# Preliminary

# Natural Resource Management Plan

## for the

# Grannis Family Property Easement

## prepared by

# Dakota County

**July 2016**

# Signature Page

## LANDOWNER

As the landowners of the property permanently protected by a natural area conservation easement (Easement) held by Dakota County, we have reviewed and approve this Preliminary Natural Resource Management Plan (NRMP). We agree to follow the guidelines included in this NRMP to manage that portion of our property included in the Easement (Protected Property). The NRMP will be used to develop a mutually acceptable Landowner Agreement with the County to begin implementing the NRMP. Other applicable local, state and federal laws and regulations not addressed within this NRMP will still be followed.

| | |
|---|---|
| _____ | _____ |
| Vance B. Grannis | Date |
| _____ | _____ |
| Darlene R. Grannis | Date |
| _____ | _____ |
| David L. Grannis III | Date |
| _____ | _____ |
| Joyce Grannis | Date |
| _____ | _____ |
| Susan O'Brien | Date |

## DAKOTA COUNTY

Dakota County has prepared and discussed this NRMP with the landowner. The County agrees to work with the landowner in using the NRMP as the basis for creating a jointly developed Landowner Agreement to implement the NRMP in a fair and reasonable manner. The County will assess and update the NRMP to assist the landowner in managing the Protected Property.

| | |
|---|---|
| _____ | _____ |
| Alan Singer, Land Conservation Manager | Date |

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# I. Executive Summary

## Background

In 2009, Vance and Darlene Grannis, David and Joyce Grannis, and Susan O'Brien (Grannis Family) applied to the Dakota County Farmland and Natural Areas Program (FNAP), seeking permanent protection for 82-acres of their family's property at Marcott Lakes. Their application was subsequently approved and the Department of Natural Resources (DNR) Metro Greenways Program provided matching funds, to acquire a 16.8-acre permanent natural area conservation easement (Easement) as a first phase of a larger land protection project. This prompted a request for the Friends of the Mississippi River (FMR) to develop an initial Natural Resource Management Plan (NRMP) for a larger portion of the property, in coordination with the landowners and the County. The second land protection phase includes acquisition of a 108.7 acre easement. This preliminary NRMP encompasses both easement areas or a total of 125.5 acres.

The Grannis Family property consists of numerous contiguous parcels located in the City of Inver Grove Heights in the northern part of the County. Although the property contains no known rare plant or animal species, it provides important wildlife habitat for many species and water quality benefits. An oak forest on the property was identified by the DNR as important for its biodiversity significance. The property has been identified as ecologically important by the Dakota County Farmland and Natural Areas Protection Plan, is located in the Northern Dakota County Greenway, and is included in a Metro Conservation Corridors Focus Area, a regional land protection plan of the DNR.

## Natural Resource Inventory and Assessment

Historically, the property was likely dominated by oak savanna. The current land cover is: 23.2 acres of cultivated land; 14.5 acres of altered deciduous woodland, 6.3 acres of lakeshore, 31.3 acres of non-native grassland with sparse trees, 23.1 acres of palustrine open water, 17.0 acres of southern dry-mesic woodland, 7.5 acres of southern mesic oak-basswood forest, and 2.6 acres of upland with planted with coniferous trees. Most areas are degraded by a dominance of non-native invasive species – buckthorn in wooded areas, smooth brome in the grasslands, and reed canary grass in the wetlands.

## Final Natural Resource Management Plan Recommendations

This document describes the preliminary recommendations, methods and approximate costs for enhancing the ecological health of the entire property, maintaining the excellent water quality of the lake, and restoring natural communities. The primary proposed restoration involves removing invasive native and exotic brush and trees, repairing erosion, restoring the

woodland to oak woodland and savanna, and enhancing grasslands toward oak savanna. A final plan for the 125.5-acre Easement, including a detailed work plan in the Landowner Agreement, will be jointly developed by the landowners and the County within six months of acquiring the easement.

Although this NRMP is required and cited in the Easement, the landowner is not required to implement all of the recommended activities. The enhancement and restoration activities detailed in the plan are allowable activities that may be completed with the consent of the landowner and the County. Moreover, the plan may be revised or altered with the joint approval of the County and landowners as necessary. Funding and implementing the plan and its associated projects and activities, though strongly encouraged, will be voluntary on the part of current or future landowners.

Other goals outlined by the Grannis' are to expand programs and classes through the Darvan Acres Outdoor Skills and Environmental Education Center (Center), create an interpretive trail system, remove carp from the lake, and conduct bow hunting to control deer and turkey populations.

## Landowner Agreement

A Landowner Agreement between the landowner and the County (and partners) that describes priority activities, schedule, costs, roles, responsibilities, and cash and in-kind contributions will be included in the final NRMP.

# II. Purpose of the NRMP

The purpose of the NRMP is to describe the current and preferred natural resource conditions, goals, and activities for the portion of the landowner's property (Protected Property) included in the Easement held by the County. The NRMP includes information on the Protected Property's location; historic, existing, and adjacent land use; bedrock and surficial geology; soils; topography; hydrology, including groundwater and surface water; historic and existing vegetation cover, noxious and invasive plants, and land cover; ecological impacts, both past and present from land use, fire suppression, diseases, wildlife, and climate change; plant community assessment; wildlife; target vegetation communities, including management priorities and methods; five year work plan; and long-term work plan. The Final NRMP also includes plant restoration goals and recommendations, a restoration process, schedule, and cost estimates.

A Landowner Agreement (Agreement) is developed in conjunction with the NRMP that includes a work plan for implementing jointly agreed upon natural resource activities and priorities. The respective role and responsibilities of the landowners, the County or partners; and schedules, cost estimates and funding/in-kind sources is included in the Agreement.

The status of any approved activity under the Agreement will be monitored and assessed as part of the annual Easement monitoring process. The NRMP will be reviewed and updated every five years, or as needed to maintain its relevancy.

## Contacts

**Dakota County Environmental Resources Department**
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**Friends of the Mississippi River**
Karen Schik
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St. Paul, MN 55101
kschik@fmr.org

# III. General Conservation Easement Information

## Landowner Information

Names: Vance and Darlene Grannis
Address: 9249 Barnes Avenue
City: Inver Grove Heights Zip Code: 55077
Phone Numbers: Home: (651) 457-4448
Office: (651) 456-9000

Names: David L. Grannis III and Joyce Grannis
Address: 306 15th Avenue South
City: South St. Paul, MN 55075

Name: Susan O'Brien
Address: 253 16th Avenue South
City: South St. Paul, MN 55075

## Protected Property Information

Section SW16, NE20 and NW21; Township 27 and Range 22

Name of Watershed: Lower Mississippi River
and Watershed Organization: Lower Mississippi WMO

Parcel Identification Number and Location, and Legal Description of Protected Property:
All eight parcels are in Township 27 North and Range 22 West. Starting in the north-east corner of the Protected Property and proceeding in a clock-wise fashion, the following list of parcels constitute the Protected Property:

1. **PIN 20-01600-54-020:** Southwest portion of Section 16.
2. **PIN 20-02100-29-010:** 9001 Barnes Avenue, Inver Grove Heights, MN, 55077, Northwest part of Section 21
3. **PIN 20-02100-50-014**: 9249 Barnes Avenue, Inver Grove Heights, MN, 55077, Northwest portion of Section 21
4. **PIN 20-02000-03-013**: Northeast part of Section 20
5. **PIN 20-02000-01-012**: Northeast part of Section 20
6. **PIN 20-02000-05-012**: Northeast part of Section 20
7. **PIN 20-14000-01-041**: Northeast part of Section 20
8. **PIN 20-02000-05-013**: Northeast part of Section 20

**Legal Description of the Protected Property Encumbered by Easement I and II on Property Jointly Owned by Vance B. Grannis Jr. and Darlene R. Grannis, David L. Grannis III (AKA David L. Grannis) and Joyce Grannis, and Susan O'Brien**

The South one-half (1/2) of the South one-half (1/2) of the Southwest ¼ of the Southwest ¼ and that part of the Southwest ¼ of the Southeast ¼ of the Southwest ¼ lying Westerly of the centerline of the German Road (now known as Barnes Avenue East) all in Section 16, Township 27, Range 22; also described as The South one-half (1/2) of Lots 11 and 12 and that part of Lot 15 lying Westerly of the centerline of the German Road (now known as Barnes Avenue East), all in the Southwest ¼ of Section 16, Township 27, Range 22.

AND

The Northwest Quarter of the Northwest Quarter of Section 21, Township 27 North, Range 22 West, Dakota County, Minnesota, EXCEPT the West 700 feet of the South 100 feet thereof and also EXCEPTING that part of said Northwest Quarter of the Northwest Quarter lying east of the following described line: Beginning at a point on the north line of said Section 21, distant 987.75 feet east of the northwest corner of said Section 21, thence sight east along said north line and deflect to the right 90 degrees 50 minutes a distance of 1309.52 feet to the south line of said Northwest Quarter of the Northwest Quarter and said line there terminating.

AND

The Northeast ¼ of the Northeast ¼ of Section 20, Township 27, Range 22 EXCEPT that part of the NE ¼ of the NE ¼ of Section 20, Township 27N, Range 22W, Dakota County, Minnesota, lying Northerly, Northeasterly and Northwesterly of the following described line:

Commencing at the Northwest corner of said E ½ of the NE ¼; thence southerly, along the west line of said E ½, a distance of 600.00 feet to the point of beginning of the line to be described; thence easterly, parallel with the north line of said E 1/2, a distance of 300.00 feet; thence southeasterly 550 feet, more or less, to a point which is 750.00 feet east of the west line of said E ½ (measured parallel with said north line) and 1025.00 feet south of said north line (measured at a right angle to said north line); thence northeasterly 900.00 feet, more or less, to a point on the east line of said E 1/2, which point is 300.00 feet south of the NE corner of said E ½ (measured along said east line) and there terminating.

And EXCEPT the South 100 feet of the East 565 feet of the North ½ of the Northeast ¼ of Section 20, Township 27, Range 22;

And EXCEPT Five acres in the southwest corner of the Northeast Quarter of the Northeast Quarter of said Section 20, the west and south lines of which are the west and south line of said

Northeast Quarter of the Northeast Quarter respectively and which five acre parcel forms a parallelogram having four equal sides.

AND

Together with that part of the Southeast Quarter of the Northeast Quarter of Section 20, Township 27 North, Range 22 West, Dakota County, Minnesota lying south of the north 950.00 feet thereof and easterly of the following described line: Commencing at the southwest corner of said Southeast Quarter of the Northeast Quarter; thence easterly to the southeast corner of the West Half of said Southeast Quarter of the Northeast Quarter, said point being the point of beginning of the line to be described; thence northerly at a right angle 110.00 feet; thence North 36 degrees 42 minutes 10 seconds East (assuming the west line of said Southeast Quarter of the Northeast Quarter has a bearing of North 00 degrees 11 minutes 35 seconds East) to the south line of the north 990.00 feet of said Southeast Quarter of the Northeast Quarter; thence northerly at a right angle to said south line of the north 990.00 feet, to the south line of the north 950.00 feet of said Southeast Quarter of the Northeast Quarter and there terminating.

AND

The East 565.00 feet of the South 100.00 feet of the North Half of the Northeast Quarter of Section 20, Township 27 North, Range 22 West, Dakota County, Minnesota and the East 565.00 feet of the North 950.00 feet of the South Half of the Northeast Quarter of Section 20, Township 27 North, Range 22 West, Dakota County, Minnesota EXCEPTING therefrom the following described parcel:

Beginning at the northeast corner of said South Half of the Northeast Quarter of Section 20; thence North 89 degrees 48 minutes 48 seconds West on an assumed bearing along the north line of said South Half of the Northeast Quarter, a distance of 116.48 feet; thence South 00 degrees 11 minutes 18 seconds East a distance of 261.97 feet; thence South 39 degrees 36 minutes 04 seconds West a distance of 208.63 feet; thence North 89 degrees 48 minutes 48 seconds West a distance of 143.65 feet; thence South 00 degrees 11 minutes 18 seconds East a distance of 234.27 feet; thence South 89 degrees 48 minutes 48 seconds East a distance of 393.66 feet to the east line of said South Half of the Northeast Quarter of Section 20; thence North 00 degrees 11 minutes 18 seconds West along said east line a distance of 657.42 feet to the point of beginning.

AND

That part of the E ½ of the NE ¼ of Section 20, Township 27N, Range 22W, Dakota County, Minnesota, lying Northerly, Northeasterly and Northwesterly of the following described line:

Commencing at the Northwest corner of said E ½ of the NE ¼; thence southerly, along the west line of said E ½, a distance of 600.00 feet to the point of beginning of the line to be described; thence easterly, parallel with the north line of said E ½, a distance of 300.00 feet; thence southeasterly 550 feet, more or less, to a point which is 750.00 feet east of the west line of said E ½ (measured parallel with said north line); and 1025.00 feet south of said north line (measured at a right angle to said north line); thence northeasterly 900.00 feet, more or less, to a point on the east line of said E ½, which point is 300.00 feet south of the NE corner of said E ½ (measured along said east line) and there terminating.

AND

That part of the South Half of the Northwest Quarter of Section 21, Township 27 North, Range 22 West, Dakota County, Minnesota described as follows:

Beginning at a point on the west line of the Northwest Quarter of said Section 21, distant 356.18 feet northerly of the southwest corner thereof; thence North 00 degrees 32 minutes 38 seconds West on an assumed bearing along the west line of said Northwest Quarter, a distance of 950.05 feet to the northwest corner of the South Half of the Northwest Quarter of said Section 21; thence North 88 degrees 52 minutes 14 seconds East along the north line of the South Half of said Northwest Quarter, a distance of 1603.00 feet to the centerline of C.S.A.H. No. 73 (Barnes Avenue); thence South 16 degrees 10 minutes 07 seconds West along said centerline, a distance of 617.58 feet; thence South 88 degrees 52 minutes 14 seconds West a distance of 485.98 feet; thence South 46 degrees 22 minutes 00 seconds West a distance of 176.19 feet; thence South 88 degrees 52 minutes 14 seconds West a distance of 310.77 feet; thence South 29 degrees 54 minutes 00 seconds West a distance of 132.36 feet; thence South 45 degrees 24 minutes 00 seconds West a distance of 185.89 feet; thence South 88 degrees 52 minutes 14 seconds West a distance of 299.30 feet to the point of beginning.

EXCEPTING therefrom the easterly 75.00 feet for public road purposes and also EXCEPTING therefrom that part lying northerly of the following described line: Commencing at the southwest corner of said Northwest Quarter of Section 21; thence North 00 degrees 32 minutes 38 seconds West on an assumed bearing along the west line of said Northwest Quarter, a distance of 873.13 feet to the point of beginning of the line to be described; thence North 39 degrees 14 minutes 44 seconds East a distance of 227.18 feet; thence North 88 degrees 52 minutes 14 seconds East a distance of 154.62 feet; thence North 47 degrees 04 minutes 30 seconds East a distance of 277.58 feet; thence North 88 degrees 52 minutes 14 seconds East a distance of 1075.34 feet to said centerline of C.S.A.H. No. 73 (Barnes Avenue) and said line there terminating.

Together with the west 700.00 feet of the south 100.00 feet of the North Half of the Northwest Quarter of Section 21, Township 27, Range 22, Dakota County, Minnesota.

AND

Five acres in the SW corner of the Northeast ¼ of the Northeast ¼ of Section 20, Township 27, Range 22, Dakota County, Minnesota, the west and south lines of which are the west and south lines of said NE ¼ of the NE ¼ respectively, and which 5-acre parcel forms a parallelogram having 4 equal sides.

Together with the SE ¼ of the NE ¼ of Section 20, Township 27 North, Range 22 West, Dakota County, Minnesota, excepting therefrom the east 565.00 feet of the North 950.00 feet thereof,

Further excepting therefrom that part of said SE ¼ of the NE ¼ lying southwesterly and southerly of the following described line:

Commencing at the SW corner of said SE ¼ of the NE ¼; thence North 0 degrees 11 minutes 35 seconds East, assumed bearing, along the west line of said SE ¼ of the NE ¼ a distance of 825.00 feet to the point of beginning of the line to be described; thence South 75 degrees 39 minutes 31 seconds East, 540.00 feet; thence southeasterly to the SW corner of said east 565.00 feet of the north 950.00 feet; thence easterly, along the south line of said north 950.00 feet, to the east line of said SE ¼ of the NE ¼ and there terminating.

And further excepting that part of the SE ¼ of the NE ¼ of Section 20, Township 27 North, Range 22 West, Dakota County, Minnesota, lying south of the north 950.00 feet thereof and easterly of the following described line:

Commencing at the SW corner of said SE ¼ of the NE ¼; thence easterly to the SE corner of the W ½ of said SE ¼, of the NE ¼, said point being the point of beginning of the line to be described; thence northerly at a right angle 110.00 feet; thence North 36 degrees 42 minutes 10 seconds East (assuming the west line of said SE ¼ of the NE ¼ has a bearing of North 0 degrees 11 minutes 35 seconds East) to the south line of the north 990.00 feet of said SE ¼ of NE ¼; thence northerly at a right angle to said south line of the north 990.00 feet, to the south line of the north 950.00 feet of said SE ¼ of the NE ¼ and there terminating.

And

Lot 4, Block 1, Birch Pond except the South 900 feet thereof, Dakota County, Minnesota.

Area = 125.5 acres

## Access to Protected Property

General Description:

From the County's northern boundary, take U.S. Highway 52 south, and take the 80th Street East exit toward Minnesota Highway 55 West. Continue on Barnes Avenue for 1.5 miles. The Protected Property will be on the right.

From the southern boundary at the City of Randolph, proceed on 52 North 20.5 miles. Exit at Dakota County Road 65 and Concord Boulevard. Take a left onto Concord Boulevard East, and then turn right onto Courthouse Boulevard. After one mile, turn left on Barnes Avenue, and the Protected Property will be .8 miles on the right.

From the east (South Saint Paul), take Interstate 494 west, and then take 52 south for 3.3 miles, and take the 80th Street exit which turns into Barnes Avenue after crossing 80th Street East. Follow Barnes Avenue south for 1.6 miles and the Protected Property will be on the right.

From the west, follow Interstate 494 east, and then take Dodd Road toward Minnesota Highway 55. Take the Barnes Avenue exit toward County Road 73. Turn right on Barnes Avenue, and the Protected Property will be 0.8 miles on the right.

Legal Description of Protected Property Access Easement:

A permanent easement for access purposes over and across part of the Northwest 1/4 of Section 21, Township 27 North, Range 22 West Dakota County, Minnesota described as follows:

A 10.00-foot wide strip of land in said Northwest 1/4 lying Northerly of and contiguous to the plat of Shamrock Oaks, according the recorded plat thereof, Dakota County, Minnesota, and lying Westerly of the centerline of C.S.A.H. No. 73 (Barnes Avenue) and lying Easterly of a line 75.00 feet Westerly of and parallel to said centerline of C.S.A.H. No. 73 (Barnes Avenue).

AND

A permanent easement for access purposes over and across the south 10.00 feet of the Southeast Quarter of the Southwest Quarter of Section 16, Township 27 North, Range 22 West Dakota County, Minnesota lying westerly of the centerline of C.S.A.H. No. 73 (Barnes Avenue).

**Easement Acquisition Date:** _____ 2016.

**Recorded Document Number and Date:** To Be Determined

**Funding Sources for Acquisition of the Easement:** ML13 Outdoor Heritage OH Funds, Dakota County Land Conservation Capital Improvement Program and Landowner Donation.

# IV. Introduction

Most of Dakota County's 400,000 residents live in the highly urbanized northern one-third of the County, a rolling landscape bordered by major rivers on the north and dotted with lakes, forests, wetlands and other natural areas. The southern two-thirds of the County are generally level and open where agriculture is the predominant land use. This portion of the County is dissected by many streams and tributaries, and includes the largest tracts of natural areas.

As a result of the County's rich soils and close proximity and easy transportation access to St. Paul and Minneapolis, the combination of agricultural use and suburban development has resulted in the loss of most pre-settlement wetlands, prairies, savannas, and upland forests. Many of the remaining natural areas are degraded and fragmented which make it increasingly difficult for them to function as healthy ecosystems. Moreover, many of the remaining natural areas are the most attractive undeveloped areas for future residential development. Although relatively few in number and extent, some of these natural areas include important plant and animal communities. Residential surveys consistently indicate that the majority of County citizens think it is important that the County has an active role in protecting these areas.

To address citizen's concerns over the loss of open space and natural areas throughout the County, and to determine how to protect these areas using incentive-based tools, the Dakota County Board adopted the "Dakota County Farmland and Natural Area Protection Plan" (Plan) in 2002. The Plan identified 36,000 acres of high quality natural areas as a priority for protection which overlapped with the nearly 60,000 acres of land eligible for farmland protection. The Plan identified the following public purposes for protecting natural areas:

- Increase property values and enhance neighborhoods appeal
- Provide close-to-home opportunities for people to enjoy and interact with nature
- Provide critical habitat for plants and animals and preserving critical ecological connections between habitat areas
- Provide environmental services, including filtering pollutants from soil and water, reducing soil erosion, and absorbing air pollutants and carbon dioxide
- Provide natural flood control for area streams and rivers by retaining wetlands and vegetated corridors to absorb flood waters

Citizen input was used to identify the desired characteristics for natural areas:

- Lands of biological significance
- Lands adjacent to lakes, rivers, and streams to improve water quality
- Lands that provide wildlife habitat
- Lands that provide some level of public access

The Plan found that there were high quality natural areas worth protecting and identified three primary strategies to protect these areas:

**Strategy 1**: Protect priority natural areas in eligible areas and corridors using conservation easements and fee title acquisition from willing sellers and donors.

**Strategy 2**: Work with other agencies through their programs to protect County priority natural areas.

**Strategy 3:** Work with owners of large land tracts and agencies to protect natural areas on their properties with conservation easements and natural resource management plans.

The Farmland and Natural Areas Program (FNAP) was developed to implement the Plan and was initially funded through a $20 million bond referendum approved by voters in November 2002. Half of the funds were targeted for protecting highly productive farmland and associated natural areas and half of the funds were focused entirely on natural areas. The first FNAP application round occurred in 2003, with annual application rounds thereafter. The program seeks to work with landowners and a wide variety of partners to protect, restore, and connect threatened natural areas throughout the County to assure that the ecological, social, and financial benefits of these areas can be maintained and enhanced. A County Board-appointed Citizen Advisory Committee reviewed and evaluated land protection projects and made recommendations to the County Board until 2011 when the bond funds had been entirely expended. Currently, County and Dakota County Soil and Water Conservation District (SWCD) staff evaluate and recommend projects for County Board consideration. Projects are funded through a mix of federal, state, County, and local funds.

Building on the concepts in the FNAP, the County Board approved the Vermillion River Corridor Plan in November 2010, which sought the enhanced protection and improvement of water quality and wildlife habitat with increased opportunities for outdoor recreation for the Vermillion River corridor and its major tributaries. In 2012, the County began the ShoreHolders Program to implement the Corridor Plan goals along all of the rivers, streams and undeveloped lakeshore throughout the County. In 2015, these programs were merged into the Land Conservation Program. Matching State Environment and Natural Resource Trust Fund (ENTRF) and Outdoor Heritage OH Fund grants have been appropriated to the County to implement its programs.

## A. Natural Area Protection

Natural area projects include permanent conservation easements on private lands and funding assistance to other public entities to acquire fee title. Diverse projects ranging from private open spaces and special city parks to DNR Wildlife and Aquatic Management Areas and

Scientific and Natural Areas, totaling over 3,000 acres, have been completed. These easement and fee title acquisition projects are located throughout the County. The County has expended more than $9 million on projects to-date, which has leveraged an additional $38 million in non-County funding and landowner donation. An estimated 40 miles of river, stream and lake shoreline have been protected through the County's related conservation efforts on private and public land. Natural area protection and natural resource management focuses on the improvement and preservation of water quality, wildlife habitat and other benefits of protecting and managing undeveloped open space and shoreland areas. All local government and private Easement projects require a Natural Resource Management Plan (NRMP).

### B. Farmland Protection

More than 7,700 acres have been protected since 2004 through agricultural conservation easements funded with federal and County funds and landowner donation. Many of these projects involve the creation of permanent, vegetative buffers along all rivers, streams and wetlands and maintaining significant associated natural areas in addition to preventing development on cultivated land. Approximately 1,300 acres of riparian and other natural areas have been protected within these agricultural easements, including 48 miles of shoreline. Stewardship Plans, describing voluntary best management practices, are required for all agricultural easements. With the assemblage of larger blocks of contiguous, protected land and changes in the project evaluation criteria, agricultural easement projects are protecting more substantive natural areas. NRMPs are developed for appropriate agricultural easement projects.

## V. Landscape Context

### A. Location

Several different greenway corridor-planning efforts have taken place in Dakota County to designate the most important parcels to consider for permanent protection and/or natural resource restoration, based on various ecological criteria. The Marcott Lakes properties fall within the Metro Conservation Corridors, a regional land protection plan of the DNR and the Northern Dakota County Greenway - a local greenway plan. The property is also included in the FNAP natural areas eligibility zone. For more contexts of these features relative to the location of the Protected Property, refer to Figures 1, 2 and 3.

The Grannis Family is the owner of eight parcels totaling 134.2 acres. As shown in red outline in Figure 1, the Protected Property consists of 125.5 acres within this area, and is dominated in its western portion by a 19-acre lake and a three-acre pond. The upland contains a mixture of oak

forest, woodland and grassland. Though the site is degraded by historic agricultural uses, it nevertheless provides important wildlife habitat and natural area connectivity across the landscape. Because the Protected Property is fully protected by perennial vegetation surrounding the water bodies, soil is prevented from eroding from the steep slopes north-east of the lake, and south-west of the pond. The eight-acre oak forest was designated in the DNR county biological survey as having moderate biodiversity significance.

## B. Historic and Existing Land Use

European settlement significantly changed the Dakota County landscape. Native prairies were plowed, forests and woodlands cut, wetlands drained, fires suppressed, and intense agricultural practices introduced, including row cropping and livestock grazing.

Some of the best evidence of past land use is depicted in historical aerial photographs. Figures 4 through 6 are historic aerial photos for the Protected Property and surrounding area from 1937 to 2015.

Vance Grannis' grandfather purchased portions of the existing property in 1920 and used it for a dairy farm. In 1955 he purchased the area north of the lake, in part, to control the deepening of gullies and continued sedimentation and deterioration of lake water quality caused by adjacent farming activities. He converted cropland to grassland, constructed earthen berms and planted pine trees to effectively halt the soil erosion.

All parts of the Protected Property have been used for pasture at some time, but most of the grazing ceased in the 1950's and 60's. The Protected Property south of the house (exception area) is currently horse pasture. The Protected Property was never logged and only dead wood was used for firewood.

Vance and Darlene Grannis moved to the property in 1963. Vance excavated the wetland to the southeast of the lake and constructed islands, for the purpose of raising trumpeter swans and other waterfowl to release into the wild. The location of the wetlands is shown on Figure 16 as a reverse 'C', in the southern portion of the Protected Property.

In recent years the Protected Property has mostly been used for passive recreation and limited educational programs. Some ecological restoration work has been done, primarily exotic brush removal along the south edge of the lake and south of the horse pasture.

Also of note is the Xcel pipeline located in a north-south transect east of the lake.

## C. Adjacent Land Use

The adjacency of parkland, cultivated land, open areas, and residential sub-divisions can affect vegetation 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.

The properties immediately adjacent to Grannis' are primarily large-lot houses and natural or semi-natural areas. Recently, new homes were built immediately south of the Protected Property. As shown in the yellow diagonal area in Figure 3 directly northwest of the Protected Property, the County acquired a 103-acre permanent natural area easement in 2012.

The primary concern from adjacent residential properties is runoff. A culvert near the southwest border of the Protected Property (**Photos 1 and 2**) conveys a significant amount of sediment from a housing development toward the lake. A delta of recent sediment can be seen on the forest floor, and the culvert has partially filled with sediment. While it did not appear that the sediment had reached the lake, the water and any pollutants within it could reach the lake.

Photo 1 Culvert off-site to the west, carrying sediment from housing.

Photo 2 Sediment outwash from culvert covering ground.

Once the property is restored to native vegetation, there may be issues with exotic species, commonly found on unmanaged properties, spreading to the restoration area. Providing information to adjacent property owners about exotic species identification and control is one way to potentially reduce the spread of those species.

## D. Rare Features of the Protected Property

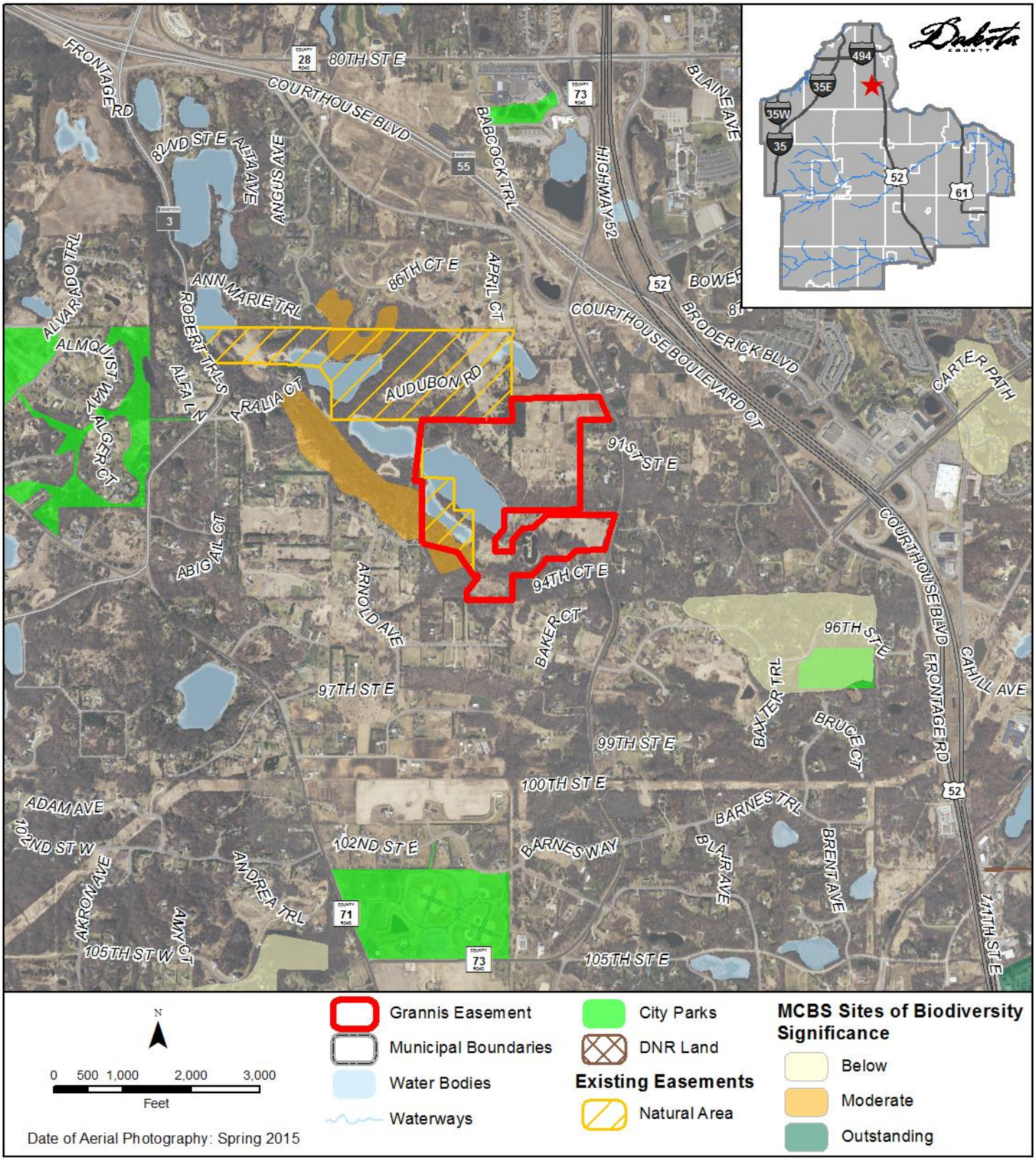
The DNR Natural Heritage Database has no records of rare plant or animal occurrences at or near the Protected Property. Blandings turtle (*Emydoidea blandingii*), a special concern species, is the closest record, over a mile away. Suitable habitat for this species exists at the Grannis

Family property, but it was not detected in a brief herpetological survey in 2009. Blandings turtle has a state rank of S2, meaning it is imperiled due to rarity.

The mesic oak-basswood forest at the property was classified by the DNR as having moderate biodiversity significance.

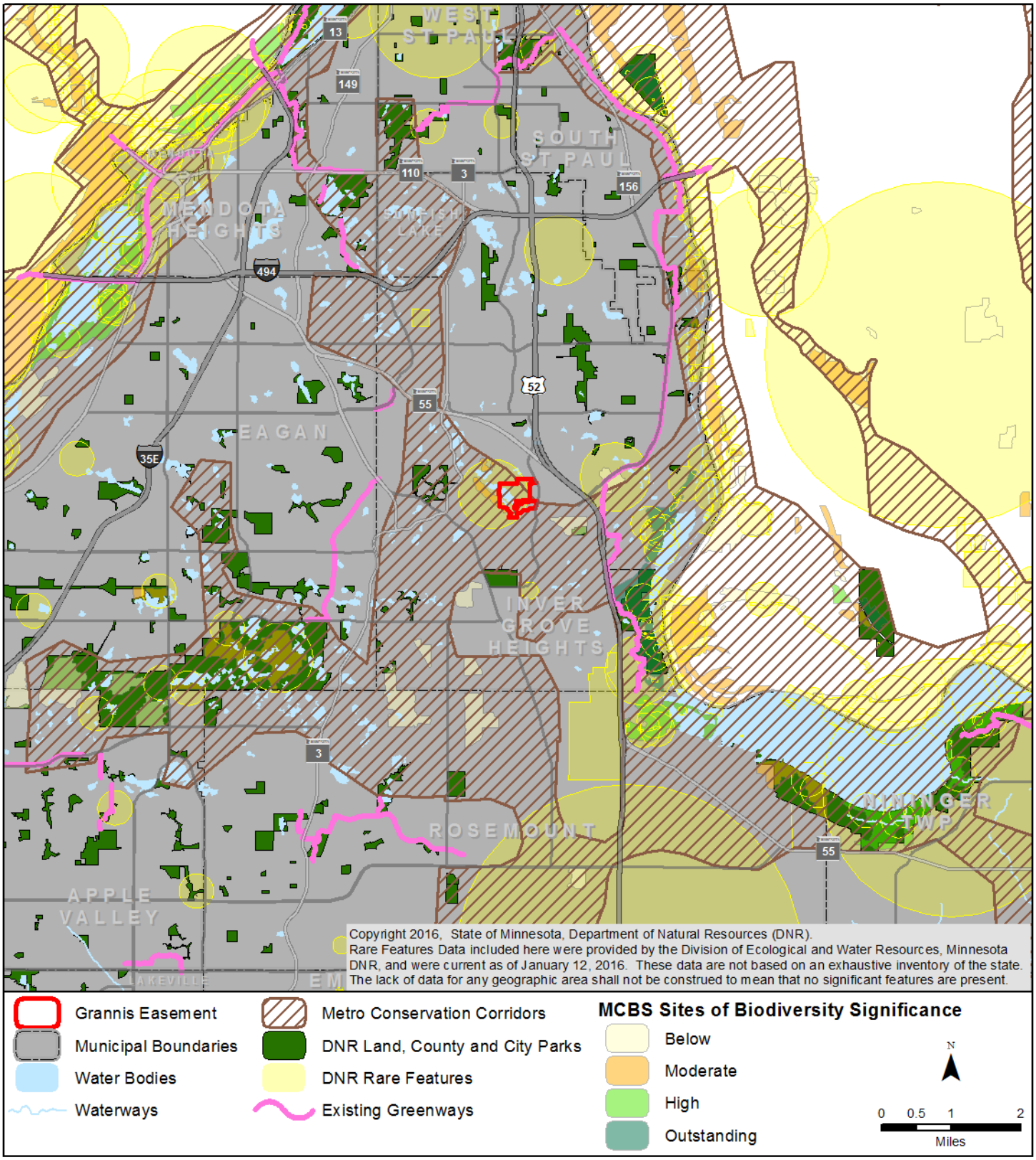
Although there were no rare species recorded at the property, *Tomorrow's Habitat for the Wild and Rare* (DNR 2006) shows that within the vicinity of the Grannis Family property there are 16 to 20 "Species of Greatest Conservation Need" (SGCN) – species whose populations have declined, primarily due to habitat loss. The key habitats are prairie, savanna and grassland, with forests also being important. Bird wildlife are the primary species group for these habitats, with 17 SGCN in grasslands, 16 in savanna and forest, and 15 in prairie (some species are in multiple habitats). It is important to manage the Protected Property to increase habitat for these species, which include rose-breasted grosbeak, eastern wood pewee, black-billed cuckoo, and wood thrush. The site may also provide habitat for SGCN reptiles, amphibians, insects, and mammals. For a more complete discussion of the SGCN that have been documented at the Protected Property, refer to the 'Existing Wildlife' and 'Indicator Species' sections of this Plan which being on page 95. Surveys of the animal communities, especially birds, would be valuable for documenting existing conditions. As restorations activities occur, subsequent surveys may show how the changes affect wildlife.

## Figure 1. Location of Natural Area Easement




tha

## Figure 2. Sub-Regional Landscape Context



## Figure 3. Local Landscape Context

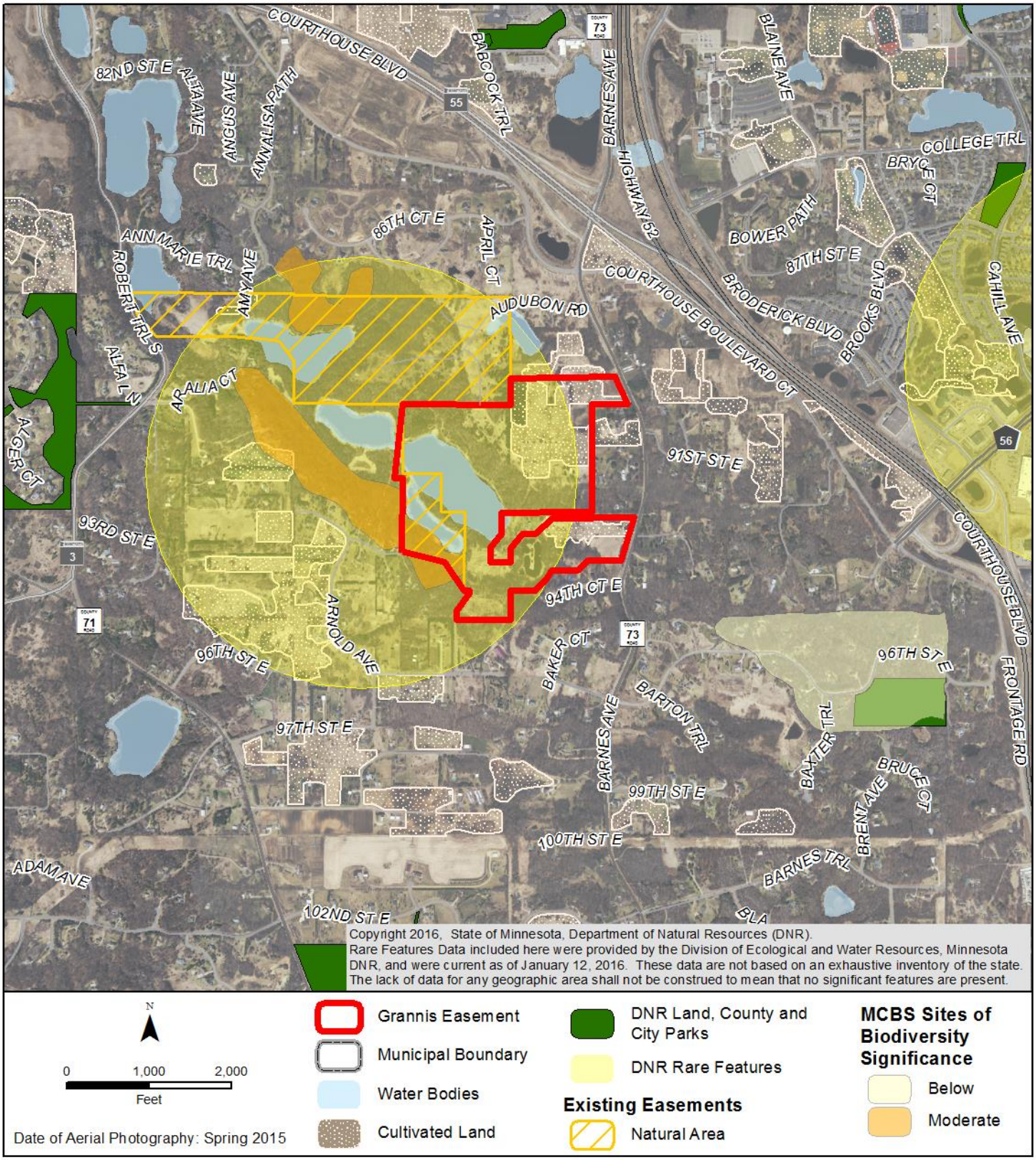


**Figure 4. 1937 Historical Aerial Photo**

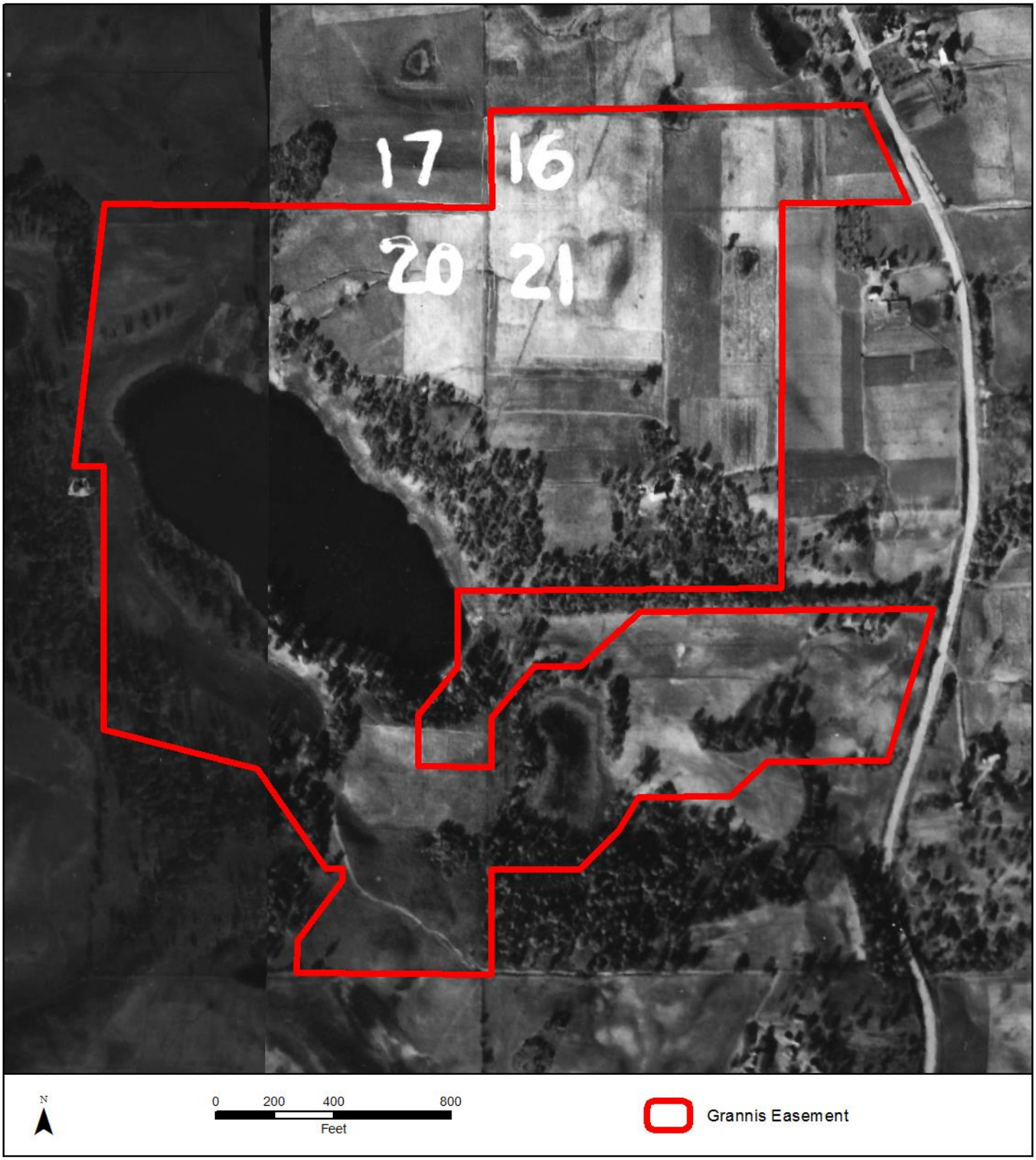


**Figure 5. Historical Aerial Photos**

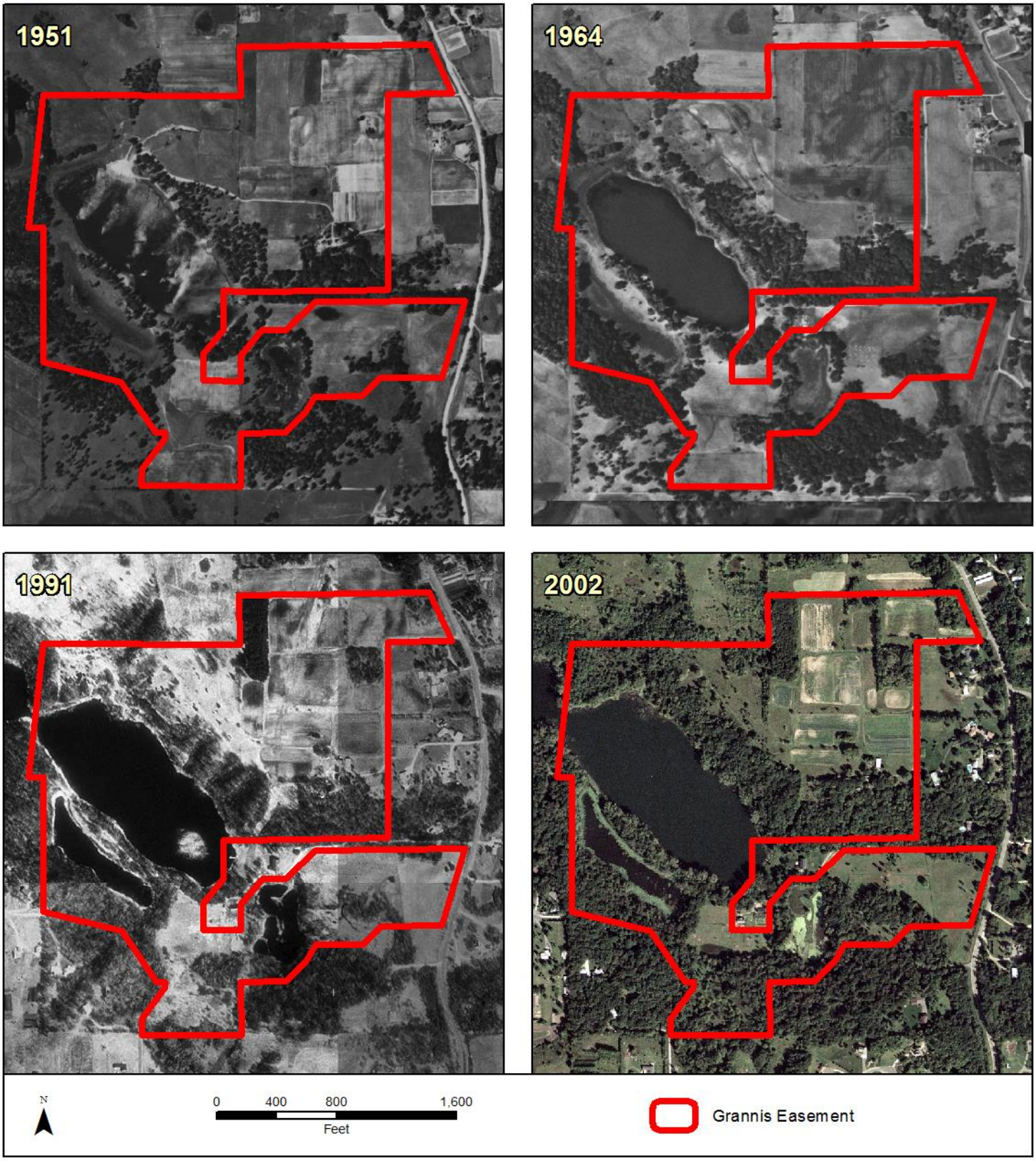
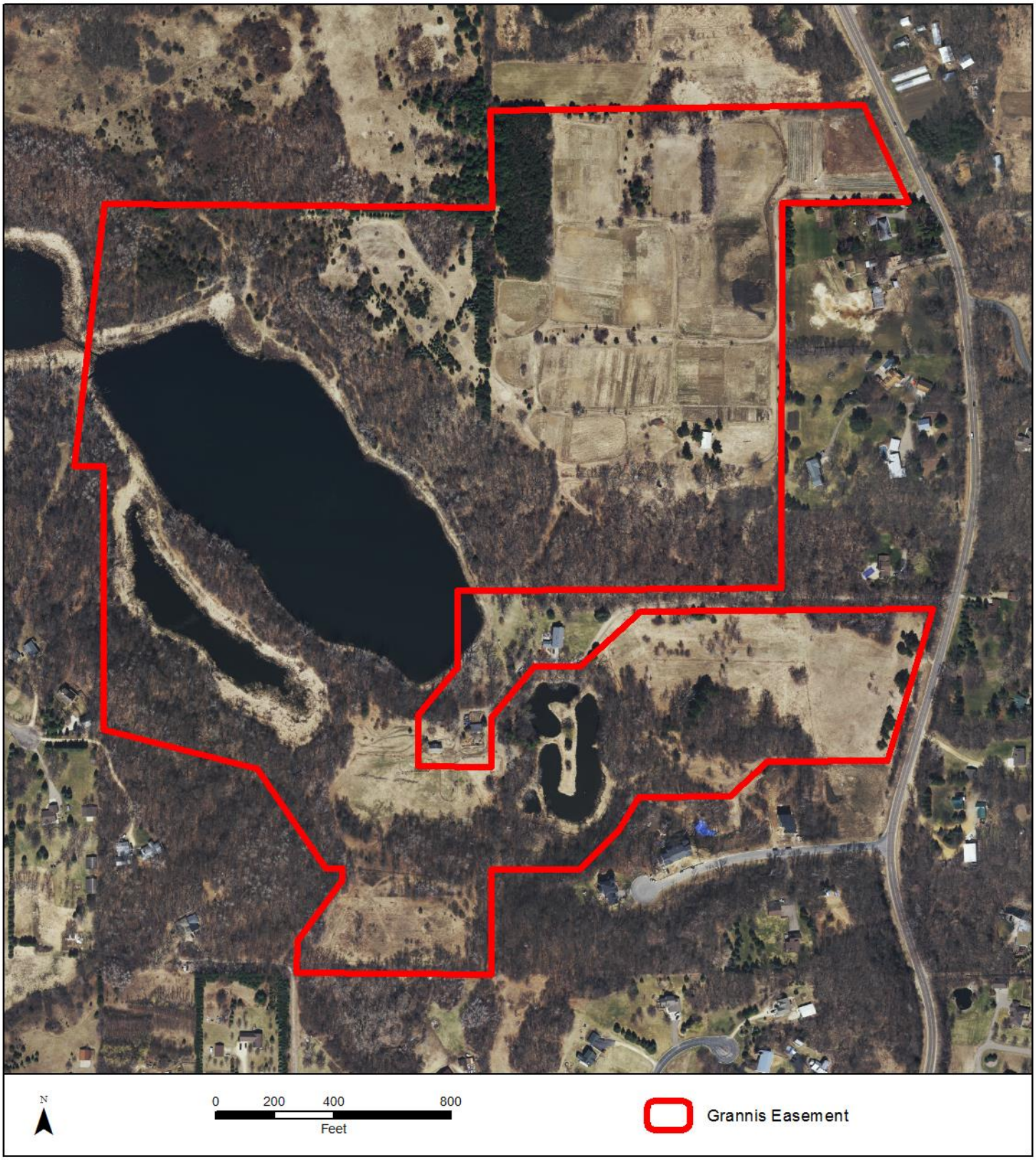


**Figure 6. 2015 Aerial Photo**



# VI. Physical Conditions

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

## A. Geology

Glaciers were the primary force that shaped the present-day landscape of the Twin Cities metropolitan area. They determined the existing soil types, which, in turn, affected the types of plant communities that developed. Glacial activity carved the landscape of the region, worked and re-worked the land surface, and deposited tremendous amounts of till and outwash. Soils at the Grannis property formed primarily on glacial till deposits left by the Superior lobe, which advanced and retreated several times in the late Wisconsin period, 30,000 to 14,000 years ago (Hobbs, Aronow and Patterson 1990). The glacial till was a reddish brown, sandy loam, with cobbles and boulders. Masses of sand and gravel were also common. Below the till is a layer of sand and gravel outwash and below that is more till. Marcott Lakes lies along the northeast side of Rich Valley, which was formed by glacial river meltwater during the Late Wisconsinan period.

The depth to bedrock is about 150 to 250 feet over most of the Protected Property. Bedrock consists of the Prairie du Chien group, marine sedimentary rocks formed by ancient shallow seas that covered the area. Prairie du Chien bedrock contains the Prairie du Chien aquifer over much of its expanse. This aquifer underlies most of the County and is a primary source of drinking water. The water table at the Protected Property is at a depth of 50 to 250 feet in the northeast half, and 250 to 500 feet in the southwest half. Groundwater flow is toward the southwest. The Protected Property has a rating of “Moderate” for sensitivity of the Prairie du Chien-Jordan aquifer to pollution (Balaban and Hobbs 1990). The estimated travel time for water-borne contaminants from the surface to reach the aquifer is several years to decades.

## B. Aquifer Sensitivity and Water Quality Considerations

Groundwater is contained in aquifers, which are underground layers of water-bearing permeable rock, rock fractures or unconsolidated materials (gravel, sand or silt), from which groundwater can be extracted using a well.

The DNR defines groundwater sensitivity as an area where natural geologic factors create a significant risk of groundwater degradation through the migration of waterborne contaminants. Migration of contaminants dissolved in water through unsaturated and saturated sediments is

affected by many things, including biological degradation, and contaminant type and density. General assumptions include:

- Contaminants move conservatively with water
- Flow paths are vertical
- Permeability of the sediment is the controlling factor

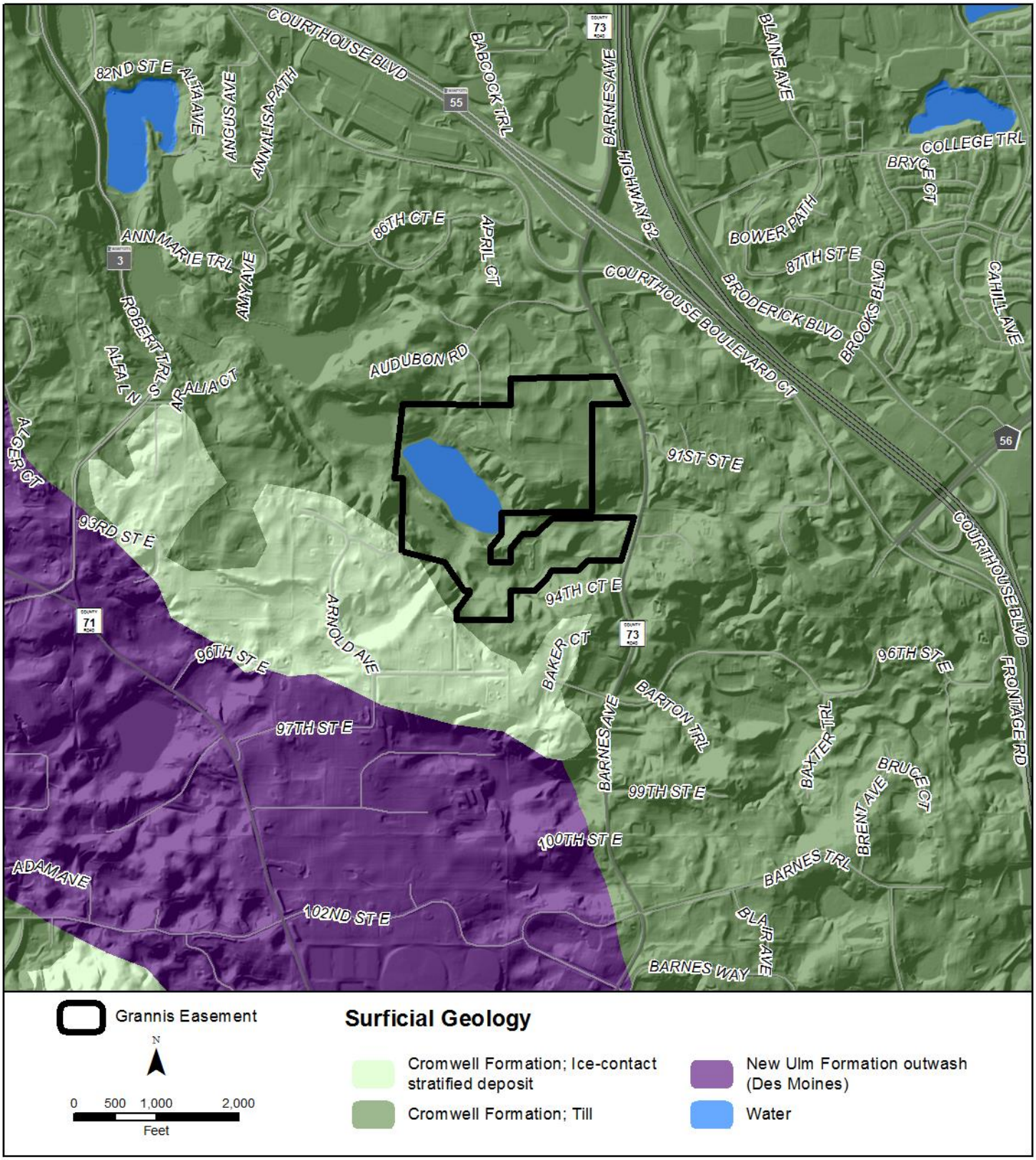
Infiltration rates are based on the soil type and the texture of surficial geology. The travel time varies from hours to approximately a year. The pollution sensitivity of buried sand and gravel aquifers and of the first buried bedrock surface represents the approximate time it takes for water to move from land surface to the aquifer.

Five relative classes of geologic sensitivity are based on overlapping time of travel ranges (Very High, High, Medium, Low, and Very Low). The pollution sensitivity is inversely proportional to the time of travel.

- In areas of higher sensitivity contaminants may reach the groundwater within hours to months.
- In areas of lower sensitivity there is time for a surface contamination source to be investigated, and possibly corrected, before serious groundwater pollution develops.

With reference to Figure 11, the Prairie du Chien bedrock underlying the Protected Property is moderately sensitive to surface pollution

## Figure 7. Surficial Geology



## C. Soils

Extensive work in identifying and classifying soils has been undertaken because of its importance to management and restoration of the Protected Property. The "Soil Survey of Dakota County Minnesota," issued April 1983 and updated in May 1994, provides a generalized depiction and descriptions of soils in Dakota County. Soil formation is the result of the interaction of five soil-forming factors: parent material, climate, organisms, topographic position or slope, and time (Foth, 1990). Taken collectively, these factors can help determine the dominant plant and animal communities that helped form the soils. There are ten general soil units based on formation, relief, and drainage. Soil units/types are important because they affect the vegetative and hydrologic features of the Protected Property, and suggest the most appropriate use and management of the land.

**Table 1: Soil Types at Grannis Property**

| Soil Code | Soil Name | Taxonomic Class | % Slope | Acres | Drainage | Depth to water table (cm) | Hydric Soil? | Highly Erodible? |
|---|---|---|---|---|---|---|---|---|
| 150B | Spencer silt loam | Fine-silty, mixed, superactive, frigid Oxyaquic Glossudalfs | 3 | 1.86 | Moderately well drained | 76 | Yes | No |
| 1816 | Kennebec variant silt loam | Fine-silty, mixed, superactive, mesic Cumulic Hapludolls | 1 | 0.11 | Moderately well drained | 91 | Yes | No |
| 1824 | Quam silt loam, ponded | Fine-silty, mixed, superactive, frigid Cumulic Endoaquolls | 0.5 | 3.02 | Very poorly drained | 0 | Yes | No |
| 189 | Auburndale silt loam | Fine-silty, mixed, superactive, frigid Mollic Epiaqualfs | 0.5 | 1.1 | Poorly drained | 0 | Yes | No |
| 1902B | Jewett silt loam | Fine-loamy, mixed, superactive, frigid Typic Hapludalfs | 3 | 4.37 | Well drained | 201 | No | No |
| 250 | Kennebec silt loam | Fine-silty, mixed, superactive, mesic Cumulic Hapludolls | 1 | 0.48 | Moderately well drained | 91 | No | No |
| 313 | Spillville loam, occasionally flooded | Fine-loamy, mixed, superactive, mesic Cumulic Hapludolls | 0.5 | 7.79 | Moderately well drained | 91 | No | No |
| 342B | Kingsley sandy loam | Coarse-loamy, mixed, superactive, mesic Mollic Hapludalfs | 4 | 13.3 | Well drained | 201 | Yes | No |
| 342C | Kingsley sandy loam | Coarse-loamy, mixed, superactive, mesic Mollic Hapludalfs | 10 | 20.37 | Well drained | 201 | Yes | No |
| 342E | Kingsley sandy loam | Coarse-loamy, mixed, superactive, mesic Mollic Hapludalfs | 20 | 0.7 | Well drained | 201 | No | Yes |
| 342F | Kingsley sandy loam | Coarse-loamy, mixed, superactive, mesic Mollic Hapludalfs | 30 | 28.59 | Well drained | 201 | No | Yes |
| 344 | Quam silt loam | Fine-silty, mixed, superactive, frigid Cumulic Endoaquolls | 0.5 | 1.83 | Very poorly drained | 0 | Yes | No |
| 539 | Palms muck | Loamy, mixed, euic, mesic Terric Haplosaprists | 0 | 3.89 | Very poorly drained | 0 | Yes | No |

| Soil Code | Soil Name | Taxonomic Class | % Slope | Acres | Drainage | Depth to water table (cm) | Hydric Soil? | Highly Erodible? |
|---|---|---|---|---|---|---|---|---|
| 7D | Hubbard loamy sand | Sandy, mixed, frigid Entic Hapludolls | 15 | 0.09 | Excessively drained | 201 | No | Potentially |
| 895B | Kingsley-Mahtomedi-Spencer complex | Coarse-loamy, mixed, superactive, mesic Mollic Hapludalfs | 4 | 2.11 | Well drained | 201 | No | No |
| 895C | Kingsley-Mahtomedi-Spencer complex | Coarse-loamy, mixed, superactive, mesic Mollic Hapludalfs | 10 | 5.28 | Well drained | 201 | No | Yes |
| 896E | Kingsley-Mahtomedi complex | Coarse-loamy, mixed, superactive, mesic Mollic Hapludalfs | 18 | 12.4 | Well drained | 201 | No | Yes |
| 896F | Kingsley-Mahtomedi complex | Coarse-loamy, mixed, superactive, mesic Mollic Hapludalfs | 30 | 2.1 | Well drained | 201 | No | Yes |
| 98 | Colo silty clay loam, occasionally flooded | Fine-silty, mixed, superactive, mesic Cumulic Endoaquolls | 1 | 1.05 | Poorly drained | 15 | Yes | No |
| W | Water | - | 0 | 14.93* | - | 201 | No | - |

*Data Source: USDA-NRCS SSURGO soil data is provided by an independent entity, and will be justified with the National Wetlands Inventory and the information in Table 4, "Existing Land Cover", with the preparation of the final NRMP.

The areas with the most erodible soil types on the steeper slopes are northeast of the lake and southwest of the pond.

## D. Topography

Topography and the orientation of slopes (aspect) relative to north, south, east, and west, are an important factor in the development and formation of soil, potential for soil erosion, and the type and stability of vegetation that will grow in a given location. In general, more topographic variation will result in more complexity and diversity of vegetation communities and hydrologic features. Generally, south and southwest facing slopes will be drier and support less vegetation than north and north-east facing slopes.

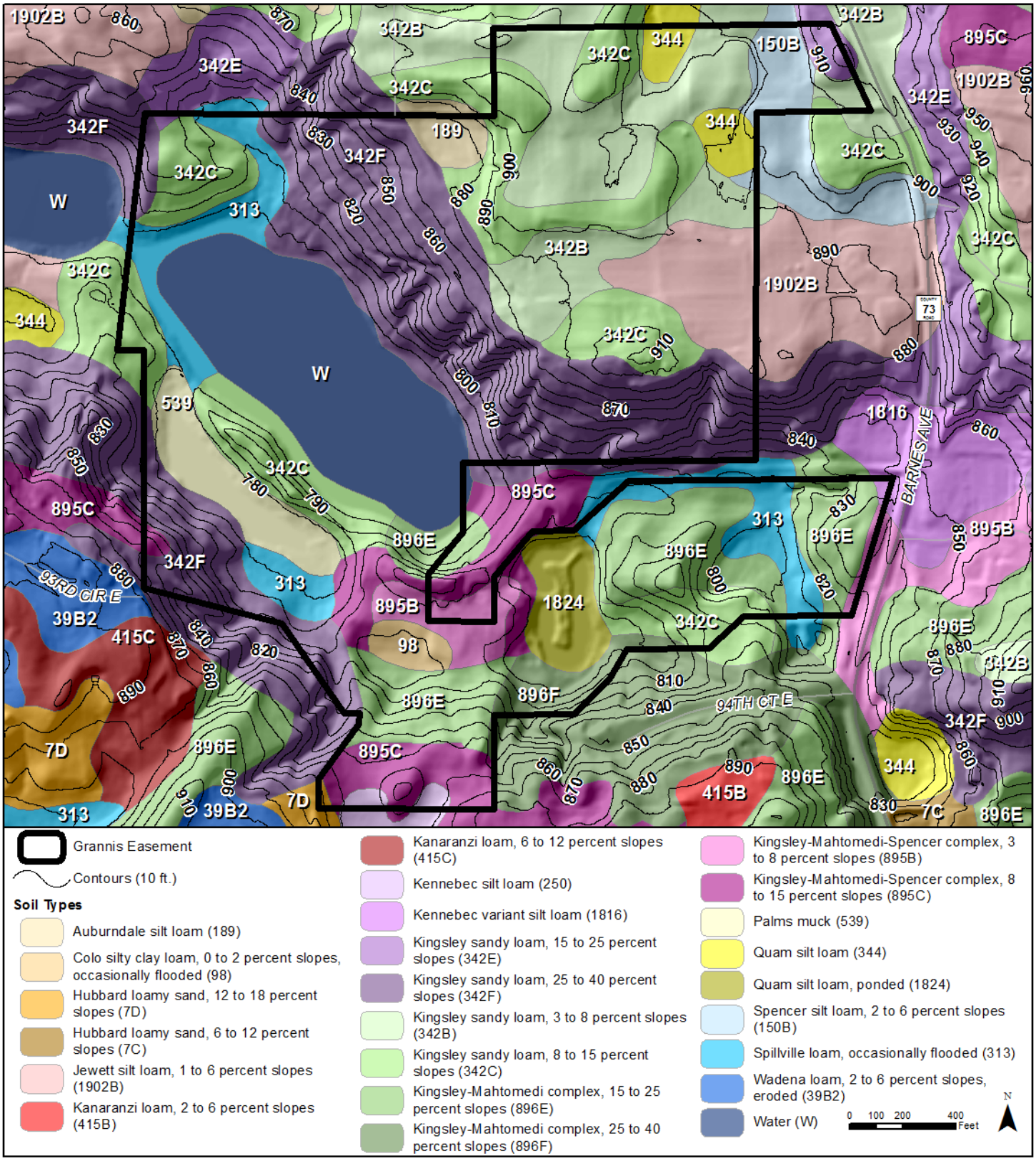
The topography of the site is primarily a consequence of historic water flow, which resulted in a landscape of moderately steep hills and ravines, with associated small lake and wetland basins.

At the time of the survey, the site appeared well vegetated throughout with low amounts of erosion at specific locations.

The elevation on the property changes about 140 feet, from a maximum of 918 feet above sea level in the northeast part of the site to 778 feet at Marcott Lake

Aspect can have a strong influence on soil temperature and moisture. In the northern hemisphere, north-facing slopes are often shaded, while south-facing slopes receive more solar radiation for a given surface area, because the slope is tilted toward the sun and is not shaded directly by the earth. The slope aspect can significantly influence its location climate (microclimate). Soil temperatures and soil moisture on south-facing slopes are typically warmer and dryer than those on north-facing slopes, due in part to the increased solar radiation and direction of the prevailing winds in the summer. Likewise, soils on north-facing slopes tend to be cooler and wetter, due to diminished solar energy. The northeast facing slopes of the Protected Property remain cooler than the southwest facing hillsides northeast of the lake. See for more information Figure 9.

## Figure 8. Soils and Topography



## Figure 9. Aspect and Topography

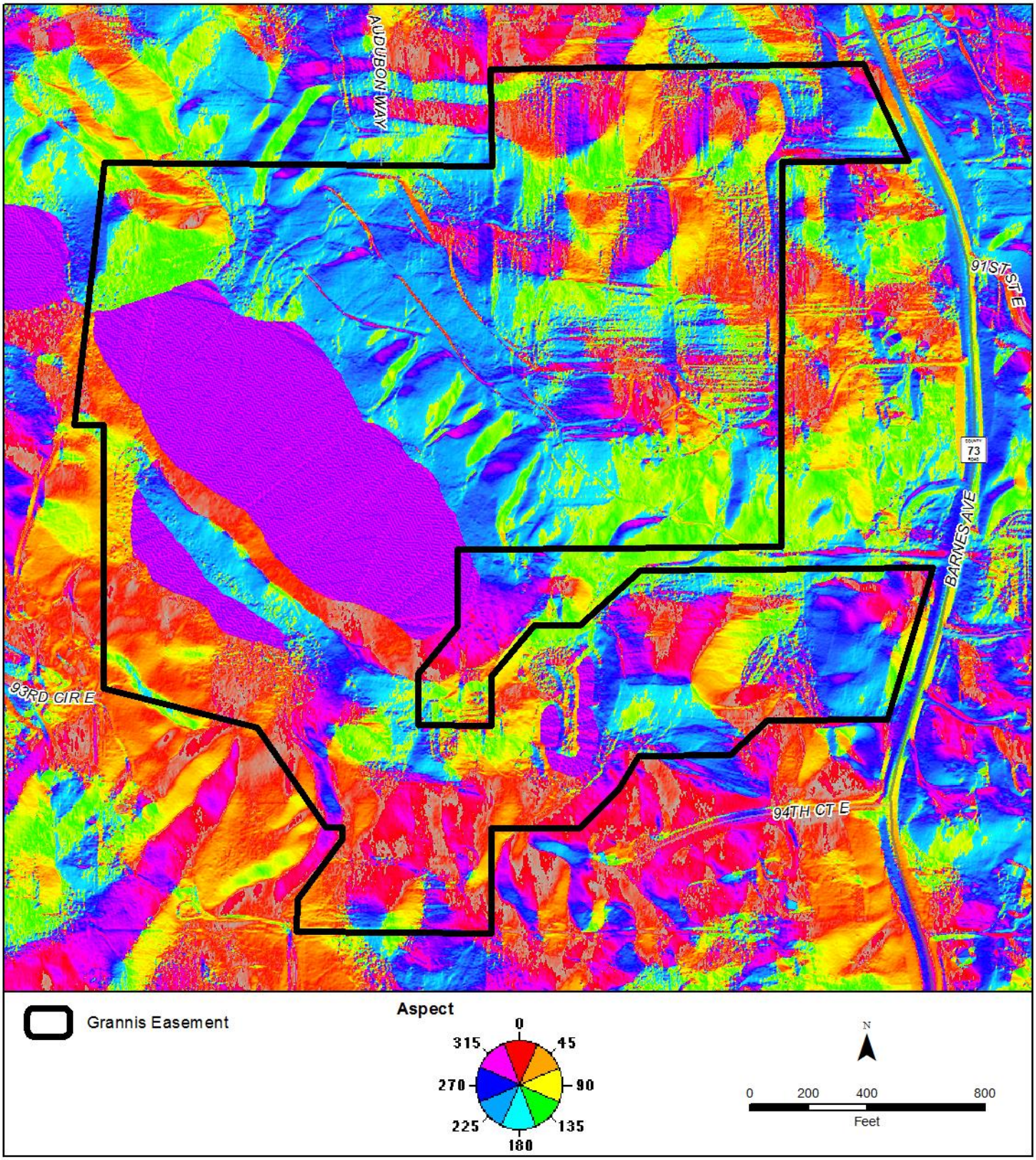
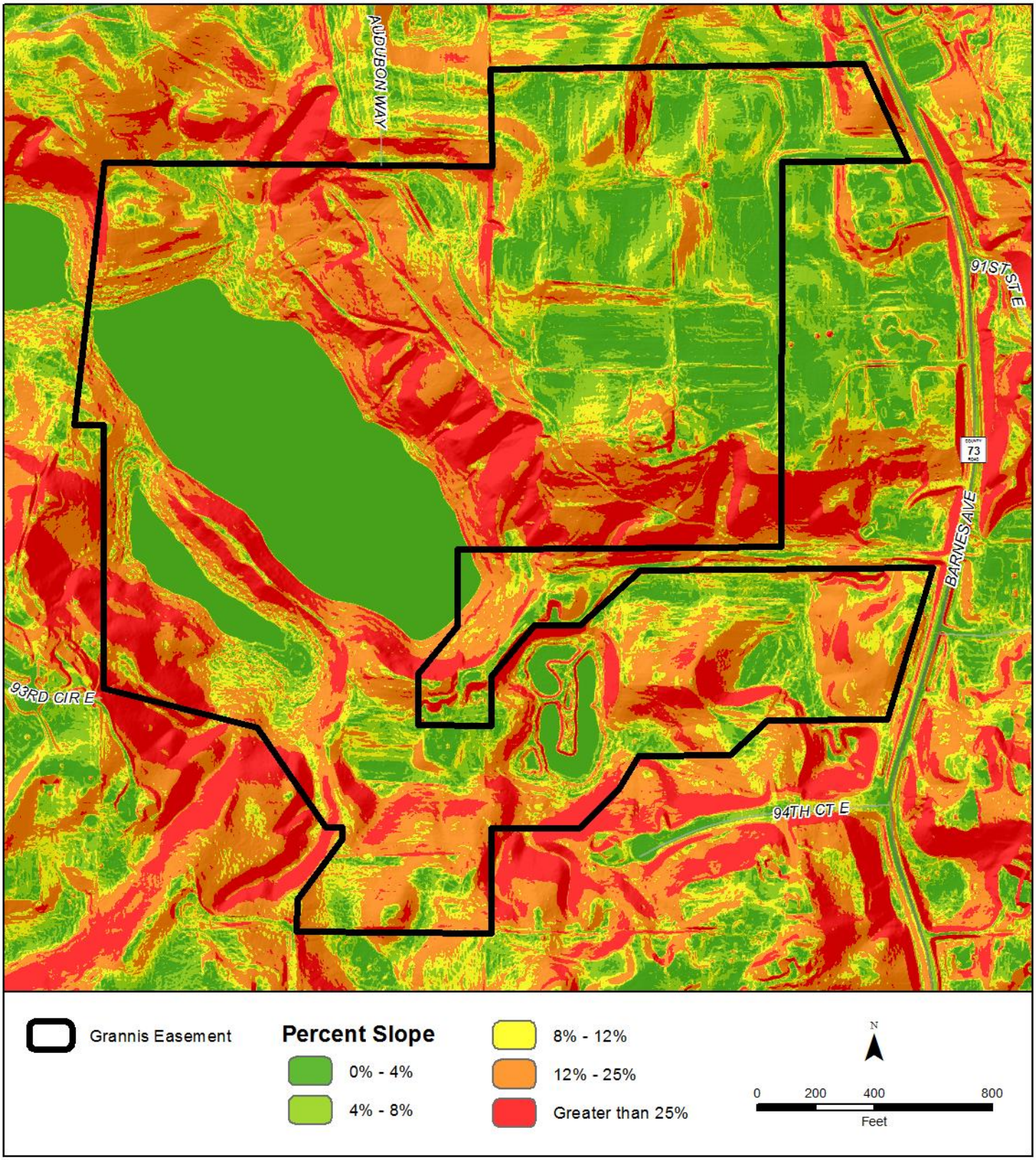


**Figure 10. Percent Slope and Topography**



## E. Hydrology

There are two key interrelated hydrologic components of the Protected Property: groundwater and surface water.

### 1. Groundwater

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

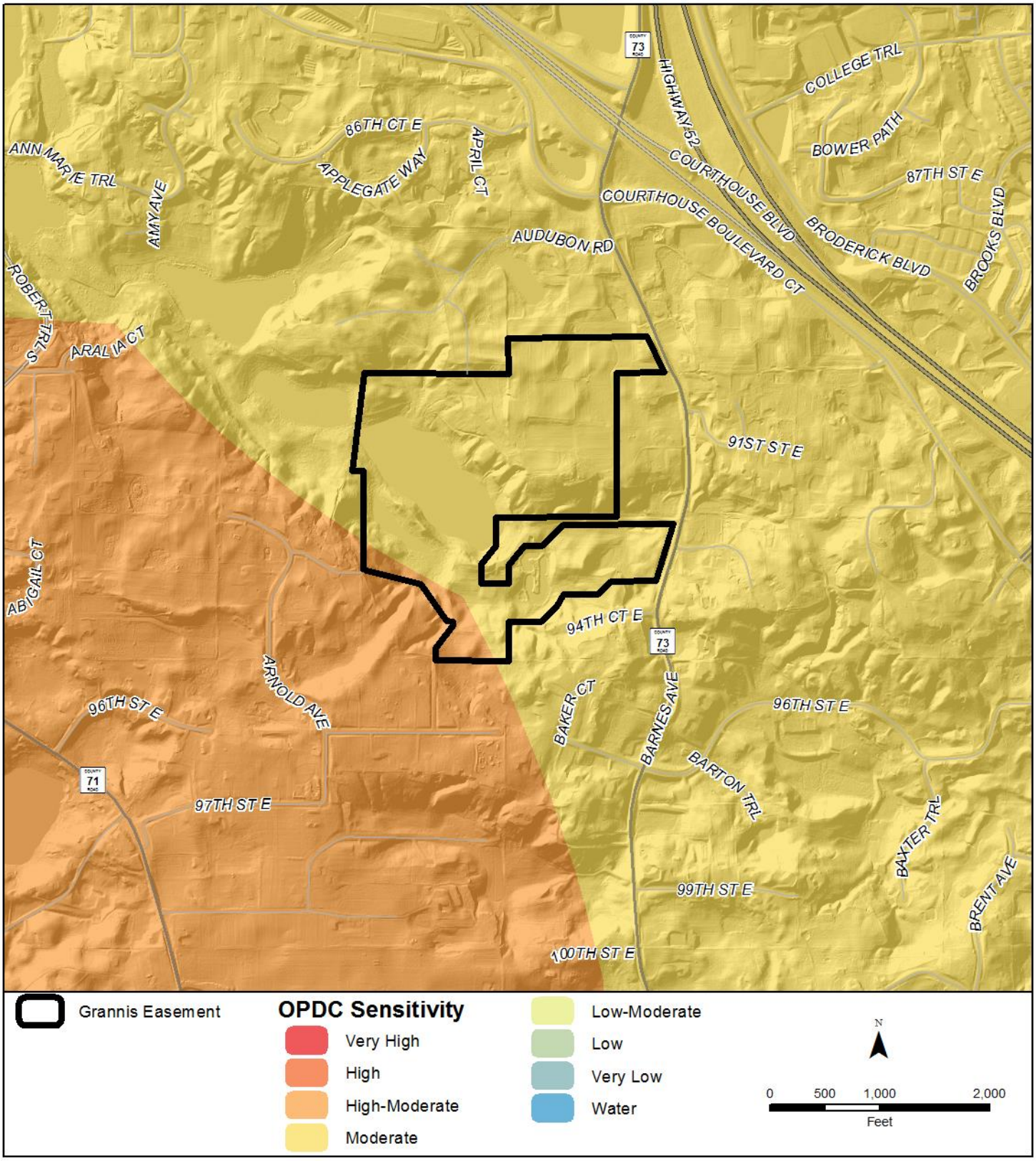
Due to its relative abundance, quality and reasonable access, groundwater provides drinking water for the majority of County citizens, irrigation water for agricultural crops (especially on the sandier soils in the eastern part of the County), and process and cooling water used by industrial and manufacturing companies. The amount of available groundwater appears to be stable, but there is growing concern about the supply of groundwater due to increased agricultural irrigation, suburban water use, changing climate, and improved information on the role of groundwater to ecological systems like trout streams. At the same time, most of the County's groundwater is "highly sensitive" to surface contamination. Once an aquifer is polluted, it is very expensive or prohibitive to improve its quality to drinking water standards.

Given its importance and potential vulnerability, it is important to be aware of the potential for groundwater contamination from pesticide and herbicide use. Factors to consider during natural resource management activities are depth to groundwater and the ability of the overlying geologic materials to protect the groundwater aquifer.

**Groundwater recharge or infiltration areas**

It is not known if there are any recharge or infiltration areas at the Grannis Family property, but it seems unlikely, as the site is rated "Moderate" for sensitivity of the Prairie du Chien-Jordan aquifer to pollution (Balaban and Hobbs 1990). With reference to Figure 11, the estimated travel time for water-borne contaminants to reach the aquifer is several years to decades, indicating that the site would not readily recharge the groundwater.

**Figure 11. Sensitivity of the Prairie Du Chien Aquifer (OPDC) to Pollution**



## 2. Surface Water

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.

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 (such as nitrogen and phosphorous from fertilizer), and lack of dissolved oxygen that affects the ability of fish and other aquatic organisms to live and reproduce. Although 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 these water quality goals.

There are two main water bodies on the Protected Property, and two other wetlands (Table 2). The largest is identified by the Department of Natural Resources as Ohman (Marcott) Lake (Lake Identification No. 19-0042), which is the most southeast of the Marcott chain of lakes (http://www.dnr.state.mn.us/lakefind/results.html). The lake is nearly 19 acres in size and about 55 feet deep, with an ordinary high water elevation of 778.4 feet. It has excellent water quality, as determined by the Minnesota Pollution Control Agency, with low levels of phosphorus and chlorophyll. Water levels in the lake became higher than historic levels (according to a personal communication with Vance Grannis), when Highway 55 was converted from a diamond to cloverleaf interchange. Water clarity is quite high, with average clarity readings of 14.4 feet in 1984, 11.5 feet in 1997, and 13.4 feet in 2013, the most recent year for which records were available.
(http://www.pca.state.mn.us/water/clmp/clmpSearchResult.cfm?lakeid=19-0042).

The pond to the southwest of Ohman (Marcott) Lake is about three acres.

**Table 2:** National Wetlands Inventory

| Wetland No. | NWI code | Description | Priority Area | Acres |
|---|---|---|---|---|
| 1 | PUBG | Lake Ohman | 1 | 18.6 |

| | | | | |
|---|---|---|---|---|
| 2 | PEMF | Open water | 1 | 3.0 |
| 3 | PUB/PEMF | Palustrine open water | 2 | 3.0 |
| 4 | PEMC | Palustrine forested, temporarily flooded | 3 | 0.6 |

**Storm water management issues (erosion, contaminants, and buffers)**

Surface water runoff on the Protected Property is generally toward the lake (**see Figure 8**). As described in the soils section, there is significant erosion potential, with highly erodible soils over much of the Protected Property. At the time of the assessment, some of the scars from historic erosion were still visible on the land, but the worst erosion areas have healed.

Photo 3: Erosion at lakeshore/lawn edge.

Photo 4: Rill erosion at lakeshore/lawn edge.

There are still some active erosion areas. The most conspicuous area is located along the south shore of the lake, where runoff is causing rill erosion in the former beach area (**Photos 3 and 4**). The problem stems from the combination of the sloping terrain, short lawn grasses that do not adequately slow the water flow and lack of vegetation in the sandy beach. The sediment is carried into the lake, along with lawn nutrients and chemicals.

In the wooded area to the west of the beach there is a truck track on the slope that is becoming entrenched (**Photo 5**). Other truck tracks northwest of the lake also had moderate amounts of erosion (**Photo 6**).

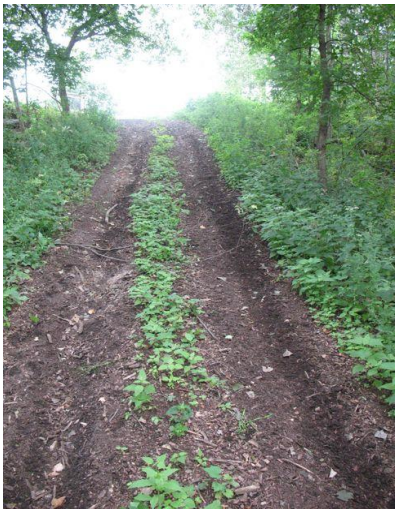


Photo 5: Truck track on south edge of Lake; entrenched and erosive.

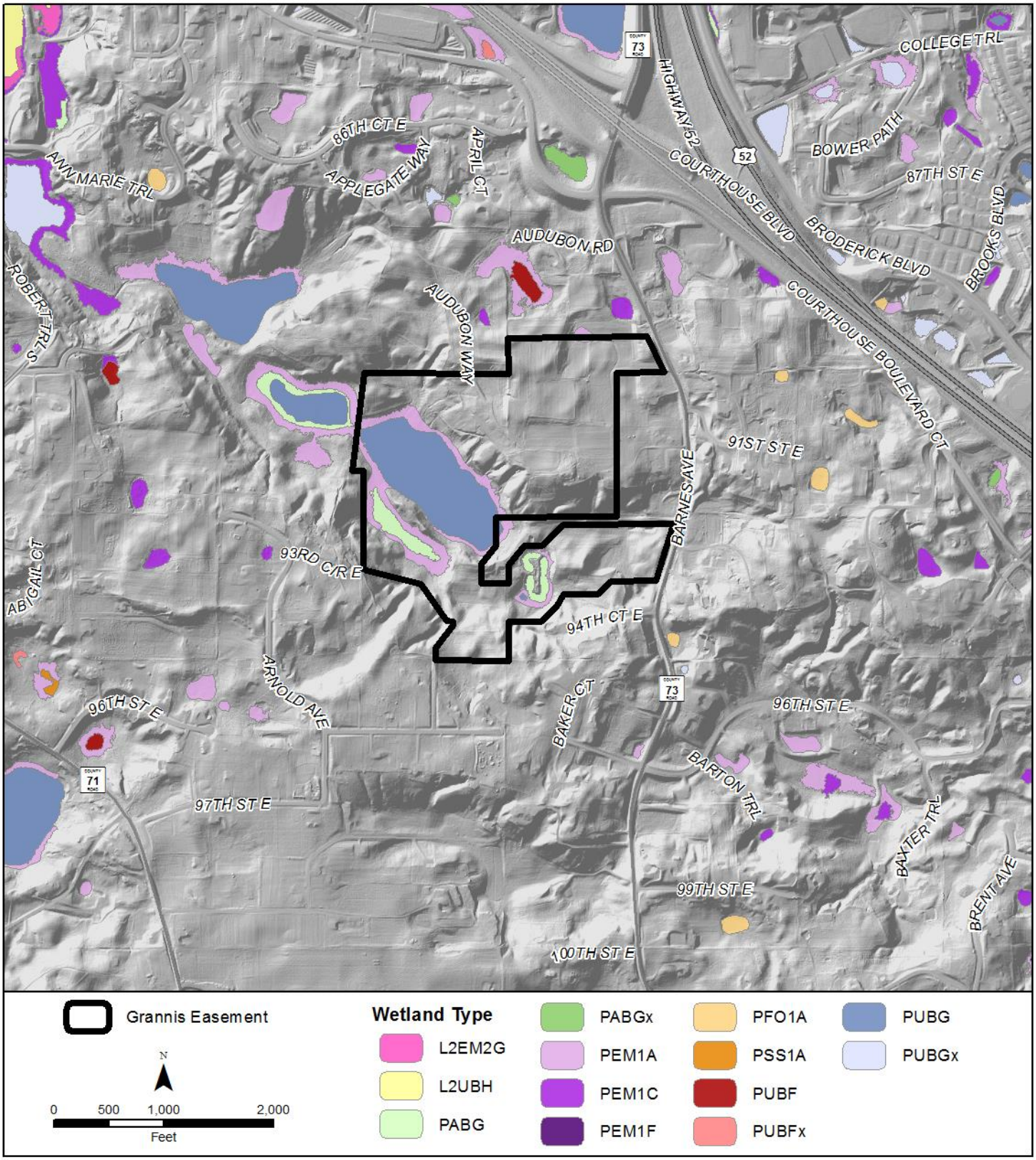
Photo 6: Truck track northwest side of lake with some erosion.

Erosion issues will be addressed in the management recommendations of this plan.

**Water resource management and restoration**

Since most of the soils on the property are highly erodible, taking those parts of the Protected Property still remaining in cultivation out of agricultural production is the best method for reducing erosion and other negative impacts. Continuing to monitor and correct erosion issues that may occur is critical for the long-term health of the lake. The site should be surveyed annually or after heavy rain events to detect and correct any erosion issues. The Dakota SWCD can assist if needed with developing control methods.

## Figure 12. National Wetland Inventory Features



# VII. Vegetation

The vegetation found on the Protected Property is determined by a number of factors including, but not limited to: physical site conditions, such as 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 change the vegetation structure and composition very quickly and for long time periods. Human-induced changes, such as farming, pasturing and tree cutting, can have the same effects. Natural succession, or the gradual change in structure and species composition, occurs as the vegetation changes and naturally modifies from changes in various environmental variables (light, water and nutrients) over time. These modifications change the variety of species most adapted to grow, survive and reproduce in an area and create slow and broadly predictable changes in the vegetation.

The effects of disturbance and succession can vary widely. Different areas will be at varying developmental stages due to diverse local histories – particularly since the time of any last major disturbance. These conditions interact with inherent environmental variability (e.g., soils, climate, topography, etc.) to create a mosaic of vegetation in various conditions across the Protected Property and the larger landscape.

## A. Historical

One major consideration for developing a comprehensive NRMP is to understand the types of vegetation found on the Protected Property or in the local area prior to European settlement. This information can be a helpful indicator of what plants may be found or thrive on the Protected Property. Fortunately, field notes on vegetation were taken during original territorial surveys in the 1840s 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 around 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. Depending on soils, topography and hydrology, tall grasses measuring eight feet in height 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 types of forbs were found on sandy or gravelly areas, or

steeper slopes. Savannas with scattered oak trees formed a transitional plant community between grasslands and forests. Forested floodplains with cottonwood, silver maple, willow, and American elm were found in wider river valleys. Near smaller rivers, prairie or savanna would often be found, even up to the water's edge. A much larger number of wetlands existed in the southwestern portion of the County than are found today. In fact, only 12 to 15 percent of pre-statehood wetlands remain in Dakota County (Dakota County SWCD, November, 2013).

The best information available on plant communities present at the time of European settlement comes from the 1850's land surveyor notes, which recorded plant species at each one-mile node. A compilation of those notes into a map as shown in Figure 13 indicates that the Grannis property was within the Big Woods region. However, the dominant trees recorded, bur oak, were rather far apart, 24 to 160 feet, indicating the area may have been more of a savanna type habitat or a mixture of woodland and savanna. "Oak openings and barrens," known today as oak savanna, was also documented nearby and the map is a generalization, not an exact depiction. Wetlands and lakes are also not depicted at the scale of the historic map and were interspersed in the landscape.

Historic aerial photographs in Figures 4 through 6 also provide some indication of the previous site conditions and vegetation. Although even the 1937 photograph was taken many decades after European settlement of the area, it still provides some indications of what site conditions may have been. The 1937 photo shows significant tree cover, but it has a fairly open canopy, which suggests oak woodland on the southwest side of the lake, and oak woodland/savanna on the northeast side. Some of the treeless areas had probably been cleared, while others, especially to the north, may have been prairie or savanna. Most of the treeless areas were apparently used for pasture, with some cropland in the northeast.

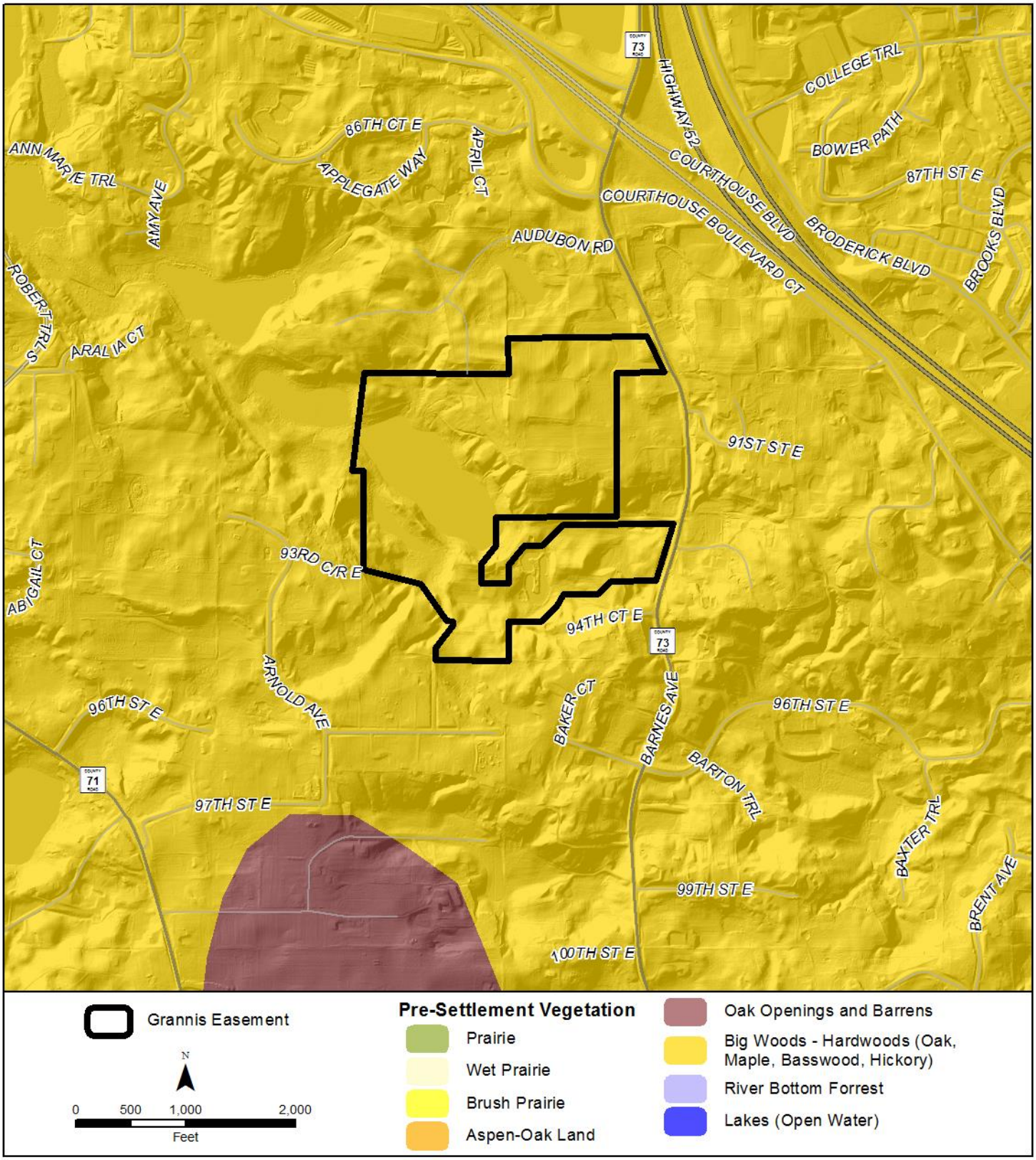
The 1951 photo shows the actual tree coverage appears to be similar to 1937. One significant observation from the 1951 photo is the evidence of erosion northeast of the lake. Though apparent in 1937, erosion became much greater by 1951. A large delta of eroded soil can be seen in the lake. On the east side of the lake and further to the south, there is another smaller delta from an eroded ravine. By 1964, there is a marked difference in the vegetation and the erosion problems have largely disappeared. Evidence of past erosion is still visible on the land, but the sedimentation in the lake appears vegetated, not fresh. The erosion was due to past cultivation activities and was mitigated by Vance Grannis' grandfather, who discontinued cultivation of sensitive areas, created berms, and planted many trees and shrubs.

By the time of the 2002 photo, the tree cover on the Protected Property had greatly increased over 1937 levels. Pine trees in the northeast plantation have reached a substantial size, the pastureland at the south has over 50 percent tree cover, and the trees are generally larger and denser.

All of this information suggests that the site probably had historically been a mix of oak savanna, oak woodland, prairie, and lake surrounded by wet meadow. According to the DNR's County Biological Survey, only about 2.6 percent of high quality, native plant communities remained in Dakota County as of the 1997 survey. Urban development in the county has increased rapidly in recent years and the growth rate is expected to continue at a high pace. This growth continues to expand into farmland and natural areas, making protection and restoration of remnant natural areas increasingly important.

In addition, oak savanna has decreased from 50 percent coverage of the land in the 1850's to 2.8 percent today. This habitat type is second only to prairie in its importance in the landscape. 36 Species of Greatest Conservation Need use savanna habitat, including 11 species that are specialists.

## Figure 13. Pre-Settlement Vegetation



## B. Ecological Communities

To further understand the Protect Property's vegetation, the DNR developed a system called the Minnesota Land Cover Classification System (MLCCS), which integrates cultural and vegetative features of the landscape into one comprehensive land classification system. This information was used as a basis for the site evaluation, which was conducted by Karen Schik of Friends of the Mississippi River.

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. The Protected Property is classified as follows (see also the areal depiction in Figure 14):

Ecological Province: Eastern Broadleaf Forest

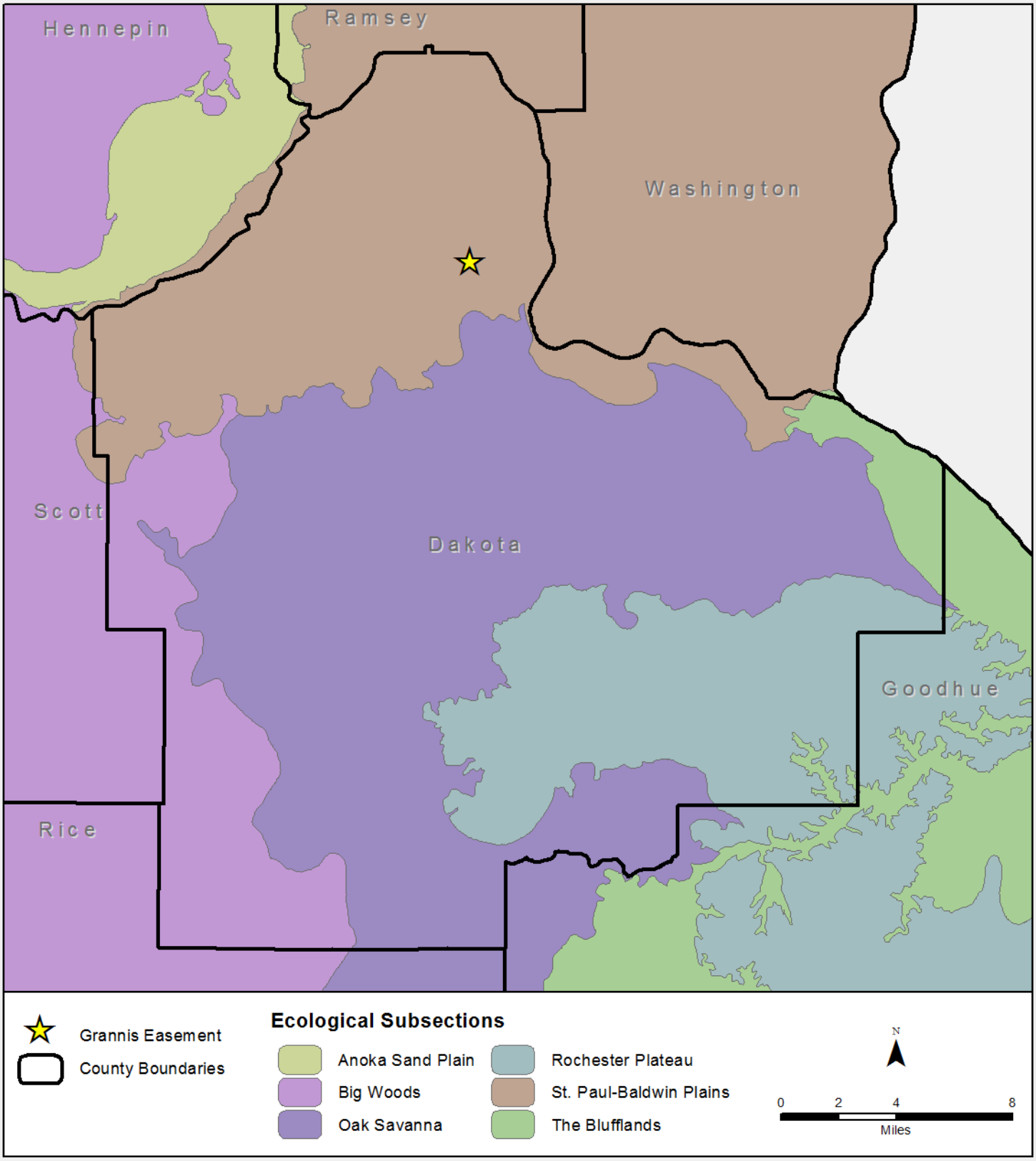
Section: Minnesota and Northeast Iowa Morainal

Subsection: St. Paul Baldwin Plains and Moraines

The Protected Property's ecological sub-section is defined as follows:

**St. Paul-Baldwin Plains and Moraines:** This subsection covers an area corresponding to the northern tier of cities in the County: Inver Grove Heights, South St. Paul, West St. Paul, Mendota Heights, Mendota, Eagan, Burnsville, and the northern portions of Apple Valley and Rosemount. This area was a mosaic of oak woodland, oak and aspen savanna, tall-grass prairie, and maple basswood forest. Tall-grass prairie was concentrated on level to gently rolling portions of the landscape. Oak savanna developed on rolling moraine ridges in the northwestern portions of the County and in dissected ravines along the eastern edge. Maple basswood forest was restricted to the portions of the landscape with the greatest fire protection – either in steep, dissected ravines or where stream orientation or lakeshore reduced fire frequency or severity. Suburban development is the primary use and fire is no longer the primary disturbance. However, management of the Protected Property may involve the use of prescribed burns to regenerate prairie and savanna areas.

**Figure 14. Ecological Subsections**



## C. Plant Community Assessment

### 1. Land Cover

The following are descriptions, and designations of the various MLCCS cover types found on the Protected Property. Designated MLCCS land cover types and their respective descriptions are used as the basis for the plant community assessment. Some of the cover types were re-designated to a more appropriate type than was designated by MLCCS. The property as a whole is divided into subunits with a mix of cover types within each unit. Please refer to Figure 15 (MLCCS Land Cover), Figure 16 (Land Cover Management Areas) and Figure 17 (Target Plant Communities) throughout this section.

For determining target plant communities for restoration (Table 4), the historic conditions, existing conditions, and relative effort versus benefits were considered. As a guideline for the target plant community goals, "The *Field Guide to the Native Plant Communities of Minnesota: the Eastern Broadleaf Forest Province* (DNR 2005)." This book describes the system developed by the DNR for identifying ecological systems and native plant community types in the state, based on multiple ecological features such as major climate zones, origin of glacial deposit, plant composition, and so on. 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. The Grannis Family property is classified as follows:

Ecological Province: Eastern Broadleaf Forest

Section: Minnesota and Northeast Iowa Morainal

Subsection: St. Paul Baldwin Plains and Moraines

Since the Grannis Family property is located very close to the Oak Savanna Subsection, the plant community types probably overlap. Plant communities for each management area were evaluated when determining restoration goals, as site features may be more conducive to one type over another. This property was most likely a mosaic of Southern Mesic Savanna, Southern Dry-Mesic Oak Woodland and Southern Mesic Oak-basswood Forest. These plant communities are generally still appropriate for the site, although there has been some succession of communities. Some areas that had been oak savanna have become oak woodland. In general, south and west slopes would now support oak woodland and the northeast-facing slopes support mesic oak-basswood forest. The open grassland areas would be oak savanna.

In addition to the ecological goals and management practices described below, the landowner has outlined several other goals that are suitable for the site: creating interpretive trails that

minimize impacts on the natural areas and leaves some areas trail-free, removal of carp from the lake, and bow hunting to control deer and turkey populations.

## 2. Site Evaluation

Plant species lists for each land cover management area are provided in Appendix A. Each of the land cover units are evaluated using criteria in Table 2 and other site conditions to develop a general score for overall "ecological health." The land cover types are summarized in Table 3 and depicted in Figure 16.

With respect to Figure 16, what follows is a description of each identified land cover management unit:

**Altered Deciduous Woodland (Units DW 1, 2, 3, and 4)**

Photo 7: Woodland north of lake. Huge cottonwood, dense buckthorn understory.

Altered deciduous woodland is found in four locations, totaling 14.5 acres. These areas typically had some disturbance activity in the past, such as grazing or tree removal. Most have relatively young trees, and an undeveloped plant community. Canopy trees include basswood, red oak and hackberry, with boxelder being common along the edges. The shrub layer tended to be fairly dense and dominated by buckthorn (Photo 7). Honeysuckle was also common, as well as prickly ash and raspberries, typical of previously pastured areas. Unit DW1 (in the extreme north-east part of the Protected Property) had a grove of red cedar trees, indicative of a more open canopy in the past and suggesting the area may have been open woodland or savanna.

The target plant community is southern dry-mesic oak woodland (refer to figure 17). Management goals for these areas will be to reduce the cover of exotic invasive shrub and tree species, restore fire regime, increase native shrub diversity (see Appendix B for species), and control erosion.

Photo 8: Fairly intact shoreline with emergent vegetation (floating pondweed) and an upland mix of native and non-native species.

These woodlands would have burned periodically and fire should be re-incorporated to reduce exotic brush control. These areas should be burned in the fall or spring following the first buckthorn removal, to reduce seedlings. Burning in the subsequent one to two years may be necessary to continue control efforts. In the long term, the burn cycle should be roughly seven to ten years, depending on conditions.

**Lakeshore (Unit SH)**

Photo 9: Lakeshore from the northwest end of pond toward the southeast. Reed canary grass is dominant is some areas.

The Lakeshore consists of about 6.3 acres of wet-edge plant community that encircles the lake, the pond southwest of the lake, and the constructed pond south of the existing residence. The lakeshore is an area subject to seasonal changes in surface or soil water levels, with two distinct vegetation zones. The upper zone lies above the normal high water, but is strongly affected by seasonal flooding, waves, and ice scouring. The lower zone is at or just below the ordinary high water and includes both emergent and submergent aquatic plants (Photo 8).

The lower zone of the lake and ponds were not evaluated in detail, but floating pondweed, water lily, narrow-leaved cattail, arrowhead, bulrush and willow were some of the noted aquatic plants (Appendix A). The composition of the upper zone contained many of the species typical of a native plant community; including boneset, bugleweed, pink knotweed, and broad-leaved arrowhead, rice cut-grass, dark green bulrush, and sandbar willow (Appendix A). However, the vegetation was generally dominated by non-native species, especially reed canary grass (Photo 9) or native, invasive species, such as Canada goldenrod. Other non-native species included white sweet clover, amaranth, lamb's quarters, Canada thistle, carpetweed, and narrow-leaved cattail, and Siberian elm (primarily seedlings). Of these, the primary concerns

Photo 10: Open sand on south lakeshore by lawn.

Photo 11: Non-native species on southwest lakeshore.

are reed canary grass and Siberian elm, followed by Canada thistle and cattail. The latter is very invasive and can displace most other aquatic species, overtaking lakeshores and wetlands.

Lakeshore vegetation is critical to lake health, as it filters nutrients and sediments from runoff and is important for wildlife habitat. The lakeshore was well-vegetated in all areas except the southeast end of the lake, where sand had been added decades ago to create a swimming beach. No longer used or maintained as a beach, the sand is either non-vegetated or supports non-native (annual species) (Photos 10 and 11). Part, if not most of this area just described south-east of the lake is outside the boundary of the Protected Property. Runoff from the lawn has created some rill erosion (Photos 1 and 2). Sediment and lawn runoff are likely carried into the lake.

Photo 12: Mowed turf at southeast end of lake.

The target plant community for the lakeshore is Inland Lakeshore (Appendix B). The highest priority will be to reduce erosion at the southeast end by re-vegetating the shoreline in the former beach area. Restoring the remaining shoreland to native vegetation could be difficult at this site. A primary species of concern is reed canary grass, and the effort to eradicate it may not be worth the benefit. Further evaluation will be needed to assess the feasibility. Other species that are more isolated, such as Canada thistle, could be controlled by spot-spraying. The narrow-leaved cattail stand is small enough that it could also still be managed. This species is very difficult to control, especially once it becomes more abundant.

**Non-native Grassland with Sparse Trees (Units GT1, 2, 3, 4 and 5)**

Most parts of the GT units were cropped at some point in the past. Most areas were later converted to grassland and pastured. Today only Unit GT3 is pastured (Photo 13). Unit GT2 in the northwest had significant erosion problems in the 1940's and 1950's due to runoff from cultivated fields. Vance Grannis' grandfather purchased the property, in part to repair the damage and stop erosion to the lake. He created earthen berms, converted

Photo 13: Unit GT3, horse pasture, toward the south. Pasture continues at the hilltop in back. Brush removal was occurring at the time.

the cultivated fields to grassland, and planted pine trees.

Currently, Units GT1 and GT2 are dominated by non-native grasses, with scattered individual or clusters of trees (Photo 14). Planted tree species include red pine and white pine (about 40 feet tall), Colorado blue spruce (10-30 ft.), and Scotch pine (some 10 ft.). Species that have volunteered include boxelder, red cedar, quaking aspen, and Siberian elm. The latter is a non-native, invasive species. Some of them were fairly large – 20 inch diameter and 50 feet tall.

Native shrub species include smooth sumac, American plum and nannyberry. Non-native shrubs (buckthorn and honeysuckle) were uncommon.

Photo 14: Unit GT2. Red cedar and sumac, brome grass, knapweed. Small amount of erosion on truck track.

Non-native grasses are strongly dominant in the ground cover, especially smooth brome and Kentucky bluegrass, with some reed canary grass in patches. Canada goldenrod is the dominant forb, which is a native species, but invasive. Spotted knapweed, a non-native and very invasive, is also quite abundant. Native species are not abundant, but quite a few were recorded, including sky blue aster, black-eyed Susan, heath aster, round-headed bush-clover, mountain mint, sweet everlasting, and gray goldenrod.

The target plant community for the GT units is a combination of mesic oak savanna and mesic prairie. The goals are to remove all non-native trees and shrubs, reduce the cover of trees not native to savanna, control non-native forbs, reduce native aggressive forbs, and increase the diversity of native grasses and wildflowers. While the existing grassland provides some wildlife benefits, it is significantly lacking in native forbs that are very important to native insects and birds. Native bees are critical for pollinating dozens of species, many of which are important for human consumption, and their populations have been declining.

Managing the GT units will focus first on removal of non-native trees and shrubs. Although some of the trees were planted, they are not consistent with the target plant community and should be considered for removal. After woody removal is complete, the restoration can focus on restoring some of the native savanna species. The top priorities are to reduce the cover of non-native grasses and spotted knapweed, but it will also be important to not allow Canada goldenrod to dominate. Restoration methods should be focused on avoiding erosion and minimizing chemical inputs.

The methodology that follows is the least invasive/least impact, as well as the least costly method for reducing non-native and increasing native species. However, it is a slower process than the standard method of complete eradication followed by seeding on bare soil, and it does not always result in as great a diversity of species.

Spotted knapweed must be controlled prior to other restoration activities. Biological control is recommended, whereby insects that destroy knapweed are released at the site. The knapweed will not be eradicated, but will be reduced to a level that allows the native plants to thrive. It takes several years for the insect population to have an impact, so insect release should be one of the first management activities at this site. The insects will not be impacted by the other management methods described below.

A simple and inexpensive method is increase native grasses and forbs is to burn the site in late spring to set back the cool-season non-native grasses, then broadcast a mix of some of the most common (and aggressive) native grasses and forbs. This method can be repeated every in two or three years. The native cover will gradually increase and provide some of the wildlife benefits now lacking.

The northern half of Unit GT3 has been more impacted, with little native vegetation detected. This three-acre area should have a full restoration – mow, herbicide twice, then broadcast seed in late fall. If the soil is very compacted, it may need to be lightly harrowed prior to seeding.

Long-term management of the savanna can be coordinated with the adjacent woodlands, so that some woodland and savanna areas are burned together. However, the areas should be divided into two or three burn units so that not more than one unit is burned in any year. Units DW1, DW2, GT2, and OW1 could be one burn unit. GT1 and OW2 could be another. GT3, DW3 and OW3 could be a third unit. Burn units can be better defined after the initial restoration phases are done, and with input from burn contractors.

Photo 15: Unit OW1, Large bur oak with spreading branches. Dense buckthorn below.

**Southern Dry-Mesic Oak Woodland (Units OW1, 2 and 3)**

Oak woodland comprises the majority of the plant communities at the site, with about 18 acres in three units. The canopy is somewhat open, with

large bur oak and red oak (or red-pin oak hybrid) dominant. The spreading branches of some of the larger oak trees (Photo 15) indicate the woods were more open in the past, as seen in the historic aerial photos. Large basswood trees are also abundant and large cottonwoods are common along the lakeside edges, where they tower over the canopy. One four-foot diameter oak stump, a relic of the past, was found. Ironwood is the dominant understory tree. Seedling trees are common, including ironwood, black cherry, bur oak, and red oak. Small paper birch is common in some areas.

The shrub layer is dense and dominated by common buckthorn, with honeysuckle most common along the edges. Buckthorn is especially dense in Unit OW2 (Photo 16). In the other units, the buckthorn cover is variable. Unit OW3 has low overall levels of buckthorn (Photo 17), but in some areas such as the south end, buckthorn is larger and more abundant. Unit OW1 has variable amounts. Other shrub species include nannyberry, abundant prickly ash, and gray dogwood.

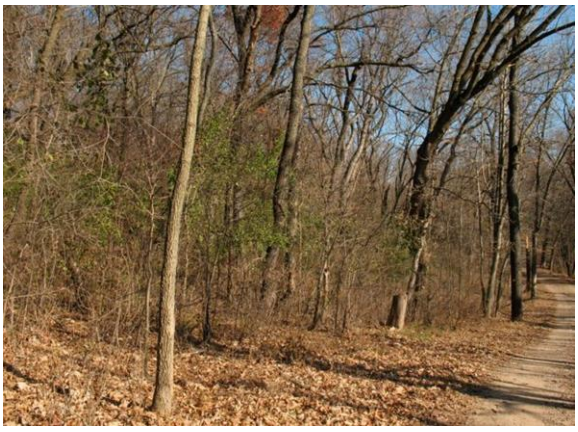


Photo 16: OW2. Dense buckthorn understory, mostly smaller stems.

Photo 17: Unit OW3. Oak woodland with many small trees scattered large. Non-native shrubs were fairly low density in this unit.

The ground cover is dense with low species diversity, primarily composed of common species. White snakeroot is dominant, as is typical of sites that have been grazed. False lily of the valley, sweet cicely, red baneberry, lady fern, enchanter's nightshade, carrion plant and wild geranium are some of the common native species. Non-native species are not abundant overall, but include burdock, motherwort and garlic mustard. The latter is a very invasive species that typically invades sites that are infested with earthworms. Garlic mustard is not yet abundant, but management of this species is difficult. Other than hand-pulling, there are no well-established control methods at this time. Biological control methods are being researched and expected to be available soon. Prescribed burning is a management tool that can eliminate garlic mustard seedlings and reduce seed production of larger plants.

The site has clear indications of the presence of earthworms, with compacted soil, little duff, and earthworm castings. All earthworms found in Minnesota are non-native. They cause significant alterations to the soil structure and are implicated in the decline of native woodland wildflowers and increase of non-native, invasive species. However, there is no method at this time for controlling earthworms, so management practices focus on improving conditions for native plant species, such a prescribe burning and eradicating non-native species.

The target plant community for these units is dry-mesic oak woodland. Although these areas may have been oak savanna in the past, they have succeeded to woodland and there is no need to alter that. The best management will be to keep non-native species at a reduced level and support the native plant community with periodic burns. After exotic brush removal, increasing native shrub diversity could also be considered,

**Southern Mesic Oak-Basswood Forest (Units OF)**

When the DNR evaluated the mesic oak forest in 1993, the following description was written: "Disturbed oak forest dominated by red oak, white oak, and American basswood 20 to 30 meters high and an average diameter of 50 to 70cm. Diversity of shrub and herb layer varies from moderate to low with Missouri gooseberry, red-berried elder, lady fern and enchanter's nightshade. Effects of past grazing and tree cutting range in degree and are patchy across the community. The forest is located on steep, northeast-facing slopes along chain of lakes and wetlands with loamy soils of the Twin Cities formation geomorphic region."

The DNR survey did not encompass every portion of the oak forest, and may have been more descriptive of the areas to the northwest of the Grannis Family easement. The OF unit on the site is a relatively young forest, with an under-developed plant community. There are scattered large (old) trees, but the woods are dominated by small trees, of a similar age (Photo 18). In 1937, this unit had a fairly open canopy. The area may have been more densely wooded in the past and then partially cleared. It appears that there has been little tree removal from the area since the 1930's and the unit is densely wooded with mostly young trees today.

Photo 18: Small to medium trees with dense canopy with relatively few non-native shrubs. Native shrub and herbaceous species diversity is low.

The dominant canopy tree is American basswood, most with relatively large (22 to 32 inch) diameters (Photo 19). Red oak trees are common and paper birch is abundant. Ironwood is the dominant sub-canopy species, with a great abundance of small (6 to 10 inch) diameter trees (Appendix A). Tree seedlings were not common, but red oak and hackberry seedlings indicate these species will continue to persist. No basswood seedlings were noted, but it is a shade tolerant species and would likely be present.

Photo 19: Scattered large trees interspersed with many small trees

The shrub cover, including buckthorn and honeysuckle is sparse, as is typical under a dense canopy. Gooseberry and currant are the dominant shrub species, and raspberry and elderberry were also noted. An abundance of prickly shrubs is common at sites that have been grazed. The ground cover is fairly densely vegetated. Some of the most abundant species are hog peanut, white snakeroot, clearweed, and mosses. Other typical species are wild geranium, lady fern, false lily of the valley, black snakeroot, and zigzag goldenrod. Non-native forbs include burdock, motherwort, and Virginia stickseed.

The overall species diversity of this unit is low, compared to the full complement typically found in a mesic oak forest (Appendix B). However, the coverage of non-native species is also quite low, which is uncommon in most wooded areas in the metro. In addition, a spring survey would be valuable to determine what other forbs may be present at the site.

Management of the oak forest will focus on removing the few exotic shrubs that are present, and monitoring for future incursions. The mesic oak forest is not a fire-dependent system. However, fire could be considered in the future if it would be beneficial for reducing non-native species. At this time, it is recommended that the area be excluded from burn plans. If a burn is ever conducted, a cool, low-flame fire would be most appropriate.

**Upland Planted Pines (Unit PN)**

The pine stand is about three acres in size. Although it is not a native plant community, there are no significant concerns with it other than having some exotic shrub species present. The trees could be removed, used for biofuels, and the area restored to native prairie. There are funding sources that may make it worthwhile to do so. However, this is considered a low priority for the site. The conifers do provide some wildlife value and are not a serious

detriment to the Protected Property. It may be advisable to thin and create more structural and age diversity within the pine stand.

**Cultivated (Unit CV)**

This area is 23.2 acres in size and is currently being cultivated in small plots by tenant farmers.

**Table 2: Quality Rankings for Plant Community Types**

## Oak/Upland Forest

| | Intact | Degraded |
|---|---|---|
| **Dominant Canopy Trees** | red and white oak, aspen, basswood, black cherry, and American elm | black locust and box elder |
| **Age Classes of Trees** | Multiple | few or no young age classes; no oak re-generation |
| **Sub-canopy** | semi-open to nearly closed; ironwood and black cherry | continuous closed |
| **Shrub Layer** | Sporadic native | dense European buckthorn and/or tartarian honeysuckle |
| **Ground Cover** | native sedges, forbs, and ephemerals: false solomon's seal, cluster-leaf tick trefoil, grape-woodbine, rough bedstraw, grape, Missouri gooseberry, stinging nettle, and bland sweet cicely, and oak seedlings | lack of native ground cover; non-native grasses, garlic mustard, Eurasian bittersweet, buckthorn seedlings, Norway maple seedlings, etc. |
| **Light Levels on Ground** | medium with mixed shade | low light, predominantly dense shade |

## Oak Woodland/ Brushland

| | Intact | Degraded |
|---|---|---|
| **Dominant Canopy Trees** | bur oak, northern pin oak, white oak, and northern red oak, and aspen | Box elder, green ash and cottonwood are typical. Elms are common associates. Hackberries, aspens and oaks may be present. |
| **Age Classes of Trees** | multiple | low diversity |

| | | |
|---|---|---|
| **Sub-canopy** | chokecherry, ironwood | Lacks Diversity |
| **Shrub Layer** | blackberry, raspberry, gooseberry, dogwood, cherries, hazelnut, prickly ash, and oak and aspen sprouts | Dominated by buckthorn and tartarian honeysuckle, but sumacs, gooseberry and elder berry can also be common. |
| **Ground Cover** | sparse | White snakeroot, motherwort, and garlic mustard |
| **Light Levels on Ground** | medium | dark |

## Upland Shrubland

| | **Intact** | **Degraded** |
|---|---|---|
| **Dominant Canopy Trees** | none | none |
| **Age Classes of Trees** | N/A | N/A |
| **Sub-canopy** | N/A | N/A |
| **Shrub Layer** | sumac, plum and grey dogwood | sumac, blackberry, prickly ash, tartarian honeysuckle, and buckthorn |
| **Ground Cover** | diverse | smooth brome grass and Kentucky blue-grass |
| **Light Levels on Ground** | high | moderate to low |

## Dry Oak Savanna

| | **Intact** | **Degraded** |
|---|---|---|
| **Dominant Trees** | bur oak, northern pin oak and white oak | black locust, box elder or siberian elm |
| **Canopy Density** | semi-open to open | continuous closed |
| **Age Classes of Trees** | multiple with natural oak regeneration | few or no young classes with no oak regeneration |

| | | |
|---|---|---|
| **Shrub Layer** | sporadic natives such as American hazelnut | dense non-native; buckthorn and tartarian honeysuckle |
| **Ground Cover** | native grass, sedge, and forbs | European brome grass, Kentucky blue grass, non-native grasses, agricultural weed species, and brambles |
| **Light Levels on Ground** | high, mixed with shade | low light, predominantly dense shade |

## Tall Grassland

| | **Intact** | **Degraded** |
|---|---|---|
| **Overall Biodiversity** | high | low |
| **Vegetation** | warm season grasses, with succession towards conservative species | weedy, non-native |
| **Indicator Species** | big bluestem, little bluestem, side-outs gramma, purple prairie clover, leadplant, sky blue aster, partridge pea, flowering spurge, blue giant hyssop, and prairie dock | European brome and other non-native grasses, ragweed, mare's tail, Queen Anne's lace, Canada thistle, wild parsnip, and woody species such as sumac, box-elder and siberian elm |
| **Shrub Layer** | sporadic native species such as American hazelnut | dense non-native; European buckthorn and tartarian honeysuckle |
| **Light Levels on Ground** | full to nearly full sun | less than nearly full sun in some areas |

## Medium Grassland

| | **Intact** | **Degraded** |
|---|---|---|
| **Dominant Canopy Trees** | none | none |

| | | |
|---|---|---|
| **Vegetation** | warm season grasses, with succession towards conservative species | weedy, non-native |
| **Indicator Species** | big bluestem, little bluestem, side-outs gramma, purple prairie clover, leadplant, sky blue aster, partridge pea, flowering spurge, blue giant hyssop, and prairie dock | European brome and other non-native grasses, ragweed, mare's tail, Queen Anne's lace, Canada thistle, wild parsnip, and woody species such as sumac, box-elder and siberian elm |
| **Shrub Layer** | sporadic native species such as American hazelnut | European buckthorn and tartarian honeysuckle |
| **Light Levels on Ground** | full to nearly full sun | less than nearly full sun in some areas |
| **Drought Tolerance** | yes | no |

## Wet Meadow

| | **Intact** | **Degraded** |
|---|---|---|
| **Dominant Canopy Trees** | None | None |
| **Age Classes of Trees** | N/A | N/A |
| **Sub-canopy** | N/A | N/A |
| **Shrub Layer** | variable, may include Bebb's willow and pussy willow | Dominated by speckled alder and glossy buckthorn |
| **Ground Cover** | Dense, closed stands of predominately wide-leaved sedges or grasses. Forb cover and diversity are high and includes spotted joe-pye weed, common mint, turtlehead, and swamp milkweed | Dominated by non-native species, especially reed canary grass. Also includes cattail stands when few other species are present. |
| **Light Levels on Ground** | nearly full sun | nearly full sun |

## Saturated Wetland

| | Intact | Degraded |
|---|---|---|
| **Dominant Canopy Trees** | none | none |
| **Age Classes of Trees** | N/A | N/A |
| **Sub-canopy** | none | none |
| **Shrub Layer** | none | none |
| **Ground Cover** | Dominated by wetland species other than cattails. Bulrushes are the most common dominant, especially hard stemmed, river, and soft-stem bulrush. Broad-leaved arrowhead is a common non-grass associate. | dominated by purple loosestrife |
| **Light Levels on Ground** | nearly full sun | nearly full sun |

## Cattail Marsh

| | Intact | Degraded |
|---|---|---|
| **Dominant Canopy Trees** | none | none |
| **Age Classes of Trees** | N/A | N/A |
| **Sub-canopy** | none | none |
| **Shrub Layer** | <30% | variable |
| **Ground Cover** | Dominated by cattails, associated with sedges, bulrushes, and broad leaved herbs such as northern marsh fern | Dominated by non-native species such as purple loosestrife, but also includes monotypic cattail stands |
| **Light Levels on Ground** | nearly full sun | variable |

## Flooded Wetland

| | Intact | Degraded |
|---|---|---|
| **Dominant Canopy Trees** | none | none |

| | | |
|---|---|---|
| **Age Classes of Trees** | N/A | N/A |
| **Sub-canopy** | none | none |
| **Shrub Layer** | none | none |
| **Ground Cover** | Emergent cover with floating-leaved aquatics. Stands may be dominated by a single species, including soft hornwort and common water milfoil. | Dominated by non-native species |
| **Light Levels on Ground** | nearly full sun | nearly full sun |

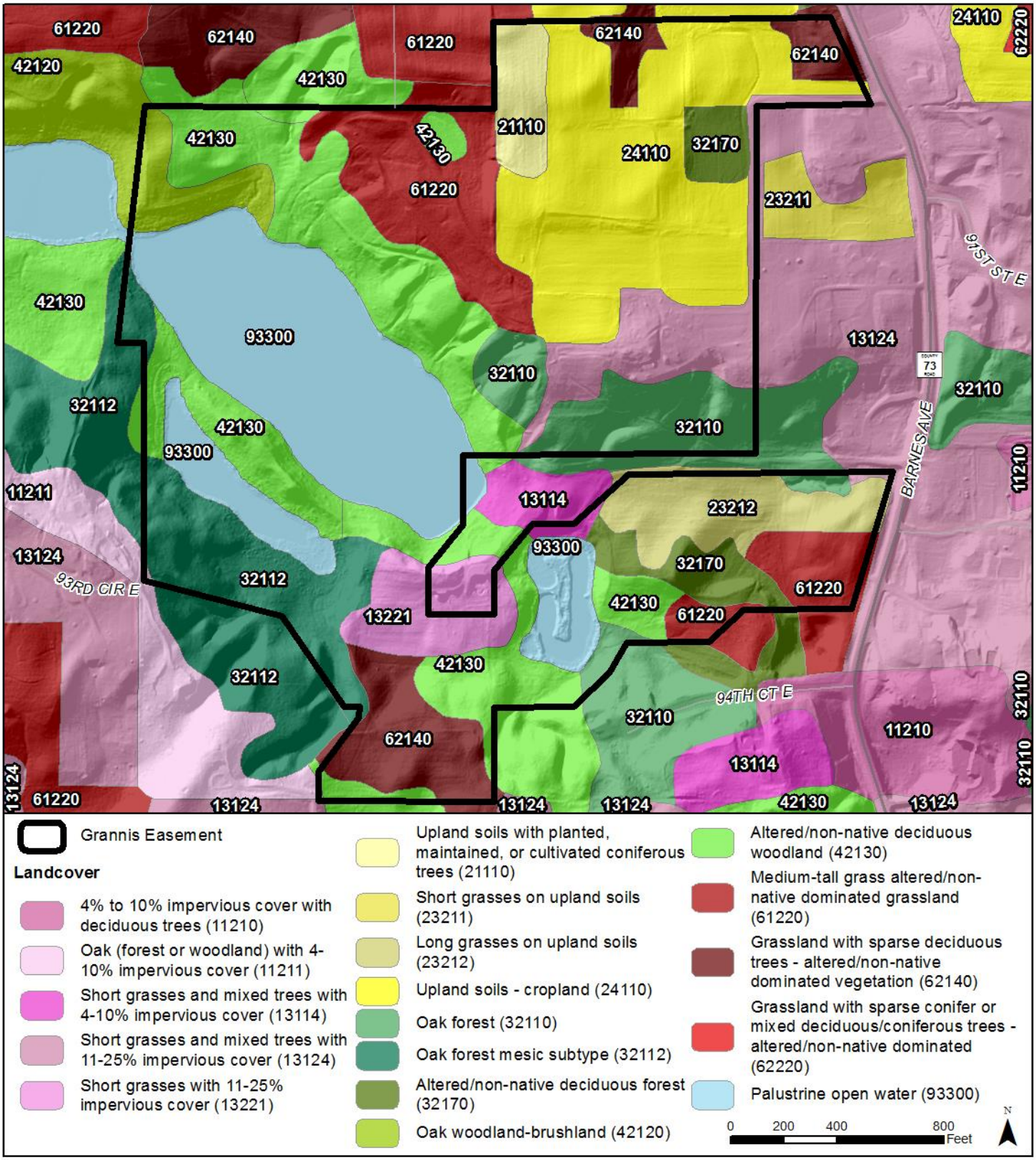
Table 3 summarizes ecological conditions of the site with a "Quality Index" score, which provides a general measure of whether a land cover unit or subunit is a degraded (score=1) or intact (score=5) ecosystem, based on the evaluation of the criteria in Table 2. A high score of 5, for example, would indicate a community with high plant diversity, very good species composition, with high representation of species for that community, and good community structure; essentially a plant community with all functions and natural processes intact. Such a community would also tend to be large, though absolute size would vary among community types. Most communities in Dakota County have impacts from invasive plants and animal species, lack of natural processes and other impacts, so a score of 5 is very unlikely.

**Table 3: Summary of Existing Land Cover**

| **Land Cover Management Area** | **Land Cover Management Unit** | **Dominant Soil Type** | **Area [Acres}** | **Quality Index** |
|---|---|---|---|---|
| Altered deciduous woodland | DW1 | Kingsley Sandy Loam, 8 to 15% slopes | 3.8 | 3 |
| | DW2 | Auburndale Silt Loam | 0.6 | 3 |
| | DW3 | Kingsley-Mahtomedi complex, 15 to 25% slopes | 9.5 | 3 |
| | DW4 | Kennebec Silt Loam | 0.6 | 3 |
| | **All DW** | | **14.5** | **3** |

| | | | | |
|---|---|---|---|---|
| Lakeshore | **SH** | N/A | **6.3** | **3** |
| Non-native grassland with sparse trees | GT1 | Kingsley Sandy Loam, 25 to 40 percent slopes | 4.4 | 2 |
| | GT2 | Kingsley Sandy Loam, 25 to 40 percent slopes | 7.8 | 2 |
| | GT3 | Kingsley – Mahtomedi Complex, 15 to 25 percent slopes | 8.4 | 2 |
| | GT4 | Kingsley-Mahtomedi Complex, 15 to 25 percent slopes | 8.5 | 2 |
| | GT5 | Kingsley Sandy Loam, 8 to 15 percent slopes | 2.2 | 2 |
| | **ALL GT** | | **31.3** | **2** |
| Palustrine open water (Lake and two Ponds) | **LK and PD** | N/A | **23.1** | **4** |
| Southern dry-mesic oak woodland | OW1 | Kingsley Sandy Loam, 25 to 40 percent slopes | 9.1 | 3 |
| | OW2 | Kingsley Sandy Loam, 25 to 40 percent slopes | 4.8 | 3 |
| | OW3 | Kingsley Sandy Loam, 8 to 15 percent slopes | 3.0 | 3 |
| | **All OW** | | **17.0** | **3** |
| Southern mesic oak-basswood forest | **OF** | Kingsley Sandy Loam, 25 to 40 Slopes | **7.5** | **4** |
| Upland, planted pine trees | **PN** | Kingsley Sandy Loam, 3 to 8 percent slopes | **2.6** | **3** |
| Cultivated | **CV** | N/A | **23.2** | **1** |
| Total Grannis Family Easement | **All Cover Types** | | **125.5** | **3** |

## Figure 15. Existing Landcover



## D. Noxious and Invasive Plants

There are a number of plants that if present on the Protected Property, are potentially injurious to the health of animals (especially livestock), humans, and the environment. A full list of plants, along with background details is found in Appendix D.

Upon an inspection of the Protected Property, the following plants were found that meet the definition of a noxious weed:

*Canada thistle* – aggressively invades a wide variety of habitats. It reduces high quality forage for grazing livestock and wildlife, reduces biological diversity for native landscapes, and complicates reforestation and landscape restoration efforts. Plants were identified in scattered locations throughout the property. Plants are required by law to be controlled to prevent propagation and it is recommended to eradicate the plants. Due to the low number of plants, herbicide treatment of individual plants would be a reasonable method of control.

*Common buckthorn*- forms dense thickets that crowd and shade out native plants, alters nitrogen levels in the soil, hosts funguses detrimental to plants, and contributes to erosion and declining water quality. It provides little food value to animals that eat the berries. Buckthorn can rapidly dominate a vulnerable woodland or forest in a matter of 30 to 50 years. It is recommended to cut existing buckthorn and basal treat the stumps with herbicide to prevent regrowth.

*Garlic Mustard* - is a biennial herbaceous plant with weak single stems 12 to 36" high in its second and flowering year. It is the only plant of this height blooming white in wooded environment. Its leaves are round, scallop-edged, dark green; first year, rosettes of 3 or 4 leaves; second year plants have alternate stem leaves. Leaves and stems smell like onion or garlic when crushed. Its flowers are white, small and numerous, with four separate petals. Each plant has one or two flowering stems on second year plants. The seeds are slender capsules one to two and one-half inches long, containing a single row of oblong black seeds. Seeds are viable in the soil for five years. Its roots are white, with a slender taproot, "S"-shaped at the top. The ecological threat posed is that garlic mustard spreads into high quality woodlands upland and floodplain forests, not just into disturbed areas. Invaded sites undergo a decline in native herbaceous cover within ten years. Garlic mustard alters habitat suitability for native insects and thereby birds and mammals. This European exotic occurs now in 27 mid-western and northeastern states and in Canada. Garlic mustard is a MDA restricted noxious weed in Minnesota. Recommended methods of control include hand-pulling in areas of light infestations, stem cutting at ground level when the plant is flowering, and prescribed burning if there is enough fuel to carry the flames. Spot application of 2% glyphosate in early spring or late fall when native plants are dormant is also effective. Biological control through the use of insects is not available at this time. Research is on-going for biological control of garlic mustard. See the US Forest Service's Biology and Biological Control of Garlic Mustard

*Spotted Knapweed* - is a biennial or short-lived perennial herbaceous plant two to three feet high. Basal leaves form a rosette the first year from which grow one to twenty wiry, hoary, branched stems during the second year. Its leaves are alternate, grayish, hoary, and divided into lance-shaped lobes decreasing in size at the top. Its flowers are thistle-like pink to purple flowers sit at the tips of terminal and axillary stems, and bloom from July through September. Seeds are brownish, 1/4" long with small tuft of bristles, dispersed by rodents, livestock and commercial hay. Seed is viable in the soil for 7 years. The plant has a stout taproot. Lateral shoots form new rosettes near the parent plant. The ecological threat is that the plant especially threatens dry prairie, oak and pine barrens, dunes and sandy ridges. Spotted knapweed is poisonous to other plants (phytotoxic). It spreads rapidly in artificial corridors, gravel pits, agricultural field margins and overgrazed pastures. A native of Europe and Asia it has become a serious problem in pastures and rangeland of the western states. Spotted knapweed is a MDA prohibited noxious weed (Control List) in Minnesota. Control Methods include early detection and pulling, mowing as needed so plants cannot go to seed, prescribed burning (only very hot burns are effective which may also damage native plants). Chemical eradication involves the application of selective herbicide clopyralid during bud growth in early June for best results (48 oz. per 100 gal water). Use caution in quality natural areas as herbicide affects native plants of the sunflower and pea family as well. There are biological agents that are effective such as seed-head weevils, root-boring weevils, and seed-head flies.

The following plants were found that met the definition of an invasive plant:

*Reed canary grass-* is a perennial cool season grass that can grow 2-6 feet tall. It reproduces through rhizomes (horizontal stems below the surface) and through seed. It can form very dense stands that out-compete most native species. It is often the dominant ground layer vegetation in areas of wet or saturated soils. Control of established stands is extremely difficult and is best accomplished with fall herbicide application.

*Smooth brome grass-* is a perennial cool season grass that spreads into degraded prairies. It spreads aggressively and out-competes other species. It was found primarily in areas that are higher in elevation and not prone to flooding. Removal can be done with herbicide treatment and removal should be coordinated to coincide with the restoration to native species.

*White and yellow sweet clovers are* biennial plants with small flowers with seed that can persist in the soil for up to 30 years. They grow to 3-5’ tall and can invade and degrade native grasslands. Seedlings can be treated with herbicide during their first year of growth of small infestations can be hand pulled.

*Amur Maple* is a small tree up to 20' high with a broad crown, but sometimes pruned as a hedge. Twigs are smooth and light colored. Leaves turn bright red in the fall. It displaces native shrubs and understory trees in open woods, and shades out native grasses and herbaceous plants in savanna habitat. It is recommended to cut existing amur maple and basal treat the stumps with herbicide to prevent regrowth.

*Exotic Honeysuckle* is an upright, deciduous shrub, 5 -12' high. Older stems have shaggy bark and are often hollow. Leaves are opposite, simple, oval, and untoothed. Some plants have smooth, hairless leaves, and others have downy leaves. Fruits are red or yellow, situated in pairs in the leaf axils. Exotic honeysuckle replaces native forest shrubs and herbaceous plants by their invasive nature and early leaf-out. They shade out herbaceous ground cover and deplete soil moisture. It is recommended to cut existing honeysuckle and basal treat the stumps with herbicide to prevent regrowth.

## E. Recommended Target Vegetation Communities

Based on the Protected Property's geology, soils, topography, hydrology, existing land cover and use, current and anticipated ecological conditions, and the landowner and County goals, target plant communities are recommended for each of the existing land cover units in Table 4 and as shown on Figure 17. Each of the target plant communities is described, with descriptions taken directly from the *Field Guide to the Native Plant Communities of Minnesota: the Eastern Broadleaf Forest* (DNR 2005).

**Table 4: Existing Land Cover and Recommended Target Community**

| Existing Land Cover | Existing Map Unit(s) | Area (Acres) | Target Community |
|---|---|---|---|
| Altered Deciduous Woodland | DW1, DW2, and DW2 | 14.5 | Southern Dry-Mesic Oak Woodland (FDs27) |
| Lakeshore | SH | 6.3 | Inland Lake Shore (LKi32)) |
| Non-native grassland with Sparse Trees | GT1, GT2, GT3, GT4, and GT5 | 31.3 | Southern Mesic Savanna (UPs24) and/or Southern Mesic Prairie (UPs23) |
| Palustrine Open Water | LK and PD | 23.1 | N/A |
| Southern Dry-Mesic Oak Woodland | OW1, OW2, and OW3 | 17.0 | Southern Dry-Mesic Oak Woodland (FDs37) |
| Southern Mesic Oak-Basswood Forest | OF | 7.5 | Southern Mesic Oak-Basswood Forest (MHs38) |
| Upland, Planted Pine Trees | PN | 2.6 | N/A |
| Cultivated | CV | 23.2 | Southern Mesic Prairie (UPs23) |
| **All Land Cover** | | **125.5** | |

## Southern Dry-Mesic Pine-Oak Woodland (FDs27)

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

**Vegetation Structure & Composition** Description is based on summary of vegetation data from 13 plots (relevés).

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

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

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

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

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

**Landscape Setting & Soils**

**Sand terraces and other sand deposits**—Uncommon. Present on deep sands that have accumulated on valley floors of tributary streams or rivers of the Mississippi River south of the Twin Cities metropolitan area. Most of the sands originate from stream dissection and disintegration of local sandstone, but a few stream bottoms have sands derived from glacial outwash and from stream dissection of glacial till above the sandstone bedrock. Because of the

mantle of silty loess that covers the uplands of the PPL, it is likely that fine sands were deposited in the area by wind as well. The sands are deposited in a variety of landforms including stream terraces, alluvial fans, ramps created by sand blown from valley floors onto adjacent slopes, and mixed deposits of sand and rocks (colluvium) at bases of sandstone outcrops. Although the bedrock from which sands are derived initially contained some carbonates, soils are poor and acidic. Soils tend to be uniformly sandy, lacking subsoil horizons or textural bands that can help to hold or perch snowmelt and rainfall. Soils are excessively drained. Soil-moisture regime is moderately dry (Blufflands and Rochester Plateau in PPL; very local in Oak Savanna in MIM).

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

## Inland Lake Sand/Gravel/Cobble Shore (LKi32)

### Inland Lake Sand/Gravel/Cobble Shore

Plant communities characterized by variable cover of shrubs, forbs, graminoids, and aquatic plants on well-drained, wave-washed sand, gravel, or small cobbles on shores along inland lakes. Present in the zone between low-water level and the upper reach of storm waves or ice scouring.

### Vegetation Structure & Composition

Description is based on field observations, supplemented by species lists from aquatic plant surveys of 877 lakes, mostly in central and northern Minnesota.

**Vegetation** cover ranges from sparse to dense but varies seasonally. Distinct upper and lower zones are almost always present, with lower zones often expanding as water levels fall over the summer.

**Upper zone** lies above normal water levels, where seasonal flooding, erosion by large waves, and ice scouring have strong influence on the composition of plant communities. Ice-thrust ridges occur at or just above the upper extent of this zone and commonly support trees and other upland forest species.

**Characteristic Upper Zone Species MDL, WSU, MIM NSU**

**Forbs**

Swamp milkweed, Bulb-bearing water hemlock, American willow-herb, Touch-me-not, Golden dock, Spotted Joe pye weed, Common boneset, Northern bugleweed, Blue monkey flower, Nodding smartweed, Arrow-leaved tearthumb, Marsh skullcap, Mad dog skullcap, and Yellow loosestrife.

**Grasses & Sedges**

Rough barnyard grass, Tall manna grass, Path rush, Rice cut grass, Woolgrass, Brown-fruited rush, Bluejoint, Narrow reedgrass, Stalked woolgrass

**Low Shrubs** False indigo, Leatherleaf, Sweet gale

**Shrubs** Sandbar willow, Alder, Meadowsweet

**Trees** Jack pine and White cedar

**Lower zones** lie at or just above normal water levels and extend below normal water level. Lower zones are exposed during periods of low water but are washed by waves almost daily. Characteristic plants include annual herbaceous plants, emergent aquatic species, and submergent and floating-leaved aquatic species that become stranded as water levels fall during the summer.

**Characteristic Lower Zone Species MDL, WSU, MIM NSU**

**Floating-Leaved and Submergent Forbs**

Watershield, Pipewort, Braun's quillwort, Lake quillwort, American shore plantain, Slender water milfoil, Coiled pondweed, Awlwort, and Humped bladderwort

**Emergent Forbs**

Swamp milkweed, Bulb-bearing water hemlock, Touch-me-not, Northern bugleweed, Sessile-fruited arrowhead, Narrow-leaved cattail, Water horsetail, Northern blue flag, Broad-leaved cattail, Wild calla, Water lobelia, Yellow loosestrife, Buckbean, Broad-leaved arrowhead, and Lavender bladderwort

**Grasses and Sedges**

Bristly sedge, Red-stalked spikerush, Woolgrass, Soft stem bulrush, Three-way sedge, Katahdin sedge, Beaked sedge, Least spikerush, Small's spikerush, Rattlesnake grass, Soft rush, Brown-fruited rush and Slender rush.

**Shrubs**

Willows

**Landscape Setting & Soils**

LKi32 occurs on wave-washed shores on lakes across most of Minnesota in the zone between annual low-water levels and the upper reach of storm waves or ice scouring during spring breakup. Substrates consist of wave-washed sand, gravel, or cobbles less than 12in (30cm) in diameter. Soil development is minimal in upper zone and absent in lower zones.

**Natural History**

Wave action and ice scouring are important in maintaining the open structure of shoreline communities. Wave action is most important during periods of high winds, especially storms. Ice scouring occurs primarily during spring break-up, when winds may push large pieces of ice on shore, sometimes forming ice-thrust ridges. These ridges sometimes mark the upper extent of the community but more often are ecotonal between the beach and adjacent upland vegetation. Lakeshore communities typically vary in extent over the growing season and from year to year with fluctuation in water level. Characteristic plants include shrubs and perennial herbaceous species tolerant of inundation, erosion, and stranding. Many of the perennial herbaceous species are rhizomatous, and there may be a tendency for species to be dispersed by floating propagules. Also present in shoreline communities are annual species whose seeds are dispersed readily by wind or water or can remain dormant for long periods buried in sediment and then germinate when conditions are suitable (often as water levels fall and expose sediments along the shore).

**Southern Dry-Mesic Oak Woodland (FDs37)**

**Southern Dry-Mesic Oak (Maple) Woodland**

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

**Vegetation Structure & Composition**

Description is based on summary of vegetation data from 43 plots (relevés).

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

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

**Subcanopy** cover is patchy to interrupted (25–75%). The most common species are black cherry, red maple, and bur oak.

**Canopy** cover is usually interrupted to continuous (50–100%). Bur oak and northern pin oak are the most common species. Northern red oak, white oak, and red maple are occasionally present. Older trees are often open grown, indicating previously more open conditions on the site. Note: Red maple and white oak are generally absent from occurrences in the CGP.

**Landscape Setting & Soils**

**Glacial lake plains**—Common. Present on undulating sand flats that were deposited in the shallow waters of Glacial Lake Grantsburg. Parent material is stoneless, well-sorted fine sand. It was initially calcareous, but soils are now leached of carbonates. Subsoil horizons capable of perching snowmelt are lacking, but general fine-sand texture and occasional bands of silt and gravel can help to retain some soil moisture. Densely cemented layers of sand that may reflect past positions of the water table occur at depth and can help hold water for deeply rooted plants. Soils are excessively drained and the soil-moisture regime is moderately dry. (Anoka Sand Plain in MIM)

**Stagnation moraines**—Occasional. Present on hummocky moraines, often adjacent to fire-prone outwash plains and tunnel valleys that were occupied in the past by brushland or prairie. Parent material is a discontinuous cap of partially sorted gravelly sand over a base of denser till and is often complexly stratified. Parent material can be calcareous or noncalcareous; when calcareous, soils are leached of free carbonates to at least 30 in (75 cm). Although some clays have accumulated in the subsoil, clays are insufficient to perch snowmelt and rainfall. The complex stratification allows these sites to retain some rainfall, and water is available to deeply rooted plants just above the dense till. Where the sandy cap is thick, the soils are excessively drained, and the soil moisture regime is moderately dry. Where the cap is thinner, the soils are well drained, and the soil-moisture regime is fresh. (St. Paul-Baldwin Plains and Hardwood Hills

in MIM; locally in Pine Moraines and Outwash Plains in MDL; and Minnesota River Prairie in CGP.

**River bluffs**—Common. Present on steep (20–50%) south- or west-facing slopes along the Minnesota River valley and other major streams. Soils are developed on eroded calcareous till or cut-faces of gravelly terraces well above modern alluvium. Free carbonates are present at or close to the surface and topsoil layers are thin because of surface erosion. Soils are somewhat excessively to excessively drained. Soil moisture regime is dry to moderately fresh (Minnesota River Prairie in CGP).

**Natural History**

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

**0–75 years**—Young forests recovering from fire, dominated by bur oak with some northern red oak or white oak. Quaking aspen, northern pin oak, and black cherry are minor components.

**> 75 years**—Mature forests dominated by a mixture of bur oak, white oak, northern pin oak, and some northern red oak, with minor amounts of American elm. (In the past, sites now occupied by FDs37 typically supported more open communities, including brush-prairie or savanna. Air photos from the 1930s show these sites to have scattered oaks rather than forest canopies. With suppression of wildfires since the mid-1800s, these sites have developed denser tree canopies and herbs typical of mesic forests have become common in the understory. The examples of FDs37 used in this classification are best described by the mature forest growth stage.)

## Southern Mesic Savanna (UPs24)

### Southern Mesic Savanna

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

### Vegetation Structure & Composition

There is only one vegetation plot for this class; description is based mainly on inference from Southern Mesic Prairie (UPs23) and Southern Dry Savanna (UPs14).

**Graminoid** cover is interrupted to continuous (50–100%). Tallgrasses dominate, but several mid-height grasses are also important. Big bluestem and Indian grass are the dominant tallgrasses, with prairie dropseed either a codominant or subdominant component. On the drier end of the moisture gradient, little bluestem, porcupine grass, and side-oats grama are important.

**Forb cover** is sparse to patchy (5–50%). The most common species are heart-leaved alexanders, heath aster, stiff and Canada goldenrods, purple and white prairie clovers, silverleaf scurfpea, stiff sunflower, white sage, northern bedstraw, and smooth blue aster. Maximilian's sunflower, tall meadow-rue, prairie phlox, and gray-headed coneflower are common in moister examples; rough blazing star, Missouri and gray goldenrods, and bird's foot coreopsis are common in drier ones.

**Woody vines** are a minor component. Virginia creeper is frequently present, and wild grape is occasionally present.

**Shrub layer** is patchy to interrupted (50–75% cover) and composed of low (< 20in [50cm]) semi-shrubs, taller (up to 6ft [2m]) shrubs, and oak seedlings and saplings (< 6ft). The low semi-shrubs leadplant, prairie rose, and poison ivy are generally common. Common taller shrubs are chokecherry, American hazelnut, smooth sumac, gray dogwood, wolfberry, low juneberry, and wild plum.

**Trees** are scattered or in scattered clumps, with total cover < 70% and typically 25– 50%. Bur oak is most common, but northern pin oak is also usually present. • Notes: The exotic grasses Kentucky bluegrass and smooth brome are often problematic in UPs24. Pennsylvania sedge, a native graminoid that is naturally a minor component of UPs24, increases in abundance with prolonged heavy grazing. With fire suppression, trees other than the oaks become established, especially green ash, quaking aspen, and basswood.

**Landscape Setting & Soils**

Historically, UPs24 occurred most commonly in low relief prairie landscapes on ground moraines and end moraines, and less commonly on lacustrine deposits and finer textured outwash. In the Rochester Plateau Subsection of the PPL, UPs24 occurred on loess-mantled pre-Wisconsin till. Soils are somewhat poorly drained to well drained, mostly moderately permeable to permeable, fine- and medium-textured loams and loamy sands. These are mollisols, characterized by thick, dark, organic-enriched upper horizons with high base saturation and dominantly bivalent cations.

**Natural History**

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

## Southern Mesic Prairie (UPs23)

**Southern Mesic Prairie**

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

**Vegetation Structure & Composition**

Description is based on summary of vegetation data from 102 plots (relevés).

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

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

**Shrub layer** is sparse (5–25% cover). The low semi-shrubs leadplant and prairie rose are generally common. Sparse patches of wolfberry are occasional. Gray dogwood, American hazelnut, and wild plum are rare. Trees are absent except where fire suppression has allowed invasion by woody species. Notes: Kentucky bluegrass, an introduced species, is invariably present; it increases in the prolonged absence of fire but becomes dominant only with heavy grazing pressure. Smooth brome, another exotic, is a very troublesome invasive species favored by disturbance, including natural disturbance by pocket gophers.

**Landscape Setting & Soils**

The region of Minnesota in which UPs23 occurs is predominantly a low-relief landscape interrupted by local areas of greater relief associated with stagnation moraines and large erosional features created by glacial meltwaters. The deeply dissected PPL in the southeast corner of the state, where UPs23 is rare, is exceptional. Historically in the PPL, UPs23 was confined to the tops of broader interfluves. UPs23 typically occupies ground moraines and end moraines and smaller inclusions of outwash and lacustrine sediments. In southwestern and southeastern Minnesota, outside the boundaries of the Wisconsin glacial deposits, UPs23 occurs on older, loess-mantled ground moraines. Soils are somewhat poorly drained to well

drained, mostly moderately permeable to permeable, fine- and medium-textured loams and loamy sands. Soils are mollisols, characterized by thick, dark, organic-enriched upper horizons with high base saturation and dominantly bivalent cations.

**Natural History**

UPs23 is present on level to gently sloping sites where the water table is below the rooting zone except for brief periods during the growing season. Soil moisture availability remains high on average because of soil texture and composition. Recurrent fire is essential for the existence of UPs23, as environmental conditions are otherwise suitable for the growth of trees; where propagules are available, succession to forest occurs rapidly in the absence of fire. Fires also recycle nutrients bound up in litter and promote flowering and seed production. These events temporarily expose the soil surface and so probably play an important role in plant regeneration. Before Euro-American settlement, grazing and trampling by large ungulates were regular occurrences in UPs23. The contribution of this disturbance to the composition and structure of the vegetation is not well understood, although it is known that confined grazing by domestic livestock can quickly destroy mesic prairies, promoting the replacement of most native species by introduced ones. Episodic grazing probably enables the persistence of some native species that cannot otherwise reproduce in the dense canopy of tall grasses and forbs characteristic of UPs23; these would include shorter species and especially annual or biennial species. Spatial patchiness in grazing intensity is also thought to have influenced fire behavior, providing a shifting patchwork of refugia for fire-sensitive animal species. The fertile soils and gentle relief of UPs23 are ideal for row-crop agriculture, and almost all of the land that supported this class has been converted to cropland.

## Southern Mesic Oak-Basswood Forest (MHs38)

**Southern Mesic Oak-Basswood Forest**

Mesic hardwood or, occasionally, hardwood-conifer forests. Present on wind-deposited silt on bedrock bluffs, on calcareous till on rolling till plains, and, rarely, in association with natural fire breaks in prairie landscapes or on weakly calcareous till on stagnation moraines.

**Vegetation Structure & Composition**

Description is based on summary of vegetation data from 128 plots (relevés).

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

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

**Subcanopy c**over is interrupted to continuous (50–100%); important species include ironwood, sugar maple, and basswood. American elm, red elm, and bitternut hickory are occasionally present, with blue beech occasional in southeastern and east-central Minnesota.

**Canopy** cover is interrupted to continuous (50–100%); the most common species are basswood, northern red oak, and sugar maple, with bur oak and green ash replacing northern red oak in importance in western Minnesota, especially in the CGP, and white oak abundant in some stands in eastern Minnesota. On rare occasions a super canopy with abundant white pine is present.

**Landscape Setting & Soils**

Loess-covered bedrock bluffs—Common. Present mostly on middle and upper slopes on bedrock hills, with a strong affinity for north- and northeast-facing aspects on steeper slopes. Parent material is wind-deposited silt that is generally deeper than 60in (150cm) over sedimentary bedrock. Outcrops of bedrock and large colluvial boulders are common. Gravel-sized rock fragments are absent, while flagstone-sized rocks are common deeper in soils just above bedrock. Soils have dark, organic-rich surface horizons, indicating former occupation of these sites by oak woodland or prairie. Little clay is available for formation of subsoil horizons capable of perching snowmelt and rainfall. Soils are well drained. Soil moisture regime is fresh. (Blufflands in PPL).

Till plains—Common landscape is rolling to hummocky. Parent material is fine textured, calcareous till with modest amounts of gravel and few stones. Soils have clayey subsoil horizons but lack evidence of prolonged saturation. Gray soil colors and deposits of free carbonates are common below the clay-loam horizon, indicating availability of water and nutrients below clay horizon. Soils are well drained. Soil moisture regime is fresh. (MIM; PPL; RRV; LAP; localized in Coteau Moraines and Minnesota River Prairie in CGP)

Stagnation moraines—Rare, present on coarse-textured till near lakes. Parent material is gravelly, partially sorted, noncalcareous or weakly calcareous drift. Subsoil horizons capable of perching snowmelt or rainfall are absent. Soils are well drained. Soil moisture regime is moderately dry to moderately fresh. (MIM; Rochester Plateau in PPL)

**Natural History**

In the past, catastrophic disturbances were rare in MHs38. An analysis of Public Land Survey records indicates that the rotation of catastrophic fires was in excess of 1,000 years, and the rotation of catastrophic wind-throw was about 360 years.1 Events that resulted in partial loss of

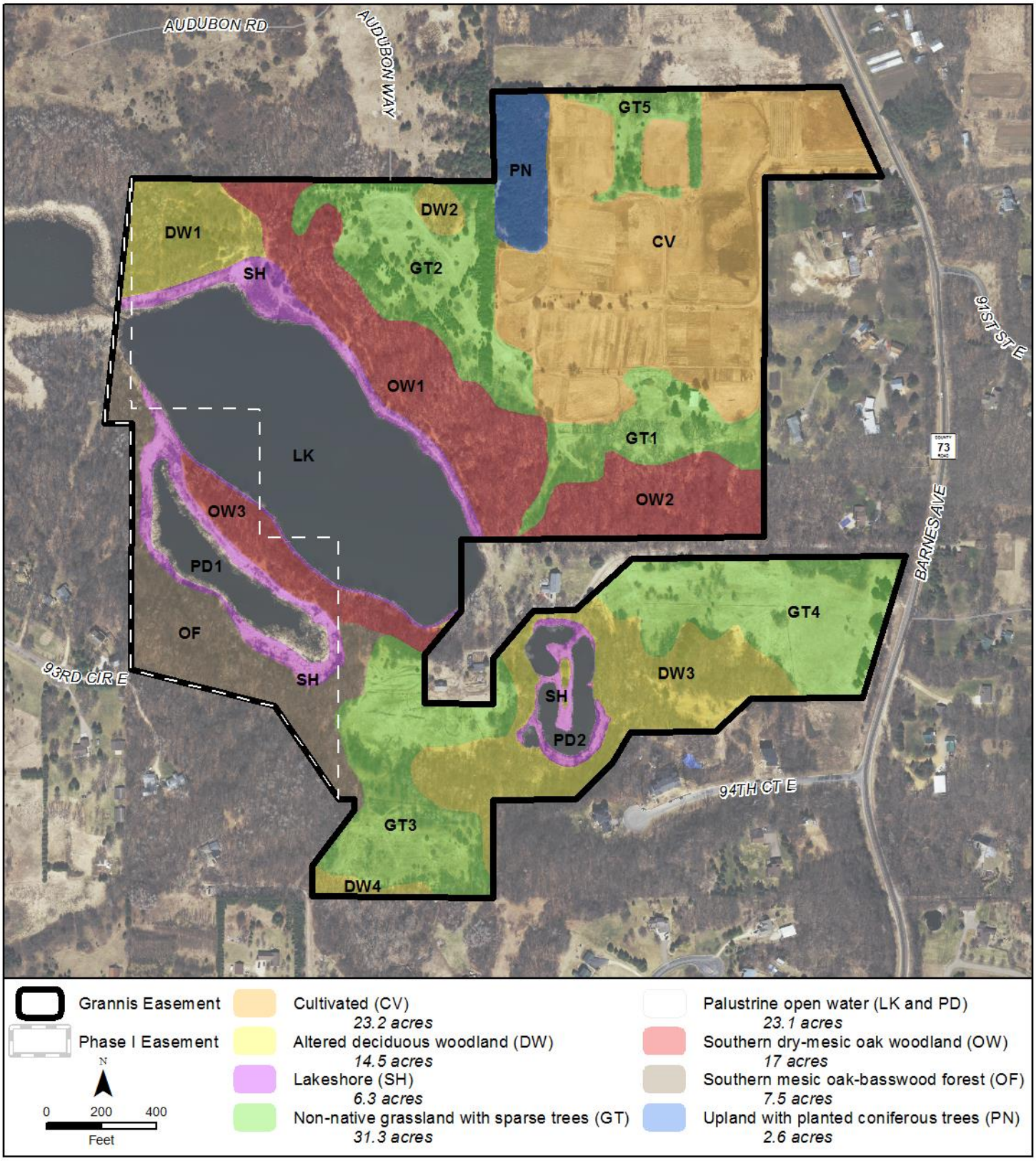
trees, especially light surface fires, were much more common, with an estimated rotation of 35 years. Based on the historic composition and age structure of these forests, MHs38 had two growth stages separated by a period of transition.

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

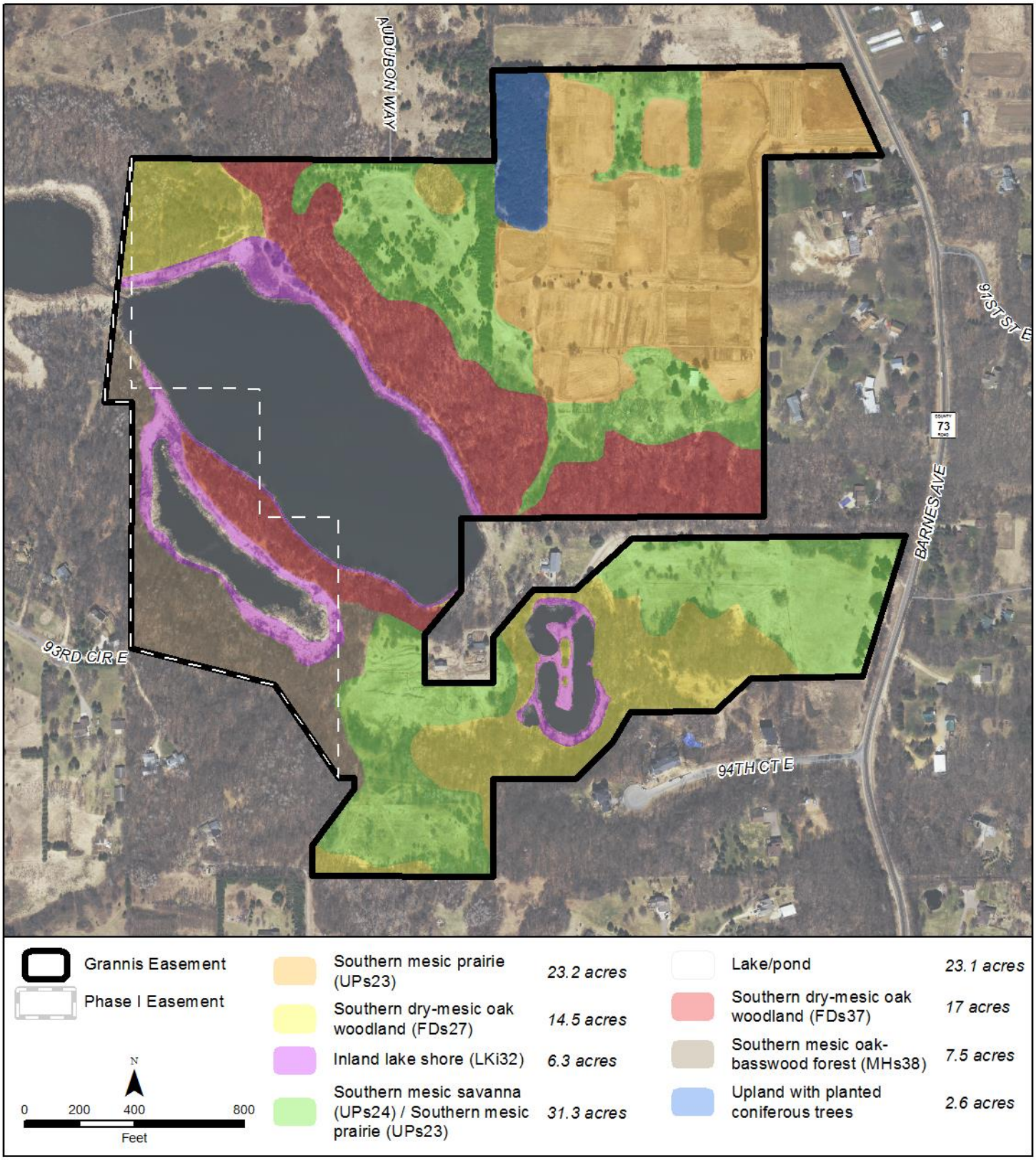
**35–75 years**—a transition period marked by the gradual decline of northern red oak and its replacement by sugar maple. Basswood, American elm, and ironwood increase during this period, and white oak becomes established.

**> 75 years**—mature forests of sugar maple mixed evenly with basswood, American elm, ironwood, northern red oak, and white oak. (Green ash is more common in modern vegetation samples than in the historic records for MHs38.)

## Figure 16. Land Cover Management Areas



## Figure 17. Target Plant Communities



# VIII. Land Management

## A. General Restoration Process

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. 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 on the Protected Property.

## B. General Goals

The primary objective for this site is to improve the composition of the plant communities throughout the property to better reflect the diversity, composition and structure that would have been present at the time of European settlement and to improve the ecological functions that the historic native plant communities would have provided, including:

- habitat for a diversity of wildlife species,
- nutrient and water cycling,
- carbon storage,
- moderation of water-table levels,
- erosion control,
- filtration of nutrients, sediments and pollutants,
- development and enrichment of soils,
- local temperature moderation.

Though somewhat degraded by past uses, the existing plant cover retains a good variety of native species and could be readily improved. A healthy and diverse plant community can

provide much greater wildlife value than a degraded one, and tends to be much more stable, and less susceptible to disease, invasive species and other concerns.

Land cover management unit recommendations were developed for each land cover area, with the overall goals for the easement area described in the Table 5.

**Table 5: Land Cover Management Unit Recommendations**

| Land Cover Management Unit | Area [acres] | Quality Index | Target Plant Community | General Recommendations |
|---|---|---|---|---|
| Altered Deciduous Woodland | 14.5 | 3 | Southern Dry-Mesic Oak Woodland (FDs27) | -Woodlands should be burned periodically, following buckthorn removal |
| Lakeshore | 6.3 | 3 | Inland Lake Shore (LKi32)) | -Removal of reed canary grass is difficult. Canadian thistle could be spot-sprayed, and cattails are confined to a small enough area so that they can be managed |
| Non-native grassland with Sparse Trees | 31.3 | 2 | Southern Mesic Savanna (UPs24) and/or Southern Mesic Prairie (UPs23) | -Reduce non-native species and support native community with prescribed burns<br>-After exotic brush removal, increasing native shrub diversity should be considered |
| Palustrine Open Water | 23.1 | 4 | N/A | N/A |
| Southern Dry-Mesic Oak Woodland | 17.0 | 3 | Southern Dry-Mesic Oak Woodland (FDs37) | -No need to covert this area back to savanna<br>-Keep non-native species at a reduced level and |

| | | | | |
|---|---|---|---|---|
| | | | | support the native plant community with periodic burns -After exotic brush removal, increasing native shrub diversity could also be considered |
| Southern Mesic Oak- Basswood Forest | 7.5 | 4 | Southern Mesic Oak-Basswood Forest (MHs38) | -Spring survey should be considered to determine presence of forbs -The area is to be exclude from burn plans; if a burn plan is ever considered a low flame fire would be most appropriate |
| Upland, Planted Pine Trees | 2.6 | 3 | N/A | A low priority to restore this area to native prairie. However, the conifers do provide some wildlife value and are not a detriment to the Protected Property |
| Cultivated | 23.2 | 1 | Southern Mesic Prairie (UPs23) | -Spray for invasive and perennial plants in the fall, and plant prairie mix in the spring |
| **Total** | **125.5** | | | |

## C. Priorities

The restoration process can be divided into three overall phases**.**

**Phase I**

- Correct and prevent the current beach and truck track erosion in the woods
- Release spotted knapweed biological control agents in unit G2, and
- Conduct exotic shrub/small control throughout the site

Unit OF is the highest quality area of the site, so exotic brush removal should begin there. It can initially be limited to plants that are at or near fruiting size. Smaller plants can be removed in subsequent years. After Unit OF, Unit OW is the next priority and all other units would follow after that. Achieving reasonable brush control typically takes three to five years or more. Prescribed burns, which will reduce exotic species seedlings and help to foster native species, would be conducted in all units except OF and GT. Unit OF would only be burned if further evaluation determines it would be beneficial. Unit GT will be burned as part of a second restoration phase.

**Phase II**

- Enhance the grassland areas by controlling exotics, burning and overseeding.
    - Unit GT2 would be the first priority, followed by Units GT1, GT3, and GT4.

**Phase III**

- Increase shrub and possibly the forb diversity in the woodlands by planting bareroot plants.
    - This would be conducted several years after the buckthorn is removed so that
        - natural recovery can be assessed, and
        - additional buckthorn follow-up work, including burns, can be conducted without harm to plantings.

**Long term**

- Periodic woodland and prairie burns.
- Annual site-wide monitoring for invasive species and erosion.

**Guidelines for restoration activities are:**

- Seek methods that have the least negative impact on the land and it inhabitants.
- For all tasks, seek viable options to avoid or minimize the use of chemicals. When chemicals are used, certified professionals should do it.
- When there are multiple options for effective chemicals, use the ones with the lowest toxicity and least soil residual.
- For applications within 50 feet of the lake or pond, use aquatic formula chemicals
- For planting or seeding, use native plant species whose genetic origin is as close as possible to the site or within 100 miles if possible.

Additional detail on restoration is provided below and a schedule of tasks and rough cost estimates is provided in Table 6. However, these details are meant as guidelines. The exact procedures are likely to be modified as the project develops. Species list for all the plant community restorations are provided in Appendix B.

Undertaking a restoration project of this size is a significant task and assistance is available to help landowners with the process. The County will continue to work closely with the landowners, if desired, by helping to secure funding and providing project management and oversight. Professional firms that can conduct management tasks are available upon request.

**Erosion Control**

One of the first issues to address at the site is erosion control. At the beach, non-native species (primarily thistle and reed canary grass) can be spot-treated with Rodeo. In order to establish native plants, it would be beneficial to import a couple inches of topsoil and work it into the sand. The area will need to be graded, and then seeded with native shoreland species. A natural fiber erosion blanket should be placed on top, after seeding. Do not use blankets made with nylon or plastic, as small animals get trapped in it and the blanket does not degrade well.

The truck tracks are becoming entrenched and some show erosion channels. Repair of these tracks will need additional evaluation and design, but in general, they will need to be re-graded and have water diversion structures such as water bars, dips, etc. installed. The Dakota Soil and Water Conservation District can help to assess all the erosion issues and make recommendations on remediation and prevention.

**Invasive Woody Plant Removal**

Although there are roughly 62.8 acres that have some exotic brush, the brush is at very low density in many areas, such as the 16-acre grassland and the 8-acre oak forest. Brush removal could be staged over time, beginning with Units OF and OW. Detailed woody species removal information is provided in Appendix E.

If possible, woody debris should be gathered and hauled away for use as biofuels. If that is not feasible, other options include stacking and burning, or to cut the stems into smaller lengths and scatter them on the ground. The latter is suitable in woodland areas or where scattered cut brush is very light and easily consumed by fire. Although the first approach can reduce exotic brush removal costs, brush left lying on areas of dense exotic growth, can be impede future management if regrowth occurs through the debris.

Prescribed burning is an important management tool for reducing buckthorn seedlings in wooded areas, and was historically a very important component of the plant communities at this site. Woodland burns could be completed in fall or spring, depending on the amount of leaf litter (for fuel), within one year of the initial brush removal. Burning two or three consecutive years is beneficial, especially if combined with herbicide treatment of re-sprouts.

Follow-up management would include treating re-sprouting shrubs in the fall for at least two years. Once the exotic brush population is reduced and manageable, long-term maintenance will consist of small amounts of cutting or treating every one to three years, and periodic prescribed burning.

Once the exotic brush is under control in the wooded areas, and several burns have been accomplished, the woodlands should be assessed for regeneration of native forb and shrub cover. It may take several years after buckthorn removal to determine regeneration, especially of woody species. If the species diversity is found to be sparse, planting or seeding native species should be considered. Appropriate species lists for oak woodland are found in Appendix B. Shrubs will need to be protected from deer browsing by encircling them with mesh. Native woodland forbs can be difficult to establish, but native seed can be broadcast in late fall. Monitoring plots should be set up to evaluate the success of the seeding. Woodland forbs, however, can take many years to mature. The woodland should not be burned after seeding for at least two to three years.

**Grassland Restoration to Prairie and Savanna**

The first step in grassland restoration is release of spotted knapweed biological control agents, as described earlier. In addition to that, the most basic grassland enhancement would be to simply do a late fall burn, then broadcast native prairie seed. An alternative approach to reducing non-native grass cover is to burn earlier in fall, applying a grass herbicide to the regrowth, followed by seeding. The grass herbicide could be applied again in early spring. It may also be necessary to control the goldenrod by herbicide application to individual plants. This will need to be repeated two or three times to reduce the stand.

After seeding, the site should be mowed two to three times the first year. When vegetation reaches about 10 inches, a flail mower is used to reduce vegetation height to about 6 inches in late summer and again in spring of the second year. A prescribed burn is scheduled for spring of the third year. During the second and third years, there may also be additional herbicide control needed for thistles or other species.

Once the native ground cover is established and the first burn completed (after three years), it will be feasible to plant bur oak trees or acorns, as well as other appropriate shrubs. New plantings should be protected from animal browsing and oak trees may also need protection from the next prescribed burn if they are still small.

**Lakeshore Restoration**

Aside from the erosion control/revegetation described above, restoration of the rest of the lakeshore will focus on spot-treatment of Canada thistle, narrow-leaved cattail and any other

noxious weed detected. Typically thistle would be cut in mid-summer, just after flowering, and then treated with herbicide in the fall.

If controlling reed canary grass is feasible, it would also be cut in mid-summer, and then treated in late summer and again in fall with an aquatic formula herbicide (e.g. Rodeo) in order to protect aquatic organisms. A second treatment can be applied in the fall or the following spring. This process can be repeated in the second year, followed by broadcast seeding with native wet meadow species (Appendix B) in late fall. Follow up management would be similar to the first three years of prairie management, with two mowings and a third-year burn.

If significant native species are mixed among the reed canary grass, a grass-specific herbicide can be used instead of glyphosate. In that case, the grass would be mowed or burned in spring, followed by herbicide.

**Long-term Management and Monitoring**

Once the primary restoration tasks are completed, the restoration process will convert to a monitoring and adaptive management phase. Long-term maintenance for the savanna areas will consist of burning every two to six years and monitoring for and managing exotic species. Although mowing in fall (September or October) can be used as a substitute if necessary, burning is still the optimum tool for establishing and maintaining fire-type communities such as prairie and savanna. All of the oak woodlands areas, but not the oak forest (OF) should also be periodically burned, roughly every seven to ten years.

Restored areas must be regularly monitored to identify ecological issues, such as erosion, invasive species, and disease. Monitoring is also important for detecting human-related issues such as illegal activities (hunting, ATV use, etc.). Early detection of concerns enables quick responses to address them before they become significant problems.

Monitoring animal as well as plant communities is also helpful for evaluating results of the restoration. A comparison of bird populations before and after restoration, for example, would be a valuable tool for quantifying positive impacts on the land.

## D. 5-Year Work Plan

A 5-year Work Plan will be developed as part of the preparation of the Final NRMP. The Plan will focus on the natural resource management and restoration priorities for improving the Protected Property. Based on the ecological assessment performed to-date, the primary focus of the restoration activities will be erosion control and exotic brush control in selected management units.

# IX. Wildlife

## A. Historical

Dakota County encompasses a variety of ecological subsections, including Big Woods, Oak Savanna, the Rochester Plateau, and the St. Paul Baldwin Plains and Moraines. Each subsection contains multiple habitats, and has an associated suite of wildlife species of greatest conservation need (SGCNs). Coupled with an abundance of water resources, there were diverse plant communities and associated wildlife. However, European settlement, over time, brought many changes to the landscape. The deep, fertile soils of most prairies were converted to agricultural fields. Forests were logged, wetlands were drained and the courses and flows of streams and rivers were altered. Overhunting was also a major issue and many wildlife populations declined precipitously.

Large mammal species such as bison, elk, black bear, wolves, and mountain lion were once found in the County. In the 1800s, early explorers and settlers from Radisson to Hennepin documented bison grazing the prairie terraces near Fort Snelling. By 1860, bison were nearly extirpated from all of North America. During the drought years in the 1930s, numerous elk antlers were retrieved from shallow lakes in southern Minnesota: evidence of their historical presence on the landscape. Black bears, among other predators, were common throughout the 18$^{th}$ and 19$^{th}$ centuries, demonstrating that the animal diversity in both the state and the County could support a variety of large predators.

Smaller mammals were also likely more abundant during the pre-settlement era within the County. From fur traders' records in the 1930s, it is evident that beaver, muskrats, and mink were killed for their furs, and populations of these species declined precipitously. Prairie species such as Franklin's ground squirrel, American badger, and a number of voles and mice species declined with the conversion of prairie and savanna to agriculture, though these declines are mostly anecdotal.

Hunting and land use changes also affected bird populations. The extinction of the passenger pigeon highlights the extreme pressure that hunting had on many of the County's wildlife species, while species such as prairie chickens were locally extirpated as prairie was converted to agriculture. Waterfowl populations declined as well, due to both hunting and wetland drainage for agriculture and development. During the mid-20$^{th}$ century, predators such as hawks eagles and owls were negatively impacted by hunting and human-caused pollution. Chemicals such as DDT caused declines in populations of species like bald eagles, as the chemical weakened egg shells and led to low brood success. This particular species was listed as threatened on the first state endangered species list published in 1984.

Largely anecdotal information exists regarding the declines of reptiles and amphibians in the County. Many reptiles, such as eastern racers and six-lined racerunners, depend on prairie habitat – particularly bluff prairies – and have likely experienced precipitous declines given historical habitat conversion. Wetland drainage and pollution by fertilizers and other chemicals has led to declines in wetland species, including amphibians such as Blanchard's cricket frog and reptiles such as Blanding's turtles. These more amphibious species are not only tied to both land and water habitats, but are also often sensitive to pollution of these habitats as well.

Soil erosion from agricultural operations and intense land use increased sediment loads to rivers and streams, negatively affecting aquatic ecosystems. Suburban development resulted in more warm water runoff into cool streams, which led to adverse thermal effects and stressed aquatic life. These land use changes had many negative effects on wildlife. Frog and salamander species, sensitive to chemicals and changes in hydrology, declined. As runoff and pollution flowed into rivers like the Vermillion, it resulted in declines in many types of aquatic species. Brook trout, for example, are sensitive to warm water, and rivers like the Vermillion saw declines in trout populations as runoff, pollution, and warm water from treatment plants flowed into the river. While there is conflicting evidence as to whether brook trout were native to the river, having potentially been stocked in the 1800s, and their decline throughout the 20$^{th}$ century is a clear example of the effects of development on wildlife. Brook trout are now restricted to only three streams in the entire County.

Importantly, the combination of research, public interest, education, changing attitudes, laws and regulations, and increased land protection and natural resource management have had a generally beneficial effect on wildlife during the last decades. Increased environmental regulation has benefitted wildlife populations. Beginning in the 1980s, the introduction of water quality rules at both the federal and state level has improved water quality impacted by point source pollution (such as waste-water treatment plants), and is also providing a solid framework to quantify and limit non-point sources (such as field runoff), which should be of great benefit to wildlife that relies on clean water. Other pollution regulations, like the ban on the use of DDT, have resulted in increases in bald eagle and other raptor populations in the County and in the region as a whole. A greater focus on land conservation has also ensured that there is available habitat for County wildlife. For example, the establishment and expansion of critical protected public and private lands has protected habitat for numerous Species of Greatest Conservation Need (SGCN) and other wildlife. Ecological restoration of these and other habitats has also ensured that quality habitat exists for these populations. And finally, an increase in public involvement in conservation has benefited a number of species. For example, the rebound of the bluebird population from its historical low in the mid-1900s was due in large part to nest box campaigns involving local citizens.

However, residential and agricultural development, invasive species and climate change continue to have significant impacts on County wildlife. Those animals that require specific habitat types, or habitats adversely impacted by development, agriculture and pollution, have been most impacted. Invasive species have become one of the most significant issues for native species diversity in Minnesota. Invasive shrubs like buckthorn not only adversely affect native plant diversity, but have been shown to cause declines in shrub-nesting bird species and can negatively impact frog development. Invasive European earthworms have also been linked to declines in forest floor dwellers like salamanders and ovenbirds.

Looking forward, tree pests and diseases like the emerald ash borer and oak wilt have been shown to provide avenues for the introduction of invasive plant species, which could negatively affect wildlife in the future. However, these tree maladies may also provide welcome habitat for species like cavity-nesting birds. Climate change's effects on wildlife will depend on a number of factors, and is predicted to shift the range of many species northward and potentially out of Dakota County. Ultimately, climate change may either create or remove habitat for many native wildlife species

## B. Existing Wildlife

Despite all of the landscape changes that have occurred, there are relatively large protected areas in the County. The federal Minnesota Valley National Wildlife Refuge along the western County boundary and the state Gores Pool #3 Wildlife Management Area along the eastern boundary support riverine wetlands, floodplain forests, oak savannas and forest, and grasslands. The 5,000-acre Vermillion Highlands complex owned by the University of Minnesota, Department of Natural Resources, Metropolitan Council, and the County located in the central portion of the County also provides a rich mosaic of natural and restored habitat. These habitats support more than 250 species of birds at some time during the year, including nesting bald eagles and peregrine falcons. The bird diversity is complemented by a least fifty species of mammals and thirty species of reptiles and amphibians. Additional state Wildlife and Aquatic Management and Scientific and Natural Areas and County Parks also provide larger tracts of protected wildlife habitat. These areas offer a glimpse of some of the potential species that could be present on the property.

The Grannis Family property falls within the St. Paul Baldwin Plains and Moraines subsection, on the border of the Oak Savanna subsection. Key habitats within the St. Paul Baldwin Plains and Moraines subsection include upland deciduous forest, oak savanna, prairie, non-forest wetland, grassland, shorelines, lakes and rivers. Urban development is the primary land use. The borders of these subsections were likely not distinct, and the habitats contained therein likely blended together in transition zones. With the variety of habitats on the Protected

Property, the Protected Property has the potential to harbor a large number of wildlife species of greatest conservation need (SGCN). It is estimated that 149 SGCNs are known to inhabit prairies, grasslands, woodland, and forest in the St. Paul Baldwin Plains and Moraines ecological subsection. Because the Protected Property encompasses many of the wetland, native prairie, woodland, and forest community types found within this subsection, the number of SGCNs likely to use the Protected Property is similar to the list for the entire subsection.

There are many wildlife species that still frequent the property, even in its degraded state, including some SGCNs. For instance, wildlife has been documented over many years by Vance Grannis, the Audubon Society, and other visitors to the Protected Property. Documented species include 27 mammals, 109 birds, five reptiles, eight amphibians, and ten fish. Included within this group, are several SGCN, including the following: big brown bat, least weasel, acadian flycatcher, five-lined skink, and spotted salamander. This is not an exhaustive list of the wildlife that uses or frequents the property, and likely represents only a fraction of the species present.

In order to better document the wildlife using the property, occasional landowner surveys could provide useful data. These surveys could be low intensity, low effort undertakings, and could be accomplished by walking portions of the property. For example, taking pictures of animal tracks, whether in the mud or snow, is a good way of identifying many mammal species. If the landowners are not familiar with tracks, photos can be sent to local wildlife officials for verification. Moreover, the landowners can keep a log of the species that visit their wetland bird boxes, taking photos when necessary. Trail cameras are another good resource for capturing photos of wildlife. Positioning these cameras near water, known feeding areas, or along paths and deer trails can capture a variety of animals using these areas. Cameras can be purchased by the landowner or borrowed from other agencies.

Bird surveys can be conducted by the landowners if they have birding knowledge, especially during breeding season. These surveys can capture resident birds who use the property year round, as well as migrants who use the property as an important stop-over or breeding ground. For reptiles, the use of artificial refugia (pieces of corrugated metal or heat-trapping materials like roofing material or rubber car mats) can attract individuals seeking to warm their bodies. Springtime is the best for surveying, when species like snakes are most active. Surveys consist of establishing refugia and checking on and under them when conditions are right (cool, sunny days in early-mid spring are best). Amphibians are best surveyed during the spring and summer, often by identifying their calls in the evening or at night. Recording unknown calls can also allow experts to help identify them. Lastly, keeping a list of bees, butterflies and other insects can help characterize the overall insect community. Property owners should refer to section B for a list of species they can monitor for.

One of the main restoration goals for the property will be to increase wildlife habitat. Providing improved habitat for the species present on the property, as well as restoring habitat for species that may have historically used the property, will help to increase both plant and animal diversity and overall ecosystem health. Land managers should refer to *Tomorrow's Habitat for the Wild and Rare: An Action Plan for Minnesota Wildlife* in order to determine and plan for SGCNs that could potentially utilize the property. Apart from the plant community restoration, there are specific restoration tasks that could be undertaken by the land manager or property owner to encourage wildlife use of the property. For example, Red Headed Woodpeckers, a Rochester Plateau and Oak Savanna subsection SGCN; depend on dead trees in mixed forest and savanna habitats for nesting and feeding. Retaining dead trees throughout the property and purposely girdling undesirable live trees could provide much needed habitat for this species. Other examples include providing structural diversity in the prairie and savanna areas by seeding and planting shrub species. This diversity can provide important habitat for small mammals like the western harvest mouse and prairie vole (both SGCNs), and reptiles like the eastern fox snake (another SGCN). In the case of snakes, these animals often use the structural diversity for safety, sunning themselves in short grass near taller grasses or shrubs. The structure provides cover and an avenue of escape if a predator appears.

Even with overall restoration of the property and focused tasks to benefit specific wildlife species, there is no guarantee that these species will use the property or increase their populations. For example, terrestrial species such as prairie voles and snakes that may have historically used the Protected Property might not be able to reach it due to the surrounding matrix of current land uses, roads etc., and lack of connectivity to other natural areas in the County. Birds may be able to overcome these land use "barriers", but the Protected Property may not provide suitable habitat for many species simply due to its inadequate size. The most sensitive wildlife species require large tracks of unaltered native plant communities. The presence of roads and even trails also present barriers, especially to small animals. Establishing a network of parks, preserves and private conservation easements may allow species to use restored areas that may otherwise be inaccessible. Protecting properties with this connectivity in mind will provide important benefits for the wildlife of Dakota County.

## C. Indicator Species

The following are relatively common species that are largely dependent on grassland or prairie habitat for breeding. Not all of these species would be expected at any given site. Presence/absence can depend on multiple factors such as size and shape of grassland, proximity to woods or other habitat types, degree of isolation, and structural and species diversity. There are many additional species that would also be expected on prairies, but are not considered as prairie-dependent.

**Mammals, Birds, Reptiles, and Insects**

Plains pocket gopher (keystone species)

Thirteen-lined ground squirrel

American badger (requires large areas)

Prairie vole (Species of special concern [SPC])

Franklin's ground squirrel

Eastern kingbird

American kestrel

Loggerhead shrike (Endangered, SGGN)

Horned lark

Tree swallow

Northern rough-winged swallow (SGCN)

Barn swallow

Eastern bluebird

Clay-colored sparrow (SCGN)

Field sparrow

Lark sparrow

Savannah sparrow (SPC)

Grasshopper sparrow (SCGN)

Henslow's sparrow (Endangered, SCGN)

Song sparrow

Dickcissel (SGCN)

Eastern meadowlark (SGCN)

Species that may be found along the edge because they require trees for nesting:

Ruby throated hummingbird

Brown thrasher

Chipping sparrow

Indigo bunting

Orchard oriole

Baltimore oriole

American goldfinch

Prairie skink

Six-lined racerunner (SGGN)

Bull snake (SPC)

Eastern racer (SPC, SGGN)

Plains (western) hognose snake (SPC)

Smooth Green Snake (SGGN)

Monarch butterfly

Regal Fritillary

The following are bird species that are largely dependent on woodland habitat. Not all of these species would be expected at any given site. Presence/absence can depend on multiple factors such as size and shape of the woodland, proximity to prairie or other habitat types, degree of isolation, and structural and species diversity. There are many additional species that would also be expected on woodlands, but are not considered as woodland-dependent.

**WOODLAND BIRDS**

Cooper's hawk

Black-billed cuckoo

Great horned owl

Barred owl

Red-bellied woodpecker

Yellow-bellied sapsucker

Downy woodpecker

Hairy woodpecker

Pileated Woodpecker

Eastern wood pewee

Eastern phoebe

Least flycatcher

Great crested flycatcher

Yellow-throated vireo

Warbling vireo

Red-eyed vireo

Black-capped chickadee

White breasted nuthatch

Brown creeper

Blue-gray gnatcatcher

Ovenbird

Blue-winged warbler

Yellow-rumped warbler

American redstart

Scarlet tanager

Rose breasted grosbeak

Baltimore Oriole

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# APPENDICES

## Appendix A: Plant Species Recorded at the Protected Property

The following plant species were identified at the site by Friends of the Mississippi River in 2010.

### Mesic Oak-Basswood Forest MHs38

| Non-Native | Family | Scientific Name | Common Name | Cov* | Diam (In) | Comments |
|---|---|---|---|---|---|---|
| **Groundcover to 4 ft** | | | **Total cover:** | 4 | | |
| | | ***Forbs*** | | 4 | | |
| | Fabaceae | *Amphicarpaea bracteata* | hog peanut | 2 | | |
| x | Asteraceae | *Arctium minus* | common burdock | 1 | | |
| | Polypodiaceae | *Athyrium filix-femina* | lady fern | 1 | | |
| | Umbelliferae | *Cryptotaenia canadensis* | honewort | + | | |
| | Asteraceae | *Eupatorium rugosum* | white snakeroot | 2 | | Common |
| | Rubiaceae | *Galium aparine* | cleavers | 1 | | |
| | Geraniaceae | *Geranium maculatum* | wild geranium | 1 | | |
| x | Boraginaceae | *Hackelia virginiana* | Virginia stickseed | 1 | | |
| x | Lamiaceae | *Leonurus cardiaca* | motherwort | 1 | | |
| | Liliaceae | *Maianthemum canadense* | false lily of the valley | 1 | | |
| | Urticaceae | *Pilea pumila* | clearweed | 2 | | Dense in some areas |
| | Liliaceae | *Polygonatum sp.* | Solomon's seal | + | | |
| | Umbelliferae | *Sanicula marilandica* | black snakeroot | 1 | | |
| | Liliaceae | *Smilax herbacea* | carrion plant | + | | |
| | Asteraceae | *Solidago flexicaulis* | zigzag goldenrod | 1 | | |
| | *Bryophyte fam* | | moss spp | | | Abundant |
| | | ***Graminoids*** | | 1 | | |
| | Cyperaceae | *Carex pensylvanica* | Pennsylvania sedge | 1 | | |
| | | ***Vines and woody species*** | | 2 | | |
| | Ulumaceae | *Celtis occidentalis* | Hackberry | + | seedling | |
| | Vitaceae | *Parthenocissus inserta* | Virginia creeper | 2 | | |
| | Fagaceae | *Quercus rubra* | red/pin oak | + | seedling | |
| | Vitaceae | *Vitis riparia* | wild grape vine | 1 | | |
| **Understory/shrub layer 4-15 ft** | | | **Total cover:** | 2 | | |
| x | Caprifoliacea | *Lonicera tartarica* | Tartarian honeysuckle | + | | |
| | Roseaceae | *Prunus serotina* | black cherry | + | | |
| x | Rhamnaceae | *Rhamnus cathartica* | common buckthorn | + | | |
| | Saxifragaceae | *Ribes sp* | gooseberry/currant | 2 | | Dominant |
| | Roseaceae | *Rubus ideaus* | raspberry | 1 | | More abundant in openings |
| | Caprifoliaceae | *Sambucus canadensis* | common elderberry | 1 | | |
| **Canopy 40 - 80 ft height** | | | **Total cover:** | 5 | | |
| | Betulaceae | *Betula papyrifera* | paper birch | 2 | 10 | |
| | Betulaceae | *Ostrya virginiana* | ironwood | 3 | 6-10 | Dominant in subcanopy |
| | Fagaceae | *Quercus rubra* | red/pin oak | 1 | 22 | |
| | Tiliaceae | *Tilia americana* | American basswood | 2 | 22-32 | Dominant |

* Relative amount of cover for individual species and vegetation layers: + (0-1%), 1 (1-5%), 2 (5-25%), 3 (25-50%), 4 (50-75%), 5 (75-100%).

### Units OW1, 2 and 3 Southern Dry Mesic Oak Woodland FDs37

| Non-Native | Family | Scientific Name | Common Name | Cov* | Diam (In) | Comments |
|---|---|---|---|---|---|---|
| **Groundcover to 4 ft** | | | **Total cover:** | **4** | | |
| | | ***Forbs*** | | 4 | | |
| | Ranunculaceae | *Actaea rubra* | red baneberry | + | | |
| x | Brassicaceae | *Alliaria officinalis* | garlic mustard | 1 | | Esp at southeast end |
| | Fabaceae | *Amphicarpaea bracteata* | hog peanut | + | | |
| | Ranunculaceae | *Anemonella thalictroides* | rue anemone | 1 | | |
| x | Asteraceae | *Arctium minus* | common burdock | 1 | | |
| | Polypodiaceae | *Athryrium filix-femina* | lady fern | 1 | | |
| | Onagraceae | *Circaea leutetiana* | enchanter's nightshade | 1 | | |
| | Asteraceae | *Eupatorium rugosum* | white snakeroot | 2 | | Dominant |
| | Roseacea | *Fragaria virginiana* | wild strawberry | + | | |
| | Rubiaceae | *Galium aparine* | cleavers | + | | |
| | Geraniaceae | *Geranium maculatum* | wild geranium | 1 | | |
| | Balsaminaceae | *Impatiens cf pallida* | pale jewelweed | + | | |
| x | Lamiaceae | *Leonurus cardiaca* | motherwort | 1 | | |
| | Liliaceae | *Maianthemum canadense* | false lily of the valley | 1 | | |
| | Umbelliferae | *Osmorhiza claytonii* | sweet cicely | 1 | | |
| | Roseaceae | *Rubus occidentalis* | Black raspberry | 1 | | |
| | Liliaceae | *Smilax herbacea* | carrion plant | 1 | | |
| | *Bryophyte family* | | moss spp | + | | |
| | | ***Graminoids*** | | **2** | | |
| | Cyperaceae | *Carex pensylvanica* | Pennsylvania sedge | 2 | | Esp. abundant on road thru center |
| | Cyperaceae | *Carex sp.* | Sedge | + | | Wide blade |
| | | ***Vines and woody species*** | | **2** | | |
| | Betulaceae | *Ostrya virginiana* | ironwood | 1 | seedling | Common |
| | Vitaceae | *Parthenocissus inserta* | Virginia creeper | 1 | | |
| | Roseaceae | *Prunus serotina* | black cherry | + | seedling | |
| | Fagaceae | *Quercus macrocarpa* | bur oak | + | seedling | Uncommon - south facing open areas. |
| | Fagaceae | *Quercus rubra* | red/pin oak | + | seedling | |
| | Rhamnaceae | *Rhamnus cathartica* | common buckthorn | 2 | seedling | very common |
| | Saxifragaceae | *Ribes cf missouriense* | Missouri gooseberry | 1 | | |
| | Anarcardiaceae | *Toxicodendron rydbergii* | poison ivy | + | | |
| | Vitaceae | *Vitis riparia* | wild grape vine | 1 | | |
| | Rutaceae | *Zanthoxylum americana* | prickly ash | + | | |
| **Understory/shrub layer 4-15 ft** | | | **Total cover:** | **4** | | |
| | Cornaceae | *Cornus racemosa/foemina* | gray dogwood | 1 | | |
| | Cupressaceae | *Juniperus virginiana* | red cedar | + | | |
| | Caprifoliaceae | *Lonicera tartarica* | Tartarian honeysuckle | 2 | | |
| x | Rhamnaceae | *Rhamnus cathartica* | common buckthorn | 2-3 | Mostly 1/2-1", few 2"-4' | Dominant, but overall not dense. Most dense along edges. |
| | Ulmaceae | *Ulmus americana* | American elm | 1 | 3 | |
| | Caprifoliaceae | *Viburnum lentago* | Nannyberry | 1 | | |
| | Rutaceae | *Zanthoxylum americana* | prickly ash | 2 | | |
| **Subcanopy 15-40 ft height** | | | **Total cover:** | **4** | | |
| | Betulaceae | *Ostrya virginiana* | ironwood | 3 | 4, 6 | Dom. |
| | Roseaceae | *Prunus serotina* | black cherry | + | 8 | |
| | Fagaceae | *Quercus rubra* | red/pin oak | 1 | 3, 8 | |
| | Tiliaceae | *Tilia americana* | American basswood | 2 | 3, 6 | |
| **Canopy 40 - 80 ft height** | | | **Total cover:** | **3** | | |
| | Aceraceae | *Acer negundo* | boxelder | 1 | | Woodland edge |
| | Aceraceae | *Acer saccharinum* | silver maple | 1 | | Few. Low on slope. |
| | Betulaceae | *Betula papyrifera* | paper birch | 2 | 12 | |
| | Fagaceae | *Quercus macrocarpa* | bur oak | 2 | 20 | Dominant |
| | Fagaceae | *Quercus rubra* | red/pin oak | 1 | 20, 24 | Dominant. 4 ft diam stump found (oak species) |
| | Populaceae | *Populus deltoides* | cottonwood | 2 | 22,40 | Mostly lake edge |
| | Tiliaceae | *Tilia americana* | American basswood | 2 | 24 | Abundant |

## Units GT1, 2 and 3 Non-Native Grassland with Sparse Trees

| Non-Native | Scientific Name | Common Name | Cov[2] | Diam (In) | Comments |
|---|---|---|---|---|---|
| Ground layer - Herbaceous | | | | | |
| | *Antennaria plantaginifolia* | plantain-leaved pussytoes | + | | |
| | *Aster ericoides* | heath aster | 1 | | |
| | *Aster novae-angliae* | New England aster | + | | |
| | *Aster oolentangiensis* | sky-blue aster | 1 | | |
| x | *Centaurea maculosa* | spotted knapweed | 2 | | |
| | *Cirsium discolor* | field thistle | 1 | | |
| | *Gnaphalium obtusifolium* | sweet everlasting | + | | |
| | *Lespedeza capitata* | round-headed bushclover | + | | |
| x | *Melilotus alba* | white sweet-clover | 1 | | |
| | *Pycnanthemum virginianum* | mountain mint | + | | |
| | *Rudbeckia hirta* | black-eyed Susan | 1 | | |
| | *Solidago canadensis* | Canada goldenrod | 2 | | dominant forb |
| | *Solidago nemoralis* | gray goldenrod | + | | |
| | *Solidago rigida* | stiff goldenrod | 1 | | |
| | *Toxicodendron rydbergii* | poison ivy | 1 | | |
| x | *Trifolium hybridum* | alsike clover | + | | |
| Ground layer - Graminoids | | | | | |
| x | *Bromus inermis* | smooth brome | 4 | | |
| x | *Phalaris arundinaceae* | reed canary grass | 1 | | small patches |
| x | *Poa pratensis* | Kentucky bluegrass | 2 | | |
| Ground layer - Woody species | | | | | |
| | *Populus tremuloides* | quaking aspen | 1 | | |
| **Understory/shrub layer 4-10 ft** | | | | | |
| | *Juniperus virginiana* | red cedar | 1 | | |
| | *Populus tremuloides* | quaking aspen | 1 | | |
| | *Prunus americana* | American plum | + | | |
| | *Rhus glabra* | smooth sumac | 1 | | |
| x | *Ulmus pumila* | Siberian elm | 1 | | |
| | *Viburnum lentago* | Nannyberry | + | | |
| **Canopy** | **10-50 ft height** | | | | |
| | *Acer negundo* | boxelder | + | | |
| | *Juniperus virginiana* | red cedar | 1 | | |
| | *Picea pungens* | Colorado blue spruce | 1 | | |
| | *Pinus resinosa* | red pine | 1 | | |
| | *Pinus strobus* | white pine | 1 | | |
| | *Pinus sylvestris* | Scotch pine | + | | |
| x | *Ulmus pumila* | Siberian elm | 1 | | |

## Unit LK Lakeshore

All species were in the upper zone, except where noted.

| Non-Native | Scientific Name | Common Name | Cov* | Comments |
|---|---|---|---|---|
| Ground layer - Herbaceous | | | | |
| x | *Amaranthus sp* | amaranth | + | |
| | *Asclepias syriaca* | common milkweed | 1 | |
| | *Bidens sp* | bur marigold | 1 | |
| x | *Chenopodium album* | lamb's quarters | + | |
| x | *Cirsium arvense* | canada thistle | + | |
| | *Cirsium cf muticum* | thistle species | + | |
| | *Epilobium sp.* | willow herb | + | Upper and lower zone |
| | *Erigeron strigosus* | daisy fleabane | 1 | |
| | *Eupatorium perfoliatum* | boneset | 1 | |
| | *Geum canadense* | white avens | + | |
| | *Lemna sp* | duckweed | 3 | dominant aquatic |
| | *Lobelia siphilitica* | great blue lobelia | + | |
| | *Lycopus sp* | bugleweed | 1 | |
| x | *Melilotus alba* | white sweet-clover | 2 | |
| x | *Mollugo verticillata* | carpetweed | + | |
| | *Nymphea or nuphar* | waterlily | 2 | aquatic |
| | *Onoclea sensibilis* | sensitive fern | + | |
| | *Polygonum pensylvanicum* | pink knotweed | 1 | |
| | *Rudbeckia hirta* | black-eyed Susan | + | upper edges |
| | *Sagittaria latifolia* | broad-leaved arrowhead | | Lower zone-aquatic |
| x | *Silene latifolia* | white campion | + | |
| | *Solidago canadensis* | Canada goldenrod | 2 | |
| | *Solidago gigantea* | late goldenrod | 1 | |
| | *Urtica dioica* | stinging nettle | 3 | |
| | *Verbena hastata* | blue vervain | + | |
| Ground layer - Graminoids | | | | |
| | *Cyperus esculentus* | yellow nutsedge | | Lower zone-aquatic |
| | *Echinocloa spp.* | barnyard grass | | Lower zone. Could be native or non native species. |
| | *Leersia oryzoides* | rice cut-grass | 1 | |
| x | *Phalaris arundinaceae* | reed canary grass | 2 | Upper and lower zone |
| | *Scirpus acutus* | hard stem bulrush | 1 | |
| | *Scirpus atrovirens* | Dark-green bulrush | | Lower zone-aquatic |
| x | *Setaria glauca* | yellow foxtail | 1 | |
| | *Typha angustifolia* | Narrow-leaved cattail | | Lower zone-aquatic |
| Shrub layer | | | | |
| | *Cornus sericea* | Red-osier dogwood | + | |
| | *Sambucus canadensis* | elderberry | 1 | |
| | *Populus deltoides* | Cottonwood | + | seedling |
| x | *Ulmus pumila* | Siberian elm | + | seedling |
| | *Salix exigua* | Sandbar willow | 1 | Upper and lower zone |
| | *Salix sp* | Willow species | | Lower zone-aquatic |

*Relative amount of cover for individual species and vegetation layers: + (0-1%), 1 (1-5%), 2 (5-25%), 3 (25-50%), 4 (50-75%), 5 (75-100%).

## Appendix B: Plant Species for Restoration of the Protected Property

The following species lists are based on data collected by the MN DNR of species recorded at native MN plant communities. The lists are not comprehensive – there may be other species suitable for a site – nor will all species listed necessarily be needed or available from nurseries. Detailed species lists and quantities will need to be developed by an ecologist after site preparation and additional evaluation. All seed and plant material used at the property should be of Minnesota origin, ideally from within 100 miles of the site. Nurseries should provide seed/ plant origin information.

### Southern dry-mesic oak woodland (FDs27)

| Scientific name | Common name |
|---|---|
| **Forbs** | |
| *Amphicarpaea bracteata* | hog-peanut |
| *Antenaria spp* | pussytoes |
| *Anemone americana* | round-lobed hepatica |
| *Aquilegia Canadensis* | columbine |
| *Aralia nudicaulis* | wild sarsaparilla |
| *Aster cordifolius* | heart-leaved aster |
| *Athyrium filix-femina* | lady fern |
| *Campanula rotundifolia* | harebell |
| *Carex pensylvanica* | Pennsylvania sedge |
| *Circaea lutetiana* | enchanter's nightshade |
| *Desmodium glutinosum* | pointed-leaved tick-trefoil |
| *Eupatorium rugosum* | white snakeroot |
| *Euphorbia corollata* | flowering spurge |
| *Fragaria virginiana* | wild strawberry |
| *Galium boreale* | northern bedstraw |
| *Galium triflorum* | three-flowered bedstraw |
| *Geranium maculatum* | wild geranium |
| *Geum canadense* | white avens |

| | |
|---|---|
| *Helianthus strumosus* | woodland sunflower |
| *Maianthemum canadense* | Canada mayflower |
| *Osmorhiza claytonii* | sweet cicely |
| *Phyrma leptostachya* | lopseed |
| *Sanicula gregari* | gregarious black snakeroot |
| *Smilacina racemosa* | false solomon's seal |
| *Solidago ulmifolia* | elm-leaved goldenrod |

## Shrubs

| | |
|---|---|
| *Cornus alternifolia* | Pagoda dogwood |
| *Cornus racemosa* | Gray dogwood |
| *Corylus americana* | American hazelnut |
| *Prunus virginiana* | Chokecherry |
| *Prunus pennsylvanica* | pin cherry |

## Trees

| | |
|---|---|
| *Betula papyrifera* | Paper birch |
| *Carya cordiformes* | Bitternut hickory |
| *Celtis occidentalis* | Hackberry |
| *Ostrya virginiana* | Ironwood |
| *Prunus serotina* | Black cherry |
| *Quercus alba* | White oak |
| *Quercus macrocarpa* | Bur oak |
| *Quercus rubra* | Northern red oak |

## Southern Mesic Oak-Basswood Forest MHs38

| Genus | Species | Common Name |
|---|---|---|
| **Trees** | | |
| *Acer* | *saccharum* | Sugar maple |
| *Betula* | *papyrifera* | Paper-birch |
| *Carpinus* | *caroliniana* | Blue beech |
| *Carya* | *cordiformis* | Bitternut hickory |
| *Celtis* | *occidentalis* | Hackberry |
| *Fraxinus* | *pennsylvanica* | Green ash |
| *Fraxinus* | *nigra* | Black ash |
| *Ostrya* | *virginiana* | Ironwood |
| *Populus* | *tremuloides* | Quaking aspen |
| *Populus* | *grandidentata* | Big-toothed aspen |
| *Prunus* | *serotina* | Black cherry |
| *Quercus* | *rubra* | Northern red oak |
| *Quercus* | *alba* | White oak |
| *Quercus* | *macrocarpa* | Bur oak |
| *Tilia* | *americana* | Basswood |
| **Shrubs** | | |
| *Amelanchier* | cmx. | Juneberry |
| *Cornus* | *alternifolia* | Pagoda dogwood |
| *Cornus* | *racemosa* | Gray dogwood |
| *Corylus* | *cornuta* | Beaked hazelnut |
| *Corylus* | *americana* | American hazelnut |
| *Diervilla* | *lonicera* | Bush honeysuckle |
| *Lonicera* | *dioica* | Wild Honeysuckle |
| *Prunus* | *virginiana* | Chokecherry |
| *Sambucus* | *canadensis* | Common elder |
| *Sambucus* | *racemosa* | Red-berried elder |
| *Staphylea* | *trifolia* | Bladdernut |
| *Symphoricarpos* | cmx | Snowberry |
| *Viburnum* | *rafinesquianum* | Downy arrow-wood |
| *Viburnum* | *lentago* | Nannyberry |
| *Viburnum* | *opulus* | High-bush cranberry |
| *Zanthoxylum* | *americanum* | Prickly ash |
| **Vines** | | |
| *Celastrus* | *scandens* | Climbing bittersweet |
| *Lonicera* | *prolifera* | Grape honeysuckle |
| **Grasses, Rushes and Sedges** | | |
| *Carex* | *pedunculata* | Long-stalked sedge |
| *Carex* | *pensylvanica* | Pennsylvania sedge |
| *Carex* | *blanda* | Charming sedge |
| *Carex* | *gracillima* | Graceful sedge |
| *Carex* | *deweyana* | Dewey's sedge |
| *Carex* | *sprengelii* | Sprengel's sedge |
| *Carex* | *radiata* | Stellate sedge |
| *Carex* | *rosea* | Rolled-up sedge |
| *Elymus* | *hystrix* | Bottlebrush grass |
| *Elymus* | *virginicus* | Virginia wild rye |
| *Festuca* | *subverticillata* | Nodding fescue |
| *Leersia* | *virginica* | White grass |
| *Oryzopsis* | *racemosa* | Black-fruited rice-grass |
| *Oryzopsis* | *asperifolia* | Moutain rice-grass |
| *Schizachne* | *purpurascens* | False melic grass |
| **Ferns** | | |
| *Athyrium* | *filix-femina* | Lady-fern |
| *Adiantum* | *pedatum* | Maidenhair fern |
| *Osmunda* | *claytoniana* | Interrupted fern |

| Genus | Species | Common Name |
|---|---|---|
| **Forbs** | | |
| *Actaea* | *rubra* | Red baneberry |
| *Allium* | *tricoccum* | Wild leek |
| *Amphicarpaea* | *bracteata* | Hog-peanut |
| *Anemone* | *quinquefolia* | Wood-anemone |
| *Anemone* | *acutiloba* | Sharp-lobed hepatica |
| *Anemone* | *americana* | Round-lobed hepatica |
| *Aplectrum* | *hyemale* | Putty-root |
| *Apocynum* | *androsaemifolium* | Spreading dogbane |
| *Aquilegia* | *canadensis* | Columbine |
| *Aralia* | *nudicaulis* | Wild sarsaparilla |
| *Aralia* | *racemosa* | American spikenard |
| *Arisaema* | *triphyllum* | Jack-in-the-pulpit |
| *Asarum* | *canadense* | Wild ginger |
| *Asclepias* | *exaltata* | Poke milkweed |
| *Aster* | *cordifolius* | Heart-leaved aster |
| *Aster* | *macrophyllus* | Large-leaved aster |
| *Aster* | *lateriflorus* | Side-flowering aster |
| *Aster* | *sagittifolius* | Tall-leaved aster |
| *Campanula* | *americana* | Tall bellflower |
| *Campanula* | *rotundifolia* | Harebell |
| *Cardamine* | *concatenata* | Cut-leaved toothwort |
| *Caulophyllum* | *thalictroides* | Blue cohosh |
| *Cryptotaenia* | *canadensis* | Honewort |
| *Desmodium* | *glutinosum* | Pointed-leaved tick-trefoil |
| *Dicentra* | *cucullaria* | Dutchman's-breeches |
| *Dioscorea* | *villosa* | Wild yam |
| *Eupatorium* | *rugosum* | Common snakeroot |
| *Fragaria* | *virginiana* | Common strawberry |
| *Galium* | *boreale* | Northern bedstraw |
| *Geranium* | *maculatum* | Wild geranium |
| *Helianthus* | *pauciflorus* | Stiff sunflower |
| *Lilium* | *michiganense* | Michigan lily |
| *Maianthemum* | *canadense* | Canada mayflower |
| *Mitella* | *diphylla* | Two-leaved miterwort |
| *Orchis* | *spectabilis* | Showy orchis |
| *Osmorhiza* | *claytonii* | Clayton's sweet cicely |
| *Pedicularis* | *canadensis* | Wood-betony |
| *Phlox* | *divaricata* | Blue phlox |
| *Phryma* | *leptostachya* | Lopseed |
| *Polygonatum* | *biflorum* | Giant Solomon's-seal |
| *Pyrola* | *elliptica* | Common pyrola |
| *Rudbeckia* | *laciniata* | Goldenglow |
| *Sanguinaria* | *canadensis* | Bloodroot |
| *Smilacina* | *racemosa* | false Solomon's-seal |
| *Solidago* | *flexicaulis* | Zig-zag goldenrod |
| *Strophostyles* | *helvola* | Wild bean |
| *Thalictrum* | *dioicum* | Early meadow-rue |
| *Thalictrum* | *thalictroides* | Rue-anemone |
| *Trillium* | *cernuum* | Nodding trillium |
| *Trillium* | *grandiflorum* | Large-flowered trillium |
| *Uvularia* | *grandiflora* | Yellow bellwort |
| *Uvularia* | *sessilifolia* | Pale bellwort |
| *Veronicastrum* | *virginicum* | Culver's root |

**Southern Mesic Savanna (UPs24) and Southern Mesic Prairie (UPs23) Species**

While restoring a full complement of species for any type of restoration is not feasible and often dependent upon funding, the following guidelines can be used:

- Low diversity: 20 to 30 species (6 to 8 grasses, 15 to 20 forbs, 1 low shrub)
- Moderate diversity: 35 to 40 species (9 to11 grasses, 25 to30 forbs, 2 to3 low shrubs)
- High diversity: 50 to 60 species (12 to14 grasses, 30 to 40 forbs, 3 to 4 low shrubs)

| Genus | Species | Common Name |
|---|---|---|
| **Shrubs** | | |
| *Amorpha* | *canescens* | Lead-plant |
| *Amorpha* | *nana* | Fragrant false indigo |
| *Prunus* | *virginiana* | Chokecherry |
| *Rhus* | *typhina* | Staghorn sumac |
| *Rosa* | *arkansana* | Prairie rose |
| *Rosa* | cmx. | Smooth wild rose |
| *Salix* | *humilis* | Prairie willow |
| *Symphoricarpos* | cmx. | Snowberry |
| **Grasses, Rushes and Sedges** | | |
| *Andropogon* | *gerardii* | Big bluestem |
| *Bromus* | *kalmii* | Kalm's brome |
| *Carex* | *bicknellii* | Bicknell's sedge |
| *Carex* | *muhlenbergii* | Muhlenberg's sedge |
| *Carex* | *meadii* | Mead's sedge |
| *Carex* | *tenera* | Marsh-straw sedge |
| *Elymus* | *wiegandii* | Canada wild rye |
| *Elymus* | *trachycaulus* | Slender wheatgrass |
| *Eragrostis* | *spectabilis* | Purple lovegrass |
| *Muhlenbergia* | *mexicana* | Mexican satin-grass |
| *Panicum* | *oligosanthes* | Few-flowered panic grass |
| *Panicum* | *virgatum* | Switchgrass |
| *Panicum* | *perlongum* | Long-leaved panic grass |
| *Schizachyrium* | *scoparium* | Little bluestem |
| *Sorghastrum* | *nutans* | Indian grass |
| *Sporobolus* | *heterolepis* | Prairie dropseed |
| *Stipa* | *spartea* | Porcupine-grass |
| Trees: 15 to 25% cover | | |
| Quercus | macrocarpa | Bur oak |

| Genus | Species | Common Name |
|---|---|---|
| **Forbs** | | |
| *Allium* | *stellatum* | Prairie wild onion |
| *Allium* | *canadense* | Wild garlic |
| *Anemone* | *cylindrica* | Long-headed thimbleweed |
| *Anemone* | *virginiana* | Virginia thimbleweed |
| *Anemone* | *canadensis* | Canada anemone |
| *Antennaria* | *spp.* | Pussytoes |
| *Apocynum* | *androsaemifolium* | Spreading dogbane |
| *Artemisia* | *frigida* | Prairie sagewort |
| *Asclepias* | *tuberosa* | Butterfly-weed |
| *Asclepias* | *synaca* | Common milkweed |
| *Aster* | *oolentangiensis* | Sky-blue aster |
| *Aster* | *ericoides* | Heath aster |
| *Aster* | *lanceolatus* | Panicled aster |
| *Aster* | *novae-angliae* | New England aster |
| *Aster* | *laevis* | Smooth aster |
| *Astragalus* | *canadensis* | Canada milk-vetch |
| *Campanula* | *rotundifolia* | Harebell |
| *Chrysopsis* | *villosa* | Prairie golden aster |
| *Comandra* | *umbellata* | Bastard toad-flax |
| *Coreopsis* | *palmata* | Stiff tickseed |
| *Dalea* | *purpurea* | Purple prairie-clover |
| *Dalea* | *candida* | White prairie-clover |
| *Desmodium* | *canadense* | Canadian tick-trefoil |
| *Euphorbia* | *corollata* | Flowering spurge |
| *Euthamia* | *graminifolia* | Grass-leaved goldenrod |
| *Fragaria* | *virginiana* | Common strawberry |
| *Galium* | *boreale* | Northern bedstraw |
| *Gentiana* | *billingtonii* | Closed gentian |
| *Geum* | *triflorum* | Prairie smoke |
| *Helenium* | *autumnale* | Autumn sneezeweed |
| *Helianthus* | *maximiliani* | Maximilian's sunflower |
| *Helianthus* | *pauciflorus* | Stiff sunflower |
| *Heliopsis* | *helianthoides* | Ox-eye |
| *Heuchera* | *richardsonii* | Alum-root |
| *Lathyrus* | *venosus* | Veiny pea |
| *Lespedeza* | *capitata* | Round-headed bush-clover |
| *Liatris* | *aspera* | Rough blazing star |
| *Liatris* | *ligulistylis* | Northern plains blazing star |
| *Liatris* | *pycnostachya* | Gayfeather |
| *Lilium* | *philadelphicum* | Wood lily |
| *Lobelia* | *spicata* | Rough-spiked Lobelia |
| *Mirabilis* | *hirsuta* | Hairy four-o'clock |
| *Monarda* | *fistulosa* | Wild bergamot |
| *Oenothera* | *biennis* | Common evening-primrose |
| *Pedicularis* | *canadensis* | Wood-betony |
| *Phlox* | *pilosa* | Prairie phlox |
| *Physalis* | *heterophylla* | Clammy ground-cherry |
| *Polygala* | *polygama* | Racemed milkwort |
| *Potentilla* | *arguta* | Tall cinquefoil |
| *Pycnanthemum* | *virginianum* | Virginia mountain-mint |
| *Ratibida* | *pinnata* | Gray-headed coneflower |
| *Rudbeckia* | *hirta* | Black-eyed Susan |
| *Sisyrinchium* | *campestre* | Field blue-eyed grass |
| *Smilacina* | *stellata* | Starry false Solomon's-seal |
| *Smilacina* | *racemosa* | False Solomon's-seal |
| *Solidago* | *nemoralis* | Gray goldenrod |
| *Solidago* | *missouriensis* | Missouri goldenrod |
| *Solidago* | *ptarmicoides* | Upland white aster |
| *Solidago* | *speciosa* | Showy goldenrod |
| *Thalictrum* | *dasycarpum* | Tall meadow-rue |
| *Tradescantia* | *bracteata* | Bracted spiderwort |
| *Veronicastrum* | *virginicum* | Culver's root |
| *Vicia* | *americana* | American vetch |
| *Viola* | *pedatifida* | Prairie bird-foot violet |
| *Zizia* | *aurea* | Golden alexanders |
| *Artemisia* | *campestris* | Tall wormwood |

## Lakeshore LKi32

**Upper Zone Species**

**Forbs**

| Scientific name | Commmon name |
|---|---|
| *Asclepias incarnata* | Swamp milkweed |
| *Cicuta bulbifera* | Bulb-bearing water hemlock |
| *Epilobium ciliatum* | American willow-herb |
| *Eupatorium maculatum* | Spotted Joe pye weed |
| *Eupatorium perfoliatum* | Common boneset |
| *Impatiens capensis* | Touch-me-not |
| *Lycopus uniflorus* | Northern bugleweed |
| *Lysimachia terrestris* | Yellow loosestrife |
| *Mimulus ringens* | Blue monkey flower |
| *Polygonum sagittatum* | Arrow-leaved tearthumb |
| *Scutellaria galericulata* | Marsh skullcap |
| *Scutellaria lateriflora* | Mad dog skullcap |
| Grasses & Sedges | |
| *Calamagrostis canadensis* | Bluejoint |
| *Echinochloa muricata* | Rough barnyard grass |
| *Glyceria grandis* | Tall manna grass |
| *Juncus pelocarpus* | Brown-fruited rush |
| *Juncus tenuis* | Path rush |
| *Leersia oryzoides* | Rice cut grass |
| *Scirpus cyperinus* | Woolgrass |
| *Scirpus cyperinus* | Stalked woolgrass |
| Shrubs | |
| *Amorpha fruticosa* | False indigo |
| *Spiraea alba* | Meadowsweet |

**Lower Zone Species**

| Scientific name | Commmon name |
|---|---|
| Floating-Leaved & Submergent Forbs | |
| Brasenia schreberi | Watershield |
| Eriocaulon aquaticum | Pipewort |
| Isoetes echinospora | BraunÕs quillwort |
| Isoetes lacustris | Lake quillwort |
| Littorella uniflora | American shore plantain |
| Myriophyllum tenellum | Slender water milfoil |
| Potamogeton spirillus | Coiled pondweed |
| Subularia aquatica | Awlwort |
| Utricularia gibba | Humped bladderwort |
| Emergent Forbs | |
| Asclepias incarnata | Swamp milkweed |
| Calla palustris | Wild calla |
| Cicuta bulbifera | Bulb-bearing water hemlock |
| Impatiens spp | Touch-me-not |
| Iris versicolor | Northern blue flag |
| Lobelia dortmanna | Water lobelia |
| Lycopus uniflorus | Northern bugleweed |
| Lysimachia terrestris | Yellow loosestrife |
| Menyanthes trifoliata | Buckbean |
| Sagittaria latifolia | Broad-leaved arrowhead |
| Sagittaria rigida | Sessile-fruited arrowhead |
| Utricularia resupinata | Lavender bladderwort |
| Grasses & Sedges | |
| Carex comosa | Bristly sedge |
| Carex utriculata | Beaked sedge |
| Dulichium arundinaceu | Three-way sedge |
| Eleocharis acicularis | Least spikerush |
| Eleocharis palustris | Red-stalked spikerush |
| Eleocharis smallii | SmallÕs spikerush |
| Glyceria canadensis | Rattlesnake grass |
| Juncus effusus | Soft rush |
| Juncus pelocarpus | Brown-fruited rush |
| Scirpus cyperinus | Woolgrass |
| Scirpus validus | Soft stem bulrush |

# Appendix C: Potential Ecological Impacts

## A. Fire Suppression

The application or withdrawal of ecosystem functions, processes, and components will have varying affects. Sometimes these affects are subtle and sometimes they are overt. They can be acute or chronic. As is so oftentimes the case, there are complex interactions between species and amongst abiotic features, which result in changes to or even shifts in ecosystems. For example, periodic fires were very important parts of natural processes prior to settlement. Fire kills small woody seedlings that might otherwise grow into mature trees and shrubs, thus keeping the understory of woodland and the ground layer of savannas open. The resulting open areas allow wildflowers, grasses, sedges, and ferns to thrive. When fires occurred historically, a very diverse and varied herbaceous ground layer flourished under woodlands and savannas, with hundreds of species occurring. The lack of fire over the last 150 years has negatively impacted the native woodlands and savannas. In broad terms, woodlands have succeeded and are currently succeeding to forests, with savannas and prairies succeeding to woodlands.

## B. Disease

### 1. Oak Wilt

Oak wilt is a very serious fungal disease of oak trees that results in tree mortality. Once the oak wilt fungus becomes established in one tree, it can move through common root systems to adjacent trees of the same species—red oaks to other red oaks, and white oaks to other white oaks—thus the formation of an "infection center." Infection centers spread rapidly through red oaks and slowly through white oaks. Bur oaks are intermediate in spread rate. Oak wilt can be controlled primarily through reducing and preventing the wounding of trees.

Overland spread of oak wilt by insects can be prevented by following these guidelines on when to prune and when to paint.

**High Risk Period:** Don't wound or prune during April, May and June. If trees are accidentally wounded or pruning is unavoidable, cover the wounds immediately or within minutes using one of the preferred materials such as water-based paint or shellac.

When oak trees are wounded, they are more susceptible to oak wilt since beetles, which carry fungal spores on their bodies, are attracted to the scent of fresh wounds and become vectors of the disease. Storm damage can also result in potential infestations.

**Low Risk Period**: July through October. The tree's vascular system begins shutting down during this period and appears to be better able to prevent fungal growth. However, infections may rarely occur due to weather conditions and insect populations. Covering wounds is optional.

**Safe Period**: November through March. This is the preferred time for pruning since the fungal pathogen and insect vectors are inactive.

Tree climbing irons should never be used on living oak trees, even during the "safe period."

***Control***

When oak trees are wounded, they are more susceptible to oak wilt since beetles, which carry fungal spores on their bodies, are attracted to the scent of fresh wounds and become vectors of the disease. Storm damage can also result in potential infestations.

To slow the underground spread of the fungus, root barriers are required. The most cost-effective method of creating root barriers is with a vibratory plow—a large, modified backhoe that pulls a vibrating blade through the ground. The blade typically extends five-feet deep into the soil, cutting roots as it moves. This procedure can be more or less disturbing to the soil and plant community, so deciding whether or not to root-cut should include an analysis of the costs and benefits. Also, vibratory plows will not operate on slopes that are too steep or soils that are too wet or too hard. It is not recommended on the steep slopes of the site, but rather on relatively broad, flat areas. Access for a vibratory plow must be considered and a 10-foot wide lane must be available for the machine to be used.

An alternative method is chemical injections into individual trees, which is used in situations where trees are of high value and/or vibratory plowing is not an option. The downsides of using chemicals is that they are more expensive, they only treat individual trees, not groups of trees, and injections must be repeated every two years to be effective.

Most of the time, oak wilt will affect red or pin oaks, and not affect bur and white oaks. This situation is usually tolerable, since red and pin oaks are somewhat invasive in woodlands and savannas, and reducing tree density helps to restore woodlands and savannas. However, if the burs and whites become infected, control measures should be assessed as soon as possible. Sometimes there will be no good control options, due to steepness of slopes and presence of outcropping bedrock, etc. It is recommended to remove wilting red and pin oaks (after control lines are in place, if feasible), and properly dispose of the wood since they can produce spore mats that can spread the disease to any nearby oaks. If there is a high amount of spores in an area, the likelihood of overland infection goes up, even for bur oaks and white oaks.

In some circumstances, monitoring and replanting with a different tree species or a diversity of tree species is the only solution. See Appendix A for a list of appropriate tree species for your site.

**2. Bur Oak Blight**

Bur Oak Blight (BOB) is a relatively new fungal disease in Minnesota that was recently discovered. This disease has been confirmed in several counties in Minnesota, including Ramsey and Hennepin, so it could potentially occur in Dakota County. This disease kills trees, but moves much more slowly than does Oak Wilt. It only affects bur oaks, which is a concern in areas containing valuable bur oaks. BOB seems to be influenced by the frequency of rainfall, with more rainfall resulting in conditions more suitable for the disease. Symptoms occur on leaves during July and August, with large, brown, wedge-shaped necrotic lesions forming. Sometimes leaf veins also turn brown. One of the best ways to diagnose the presence of this disease is by examining bur oaks during the winter. Normal bur oaks drop all of their leaves during the winter. If the leaves are retained (even a few), this may indicate that the tree is infected with BOB. The disease overwinters in leaf petioles and spreads throughout the crown of the tree and potentially into other nearby trees over the span of several years. Mortality can result, but often trees that die are located next to ones that are unaffected, so the rate of spread is relatively slow. Control of this disease cannot be attained through raking and burning of fallen leaves, since many leaves remain attached to the tree over winter. However, periodic site-wide burning would reduce the spore load, since many fallen leaves bear fungal spores. Researchers are supporting the use of fungicide injections since the protection provided by a single injection seems to last for several years.

**3. Dutch Elm Disease**

Dutch Elm Disease (DED) is caused by a fungus. Like oak wilt, this disease kills trees and is transmitted via root grafts from tree to tree. Even though it has been active in Minnesota for decades, it has not disappeared and continues to infect and kill many elm trees every year. This should not significantly affect site management unless large trees die and create large canopy gaps. Gaps will induce a flush of understory plants, which may be dominated by buckthorn, so the sites should be monitored and managed as appropriate. It may not be necessary to replace dead elms with new plantings, since native seedlings will sprout in the gaps. Researchers are searching for and propagating individual trees that are resistant to DED which may restore lost American elms as well as replace dying ash trees. Some DED-resistant elms are available now, but these are hybrids of Asian species, which may not be desirable, and often difficult to obtain. It will be many years before native genotype DED-resistant elms become commercially available.

## C. Exotic and Over Populated Animals

### A. Earth Worms

No species of earthworms were native to the northern part of the U.S., since the last glaciation over 10,000 years ago. During the last century, “litter dwelling,” “soil dwelling” and “deep burrowing” species of have been introduced - primarily as cast-off bait from anglers. Since then, they have become established and are very invasive in our native woodlands and forests. These species move into new areas in waves, one species following another, with ultimately the largest worms, night-crawlers, invading and becoming established. Where soils/systems have evolved without them, these earthworm species, contrary to popular opinion, are not good for the soil—tunneling into the top layers of soil and consuming large amounts of leaf litter (duff). The result of their activities is a net soil compaction and a marked increase in the duff turnover rate (the time it takes for the litter layer to be decomposed and turn into humus). Where there used to be several inches of the light, fluffy duff layer in native forests and woodlands, there is now only a trace of duff or often none at all, with compacted, bare soil often prevalent. This situation can result in increased erosion and nutrient runoff and lead to detrimental impacts for nearby lakes and streams. The lack of duff layer and soil compaction have negative ramifications on native forb populations, especially spring ephemerals which have evolved under conditions that required thick, fluffy duff layers.

### B. White-tail Deer

Another factor of the woodland decline is over-browsing/over-grazing. Areas that were pastured by cattle or sheep received heavy grazing pressure that was previously unknown. Native grazers (primarily bison and antelope) would move around and not concentrate in one area for long periods of time. This allowed for a very diverse forb layer to thrive. With the introduction of cattle in the last century and a half, that grazing pattern changed. Cattle will concentrate their grazing much longer and their impacts are much greater. Many of the native forbs simply can not survive this new pressure.

Today, browsing by deer, not grazing, has a more significant negative impact on woodlands. Deer populations in the metropolitan area have greatly increased over the last century due to both direct and indirect causes. The conversion of native forest, woodland, savanna, and prairie first to agricultural land and then to more “suburbanized landscapes” have favored deer. Fragmentation of forests and managing for large gaps and residential lots with linear woodlands has greatly increased the suburban “edge effect.” Deer prefer areas with large amounts of long, linear forest/woodland edge that can be used both as open areas to feed and wooded areas for cover. Active management for deer hunting by wildlife managers has

also had a direct increase in deer abundance. Deer prefer to feed on many of the native forbs, shrubs, and tree seedlings. Although deer will eat buckthorn and honeysuckle, they do not prefer them if given the choice. This combination of factors greatly increases the browsing pressure on the few natives that can survive earthworm and buckthorn. The lack of oak regeneration, typical of such woodlands, is one result of these conditions.

The synergistic effect of the three factors, fire suppression, earthworm infestation, buckthorn/honeysuckle invasion, and high deer browsing pressure has resulted in a situation of oak woodland decline. Although difficult to turn around, this decline can be ameliorated and possibly reversed, under appropriate management activities.

### C. Emerald Ash Borer

Emerald Ash Borer (EAB) is a small beetle from Asia that was recently introduced to this country, first showing up in Michigan and Maryland in the 1990's (via packing material), and now in Minnesota since 2009. EAB is a tree killer. It is a wood boring insect whose larvae feeds on the inner bark and phloem of ash trees. All native species of ash are susceptible, including black, green, red, and white, as well as many planted cultivars. Primary damage is caused by larvae as they feed and produce galleries within the phloem and outer sapwood. Tree mortality occurs within one to three years of initial attack. For more information on the life cycle, symptoms, and control of EAB, see the MN Dept. of Agriculture website: http://www.mda.state.mn.us/en/plants/pestmanagement/eab.aspx.

Most experts agree that it is only a matter of time before EAB becomes widely established in the state. When that time comes, all properties with ashes will be affected. One small bit of hope for a natural control of EAB is cold temperatures. According to Lee Frelich, Director of the University of Minnesota Center for Forest Ecology, "winter mortality of EAB is definitely temperature dependent." A recent study in Minnesota showed that five percent of insect larvae die at 0 degrees Fahrenheit (F), 34 percent at -10 degrees F, 7 percent at -20 degrees F, and 98 percent at -30 degrees F. Since the larvae overwinter under the bark and are insulated, air temperatures they will need to be slightly colder to have the same effect. They also need to be exposed for prolonged periods of time for mortality to occur.

Another potential method of biological control is with three species of Asian wasps. These wasps are tiny and stingless, about the size of a gnat. In their native China, they parasitize the larvae and eggs of emerald ash beetles, which reduce EAB populations over the long term. EAB will never be eradicated by wasps since there will always be a level of population that does not get parasitized, but has the potential to keep EAB in check.

Proper sanitation is an important strategy for slowing the spread of EAB. Sanitation is the prompt removal and appropriate disposal of dead and dying ash trees that are symptomatic for EAB, when EAB is known to occur in the vicinity (within 15 miles). Usually this strategy does not eradicate the insect.

For more information on the life cycle, symptoms, and control of EAB, see the MN Dept. of Agriculture website: http://www.mda.state.mn.us/en/plants/pestmanagement/eab.aspx.

## D. Climate Change

With the advent of global climate change, conditions for plant communities are changing. By the end of the century, scientists believe that much of the state of Minnesota will not be conducive for growth of boreal pine or boreal mixed forests. The climate of the Twin Cities will be more like that surrounding Sioux Falls, South Dakota, or that surrounding Oklahoma City. The state is expected to receive the same average amounts of precipitation or slightly more, but yearly distributions will be different. More rain is expected during the winter months and less rain during the summer months. The result will be a sort of "savannafication" of the region.

By facilitating the movement of plants from more southerly and westerly regions of Minnesota, degradation of natural areas may be able to be mitigated or averted. By promoting healthy oak woodland and oak savanna ecosystems, the potential negative shift from unsustainable land management expectations and serious loss of diversity can occur by focusing on strategies emphasizing resistance and resilience. Appropriate actions could "mimic," assist, or enable ongoing natural adaptive processes such as species dispersal and migration, population mortality and colonization, changes in species dominance and community composition, and changing disturbance regimes.

# Appendix D: List of Noxious and Invasive Plants

There are a number of plants that if present on the Protected Property, are potentially injurious to the health of animals (especially livestock), humans, and the environment. Upon an inspection of the Protected Property, the following plants were noted as follows along with a brief description of the plant, and what makes it harmful to humans and the environment.

1. A number of annual, biennial or perennial plants have been designated by the Minnesota Commissioner of Agriculture as being injurious to public health and the environment.

- Cut-leaf Teasel has been verified in Ramsey and Olmsted counties. It displaces desirable vegetation and can invade high quality areas such as prairies, savanna, seeps, and sedge meadows.
- Grecian Foxglove has been verified in Washington County. It is toxic to humans, livestock and wildlife, and displaces native plants.
- Oriental Bittersweet has been verified in Twin City area rights-of-way. It is fast growing vine that overwhelms other plant communities.

2. The following species, many of which are established throughout Minnesota or regions of the state, and should be controlled by the landowner to prevent the plant's maturation and spread of propagating parts:

    - Canada Thistle aggressively invades a wide variety of habitats. It reduces high quality forage for grazing livestock and wildlife, reduces biological diversity for native landscapes, and complicates reforestation and landscape restoration efforts.
    - Common Tansy is highly invasive and can severely reduce pasture capacity and desirable forage, degrade wildlife habitat, hinder reforestation and landscape restoration effort, and in some instance, be toxic to humans.
    - Leafy Spurge creates large monocultures that reduce the forage quality of grasslands and lessens biological diversity of many grassland ecosystems.
    - Narrow-leaf Bittercress overtakes desirable vegetation which may result in decreased species diversity and habitat quality.
    - Spotted Knapweed exudes a chemical that inhibits the growth of other plants, spreads quickly to form mono-cultures, overtakes desirable vegetation in pastures and natural areas, and reduces plant diversity.
    - Plumless Thistle is highly invasive to disturbed habitats and can quickly replace desirable plants, creating large monocultures that significantly lessen the biological diversity and productivity of native landscapes.
    - Purple Loosestrife aggressively invades lakes, rivers and wetlands, and creates large monocultures that significantly decrease the biological diversity of native plant and wildlife populations.
    - Wild Parsnip is highly invasive and out-competes native vegetation, creating large monocultures and displacing native animal and plant habitat. This plant is toxic to humans if the skin comes into contact with the plant's sap.

3. In addition, the following list of invasive, terrestrial plants detrimental to human and animal health and the environment are now widely distributed in Minnesota:

- Common or European Buckthorn can thrive in a wide range of soil and light conditions, enabling it to invade a wide variety of habitats. It forms dense thickets that crowd and shade out native plants, alters nitrogen levels in the soil, hosts funguses detrimental to plants, contributes to erosion and declining water quality. Recent research suggests it also releases compounds that are toxic to the embryos of native amphibian species. Its fruit is somewhat toxic, with a strong laxative effect on birds and other wildlife. As such, it provides little food value to animals that eat the berries. Once a few large seed-producing buckthorn trees take hold in an area, a virtual carpet of buckthorn seedlings will radiate outward from each "mother plant," thus displacing or preventing native plants from re-establishing these areas. The berries of buckthorn are dispersed by birds throughout the woodland. Trees that offer perches for birds are typically choked with buckthorn plants growing under their crowns. Buckthorn can rapidly dominate a vulnerable woodland or forest in a matter of 30 to 50 years.
- Glossy Buckthorn is a great threat to wetlands, where it can form dense stands that cause the growth of other species to be suppressed. It is also an alternative host to fungi that infects oats.
- Tartarian Honeysuckle is an upright, deciduous shrub with red or orange berries that replaces native forest shrubs and herbaceous plants by their invasive nature and early leaf-out.
- Multi-flora Rose-forms small to large infestations often climbing into trees, invades forest and forest margins
- Common Reed-vigorous plant that rapidly takes over, creating dense patches that consume available growing space and push out native species, alters wetland hydrology, increases potential for fire, and may reduce and degrade wetland wildlife habitat.
- Garlic Mustard has had a significant impact on forest understory. Due to its ability to aggressively spread, out-compete important native understory species and create large monocultures, many ecologically important plant communities are displaced.

4. Specially Regulated Plants that have the potential to cause harm in non-controlled environments include:

    - Giant Knotweed forms dense stands where it can crowd out native vegetation.
    - Japanese Knotweed forms dense thickets that exclude native vegetation and greatly alters ecosystems.
    - Poison Ivy can appear as a trailing vine, a shrub up to four feet high or as a climbing vine that grows on trees or some other support. The sap of poison ivy creates an

allergic reaction that causes contact dermatitis and in extreme cases, can progress to anaphylaxis. Around 15 to 30 percent of people have no allergic reaction, but most people will have a greater reaction with repeated or more concentrated exposure. A poison ivy rash usually develops within a week of exposure and can last anywhere from one to four weeks, depending on severity and treatment. In rare cases, poison ivy reactions may require hospitalization.

Poison ivy sap can remain active for several years, so handling dead leaves or vines can cause a reaction. In addition, sap transferred from the plant to other objects such as pet fur can cause a rash if it comes into contact with the skin. Clothing, tools, and other objects that have been exposed to the oil should be washed to prevent further transmission. If poison ivy is burned and the smoke then inhaled, a rash will appear on the lining of the lungs, causing extreme pain and possibly fatal respiratory difficulty.

5. The DNR maintains a list of invasive, terrestrial plants.
6. The DNR maintains a list of invasive, aquatic plants.

## Appendix E: Methods for Controlling Exotic, Invasive Plant Species

**TREES AND SHRUBS**

Common Buckthorn, Tartarian Honeysuckle, Siberian Elm, and Black Locust are some of the most common woody species likely to invade native woodlands or prairies in Minnesota. Buckthorn and honeysuckle are European species that escaped urban landscapes and invaded woodlands in many parts of the country. They are exceedingly aggressive and, lacking natural disease and predators, can out-compete native species. Invasions result in a dense, impenetrable brush thicket that reduces native species diversity.

Siberian elm, native to eastern Asia, readily grows, especially in disturbed and low-nutrient soils with low moisture. Seed germination is high and seedlings establish quickly in sparse vegetation. It can invade and dominate disturbed areas in just a few years. Black locust is native to the southeastern United States and the very southeastern corner of Minnesota. It has been planted outside its natural range, and readily invades disturbed areas. It reproduces vigorously by root suckering and can form a monotypic stand.

***Chemical Control***

The most efficient way to remove woody plants that are 1/2 inch or more in diameter is to cut the stems close to the ground and treat the cut stumps with herbicide immediately after they

are cut, when the stumps are fresh and the chemicals are most readily absorbed. Failure to treat the stumps will result in resprouting, creating much greater removal difficulty.

In non-freezing temperatures, a glyphosate herbicide such as Roundup can be used for most woody species. It is important to obtain the concentrated formula and dilute it with water to achieve 10% glyphosate concentration. Adding a marker dye can help to make treated stumps more visible. In winter months, an herbicide with the active ingredient triclopyr must be used. Garlon 4 is a common brand name and it must be mixed with penetrating oil, such as diluent blue. Do not use diesel fuel, as it is much more toxic in the environment and for humans.

Brush removal work can be done at any time of year except during spring sap flow, but late fall is often ideal because buckthorn retains its leaves longer than other species and is more readily identified. Cutting can be accomplished with loppers or handsaws in many cases. Larger shrubs may require brush cutters and chainsaws, used only by properly trained professionals.

For plants in the pea family, such as black locust, an herbicide with the active ingredient clopyralid can be more effective than glyphosate. Common brand names for clopyralid herbicides are Transline, Stinger, and Reclaim.

In the year following initial cutting and stump treatment, there will be a flush of new seedlings as well as resprouting from some of the cut plants. Herbicide can be applied to the foliage of these plants. Fall is the best time to do this, when desirable native plants are dormant and when the plant is pulling resources from the leaves down into the roots. Glyphosate and Krenite (active ingredient – fosamine ammonium) are the most commonly used herbicides for foliar application. Krenite prevents bud formation so the plants do not grow in the spring. This herbicide can be effective, but results are highly variable. Glyphosate or a triclopyr herbicide such as Garlon can also be used. Glyphosate is non-specific and will kill anything green, while triclopyr targets broadleaf plants and does not harm graminoids. All herbicides should be applied by licensed applicators and should not be applied on windy days. Care should be taken to avoid application to other plants. “Weed Wands” or other devices that allow dabbing of the product can be used rather than spraying, especially for stump treatment.

Undesirable trees and shrubs can also be destroyed without cutting them down. Girdling is a method suitable for small numbers of large trees. Bark is removed in a band around the tree, just to the outside of the wood. If girdled too deeply, the tree will respond by resprouting from the roots. Girdled trees die slowly over the course of one to two years. Girdling should be done in late spring to mid-summer when sap is flowing and the bark easily peels away from the sapwood. Herbicide can also be used in combination with girdling for a more effective treatment.

Basal bark herbicide treatment is another effective control method. A triclopyr herbicide such as 10% Garlon 4, mixed with penetrating oil, is applied all around the base of the tree or shrub, taking care so that it does not run off. If the herbicide runs off it can kill other plants nearby. More herbicide is needed for effective treatment of plants that are four inches or more in diameter.

***Mechanical Control***

Three mechanical methods for woody plant removal are hand pulling (only useful on seedlings and only if few in number), weed wrenching (using a weed wrench tool to pull stems of one to two inches diameter), and repeated cutting. Pulling and weed wrenching can be done any time when the soil is moist and not frozen. The disadvantage to both methods is that they are somewhat time-consuming, as the dirt from each stem should be shaken off. Weed wrenching also creates a great deal of soil disturbance and should not be used on steep slopes or anywhere that desirable native forbs are growing. The soil disturbance also creates opportunities for weed germination. This method is probably best used in areas that have very little desirable native plant cover.

Repeated cutting consists of cutting the plants (by hand or with a brush cutter) at critical stages in its growth cycle. Cutting in mid spring (late May) intercepts the flow of nutrients from the roots to the leaves. Cutting in fall (about mid-October) intercepts the flow of nutrients from the leaves to the roots. Depending on the size of the stem, the plants typically die within three years, with two cuttings per year.

***Stems, Seedlings and Re-sprouts***

Prescribed burning is the most efficient, cost effective, and least harmful way to control very small stems, seedlings, and resprouts of all woody plants. It also restores an important natural process to fire-dependant natural communities (oak forests, for example). Burning can only be accomplished if adequate fuel (leaf litter) is present and can be done in late fall or early spring, depending site conditions.

If burning is not feasible, critical cutting in the spring is also effective, though it can impact desirable herbaceous plants as well. Foliar (leaf) application of a bud-inhibitor herbicide (Krenite) during fall is also effective. This method can also affect non-target species, though most natives will be dormant by that time.

***Disposal***

The easiest and most cost-effective method to handle large amounts of brush is usually to stack it and burn it in winter. In areas where brush is not dense, it can be cut up into smaller pieces

and left on the ground where it will decompose in one to three years. This method is especially useful on slopes to reduce erosion potential. Small brush piles can also be left in the woods as wildlife cover. Where there is an abundance of larger trees, cut trees may be hauled and chipped and used for mulch or as a biofuel. Alternatively, the wood can be cut and used for firewood, if a recipient can be found.

**FORBS**

***Canada Thistle***

While native thistles are not generally problematic, exotics such as Canada thistle are clone-forming perennials that can greatly reduce species diversity in old fields and restoration areas (Hoffman and Kearns 1997). A combination of chemical and mechanical control methods may be needed at the Empire property. Chemical control is most effective when the plants are in the rosette stage and least effective when the plants are flowering. A broadleaf herbicide such as 2, 4-D would be appropriate for the south grassland (G1), to minimize damage to native grasses. It is most effective when applied 10-14 days before the flowering stems bolt. It is applied at rate of 2-4 lb/acre using a backpack or tractor-mounted sprayer or in granular form. Dicamba could also be used, with the advantages that it can be applied earlier in the spring at a rate of 1 lb/acre. Plants that do not respond to treatment or that are more widely dispersed could be controlled mechanically.

Mechanical control, involving several cuttings per year for three or four years, can reduce an infestation, if timed correctly. The best time to cut is when the plants are just beginning to bud because food reserves are at their lowest. If plants are cut after flowers have opened, the cut plants should be removed because the seed may be viable. Plants should be cut at least three times throughout the season. Late spring burns can also discourage this species, but early spring burns can encourage it. Burning may be more effective in an established prairie, where competition from other species is good, than in an old field, where vegetation may not be as dense.

**Wild Parsnip**

Treat wild parsnip similar to Canada thistle. These are the recommendations listed by MN DNR:

Mechanical

Do nothing in healthy prairies; natives can sometimes outcompete the parsnip

Hand pulling and removing of plants

Cut the plant below the root crown before seeds set, and remove the cut plant

Mow or cut the base of the flowering stem and remove

Chemical

Use sparingly in quality habitats

Spot application with glyphosate or selective metsulfuron after a prescribed burn, parsnip is one of the first plants to green up

This plant can be very irritating to the skin for some people. It contains a toxin that reacts with sunlight to produce welts on the skin, similar to poison ivy. The welts can itch and get infected. Use gloves and long sleeves when handling this plant.

*Sweet Clover*

White and yellow sweet clovers are very aggressive annual species that *increase* with fire. Sweet clover was found in the brome field (G2) and would be eliminated by treatment that eliminates the brome if prairie restoration occurs. However, it is a common plant in agricultural areas, so if restoration is implemented, the area should be surveyed for this species on an annual basis. Individual plants or small populations can be removed by hand-pulling. If seed production occurs, prodigious amounts of seed could be spread at the site.

**GRASSES**

**Reed Canary Grass**

(These recommendations are taken from Reinhardt, C. H. and Galatowitsch, S. M. 2004. Best Management Practices for the Invasive Reed Canary Grass *(Phalaris arundinacea* L.) in Wetland Restorations.)

General recommendations for Reed Canary Grass (RCG) control

The dense populations of that currently exist on-site will need to be removed for native species to establish. In addition to the existing vegetation, in areas where RCG has been established for multiple years the RCG seed bank may be as high as 1200 seeds per square meter. Because this density of the RCG seed bank presents competition for any planting of native species, it must be considered in the management plan. Seeds near the surface will germinate when the RCG canopy is removed. Subsequent herbicide applications will remove these seedlings, and burning/ herbicide treatments will deplete the seed bank in this way. For the RCG seed bank to deplete to levels that will not prevent native species establishment, RCG control will likely need to take place over several growing seasons. Minimize disturbance of the soil to prevent turning

up additional RCG seed in these areas. While areas are undergoing herbicide treatment, large areas of exposed soil will need to be stabilized, e.g. through the use of stabilization blankets.

Herbicide applications are a major part of the plan to control RCG. A glyphosate-based herbicide is recommended because 1) it is relatively non-toxic, 2) its effect on RCG has been demonstrated, and 3) it is widely available and easy to apply. To maximize glyphosate herbicide effectiveness, apply herbicide in the later season, after late August, to ensure translocation of the herbicide to rhizomes (and therefore rhizome mortality). Apply glyphosate herbicide at the rate and concentration specified by the label for weedy perennial grasses; this will differ with respect to the glyphosate-based product chosen.

RCG -dominated areas will require herbicide control over several growing seasons. Removal of RCG will result in areas of temporarily exposed soil that are subject to erosion. Implementing control on selected management units separately through time will minimize erosion-related problems on site. Further discoveries about best management practices may result from observing the implementation of this plan over time, and the plan may be modified according to lessons learned during the management process.

For RCG-dominated areas, a broad-scale herbicide application is recommended, as damage to non-target species within these management units does not need to be considered. Apply herbicide in late August and later as this application timing maximizes translocation of the herbicide to the rhizomes, ensuring maximum rhizome mortality, which is crucial to control of RCG. Two herbicide applications can be implemented during this window if necessary.

After the standing RCG vegetation is killed in the first year of treatment, a heavy layer of thatch will remain. A controlled burn will be applied to remove thatch and encourage germination of RCG from the seed bank in the interests of reducing RCG seed bank density. Subsequent herbicide applications will control this flush from the seed bank. We recommend a late fall burn to remove thatch (spring burns may encourage growth from rhizome-based shoots).

Even after two years of effective herbicide application, RCG will recolonize, largely from the seed bank and from incoming propagules, and outcompete new native vegetation from a restoration seeding. Therefore, three years of herbicide application are recommended.

For areas with native species cover, selective removal of RCG will be critical to the maintenance of these native populations. We recommend hand weeding of RCG seedlings in the early spring as soon as they reach an identifiable stage (removal will be easiest before the seedlings establish a network of rhizomes) and herbicide wicking of established RCG individuals in the fall (damage to non-target species will be lowest at this time when many native species have already senesced). Herbicide wicking is also an option in the early spring, but hand weeding is preferable, as herbicide applications during the early spring may not achieve complete

mortality. Selective control of RCG in these areas can begin immediately and continue for as long as needed.

**For areas with woody species cover**

Some management units with woody species cover (shrub units) have been invaded by RCG, although other species exist in the understory. Similar to the areas with native species cover, selective removal of RCG rather than homogeneous treatment over a large-scale area, will be necessary. We recommend hand weeding of RCG seedlings in the early spring and herbicide wicking of established RCG individuals in the fall. Herbicide wicking is also an option in the early spring, but hand weeding is preferable, as herbicide applications during the early spring may not achieve complete mortality. Selective control of RCG in these areas can begin immediately and continue for as long as needed.

**Reestablishment of native vegetation**

Following control of RCG seeding with a native species restoration mix will be needed to stimulate reestablishment of native vegetation. Given that there are no high quality wetlands nearby to serve as propagule sources, and that years of drainage have made the seed bank depauperate, it is highly unlikely that vegetation will establish through natural means of propagule dispersal to this site.

Areas that have been treated with broad-scale herbicide applications must be seeded uniformly. To prepare the soil for the native seeding in mid- to late May, first burn the area (either in the previous fall or the early spring of that year) if necessary to remove dead vegetation. A wet meadow grass mixture will be seeded at 13 lbs/ac PLS or greater, and a wet meadow forb mixture will be seeded at 4 lbs/ac PLS or greater. The combined seeding rate of 17 lbs/ac pure live seed (PLS) was determined to be an average seeding rate, and increasing seeding rate will likely increase native species establishment.

For areas that have received selective removal of RCG (not broadcast herbicide application), inter-seeding is recommended for areas left open after RCG removal. Species-appropriate seedings will be necessary, e.g. woodland forb species in the understory of areas with woody species cover, and aquatic species in the *Seepage meadow/carr* area. After seeding with native species, monitoring of RCG recruits will likely be necessary for as long as the site is exposed to an influx of new RCG (i.e. e. indefinitely). As native species begin to establish, we recommend selective removal of new recruits of RCG as they emerge within the establishing native community, via hand-weeding or selective treatment with

# Appendix F: Suggested Native Shrubs for Replacing Common Buckthorn

**Suggested native shrubs for replacing common buckthorn**

DRY UPLAND

| Common Name | Scientific Name | Height | Light | Wildlife Value | Comments |
|---|---|---|---|---|---|
| Gray dogwood | *Cornus racemosa* | 9 ft | Sun/shade | Very high | Used by 40 some species of wildlife. Spreads |
| American hazelnut | *Corylus americana* | 6-12 ft | Sun/part shade | Highly valued by mammals (mice, deer, etc.) and birds (blue jays, turkeys, etc.) | Spreads, but slowly; forms very deep roots |
| Beaked hazelnut | *Corylus cornuta* | 6-12 ft | Sun/shade | High | Spreads, but slowly. More northern range than American hazelnut. |
| Eastern red cedar | *Juniperus virginiana* | 20 ft | Sun | High | Aggressive colonizer. Invades prairies in absence of fire. Important for bird cover during winter and during the heat of summer. |
| Pin cherry | *Prunus pensylvanica* | 10-30 ft | Sun | Excellent | Used by 81 species of wildlife |
| Smooth rose or Prairie rose | *Rosa blanda, Rosa arkansana* | 4-6 ft | Sun/part shade | High: birds, mammals. | Low shrub that blends well with prairie forbs. Rose hips ripe in late summer and fall. Flowers favorite of Japanese beetles. |
| New Jersey tea | *Ceanothus americanus* | 2-3 ft | Full sun | High: butterflies and hummingbirds | Beautiful patches of shrubs in prairie setting |
| Silver buffaloberry | *Shepherdia argentea* | 8-10 ft | Full sun | High: birds | Thicket-forming in prairies; silvery green foliage; red berries in late summer |
| Wolfberry | *Symphoricarpos occidentalis* | 2-4 ft | Full sun | High: birds | Thicket forming in prairie; small pinkish flowers; white berries in late summer |
| Coralberry | *Symphoricarpos orbiculatus* | 2 | Full sun | High: birds | Low shrub; thicket forming in prairie; small white flowers; red berries in late summer. Northern part of its range in MN. |

DRY-MESIC UPLAND

| Common Name | Scientific Name | Height | Light | Wildlife Value | Comments |
|---|---|---|---|---|---|
| Allegheny serviceberry | *Amelanchier laevis* | 15-25 ft | Sun/part shade | High | Edible fruits. White flowers in spring. |
| Eastern wahoo | *Euonymus atropurpurea* | 6-20 ft | Sun/shade | | Cultivars are common; native wild type is uncommon. Attractive scarlet-red foliage and purple fruit. Spreads. |
| American plum | *Prunus americana* | 20-35 ft | Sun | High | Fruits edible; ripe in summer. Forms thickets. |

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|---|---|---|---|---|---|
| Ptelea trifoliata | *Wafer ash* | 10-15 ft | Sun to shade | Larval host for swallowtail butterfly | Foliage more open form in shade, dense in sun. |
| Choke cherry | *Prunus virginiana* | 20-30 ft | Sun/part shade | Excellent | Common woodland and forest understory shrub. |
| Smooth rose | *Rosa blanda* | 4-6 ft | Sun/part shade | High: birds, mammals. | Rose hips ripe in late summer and fall. Flowers favorite of Japanese beetles. |
| Red-berried elder | *Sambucus pubens* | 6-12 ft | Shade | Very high | Excellent massing plant, fast growing. |
| Bladdernut | *Staphylea trifolia* | 8-15 ft | Shade | | Tolerates many soil conditions, disease resistant |
| Highbush cranberry | *Viburnum trilobum* | 6-12 ft | Sun to shade | High -Birds eat fruits. | Foliage more open form in shade, dense in sun. |
| Arrowwood viburnum | *Viburnum rafinesquianum* | 5-8 ft | Part shade, shade | High | Pretty foliage; straight stems; grows in understory of woodlands, forests. |
| Round-leaved dogwood | *Cornus rugosa* | 8-12 ft | Part sun/shade | Butterflies use flowers. Birds eat berries | Dense, flat-topped clusters of creamy-white flowers in June, followed by light-blue berries on red stems in August. Prefers sandy soil. |
| Sambucus pubens | *Red-berried elder* | 10-12 ft | Sun/part shade | High value: bird food | Cluster of white flowers; red berries in early summer. |
| Common ninebark | *Physocarpus opulifolius* | 8-10 ft | Full sun | Bird food | Dense growth habit |

FLOOD TOLERANT

| Common Name | Scientific Name | Height | Light | Wildlife Value | Comments |
|---|---|---|---|---|---|
| Black chokeberry | *Aronia melanocarpa* | 5-8 ft | Sun/shade | Bird food | |
| Pagoda dogwood | *Cornus alternifolia* | 15-20 ft | Sun/shade | Birds | Especially lovely as an ornamental shrub. Flat clusters of white flowers and blue-black fruits. Cool, moist, slightly acidic soils are best. |
| Nannyberry | *Viburnum lentago* | 16-20 ft | Sun/part shade | High | Dense foliage. Fruit are dark blue drupes that hang from branches. Good for wetland edges. |
| False Indigo | *Amorpha fruticosa* | 8-10 ft | Sun/part shade | Butterflies | Attractive flower; forms open, loose canopy, compatible with grasses, sedges, and fobs. Great lakeshore stabilizer. |
| Buttonbush | *Cephalanthus occidentalis* | 6-12 ft | Full sun | Birds, butterflies | Round flower head; fragrant; showy. |
| Silky dogwood | *Cornus amomum* | 6-12 ft | Full sun | Bird food | Blue fruit; reddish-purple bark |
| Red twig dogwood | *Cornus sericea* | 6-12 ft | Sun/part shade | Bird food | Red twigs, greenish-white fruit |

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|---|---|---|---|---|---|
| Witch hazel | *Hamamelis virginiana* | 20-30 ft | Sun or shade | Late-season pollinators | Unique, spider-shaped yellow flowers that bloom late in the year. |
| St. Johns Wort | *Hypericum kalmianum* | 2-3 ft | Sun/part shade | Pollinators | Masses of yellow flowers in summer |
| Winterberry | *Ilex verticillata* | 6-8 ft | Sun/lt shade | Bird food | Showy, small, scarlet-colored fruit in fall and winter. |
| Black Currant | *Ribes americanum* | 3-6 ft | Sun/lt shade | High value: birds and mammals | White flowers; black-purple fruit, edible |
| Pussy willow | *Salix discolor* | 20 ft | Full sun | Soil stabilizer | Showy catkins; ornamental |
| Slender willow | *Salix petiolaris* | 25 ft | Full sun | Good cover for birds | Forms loose thickets; still allows enough light for dense ground layer growth. |
| Red willow | *Salix sericea* | 6-8 ft | Full sun | Bird food | Upright, rounded form; reddish-brown twigs |
| American elder | *Sambucus canadensis* | 8-10 ft | Full sun | High value: bird food | Very tolerant of soil conditions; blue-black fruit in late summer; edible. |
| Red elderberry | *Sambucus pubens* | 8-10 ft | Sun/part shade | High value: bird food | Red berries in May/June; not edible by people, but birds love them. |
| Meadowsweet | *Spirea alba* | 3-6 ft | Full sun | Bird food | Of wet meadows. Erect branching; white flower spikes in July. |
| Highbush cranberry | *Viburnum trilobum* | 6-12 ft | Sun/part shade | High value: bird food | Upright, arching habit; white flat-topped flower clusters; red fruit persists until spring; red color to foliage in autumn. Verify native species, since cultivars are common. |

**Suggested plant sources**

We suggest using only native Minnesota plants, and especially plants that originated within about 100 miles of where they will be planted. Many large nurseries sell plants to MN, but they were obtained from other parts of the USA. The following are known sources in the Twin Cities. See attached DNR list for additional information.

**Potted Plants**

Outback Nursery, Hastings. 651-438-2771 http://www.outbacknursery.com/
Prairie Restorations, Scandia & Princeton locations. http://prairieresto.com/
Dragonfly Gardens, Amery, WI
Landscape Alternatives, Scandia, MN
Prairie Moon Nursery, Winona, MN

**Bare root plant material**

A limited selection of native trees and shrubs (typically of MN stock, but probably not local to the county where they are sold) are available from local Conservation Districts (not available in Hennepin or Ramsey Counties).

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Anoka Conservation District: http://www.anokanaturalresources.com/acd/index.htm
Dakota County Soil and Water Conservation District: http://www.dakotacountyswcd.org/
Washington Conservation District: http://www.mnwcd.org/

Once installed, we recommend protecting plants from deer browse by installing fencing. Four-foot vinyl coated wire (e.g. Menard's, $40/50 ft), works very well for individual or small groups of plants. Larger planting areas would need taller fence or other methods (such as electric wire). For individual plants in ornamental locations, spraying plants with Tree Guard or similar spray can work well to deter browsing. Tree Guard does not wash off, but must be re-applied as the plant grows.

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# Appendix G: Seed Mixes for Target Plant Communities

The following tables are Board of Water and Soil Resources (BWSR) seed mixes that match, and are appropriate for, the open wetland target native plant communities listed in this document (WMs83, WPs54). Not all species that are found in each native plant community will be represented in these mixes, but they are adequate, commonly commercially available, and relatively diverse, compared to other mixes.

Mix 34-171, "Wetland Rehabilitation", is recommended for use in Wet Prairie (WPs54) and in Wet Seepage Meadow/Carr during dry years (WMs83) following weed control treatment (e.g. reed canary grass control treatment). Mix 34-181, "Emergent Wetland", is recommended for use in the slightly deeper hydrology of the seepage meadow/carr (WMs83), but it has some species in common with other mixes. Mix 34-262, "Wet Prairie" is recommended for use in the wet prairie community (WPs54), and also has many species in common with the other lists, but is intended for a "permanent cover", thus is more diverse than the wetland rehabilitation list.

Mix 35-641, "Mesic Prairie Southeast", is recommended for use in the upland mesic prairie (UPs23).

**34-171** **Wetland Rehabilitation**

| Common Name | Scientific Name | Rate (kg/ha) | Rate (lb/ac) | % of Mix (% by wt) | Seeds/ sq ft |
|---|---|---|---|---|---|
| Virginia wild rye | *Elymus virginicus* | 3.36 | 3.00 | 56.61% | 4.63 |
| fowl bluegrass | *Poa palustris* | 1.12 | 1.00 | 18.89% | 47.80 |
| | **Total Grasses** | **4.48** | **4.00** | **75.50%** | **52.43** |
| fox sedge | *Carex vulpinoidea* | 0.22 | 0.20 | 3.85% | 7.50 |
| path rush | *Juncus tenuis* | 0.18 | 0.16 | 3.03% | 59.00 |
| dark green bulrush | *Scirpus atrovirens* | 0.40 | 0.36 | 6.70% | 60.00 |
| woolgrass | *Scirpus cyperinus* | 0.09 | 0.08 | 1.51% | 50.00 |
| | **Total Sedges and Rushes** | **0.90** | **0.80** | **15.09%** | **176.50** |
| nodding bur marigold | *Bidens cernua* | 0.15 | 0.13 | 2.45% | 1.00 |
| Water Horehound | *Lycopus americanus* | 0.37 | 0.33 | 6.29% | 23.15 |
| blue monkey flower | *Mimulus ringens* | 0.04 | 0.04 | 0.67% | 30.00 |
| | **Total Forbs** | **0.56** | **0.50** | **9.41%** | **54.15** |
| | **Totals:** | **5.94** | **5.30** | **100.00%** | **283.08** |

| | |
|---|---|
| **Purpose:** | Interseeding into establishing wetlands after weed control spraying. Also suitable for two to five year short term soil stabilization for areas with saturated soils. |
| **Planting Area:** | Statewide |

We recommend adding the following species to Mix 34-1710: Lake Sedge (*Carex lacustris)*, Bottle-brush or Porcupine Sedge *(Carex hystericina),* and Canada Bluejoint Grass (*Calamagrostis canadensis).*

**34-181** **Emergent Wetland**

| Common Name | Scientific Name | Rate (kg/ha) | Rate (lb/ac) | % of Mix (% by wt) | Seeds/ sq ft |
|---|---|---|---|---|---|
| American slough grass | *Beckmannia syzigachne* | 0.78 | 0.70 | 14.07% | 12.92 |
| tall manna grass | *Glyceria grandis* | 0.28 | 0.25 | 4.98% | 6.40 |
| rice cut grass | *Leersia oryzoides* | 0.34 | 0.30 | 5.93% | 3.70 |
| | **Total Grasses** | **1.40** | **1.25** | **24.98%** | **23.02** |
| river bulrush | *Bolboschoenus fluviatilis* | 0.85 | 0.76 | 15.20% | 1.20 |
| bristly sedge | *Carex comosa* | 0.20 | 0.18 | 3.63% | 2.00 |
| lake sedge | *Carex lacustris* | 0.07 | 0.06 | 1.19% | 0.24 |
| tussock sedge | *Carex stricta* | 0.04 | 0.04 | 0.77% | 0.75 |
| least spikerush | *Eleocharis acicularis* | 0.11 | 0.10 | 1.94% | 2.50 |
| marsh spikerush | *Eleocharis palustris* | 0.11 | 0.10 | 2.03% | 1.90 |
| Torrey's rush | *Juncus torreyi* | 0.04 | 0.04 | 0.85% | 25.00 |
| Three-square bulrush | *Schoenoplectus pungens* | 0.26 | 0.23 | 4.54% | 1.00 |
| soft stem bulrush | *Schoenoplectus tabernaemontani* | 0.49 | 0.44 | 8.78% | 5.00 |
| woolgrass | *Scirpus cyperinus* | 0.06 | 0.05 | 1.02% | 32.00 |
| | **Total Sedges and Rushes** | **2.24** | **2.00** | **39.95%** | **71.59** |

| | | | | | |
|---|---|---|---|---|---|
| Sweet flag | *Acorus americanus* | 0.31 | 0.28 | 5.53% | 0.67 |
| common water plantain | *Alisma triviale* | 0.45 | 0.40 | 8.00% | 9.70 |
| marsh milkweed | *Asclepias incarnata* | 0.31 | 0.28 | 5.67% | 0.50 |
| broad-leaved arrowhead | *Sagittaria latifolia* | 0.34 | 0.30 | 6.07% | 6.80 |
| giant bur reed | *Sparganium eurycarpum* | 0.55 | 0.49 | 9.80% | 0.09 |
| | **Total Forbs** | **1.96** | **1.75** | **35.07%** | **17.76** |
| | **Totals:** | **5.60** | **5.00** | **100.00%** | **112.37** |
| **Purpose:** | Emergent wetland restoration for use in wetland mitigation, shoreline restoration, wet stormwater ponds where emergent vegetation is desired. | | | | |
| **Planting Area:** | Statewide | | | | |

Another source for seed mixes is Minnesota Department of Transportation (MnDOT).

**STANDARD MIX 34-182: PERSISTENTLY FLOODED**

Species with "*" cannot be substituted

**Graminoids**

| Guild | Scientific Name | Common Name | Net # seeds/ s.f. | Oz/ acre | Lb/ acre |
|---|---|---|---|---|---|
| G | *Beckmannia syzigachne* | American slough grass | 16.07 | 14 | 0.88 |
| G | *Calamagrostis canadensis* | Bluejoint | 6.43 | 1 | 0.06 |
| G | *Eleocharis palustris* | Marsh spikerush | 2.34 | 2 | 0.13 |
| G | *Glyceria grandis* | Tall manna grass | 19.28 | 12 | 0.75 |
| G | *Leersia oryzoides** | Rice cut grass | 2.34 | 3 | 0.19 |
| G | *Scirpus acutus* | Hardstem bulrush | 1.38 | 3 | 0.19 |
| G | *Scirpus atrovirens* | Dark green bulrush | 31.68 | 3 | 0.19 |
| G | *Scirpus cyperinus* | Woolgrass | 78.05 | 2 | 0.13 |
| G | *Scirpus fluviatilis* | River bulrush | 1.58 | 16 | 1.00 |
| G | *Scirpus validus* | Soft stem bulrush | 5.69 | 8 | 0.50 |
| | **Total** | | **164.85** | **64.00** | **4.00** |

**Forbs**

| Guild | Scientific Name | Common Name | Net # seed s/ s.f. | Oz/ acre | Lb/ acre |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| F | *Acorus calamus** | Sweet flag | 0.06 | 6 | 0.38 |
| F | *Alisma triviale* | Water plantain | 0.57 | 6 | 0.38 |
| F | *Asclepias incarnata* | Swamp milkweed | 0.04 | 6 | 0.38 |
| A | *Bidens cernua* | Nodding bur marigold | 0.06 | 2 | 0.13 |
| F | *Iris versicolor* | Northern blue flag | 0.01 | 8 | 0.5 |
| F | *Sagittaria latifolia* | Broad-lvd arrowhead | 0.35 | 4 | 0.25 |
| F | *Sparganium eurycarpum* | Giant bur reed | 0.01 | 16 | 1.0 |
| | **Total** | | **1.10** | **48.00** | **3.00** |

**STANDARD MIX 33-261: TEMPORARILY FLOODED**

Species with "*" cannot be substituted

**Graminoids**

| Guild | Scientific Name | Common Name | Net # seeds/ s.f. | Lb/ Acre |
|---|---|---|---|---|
| G | *Andropogon gerardii** | Big bluestem | 7.35 | 2.00 |
| G | *Bromus ciliatus** | Fringed brome | 8.10 | 2.00 |
| G | *Calamagrostis canadensis** | Bluejoint | 6.40 | 0.06 |
| G | *Carex stipata* | Awl-fruited sedge | 3.10 | 0.25 |
| G | *Elymus trachycaulus** | Slender wheatgrass | 2.53 | 1.00 |
| G | *Elymus virginicus** | Virginia wild rye | 2.31 | 1.5 |
| G | *Panicum virgatum* | Switchgrass | 1.93 | 0.38 |
| G | *Poa palustris** | Fowl bluegrass | 50.70 | 1.06 |
| G | *Scirpus atrovirens** | Dark green bulrush | 31.70 | 0.19 |
| G | *Scirpus cyperinus* | Woolgrass | 39.00 | 0.06 |
| G | *Sorghastrum nutans** | Indian grass | 0.55 | 0.12 |
| G | *Spartina pectinata** | Prairie cordgrass | 0.91 | 0.38 |
| | **Total** | | **167.67** | **9.00** |

**Forbs**

| Guild | Scientific Name | Common Name | Net # seeds/ s.f. | Lb/ Acre |
|---|---|---|---|---|
| F | *Anemone canadensis* | Canada anemone | | |
| F | *Asclepias incarnata* | Swamp milkweed | | |
| A | *Aster novae-angliae (Symphyotrichum novae-angliae)* | New England aster | | |

| | | | | |
|---|---|---|---|---|
| A | *Aster umbellatus (Doellingeria umbellata)* | Flat-topped aster | | |
| A | *Bidens frondosa*** | Leafy beggarticks | | |
| A | *Eupatorium maculatum* | Spotted Joe Pye weed | | |
| A | *Helenium autumnale var. autumnale* | Autumn sneezeweed | | |
| F | *Physostegia virginiana* | Obedient plant | | |
| A | *Rudbeckia laciniata* | Tall coneflower | | |
| F | *Verbena hastata* | Blue vervain | | |
| F | *Zizia aurea* | Golden alexanders | | |
| | **Total** | | **17.20** | **1.00** |

**Can be substituted by *B. cernua* or *B. coronata* using appropriate multipliers

**Cover Crop**

1. Add cover crop at the rate that best fits your site per table below.
2. Use oats *(Avena sativa)* in spring or summer, winter wheat (*Triticum aestivum)* in fall.

| **Site Condition** | | **Cover Crop Rate (PLS lbs./acre)** |
|---|---|---|
| Interseeding into site with >85% vegetated cover | | 12 |
| Seeding onto exposed site: | Slope <5% (1:20) | 25 |
| | Slope 5 – 10% | 35 |
| | Slope >10% | 56 |

There were no BWSR or MnDOT seed mixes specifically for a Wet Ash Seepage Swamp (WFx57), so the species list in Appendix B and recommendations given in this plan will have to suffice for that community.