Westwood Hills Nature Center
Natural Resource Management Plan

Great River Greening
December 2017

GREAT RIVER GREENING
RESTORING LAND, WATER AND WONDER

Executive Summary

This natural resources management plan (NRMP) is for Westwood Hills Nature Center (WHNC) located in St. Louis Park, MN. The nature center is owned and operated by the City of St. Louis Park and encompasses 160 acres. The purpose of this document is to identify the most appropriate opportunities for restoring and managing the habitats/ecosystems at Westwood Hills Nature Center. The NRMP also provides the city of St. Louis Park and WHNC staff guidance for implementing the enhancement of Westwood Hills Nature Center plant communities.

The goals and recommendations in the NRMP are based on a review of background information gathered from online resources developed by various state agencies as well as an on-the-ground assessment of the current status of each of the management units identified within the nature center. A desk review of the property included review of aerial photography, site history of WHNC, soils, topography, surficial geology, and Minnesota Land Cover Classification System (MLCCS) data. The field review included evaluation of species composition of plant communities, invasive species distribution and abundance, and ecological restoration opportunities. The NRMP describes site conditions, key ecological features, management goals, and a framework to manage natural resources. The management plan also identifies opportunities to engage volunteers in the implementation and management of the native habitat.

The highest quality plant communities of WHNC are the oak forest (17.4 acres) on the terminal moraine just north of the visitor center and the oak savanna (3.0 acres) along the entry drive. Although ranked as the highest quality plant communities on the site, both the oak forest and the oak savanna are still only considered of moderate ecological quality. A small stand of oak forest (1.9 acres) on the west side of Westwood Lake was deemed poor quality. The quality of other plant communities on the site were ranked as altered, with no natives present. This NRMP finds that a ranking of “altered, no natives present” is a more grim view than the reality for most of these plant community assemblages. There are native species present in each of the MLCCS units with this ranking. The ground layer is typically more degraded than the canopy layer in many of the units.

Management objectives are to enhance the diversity and resilience of the plant communities at WHNC to increase their value as both wildlife habitat and to enhance their utility as outdoor classrooms in which to present the broad array of nature-based programs offered by staff of the nature center.

Management strategies will include control of invasive species through mechanical means, herbicide application, and prescribed burns where applicable. Seeding and planting of native trees, shrubs, and herbaceous species will occur where necessary to replace invasive species.

Restoration Targets

Although several elements of the site assessment point to oak savanna, upland prairie, and wet prairie as historic plant communities in the area around WHNC prior to European settlement, it does not seem prudent or sustainable to attempt to return the plant communities of WHNC to that historic state. The restoration targets for WHNC will be guided by existing vegetation, soils, topography, as well as by management constraints imposed due to the location of WHNC in the midst of a densely built up urban area. The disturbance factors inherent with WHNC's location in a large metropolitan area are at play and have caused varying levels of degradation and invasion by invasive species. Plant communities typical of the area at the time of European settlement have been altered due to development, suppression of natural disturbance regimes (fire), alteration of the hydrologic regime, the introduction of introduced, invasive species, and likely the over-population of native whitetail deer and wild turkeys. Using the historic conditions as models for moving forward with the restoration of future plant communities may not be desirable given the likelihood of ongoing disturbance and limitations to implementing appropriate disturbance regimes (prescribed burns) as needed in the future to maintain a given plant community. The restoration effort should instead target as outcomes, plant communities that are diverse (when that is a reasonable outcome), resilient, and sustainable. These plant communities should also contribute to the mission of the nature center to engage and educate the public about the natural world around us.

Long-term Management

Before committing to a restoration project, each organization should assess its capacity to not only implement a restoration project, but also its capacity to sustain the restoration over time.
The restoration actions taken in each management unit during the initial funding phase should be considered the beginning of a long-term commitment to manage the resource. Some of the disturbances impacting a given site may be ongoing and intractable, and persistent timely effort will be required to transition a habitat from a plant community dominated by invasive species to a more diverse and ecologically functional plant community. At WHNC, implementation of native habitat restoration will be ongoing over a period of a few years, and management of the restored plant communities will require a further long term commitment from city and nature center staff. It is clear that the initial efforts to remove invasive species from a site will have been in vain if resources for ongoing management are not committed for the long term.

Funding

The restoration of habitats at WHNC has many elements that are compelling for funders, including its long-standing stature as a venue for high quality environmental programming, its reputation as a birdwatching hotspot, and its significance as a green space within a heavily developed inner ring suburb. The restoration can be broken down into discreet work units in which needed restoration actions are part of a cohesive plan required to restore the plant community specific to each unit. Estimated costs can be determined for each restoration action in each unit.

Acknowledgements

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Site Description

The City of St. Louis Park began acquiring the land for WHNC in 1959. Beginning in the 1960s, it was used as a day camp, and it was not until 1981 that the Interpretive Center was occupied. The north side of the site is bordered by Wayzata Blvd, a frontage road along Interstate 394, which accesses a mix of commercial and residential properties (Figure 1). On the remaining three sides, WHNC is bordered by local streets and residential properties. There are no significant natural areas in the surrounding communities to which greenway corridors could connect, however the site itself is significant for its role in providing a refuge for wildlife and a place for respite and experiential learning for the residents of St. Louis Park and beyond. The WHNC site is comprised of a mosaic of plant community types covering 160 acres. Within the site, upland and wetland habitats surrounding Westwood Lake are connected by a system of trails and boardwalks that facilitate easy access to the diverse natural resources. Westwood Lake and the marsh surrounding the lake cover nearly 45% of the nature center property. The remaining 55% of the property consists of degraded upland or seasonally wet habitats, which will be the focus of restoration efforts.

Project Area Location

Westwood Hills Nature Center (WHNC) is located at 8300 W. Franklin Ave; St. Louis Park, Hennepin County Minnesota. Located in Section 6, Range 21, Township 117.
Latitude: 44.966631 Longitude: -93.386954

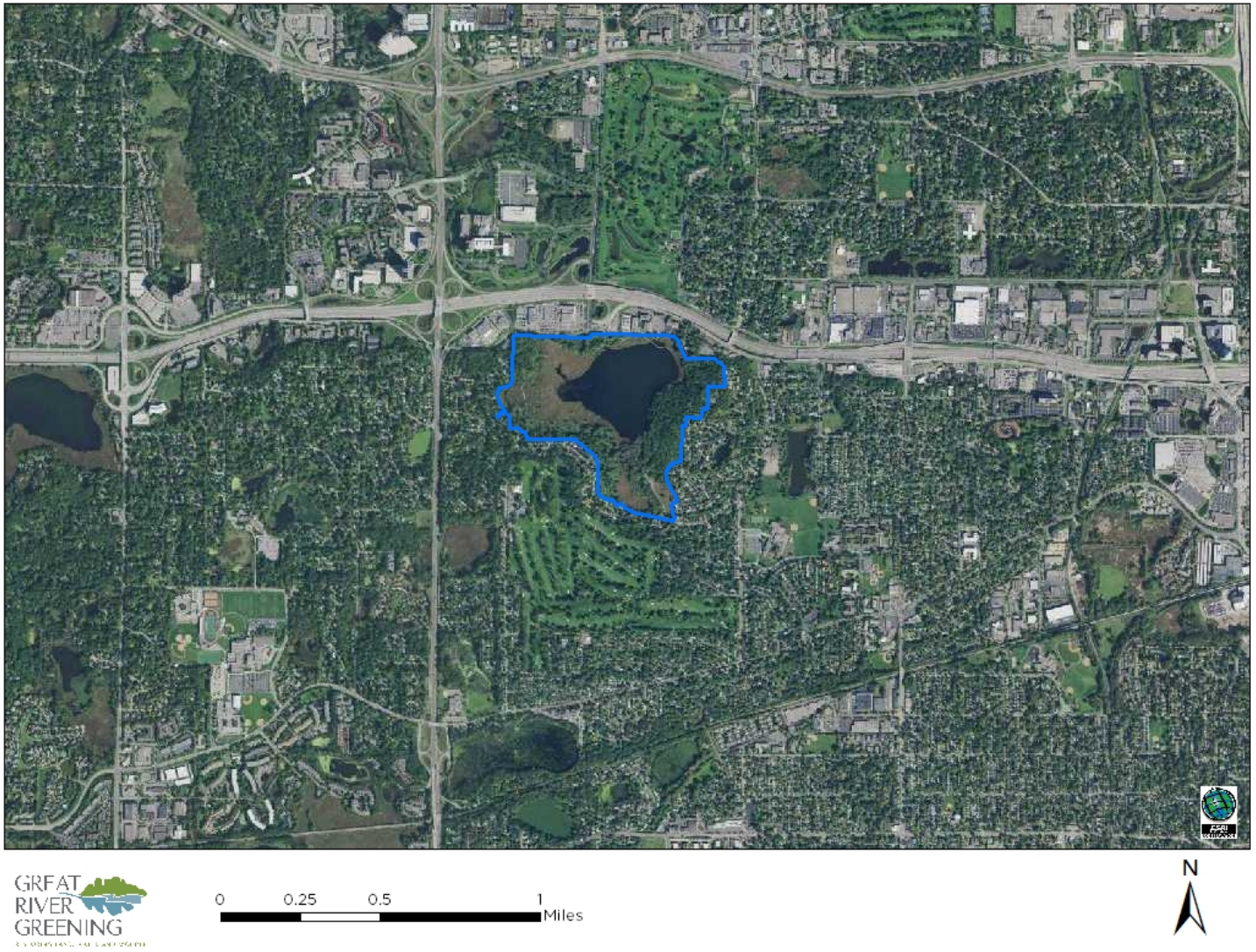
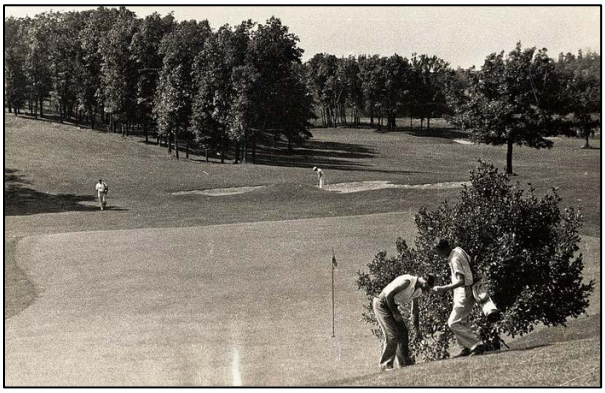


Figure 1. Westwood Hills Nature Center in the context of the current surrounding urban development.

History

In 1890 Thomas Barlow Walker, a local business man and his colleagues, began purchasing land in the area of St. Louis Park for a business development intended to attract new manufacturing industry to Minneapolis. The land in the area of St. Louis Park at that time was being used primarily for truck farming and dairy production. A Minneapolis Alderman accused the developers of attracting businesses by promoting the resources of the City of Minneapolis, but then building the new factories "into the country several miles". In October 1892, several Minneapolis businessmen were invited by the developers to visit the Park to inspect the new factories. Reporters interviewed some of the businessmen for their reactions. One guest stated, "Yesterday was the first time I have been in that country for seven years, and I was greatly surprised to see what was an open prairie in 1885 transformed into a modern city". A Mr. Egan responded, "I platted this section of the country only a little over a year ago, and where I saw bald prairie now there are over 100 houses".



Westwood Hills Golf Course being used in the early 1900s (top) and the early construction of the interpretative building in the 1980s

Nearby this early manufacturing development, Minnesota's first 27-hole golf course was developed in the vicinity of WHNC. Westwood Hills Golf Course opened for play in 1928. Golfer John Hubbell recalled that the course was fun, but noted that there was a lot of peat and that the course could be "kind of bouncy". Both a 1937 and a 1956 aerial photograph show Westwood Lake drained. Areas that are now marsh were fairways. In the mid-1950s when the golf course was no longer profitable, the owners began to develop the land, selling off lots, and building houses in the area. In 1957, when 400-500 homes were proposed to be built on 117 acres, a group of citizens formed the "Save the Green" committee with the intent to stop the residential development. The City of St. Louis Park acquired 90 acres of land in 1958 from Westwood Hills Golf Course. Thirty acres of this purchase was used to build the Westwood Junior High School. In 1959 during construction of some houses, a section of the drain tile that was keeping the Westwood Lake basin drained was broken. The lake began to fill and over the next year, trees began to die around the perimeter of the lake. In 1971, the city began to explore the development of a nature center. A decade later, in 1981, the Westwood Hills Nature Center's Interpretive Center Building was opened. Today, the nature center hosts thousands of youth and families in a suite of seasonal interpretive programs that take advantage of the natural wealth of Westwood Hills Nature Center. The mosaic of habitats host a variety of song birds, pileated woodpeckers, whitetail deer, fox, mink, cottontail rabbits, coyotes, wild turkeys, hawks, waterfowl, and owls.

Geology

Paleozoic sedimentary rocks underlie the landscape in the Twin Cities metropolitan area (Figure 2). The major rock types are sandstone, shale, limestone, and dolomite, relicts of a historic sea that once covered the region. The Platteville-Glenwood Formation underlies the high ground to the east of the site and St. Peter Sandstone underlies the lower areas to the west.

Hennepin County was completely covered by ice sheets. The landscape of the county is very young, with the most recent glaciers that arrived about 25,000 years ago having impacted its development. The historic bedrock surface influenced the way in which the glaciers and their associated meltwater streams shaped the landforms as they either planed or cut the bedrock respectively. These glaciers gave the region its current topographic character.

In the Twin Cities area, the Des Moines lobe, with drift generated from shale and limestone, advanced from the west and over-rode the drift contributed from the Superior Lobe that had advanced from the north where its sediments were derived from the Lake Superior region. The meltwater streams of the retreating glaciers deposited sand and gravel. The result were layers of different tills and a topography defined by both glaciers. Depth to bedrock varies in the vicinity of Westwood Hills Nature Center from 51-100 feet in much of the western portion, from 101-150 feet to the east, and from 151-200 feet to the north.

Winter view of the Y Dock and Interpretive Center, as well as the terminal moraine that dominates the east side of the Westwood Hills Nature Center property.

The WHNC's Brick House, which is sited just outside the perimeter fence on the north-east side of the property, sits on a terminal moraine. At 114 feet above Westwood Lake, the terminal moraine is one of the highest points in St. Louis Park. The lakes and bogs of Hennepin County occur in depressions left by the melting of ice buried under sediments or were created by the collapse and settling of glacial outwash. The origin of soils in these depressions is chiefly from organic material and coprogenic material.

The geologic origin of the soils on the slopes of WHNC are outwash deposits of sand, silty sand and gravel, overlain by a veneer of clay loam or silt. The outwash was laid down by meltwater streams originating from western Hennepin County and southern Anoka County. In St. Louis Park, outwash originating from the Grantsburg sub-lobe was an important source of gravel due to its being shale-poor, as opposed to the poorer quality shale-rich outwash originating from the Des Moines lobe deposits to the west. Thus, high grade sand and gravel deposits occur in several locations in St. Louis Park and several excavation sites were developed in the area. At the end of WWII there were eight gravel mines in operation in the city of St. Louis Park, some of which were still in operation into the 1960's before the resource was depleted and the land given over for other forms of development. The gravel excavated from the local pits was used for construction and road work in Minneapolis and the surrounding area.

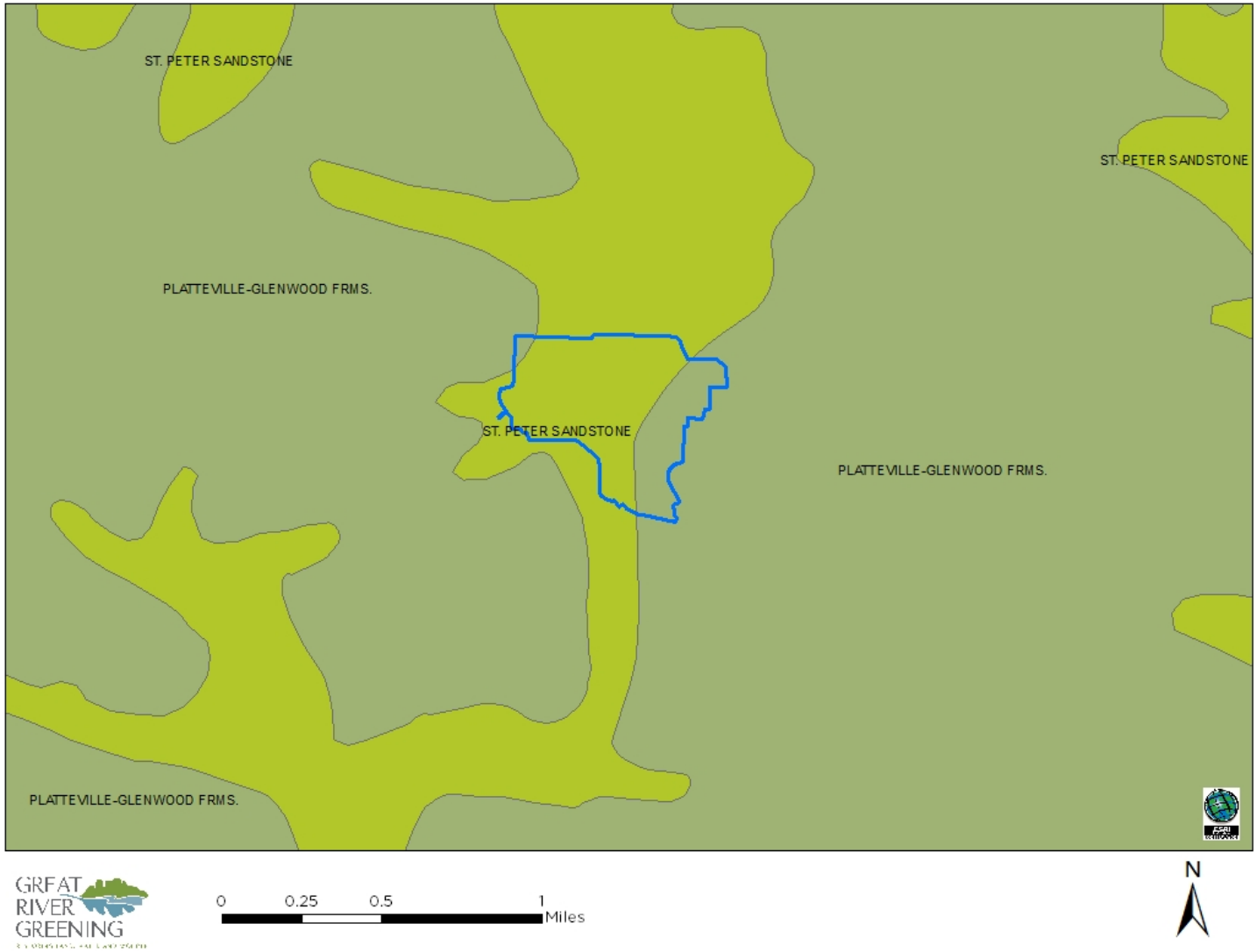


Figure 2. Bedrock formations of Westwood Hills Nature Center and the surrounding area.

Soils

The soils throughout much of WHNC do not appear to be accurately delineated in the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) online soil resource, the Web Soil Survey. Each of the soil map units occurring within the boundaries of the WHNC are either wetland soils or disturbed urban soil complexes (Figure 3 and Table 1). The polygon representing the largest soil map unit within the WHNC defines the Houghton and Muskego soils map unit and encompasses low elevation wetland areas typical for the development of these wetland soils. However, this soil map unit also erroneously encompasses the forested upland areas on the terminal moraine on the east side of Westwood Lake. Given the past land use history of the site, Udorthents or Urban land-Udorthents may be a more accurate classification for soils throughout much of the upland areas of the site. Udorthents soil map units typically represent soils that have experienced cut and fill or some other anthropogenic disturbance. Some of the soil map units on adjoining properties may be more representative of the historic soils on this site prior to development, and they have been included in the soils summary for context. The soil map units documented in the surrounding area allude to the historic upland vegetation of the site (Figure 4). All of the upland soils within a narrow radius of the WHNC developed under upland savanna plant communities. Most of the upland soil map units have a natural drainage class of well-drained and no soil map units are hydric soils.

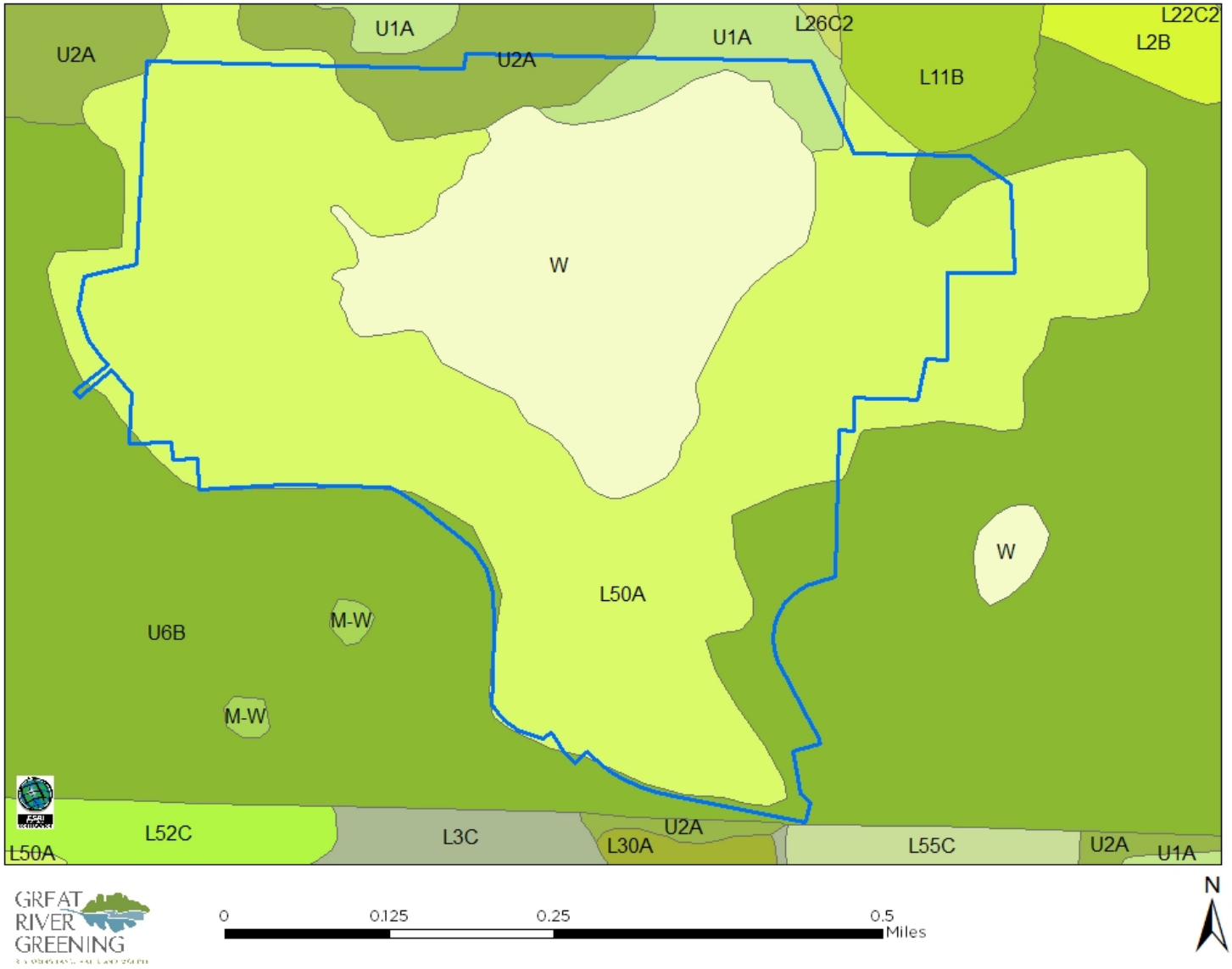


Figure 3. USDA NRCS soil map units of Westwood Hills Nature Center and immediate vicinity.

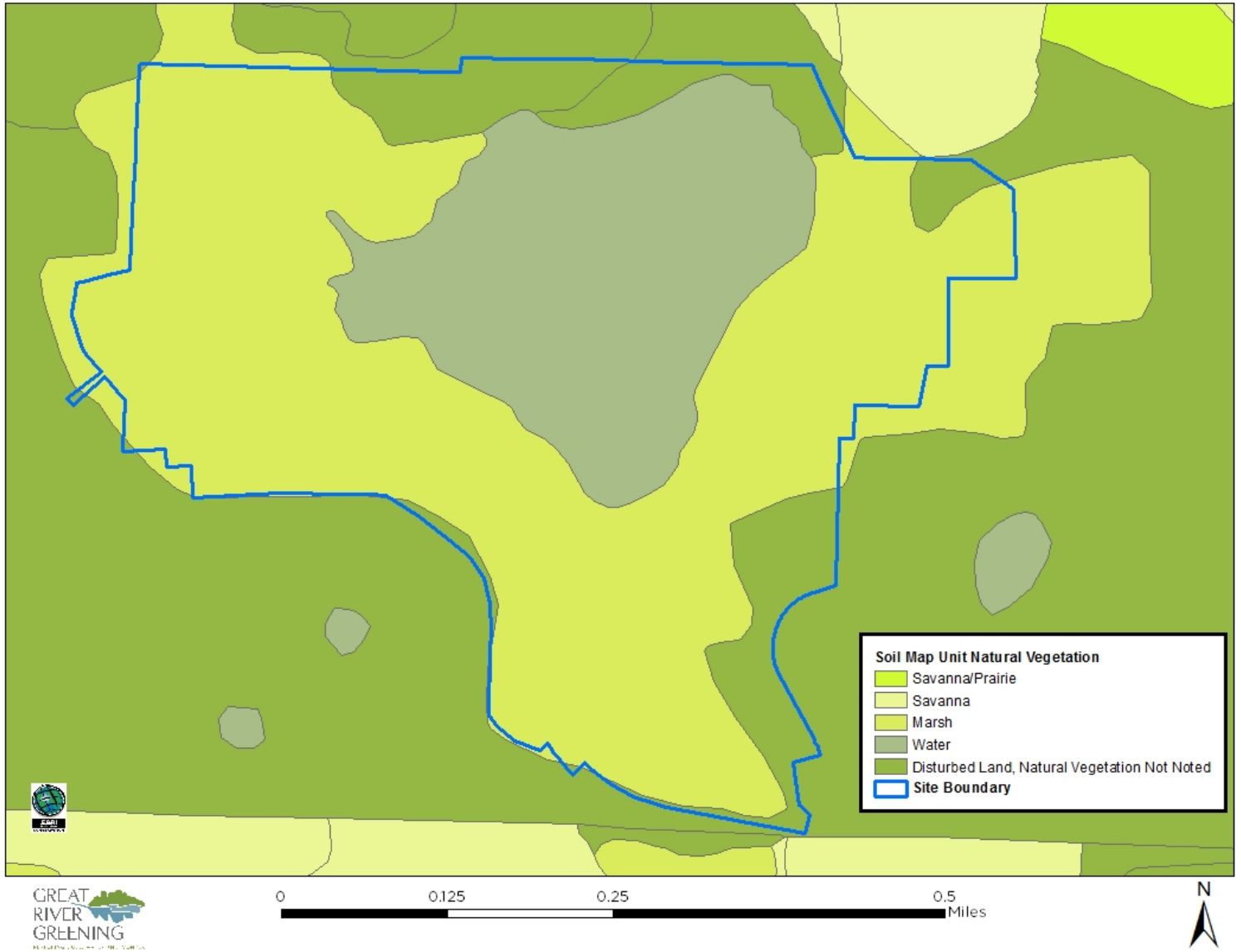


Figure 4. Natural vegetation supported by soil of Westwood Hills Nature Center and immediate vicinity.

Table 1. Key to the USDA NRCS soil map units of Westwood Hills Nature Center and immediate vicinity.

Map Unit	Map Unit Name	Natural Vegetation	Parent Material	Hydric Soil Rating	Natural Drainage Class	Acres within WHNC
L2B	Marlardi-Hawick complex, 1-6% slopes	sandy upland savannas, sandy upland prairies	outwash	No	Somewhat excessively drained/Excessively drained	NA
L3C	Rasset sandy loam, 6-12% slopes	sandy upland savannas	outwash	No	Well drained	NA
L11B	Grays very fine sandy loam, 2-8% slopes	loamy upland savannas	glaciofluvial sediments	No	Moderately well drained	NA
L22C2	Lester Loam, 6-10% slopes, moderately eroded	loamy upland savannas	fine-loamy till	No	Well drained	NA
L26C2	Shorewood silty clay loam, 6-12% slopes, eroded	clayey upland savannas	lacustrine sediments over till	No	Somewhat poorly drained	NA
L30A	Medo soils, depressional, 0-1% slopes	organic marsh	organic material over outwash	Yes	Very poorly drained	NA
L37B	Angus loam, 2-6% slopes	loamy upland savanna	Fine loamy till	No	Well drained	NA
L50A	Muskego and Houghton soils, 0-1% slopes	organic marsh, depressional marsh	organic material over coprogenic material	Yes	Very poorly drained	97
L52C	Urban land-Lester complex, 2-18% slopes	loamy upland savannas	loamy till-till	No	Well drained	NA
L54A	Urban land-Dundas complex, 8-18% slopes	loamy upland savannas	loamy till	No	Somewhat poorly drained	NA
L55C	Urban land-Malardi complex, 8-18% slopes	sandy upland savannas	sandy-gravelly outwash-outwash	No	Somewhat excessively drained	NA
U1A	Urban land-Udorthents, wet substratum, complex, 0-2% slopes		variable soil material		Well drained	4
U2A	Udorthents, wet substratum, complex, 0-2% slopes		variable soil material		Well drained	5.6
U6B	Urban land-Udorthents (cut and fill land) complex, 0-6% slopes		variable loamy material		Well drained	9.8
W	Water					42.5
M-W	Water, miscellaneous					NA

Vegetation Prior to European Settlement

Frederick J. Marschner's map of "The Original Vegetation of Minnesota" depicts the historic plant communities in the vicinity of WHNC as Oak Openings/Barrens and Wet Prairie (Figure 5). The most common species recorded as bearing trees during the Public Land Survey of the area was red oak along with some bur oak, white oak, and northern pin oak. The Marschner map was developed using the notes of surveyors of the Public Land Survey, who marked off the grid of section lines across the state as they surveyed the area. The Public Land Survey, which documented oaks as the dominant tree species in the area, is supported by evidence from the soil surveys that the soils developed under upland savanna plant communities. Hardwood forest composed of sugar maple, American basswood, and oak occurred in scattered pockets around the nature center, but become a more dominant plant community a few miles to the west of WHNC.

Land Use in the 1900s

Historic aerial photos of the area from 1937 to 1971 (Figures 6-8) reveal the progression of land use at WHNC, from the manicured fairways that utilized acreage exposed when Westwood Lake was tile drained, through the commercial and residential development that began as the golf course scaled back and began selling off parcels beginning in the 1950s. Only forested land on the terminal moraine east of Westwood Lake and that in the northwest corner of the property, as well as the saturated center of the drained Westwood Lake were spared from intense golf course development. These lands likely suffered impacts from other historic land uses. The 1937 aerial shows cultivated land in the northeast corner of the site. The agriculture lands appear to be in production into the 1950's. The 1971 aerial photo shows Westwood Lake after tile drainage was interrupted and the hydrology was restored. By 1971, residential neighborhoods and a few large commercial complexes are well established in the area surrounding WHNC.

Current Vegetation - Minnesota Land Cover Classification System

The Minnesota Land Cover Classification System (MLCCS) cover types for WHNC are shown in Figure 10. The MLCCS survey identified eighteen different land cover types at WHNC (Table 2). The majority of the site is mapped as non-native dominated vegetation. Only two of the cover type units are ranked as ecologically significant by Hennepin County Natural Resources. Although only designated as moderate quality in the 2008 MLCCS survey, the oak forest mesic subtype in the northeast corner of the site and the restored dry oak savanna in the southeast corner are considered ecologically significant areas. The oak woodland in the northwest is classified as poor quality. The remainder of the units including the wetlands, shrub wetlands, and other deciduous woodland areas surrounding Westwood Lake are designated as altered plant communities dominated by non-native species with low or no cover of native species present. Land cover as it relates to the topography of the site is illustrated in Figure 11.

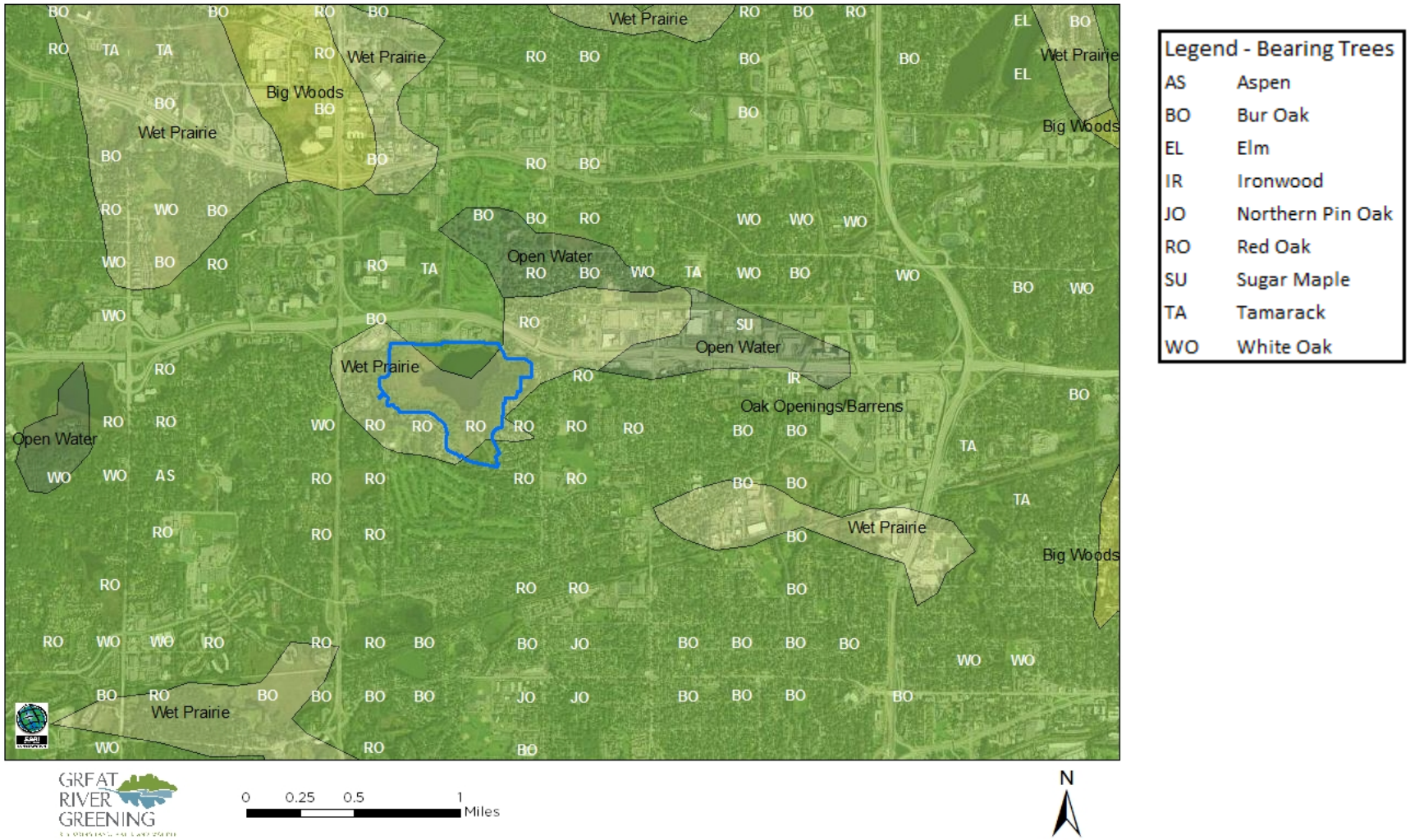


Figure 5. Westwood Hills Nature Center in the context of bearing trees from the public land surveyor notes overlaid on the vegetation at the time of European settlement (Based on Marschner, 1974).

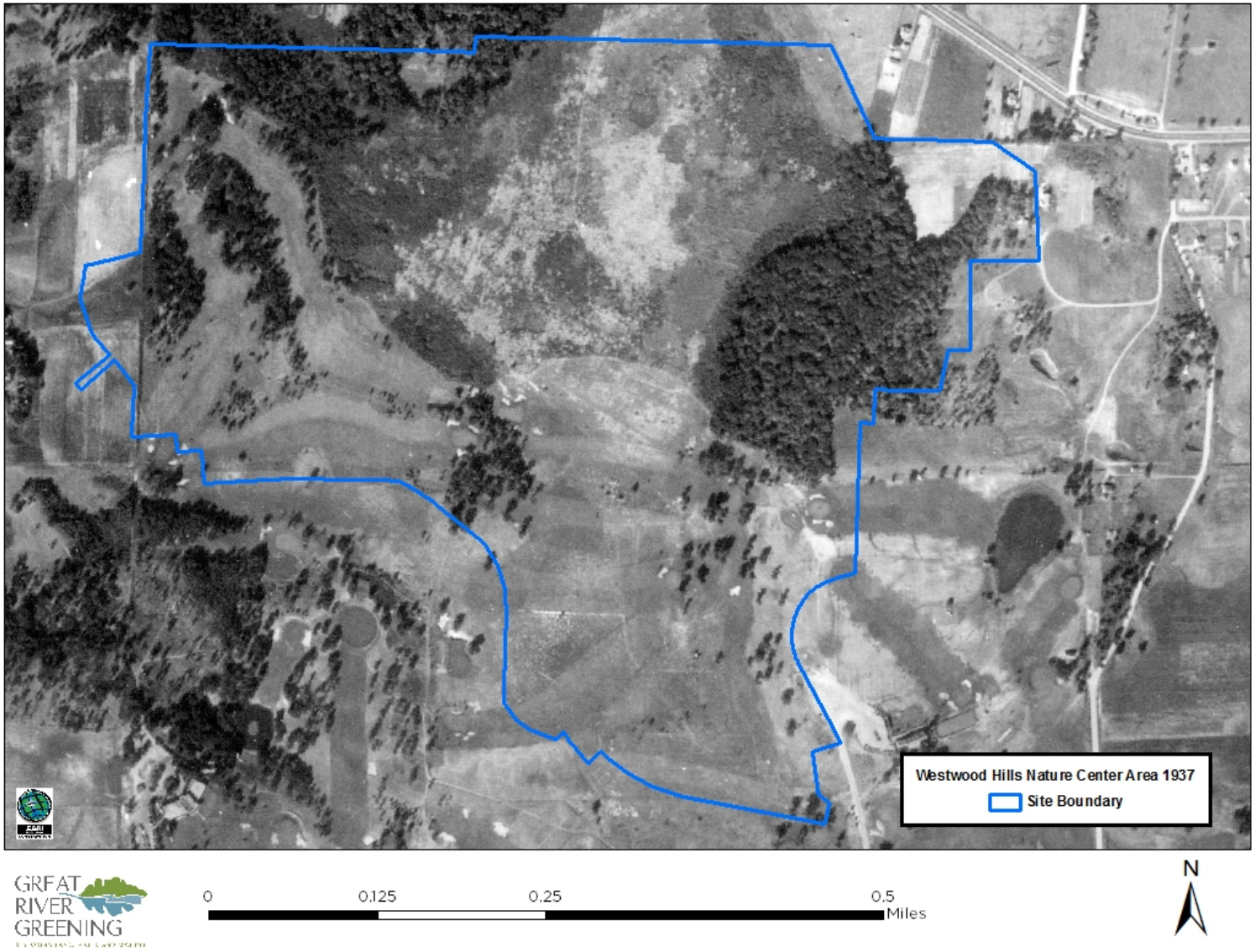


Figure 6. 1937 Aerial Photograph of Westwood Hills Nature Center and Surrounding Area.

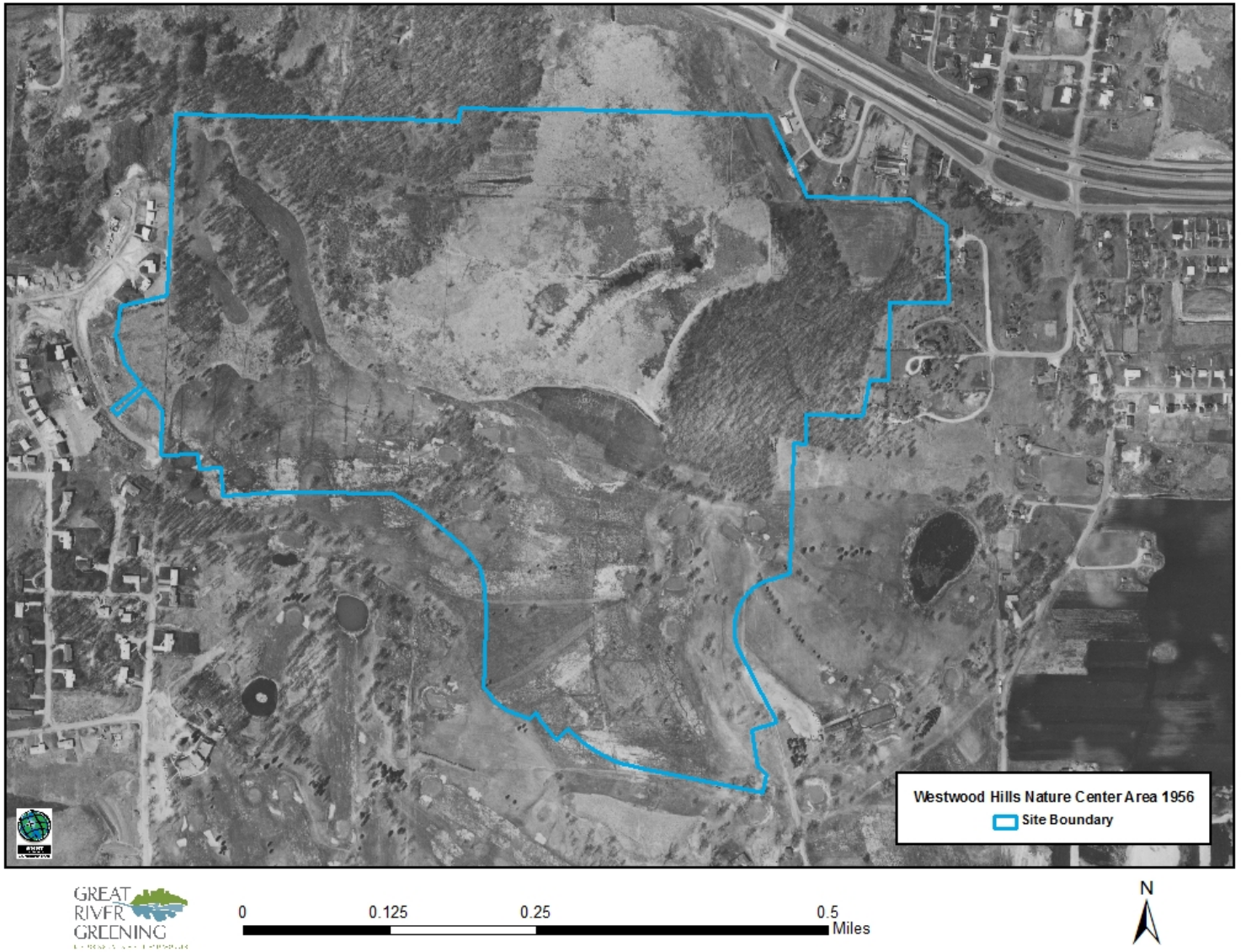


Figure 7. 1956 Aerial Photograph of Westwood Hills Nature Center and Surrounding Area.

Figure 8. 1971 Aerial Photograph of Westwood Hills Nature Center and Surrounding Area.

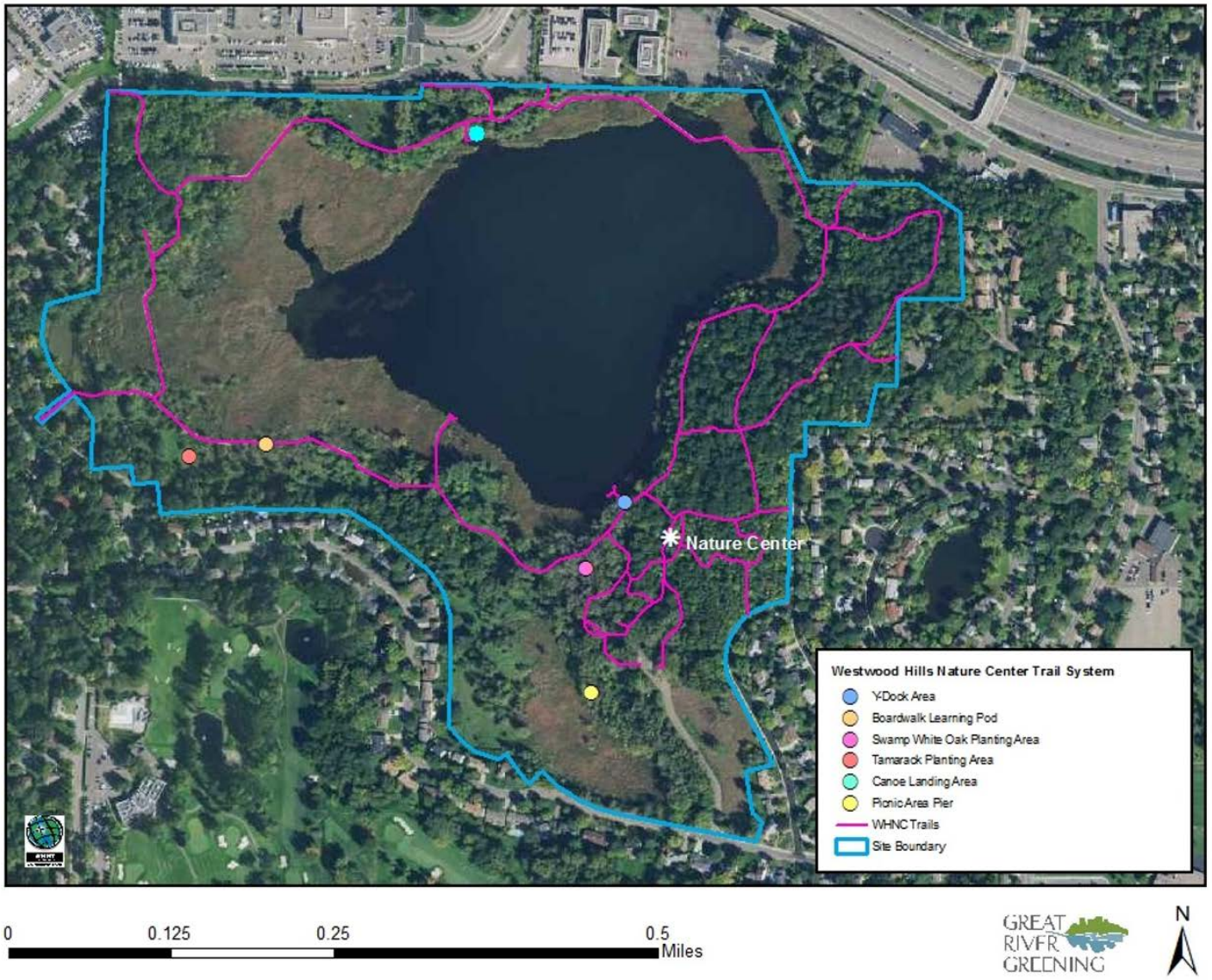


Figure 9. Current configuration of Westwood Hills Nature Center trails and areas of note.

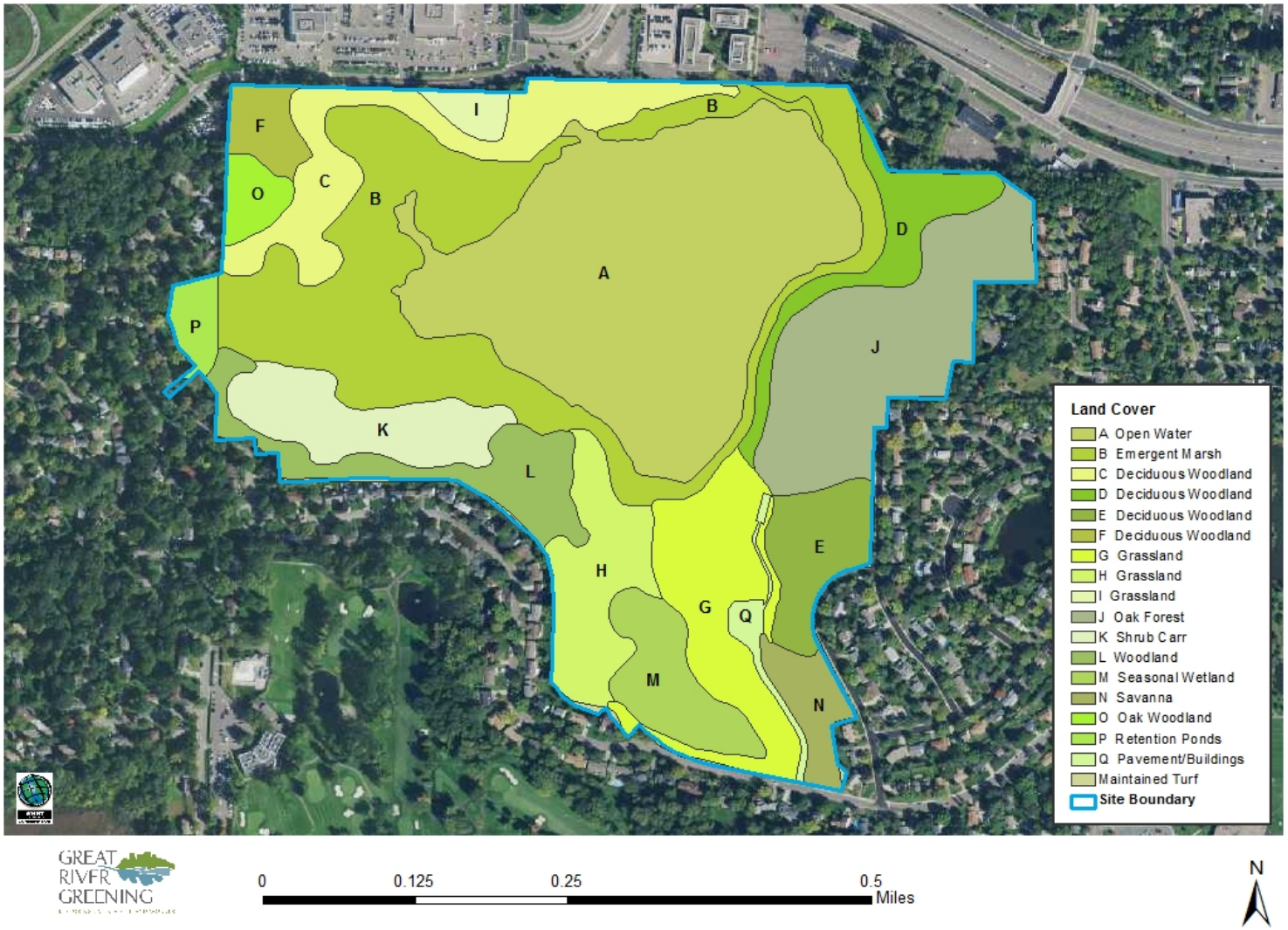


Figure 10. Current Land Cover at Westwood Hills Nature Center using the Minnesota Land Cover Classification System (MLCCS).

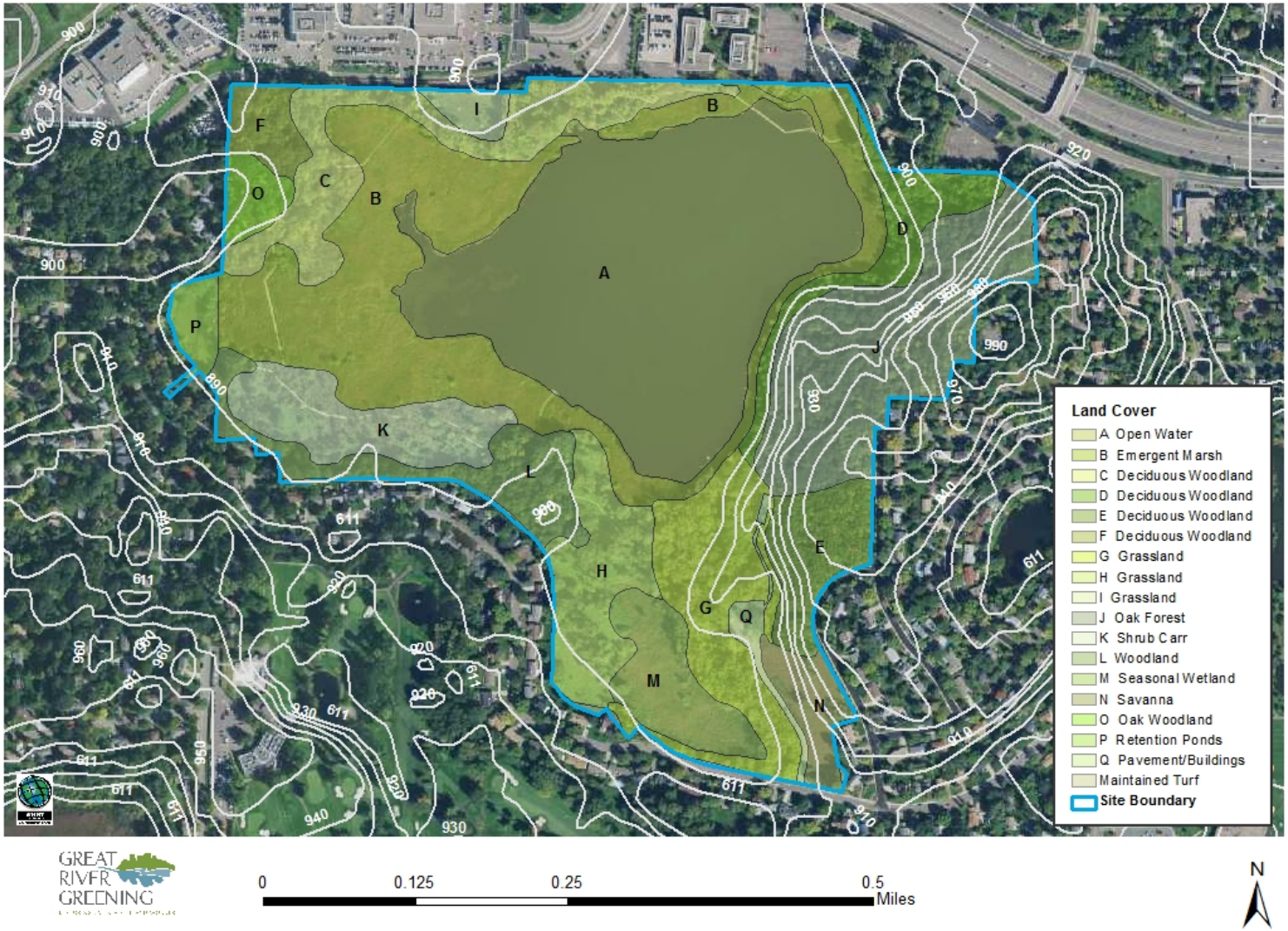


Figure 11. Current Land Cover at Westwood Hills Nature Center using the MLCCS as it relates to topography.

Table 2. Minnesota Land Cover Classification System for plant communities at Westwood Hills Nature Center. Based on 2007 survey data.

MLCCS Unit	Map Unit Name	MLCCS Description	Quality	Acres
A	Open Water	Littoral open water	NA	42.0
B	Emergent Marsh	Semipermanently flooded altered/non-native dominated vegetation	Altered	29.5
C	Deciduous Woodland	Altered/non-native deciduous woodland - saturated	Altered	10.3
D	Deciduous Woodland	Altered/non-native deciduous woodland - saturated	Altered	5.3
E	Deciduous Woodland	Altered/non-native deciduous woodland	Altered	5.2
F	Deciduous Woodland	Altered/non-native deciduous woodland	Altered	2.4
G	Grassland	Altered/non-native grassland with sparse deciduous trees – temporarily flooded	Altered	10.7
H	Grassland	Grassland with sparse deciduous trees – altered/non-native dominated vegetation	Altered	7.6
I	Grassland	Medium tall grass altered/non-native dominated grassland	Altered	1.4
J	Oak Forest	Oak forest mesic subtype	Moderate	17.0
K	Shrub Carr	Altered/non-native dominated saturated shrubland	Altered	7.4
L	Woodland	Altered/non-native deciduous woodland – temporarily flooded	Altered	6.7
M	Seasonal Wetland	Seasonally flooded altered/non-native dominated emergent vegetation	Altered	5.5
N	Savanna	Dry oak savanna	Moderate	3.0
O	Oak Woodland	Oak woodland - brushland	Poor	1.9
P	Retention Ponds	NA	Altered	1.7
Q	Pavement/Buildings	Buildings and pavement with 91-100% impervious cover	Altered	1.3
R	Maintained Turf	Short grasses and mixed trees with 26-50% impervious cover	Altered	0.7

Management Units

Management units have been developed to provide a geographic context for describing the plant communities and management recommendations within WHNC. The management units do not directly correspond to the MLCCS Map Units. Rather, the management units are defined areas that may correspond to vegetation type, but for convenience are also contiguous identifiable parcels of land whose boundaries lend themselves to easy access for managing the parcel. Management units are shown in Figure 12. Plant species observed during site visits are listed for each management unit in Appendix A. It should be noted that the plant species list for each unit are not complete. Many species were not observable at the time of the site visits.

Management recommendations for each unit generally target removal and ongoing management of invasive species. Invasive species typically targeted include species such as Siberian elm, common buckthorn, glossy buckthorn, garlic mustard, and reed canary grass, but several other invasive species also occur throughout the site and will be managed where appropriate. In forested units, management activities may prescribe thinning of native trees to decrease the density of smaller diameter trees that have established via natural recruitment. The city has been pro-active in identifying and removing trees infected with Dutch elm disease throughout WHNC. As a follow-up to invasive species removal, planting or seeding will occur in some units, where appropriate and as budgets allow. The extent of regeneration of native herbaceous species from the seed bank or remnant populations is unknown and will vary from unit to unit.

White-tailed deer are frequently seen around the property.

A significant limitation to the success of new plantings is the large population of resident white-tailed deer residing within the boundaries of the nature center. Plantings of herbaceous materials, especially forb species in the forested units, will likely need to be permanently protected by fencing unless deer populations are managed on an annual basis to maintain populations at sustainable levels. If deer are not managed, the plantings are not likely to expand significantly, if at all, beyond the fenced plots. Newly planted trees anywhere in the site will require protection that deters bucks during the rut from antler rubbing and scraping and the resulting girdling of trees. Trees are at risk until they reach at least 4-5” dbh. Some tree and shrub species, including cherries and American basswood, are more susceptible to being browsed than other species. When deer populations are higher than the carrying capacity of a given natural space, damage to species other than those normally favored by deer will also be intensive. Tree shelters or individual tree exclosures can deter scraping and browsing and should be provided temporarily for all tree and shrub plantings. Wild turkeys are known to disturb or dislodge ground layer flora by their scratching behavior as they forage for seeds and insects throughout their habitat. Seeded and planted areas will need to be protected from turkeys during establishment.

A narrative describing each management unit and the management objectives for each follows here. A table outlining the management needs of each unit can be found in Appendix B.

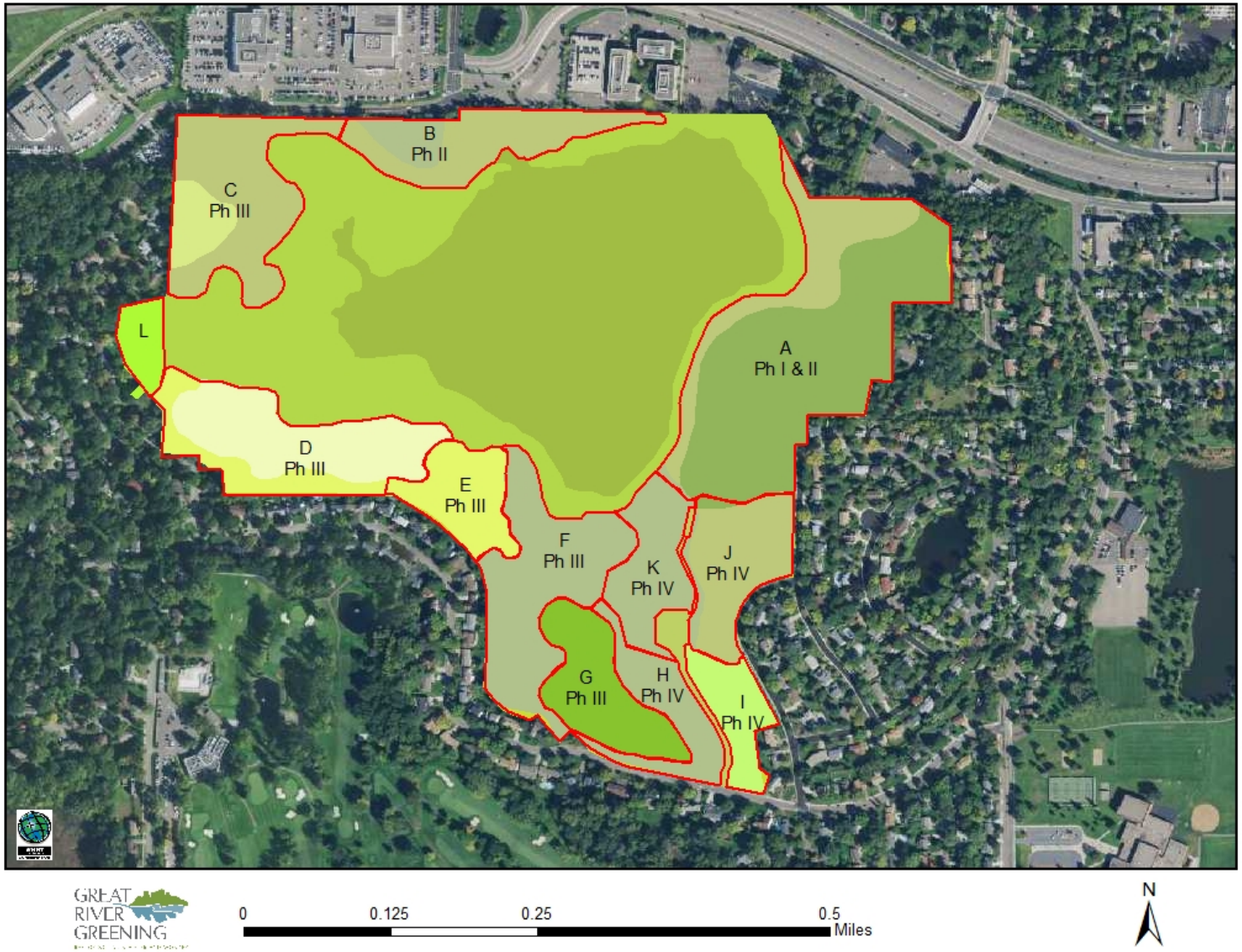


Figure 12. Management Units overlaid on the MLCCS Map with the projected funding phase during which restoration will occur in each unit.

Management Unit A - NE Oak Woodland (22.3 acres)

MLCCS description: Oak forest mesic subtype *and* Altered/non-native deciduous woodland – saturated.

Typical oak-dominated forest in Management Unit A (top), and tapped maple trees in the "Sugar Bush" (bottom).

Unit description: On the higher elevations in this unit, the canopy and subcanopy of the oak forest is dominated by red oak, American basswood, hackberry, sugar maple, black cherry, green ash, and red elm. In 1935 sugar maples were planted at the top of the slope, in an area known today as the Sugar Bush. These maple trees and several others in the unit are tapped in spring as part of the nature center's interpretive programming. Native ironwood is common in the subcanopy. The understory is dominated by common buckthorn. Barberry, an invasive horticultural escape, is also present, but not common. The areas invaded by these exotic species were managed in winter 2017 by forestry mowing in areas accessible by equipment and by cutting and stump treatment on the steep slopes.

There is modest cover of several native shrub species including wild currants, brambles, prickly ash, and elderberry. There is little regeneration of native tree species, however, in some areas ash or maple seedlings provide cover. Diversity of the herbaceous ground layer is poor. Ostrich fern occurs in limited areas, including in the fern glade. Weedy native species such as white snakeroot and stickseed occur along with non-native motherwort. Aster and zig-zag goldenrod occur primarily along the foot of the slope, where they may be remnants of the native flora. Eight fenced plots (approximately 10 feet x 10 feet) were planted with herbaceous species in 2015 and 2016. These are located adjacent to the southern set of steps and along the lower trail. Species planted in the plots are listed in Appendix D. On one section of the west-facing slope, grass was seeded and has established well, a possible example for management of the rest of the slope. Garlic mustard, an invasive biennial, occurs in large patches and random small infestations throughout the forest area. It is likely to continue to spread via dispersal of seeds in eroding soil and movement of deer through the site.

In the lower elevations of the unit, the canopy has been dominated by boxelder, with some cover of hackberry, green ash, and oak. In the north end of the unit on disturbed formerly cultivated soils, weedy trees were cleared and about a dozen of the elm cultivar 'Princeton' were planted. Boxelder had remained standing on a significant portion of this former agricultural land, but was removed in winter 2017 along with Siberian elm and other weed tree species. Boxelder will be left in place along the edge of Westwood Lake, particularly on the lake side of the lower trail. Common buckthorn and Tatarian honeysuckle were ubiquitous throughout at these lower elevations but were removed in winter 2017. The ground layer cover includes introduced grasses, including reed canary grass along the shore. Garlic mustard is prevalent in the lower elevation on the saturated soils as well. There is a sizeable area of ostrich fern spanning the trail near intersection by the northern gate. Other native forbs present include Canada goldenrod, white snakeroot and wild lavender bergamot.

The low cover of native ground layer species is likely due in part to the whitetail deer and wild turkeys that inhabit the park, as well as competition from buckthorn and impacts from non-native earthworms. Nature center staff have begun planting branched trees, into the forest, particularly along the trail corridors to begin the process of reintroducing desirable tree species and age stratification into the forest. In particular, sugar maple, red maple, and swamp white oak have been planted; the sugar maple at higher elevations, and the red maple and swamp white oak along the lower trail. The trees have suffered some loss or damage due to being used as deer rubs or from other environmental causes.

Management: Non-native or small diameter trees of lower value were thinned from the forest on the slopes in winter 2017. Species removed included Siberian elm, mulberry, boxelder, green ash, and American basswood. The thinning of small diameter native trees could have been more intense in some areas. Further thinning could happen at a future time to release a select suite of trees that would grow more quickly with less competition.

The stand of boxelder trees was removed in the north end of Management Unit A in winter 2017. A mix of hardwood tree species were planted in the summer of 2017 to reforest the area, however survival is unknown due to deer grazing prior to protective fence installation. Planting a mix of species will build in resilience in the face of impacts from climate change and will prevent the loss of an entire monotypic planting due to potential future disease or insect outbreaks. After management of the ground layer, an inexpensive native grass mix could be seeded in this area as a cover crop while the trees establish.

Also in 2017, buckthorn was removed from the upland areas throughout the unit by either forestry mowing on more accessible terrain or by brush saw/stump treatment on the steep slopes. Buckthorn along the shoreline of Management Unit A was removed by a crew and volunteers in 2017. Follow-up foliar treatment of resprouts of buckthorn, honeysuckle, and barberry occurred in fall 2017, with visually confirmed success in November.

Approximately 50% of the downed deadwood throughout the unit was removed. Downed wood along the perimeter of the nature center was a priority for removal in order to minimize the likelihood of fire hazard to the adjacent properties. Larger diameter deadwood and deadwood on the steep slopes was left in place for its habitat value and its effects in mitigating erosion. Downed wood and snags provide essential cover and food resources for a variety of insects, reptiles, birds, and mammals. Ideally, dead standing trees will be left in place unless they are diseased or located where they may be a hazard to visitors or structures.

In areas of the upland where gaps in the canopy have been created by the removal of trees or through natural losses of trees, native trees could be planted. It is not necessary to replant all of these gaps as they add diversity to the light environment within the plant community. When trees are planted, a mix of native hardwood tree species should be replanted to create diversity in the regenerating strata of the forest stand. The mix could include hackberry, red oak, bur oak, white oak, ironwood, sugar maple, black cherry, and basswood on the upland areas. Hackberry, red maple, American basswood, and elm could be planted along the shoreland.

Garlic mustard should be controlled throughout the unit by a combination of mechanical and chemical treatments. Once control of buckthorn and garlic mustard have been initiated, annual monitoring and follow-up efforts will be required in order to keep these weed species in check. After follow-up treatment of buckthorn has been successfully implemented, shrubs could be planted in the understory. Pagoda dogwood, chokecherry, and bush honeysuckle could be planted on the uplands, while red-twigged dogwood, red-berried elder, common elderberry, nannyberry viburnum, cranberry bush viburnum, and arrowwood viburnum could be planted along the shore.

Additional locations for planting herbaceous ground layer species could be identified. Areas that are currently invaded by garlic mustard will not be good candidates for ground layer planting for the foreseeable future as they will require ongoing follow-up management. Any new ground layer plantings will require fencing to exclude deer and wild turkeys. Plots not larger than 12’ x 12’ may be sufficient to exclude deer. Deer may be more inclined to jump the fence into larger more open plots.

Goals:

- Strive for 100% control of buckthorn, honeysuckle, and barberry in woodland and along shoreline by year 2
- Seed 0.72 acres of steep slope along shoreline with a mix of native sedges, grasses, and wildflowers. Achieve 75% ground cover by year 4.
- Plant 13 additional wildflower exclosures to facilitate re-establishment of native wildflowers, sedges and grasses.
- Plant 1.5 acres of cleared land on the north end with a diverse mix of desirable hardwood tree species by year 2.
- Control non-native ground layer vegetation in this area and seed a perennial native cover crop to achieve 80% native cover by year 3.
- Strive to control 100% of the garlic mustard in high priority areas, including in the areas around the wildflower exclosures.
- Monitor and prevent establishment of new populations of garlic mustard.

Management Unit B - Northshore (6.4 acres)

MLCCS description: Altered/non-native deciduous woodland - saturated *and* Medium tall grass altered/non-native dominated grassland.

Path leading west along the shore of Westwood Lake in Management Unit B.

Unit description: This unit is on low profile terrain, with poor soils containing concrete and asphalt rubble which was originally used as fill. Mature cottonwoods are the dominant trees along the shoreline, forming a super canopy over hackberry, boxelder, and silver maple. Islands of volunteer trees including boxelder, black willow, green ash, black walnut, and Russian olive have established in the altered habitat upland from the shoreline. Russian olive may have been planted where it occurs along the highway sound barrier wall. Poplars and spruce trees have also been planted to mask the concrete sound barrier between the nature center property and Wayzata Road and Hwy 394. Ultimately, it may be desirable to plant fire resistant native shrubs and trees to disrupt the continuity and mass of the sound barrier. The trees planted within the grassy opening will break up the wall as seen from the trail; all of the plantings do not have to be within a few feet of the wall itself. Mature spruce trees that may be remnants of an old homestead planting also occur. Common buckthorn and Tatarian honeysuckle dominated the understory along the shoreline and in the midst of the islands of volunteer trees in the upland until the area was forestry mowed in winter 2107.

The ground layer species present are primarily species associated with poor quality habitats including garlic mustard, burdock, Canada thistle, bull thistle, and motherwort. However, a few species associated with high quality wetland habitat, including bugleweed and skullcap, are represented on the shoreline where they occur with very low cover amongst a matrix dominated by reed canary grass. Muhly grass, wild lavender bergamot, and black-eyed Susan's occur in the old field. Otherwise, diversity is generally quite low with a dominant cover of Canada goldenrod and non-native cool season grasses. The old field has been planted with tree species which confuse the ultimate restoration goal of the small parcel. Red cedar, pines, spruce, cottonwoods, and oaks have each been planted. The red cedar and a number of volunteer green ash trees were removed in winter 2017 by forestry mower. It is recommended that the small spruce trees in the middle of the area be removed as well to facilitate future management. A chimney swift tower was installed in the middle of the grassy opening. However, chimney swift towers should be located in wide open areas, which this site likely was. The tree plantings will soon create too much cover near the chimney swift tower, making it unsuitable for chimney swifts.

Buckthorn was removed by forestry mowing along the entire shoreline in this unit in winter 2017. The buckthorn had been established for so long that little ground layer diversity was observed beneath its canopy. Due to the density of the buckthorn, the layer of shredded wood covering the ground is now quite thick and will need to break down before any revegetation can occur.

Management: The North Shore Management Unit was forestry mowed in winter 2017 to control common buckthorn. Follow-up management occurred in fall 2017 on any resprouting stumps and leaves. Continued ongoing management throughout the unit will be needed to prevent buckthorn from

re-establishing. Other invasive tree species will need to be removed from the unit, including Siberian elm and Russian olive as funds are available. In the areas where buckthorn was removed the density of the mature trees is not very high, however, the ground is likely to be shaded through much of the day regardless. An inexpensive seed mix should be selected or designed for these site conditions and broadcast after the woody material deteriorates sufficiently. More intensive site preparation may be needed in some or all of the area. Weed management will likely be required in the interim, including broadcast and/or spot treatment of weedy species that establish. These are likely to include burdock, garlic mustard, thistle, etc.

The old field could be treated with herbicides and reseeded with a native seed mix including a mix of wildflowers to attract and support native pollinators. More consideration should be given to whether the evergreen trees and poplars should be removed from within the boundaries of the old field. If prescribed burns were to be used to manage this area, these flammable and fire sensitive tree species would be incompatible. However, given the proximity of the unit to Interstate 394, opportunities to conduct prescribed burns may be limited and mowing and spot treatment with herbicides may be more reliable management tools.

The shoreline adjacent to the canoe landing is an area where reed canary grass could be managed (see Figure 9). Controlling the non-native grass would enhance remnant populations of native sedges and forbs that continue to grow on the shoreline amidst the cover of reed canary grass. Whether or not this area should be prioritized over other areas depends to some degree on whether this area is currently or would be used for interpretive programming. As with all areas where reed canary grass control is being contemplated, it would require ongoing management to change the trajectory of the plant community toward native species. The shoreline should be revegetated and stabilized in this unit after disturbance at the canoe landing.

Goals:

- Strive for 100% control of buckthorn and honeysuckle throughout the unit by year 2
- Strive for 100% control of additional invasive tree species or tree species inappropriate for the plant community from throughout the unit by year 5.

Forestry mowed areas

- Manage ground layer vegetation to reduce cover of non-native herbaceous species to not more than 25% cover.
- At approximately year 2 or 3 after the shredded buckthorn material has degraded sufficiently and cover of introduced/invasive ground layer species has been controlled, sow seed mixes composed of robust, readily available native species with emphasis on graminoids. Achieve 85% native cover by year 5.

Old field

- Dormant overspray to control cool season grasses to reduce cover by 75%. Spot treat Canada goldenrod to reduce cover by 60%. Interseed with native prairie seed mix including grasses, sedges, and wildflowers.

Management Unit C - NW Oak Woodland (9.5 acres)

MLCCS description: Altered/non-native deciduous woodland/oak woodland – brushland *and* Oak woodland – brushland *and* Altered/non-native deciduous woodland – saturated.

An understory dominated by invasive garlic mustard rosettes in Management Unit C.

Unit description: An area of high ground in the northwest corner of the nature center hosts a few large open grown oak trees in a degraded woodland. Native trees in the canopy include bur oak, red oak, hackberry, green ash, black cherry, and American basswood. Ironwood occurs in the subcanopy. Cottonwood, green ash, black willow, red elm, and boxelder occur on the lower elevations of the unit where the upland soils grade into saturated wetland soils. Common buckthorn occurs throughout the management unit, while glossy buckthorn also occurs on the saturated soils. Disturbed areas in the upland host a suite of ground layer species typical of disturbance, including garlic mustard, burdock, bull thistle, stickseed, motherwort, catnip, reed canary grass, and mullein. The dominant ground cover in the lower saturated zone is reed canary grass.

Management: The management of the deciduous woodland has been deferred to a later phase of the restoration due to ongoing garlic mustard research in the uplands of the unit. Initial management in this unit will include removal of buckthorn via forestry mower, brush saw, or other appropriate method. Different methods may be required to control buckthorn in the various site conditions. Invasive tree species, including Siberian elm, should be removed. Some thinning of native trees may be desirable, especially around old, established oaks. Garlic mustard control can occur after buckthorn management. A combination of mechanical and chemical means may be utilized to control garlic mustard. Other herbaceous weed species can be managed simultaneously with the garlic mustard. Applications of a broad spectrum systemic herbicide will be effective for most of the weed species in this unit.

If funding is limited, this unit would be a lower priority for active restoration of a high quality ground layer flora. Ongoing management for common and glossy buckthorn will be needed. Likewise, garlic mustard control will be ongoing. Control of reed canary grass is not a priority in the saturated soil areas of this unit.

Goals:

- Strive for 100% control of buckthorn, honeysuckle and barberry throughout the unit by year 2.
- Strive for 100% control of invasive tree species, including Siberian elm, by year 2.
- Use twice annual control to limit flowering and seed dispersal of garlic mustard throughout uplands.
- Control non-native ground layer vegetation in the uplands, reducing cover to less than 10%
- Seed zones where management has been most effective with a native woodland seed mix to achieve 50% native cover by year 3. Use a seed mix heavy on sedges, with some native grasses and wildflowers.

Management Unit D - Shrub Carr (10.0 Acres)

MLCCS description: Altered/non-native dominated saturated shrubland *and* Altered/non-native deciduous woodland – temporarily flooded

Planted tamarack trees, as well as invasive reed canary grass, line the boardwalk in the southwest corner of Management Unit D.

Unit description: A shrub carr is a wetland community dominated by tall shrubs with a ground flora dominated by grasses, sedges, and forbs typical of wet meadows. Common native shrub species that occur in this unit include elderberry, pussy willow, and red-twigged dogwood. Green ash trees are common scattered throughout the shrub carr. Red maple and silver maple have been planted along the boardwalk. In the southwest corner of the unit, a modest sized area has been planted with tamarack. Most of the tamarack are between 8-12 feet tall, but a couple of older trees are as much as 25 feet tall. The smaller trees are protected from deer browsing with fencing. Invasive shrub species including both glossy and common buckthorn are common throughout the unit. Reed canary grass is the dominant herbaceous cover in this unit, where it likely provides intense competition to the trees planted amongst it. In the ground layer, there is a small remnant presence of native sedge as well as a few forbs, including joe-pye-weed, boneset, marsh milkweed, and bugleweed. Narrow-leaf cattails occur where this unit abuts the emergent marsh, but also in pockets within the shrub carr itself.

Along the south edge of the unit where it abuts the adjoining residential properties the elevation is slightly higher and supports cottonwood and a well-established northern pin oak. This area of higher ground is generally choked with broken snags, dead downed wood, and common buckthorn. There is some half-buried debris from the site's history as a golf course in this area.

Management: It would be valuable to treat the reed canary grass around each of the planted tamaracks (Figure 9) to reduce competition and facilitate better growth, although this minimal management would not have a lasting impact unless the surrounding population of reed canary grass is also managed. If more intensive management of reed canary grass were to be done, the entire area where the tamarack are planted would be a good discrete location to attempt to control it. Treatment of reed canary grass around the learning pod (Figure 9) along the boardwalk could be done to enhance the diversity of the plant community in that area to improve its educational potential. These broadcast or spot treatments could be done once each year in the fall after the tamaracks have dropped their needles. A glyphosate product formulated for use over water (ex: Rodeo) could be used. Once reed canary grass has been controlled, supplemental seeding or planting may be necessary if regeneration of native species from remnant populations or the seed bank is not sufficient to revegetate the area.

Both common and glossy buckthorn should be removed from the entire unit. This work would occur in winter on frozen ground to improve access into the wetter areas of the unit. Techniques should be tailored to site conditions in each area of the unit, but might include forestry mowing, brush saw/stump treatment, etc. Invasive tree species within the shrub carr as well as on the higher ground along the south property boundary should be removed. Ongoing management for common and glossy buckthorn will be needed. Shrubs typical of a shrub carr plant community could be planted in areas where extensive cover of buckthorn is removed.

Goals:

- Strive for 100% control of buckthorn throughout the unit by year 2.
- Strive for 100% control of invasive tree species, including Siberian elm, by year 2.
- Annually treat (or weed whip) the reed canary grass around each planted tamarack to reduce competition OR treat reed canary grass throughout the planted area to reduce cover to less than 10% by year 2.
- If there is not adequate regeneration of native species after reed canary grass is controlled, seed with a mix of appropriate species (wet meadow) to achieve at least 75% cover.
- Plant shrubs appropriate for shrub carr habitat in 25% of the area where buckthorn has been controlled.

Management Unit E - Oak Woodland (4.0 Acres)

MLCCS description: Altered/non-native deciduous woodland – temporarily flooded.

Second year plants of the invasive garlic mustard dominate the understory in Management Unit E.

Unit description: This unit is worthy of being called out from the remainder of the surrounding plant communities due to the high ground upon which two large oak trees are growing. In addition to the 2 imposing oaks, there are a large number of younger-aged volunteer American basswood trees and a few black cherry. A handful of spruce and red pines, likely remnants from the site's golf course era, occur along the property boundary. This unit grades into adjacent saturated soils where green ash and boxelder are more typical tree species. Common buckthorn and garlic mustard both occur in the unit and require management. A small exclosure on the side of the hillside is in disrepair, but could be resurrected if a goal was set to establish some ground layer diversity in the unit.

Management: The focus of management in this unit would be to remove buckthorn and invasive tree species throughout. In addition, basswood could be selectively removed to open up around the 2 large oak trees and to reduce competition and facilitate the growth of the remaining trees. Garlic mustard will need to be managed in

the ground layer by mechanical and/or chemical means. Management of both buckthorn and garlic mustard will require ongoing effort before any enhancement of the ground layer flora should be attempted.

Goals:

- Strive for 100% control of buckthorn and honeysuckle throughout the unit by year 2.
- Strive for 100% control of invasive tree species, including Siberian elm, by year 2.
- Use twice annual control to limit flowering and seed dispersal of garlic mustard throughout uplands.
- Control non-native ground layer vegetation in the uplands, reducing cover to less than 10%
- Seed or plug zones where management has been most effective using a native woodland seed mix to achieve 50% native cover by year 3. Use a seed mix heavy on woodland sedges, with some native woodland grasses and aggressive wildflowers.

Management Unit F - Seasonal Meadow (9.4 Acres)

MLCCS description: Grassland with sparse deciduous trees – altered/non-native dominated vegetation

Unit description: The deciduous tree cover in this unit consists primarily of boxelder, black willow, and silver maple in the more open areas, with a heavier cover of cottonwood in the more northerly part of the unit. Tamarack trees have been planted in a saturated soil area adjacent to the trail. Another low saturated soil area beneath a canopy of mature cottonwood trees in the northeast corner of the unit has been planted with swamp white oaks. Common buckthorn occurs in scattered patches, primarily around groups of trees on subtly higher ground. In general, the ground layer cover is dominated by undesirable non-native species, including a dense cover of reed canary grass throughout most of the unit. The planted swamp white oaks and tamaracks are growing amidst a cover of reed canary grass, which is likely slowing their growth. Some trees are bent at the base from having to compete with the dense cover of reed canary grass. This may impact the longevity of these trees. Garlic mustard has obtained a foothold amongst the reed canary grass cover in places. Other herbaceous weed species of note include narrow-leaf cattails, burdock, Canada thistle, and bull thistle.

Competition for light between trees and invasive reed canary grass has produced bent trunks in Management Unit F.

Management: The focus of management in this unit would be to remove buckthorn and invasive tree species throughout. Further restoration of this unit would take a significant investment of time in order to eliminate the extant cover of reed canary grass as well as the seed bank before native species could be introduced. It would be valuable to treat the reed canary grass around each of the planted tamaracks and swamp white oaks (Figure 9) to reduce competition and facilitate better growth, although this minimal management would not have a lasting impact unless the surrounding population of reed canary grass is also managed. If more intensive management of reed canary grass were to be done, the entire

areas where the tamaracks and swamp white oaks are planted would be good discrete locations to attempt to control it. The use of an adaptive management approach would be a good strategy if management of reed canary grass is attempted. The number, timing, and exact nature of subsequent treatments should be determined based upon the observed results of previous treatments. The areas to be treated could be broadcast once each year in the fall after the tamaracks have dropped their needles. A glyphosate product formulated for use over water (ex: Rodeo) could be used for control. Spot treatments can be used for maintenance, once reed canary grass is eliminated from the bulk of the managed areas. Supplemental seeding may not be necessary if native species establish from remnant populations or the seed bank once reed canary grass was controlled. This can be assessed as management proceeds, since at least two seasons of treatment should be implemented before any seeding would occur. Garlic mustard occurs within the reed canary grass in some areas. If the site is accessible in early summer prior to flowering, mowing or cutting to prevent seed production could be employed to reduce additional seed inputs.

Goals:

- Strive for 100% control of buckthorn throughout the unit by year 2.
- Strive for 100% control of invasive tree species, including Siberian elm, by year 2.
- Annually treat the reed canary grass around each planted tamarack and swamp white oak to reduce competition OR treat reed canary grass throughout the planted area to reduce cover to less than 10% by year 2.
- If there is not adequate regeneration of native species after reed canary grass is controlled, seed with a mix of appropriate species (wet meadow) to achieve at least 75% cover.

Management Unit G - Cattail Marsh (5.5 acres)

MLCCS description: Seasonally flooded altered/non-native dominated emergent vegetation.

Unit description: This 5.5 acre unit has low diversity, with the plant community being dominated by narrow-leaf cattails and reed canary grass. The presence of Canada blue joint grass, lake sedge, willow herb, and field mint hint at the historic native plant community. Each of these native species occurred with low cover in the unit.

Management: It is a significant endeavor to take on the restoration of an emergent marsh, dominated by narrow-leaf cattails, but if it were to be attempted at this site, this discrete 5.5 acre marsh would be a reasonable place to undertake it. One approach would be to mow off the dead stems in winter when the ground is frozen. In the following season, apply glyphosate approved for wetland use in late August to mid-September to maximize uptake. At least one additional herbicide treatment will be needed in the following season. Ongoing follow-up treatments will be required simply due to the invasive nature of narrow-leaf cattails and reed canary grass, and the proximity of both species in the areas surrounding the marsh. After 2 seasons it may be evident whether or not there is any native seed bank present and whether the seed bank is sufficient to revegetate the wetland. If it is not, then a wetland seed mix appropriate for the hydrology of the site could be purchased and broadcast in fall as a dormant seeding. Adaptive management will be a good approach in for this effort, as the number and exact nature of treatments may vary depending on the observed results of previous treatments.

Any buckthorn, invasive trees, and garlic mustard should be managed within the unit.

Goals:

- Strive for 100% control of cattails and reed canary grass throughout the unit by year 2.
- Seed unit with a mix of appropriate species (emergent marsh and/or wet meadow) to achieve at least 90% cover.
- Strive for 100% control of buckthorn and invasive trees throughout the unit by year 2.

As noted in the management text above, restoration of this unit is not advisable if adequate site preparation treatments cannot be implemented to obtain full control and if seeding the area with a diverse emergent marsh/wet meadow seed mix is not feasible, and if a commitment to follow-up management cannot be made.

Management Unit H - Entry Woodland (3.8 acres)

MLCCS description: Altered/non-native grassland with sparse deciduous trees – temporarily flooded.

Winter view of the dense buckthorn and honeysuckle understory in Management Unit H.

Unit description: This unit consists of a degraded wooded area with a canopy composed primarily of cottonwood, green ash, red elm, and boxelder. The understory has a high cover of common buckthorn and Tatarian honeysuckle. The ground in this area is impacted by past land uses with some partially buried debris and fill deposited in 1968 from excavation of a nearby pond. Channels have been dug across the unit to facilitate runoff from the paved driveway to the cattail marsh in adjacent Management Unit G. In winter 2017, trees were removed and a part of this unit was used as a staging area for trees removed as hazard or diseased trees. This unit is likely to be subject to dramatic alterations during future construction, with potential development ranging from integrating stormwater management capacity into the landscape plantings to construction of parking facilities. Plans for future development will determine the extent to which this unit is managed during Phase IV.

Management: Mechanical and/or chemical treatments could be utilized. Buckthorn and honeysuckle removal is needed throughout the unit. Forestry mowing and/or cut/stump treat methods could be used. Tree thinning should also occur to open up around more desirable keep trees. If invasive and less desirable weed tree species are removed, desirable species could be inter-planted in the gaps. Desirable species for this unit include red maple, hackberry, American basswood, and silver maple, closer to the marsh. Shrubs with both aesthetic and wildlife value can be planted in the understory. Suggested species include red-twigged dogwood, cranberry bush viburnum, nannyberry viburnum, and downy arrow-wood. Each of these species will provide attractive blooms, fruit for wildlife, and fall color interest. Garlic mustard will need management throughout the unit. After garlic mustard is controlled, ground layer species could be seeded to increase diversity and stabilize soils beneath the trees. Use of a graminoid only seed mix initially will allow continued management of garlic mustard with broadleaf herbicides or mowing. Forbs could be interseeded at a later date when garlic mustard is controlled.

Goals:

- Strive for 100% control of buckthorn and honeysuckle throughout the unit by year 2.
- Strive for 100% control of invasive tree species, including Siberian elm, by year 2.
- Use twice annual control to limit flowering and seed dispersal of garlic mustard throughout uplands.
- Thin trees by 10-25% to open up around desirable keep trees. Plant shrubs with wildlife food and cover values in understory with an anticipated mature cover of 10-25%.
- Seed entire unit with a native shade appropriate mix of grasses to achieve a cover of at least 90% by year 3.

Management Unit I - Oak Savanna (3.0 Acres)

MLCCS description: Dry Oak Savanna

Scattered oak cover in the open, restored prairie habitat of Management Unit I.

Unit description: Prairie Restorations, Inc. began the planning and implementation of the WHNC prairie in 1978. Now nearly 40 years old, the prairie is on an annual management plan. Prescribed burns are conducted periodically and invasive species are being managed with spot herbicide treatments. In 2009, the prairie was enhanced with the addition of wildflowers near the edge along the driveway. The prairie flora includes the native grasses big bluestem, indiangrass, switchgrass, sideoats grama, and little bluestem. Native forbs include hoary vervain, gray-headed coneflower, dotted blazingstar, wild lavender bergamot, common ox-eye, compass plant, and cupplant. Herbaceous invasive species include reed canary grass, smooth brome, garlic mustard, thistle, and leafy spurge. Some of these species occur throughout the prairie, while others are concentrated in areas of disturbance. Woody invasive species occur in a couple of tree islands within the prairie, as well as in areas along the perimeter. They include Siberian elm, common buckthorn, and Tatarian honeysuckle. Native woody species that are not appropriate in this unit and should be removed include boxelder, green ash, and red cedar. An apple tree could be removed if it is the source of volunteer seedlings in the prairie.

Management: The current management program for controlling herbaceous weeds in the prairie could be reassessed for effectiveness. Leafy spurge control in particular, is challenging to manage in an established native plant community where the use of herbicides must be carefully managed so as not to impact native species. Spot treatment of smooth brome and reed canary grass provide similar challenges. Prescribed burns timed for late spring will negatively impact non-native cool season grasses such as reed canary grass and smooth brome. Dormant oversprays can be used to manage both invasive grasses and favor expansion of native species.

Other steps to enhance the prairie unit include the removal of trees, common buckthorn, and Tatarian honeysuckle that occur in a couple of pockets at the top of the slope. Disturbed bare soil areas exposed by removal of trees and shrubs should be prepped and seeded after any herbaceous invasive weeds have been effectively controlled. The seed mix should prioritize quick-establishing aggressive native species that will fill in quickly to compete with a potential weed seed bank. Prescribed fire should remain in the management profile on a 3-5 year rotation, with mowing or haying as a management option when burns cannot be implemented in a timely manner. Fire can be used to remove thatch in preparation for herbicide treatment or as a follow-up to herbicide treatment to remove dead vegetative cover.

Goals:

- Maintain cover of leafy spurge at less than 2%.
- Reduce cover of other non-native herbaceous broadleaf weeds, including burdock to less than 5%.
- Strive to remove 100% of non-native woody vegetation.
- Strive to remove 100% of all woody native species other than oak.
- Seed bare spots created by removal of woody and herbaceous species by seeding a mix of quick establishing aggressive native grasses and wildflowers to achieve 90% cover by year 3 post-seeding.
- Reduce cover of smooth brome using a combination of spring prescribed burns and spring or fall dormant over-sprays.

Management Unit J - Pine Planting (5.7 acres)

MLCCS description: Altered/non-native deciduous woodland

Densely planted pines in Management Unit J.

Unit description: MLCCS Unit E is an altered woodland dominated in part by planted evergreen species with additional cover provided by native deciduous hardwood tree species. At least some of the evergreens were planted as long ago as 1960. However, the conifer planting has not been managed to attain a density that would support the healthy growth of trees. Many of the trees in the unit are crowded, with small diameters (dbh's) and similarly stunted crowns. The planting of mixed evergreen species provides diversity in the plant community, offering cover and foraging niches that potentially increase the diversity of wildlife species that utilize the site. It also creates additional programming opportunities for the nature center. The pine planting is comprised of red pine, white pine, northern white cedar, and white spruce. Additional pine trees have been planted more recently in the same unit. Native hardwood species represented in the unit include bur oak, red oak, green ash, American basswood and black cherry. The woody invasives Russian olive, Siberian elm, common buckthorn and Tatarian honeysuckle

occur in the unit. Garlic mustard, burdock, nettles, stickseed and motherwort are common in the ground layer, suggesting a disturbed soil environment.

Management: This area will be heavily disturbed due to new building construction to be completed in 2020. Management activities should be designed to account for that disturbance. Additional selective thinning of the evergreen tree species is desirable to promote healthy growth of the remaining trees. Some invasive shrub removal has been done in the north part of the unit. As part of the overall restoration plan the remainder of the population should be controlled by forestry mowing, cut and stump treat, or basal bark treatment. The steep slope in parts of the unit will dictate what methods are used there. Invasive trees should be removed throughout the unit. Some of the dead downed wood could be strategically removed to facilitate future management, while leaving adequate dead wood for habitat purposes. Garlic mustard occurs in patches in the unit. Control should be achieved by either mechanical or chemical treatment. Nettles and other weedy herbaceous species occur in the disturbed soils. These can be treated with herbicides. Follow up treatment of buckthorn and garlic mustard should be scheduled once preliminary management has been accomplished. Planting patches of herbaceous ground layer species could occur in selected areas. Species adapted to a pine litter duff layer will be appropriate here.

Goals:

- Strive for 100% control of buckthorn and honeysuckle throughout the unit by year 2.
- Strive for 100% control of invasive tree species, including Siberian elm, by year 2.
- Thin the pine planting, with a goal of removing 100% of all evergreen trees in the canopy with a DBH of less than 6 inches.
- Use twice annual control to limit flowering and seed dispersal of garlic mustard throughout uplands.
- Manage stinging nettles by chemical treatment to strive for 100% control by year 2.
- Reduce cover of motherwort by 50% by treating with herbicides.
- Plant 5-10 12x12 planting plots using appropriate woodland sedges, grasses, and forbs within 2 years of buckthorn management.

Management Unit K - Nature Center Plantings (4.5 acres)

Lady ferns surrounding a boardwalk in Management Unit K.

MLCCS description: Altered/non-native grassland with sparse deciduous trees – temporarily flooded.
Unit description: This unit was described as altered/non-native grassland during the survey of 2007, however, it generally has a mature tree cover throughout most of the unit and much of the ground layer is not dominated by graminoids, as suggested by its MLCCS description of altered/non-native grassland. This unit includes the built infrastructure of the picnic and play area facilities adjacent to the parking lot, as well as the apiary and developed areas in front of the nature center building including a landscaped pond, waterfall, and decks. Areas within this unit have been manipulated and planted, as it is a more highly visible and highly utilized area of WHNC. Some of the unit is on low ground that may be saturated to occasionally

temporarily flooded, but the unit also contains upland plant communities on the foot of the west facing slope. Trees in the canopy in the wet soils include cottonwood, green ash, hackberry, and boxelder. Trees in the canopy on the higher ground include white oak, red oak, bur oak, American basswood, green ash, and black cherry. White spruce, sugar maple, red maple, swamp white oak, and other species have been planted in the vicinity of the picnic shelter, as well as along the trails throughout the unit. Siberian elm, common buckthorn, Tatarian honeysuckle, and barberry occur as invasive woody species in the subcanopy and understory. Garlic mustard occurs in significant patches throughout the unit. Adjacent to the lower trail below the nature center building, a large area of Canada thistle is established. Other herbaceous weed species include reed canary grass, motherwort, and burdock. Native ground layer species are limited in both diversity and cover, but include lady fern, white snakeroot, cleavers, avens, and zigzag goldenrod.

Management: Because this management unit is centered around the visitor center, much of the area has been planted with trees, shrubs, and wildflowers, more care will be needed in the removal and management of invasive and weed species. A more detailed inventory will be needed to identify desirable species that must be worked around. It will be important to identify keep trees and shrubs and to distinguish them from remove trees and shrubs during management activities in this area. While this area is being inventoried, it is a good time to identify any planted species that are potentially problematic or no longer contribute to WHNC goals. Weedy or invasive trees and shrubs should be removed. Forestry mowing will not be appropriate in much of this unit due to the challenge of working around planted trees and shrubs. More selective methods of removal will likely be needed to avoid impacts to desirable plantings.

Likewise, some of the extensive areas of garlic mustard likely intersect with areas planted with wildflowers. Other herbaceous weed species can also be targeted for control in these high priority areas. These more intensively managed areas will require removal methods and/or timing that minimize impacts to planted wildflowers. Spot treatment will likely be needed in some areas, while more aggressive mechanical or chemical treatment methods may be suitable in other areas. Additional planting of hardy native ground layer species will be desirable in this area to add to the educational and aesthetic value of the unit. Any additional plantings should be planned for locations that were not invaded by garlic mustard, or should be delayed until garlic mustard is adequately controlled.

The shoreland area adjacent to the Y-dock (Figure 9) may provide the best opportunity to control reed canary grass, narrow-leaf cattails, and purple loosestrife in order to establish a pocket of native wetland species that could be highlighted for educational programs. Glyphosate formulated for use over water should be broadcast over a defined section of the area in late August to mid-September. One or more follow-up treatments will be needed the following year. Some native species may establish with the removal of competition from the invasive species. Additional species could be planted. Ongoing maintenance will be required to maintain this planting area. If ongoing maintenance is not reasonable, then the planting should not be attempted. The shoreline in this vicinity could be planted with an appropriate seed mix and shrubs after management of weeds along the shore.

To enhance the flora around the constructed pond feature, sedges tolerant of standing water and shade could be planted around its perimeter. Shade tolerant forbs could be added if they can be protected from herbivory and browsing.

Goals:

- Strive for 100% control of buckthorn and honeysuckle throughout the unit by year 2.
- Strive for 100% control of invasive tree species, including Siberian elm, by year 2.
- Use twice annual control to limit flowering and seed dispersal of garlic mustard throughout uplands.
- Intensive management can be focused on previously planted areas to attempt to recover and reinvigorate those plantings. Reinstall protective deer fencing around planted areas. If planted species do not recover adequately within 2 years, consider replanting areas within deer exclosures.

Y-Dock Shoreland Planting

- Strive for 100% control of cattails and reed canary grass in space around and behind the Y-dock by year 2.
- Plug and/or seed a mix of native emergent/wet meadow grasses, sedges and wildflowers when up to 100% control has been achieved.
- Maintain a program of annual spot treatment within the planting area and a perimeter treatment to prevent vegetative intrusion of reed canary grass and cattails into the planting area from the adjoining area. The perimeter treatment can be used to expand the boundaries of the restored area once native species are successfully established within the initial planting area.

Management Unit L - Westdale Ponds (1.6 Acres)

MLCCS description: The retention ponds were developed after the MLCCS survey was completed, so the survey results no longer apply to this parcel.

Unit description: This built retention/water treatment pond system was installed after 2007 when the MLCCS survey was completed. The ponds were planted/seeded with species appropriate for wet meadow and emergent marsh conditions. The vegetation on the pond edge includes the invasive species reed canary grass and purple loosestrife. Common buckthorn is encroaching from the perimeter of this unit where it occurs amongst pussy willow, red-twigged dogwood, and elderberry. Native wetland forbs occurring around the perimeter of the ponds include marsh milkweed, boneset, joe-pye-weed, blue vervain. Native graminoids include Canada blue joint grass, lake sedge, switchgrass, woolly rush, river bulrush, and prairie cordgrass.

Management: Both reed canary grass and purple loosestrife could be spot treated with glyphosate approved for use over water. If narrow-leaf cattails invade these stormwater ponds, they should be treated as well. There may be areas where larger patches of reed canary grass will require a broadcast treatment. Optimum treatment timing for purple loosestrife will be prior to seed development in mid-summer. Reed canary grass and cattails should be treated in late summer. If large gaps are created in the plant community, reseeding should be considered. Seed could be broadcast as a dormant seeding in late October. Alternatively, plugs could be installed in the gaps.

Goals:

- Strive for 100% control of buckthorn and honeysuckle throughout the unit by year 2.
- Strive for 100% control of invasive tree species, including Siberian elm, by year 2.
- Spot treat reed canary grass, non-native cattails, and purple loosestrife annually to maintain cover of each invasive species at less than 2%.
- Maintain cover of native vegetation at greater than 90%. Reseed or plug gaps in the plant community created by management of invasive species once full control has been obtained.

MLCCS Unit - Open Water (42.0 acres)
MLCCS description: Littoral Open Water

Westwood Lake in summer with open water and cattail edges.

Unit description: Westwood Lake is a DNR public waters. The open water or littoral zone of Westwood Lake is 42 acres in area with a maximum lake depth of 5 feet. Westwood Lake is in the Basset Creek Watershed. The watershed of the landlocked lake is 463 acres. Westwood Lake has no MPCA impairments. Historically, the lake and the surrounding marsh were tile drained. When a drain tile was accidentally broken in 1959, the lake refilled, killing some trees that had established around the perimeter. The lake contains the prohibited invasive species curly-leaf pondweed.

Management: Although complete eradication of curly-leaf pondweed is not feasible, it might be desirable to explore either mechanical or chemical control methods for it if it interferes with the ecological function or recreational use of the lake. If management were to be attempted, DNR permits would be required within this public water. Prevent further spread of curly-leaf pondweed by removing any plant fragments from watercraft before moving them from one body of water to another.

Goals: NA

MLCCS Unit - Emergent Marsh (29.5 acres)
MLCCS description: Semipermanently flooded altered/non-native dominated vegetation

Westwood Lake emergent vegetation.

Unit description: Dominant species in the emergent marsh include the invasive species narrow-leaf cattail, purple loosestrife, and reed canary grass as well as native willow species. Other invasive species include giant reed grass. A few native species of note include tufted loosestrife, marsh milkweed, willow herb, Canada blue joint, and bottlebrush sedge. None of these native species is well represented in the plant community. The existing plant community is neither diverse nor high quality.

Management: No mechanical or chemical treatment is recommended for the Emergent Marsh. Management options and access for mechanical or chemical treatment would be limited due to the high levels of inundation. A hydrological assessment would be required to determine if a complete manipulation of the plant community were even feasible. If management were to be attempted, DNR permits would be required to manage the vegetation within the emergent zone of this public water and long-term follow-up would be needed to

successfully shift the plant community from an invasive dominated community to a native dominated community. The introduction of biological controls for purple loosestrife control was implemented roughly 20 years ago, and do appear to successfully have a negative impact on populations, frequently to the extent of suppressing flower production.

Goals: NA

Management Unit - Pavement/Buildings (1.3 Acres)

MLCCS description: Buildings and pavement with 91-100% impervious cover

Unit description: The footprint of the nature center's buildings and impervious paths and roadways accounts for a relatively small percentage of the overall cover at WHNC.

Management: Consideration should always be given to ways to reduce runoff from impervious surfaces onto natural pervious surfaces. Installation of additional rain gardens may be desirable in some areas. Healthy vegetation in the adjoining natural areas increases infiltration of rainwater and snow melt into the ground, reducing runoff onto paved surfaces from the surrounding higher ground.

Goals: NA

Management Unit - Maintained Turf

MLCCS description: Short grasses and mixed trees with 26-50% impervious cover

Unit description: These areas are mowed turf and shade trees on residential properties documented on the perimeter of the site. These parcels are not labeled on Figure 10.

Management: Management of areas noted as short grasses on the MLCCS survey will be incorporated into the adjacent management units.

Goals: NA

Appendices

Appendix A: Management Unit Observed Species Lists

Key
Native Status: N- Native, I- Introduced, II- Introduced Invasive, C- Cultivated
Physiognomy: C- Climbing, D- Deciduous, E- Evergreen, F- Fern, H- Herbaceous, G- Graminoid
Stratum: T- Tree, S- Shrub, H- Herb, V- Vine
Abundance: A- Abundant, C- Common, O- Occasional, R- Rare

Management Unit A - NE Oak Woodland (MLCCS Units D/J)

Latin Name	Common Name	Native Status	Physiognomy	Stratum	Abundance
Agastache cf. *foeniculum*	hyssop	N	H	H	R
Actaea sp.	baneberry	N	H	H	R
Ageratina altissima	white snakeroot	N	H	H	C
Alliaria petiolata	garlic mustard	II	H	H	C
Aquilegia canadensis	columbine	N	H	H	O
Arctium minus	burdock	I	H	H	O
Asarum canadense	wild ginger	N	H	H	R
Arnoglossum atriplicifolia	pale Indian plantain	I	H	H	O
Athyrium filix-femina	lady fern	N	F	H	O
Blephilia hirsuta	hairy woodmint	N	H	H	
Carex cf. *lacustris*	lake sedge	N	G	H	R
Carex pensylvanica	Pennsylvania sedge	N	G	H	O
Carex sp.	sedge	N	G	H	O
Circaea lutetiana	Enchanter's nightshade	N	H	H	R
Dicentra cucullaria	Dutchman's breeches	N	H	H	O
Enemion biternatum	false rue anemone	N	H	H	R
Epilobium sp.	willow herb	N	H	H	O
Erigeron sp.	fleabane daisy	N	H	H	R
Galium aparine	cleavers	N	H	H	C
Galium sp.	bedstraw	N	H	H	R
Geranium maculatum	wild geranium	N	H	H	R
Geum sp.	avens	N	H	H	C
Glechoma hederacea	creeping Charlie	I	H	H	O
Hackelia virginiana	stickseed	N	H	H	O
Laportia canadensis	wood nettle	N	H	H	O
Leonurus cardiaca	motherwort	I	H	H	O
Matteuccia struthiopteris	ostrich fern	N	F	H	C

Mertensia virginica	Virginia bluebells	N	H	H	R
Mitella diphylla	miterwort	N	H	H	R
Monarda fistulosa	wild lavender bergamot	N	H	H	O
Nepeta cataria	catnip	I	H	H	O
Onoclea sensibilis	sensitive fern	N	F	H	R
Phalaris arundinacea	reed canary grass	II	G	H	C
Phlox divaricata	woodland phlox	N	H	H	R
Polemonium reptans	Jacob's ladder	N	H	H	R
Prunella vulgaris	selfheal	I	H	H	O
Sanguinaria canadensis	bloodroot	N	H	H	R
Solidago canadensis	Canada goldenrod	N	H	H	C
Solidago flexicaulis	zig zag goldenrod	N	H	H	O
Symphyotrichum sp.	aster	N	H	H	O
Thalictrum dioicum	early meadow rue	N	H	H	R
Thalictrum thalictroides	rue anemone	N	H	H	R
Trillium cernuum	nodding trillium	N	H	H	R
Urtica dioica	stinging nettle	N	H	H	O
Viola pubescens	yellow violet	N	H	H	O
Berberis thunbergii	barberry	II	D	S	R
Cornus alternifolia	pagoda dogwood	N	D	S	R
Cornus sericea	red-twigged dogwood	N	D	S	C
Lonicera tatarica	Tatarian honeysuckle	II	D	S	O
Rhamnus cathartica	common buckthorn	II	D	S	A
Rhus sp.	sumac	N	D	S	O
Ribes sp.	gooseberry	N	D	S	O
Rubus sp.	brambles	N	D	S	O
Sambucus sp.	elderberry	N	D	S	O
Toxicodendron rydbergii	poison ivy	N	D	S	C
Zanthoxylum americanum	prickly ash	N	D	S	O
Acer negundo	boxelder	N	D	T	C
Acer rubrum	red maple	N	D	T	O
Acer rubrum 'Burgundy Belle'	red maple	C	D	T	R
Acer saccharum	sugar maple	N	D	T	O
Amelanchier laevis	Allegheny serviceberry	N	D	T	R
Carya cordiformis	bitternut hickory	N	D	T	R
Celtis occidentalis	hackberry	N	D	T	O
Cercis canadensis	eastern redbud	I	D	T	R
Cf. Carpinus caroliniana	musclewood	N	D	T	R
Cornus alternifolia	pagoda dogwood	N	D	T	O
Fraxinus pennsylvanica	green ash	N	D	T	A
Juniperus virginiana	red cedar	N	E	T	R

Malus sp.	apple	I	D	T	R
Morus cf. *alba*	mulberry	N	D	T	R
Ostrya virginiana	ironwood	N	D	T	A
Picea glauca	white spruce	N	E	T	O
Populus deltoides	cottonwood	N	D	T	O
Prunus americana	American plum	N	D	T	R
Prunus pensylvanica	pin cherry	N	D	T	R
Prunus serotina	black cherry	N	D	T	C
Quercus alba	white oak	N	D	T	C
Quercus bicolor	swamp white oak	N	D	T	C
Quercus macrocarpa	bur oak	N	D	T	C
Quercus rubra	red oak	N	D	T	C
Salix nigra	black willow	N	D	T	C
Tilia americana	American basswood	N	D	T	C
Ulmus 'Princeton'	Princeton elm	C	D	T	C
Ulmus pumila	Siberian elm	II	D	T	O
Ulmus rubra	red elm	N	D	T	O
Sicyos angulatus	bur cucumber	N	C	V	O
Vitis riparia	river grape	N	C	V	C

Key
Native Status: N- Native, I- Introduced, II- Introduced Invasive, C- Cultivated
Physiognomy: C- Climbing, D- Deciduous, E- Evergreen, F- Fern, H- Herbaceous, G- Graminoid
Stratum: T- Tree, S- Shrub, H- Herb, V- Vine
Abundance: A- Abundant, C- Common, O- Occasional, R- Rare

Management Unit B - North Shore - Woodland (MLCCS Units C/I)

Latin Name	Common Name	Native Status	Physiognomy	Stratum	Abundance
Ageratina altissima	white snakeroot	N	H	H	O
Alliaria petiolata	garlic mustard	II	H	H	O
Arctium minus	burdock	I	H	H	O
Carex pensylvanica	Pennsylvania sedge	N	G	H	C
Carex sp.	sedge	N	G	H	R
Carex sp.	sedge	N	G	H	O
Cirsium arvense	Canada thistle	II	H	H	O
Cirsium vulgare	bull thistle	II	H	H	O
Euphorbia esula	leafy spurge	II	H	H	O
Geranium maculatum	wild geranium	N	H	H	R
Geum sp.	avens	N	H	H	O
Hydrophyllum virginianum	Virginia waterleaf	N	H	H	O
Impatiens sp.	touch-me-not	N	H	H	O
Leonurus cardiaca	motherwort	I	H	H	O
Lycopus sp.	bugleweed	N	H	H	R
Monarda fistulosa	wild lavender bergamot	N	H	H	O
Muhlenbergia sp.	muhly grass	N	G	H	O
Phalaris arundinacea	reed canary grass	II	G	H	C
Rudbeckia hirta	black-eyed Susan	N	H	H	R
Scutellaria lateriflora	skullcap	N	H	H	R
Solidago canadensis	Canada goldenrod	N	H	H	A
Triosteum perfoliatum	late horse gentian	N	H	H	C
Verbascum thapsus	mullein	I	H	H	O
Verbena urticifolia	white vervain	N	H	H	O
Cornus sericea	red-twigged dogwood	N	D	S	O
Lonicera tatarica	Tatarian honeysuckle	II	D	S	O
Rubus sp.	brambles	N	D	S	C
Salix discolor	pussy willow	N	D	S	O
Viburnum lentago	nannyberry viburnum	N	D	S	R
Abies balsamea	balsam fir	N	E	T	R
Acer negundo	boxelder	N	D	T	A
Acer saccharinum	silver maple	N	D	T	O
Celtis occidentalis	hackberry	N	D	T	O
Cf. *Eleagnus angustifolia*	Russian olive	II	D	T	R

Ulmus rubra	red elm	N	D	T	O
Fraxinus pennsylvanica	green ash	N	D	T	C
Juglans nigra	black walnut	N	D	T	R
Juniperus virginiana	red cedar	N	E	T	R
Picea abies	Norway spruce	N	E	T	O
Picea cf. *glauca*	white spruce	N	E	T	O
Pinus strobus	white pine	N	E	T	O
Populus deltoides	cottonwood	N	D	T	C
Quercus ellipsoidalis	northern pin oak	N	D	T	R
Quercus macrocarpa	bur oak	N	D	T	O
Rhamnus cathartica	common buckthorn	II	D	T	A
Salix nigra	black willow	N	D	T	O
Vitis riparia	river grape	N	C	V	O

Key
Native Status: N- Native, I- Introduced, II- Introduced Invasive, C- Cultivated
Physiognomy: C- Climbing, D- Deciduous, E- Evergreen, F- Fern, H- Herbaceous, G- Graminoid
Stratum: T- Tree, S- Shrub, H- Herb, V- Vine
Abundance: A- Abundant, C- Common, O- Occasional, R- Rare

Management Unit C - NW Oak Woodland (MLCCS Units C/F/O)

Latin Name	Common Name	Native Status	Physiognomy	Stratum	Abundance
Ageratina altissima	white snakeroot	N	H	H	C
Alliaria petiolata	garlic mustard	II	H	H	C
Arctium minus	burdock	II	H	H	O
Cirsium vulgaris	bull thistle	II	H	H	O
Epilobium sp.	willow herb	N	H	H	O
Glechoma hederacea	creeping charlie	I	H	H	O
Hackelia virginiana	stickseed	N	H	H	C
Leonurus cardiaca	motherwort	I	H	H	O
Nepeta cataria	catnip	I	H	H	R
Phalaris arundinacea	reed canary grass	II	G	H	O
Solidago canadensis	Canada goldenrod	N	H	H	C
Urtica dioica	stinging nettles	N	H	H	O
Verbascum thapsus	mullein	I	H	H	O
Cornus sericea	red-twigged dogwood	N	D	S	C
Frangula alnus	glossy buckthorn	II	D	S	C
Rhamnus cathartica	common buckthorn	II	D	S	A
Acer negundo	boxelder	N	D	T	C
Celtis occidentalis	hackberry	N	D	T	O
Fraxinus pennsylvanica	green ash	N	D	T	A
Ostrya virginiana	ironwood	N	D	T	A
Populus deltoides	cottonwood	N	D	T	C
Prunus serotina	black cherry	N	D	T	C
Quercus macrocarpa	bur oak	N	D	T	O
Quercus rubra	red oak	N	D	T	C
Tilia americana	American basswood	N	D	T	C
Ulmus rubra	red elm	N	D	T	O
Vitis riparia	river grape	N	C	V	C

Key
Native Status: N- Native, I- Introduced, II- Introduced Invasive, C- Cultivated
Physiognomy: C- Climbing, D- Deciduous, E- Evergreen, F- Fern, H- Herbaceous, G- Graminoid
Stratum: T- Tree, S- Shrub, H- Herb, V- Vine
Abundance: A- Abundant, C- Common, O- Occasional, R- Rare

Management Unit D - Shrub Carr (MLCCS Units K/L)

Latin Name	Common Name	Native Status	Physiognomy	Stratum	Abundance
Alliaria petiolata	garlic mustard	II	H	H	C
Asclepias incarnata	marsh milkweed	N	H	H	R
Carex lacustris	lake sedge	N	G	H	R
Carex stipata	awl-fruited sedge	N	G	H	O
Cf. *Cuscuta*	dodder	N	H	H	R
Cirsium arvense	Canada thistle	II	H	H	O
Epilobium sp.	willow herb	N	H	H	O
Eupatorium maculatum	joe-pye-weed	N	H	H	R
Eupatorium perfoliatum	boneset	N	H	H	R
Glechoma hederacea	creeping Charlie	I	H	H	O
Lycopus sp.	bugleweed	N	H	H	R
Lythrum salicaria	purple loosestrife	II	H	H	C
Persicaria sagittata	tear thumb smartweed	N	H	H	C
Phalaris arundinacea	reed canary grass	II	G	H	A
Rumex orbiculatus	great water dock	N	H	H	R
Scirpus fluviatilis	river bulrush	N	G	H	O
Scutellaria lateriflora	mad-dog skullcap	N	H	H	R
Solanum dulcamara	nightshade	I	H	H	O
Stellaria longifolia	long-leaf starwort	N	H	H	R
Symphyotrichum sp.	aster	N	H	H	R
Typha sp.	non-N cattail	II	G	H	A
Urtica dioica	stinging nettle	N	H	H	O
Valeriana officinalis	garden heliotrope	II	H	H	O
Cornus sericea	red-twigged dogwood	N	D	S	O
Frangula alnus	glossy buckthorn	II	D	S	O
Rhamnus cathartica	common buckthorn	II	D	S	C
Ribes sp.	gooseberry/currant	N	D	S	O
Salix discolor	pussy willow	N	D	S	C
Sambucus sp.	elderberry	N	D	S	O
Unknown shrub	shrub	N	D	S	O
Acer negundo	boxelder	N	D	T	C

Acer rubrum	red maple	N	D	T	O
Acer saccharinum	silver maple	N	D	T	O
Fraxinus pennsylvanica	green ash	N	D	T	C
Larix laricina	tamarack	N	D	T	C
Populus deltoides	cottonwood	N	D	T	C
Populus sp.	poplar	N	D	T	O
Quercus ellipsoidalis	northern pin oak	N	D	T	O
Salix nigra	black willow	N	D	T	O
Ulmus rubra	red elm	N	D	T	C
Vitis riparia	river grape	N	D	V	O

Key
Native Status: N- Native, I- Introduced, II- Introduced Invasive, C- Cultivated
Physiognomy: C- Climbing, D- Deciduous, E- Evergreen, F- Fern, H- Herbaceous, G- Graminoid
Stratum: T- Tree, S- Shrub, H- Herb, V- Vine
Abundance: A- Abundant, C- Common, O- Occasional, R- Rare

Management Unit E - Oak Woodland (MLCCS Unit L)

Latin Name	Common Name	Native Status	Physiognomy	Stratum	Abundance
Arctium minus	burdock	N	H	H	O
Alliaria petiolata	garlic mustard	II	H	H	C
Arisaema triphyllum	Jack-in-the-pulpit	N	H	H	O
Circaea lutetiana	enchanter's nightshade	N	H	H	O
Glechoma hederacea	creeping Charlie	I	H	H	O
Monarda fistulosa	wild lavender bergamot	N	H	H	R
Phalaris arundinacea	reed canary grass	II	G	H	A
Solidago canadensis	Canada goldenrod	N	H	H	C
Urtica dioica	stinging nettle	N	H	H	O
Rhamnus cathartica	common buckthorn	II	D	S	A
Ribes sp.	Gooseberry/currant	N	D	S	O
Sambucus sp.	elderberry	N	D	S	O
Acer negundo	boxelder	N	D	T	O
Fraxinus pennsylvanica	green ash	N	D	T	C
Picea glauca	white spruce	N	E	T	O
Pinus resinosa	red pine	N	E	T	O
Prunus serotina	black cherry	N	D	T	O
Quercus cf. *macrocarpa*	bur oak	N	D	T	C
Quercus rubra	red oak	N	D	T	C
Tilia americana	American basswood	N	D	T	A
Vitis riparia	river grape	N	C	V	O

Key
Native Status: N- Native, I- Introduced, II- Introduced Invasive, C- Cultivated
Physiognomy: C- Climbing, D- Deciduous, E- Evergreen, F- Fern, H- Herbaceous, G- Graminoid
Stratum: T- Tree, S- Shrub, H- Herb, V- Vine
Abundance: A- Abundant, C- Common, O- Occasional, R- Rare

Management Unit F - Seasonal Meadow (MLCCS Units G/H)

Latin Name	Common Name	Native Status	Physiognomy	Stratum	Abundance
Alliaria petiolata	garlic mustard	II	H	H	O
Arctium minus	burdock	N	H	H	O
Cirsium arvense	Canada thistle	II	H	H	O
Cirsium vulgare	bull thistle	II	H	H	O
Epilobium sp.	willow herb	N	H	H	O
Erigeron sp.	fleabane daisy	N	H	H	R
Hackelia virginiana	stickseed	N	H	H	O
Impatiens sp.	touch-me-not	N	H	H	C
Phalaris arundinacea	reed canary grass	II	G	H	A
Scirpus fluviatilis	river bulrush	N	G	H	O
Solanum dulcamara	nightshade	II	H	H	O
Solidago cf. *canadensis*	Canada goldenrod	N	H	H	C
Typha sp.	narrow-leaf cattail	II	G	H	A
Urtica dioica	stinging nettle	N	H	H	C
Cornus sericea	red-twigged dogwood	N	D	S	O
Rhamnus cathartica	common buckthorn	II	D	S	A
Ribes sp.	gooseberry	N	D	S	C
Rubus sp.	brambles	N	D	S	O
Sambucus sp.	elderberry	N	D	S	O
Unknown shrub	shrub	N	D	S	A
Acer cf. *saccharinum*	silver maple	N	D	T	O
Acer negundo	boxelder	N	D	T	C
Acer rubrum	red maple	N	D	T	O
Celtis occidentalis	hackberry	N	D	T	O
Fraxinus pennsylvanicus	green ash	N	D	T	C
Larix laricina	tamarack	N	D	T	C
Picea cf. *abies*	white spruce	I	E	T	O
Populus deltoides	cottonwood	N	D	T	C
Quercus bicolor	swamp white oak	N	D	T	C
Salix nigra	black willow	N	D	T	O
Celastrus cf. *scandens*	American bittersweet	N	C	V	O
Vitis riparia	river grape	N	C	V	C

Key
Native Status: N- Native, I- Introduced, II- Introduced Invasive, C- Cultivated
Physiognomy: C- Climbing, D- Deciduous, E- Evergreen, F- Fern, H- Herbaceous, G- Graminoid
Stratum: T- Tree, S- Shrub, H- Herb, V- Vine
Abundance: A- Abundant, C- Common, O- Occasional, R- Rare

Management Unit G - Cattail Marsh (MLCCS Unit M)

Latin Name	Common Name	Native Status	Physiognomy	Stratum	Abundance
Calamagrostis canadensis	Canada blue-joint	N	G	H	O
Carex lacustris	lake sedge	N	G	H	O
Cf. *Fallopia convolvulus*	bindweed	I	H	H	R
Cirsium arvense	Canada thistle	II	H	H	O
Epilobium sp.	willow herb	N	H	H	O
Mentha arvensis	field mint	N	H	H	R
Persicaria sagittata	tear thumb smartweed	N	H	H	O
Phalaris arundinacea	reed canary grass	II	G	H	A
Solanum dulcamara	nightshade	II	H	H	O
Solidago cf. *canadensis*	Canada goldenrod	N	H	H	C
Typha sp.	narrow-leaf cattail	II	G	H	A
Urtica dioica	stinging nettle	N	H	H	O
Ribes sp.	gooseberry	N	D	S	O
Ulmus rubra	red elm	N	D	T	O
Salix nigra	black willow	N	D	T	O

Management Unit H - Entry Woodland (MLCCS Unit G)

Latin Name	Common Name	Native Status	Physiognomy	Stratum	Abundance
Acer negundo	boxelder	N	D	T	C
Alliaria petiolata	garlic mustard	II	H	H	O
Rhamnus cathartica	common buckthorn	II	D	S	C
Lonicera tatarica	Tatarian honeysuckle	II	D	S	O
Populus deltoides	cottonwood	N	D	T	C
Ulmus rubra	red elm	N	D	T	C
Glechoma hederacea	creeping Charlie	I	H	H	C
Fraxinus pennsylvanica	green ash	N	D	T	O
Geum sp.	avens	N	H	H	O
Leonurus cardiaca	motherwort	I	H	H	O

Key
Native Status: N- Native, I- Introduced, II- Introduced Invasive, C- Cultivated
Physiognomy: C- Climbing, D- Deciduous, E- Evergreen, F- Fern, H- Herbaceous, G- Graminoid
Stratum: T- Tree, S- Shrub, H- Herb, V- Vine
Abundance: A- Abundant, C- Common, O- Occasional, R- Rare

Management Unit I - Oak Savanna (MLCCS Unit N)

Latin Name	Common Name	Native Status	Physiognomy	Stratum	Abundance
Achillea millefolium	yarrow	N	H	H	O
Ambrosia artemisifolia	ragweed	N	H	H	O
Andropogon gerardii	big bluestem	N	G	H	A
Arctium minus	burdock	I	H	H	O
Bouteloua curtipendula	side-oats grama	N	G	H	O
Bromus inermis	smooth brome	II	G	H	C
Alliaria petiolata	garlic mustard	II	H	H	O
Cf. *Liatris* sp.	blazing star	N	H	H	R
Cf. *Scrophularia* sp.	figwort	N	H	H	R
Cirsium vulgare	bull thistle	I	H	H	R
Euphoria esula	leafy spurge	II	H	H	O
Heliopsis helianthoides	common ox-eye	N	H	H	O
Sonchus sp.	sow thistle	I	H	H	O
Leonurus cardiaca	motherwort	I	H	H	O
Liatris punctata	dotted blazing star	N	H	H	R
Monarda fistulosa	wild lavender bergamot	N	H	H	C
Panicum virgatum	switchgrass	N	G	H	C
Phalaris arundinacea	reed canary grass	II	G	H	A
Ratibida pinnata	gray-headed coneflower	N	H	H	O
Rumex sp.	dock	I	H	H	O
Schizachyrium scoparium	little bluestem	N	G	H	O
Setaria sp.	foxtail	II	H	H	O
Silphium laciniatum	compass plant	N	H	H	O
Silphium perfoliatum	cup plant	N	H	H	O
Solidago canadensis	Canada goldenrod	N	H	H	C
Sorghastrum nutans	indiangrass	N	G	H	O
Symphyotrichum spp.	aster	N	H	H	O
Verbascum thapsus	mullein	I	H	H	R
Verbena cf. *urticifolia*	white vervain	N	H	H	O
Verbena stricta	hoary vervain	N	H	H	C
Lonicera tatarica	honeysuckle	II	D	S	O
Rhamnus cathartica	common buckthorn	II	D	S	C
Acer negundo	boxelder	N	D	T	R
Cf. *Malus* sp.	apple	I	D	T	R

Fraxinus pennsylvanica	green ash	N	D	T	O
Juniperus virginiana	red cedar	N	E	T	O
Populus deltoides	cottonwood	N	D	T	O
Quercus macrocarpa	bur oak	N	D	T	O
Quercus rubra	red oak	N	D	T	O
Ulmus pumila	Siberian elm	II	D	T	O

Key
Native Status: N- Native, I- Introduced, II- Introduced Invasive, C- Cultivated
Physiognomy: C- Climbing, D- Deciduous, E- Evergreen, F- Fern, H- Herbaceous, G- Graminoid
Stratum: T- Tree, S- Shrub, H- Herb, V- Vine
Abundance: A- Abundant, C- Common, O- Occasional, R- Rare

Management Unit J - Pine Planting (MLCCS Unit E)

Latin Name	Common Name	Native Status	Physiognomy	Stratum	Abundance
Alliaria petiolata	garlic mustard	II	H	H	C
Arctium minus	burdock	II	H	H	O
Galium sp.	cleavers	N	H	H	C
Geum sp.	avens	N	H	H	C
Glechoma hederacea	creeping Charlie	I	H	H	O
Hackelia virginiana	stickseed	N	H	H	C
Leonurus cardiaca	motherwort	I	H	H	C
Urtica dioica	stinging nettles	N	H	H	O
Cornus sp.	dogwood	N	D	S	O
Lonicera tatarica	honeysuckle	II	D	S	O
Rhamnus cathartica	common buckthorn	II	D	S	C
Rubus sp.	brambles	N	D	S	C
Zanthoxylum americanum	prickly ash	N	D	S	O
Acer negundo	boxelder	N	D	T	O
Eleagnus angustifolia	Russian olive	II	D	T	R
Fraxinus pennsylvanica	green ash	N	D	T	C
Picea cf. *glauca*	white spruce	N	E	T	C
Pinus resinosa	red pine	N	E	T	C
Pinus strobus	white pine	N	E	T	C
Populus deltoides	cottonwood	N	D	T	C
Populus sp.	poplar	N	D	T	O
Prunus serotina	black cherry	N	D	T	O
Quercus macrocarpa	bur oak	N	D	T	O
Quercus rubra	red oak	N	D	T	C
Thuja occidentalis	white cedar	N	E	T	O
Tilia americana	American basswood	N	D	T	C
Ulmus pumila	Siberian elm	II	D	T	O

Key
Native Status: N- Native, I- Introduced, II- Introduced Invasive, C- Cultivated
Physiognomy: C- Climbing, D- Deciduous, E- Evergreen, F- Fern, H- Herbaceous, G- Graminoid
Stratum: T- Tree, S- Shrub, H- Herb, V- Vine
Abundance: A- Abundant, C- Common, O- Occasional, R- Rare

Management Unit K - Nature Center Plantings (MLCCS Unit G)

Latin Name	Common Name	Native Status	Physiognomy	Stratum	Abundance
Agastache foeniculum	giant blue hyssop	N	H	H	O
Alliaria petiolata	garlic mustard	II	H	H	O
Andropogon gerardii	big bluestem	N	G	H	O
Arctium minus	burdock	II	H	H	O
Asclepias syriaca	common milkweed	N	H	H	R
Caltha palustris	marsh marigold	N	H	H	R
Cf. *Helianthus* spp.	sunflower	N	H	H	O
Echinacea purpurea	purple coneflower	N	H	H	O
Eryngium yuccifolium	rattlesnake master	N	H	H	R
Eutrochium maculatum	joe-pye-weed	N	H	H	R
Glechoma hederacea	creeping Charlie	I	H	H	C
Hasteola suaveolens	Sweet-smelling Indian plantain	N	H	H	O
Impatiens sp.	touch-me-not	N	H	H	C
Iris versicolor	northern blue flag	N	H	H	O
Leonurus cardiaca	motherwort	I	H	H	O
Matteuccia struthiopteris	ostrich fern	N	F	H	O
Panicum virgatum	switchgrass	N	G	H	O
Ratibida pinnata	gray-headed coneflower	N	H	H	O
Rudbeckia cf. *triloba*	brown-eyed Susan	N	H	H	O
Schizachyrium scoparium	little bluestem	N	G	H	O
Setaria sp.	foxtail	I	G	H	O
Silpium perfoliatum	cup plant	N	H	H	O
Symphyotrichum sp.	aster	N	H	H	O
Verbena urticifolia	white vervain	N	H	H	O
Vernonia fasciculata	ironweed	N	H	H	O
Viola canadensis	Canadian white violet	N	H	H	O
Cornus sericea	red-twigged dogwood	N	D	S	O
Lonicera tatarica	Tatarian honeysuckle	II	D	S	O
Rhamnus cathartica	common buckthorn	II	D	S	C
Rubus sp.	brambles	N	D	S	O
Sambucus sp.	elderberry	N	D	S	O
Acer negundo	boxelder	N	D	T	C
Acer saccharum	sugar maple	N	D	T	O
Celtis occidentalis	hackberry	N	D	T	O

Cf. *Morus* sp.	mulberry	II	D	T	O
Ulmus rubra	red elm	N	D	T	O
Fraxinus pennsylvanica	green ash	N	D	T	C
Juniperus virginiana	red cedar	N	E	T	O
Larix laricina	tamarack	N	D	T	O
Malus sp.	crabapple	I	D	T	R
Abies cf. *concolor*	white fir	I	E	T	R
Picea glauca	white spruce	N	E	T	C
Pinus strobus	white pine	N	E	T	O
Populus deltoides	cottonwood	N	D	T	C
Quercus bicolor	swamp white oak	N	D	T	C
Tilia americana	American basswood	N	D	T	C
Vitis riparia	river grape	N	C	V	O

Key
Native Status: N- Native, I- Introduced, II- Introduced Invasive, C- Cultivated
Physiognomy: C- Climbing, D- Deciduous, E- Evergreen, F- Fern, H- Herbaceous, G- Graminoid
Stratum: T- Tree, S- Shrub, H- Herb, V- Vine
Abundance: A- Abundant, C- Common, O- Occasional, R- Rare

Management Unit L - Westdale Ponds (MLCCS Unit P)

Latin Name	Common Name	Native Status	Physiognomy	Stratum	Abundance
Asclepias incarnata	marsh milkweed	N	H	H	O
Asclepias syriaca	common milkweed	N	H	H	O
Calamagrostis canadensis	Canada blue joint grass	N	G	H	O
Carex cf. *lacustris*	lake sedge	N	G	H	O
Eupatorium perfoliatum	boneset	N	H	H	O
Eutrochium maculatum	joe-pye-weed	N	H	H	O
Geum sp.	avens	N	H	H	O
Lythrum salicaria	purple loosestrife	II	H	H	O
Monarda fistulosa	wild lavender bergamot	N	H	H	C
Panicum virgatum	switchgrass	N	G	H	C
Phalaris arundinacea	reed canary grass	II	G	H	A
Scirpus cyperinus	woolly rush	N	G	H	O
Scirpus fluviatilis	river bulrush	N	G	H	O
Spartina pectinata	prairie cordgrass	N	G	H	O
Typha sp.	narrow-leaf cattail	II	G	H	C
Verbena hastata	blue vervain	N	H	H	O
Cornus sericea	red-twigged dogwood	N	D	S	C
Rhamnus cathartica	common buckthorn	II	D	S	C
Salix discolor	pussy willow	N	D	S	O
Sambucus sp.	elderberry	N	D	S	O
Populus deltoides	cottonwood	N	D	T	C
Quercus bicolor	swamp white oak	N	D	T	O
Salix nigra	black willow	N	D	T	C

Key
Native Status: N- Native, I- Introduced, II- Introduced Invasive, C- Cultivated
Physiognomy: C- Climbing, D- Deciduous, E- Evergreen, F- Fern, H- Herbaceous, G- Graminoid
Stratum: T- Tree, S- Shrub, H- Herb, V- Vine
Abundance: A- Abundant, C- Common, O- Occasional, R- Rare

Management Unit - Open Water (MLCCS Unit A)

Latin Name	Common Name	Native Status	Physiognomy	Stratum	Abundance
Lemna trisulca	star duckweed	N	H	A	C
Potamogeton crispus	curly-leaf pondweed	II	H	A	

Management Unit - Emergent Marsh (MLCCS Unit B)

Latin Name	Common Name	Native Status	Physiognomy	Stratum	Abundance
Asclepias incarnata	marsh milkweed	N	H	H	R
Calamagrostis canadensis	Canada blue joint grass	N	G	H	O
Carex comosa	bottlebrush sedge	N	G	H	R
Carex lacustris	lake sedge	N	G	H	O
Cicuta bulbifera	Bulblet-bearing water hemlock	N	H	H	O
Epilobium sp.	willow herb	N	H	H	O
Impatiens sp.	touch-me-not	N	H	H	O
Lysimachia thyrsiflora	whorled loosestrife	N	H	H	O
Lythrum salicaria	purple loosestrife	II	H	H	C
Onoclea sensibilis	sensitive fern	N	H	H	O
Persicaria sagittata	tear thumb smartweed	N	H	H	O
Phalaris arundinacea	reed canary grass	II	G	H	A
Phragmites sp.	giant reed grass	?	G	H	O
Rumex orbiculatus	great water dock	N	H	H	O
Thelypteris palustris	marsh fern	N	H	H	O
Typha sp.	narrow-leaf cattail	II	G	H	A
Cornus sericea	red-twigged dogwood	N	D	S	O
Rubus sp.	brambles	N	D	S	O
Salix discolor	pussy willow	N	D	S	C
Frangula alnus	glossy buckthorn	II	D	S	C
Acer cf. *ginnala*	Amur maple	II	D	T	O

Appendix B: Management Recommendations Outline

Whenever an entity embarks upon the management and enhancement of native ecosystems, they should be prepared to enter a long-term commitment. In fact, a commitment to long-term management is required for projects that receive funding from the Environment and Natural Resources Trust Fund. Up-front expenditures of time and financial resources are often wasted when resources are not allocated for ongoing management. The following tables highlight some of the primary tasks required for restoring the plant communities of each Management Unit at Westwood Hills Nature Center. Short-term and long-term tasks are identified.

^Task Categories

LTM - Long-term management

STM - Short-term management

SP - Site preparation

R - Revegetation

***Seed/Plant Mix Sources**

Custom seed mixes can be designed using the species recommended for each Management Unit in Appendix C or select and use one of the seed mixes developed by the Minnesota native seed producers for specific site conditions.

Standard seed mixes developed by the Board of Soil and Water Resources and the Minnesota Department of Transportation can also be useful for some applications. Some state seed mixes are listed in this table as a reference.
http://www.bwsr.state.mn.us/native_vegetation/state_seed_mixes.pdf

Mngt Unit	Task^ Category	Description	Location	Timing	Seed/Plant Mix*	Notes
A NE Oak Woodland	STM	Control buckthorn, other invasive shrubs	Throughout	Phase II (2017)		See buckthorn management protocol
	LTM	Ongoing buckthorn control	Throughout	Ongoing		See buckthorn management protocol
	STM	Thin existing native trees	Throughout	Phase II (2017)		Some species will require stump treatment
	STM	Control invasive tree species	Throughout	Phase II (2017)		See invasive woody control protocol
	STM	Remove boxelder	Former orchard area	Phase II (2017)		See invasive woody control protocol for stump treatment guidance
	LTM	Manage garlic mustard	Throughout	Ongoing		See garlic mustard management protocol
	STM	Remove dead downed wood	Throughout, emphasis along property boundary	Phase II (2017)		Target 25-50% removal, leaving large diameter trunks with cavities for habitat
	SP	Site preparation	Former orchard area	2017-2018 or as funds available		Follow seeding site prep protocol
	R	Plant trees and shrubs	Former orchard area	As funds available	See Appendix D Planting/Seeding List	Tree planting could occur after seeding site prep
	R	Seed ground layer species	Former orchard area	2017 or 2018 after site prep	36-211 Woodland Edge South & West	
	R	Seed ground layer species	Steep slope facing Westwood Lake	2017	See Appendix D Planting/Seeding List 36-211 Woodland Edge South & West	May choose to use only a limited palette of forbs unless can fence the slope
	R	Seed ground layer species	Shoreline, selected locations	As funds available	34-271 Wet Meadow South & West	Requires management of existing ground layer species; follow seeding site prep protocol
	R	Plant/seed ground layer species	Ravine at bridge	2017	See Appendix D Planting/Seeding List	
	R	Plant shrubs	Shoreline, selected locations	As funds available	See Appendix D Planting/Seeding List	
	R	Plant trees and shrubs	Upland, throughout	Ongoing as opportunities arise	See Appendix D Planting/Seeding List	
	R	Plant/seed ground layer species	Locations not invaded by garlic mustard	Phase I (2015) Phase II (2017), Ongoing as needed	See Appendix D Planting/Seeding List 36-211 Woodland Edge South & West	

Mngt Unit	Task Category	Description	Location	Timing	Seed/Plant Mix*	Notes
B North Shore - Woodland	STM	Control buckthorn, other invasive shrubs	Throughout	Phase II (2107)		See buckthorn management protocol
	STM	Control invasive tree species	Throughout	As funds available		See invasive woody control protocol
	LTM	Manage garlic mustard	Throughout	As funds available		See garlic mustard management protocol
	LTM	Ongoing buckthorn control	Throughout	Ongoing		
	SP	Site preparation	Old field	As funds for seeding are available		Follow seeding site prep protocol
	R	Seed ground layer species	Old field	As funds available	35-641 Mesic Prairie Southeast	If prairie were to be maintained in this location, some of the trees planted in the old field should be removed (i.e. Spruce, Populus, etc.)
	SP	Site preparation	Throughout in areas other than old field and shoreline	As funds available		Follow seeding site prep protocol
	R	Seed ground layer species	Throughout in areas other than old field and shoreline	As funds available	36-211 Woodland Edge South & West	
	R	Plant shrubs	Shoreline, selected locations	As funds available	See Appendix D Seeding/Planting List	
	SP	Site preparation	Shoreline, selected locations	As funds for seeding are available		Follow seeding site prep protocol
	R	Seed ground layer species	Shoreline, selected locations	As funds available	34-271 Wet Meadow South & West 36-211 Woodland Edge South & West	
C NW Oak Woodland	STM	Control buckthorn, other invasive shrubs	Throughout	Phase III		See buckthorn management protocol
	LTM	Ongoing buckthorn control	Throughout	Ongoing		See buckthorn management protocol
	STM	Thin existing native trees	Throughout	Phase III		Some species will require stump treatment
	STM	Control invasive tree species	Throughout	Phase III		See invasive woody control protocol
	LTM	Manage garlic mustard	Throughout	Phase III		See garlic mustard management protocol
	STM	Remove dead downed wood	Throughout, emphasis along property boundary	Phase III		Target 25-50% removal, leaving large diameter trunks with cavities for habitat
	R	Seed ground layer species	Locations not invaded by garlic mustard	Phase III or as funds available	See Appendix D Seeding/Planting List	Sow graminoids only in garlic mustard areas. This unit may not warrant investment in expensive forbs

Mngt Unit	Task Category	Description	Location	Timing	Seed/Plant Mix*	Notes
D Shrub Carr	STM	Control buckthorn, other invasive shrubs	Throughout	Phase III		See buckthorn management protocol
	LTM	Ongoing buckthorn control	Throughout	Ongoing		See buckthorn management protocol
	STM	Control invasive tree species	Throughout	Phase III		See invasive woody control protocol
	LTM	Long term reed canary grass control	Tamarack planting	As funds available		Reduce competition around tamaracks. See reed canary grass management protocol
	LTM	Manage garlic mustard	On higher ground along property boundary	Phase III		See garlic mustard management protocol
	R	Plant shrubs	In areas where extensive buckthorn removed	As funds available	See Appendix D Seeding/Planting List	
E Oak Woodland	STM	Control buckthorn, other invasive shrubs	Throughout	Phase III		See buckthorn management protocol
	LTM	Ongoing buckthorn control	Throughout	Ongoing		See buckthorn management protocol
	STM	Thin existing native trees	Throughout	Phase III		Some species will require stump treatment
	STM	Control invasive tree species	Throughout	Phase III		See invasive woody control protocol
	LTM	Manage garlic mustard	Throughout	Phase III		See garlic mustard management protocol
	STM	Remove dead downed wood	Throughout, emphasis along property boundary	Phase III		Target 25-50% removal, leaving large diameter trunks with cavities for habitat
	R	Seed ground layer species	Upland locations not invaded by garlic mustard	Phase III or as funds available	See Appendix D Seeding/Planting List	Sow graminoids only in garlic mustard areas. Upland areas seeded/planted with forbs should be fenced.
F Seasonal Meadow	STM	Control buckthorn, other invasive shrubs	Throughout	Phase III		See buckthorn management protocol
	LTM	Ongoing buckthorn control	Throughout	Ongoing		See buckthorn management protocol
	STM	Control invasive tree species	Throughout	Phase III		See invasive woody control protocol
	LTM	Long term reed canary grass control	Swamp white oak and tamarack plantings	As funds available		Reduce competition around swamp white oaks and tamaracks. See reed canary grass management protocol
	LTM	Manage garlic mustard	Throughout	Phase III		See garlic mustard management protocol

Mngt Unit	Task Category	Description	Location	Timing	Seed/Plant Mix*	Notes
G Cattail Marsh	STM	Control buckthorn, other invasive shrubs	Throughout	Phase III		See buckthorn management protocol
	LTM	Ongoing buckthorn control	Throughout	Ongoing		See buckthorn management protocol
	STM	Control invasive tree species	Throughout	Phase III		See invasive woody control protocol
	LTM	Control reed canary grass	Throughout, if committed to LTM	As funds available		See reed canary grass management protocol
	LTM	Control narrow-leaf cattails	Throughout, if committed to LTM	As funds available		See cattail management protocol
	R	Seed emergent marsh mix	Throughout, when control obtained	As funds available	34-181 Emergent Wetland	
H Entry Woodland	STM	Thin existing native trees	Throughout	Phase IV		Some species will require stump treatment
	STM	Control invasive tree species	Throughout	Phase IV		See invasive woody control protocol
	LTM	Manage garlic mustard	Throughout	Phase IV		See garlic mustard management protocol
	STM	Control buckthorn, other invasive shrubs	Throughout	Phase IV		See buckthorn management protocol
	LTM	Ongoing buckthorn control	Throughout	Ongoing		See buckthorn management protocol
	R	Seed ground layer species	Under tree cover along entry drive	Phase IV or as funds available	See Appendix D Seeding/Planting List	Sow graminoids only in garlic mustard areas. Upland areas seeded/planted with forbs should be fenced.
	R	Plant trees and shrubs	Where gaps were created	Phase IV or as funds available	See Appendix D Seeding/Planting List	
I Oak Savanna	STM	Remove existing native trees, except oak	Perimeter and pockets in the middle	Phase IV		Some species will require stump treatment
	STM	Control invasive tree species	Perimeter and pockets in the middle	Phase IV		See invasive woody control protocol
	STM	Control buckthorn, other invasive shrubs	Perimeter and pockets in the middle	Phase IV		See buckthorn management protocol
	LTM	Ongoing buckthorn control	Perimeter and pockets in the middle	Ongoing		See buckthorn management protocol
	LTM	Control smooth brome		Ongoing		See smooth brome management protocol
	LTM	Control reed canary grass		Ongoing		See reed canary grass management protocol
	LTM	Manage garlic mustard		Ongoing		See garlic mustard management protocol
	LTM	Control leafy spurge		Ongoing		See leafy spurge management protocol
	LTM	Prescribed burns	on a 3-5 year rotation	Ongoing		Removes thatch to prep for seeding after herbicide treatment and promotes growth of established natives
	R	Interseed	Areas disturbed by tree removal or weed control	Ongoing	See Appendix D Seeding/Planting List	

Mngt Unit	Task Category	Description	Location	Timing	Seed/Plant Mix*	Notes
J Pine Planting	STM	Thin existing native trees, including evergreens	Throughout	Phase IV		The evergreen planting needs thinning to facilitate healthy growth. Some species will require stump treatment
	STM	Control invasive tree species	Throughout	Phase IV		See invasive woody control protocol
	STM	Control buckthorn, other invasive shrubs	Throughout	Phase IV		See buckthorn management protocol
	LTM	Ongoing buckthorn control	Throughout	Ongoing		See buckthorn management protocol
	STM	Remove dead downed wood	Throughout, emphasis along property boundary	Phase IV		Target 25-50% removal, leaving large diameter trunks with cavities for habitat
	LTM	Manage garlic mustard	Throughout	Ongoing		See garlic mustard management protocol
	LTM	Control aggressive undesirable herbaceous species	Throughout	Ongoing		Spot treat/broadcast as needed when nettles, thistles or other aggressive species establish
	R	Seed ground layer species	Areas disturbed by tree removal or weed control, steep slopes for stabilization, high visibility areas	Phase IV or as funds available	See Appendix D Seeding/Planting List	Sow graminoids only in garlic mustard areas. Upland areas seeded/planted with forbs should be fenced.

Mngt Unit	Task Category	Description	Location	Timing	Seed/Plant Mix*	Notes
K Nature Center Plantings	STM	Thin existing native trees	Throughout	Phase IV		Some species will require stump treatment
	STM	Control invasive tree species	Throughout	Phase IV		See invasive woody control protocol
	STM	Control buckthorn, other invasive shrubs	Throughout	Phase IV		See buckthorn management protocol
	LTM	Ongoing buckthorn control	Throughout	Ongoing		See buckthorn management protocol
	STM	Remove dead downed wood	Throughout	Phase IV		Target 25-50% removal, leaving large diameter trunks with cavities for habitat
	LTM	Manage garlic mustard	Throughout	Ongoing		See garlic mustard management protocol
	LTM	Control Canada thistle and other weeds	Disturbed areas throughout	Ongoing		
	R	Seed ground layer species	Areas disturbed by tree removal or weed control, steep slopes for stabilization, high visibility areas	Phase IV or as funds available	See Appendix D Seeding/Planting List	Sow graminoids only in garlic mustard areas. Upland areas seeded/planted with forbs should be fenced.
	R	Plant ground layer species	Locations not invaded by garlic mustard	Phase IV or as funds available	See Appendix D Seeding/Planting List	
	R	Plant shrubs	Shoreline, selected locations	Phase IV or as funds available	See Appendix D Seeding/Planting List	
	R	Plant trees and shrubs	Upland, throughout	Ongoing as opportunities arise	See Appendix D Seeding/Planting List	
	R	Plant sedges and wildflowers	Pond	As funds available	See Appendix D Seeding/Planting List	
	SP	Control reed canary grass/non-native cattails/purple loosestrife	Y-Dock	Phase II		See reed canary grass and cattail management protocols; glyphosate formulated for use over water will control purple loosestrife when treated simultaneously with reed canary grass and cattails.
	R	Seed emergent marsh mix	Y-Dock	Phase II	34-181 Emergent Wetland	
	LTM	Post-seeding spot treatment of reed canary grass/non-native cattails/purple loosestrife	Y-Dock Planting	Ongoing		See reed canary grass and cattail management protocols
L Westdale Ponds	LTM	Control reed canary grass	Throughout	Ongoing		See reed canary grass management protocol
	LTM	Control purple loosestrife	Throughout	Ongoing		Spot treat with glyphosate formulated for use over water
	LTM	Control narrow-leaf cattails	Throughout	Ongoing		See cattail management protocol
	R	Revegetate by seeding or plugs		As needed	33-261 Stormwater South & West	Where treatment of invasives creates gaps in the plant community

Appendix C: Recommended Species Planting Lists

Management Unit Focus Areas for seeding or planting in units A, B, C, E, H, J, and K

A1 - Steep west-facing slopes along lakeshore
A2 - Fenced planted plots
A3 - Old orchard where boxelder was removed
A4 - Perimeter along east woodland edge
A5 - Areas where aggressive weeds have been controlled
A6 - Interior
B1 - Throughout, wherever buckthorn was removed
C1 - Throughout
E1 - High ground
H1 - Throughout
J1 - Under the pines
J2 - Fenced planted plots
J3 - Perimeter along woodland edge
K1 - Areas where aggressive weeds have been controlled
K2 - Fenced planted plots
K3 - General use

Life Form

F - Forb
FF - Fern
G - Graminoid
S - Shrub
T - Tree
V- Vine

Propagule Type

S - Seed
P - Plug
C - Container
CC - Cuttings

Woodland/Forest/Forest Edge

Species list for use in Management Units A, B, C, E, H, J, and K

Latin Name	Common Name	Life Form	Propagule Type	Management Unit Focus Area
Adiantum pedatum	maidenhair fern	FF	C	A2
Athyrium filix-femina	lady fern	FF	C	A2
Matteuccia struthiopteris	ostrich fern	FF	C	A
Achillea millefolium	yarrow	F	S	A1
Actaea rubra	red baneberry	F	P C	A2
Agastache foeniculum	blue giant hyssop	F	S P	A1 A3 A4
Ageratina altissima	white snakeroot	F	S	A3 H1
Allium tricoccum	wild leek	F	P C	A2 K2
Amphicarpaea bracteata	hog peanut	F	S	A6 H1
Anemone acutiloba	sharp-lobed hepatica	F	C	A2 K2
Anemone americana	round-lobed hepatica	F	P C	J2
Anemone quinquefolia	wood anemone	F	P C	J2
Anemone virginiana	tall thimbleweed	F	S P	A1 J1
Apocynum androsaemifolium	spreading dogbane	F	S	A1 A4 H1 J1 J3
Aquilegia canadensis	columbine	F	S	A1 A2 A4 B1 C1 E1 H1 J1 J3 K2
Aralia nudicaulis	wild sarsaparilla	F	C	A2 K2
Aralia racemosa	spikenard	F	C	K2
Asarum canadense	wild ginger	F	P C	A2 J2 K2
Asclepias exaltata	poke milkweed	F	S	A2 K2

Campanula rotundifolia	harebell	F	S	A1
Caulophyllum thalictroides	blue cohosh	F	P C	A2 K2
Coreopsis palmata	prairie tickseed	F	S	A1 A3
Desmodium glutinosum	pointed-leaved tick trefoil	F	S P	A2
Dicentra cucullaria	dutchman's breeches	F	P C	A2 K2
Enemion biternatum	false rue anemone	F	P C	A2 K2
Eurybia macrophylla	large-leaf aster	F	S P C	A B C E H J K
Eutrochium purpureum	Sweet joe pye weed	F	S P C	A1 A3 A4 K3
Fragaria virginiana	common strawberry	F	P C	A1 A4 B1 J3
Galium boreale	northern bedstraw	F	S P	A1 A3 B1
Galium triflorum	sweet-scented bedstraw	F	S	A B C E H J K
Geranium maculatum	wild geranium	F	P	A2 K2
Helianthus strumosus	woodland sunflower	F	S P	A1 A3 A4 B1 H1 J3
Heuchera richardsonii	alumroot	F	S	A1
Hydrophyllum virginianum	Virginia waterleaf	F	S P	A B C E H J K
Maianthemum canadense	Canada mayflower	F	P C	J2
Monarda fistulosa	wild bergamot	F	S P C	A1 A3 A4 H1 J3
Monarda punctata	dotted horsemint	F	S	A1
Osmorhiza claytonii	sweet cicely	F	P C	A B C E H J K
Phlox divaricata	blue phlox	F	P C	A2 K2
Phyrma leptostachya	lopseed	F	S	A B C E H J K
Polemonium reptans	Jacob's ladder	F	P C	A2 K2
Polygonatum biflorum	giant Solomon's seal	F	C	A2 J2 K2
Rudbeckia hirta	black-eyed Susan	F	S	A1 A3
Sanguinaria canadensis	bloodroot	F	P C	A2 J2 K2
Smilacina racemosa	false solomon's seal	F	C	A2 J2 K2
Smilax herbacea	smooth carrion flower	F	S	A2 J2 K2
Solidago flexicaulis	zig-zag goldenrod	F	S P C	A B C E H J K
Solidago ulmifolia	elm-leaved goldenrod	F	S P	A1 A2 A4 H1 J1 J2 K2
Symphyotrichum ciliolatum	Lindley's aster	F	S	A B C E H J K
Symphyotrichum cordifolium	blue wood aster	F	S P C	A B C E H J K
Symphyotrichum ericoides	heath aster	F	S	A1 A3
Symphyotrichum lateriflorum	side-flowering aster	F	S P	A B C E H J K
Thalictrum dioicum	early meadow-rue	F	S P C	A B C E H J K
Thalictrum thalictroides	rue anemone	F	P	A2
Trillium grandiflorum	large-flowered trillium	F	C	A2 K2
Triosteum perfoliatum	late horse gentian	F	S	A1 A3 A4 H1 J3
Uvularia grandiflorum	large-flowered bellwort	F	P C	A2 K2
Veronicastrum virginicum	Culver's root	F	S P	A1 A3
Viola pubescens	yellow violet	F	P C	A B C E H J K
Viola sororia	blue violet	F	P	A2

Zizia aurea	golden alexanders	F	S P	A1 A3
Bouteloua curtipendula	side-oats grama	G	S	A1 A3
Brachyelytrum erectum	bearded shorthusk	G	S	A B C E H J K
Bromus ciliatus	fringed brome	G	S	A B C E H J K
Carex blanda	bland sedge	G	S	A B C E H J K
Carex deweyana	Dewey's sedge	G	S P	A B C E H J K
Carex gracillima	graceful sedge	G	S P	A B C E H J K
Carex grisea	wood gray sedge	G	S	A B C E H J K
Carex hirtifolia	hairy wood sedge	G	S	A B C E H J K
Carex pedunculata	long-stalked sedge	G	S	A B C E H J K
Carex pensylvanica	Pennsylvania sedge	G	S P	A B C E H J K
Carex radiata	eastern star sedge	G	S P	A1
Carex sprengelii	Sprengel's sedge	G	S P	A B C E H J K
Elymus hystrix	bottlebrush grass	G	S P	A B C E H J K
Elymus villosus	silky wild rye	G	S P	A B C E H J K
Festuca subverticillata	nodding fescue	G	S	A B C E H J K
Juncus tenuis	path rush	G	S P	A1 A3
Oryzopsis asperifolia	mountain rice grass	G	S	A B C E H J K
Schizachyrium scoparium	little bluestem	G	S P	A1 A3 B1
Cornus alternifolia	pagoda dogwood	S	C	A6 K3
Cornus amomum	round-leaved dogwood	S	C	H1 K3
Cornus racemosa	gray dogwood	S	C	A3 A6 B1 H1 K3
Corylus americana	American hazelnut	S	C	A1 A3 A4 A5 B1 H1 J1 J3
Corylus cornuta	beaked hazelnut	S	C	A1 A3 A4 A5 B1 H1 J1 J3
Diervilla lonicera	bush honeysuckle	S	C	A1 J1 K3
Prunus virginiana	common chokecherry	S	C	A3 A6 E1 J1 K3
Rhus typhina	staghorn sumac	S	C	B1
Ribes americanum	American black currant	S	C	A4 J1 J3 K1
Ribes cynosbati	pasture gooseberry	S	C	A4 J1 J3 K1
Ribes missouriense	Missouri gooseberry	S	C	A4 J1 J3 K1
Rosa arkansana	prairie wild rose	S	C	A1 A3 A4 J3 K3
Rosa blanda	smooth wild rose	S	C	A1 A3 A4 J3 K3
Sambucus canadensis	American elder	S	C	B1 K3
Sambucus pubens	red-berried elder	S	C	A3 B1 K3
Symphoricarpos albus	snowberry	S	C	A1 A3 A4 B1 H1 J1 J3
Viburnum rafinesquianum	downy arrow-wood	S	C	H1 K3
Acer rubrum	red maple	T	C	
Acer saccharum	sugar maple	T	C	
Amelanchier spp.	serviceberry	T	C	A3
Carya cordiformis	bitternut hickory	T	C	A
Celtis occidentalis	hackberry	T	C	A3 B1

Crataegus mollis	downy hawthorn	T	C	A3
Ostrya virginiana	Ironwood	T	C	A3
Populus tremuloides	quaking aspen	T	C	B1
Prunus americana	American plum	T	C	A3 B1
Prunus pensylvanica	pin cherry	T	C	A3 B1
Prunus serotina	black cherry	T	C	A3 B1
Quercus alba	white oak	T	C	A3 B1
Quercus bicolor	swamp white oak	T	C	
Quercus macrocarpa	bur oak	T	C	A3 B1
Quercus rubra	northern red oak	T	C	A3 B1
Tilia americana	American basswood	T	C	A3
Ulmus 'Princeton'	Princeton elm	T	C	A3
Lonicera dioica	wild honeysuckle	V	C	A2 K2
Parthenocissus inserta	Virginia creeper	V	C	J1

Oak Savanna/Prairie

Species list for use in Management Units B and I. An inexpensive seed mix could be used as a temporary ground cover in parts of the old orchard during the establishment of a tree planting.

Latin Name	Common Name	Life Form	Propagule Type
Agastache foeniculum	giant blue hyssop	F	S P
Anemone cylindrica	long-headed thimbleweed	F	S
Asclepias syriaca	common milkweed	F	S
Asclepias tuberosa	butterfly-weed	F	S P
Asclepias verticillata	whorled milkweed	F	S
Aster ericoides	heath aster	F	S
Astragalus canadensis	Canada milkvetch	F	S
Baptisia lactea (B. alba/B. leucantha)	white wild indigo	F	S C
Coreopsis palmata	prairie coreopsis	F	S
Dalea candida	white prairie clover	F	S
Dalea purpurea	purple prairie clover	F	S
Desmodium canadense	Canada tick trefoil	F	S
Echinacea purpurea	purple coneflower	F	S P
Galium boreale	northern bedstraw	F	S
Heliopsis helianthoides	common ox-eye	F	S P
Lespedeza capitata	round-headed bush clover	F	S
Liatris ligulistylis	meadow blazing star	F	S P
Liatris punctata	dotted blazing star	F	S P
Liatris pycnostachya	prairie blazing star	F	S P
Monarda fistulosa	wild bergamot	F	S P
Monarda punctata	horse mint	F	S P
Physalis heterophylla	clammy ground cherry	F	S
Potentilla arguta	prairie cinquefoil	F	S
Pycnanthemum virginianum	Virginia mountain mint	F	S
Ratibida pinnata	gray-headed coneflower	F	S
Rudbeckia hirta	black-eyed Susan	F	S
Solidago flexicaulis	zig-zag goldenrod	F	S P
Solidago nemoralis	gray goldenrod	F	S P
Solidago ptarmicoides	upland goldenrod	F	S P
Solidago rigida	stiff goldenrod	F	S P
Solidago speciosa	showy goldenrod	F	S P
Symphyotrichum oolentangiense	sky blue aster	F	S P
Symphyotricum laeve	smooth aster	F	S P
Thalictrum dasycarpum	tall meadow-rue	F	S
Tradescantia ohiensis	Ohio spiderwort	F	S P

Verbena stricta	hoary vervain	F	S P
Veronicastrum virginicum	Culver's root	F	S
Zizia aurea	golden alexanders	F	S
Andropogon gerardii	big bluestem	G	S
Bouteloua curtipendula	side oats grama	G	S
Bromus ciliatus	fringed brome	G	S
Bromus	hairy wood chess	G	S
Carex bicknellii	Bicknell's sedge	G	S
Carex scoparia	pointed broom sedge	G	S
Danthonia spicata	poverty oat grass	G	S
Elymus canadensis	Canada wild rye	G	S
Elymus villosus	silky wild rye	G	S
Muhlenbergia	muhly grass	G	S
Panicum virgatum	switchgrass	G	S
Schizachyrium scoparium	little bluestem	G	S
Sorghastrum nutans	indiangrass	G	S
Sporobolus heterolepsis	prairie dropseed	G	S
Amorpha canescens	leadplant	S	S C
Rosa arkansana	prairie rose	S	S C
Symphoricarpos occidentalis	wolfberry	S	C

Shoreland/Wet Meadow/Emergent Marsh

Species list for use in the emergent marsh and seasonal wetland zones of Management Units A, B, D, E, F, G, K

Life Form		Propagule Type	Wetland Zone
F - Forb	S - Shrub	S - Seed	E - Emergent Marsh
FF - Fern	T - Tree	P - Plug	M - Wet Meadow or
G - Graminoid	V- Vine	C - Container	Seasonal Wetland
		CC - Cuttings	

Latin Name	Common Name	Life Form	Propagule Type	Wetland Zone	Mngt Unit
Acorus calamus	sweetflag	F	S	E	A
Alisma triviale	common water plantain	F	S	E	A
Anemone canadensis	Canada anemone	F	S C	M	A D
Arisaema triphyllum	jack-in-the-pulpit	F	S P	M	A K
Asclepias incarnata	marsh milkweed	F	S P	M	A D
Bidens sp.	bur marigold, beggar's ticks	F	S	E M	A
Boltonia asteroides	false white aster	F	S	M	A D F K
Caltha palustris	marsh marigold	F	S P C	M	A F K
Campanula americana	tall bellflower	F	S	M	F K
Circaea lutetiana	enchanter's nightshade	F	S	M	A K
Eutrochium maculatum	Joe-pye weed	F	S P	M	A D F
Eutrochium perfoliatum	boneset	F	S P	M	A D F
Helenium autumnale	sneezeweed	F	S	M	A D
Impatiens capensis	touch-me-nots	F	S	M	A D F K
Impatiens pallida	touch-me-nots	F	S	M	A D F K
Iris versicolor	northern blue flag	F	S P C	E M	A D F K
Lycopus americanus	cut-leaved bugleweed	F	S	M	A
Lycopus asper	rough bugleweed	F	S	M	A
Mentha arvensis	field mint	F	S	M	A D F
Monarda fistulosa	wild bergamot	F	S P	M	A
Polygonum amphibium	water smartweed	F	S	E M	A
Pycnanthemum virginianum	Virginia mountain mint	F	S P	M	A
Rudbeckia laciniata	tall coneflower	F	S	M	A F K
Sagittaria latifolia	broad-leaved arrowhead	F	S	E	A
Silphium perfoliatum	cupplant	F	S	M	A
Sium suave	water parsnip	F	S	E	A
Sparganium eurycarpum	bur reed	F	S	E	A
Stachys palustris	hedge nettle	F	S	M	A D F
Symphyotrichum lanceolata	eastern panicled aster	F	S	M	A D F
Symphyotrichum puniceum	red-stemmed aster	F	S P	M	A D F
Symphyotrichum umbellatum	flat-topped aster	F	S P	M	A D F K
Teucrium canadense	germander	F	S	M	A D F
Thalictrum dasycarpum	tall meadow-rue	F	S	M	A D F K
Verbena stricta	blue vervain	F	S P	M	A D
Veronicastrum virginicum	Culver's root	F	S P	M	A D F K
Vernonia fasciculata	ironweed	F	S	M	A D
Zizia aurea	golden alexanders	F	S P	M	A D F
Onoclea sensibilis	sensitive fern	FF	C	M	A D F K

Thelypteris palustris	marsh fern	FF	C	M	A D F K
Calamagrostis canadensis	Canada blue joint grass	G	S	E M	A D F
Carex comosa	bottle brush sedge	G	S	E	A D F K
Carex hystericina	porcupine sedge	G	S	M	A
Carex interior	interior sedge	G	S	M	A
Carex lacustris	lake sedge	G	S	E	A D F
Carex pellita	woolly sedge	G	S	M	A
Carex pseudocyperus	cyperus sedge	G	S	E M	A D F K
Carex stipata	awl-fruited sedge	G	S	M	A
Carex vulpinoidea	fox sedge	G	S	M	A
Elymus virginicus	Virginia wild rye	G	S	M	A K
Leersia virginica	white grass	G	S	M	A
Panicum virgatum	switchgrass	G	S	M	A
Scirpus atrovirens	green bulrush	G	S	M	A
Scirpus cyperinus	wool sedge	G	S	E M	A D F
Scirpus fluviatilis	river bulrush	G	S	E	A
Scirpus validus	soft-stem bulrush	G	S	E	A
Spartina pectinata	prairie cordgrass	G	S	M	A
Aronia melanocarpa	black chokeberry	S	C	M	A
Cephalanthus occidentalis	buttonbush	S	C	M	A K
Cornus amomum	silky dogwood	S	C	M	A F K
Cornus sericea	red-twigged dogwood	S	C CC	M	A D F K
Salix discolor	pussy willow	S	CC	M	D F
Salix interior	sandbar willow	S	CC	M	D F
Salix petiolaris	slender willow	S	CC	M	D F
Sambucus canadensis	common elder	S	C	M	A F K
Spiraea alba	meadowsweet	S	C	M	A D
Spiraea tomentosa	steeplebush	S	C	M	A D
Viburnum lentago	nannyberry viburnum	S	C	M	A
Viburnum trilobum	cranberry bush viburnum	S	C	M	A D F K
Acer negundo	boxelder	T		M	
Acer rubrum	red maple	T	C	M	
Acer saccharinum	silver maple	T	C	M	
Alnus incana	speckled alder	T	C	E M	
Celtis occidentalis	hackberry	T	C	M	
Fraxinus pensylvanica	green ash	T		M	
Larix laricina	tamarack	T	C	M	
Picea mariana	black spruce	T	C	M	
Populus deltoides	cottonwood	T	C	M	
Quercus bicolor	swamp white oak	T	C	M	
Salix nigra	black willow	T		M	
Tilia americana	American basswood	T	C	M	
Ulmus rubra	red elm	T		M	

Appendix D: Species Planted or Seeded at WHNC

Species known to have been planted and seeded at WHNC. Lists developed from invoices (2005 -2016) provided by Great River Greening and WHNC. Some trees included on the list were planted, but were not documented by the invoices. The lists are likely incomplete.

Herbaceous species seeded in Unit A in 2017.

Latin Name	Common Name
Agastache foeniculum	blue giant hyssop
Anemone virginiana	tall thimbleweed
Aquilegia canadensis	columbine
Campanula rotundifolia	harebell
Coreopsis palmata	prairie tickseed
Eutrochium purpureum	sweet joe-pye weed
Galium boreale	northern bedstraw
Helianthus strumosus	woodland sunflower
Heuchera richardsonii	alumroot
Hydrophyllum virginianum	Virginia waterleaf
Monarda fistulosa	wild bergamot
Monarda punctata	horsemint
Rudbeckia hirta	black-eyed Susan
Solidago ulmifolia	elm-leaved goldenrod
Symphyotrichum ciliolatum	Lindley's aster
Symphyotrichum cordifolium	blue wood aster
Symphyotrichum ericoides	heath aster
Symphyotrichum lateriflorum	side-flowering aster
Thalictrum dioicum	early meadow-rue
Veronicastrum virginicum	Culver's root
Zizia aurea	golden alexanders
Bouteloua curtipendula	side oats grama
Bromus ciliatus	fringed brome
Carex gracillima	graceful sedge
Carex grisea	wood gray sedge
Carex radiata	eastern star sedge
Carex sprengelii	Sprengel's sedge
Elymus hystrix	bottlebrush grass
Elymus villosus	silky wild rye
Festuca subverticillata (obtusa)	nodding fescue
Juncus tenuis	path rush
Schizachyrium scoparium	little bluestem

Herbaceous species planted in Unit A in 2017 with quantities.

Latin Name	Common Name	Qty
Allium tricoccum	wild leek	48
Anemone americana	round-lobed hepatica	20
Anemone quinquefolia	wood anemone	20
Anemone virginiana	tall thimbleweed	12
Aquilegia canadensis	columbine	36
Asarum canadense	wild ginger	40
Athyrium filix-femina	lady fern	20
Campanula rotundifolia	harebell	36
Caulophyllum thalictroides	blue cohosh	16
Dicentra cucullaria	Dutchman's breeches	20
Diervilla lonicera	bush honeysuckle	8
Enemion biternatum	false rue anemone	48
Eurybia macrophylla	large-leaf aster	60
Fragaria virginiana	common strawberry	84
Galium boreale	northern bedstraw	24
Geranium maculatum	wild geranium	60
Helianthus strumosus	woodland sunflower	36
Hydrophyllum virginianum	Virginia waterleaf	36
Maianthemum stellatum	starry false solomon's seal	10
Osmorhiza claytonii	sweet cicely	10
Phlox divaricata	blue phlox	36
Polemonium reptans	Jacob's ladder	36
Polygonatum biflorum	giant Solomon's seal	12
Rosa blanda	smooth wild rose	8
Smilacina racemosa	false solomon's seal	36
Solidago flexicaulis	zig-zag goldenrod	72
Symphyotrichum ciliolatum	Lindley's aster	36
Symphyotrichum cordifolium	blue wood aster	36
Symphyotrichum ericoides	heath aster	24
Symphyotrichum lateriflorum	side-flowering aster	24
Thalictrum dioicum	early meadow-rue	36
Thalictrum thalictroides	rue anemone	10
Viola pubescens	yellow violet	24
Viola sororia	common blue violet	36
Bromus ciliatus	fringed brome	84
Carex deweyana	Dewey's sedge	114
Carex gracillima	graceful sedge	84
Carex pensylvanica	Pennsylvania sedge	300
Carex radiata	eastern star sedge	114

Carex sprengelii	Sprengel's sedge	186
Elymus hystrix	bottlebrush grass	120
Elymus villosus	silky wild rye	96
Juncus tenuis	path rush	36

Herbaceous species planted or seeded 2005-2016.

Latin Name	Common Name	Qty	Planted
Actaea rubra	red baneberry	8	A
Adiantum pedatum	maidenhair fern	16	A
Anemone canadensis	Canada mayflower	30	A
Aralia racemosa	spikenard	8	A
Asarum canadense	wild ginger	34	A
Asclepias tuberosa	butterfly-weed	10	A
Athyrium filix-femina	lady fern	18	A
Dicentra cucullaria	Dutchman's breeches	16	A
Echinacea purpurea	purple coneflower	10	A
Geum triflorum	prairie smoke	5	A
Liatris punctata	dotted blazing star	5	A
Rudbeckia hirta	black-eyed Susan	10	A
Solidago flexicaulis	zig-zag goldenrod	5	A
Tradescantia ohiensis	Ohio spiderwort	5	A
Trillium grandiflorum	large-flowered trillium	10	A
Uvularia grandiflorum	large-flowered bellwort	10	A
Aquilegia canadensis	wild columbine	204	B
Blephilia hirsuta	hairy wood mint	48	B
Campanula americana	tall bellflower	48	B
Clematis virginiana	virgin’s bower	60	B
Elymus hystrix	bottlebrush grass	48	B
Fragaria virginiana	wild strawberrry	12	B
Geranium maculatum	wild geranium	198	B
Isopyrum biternatum	false rue anemone	180	B
Maianthemum canadense	Canada mayflower	48	B
Sanguinaria canadensis	bloodroot	114	B
Solidago flexicaulis	zig-zag goldenrod	48	B
Solidago ulmifolia	elm-leaved goldenrod	48	B
Festuca subverticillata	nodding fescue	Seed	C

*A 1-gallon containers planted in 2005, 2006, and 2007

*B Plugs or 4" pots planted in 2015 and 2016 in Management Unit A

*C Seeded in Management Unit A

Trees planted in the Old Orchard Area in May and June 2017.

Latin Name	Common Name	Qty
Amelanchier laevis	Allegheny serviceberry	4
Carya cordiformis	bitternut hickory	5
Celtis occidentalis	hackberry	4
Prunus americanus	American plum	4
Prunus pensylvanica	pin cherry	2
Quercus alba	white oak	4
Quercus alba*	white oak	~25
Quercus macrocarpa	bur oak	8
Quercus macrocarpa*	bur oak	~25
Quercus rubra	red oak	8
Tilia americana	American basswood	8

*Bareroot seedlings, MN locally sourced; all others container trees of various sizes sourced from Outback Nursery.

Trees and Shrubs planted in Management Units A, B, D, E, and F. List based on invoices from 2005 to 2013 and trees found on the ground.

Latin Name	Common Name	Qty
Abies balsamea	balsam fir	10
Acer rubrum	red maple	20
Acer rubrum 'Burgundy Belle'	Burgundy Belle red maple	
Acer saccharinum	silver maple	56
Acer saccharum	sugar maple	43
Acer saccharum 'Fall Fiesta'	Fall Fiesta sugar maple	45
Acer x freemanii 'Autumn Blaze'	Autumn Blaze maple	4
Alnus rugosa	speckled alder	40
Amelanchier x *grandiflora*	serviceberry	7
Carpinus caroliniana	blue beech	10
Celtis occidentalis	hackberry	28
Cornus racemosa	gray dogwood	20
Cornus sericea	red-twigged dogwood	15
Corylus americana	American hazelnut	55
Crataegus mollis	downy hawthorn	5
Juniperus virginiana	eastern red cedar	16
Larix laricina	tamarack	16
Malus 'Spring Snow'	Spring Snow crabapple	1
Parthenocissus inserta	Virginia creeper	30
Picea mariana	black spruce	18
Pinus strobus	white pine	16
Populus deltoides	cottonwood	5
Populus deltoides 'Siouxland'	Siouxland cottonwood	23
Populus tremuloides	quaking aspen	32
Prunus serotina	black cherry	32
Prunus virginiana	common chokecherry	10
Quercus alba	white oak	31
Quercus bicolor	swamp white oak	49
Quercus macrocarpa	bur oak	
Quercus rubra	northern red oak	55
Rhus typhina	staghorn sumac	15
Ribes americanum	American black currant	10
Ribes cynosbati	pasture gooseberry	10
Salix interior/S. discolor	willow live stakes	100
Sambucus canadensis	American elder	35
Sambucus pubens	red-berried elder	120
Tilia americana	American basswood	19
Ulmus 'Princeton'	Princeton elm	
Viburnum lentago	nannyberry viburnum	10
Zanthoxylum americanum	prickly ash	40
Total		1051

Appendix F: Management Goals

Restoration Goals

The goals summarized here can also be found in the narrative for each management unit. The specific quantitative goals defined here for each management unit may be adjusted if unforeseen site conditions or budget constraints don't allow fulfillment of a specific goal.

Management Unit A - NE Oak Woodland (22.3 acres)

Goals:

- Strive for 100% control of buckthorn, honeysuckle, and barberry in woodland and along shoreline by year 2.
- Seed 0.72 acres of steep slope along shoreline with a mix of native sedges, grasses, and wildflowers. Achieve 75% ground cover by year 4.
- Plant 13 additional wildflower exclosures to facilitate re-establishment of native wildflowers, sedges and grasses.
- Plant 1.5 acres of cleared land on the north end with a diverse mix of desirable hardwood tree species by year 2.
- Control non-native ground layer vegetation in this area and seed a perennial native cover crop to achieve 80% native cover by year 3.
- Strive to control 100% garlic mustard in high priority areas, including in the areas around the wildflower exclosures.
- Monitor and prevent establishment of new populations of garlic mustard.

Management Unit B - Northshore (6.4 acres)

Goals:

- Strive for 100% control of buckthorn and honeysuckle throughout the unit by year 2.
- Strive for 100% control of additional invasive tree species or tree species inappropriate for the plant community from throughout the unit by year 5.

Forestry mowed areas

- Manage ground layer vegetation to reduce cover of non-native herbaceous species to not more than 25% cover.
- At approximately year 2 or 3 after the shredded buckthorn material has degraded sufficiently and cover of introduced/invasive ground layer species has been controlled, sow seed mixes composed of robust, readily available native species with emphasis on graminoids. Achieve 85% native cover by year 5.

Old field

- Dormant overspray to control cool season grasses to reduce cover by 75%. Spot treat Canada goldenrod to reduce cover by 60%. Interseed with native prairie seed mix including grasses, sedges, and wildflowers.

Management Unit C - NW Oak Woodland (9.5 acres)

Goals:

- Strive for 100% control of buckthorn, honeysuckle and barberry throughout the unit by year 2.
- Strive for 100% control of invasive tree species, including Siberian elm, by year 2.

- Use twice annual control to limit flowering and seed dispersal of garlic mustard throughout uplands.
- Control non-native ground layer vegetation in the uplands, reducing cover to less than 10%.
- Seed zones where management has been most effective with a native woodland seed mix to achieve 50% native cover by year 3. Use a seed mix heavy on sedges, with some native grasses and wildflowers.

Management Unit D - Shrub Carr (10.0 Acres)

Goals:

- Strive for 100% control of buckthorn throughout the unit by year 2.
- Strive for 100% control of invasive tree species, including Siberian elm, by year 2.
- Strive for 100% control of garden heliotrope throughout the unit by year 4.
- Annually treat the reed canary grass around each planted tamarack to reduce competition OR treat reed canary grass throughout the planted area to reduce cover to less than 10% by year 2.
- If there is not adequate regeneration of native species after reed canary grass is controlled, seed with a mix of appropriate species (wet meadow) to achieve at least 75% cover.
- Plant shrubs appropriate for shrub carr habitat in 25% of the area where buckthorn has been controlled.

Management Unit E - Oak Woodland (4.0 Acres)

Goals:

- Strive for 100% control of buckthorn and honeysuckle throughout the unit by year 2.
- Strive for 100% control of invasive tree species, including Siberian elm, by year 2.
- Use twice annual control to limit flowering and seed dispersal of garlic mustard throughout uplands.
- Control non-native ground layer vegetation in the uplands, reducing cover to less than 10%.
- Seed or plug zones where management has been most effective using a native woodland seed mix to achieve 50% native cover by year 3. Use a seed mix heavy on woodland sedges, with some native woodland grasses and aggressive wildflowers.

Management Unit F - Seasonal Meadow (9.4 Acres)

Goals:

- Strive for 100% control of buckthorn throughout the unit by year 2.
- Strive for 100% control of invasive tree species, including Siberian elm, by year 2.
- Annually treat the reed canary grass around each planted tamarack and swamp white oak to reduce competition OR treat reed canary grass throughout the planted area to reduce cover to less than 10% by year 2.
- If there is not adequate regeneration of native species after reed canary grass is controlled, seed with a mix of appropriate species (wet meadow) to achieve at least 75% cover.

Management Unit G - Cattail Marsh (5.5 acres)

Goals:

- Strive for 100% control of cattails and reed canary grass throughout the unit by year 2.
- Seed unit with a mix of appropriate species (emergent marsh and/or wet meadow) to achieve at least 90% cover.
- Strive for 100% control of buckthorn and invasive trees throughout the unit by year 2.

As noted in the Management text, restoration of this unit is not advisable if adequate site preparation treatments cannot be implemented to obtain full control and if seeding the area with a diverse emergent marsh/wet meadow seed mix is not feasible and if a commitment to follow-up management cannot be made.

Management Unit H - Entry Woodland (3.8 acres)

If this unit is not included in the new development plans, the following goals may be appropriate:
Goals:

- Strive for 100% control of buckthorn and honeysuckle throughout the unit by year 2.
- Strive for 100% control of invasive tree species, including Siberian elm, by year 2.
- Use twice annual control to limit flowering and seed dispersal of garlic mustard throughout uplands.
- Thin trees by 10-25% to open up around desirable keep trees. Plant shrubs with wildlife food and cover values in understory with an anticipated mature cover of 10-25%.
- Seed entire unit with a native shade appropriate mix of grasses to achieve a cover of at least 90% by year 3.

Management Unit I - Oak Savanna (3.0 Acres)

Goals:

- Maintain cover of leafy spurge at less than 2%.
- Reduce cover of other non-native herbaceous broadleaf weeds, including burdock to less than 5%.
- Strive to remove 100% of non-native woody vegetation.
- Strive to remove 100% of all woody native species other than oak.
- Seed bare spots created by removal of woody and herbaceous species by seeding a mix of quick establishing aggressive native grasses and wildflowers to achieve 90% cover by year 3 post-seeding.
- Reduce cover of smooth brome using a combination of spring prescribed burns and spring or fall dormant over-sprays.

Management Unit J - Pine Planting (5.7 acres)

Goals:

- Strive for 100% control of buckthorn and honeysuckle throughout the unit by year 2.
- Strive for 100% control of invasive tree species, including Siberian elm, by year 2.
- Thin the pine planting, with a goal of removing 100% of all evergreen trees in the canopy with a DBH of less than 6 inches.
- Use twice annual control to limit flowering and seed dispersal of garlic mustard throughout uplands.
- Manage stinging nettles by chemical treatment to achieve 100% control by year 2.
- Reduce cover of motherwort by 50% by treating with herbicides.
- Plant 5-10 12x12 planting plots using appropriate woodland sedges, grasses, and forbs within 2 years of buckthorn management.

Management Unit K - Nature Center Plantings (4.5 acres)

Goals:

- Strive for 100% control of buckthorn and honeysuckle throughout the unit by year 2.
- Strive for 100% control of invasive tree species, including Siberian elm, by year 2.
- Use twice annual control to limit flowering and seed dispersal of garlic mustard throughout uplands.
- Intensive management can be focused on previously planted areas to attempt to recover and reinvigorate those plantings. Reinstall protective deer fencing around planted areas. If planted species do not recover adequately within 2 years, consider replanting areas within deer exclosures.

Y-Dock Shoreland Planting

- Strive for 100% control of cattails and reed canary grass in space around and behind the Y-dock by year 2.
- Plug and/or seed a mix of native emergent/wet meadow grasses, sedges and wildflowers when up to 100% control has been achieved.
- Maintain a program of annual spot treatment within the planting area and a perimeter treatment to prevent vegetative intrusion of reed canary grass and cattails into the planting area from the adjoining area. The perimeter treatment can be used to expand the boundaries of the restored area once native species are successfully established within the initial planting area.

Management Unit L - Westdale Ponds (1.6 Acres)

Goals:

- Strive for 100% control of buckthorn and honeysuckle throughout the unit by year 2.
- Strive for 100% control of invasive tree species, including Siberian elm, by year 2.
- Spot treat reed canary grass, non-native cattails, and purple loosestrife annually to maintain cover of each invasive species at less than 2%.
- Maintain cover of native vegetation at greater than 90%. Reseed or plug gaps in the plant community created by management of invasive species once full control has been obtained.

Appendix G: Invasive Species Management Protocols

Complete eradication of some invasive species from a site is often not an attainable goal once they have become well established. A more realistic goal is to achieve a reduction of cover and ongoing management over time. In general, any given invasive species should not dominate and compromise the integrity of the ecosystem. However, even this goal is not practical for some populations of invasive species such as the narrow-leaf cattails and reed canary grass that dominate the marsh surrounding Westwood Lake. For invasive populations that are reasonable to manage, inputs in the short-term are required, as well as a long-term commitment. Establishment and maintenance of a diverse native plant community can help prevent further invasion.

Overview of Management Strategies

There are a range of effective treatment options for invasive species management. The trade-offs in terms of cost, effectiveness, and collateral impacts should all be factored in when making management decisions. Some treatment options may not be practical for any number of reasons including lack of equipment access, disruption to visitor access, etc. Prescribed burns, biological control, and various chemical or mechanical treatments can be considered as management options. Combinations of treatment methods often offer better control.

Mechanical: Mechanical control can include girdling, mowing, haying, cutting, and physical removal by hand-pulling or digging. Properly timed mowing can achieve some management objectives, particularly for managing annual weeds or in lieu of a prescribed burn when prescribed burn objectives cannot be met due to the lack of appropriate burn conditions. Forestry mowing in winter that shatters the base of woody stems can lead to the death of an invasive tree by desiccation under the right winter conditions. Hand removal can be effective for small populations or when groups of volunteers can be organized to work through an area.

Prescribed Burns: Fire can serve a few of functions in the maintenance and management of native ecosystems. It is an effective tool for maintaining fire dependent grassland and woodland ecosystems which require periodic fires to remove thatch or leaf litter, return nutrients to the soil, and set back invasive species. The timing of fire in various ecosystems can be used to impact woody or herbaceous invasive species that are in a susceptible life stage. Fire can be used as a tool to facilitate herbicide treatments by removing thatch either in preparation for herbicide treatment or as a follow-up to herbicide treatment. Fire can also be used to remove thatch or litter in preparation for seeding or interseeding.

Chemical: The herbicide product, herbicide formulation, timing of application, site conditions, target species, and proximity to non-target species must all be factored in when designing an herbicide treatment plan. A range of herbicide products are available to use selectively for specific restoration applications. Herbicide treatments can be broadcast or spot treatments depending on the density of the target species and the composition and density of the surrounding desirable species. Herbicides can be applied by a variety of different methods, including foliar, basal bark, or cut stem treatments. Herbicides

for selective or broad spectrum applications can be chosen to either fine tune a response or to treat large contiguous areas of invasive or weed species.

Biological Control: Biological control agents are available for a handful of invasive species. At WHNC, leafy spurge and purple loosestrife are potential candidates for treatment with biological control agents. At this site, the density and extent of leafy spurge may not be enough to sustain a population of biological control agents. Purple loosestrife is abundant enough around Westwood Lake to support biological control, which was implemented roughly 20 years ago. Biological control will not typically eliminate an invasive species, but rather, is more likely to reduce populations to tolerable levels at which the native plant community can also express itself. Staff have seen an impact resulting in loosestrife flowering suppression, suggesting that the cycle of control is still active.

Cultural Control: Preventing new invasions plays a role in habitat management as well. There are several best practices that can minimize the potential of invasive species to establish. In general, maintaining a stable, healthy and diverse plant community in forest, prairie, and wetland ecosystems will be one key to preventing invasions. Human caused disturbances, such as uncontrolled foot traffic that kills vegetation or causes compaction or high water levels that drown native vegetation, are examples of disturbances that create conditions that favor invasive species. It is likely that impacts from foot traffic can be mitigated by redirecting and managing traffic flow patterns. On the other hand, high water levels caused by runoff from surrounding impervious surfaces is not a condition that can likely be resolved easily, if at all.

To prevent or limit introductions of invasive species on public lands, the Minnesota DNR has implemented Operational Order 113, 'Come Clean, Leave Clean'. Many of these common sense protocols can be used in the setting of an urban park reserve as well.
http://www.dnr.state.mn.us/invasives/dnrlands.html

Recommendations for management treatments to control invasive species at WHNC are outlined below.

Forbs

Garlic Mustard (*Alliaria petiolata*)

Description

Garlic mustard is native to Europe. In Minnesota, it is listed as a restricted noxious weed. Garlic mustard invades woodlands, riparian forests, and disturbed ground along forested roadsides, trails and waterways. Its proliferation in Minnesota native ecosystems has had a significant impact on forest understory habitats. It is able to spread aggressively, create large monocultures, outcompete native forest ground layer species, and displace ecologically important components of the native flora. Habitat suitability for native wildlife is severely reduced where garlic mustard has taken hold.

Garlic mustard is an early season biennial herb with coarsely toothed, alternate, triangular to heart-shaped leaves that release a garlic-like smell when crushed. Evergreen basal rosettes are produced from seeds the first year. In the second year, the rosettes mature and bolt, producing erect, 1- to 3-foot tall stalks. Small 4-petaled white flowers develop into slender 1-2.5 inch long seed capsules, each with a single row of oblong black seeds. Garlic mustard reproduces via the prolific seed it generates. A single garlic mustard plant drops hundreds of seeds that remain viable in the seed bank for up to five years. The seeds are readily dispersed initially from the tall stiff flowering stems that catapult the seed away from the mother plant and secondarily via soil displacement during erosion events and when soil containing the seed is picked up on the feet of wildlife or humans or on tools and equipment. Eradication of garlic mustard may not be feasible. However, there are areas that are a higher priority for control. Strategies for control include maintaining zero tolerance for seed production in priority areas. Volunteers can be utilized to monitor and prevent establishment of new isolated populations.

Mechanical

If a population of garlic mustard is small enough, the best option for control is to manually pull the plants before they develop seed and bag them for removal. If the infestation is too large or too dense for hand removal, Weed whipping or mowing are viable control options. It is essential to mow before the plant flowers because garlic mustard will continue to develop seeds even after being cut. It is recommended to mow vegetative plants to the ground with a flail mower to shred the plant and prevent seed production. If the plant is in flower or past flower, mowing will spread the seed and increase the infestation footprint. Careful attention to sensitive native plants around the mowed areas will need to be taken to ensure they are not impacted. Mowed garlic mustard may form new flowers; however the plant will be much shorter and will typically produce fewer seeds. A second mowing is sometimes needed to treat the regrowth.

In fire dependent ecosystems, prescribed fire is an effective management tool against first year garlic mustard, if there is sufficient fuel to carry a fire. Second year garlic mustard will potentially sprout following a burn, so follow up treatment is required. Prescribed fire is best used as part of an integrated management approach in which mechanical or chemical control are used as a follow-up treatments. Spot treating small populations with a propane torch can be effective on garlic mustard seedlings. Where garlic mustard is found growing amongst native wildflowers, it should be hand pulled. Garlic

mustard pulled when it is flowering or in seed should be bagged in black plastic bags and allowed to "cook" to kill the seed.

Chemical
Garlic mustard can be chemically treated with glyphosate in early spring before flowering or in the late fall when native plants are dormant. Glyphosate is a nonselective herbicide and will kill all plants including forbs, grasses, sedges and woody species. Triclopyr, a broadleaf specific herbicide can be used to control garlic mustard when native species are dormant or when garlic mustard is growing amongst grasses and sedges. Monitoring and follow-up treatment will be necessary.

Long-term Management
Because garlic mustard is such a prolific seed producer and because the seed is readily transported in soil from neighboring populations, it is likely that seedlings will appear for many years in areas that have previously been treated. Monitoring and follow-up treatment will be needed annually.

Garlic Mustard

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Burn									
Foliar Herbicide									
Cut Stem Herbicide									
Mow									
Don't mow									
Flowering									

Common Burdock (*Arctium minus*)

Description

Burdock is a biennial native to Europe. In the plant's first year, it forms a rosette, similar in appearance to rhubarb. The rosette can reach 3 feet across, with large, heart-shaped leaves. In its second year, the plant develops a branched, 3- to 7-foot tall hollow stem. The grooved stem can be green or reddish-purple in color, with tapered leaves along its length. Leaves are dark green, coarse-textured above and woolly beneath, with wavy margins. The plant arises from a large, fleshy taproot. Flowering occurs from July until frost. The pink to purple flowers of this member of the Aster Family occur in heads that are about ¾ inch wide. The thistle-like flower heads are surrounded by spiny bracts with hooks at the tip. Flowers heads are clustered at the ends of branches and in leaf axils along the stem. The mature flower heads become burs that facilitate seed dispersal by clinging to clothing and hair. A single plant produces an average of 15,000 seeds.

Common burdock occurs along roadsides and ditch banks, as well as in pastures and other disturbed areas, where the plant effectively outcompetes desirable species by shading them out with its large basal leaves. Burdock generally prefers moist, nitrogen-rich soils, but will grow in a variety of soils.

Mechanical

Cultivation can be used to control small plants. For larger plants, the entire plant needs to be removed which can be challenging because of the long taproot. Severing the tap root as deep as possible with a shovel or parsnip predator can knock the plant back, if not kill it completely. Mowing the rosette or lopping the flowering stalk when it is in bud or recently flowered will prevent the plant from seeding or at least significantly reduce the amount of seed the plant produces. Mowing the plant when it begins to bolt (send up a flower stalk) will allow time for a second mow later in the year to control any resprouts. If burdock has already gone to seed, clip and bag the seed heads to prevent seed dispersal. Prescribed fire can kill young burdock and top kill older plants if there is sufficient fuel to carry a burn.

Chemical

Apply 2,4-D, glyphosate, or triclopyr as a foliar application to the first year rosette. Foliar herbicide treatment may only top-kill the plant, Follow-up treatment may be required. Alternatively, cut the plant below the basal leaves and stump treat the tap root with glyphosate before the bud stage.

Long-Term Management

In fire adapted plant communities, prescribed burns can alter the conditions of the site to favor the establishment of native species that can compete with burdock. Fire will also accelerate removal of nutrients including nitrogen which favors burdock.

Common Burdock

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Burn									
Foliar Herbicide									
Cut Stem Herbicide									
Mow									
Flowering									

Canada Thistle (*Cirsium arvense*)

Description

This Eurasian member of the Aster Family was introduced to North America in the early 1600s, and is now one of the most tenacious and economically important agricultural weeds. It is listed as a noxious weed in 43 states. This perennial has an extensive root system with horizontal roots extending 15 feet or more and vertical roots which may grow to 15 feet deep. Its extensive rhizomatous growth allows it to form large clones. Canada thistle's ability to rapidly spread both by rhizomes and prolific seed make it particularly difficult to manage.

Canada thistle emerges as a small rosette in late-April to early-May, but new shoots can emerge during most of the growing season. Leaves are irregularly lobed with small spines along the margins. The upper surface of mature leaves is dark green, with a paler underside. Mature plants reach two-five feet in height and begin flowering in June. The numerous magenta florets are arranged in ¾"-1" diameter heads. By July the seeds are windborne on their delicate pappus, and can be found throughout the landscape. Canada thistle may produce 1,000 to 1,500 seeds per flowering stalk and seeds can remain viable in the seed bank up to twenty years. Canada thistle grows in meadows, prairies, fields, pastures and waste places with a variety of site conditions including full sun or part-shade exposure, and wet or dry soils.

Mechanical

Mowing or cutting Canada thistle may be effective if repeated on a regular basis until the plant's root reserves are depleted. The optimal time to mow Canada thistle is when the buds are formed or early flowering stage. Mowing should be avoided after seeds have developed, as it may disperse the seed. Clipping and bagging seed heads can be done in smaller populations.

Chemical

Foliar treat Canada thistle with clopyralid, glyphosate, or triclopyr. Glyphosate can be used for careful spot treatment or when broadcast treating in areas where there is no cover of desirable species. Clopyralid, a broadleaf herbicide for use particularly on members of the Aster and Legume family, is useful for control of Canada thistle where cover of native species is high. Herbicide should be applied during the rosette stage for best results, but can be applied up until flower buds are formed and again in the fall. Repeat treatments are required. Herbicide can also be applied to cut stems for treatment of small areas. It is essential to apply herbicide to each stem that may be connected by rhizomes. Any missed stems will allow the clone to survive. Continued follow-up treatments will be needed.

Biological

There are biological control agents available for thistle control. However, caution is warranted as the available weevils have been observed feeding on native thistles.

Long-term Management

Prescribed fire can have mixed results for Canada thistle control and is best used as part of an integrated management program. Using prescribed fire to increase the health and diversity of fire dependent native plant communities is a recommended tactic.

Canada Thistle

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Burn									
Foliar Herbicide									
Cut Stem Herbicide									
Mow									
Don't mow									
Flowering									

Bull Thistle (*Cirsium vulgare*)

Description

Bull thistle is a biennial herbaceous plant which develops a rosette in the first year and then sends up a 3-6 foot flowering stalk the second season. The plant is prickly, with spine-tipped lobes on the leaves and stems with prominent ridges armed with spines. The upper surface of the leaves is rough to the touch. Bull thistle is in the composite or Aster Family, so the purple florets are arranged in dense flower-heads. Seeds with their attached plumes are dispersed by wind and may persist in the seed bank for 10 years or more. Bull thistle readily invades disturbed prairies, as well as low quality pastures, fallow fields, and roadsides. It is readily identifiable in over-stocked pastures where the livestock have grazed around it. It is not a significant problem in high quality natural areas where it cannot easily get a foothold.

Mechanical

Bull thistles can be cut or mowed prior to their going to seed. If seeds have developed, the plant material should be removed from the site. Severing the tap root as deep as possible with a shovel or parsnip predator can kill the plant. This method can be used for rosettes or flowering plants.

Chemical

Bull thistles can be spot treated with glyphosate, clopyralid, triclopyr, or metsulfuron while they are in the rosette stage.

Biological

There are biological control agents available for thistle control. However, caution is warranted as the available weevils have been observed feeding on native thistles.

Long-term Management

Maintaining a vigorous, diverse plant community is a first line of defense against invasion by bull thistle. When bull thistle is present, simply cutting off and removing the inflorescences can prevent additional seed inputs to the system.

Bull Thistle

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Foliar Herbicide									
Mow									
Flowering									

Crown Vetch (*Coronilla varia*)

Description

Crown vetch is a perennial legume, native to Eurasia. It reproduces both by seed and vegetatively by rhizomes, forming large patches. Its sprawling growth habit allows it to rapidly cover and shade out native vegetation. A single plant may fully cover 70 to 100 square feet within a four-year period. Leaves are pinnately compound with 15 to 25 pairs of oblong leaflets. The two-toned pink and white flowers are arranged in umbels on long stalks. Slender finger-like seedpods develop after bloom. The mechanism of seed dispersal is not known, however animals likely play a role, since some populations turn up miles from a nearby seed source. Crown vetch blooms from May through August, during which time it is very conspicuous with its profuse pink blossoms.

Crown vetch has been grown extensively in the northern two-thirds of the United States as a temporary ground cover, for erosion control, and as a green fertilizer crop. It prefers open, sunny areas; typically occurring along roadsides, other rights-of-way, and in open fields and prairies. Where it establishes, it readily displaces native plants and decreases biodiversity.

Mechanical

Crown vetch can be mowed in June when the plant is flowering. Mowing slows the growth of the plant and removes thatch, making future chemical applications more efficient. Repeated mowing can be used to negatively impact the plant long-term. Plants can be pulled where infestations are small and soil conditions are amenable.

Prescribed fire can be helpful in removing thatch to facilitate herbicide treatments; and it can kill some small plants and can impact the growth of larger plants. However, prescribed fire is not enough to control crown vetch and should be integrated with other control methods.

Chemical

Chemical applications are currently the most effective management strategy. Glyphosate, clopyralid, and triclopyr can all be used for foliar treatment. Glyphosate is non-selective and may not be a viable choice for managing small scattered populations in established native plant communities. Clopyralid and triclopyr are both broadleaf specific and can be used where native grasses are established. Follow-up treatments will be required to ensure mature plants are controlled and to manage seedlings that establish from the seed bank.

Long-term Management

Crown vetch can readily invade established native plant communities. Monitoring and ongoing management will be required to maintain control of previously treated locations and to identify and treat new invasions.

Crown Vetch

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Burn/Foliar									
Foliar Herbicide									
Mow									
Flowering									

Leafy Spurge (*Euphorbia esula*)

Description

Leafy spurge is native to Eurasia. Plants are characterized by white milky sap and flower parts in three's. The erect, perennial herb is 2 to 3½ feet tall. Smooth stems arise in clusters from a vertical root that extends many feet into the ground. Leaves are alternate and lance-shaped on upper stems and scale-like on the lower stem. Inconspicuous flowers are surrounded by showy yellow-green bracts. Bracts open in late May, while flowers bloom June into fall. Leafy spurge is an aggressive invasive and once present, can completely overtake large areas of open land. Leafy spurge tolerates moist to dry soil in sun or part shade. It is most aggressive in dry conditions where competition from native plants is reduced. It is capable of invading disturbed prairies, savannas, pastures, fallow fields, and roadsides. Leafy spurge reproduces readily by seeds, which may remain viable in the soil for at least seven years. Seed capsules open explosively, dispersing seed up to 15 feet from the parent plant. Leafy spurge spreads vegetatively at a rate of several feet per year. The root system may reach 15 or more feet into the ground, and also spreads laterally. Buds at the base of the stem sprout when the plants are grazed or mowed.

Mechanical

An integrated approach that combines prescribed burning, chemical treatment, and/or biological controls is ideal. If biological control agents are introduced, other treatments must be timed so they don't impact the biological control agents. Spring fires can reduce the number of new seedlings.

Chemical

Treating leafy spurge is tough in any situation, but when it occurs in an established prairie, it is particularly difficult to manage without collateral damage to desirable native species, even when carefully attempting to spot treat it. If the leafy spurge occurs in a discreet area and not throughout the unit, it may be necessary to sacrifice some forbs to obtain control. A mix of chemicals will be more effective for treatment. Glyphosate, quinclorac, and 2,4-D are an effective mix when applied in June at flowering and again in September prior to senescence. Glyphosate, of course is a broad spectrum herbicide and will kill both graminoids and forbs, so must be used with caution or avoided in high quality areas. Leafy spurge can also be treated with broadleaf specific herbicides only to avoid impacts to native grasses. Chemical treatment will be needed for several years. Efficacy of chemical treatments may be improved when combined prescribed fire.

Biological

Biological control agents can be obtained and released to control spurge. The flea beetle, *Aphthona lacertosa*, has been found to be particularly effective against leafy spurge in Minnesota. Adult flea beetles feed on leafy spurge foliage, while the larvae feed on the roots, damaging or killing the plant. Control can take 3-10 years to achieve depending on the size of the site, density of the invasion, and other environmental factors. Chemical treatments can negatively impact the biological control agents, so consideration should be given to these impacts prior to incorporating herbicide treatments.

Cultural

Leafy spurge can invade and thrive in established prairies. The best method of control is prevention.

Long-term Management

Once leafy spurge has established a seed bank, it is very difficult to eradicate. Biological control can be used to maintain populations at low levels.

Leafy Spurge

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Burn*									
Foliar Herbicide									
Mow									
Don't mow									
Flowering									

Motherwort (*Leonurus cardiaca*)

Description

Motherwort is a perennial, herbaceous plant in the mint family. Originally from Eurasia, it is widely established around the world due to its use as a medicinal herb. Motherwort is found in both sun and shade, often in highly disturbed sites, and is becoming particularly common and problematic in many woodland sites. Motherwort is 2-4 feet tall. As is typical of members of the mint family, the stem is square and the leaves are opposite. The leaves are variable in shape, with 3 or 5 sharply-pointed lobes, and deeply toothed margins. The flowers are arranged in whorls at the nodes where the leaf stalks meet the stem. The small, tubular, lavender flowers are generally hairy or fuzzy and bloom from June through August. The seeds have spiny burs that catch in clothing or animal fur.

Mechanical

Digging or hand-pulling motherwort can effectively control the plant if all of the root is removed. Continuous mowing or whipping can reduce the vigor of the plant over time and reduce seed production.

Chemical

Applying glyphosate or triclopyr prior to seed production can effectively control motherwort. Follow-up applications are required for plants that germinate from the seed bank.

Long-term Management

Planting and seeding native species to provide competition will help suppress and eliminate motherwort.

Motherwort

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Burn									
Foliar Herbicide									
Mow									
Flowering									

Birds-foot Trefoil (*Lotus corniculatus*)

Description

Birds-foot trefoil is a low-growing perennial, native to Eurasia and North Africa. It was introduced into the United States for erosion control and livestock forage and is still sold commercially. Birds-foot trefoil is a member of the Legume Family. Its compound clover-like leaves are alternate with three oval leaflets and a pair of stipules. Bundles of yellow, pea-like flowers develop from May to August. Brown cylindrical seed pods develop after flowering in clusters that resemble a bird's foot. Birds-foot trefoil produces a long taproot that may extend over three feet. It also has rhizomes that form secondary roots. Stolons, or modified above-ground stems, allow it to form dense mats. The plant reproduces by seeds and spreads laterally by stolons and rhizomes. Birds-foot trefoil tolerates a wide range of soil conditions and is found along roadsides, in fields, prairies, wildlife openings, and other open disturbed areas. Burning increases seed germination allowing the plant to spread rapidly in areas where it is established.

Mechanical

Mowing is not an optimal treatment for birds-foot trefoil, which responds quickly to being mowed and will regrow within a couple of weeks. Continuous monitoring and mowing would be required to prevent it from going to seed. Continuously mowing birds-foot trefoil at a 2" height periodically throughout the year for several years may eventually kill the plant. However, doing so will obviously also harm native plants in the mowed area. Birds-foot trefoil is plastic in its growth form and in some settings adapts to frequent mowing by growing as a low-profile ground-hugging plant, thereby avoiding the mower blades. Birds-foot trefoil can be hand-pulled in areas where it has only very low cover and the soils are light. Severing the tap root as deep as possible with a shovel or parsnip predator can kill the plant.

Prescribed fire is not recommended as the sole management strategy as it increases seed germination; however, it can be part of an integrated approach to increase effectiveness of other methods. A spring burn will remove thatch, exposing the soil and stimulating germination from the seed bank. Such timing will increase the effectiveness of herbicide applications and accelerate the depletion of the seed bank.

Chemical

Triclopyr applied to fast growing plants before flowering, or glyphosate applied in spring before or during flowering will kill birds-foot trefoil. Clopyralid, a broadleaf herbicide selective for members of the aster and legume families, can also be used to control birds-foot trefoil. Follow-up applications will be required over several years to manage new plants establishing from the seed bank.

Long-term Management

Maintaining a healthy diverse, plant community that limits light to the soil is the best defense against invasion by birds-foot trefoil.

Birds-foot Trefoil

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Burn									
Foliar Herbicide									
Mow									
Don't mow									
Flowering									

Purple Loosestrife (*Lythrum salicaria, L. virgatum*)

Description

Introduced as an ornamental to North America from Europe and Asia, purple loosestrife is now an invasive species in wetlands, lakeshores, and ditches. It replaces native vegetation in the habitats it invades, forming dense stands with low wildlife food or cover value. Plants are 2-7 feet tall, with an upright habit. Leaves are slender, oblong-oval and downy, with smooth margins. Leaves are arranged in opposite pairs or whorls of 3. Stems are variously 4, 5, or 6-sided and feel grooved to the touch. Reddish-purple, 5-7-petaled flowers are produced in terminal spikes, with flowering from lateral stems as well. Flowering occurs in mid-summer. Purple loosestrife produces as many as 2 million seeds per plant each year. Seeds are efficiently dispersed by moving water and by animals. Purple loosestrife root systems consist of fibrous roots as well as rhizomes, allowing it to spread vegetatively as well as by seed.

Mechanical

Hand-pulling or digging purple loosestrife is not recommended. Any pieces of the roots that are missed when a plant is removed by pulling or digging can resprout. Mowing could be used to reduce seed inputs, but is often not practical due to the wet site conditions that loosestrife is typically found in. Follow-up treatments will be needed to control the resprouts.

Chemical

Where purple loosestrife is established in smaller accessible populations, it can be controlled by herbicide treatment. It may be possible to time the treatment when other herbaceous species, such as reed canary grass, are being controlled. Glyphosate formulated for use over water will likely be needed as the purple loosestrife typically grows in wetlands. Herbicide treatment for purple loosestrife should be timed for July through August. Herbicide treatment will be most effective in this window and the plants are readily identifiable while they are in bloom. Treating while in bloom also preempts additional seed inputs into the seed bank. Small populations can be treated by spot spraying with a glyphosate product formulated for use over water (Rodeo, Aquaneat, etc.). To ensure no seed is produced, small populations can be deadheaded as they are treated. Bag the inflorescences and remove from the site. Permits are required for treating aquatic weeds within the boundaries of state protected waters.

Biological

Biological control is effective at reducing populations of purple loosestrife in large wetland systems. Biological control agents could be introduced to the large emergent marsh surrounding Westwood Lake. Four species of insects have been approved as biological control agents, two leaf eating beetles, a root boring beetle, and a flower feeding beetle. Biological controls will reduce the population of purple loosestrife to low levels, but will not likely eliminate it.

Long-term Management

Any areas previously treated for purple loosestrife will require ongoing monitoring and management.

Purple Loosestrife

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Foliar Herbicide									
Cut Stem Herbicide									
Flowering									

Sweet Clover (*Melilotus officinalis, M. alba*)

Description

As biennials, the white and yellow sweet clovers invest in a healthy root system the first year. In the second year, new shoots emerge from the taproot. Second year plants flower from May through September. The small white or yellow pea-like flowers are crowded in narrow spikes at the tips of the flowering stems. Each flower produces one or two seeds. Seeds may remain viable in the soil for up to 30 years or more and are dispersed by runoff and stream flow. The compound leaves of sweet clover are alternate with three finely toothed, longer than broad leaflets. Sweet clover is native to Europe and Asia, but was recorded in North America as early as 1664. Sweet clover is cultivated as a forage crop and soil builder, and is also cultivated as a wildlife cover crop and for the production of honey. Sweet clover is adapted to a variety of conditions, growing well in full and part sun. Sweet clover prefers calcareous or loamy soils. Sweet clover readily invades roadsides, abandoned fields, pastures and open natural communities such as a prairies.

Mechanical

Sweet clover can be mowed or cut below the lower stems in the early flower stage before seed production has occurred. If cut low enough, the plant will typically not regrow. Sweet clover can be hand-pulled when soils are moist and the taproot can easily be removed. Fall cutting of first year growth disturbs the plant while it is sending nutrients into its taproot, making the plant weaker the next year.

Well-timed prescribed burns are a recommended control method for sweet clover. As it is a biennial, pairing burns together in consecutive years is optimal. An early spring season burn (April) will increase germination rates of sweet clover. A hot, complete late spring burn (May) the following year should kill the germinated sweet clover before it flowers and seeds. Doing this every two years can successfully control sweet clover. If the burn is not complete and thorough, spot treatment with another control method will be necessary.

Chemical

Glyphosate or triclopyr can be used to spot treat sweet clover; however, follow-up treatments might be necessary. A surfactant is also recommended. A good time to spray is before the early flower stage or in the fall when other native plants are dormant. Sweet clover can grow quite tall and foliage may be sparse, so spray drift and overspray should be noted and avoided.

Long-term Management

Sweet clover is a biennial, so seed production is critical for its life cycle. Interrupting seed development is key to controlling it. If the flowering stage of sweet clover is halted, so is seed production. Management procedures must continue long enough to deplete viable seeds remaining in the soil.

Sweet Clover

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Burn									
Foliar Herbicide									
Mow									
Don't mow									
Flowering									

Garden Heliotrope (*Valeriana officinalis*)

Description

Garden heliotrope grows 1.5-4 feet tall from fibrous roots. It spreads by rhizomes or aerial stolons. Stems are usually pubescent, especially at the leaf nodes. Basal rosettes develop first. Leaves of the basal rosette and the stem leaves are similar in appearance, although the stem leaves may be less coarsely toothed. Leaves are opposite and pinnately divided into 11 or more segments, which are entire to coarsely toothed. Leaves may have a few hairs on the lower side. Leaves are petioled, with petiole length decreasing up the stem. The fragrant flowers are white to pale pink and arranged in a flattened to rounded umbel. It blooms from June to August. Seeds are wind dispersed. Garden heliotrope is native to Europe and parts of Asia. It was cultivated for its medicinal uses, but can now be found escaped and spreading in native habitats. It is tolerant of a variety of conditions including wet to dry soils and full sun to part shade exposure.

Mechanical

Garden heliotrope may be dug out when isolated plants or small populations are found. Small populations can be deadheaded to slow the spread until plants can be removed or treated.

Chemical

In order to prevent garden heliotrope from spreading either by seed or vegetatively, it is likely best to spot treat with glyphosate from May to September whenever it is found. Since it is found in wet soils in the Shrub Carr, an herbicide formulation for use over water should be used.

Long-term Management

Monitoring and follow-up treatments will be needed to obtain full control.

Garden Heliotrope

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Burn									
Foliar Herbicide									
Mow									
Don't mow									
Flowering									

Graminoids

Smooth Brome (*Bromus inermis*)

Description

Smooth brome is a perennial cool season grass introduced to North American from Eurasia as a forage crop. It is able to persist through drought and occasional flooding. It grows from 2-4 feet tall with an upright habit. The ¼" wide leaf blades have a prominent W- or M-shaped constriction across the blade. In fall the persistent leaves brown and curl on the stems. The inflorescence is an open panicle with flowers occurring on 4-10 erect branches from a main axis. Flowering occurs in June and July. When the achenes ripen, the lateral branches of the seedhead relax from their upright posture and nod sideways. Smooth brome reproduces from seed as well as by rhizomes which spread laterally through the soil.

Mechanical

Smooth brome often occurs in native grassland habits intermixed with warm season grasses. Because smooth brome is a cool season grass, it may be best controlled in this situation with well-timed prescribed burns. Burns timed for late spring when smooth brome is beginning to green up, but before the native grasses are actively growing will knock back the cool season grasses, although the burn will not kill the rhizomes. This same timing is advantageous to warm season native grasses which are slower to green-up in the spring. Repeated mowing can be used to set back smooth brome. However, repeated mowing can have adverse effects on populations of native species as well. Mowing combined with herbicide is a more effective treatment method. Mowing can be used to facilitate herbicide treatment of smooth brome. Mow and then allow brome to regrow before applying herbicide.

Chemical

Non-selective systemic herbicides (glyphosate) or grass specific herbicides (fluazifop-p-butyl) can be used to control smooth brome, particularly where it grows in monotypic stands. Where smooth brome is mixed with native grasses and forbs, treatment is best in early spring or late fall when native species are more likely to be dormant and less susceptible to the herbicides. Fall treatments favor the translocation of the chemical to the roots resulting in better control. Mowing can be used to condition a stand of smooth brome for an herbicide treatment. Mowing removes dead standing vegetation and promotes a flush of new growth. Another strategy for control is to apply a dormant overspray in areas where smooth brome provides a more dense cover. A grass specific herbicide can be applied in late fall if treatment is carefully timed when cool season grasses are still actively growing, but warm season grasses are not.

Long-term Management

Monitoring and follow-up treatments will be needed to obtain full control.

Smooth Brome

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Burn									
Foliar Herbicide									
Mow									
Flowering									

Reed Canary Grass (*Phalaris arundinacea*)

Description

Reed canary grass is a robust cool season grass that is likely circumboreal in origin. Ecotypes and/or cultivars of Eurasian origin were widely planted for use as a forage, conservation plantings, and erosion control, and are likely the aggressive grass that invades and dominates native wetlands and other moist soil habitats throughout Minnesota. Reed canary grass can reach 6 feet in height, but typically lays over, forming a dense mat that smothers native vegetation. The plant is hairless. Leaf blades are ½ to ¾ inches wide, flat, rough to the touch and blue-green in color. The ligule, found at the base of the leaf blade where it joins the sheath, is long and membranous. Flowering occurs from May to mid-June. The inflorescences are 3-16 inches long and initially purple tinged, with lax branches. As the seeds ripen, the inflorescences turn a tawny beige color and the branches close up against the main axis. The shiny seeds rain out of the inflorescences when disturbed after ripening. Seeds disperse on water, and are moved by humans and animals as well. The plants are clonal, spreading aggressively by rhizomes. Reed canary grass is adaptable in its cultural requirements, growing in dry upland soils and part shade as well as the moist to wet soils in full sun where it does best. Reed canary grass management should only be tackled if there are adequate resources for both adequate initial treatment as well as ongoing follow-up treatment. It is not reasonable to attempt to control a discrete area of reed canary grass within a larger system invaded by the grass, as there will continue to be inputs of seed and perhaps even invasion by rhizomes.

Chemical

A preferred method to control dense stands of reed canary grass is to broadcast treat it with glyphosate in early to mid-fall while the cool season plants are still actively growing and the chemical will be translocated to the plants roots and rhizomes. Glyphosate formulated for use over water should be used for reed canary grass control where it occurs in wetlands. In upland areas, glyphosate or a grass specific herbicide such as fluazifop-p-butyl can be used. When treating dense clones of reed canary grass, there is little chance of overspray contacting desirable species. However care should be taken to avoid overspray when treating smaller patches of reed canary grass occurring within a remnant or restored native plant community. Where feasible, mowing prior to herbicide treatment can facilitate application. Mow prior to seed production or in late summer for a fall foliar herbicide treatment. If the population is especially dense, one herbicide treatment is not likely to be enough for complete control.

Mechanical

In theory, intensive grazing, mowing or haying could diminish the resources of this robust perennial grass, but in practice that is difficult to achieve. Reed canary grass is typically found in environments that are too wet to mow as needed. In addition, this method will not eliminate reed canary grass. More likely, it will merely set reed canary grass back temporarily allowing some other species to occupy the space. But if ongoing maintenance does not occur, reed canary grass will recover and dominate the plant community again. Mowing can be used to facilitate herbicide treatment on invaded areas that are accessible by equipment. Mow ahead of herbicide treatment, allowing adequate time for reed canary grass to grow back. Prescribed fire can be used to remove thatch and prepare a previously treated area

for follow-up treatment. Mowing can be used in lieu of a prescribed fire to remove the dead canopy of previously treated reed canary grass. Mowing, of course may be limited by access on wet sites.

Long-term Management

Monitoring and follow-up treatment will be necessary to obtain control. The seed bank will germinate once the canopy is removed and will require follow-up management. It is not advised to begin control unless a long-term management plan is in place. Revegetation should not be attempted until at least the end of the second season of treatment.

Reed Canary Grass

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Burn									
Foliar Herbicide									
Mow									
Flowering									

Narrow-leaf and Hybrid Cattail (*T. angustifolia, Typha* x *glauca*)

Description

The cylindrical velvet brown flower heads of cattails are readily identifiable, but distinguishing the native broad-leaf cattail from the invasive narrow-leaf cattail and hybrid cattail requires closer study. The narrow-leaf and hybrid cattail tend to grow in deeper water and form denser clones. The hybrid grows taller, 6-9 feet versus 3-9 feet for broad-leaf and narrow-leaf cattail. The narrow-leaf cattail has narrower leaves, less than ½ inch wide versus ½ - 1 inch for broad-leaf cattail. The leaves of the hybrid are variable, but range between those of the broad-leaf and narrow-leaf cattail. In cattail flower spikes, the female flowers form the brown club. The male flowers, which occur above the female flowers, are yellow when loaded with pollen, but soon wither after the pollen is shed. In narrow-leaf and hybrid cattail, the male flowers are separated from the female flowers by a gap of 1-1.5 inches. In broad-leaf cattail spikes, the male flowers are contiguous with the female flowers.

The thick starchy rhizomes of narrow-leaf cattail intertwine to form a dense mat. In some wetlands, the mat may be floating. Cattails reproduce by wind-borne seeds and rhizomes. The altered hydrology of urban wetlands favors the establishment and growth of narrow-leaf cattails over desirable native species, allowing them to dominate the wetland flora. Large areas of narrow-leaf cattail in WHNC, including the emergent marsh surrounding Westwood Lake are too large to manage effectively. Where scattered populations of narrow-leaf cattail are established in other actively managed units, they could be controlled by treating them with herbicides when other herbaceous species, such as reed canary grass, are being controlled.

Chemical

Narrow-leaf cattails growing in wet pockets along the pathways and boardwalk are candidates for control. Application of glyphosate in late-summer to fall when the herbicide will be translocated to the rhizomes increases the efficacy of the treatment. Glyphosate products formulated for use over water should be used. Wick application, spot treatment, or broadcast may be appropriate techniques. Treatment of other invasive species such as reed canary grass and purple loosestrife may occur at the same time.

Mechanical

Mowing or prescribed fire could be used after an initial herbicide treatment to remove thatch and facilitate follow-up herbicide treatments. However these typically these treatments would be difficult to implement considering the wet habitat preferred by narrow-leaf cattails.

Long-term Management

Monitoring and follow-up treatment will be necessary to obtain control. It is not advised to begin control unless a long-term management plan is in place. Any revegetation efforts should not be attempted until at least the end of the second season.

Narrow-leaf and Hybrid Cattail

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Burn									
Foliar Herbicide									
Mow									
Flowering									

Woody Species

Oriental Bittersweet (*Celastrus orbiculatus*)

Description

Oriental bittersweet is a recent threat to Minnesota native habitats, having escaped from cultivation. It is a robust vine that climbs by twining around a support. The vine can grow up to 60 feet or more. The vines have been reported to be so vigorous that they can overwhelm and kill a tree either by blocking light to the canopy or by causing it to be more susceptible to windthrow and breakage when loaded with ice or snow. The vines may also girdle trees as they twine around the trunk. Stems are gray-brown with raised lenticels and may grow as big as 4 inches around. Vegetatively, it is very similar to and difficult to distinguish from the native American bittersweet. The leaves of both species are alternate, simple, and range from oblong to nearly round in shape with rounded teeth on the margins.

Male and female flowers occur on separate plants, so only the female plants will have the showy fruit for identification. American bittersweet flowers and fruits occur on the terminal ends of the stems, while those of oriental bittersweet occur in the leaf axils along the stem. The fruits of American bittersweet are red with an orange capsule, while those of oriental bittersweet are red with a yellow capsule. The two species are known to hybridize, and the hybrids should be controlled as well. Oriental bittersweet, like its native counterpart, spreads by suckering as well as by seed.

Mechanical

Small populations can be controlled by digging in locations where that treatment is feasible. Mowing is not recommended and may stimulate additional suckering from the root system.

Chemical

Cutting and treating the stumps will likely be the most effective control method. Cut stems may be treated with glyphosate or triclopyr. Cut stump treatment can occur from mid-summer through winter. In areas with extensive establishment of seedlings and young plants, a foliar herbicide treatment can be used for control.

Long-term Management

Oriental bittersweet is a prohibited noxious weed. All parts of it must be destroyed. Do not transport, propagate, or otherwise distribute any plant parts, including the ornamental fruits.

Oriental Bittersweet

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Foliar Herbicide									
Cut Stem Herbicide									
Mow									
Flowering									

Japanese Barberry (*Berberis thunbergii*)

Description

Barberry is a small spiny shrub, growing 3-5 feet tall. It may be rather spindly in habit when growing in deep shade, or more compact when growing in part-shade and sun. The small rounded leaves taper to the stem and occur in small clusters associated with one of the spines along the stems. Insignificant yellow flowers open in May. They occur singly or in groups of 2-4, hanging beneath the branches. Fruit are bright red oblong berries which may persist into winter if they aren't eaten first by birds which disperse the seeds. Barberry has the ability to spread by layering, when its lower branches root into the ground.

Japanese barberry, along with many of its horticultural cultivars are sold as ornamentals in Minnesota and other states. Japanese barberry is currently a Minnesota Department of Agriculture Specially Regulated Plant, which means that the species type and several cultivars of *Berberis thunbergii* are being phased out of the nursery trade and may not be legally sold in the state after December 31, 2017.

Mechanical

Small populations of Individual plants can be rogued out with a shovel, mattock, or weed wrench. Because the lower stems may have rooted down, care must be taken to up-root all stems for complete control. Forestry mowing in winter may control barberry if the shredded stems are exposed to dessicating conditions, however, follow-up foliar treatment is often necessary. Cut stems must be treated with herbicide or the shrub will resprout from the base.

Chemical

Cut-stump treatment with glyphosate or triclopyr is effective at controlling barberry. The herbicide should be applied to the stump without delay for optimal effectiveness. Barberry may be difficult to control due to its ability to layer. If all of the rooted stems are not cut and treated, barberry may survive cut stump treatment. Foliar herbicide treatments can also be effective, but care needs to be taken to avoid collateral damage to native species. Timing foliar treatments using glyphosate or triclopyr while native species are dormant is necessary to minimize damage to desirable species.

Long-term Management

Barberry are prolific seed producers, so monitoring and follow-up treatment will be needed to obtain control.

Common Barberry

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Burn									
Foliar Herbicide									
Basal Bark Herbicide									
Cut Stem Herbicide									
Flowering									

Honeysuckle (*Lonicera tartarica*, *L. morrowii*, *L.* x *bella*)

Description

Invasive honeysuckles most often occur on forest edges and interiors, but also occur on fallow agricultural land, and road and rail rights-of-way. They grow in poor to well-drained soils. Exotic honeysuckles replace native forest shrubs and herbaceous plants by their invasive nature. They leaf out early, shade out herbaceous ground cover and deplete soil moisture. Research suggests that honeysuckles inhibit the growth of nearby plants through allelopathy. Honeysuckle reproduces primarily via seeds which are dispersed by birds that eat the fruits. Honeysuckle is one of the first plants to leaf out in the spring and one of the last to retain its leaves in the fall. It is challenging to correctly identify *L. tatarica*, *L. morrowii*, or the hybrid, *L*. x *bella*. Since they are managed the same way, it is not necessary to make a positive identification. *Lonicera tatarica* (native to central Russia) has 1-2.5 inch long, glabrous, ovate to oblong leaves. Its white-pink flowers are glabrous. Fruits are red or rarely yellow. Height reaches 9 feet. The gray-green leaves of *Lonicera morrowii* (native to Japan) are soft-pubescent beneath. Flowers are pubescent, white fading to yellow on densely hairy peduncles. Fruits are red. Height reaches 6 feet. The hybrid *L*. x *bella* has intermediate characteristics. Leaves are slightly hairy beneath. Flowers are pink fading to yellow, on sparsely hairy peduncles. Fruits are red or rarely yellow. Height can reach 15 feet.

Mechanical

Brush mowing or cutting honeysuckle without herbicide treatment is ineffective unless done continuously for several years. The lower branches tend to grow horizontally along the ground, making it challenging for mowers to effectively cut the plant. Combining mowing with a fall herbicide application is very effective. Repeated prescribed fire will kill young honeysuckles and potentially girdle and top kill larger plants. However, carrying fire through areas of high infestation is a challenge because of insufficient fuel. Combining prescribed fire with other control methods is preferable.

Chemical

Cut-stump treatment with glyphosate or triclopyr is effective at controlling honeysuckle. The herbicide should be applied to the stump without delay for optimal effectiveness. Honeysuckle can be difficult to control due to its ability to layer. Layering occurs when plant stems lay on moist ground and root from adventitious buds. If all of the rooted stems are not cut and treated, honeysuckle may survive cut stump treatment. Foliar herbicide treatments can also be effective, but care needs to be taken to avoid collateral damage to native species. Timing foliar treatments using glyphosate or triclopyr while native species are dormant is necessary to minimize damage to desirable species.

Long-term Management

Long-term management focus should be on minimizing seed dispersal via monitoring and on-going management efforts.

Honeysuckle

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Burn									
Foliar Herbicide									
Basal Bark Herbicide									
Cut Stem Herbicide									
Flowering									

Common Buckthorn (*Rhamnus cathartica*), **Glossy Buckthorn** (*Frangula alnus*)

Description

Both common buckthorn and glossy buckthorn were introduced to North America as ornamental shrubs for use in fence rows, and as wildlife habitat. Both buckthorns were valued for their hardiness and ability to thrive in a variety of soil and light conditions. They also have a dense habit making them ideal for use as privacy hedges in densely populated urban areas. As an invasive in native habitats, common buckthorn tends to form dense, even-aged thickets, crowding and shading out native shrubs and herbs. Dense buckthorn invasions also prevent native tree and shrub regeneration.

Common buckthorn is a shrub or small tree that can grow to 22 feet in height with as much as a 10" diameter trunk, although stems are typically more in the range of 2"-5" diameter. The crown of mature plants is spreading and irregular. The bark is gray to brown, rough textured when mature and may be confused with that of plum trees in the genus *Prunus*. When cut, the inner bark is yellow. Twigs are often tipped with a spine. In spring, dense clusters of 2 to 6, inconspicuous yellow-green, 4-petaled flowers emerge near the bases of the leaf stalks. Male and female flowers are borne on separate plants. Small black fruits about 1/4 inch in cross-section and containing 3-4 seeds, develop after blooming. Leaves are broadly oval, with toothed margins, rounded or pointed at the tip, and with 3-4 pairs of up-curved veins. The upper and lower leaf surfaces are hairless. Leaves appear dark, glossy green on the upper surface and stay green late into fall, after the leaves of most other deciduous species have fallen. Glossy buckthorn does not have a spine at its twig tips, its leaves are not toothed, and the undersides of the leaves are hairy. The trunks and stems have lighter colored lenticels. It similarly produces dark fruit on the female plants. The fruits of both species, if not eaten by birds, typically fall directly beneath the shrubs, creating a dense understory of seedlings characteristic of common buckthorn stands. The fruit is eaten by birds and mice and is known to cause a severe laxative effect, helping distribute seeds via birds, often far from the parent plant.

Common buckthorn is primarily an invasive species of upland habitats, but it also occurs within wetlands. It prefers lightly shaded conditions, invading open oak woods, and wood edges; it may also be found in prairies, open fields, and wetlands. It is tolerant of many soil types; well drained sand, clay, poorly drained calcareous, neutral or alkaline, wet or dry. Common buckthorn occurs in nearly every management unit at WHNC. Management strategies vary depending on the terrain and timing of control. Glossy buckthorn prefers wetland habitats, but will grow in upland conditions as well. Some of the wetlands at WHNC are accessible when they are seasonally dry. Others are likely to have standing water or at least saturated soil for much of the growing season that will limit access by equipment. Initial control of glossy buckthorn should therefore occur in winter when the ground is frozen to facilitate access to all areas. Some areas will be difficult to access with equipment even in winter because of the other shrub species amongst which it grows.

Mechanical

On level upland areas, forestry mowing is an efficient method to remove the standing trees. If the stems are shattered close to the base and conditions after forestry mowing are very cold and dry, the wood is

prone to drying out and may not be capable of resprouting. On steep slopes, brush saws can be used to cut the stems. The cut stumps should be treated immediately with herbicide. In wetland areas, brush saws will likely be needed to cut the stems. A forestry mower should be used only in areas where it will be possible to access the site for follow-up foliar treatment. Triclopyr with blue marker dye or a 50% solution of glyphosate with blue marker dye are effective for control. Areas cut by either method will require a follow-up foliar herbicide treatment, as it is likely that a percentage of the stems will resprout.

Mowing repeatedly for several years, often multiple times a year, will eventually kill buckthorn. The goal is to deplete the roots of stored energy. Smaller buckthorn and seedlings will require fewer mowings. Small saplings can often be hand-pulled if the soil conditions are right, as in invaded forests without a dense ground layer. Manually pulling smaller buckthorn with weed-wrenches or simply levering it out with a shovel is a useful method in smaller populations or when volunteers are involved. Weed-wrenches and shovels create disturbance in the soil which can expose new weed seed, so consideration should be given to the results of this disturbance when choosing where to implement this method. It is possible in some settings that disturbance may facilitate establishment of suppressed native species as well. Prescribed fire can be a useful tool as part of an integrated buckthorn management approach in fire dependent plant communities. Fire provides a means to kill buckthorn seedlings and set back mature plants. However, even in fire-adapted ecosystems when buckthorn is present in dense patches, it is often difficult to carry fire because of the lack of ground cover beneath the buckthorn to provide fuel.

Chemical

There are several strategies to chemically treat buckthorn. Applying triclopyr or glyphosate to the cut stump of buckthorn is highly effective. Triclopyr can also be applied as a foliar spray in late summer, or in fall when other desirable woody species have dropped their leaves. Cutting buckthorn in June and returning to foliar spray in the fall when the stumps have resprouted is an effective way to kill it. Frill cutting and spraying larger buckthorn is also effective. It can also be treated by spraying around the base of the trunk with triclopyr.

Long-term management

Buckthorn seeds can stay viable in the soil for up to 5-7 years. In addition, dispersal of buckthorn seeds from adjacent properties makes long-term monitoring and management essential in all formerly invaded ecosystems. Areas disturbed by heavy infestations of buckthorn are often prone to invasion by other exotic species as well, so revegetation to provide competition, as well as ongoing management are necessary. Where hand removal is feasible scouting and hand-pulling on an annual basis will be a useful method to maintain sites where initial management has occurred. Alternatively, budgeting for follow-up forestry mowing, prescribed burns, and/or chemical treatment will be required.

Common buckthorn

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Burn									
Foliar Herbicide									
Basal Bark Herbicide									
Cut Stem Herbicide									
Flowering									

Glossy buckthorn

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Burn									
Foliar Herbicide									
Basal Bark Herbicide									
Cut Stem Herbicide									
Flowering									

Siberian Elm (*Ulmus pumila*)

Description

Siberian Elm is a small or medium-sized tree with spreading branches. Bark is gray-brown with shallow furrows. Twigs and buds are nearly hairless. Leaves are elliptical, prominently veined and single-toothed. Leaves are softly pubescent when young and arranged alternately. Leaves are rarely more than 2 inches long, distinguishing it from native elms, for which the leaves are typically more than 3 inches long. Siberian elm is tolerant of dry, nutrient poor soil. The winged seeds are wind-dispersed in spring, soon after flowering. Seedlings grow rapidly and may form thickets in disturbed areas. Siberian elm occurs throughout WHNC in lower elevations on moist soils.

Mechanical

Trees may be girdled and allowed to die over time. Girdle in late-spring to mid-summer while the sap is flowing and the bark peels away from the sapwood. Use caution that the girdling cut is not made too deep as this will cause the tree to resprout from the base. If the tree resprouts, the sprouts can be cut and stump treated. Seedlings can be hand-pulled and saplings can be removed with a weed wrench or shovel. A regime of periodic prescribed fire will control seedlings in fire dependent plant communities.

Chemical

Trees may be cut stump treated in fall and winter. Cut stems may be treated with glyphosate or triclopyr. Basal bark treatment with triclopyr will also be effective.

Long-term Management

Monitoring for establishment of new individuals and populations will be necessary. Treat seedlings and saplings before they are large enough to develop seed.

Siberian Elm

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Burn									
Girdle									
Foliar Herbicide									
Basal Bark Herbicide									
Cut Stem Herbicide									

Russian Olive (*Elaeagnus angustifolia*)

Description

Russian olive is a deciduous nitrogen fixing small tree/large shrub, growing up to 25' tall. Its crown is generally rounded, but often unruly in appearance. Twigs have a terminal spine. Leaves are alternate, lance-shaped and silvery-white in color. Fragrant yellow flowers bloom in late spring and produce a hard, olive-like fruit. The trees are tap-rooted. Russian olive was introduced to North America for use in shelterbelt plantings and highway rights-of-way. It is hardy, tolerant of a range of soil conditions and capable of sprouting from adventitious buds on the crown and root suckers. Russian olive may have been planted on the site where it occurs along the sound barrier wall in Management Unit B.

Mechanical

Seedlings can be hand-pulled and saplings can be removed with a weed wrench or shovel. To be effective, all roots must be removed. Repeated mowing of small plants initiated in summer when stored root reserves are low may be an effective control. A regime of periodic prescribed fire will control seedlings in communities that are managed with fire.

Chemical

Trees may be cut stump treated in fall and winter. Cut stems may be treated with glyphosate or triclopyr. Basal bark spray around the lower stem with triclopyr when dormant.

Long-term Management

Monitoring for establishment of new individuals and populations will be necessary. Treat seedlings and saplings before they are large enough to develop seed.

Russian Olive

	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Burn									
Foliar Herbicide									
Basal Bark Herbicide									
Cut Stem Herbicide									

Combined Management Tables by Species

Burn	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Garlic mustard									
Burdock									
Canada thistle									
Crown vetch									
Leafy spurge									
Motherwort									
Birds-foot trefoil									
Sweet clover									
Smooth brome									
Reed canary grass									
Narrow-leaf cattail									
Honeysuckle									
Buckthorn									
Siberian elm									
Russian olive									

Foliar Herbicide	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Garlic mustard									
Burdock									
Canada thistle									
Bull thistle									
Crown vetch									
Leafy spurge									
Motherwort									
Birds-foot trefoil									
Purple loosestrife									
Sweet clover									
Garden heliotrope									
Smooth brome									
Reed canary grass									
Narrow-leaf cattail									
Oriental bittersweet									
Honeysuckle									
Buckthorn									
Siberian elm									
Russian olive									

Basal Bark Herbicide	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Buckthorn									
Siberian elm									
Russian olive									

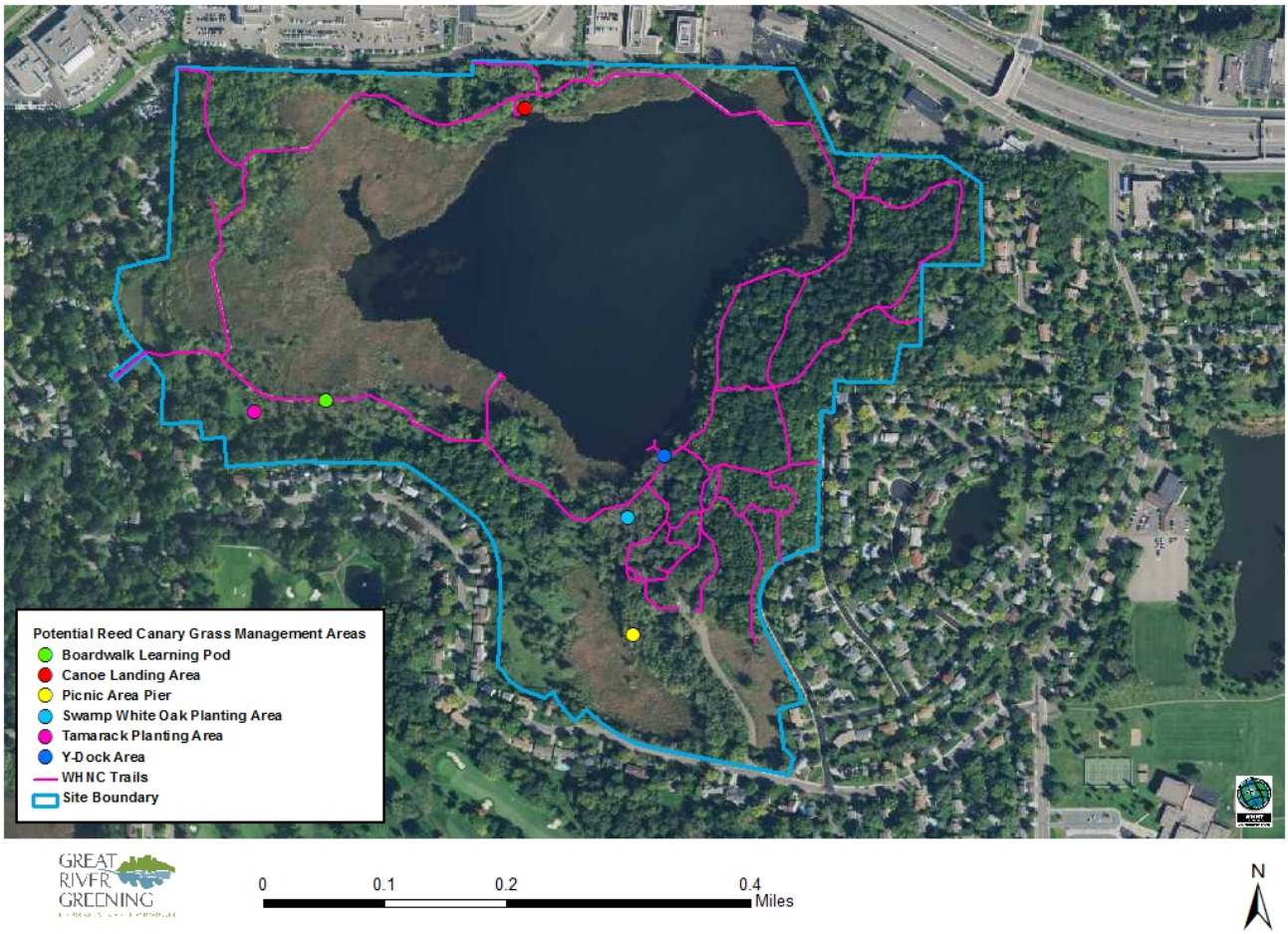
Cut Stem Herbicide	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Canada thistle									
Oriental bittersweet									
Japanese barberry									
Honeysuckle									
Buckthorn									
Siberian elm									
Russian olive									

Mow	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Garlic mustard									
Burdock									
Canada thistle									
Bull thistle									
Crown vetch									
Leafy spurge									
Motherwort									
Birds-foot trefoil									
Sweet clover									
Smooth brome									
Reed canary grass									
Narrow-leaf cattail									
Oriental bittersweet									

Don't Mow	April	May	June	July	Aug	Sept	Oct	Nov	Dec-Mar
Garlic mustard									
Canada thistle									
Leafy spurge									
Birds-foot trefoil									
Sweet clover									
Garden heliotrope									

Appendix H: Shoreline and Reed Canary Grass Management Priority Areas

The map below highlights suggested areas where shoreline management could be prioritized as an opportunity to increase diversity for programs and/or to reduce competition around tree plantings. The Y-dock below the nature center building is a very visible location with easy access for programs. It may be possible to treat and manage the narrow-leaf cattail, purple loosestrife, and reed canary grass behind the wings of the Y-dock and enhance this area with wetland species that would enrich the shoreline for wildlife as well as for programming opportunities. The tamarack and swamp white oak trees in planted in the saturated soils along the boardwalk would benefit from reed canary grass management to reduce competition and increase their establishment and growth success.



Appendix I: Recommendations for Involving Volunteers

Volunteers can be a way to leverage the efforts of paid staff and contain costs while realizing restoration goals. Volunteers can assist in habitat management by periodically walking through the site and reporting on management needs and/or actively conducting management. Volunteers can be utilized to participate in ongoing management activities such as buckthorn removal, garlic mustard weeding, planting, seed collecting, etc. Several patrons of the WHNC are already enthused about the mission of the nature center and would likely be eager for an opportunity to further contribute to the stewardship of its habitats.

Groups or individual volunteers that need minimal supervision can be organized to contribute their efforts on a weekly or monthly basis to monitor and control invasive species.
Programs operated by the DNR SNA program, The Nature Conservancy, Three Rivers Park District or Wild River State Park may provide models for how volunteer stewardship programs may be implemented. In some models, work days are scheduled with a staff supervisor to guide the work. Alternatively, some models such as the TNC and SNA programs empower experienced volunteer stewards to schedule monthly or periodic work days and supervise the work of other volunteers. Under this type of arrangement, the volunteer stewards take on projects both large and small. Three Rivers Park District and Wild River State Park train individual volunteers or self-selected groups of volunteers and assigns them a discreet area of the park to adopt. In their adopted unit the volunteer(s) is(are) responsible to monitor and manage weed species such as buckthorn or spotted knapweed on a schedule that works for them. This type of arrangement is particularly helpful once initial management has occurred and follow-up maintenance is needed. Expectations of a minimum time commitment should be made clear to the volunteers. Training and ongoing opportunities to follow-up with the volunteers contribute to a successful program.

Volunteer tasks suitable for a self-managed volunteer program

- Monitor and adjust or remove tree shelters and tags on trees. Prune broken branches.
- Add exclosure fencing to selected trees. Remove or repair fencing as needed.
- Monitor and repair fencing around planting plots.
- Weed within fenced planting plots.
- Handpull buckthorn and honeysuckle seedlings.
- Handpull garlic mustard; report invasions requiring mechanical or chemical treatment.
- Deadhead invasive species, such as garden heliotrope, to prevent seed dispersal.

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