COTTAGE GROVE RAVINE REGIONAL PARK

ECOLOGICAL RESTORATION PLAN FOR SOUTHERN HALF

Ravine Lake from south, knotty bur oak in oak forest, great blue heron in marsh, 41" diameter pin oak in oak woodland.

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This Natural Area Management Plan and Work Plan has been reviewed and approved by:

Washington County

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Director, Parks Division

Peter Mott _____Date: _____
Parks Manager, Planning and Programming

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EXECUTIVE SUMMARY

In 2007 a Master Plan was developed for Cottage Grove Ravine Regional Park (Brauer and Associates, 2007). As a comprehensive plan, it provides an overview of existing park conditions and a general framework for ecological restoration, along with many other recreational features and plans for the park. The plan in hand is focused only on the ecological aspects of the Master Plan, with the purpose of taking the restoration recommendations to the next step. This plan suggests where to begin the restoration process, provides detailed steps on how to proceed, and outlines anticipated costs. It includes a description of what to expect during the process and long-term monitoring and management recommendations. While small amounts of information from the Master Plan may also be included in this plan where needed, the majority of the Master Plan information is included by reference only.

This plan is written for the southern half of Cottage Grove Ravine Park, an area of about 300 acres. This half of the park was identified as the most ecologically diverse, according to records from the Minnesota Department of Natural Resources, and was ranked as moderate biological diversity. The park provides important assets for wildlife due to its relatively large size and its location within a corridor of connected natural areas. It is located within the Metro Conservation Corridors, a regional land protection plan of the DNR that identifies ecologically important areas, and is adjacent to an Important Bird Area, a global designation of the Audubon Society. Two rare species, blandings turtle (*Emydoidea blandingii*) and kittentail (*Besseya bullii*), have been recorded at the project area.

Prior to European settlement, most of this area was probably savanna. Today it is almost entirely oak woodland and forest, with some open grassland in the southwest and in other scattered patches and four very small relict prairie patches, on south-facing slopes, surrounded by oak forest. 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. Restoration to the pre-settlement condition is not recommended over most of the site. As described in the Master Plan, succession has been occurring for too long and most of the former savanna is now established oak forest or woodland.

The proposed first phase of restoration is around the lake edges, and in the southwest, where the new entrance will be. Ecological management and restoration recommendations are targeted first at managing the four small prairie remnants, by removing invasive native and non-native brush and trees. Extensive exotic brush removal is then needed for about 40 acres of oak forest and woodland. Several areas around the lake would be restored to oak savanna, which will offer pleasing viewscapes of the lake. The grassland in the southwest retains some native prairie species and would be restored to prairie. This document further describes the recommendations, methods and approximate costs for enhancing the ecological health of the entire property and restoring natural communities.

INTRODUCTION

This Natural Resource Management Plan builds on the general restoration recommendations of the 2007 Master Plan for the park; it identifies the highest priority areas to restore and provides specific details on how to proceed. This plan includes only the southern 300 acres of the roughly 600-acre Cottage Grove Ravine Regional Park, as this was the area designated as *moderate biodiversity significance* by the Minnesota Department of Natural Resources and the north half of the park was not ranked.

Cottage Grove Ravine Regional Park was established as a local park in 1969 and was incorporated into the Metropolitan Regional Parks system in 1974. It has been managed by Washington County Park for recreational purposes, with an extensive hiking/skiing trail system, picnic shelter, and fishing piers. The native plant communities have had little significant management.

The park straddles a long ravine corridor, which carves through the southern part of Washington County. Several side ravines also dissect the slopes, resulting in a diverse terrain of hills and narrow valleys. Prior to European settlement, the upland vegetation a the site was composed primarily of oak savanna type of habitat – prairie plants with scattered clusters of bur oak trees and brushland – as well as oak forest and prairie. Low areas in the ravines were more fire-protected and may have been more wooded. Open water consisted of the lake and pond, as present today, and additional wetland areas were likely associated with these. The plant communities throughout the property have been altered by many decades of pasture and cultivation, lack of natural fire, and invasion of non-native species. Vegetated cover is currently dominated by oak forest, oak woodland, grassland, and other altered areas of mixed grasses and trees. These areas occupy about 275 acres around the 25-acre Ravine Lake, which is a main feature of the park.

This plan was developed to:

- Evaluate the existing condition of natural communities in the project area
- Identify target natural communities and restoration goals
- Describe methods for achieving target communities
- Identify opportunities to engage the local community in volunteer activities

Ecological Management Goals for the Property

When conducting ecological restoration at site, the pre-European condition (mid-1800's) is typically used as a guideline, but it is not necessarily the desired goal in all cases, depending on how far ecological succession has progressed and what other cultural goals there may be for the site. The over-arching goal for the Ravine Park is to restore ecological functions to the native plant communities as much as possible. Specific ecological goals are to:

- Restore a complement of native plant communities
- Improve wildlife habitat
- Increase biological diversity
- Enhance and expand the ecological functions of the property and of the larger Metro Conservation Corridor

SITE INFORMATION

PARCEL INFORMATION

Site name, address, city/township, county, and phone

Cottage Grove Ravine Regional Park
9940 Point Douglas Road
Cottage Grove, MN 55016

Mailing address:
Cottage Grove Ravine Regional Park
c/o Parks Division
10191 St. Croix Trail S.
Hastings, MN 55033
651-430-8240

Township, range, section: T27N, R21W, portions of sections 22, 23, 26, 27

Watershed: South Washington County, East Ravine subwatershed

Watershed Management Organization: South Washington Watershed District

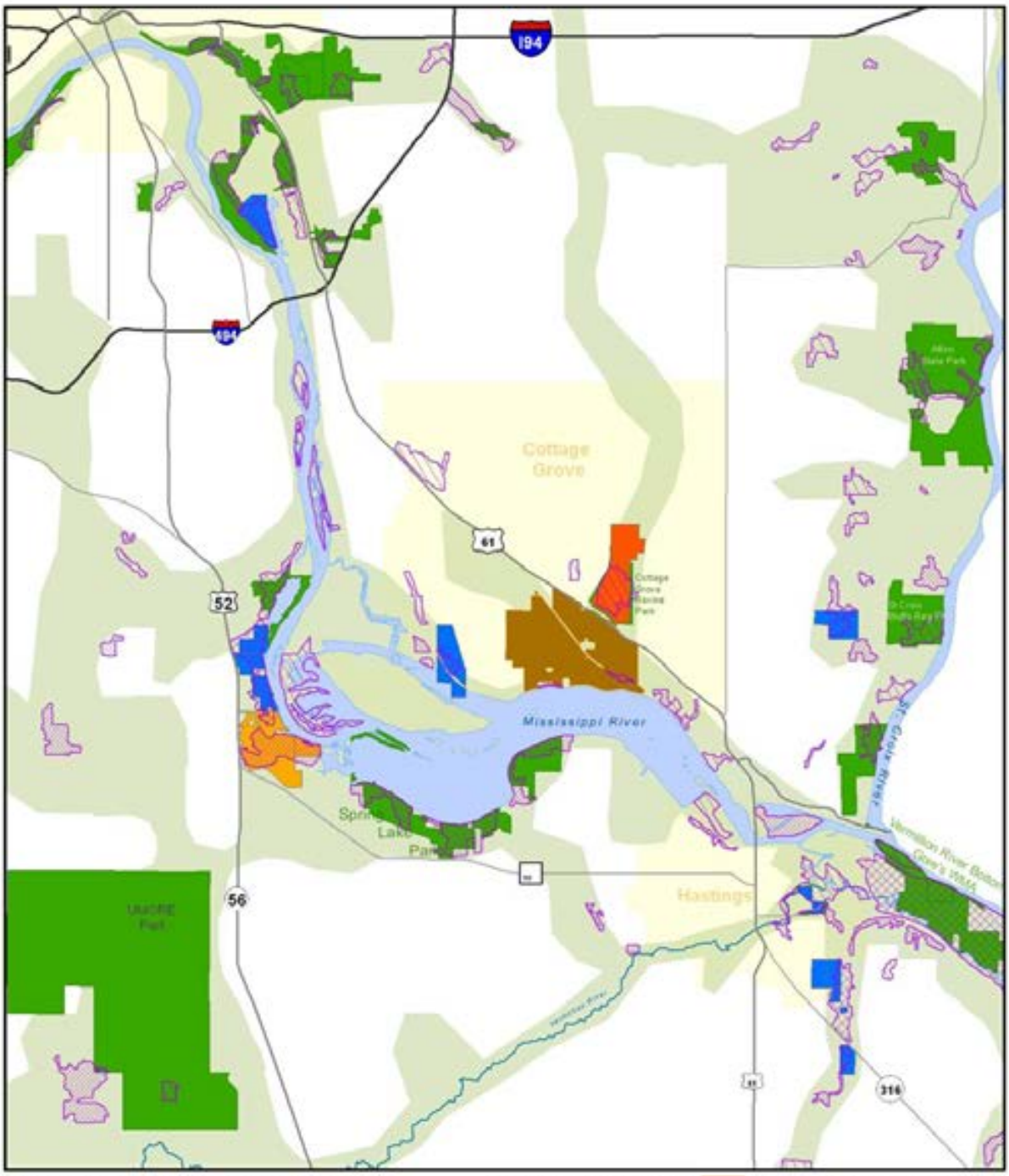
Element occurrence: One record of blandings turtle (*Emydoidea blandingii*) in 2002, and one population of kittentail (*Besseya bullii*) in 2000, both of which are state threatened. Neither was re-located in 2012. Important plant communities documented in 1987 were: dry sand-gravel prairie, dry sand-gravel savanna and northern bulrush-spikerush marsh. The savanna was not relocated in 2012. Element occurrences are discussed in more detail in the Rare Features section.

LANDSCAPE CONTEXT

Cottage Grove Ravine Regional Park lies within the Metro Conservation Corridors, a regional land protection plan of the Department of Natural Resources (DNR) (**Map 1**). The corridors identify natural connections across the landscape, which are critical for the movement of plant and animal species. The site is especially significant for its proximity and connectivity to the Mississippi River, to which it is linked via the stream that drains from Ravine Lake and via the forested corridor surrounding that stream at the 3M property to the south. The Mississippi River corridor through the Twin Cities Metropolitan area is an Important Bird Area, a global designation of the Audubon Society. It is a migratory corridor for 40 percent of North American Waterfowl, and for dozens of other species. Ravine Park lies just outside of the IBA, but is an important connection to that system, providing valuable resting and breeding habitat for many bird species.

Most of the southern half of the park was classified by the DNR as moderate biodiversity significance, indicating the site has been impacted by past uses but still provides very good native habitat.

MAP 1. LOCATION AND LANDSCAPE CONTEXT



SITE GEOLOGY

Geologic formation and bedrock

MAP 2. SURFICIAL GEOLOGY OF RAVINE PARK

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 Ravine Park formed primarily on outwash deposits left by the Superior lobe (**Map 2**), which advanced and retreated several times in the late Wisconsin period, 30,000 to 14,000 years ago, leaving a rolling terrain at this site. The outwash consists of sand, loamy sand, and gravel, with cobbles in places. It is typically covered by two to five feet of loess.

Buried ice blocks, insulated by peat and sediments for hundreds or thousands of years after the glaciers retreated, eventually melted to form Ravine Lake (Meyer et al 1990).

The depth to bedrock ranges from about 51 feet to 250 feet, with the shallower depths at the higher elevations in the southwest, and the deeper depths in the lowest areas of the ravine. All bedrock in the Twin Cities areas is marine sedimentary rock, which formed when shallow seas covered southeastern MN during the Early Paleozoic era (525-400 mybp). The Prairie du Chien group, which is primarily dolostone, underlies much of Ravine Park (**Map 3**). In the ravine, however, the Prairie du Chien was carved away by erosion, leaving Jordan Sandstone along the ravine walls. The bottom of the ravine is underlain by St. Lawrence Formation, consisting of dolomitic shale and siltstone, and by the fine-grained sandstone Franconia Formation.

MAP 3. BEDROCK GEOLOGY AT RAVINE PARK.
The St. Lawrence and Franconia Formation is at the center of the ravine (green), flanked by Jordan Sandstone (yellow) and the Prairie du Chien group beyond (blue).

Prairie du Chien bedrock contains the Prairie du Chien aquifer over much of its expanse. This aquifer underlies most of Washington County and is a primary source of drinking water. The depth to water table ranges from zero (at the lake), to approximately 100 feet at some of the higher elevations. The site has a rating of "high-moderate" in the ravine, to "high", for sensitivity of the Prairie du Chien-Jordan aquifer to pollution (Meyer 1990). The estimated travel time for water-borne contaminants to reach the aquifer is several years to a decade in high-moderate areas, or weeks for "high" rated areas.

Soil and Topography

The loamy soils that formed at Ravine Park reflect the character of the sandy and loamy glacial deposits. The soils data were reviewed in the Master Plan and are presented here as a summary. Loamy sand is the predominant soil type, covering 60 percent of the site (**Table 1**). These soils are excessively drained, susceptible to drought, and have low fertility, factors that should be considered in any ecological restoration projects. Most of the soils in the park are also highly susceptible to erosion, as shown in **Map 4**. Consequently, any activities that will either disturb or expose soils need to consider potential erosion that could occur and avoidance/mitigation methods.

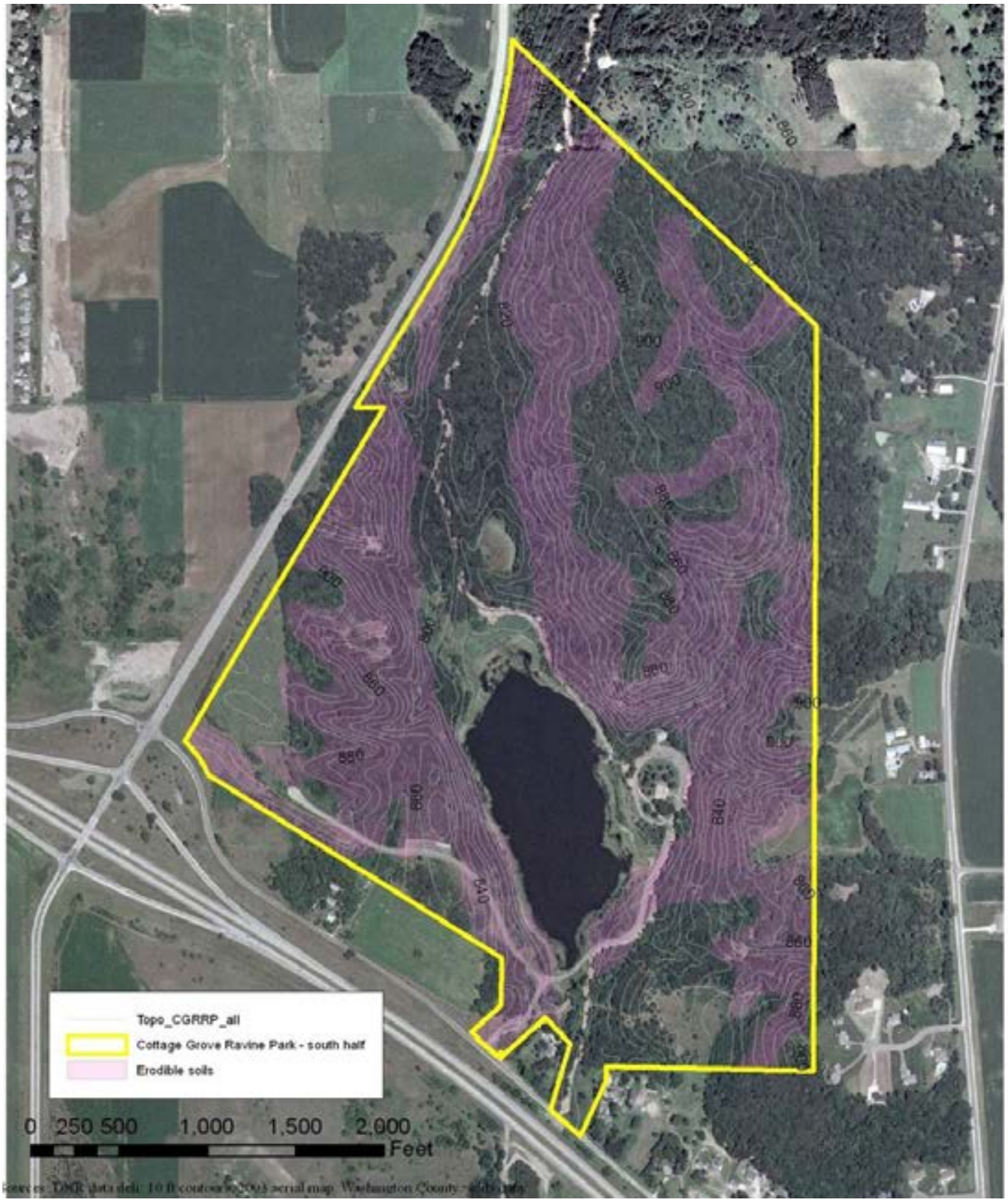
Table 1. Soil Types

Soil code	Name	Texture	Slope %	Acres	Percent	Erodibility*
7D	Hubbard	loamy sand	12-18	15.1	5%	H
8B	Sparta	loamy sand	2-6	4.1	1%	
8C	Sparta	loamy sand	6-15	3.8	1%	H
49B	Antigo	silt loam	2-6	35.3	12%	M
301B	Lindstrom	silt loam	2-4	6.3	2%	
327	Dickman	sandy loam	0-2	1.4	0%	
327B	Dickman	sandy loam	2-6	0.8	0%	
411	Waukegan	silt loam	0-2	10.9	4%	
454B	Mahtomedi	loamy sand	0-6	3.5	1%	
454C	Mahtomedi	loamy sand	6-12	24.8	8%	
454D	Mahtomedi	loamy sand	12-25	49	16%	H
454F	Mahtomedi	loamy sand	25-40	86.1	29%	H
488F	Brodale	slaggy loam	20-50	3.9	1%	H
507	Poskin	silt loam		1.2	0%	
543	Markey	muck		15.7	5%	
1847	Barronett	silt loam		32.5	11%	
	Water			7.6	3%	
Total				**302**		**52%**

* H= high, M=Moderate

The topography of the site is generally described as rolling hills, but the overriding feature is the valley, with steep flanking slopes. The elevation at the lakeshore is 770 feet, with hills rising to 900 feet at high points along either side of the ravine (**Map 4**). The highest point at the site is 910 feet at the overlook in the southwest.

MAP 4. SOILS AND TOPOGRAPHY



RARE FEATURES AND SPECIES OF CONSERVATION NEED

The Natural Heritage Database at the Department of Natural Resources has one rare animal and one rare plant record within Ravine Park, as well as three plant communities. All of the records were in the southern half of the park (**Table 2**). Blandings turtle (*Emydoidea blandingii*), a state threatened species, was last recorded in 2002. Suitable habitat for this species still exists at the park, though the species was not noted in 2012. Blandings turtle has a state rank of S2, meaning it is imperiled due to rarity. Kittentails (*Besseya bullii*), a plant that is also threatened with a state rank of S2, was last found in the park in 2000. A large population was present at the time, about 200 plants. The area was searched on two occasions in 2012, but the plants were not relocated. The buckthorn in the area is now quite dense and may have caused the kittentail to die off, or the plants may not have been found simply because the brush was too dense and they were overlooked.

Table 2. Element Occurrence records within Cottage Grove Ravine Park (south half)

Scientific name	Common name	State status*	State Rank**	Global Rank**	Last record	Viability Rank	DNR Description
Besseya bullii	Kitten-tails	THR	2	3	6/1/00	C - Fair estimated viability	The plant was first observed here in 1988. There were more than 200 plants observed on a sandy hillside. In 2000, the plants were observed to be abundant along a deer trail that ascends the slope. Dry oak forest on east/southeast facing slope. Shady canopy of *Quercus macrocarpa*. Scattered *Rhamnus cathartica* in shrub layer.
Emydoidea blandingii	Blanding's Turtle	THR	2	4	5/17/02	Not ranked	One adult and three juvenile blanding's turtles observed at Cottage Grove Ravine Regional Park. The adult was photographed.
Dry Sand - Gravel Prairie (Southern) Type	Dry Sand - Gravel Prairie (Southern) UPs13b		2	NR	9/22/87	C - Fair estimated viability	Dry sand prairie occurs on the southwest-facing bluff above the lake and just north of the park shelter. The graminoid cover is almost entirely *Stipa spartea*, with *Cyperus filiculmis, C. schweinitzii, Bouteloua curtipendula, B. hirsuta, Koeleria cristata*, and *Andropogon gerardii* occasional. Few prairie forbs or exotic weeds occur in the dense sod of native grasses. Soils are sandy loam. Scattered oaks occur in the prairie and mixed oak forest occupies the lower slopes.
Dry Sand - Gravel Prairie (Southern) Type	Dry Sand - Gravel Prairie (Southern) UPs13b		2	NR	9/22/87	C - Fair estimated viability	Dry sand prairie occurs on a southwest-facing slope of a narrow ravine sloping southeast to the lake. The graminoid flora is diverse, dominated by Bouteloua hirsuta, Cyperus schweintzii, and Leptoloma cognata, with several other species occasional. The soil is fine sands, erodable, and exposed in spots. Both sand prairie species and exotic weeds have colonized bare soil areas. Upper slope fenced and recently grazed.
Northern Bulrush-Spikerush Marsh MRn93	Northern Bulrush-Spikerush Marsh		NR	NR	7/20/88	C - Fair estimated viability	A small emergent marsh on northwest end of lake grades to wet meadow and old field. Dominant cover is graminoid, *Leersia oryzoides* and several species of *Cyperus*. The forb component is diverse with species typical of marsh, wet meadow, and some agricultural weeds. Characteristic native forbs are: *Polygonum lapathifolium*, *P. coccinium*, *Verbena hastata, Amaranthus tamaricina, Rumex meridimus, Mentha arvensis*, etc. *Lythrum salicaria* present in small numbers. Probably grazed in past

* THR = threatened ** 2 = imperiled due to rarity *** 3 = Vulnerable—At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors. 4=Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors.

The three plant communities listed in the DNR database for the park were dry sand-gravel praire, dry sand-gravel savanna and northern bulrush-spikerush marsh. The savanna and prairie are both listed S2, indicating they are imperiled in the state. The marsh does not have a state rank. All three were recorded in 1987 or 1988, and were classified as C-rank for fair estimated viability. The prairie and marsh were located during the 2012 survey, but are in further degraded conditions and no longer contain all the species listed in 1987. The savanna was not clearly found, though there are strong indications of it. All communities will be discussed in more detail in the Ecological Management section.

Several long-bearded hawkweed plants, (*Hieracium longipilum*) were also found in the old field to the southwest during the 2012 survey. This species does not have any protection status in the state, but is tracked by the DNR as it is uncommon. This species was not listed in the DNR database for Ravine Park, but it was shown as occurring within a mile of the park (**Table 3**). Several other rare species occurrences within a mile of the park, in particular, loggerhead shrike and western fox snake, are species that could also occur in the park, especially if habitat restoration activities provide suitable conditions for them.

Table 3. Element Occurrence records within 1 mile of Ravine Park

Scientific name	Common name	State protection status	State Rank**	No. Records	Last record
Falco peregrinus	Peregrine Falcon	THR	2B	1	2012
Lanius ludovicianus	Loggerhead Shrike	THR	2B	3	1995
Besseya bullii	Kitten-tails	THR	2	2	1998
Elaphe vulpina	Western Fox Snake	NON	NR	2	1997
Hieracium longipilum	Long-bearded Hawkweed	NON	NR	1	1987
Dry Sand - Gravel Oak Savanna (Southern) Type UPs14b	Dry oak savanna (southeast) sand-gravel subtype		2	2	1987
Dry Sand - Gravel Prairie (Southern) Type UPs13b	Dry prairie (southeast) sand-gravel subtype		2	2	1987

* THR=threatened, NON=no official status, but tracked by state.
** 2=imperiled, 3=vulnerable, 4=apparently secure

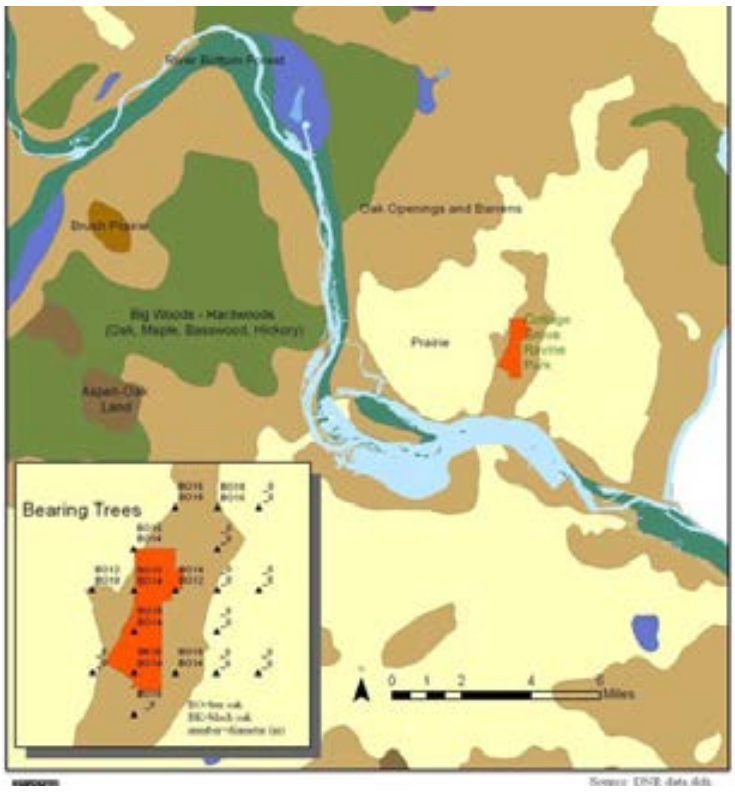
In addition to records of rare species, several species of greatest conservation need (SGCN), as defined in *Tomorrow's Habitat for the Wild and Rare* (DNR 2006), were noted during the 2012 site visits: eastern wood pewee, ovenbird, rose-breasted grosbeak, and woodthrush. These are species whose populations have declined, primarily due to habitat loss and/or degradation. All were detected during the breeding season. Also seen were scarlet tanagers, which are not rare, but are relatively uncommon and a spectacular sight.

Ravine Park is located in the St. Paul Baldwin Plains and Moraines ecological subsection, in which 149 species of greatest conservation need (SGCN) are known or predicted to occur, the second most of all subsections in Minnesota. The key habitats that are needed in Washington

County to support SGCNs are prairie (41 species) and savanna (36 species). 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.

HISTORIC VEGETATION

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. Those notes were later compiled into a map, which shows that Ravine Park was within the plant community referred to as "oak openings and barrens" (**Map 5**). Today we commonly refer to this as oak savanna, which disagrees with the information presented in the Master Plan, showing the presettlement vegetation was Big Woods. Big Woods was a very different plant community, much more heavily wooded and dominated by red oak, sugar maple, basswood, and American elm.



MAP 5. PRE-EUROPEAN SETTLEMENT VEGETATION

It appears the authors of the master plan may have been looking only at the hardcopy map of the site, where it would be easy to misinterpret the notations for the different land covers. The GIS digital data, however, is quite clear. The bearing tree data – the actual record of species that the land surveyors recorded at 0.5 or 1-mile intervals – shows a preponderance of bur oak trees, which is consistent with an oak savanna type of cover. In addition, the existing on-site conditions strongly point to a history of savanna rather than forest. Many of the large oak trees have wide spreading branches, an indication they grew up with much less tree cover around them. There are also many red cedars and the small remnant "prairie" openings, all indicative of a more open canopy in the past.

Another clue to past land cover is from historic aerial photographs. While the oldest available only go back to the 1930's – about 80 year after settlement – they still provide some evidence of the historic condition. **Map 6** from 1936 shows a fairly open site, although tree cover is abundant, especially in some of the ravines. A possible scenario is that the site was a more open savanna at the time of European settlement, with patchy woods in ravines and other fire-protected areas. With fire suppression after settlement, more trees became established, pushing the savanna more towards woodland overall. It is likely that the site was used for grazing and some logging.

Once established, the tree cover expanded quickly and by 1953 the area north of the lake appeared to have a nearly continuous canopy. Over subsequent decades trees continued to fill-in over most of the rest of the site, to reach the fairly dense canopy present today. In some areas, trees, especially pines, were also planted.

According to the Department of Natural Resources County Biological Survey, less than five percent of high quality, native plant communities remained in Washington County as of the 1990 survey. That amount has surely declined with the rapid urban development that occurred in the past 20 years. 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. Thirty-six species of greatest conservation need (SGCN) use savanna habitat, including 11 species that are specialists (DNR 2006).

MAP 6. 1936 AERIAL PHOTOGRAPH

WATER RESOURCES

An inventory of surface water resources and associated issues such as erosion, vegetated buffers, impairment, and groundwater infiltration or recharge are typically addressed in a Natural Resource Management Plan. Most of these topics were covered in the Master Plan for the park (Brauer and Associates, 2007), however, and are thus not included here except where pertinent in the ecological restoration discussion.

Erosion of the highly erodible soils in the park has been and continues to be a challenging issue. While the Master Plan stated that erosion was slight to moderate at the park, we observed what appeared to be somewhat significant erosion, both within the stream that flows through the eastern oak forest, and on the steep trails (**Photos** 1-4).

Photo 1. Erosion at culvert, GPS 12. 6-15-12

Photo 2. Undercut banks in eastern stream. GPS 13. 6-15-12

Photo 3. Erosion in floodway. GPS 11. 6-15-12

Photo 4. Trail erosion, eastern oak forest. GPS 9. 6-15-12

A relatively simple solution to the prevalent trail erosion would be to install water bars, whereby a log is laid in a shallow trench, leaving about 1-inch of the log exposed above ground. The trench is dug perpendicular to the trail, at an angle, so that water flow is directed off the trail. Such methods are commonly seen at the state parks. Conservation Corp Minnesota often works on this type of project.

Addressing the more significant erosion issues is beyond the scope of this document, and will require more intensive study. As with other water resource issues, the Washington Conservation District and South Washington Watershed District (SWWD) can help address these concerns. The SWWD reported in 2011 that water quality in Ravine Lake had improved, based on citizen monitoring. Nevertheless, the lake is still classified as eutrophic. Reducing erosion, heavy metals and other toxins to the lake is still needed, not only for the lake quality itself, but also because it drains to the Mississippi River.

ECOLOGICAL EVALUATION and MANAGEMENT RECOMMENDATIONS

SITE EVALUATION

The 300 acres of the southern half of Cottage Grove Ravine Regional Park were evaluated to record the existing plant community and determine a target restoration community. The Department of Natural Resources (DNR) developed a system called the Minnesota Land Cover Classification System (MLCCS) (DNR 2005), which defines and classifies all types of land cover. This information was used as a basis for the site evaluation, which was conducted by FMR's ecologist in spring and summer 2012. Based on field observations, some of the MLCCS landcovers were then modified; some polygons were altered and a few land cover types were changed to a different cover type. Some cover type names were also abbreviated or modified for clarity and ease of use. The land covers are summarized in **Table 4** and shown in **Map 7**.

Information recorded during field surveys included plant species and their percent coverage in each vegetation layer (tree, shrub, grass) (**Appendix A**), soil type, slopes, animal signs, and ecological concerns, such as erosion, exotic species etc. Each polygon was given a unit name, which was based on the original labels used in the 1992 inventory, for ease of comparison.

To determine target plant communities for restoration (**Table 4**), we considered the historic conditions, existing conditions, and relative effort vs. benefits. As a guideline for the target plant community goals, we used 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 Minnesota Department of Natural Resources 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, and plant composition. 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. Ravine Park is classified as follows:

Ecological Province: Eastern Broadleaf Forest
Section: Minnesota and Northeast Iowa Morainal
Subsection: St. Paul Baldwin Plains and Moraines

This property was likely dominated by southern dry sand-gravel savanna, with some combination of other plant communities, especially southern dry sand-gravel prairie on south and west-facing slopes, northern bulrush-spikerush marsh near the lake, and southern dry-mesic oak woodland in the ravines and north-facing slopes. These plant communities are generally still appropriate for the site, although there has been some succession of communities. Many areas that had been oak savanna have developed into oak woodland or oak forest, and it may no longer be desirable to revert back to savanna.

Each land cover unit is described in more detail in the subsections below, including primary ecological concerns and general management recommendations.

Table 4. Existing Land Cover and Proposed Restoration

Unit Map 7	Acres	MN Land Cover Classification	Target Native Plant Community	Plant Comm Code	Mgmt Units Map 8	Dom soil type
WOODED AREAS						
A	29.4	Dry oak forest	Southern dry-mesic oak (maple) woodland & southern dry oak savanna	FDs37, UPs14	OW4, SV8	Mahtomedi loamy sand
J	53.1				OW3, SV9	
N	37.3				OW2, SV4	
	119.8					
F	13	Dry-mesic oak forest	Southern dry-mesic oak forest	MHs37	OF3	Mahtomedi loamy sand
Ia	19.3				OF1	Barronett silt loam
Ib	14.8				OF2	
	47.1					
H	42.7	Oak woodland-brushland	Southern dry-mesic oak forest	MHs37	OF2	Mahtomedi loamy sand & Antigo silt loam
K	5.1				OF2	
	47.8					
Q	1	Altered deciduous woodland	Southern dry savanna	UPs14	SV5	Mahtomedi loamy sand
G1	1.6		Southern dry-mesic oak (maple) woodland	FDs37	OW1	Hubbard loamy sand
S2	0.3		Southern wet-mesic hardwood forest	MHs49	MF	Poskin silt loam
	2.9					
B	2.2	Mixed pine-hardwood forest	Southern dry savanna	UPs14	SV2	Mahtomedi loamy sand
D2	5.1	Red pine tree plantation	Southern dry-mesic oak (maple) woodland	FDs37	OW4	
	7.3					
GRASSLAND AREAS						
L-1	1.2	Dry prairie, sand-gravel subtype	Southern dry prairie, sand-gravel subtype	UPs13b	DP1	Mahtomedi loamy sand
L-4	0.1				DP2	
L-3	0.3				DP3	
L-2	0.3				DP4	
	1.9					
E1	1.5	Grassland with mixed Coniferous/Deciduous Trees	Southern dry savanna	UPs14	SV10	Sparta & Hubbard loamy sand
G2	3.5				SV3	Sparta loamy sand
G3	2.7				SV1	Hubbard loamy sand
S	1.6				SV6	Mahtomedi loamy sand
	9.3					
C	5.2	Medium-tall, altered/non-native dominated grassland	Southern dry prairie	UPs13	DP7	Mahtomedi loamy sand
D	9.4		Southern dry prairie	UPs13	DP8	Waukegon silt loam
E2	1.7		Southern mesic prairie	UPs23	MP1	Barronett silt loam & Sparta loamy sand
P	1.4		Southern mesic prairie	UPs23	MP2	Mahtomedi loamy sand
R	3		Southern dry prairie	UPs13	DP5	Mahtomedi loamy sand
	20.7					
WETLAND AREAS						
W	3	Mixed emergent, seasonally flooded marsh	Northern wet meadow/carr	WMn82	WM	Barronett silt loam
M	1.6	Palustrine emergent wetland	Palustrine emergent wetland		EM	Barronett silt loam
V	24.9	Lake (lacustrine)	NA	NA	NA	NA
T	0.3					
	25.2					
OTHER ALTERED LAND COVERS						
CN	2	Cropland-upland	Southern dry savanna	UPs14	SV7	Antigo silt loam
CS	0.6		Southern dry-mesic oak (maple) woodland	FDs37	OW5	
	2.6					
Paved	12.8	Pavement, mowed turf grass, sparse trees	NA	NA	NA	NA
TOTAL	**302**					

MAP 7. EXISTING LAND COVER

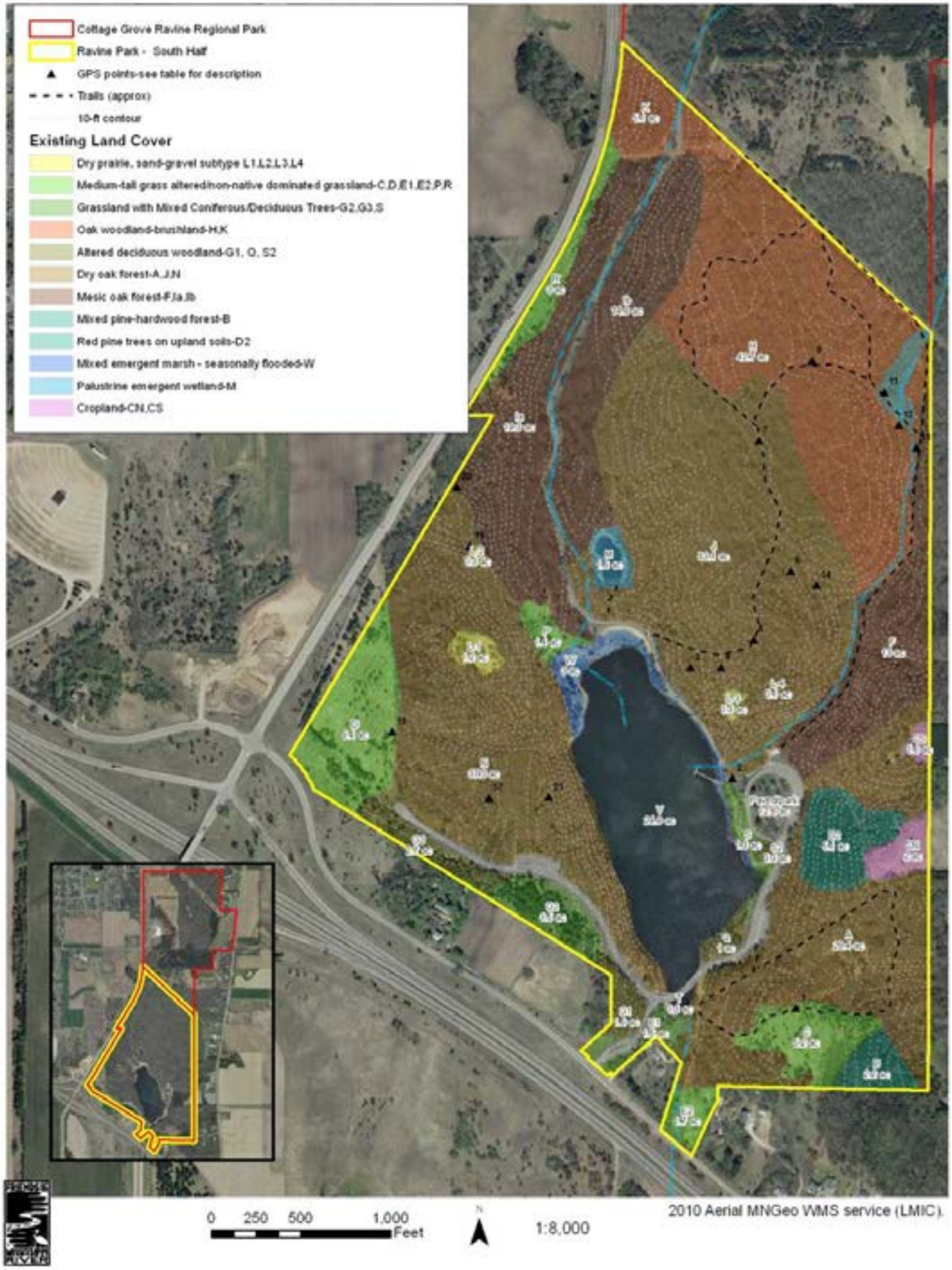


Table 5. GPS points and descriptions

No.	Description
1	Oak wilt - about 80 trees
2	Crown vetch along path
3	24" pin oak, buckthorn understory
4	Buckthorn sparse, but garlic mustard abundant. Heard scarlet tanager.
5	Very dense buckthorn
6	Bowl area. Open understory, buckthorn sparse but many seedlings. Garlic mustard abundant.
7	More hackberry, younger woods, fewer large oak, more elm.
9	Trail erosion. Buckthorn sparse.
11	Eroded floodway
12	Erosion at culvert. Trail intersect
13	Eroded bank
14	Barberry
17	Photo to N. Shallow ravine. BT small here - 3 ft
18	W edge of unit N to North
19	Fence
20	North slope - less BT
21	V dense BT wall to south

Existing Wooded Areas

Dry Oak Forest and Oak Woodland-Brushland
Units N, J, A - 120 acres, and Units H, K – 48 acres

Dry oak forest is the largest native plant community at the park, and where most of our ecological evaluation was focused. The oak woodland-brushland units were included in this description because the plant communities were quite similar and would be similarly managed. Together, these units cover about 168 acres, over half of the southern park area.

Oak forest and woodland are located on hills that flank the east and west sides of the main valley that transects the park. The forest to the west of the main ravine (Unit N) is mostly dissected slopes directed easterly toward the ravine, with more level topography at the west edge of the unit. The combined eastern units (J, K, H) are more level in the center, with dissected slopes directed westward toward the main ravine and eastward toward the sub-ravine. Unit A in the southeast part of the site is more level to the east, with slopes and ravines mostly directed


Photo 5. Oak wilt patch of about 80 trees. Map 7, pt 1. 8/30/12

toward the east.

In all units, pin oak was the dominant canopy species, ranging from about 8 to 24 inches in diameter, with at least one giant found of 41 inches (see cover photo). While bur oak was subdominant in the canopy, the trees were typically larger than pin oak, ranging from 10 to 28 inches in diameter with most about 22. Bur oak trees mostly had a spreading branch form, indicating they matured in a much more open savanna-like setting. With fire suppression since the mid-1800's, denser tree canopies developed. Pin oak seedlings were commonly found, but bur oaks were not regenerating due to the deep shade conditions. They may decrease further over time, but there will likely be some regeneration too, when canopy gaps are created by windfall and disease, especially oak wilt. In Unit A, for example, a stand of about 80 pin oak trees have succumbed to oak wilt (Photo 5 and Map 7, gps point 1).

Quaking aspen, red cedar, big-tooth aspen, hackberry and paper birch were other common species in the oak forest (Photo 6), with occasional American basswood. Boxelder was common along the edges.

Photo 6. A stand of quaking aspen near the parking lot at unit N (map 7, gps 21). 6/20/12.

Common buckthorn, a non-native invasive shrub, was dominant in the understory in all forested areas (Photos 7 and 8). There were patches where the buckthorn was sparse or small size (Photos 9 and 10), but overall it was quite dense, with a 2-inch diameter size common. The other common non-native invasive, Tartarian honeysuckle, was abundant along forested edges. Prickly ash, a native invasive shrub, was subdominant in most areas. Other native species in the shrub layer were mostly saplings of canopy trees, with small amounts of currant, gooseberry, and, rarely, American hazelnut.

Photo 7. A large, 24-inch diameter pin oak is choked by dense buckthorn below. Map 7, pt 3. 6/15/12

Photo 8. Buckthorn was typically smaller diameter in Unit N, but very dense. Map 7, pt 21. 6/20/12

Photo 9. Buckthorn is sparse at this point, but garlic mustard is abundant. Map 7, pt 4. 6/15/12

Photo 10. Buckthorn is sparse in this small area, but garlic mustard is abundant. A scarlet tanager was heard here. Map 7, pt 6. 8/30/12

The ground layer had a moderately dense cover, though garlic mustard was the most abundant species. Native wildflower species were not abundant, but included wild geranium, false lily of the valley, columbine, wild sarsaparilla, enchanter's nightshade and sweet cicely. Earthworms, none of which are native to Minnesota, were present throughout the site. Invasion by earthworms is believed to be a primary factor in altering a native plant community. As the soil chemistry and structure is changed, native plants disappear. Garlic mustard and buckthorn are typically the first species to move in following earthworm invasion.

The primary concerns for all wooded areas were the abundance of non-native invasive shrubs and herbaceous plants, especially common buckthorn, Tartarian honeysuckle, and garlic mustard. Associated with that is the loss of plant and animal biodiversity that has occurred.

Restoration should address means for re-establishing a diversity of native plants as well as the natural forest structure. While the unit was likely savanna in the past, it has now succeeded to oak forest and brushland. Buckthorn has replaced native shrubs and to some degree provides the structure the native shrubs provided. It is very detrimental in other ways, however. The food quality it provides is lower quality, and it does not provide secure nesting for bird species. Studies have shown that bird species that nest in buckthorn have higher predation rates than those that nest in native shrubs.

Removing the buckthorn will displace some animal species that have adjusted to it. Many of those species are likely to be generalist species, but more sensitive species may be temporarily displaced as well. In the long-term, the diversity and abundance of native species will be far greater in a native plant community, so the disruption will be temporary. It will be important to re-establish native shrubs and small trees as well as herbaceous species, and to re-introduce fire back into the natural disturbance regime to help regain proper ecosystem functioning. This process will take some years. It would be very valuable to have monitoring tools in place, including vegetation and animal surveys (e.g. breeding bird survey) to help evaluate site changes over time. Although these woodlands are quite degraded, they still provide important ecological services. Improving them is possible, and worthwhile, but it will be a significant investment and a commitment of many years.

The target plant community for most of this unit is Southern Dry Mesic Oak Woodland, which will be described in the restoration section. Much of this unit was likely oak savanna in the past, and there are still indications of that along some of the edges, especially at the southwestern areas of Units N and J. Therefore, the restoration map (**Map 8**) shows these areas, totaling about 9 acres, as targeted for dry oak savanna.

Another issue, though less of an ecological one, is the illicit dumping of trash that was noted, especially near the western parking lot (Photo 11). A new entry road is planned in this area so it may cease to be an issue, but in the short term, at least, the debris should be removed. If necessary, methods to prevent such behavior in the future should be explored (e.g. physical barriers, hidden cameras).


Photo 11. Trash, including old appliances and broken glass, was found near the parking lot at Unit N. Map 7, 6/20/12

Management goals for these units are to:

- Control non-native woody species (buckthorn, honeysuckle, prickly ash)
- Reduce cover of non-native herbaceous species (especially garlic mustard)
- Re-establish oak savanna over portions of the site
- Increase abundance and diversity of native woodland shrubs and forb, grass, and sedge species
- Remove trash at Unit N.

Dry-Mesic Oak Forest

Units F, Ia, Ib - 47 acres


Photo 12. Dense buckthorn and honeysuckle in Unit Ia, west of paved trail. 12/8/12

The plant community of the mesic oak forest units was not surveyed in detail, but the species composition appeared similar to the dry-mesic oak woodland units and management methods will be similar.

Canopy species included pin oak, big-toothed aspen, quaking aspen, American elm, and green ash. The shrub layer was dominated by common buckthorn, which was generally dense, large diameter plants; Tartarian honeysuckle, primarily along edges; and prickly ash (photo 12).

Management of these units will focus on exotic woody control followed by re-establishing native shrub and herbaceous species. The ecological management goals and methods will be the same as for the dry oak forest units, except that the target plant community for these units will be a little different. As these units are located lower in the landscape and tend to have moister soils, the target community will be dry-mesic oak forest. This plant community type is similar to the target community (dry-mesic oak woodland) for the dry oak forest and the two areas will essentially be managed together.

One other important consideration for Units Ia and Ib relates to the Central Draw Storage Facility Overflow Project, the plan developed by the South Washington Watershed District to route overflow runoff from Woodbury and Cottage Grove through Ravine Park to the Mississippi River (http://www.swwdmn.org/projects/central-draw-storage-facility-overflow-project-environmental-assessment-worksheet-eaw/). If this plan is implemented, every effort should be made to minimize negative impacts to the park and Ravine Lake. The primary concern is the potential for very significant pollutants that would likely be carried to Ravine Lake – sediment, heavy metals, nutrients, and other toxins – all of which would be very damaging to an already impaired lake. The lake could essentially become a stormwater treatment pond, with much less recreational appeal. Pre-treatment methods should be designed to prevent pollutants from reaching the lake.

A secondary concern is for the channel itself that would carry the runoff, as it would be very susceptible to erosion. Efforts to minimize erosion, however, should avoid heavy armoring and otherwise unnatural features. Bioengineering methods, including the use of boulders and native vegetation, would retain the natural feel and features of the park, while also providing less costly, more effective and lower maintenance erosion control.

Altered Deciduous Woodland
Units Q, G1, S2 – 2.9 acres


Photo 13. Stand of red pines at Q. If removed, would open lake view and restore small savanna. 11/19/12

The altered deciduous woodlands were similar to other forested areas, but had been altered more by park development and historic activities. All units were located next to a park driveway, where they were likely altered as part of the site development. Units G1 and Q also had planted red pines (Photo 13). Other tree species were similar to those found in the oak forest – pin oak, bur oak, hackberry, American elm, quaking aspen, red cedar and box elder. Unit S2 was in a lowland area and was dominated by quaking aspen. The tree canopy coverage was about 80 percent, consisting mostly of fairly young trees, though a few were 20 inches or more in diameter.

Common buckthorn and honeysuckle were dominant in the shrub layer, which had coverage of 60 to 90 percent. Wild grapevine, Virginia creeper, gooseberry, white snakeroot and Virginia stickseed were some of the other most common species.

While not high quality communities, these are high visibility and may be some of the first areas targeted for restoration.

The target plant community for Unit G1 is dry-mesic oak woodland. The primary goal for that unit would simply be exotic species control. Increasing native species diversity is probably not worth the effort for such a small unit, however, removing the few red pine trees which are not native to this part of the state, could be considered.

For Unit Q, the target community is dry oak savanna. Management goals will be similar to those listed for Dry Oak Woodland. Unit Q also has a stand of about 20 red pine trees and it would be beneficial to remove them. Red pines were planted in large plantations at other parts of the site, which we do not recommend removing. Opening the canopy at Unit Q and restoring it to oak savanna would be create a very scenic knoll at the south side of the lake. Savanna at this unit would also be consistent with the target restoration for adjacent areas.

The target community for Unit S2 is southern wet-mesic hardwood forest. This unit is located on mesic soils in low area next to the lake, with occasional flooding.

Exotic brush removal was already completed at Units Q and S2 in fall 2012 by Friends of the Mississippi River. With funding from the 3M Foundation, contractors cut and treated the material, volunteers hauled and stacked it, then County Parks staff chipped it and hauled it away (Photos 14-17).

Photo 14. Dense buckthorn along lakeshore at Unit Q. 8/30/12

Photo 15. Lakeshore after exotic brush removal. 11/18/12

Photo 16. Unit S, prior to exotic brush removal. 8/23/12

Photo 17. After exotic brush removal, which was completed on 10/27/12

Mixed Pine-Hardwood Forest and Red Pine Plantation
Units B, D2 – 7.3 acres

Units B and D2 both consist of pine plantations. Unit B contains red and Scotch pine as well as an abundance of small diameter (2 inch) black locust along the edge (Photo 18). The ground cover is sparse but includes smooth brome and white snakeroot.


Photo 18. Pine plantation at Unit B. 8/30/12

These plantations are highly altered landscapes. They do, however, provide wildlife value, and restoring native communities could be costly and labor intensive. At this time we do not recommend much management other than controlling the black locust, which is quite invasive.

Restoration to a native plant community would be considered a low priority, but may be feasible in the future. The trees could potentially be harvested for salvage (e.g. for biofuels) and removed on a large scale. Specific project plans would need to be developed, but tree removal work should take place with snow cover to prevent soil compaction. A prairie/savanna community would be appropriate at Unit B, but woodland might be more suitable at Unit D, which would be a more lengthy process.

Existing Grassland Areas

Dry Prairie, Sand-Gravel subtype (UPs13b)
Units L1, L2, L3, L4 - 1.9 acres

Dry sand-gravel prairie remnants were located in four small woodland openings on south and west-facing slopes. Historically these were probably part of a savanna complex, but now stand out from the woodlands as tiny remnants of that landscape. Each of the prairie nodes had fairly different species compositions (**Appendix A**), though the vegetation data are not comprehensive and some nodes were surveyed at different times of year than others. Scribner's panic grass and porcupine grass were found at all sites, Kentucky bluegrass and


Photo 19. Prairie L1, with prickly ash near edges, red cedar encroaching, and a patch of spotted knapweed. 4/18/12

Pennyslvania sedge were found at most sites, and graminoids were the dominant cover at all sites. While the overall species diversity was fairly low at each node, as would be expected for such small sites, the composition including typical sand-gravel prairie representatives, such as large-flowered penstemon, whorled milkweed, western ragweed, porcupine grass, and gray goldenrod, as well as hairy puccoon, which is a much more conservative species.

Primary ecological concerns at the prairie nodes are woody encroachment, including non-native species (common buckthorn and Tartarian honeysuckle) as well as native species (e.g. prickly ash, red cedar, red/pin oak) (Photo 19); and non-native, invasive herbaceous species. Of the latter, the primary species noted were spotted knapweed (at L1 and L2), butter-and-eggs (at L2), and Kentucky bluegrass (at all sites except L3) (Photos 20 and 21). Lack of fire has also interrupted the flow of nutrients and may have altered the native species diversity.

Management goals for these units will be to:

- Reduce cover of non-native herbaceous species
- Reduce cover of native and non-native woody species
- Expand prairie size
- Increase abundance and diversity of native prairie species

Because there is so little native prairie remnant at the park, these small units represent relicts from the past. They are a top priority for management and restoration.

Photo 20. Prairie L2. Large-flowered penstemon and porcupine grass emerging in early spring. 4/18/12

Photo 21. Prairie L3. Hairy puccoon and other natives threatened by encroaching Canada goldenrod, buckthorn and oaks. 8/21/12

Grassland with Scattered Coniferous and Deciduous Trees

Units E1, G2, G3, S – 9.3 acres

These units did not represent a native plant community, but were generally a composite of nearly equal coverage grassland species, shrubs and trees. The dominant grass was smooth brome. The tree canopy in Unit G2 included planted red pines (30 ft tall), red cedar, pin oak (12-inch dbh and one enormous approximately 48-inch dbh – photo 22), and box elder. The

shrub layer had abundant prickly ash, red raspberry and smooth sumac (Photo 23). Tartarian honeysuckle was common, and a few hazelnut were present. While brome grass dominated the grassland, there were small numbers of native plants present, including common milkweed, whorled milkweed, late goldenrod, sweet everlasting, common yarrow, heather aster, round-headed bushclover, Scribner's panic grass and wild grapevine. Bur oak seedlings were also found. Butter and eggs was the only invasive non-native noticed, but spotted knapweed is in the area too. E1 and G3 were similar to G2, but with different shrub species (less sumac) and fewer native species in the ground layer.

Photo 22. Approximately 48" dbh pin oak in Unit G2. 8/23/12

Photo 23. G2 unit had abundant red cedar and smooth sumac at the west end. 8/23/12

Unit S had very short canopy trees, dominated by red cedar and amur maple (Photo 24). The latter, a non-native species, was planted some years ago, but is now considered an invasive species. A few river birch were also planted and possibly other species. The ground cover is dominated by Kentucky bluegrass and smooth brome, and spotted knapweed is common. The lakeshore side had abundant buckthorn and some honeysuckle. Reed canary grass occupied a narrow swath along the shoreline.

The primary ecological concern at all these units is the lack of native species diversity. Removing both native and non-native invasive woody species will be the first step toward restoring these areas to the target plant community of southern dry oak savanna.

Photo 24. Canopy of red cedar and amur maple at Unit S. 12/8/12

Medium-tall, Non-native Dominated Grassland
Units C, D, E2, P, R - 22 acres


Photo 25. Unit C grassland with scattered trees.

These units were all dominated by grassland, consisting primarily of non-native species (smooth brome and Kentucky bluegrass). Scattered trees are present, generally less than 20% of the cover, and include both native and non-native species, deciduous and coniferous. These types of areas are commonly referred to as "old field" as they were typically grazed in the past. The target plant community for these units will be dry or mesic prairie. The goals are to remove all non-native trees and shrubs, reduce the tree cover, control non-native forbs, reduce native aggressive forbs, and increase the diversity of native grasses and wildflowers. While the existing grasslands provide some wildlife benefits, they are significantly lacking in the full assemblage of native prairie species, which provide many more benefits than the existing vegetation. Native prairie, for example, is used by 20 specialist bird species whereas grassland is used by only 6 (DNR 2006). Native plants also provide habitat for native bees, which are play a critical role in pollination, and many of which are showing significant population declines.

Unit C was dominated by brome, with abundant Canada goldenrod (Photo 25). Other native species, such as bergamot and field thistle, were sparse. Red cedar, Scotch pine, and red pine were scattered. Prickly ash was the most common shrub. Southern dry prairie is the target community for this unit.


Photo 26. The east side of Unit D to the north, showing scattered trees, abundant goldenrod and brome.


Photo 27. Long-bearded hawkweed (*Hieracium longipilum*), an uncommon species, was found in Unit D.

Unit D on the west side of the park was the largest grassland, at nearly 10 acres. Although dominated by brome and bluegrass (Photo 26), it also had some diversity of native prairie species, the most significant of which was long-bearded hawkweed (Photo 27), which is on the DNR "watch list", though it currently has no rare species status. Other native species found were: stiff goldenrod, stiff sunflower, common milkweed, whorled milkweed, heath aster, field thistle, hoary vervain, and evening primrose. Non-native invasive forbs included spotted knapweed, birds'foot trefoil (quite dense at the far north end of the unit), dotted St. Johnswort, and crown vetch. Red raspberry was common and woody plants included smooth sumac, quaking aspen, red cedar and prickly ash. Some Jack pine found at the north end were probably planted. While the Waukegan silt loam soils are heavier than the sandy loams found at the dry prairie sites, they are still subject to drought. The target plant community for this unit would therefore be southern dry prairie, but components of southern mesic prairie may also be incorporated.

Photo 28. The stream from Ravine Lake flows through Unit E2. 12/3/12

Photo 29. Unit E2 is dominated by non-native grasses with scattered trees and shrubs. 12/3/12

Unit E2, located east of the main entrance, included the stream that drains from Ravine Lake (Photo 28). Associated with the stream, this area had more mesic soils. Smooth brome still dominated, but there were also areas of reed canary grass (Photo 29). Scattered trees included red cedar and boxelder and shrub cover included blackberries, American plum, and nannyberry. The target plant community for this unit is southern dry-mesic prairie. This would be a fairly high priority since the new park entrance is planned to go through this unit.

Unit P was classified in the MLCCS as mesic prairie, but it was now dominated by non-native species, especially Kentucky bluegrass and spotted knapweed (Photo 30). Woody plants were encroaching from the edges, especially smooth sumac, prickly ash, red cedar, and

Photo 30. Unit P, dominated by non-native grasses. 12/8/12

Tartarian honeysuckle. Raspberries was also abundant.

While mesic prairie would be the target plant community for this unit, because it is so small and so difficult to get to, we do not recommend any significant management in the short term. Releasing biological control for spotted knapweed would be good, to reduce threat of this species throughout the park. The unit could be burned, if any adjacent units are burned, but otherwise the effort would not be worth the cost. If the site is burned, then broadcasting native prairie seed after a fall burn would be a good way to increase the native plant diversity.

Unit R was a long, narrow, 3-acre swath on a roadside slope of CR 19, on the far western side of the park (Photo 31). The unit was dominated by non-native grasses with scattered shrubs and trees. Although it persists as grassland, with the east-facing slopes, it could also be suitable as dry-mesic oak woodland. Given its location and the difficulty of managing it as grassland (burning would be costly and difficult), allowing native trees to gradually fill in would be a suitable goal. If, however, the unit is kept open for the purpose of the valley view from the road, then no other management is needed other than controlling non-native invasive species.

Photo 31. Unit R is a non-native dominated grassland on the east side of CR 19. 8/30/12

Wetland Areas

Mixed Emergent Seasonally Flooded Marsh
Unit W - 3 acres

Unit W includes the seepage meadow at the north end of Ravine Lake (Photo 32) as well as a narrow strip along much of the lakeshore. The area at the north end is one of the few areas in the park with fairly good representation of a native plant community.

Photo 32. Viewed toward the south, Unit W has a very nice complement of seepage meadow species.

The 1988 DNR survey described the wetland as follows: "A small emergent marsh on northwest end of lake grades to wet meadow and old field. Dominant cover is graminoid, *Leersia oryzoides* and several species of *Cyperus*. The forb component is diverse with species typical of marsh, wet meadow, and some agricultural weeds. Characteristic native forbs are: *Polygonum lapathifolium*, *P. coccinium*, *Verbena hastata, Amaranthus tamaricina,*

Rumex meridimus, Mentha arvensis, etc. *Lythrum salicaria* present in small numbers. Probably grazed in past."

Photo 33. The east shore of the lake had many planted wet meadow flowers.

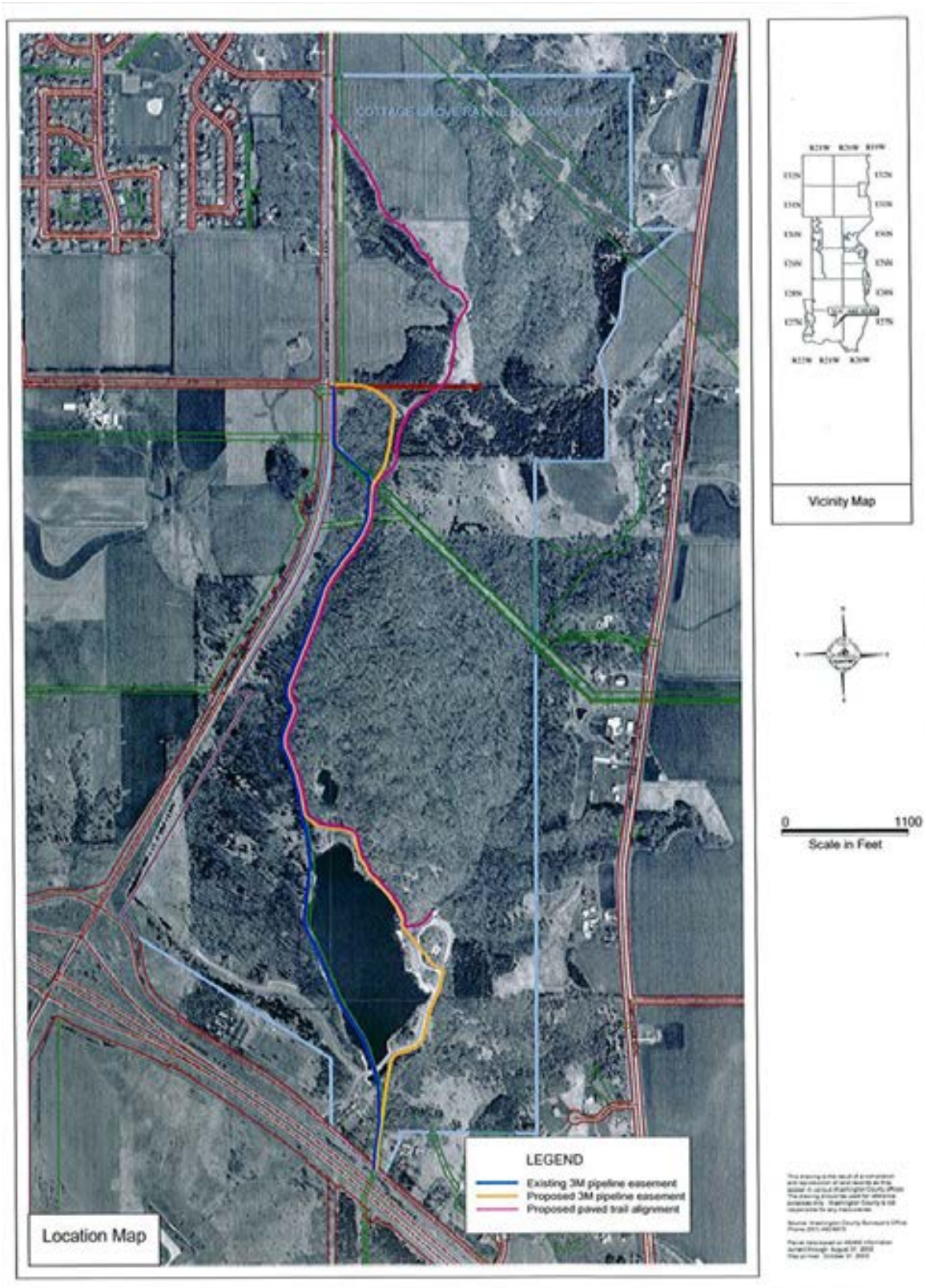
Remarkably, the wet meadow still retains many of the same species and characteristics. Native plants dominated the main part of the unit and included, woolgrass, broad-leaved cattail, mountain mint, jewelweed, marsh fern, willow herb, swamp milkweed, and great blue lobelia (full plant list in **Appendix A**). There were few trees, but boxelder and red cedar were the most commonly found. There are some large buckthorn and honeysuckle, especially along the northeast shoreline of the lake. Along the east shoreline of the lake were a mix of shrubs and herbaceous plants, including planted dogwood shrubs and other wet meadow species, which may have been planted (Photo 33).

The primary ecological concerns for this unit were non-native invasive plants. While the main portion of the wet meadow (the area at the north end of the lake) is dominated by native wet meadow species, there are many invasives in periphery areas and along the lakeshore perimeter. In particular, a large patch of reed canary grass was present just east of Photo 32, and also occurred in a narrow band along much of the shoreline. Common buckthorn, some that were very large, were present along the shoreline, though not generally abundant, and occasional Tartarian honeysuckle were found.

A secondary concern was made apparent in late fall when a large truck was driven into the wet meadow, subsequently getting stuck and creating deep gouges in the wetland (Photo 34). Repairing the damage may not be possible, but over time the ruts may fill in somewhat. It was later determined that this particular incident was probably due to a 3M employee or contractor, who drove onto the site to check on the 3M pipeline that runs under the trail (**Map 8**). The pipe carries leachate from a 3M dumpsite to the plant for treatment. We suggest meeting with 3M representatives to develop protocols for future on-site activities to prevent such destruction in the future. Additionally, it would be in the very beneficial to install a sign or physical barrier so that it is clear vehicles should not drive in this area.

Photo 34. A truck driven into the wet meadow created deep ruts. 12/8/12

MAP 8. 3M PIPELINE THROUGH RAVINE PARK



Palustrine Emergent Wetland
Units M – 1.6 acres

Unit M was a small open-water wetland north of the pavilion (Photo 35). It had a narrow band of herbaceous vegetation along the shore, but was otherwise surrounded by oak forest. Little ecological management of this unit is needed, but eradicating the reed canary grass before it spreads further would be beneficial. Some wetland health evaluations of this pond would be interesting, such as basic water quality measures and surveys of macroinvertebrates and amphibians. Citizen monitors could be recruited for this as well as for the lake.


Photo 35. Unit M is a small open water wetland surrounded by woods. 12/8/12

Lake
Units V, T – 25.2 acres

Evaluation of the lake was beyond the scope of this management plan. The South Washington Watershed District had done some monitoring of the lake and identified management needs in the 2007 Watershed Management Plan.

Other Altered Land Cover Areas

Cropland
Units CN, CS – 2.6 acres

When the opportunity arises to transition these units out of crop production, they can be readily converted to native vegetation. The long-term target community would be oak savanna, but the first step toward savanna would be to install native prairie. Converting cropland to prairie is a fairly simple process and the cheapest way to install a prairie. Once the last crop is harvested from the field, most of the site preparation has already occurred and it is virtually ready to seed to prairie. Some minor site preparation may be needed to create a proper seedbed. As these units are quite small, the installation cost will be low. Three or four years of additional management will be needed before the prairie is established, then annual maintenance costs will be minimal. A prescribed burn should be done every 3 to 5 years.

Paved, Mowed Turf, Sparse Trees
Unit Paved – 12.6 acres

This unit is primarily all the paved landscape – roadways and parking lots. It also includes the park playground area and park buildings. These areas are the basic infrastructure of the park and no ecological management needs were noted.

ECOLOGICAL MANAGEMENT RECOMMENDATIONS

This section describes more general ecological goals for the site and outlines a specific restoration strategy. Because this property is so large, implementation of restoration projects must occur in phases. A suggestion for the first restoration phase is described in more detail below.

Restoration 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 degraded by past uses and non-native invasive species, the existing plant cover retains a good variety of native species. The plant community composition and structure is highly altered, but the primary canopy cover provides the basic framework for native plant community restoration. 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.

Specific restoration goals identified for the site are to:

- Restore a complement of native species to the site, based on pre-European settlement conditions, according to the target habitats described below.
- Engage the public in the restoration process by hosting volunteer events for woody removal, planting etc.

Additional suggestions that can be considered are to:

- Enhance wildlife habitat by installing wildlife houses targeted for certain species (e.g. species declining due to habitat loss).
- Increase public awareness about native plant communities by creating a demonstration garden and/or display near the pavilion.

Specifications that should be applied to all restoration and management are:

- Seek methods that have the least negative impact on the land and it inhabitants.

- Avoid or minimize the use of chemicals as much a possible. Only certified professional should apply chemicals.
- When there are multiple options for effective chemicals, use the lowest toxicity and the one with the least soil residual.
- Use aquatic formula chemicals within 50 feet of the lake or pond.
- 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.

Target Plant Communities

At the time of European settlement, this property was located near the edge of prairie, savanna, and woodland/forested communities, and may have included all cover types. These plant communities are still appropriate for the site, although the proportions of each will be considerably different than in the past. General recommendations for restoration targets were identified in the Master Plan (p. 5.14). The current plan deviates from those recommendations very moderately (**Table 7, Map 8**). As described in the Master Plan, while reverting to a historical condition may be desirable, it is probably unrealistic at this park. The historic condition is important, but must be balanced by the extent to which succession has altered the vegetation, as well as the costs, both monetary and ecological, of restoring the historic community. Much of the existing oak forest west of the lake, for example, was historically oak savanna. But because it has transitioned so far to oak forest, converting it back to savanna would be exceedingly costly and probably more detrimental to the land than keeping it as is. The grassland in the southwest, however, still retains relict prairie species and is still quite open as a grassland. So in that area we deviate from the master plan and would recommend prairie as a restoration goal.

Other moderate changes would be to restore oak to some areas along the south edge and by the lake. These areas already have some characteristics of savanna. Once the exotic brush is removed the step to savanna will not be too difficult. These areas were savanna in the past, and savanna is one of the most imperiled land covers in Minnesota, so opportunities to restore it should be considered.

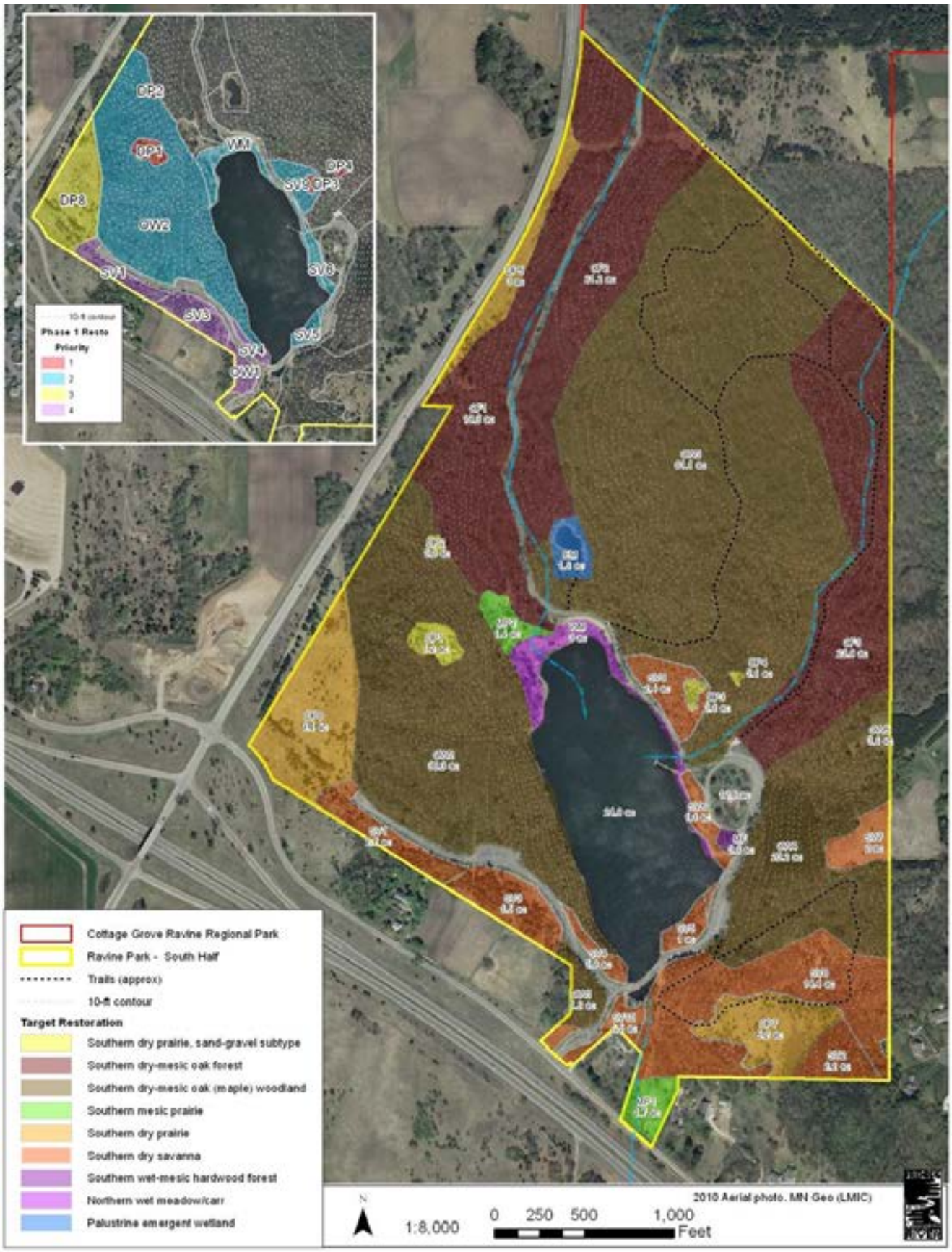
The proposed plant community species for each restoration type (**Appendix B**) are derived from the *Field Guide to the Native Plant Communities of Minnesota: the Eastern Broadleaf Forest Province* (DNR 2005), which is based on characteristics of intact native plant communities. Target community descriptions for Phase I units are described in the restoration recommendations for those units. Descriptions for plant communities that are not included in Phase I are described below.

Southern Dry-Mesic Oak Forest (MHs37) is described in *Native Plant Communities of Minnesota* (DNR 2006) as: Dry-mesic hardwood forest occurring most often on thin, wind-deposited silt on crests and upper slopes of bedrock bluffs. The ground-layer varies from patchy to continuous. Important species include lady fern, pointed-leaved tick trefoil, Clayton's sweet cicely, enchanter's nightshade, wild geranium, hog peanut, and white snakeroot. Shrub layer cover is patchy to interrupted. Common species include red oak, black cherry, chokecherry, American hazelnut, Missouri gooseberry, and pagoda dogwood. Subcanopy species include basswood, black cherry, red oak, white oak and shagbark

hickory. The canopy is interrupted to continuous. The most common species are red oak, white oak, and basswood.

Catastrophic disturbances were rare in this plant community. Analysis of Public Land Survey records indicates that the rotation of catastrophic fires was in excess of 1,000 years and the rotation of catastrophic windthrow was about 390 years. Events that resulted in partial loss of trees, especially light surface fires, were much more common, with an estimated rotation of about 20 years. Based on the historic composition and age structure of these forests, there would be two growth stages separated by a long period of transition.

MAP 9. ECOLOGICAL RESTORATION GOALS



Restoration Recommendations

Because this is a large property, it is not feasible to undertake restoration of the whole park, or even the entire south half, at once. The recommended first phase of restoration (**Map 8**), therefore, targets the highest quality units (remnant dry prairie and wet meadow), areas most visible to the public (lake shore and park entry), and the area where park development is planned in the near future (the western grassland and woodland). Phase I totals about 64 acres, and is further prioritized in **Table 6**. Although the priority units are shown separately, some of the management tasks, such as exotic brush removal, apply to all units. So work on different priority areas may not be entirely sequential, as some steps will happen concurrently.

Table 6. Phase I Management Units and Priorities
(see Map 8 for color-coordinated map units)

Mgmt Unit	Target Community	Acres	Priority
DP1	Southern dry prairie, sand-gravel subtype	1.2	1
DP2	Southern dry prairie, sand-gravel subtype	0.3	1
DP3	Southern dry prairie, sand-gravel subtype	0.3	1
DP4	Southern dry prairie, sand-gravel subtype	0.1	1
		1.9	
OW2	Southern dry-mesic oak (maple) woodland	36.3	2
SV5	Southern dry savanna	1	2
SV6	Southern dry savanna	1.3	2
SV9	Southern dry savanna	2.4	2
WM	Northern wet meadow/carr	3	2
		44	
DP8	Southern dry prairie	9.4	3
OW1	Southern dry-mesic oak (maple) woodland	1.6	4
SV1	Southern dry savanna	2.7	4
SV3	Southern dry savanna	3.5	4
SV4	Southern dry savanna	0.9	4
		8.7	
Total		**64**	

Completion of Phase I work is expected to take 5 to 8 years. As work is nearing completion, plans for the next work can be developed (assuming funding is available). Additional phases were not identified at this point as there was no obvious priority; there were no areas identified as higher quality or with more significant threats than others. Results and experiences from Phase I work will likely inform the desired next steps and the next phase will should build on the Phase I projects. Alternatively, opportunities may arise in other areas that require attention. For example, the oak wilt in Unit SV8 may dictate the need for restoration work in that unit. This plan, therefore, is not intended to be a rigid template, but more of a guideline for how to proceed. All of the management units, excluding Phase I, are listed in **Table 7**.

Table 7. Summary of All Other Management Units (excluding Phase I)

Mgmt Unit	Target Community	Acres
DP5	Southern dry prairie	3
DP7	Southern dry prairie	5.2
		8.2
EM	Palustrine emergent wetland	1.6
MF	Southern wet-mesic hardwood forest	0.3
MP1	Southern mesic prairie	1.7
MP2	Southern mesic prairie	1.4
		3.1
OF1	Southern dry-mesic oak forest	19.3
OF2	Southern dry-mesic oak forest	21.2
OF3	Southern dry-mesic oak forest	23.9
		64.4
OW3	Southern dry-mesic oak (maple) woodland	81.1
OW4	Southern dry-mesic oak (maple) woodland	20.2
OW5	Southern dry-mesic oak (maple) woodland	0.6
		101.9
SV2	Southern dry savanna	2.2
SV7	Southern dry savanna	2
SV8	Southern dry savanna	14.4
SV10	Southern dry savanna	1.5
		20.1
	Lake (lacustrine)	24.9
	Lake (lacustrine)	0.3
	Paved, mowed turf, play area, sparse trees	12.6
		237.4

Priority 1: Sand-Gravel Prairie – Units DP1, 2, 3, 4

Southern Dry Prairie (UPs13) has the following characteristics: trees are absent, other than an occasional bur oak or red cedar. The shrub layer is sparse, 1 to 5%, and consists of low species such as lead plant, New Jersey Tea, prairie rose, prairie willow and smooth sumac. Graminoid and forbs each have of cover of 5 to 50%, and there may be bare soil visible. Little bluestem is often dominant and other common mid-height species are prairie dropseed, Junegrass, side-oats grama, porcupine grass and Muhly grass. The tallgrasses, e.g. big bluestem, Indiangrass, switchgrass, are present, but less abundant. Common forb species include gray goldenrod, silky aster, dotted blazing star, golden aster, false boneset, flowering spurge, purple prairie clover and stiff sunflower.

Management methods:

- Exotic brush removal
- Prescribed burn
- Hand-pull and/or spot-spray non-native forbs and grasses
- Broadcast native prairie seed as area around existing prairie is opened up

Management of the prairie units is a top priority, because they will soon be taken over by woody encroachment and the few remnant prairie species will be lost. The first task is removal of native and non-native woody species (see **Appendix C** for details on cutting, herbicide and disposal). All common buckthorn, Tartarian honeysuckle and prickly ash would be removed. All red and bur oaks would be removed unless quite large. Red cedar trees can be reduced so that they cover no more than 10 percent of the prairies. Woody removal should be completed within each unit and along the edges to a width of at least 30 feet. This will begin to expand the edges to eventually enlarge them. These edges should be seeded with native prairie seed. Species seeded should be the same as those found on-site, and can include other species found in **Appendix B**. Local genotype seed should be used, within 100 miles if possible.

After woody removal is complete, the prairies can be burned. Initially, they may be burned as discreet units, but eventually they could be burned as part of the adjacent woodland/savanna. Burning the prairies will help to reduce seedling woody plants and will invigorate and promote the growth of native species. Burning also removes dead vegetation, which facilitates any follow-up spot-spraying work.

Spotted knapweed is the first non-native herbaceous species to target. There are typically four methods for control: hand-pull, spot spray, bio-control, burning. At unit DP2 it is sparse and can be hand-pulled by volunteers. At Unit DP1, it is much more abundant. Hand-pulling is a viable option, but will need to be done at least once annually, for about 5 or 6 years. The primary disadvantage to hand-pulling is the soil disturbance caused by pulling plants and by many feet digging into the steep slopes. This can lead to soil erosion, increased weeds, and loss of native plants due to trampling or accidental pulling. It is also labor intensive. While these are all cautions to be heeded, hand-pulling is a useful tool and has been successfully used at similar sites. Releasing biological control agents (insects) can be considered for other parts of the park, but at the prairie units the knapweed is at a level where complete eradication is feasible. Since the units are so small it would be better to have the knapweed all gone.

Spot spraying would typically not be recommended for such small prairie remnants, due to the potential harm to native species. At this site it may be feasible if done with extreme caution. The recommended method is to wait until late fall, when most native species are dormant. The knapweed stays green much longer and is easy to target. The least toxic herbicide to use is glyphosate (Round-up), which can be applied at a 2-10% solution. Any herbicide with a long soil residual (e.g. picloram) or an oil base (e.g. garlon 4) *should be strictly avoided* as these will kill non-target species, even during dormancy. A combination of spot-spraying in fall followed by hand-pulling in summer can be a very effective control strategy.

Butter and eggs was found in low abundance at DP2, but may be at other units as well. This species spreads aggressively and should be spot-sprayed in spring before it gets worse.

Mullein was another non-native species noted at DP1. It was not abundant, but can be hand-pulled wherever found. Canada goldenrod can form monotypic stands and overtake a site.

Reducing it can be difficult, without harming adjacent native species. One method that seems to be showing good results is to mow the goldenrod in early summer (e.g. late June/early July).

Priority 2: Southern dry-mesic oak (maple) woodland – Unit OW2

Though described separately, Priorities 1 and 2 would likely occur simultaneously for economy of scale, since the priority 1 areas are so small.

Southern Dry-Mesic Oak (Maple) Woodland (FDs37) is described in the *Native Plant Communities of Minnesota* (DNR 2006) as follows: Dry-mesic hardwood forests occurring on undulating sand flats, hummocky moraines, and river bluffs, mostly on fine sand or sand-gravel soils. Historically, fires were common in this community, and many stands are on sites occupied by brushlands 100–150 years ago. The 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. The subcanopy cover is patchy to interrupted (25–75%). The most common species are black cherry, red maple, and bur oak. Because of the open canopy, the shrub layer is often very dense with patchy to continuous cover (25–100%). Common species include black cherry, red maple, chokecherry (*Prunus virginiana*), American hazelnut (*Corylus americana*), gray dogwood (*Cornus racemosa*), prickly ash (*Zanthoxylum americanum*), Virginia creeper (*Parthenocissus* spp.), and poison ivy (*Toxicodendron rydbergii*). The ground-layer cover is patchy to continuous (25–100%). Pointed-leaved tick trefoil (*Desmodium glutinosum*), Clayton's sweet cicely (*Osmorhiza claytonii*), hog peanut (*Amphicarpaea bracteata*), Canada mayflower (*Maianthemum canadense*), and wild geranium (*Geranium maculatum*) are commonly present. Pennsylvania sedge (*Carex pensylvanica*) is the most abundant graminoid. Dewey's sedge (*Carex deweyana*) and starry sedge (*Carex rosea*) may also be present.

Management methods for OW2 are:

- Exotic brush removal
- Prescribed burn
- Re-establish native woodland shrubs and herbaceous species

Unit OW2 is the largest project area in Phase I, about 36 acres. The south end of this unit is planned for some park development, which will provide an excellent opportunity for restoration work, as some of the ecological tasks (primarily exotic brush removal) may be accomplished as part of the site development. Any park roads, buildings and trails should be either completed prior to doing the ecological restoration, or clearly laid out so that there is no duplication of effort. The park development project may also improve access to this unit, which will make brush removal more cost effective.

The brush removal steps will proceed as described in **Appendix C**. Brush disposal may include hauling brush out and chipping it, but most of the unit is too inaccessible and brush will be stacked and burned. In a few areas brush may be less dense and letting it decompose may be an option (scatter and make sure that cut brush contacts the soil, if this option is used). Ideally, brush removal would happen in late fall. This timeframe is optimal because

the buckthorn is the only plant with green leaves. Fewer plants are missed and less time is spent identifying plants. The herbicide is also taken up more effectively in fall.

Following brush removal, there will be a large flush of seedling buckthorn. Prescribed burning will be an important control measure. Because of the large amount of pin oaks, which tend to hold their leaves over the winter, the best time for a burn will be spring. The buckthorn will not likely have germinated by the first spring after removal, so the initial burn may not be until the second spring. It should be timed so that the buckthorn seedlings have leafed out. A second burn the following spring is recommended.

After the second burn, the site should be evaluated to determine the next best steps. There may still be an abundance of buckthorn. But small buckthorn stems can be more costly to deal with than larger ones. It is often beneficial to wait a few years before doing more cutting work. By then the stems are large enough in diameter to treat, and the plants have thinned themselves out from the extreme density that happens early on. The main thing is to do additional management before the new plants begin to produce fruit. Fruiting can happen within three years for some plants growing in full sun. But in a more shaded area such as this unit, it may be 4 or 5 years before some of the edge plants produce fruit, and longer for interior plants.

After the second burn is completed, the site may be suitable for installing native shrubs to increase the native diversity and to replace the shrub component of the forest. Suitable species are listed in **Appendix B**. More detailed plans will need to be developed to determine where to install the plants and how. It is advisable to install barriers to prevent deer browsing. We have found installing 4' vinyl coated wire fences around individual shrubs or small clusters has been a relatively inexpensive and effective means of protection.

Garlic mustard is prevalent throughout the woodland areas and there is currently no good means of control for large stands of it. However, some recent research has indicated that garlic mustard may not be *displacing* native forbs so much as *replacing* them, while in reality other factors (e.g. earthworms) actually cause the native species to disappear. In fact, studies have shown that establishing garlic mustard in native woodland plant stands did not impede the native species diversity, and that robust native plant stands may deter garlic mustard establishment (Phillips-Mao 2010).

Therefore, in addition to shrubs, planting some forb components will also be desirable. They can also be enclosed in fencing, partly for protection, and partly to be able to re-find them easily. The shrub and wildflower plantings are not intended to fill the woodland but to provide some seed source so the species will eventually spread. At this unit in particular, the plantings will be beneficial in the development areas, for aesthetics. Using seed instead of plant material may also be an option, though good results from woodland seeding can be difficult to achieve.

Priority 2: Southern dry savanna – Units SV5, SV6, SV9

Southern dry savanna (UPs14) is characterized by a grass-dominated herbaceous cover, sparse trees, mostly oaks, and droughty soils. The topography can be variable, from nearly level plains to steep slopes. One of the most common places UPs14 occurs is on terraces

along the Mississippi River. Savannas are commonly associated with prairies in a landscape where features fires would have carried across open flat terrain, but would have been halted by steep topography or surface waters, thus providing conditions suitable for savanna species. The plant community is especially adapted to low fertility and drought susceptible soils, conditions that make it more resilient than mesic sites. Fewer species are tolerant of these conditions so there is less competition among species in savannas and more open ground. Where savanna historically covered over 5 million acres in Minnesota, less than 0.1 percent remains today, and it is one of the primary plant communities needed in the Cottage Grove area, according to the DNR (DNR 2005).

Trees in savannas occur as scattered individuals or clusters, with a total cover of 25-50%. Bur oak is the most common, but pin oak is also present. The shrub layer is patchy with a total cover of 25-50%. Common low shrubs are leadplant, prairie rose, poison ivy, while chokecherry, hazelnut, and smooth sumac are important tall shrubs. The forb cover is about 5-50%. Typical species include western ragweed, Virginia ground cherry, hairy puccoon, gray goldenrod, hoary frostweed, and purple prairie clover. The graminoid cover is 25-100%, and dominated by mid-height species such as little bluestem, porcupine grass, and Junegrass. Tall grasses are also important, especially big bluestem and Indiangrass. Purple lovegrass and Muhlenberg's sedge are common short species.

Units SV5 and SV6 are located along the lakeshore (on the east side of the lake) and were prioritized due to their high visibility. Because of their proximity to the lake, it will also be important to use aquatic formula herbicide in these units. The descriptions below include woody removal followed by savanna seeding. Although the savanna restoration process may be more efficient if combined with other savanna restoration units at the site, these units could also serve as a pilot project, which would better inform restoration of the other units.

Unit SV5 restoration has already begun with exotic brush removal (completed in fall 2012). While the next step toward savanna restoration will be to remove the approximately 18 red pine trees and selected other small trees to achieve a tree coverage of 50 percent or less, we suggest the more significant tree removal process may wait, unless there is an immediate opportunity for using the woody material for biofuels. Otherwise, the intensive effort to remove larger woody material makes it a lower priority.

What will be needed in the short-term is follow-up buckthorn control to treat any missed or resprouting plants. The prickly ash, and selected other small trees, can also be removed . The unit, however, would retain a significant canopy (up to 50% cover). After woody removal, a prescribed burn is recommended and could be combined with burning another unit to be more cost effective. The oak leaves should be adequate to carry a fire, but it may be somewhat spotty at first, until more fine fuels (grasses) are established. Once the larger trees are removed, savanna seed should be broadcast onto the site. An optimal time for seeding is fall, but if the burn happens in spring, seeding can still be successful at that time.

Unit SV6 restoration would begin with removing the exotic brush and trees, including amur maple. The next steps toward establishing native savanna community would be completed in conjunction with DP8 (Priority 3), for efficiency and economy. SV6 is a small unit, so the cost per acre for restoration work will be quite high unless contractors have another similar

project to do on-site. The management activities at DP8 should be very similar to what is needed at SV6. The steps (also described in DP8) would consist of mowing the existing upland vegetation in spring, spraying the regrowth sprayed with herbicide when it's about 6 inches high, spraying again in early fall, then burning and lightly discing prior to seeding in late fall.

Unit SV9 is located on a west-facing slope on the east side of the lake. It was prioritized due to its proximity just below a dry prairie, Unit DP3. A goal for Unit DP3 is to increase the size of the opening, which would be accomplished at SV9. In addition to exotic brush removal, other small native trees can be removed. Bur oaks and large native trees can be left. The steepness of the slope will make the work challenging, but not prohibitive. Another concern will be the slope erodibility. Conducting the woody removal work in winter will reduce impacts. There will likely be adequate root mass and woody debris to keep the soils intact, but the site should be seeded as soon as possible after woody removal. If necessary, erosion control steps should be taken, such as laying brush horizontally on the slope, or possibly using erosion blanket if there are large bare areas. Suitable savanna and dry prairie species for seeding are listed in **Appendix** B**.**

Priority 2: Northern wet meadow-carr – Unit WM

Northern wet meadow-carr (WMn82) occurs in wetland basins associated with streams and drainageways. Water levels are deep enough to prevent trees from growing, but there may be little or no standing water during the growing season. Water levels fluctuate moderately with spring runoff, heavy rains, and summer drawdowns. These wetlands are characterized by dense broad-leaved graminoids (e.g. Canada bluejoint grass, tussock sedge, lake sedge) or tall shrubs (e.g. willows, red-osier dogwood, speckled alder, meadowsweet). Forbs include tufted loosestrife, marsh bellflower, great waterdock, northern bugleweed, northern marsh fern, and others.

While a portion of the wet meadow is dominated by native wet meadow species, there are many invasives in periphery areas and along the lakeshore perimeter. The first management step will be removal of non-native trees and shrubs, especially buckthorn and honeysuckle.

The next steps for this unit will be to reduce the cover of reed canary grass. Reed canary grass is difficult to control, and often not advised in areas that are subject to flooding, where new seeds will continually be washed in. Because this is a fairly contained area, reed canary control should be manageable. A prescribed burn would be completed in the spring to remove the dead vegetation then aquatic formula herbicide (Rodeo) would be applied to the reed canary, with great care to prevent drift into desirable vegetation. A second and third herbicide treatment may be needed in late summer and fall. Then the site would be seeded in late fall. As wetland conditions may preclude an initial burn, the next option is to mow the vegetation when conditions permit, but before plants produce seed, followed by two or three herbicide treatments. A prescribed burn may be needed prior to seeding. This method of reed canary grass control should significantly reduce the grass, but may not eradicate it completely. There will likely be a need for additional spot-treatment over the next couple years.

Priority 3: Southern dry-mesic prairie – Unit DP8

This unit will tend toward dry prairie, but may include components of mesic prairie as well. **Southern mesic prairie** (UPs23) has a more or less continuous ground cover, composed of 75-100% grasses and 5-50% forbs (DNR 2005). The shrub layer is sparse, with 5-25% cover, and includes low shrubs such as lead plant and prairie rose. Wolfberry may occur in sparse patches. Gray dogwood, hazelnut, and wild plum are rare. Trees are absent.

Big bluestem and Indiangrass are dominant, with prairie dropseed co- or subdominant. Little bluestem, porcupine grass, side-oats grama, switchgrass, and prairie cordgrass are also common, depending on the moisture gradient.

Typical forbs (flowering plants) include purple prairie clover, rough blazing star, stiff goldenrod, Canada goldenrod, smooth aster, heath aster, flowering spurge, stiff sunflower, white sage, heart-leaved alexander, alum-root, northern bedstraw, prairie phlox, yellow coneflower, and bergamot.

Because Unit DP8 has some interesting native species components, especially the long-bearded hawkweed, we recommend a more conservative approach to restoration, rather than the typical method, which would spray to kill all existing vegetation and essentially start over. Instead of that, the site can follow a sequence of burn, grass herbicide, and seeding. Perform the burn in late spring (to set back the cool-season non-native grasses), then a grass herbicide should be applied, followed by sowing a mix of native grasses and forbs.

The burn should be conducted when cool season grasses are growing, but there must still be enough dead vegetation to carry the fire. Typically mid to late May is a suitable time. After re-growth to about 4-6 inches, a grass herbicide can be applied. As there were very few native grasses found at the site, this will be an effective way to eradicate non-native grasses without harming native forbs. A fall mowing and grass herbicide treatment will also likely be needed. The two options for applying the seed are broadcast or drilling. Broadcasting results in a more natural appearance of the vegetation, but requires more seed and is also dependent on having good rains after the burn to get the seed set in the soil. Broadcasting often works best in fall, when winter freeze-thaw works the seed into the soil. Because of the timing and the presence of existing vegetation and roots of dead plants, drilling may be the preferred option at this site.

Following seeding, the site should be kept at a height of about 6 inches for the rest of the growing season. This will likely entail two mowings. The following year, the site can be mowed once in late spring. The year after that the site should be ready for a burn. After burning, more native seed can be applied if necessary.

Long-term maintenance will consist of spot-spraying and/or spot mowing weeds, and periodic burns, about every 3 to 5 years. After burning, native seed can continue to be hand-broadcast in targeted areas as needed. Canada goldenrod can become quite aggressive at sites such as this, and may form nearly monocultural stands. Mowing goldenrod in early June, when it begins to form flowers, can be an effective way to reduce it.

Priority 4: Southern dry-mesic oak (maple) woodland and Southern dry savanna – Units OW1, SV1, SV3, SV4

Restoration of these units would proceed as described for the previous OW and SV units. These units were designated as lower priority primarily to allow for manageable pieces of restoration to occur at once. They are more degraded than the priority units 1,2 and 3, but they are also located in a fairly visible area along the park entrance road. Therefore, park staff may decide to raise the priority level for these units.

The first management step will be removal of exotic brush and trees and other undesirable woody species, such as prickly ash, pine trees and other selected trees (e.g. box elder, small elm and green ash). A spring burn will follow. In SV units, herbicide may be needed to reduce the non-native grass cover, followed by broadcasting native seed. The process will be similar to the SV6 and DP8.

Long-term monitoring

Once the primary restoration tasks are completed and exotic brush is in control, the restoration process will convert to a monitoring and adaptive management phase. Long-term maintenance for the oak woodland and dry oak forest will consist of regular exotic brush management and periodic prescribed burning. Exotic brush should be treated before it is large enough to produce fruit, so a pass through the units every three years may be adequate. Prescribed burn rotations may be every 7 to 10 years. The park should be divided into multiple burn units so that no more than 50 percent of any plant community is burned in any year, unless that community type is abundant in adjacent areas.

Management of savanna areas will consist of annual monitoring and treating non-native invasive plant species and burning every 5 to 7 years. Although mowing can be used as a substitute if necessary, burning is still the optimum tool for establishing and maintaining fire-dependent communities such as prairie and savanna. Prairie management will be similar, though the burn frequency may be higher, at about 3 to 5 year intervals.

All managed and 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.

Restoration Schedule and Cost Estimates

An approximation of restoration/management tasks, priorities, and costs is provided in **Table 8,** below. This table is intended for general planning purposes only - project cost estimates are not based on actual contractor bids, but on typical costs for similar projects. Actual project costs could be significantly higher or lower, depending on multiple factors. Costs could potentially be decreased by, for example, reducing the diversity of prairie seed costs, contracting for the entire project with one contractor, using volunteers or STS (Sentence to Serve) crew for portions of the labor such as hauling brush. Some activities may also be carried out by parks staff. Specific project tasks may also change over time, as more information is learned about the property and as the site conditions change.

Table 8. Phase I Restoration Schedule and Cost Estimates

Yr	Season	Units	Activity	Ac	Cost/ac	Cost est
1	June		Set up and conduct breeding bird survey (2 surveys. Include Phase I and other areas).	82		$ 2,100.00
1	June	DP 1-4	Spot-spray butter and eggs & other targeted species	2	$ 100.00	$ 200.00
1	July	DP 1-4	Volunteer event to hand-pull knapweed & mullein	2		$ 1,400.00
1	Sept-Dec	DP 1-4; OW2; SV5,6,9; WM	Cut, treat, burn (or chip or slash) exotic trees and brush. Cut/treat prickly ash in SV5, 6, 9	45.9	$ 1,300.00	$ 59,670.00
1	Dec-Mar	SV9	Cut,treat,burn small trees in SV5, 6, 9 with snow cover	38.6	$ 1,200.00	$ 46,320.00
1		all	Ecological evaluation & monitoring			$ 1,680.00
			Year 1 subtotal			**$ 111,370.00**
2	Spring	DP 1-4	Prescribed burn	2	$ 500.00	$ 950.00
2	Spr-fall	DP8	Prescribed burn or mow, apply herbicide, fall mow, herbicide, seed	9	$ 3,000.00	$ 28,200.00
2	Spr-fall	WM	Prescribed burn or mow, then herbiicide 2-3 times, fall burn, drill seed.	3	$ 3,000.00	$ 9,000.00
2	June		Breeding bird survey (2)			$ 1,500.00
2	July	DP 1-4	Volunteer event to hand-pull knapweed & mullein	2		$ 1,400.00
2	Oct	DP 1-4; OW2; SV5,6,9; WM	Treat exotic brush repsrouts	45.9	$ 400.00	$ 18,360.00
2		all	Ecological evaluation & monitoring			$ 1,680.00
			Year 2 Subtotal			**$ 61,090.00**
3	Spring	OW2, SV5, SV6	Prescribed burn (first time)	39		$ 8,800.00
3	Spr-fall	DP8	Mow two to three times (to six inches) to enable native seed to grow.	18	$ 200.00	$ 3,600.00
3	Spr-fall	WM	Herbicide RCG in spring, mow site two to three times (to six inches) to enable native seed to grow, herbicide RCG again in fall if needed.	9	$ 350.00	$ 3,150.00
3	June		Breeding bird survey (2)	60		$ 1,500.00
3	July	DP 1-4	Volunteer event to hand-pull knapweed & mullein	2		$ 1,400.00
3		all	Ecological evaluation & monitoring			$ 1,680.00
			Year 3 Subtotal			**$ 20,130.00**

Table 8. Phase I Restoration Schedule and Cost Estimates (*continued*)

Yr	Season	Units	Activity	Ac	Cost/ac	Cost est
4	Spring	DP8	Mow once in late spring	9	$ 175.00	$ 1,575.00
4	Spring	OW2	Prescribed burn (second time)	36		$ 8,800.00
4	Spr-fall	WM	Mow site once in spring. Spot spray RCG in fall if needed.	9	$ 200.00	$ 1,800.00
4	July	DP 1-4	Volunteer event to hand-pull knapweed & mullein	2		$ 1,400.00
4	Sept-Dec	OW1, SV1,3,4	Cut, treat, burn (or chip or slash) exotic trees and brush. Cut/treat prickly ash and small trees	8.7	$ 1,000.00	$ 8,700.00
4		all	Ecological evaluation & monitoring			$ 1,680.00
			Year 4 Subtotal			**$ 23,955.00**
5	Spring	DP8	Prescribed burn	9	$ 300.00	$ 2,700.00
5	Spr	OW1, SV1,3,4	Prescribed burn	3	$ 300.00	$ 900.00
5	Spr-fall	WM	Rx burn	9	$ 350.00	$ 3,150.00
5	Spr/smr	OW1, SV1,3,4	Follow up herbicide and seeding as needed	3	$ 300.00	$ 900.00
			Year 5 subtotal			**$ 7,650.00**
			Total Phase I			**$ 224,195.00**

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- http://www.dnr.state.mn.us/invasives/index.html
- http://dnr.wi.gov/topic/Invasives/species.asp

MN Department of Natural Resources (DNR): http://www.dnr.state.mn.us/nr/index.html
South Washington County Watershed District: http://www.swwdmn.org

APPENDIX A. Plant Species Recorded At Cottage Grove Ravine Regional Park

The following plant species lists were recorded by Friends of the Mississippi River ecologists in 2012.

Southern Dry-Mesic Oak Woodland (FDs37)

Units A, J, N

				N			J			A		
Non-Native	Family	Scientific Name	Common Name	Cov*	Diam (In)	Comments	Cov*	Diam (In)	Comments	Cov*	Diam (In)	Comments
Groundcover to 4 ft			**Total cover:**	3			3			3		
		Forbs								2		
x	Brassicaceae	*Alliaria officinalis*	garlic mustard	2			2					
	Asteraceae	*Ambrosia artemisiifolia*	common ragweed	+		openings						
	Ranunculaceae	*Aquilegia canadensis*	columbine	+			+					
	Araliaceae	*Aralia nudicaulis*	wild sarsaparilla				+					
x	Asteraceae	*Arctium minus*	common burdock	+								
	Asclepiaceae	*Asclepias syriaca*	common milkweed				+		Open edge			
	Asteraceae	*Aster laevis*	Smooth Blue Aster				+		Open edge			
	Asteraceae	*Aster sp*	aster	+								
	Polypodiaceae	*Athyrium filix-femina*	lady fern							+		
x	Asteraceae	*Centaurea maculosa*	spotted knapweed				+		Open edge			
	Onagraceae	*Circaea leutetiana*	enchanter's nightshade	1						1		
	Asteraceae	*Eupatorium rugosum*	white snakeroot	1			1					
	Roseacea	*Fragaria virginiana*	wild strawberry	+								
	Rubiaceae	*Galium aparine*	cleavers	1						+		
	Rubiaceae	*Galium boreale*	northern bedstraw	+			+					
	Rubiaceae	*Galium triflorum*	sweet-scented bedstraw				1					
	Geraniaceae	*Geranium maculatum*	wild geranium	1			1					
	Roseacea	*Geum canadense*	white avens	+			+					
x	Lamiaceae	*Glechoma hederacea*	creeping charlie							+		
x	Lamiaceae	*Leonurus cardiaca*	motherwort	+			1					
	Liliaceae	*Maianthemum canadense*	false lily of the valley	1			1					
	Lamiaceae	*Monarda fistulosa*	bergamot				+		Open edge			
	Apiaceae	*Osmorhiza claytonii*	sweet cicely				1			1		
	Oxalidaceae	*Oxalis stricta*	wood sorrel				+					
	Roseaceae	*Rubus ideaus*	raspberry	1			1		Open edge	1		
	Apiaceae	*Sanicula marilandica*	black snakeroot				1					
	Liliaceae	*Smilax cf herbacea*	carrion plant	+								
	Smilacaceae	*Uvularia sessilifolia*	sessile bellwort	+								
x	Scrophulariaceae	*Verbascum thapsus*	common mullein				+					
	Bryophyte family		moss spp	2								
		Graminoids								1		
	Cyperaceae	*Carex pensylvanica*	Pennsylvania sedge	1			1			1		
	Cyperaceae	*Carex blanda*	Eastern woodland sedge							+		
		Vines and woody species										
	Aceraceae	*Acer negundo*	boxelder	1								
	Betulaceae	*Corylus americana*	American hazelnut	+								
	Oleaceae	*Fraxinus pennsylvanica*	Green ash				+					
	Betulaceae	*Ostrya virginiana*	ironwood				1					
	Vitaceae	*Parthenocissus inserta*	Virginia creeper	1			1			2		
	Populaceae	*Populus tremuloides*	quaking aspen	+			+					
	Roseaceae	*Prunus serotina*	black cherry	1			1					
	Fagaceae	*Quercus palustris*	pin oak	+			+					
	Rhamnaceae	*Rhamnus cathartica*	common buckthorn	3			2			3		
	Anarcardiaceae	*Rhus glabra*	smooth sumac				+		Open edge			
	Saxifragaceae	*Ribes cf americana*	currant	+						1		
	Tiliaceae	*Tilia americana*	American basswood	+								
	Anarcardiaceae	*Toxicodendron rydbergii*	poison ivy				+					
	Vitaceae	*Vitis riparia*	wild grape vine	1			1					
	Rutaceae	*Zanthoxylum americana*	prickly ash	1			1					

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

Southern Dry-Mesic Oak Woodland FDs37 (*continued*)
Units A, J, N

Understory/shrub layer 4-15 ft			**Total cover:**				4			4		
	Aceraceae	*Acer negundo*	boxelder				+					
	Betulaceae	*Corylus americana*	American hazelnut				+					
	Cupressaceae	*Juniperus virginiana*	red cedar	+		especially west edge	+			1		
x	Caprifoliaceae	*Lonicera tartarica*	Tartarian honeysuckle	2		mostly edges	2		edges	2		
	Pinaceae	*Pinus resinosa*	red pine							1		Planted-near road
	Populaceae	*Populus tremuloides*	quaking aspen				+					
	Roseaceae	*Prunus serotina*	black cherry	1								
	Roseaceae	*Prunus virginiana*	choke cherry	1								
	Fagaceae	*Quercus macrocarpa*	bur oak				+					
	Fagaceae	*Quercus palustris*	pin oak				1					
x	Rhamnaceae	*Rhamnus cathartica*	common buckthorn	4	1	Mostly about 6 ft tall	4			3		
	Saxifragaceae	*Ribes americana*	currant	1								
	Saxifragaceae	*Ribes cf cynosbati*	gooseberry	1								
	Ulmaceae	*Ulmus americana*	American elm	1								
	Rutaceae	*Zanthoxylum americana*	prickly ash	4		subdominant	2			2		
Subcanopy 15-30 ft height			**Total cover:**				3					
	Aceraceae	*Acer negundo*	boxelder	1			1					
	Betulaceae	*Betula papyrifera*	paper birch				+	6				
	Ulumaceae	*Celtis occidentalis*	Hackberry				+	6				
	Oleaceae	*Fraxinus pennsylvanica*	Green ash				+					
	Cupressaceae	*Juniperus virginiana*	red cedar				1		edges			
	Betulaceae	*Ostrya virginiana*	ironwood				2					
	Roseaceae	*Prunus serotina*	black cherry				1					
	Fagaceae	*Quercus palustris*	pin oak				2					
	Ulmaceae	*Ulmus americana*	American elm				1					
Canopy 30 - 100 ft height			**Total cover:**	4			4			4		
	Aceraceae	*Acer negundo*	boxelder	1			1	10	edges	1		
	Betulaceae	*Betula papyrifera*	paper birch	1	14							
	Ulumaceae	*Celtis occidentalis*	Hackberry	1						1	10	
	Oleaceae	*Fraxinus pennsylvanica*	Green ash				1	10				
	Cupressaceae	*Juniperus virginiana*	red cedar	1			1		edges			
	Populaceae	*Populus grandidentata*	big-toothed aspen				1	8				
	Populaceae	*Populus tremuloides*	quaking aspen	1	10		2	8	patches			
	Roseaceae	*Prunus serotina*	black cherry	1	26		+	10		1		
	Fagaceae	*Quercus macrocarpa*	bur oak	3	10-28	Subdominant. Mostly about 22" diam.	2	18, 24	Scattered trees, open branched	2	20	
	Fagaceae	*Quercus palustris*	pin oak	3	8-24	Dominant. One 41" diam.	3	8-24	Scattered large trees	4	8-22	Significant oak wilt. Some open branched trees. Very tall canopy
	Tiliaceae	*Tilia americana*	American basswood	1	8,10					1	12	
	Ulmaceae	*Ulmus americana*	American elm	1								

Southern Dry Sand-Gravel Prairie (UPs13)
Units L1, L2, L3, L4

			Units:	L1		L2	L3		L4	
Non-Native		Scientific Name	Common Name	Cov*	Comment	Cov*	Cov*	Comment	Cov*	Comment
Ground layer										
	Herbaceous			2		2	3		3	
x	Asteraceae	*Achillea millefolium*	yarrow	+			2			
	Asteraceae	*Ambrosia psilostachya*	western ragweed				2		2	dom
	Asteraceae	*Antennaria neglecta*	field pussytoes	+						
	Asteraceae	*Antennaria sp.*	pussytoes	+						
	Asclepiacea	*Asclepias syriaca*	common milkweed						1	
	Asclepiacea	*Asclepias verticillata*	whorled milkweed						1	
x	Asteraceae	*Centaurea maculosa*	spotted knapweed	2		+				
	Asteraceae	*Cirsium discolor*	field thistle	+						
	Equiseteaceae	*Equisetum arvense*	field horsetail				1			
	Fabaceae	*Lespedeza capitata*	round-headed bushclover	1						
x	Scrophulariaceae	*Linaria vulgaris*	butter and eggs			+				
	Boraginaceae	*Lithospermum caroliniense*	hairy puccoon				2		2	
	Lamiaceae	*Monarda fistulosa*	bergamot	+					1	
	Scrophulariaceae	*Penstemon grandiflorus*	Large-flowered penstemon			2	1		1	
	Roseaceae	*Potentilla sp*	cinquefoil	+						
	Roseaceae	*Rubus ideaus*	raspberry				1			
	Selaginellaceae	*Selaginella rupestris*	rock spike-moss	1						
	Asteraceae	*Solidago canadensis*	Canada goldenrod				1			
	Asteraceae	*Solidago nemoralis*	gray goldenrod				1		1	
x	Scrophulariaceae	*Verbascum thapsus*	common mullein	1						
	Violaceae	*Viola pedatifida*	prairie violet	+						
	Woody						**2**		**2**	
	Fabaceae	*Amorpha canescens*	leadplant				2			
	Populaceae	*Populus tremuloides*	quaking aspen						1	
	Fagaceae	*Quercus palustris*	pin oak (seedlings)				1			
x	Rhamnaceae	*Rhamnus cathartica*	common buckthorn (seedling)				+		1	
	Roseaceae	*Rosa arkansana*	prairie rose	+						
	Rutaceae	*Zanthoxylum americana*	prickly ash	1					1	
	Graminoids			**3**		**4**	**4**		**5**	
	Poaceae	*Bouteloua curtipendula*	side-oats grama	2						
	Cyperaceae	*Carex cf muhlenbergii*	muhly sedge			1			1	
	Cyperaceae	*Carex pensylvanica*	Pennsylvania sedge	3	dom in lower half				4	dom
	Poaceae	*cf Muhlenbergia richardsonis*	muhly grass			3				
	Poaceae	*Dichanthelium oligosanthes*	Scribners panic grass	1		1	1		1	
	Poaceae	*Eragrostis spectabilis*	purple lovegrass				2		2	
x	Poaceae	*Poa pratensis*	Kentucky bluegrass	+			2		2	
x	Poaceae	*Setaria viridis*	green foxtail						1	
	Poaceae	*Stipa spartea*	Porcupine Grass	2	dom in upper half	1	1		1	
Understory/shrub layer 4-10 ft				**3**		**2**	**2**		**0**	
	Cupressaceae	*Juniperus virginiana*	red cedar	2						
x	Caprifoliaceae	*Lonicera tartarica*	Tartarian honeysuckle	2		1				
x	Rhamnaceae	*Rhamnus cathartica*	Common buckthorn			1	2	Small plants in prairie, but wall around edges		
	Fagaceae	*Quercus palustris*	pin oak				1			
	Rutaceae	*Zanthoxylum americana*	prickly ash	3		2				
Canopy	**10-50 ft height**			**2**		2				
	Cupressaceae	*Juniperus virginiana*	red cedar	2		2				
	Fagaceae	*Quercus macrocarpa*	bur oak				3			

Northern Wet Meadow/Carr (WMn82)
Unit W

Non-Native	Family	Scientific Name	Common Name	Cov*	Comments
Groundcover to 4 ft					
	Herbaceous			5	
	Roseacea	*Agrimonia striata*	roadside agrimonia	1	
	Asclepiaceae	*Asclepias incarnata*	swamp milkweed	1	
	Asteraceae	*Cirsium sp.*	thistle sp.	+	
	Onagraceae	*Epilobium sp.*	willow herb	1	
	Asteraceae	*Helianthus sp*	sunflower sp	1	
	Balsaminaceae	*Impatiens capensis*	spotted jewelweed	3	dom
	Campanulaceae	*Lobelia siphilitica*	great blue lobelia	+	
	Lamiaceae	*Lycopus americanus*	water horehound	2	
x	Lythraceae	*Lythrum salicaria*	purple loosestrife	1	1 plant found and cut
	Lamiaceae	*Mentha arvensis*	common mint	1	
	Polypodiaceae	*Onoclea sensibilis*	sensitive fern	1	
	Osmundaceae	*Osmunda regalis*	royal fern	1	
	Polygonaceae	*Polygonum lapathifolium*	pale smartweed	1	
	Polygonaceae	*Polygonum sp*	pink smartweed	1	
	Lamiaceae	*Pycnanthemum virginianum*	mountain mint	2	
	Roseaceae	*Rubus ideaus*	raspberry	1	
	Polygonaceae	*Rumex sp*	species of dock		
	Asteraceae	*Solidago gigantea*	late goldenrod	1	
	Lamiaceae	*Teucrium canadense*	American germander	+	
	Polypodiaceae	*Thelypteris palustris*	marsh fern	2	
	Urticaceae	*Urtica dioica*	stinging nettle	1	
	Verbenaceae	*Verbena hastata*	blue vervain	1	
	Graminoids			2	
	Cyperaceae	*Carex sp*	sedge	3	
	Cyperaceae	Cyperus esculentus	yellow nut sedge	1	
x	Poaceae	*Phalaris arundinaceae*	reed canary grass	3	Large patch on east side. Extends around lake edge.
x	Poaceae	*Poa pratensis*	Kentucky bluegrass	3	
	Cyperaceae	*Schoenoplectus cyperinus*	woolgrass	1	
	Typhaceae	*Typha latifolia*	broad-leaved cattail	2	patch on east side
Understory/shrub layer 4-15 ft				2	
x	Caprifoliaceae	*Lonicera tartarica*	Tartarian honeysuckle	1	
x	Rhamnaceae	*Rhamnus cathartica*	common buckthorn	2	
	Caprifoliaceae	*Salix sp*	willow	+	
Canopy	**15-50 ft height**			2	
	Aceraceae	*Acer negundo*	boxelder	1	
	Cupressaceae	*Juniperus virginiana*	red cedar	2	

*Relative Cover Classes 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 At Cottage Grove Ravine Regional Park

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 (maple) woodland FDs37

Genus	Species	Common Name	Freq %
Forbs, ferns			
Amphicarpaea	*bracteata*	hog-peanut	76
Anemone	*quinquefolia*	wood anemone	40
Apocynum	*androsaemifolium*	spreading dogbane	38
Aquilegia	*canadensis*	columbine	40
Aralia	*nudicaulis*	wild sarsaparilla	60
Aster	*macrophyllus*	large-leaved aster	49
Aster	*sagittifolius*	tail-leaved aster	18
Athyrium	*filix-femina*	lady-fern	51
Circaea	*lutetiana*	enchanter's nightshade	60
Desmodium	*glutinosum*	pointed-leaved tick-trefoil	78
Galium	*triflorum*	three-flowered bedstraw	51
Geranium	*maculatum*	wild geranium	69
Maianthemum	*canadense*	Canada mayflower	73
Osmorhiza	*claytonii*	Clayton's sweet cicely	78
Osmunda	*claytoniana*	interrupted fern	20
Phryma	*leptostachya*	lopseed	60
Polygonatum	*biflorum*	giant Solomon's-seal	27
Pteridium	*aquilinum*	bracken	51
Pyrola	*elliptica*	shinleaf	20
Sanicula	*marilandica*	Mariland black snakeroot	36
Smilacina	*racemosa*	false Solomon's-seal	60
Smilacina	*stellata*	starry false solomon's	22
Thalictrum	*dioicum*	early meadow-rue	31
Trientalis	*borealis*	starflower	20
Uvularia	*sessilifolia*	pale bellwort	60
Graminioids			
Carex	*pensylvanica*	Pennsylvania sedge	84
Elymus	*hystrix*	bottlebrush grass	11
Festuca	*subverticillata*	nodding fescue	11
Oryzopsis	*asperifolia*	mountain rice grass	40
Shrubs			
Amelanchier spp		Juneberry	47
Cornus	*racemosa*	gray dogwood	67
Cornus	*rugosa*	round-leaved dogwood	16
Corylus	*americana*	American hazelnut	80
Corylus	*cornuta*	beaked hazelnut	22
Diervilla	*lonicera*	bush honeysuckle	33
Prunus	*virginiana*	chokecherry	82
Ribes	*cynosbati*	gooseberry	49
Ribes	*missouriense*	Missouri gooseberry	24
Sambucus	*racemosa*	red-berried elder	20
Symphoricarpos	*cmx*	snowberry	20
Viburnum	*rafinesquianum*	downy arrow-wood	49
Viburnum	*lentago*	nannyberry	42

Canopy Trees			
Betula	*papyrifera*	paper-birch	20
Fraxinus	*pennsylvanica*	green ash	9
Ostrya	*virginiana*	Ironwood	19
Populus	*tremuloides*	quaking aspen	27
Populus	*grandidentata*	big-tooth aspen	11
Prunus	*serotina*	black cherry	29
Quercus	*macrocarpa*	bur oak	67
Quercus	*rubra*	northern red oak	33
Quercus	*alba*	white oak	29
Quercus	*ellipsoidalis*	pin oak	60
Ulmus	*americana*	American elm	21
Additional species that belong in the plant community, but would probably not be planted at Ravine Park.			
Acer	*rubrum*	Red maple	27
Rubus	*ideaus*	red raspberry	64
Rubus	*allegheniensis*	blackberry	47
Toxicodendron	*rydbergeii*	poison ivy	67
Zanthoxylum	*americanum*	prickly ash	67

Southern Dry-Mesic Oak Forest MHs37

The species listed below were taken from the DNR Plant Community guide. The canopy species probably will not need to be planted, but were included as reference.

Genus	Species	Common Name	[3]Freq	[4]Abund	[5]Index
Forbs, ferns, graminoids					
Actaea	*rubra*	Red baneberry	60	2	120
Adiantum	*pedatum*	Maidenhair fern	40	3	120
Amphicarpaea	*bracteata*	Hog-peanut	60	4	240
Anemone	*americana*	Round-lobed hepatica	20	3	60
Apocynum	*androsaemifolium*	Spreading dogbane	20	3	60
Aquilegia	*canadensis*	Columbine	20	3	60
Aralia	*nudicaulis*	Wild sarsaparilla	60	6	360
Aralia	*racemosa*	American spikenard	40	2	80
Arisaema	*triphyllum*	Jack-in-the-pulpit	60	4	240
Aster	*sagittifolius*	Tail-leaved aster	20	3	60
Athyrium	*filix-femina*	Lady-fern	100	5	500
Botrychium	*virginianum*	Rattlesnakefern	20	5	100
Carex	*pensylvanica*	Pennsylvania sedge	40	2	80
Caulophyllum	*thalictroides*	Blue cohosh	40	3	120
Circaea	*lutetiana*	Enchanter's nightshade	80	8	640
Cryptotaenia	*canadensis*	Honewort	60	3	180
Desmodium	*glutinosum*	Pointed-leaved tick-trefoil	80	18	1440
Dioscorea	*villosa*	Wild yam	20	3	60
Galium	*triflorum*	Three-flowered bedstraw	60	3	180
Geranium	*maculatum*	Wild geranium	100	7	700
Geum	*canadense*	White avens	80	3	240
Hackelia	*spp.*	Stickseed	40	3	120
Hydrophyllum	*virginianum*	Virginia waterleaf	60	4	240
Impatiens	*spp.*	Touch-me-not	40	4	160
Maianthemum	*canadense*	Canada mayflower	60	3	180
Mitella	*diphylla*	Two-leaved miterwort	20	3	60
Osmorhiza	*claytonii*	Clayton's sweet cicely	80	10	800
Osmunda	*claytoniana*	Interrupted fern	40	5	200
Phryma	*leptostachya*	Lopseed	100	6	600
Polygonatum	*pubescens*	Hairy Solomon's-seal	20	3	60
Polygonatum	*biflorum*	Giant Solomon's-seal	40	3	120
Pteridium	*aquilinum*	Bracken	20	5	100
Sanguinaria	*canadensis*	Bloodroot	80	3	240
Sanicula	*marilandica*	Mariland black snakeroot	60	3	180
Smilacina	*racemosa*	false Solomon's-seal	80	3	240
Thalictrum	*dioicum*	Early meadow-rue	100	4	400
Uvularia	*grandiflora*	Yellow bellwort	100	3	300
Uvularia	*sessilifolia*	Pale bellwort	20	3	60
Veronicastrum	*virginicum*	Culver's root	20	3	60
Viola	*Viola sp*	Violet	60	2	120

Southern Dry Mesic Oak Forest MHs37 (continued)

Genus	Species	Common Name	[3]Freq	[4]Abund	[5]Index
Shrubs					
Cornus	*alternifolia*	Pagoda dogwood	100	6	600
Cornus	*racemosa*	Gray dogwood	20	1	20
Corylus	*americana*	American hazelnut	40	9	360
Corylus	*cornuta*	Beaked hazelnut	40	2	80
Prunus	*virginiana*	Chokecherry	60	4	240
Rosa	*blanda*	Smooth wild rose	20	1	20
Sambucus	*racemosa*	Red-berried elder	40	3	120
Symphoricarp	cmx	Snowberry	20	3	60
Viburnum	*rafinesquianum*	Downy arrow-wood	40	3	120
Viburnum	*lentago*	Nannyberry	20	1	20
Canopy Trees (>10m)					
Acer	*rubrum*	Red maple	20	88	1760
Acer	*saccharum*	Sugar maple	40	9	360
Betula	*papyrifera*	Paper-birch	20	1	20
Carpinus	*caroliniana*	Blue beech	20	3	60
Carya	*cordiformis*	Bitternut hickory	40	3	120
Celtis	*occidentalis*	Hackberry	60	2	120
Ostrya	*virginiana*	Ironwood	40	9	360
Prunus	*serotina*	Black cherry	100	9	900
Quercus	*rubra*	Northern red oak	100	31	3100
Quercus	*alba*	White oak	60	46	2760
Tilia	*americana*	Basswood	40	4	160

[3]Frequency: Number of releve plots in which species occurs divided by total number of releve plots, multiplied by 100
[4]Abundance: Average percent cover of species within the community. It is most appropriate to interpret each value as a cover class similar to those used for original data collection (see text of report for more details)
[5]Index of Commonness: Frequency multiplied by Abundance

Southern Dry Savanna (UPs14)

Species Lists taken from Terrestrial and Palustrine Native Plant Communities in East-central Minnesota (DNR 2005). Restoring a full complement of species for any type of restoration is not feasible. For savanna and prairie, the following guidelines can be used, depending on funding.

Low diversity: 20-30 species (6-8 grasses, 15-20 forbs, 1 low shrub)
Moderate diversity: 35-40 species (9-11 grasses, 25-30 forbs, 2-3 low shrubs)
High diversity: 50-60 species (12-14 grasses, 30-40 forbs, 3-4 low shrubs)

Genus	Species	Common Name	[3]Freq	Genus	Species	Common Name	[3]Freq
Forbs & low shrubs							
Physalis	*virginiana*	Ground-cherry	100	*Allium*	*stellatum*	Prairie wild onion	11
Helianthemum	*bicknellii*	Hoary frostweed	89	*Asclepias*	*tuberosa*	Butterfly-weed	11
Antennaria	*spp.*	Pussytoes	89	*Comandra*	*umbellata*	Bastard toad-flax	11
Dalea	*purpurea*	Purple prairie-clover	78	*Fragaria*	*virginiana*	Common strawberry	11
Lechea	*stricta*	Prairie pinweed	67	*Silene*	*antirrhina*	Sleepy catchfly	11
Viola	*pedatifida*	Prairie bird-foot violet	67	*Sisyrinchium*	*campestre*	Field blue-eyed grass	11
Potentilla	*arguta*	Tall cinquefoil	67	*Desmodium*	*canadense*	Canadian tick-trefoil	11
Amorpha	*canescens*	Lead-plant	56	*Thalictrum*	*dasycarpum*	Tall meadow-rue	11
Aster	*oolentangiensis*	Sky-blue aster	56	*Arabis*	*divaricarpa*	Spreading rock-cress	11
Campanula	*rotundifolia*	Harebell	56	*Penstemon*	*grandiflorus*	Large-flowered beard-tongue	11
Asclepias	*syriaca*	Common milkweed	56	*Aralia*	*nudicaulis*	Wild sarsaparilla	11
Artemisia	*ludoviciana*	Western mugwort	44	*Prenanthes*	*racemosa*	Smooth rattlesnake-root	11
Smilacina	*stellata*	Starry false Solomon's-seal	44	*Ranunculus*	*rhomboideus*	Prairie buttercup	11
Geum	*triflorum*	Prairie smoke	44	*Heuchera*	*richardsonii*	Alum-root	11
Coreopsis	*palmata*	Stiff tickseed	44	*Chrysopsis*	*villosa*	Prairie golden aster	11
Dalea	*candida*	White prairie-clover	44				
Solidago	*nemoralis*	Gray goldenrod	44	**Grasses, Rushes and Sedges**			
Liatris	*aspera*	Rough blazing star	44	*Andropogon*	*gerardii*	Big bluestem	100
Lespedeza	*capitata*	Round-headed bush-clover	44	*Carex*	*siccata*	Hay sedge	78
Aster	*ericoides*	Heath aster	44	*Eragrostis*	*spectabilis*	Purple lovegrass	78
Helianthus	*pauciflorus*	Stiff sunflower	33	*Schizachyrium*	*scoparium*	Little bluestem	78
Galium	*boreale*	Northern bedstraw	33	*Cyperus*	*lupulinus*	Hop-like cyperus	67
Aster	*sericeus*	Silky aster	33	*Koeleria*	*pyramidata*	June-grass	67
Anemone	*cylindrica*	Long-headed thimbleweed	33	*Sorghastrum*	*nutans*	Indian grass	67
Rudbeckia	*hirta*	Black-eyed Susan	33	*Sporobolus*	*heterolepis*	Prairie dropseed	67
Asclepias	*ovalifolia*	Oval-leaved milkweed	33	*Stipa*	*spartea*	Porcupine-grass	67
Arabis	*hirsuta*	Hairy rock-cress	33	*Carex*	*pensylvanica*	Pennsylvania sedge	44
Penstemon	*gracilis*	Slender beard-tongue	22	*Panicum*	*perlongum*	Long-leaved panic grass	44
Mirabilis	*hirsuta*	Hairy four-o'clock	22	*Bouteloua*	*curtipendula*	Side-oats grama	33
Solidago	*speciosa*	Showy goldenrod	22	*Elymus*	*trachycaulus*	Slender wheatgrass	33
Phlox	*pilosa*	Prairie phlox	22	*Panicum*	*lanuginosum*	Hairy panic grass	33
Delphinium	*carolinianum*	Prairie larkspur	22	*Calamovilfa*	*longifolia*	Sand reed-grass	22
Smilax	*cmx.*	Carrion-flower	22	*Panicum*	*linearifolium*	Linnear-leaved panic grass	22
Apocynum	*androsaemifolium*	Spreading dogbane	11	*Panicum*	*oligosanthes*	Few-flowered panic grass	22
Oenothera	*biennis*	Common evening-primrose	11	*Agrostis*	*hyemalis*	Rough bent-grass	11
Artemisia	*campestris*	Tall wormwood	11	*Aristida*	*basiramea*	Base-branched three-awn	11
Pedicularis	*canadensis*	Wood-betony	11	*Bouteloua*	*gracilis*	Blue grama	11
Euphorbia	*corollata*	Flowering spurge	11	*Bouteloua*	*hirsuta*	Hairy grama	11
Monarda	*fistulosa*	Wild bergamot	11	*Bromus*	*kalmii*	Kalm's brome	11
Geranium	*maculatum*	Wild geranium	11	*Calamagrostis*	*canadensis*	Bluejoint	11
Anaphalis	*margaritacea*	Pearly everlasting	11	*Carex*	*brevior*	Short sedge	11
Solidago	*missouriensis*	Missouri goldenrod	11	*Carex*	*tenera*	Marsh-straw sedge	11
Solidago	*rigida*	Stiff goldenrod	11	*Muhlenbergia*	*cuspidata*	Plains muhly	11

Southern Dry Prairie, sand-gravel subtype (UPs13b)

Genus	Species	Common Name	Freq*
Forbs			
Allium	*stellatum*	Prairie wild onion	18
Anemone	*cylindrica*	Long-headed thimbleweed	36
Anemone	*patens*	Pasque-flower	27
Antennaria	*spp.*	Pussytoes	27
Artemisia	*campestris*	Tall wormwood	45
Artemisia	*ludoviciana*	Western mugwort	18
Asclepias	*verticillata*	Whorled milkweed	18
Asclepias	*viridiflora*	Green milkweed	45
Asclepias	*syriaca*	Common milkweed	18
Asclepias	*tuberosa*	Butterfly-weed	27
Aster	*ericoides*	Heath aster	18
Aster	*sericeus*	Silky aster	45
Aster	*oblongifolius*	Aromatic aster	18
Aster	*oolentangiensis*	Sky-blue aster	27
Aster	*prenanthoides*	Crooked-stemmed aster	9
Aster	*laevis*	Smooth aster	9
Astragalus	*crassicarpus*	Buffalo-bean	27
Calylophus	*serrulata*	Toothed evening primrose	27
Campanula	*rotundifolia*	Harebell	27
Chrysopsis	*villosa*	Prairie golden aster	18
Comandra	*umbellata*	Bastard toad-flax	36
Coreopsis	*palmata*	Stiff tickseed	18
Cycloloma	*atriplicifolium*	Winged pigweed	9
Dalea	*purpurea*	Purple prairie-clover	55
Dalea	*villosa*	Silky prairie-clover	9
Dalea	*candida*	White prairie-clover	9
Delphinium	*carolinianum*	Prairie larkspur	18
Desmodium	*illinoense*	Illinois tick-trefoil	9
Euphorbia	*corollata*	Flowering spurge	18
Helianthemum	*bicknellii*	Hoary frostweed	9
Helianthus	*pauciflorus*	Stiff sunflower	36
Kuhnia	*eupatorioides*	False boneset	18
Lathyrus	*venosus*	Veiny pea	9
Lespedeza	*capitata*	Round-headed bush-clover	36
Liatris	*punctata*	Dotted blazing star	45
Liatris	*aspera*	Rough blazing star	18
Linum	*sulcatum*	Grooved yellow flax	18
Lithospermum	*caroliniense*	Hairy puccoon	27
Lithospermum	*incisum*	Narrow-leaved puccoon	27
Mirabilis	*hirsuta*	Hairy four-o'clock	45
Monarda	*fistulosa*	Wild bergamot	27
Oenothera	*biennis*	Common evening-primrose	9
Oenothera	*clelandii*	Cleland's evening-primrose	18
Onosmodium	*molle*	False gromwell	9
Oxalis	*cmx.*	Wood-sorrel	9
Pediomelum	*argophyllum*	Silvery scurf-pea	9
Pediomelum	*esculentum*	Prairie-turnip	9
Penstemon	*grandiflorus*	Large-flowered beard-	45
Penstemon	*gracilis*	Slender beard-tongue	9
Physalis	*virginiana*	Ground-cherry	36
Physalis	*heterophylla*	Clammy ground-cherry	36
Potentilla	*arguta*	Tall cinquefoil	36
Ratibida	*pinnata*	Gray-headed coneflower	9
Rudbeckia	*hirta*	Black-eyed Susan	9
Senecio	*plattensis*	Prairie ragwort	27
Silene	*antirrhina*	Sleepy catchfly	36
Solidago	*nemoralis*	Gray goldenrod	73
Solidago	*missouriensis*	Missouri goldenrod	18
Solidago	*rigida*	Stiff goldenrod	18
Solidago	*ptarmicoides*	Upland white aster	9
Solidago	*speciosa*	Showy goldenrod	9
Thalictrum	*dasycarpum*	Tall meadow-rue	9
Tradescantia	*occidentalis*	Western spiderwort	36
Verbena	*stricta*	Hoary vervain	27
Veronicastrum	*virginicum*	Culver's root	9
Viola	*pedatifida*	Prairie bird-foot violet	27
Zizia	*aptera*	Heart-leaved alexanders	9
Grasses, Rushes and Sedges			
Andropogon	*gerardii*	Big bluestem	55
Aristida	*basiramea*	Base-branched three-awn	18
Bouteloua	*curtipendula*	Side-oats grama	64
Bouteloua	*hirsuta*	Hairy grama	27
Bromus	*kalmii*	Kalm's brome	9
Calamovilfa	*longifolia*	Sand reed-grass	18
Carex	*pensylvanica*	Pennsylvania sedge	18
Carex	*tenera*	Marsh-straw sedge	9
Carex	*muhlenbergii*	Muhlenberg's sedge	9
Carex	*siccata*	Hay sedge	9
Cyperus	*schweinitzii*	Schweinitz' cyperus	27
Cyperus	*lupulinus*	Hop-like cyperus	27
Elymus	*wiegandii*	Canada wild rye	9
Elymus	*trachycaulus*	Slender wheatgrass	18
Eragrostis	*spectabilis*	Purple lovegrass	27
Koeleria	*pyramidata*	June-grass	73
Muhlenbergia	*cuspidata*	Plains muhly	27
Panicum	*perlongum*	Long-leaved panic grass	18
Panicum	*oligosanthes*	Few-flowered panic grass	45
Panicum	*wilcoxianum*	Wilcox's panic grass	27
Panicum	*virgatum*	Switchgrass	9
Panicum	*leibergii*	Leiberg's panic grass	9
Schizachyrium	*scoparium*	Little bluestem	64
Sorghastrum	*nutans*	Indian grass	36
Sporobolus	*cryptandrus*	Sand dropseed	45
Sporobolus	*heterolepis*	Prairie dropseed	45
Stipa	*spartea*	Porcupine-grass	55
Stipa	*comata*	Needle-and-thread grass	9
Shrubs			
Amorpha	*canescens*	Lead-plant	45
Artemisia	*frigida*	Prairie sagewort	18
Ceanothus	*americanus*	American New Jersey tea	9
Symphoricarpos	*sp*	Snowberry	9

Southern Mesic Prairie (UPs23)

Genus	Species	Common Name	
Forbs			
Allium	*stellatum*	Prairie wild onion	8
Allium	*canadense*	Wild garlic	8
Anemone	*cylindrica*	Long-headed thimbleweed	25
Anemone	*virginiana*	Virginia thimbleweed	8
Anemone	*canadensis*	Canada anemone	8
Antennaria	*spp.*	Pussytoes	17
Apocynum	*androsaemifolium*	Spreading dogbane	25
Artemisia	*frigida*	Prairie sagewort	8
Asclepias	*tuberosa*	Butterfly-weed	25
Asclepias	*syriaca*	Common milkweed	25
Aster	*oolentangiensis*	Sky-blue aster	67
Aster	*ericoides*	Heath aster	58
Aster	*lanceolatus*	Panicled aster	17
Aster	*novae-angliae*	New England aster	17
Aster	*laevis*	Smooth aster	8
Astragalus	*canadensis*	Canada milk-vetch	8
Campanula	*rotundifolia*	Harebell	17
Chrysopsis	*villosa*	Prairie golden aster	8
Comandra	*umbellata*	Bastard toad-flax	58
Coreopsis	*palmata*	Stiff tickseed	58
Dalea	*purpurea*	Purple prairie-clover	50
Dalea	*candida*	White prairie-clover	50
Desmodium	*canadense*	Canadian tick-trefoil	25
Euphorbia	*corollata*	Flowering spurge	8
Euthamia	*graminifolia*	Grass-leaved goldenrod	8
Fragaria	*virginiana*	Common strawberry	33
Galium	*boreale*	Northern bedstraw	42
Gentiana	*billingtonii*	Closed gentian	17
Geum	*triflorum*	Prairie smoke	8
Helenium	*autumnale*	Autumn sneezeweed	8
Helianthus	*maximiliani*	Maximilian's sunflower	17
Helianthus	*pauciflorus*	Stiff sunflower	58
Heliopsis	*helianthoides*	Ox-eye	8
Heuchera	*richardsonii*	Alum-root	17
Lathyrus	*venosus*	Veiny pea	17
Lespedeza	*capitata*	Round-headed bush-clover	42
Liatris	*aspera*	Rough blazing star	42
Liatris	*ligulistylis*	Northern plains blazing star	33
Liatris	*pycnostachya*	Gayfeather	25
Lilium	*philadelphicum*	Wood lily	17
Lobelia	*spicata*	Rough-spiked Lobelia	8
Mirabilis	*hirsuta*	Hairy four-o'clock	8
Monarda	*fistulosa*	Wild bergamot	50
Oenothera	*biennis*	Common evening-primrose	25
Pedicularis	*canadensis*	Wood-betony	17
Phlox	*pilosa*	Prairie phlox	42
Physalis	*heterophylla*	Clammy ground-cherry	17
Polygala	*polygama*	Racemed milkwort	8
Potentilla	*arguta*	Tall cinquefoil	17
Pycnanthemum	*virginianum*	Virginia mountain-mint	50
Ratibida	*pinnata*	Gray-headed coneflower	33
Rudbeckia	*hirta*	Black-eyed Susan	25
Sisyrinchium	*campestre*	Field blue-eyed grass	8

Southern Mesic Prairie (UPs23) (continued)

Genus	Species	Common Name	[3]Freq
Smilacina	*stellata*	Starry false Solomon's-seal	17
Smilacina	*racemosa*	False Solomon's-seal	8
Solidago	*nemoralis*	Gray goldenrod	25
Solidago	*missouriensis*	Missouri goldenrod	17
Solidago	*ptarmicoides*	Upland white aster	8
Solidago	*speciosa*	Showy goldenrod	8
Thalictrum	*dasycarpum*	Tall meadow-rue	25
Tradescantia	*bracteata*	Bracted spiderwort	8
Veronicastrum	*virginicum*	Culver's root	58
Vicia	*americana*	American vetch	8
Viola	*pedatifida*	Prairie bird-foot violet	33
Zizia	*aurea*	Golden alexanders	25
Artemisia	*campestris*	Tall wormwood	17
Shrubs			
Amorpha	*canescens*	Lead-plant	58
Amorpha	*nana*	Fragrant false indigo	8
Prunus	*virginiana*	Chokecherry	8
Rhus	*typhina*	Staghorn sumac	8
Rosa	*arkansana*	Prairie rose	58
Rosa	cmx.	Smooth wild rose	8
Salix	*humilis*	Prairie willow	8
Symphoricarpos	cmx.	Snowberry	25
Grasses, Rushes and Sedges			
Andropogon	*gerardii*	Big bluestem	100
Bromus	*kalmii*	Kalm's brome	25
Carex	*bicknellii*	Bicknell's sedge	33
Carex	*muhlenbergii*	Muhlenberg's sedge	8
Carex	*meadii*	Mead's sedge	17
Carex	*tenera*	Marsh-straw sedge	17
Elymus	*wiegandii*	Canada wild rye	25
Elymus	*trachycaulus*	Slender wheatgrass	8
Eragrostis	*spectabilis*	Purple lovegrass	8
Muhlenbergia	*mexicana*	Mexican satin-grass	8
Panicum	*oligosanthes*	Few-flowered panic grass	33
Panicum	*virgatum*	Switchgrass	17
Panicum	*perlongum*	Long-leaved panic grass	8
Schizachyrium	*scoparium*	Little bluestem	33
Sorghastrum	*nutans*	Indian grass	100
Sporobolus	*heterolepis*	Prairie dropseed	42
Stipa	*spartea*	Porcupine-grass	33

Northern Wet Meadow-Carr (WMn82)

Genus	Species	Common Name	Freq %
Shrubs			
Alnus	*incana*	Speckled alder	24
Betula	*pumila*	Bog-birch	14
Cornus	*sericea*	Red-osier dogwood	24
Salix	*bebbiana*	Bebb's willow	20
Salix	*discolor*	Pussy willow	29
Salix	*petiolaris*	Slender willow	42
Spiraea	*alba*	Meadowsweet	23
Forbs, ferns and fern allies			
Acorus	*calamus*	Sweet flag	11
Asclepias	*incarnata*	Swamp milkweed	22
Aster	*borealis*	Bog aster	12
Aster	*puniceus*	Red-stemmed aster	19
Bidens	*spp.*	Beggar-ticks	21
Caltha	*palustris*	Swamp marsh-marigold	17
Campanula	*aparinoides*	Marsh bellflower	58
Cicuta	*bulbifera*	Bulb-bearing water-hemlock	46
Dryopteris	*cristata*	crested fern	24
Epilobium	sp	Willow-herb	44
Eupatorium	*maculatum*	Spotted Joe-pye weed	34
Eupatorium	*perfoliatum*	Common boneset	11
Galium	*trifidum*	Three-cleft bedstraw	46
Impatiens	*spp.*	Touch-me-not	39
Iris	*versicolor*	Northern blue Flag	22
Lathyrus	*palustris*	Marsh vetchling	17
Lycopus	*americanus*	Cut-leaved bugleweed	17
Lycopus	*uniflorus*	Northern bugleweed	45
Lysimachia	*thyrsiflora*	Tufted loosestrife	59
Mentha	*arvensis*	Common mint*	19
Onoclea	*sensibilis*	Sensitive fern	20
Polygonum	*amphibium*	Water smartweed	42
Polygonum	*sagittatum*	Arrow-leaved tearthumb	28
Potentilla	*palustris*	Marsh cinquefoil	38
Rubus	*pubescens*	Dwarf raspberry	11
Rumex	*orbiculatus*	Great water dock	52
Sagittaria	*lateriflora*	Broad-leaved arrowhead	22
Scutellaria	*galericulata*	Marsh skullcap	53
Scutellaria	*lateriflora*	Mad-dog skullcap	12
Thelypteris	*palustris*	Northern marsh-fern	40
Triadenum	*fraseri*	Marsh St. John's wort	23
Viola	sp	Big-leaf violet	12
Grasses, Rushes and Sedges			
Bromus	*ciliatus*	Fringed brome	
Calamagrostis	*canadensis*	Bluejoint	80
Carex	*aquatilis*	Water sedge	11
Carex	*lacustris*	Lake-sedge	72
Carex	*lasiocarpa*	Wire-sedge	29
Carex	*stricta*	Tusssock-sedge	41
Carex	*utriculata*	Beaked sedge	33
Scirpus	*cyperinus*	Wool-grass	22

APPENDIX C. Methods For Controlling Exotic, Invasive Plant Species

TREES AND SHRUBS

Common buckthorn (*Rhamus cathartica*), Tartarian honeysuckle (*Lonicera tartarica*), Siberian elm (*Ulmus pumila*), and black locust (*Robinia pseudoacacia*) 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. Prickly ash is a very common native shrub that can become excessively abundant, especially in areas that have been disturbed or grazed. Complete eradication may not be necessary, but management may target reducing the extent of a population. Removal is most easily accomplished in the same manner as for buckthorn – cutting shrubs and treating cut stumps with glyphosate herbicide. Cutting can be completed at any time of the year.

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 a 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 sapflow, 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. The best way to deal with seedlings is fire. When that is not feasible or not totally effective, herbicide can be applied to the foliage of the 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. Roundup (glyphosate), Garlon (triclopyr), 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. Glyphoste is non-specific and will kill anything green, while

triclopyr targets broadleaf plants and does not harm graminoids. Extreme caution with Garlon should be used, because the surfactants added that allow it to penetrate bark also seep into the soil and kill many plants within a radius of the treated plant. For this reason, a wick application may be a better application method than broadcast spraying, depending on what the groundcover composition is.

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 a 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.

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.

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. In both cases the dirt must be shaken off the stems after removal. The disadvantage to both methods is that they are very slow and labor intensive, and create a great deal of soil disturbance, especially weed wrenches. They 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 or where the invasive shrubs are not very abundant and are fairly small.

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 may die within three years, with two cuttings per year. This method is also very labor intensive and costly and depends on a very consistent effort. The success rate varies depending on the size of the plant.

Stems, Seedlings and Resprouts

Prescribed burning is the most efficient, cost effective, and least harmful way to control very seedlings 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. Disadvantages to burning are that fire coverage is inconsistent over the site and there will be areas that are missed. Fires are typically “cool” in order to be conducted safely, so that even very small stems sometimes survive and resprout. Burning alone may reduce saplings plants, but only if burns are repeated annually for several consecutive years (which will likely also reduce native shrubs). Even then, the level of control is only moderate. Burning is best combined with chemical treatment for greatest effectiveness.

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

Birdsfoot trefoil (Lotus corniculatus)
Birdsfoot trefoil forms dense mats that choke out most other vegetation. It is especially problematic in prairies and disturbed open areas. Prescribed burns increase seed germination making it difficult to manage in native prairies.

Mechanical control alone is not very effective at reducing this species, especially if desirable plants are nearby as they will be impacted as well. More effective is a combination of mowing or burning and chemical application. A 1-2% solution of glyphosate can be spot-sprayed (or broadcast) in the spring when the plant is fully leafed out. Glyphosate is a broad spectrum herbicide, so to avoid damage to grasses, a broadleaf herbicide can be used. The most effective is aminopyralid (e.g. Milestone). (Note that aminopyralid herbicides also affects native plants of the sunflower and pea families).

Spotted knapweed (Centaurea maculosa)
This is a very aggressive invasive species that is difficult to control. It is a biennial or short-lived perennial plant with very prolific seed production and allelopathic compounds in the roots that prevent other species from growing nearby. Control of small populations, especially if growing in a native prairie where chemical used is undesirable, can be achieved by hand-pulling. All flowering plants must be pulled every year for about five years.

Small stands can also be eradicated by using herbicide. While the picloram herbicides are generally considered the most effective for knapweed, they have a long soil residual and we prefer to avoid them. Glyphosate is considered to have less harmful environmental impacts than most other herbicides. We have found a 2-5% glyphosate solution applied to basal rosettes to be very effective. The optimal season is fall when plants are moving resources to the roots, and it can be done in late fall when most natives are dormant. The fall spray can be preceded by a late June mowing, to reduce flowering and seeding of second-year plants. Herbicide can also be used on basal rosettes after a spring burn. However, solid stands of knapweed do not carry a fire very well and the dead vegetation may not get burned off. Burning does not otherwise control knapweed.

In areas where knapweed is very abundant and/or covers large areas, biological control is likely the best option. Knapweed root weevils (*Cyphocleonus achates*) are the "king" of knapweed control. Knapweed seedhead weevils (*Larinus minutus/obtusus*) are also helpful. Results from biological control typically take 4-6 years to see. The knapweed will not be eradicated, but will be reduced to more natural levels so that native species diversity is not impeded.

GRASSES

Reed canary grass *(Phalaris arundinacea)*

This species is extremely difficult to eradicate and requires repeated treatment over a period of one to three years. A combination of burning, chemical treatment and mowing can be used, in accessible areas, or chemical treatment alone in inaccessible areas. The combination method starts by burning in late spring to remove dead vegetation and to stimulate new growth. When new sprouts have reached a height of 4 to 6 inches, the site can be sprayed with a 5% solution of a glyphosate herbicide appropriate for wetland habitat (e.g. Rodeo). The site is then mowed in late summer, followed by chemical application after re-growth. This treatment will stimulate new growth and germination to deplete the seed bank. The sequence of chemical treatment and mowing are repeated for at least a second season, and possibly a third until the grass is completely eradicated. Then native grass and forb seed can be broadcast or drilled.

If reed canary is eradicated from an area, future management of the grassland, namely burning, will likely keep the reed canary in check. Monitoring and mapping new individuals or clumps should continue, however, and be treated if burning is not adequate. If the plants are small they can be removed by digging out the entire root. Generally though, chemical treatment is more feasible. If plants are clumped, they can be treated by tying them together, cutting the blades, and treat the cut surface with herbicide. Otherwise herbicide should only be applied in native planted areas on very calm days to avoid drift to non-target plants.

Smooth brome *(Bromus inermis)*

Smooth brome and most other non-native grasses are often controlled effectively by burning. Timing is important – a late spring burn (e.g. mid-May) will target the brome when it is tillering (producing shoots) and most vulnerable. The late spring burn also warms the ground and gives native grasses a boost at the time when they are ready to emerge from the ground. Within a few weeks, summer conditions will be most favorable for the native warm-season grasses, and further detrimental to cool season grasses (brome).

Burning may be adequate to reduce brome, especially if repeated two years in a row. However, in some cases additional chemical control is necessary. After a late spring burn, one or two follow-up treatments with a glyphosate herbicide such as Roundup will eliminate most of the brome. The area could then be seeded with native species. On-going management of the restored site, including prescribed burning, mowing, and spot treatment, should be adequate to keep any new brome plant populations in check. Annual monitoring should document the extent of brome patches.

APPENDIX D. General Restoration Strategies And Considerations For Oak Savannas In The Midwest

By Claudia Naninga

There are several ways in which oak savannas in the Midwest can be restored. The longer the savanna has faced fire-suppression, grazing and other stresses the more intensive the restoration efforts that are needed. If an alternate stable state has been reached, several methods have to be combined for an extended amount of time. For example, it might be impossible to get rid of encroached woody species as long as there is not the right understory fuel availability to create large enough fires. Or removing the woody invasive species might not lead to the expected results as after removal of mesophytic species, other mesophytic instead of the required savanna species encroach the site again (Brudvig *et al.* 2007).

The main goals of restoration are the reduction of the overstory tree density and the promotion of oak dominance (Brudvig *et al.* 2011). Specifically this includes the creation of a natural savanna age structure and canopy composition, the reduction of exotics species, and the creation of refugia for oaks and oak-dependent species (Wolf 2006).

A number of restoration approaches have been used in the past: In some cases it might be enough to re-introduce the main natural disturbance, which in case of oak savannas is fire. This approach assumes that the system is already within its natural range of variability and that the re-introduction of a natural disturbance is enough to restore the original system (Nielsen et al. 2003). In other cases the initial removal of selected trees followed by the re-introduction of fire, sometimes referred to as the 'structural manipulation approach', might be necessary. This approach is based on the idea that the reintroduction of a more natural structure before the use of fire will assist the recovery of dynamics much faster and more efficiently than the mere use of the disturbance (Nielsen et al. 2003). It is especially useful if there have been major structural changes, such as canopy closure and the development of a midstory canopy layer (Brudvig *et al.* 2007).

Generally, the use of just one method can be short-sided. For example, Abella *et al.* (2004) and Nielsen *et al.* (2003) were unable to find a change in understory diversity and richness after using fire only. When using the structural manipulation approach, on the other hand, Nielsen *et al.* (2003) achieved increases in species richness. Brudvig *et al.* (2007) did a study in which they didn't use fire and purely removed encroaching species in a savanna. They never got past a threshold and mesophytic species were the dominant invaders after 3 years, while oak was largely unaffected by the treatment. Also shrub-densities returned to pre-treatment levels. They concluded that repeated treatments in combination with fire might be more efficient.

Structural manipulation approach

The first step of regenerating an oak savanna when using the structural manipulation approach is the removal of invasive shrubby species and encroaching trees to create a structure that more resembles a natural system. For example Brudvig (2007) recommends the reduction of the basal area to 30%, the creation of a canopy cover that covers up to 50% of the site, and the removal of all non-oak woody stems that are larger than 150 cm in size. Treatments should be organized during the winter months when the soil is frozen to reduce negative impacts. There are several ways of removing trees and shrubs, including manual, chain saws, brush cutters. In many cases, especially for exotic invasive species, the use of herbicides will be necessary (Maloney 1997).

After the removal of encroaching exotic species and tree species, fires should be re-introduced. Because of their thick bark and ability to resprout after topkill, most oak species are naturally adapted to fire and fires have been an essential disturbance that keeps savannas from developing into woodland (Wolf 2006). The specific effect of fire in degraded savannas is the reduction of invasive grasses and woody species and to sustain higher levels of habitat and species diversity (Wolf 2004). But fires don't always yield the expected result as all plant species that are part of a savanna respond to fire in an individualistic manner. For example, in study in Minnesota, Tester (1996) found that true prairie grasses and forbs generally were positively related to burn frequency, but that also some introduced grasses, e.g. *Poa pratensis* (C3) and *Setaria lutescens* (C4), reacted to the disturbance with increased growth. On the other hand, *Agropyron repens* (C3) and *Bromus inermis* (C3) and six of seven native non-savanna species that are associated with forests showed decreased growth after fire. This study shows how important it is to understand the response of species to fire.

Knowledge about fire frequency and intensity is also essential. Taking natural fire regimes in a savanna as a reference, the frequency of low-intensity fires was every 4 or 8 years for bur oak or white oak dominated savannas respectively. So even oak trees, whose germination is supported by fires, need fire-free periods for seedlings and saplings to successfully develop (Wolf 2006). Extreme fires, on the other hand, occurred much less frequently, only around every 35-100 years (Apfelbaum *et al.* 1991). There is a range of recommendations concerning the use of prescribed fires in the literature. Generally, fire frequencies that are either too high or too low can shift resource availability and alter species dominance. Some sources say that low-intensity prescribed fires should be used annually or at least every other year (Maloney 1997, Apfelbaum *et al.* 1991). Others say that rather than that, high-intensity fires should be used, because low-intensity fires are not likely to result in the mortality of large overstory stems. Additionally, frequent low-intensity fires have the potential to destroy seed-banks and endangered savanna species (Nielsen *et al.* 2003, Packard 1997), increase the likelihood of invasive species infestation, change resource availability, and prevent the growth of oak seedlings large enough to survive future fires (Wolf 2006).

In many savannas it is necessary to seed and/or plant the site, especially if no viable seed bank is available and no remnants are close enough for seeds to reach the area. It is possible to either collect seeds from functional remnant savanna sites or order them. After the soil type has been determined, a seed mix should be used that is suitable for the microhabitat. The seeds can be applied by broadcasting or with a native seed drill (Maloney 1997). A good time for seeding is spring or fall, after the seeds have ripened (Packard 1997). Several native plant lists for the Midwest are available: Wolf (2004), Maloney (1997), Tester (1996), Brudvig (2008), Packard (1997). After initial treatment it is necessary to monitor the site for some years, continue removing invasive species and potentially interseed. After that, it might be sufficient to regularly burn the site (Maloney 1997).

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APPENDIX E. Ecological Contractors

Following is a list of contractors to consider for implementing the management plans. While this is not an exhaustive list, it does include firms with ecologists who are knowledgeable about natural resource management. Unless otherwise noted, all firms do prescribed burning. Many other brush removal companies are listed in the yellow pages (under tree care), but most do not have knowledge or understanding of native plant communities. We recommend hiring firms that can provide ecological expertise. Additional firm listings can be found on the DNR website: http://www.dnr.state.mn.us/gardens/nativeplants/index.html

Friends of the Mississippi River (FMR) has extensive experience working with landowners to implement natural resource management plans. FMR can assist Washington County Parks staff by obtaining funding for restoration and management projects; providing project management, including contractor negotiations, coordinating restoration and management work, site monitoring and evaluation; and by coordinating and hosting community volunteer events.

Applied Ecological Services, Inc.
21938 Mushtown Rd
Prior Lake, MN 55372
952-447-1919
www.appliedeco.com

Conservation Corps Minnesota
2715 Upper Afton Road, Suite 100
Maplewood, MN 55119
(651) 209-9900

Great River Greening
35 West Water St, Suite 201
St. Paul, MN 55107
651-665-9500
www.greatrivergreening.org

Minnesota Native Landscapes, L.L.C.
14088 Highway 95 N.E.
Foley, MN 56329
(320) 968-4222 Phone
www.mnnativelandscapes.com

Natural Resources Restoration Inc
2013 Walnut St NW
New Brighton, MN 55112
651-636-3462

Prairie Restorations, Inc.
PO Box 305
Cannon Falls, MN 55009
507-663-1091
www.prairieresto.com

Stantec Inc
2335 West Highway 36
St. Paul, MN 55113
651-604-4812
www.stantec.com

Wetland Habitat Restorations Inc
1397 Chelmsford St
St. Paul, MN 55108
612-385-9105