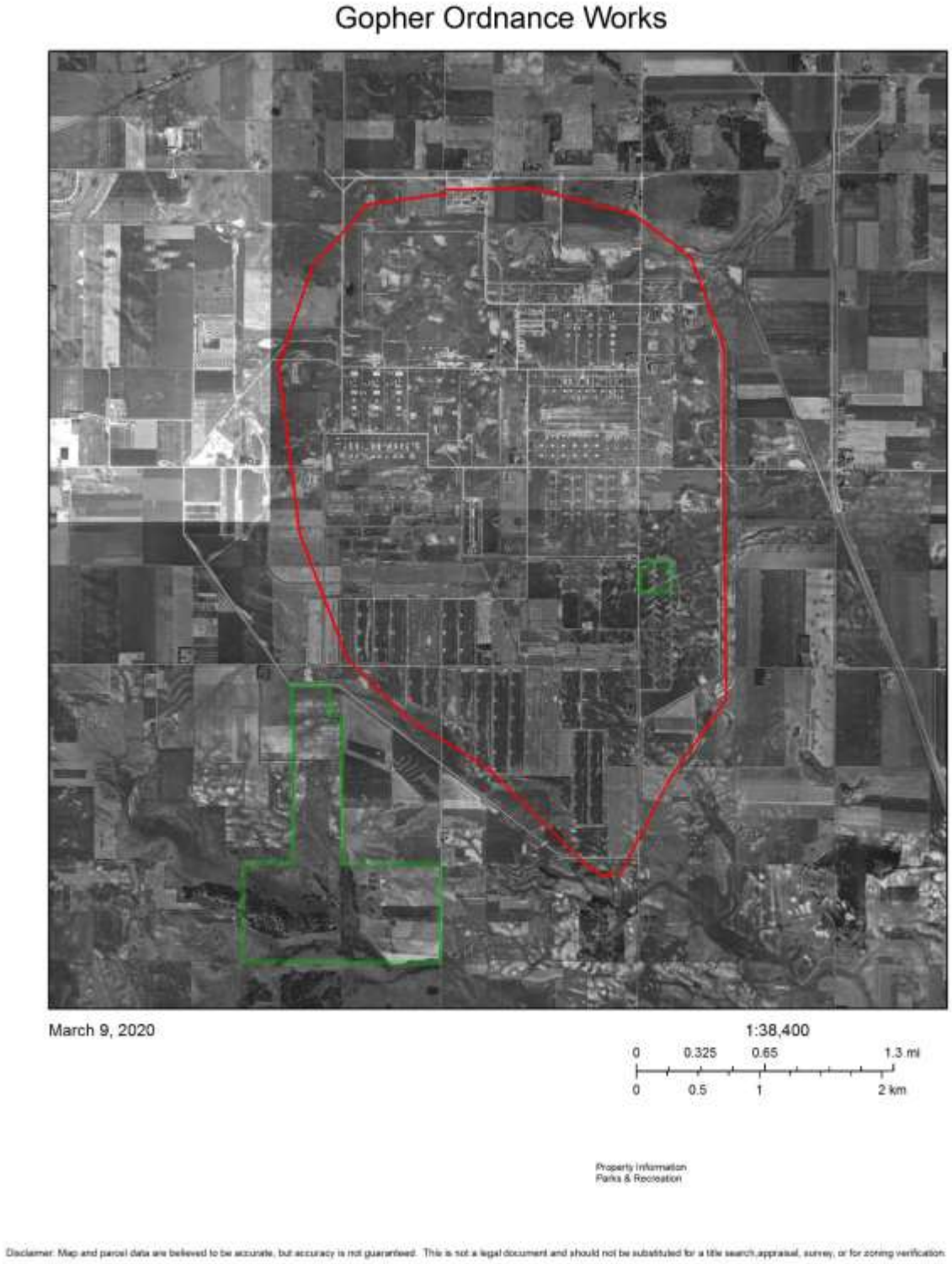


Figure 29. 1951 aerial photo of Gopher Ordnance Works (circled in red). WWRP and Dog Park are bounded in green. .

5.10. Relatively Small Size of the Park

At 456 acres, this park is relatively small to provide meaningful core habitat. Fortunately, since the park is part of a much larger natural area (over 4,000 acres), this helps provide an extensive habitat. Nevertheless, every effort should be made to coordinate with County Capital Improvements and Visitor Services to protect core habitat and to conserve native floral and faunal communities. Localizing higher intensity recreational use areas to a limited number of areas within the park, as identified in the master plan, is recommended, which would help limit the "development footprint" by maintain as much effective habitat as possible. To protect wildlife populations during development of the park, it is highly recommended to work within the principles and constructs of the Wildlife Habitat Relationships (WHR) concept (Appendix E). Essentially, WHR defines priority species and critical plant communities for each species and identifies critical habitat on the site for each species. Lists, tables, and maps are generated and then used to inform development as it proceeds. Visitor services and recreation needs are integrated with wildlife and habitat requirements to produce a harmonious result. It has been shown that if the needs and requirements of species are not considered before development occurs, species conservation will not be successful.

5.11. Invasive Species

For the most part, invasive species can be seen as sort of a "symptom" rather than a "cause" of a stressed ecosystem. For example, an old field is one that used to be a producing crop field has been laying fallow for many years. Old fields abound at Whitetail Woods. In Dakota County, most old fields previously were prairie or savanna with little opportunity for invading annuals and biennials to become established. There were few spaces available. If one were to be introduced, it may eventually get established, but probably not. Today, because of all of the disruptions and damage to plant communities from modern land use (agriculture and urban development), it is much easier for new plant species to become established.

The way most invasive species were introduced to the "new world" was by being brought over from the "old world", either intentionally or not. This represents a "bridging" of a prior to almost impenetrable barrier—the Atlantic or Pacific oceans. Thus, species suddenly appeared on the scene almost out of nowhere. Normally, the chances of such species getting established would be minimal. But many of what we know to be invasive species today were able to capitalize on opportunities given them by European settlers, such as massive changes to land use, alterations in hydrology, and wholesale shifts in floral and faunal populations and patterns. Given this, it's no wonder that there are so many problems managing vegetation today.

Another advantage some exotic species have over local ones is that they have evolved amongst a larger pool of competitors and have developed strategies that can be brought to their advantage under new circumstances. For example, European buckthorn (*Rhamnus cathartica*) has the habit of holding on to its leaves much later in the season than most all other woody species from Minnesota, therefore giving it several more weeks to photosynthesize and build energy than its competitors.

Sometimes exotic species are able to hybridize with local species, thus re-shuffling the genetic deck, so to speak, to come up with novel and unique characteristics that give them an advantage. For example, cattails. The native cattail, called "broad-leaved cattail", or *Typha latifolia*, grows loosely among its floral neighbors, so that many other plants can grow in between its underground stems (rhizomes). It can also send out very long rhizomes, up to 3 m per year. The European "narrow-leaved cattail" or *Typha angustifolia*, grows very densely, allowing few other plants to grow amongst the colony, but it's rhizomes are quite short, usually less than a meter. Then a hybrid formed between these two parent types, called "hybrid cattail" or Typha x glauca. The hybrid is able to grow very densely and also to form very large rhizomes, which makes it a growing machine that can rapidly fill a space. They also form floating mats that can move even larger distances to start new colonies. Given the alteration of hydrology and wholesale loss of wetlands that occurred in the US (including Dakota County that lost 85% of its wetlands since statehood), hybrid cattail spread virulently.

Other times invasive species proliferate because they have no or few natural predators or diseases, since they are newcomers upon the scene. This allows their population's to grow unchecked, whereas back in their home range, they did not. A good example is buckthorn and goats. In eastern Europe and western Asia, where buckthorn is native, goats were common, and their continuous browsing helped keep the species in check. In the U.S., goats are uncommon, so no such population control for buckthorn exists here. Another example is Tatarian honeysuckle (*Lonicera tatarica*) that is easily top-killed by fire, but when fire is suppressed can proliferate virtually unchecked.

In some cases, people engineered a problem. Take the case of reed canary grass, *Phalaris arundinacea*. This wetland edge species came from Eurasia. In the U.S., it was viewed as a potentially good forage species for domestic cattle, and for many years was deliberately planted. But that's not all—new varieties of the species were cultivated that could grow not only in the wet margins of wetlands, but also in the drier uplands. Today, reed canary grass can be found in almost all wet to medium-moist soils. It forms dense monocultures of sod that crowd out most other plants, thus driving down diversity. It is also an inferior stabilizer of soil on streambanks due to its shallow root system. Ironically, it turned out that cattle actually do not prefer the taste of reed canary grass, except when it makes new shoots—thus backfiring in the purpose it was intended for.

Today, in many of our degraded natural areas, we have a situation where novel plant and animal communities have formed and are forming that have never been seen before, where multiple exotic and overabundant native species help support each other. For example, our degraded woodlands have a synergistic effect between exotic earthworms, European buckthorn, and whitetail deer. The worms eat the duff layer of the forest floor, which in turn allows buckthorn to readily germinate. The deer are overabundant and ravenously eat non-buckthorn seedlings wherever they can be found. Adding fire suppression to this "equation" gives these species a huge advantage over most other native woodland species, and a sort of new steady state occurs in the ecosystem that is very difficult to "flip back" or overcome. In this case, they are no longer a "symptom" but instead they are a "cause" or "driver" of the problem. This was the case at many of the natural areas in Minnesota and Dakota County. It is also the reason why nearly every restoration project begins with the removal of problematic invasive species.

Invasive plants. Several invasive plants have exerted considerable pressure on native plant communities and aquatic systems at WWRP. 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 WWRP.
- Japanese hedge parsley (*Torilis japonica*) is an emerging invasive plant that is becoming widely established in Dakota County and is present in portions of WWRP.
- Cheat grass (*Bromus tectorum, B. japonica,* etc.) is present along the trails throughout the eastern half of the park (east of the lake). It has currently not escaped into the rest of the area but has the potential to do so.
- Curly leaf pondweed (*Potamogeton crispus*) was documented in an Aquatic Invasive Species (AIS) survey in Empire Lake in 2016. It was present, and its growth potential was ranked as "light to moderate".
- Eurasian water milfoil (*Myriophyllum spicatum*) was *not* documented in Empire Lake during the 2016 AIS survey, and it's growth potential was ranked as "light".
- Tatarian honeysuckle (*Lonicera tatarica*) and other nonnative honeysuckle shrubs are present at WWRP.
- 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. It is abundant throughout the wetlands of the park, on the margins of Empire Lake, and along the ditches.
- Spotted knapweed (*Centaura stoebe*) is present in small amounts in upland, sandy soils at WWRP.
- Hybrid cattail (*Typha x glauca, T. angustifolia*) is present at Empire Lake and associated wetlands.
- Canada thistle (*Cirsium arvense*) is present in disturbed areas of the park, especially north of Empire Lake.
- Common burdock (*Arctium minus*) is present throughout the park, especially in the disturbed uplands north of Empire Lake.

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 possibly feral cats. Although cold winters help reduce their incidence, every year in the US, billions of birds are harassed and killed by feral cats. According to People for the Ethical Treatment of Animals (PETA), the best way to control feral cats is by the trap, neuter and release method (https://www.peta.org/issues/animal-companion-issues/animal-companion-factsheets/trap-neuter-return-monitor-programs-feral-cats-right/).

Currently, there are a few methods to control earthworms, such as mustard solution and worm grunting, but none that can be used for a large areas such as WWRP.

Neither zebra mussels nor common carp were identified in the 2016 AIS Survey in Empire Lake, and their growth potential was ranked as "light". All of these species need to be controlled

throughout the park and 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.

6. OPPORTUNITIES

6.1.1. Inherent Ecological Strengths of the Park

The park has several inherent strengths, ecologically. The following is a list of those strengths/opportunities:

- Recently restored
- Part of a larger natural landscape
- Can coordinate management activities with adjacent properties
- Burning will be less of a problem as compared to most park sites
- There is an excellent habitat diversity across the site, from dry sand-gravel prairies to mesic savanna to spring-fed wet meadows.
- Rare species occur on and nearby the site
- No residential neighbors with encroaching land uses

7. GOALS

7.1. Goal 1 Manage and Conserve Biodiversity

7.1.1. Identify High Priority Natural Features Known to Occur in 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. See Section 6 for more on the priority features of the park.

7.1.2. Conserve Wildlife Species of Conservation Need

The overall intent to manage native vegetation at WWRP 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. Natural resource issues should be addressed during the design phase in the construction development. 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 considering 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 **Tables 6 and 7** for a lists 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 (see Section 8).

Other things to consider are the following:

- 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.

7.1.3. Foster Native Plant Species Biodiversity and 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). 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, WWRP has also become increasingly isolated from other remnant native plant communities, meaning the previously displaced native plant species have no practical way of recolonizing WWRP.

Restoring diverse, stable, and resilient plant communities at WWRP 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 WWRP

- Protect and buffer remnant plant communities.
- Provide heterogeneity on the land, which will form the foundation for a diverse and rich biota
- Protect and expand core habitat for an array of faunal species
    - 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. Refer to the County Land Conservation Program Plan (LCPP) since a preliminary Conservation Focus Area includes lands surrounding the park.

7.1.4. Protect Water Resources

Surface water and groundwater resources

Surface Water:

- Maintain and improve the water resources of the park.
- Complete a Subwatershed Assessment Study for the subwatershed the contains WWRP that will generate a list of recommendations and improvement projects.
- Incorporate vegetation management of wetlands and near-shore habitats.
- 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.
- Collaborate with partners to improve water quality, including Vermillion River Watershed Joint Powers Organization (VRWJPO), Soil and Water Conservation District of Dakota County (SWCD), Empire Township, UMORE Park, adjacent private landowners, and Dakota County Water Resources Department.
- 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 impervious and impermeable surfaces.
- Look at upstream privately owned farmland to provide adequate buffering to address surface water runoff from progressing further downstream. Consider cost share program as described in the Land Conservation Plan (2020).

- Consider practices on County-owned property that would reduce or address surface water runoff from progressing further downstream.
- Consider surface water runoff leaving the park, where there are opportunities to reduce runoff to adjacent properties, and collaborating with adjacent landowners such as UMORE Park.

Groundwater:

- 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 WWRP.
- Although there are significant obstacles in working with the U of MN and the US Army Corps of Engineers, stay involved with the Gopher Ordnance Works issue. Past land use has caused physical and chemical hazards that can affect human health and the environment. Although direct impacts to WWRP are unlikely, indirect impacts may have resulted. Enrollment of the GOW in the FUDS program represents the best opportunity to address these issues and the County's continued involvement is critical in obtaining cleanup funds from FUDS Program.
- Sample groundwater for contaminants
- Refer to the County Groundwater Protection Plan, currently under development. Review the draft strategies proposed in the (GPP)

7.2. Goal 2 Restore Ecosystem Processes and Native Habitats

7.2.1. Manage at the Ecosystem-Level

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.

Ecosystem Maturity

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 [unity], 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 strategies 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

7.2.2. Use 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 WWRP (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 WWRP. In the case of WWRP, 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).

7.2.3. Conduct 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. The ultimate goal is to achieve and maintain a diverse natural community at the site, 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. See Section 7.9 for more information on adaptive management.

Much effort has been devoted to restoring most of the natural areas of the park. *Restoration and enhancement or native animal and plant communities should be continued.* The following is a list of specific goals for restoration for the park:

- 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 in preparation for developing the next 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.
- Natural Resources expertise are utilized and addressed as part of core planning teams for proposed park improvement projects.
- Follow up on and enhance areas already restored
    - Reintroduce (or continue to promote) formerly lost ecosystem processes
        - Fire

- Grazing
    - Consider using Bison
    - Consider using other grazers (e.g., long-horned steers)
    - When grazers are not possible, mimic grazing (e.g., haying)
- Browsing
    - Consider using goats
    - Mimic browsing (e.g., brush cutting, forestry mowing)
- Hydrology
    - Conduct periodic drawdowns of Empire Lake

7.2.4. Increase Ecological Connectivity

- Maintain ongoing communications with adjacent 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 Land Conservation 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.
- 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.

7.3. Goal 3 Achieve Ecological Resilience and Provide Ecological Services

By protecting remnant communities, buffering them, expanding outward from them, and connecting them, this forms the framework for restoration in the park that everything else can be built upon. Reintroducing ecosystem processes will provide the conditions for native communities to survive and flourish. Together, this builds ecological resilience and provides ecosystem services. Ecosystem services are those things that are provided by nature that people do not have to pay for, e.g., clean air and clean water. It is important to strive for the maximization of ecosystem services when managing natural areas, but this is more pertinent on a large scale. Every little bit matters, though, and managing Dakota County parks, and Whitetail Woods Park, with ecosystem services in mind is recommended.

Specific goals include:

- Maximizing landscape heterogeneity
- Maximizing biodiversity

- Creating a shifting patchwork of refugia
- Protecting core habitat
- Protecting clean air and water
- Providing for aesthetically pleasant settings and viewsheds
- Planning for climate change

7.3.1. Mitigate Impacts of Climate Change

Much of a seemingly well-managed natural area can come undone by the potentially huge disruption of global warming and climate change. In planning for the management of WWRP'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 floral and faunal 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 WWRP, 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 WWRP 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 WWRP 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.

7.4. Goal 4 Achieve Regionally Outstanding Quality

By achieving the goals listed here, it should be possible to achieve regionally outstanding quality. Comparisons can be made to other parks of similar size and nature. The NRMSP compared Dakota County with other similar agencies and found that we are a bit behind in management of our parks. For instance, Three River Parks District has the oldest restored prairie in Minnesota (Crow-Hassan Prairie) and several high-quality woodlands. On the other hand, with respect to many of local municipal parks, and to Washington County and Anoka County Parks, Dakota County parks compare

favorably. Continued management following the recommendations of this NRMP should put the park on a successful trajectory of regional outstanding quality, but it may take many years.

Specific goals include:

- Partner with adjacent landowners, including UMORE park and DNR, to coordinate management activities on all of the lands so as to reach common goals
- Control Invasive Species
    - European buckthorn, Tartarian honeysuckle, reed canary grass, common burdock, etc.

7.4.1. Control Invasive Species

Until recently, at Whitetail Woods Regional Park, terrestrial nonnative species have increasingly expanded over the course of decades and are a significant force in degrading the composition, structure, and function of native habitats. 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.

Within the woodlands, the most troublesome species are common buckthorn and Tartarian honeysuckle which were dominant throughout most of the park prior to 2015, having formed a nearly continuous cover in the shrub layer. Today, populations of these species have been significantly set back, with the large individuals having been removed, but seedings and stump resprouts that persist will need to be controlled on a continuing basis for many years. Buckthorn seeds are viable in the soil, on average, for about 3-8 years, and if not treated with herbicide or browsed by goats, stumps will resprout indefinitely.

Within wetland areas, the nonnatives reed canary grass and hybrid/narrowleaf cattail are present in varying amounts in wetlands with a history of hydrologic disturbance, sedimentation, nutrient loading, and other factors.

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.

- White poplar (*Populus alba*)
- Multiflora rose (*Rosa multiflora*)
- Soapwort (*Saponaria officinalis)*
- Common reed grass (*Phragmites australis*)

Aquatic invasive species observed within WWRP include curlyleaf pondweed (*Potamogeton crispus*). Eurasian watermilfoil (*Myriophyllum spicatum*) was not found in a survey in 2015 but has the potential to grow here. Purple loosestrife (*Lythrum salicaria*), zebra mussels (*Dreissena polymorpha),* and other invasive, nonnative aquatic plant and animal species could be accidently transported to the park. Common reed grass (*Phragmites australis*) is another aquatic exotic invasive herbaceous plant to watch out for. The native species of reed grass is present on the south side of Empire Lake

WWRP 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.

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.

7.5. Goal 5 Enhance Visitor Experience and Environmental Education

Use natural resource management and associated topics as a platform to enhance the park visitor's experience and improve environmental education.

7.5.1. Improve the Natural Resource Experience for All Park Visitors

- 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.
- 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 Management Recommendations (pp. 94-95, 98-110).
- 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.

7.5.2. Engage the Public through Volunteerism, Interpretation, and Education

- Collaborate with County staff from a variety of program areas, including Visitor Services, 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 with County staff. May involve volunteers.

7.6. Goal 6. Manage Important Natural Resources While Providing for Compatible Recreation

- Review proposed development projects that may impact resources within WWRP (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 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.
- Limit access to a few, ecologically sensitive areas, such as canoe access to the wetland complex at the west end of Empire Lake.

7.7. Develop Target Plant Communities for the Park

Target plan communities would help guide the restoration of the park in specific ways, which would help determine management/work units and organize natural resource restoration and management going forward. Based on all of the preceding information from Section 3 and input from the public and stakeholders, Target Native Plant Community map for the entire park was developed. This map illustrates the future desirable state or condition of the land. The vision for native plant communities at WWRP 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 and wetland communities in the lowlands. 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 will tend to shift back and forth over the course of time.

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 WWRP, 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 WWRP 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 WWRP, current ecological restoration best management practices, and others. The result is shown in Figure 17 on the page 81

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 **Figure 30**, 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.

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, discrete community units were developed to help guide the restoration of the park. By no means are these community units meant to be discrete 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 discrete.

See Appendix xx for a description of each of the native plant communities that are targeted for Whitetail Woods, 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.

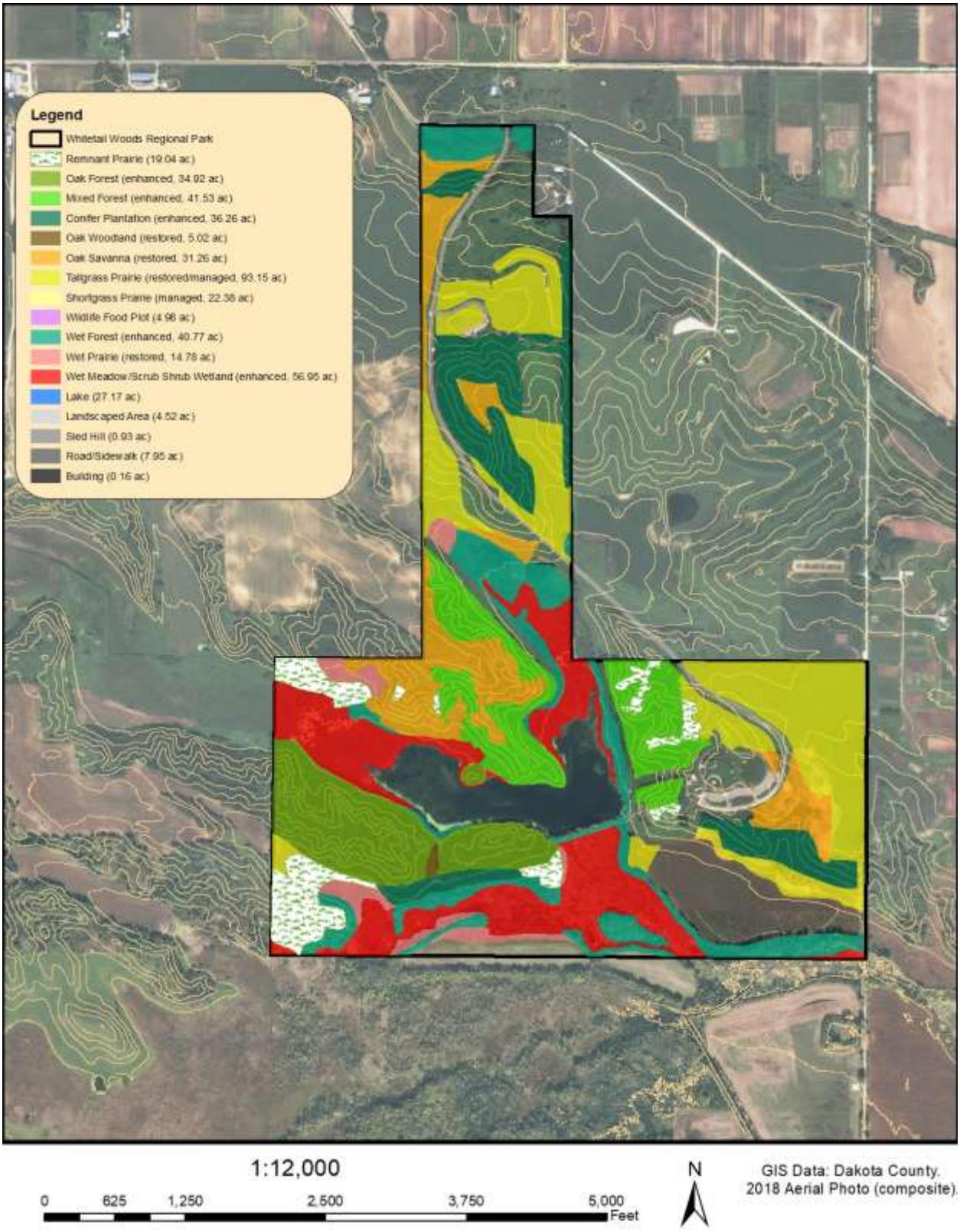


Figure 30. Target Plant Communities of Whitetail Woods Park.

7.8. Develop a 5-Year and a 20-Year Work Plan

Work Plans create management units for the park (**Figure 19**), list and prioritizes management tasks, and estimate associated costs. See Section xx, below, for details.

7.9. Develop Adaptive Management and Monitoring

Adaptive management will be key to determining what aspects of management are working or not, moving forward. It can be described as a strategy that uses evaluation, reflection, communication, and also incorporates learning into planning and management. This is a much better management approach than the more traditional "command and control" approach.

The ultimate goal of ecological restoration 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 31**) 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.

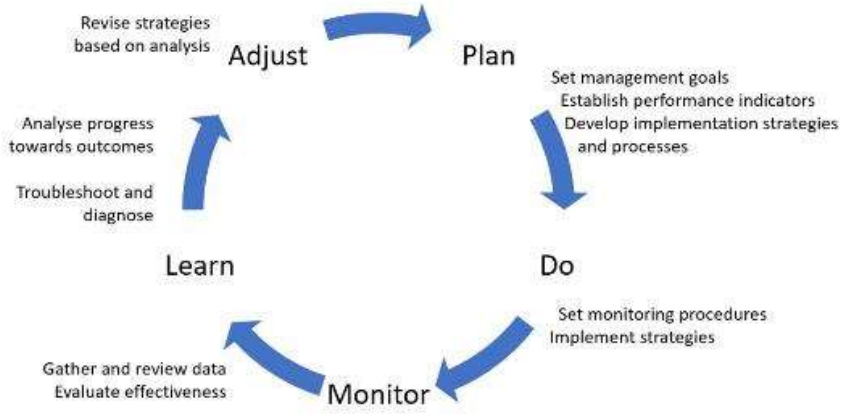


Figure 31. *Adaptive Management cycle (Jones, G, 2005, 2009).*

8. PRIORITY FEATURES

8.1. 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.

8.1.1. Prioritization at Whitetail Woods Regional Park

Natural resource priorities were based on the following criteria:

- Extent of anthropogenic disruption
- Similarity to ecological reference sites
- Rare species
- Significant geologic feature
- Uncommon communities for the region or park system
- Feature that cannot be restored or cannot be easily restored

The following are high priority features at the park:

8.1.2. High Priorities

Rare Flora

- Remnant prairies/savannas
    - Dry hill prairie, southern
    - Wet Prairie, southern
- High quality wetlands and high quality aquatic resources
- Old growth forests and woodlands
    - Oak woodland-brushland southeast
- Areas to buffer and/or connect remnants.
- Rare plant species
    - Cowbane, *Oxypolis rigidior*
    - Edible valerian, *Valeriana edulis* var. *ciliata*
    - Wild sweet William, *Phlox maculata*

Rare Fauna

- Species that are either endangered, threatened, special concern, or Minnesota delisted that have been observed in the park or just outside of it
    - Loggerhead shrike, *Lanius ludovicianus* (endangered)
    - Bell's vireo, *Virio bellii* (special concern)
    - Lark sparrow, *Chondestes grammacus* (special concern)
    - Trumpeter swam, *Cygnus buccinator* (special concern)
    - Blanding's turtle, *Emydoidea blandingii* (threatened)
    - Baltimore checkerspot,
- Species of Local Conservation Interest (SLCI) that have been observed in the park or just outside of it
    - Upland sandpiper, *Bartramia longicauda*
    - Bald eagle, *Haliaeetus leucocephalus* (de-listed)
    - Dickcissel,
    - American black duck
    - Northern pintail
    - Black-crowned night heron
    - Sandhill crane
    - Black-billed cuckoo
    - Common nighthawk
    - Red-headed woodpecker
    - Least flycatcher
    - Willow flycatcher
    - Northern rough-winged swallow
    - Bobolink

- Critical Habitat (hibernacula for snakes, marsh for secretive marsh-birds, prairie-wetland complexes for turtles, floral-rich areas for pollinators, etc.)
- Areas to buffer and/or connect critical habitat
- Important Bird Areas (IBAs)

Important Water Resources

- High sensitivity to groundwater contamination
- Groundwater infiltration areas and seepage areas
- Empire Lake
- Wetlands

Sensitive Upland Areas

- Erosion-prone areas
- Steep slopes
- Bluffs

8.1.3. Medium Priorities

- Areas previously restored
- High-use recreational areas that merit attention, mitigation, or restoration e.g., Picnic Shelter or highly used trails
- Raingardens
-

8.1.4. Lower Priorities

- Food Plots
- Roadsides
- Possible Dog Park Area (TBD)
- Low-use Recreational Areas

9. SITE SPECIFIC RECOMMENDATIONS

9.1.1. Recommendations

These are recommendations that are specific to the site of the park. These often are objectives to the goals listed above, and sometimes provide potential approaches regarding achieving the goals.

9.1.2. Convert Novel, Non-historical Plant Communities to More Appropriate Native Plant Communities

Slowly convert novel, non-historical plant communities (including conifer plantations and walnut savannas) to more appropriate native plant communities. This has been occurring for the past five years in the park, and we recommend continuing it. Non-historical plant communities include ones such as conifer plantations, old fields, exotic species dominated wetlands, etc. We have developed a transition plan for these communities that will be included in the NRMP.

9.1.3. Revisit each restoration unit and evaluate its status

We need to revisit each area that was restored, each restoration unit, and evaluate its status, changing unit boundaries or approaches as necessary. We are in the process of doing this and will incorporate this information in the next go-around at final draft phase. Examples include:

- Consider converting game animal food plots to a more appropriate native plant community (wet prairie). Food plots are difficult to access—can't be accessed directly without crossing DNR land. Part on park land is topmost strip of food plot and would be inconsistent with DNR management. First coordinate with DNR before converting park land food plots.
- Manage "Bowling Alley" old field tree planting as an open oak woodland and gradually, over a period of perhaps ten years, thin tree whips to appropriate densities.
- Clear afforested wooded areas surrounding remnant prairies to provide them a buffer and allow them to expand into overtime. Collect seed from the remnants to use exclusively for these buffer zones
- Joining similar restoration units will create larger core habitat and allow for better management of similar cover types.
- Burn units are related but separate entities from management units. Allow for burning to be done at the manager's discretion, so as to create shifting patchworks. Ideally, combining other processes such as grazing to create a dynamic burn-graze-rest patchwork across the landscape.
- Remove undesirable vegetation that remains throughout the park, as indicated by target plant community goals for each work unit. Examples include: 1) removing silver maples on the east side of Empire Lake, 2) removing and controlling reed canary grass in the wetlands margins of Empire Lake and the wetlands in the rest of

the park, 3) controlling cheat grass along the mowed trails and trail borders throughout the park, 4) slowly converting pine plantations to prairie, woodland, and savanna, and 5) controlling exotic herbaceous forbs such as bull thistle, common burdock, garlic mustard, and sweet clover in the uplands.

9.1.4. Empire Lake: Increase the Diversity and Wildlife Value of the Vegetation of the Lake

- Consider introducing more native aquatic plant species, emergent, floating-leaved, and submerged, that will increase the diversity and resiliency of the shallow lake ecosystem. For instance, wild celery and wild rice are both excellent wildlife food and cover species that may do well in this shallow, tranquil deep marsh setting. Wild rice, although providing an excellent source of food for waterfowl forage, can dominate a shallow lake and change the aesthetic of the lake and the possible recreational uses of the lake, so all of the consequences need to be considered. A strategy will need to be devised to reduce the dominance of coontail to make room for new types of vegetation.
- Perform periodic drawdowns of the lake, for the benefit of water quality and habitat. Drawdowns are known to improve the firmness of lake bottoms, reduce densities of coontail and other turbid-state dominants, and to release dormant vegetation in shallow wetlands and lakes. Drawdowns need to be coordinated with wildlife issues, so that negative impacts to wildlife do not occur. For instance, drawdowns in the winter will damage and kill overwintering herps, turtles, and fish, so they should always be performed in the summer months. Also, too many drawdowns done within a certain number of years may induce beavers to build higher dams, which could impact boardwalks and trails.

9.1.5. Reintroduce grazing to the park

The ecological drivers of prairie ecosystem are: climate, fire, and grazing. The climate and the fire components are present; the grazing component is the missing element that would complete things. We recommend considering the reintroduction of grazing to parts of the park. The historic grazers of the prairie were bison. Bison have many advantages over other types of grazers, including the following: they are adapted to the unique perturbations of our climate and site conditions, they primarily eat grass (helps increase forb diversity in prairies), they are winter-hardy, they do not require a lot of extra care, and they help support many other prairie species that otherwise would struggle in their absence. For a bison herd to have enough room to roam, the County would need to partner with the Vermillion Highlands to the east of the park. Other grazers to consider are cattle, long-horned steers, and sheep. More research would be necessary to move forward using these types of grazers, however.

9.1.6. List Priority Features for the Park and their Recommendations

Another site specific recommendation for the park is to develop a list of Priority Features with goals for each feature. Priority features include high quality plant communities such as

remnant prairies, old growth woodlands, and wetlands. They also include important or key wildlife species including Blanding's turtle, top predators, etc. Also included would be significant geologic, soil, and water features. Priority features work hand in hand with critical ecological processes, and both of them should be restored together.

9.1.7. Restore All Areas that Did Not Get Restored Previously

Examples include some of the wetlands, Empire Lake area, small areas scattered across the park. Consider re-meandering channelized ditches. In the Work Plan that follows (p. 98), no vegetation restoration is listed, since mostly all of the uplands areas have been restored Restoration of aquatic resources such as Empire Lake and the wetlands of the park, however, are included in the Water Resources work plan.

9.1.8. Enhance All Areas that Received Initial Restoration

For all areas of the park that have received initial restoration, consider what their continued needs are and plan for future enhancements for each community type for the next 20-50 years. Continue to control exotic invasives (crown vetch, cheat grass, RCG, buckthorn, thistle, smooth brome, Siberian elm) and undesirable natives (silver maple, walnut vs oaks, etc.)

10. IMPLEMENTATION

10.1. Management Units

Because the site is large, it is easier to manage if it is divided it into "management" or "work" units (Figure 32). There are 84 work units in the park. Work units are labeled according to their dominant vegetation type and by their type of management activity required. For example, "PR" stands for "prairie", "SAV" for "savanna", etc., and "m" stands for "maintenance", "e" for "establishment", "f" for "future", etc. So, for the unit "PR-m1", this means that it is the first prairie unit and is in maintenance mode. "SAV-E4" is the fourth savanna unit and is to be established. "WP-f2" is the second wet prairie unit to be restored in the future. Over time, as units become established and fully restored, they can be pooled together, thus reducing the number of units. Also, units may be broken up into subunits, for ease of burning, etc., as Natural Resource staff so wish. The following tables shows all of the codes and their meanings.

Vegetation Code	Dominant Vegetation Type
PR	Prairie
SAV	Savanna
WP	Wet Prairie
SH-Carr	Shrub-carr wet meadow
Wet	Wetland
WF	Wet Forest
OW	Oak Woodland
CP	Conifer Plantation
DW-marsh	Deep water marsh
REC	Recreation element

Management Code	Primary Management Activity Required
m	Maintenance
est, e	establishment
r	remnant
f	future (to be restored)
fct	future canopy transition
sb	seed bank
enh, e	enhancement
t	transition

Unit Number
1
2
3
etc.

Table 8. Management/Work Unit Codes

Work unit boundaries were delineated using both natural and artificial features such as lakes, topography, and trails. Each work unit has a summary of prescribed management activities for the next 20 years (Table 9). Work units were also designed with grant funding in mind—they are of a size that County staff typically use in grant requests.

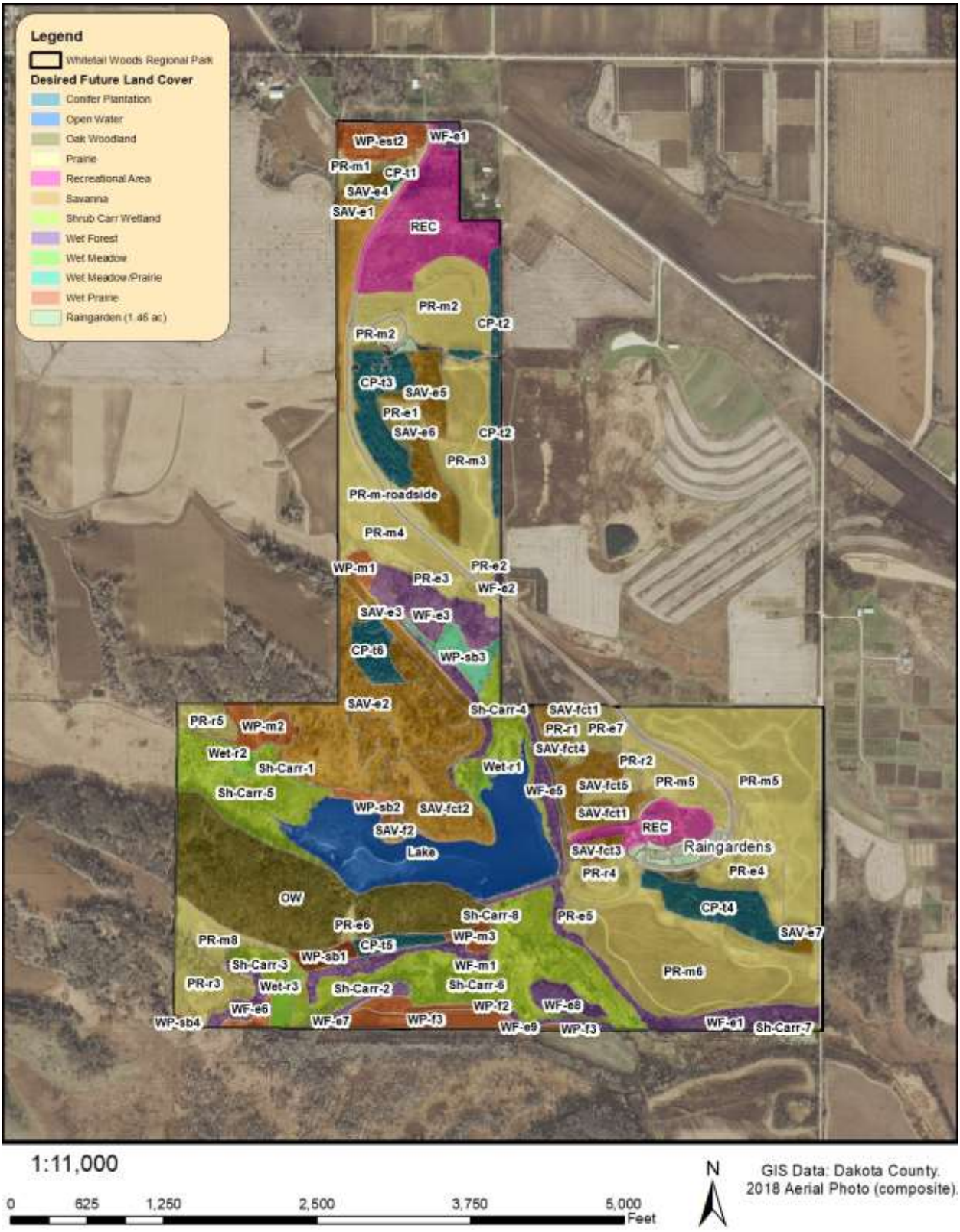


Figure 32. Management/Work Unit Map.

10.2. Vegetation Resources Work Plans (five-year and twenty-year)

The following table is a work plan that shows recommended tasks for each Work Unit in 5-year increments up to the next 20 years. It also shows cost estimates for each task. Years 1-5 are in black, 6-10 are in blue, 10-20 are in green, and ongoing maintenance years are in red.

Novel PC Code	Resto Time-line	Unit Description	Old Unit(s) Names	NRMP Unit	Acres	Mgmt Activity 1 Proposed (Year 1)	Cost per acre	Cost 1	Mgmt Activity 2 Proposed (Year x)	Cost per acre	Cost 2	Mgmt Activity 3 Proposed (Year x)	Cost per acre	Cost 3	Mgmt Activity 4 Proposed (Year x)	Cost per acre	Cost 4	Mgmt Activity 5 Proposed (Year x)	Cost per acre	Cost 5	Mgmt Activity 6 Proposed (Years x-x)	Cost per acre	Cost 6	Mgmt Activity 7 Proposed (Years x-x)	Cost per acre	Cost 7
13	short	White Pine	C1 (19ECP4)	CP-t1	1.28	Site prep, seeding, plugs	$ 4,000		Plant pockets of bur oaks (Yrs 3-5)	$ 3,000	$ 3,840	Spot Spray, Mow (Yrs 2-10)	$ 500	$ 640												
13a	medium future	White Pine	C1	CP-t1	0.55	Maintain sense of "entry gateway/portal" along driveway. No action in year 1-5.	$ -	$ -	Evaluate white pine health. Lightly thin for stand health and regeneration. (Yr 5-10)	$ 2,500	$ 1,375	Consider interplanting bur oaks. (Yr 10-15)	$ 3,000	$ 1,650	Consider overseeding with native grasses (Yrs 10-15)	$ 500	$ 275	Spot Spray, Mow, burn (duration)	$ 500	$ 275	Assess visual buffer. Remove select white pines as possible	$ 300	$ 165			$ -
11	medium	Red pine, closely spaced rows	C2	CP-t2	2.07	Improve health of declining stand. Remove 25-50% of pine stems (increasing intensity going south) (Yrs 1-5)	$ 2,500	$ 5,175	Begin to manage with fire (Yrs 1-5, but ongoing as well)	$ 500	$ 1,035	Seed with native grasses on southern end. (Yrs 1-5)	$ 500	$ 1,035	Continue stand improvement plus start to prepare for conversion to oak savanna. Remove 30% of pine stems. (Yrs 5-10)	$ 1,500	$ 3,105	Seed understory with native grasses. (Yrs 5-10)	$ 650	$ 1,346	Plant bur oaks. (Yrs 5-10)	$ 4,000	$ 8,280	Remove remaining conifers. Plant more oaks if necessary. Overseed for diverse native prairie. (Yrs 10-20) Ongoing management (duration)	$ 2,500	$ 5,175
12	medium	Red pine rows	C2	CP-t2	1.20	Improve health of declining stand. Remove 20% of pine stems. (Yr 1)	$ 1,000	$ 1,200	Continue stand improvement plus prepare for oak savanna. Remove 30% of pine stems. (Yrs 5-10)	$ 1,500	$ 1,800	Begin to manage with fire, if possible. Seed understory with native grasses. (Yrs 5-10)	$ 500	$ 600	Plant bur oaks (yrs !	$ 4,000	$ 4,800	Complete conversion to oak savanna. Remove remaining conifers; overseed for native diverse prairie. (Yrs 10-15)	$ 3,000	$ 3,600	Plant bur oaks. (Yrs 10-15)	$ 3,000	$ 3,600	Overseed for diverse native prairie (yrs 10-15). Ongoing management (duration)	$ 300	$ 360
6	medium	Blue spruce core, red pine exterior	C3	CP-t3	0.88	Improve health of declining spruce-red pine stand. Thin 30% (year 1-5).	$ 1,500	$ 1,320	Monitor stand health. Remove diseased and dying stems (trail hazards) as needed (yr 5-10)	$ 3,000	$ 2,640	Improve health of declining stand. Thin 30%, seed understory with native grasses, begin to manage with fire, if possible. (Yr10-15)	$ 2,000	$ 1,760	Monitor stand health. Remove diseased and dying stems (trail hazards) as needed. Continue to manage with fire. Plant bur oaks in pockets (Yrs 15-20).	$ 2,500	$ 2,200	Complete conversion to oak savanna. Remove remaining conifers; overseed for native diverse prairie. (Yrs 20-25)	$ 2,000	$ 1,760			$ -			$ -
8	cultural area	Primarily blue spruce in relatively good condition	C3	CP-t3	1.20	Maintain for visual screening. No management needed. (duration)	$ -	$ -			$ -			$ -			$ -			$ -			$ -			$ -

Novel PC Code	Resto Time-line	Unit Description	Old Unit(s) Names	NRMP Unit	Acres	Mgmt Activity 1 Proposed (Year 1)	Cost per acre	Cost 1	Mgmt Activity 2 Proposed (Year x)	Cost per acre	Cost 2	Mgmt Activity 3 Proposed (Year x)	Cost per acre	Cost 3	Mgmt Activity 4 Proposed (Year x)	Cost per acre	Cost 4	Mgmt Activity 5 Proposed (Year x)	Cost per acre	Cost 5	Mgmt Activity 6 Proposed (Years x-x)	Cost per acre	Cost 6	Mgmt Activity 7 Proposed (Years x-x)	Cost per acre	Cost 7
9	medium	Dense primarily red pine with white pine row	C3	CP-t3	2.50	Improve health of declining stand. Thin 30% of the pine stems (year 1-5).	$ 1,500	$ 3,750	Improve health of declining stand and prepare for conversion to oak savanna. Remove another 30% of pine stems. (Year 5-10)	$ 1,500	$ 3,750	Seed understory with native grasses (yrs 5-10)	$ 650	$ 1,625	Plant bur oaks and native shrubs (yrs 5-10)	$ 3,000	$ 7,500	Monitor stand health. Begin to manage with fire. (yrs 10-15)	$ 750	$ 1,875	Complete conversion to oak savanna. Remove remaining conifers. (Yrs 15-20)	$ 1,500	$ 3,750	Plant bur oaks and plant native shrubs and native prairie (yrs-15-20)	$ 2,000	$ 5,000
19	medium	Red pine	C4	CP-t4	0.77	Improve health of declining stand. Thin 30% of the pine stems (year 1-5).	$ 1,500	$ 1,155	Improve health of declining stand. Thin another 30% of the pine stems (year 1-5).	$ 1,500	$ 1,155	Begin stand diversification. Plant bur oaks. (Yrs 5-10)	$ 2,500	$ 1,925	Begin managing with fire; overseed with native grasses. (Yrs 5-10)	$ 600	$ 462	Complete conversion to oak savanna. Remove remaining conifers. (Yrs 10-20).	$ 3,000	$ 2,310	Plant bur oaks. (Yrs 10-20)	$ 1,500	$ 1,155	Overseed with diverse native prairie. (yrs 10-20)	$ 750	$ 578
20	medium future	Red pine	C4	CP-t4	4.58	No action, (yr 1-5)	$ -	$ -	Improve health of declining stand. Remove 30% of pine stems. (Yrs 1-5).	$ 1,500	$ 6,870	Improve health of declining stand. Remove 30% of pine stems. (Yrs 1-5).	$ 1,500	$ 6,870	Begin stand diversification. Plant bur oaks. (Yrs 5-10)	$ 2,500	$ 11,450	Begin managing with fire and overseed with native grasses. (years 5-10)	$ 750	$ 3,435	Complete conversion to oak savanna. Remove remaining conifers. (Yrs 15-20)	$ 1,500	$ 6,870	Plant bur oaks and overseed with diverse native prairie. (Yrs 15-20)	$ 2,000	$ 9,160
21	cultural area	White cedar--cultural area	C5	CP-t5	1.70	Maintain as a white cedar areas. No action (for the duration)	$ -	$ -			$ -			$ -			$ -			$ -			$ -			$ -
14	med fut	Mostly red pine	B1 (N part)	CP-t6	3.03	Improve health of declining stand. Thin 30% of the pine stems (year 1-5).	$ 1,500	$ 4,545	Monitor health of stand (Yrs 5-10)	$ 300	$ 909	Improve health of declining stand and prep for savanna conversion. Remove 30% of pine stems. (Yrs 5-10)	$ 1,500	$ 4,545	Seed understory with native grasses and plant bur oaks. (Yrs 5-10)	$ 2,500	$ 7,575	Complete conversion to savanna. Remove remaining conifers. (Yrs 10-15)	$ 1,500	$ 4,545	Plant bur oaks and overseed with diverse prairie. (Yrs 10-15)	$ 1,500	$ 4,545	Ongoing management (Yrs 15-20)	$ 300	$ 909
		Deep water marsh; former emergent wetland	NA	Lake	27.17	Evaluate for improvement of biodiversity and wildlife habitat. Devise a wetland management plan (Yrs 1-5)	$ 10,000	$ 10,000	Implement wetland management plan. E.g., seed with wild rice, wild celery, and other SAV. May involve drawdowns of the lake (Yrs 1-10)	$ 3,000	$ 81,517	Assess establishment success of new vegetation (Yrs 2-10)	$ 300	$ 8,152	Continue to assess, monitor, and manage (duration)	$ 300	$ 8,152			$ -			$ -			$ -

Novel PC Code	Resto Time-line	Unit Description	Old Unit(s) Names	NRMP Unit	Acres	Mgmt Activity 1 Proposed (Year 1)	Cost per acre	Cost 1	Mgmt Activity 2 Proposed (Year x)	Cost per acre	Cost 2	Mgmt Activity 3 Proposed (Year x)	Cost per acre	Cost 3	Mgmt Activity 4 Proposed (Year x)	Cost per acre	Cost 4	Mgmt Activity 5 Proposed (Year x)	Cost per acre	Cost 5	Mgmt Activity 6 Proposed (Years x-x)	Cost per acre	Cost 6	Mgmt Activity 7 Proposed (Years x-x)	Cost per acre	Cost 7
		Oak woodland	A1, J7	OW	34.63	Manage with fire. Divide into burn units. Stagger burning of units on a rotation. Create shifting patchworks. (Year 1-20)	$ 500	$ 10,000	Follow up on buckthorn control. Treat seedlings and resprouts that do not get killed by fire. (Yrs 1-20)	$ 500	$ 17,316	Assess understory for diversity, oak regeneration, leaf litter, etc. Interseed and overseed with native woodland species following burns, if necessary. Plant plugs if appropriate, especially species that do not germinate well from seed. Protect oak seedlings from browsing, if necessary (yrs 1-20)	$ 1,000	$ 34,631	**Ongoing management (duration)**	**$ 300**	**$ 10,389**						$ -			$ -
		Old field	G2	PR-e1	2.26	Establish the prairie. Mow, spot spray. (Yrs 3-5)	$ 500	$ 1,130	Establish the prairie. Mow, spot spray. (Yrs 3-5)	$ 500	$ 1,130	**Manage with fire rotations and spot spraying and overseeding following burns. (Duration)**	**$ 600**	**$ 1,356**									$ -			$ -
		Old field	G3	PR-e2	1.07	Convert weedy old field to native prairie. Remove woody invasives. (Yrs 1-5)	$ 1,000	$ 1,065	Broadcast herbicide as many times as necessary to flush our weed seed bank. Inlcued site prep burns as necessary. (Yrs 1-5)	$ 700	$ 746	Prepare soil as necessary. Break up clumps. Seed with a medium diverse native savanna mix. (Yr 3)	$ 500	$ 533	Establish the prairie. Mow, spot spray. (Yrs 3-5)	$ 500	$ 533	**Manage with fire rotations and spot spraying and overseeding following burns. (Duration)**	$ 600	$ 639			$ -			$ -
		Old field	D2	PR-e3	1.66	Convert weedy old field to native prairie. Remove woody invasives. Blend into surrounding units as best as possble. Remove woody invasives. (Yrs 1-5)	$ 1,000	$ 1,656	Broadcast herbicide as many times as necessary to flush our weed seed bank. Inlcued site prep burns as necessary. (Yrs 1-5)	$ 700	$ 1,159	Prepare soil as necessary. Break up clumps. Seed with a medium diverse native savanna mix. (Yr 3)	$ 500	$ 828	Establish the prairie. Mow, spot spray. (Yrs 3-5)	$ 500	$ 828	**Manage with fire rotations and spot spraying and overseeding following burns. (Duration)**	**$ 600**	**$ 994**			$ -			$ -

Novel PC Code	Resto Time-line	Unit Description	Old Unit(s) Names	NRMP Unit	Acres	Mgmt Activity 1 Proposed (Year 1)	Cost per acre	Cost 1	Mgmt Activity 2 Proposed (Year x)	Cost per acre	Cost 2	Mgmt Activity 3 Proposed (Year x)	Cost per acre	Cost 3	Mgmt Activity 4 Proposed (Year x)	Cost per acre	Cost 4	Mgmt Activity 5 Proposed (Year x)	Cost per acre	Cost 5	Mgmt Activity 6 Proposed (Years x-x)	Cost per acre	Cost 6	Mgmt Activity 7 Proposed (Years x-x)	Cost per acre	Cost 7
18	short	Red pine	F4 (19ECP4	PR-e4	1.39	Site prep and seed prairie. (Yr 1-5)	$ 750	$ 1,043	Ongoing management (duration)	$ 300	$ 417						$ -			$ -		$ -			$ -
16	short	Small diameter black walnut	F4 (19ECP4	PR-e4	1.18	Begin managing with fire (Yrs 1-10)	$ 500	$ 590	Seed with diverse prairie mix. (Yrs 2-10)		$ -	Plant bur oaks (Yrs 10-20)	$ 2,500	$ 2,950	Ongoing management (duration)	$ 500	$ 590						$ -			$ -
17	short	Red pine and cottonwood	F4 (19ECP4	PR-e4	0.59	Site prep and seed prairie. (Yr 1-5)	$ 750	$ 443	Ongoing management (duration)	$ 300	$ 177						$ -			$ -		$ -			$ -
		Old field	H7	PR-e5	1.29	Convert weedy old field to native prairie. Blend into surrounding units as best as possble. . (Yrs 1-5)	$ 500	$ 647	Broadcast herbicide as many times as necessary to flush our weed seed bank. Inlcued site prep burns as necessary. (Yrs 1-5)	$ 700	$ 905	Prepare soil as necessary. Break up clumps. Seed with a medium diverse native savanna mix. (Yr 3)	$ 500	$ 647	Establish the prairie. Mow, spot spray. (Yrs 3-5)	$ 500	$ 647	Manage with fire rotations and spot spraying and overseeding following burns. (Duration)	$ 600	$ 776			$ -			$ -
		Weedy grassland	E1	PR-e6	0.56	Small grassland opening in woodland. Remove woody invasives. Blend into surrounding units as best as possble. Remove woody invasives. (Yrs 1-5)	$ 1,000	$ 557	Broadcast herbicide as many times as necessary to flush our weed seed bank. Inlcued site prep burns as necessary. (Yrs 1-5)	$ 700	$ 390	Prepare soil as necessary. Break up clumps. Seed with a medium diverse native savanna mix. (Yr 3)	$ 500	$ 278	Establish the prairie. Mow, spot spray. (Yrs 3-5)	$ 500	$ 278	Manage with fire rotations and spot spraying and overseeding following burns. (Duration)	$ 600	$ 334			$ -			$ -
		Walnut plantation	B2 (clearcut	PR-e7	1.86	Clearcut B2 segment (Years 1-5)	$ 5,000	$ 9,310	Manage with fire (start yrs 1-5)	$ 500	$ 931	Site prep and seed native prairie. (Yrs 1-5)	$ 750	$ 1,396	Ongoing management (Yrs 6-20)	$ 300	$ 559			$ -			$ -			$ -
		Roadside	25A-East	PR-m-roadside	1.99	Ongoing management--burn on rotation, spot spray occassionally, overseed following burns, monitor. (duration)	$ 300	$ 596			$ -			$ -			$ -			$ -		$ -			$ -

Novel PC Code	Resto Time-line	Unit Description	Old Unit(s) Names	NRMP Unit	Acres	Mgmt Activity 1 Proposed (Year 1)	Cost per acre	Cost 1	Mgmt Activity 2 Proposed (Year x)	Cost per acre	Cost 2	Mgmt Activity 3 Proposed (Year x)	Cost per acre	Cost 3	Mgmt Activity 4 Proposed (Year x)	Cost per acre	Cost 4	Mgmt Activity 5 Proposed (Year x)	Cost per acre	Cost 5	Mgmt Activity 6 Proposed (Years x-x)	Cost per acre	Cost 6	Mgmt Activity 7 Proposed (Years x-x)	Cost per acre	Cost 7
		Old field	D1, C1 portions	PR-m1	1.96	Ongoing management--burn on rotation, spot spray occassionally, overseed following burns, monitor. (duration)	$ 300	$ 587			$ -			$ -			$ -			$ -			$ -			$ -
1, 2, 3	cult, cult, cult	Mixed white and red pine	I2, I2, H1, C2	PR-m2	3.32	Thin the conifers (Yrs 1-5)	$ 2,500	$ 8,300	Burn on appropriate rotation (duration)	$ 500	$ 1,660	Seed or plant with appropriate understory species; may be found elsewhere in state. (Yrs 1-20)	$ 1,000	$ 3,320	**Monitor and enhance as needed (duration)**	**$ 300**	**$ 996**			$ -			$ -			$ -
4	short	Boxelder	C3 (19ECP4	PR-m2	0.22	Site prep (Yr 1 or 2)		$ -	Seed with prairie; establishment mgmt (yr 2 or 3)	$ 500	$ 110	**Assess bur oak establishment and plant more as needed (yr 5)**	**$ 500**	**$ 110**	**Ongoing mgmt (yrs 6-20**	**$ 300**	**$ 66**						$ -			$ -
		Restored prairie	12, 13	PR-m3	15.04	**Ongoing management--burn on rotation, spot spray occassionally, overseed following burns, monitor. Blend in with adjacent savanna and prairie units. (duration)**	**$ 300**	**$ 4,513**			$ -			$ -			$ -			$ -			$ -			$ -
		Roadside and newly restored prairie	I4, 25A-west	PR-m4	12.58	**Ongoing management--burn on rotation, spot spray occassionally, overseed following burns, monitor. Blend in with adjacent savanna and prairie units. (duration)**	**$ 300**	**$ 3,774**			$ -			$ -			$ -			$ -			$ -			$ -
		Roadside and newly restored prairie	I6, H5	PR-m5	36.94	**Ongoing management--burn on rotation, spot spray occassionally, overseed following burns, monitor. Blend in with adjacent savanna and prairie units. (duration)**	$ 600	$ 22,164						$ -			$ -			$ -			$ -			$ -

Novel PC Code	Resto Time-line	Unit Description	Old Unit(s) Names	NRMP Unit	Acres	Mgmt Activity 1 Proposed (Year 1)	Cost per acre	Cost 1	Mgmt Activity 2 Proposed (Year x)	Cost per acre	Cost 2	Mgmt Activity 3 Proposed (Year x)	Cost per acre	Cost 3	Mgmt Activity 4 Proposed (Year x)	Cost per acre	Cost 4	Mgmt Activity 5 Proposed (Year x)	Cost per acre	Cost 5	Mgmt Activity 6 Proposed (Years x-x)	Cost per acre	Cost 6	Mgmt Activity 7 Proposed (Years x-x)	Cost per acre	Cost 7
		Restored prairie	H6, 13	PR-m6	32.28	Evaluate for species composition. Non-local prairie species should be managed appropriately, perhaps controlled. South and east edges of unit should be transitioned to wet prairie over time, but sooner if ditches get plugged. (Yrs 1-10)	$ 500	$ 16,141				Ongoing management--burn on rotation, spot spray occassionally, overseed following burns, monitor. Blend in with adjacent savanna and prairie units. (duration)	$ 600	$ 19,369			$ -			$ -					$ -
		Transitional area between woodland, shrub-carr, and upland prairie remnant	H9, L3-wes	PR-m8	3.96	Transitional area between woodland, shrub-carr, and upland prairie remnant. Manage carefully so that plants in nearby units are not adversly affected. (duration)	$ 500	$ 1,982	Ongoing management--burn on rotation, spot spray occassionally, overseed following burns, monitor. Blend in with adjacent units. (duration)	$ 600	$ 2,378			$ -			$ -			$ -					$ -
15	short	Red pine in ravines between prairie fingers	H3 (19ECP4	PR-r1	0.77	Manage with fire. (Yrs 1-5)	$ 500	$ 385	Site prep and seed native prairie. (Yrs 1-5)	$ 1,000	$ 770	Plant bur oaks in pockets. (Yrs 5-10)	$ 2,500	$ 1,925	Assess bur oak establishment. Plant more bur oaks as needed. (Yrs 10-15)	$ 1,500	$ 1,155	Ongoing management. (Duration)	$ 300	$ 231						$ -
		Remnant prairie south of road. Portions are of moderate quality and other portions are of high quality.	H4	PR-r2	1.95	Manage primarily with fire. If necessary, spot spray, very carefully, for the first couple years. Monitor and overseed with seed from more diverse parts of nearby remnants, if needed. Avoild using purchased seed.	$ 750	$ 1,461	Ongoing management--burn on rotation, spot spray occassionally, overseed (locally collected remnant seed only) following burns, monitor. Blend in with adjacent units. (duration)	$ 600	$ 1,169	Evaluate for species diversity. If there are blatant gaps, consider introducing from purchased seed or plantings, but sparingly. Avoid using herbicide to prevent damage to remnant populations. (Yr 5-duration)	$ 500	$ 974			$ -			$ -					$ -

Novel PC Code	Resto Time-line	Unit Description	Old Unit(s) Names	NRMP Unit	Acres	Mgmt Activity 1 Proposed (Year 1)	Cost per acre	Cost 1	Mgmt Activity 2 Proposed (Year x)	Cost per acre	Cost 2	Mgmt Activity 3 Proposed (Year x)	Cost per acre	Cost 3	Mgmt Activity 4 Proposed (Year x)	Cost per acre	Cost 4	Mgmt Activity 5 Proposed (Year x)	Cost per acre	Cost 5	Mgmt Activity 6 Proposed (Years x-x)	Cost per acre	Cost 6	Mgmt Activity 7 Proposed (Years x-x)	Cost per acre	Cost 7
		Upland dry prairie remnant of moderate quality.	F5	PR-r3	6.51	Manage with fire. Monitor for seedbank expression. (Yrs 1-10)	$ 500	$ 3,255	Ongoing management--burn on rotation, spot spray occassionally, overseed (locally collected remnant seed only) following burns, monitor. Blend in with adjacent units. (duration)	$ 600	$ 3,906	Evaluate for species diversity. If there are blatant gaps, consider introducing from purchased seed or plantings, but sparingly. Avoid using herbicide to prevent damage to remnant populations. (Yr 5-duration)	$ 500	$ 3,255			$ -			$ -			$ -			$ -
		Sand-gravel prairie of moderate quality.	H8	PR-r4	0.72	Carefully hand-pull exotic species. Expand outward in a buffer around the perimeter of the prairie. Remove woody plants-stump treat very carefully. (Yrs 1-5)	$ 1,500	$ 1,083	Re-vegetate foot path with native veg collected from the unit itself (no off-unit seed recommended, at first). (Yrs-1-10)	$ 200	$ 144	Manage with fire. Burn beyond the unit and into adjacent woodier units. Manage in conjunction with reconstructed prairies near trails. (duration)	$ 600	$ 433	Evaluate for species diversity. If there are blatant gaps, consider introducing from purchased seed or plantings, but sparingly. Avoid using herbicide to prevent damage to remnant populations. (Yr 5-duration)	$ 500	$ 361			$ -			$ -			$ -
		Upland mesic prairie remnant of moderate quality.	(NW corne	PR-r5	2.67	Manage with fire. Monitor for seedbank expression. Blend unit with nearby wet prairie and wet meadow units. Try to protect from negative effects of nearby private property. (Yrs 1-10)	$ 600	$ 1,605	Ongoing management--burn on rotation, spot spray occassionally, overseed (locally collected remnant seed only) following burns, monitor. Blend in with adjacent units. (duration)	$ 700	$ 1,872	Evaluate for species diversity. If there are blatant gaps, consider introducing from purchased seed or plantings, but sparingly. Avoid using herbicide to prevent damage to remnant populations. (Yr 5-duration)		$ -			$ -			$ -			$ -			$ -
		Recreation area. Mowed turf, picnic shelter, nature play.		REC	23.22	Incorporate native plantings when possible and feasible. (Yrs 1-10)	$ 2,500	$ 58,053	Manage native plantings (ongoing).	$ 300	$ 6,966			$ -			$ -			$ -			$ -			$ -

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		Old field	G1	SAV-e1	6.02	Establish management (Yr 1-3)	$ 600	$ 3,611	Begin managing with fire (Yr 5-10)	$ 500	$ 3,009	Ongoing management (duration)	$ 300	$ 1,805						$ -			$ -			$ -
		Old field	F1, F6	SAV-e2	22.44	Establish management (Yr 1-3)	$ 600	$ 13,462	Begin managing with fire (Yr 5-10)	$ 500	$ 11,219	Ongoing management (duration)	$ 300	$ 6,731						$ -			$ -			$ -
		Roadside and newly restored prairie	25A-West	SAV-e3	3.31	Begin managing with fire (Yr 5-10)	$ 500	$ 1,653	Ongoing management (duration)	$ 300	$ 992									$ -			$ -			$ -
5, 7	medium	White pine row, blue spruce row	C3	SAV-e5	0.93	Begin stand diversification. Selective removal of declining spruce and pine (yr 1).	$ 1,500	$ 1,395	Seed native grasses in sunlit gaps. Plant bur oak pockets in sunlit gaps where possible (yr 2-4).	$ 2,500	$ 2,325	Continue stand diversification. Fire, thin 30%, overseed with native grasses (yr 5-10).	$ 1,500	$ 1,395	Continue oak savanna transition. Thin 30%, overseed with native grasses, plant bur oaks in pockets, manage with fire (yrs 10-20).	$ 2,000	$ 1,860	Complete oak savanna transition. Remove remaining pines and spruces. Overseed with native grasses. Plant pockets of bur oaks. Manage with fire (yrs 20-40).	$ 2,500	$ 2,325	Ongoing mgmt. (duration)	$ 300	$ 279			$ -
7	short	Primarily boxelder, with black cherry, red pine intermixed	C3 (19ECP4)	SAV-e5	0.40	Begin site prep and seed with prairie (yr 2-4).	$ 750	$ 300	Continue oak savanna transition: assessbur oak establishment; plant more as needed. (Yrs 5-10)	$ 1,500	$ 600	Ongoing mgmt. (duration)	$ 300	$ 120						$ -			$ -			$ -
10	short	30% each, in rows/clumps: aspen, boxelder, black cherry, white pine	G2	SAV-e6	3.17	Plant bur oaks in pockets. (Yr 1-5)	$ 500	$ 1,585	Manage with fire (Yrs	$ 600	$ 1,902	Continue oak savanna transition. Remove 30-50% of pine stems. Overseed native herbs. (Yrs 5-10)	$ 1,500	$ 4,755	Continue oak savanna transition. Remove 30-50% of pine stems. Overseed native herbs. (Yrs 5-10)	$ 1,500	$ 4,755	Ongoing management. (duration)	$ 300	$ 951						
10a	medium	White pine windrow	C3 (19ECP3	SAV-e6	0.35	Maintain white pine windrow on east boundary to enhance camper cabin experience. Identify opportunities to plant bur oaks adjacent to pines to beging building a more ecologically appropriate "frame" for camper cabin views. (yrs 1-5)	$ 3,000	$ 1,050	Remove select, obviously failing pines as needed. (Yrs 1-5)	$ 1,500	$ 525	Begin gradual oak savanna transition. Begin slow, selective removal of white pine. Interplant with oaks as possible. (Yrs 5-10)	$ 2,000	$ 700	Continue gradual oak savanna transition. Continue slow removal of white pines. Interplant with bur oaks as possible. (duration)	$ 1,500	$ 525			$ -			$ -			$ -

Novel PC Code	Resto Time-line	Unit Description	Old Unit(s) Names	NRMP Unit	Acres	Mgmt Activity 1 Proposed (Year 1)	Cost per acre	Cost 1	Mgmt Activity 2 Proposed (Year x)	Cost per acre	Cost 2	Mgmt Activity 3 Proposed (Year x)	Cost per acre	Cost 3	Mgmt Activity 4 Proposed (Year x)	Cost per acre	Cost 4	Mgmt Activity 5 Proposed (Year x)	Cost per acre	Cost 5	Mgmt Activity 6 Proposed (Years x-x)	Cost per acre	Cost 6	Mgmt Activity 7 Proposed (Years x-x)	Cost per acre	Cost 7
		Newly restored savanna	H6 (19ECP4	SAV-e7	1.28	Continue establishment mowings	$ 150	$ 191	Start Rx burning (Yr3-5)	$ 600	$ 766	Ongoing management. (duration)	$ 300	$ 383			$ -			$ -			$ -			$ -
		Old pasture	B1-penninsula	SAV-f2	0.80	Continue to thin canopy (Yr 1-5)	$ 1,500	$ 1,207	Treat woody resprouts and foliar treatments (Yr 1-10)	$ 350	$ 282	Sweep for Japanese hedge parsley (Yr 1-10)	$ 350	$ 282	Start Rx burning (Yr3-5)	$ 600	$ 483	Ongoing management (duration)	$ 300	$ 241			$ -			$ -
		Old pasture, walnut plantation	B2-north	SAV-fct1	5.20	Thin walnut canopy (Yr1-10)	$ 1,500	$ 7,800	Follow up treatment of woody invasives (Yr 1-10)	$ 350	$ 1,820	JHP sweep targeting trail edges anually (yr 1-10)	$ 350	$ 1,820	Start Rx burning (Yr3-5)	$ 600	$ 3,120	Ongoing management (duration)	$ 300	$ 1,560			$ -			$ -
		Old pasture, aforested	H3	SAV-fct1	1.36	Burn followed by grass selective overspray (Yr 1-5)	$ 750	$ 1,021	Annual spot spraying (Yr 1-10)	$ 500	$ 681	Ongoing management. (duration)	$ 300	$ 408			$ -			$ -			$ -			$ -
		Old pasture, aforested	B1	SAV-fct2	15.09	Continue to thin canopy (Yr 1-5)	$ 1,000	$ 15,093	Treat woody resprouts and foliar treatments (Yr 1-10)	$ 350	$ 5,283	Sweep for Japanese hedge parsley (Yr 1-10)	$ 350	$ 5,283	Start Rx burning (Yr3-5)	$ 600	$ 9,056	Ongoing management (duration)	$ 300	$ 4,528			$ -			$ -
		Contains nature play area	B3, H7	SAV-fct3	1.66	Needs a site plan with Outdoor Ed staff (Yr 1-3)	$ 5,000	$ 8,299	Follow up treatment of woody invasives (Yr 1-10)	$ 350	$ 581	JHP sweep anually (yr 1-10)	$ 350	$ 581	Ongoing management (duration)	$ 300	$ 498			$ -			$ -			$ -
15	short	Red pine in ravines between prairie fingers	H4 (19ECP4	SAV-fct4	0.28	Begin transition to oak savanna. Remove non-oaks. (Yr 1-5)	$ 3,000	$ 840	Manage with fire. (Yr 1-5)	$ 600	$ 168	Seed native prairie. (Yrs 1-5)	$ 1,500	$ 420	Plant bur oaks in pods. (Yrs 1-5)	$ 2,500	$ 700	Ongoing savanna restoration. Assess bur oak establishment; plant more as needed. (Yrs 5-10)	$ 2,500	$ 700	Ongoing management. (duration)	$ 300	$ 84			$ -
		Old pasture, aforested	B2-south	SAV-fct5	1.35	Manage with fire (duration)	$ 500	$ 676	Spot spray as necessary (duration)	$ 350	$ 473			$ -			$ -			$ -			$ -			$ -
		Shrub-carr wetland	J5	Sh-Carr-1	1.18	Control RCG (anually)	$ 700	$ 825	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 707	Ongoing management (duration)	$ 300	$ 354			$ -			$ -			$ -			$ -

Novel PC Code	Resto Time-line	Unit Description	Old Unit(s) Names	NRMP Unit	Acres	Mgmt Activity 1 Proposed (Year 1)	Cost per acre	Cost 1	Mgmt Activity 2 Proposed (Year x)	Cost per acre	Cost 2	Mgmt Activity 3 Proposed (Year x)	Cost per acre	Cost 3	Mgmt Activity 4 Proposed (Year x)	Cost per acre	Cost 4	Mgmt Activity 5 Proposed (Year x)	Cost per acre	Cost 5	Mgmt Activity 6 Proposed (Years x-x)	Cost per acre	Cost 6	Mgmt Activity 7 Proposed (Years x-x)	Cost per acre	Cost 7
		Shrub-carr wetland	K1	Sh-Carr-2	1.27	Control RCG (anually)	$ 700	$ 887	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 761	Ongoing management (duration)	$ 300	$ 380			$ -			$ -			$ -			$ -
		Shrub-carr wetland	K2	Sh-Carr-3	2.50	Control RCG (anually)	$ 700	$ 1,749	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 1,499	Ongoing management (duration)	$ 300	$ 749			$ -			$ -			$ -			$ -
		Shrub-carr wetland	M1-marsh	Sh-Carr-4	5.90	Control RCG (anually)	$ 700	$ 4,127	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 3,537	Ongoing management (duration)	$ 300	$ 1,769			$ -			$ -			$ -			$ -
		Shrub-carr wetland	M2-west	Sh-Carr-5	13.36	Control RCG (anually)	$ 700	$ 9,353	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 8,017	Ongoing management (duration)	$ 300	$ 4,008			$ -			$ -			$ -			$ -
		Shrub-carr wetland	M3	Sh-Carr-6	25.42	Control RCG (anually)	$ 700	$ 17,791	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 15,249	Ongoing management (duration)	$ 300	$ 7,625			$ -			$ -			$ -			$ -
		Shrub-carr wetland	M5	Sh-Carr-7	0.53	Control RCG (anually)	$ 700	$ 374	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 321	Ongoing management (duration)	$ 300	$ 160			$ -			$ -			$ -			$ -
		Shrub-carr wetland	L4-east	Sh-Carr-8	0.36	Control RCG (anually)	$ 700	$ 249	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 214	Ongoing management (duration)	$ 300	$ 107			$ -			$ -			$ -			$ -
		Sedge meadow, degraded	M1-south	Wet-r1	1.45	Control RCG, hand-wick (as needed) (ongoing)	$ 700	$ 1,017	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 872	Ongoing management (duration)	$ 300	$ 436			$ -			$ -			$ -			$ -
		High quality wet meadow	M2-boardwalk	Wet-r2	1.20	Control RCG, hand-wick (as needed) (ongoing)	$ 700	$ 840	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 720	Ongoing management (duration)	$ 300	$ 360			$ -			$ -			$ -			$ -
		Sedge meadow, degraded	M3	Wet-r3	1.77	Control RCG, hand-wick (as needed) (ongoing)	$ 700	$ 1,236	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 1,059	Ongoing management (duration)	$ 300	$ 530			$ -			$ -			$ -			$ -

Novel PC Code	Resto Time-line	Unit Description	Old Unit(s) Names	NRMP Unit	Acres	Mgmt Activity 1 Proposed (Year 1)	Cost per acre	Cost 1	Mgmt Activity 2 Proposed (Year x)	Cost per acre	Cost 2	Mgmt Activity 3 Proposed (Year x)	Cost per acre	Cost 3	Mgmt Activity 4 Proposed (Year x)	Cost per acre	Cost 4	Mgmt Activity 5 Proposed (Year x)	Cost per acre	Cost 5	Mgmt Activity 6 Proposed (Years x-x)	Cost per acre	Cost 6	Mgmt Activity 7 Proposed (Years x-x)	Cost per acre	Cost 7
		Wet Forest, degraded	J2	WF-e1	7.96	Control RCG (anually)	$ 700	$ 5,572	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 4,776	Ongoing management (duration)	$ 300	$ 2,388			$ -			$ -			$ -			$ -
		Wet Forest, degraded	J2	WF-e1	0.85	Control RCG (anually)	$ 700	$ 592	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 507	Ongoing management (duration)	$ 300	$ 254			$ -			$ -			$ -			$ -
		Wet Forest, degraded	J3	WF-e2	0.24	Control RCG (anually)	$ 700	$ 166	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 142	Ongoing management (duration)	$ 300	$ 71			$ -			$ -			$ -			$ -
		Wet Forest, degraded	J4	WF-e3	10.85	Control RCG (anually)	$ 700	$ 7,593	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 6,508	Ongoing management (duration)	$ 300	$ 3,254			$ -			$ -			$ -			$ -
		Wet Forest, degraded	J6	WF-e5	2.86	Control RCG (anually); remove silver maples	$ 700	$ 1,999	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 1,713	Ongoing management (duration)	$ 300	$ 857			$ -			$ -			$ -			$ -
		Wet Forest, degraded	J8	WF-e6	2.32	Control RCG (anually)	$ 700	$ 1,626	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 1,393	Ongoing management (duration)	$ 300	$ 697			$ -			$ -			$ -			$ -
		Wet Forest, degraded	J9	WF-e7	1.37	Control RCG (anually)	$ 700	$ 960	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 823	Ongoing management (duration)	$ 300	$ 412			$ -			$ -			$ -			$ -
		Wet Forest, degraded	J11	WF-e8	2.58	Control RCG (anually)	$ 700	$ 1,806	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 1,548	Ongoing management (duration)	$ 300	$ 774			$ -			$ -			$ -			$ -
		Wet Forest, degraded	J12	WF-e9	1.50	Control RCG (anually)	$ 700	$ 1,052	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 902	Ongoing management (duration)	$ 300	$ 451			$ -			$ -			$ -			$ -

Novel PC Code	Resto Time-line	Unit Description	Old Unit(s) Names	NRMP Unit	Acres	Mgmt Activity 1 Proposed (Year 1)	Cost per acre	Cost 1	Mgmt Activity 2 Proposed (Year x)	Cost per acre	Cost 2	Mgmt Activity 3 Proposed (Year x)	Cost per acre	Cost 3	Mgmt Activity 4 Proposed (Year x)	Cost per acre	Cost 4	Mgmt Activity 5 Proposed (Year x)	Cost per acre	Cost 5	Mgmt Activity 6 Proposed (Years x-x)	Cost per acre	Cost 6	Mgmt Activity 7 Proposed (Years x-x)	Cost per acre	Cost 7
		Wet Forest, degraded	J10	WF-m1	3.83	Control RCG (anually)	$ 700	$ 2,682	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 2,299	Ongoing management (duration)	$ 300	$ 1,149			$ -			$ -			$ -			$ -
		Wet Prairie, seeded	J1	WP-est2	4.73	Control RCG (anually)	$ 700	$ 3,310	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 2,837	Ongoing management (duration)	$ 300	$ 1,418			$ -			$ -			$ -			$ -
		Wet Prairie, degraded	L5	WP-f2	1.95	Control RCG (anually)	$ 700	$ 1,364	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 1,169	Ongoing management (duration)	$ 300	$ 585			$ -			$ -			$ -			$ -
		DNR Food Plot	Food Plot	WP-f3	4.98	Control RCG (anually)	$ 700	$ 3,489	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 2,991	Ongoing management (duration)	$ 300	$ 1,495			$ -			$ -			$ -			$ -
		Wet Prairie, seeded	L1	WP-m1	1.30	Control RCG (anually)	$ 700	$ 910	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 780	Ongoing management (duration)	$ 300	$ 390			$ -			$ -			$ -			$ -
		Wet Prairie, seeded	L2	WP-m2	3.43	Control RCG (anually)	$ 700	$ 2,402	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 2,059	Ongoing management (duration)	$ 300	$ 1,029			$ -			$ -			$ -			$ -
		Wet Prairie, seeded	L4	WP-m3	1.80	Control RCG (anually)	$ 700	$ 1,260	Rx burn when possible, with adjacent upland units (ongoing)	$ 600	$ 1,080	Ongoing management (duration)	$ 300	$ 540			$ -			$ -			$ -			$ -
22	short	White cedar	C5-west	WP-sb1	1.79	Manage native wet prairie seedbank. (yrs 1 5)	$ 500	$ 895	Overseed as necessary. (Yrs 1-5)	$ 250	$ 448	Ongoing management, including occassional fire. (duration)	$ 300	$ 537						$ -			$ -			$ -

Novel PC Code	Resto Time-line	Unit Description	Old Unit(s) Names	NRMP Unit	Acres	Mgmt Activity 1 Proposed (Year 1)	Cost per acre	Cost 1	Mgmt Activity 2 Proposed (Year x)	Cost per acre	Cost 2	Mgmt Activity 3 Proposed (Year x)	Cost per acre	Cost 3	Mgmt Activity 4 Proposed (Year x)	Cost per acre	Cost 4	Mgmt Activity 5 Proposed (Year x)	Cost per acre	Cost 5	Mgmt Activity 6 Proposed (Years x-x)	Cost per acre	Cost 6	Mgmt Activity 7 Proposed (Years x-x)	Cost per acre	Cost 7
		Wet Prairie, degraded but with potential to recover from seed bank	M2-east	WP-sb2	2.09	Control RCG (anually)	$ 700	$ 1,466	Sweep for woody invasives (Yr 1-10)	$ 500	$ 1,047	Rx burn when possible, with adjacent upland units (ongoing)	$ 500	$ 1,047	Ongoing management, including occassional fire. (duration)	$ 300	$ 628			$ -			$ -			$ -
		Wet Prairie, degraded but with potential to recover from seed bank	M1-north	WP-sb3	3.51	Control RCG (anually); remove silver maples	$ 700	$ 2,457	Sweep for woody invasives (Yr 1-10)	$ 500	$ 1,755	Rx burn when possible, with adjacent upland units (ongoing)	$ 500	$ 1,755	Ongoing management, including occassional fire. (duration)	$ 300	$ 1,053			$ -			$ -			$ -
		Wet Prairie, degraded but with potential to recover from seed bank	M3-west, M4	WP-sb4	1.36	Control RCG (anually)	$ 700	$ 950	Sweep for woody invasives (Yr 1-10)	$ 500	$ 678	Rx burn when possible, with adjacent upland units (ongoing)	$ 500	$ 678	Ongoing management, including occassional fire. (duration)	$ 300	$ 407			$ -			$ -			$ -
				TOTAL	417.42			$ 316,664			$ 246,072			$ 161,749			$ 85,006			$ 32,425			$ 28,728			$ 21,182

Table 9. Work Plan. Management/Work Unit Recommended Tasks and Associated Cost Estimates.

Total cost estimate for enhancement for all years (years 1-20) = $ 692,225, and for maintenance = $181,708, and the sum total cost estimate for both enhancement and maintenance for years 1-20 = $873,933.

692,226,

Enhancement Cost, Yrs 1-5	Enhacement Cost, Yrs 6-10	Enhancement Cost, Yrs 11-20	Total Enhancement Cost, Yrs 1-20	Ongoing Maintenance (Yrs 1-20)	Sum Total Enhancement + Maintenance (Yrs 1-20)
$539,243	$93,340	$59,643	$692,226	$181,708	$873,934

Other factors may influence the flow and/or order of tasks in the Work Plan, including the following:

- Some of the enhancement costs in the later years of the plan, years 11-20, may be done as part of ongoing maintenance, if restoration results are better than expected, or occur at a faster rate. If the "up-front" costs in the first five years are too much, they can be delayed until later, or phased.
- External funding will be sought for all enhancement activities, which would reduce the cost significantly, perhaps as much as 50% to 80%. Also, if County work crews and volunteers are utilized for enhancement activities, then costs may be reduced somewhat.
- Since external funding for maintenance activities are difficult to obtain, most of these activities will need to be funded by the County.

10.3. Water Resources work plan

Water resources occupy a large part of the surface area in WWRP and, as such, deserve much management attention. Priorities and associated cost estimates for water resources protection and improvement are listed below:

Task	Estimated Cost
Continue to monitor water quality of Empire Lake	$6,000 per first five years
Improve and enhance the emergent and submergent vegetation of Empire Lake, e.g., wild rice planting	To be determined
Restore wetland hydrology to the area, e.g., by plugging the ditches south of Empire Lake to distribute water across the area.	To be determined
Maintain a healthy vegetation on the Empire Lake Berm	$250/yr
Continue to monitor AIS in Empire Lake and the wetlands	$250/yr
Conduct a subwatershed analysis to identify surface water improvement projects	In-house: $15,000-$30,000, Contract: $30,000-$70,000

Table 10. Water Resources Work Plan

10.4. Wildlife Resources Work Plan

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 Whitetail Woods 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 WWRP approximately $180,000 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.

Table 11 summarizes the vegetation, water, and wildlife resources and gives estimates of anticipated funding for each.

	Years 1-5			Years 6-20					
Management Sphere	***Estimated External Funding***	***Estimated County Funding***	***Total Estimated Funding Years 1-5***	***Estimated External Funding***	***Estimated County Funding***	***Total Estimated Funding Years 6-20***	***Total Estimated External Funding Years 1-20***	***Total Estimated County Funding Years 1-20***	***Total Estimated Funding Years 1-20***
Vegetation Resources									
Enhancement	$431,360	$107,840	$539,200	$122,400	$30,600	$153,000	$553,760	$138,440	**$692,200**
Restoration	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
Maintenance	$36,320	$0	$36,320	$109,040	$27,260	$136,300	$145,360	$27,260	**$172,620**
VEG SUBTOTAL	**$467,680**	**$107,840**	**$575,520**	**$231,440**	**$57,860**	**$289,300**	**$699,120**	**$165,700**	**$864,820**
Water Resources									
Empire Lake Enhancement	$52,500.00	$17,500.00	$70,000	$187,500	$62,500	$250,000	$240,000	$80,000	**$320,000**
Empire Berm	$0.00	$1,250.00	$1,250	$0	$3,750	$3,750	$0	$5,000	**$5,000**
Wetland Restoration	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Water Monitoring	$360	$5,640	$6,000	$1,080	$16,920	$18,000	$1,440	$22,560	**$24,000**
AIS Monitoring	$625	$625	$1,250	$1,875	$1,875	$3,750	$2,500	$2,500	**$5,000**
Fish surveys	$0	$5,000	$5,000	$0	$15,000	$15,000	$0	$20,000	**$20,000**
Subwatershed Assessr	$0	$50,000	$50,000	$0	$0	$0	$0	$50,000	**$50,000**
Planning	$0	$40,000	$40,000	$0	$0	$0	$0	$40,000	**$40,000**
WATER SUBTOTAL	**$53,485**	**$120,015**	**$173,500**	**$190,455**	**$100,045**	**$290,500**	**$243,940**	**$220,060**	**$464,000**
Wildlife Resources									
Full spectrum of species, plus those of conservation interest and concern	$126,000	$54,000	$180,000	$0	$0	$0	$126,000	$54,000	**$180,000**
Monitor and collect baseline data	$600	$9,400	$10,000	$0	$0	$0	$600	$9,400	**$10,000**
WILDLIFE SUBTOTAL	**$126,600**	**$63,400**	**$190,000**	**$0**	**$0**	**$0**	**$126,600**	**$63,400**	**$190,000**
SUM TOTAL	**$647,765**	**$291,255**	**$939,020**	**$421,895**	**$157,905**	**$579,800**	**$1,069,660**	**$449,160**	**$1,518,820**

Table 11. Summary of natural resource management sectors and anticipated funding.

11. MONITORING AND ADAPTIVE MANAGEMENT

11.1. 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.

11.1.1. Vegetation

General Vegetation Monitoring

General vegetation monitoring across WWRP 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 WWRP 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 WWRP. 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 WWRP 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 WWRP 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.*

Figure 33. *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).*

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.*

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 33**). 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.*

11.1.2. Wildlife

Fish Survey Plan

Dakota County staff surveys fish, but have not yet done Empire Lake, other than anecdotal observations. Fish survey methods used by the County in other parks 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.

In comparison to most MN DNR surveyed lakes, Empire lacks 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 Dakota County 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. The county uses an Insect Survey Plan. Dakota County Parks staff has conducted some limited insect surveys in WWRP. 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.

As part of widespread restoration efforts of oak forest, savanna, and prairie habitats located in the park, it is important 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

The County also uses a herptile survey plan. 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 the Parks.
- Determine amphibian and reptile species richness within the Parks.
- 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 WWRP.

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 WWRP. 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

11.1.3. Mycological Surveys

Consider performing surveys of fungi, perhaps similar to those done in Lebanon Hills Regional Park—the "mycoblitzes", where, for two days (Saturday and Sunday), volunteers fan out into the park to search for fungi. Species are collected and sorted. Observations are recorded and cataloged, and also entered into *i-Naturalist* website. A small team of professional and amateur mycologists are also on hand to assist. No formal survey of fungi has been done, to date, for WWRP.

11.1.4. 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. WWRP 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.

11.1.5. Lake/Water Resources Monitoring

Intensive water quality sampling should be conducted on Empire Lake. Utilize the Metropolitan Council's CAMP program, if possible, which starts volunteers collecting data in April through October. Dakota County staff may also be involved in sample collections. Once a month surface samples from June to late September is probably adequate. Samples should be analyzed for [Total

Phosphorous] TP, chlorophyll-a, Secchi depth, chloride, Total Kjeldahl nitrogen, temperature, and dissolved oxygen. Total suspended solids (TSS) is optional.

Consider developing watershed management strategies for WWRP that are aimed at protecting and improving the water quality and ecological communities throughout the park. Objectives can be 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.

Empire Lake may be nutrient rich based on internal load that was deposited historically. If this is the case and water quality continues to be a concern in the lake even after doing drawdowns, some sediment core analysis may be needed to determine phosphorus release rates in order to address the internal load with projects.

Surface waters leaving the park should also be monitored, since there may be opportunities to benefit surface waters outside of the park. For example, addressing gully formation on UMORE property in the northeast portion of the "stovepipe".

11.2. Adaptive Management

Adaptive management 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, communication, and also incorporates learning into planning and management. It is set up like a feedback loop and looks like this: Assess Problem → Design → Implement → Monitor → Evaluate → Adjust → Assess Problem → 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 Whitetail Woods Park.

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https://thecela.org/wp-content/uploads/GRECO.pdf

Dakota County Land Conservation Program Plan

https://www.co.dakota.mn.us/Environment/LandConservation/Plan/Documents/LandConservationPlanDraft.pdf

Dakota County Surveys

Dakota County Resident Survey, May 2019. National Research Center, Inc., 2955 Valmont Road, Suite 300, Boulder, CO 80301

12.1. Appendix A. Plant Species Inventory (including invasives)

Dominant Flora and Invasive Species by Natural Land Cover Type and Layer (including cover class):

Survey Source	Species	Common Name	Form	MN Nativity	MNWI	C-value1
Transects	Acer ginnala	Amur Maple	D	Introduced		0
Transects, Releves	Acer negundo	Box Elder	D	Native	FACW-	1
Transects	Acer rubrum	Red Maple	D	Native	[FAC]	3
Transects	Acer saccharinum	Silver Maple	D	Native	FACW	3
Releves	Acer saccharum	Sugar Maple	D	Native	[FACU]	5
Transects, Releves	Achillea millefolium	Common Yarrow	H	Native	FACU	1
Releves	Actaea rubra	Red Baneberry	H	Native	FACU	7
Releves	Agastache foeniculum	Blue Giant Hyssop	H	Native		6
Transects, Releves	Ageratina altissima	White Snakeroot	H	Native	FACU	1
Transects	Agrimonia gryposepala	Common Agrimony	H	Native	FACU+	2
Releves	Alliaria petiolata	Garlic Mustard	H	Introduced	FAC	0
Releves	Allium tricoccum	Wild Leek	H	Native	FACU+	6
Transects, Releves	Ambrosia artemisiifolia	Common Ragweed	H	Native	FACU	0
Transects, Releves	Amorpha canescens	Leadplant	D	Native		7
Transects, Releves	Amphicarpaea bracteata	Hog Peanut	H	Native	FAC	2
Transects, Releves	Andropogon gerardii	Big Bluestem	G	Native	FAC-	4
Transects	Anemone canadensis	Canada Anemone	H	Native	FACW	3
Transects, Releves	Anemone cylindrica	Long-Headed Thimbleweed	H	Native		6
Releves	Anemone quinquefolia	Wood Anemone	H	Native	[FAC*]	5
Releves	Antennaria neglecta s.s.	Field Pussytoes	H	Native	0	0
Transects	Apocynum cannabinum	American Hemp	H	Native	FAC	3
Releves	Apocynum sibiricum	Clasping Dogbane	H	Native	0	0
Transects	Aquilegia canadensis	Columbine	H	Native	FAC-	4
Transects	Arctium minus	Common Burdock	H	Introduced	FACU	0
Releves	Arisaema triphyllum	Jack-In-The-Pulpit	H	Native	FACW-	4
Transects, Releves	Artemisia campestris	Field Sagewort	H	Native	UPL	4

Survey Source	Species	Common Name	Form	MN Nativity	MNWI	C-value1

Transects, Releves	Artemisia ludoviciana	White Sagebrush	H	Native	UPL	3
Transects	Asclepias incarnata	Swamp Milkweed	H	Native	OBL	5
Transects, Releves	Asclepias syriaca	Common Milkweed	H	Native	FACU	1
Transects, Releves	Asclepias tuberosa	Butterflyweed	H	Native		6
Transects, Releves	Asclepias verticillata	Whorled Milkweed	H	Native	FACU	2
Transects	Asclepias viridiflora	Green Milkweed	H	Native		9
Transects, Releves	Astragalus canadensis	Canada Milk-Vetch	H	Native	[FAC+]	5
Releves	Athyrium filix-femina	Lady Fern	H	Native		5
Releves	Baptisia lactea	Wild White Indigo	H	Native	[FACU*]	8
Transects	Bidens cernua	Nodding Bur Marigold	H	Native	OBL	3
Transects	Bidens connata	Swamp Beggarticks	H	Native	OBL	3
Transects, Releves	Boehmeria cylindrica	False Nettle	H	Native	OBL	5
Transects, Releves	Bouteloua curtipendula	Sideoats Grama	G	Native		6
Releves	Bouteloua hirsuta	Hairy Grama	G	Native		7
Transects, Releves	Bromus inermis	Smooth Brome	G	Introduced	FACU	0
Transects	Calystegia sepium	Hedge Bindweed	H	Native	FAC	1
Releves	Carex granularis	Granular Sedge	G	Native	FACW+	3
Transects	Carex hystericina	Porcupine Sedge	G	Native	OBL	4
Transects	Carex lasiocarpa	Wiregrass Sedge	G	Native	OBL	9
Transects, Releves	Carex pensylvanica	Pennsylvania Sedge	G	Native		3
Releves	Carex tetanica	Rigid Sedge	G	Native	FACW	7
Releves	Caulophyllum thalictroides	Blue Cohosh	H	Native		8
Releves	Celtis occidentalis	Hackberry	D	Native	[FAC-]	3
Transects, Releves	Centaurea stoebe	Spotted Knapweed	H	Introduced		0
Transects	Ceratophyllum demersum	Common Coontail	S, H	Native	OBL	2
Releves	Chelone glabra	White Turtlehead	H	Native	OBL	7
Transects	Chenopodium album s.s.	White Lamb's Quarters	H	Introduced	FAC-	0
Transects	Cicuta bulbifera	Bulb-Bearing Water Hemlock	H	Native	OBL	7
Transects, Releves	Circaea lutetiana	Enchanter's Nightshade	H	Native	0	0
Transects	Circaea lutetiana var. canadensis	Common Enchanter's Nightshade	H	Native	[FACU]	2

Survey Source	Species	Common Name	Form	MN Nativity	MNWI	C-value1
Transects, Releves	Cirsium arvense	Canada Thistle	H	Introduced	FACU	0
Transects, Releves	Cirsium discolor	Field Thistle	H	Native	FACU	4
Transects, Releves	Conyza canadensis	Horseweed	H	Native	[FAC-]	0
Transects	Coreopsis palmata	Bird's Foot Coreopsis	H	Native		8
Transects	Cornus foemina*	Stiff Dogwood*	D	#N/A	#N/A	#N/A
Transects, Releves	Cornus racemosa	Gray Dogwood	D	Native	[FACW-]	2
Transects, Releves	Cornus sericea	Red-Osier Dogwood	D	Native	[FACW]	3
Transects	Coronilla varia	Crownvetch	H	Introduced	0	0
Transects, Releves	Corylus americana	American Hazelnut	D	Native	FACU-	3
Transects, Releves	Cryptotaenia canadensis	Honewort	H	Native	FAC	3
Transects, Releves	Dalea purpurea	Purple Prairie Clover	H	Native		7
Releves	Desmodium glutinosum	Pointed-Leaved Tick Trefoil	H	Native	0	0
Releves	Dichanthelium oligosanthes	Scribner's Panic Grass	G	Native	FACU	3
Releves	Dichanthelium ovale	Long-Haired Panic Grass	G	Native	[FACU]	7
Transects, Releves	Dryopteris carthusiana	Spinulose Shield Fern	H	Native	[FACW-]	6
Releves	Echinocystis lobata	Wild Cucumber	H	Native	FACW-	2
Transects	Eleocharis elliptica	Elliptic Spikerush	G	Native	[FACW]	7
Transects	Eleocharis intermedia	Intermediate Spikerush	G	Native	FACW	6
Transects, Releves	Elymus canadensis	Canada Wild Rye	G	Native	FAC-	3
Transects, Releves	Elymus repens	Quackgrass	G	Introduced	[FACU]	0
Releves	Elymus virginicus	Virginia Wildrye	G	Native	FACW-	4
Transects, Releves	Equisetum arvense	Field Horsetail	H	Native	FAC	1
Releves	Equisetum fluviatile	Water Horsetail	H	Native	OBL	7
Transects	Eragrostis spectabilis	Purple Lovegrass	G	Native	UPL	3
Transects	Erechtites hieraciifolius	American Burnweed	H	Native		2
Transects, Releves	Erigeron annuus	Annual Fleabane	H	Native	FAC-	0
Releves	Erigeron strigosus	Daisy Fleabane	H	Native	FAC-	2

*This is a southern species according to USDA; it is very similar to red osier, so may have been misidentified

Survey Source	Species	Common Name	Form	MN Nativity	MNWI	C-value1

Transects	Eriochloa villosa	Hairy Cupgrass	G	Introduced		0
Transects, Releves	Eupatorium perfoliatum	Common Boneset	H	Native	[FACW+]	4
Transects, Releves	Euphorbia corollata	Flowering Spurge	H	Native		4
Transects	Euphorbia geyeri	Geyer's Spurge	H	Native		5
Transects	Euphorbia maculata	Prostrate Hairy Spurge	H	Native	[FACU-]	0
Transects	Euthamia graminifolia	Grass-Leaved Goldenrod	H	Native	FACW-	4
Transects	Euthamia gymnospermoides	Great Plains Goldenrod	H	Native	[FACW]	5
Releves	Eutrochium maculatum	Spotted Joe Pye Weed	H	Native	OBL	4
Releves	Eutrochium purpureum	Sweet-Scented Joe Pye Weed	H	Native	[FAC]	6
Transects	Fallopia convolvulus	Black-Bindweed	H	Introduced	[FAC-]	0
Transects	Fragaria vesca	Wild Strawberry	H	Native	UPL	3
Transects, Releves	Fragaria virginiana	Common Strawberry	H	Native	FAC-	2
Transects	Frangula alnus	Glossy Buckthorn	D	Introduced	[FAC+]	0
Releves	Fraxinus nigra	Black Ash	D	Native	FACW+	6
Transects, Releves	Fraxinus pennsylvanica	Green Ash	D	Native	FACW	2
Transects, Releves	Galium aparine	Cleavers	H	Native	FACU	1
Transects	Galium boreale	Northern Bedstraw	H	Native	FAC	4
Releves	Galium triflorum	Fragrant Bedstraw	H	Native	FACU+	4
Releves	Gentiana andrewsii	Bottle Gentian	H	Native	FACW	6
Releves	Geum aleppicum	Yellow Avens	H	Native	FAC+	3
Releves	Geum laciniatum	Rough Avens	H	Native	FACW	4
Releves	Geum macrophyllum	Large-Leaved Avens	H	Native	FACW	6
Releves	Glyceria striata	Fowl Manna Grass	G	Native	OBL	4
Transects, Releves	Hackelia virginiana	Virginia Stickseed	H	Native	FAC-	1
Releves	Hedeoma hispida	Mock Pennyroyal	H	Native		1
Releves	Helianthus grosseserratus	Sawtooth Sunflower	H	Native	FACW-	3
Transects	Helianthus pauciflorus	Stiff Sunflower	H	Native		7
Transects	Helianthus strumosus	Woodland Sunflower	H	Native	FACU	4
Transects, Releves	Helianthus tuberosus	Jerusalem Artichoke	H	Native	FAC	2

Survey Source	Species	Common Name	Form	MN Nativity	MNWI	C-value1
Transects	Heuchera richardsonii	Alumroot	H	Native	FAC-	7
Releves	Hydrophyllum virginianum	Virginia Waterleaf	H	Native	FACW-	3
Transects	Hypericum pyramidatum	Great St. John's-Wort	H	Native	[FAC+]	6
Releves	Hypoxis hirsuta	Yellow Star-Grass	H	Native	FAC	8
Releves	Impatiens capensis	Spotted Touch-Me-Not	H	Native	FACW	2
Transects	Impatiens pallida	Pale Touch-Me-Not	H	Native	FACW	5
Transects	Juglans nigra	Black Walnut	D	Native	FACU	4
Releves	Juniperus virginiana	Eastern Red Cedar	E	Native	FACU	3
Transects	Koeleria macrantha	Junegrass	G	Native		7
Releves	Lactuca biennis	Biennial Blue Lettuce	H	Native	FAC	3
Releves	Laportea canadensis	Woodnettle	H	Native	FACW	3
Releves	Leersia oryzoides	Rice Cut Grass	G	Native	OBL	3
Transects	Lemna minor s.s.	Lesser Duckweed	F, H	Native	OBL	5
Transects	Leonurus cardiaca	Common Motherwort	H	Introduced		0
Transects	Leucanthemum vulgare	Ox-Eye Daisy	H	Introduced	UPL	0
Transects, Releves	Liatris aspera	Rough Blazing Star	H	Native		5
Transects, Releves	Liatris punctata	Dotted Blazingstar	H	Native		7
Releves	Lobelia siphilitica	Great Lobelia	H	Native	OBL	5
Releves	Lobelia spicata	Pale-Spiked Lobelia	H	Native	FAC	7
Transects, Releves	Lonicera tatarica	Tartarian Honeysuckle	D	Introduced	FACU*	0
Transects	Lycopus uniflorus	Northern Bugleweed	H	Native	OBL	5
Releves	Lycopus virginicus	Virginia Bugleweed	H	Native	OBL	5
Transects	Lysimachia thyrsiflora	Tufted Loosestrife	H	Native	OBL	6
Releves	Maianthemum canadense	Canada Mayflower	H	Native	FAC	5
Transects	Maianthemum racemosum	False Solomon's-Seal	H	Native	FACU	5
Transects	Medicago lupulina	Black Medick	H	Introduced	FAC-	0
Transects, Releves	Medicago sativa	Alfalfa	H	Introduced	FACU	0
Transects, Releves	Melilotus alba	White Sweet Clover	H	Introduced	0	0

Survey Source	Species	Common Name	Form	MN Nativity	MNWI	C-value1
Transects, Releves	Mirabilis nyctaginea	Heart-Leaved Four O'Clock	H	Native	UPL	1
Transects, Releves	Monarda fistulosa	Wild Bergamot	H	Native	FACU	3
Transects	Moss	#N/A	#N/A	#N/A	#N/A	#N/A
Transects	Myriophyllum sibiricum	Northern Water Milfoil	S, H	Native	[OBL]	7
Transects	Nepeta cataria	Catnip	H	Introduced	FAC-	0
Releves	Onoclea sensibilis	Sensitive Fern	H	Native	FACW	4
Transects, Releves	Onosmodium molle	False Gromwell	H	Native	0	0
Transects, Releves	Osmorhiza claytonii	Clayton's Sweet Cicely	H	Native	FACU-	3
Transects	Oxalis stricta	Yellow Wood Sorrel	H	Native	[FACU]	0
Transects, Releves	Panicum virgatum	Switchgrass	G	Native	[FAC+]	2
Transects, Releves	Parthenocissus vitacea	Woodbine	C	Native	FACU	2
Releves	Pedicularis lanceolata	Swamp Lousewort	H	Native	FACW+	8
Releves	Penstemon grandiflorus	Large-Flowered Beard Tongue	H	Native		4
Releves	Persicaria sagittata	Arrow-Leaved Tearthumb	H	Native	OBL	4
Transects, Releves	Phalaris arundinacea	Reed Canary Grass	G	Introduced	FACW+	0
Transects	Phleum pratense	Timothy Grass	G	Introduced	FACU	0
Transects	Phlox pilosa	Downy Phlox	H	Native	[FAC-]	7
Releves	Phryma leptostachya	Lopseed	H	Native	UPL	5
Transects	Pilea pumila	Dwarf Clearweed	H	Native	[FACW]	3
Transects	Pinus resinosa	Red Pine	E	Native	FACU	5
Transects	Pinus strobus	White Pine	E	Native	FACU	5
Transects	Plantago major	Common Plantain	H	Introduced	FAC+	0
Transects, Releves	Poa pratensis	Kentucky Bluegrass	G	Introduced	FAC	0
Transects, Releves	Polygonatum biflorum	Giant Solomon's Seal	H	Native	[FACU]	4
Releves	Populus grandidentata	Big-Toothed Aspen	D	Native	FACU	4
Transects, Releves	Populus tremuloides	Quaking Aspen	D	Native	[FAC]	2
Transects, Releves	Potentilla arguta	Tall Cinquefoil	H	Native	0	0
Transects, Releves	Potentilla simplex	Oldfield Cinquefoil	H	Native	FACU-	2
Transects	Prunus americana	Wild Plum	D	Native	UPL	3

Survey Source	Species	Common Name	Form	MN Nativity	MNWI	C-value1
Transects, Releves	Prunus serotina	Black Cherry	D	Native	[FACU]	4
Transects, Releves	Prunus virginiana	Chokecherry	D	Native	[FAC-]	3
Transects	Ptelea trifoliata	Common Hoptree	D	Native	#N/A	#N/A
Releves	Pycnanthemum virginianum	Virginia Mountain Mint	H	Native	FACW+	6
Transects, Releves	Quercus alba	White Oak	D	Native	FACU	7
Transects, Releves	Quercus ellipsoidalis	Northern Pin Oak	D	Native		5
Transects, Releves	Quercus macrocarpa	Bur Oak	D	Native	[FAC-]	5
Transects, Releves	Quercus rubra	Northern Red Oak	D	Native	FACU	5
Transects, Releves	Ranunculus abortivus	Kidney-Leaved Buttercup	H	Native	FACW-	1
Releves	Ranunculus hispidus	Hispid Buttercup	H	Native	FAC	6
Transects	Ranunculus recurvatus	Hooked Buttercup	H	Native	FACW	5
Transects, Releves	Ratibida pinnata	Gray-Headed Coneflower	H	Native		4
Transects, Releves	Rhamnus cathartica	Common Buckthorn	D	Introduced	FACU	0
Transects, Releves	Rhus glabra	Smooth Sumac	D	Native		2
Transects, Releves	Rhus typhina	Staghorn Sumac	D	Native		2
Transects, Releves	Ribes cynosbati	Prickly Gooseberry	D	Native	FAC	3
Transects	Ribes missouriense	Missouri Gooseberry	D	Native		4
Transects, Releves	Rosa arkansana	Prairie Rose	D	Native	FACU	5
Transects	Rosa blanda	Smooth Wild Rose	D	Native	FACU	7
Transects	Rubus idaeus	Red Raspberry	D	Native	FACU	3
Transects, Releves	Rubus occidentalis	Black Raspberry	D	Native		2
Transects	Rudbeckia hirta	Black-Eyed Susan	H	Native	FACU	4
Transects, Releves	Rumex crispus	Curly Dock	H	Introduced	[FAC+]	0
Transects	Sagittaria latifolia	Broad-Leaved Arrowhead	H	Native	OBL	3
Transects, Releves	Salix petiolaris	Slender Willow	D	Native	FACW+	5
Transects, Releves	Sambucus canadensis	Common Elder	D	Native	[FACW-]	3
Releves	Sanguinaria canadensis	Bloodroot	H	Native	FACU-*	6
Releves	Sanicula canadensis	Canadian Black Snakeroot	H	Native	FACU+	5
Transects, Releves	Sanicula gregaria	Gregarious Black Snakeroot	H	Native	[FAC+]	3

Survey Source	Species	Common Name	Form	MN Nativity	MNWI	C-value1
Transects, Releves	Schizachyrium scoparium	Little Bluestem	G	Native	[FACU-]	5
Releves	Scirpus pallidus	Pale Bulrush	G	Native	OBL	4
Transects	Scutellaria galericulata	Marsh Skullcap	H	Native	OBL	5
Transects	Scutellaria lateriflora	Mad Dog Skullcap	H	Native	OBL	5
Transects	Scutellaria leonardii	Leonard's Skullcap	H	Native	0	0
Transects	Setaria faberi	Giant Foxtail	G	Introduced	FACU+	0
Transects, Releves	Setaria pumila	Yellow Foxtail	G	Introduced	FAC	0
Transects, Releves	Silene latifolia	White Campion	H	Introduced		0
Transects	Solanum carolinense	Horse Nettle	H	Introduced	[FACU-]	0
Transects, Releves	Solanum dulcamara	Bittersweet Nightshade	H	Introduced	[FAC]	0
Transects	Solidago altissima	Late Goldenrod	H	Native	FACU	0
Transects, Releves	Solidago canadensis s.s.	Canada Goldenrod	H	Native	FACU	1
Transects, Releves	Solidago gigantea	Giant Goldenrod	H	Native	FACW	3
Transects, Releves	Solidago nemoralis	Gray Goldenrod	H	Native		4
Transects, Releves	Solidago rigida	Stiff Goldenrod	H	Native	FACU	5
Transects, Releves	Solidago speciosa	Showy Goldenrod	H	Native		5
Transects, Releves	Sorghastrum nutans	Indian Grass	G	Native	FACU+	5
Transects	Sparganium androcladum	Branching Bur-Reed	H	Native	OBL	8
Transects	Sparganium emersum	European Bur-Reed	H	Native	#N/A	#N/A
Releves	Spartina pectinata	Prairie Cordgrass	G	Native	FACW+	5
Transects	Spirodela polyrrhiza	Greater Duckweed	F, H	Native	[OBL]	5
Transects	Sporobolus heterolepis	Prairie Dropseed	G	Native	FACU-	9
Releves	Sporobolus vaginiflorus	Poverty Dropseed	G	Native		1
Transects, Releves	Symphyotrichum ericoides	Heath Aster	H	Native	[FAC-]	4
Transects	Symphyotrichum laeve	Smooth Blue Aster	H	Native	FACU	6
Transects, Releves	Symphyotrichum lanceolatum	Panicled Aster	H	Native	[FACW]	5
Transects, Releves	Symphyotrichum novae-angliae	New England Aster	H	Native	[FACW]	3
Releves	Symphyotrichum oblongifolium	Aromatic Aster	H	Native		6
Releves	Symphyotrichum ontarionis	Ontario Aster	H	Native	FAC	6

Survey Source	Species	Common Name	Form	MN Nativity	MNWI	C-value1
Releves	Symphyotrichum oolentangiense	Skyblue Aster	H	Native		5
Transects	Symphyotrichum pilosum	Awl Aster	H	Native	FACU	1
Releves	Taraxacum erythrospermum	Red-Seeded Dandelion	H	Introduced		0
Transects, Releves	Taraxacum officinale	Common Dandelion	H	Introduced	FACU	0
Transects	Teucrium canadense	Germander	H	Native	FACW-	4
Transects	Thalictrum dasycarpum	Tall Meadow-Rue	H	Native	FACW-	4
Releves	Thalictrum dioicum	Early Meadow-Rue	H	Native	FACU+	5
Releves	Thalictrum thalictroides	Rue Anemone	H	Native	FACU	7
Transects, Releves	Torilis japonica	Japanese Hedge Parsley	H	Introduced		0
Transects, Releves	Toxicodendron rydbergii	Western Poison Ivy	D	Native	FAC	1
Transects, Releves	Tragopogon dubius	Yellow Goat's Beard	H	Introduced		0
Releves	Trifolium campestre	Field Hop Clover	H	Introduced		0
Transects	Trifolium hybridum	Alsike Clover	H	Introduced	FAC-	0
Transects, Releves	Trifolium pratense	Red Clover	H	Introduced	FACU+	0
Transects	Trifolium repens	White Clover	H	Introduced	FACU+	0
Releves	Trillium cernuum	Nodding Trillium	H	Native	FAC	7
Transects	Triosteum aurantiacum	Orange-Fruit Horse Gentian	H	Native		5
Transects, Releves	Ulmus americana	American Elm	D	Native	FACW-	3
Transects, Releves	Ulmus pumila	Siberian Elm	D	Introduced	UPL	0
Transects, Releves	Urtica dioica	Stinging Nettle	H	Native	FACW	1
Releves	Uvularia grandiflora	Large-Flowered Bellwort	H	Native		7
Transects, Releves	Verbascum thapsus	Common Mullein	H	Introduced	UPL	0
Transects, Releves	Verbena stricta	Hoary Vervain	H	Native		3
Releves	Verbena urticifolia	White Vervain	H	Native	FAC+	6
Releves	Viburnum lentago	Nannyberry	D	Native	FAC+	4
Releves	Viola nephrophylla	Northern Bog Violet	H	Native	FACW+	8
Transects, Releves	Viola palmata var. pedatifida	Bearded Birdfoot Violet	H	Native	FACU-	8
Transects, Releves	Viola pedata	Beardless Birdfoot Violet	H	Native	UPL	7
Releves	Viola pubescens	Yellow Violet	H	Native	FACU-	4

Survey Source	Species	Common Name	Form	MN Nativity	MNWI	C-value1
Transects, Releves	Vitis riparia	Wild Grape	C	Native	FACW-	2
Transects, Releves	Zanthoxylum americanum	Prickly Ash	D	Native	FACU	3
Releves	Zizia aptera	Heart-Leaved Alexanders	H	Native	FACU	8
Transects, Releves	Zizia aurea	Golden Alexanders	H	Native	FAC+	6

12.2. Appendix B. Wildlife Species Inventory (including invasives)

Wildlife Observations/Indications by Natural Land Cover Type (including abundance class):

Fauna Type	Species (Invasives Italic)	Scientific Name	State Status	Federal Status	SGCN Status	Evidence	Most Recent Observation	Source	SGCN Criteria
Avian	Alder Flycatcher	Empidonax alnorum	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	American Crow	Corvus brachyrhynchos	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	American Goldfinch	Spinus tristis	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	American Redstart	Setophaga ruticilla	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	American Robin	Turdus migratorius	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Bald Eagle	Haliaeetus leucocephalus	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Baltimore Oriole	Icterus galbula	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Barn Swallow	Hirundo rustica	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Belted Kingfisher	Megaceryle alcyon	NL	NL	Yes	Yes	2015, 2019	BBS, eBird	
Avian	Black-billed Cuckoo	Coccyzus erythrop-thalmus	NL	NL	Yes	Yes	2015, 2019	BBS, eBird	
Avian	Black-capped Chickadee	Poecile atricapillus	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Blue Jay	Cyanocitta cristata	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Blue-gray Gnatcatcher	Polioptila caerulea	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Brown Thrasher	Toxostoma rufum	NL	NL	Yes	Yes	2015, 2019	BBS, eBird	
Avian	Brown-headed Cowbird	Molothrus ater	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Canada Goose	Branta canadensis	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Chipping Sparrow	Spizella passerina	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Clay-colored Sparrow	Spizella pallida	NL	NL	NL	Yes	2015, 2019	BBS, eBird	grassland sp.
Avian	Common Grackle	Quiscalus quiscula	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Common Yellowthroat	Geothlypis trichas	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Cooper's Hawk	Accipiter cooperii	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Downy Woodpecker	Picoides pubescens	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Eastern Bluebird	Sialia sialis	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Eastern Kingbird	Tyrannus tyrannus	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Eastern Towhee	Pipilo erythrophthalmus	NL	NL	Yes	Yes	2015, 2019	BBS, eBird	
Avian	Eastern Wood-Pewee	Contopus virens	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Field Sparrow	Spizella pusilla	NL	NL	Yes	Yes	2015, 2019	BBS, eBird	grassland sp.
Avian	Gray Catbird	Dumetella carolinensis	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Great Blue Heron	Ardea herodias	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Great Crested Flycatcher	Myiarchus crinitus	NL	NL	NL	Yes	2015, 2019	BBS, eBird	

Fauna Type	Species (Invasives Italic)	Scientific Name	State Status	Federal Status	SGCN Status	Evidence	Most Recent Observation	Source	SGCN Criteria
Avian	Great Egret	Ardea alba	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Green Heron	Butorides virescens	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Hairy Woodpecker	Picoides villosus	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Hooded Merganser	Lophodytes cucullatus	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	House Wren	Troglodytes aedon	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Indigo Bunting	Passerina cyanea	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Killdeer	Charadrius vociferus	NL	NL	NL	Yes	2015, 2019	BBS, eBird	grassland sp.
Avian	Least Flycatcher	Empidonax minimus	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Mallard	Anas platyrhynchos	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Mourning Dove	Zenaida macroura	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Northern Cardinal	Cardinalis cardinalis	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Northern Flicker	Colaptes auratus	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Northern Rough-winged Swallow	Stelgidopteryx serripennis	NL	NL	Yes	Yes	2015, 2019	BBS, eBird	
Avian	Ovenbird	Seiurus aurocapilla	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Pileated Woodpecker	Dryocopus pileatus	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Red-bellied Woodpecker	Melanerpes carolinus	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Red-breasted Nuthatch	Sitta canadensis	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Red-eyed Vireo	Vireo olivaceus	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Red-winged Blackbird	Agelaius phoeniceus	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Ring-necked Pheasant	Phasianus colchicus	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Rose-breasted Grosbeak	Pheucticus ludovicianus	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Sandhill Crane	Antigone canadensis	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Sedge Wren	Cistothorus platensis	NL	NL	Yes	Yes	2015, 2019	BBS, eBird	
Avian	Song Sparrow	Melospiza melodia	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Swamp Sparrow	Melospiza georgiana	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Turkey Vulture	Cathartes aura	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Vesper Sparrow	Pooecetes gramineus	NL	NL	NL	Yes	2015, 2019	BBS, eBird	grassland sp.
Avian	Warbling Vireo	Vireo gilvus	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	White-breasted Nuthatch	Sitta carolinensis	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Wild Turkey	Meleagris gallopavo	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Willow Flycatcher	Empidonax traillii	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Wood Duck	Aix sponsa	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Yellow Warbler	Setophaga petechia	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	Yellow-bellied Sapsucker	Sphyrapicus varius	NL	NL	NL	Yes	2015, 2019	BBS, eBird	
Avian	American Tree Sparrow	Spizelloides arborea	NL	NL	NL	Yes	2015	BBS, eBird	

Fauna Type	Species (Invasives Italic)	Scientific Name	State Status	Federal Status	SGCN Status	Evidence	Most Recent Observation	Source	SGCN Criteria
Avian	American White Pelican	Pelecanus erythrorhynchos	SPC	NL	Yes	Yes	2015	BBS, eBird	
Avian	American Woodcock	Scolopax minor	NL	NL	Yes	Yes	2015	BBS, eBird	
Avian	Black-and-white Warbler	Mniotilta varia	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Blackburnian Warbler	Setophaga fusca	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Blackpoll Warbler	Setophaga striata	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Blue-winged Teal	Spatula discors	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Brown Creeper	Certhia americana	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Canada Warbler	Cardellina canadensis	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Cedar Waxwing	Bombycilla cedrorum	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Chestnut-sided Warbler	Setophaga pensylvanica	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Chimney Swift	Chaetura pelagica	NL	NL	Yes	Yes	2015	BBS, eBird	
Avian	Dark-eyed Junco	Junco hyemalis	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Eastern Meadowlark	Sturnella magna	NL	NL	Yes	Yes	2015	BBS, eBird	grassland sp.
Avian	Eastern Phoebe	Sayornis phoebe	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	European Starling	Sturnus vulgaris	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Fox Sparrow	Passerella iliaca	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Golden-crowned Kinglet	Regulus satrapa	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Green-winged Teal	Anas crecca	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Hermit Thrush	Catharus guttatus	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Horned Grebe	Podiceps auritus	END	NL	Yes	Yes	2015	BBS, eBird	
Avian	House Finch	*Haemorhous mexicanus*	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Lesser Yellowlegs	Tringa flavipes				Yes	2015	BBS, eBird	
Avian	Lincoln's Sparrow	Melospiza lincolnii	NL	NL	NL	Yes	2015	BBS, eBird	grassland sp.
Avian	Magnolia Warbler	Setophaga magnolia	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Nashville Warbler	Oreothlypis ruficapilla	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Northern Harrier	Circus hudsonius	NL	NL	Yes	Yes	2015	BBS, eBird	grassland sp.
Avian	Northern Parula	Setophaga americana	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Northern Pintail	Anas acuta	NL	NL	Yes	Yes	2015	BBS, eBird	
Avian	Northern Shrike	Lanius borealis	NL	NL	NL	Yes	2015	BBS, eBird	grassland sp.
Avian	Olive-sided Flycatcher	Contopus cooperi	NL	NL	Yes	Yes	2015	BBS, eBird	
Avian	Orange-crowned Warbler	Oreothlypis celata	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Osprey	Pandion haliaetus	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Palm Warbler	Setophaga palmarum	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Pied-billed Grebe	*Podilymbus podiceps*	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Pine Warbler	Setophaga pinus	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Red-shouldered Hawk	Buteo lineatus	SPC	NL	Yes	Yes	2015	BBS, eBird	

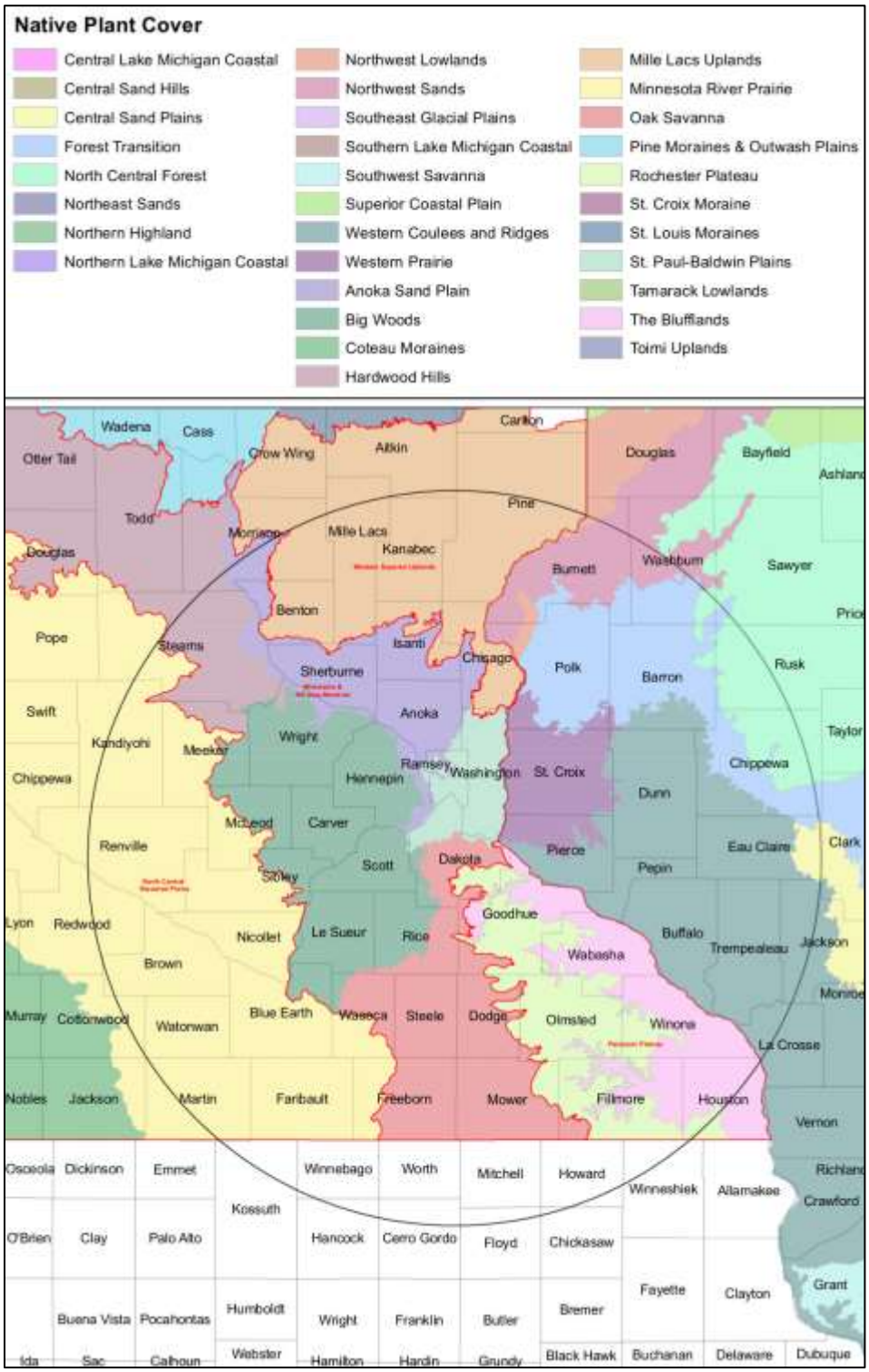
Fauna Type	Species (Invasives Italic)	Scientific Name	State Status	Federal Status	SGCN Status	Evidence	Most Recent Observation	Source	SGCN Criteria
Avian	Red-tailed Hawk	Buteo jamaicensis	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Rock Pigeon	Columba livia	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Ruby-crowned Kinglet	Regulus calendula	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Ruby-throated Hummingbird	Archilochus colubris	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Savannah Sparrow	Passerculus sandwichensis	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Sharp-shinned Hawk	Accipiter striatus	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Spotted Sandpiper	Actitis macularius	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Swainson's Thrush	Catharus ustulatus	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Tennessee Warbler	Oreothlypis peregrina	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Tree Swallow	Tachycineta bicolor	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Veery	Catharus fuscescens	NL	NL	Yes	Yes	2015	BBS, eBird	
Avian	Western Kingbird	Tyrannus verticalis	NL		Yes	Yes	2015	BBS, eBird	
Avian	White-throated Sparrow	Zonotrichia albicollis	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Wilson's Warbler	Cardellina pusilla	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Wood Thrush	Hylocichla mustelina	NL	NL	Yes	Yes	2015	BBS, eBird	
Avian	Yellow-rumped Warbler	Setophaga coronata	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Yellow-throated Vireo	Vireo flavifrons	NL	NL	NL	Yes	2015	BBS, eBird	
Avian	Lark Sparrow	Chondestes grammacus	SPC		Yes	Yes	2019	BBS, eBird	
Avian	Marsh Wren	Cistothorus palustris	NL	NL	NL	Yes	2019	BBS, eBird	
Avian	Orchard Oriole	Icterus spurius	NL	NL	NL	Yes	2019	BBS, eBird	
Avian	Red-necked Phalarope	Phalaropus lobatus				Yes	2019	BBS, eBird	
Avian	Yellow-billed Cuckoo	Coccyzus americanus	NL	NL	Yes	Yes	2019	BBS, eBird	
Avian	Cerulean Warbler	Setophaga cerulea	SPC	NL	Yes	Yes	2019	BBS	
Avian	Virginia Rail	Rallus limicola	NL	NL	Yes	Yes	2019	Marshbird survey	
Avian	Sora	Porzana carolina	NL	NL	NL	Yes	2018, 2019	arshbird survey, eBird	
Avian	American Black Duck	Anas rubripes	NL		Yes	Yes		eBird	
Avian	American Coot	Fulica americana	NL	NL	NL	Yes		eBird	
Avian	American Kestrel	Falco sparverius	NL	NL	Yes	Yes		eBird	
Avian	American Pipit	Anthus rubescens				Yes		eBird	
Avian	American Wigeon	Mareca americana				Yes		eBird	
Avian	Baird's Sandpiper	Calidris bairdii				Yes		eBird	
Avian	Bank Swallow	Riparia riparia	NL	NL	NL	Yes		eBird	
Avian	Barred Owl	Strix varia	NL	NL	NL	Yes		eBird	
Avian	Bay-breasted Warbler	Setophaga castanea	NL	NL	Yes	Yes		eBird	
Avian	Black Tern	Chlidonias niger	NL	NL	Yes	Yes		eBird	
Avian	Black-crowned Night-Heron	Nycticorax nycticorax	NL	NL	Yes	Yes		eBird	
Avian	Black-throated Green Warbler	Setophaga virens	NL	NL	NL	Yes		eBird	
Avian	Blue-headed Vireo	Vireo solitarius	NL	NL	NL	Yes		eBird	
Avian	Blue-winged Warbler	Vermivora cyanoptera	NL	NL	NL	Yes		eBird	
Avian	Bobolink	Dolichonyx oryzivorus	NL	NL	Yes	Yes		eBird	

Fauna Type	Species (Invasives Italic)	Scientific Name	State Status	Federal Status	SGCN Status	Evidence	Most Recent Observation	Source	SGCN Criteria
Avian	Bonaparte's Gull	Chroicocephalus philadelphia	NL	NL	NL	Yes		eBird	
Avian	Brewer's Blackbird	Euphagus cyanocephalus	NL	NL	NL	Yes		eBird	
Avian	Broad-winged Hawk	Buteo platypterus	NL	NL	NL	Yes		eBird	
Avian	Bufflehead	Bucephala albeola	NL	NL	NL	Yes		eBird	
Avian	Cackling Goose	Branta hutchinsii	NL	NL	NL	Yes		eBird	
Avian	Cape May Warbler	Setophaga tigrina	NL	NL	Yes	Yes		eBird	
Avian	Cliff Swallow	Petrochelidon pyrrhonota	NL	NL	NL	Yes		eBird	
Avian	Common Goldeneye	Bucephala clangula	NL	NL	NL	Yes		eBird	
Avian	Common Loon	Gavia immer	NL	NL	Yes	Yes		eBird	
Avian	Common Merganser	Mergus merganser	NL	NL	Yes	Yes		eBird	
Avian	Common Nighthawk	Chordeiles minor	NL	NL	Yes	Yes		eBird	
Avian	Common Redpoll	Acanthis flammea	NL	NL	NL	Yes		eBird	
Avian	Dickcissel	Spiza americana	NL	NL	Yes	Yes		eBird	
Avian	Double-crested Cormorant	Phalacrocorax auritus	NL	NL	NL	Yes		eBird	
Avian	Dunlin	Calidris alpina				Yes		eBird	
Avian	Eurasian Collared-Dove	Streptopelia decaocto	NL	NL	NL	Yes		eBird	
Avian	Franklin's Gull	Leucophaeus pipixcan	SPC	NL	Yes	Yes		eBird	
Avian	Gadwall	Mareca strepera	NL	NL	NL	Yes		eBird	
Avian	Golden-winged Warbler	Vermivora chrysoptera	NL	NL	Yes	Yes		eBird	
Avian	Grasshopper Sparrow	Ammodramus savan-narum	NL		Yes	Yes		eBird	
Avian	Gray-cheeked Thrush	Catharus minimus	NL	NL	NL	Yes		eBird	
Avian	Great Horned Owl	Bubo virginianus	NL	NL	NL	Yes		eBird	
Avian	Greater Yellowlegs	Tringa melanoleuca	NL		Yes	Yes		eBird	
Avian	Harris's Sparrow	Zonotrichia querula	NL	NL	NL	Yes		eBird	
Avian	Horned Lark	Eremophila alpestris				Yes		eBird	
Avian	House Sparrow	Passer domesticus	NL	NL	NL	Yes		eBird	
Avian	Lapland Longspur	Calcarius lapponicus				Yes		eBird	
Avian	Least Sandpiper	Calidris minutilla				Yes		eBird	
Avian	LeConte's Sparrow	Ammodramus leconteii	NL		Yes	Yes		eBird	
Avian	Lesser Scaup	Aythya affinis	NL	NL	Yes	Yes		eBird	
Avian	Merlin	Falco columbarius	NL	NL	NL	Yes		eBird	
Avian	Mourning Warbler	Geothlypis philadelphia	NL	NL	NL	Yes		eBird	
Avian	Northern Goshawk	Accipiter gentilis	SPC		Yes	Yes		eBird	
Avian	Northern Saw-whet Owl	Aegolius acadicus	NL	NL	NL	Yes		eBird	
Avian	Northern Shoveler	Spatula clypeata	NL	NL	NL	Yes		eBird	
Avian	Northern Waterthrush	Parkesia noveboracensis	NL	NL	NL	Yes		eBird	
Avian	Pectoral Sandpiper	Calidris melanotos				Yes		eBird	
Avian	Peregrine Falcon	Falco peregrinus	SPC	NL	Yes	Yes		eBird	
Avian	Philadelphia Vireo	Vireo philadelphicus	NL	NL	Yes	Yes		eBird	
Avian	Pied-billed Grebe	Podilymbus podiceps	NL	NL	NL	Yes		eBird	

Fauna Type	Species (Invasives Italic)	Scientific Name	State Status	Federal Status	SGCN Status	Evidence	Most Recent Observation	Source	SGCN Criteria
Avian	Pine Siskin	Spinus pinus	NL	NL	NL	Yes		eBird	
Avian	Purple Finch	Haemorhous purpureus	NL	NL	Yes	Yes		eBird	
Avian	Purple Martin	Progne subis	SPC	NL	Yes	Yes		eBird	
Avian	Red Crossbill	Loxia curvirostra	NL	NL	NL	Yes		eBird	
Avian	Red-breasted Merganser	Mergus serrator	NL	NL	NL	Yes		eBird	
Avian	Red-necked Grebe	Podiceps grisegena	NL		Yes	Yes		eBird	
Avian	Ring-billed Gull	Larus delawarensis	NL	NL	NL	Yes		eBird	
Avian	Ring-necked Duck	Aythya collaris	NL	NL	NL	Yes		eBird	
Avian	Rough-legged Hawk	Buteo lagopus	NL	NL	NL	Yes		eBird	
Avian	Rusty Blackbird	Euphagus carolinus	NL	NL	NL	Yes		eBird	
Avian	Scarlet Tanager	Piranga olivacea	NL	NL	NL	Yes		eBird	
Avian	Semipalmated Plover	Charadrius semipalmatus				Yes		eBird	
Avian	Semipalmated Sandpiper	Calidris pusilla	NL		Yes	Yes		eBird	
Avian	Snow Bunting	Plectrophenax nivalis				Yes		eBird	
Avian	Solitary Sandpiper	Tringa solitaria	NL	NL	NL	Yes		eBird	
Avian	Stilt Sandpiper	Calidris himantopus				Yes		eBird	
Avian	Trumpeter Swan	Cygnus buccinator	SPC	NL	Yes	Yes		eBird	
Avian	Tundra Swan	Cygnus columbianus	NL	NL	NL	Yes		eBird	
Avian	White-crowned Sparrow	Zonotrichia leucophrys	NL	NL	NL	Yes		eBird	
Avian	White-rumped Sandpiper	Calidris fuscicollis				Yes		eBird	
Avian	Wilson's Snipe	Gallinago delicata				Yes		eBird	
Avian	Winter Wren	Troglodytes hiemalis	NL	NL	Yes	Yes		eBird	
Avian	Yellow-bellied Flycatcher	Empidonax flaviventris	NL	NL	NL	Yes		eBird	
Avian	Yellow-headed Blackbird	Xanthocephalus xanthocephalus	NL		Yes	Yes		eBird	

12.3. Appendix C. Acceptable Source Origin of Native Seed

Native seed source origin should be from within circle shown below.



12.4. Appendix D: Species Lists for Restoration Sites

Southern Dry-Mesic Oak Forest

Genus	Species	Common Name	Likeli-hood of Establish-ment	Conserv-ation Coefficient	Commonly Commerc-ially Availabl
Canopy Trees (>10m)					
Betula	*papyrifera*	Paper-birch	M	3	x
Celtis	*occidentalis*	Hackberry	H	3	x
Juglans	*cinerea*	Butternut	L	6	x
Ostrya	*virginiana*	Ironwood	M	4	x
Prunus	*serotina*	Black cherry	M	4	x
Quercus	*alba*	White oak	L	7	x
Quercus	*rubra*	Northern red oak	M	5	x
Tilia	*americana*	Basswood	H	5	x
Ulmus	*americana*	American elm	H	3	x
Understory Trees					
Betula	*papyrifera*	Paper-birch	M	3	x
Carpinus	*caroliniana*	Blue beech	M	5	x
Celtis	*occidentalis*	Hackberry	H	3	x
Ostrya	*virginiana*	Ironwood	M	5	x
Prunus	*serotina*	Black cherry	M	4	x
Quercus	*alba*	White oak	L	7	x
Quercus	*rubra*	Northern red oak	M	5	x
Tilia	*americana*	Basswood	H	5	x
*Ulmus**	*americana**	American elm*	H	3	x
Ulmus	*rubra*	Slippery elm	M	4	x
Shrubs					
Cornus	*alternifolia*	Pagoda dogwood	M	7	x
Cornus	*racemosa*	Gray dogwood	H	2	x
Corylus	*americana*	American hazelnut	H	3	x
Corylus	*cornuta*	Beaked hazelnut	H	5	x
Prunus	*virginiana*	Chokecherry	H	3	x
Rosa	*blanda*	Smooth wild rose	M	7	x
Sambucus	*racemosa*	Red-berried elder	H	5	x
Symphoricarpos	*albus*	Snowberry	M	6	x
Viburnum	*lentago*	Nannyberry	M	4	x
Viburnum	*rafinesquianum*	Downy arrow-wood	M	7	x
Forbs					
Actaea	*rubra*	Red baneberry	M	7	x
Amphicarpaea	*bracteata*	Hog-peanut	M	4	x
Apocynum	*androsaemifolium*	Spreading dogbane	H	2	
Aquilegia	*canadensis*	Columbine	M	4	x
Aralia	*nudicaulis*	Wild sarsaparilla	M	4	x
Aralia	*racemosa*	American spikenard	L	7	x
Arisaema	*triphyllum*	Jack-in-the-pulpit	M	4	x

Genus	Species	Common Name	Likeli-hood of Establish-ment	Conserv-ation Coefficient	Common-ly Commerc-ially Available
Aster	*sagittifolius*	Tail-leaved aster	M	3	
Caulophyllum	*thalictroides*	Blue cohosh	L	8	x
Circaea	*lutetiana*	Canada enchanter's nightshade	H	2	x
Cryptotaenia	*canadensis*	Honewort	H	3	
Desmodium	*glutinosum*	Pointed-leaved tick-trefoil	M	6	
Dioscorea	*villosa*	Wild yam	M	4	
Fragaria	*vesca*	Wood strawberry	H		x
Fragaria	*virginiana*	Common strawberry	H	2	x
Galium	*aparine*	Cleavers	H	1	x
Galium	*concinnum*	Elegant bedstraw	M	5	
Galium	*triflorum*	Three-flowered bedstraw	M	4	
Geranium	*maculatum*	Wild geranium	M	4	x
Geum	*canadense*	White avens	H	2	
Hepatica	*americana*	Round-lobed hepatica	L	7	x
Hydrophyllum	*virginianum*	Virginia waterleaf	H	3	x
Maianthemum	*canadense*	Canada mayflower	M	5	x
Maianthemum	*racemosum*	Racemose false Solomon's-seal	M	5	x
Mitella	*diphylla*	Two-leaved miterwort	L	7	
Monotropa	*uniflora*	Indian pipe	L	6	
Osmorhiza	*claytonii*	Clayton's sweet cicely	H	3	x
Osmorhiza	*longistylis*	Anise-root	M	4	
Polygonatum	*pubescens*	Hairy Solomon's-seal	M	6	
Polygonatum	*biflorum*	Giant Solomon's-seal	M	4	
Ranunculus	*abortivus*	Kidney-leaf buttercup	H	1	
Ranunculus	*recurvatus*	Hooked crowfoot	M	5	
Sanguinaria	*canadensis*	Bloodroot	L	6	x
Sanicula	*gregaria*	Gregarious black snakeroot	H	3	
Sanicula	*marilandica*	Mariland black snakeroot	M	5	x
Smilax	*lasionuera*	Carrion-flower	M	4	
Thalictrum	*dioicum*	Early meadow-rue	M	5	x
Uvularia	*grandiflora*	Yellow bellwort	L	7	x
Uvularia	*sessilifolia*	Pale bellwort	M	6	x
Veronicastrum	*virginicum*	Culver's root	M	6	x
Viola	speicies	Violet (multiple species)	M	5	x
Grasses, Rushes and Sedges					
Carex	*blanda*	Charming sedge	M	3	
Carex	*pensylvanica*	Pennsylvania sedge	M	3	x
Carex	*radiata*	Stellate sedge	M	4	
Festuca	*subverticillata*	Nodding fescue	M	4	
Ferns and Fern Allies					
Adiantum	*pedatum*	Maidenhair fern	M	7	x
Athyrium	*filix-femina*	Lady-fern	M	4	x
Botrychium	*virginianum*	Rattlesnakefern	L	6	
Osmunda	*claytoniana*	Interrupted fern	M	6	x
Pteridium	*aquilinum*	Bracken	M	2	x

Preferred species
*Plant disease-resistant types.

Southern Seepage Meadow--Carr

Genus	Species	Common Name	Likeli-hood of Establish-ment	Conserv a-tion Coeffici ent	y Commerc-ially Available
Shrubs*					
Cornus	*amomum*	Silky dogwood*	M		x
Cornus	*sericea*	Red-osier dogwood*	M	3	x
Ilex	*verticillata*	Winterberry*	M	6	x
Salix	*bebbiana*	Bebb's willow*	M	6	x
Salix	*discolor*	Pussy willow*	M	3	x
Salix	*exigua*	Sandbar willow*	M	2	x
Salix	*petiolaris*	Slender willow*	M	5	x
Spiraea	*alba*	Meadowsweet*	M	5	x
Spiraea	*tomentosa*	Steeple-bush*	M	7	x
Forbs				4	
Acorus	*calamus*	Sweet flag	M		x
Alisma	*triviale*	Ordinary water-plantain	L	4	x
Anemone	*canadensis*	Canada anemone	M	3	x
Apios	*americana*	Groundnut	M	4	
Apocynum	*sibiricum*	Clasping dogbane	M	3	
Asclepias	*incarnata*	Swamp milkweed	M	4	x
Aster	*lanceolatus*	Panicled aster	M	4	x
Aster	*firmus*	Red-stemmed aster	M	6	
Aster	*umbellatus*	Flat-topped aster	M	6	x
Bidens	species	Beggar-ticks (multiple species)	M	1 to 8	
Boehmeria	*cylindrica*	False nettle			
Caltha	*palustris*	Swamp marsh-marigold	M	6	
Campanula	*aparinoides*	Marsh bellflower	M	5	
Chelone	*glabra*	White turtlehead	M	7	x
Cicuta	*bulbifera*	Bulb-bearing water-hemlock	L	7	
Cicuta	*maculata*	Spotted water-hemlock	L	5	
Cirsium	*muticum*	Swamp thistle	M	6	
Epilobium	species	Willow-herb	M	3 to 8	
Eupatorium	*maculatum*	Spotted Joe-pye weed	M	4	x
Eupatorium	*perfoliatum*	Common boneset	M	4	x
Fragaria	*virginiana*	Common strawberry	M	2	x
Galium	*trifidum*	Three-cleft bedstraw	M	6	
Gentiana	*billingtonii*	Closed gentian	L		
Geum	*aleppicum*	Yellow avens	M	3	
Helenium	*autumnale*	Autumn sneezeweed	M	4	x
Hypericum	*majus*	Large St. John's-wort	M	5	
Impatiens	*species*	Touch-me-not	H	2 to 5	
Iris	*versicolor*	Northern blue Flag	M	4	x
Lycopus	*americanus*	Cut-leaved bugleweed	M	4	
Lycopus	*uniflorus*	Northern bugleweed	M	5	
Lysimachia	*terrestris*	Yellow loosestrife	M	7	
Lysimachia	*thyrsiflora*	Tufted loosestrife	M	6	
Pedicularis	*lanceolata*	Swamp lousewort	M	8	
Polygonum	*amphibium*	Water smartweed	M	4	

Genus	Species	Common Name	Likeli-hood of Establish-ment	Conserv a-tion Coeffici ent	Commonl y Commerc-ially Available
Pycnanthemum	*virginianum*	Virginia mountain-mint	M	6	x
Ranunculus	*pensylvanicus*	Bristly buttercup	M	5	
Rubus	*pubescens*	Dwarf raspberry	M	6	
Rumex	*orbiculatus*	Great water dock	L	8	
Sagittaria	*latifolia*	Broad-leaved arrowhead	M	3	x
Saxifraga	*pensylvanica*	Swamp saxifrage	M	7	
Scutellaria	*galericulata*	Marsh skullcap	M	5	
Scutellaria	*lateriflora*	Mad-dog skullcap	M	5	
Sium	*suave*	Water-parsnip	L	5	
Maianthemum	*stellata*	Starry false Solomon's-seal	M	5	
Sparganium	*eurycarpum*	Giant bur-reed	M	5	x
Stachys	*palustris*	Woundwort	M	4	
Teucrium	*canadense*	Germander	H	4	
Thalictrum	*dasycarpum*	Tall meadow-rue	M	4	x
Verbena	*hastata*	Blue vervain	H	6	x
Veronica	*scutellata*	Marsh speedwell	M	6	
Viola	species	Violet	M	4 to 8	
Grasses, Rushes and Sedges					
Bromus	*ciliatus*	Fringed brome	M	6	x
Calamagrostis	*canadensis*	Bluejoint	M	4	x
Carex	*bebbii*	Bebb's sedge	H	4	x
Carex	*buxbaumii*	Buxbaum's sedge	M	8	
Carex	*cephalantha*	Bunched sedge	M	4	
Carex	*haydenii*	Hayden's sedge	M	8	
Carex	*interior*	Inland sedge	M	7	
Carex	*lacustris*	Lake-sedge	L	6	x
Carex	*lasiocarpa*	Wire-sedge	M	9	x
Carex	*prairea*	Prairie sedge	L	10	
Carex	*sartwellii*	Sartwell's sedge	M	7	
Carex	*scoparia*	Pointed-broom sedge	M	4	x
Carex	*stipata*	Awl-fruited sedge	M	2	x
Carex	*stricta*	Tusssock-sedge	L	7	x
Carex	*tribuloides*	Blunt-broom sedge	M	4	
Carex	*pellita*	Woolly sedge	M	4	
Carex	*utriculata*	Beaked sedge	M	7	
Dulichium	*arundinaceum*	Three-way sedge	M	8	
Eriophorum	*angustifolium*	Narrow-leaved cotton-grass	L	9	
Glyceria	*canadensis*	Rattlesnake grass	M	7	
Glyceria	*grandis*	Tall manna-grass	M	6	x
Glyceria	*striata*	Fowl manna-grass	M	4	
Juncus	*canadensis*	Canada rush	M	7	
Leersia	*oryzoides*	Rice cut grass	M	3	
Leersia	*virginica*	White grass	M	5	
Muhlenbergia	*racemosa*	Marsh muhly grass	M	4	
Schoeneplectrus	*acutus*	Hard-stemmed bulrush	M	6	
Schoeneplectrus	*validus*	Softstem bulsush	M	4	
Scirpus	*atrovirens*	Dark green bulrush	M	4	

Genus	Species	Common Name	Likeli-hood of Establish-ment	Conserv a-tion Coeffici ent	Commonl y Commerc-ially Available
Scirpus	*cyperinus*	Wool-grass	M	3	
Scirpus	*pungens*	Three-square	M	6	
Spartina	*pectinata*	Prairie cord-grass	M	5	
Ferns and Fern Allies					
Equisetum	*fluviatile*	Water horsetail	L	7	
Equisetum	*arvense*	Field horsetail	L	1	
Onoclea	*sensibilis*	Sensitive fern	M	4	x
Thelypteris	*palustris*	Northern marsh-fern	M	7	x

*Limit planting density due to aggresiveness of the species.

Dry-Mesic Oak Woodland

Genus	Species	Common Name	Liklihood of Establis h-ment	Conserva-tism Coefficie nt	Commonly Commercially Available
Canopy Trees & understory trees					
Acer	*rubrum*	Red maple	M	3	x
Betula	*papyrifera*	Paper-birch	M	3	x
Carya	*cordiformis*	Bitternut hickory	M	6	x
Fraxinus	*pennsylvanica*	Green ash	H	2	x
Pinus	*strobus*	White pine	M	5	x
Populus	*grandidentata*	Big-toothed aspen	M	3	x
Populus	*tremuloides*	Quaking aspen	M	2	x
Prunus	*serotina*	Black cherry	M	4	x
Quercus	*alba*	White oak	L	7	x
Quercus	*ellipsoidalis*	Northern pin oak	M	5	x
Quercus	*macrocarpa*	Bur oak	M	5	x
Quercus	*rubra*	Northern red oak	M	5	x
*Ulmus**	*americana**	American elm*	H	3	x
Understory Trees					
Acer	*rubrum*	Red maple	M	3	x
Betula	*papyrifera*	Paper-birch	M	3	x
Carpinus	*caroliniana*	Blue beech	M	6	x
Carya	*cordiformis*	Bitternut hickory	M	6	x
Celtis	*occidentalis*	Hackberry	H	3	x
Fraxinus	*nigra*	Black ash	M	8	x
Fraxinus	*pennsylvanica*	Green ash	H	2	x
Ostrya	*virginiana*	Ironwood	M	4	x
Pinus	*strobus*	White pine	M	5	x
Populus	*grandidentata*	Big-toothed aspen	M	3	x
Populus	*tremuloides*	Quaking aspen	M	2	x

Genus	Species	Common Name	Liklihood of Establish-ment	Conserva-tism Coefficient	Commonly Commercially Available
Prunus	*serotina*	Black cherry	M	4	x
Quercus	*alba*	White oak	L	7	x
Quercus	*ellipsoidalis*	Northern pin oak	M	5	x
Quercus	*macrocarpa*	Bur oak	M	5	x
Quercus	*rubra*	Northern red oak	M	5	x
Sorbus	*americana*	American mountain-ash	M	7	x
Tilia	*americana*	Basswood	M	5	x
*Ulmus**	*americana**	American elm*	H	3	x
*Ulmus**	*rubra**	Slippery elm*	H	4	x
Shrubs					
Amelanchier	*interior*	Juneberry	M	7	x
Amelanchier	*laevis*	Allegheny serviceberry	M	6	x
Cornus	*alternifolia*	Pagoda dogwood	M	7	x
Cornus	*rugosa*	Round-leaved dogwood	M	7	x
Cornus	*racemosa*	Gray dogwood	M	2	x
Corylus	*americana*	American hazelnut	M	3	x
Corylus	*cornuta*	Beaked hazelnut	M	5	x
Crataegus	species	Hawthorn (multiple species)	M	2	x
Diervilla	*lonicera*	Bush honeysuckle	M	6	x
Ilex	*verticillata*	Winterberry	M	7	x
Prunus	*virginiana*	Chokecherry	M	3	x
Ribes	*cynosbati*	Prickly gooseberry	M	3	x
Ribes	*missouriense*	Missouri gooseberry	M	4	x
Rosa	*arkansana*	Prairie rose	M	5	x
Rosa	*blanda*	Smooth wild rose	M	7	x
Sambucus	*racemosa*	Red-berried Elder	M	5	x
Symphoricarpos	*alba*	Snowberry	M	6	x
Viburnum	*lentago*	Nannyberry	M	4	x
Viburnum	*rafinesquianum*	Downy arrow-wood	M	7	x
Forbs					
Achillea	*millefolium*	Yarrow	H	1	x
Actaea	*rubra*	Red baneberry	L	7	x
Amphicarpaea	*bracteata*	Hog-peanut	M	4	
Anemone	*quinquefolia*	Wood-anemone	L	6	x
Anemone	*virginiana*	Tall thimbleweed	M	5	x
Apocynum	*androsaemifolium*	Spreading dogbane	M	3	
Aquilegia	*canadensis*	Columbine	L	5	x
Aralia	*nudicaulis*	Wild sarsaparilla	L	4	x
Aralia	*racemosa*	American spikenard	L	7	x
Arenaria	*lateriflora*	Side-flowering sandwort	L	6	
Arisaema	*triphyllum*	Jack-in-the-pulpit	M	4	x
Asclepias	*exaltata*	Poke milkweed	M	7	
Aster	*ciliolatus*	Lindley's aster	M	4	
Aster	*lateriflorus*	Side-flowering aster	M	3	
Aster	*macrophyllus*	Large-leaved aster	M	4	x

Aster	*oolentangiensis*	Sky-blue aster	M	5	x
Aster	*sagittifolius*	Tail-leaved aster	M	3	
Caulophyllum	*thalictroides*	Blue cohosh	L	8	x
Circaea	*lutetiana*	Canada enchanter's	H	2	
Clintonia	*borealis*	Bluebead lily	L	7	x
Cryptotaenia	*canadensis*	Honewort	H	3	
Desmodium	*glutinosum*	Pointed-leaved tick-trefoil	M	6	
Dioscorea	*villosa*	Wild yam	M	4	
Fragaria	*vesca*	Wood strawberry	M		x
Fragaria	*virginiana*	Common strawberry	M	2	x
Galium	*aparine*	Cleavers	H	1	
Galium	*boreale*	Northern bedstraw	M	5	
Galium	*concinnum*	Elegant bedstraw	M	5	
Galium	*triflorum*	Three-flowered bedstraw	M	4	
Geranium	*maculatum*	Wild geranium	M	4	x
Geum	*canadense*	White avens	H	2	
Geum	*triflorum*	Prairie smoke	L	7	x
Helianthus	*hirsutus*	Woodland sunflower	M	5	x
Helianthus	*strumosus*	Rough-leaf sunflower	M	4	x
Hepatica	*americana*	Round-lobed hepatica	L	7	x
Heuchera	*richardsonii*	Alum-root	L	7	x
Lathyrus	*venosus*	Veiny pea	M	6	
Maianthemum	*canadense*	Canada mayflower	M	5	x
Maianthemum	*racemosum*	Racemose false Solomon's-seal	M	5	x
Maianthemum	*stellatum*	Starry false Solomon's-seal	M	5	x
Mitchella	*repens*	Partridge-berry	L	6	
Osmorhiza	*claytonii*	Clayton's sweet cicely	H	3	x
Osmorhiza	*longistylis*	Anise-root	M	4	
Phryma	*leptostachya*	Lopseed	M	5	
Physalis	*heterophylla*	Clammy ground-cherry	M	3	
Polygonatum	*pubescens*	Hairy Solomon's-seal	L	6	
Polygonatum	*biflorum*	Giant Solomon's-seal	M	4	
Pyrola	*elliptica*	Common pyrola	L	6	
Pyrola	*secunda*	One-sided pyrola	L	7	
Ranunculus	*abortivus*	Kidney-leaf buttercup	H	1	
Ranunculus	*recurvatus*	Hooked crowfoot	M	5	
Rubus	*pubescens*	Dwarf raspberry	M	7	
Sanguinaria	*canadensis*	Bloodroot	L	6	x
Sanicula	*gregaria*	Gregarious black snakeroot	H	3	
Sanicula	*marilandica*	Mariland black snakeroot	M	5	x
Smilax	*lasionuera*	Carrion-flower	M	4	
Solidago	*flexicaulis*	Zig-zag goldenrod	M	6	x
Solidago	*hispida*	Hairy goldenrod	M	6	
Solidago	*uliginosa*	Bog goldenrod	L	8	
Streptopus	*lanceolatus*	Rosey twisted-stalk	L	7	
Thalictrum	*dasycarpum*	Tall meadow-rue	M	4	x
Thalictrum	*dioicum*	Early meadow-rue	M	5	x

Genus	Species	Common Name	Liklihood of Establish-ment	Conservatism Coefficient	Commonly Commercially Available
Thalictrum	*thalictroides*	Rue-anemone	L	7	x
Trientalis	*borealis*	Starflower	L	7	
Trillium	*cernuum*	Nodding trillium	L	8	
Trillium	*grandiflorum*	Large-flowered trillium	L	6	x
Uvularia	*grandiflora*	Yellow bellwort	L	7	
Uvularia	*sessilifolia*	Pale bellwort	M	6	
Veronicastrum	*virginicum*	Culver's root	M	6	
Viola	species	Violet (multiple species)	M	5	x
Zizia	*aurea*	Golden alexanders	H	7	x
Grasses, Rushes and Sedges					
Brachyelytrum	*erectum*	Bearded shorthusk	M	7	
Carex	*blanda*	Charming sedge	M	3	
Carex	*deweyana*	Dewey's sedge	M	6	
Carex	*gracillima*	Graceful sedge	M	4	x
Carex	*peckii*	Peck's sedge	M	7	
Carex	*pedunculata*	Long-stalked sedge	M	7	x
Carex	*pensylvanica*	Pennsylvania sedge	M	3	x
Carex	*tenera*	Marsh-straw sedge	M	4	
Carex	*radiata*	Stellate sedge	M	4	
Elymus	*hystrix*	Bottlebrush grass	M	6	x
Festuca	*subverticillata*	Nodding fescue	M	4	
Oryzopsis	*asperifolia*	Moutain rice-grass	M	6	
Schizachne	*purpurascens*	False melic grass	M	7	
Ferns and Fern Allies					
Athyrium	*filix-femina*	Lady-fern	M	4	x
Dryopteris	*intermedia*	Fancy wood fern	L	7	
Equisetum	*pratense*	Meadow horsetail	L	9	
Matteuccia	*struthiopteris*	Ostrich-fern	M	5	x
Osmunda	*claytoniana*	Interrupted fern	L	6	x
Pteridium	*aquilinum*	Bracken	M	2	x

Mesic Prairie

Genus	Species	Common Name	Likelihood of Establishment	Conservation Coefficient	Commonly Commercially Available
Trees					
Shrubs					
Amorpha	*canescens*	Lead-plant	L	7	x
Prunus	*virginiana*	Chokecherry	M	3	x
Rosa	*arkansana*	Prairie rose	M	5	x
Salix	*humilis*	Prairie willow	M	6	x
Symphoricarpos	*abla*	Snowberry	M	6	
Grasses, Rushes and Sedges					
Andropogon	*gerardii*	Big bluestem	M	4	x
Bromus	*kalmii*	Kalm's brome	M	8	x
Carex	*bicknellii*	Bicknell's sedge	M	6	x
Carex	*meadii*	Mead's sedge	M	6	
Carex	*muhlenbergii*	Muhlenberg's sedge	M	4	x
Elymus	*canadensis*	Canada wild rye	H	4	x
Dicanthelium	*perlongum*	Long-leaved panic grass	M	7	
Panicum	*virgatum*	Switchgrass	H	2	x
Schizachyrium	*scoparium*	Little bluestem	M	4	x
Sorghastrum	*nutans*	Indian grass	M	5	x
Sporobolus	*heterolepis*	Prairie dropseed	L	10	x
Stipa	*spartea*	Porcupine-grass	M	9	x
Forbs					
Allium	*canadense*	Wild garlic	M	4	
Allium	*stellatum*	Prairie wild onion	M	9	x
Anemone	*canadensis*	Canada anemone	M	4	x
Anemone	*cylindrica*	Long-headed thimbleweed	M	6	x
Anemone	*virginiana*	Virginia thimbleweed	M	5	
Antennaria	*species*	Pussytoes	L	3	
Apocynum	*androsaemifolium*	Spreading dogbane	M	3	
Artemisia	*campestris*	Tall wormwood	M	4	x
Artemisia	*frigida*	Prairie sagewort	L	9	
Asclepias	*syriaca*	Common milkweed	H	1	
Asclepias	*tuberosa*	Butterfly-weed	M	6	x
Aster	*ericoides*	Heath aster	M	4	x
Aster	*laevis*	Smooth aster	M	6	x
Aster	*lanceolatus*	Panicled aster	M	4	x
Aster	*novae-angliae*	New England aster	H	3	x
Aster	*oolentangiensis*	Sky-blue aster	M	5	x
Astragalus	*canadensis*	Canada milk-vetch	L	8	x
Campanula	*rotundifolia*	Harebell	M	5	x
Comandra	*umbellata*	Bastard toad-flax	L	6	
Coreopsis	*palmata*	Stiff tickseed	M	8	x
Dalea	*candida*	White prairie-clover	M	8	x
Dalea	*purpurea*	Purple prairie-clover	M	7	x
Desmodium	*canadense*	Canadian tick-trefoil	M	4	x
Euphorbia	*corollata*	Flowering spurge	M	4	

Genus	Species	Common Name	Likelihood of Establishment	Conservation Coefficient	Commonly Commerciall y Available
Euthamia	*graminifolia*	Grass-leaved goldenrod	M	4	x
Fragaria	*virginiana*	Common strawberry	M	2	x
Galium	*boreale*	Northern bedstraw	M	5	x
Gentiana x	*billingtonii*	Closed gentian	L		
Geum	*triflorum*	Prairie smoke	M	7	x
Helianthus	*maximiliani*	Maximilian's sunflower	M		x
Helianthus	*pauciflorus*	Stiff sunflower	M		x
Heliopsis	*helianthoides*	Ox-eye	H	5	x
Heterotheca	*villosa*	Prairie golden aster	M	5	
Heuchera	*richardsonii*	Alum-root	M	7	x
Lathyrus	*venosus*	Veiny pea	M	6	
Lespedeza	*capitata*	Round-headed bush-clover	M	5	x
Liatris	*aspera*	Rough blazing star	M	5	x
Liatris	*ligulistylis*	Northern plains blazing star	M	7	x
Liatris	*pycnostachya*	Gayfeather	M	7	x
Lilium	*philadelphicum*	Wood lily	L	9	x
Lobelia	*spicata*	Rough-spiked Lobelia	M	7	x
Maianthemum	*racemosum*	False Solomon's-seal	M	5	x
Maianthemum	*stellatum*	Starry false Solomon's-seal	M	5	x
Mirabilis	*hirsuta*	Hairy four-o'clock	M	3	
Monarda	*fistulosa*	Wild bergamot	H	3	x
Oenothera	*biennis*	Common evening-primrose	H	1	x
Pedicularis	*canadensis*	Wood-betony	L	8	
Phlox	*pilosa*	Prairie phlox	L	7	x
Physalis	*heterophylla*	Clammy ground-cherry	M	3	
Potentilla	*arguta*	Tall cinquefoil	M	7	
Pycnanthemum	*virginianum*	Virginia mountain-mint	M	6	x
Ratibida	*pinnata*	Gray-headed coneflower	H	4	x
Rudbeckia	*hirta*	Black-eyed Susan	H	4	x
Sisyrinchium	*campestre*	Field blue-eyed grass	L	7	x
Solidago	*missouriensis*	Missouri goldenrod	M	7	x
Solidago	*nemoralis*	Gray goldenrod	M	4	x
Solidago	*ptarmicoides*	Upland white goldenrod	M	8	
Solidago	*speciosa*	Showy goldenrod	M	5	x
Thalictrum	*dasycarpum*	Tall meadow-rue	M	4	x
Tradescantia	*bracteata*	Bracted spiderwort	M	7	x
Veronicastrum	*virginicum*	Culver's root	M	6	x
Viola	*pedatifida*	Prairie bird-foot violet	L	9	x
Zizia	*aurea*	Golden alexanders	H	6	x
Ferns and Fern Allies					
Equisetum	*arvense*	Field horsetail	L	7	
Equisetum	*hyemale*	Tall scouring-rush	L	3	
Equisetum	*laevigatum*	Smooth scouring-rush	L	2	

Dry Savanna

Genus	Species	Common Name	Freq
Trees			
Quercus	*ellipsoidalis*	N. pin oak	37
Quercus	*macrocarpa*	Bur oak	67
Semi-Shrubs			
Amorpha	*canescens*	Leadplant	53
Artemisia	*frigida*	Prairie sagew ort	18
Ceanothus	*americanus*	American New Jersey tea	9
Rosa	*arkansana*	Prairie rose	43
Shrubs			
Amelanchier	*humilis or alnifolia*	Low or Saskatoon Juneberry	37
Corylus	*americana*	American hazelnut	43
Prunus	*virginiana*	Chokecherry	50
Rhus	*glabra*	Smooth sumac	40
Rhus	*typhina*	Staghorn sumac	15
Forbs			
Allium	*stellatum*	Prairie w ild onion	18
Anemone	*cylindrica*	Long-headed thimblew eed	40
Anemone	*patens*	Pasque-flow er	27
Antennaria	*spp.*	Pussytoes	27
Artemisia	*campestris, or dracunculus*	Taragon, or Tall w ormw ood	20
Artemisia	*ludoviciana*	Western mugw ort	53
Asclepias	*syriaca*	Common milkw eed	40
Asclepias	*tuberosa*	Butterfly-w eed	27
Asclepias	*verticillata*	Whorled milkw eed	18
Asclepias	*viridiflora*	Green milkw eed	45
Aster	*ericoides*	Heath aster	27
Aster	*laevis*	Smooth aster	9
Aster	*oblongifolius*	Aromatic aster	18
Aster	*oolentangiensis*	Sky-blue aster	33
Aster	*prenanthoides*	Crooked-stemmed aster	9
Aster	*sericeus*	Silky aster	45
Astragalus	*crassicarpus*	Buffalo-bean	27

Genus	Species	Common Name	Freq
Calylophus	*serrulata*	Toothed evening primrose	27
Campanula	*rotundifolia*	Harebell	30
Chrysopsis	*villosa*	Prairie golden aster	30
Comandra	*umbellata*	Bastard toad-flax	30
Coreopsis	*palmata*	Stiff tickseed	30
Cycloloma	*atriplicifolium*	Winged pigweed	9
Dalea	*candida*	White prairie-clover	9
Dalea	*purpurea*	Purple prairie-clover	47
Dalea	*villosa*	Silky prairie-clover	17
Delphinium	*carolinianum*	Prairie larkspur	18
Desmodium	*illinoense*	Illinois tick-trefoil	9
Euphorbia	*corollata*	Flowering spurge	23
Hedeona	*hispida*	Mock pennyroyal	23
Helianthemum	*bicknellii*	Hoary frostweed	67
Helianthus	*pauciflorus*	Stiff sunflower	20
Kuhnia	*eupatorioides*	False boneset	18
Lathyrus	*venosus*	Veiny pea	9
Lechea	*stricta*	Prairie pinweed	33
Lespedeza	*capitata*	Round-headed bush-clover	33
Liatris	*aspera*	Rough blazing star	33
Liatris	*punctata*	Dotted blazing star	45
Linum	*sulcatum*	Grooved yellow flax	18
Lithospermum	*canescens*	Hoary puccoon	40
Lithospermum	*caroliniense*	Hairy puccoon	70
Lithospermum	*incisum*	Narrow-leaved puccoon	27
Mirabilis	*hirsuta*	Hairy four-o'clock	45
Monarda	*fistulosa*	Wild bergamot	27
Monarda	*punctata*	Horsemint	20
Oenothera	*biennis*	Common evening-primrose	9
Oenothera	*clelandii*	Cleland's evening-primrose	18
Onosmodium	*molle*	False gromwell	9
Oxalis	cmx.	Wood-sorrel	9
Pediomelum	*argophyllum*	Silvery scurf-pea	9
Pediomelum	*esculentum*	Prairie-turnip	9
Penstemon	*gracilis*	Slender beard-tongue	9
Penstemon	*grandiflorus*	Large-flowered beard-tongue	23
Physalis	*heterophylla*	Clammy ground-cherry	36
Physalis	*virginiana*	Ground-cherry	73

Genus	Species	Common Name	Freq
Potentilla	*arguta*	Tall cinquefoil	23
Ratibida	*pinnata*	Gray-headed coneflower	9
Rudbeckia	*hirta*	Black-eyed Susan	9
Senecio	*plattensis*	Prairie ragwort	27
Silene	*antirrhina*	Sleepy catchfly	36
Smilacina	*stellata*	Starry false solomon's seal	47
Smilax	*ecirrata, herbacea, or illinoensis*	Erect, smooth, or Illinois carrion-flower	23
Solidago	*missouriensis*	Missouri goldenrod	30
Solidago	*nemoralis*	Gray goldenrod	67
Solidago	*ptarmicoides*	Upland white aster	9
Solidago	*rigida*	Stiff goldenrod	18
Solidago	*speciosa*	Showy goldenrod	27
Thalictrum	*dasycarpum*	Tall meadow-rue	9
Tradescantia	*occidentalis*	Western spiderwort	20
Verbena	*stricta*	Hoary vervain	24
Veronicastrum	*virginicum*	Culver's root	15
Viola	*palmata*	Bearded birdfoot violet	53
Viola	*pedatifida*	Prairie bird-foot violet	27
Zizia	*aptera*	Heart-leaved alexanders	9
Grasses, Rushes and Sedges			
Andropogon	*gerardii*	Big bluestem	67
Aristida	*basiramea*	Base-branched three-awn	18
Bouteloua	*curtipendula*	Side-oats grama	23
Bouteloua	*hirsuta*	Hairy grama	30
Bromus	*kalmii*	Kalm's brome	9
Calamovilfa	*longifolia*	Sand reed-grass	37
Carex	*foenea*	Hay sedge	53
Carex	*muhlenbergii*	Muhlenberg's sedge	37
Carex	*pensylvanica*	Pennsylvania sedge	37
Carex	*tenera*	Marsh-straw sedge	9
Carex	*siccata*	Hay sedge	9
Cyperus	*lupulinus*	Hop-like cyperus	27
Cyperus	*schweinitzii*	Schweinitz' cyperus	27
Digittaria	*cognata*	Fall witch grass	23

Genus	Species	Common Name	Freq
Elymus	*trachycaulus*	Slender w heatgrass	18
Elymus	*wiegandii*	Canada w ild rye	9
Eragrostis	*spectabilis*	Purple lovegrass	53
Koeleria	*pyramidata*	June-grass	80
Muhlenbergia	*cuspidata*	Plains muhly	27
Panicum	*leibergii*	Leiberg's panic grass	9
Panicum	*oligosanthes*	Scribner's panic grass	30
Panicum	*perlongum*	Long-leaved panic grass	37
Panicum	*virgatum*	Sw itchgrass	37
Panicum	*wilcoxianum*	Wilcox's panic grass	27
Schizachyrium	*scoparium*	Little bluestem	70
Sorghastrum	*nutans*	Indian grass	40
Sporobolus	*cryptandrus*	Sand dropseed	45
Sporobolus	*heterolepis*	Prairie dropseed	37
Stipa	*comata*	Needle-and-thread grass	9
Stipa	*spartea*	Porcupine-grass	73

Southern Bulrush Marsh

Genus	Species	Common Name	Likelihood of Establishment	Conservation Coeffiecient	Commonly Commerciall y Available
Shrubs					
Amorpha	*fruticosa*	False indigo	M	6	x
Forbs					
Acorus	*calamus*	Sweet flag	M		x
Alisma	*subcordatum*	Heart-leaved water-plantain	L	4	
Alisma	*triviale*	Ordinary water-plantain	L	4	x
Aster	*lanceolatus*	Panicled aster	M	4	x
Bidens	*species*	Beggar-ticks (multiple species)	M	5	
Boehmeria	*cylindrica*	False nettle	M	5	
Campanula	*aparinoides*	Marsh bellflower	M	5	
Cicuta	*bulbifera*	Bulb-bearing water-hemlock	L	7	
Cicuta	*maculata*	Spotted water-hemlock	L	5	
Epilobium	species	Willow-herb	L	3 to 8	
Eriocaulon	*aquaticum*	Pipewort	L	9	
Eupatorium	*maculatum*	Spotted Joe-pye weed	M	4	x
Eupatorium	*perfoliatum*	Common boneset	M	4	x
Eupatorium	*purpureum*	Sweet Joe-pye weed	M	4	x
Euthamia	*graminifolia*	Grass-leaved goldenrod	M	4	x
Galium	*labradoricum*	Marsh bedstraw	M	9	
Galium	*tinctorium*	Small bedstraw	M	5	
Galium	*trifidum*	Three-cleft bedstraw	M	6	
Hypericum	*majus*	Large St. John's-wort	M	5	
Impatiens	species	Spotted touch-me-not (two species)	H	2 to 5	
Iris	*versicolor*	Northern blue Flag	M	4	x
Ludwigia	*palustris*	Common water primrose	L	5	
Lycopus	*americanus*	Cut-leaved bugleweed	M	4	
Lycopus	*asper*	Rough bugleweed	M	4	
Lycopus	*uniflorus*	Northern bugleweed	M	5	
Lysimachia	*ciliata*	Fringed loosestrife	M	5	x
Lysimachia	*terrestris*	Yellow loosestrife	M	7	
Lysimachia	*thyrsiflora*	Tufted loosestrife	M	6	
Mentha	*arvensis*	Common mint	H	3	
Mimulus	*ringens*	Purple monkey-flower	M	5	x
Nuphar	*luteum*	Yellow pond-lily	L	9	
Nymphaea	*odorata*	Waterlily	L	6	
Physostegia	*virginiana*	Obedient plant	M	6	x
Polygonum	*amphibium*	Water smartweed	M	6	
Polygonum	*lapathifolium*	Nodding smartweed	M	2	
Polygonum	*pensylvanicum*	Pennsylvania smartweed	M	1	
Polygonum	*punctatum*	Dotted smartweed	M	5	
Potentilla	*norvegica*	Rough cinquefoil	M	1	
Ranunculus	*hispidus*	Hispid buttercup	M	6	
Ranunculus	*pensylvanicus*	Bristly buttercup	M	5	
Rumex	*maritimus*	Golden dock	L	1	
Sagittaria	*latifolia*	Broad-leaved arrowhead	M	3	x
Sagittaria	*rigida*	Sessile-fruited arrowhead	M	7	
Scutellaria	*galericulata*	Marsh skullcap	M	5	

Genus	Species	Common Name	Likelihood of Establishment	Conservation Coeffiecient	Commonly Commerciall y Available
Scutellaria	*lateriflora*	Mad-dog skullcap	M	5	
Sium	*suave*	Water-parsnip	L	5	
Sparganium	*androcladum*	Branching bur reed	L	8	
Sparganium	*eurycarpum*	Giant bur-reed	M	5	x
Sparganium	*erectum*	Unbranched bur reed	L	7	
Triadenum	*fraseri*	Marsh St. John's-wort	M	6	
Verbena	*hastata*	Blue vervain	H	6	x
Grasses, Rushes and Sedges					
Calamagrostis	*canadensis*	Bluejoint	M	4	x
Carex	*comosa*	Bristly sedge	M	5	x
Carex	*diandra*	Lesser-panicled sedge	L	9	
Carex	*scoparia*	Pointed-broom sedge	M	4	
Cyperus	*odoratus*	Fragrant cyperus	M	4	
Dulichium	*arundinaceum*	Three-way sedge	M	8	
Eleocharis	*acicularis*	Least spikerush	M	4	
Eleocharis	*elliptica*	Elliptic spikerush	M	7	
Eleocharis	*ovata*	Ovoid spikerush	M	6	
Glyceria	*borealis*	Northern manna grass	M	8	
Glyceria	*grandis*	Tall manna-grass	M	6	x
Juncus	*brevicaudatus*	Narrow-panicled rush	M	7	
Juncus	*effusus*	Soft rush	M	4	x
Juncus	*nodosus*	Knotty rush	M	5	
Juncus	*canadensis*	Canada rush	M	7	
Leersia	*oryzoides*	Rice cut grass	M	3	
Schoeneplectrus	*acutus*	Hard-stemmed bulrush	M	6	x
Schoeneplectrus	*fluviatilis*	River bulrush	M	4	x
Schoeneplectrus	*smithii*	blunt-scale bulrush	M	8	
Schoeneplectrus	*validus*	Softstem bulrush	M	4	x
Scirpus	*atrovirens*	Dark green bulrush	M	4	x
Scirpus	*cyperinus*	Wool-grass	M	3	x
Spartina	*pectinata*	Prairie cord-grass	M	5	x

12.5. Appendix E: Public Engagement

Public engagement for this project consisted of reaching out to the general public via one public meeting at Phase I Inventory and Findings phase, posting updates on the County's webpage for the project, meeting with stakeholder groups, and releasing the final draft plan for a 30-day public review period. In general, there was less interest in this NRMP than others. For instance, Lebanon Hills Regional Park had many comments and many people attended public meetings. For WWRP NRMP, only a handful or people commented and attended public meetings. The comments that were received were positive and supportive of the plan. Below is a summary of the public engagement process.

PHASE I RESEARCH & FINDINGS

- Stakeholder Meetings
    - Stakeholder Meetings were held during the spring and summer of 2018 to get feedback on what was important to the stakeholders.
- Public Open House, August 28, 2018
    - The Research & Findings phase was presented at the Lebanon Hills Visitor Center. Only a few people attended. Comments were positive and everyone was interested and supportive of the plan so far.
- County Board, PDC, October 16, 2018
    - An informational update was presented to the Board

PHASE II VISION, GOALS, RECOMMENDATIONS

- Planning Commission, October 24, 2019
    - The Vision, Goals, and Recommendations phase of the plan was presented to the Planning Commission. A discussion ensued. Comments and edits were incorporated into the plan by staff.
- County Board, PDC, December 3, 2019
    - An informational update was presented to the Board

PHASE III DRAFT FINAL PLAN

- Planning Commission, May 28, 2020
    - The draft WWRP NRMP was submitted to the Planning Commission for their review. A five-year and twenty-year work plan were included that had not been presented before. The commission had several questions, but primarily, the plan was well received and supported by the commission. Comments and edits were incorporated into the plan by staff, following the meeting.
- County Board, PDC, July 7, 2020
    - An informational update and a request to release the plan to the public for a 30-day review period was presented to the Board, which was on consent agenda
    - The Board unanimously approved of the consent agenda, including the draft plan.

- 45-Day Public Review Period
    - The plan was released for a Public Review period starting on July 15 and ending on August 31, 2020 (was extended by 15 days from 30 to 45 days).
    - Public engagement during the review period consisted of the following:
        - Posting the draft plan on the County's website
        - Reaching out to cities, townships, and other stakeholders via email, phone calls, etc.
        - Public Open House
            - An Open House was held on Wednesday, August 6, 2020
            - 18 people attended, plus 3 commissioners and 3 staff
            - The plan was summarized in a PowerPoint presentation
            - Response to the plan was positive and attendees were supportive.
            - There were 7 poll questions asked of attendees during the presentation. The questions and results of responses are summarized below:

Q1. How familiar are you with Whitetail Woods Regional Park?

Very	(2) 67%
Somewhat	(1) 33%
Not very	(0) 0%
Hardly at all	(0) 0%
Not at all	(0) 0%

Q2. Have you noticed any changes in the park's natural resources in the past few years?

Yes many	(1) 33%
Yes a few	(2) 67%
Not really	(0) 0%
Not at all	(0) 0%

Q3. Do you feel the changes are for the better or for the worse?

Better	(3) 100%
Worse	(0) 0%
No opinion	(0) 0%

Q4. How do you feel about introducing wild rice to Empire Lake?

Q5. How do you feel about the direction, vision, and goals of this plan?

Just right	(4) 80%
Very good but needs a little work	(1) 20%
Pretty good with exceptions	(0) 0%
No opinion	(0) 0%

Q6. How do you feel about the priorities laid out in this plan?

Strongly agree with them	(2) 33%
Agree with them	(4) 67%
Agree with some but not others	(0) 0%
No opinion	(0) 0%

Q7. How do you feel about the work plan? About the timing and phasing of tasks and their costs?

It doesn't go far enough	(0) 0%
It's what I expected	(1) 14%
It will take too long	(2) 29%
It's too expensive	(0) 0%
Seems about right	(4) 57%
No opinion	(0) 0%

Are there any additional questions or comments you have?

There were none.

- Both the Vermillion River Watershed Joint Powers Organization and the Dakota Soil and Water Conservation District reviewed the plan and made several comments, mostly regarding water resources management. Some of the comments are listed here:
  - Include the subwatershed analysis in the Work Plan
  - Likes the approach of avoiding impacts to the park natural resources and hopes that it could be achieved more than has been in the past.
  - Identify a responsible party to conduct groundwater monitoring for the project area.
  - Consider increasing piscivorous predator fish via stocking, which could have beneficial effects on water quality of Empire Lake
  - Could Dakota County look into upstream and provide buffering on private and County properties to slow sedimentation and stormwater runoff?
  - Wild rice might come to dominate the lake if introduced.
  - Need to find out how to set back coontail before introducing new aquatic plant species. For example, conducting a draw down first may help reduce coontail.
  - Floating-leaved pondweeds should do well in this shallow lake environment.
  - Consider Met Council's CAMP program for volunteer monitoring of surface waters from April-October
  - This plan focuses on external loading to the lake, but actually there may be a significant amount of nutrients that have entered the lake in the past due to agriculture and sedimentation associated with agriculture that would be causing internal nutrient loading in the lake today. Some sediment analysis may be needed to determine phosphorous release rates.

- Planning Commission, September 26, 2020
  - The plan was brought back to the Planning Commission

    - Comments from the Public Review period and a final draft plan were presented to the Commission
    - The Commission had only one comment and question from Commissioner Graham, who wanted to know whether the NRMP should, if certain elements of the Master Plan are in conflict with high value natural communities or resources, explicitly state in the NRMP where conflicts exist and then describe how the conflicts could be resolved. Staff explained that the document does do that now, but if conflicts arise in the future, they will be dealt with during the planning and design phases of the CIP implementation.
    - The Planning Commission unanimously supported and approved of recommending the Board adopt the final draft plan.
- County Board, PDC, October 13. 2020
    - The plan was brought back to the PDC (County Board) on consent
    - Comments from the Public Review period and a final draft plan were presented to the Commission in their packets.
    - The PDC had no comments or questions about any of the consent agenda items
    - The PDC approved of the final draft plan
- No changes to the plan resulted from the Planning Commission or County Board comments.
- County Board Meeting, October 20, 2020
    - The County Board approved and adopted the NRMP for WWRP
    - Motioned by Commissioner Liz Workman, and seconded by Commissioner Mary Liz Holberg; vote was unanimous
    - Resolution Number 20-518.

BOARD OF COUNTY COMMISSIONERS

DAKOTA COUNTY, MINNESOTA

October 20, 2020 Resolution No. 20-518

Motion by Commissioner Liz WorkmanSecond by Commissioner Mary Liz Holberg

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Adoption Of Natural Resource Management Plan For Whitetail Woods Regional Park

WHEREAS, the County Board adopted the 2012 Whitetail Woods Regional Park (WWRP) master plan, which established a conceptual vision for vegetative cover within the park by Resolution No. 12-107, (February 28, 2012); and

WHEREAS, the approved 2017 Natural Resource Management System Plan recommended that a Natural Resource Management Plan (NRMP) be developed for each County park and greenway by Resolution No. 17-274, (May 23, 2017); and

WHEREAS, Dakota County Parks staff is currently preparing a NRMP for WWRP; and

WHEREAS, on October 16, 2018, the Board received an informational update on the inventory and findings of the WWRP NRMP; and

WHEREAS, on December 3, 2019, the Board received an informational update on the WWRP NRMP vision, goals, and preliminary recommendations; and

WHEREAS, on July 14, 2020, the Board approved the release of the draft plan for public review from July 15 - August 31, 2020; and

WHEREAS, the NRMP for WWRP was released for public review from July 15-August 31, 2020, with the draft NRMP having been posted on the County website and distributed through the County listserv, and the cities of Lakeville, Rosemount, and Farmington, as well as Empire Township were contacted and solicited for feedback on the NRMP, and a virtual open house was held on August 6, 2020, and the Vermillion River Watershed Joint Powers Organization and the Dakota County Soil and Water Conservation District also reviewed the draft NRMP and made comments that resulted in changes to the plan (https://www.co.dakota.mn.us/parks/About/ResourcePlans/Documents/WhitetailWoodsNaturalResourceManagementPlanDraft.pdf); and

WHEREAS, comments were received from the public, and changes were made to the NRMP for WWRP to reflect those comments.

NOW, THEREFORE, BE IT RESOLVED, That the Dakota Board of Commissioners authorizes the final draft Natural Resources Management Plan for Whitetail Woods Regional Park be approved and adopted by the County.

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