

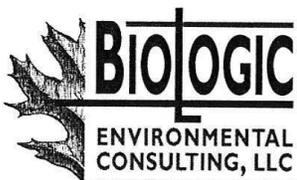
Goth Park

Ecological Assessment and Management Plan

Prepared for the Town of Middleton

by Michael P. Anderson and Bryn M. Scriver

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2505 Richardson Street
Fitchburg Wisconsin
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EXECUTIVE SUMMARY

Introduction

This report provides the results of an ecological assessment of Goth Park and recommendations for: protecting and restoring the Park's native plant communities; providing for visitor safety and enjoyment; minimizing impacts to adjoining neighborhoods; and utilizing external funding. Goth Park is approximately 20 acres and is located in the Town of Middleton along West Old Sauk Road.

This report is based on information gathered during site visits made on September 5, October 2, October 8, and October 26, 2006, coupled with secondary sources of information, such as aerial photographs, topographic maps, an interview with Jerry Goth, and the Dane County soil survey.

Summary of Existing Conditions

One hundred and twenty-nine species were identified during the survey (see Table below). Seventy-eight (60%) of the observed species are native, a relatively low proportion, although not surprising given the Park's extensive agricultural history and relatively small size.

Number of Species Observed.

Life form	Number of Species		
	Native	Exotic	Total
Trees	15	5	20
Shrubs	12	4	16
Vines	6	3	9
Grasses and Sedges	5	8	13
Forbs (flowers)	38	31	69
Ferns	2	0	2
Total	78	51	129

No Wisconsin or Federal Endangered, Threatened, or Special Concern plants or animals were observed.

Land survey records from the 1830s indicate the Park was oak savanna when the first white settlers arrived, as was most of southern Wisconsin. Currently, the Park is a mixture of old field (former agricultural fields dominated by cool season grasses with a variety of native and nonnative forbs) and southern dry-mesic forest. The conversion of oak savanna to forest due to lack of fire and

other factors is a common occurrence in southern Wisconsin. While many of the original oak savanna trees remain, few naturally occurring native groundlayer plants remain due to agricultural use, excessive shade, lack of fire, and the effects of invasive species.

Goth Park's topography is unique because the Johnstown terminal moraine passes diagonally through the Park. In addition to five kettle holes, the Park also has a distinctive, undulating topography known as *ground moraine* that's created when sediment is deposited beneath a glacier.

Threats

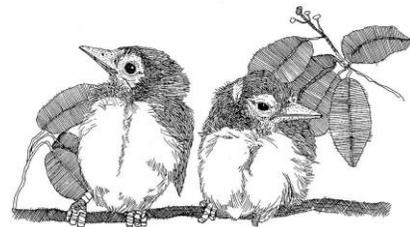
Invasive species are the greatest threat to the Park's long-term ecological integrity and health. Twelve invasive species were observed: Canada thistle, leafy spurge, white and yellow sweet clover, wild parsnip, garlic mustard, reed canary grass, buckthorn, honeysuckle, multiflora rose, black locust, and Norway maple. Honeysuckle, buckthorn, and black locust are of greatest concern because they are abundant and are eliminating native species.

Dutch elm disease and oak wilt are likely present, but haven't been confirmed by a laboratory test. Oak wilt on an adjacent property was confirmed by laboratory tests during 2005, however. Extensive oak wilt will significantly alter the character of Goth Park.

Opportunities

When white settlers began arriving in Wisconsin there were an estimated 5.5 million acres of oak savanna and 2.1 million acres of prairie. Almost immediately the prairies and savannas were plowed for agriculture, used (or over-used) for pasture, and invaded by brush and trees following fire suppression, causing their rapid demise. Today, less than 500 acres of oak savanna and less than 2,000 acres of prairie remain. Goth Park offers a wonderful opportunity to restore this lost biological heritage for the use and enjoyment of Town of residents and prairie and savanna dependant flora and fauna.

Goth Park also offers numerous opportunities for cultural and ecological interpretation for visitor enjoyment and education. Examples include the Park's settlement and farming history, glacial geology and the resulting landforms, and native plant community restoration and management.



INTRODUCTION AND METHODS

Introduction

This report provides the results of an ecological assessment of Goth Park and a series of management recommendations for the Park. More specifically, this report provides:

1. An annotated list of all observed plant species.
2. A determination of current habitat types.
3. The status of rare, threatened, and endangered species.
4. The status of invasive species.
5. Information on abiotic factors, such as topography and soil type.
6. Information on unique natural and cultural features.
7. Management recommendations.
8. Ecological information to help interpret and understand the assessment and the management recommendations.

Property Location

Goth Park is located in Dane County, Wisconsin, adjacent to the south side of West Old Sauk Road in the Town of Middleton (Figure 1). More specifically, it is located in the west ½ of the northeast ¼ of the northwest ¼ of Section 19, Township 7 North, Range 8 East (US Geological Survey 1983). The Park is approximately 20 acres.



Figure 1. Goth Park Location (black star).

Methods

Survey Unit Delineation

The Park was divided into three survey units based on vegetation and location: North Grassland, Woodland, and South Grassland (Figure 2). To facilitate the discussion of survey results and management recommendations, the Woodland Unit has been divided into East and West Subunits.

Vegetation Survey

All survey units were systematically walked during site visits made on September 5, October 2, October 8, and October 26, 2006. A record was kept of all observed species (species presence) in each survey unit during each visit. Species which are difficult to field identify (e.g., sterile specimens) were vouchered and keyed out in the office.

In addition to species presence, information was recorded for:

1. Relative species abundance (rare, uncommon, common, abundant, dominant).
2. Distribution within the survey unit.
3. Canopy and subcanopy species and their relative abundance.
4. Location and abundance of invasive species.

Abiotic Factors

Abiotic information was recorded during each visit and additional information was obtained from secondary sources, such as the Dane County Soil Survey, topographic maps, the Dane County Geographical Information System database, and the Town of Middleton Outdoor Recreation Plan (2003).

Abiotic information recorded includes:

1. Topography, including slope and aspect.



Figure 2. Survey Unit Locations. White line is property line. Red lines are survey unit boundaries.

2. Soil type.
3. Natural and cultural features.
4. Prior disturbance and the resulting effect.
5. Special management needs, opportunities, and concerns.

Aerial Photograph Analysis

Analysis of aerial photographs often provides important historical information and insights into changes in land cover and land use practices not readily observable in the field. In order to assess these types of changes a chronosequence of aerial photos from 1937 to 2005 was visually assessed for:

1. Changes in the extent and location of vegetation types.
2. Changes in infrastructure (roads, buildings) and other cultural features.

Oral History of Goth Park

Jerry Goth, great grandson of Jurgen Goth and Fredericke Grant-Goth who formerly farmed the property, was interviewed on October 22, 2006 for his recollections of the Park's historic vegetation and use history. Jerry lived on a farm adjacent to the west side of the Park (the Westphal Farm) from 1955 to 1959.



A PLANT ECOLOGY PRIMER

Introduction

Plant ecology is the scientific study of how plants interact and affect each other and their environment. This section is designed to help you understand the information contained throughout this report by providing:

1. An overview of the science of plant ecology and its relationship to land management.
2. An explanation of the term “plant community” and their classification.
3. An explanation of plant community structure.
4. A discussion of the characteristics and differences between oak savanna, oak woodland, and oak forest.

The Plant Community

Most people recognize that certain plants commonly grow together, while other plants rarely, if ever, grow side by side. Broadly speaking, groups of species that commonly grow together are called a **plant community**. More specifically, a plant community is a local assemblage of species that develops in response to site conditions such as soil moisture and fertility, local and regional climate, slope, aspect, and disturbance patterns (Curtis 1959).

Plant Community Structure

Most plant communities are composed of distinct layers of vegetation that define their **structure**. In forested communities the **canopy** is the uppermost layer. It is composed of the **dominant** (most abundant based on the amount of biomass or the species that has the strongest influence on the other plant community members) and the associate tree species.

The canopy has a strong influence on all of the other (lower) vegetation layers because of its strong effect on light levels. Alterations in the amount of canopy closure often cause a cascading effect as lower layers of vegetation adjust to the change. This is an important relationship for land managers and restorationists to understand since their activities often alter the canopy. Shifts in species composition of the canopy are often associated with successional changes. **Succession** refers to the replacement of one species with another due to differing competitive ability, changes in the

Altering canopy closure causes cascading effects as lower layers of vegetation adjust to the change, an important relationship to understand.

environment, and random events or disturbances, such as tornadoes, fire, or disease.

The **midstory** is the layer below the canopy and, like the canopy above it, has a strong effect on lower layers because of its influence on the amount of light they receive. It is often subdivided into a subcanopy layer and a shrub and seedling layer. The **subcanopy** is composed primarily of two classes of trees based on their ability to become part of the canopy, which is determined by their growth patterns. Some species grow quickly through the midstory and become part of the canopy. The amount of time they spend in the subcanopy before joining the canopy is related to their growth rate, shade tolerance, and the presence or absence of canopy gaps. Others species stay relatively short and remain in the midstory their entire life. The subcanopy is very important in determining the future composition of a forest or woodland because today's subcanopy is often tomorrow's canopy.

The **shrub and seedling layer**, the other component of the midstory, consists of various woody plants (shrubs), such as gooseberry, brambles, and dogwood, and the young offspring (seedlings) of the canopy and midstory trees. The composition and density of the shrub layer is most closely related to canopy and soil moisture conditions, although this relationship can be altered by external factors, such as grazing and fire (Figure 3). Typically, there is an inverse relationship between canopy closure and shrub density such that areas with a closed canopy have relatively few shrubs, although shade tolerant invasive shrubs, such as buckthorn and honeysuckle, often skew this relationship.

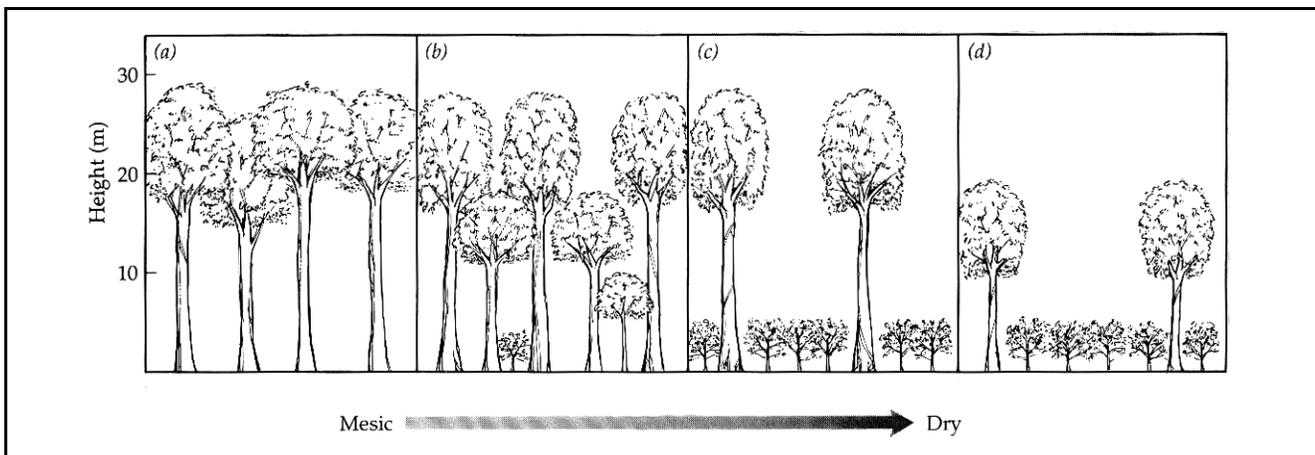


Figure 3. Changes in Forest Structure with Changes in Soil Texture.

(a) Fine-textured soils have closed upper canopies and little understory. As soils become progressively drier, canopy structure grades from (b) evenly distributed to (c) open upper canopy with significant shrub layer to (d) open upper canopy of reduced height, with significant shrub layer. (Adapted from Aber and Melillo 1991.)

The lowest layer is the **groundlayer**. The groundlayer is composed of wildflowers, ferns, grasses, sedges, and mosses. The groundlayer is typically the most diverse layer in all undisturbed native plant communities. As might be expected, the composition of the groundlayer is strongly influenced by the layers above it, as well as soil moisture and fertility.

Not all plant communities have all of these layers; prairies, for example, do not have a canopy or subcanopy because they lack trees.

Savanna, Woodland or Forest?

Understanding the differences between oak savanna, oak woodland, and oak forest is helpful for understanding the historic and current vegetation of the tree-covered areas of Goth Park. It's *crucial* for understanding the restoration and management of this area.

Although precise definitions are difficult and aren't universally accepted, it's safe to say the primary difference between these three plant communities is the density of oak trees and the resulting differences in canopy closure (Figure 4).

Oak savannas are generally considered to have at least one tree per acre, but less than fifty percent canopy cover. Oak woodland canopies are more closed, typically 40 to 70 percent, but can range from 30 to 90 percent. Oak forest canopies are typically 70 to 100 percent closed, although there are often gaps caused by disease, wind, and mortality.

Due to the differing amount of sunlight the oak trees receive in each of the three plant communities, there are significant differences in their appearance (Figure 4, Figure 5). Oak savanna trees typically have a characteristic growth form referred to as **open grown** in which there are wide-spreading, horizontally growing branches, often originating very low on a trunk that is relatively short and thick. The open grown form is a response to the abundant sunlight—why grow up to reach the sunlight when it's already there?

Conversely, trees that develop in the shade of a forest have a growth form referred to as **forest grown** in which there are few, if any, lower branches because there isn't enough light to support their growth. Because young trees need to grow upward to reach the sun, their trunks are typically relatively tall and slender (Figure 4).

Oak woodland trees have some characteristics of both savanna and forest trees, but are easily distinguished by a trained eye. Because the woodland canopy is somewhat open, some of the trees will have an open grown form, although the form is usually less pronounced than in oak savanna

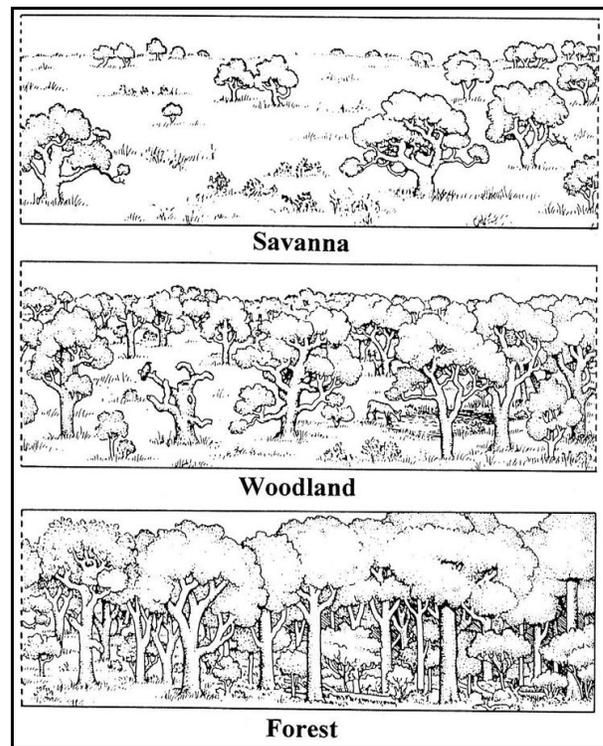


Figure 4. Savanna, Woodland, and Forest Canopy and Midstory Variation. Adapted from The Tallgrass Restoration Handbook, Packard and Mutel, 1997.

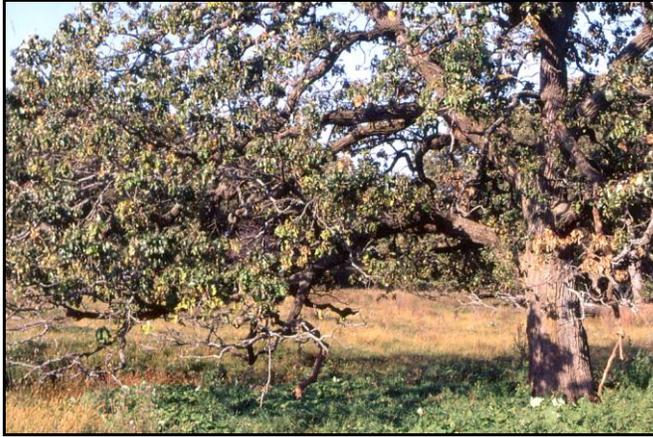


Figure 5. Open Grown Oak Tree (l) and Woodland Grown Oak Trees (r).

trees because there isn't enough sunlight to support fully developed lower branches. More common is a tall, moderately slender tree, perhaps with a few smaller diameter horizontally growing branches low on the trunk, but with the majority of the branches in the upper half of the tree where they receive more sunlight. These branches frequently take on a contorted, twisted, open, spreading appearance (Figure 5).

The differences in tree form and canopy closure between oak savanna, oak woodland, and oak forest create significant differences in the amount of light reaching the midstory and groundlayer, producing noticeable differences in their structure and composition.

Grasses are dominant in oak savanna, while trees, especially oak, are dominant in oak woodland and, especially, oak forests. Shrubs are common in all three communities, but in oak savanna and oak woodland frequent fires prevent them (or historically prevented them) from becoming dense and tall. In oak forest the shrubs are typically tall and dense because fire is less frequent because of the shady and moist forest environment. In early settler accounts, oak woodland and oak savanna are both frequently described as "park-like," a term not extended to oak forests.

When European settlers began arriving in Wisconsin there was an estimated 5.5 million acres of oak savanna. The acreage of oak woodland is largely unknown because early ecologists and land surveyors failed to recognize it as a distinct plant community and therefore included it with oak savanna (when the canopy was relatively open) or oak forest (when the canopy was relatively closed). However, it's very likely it was nearly as widespread as oak savanna (WDNR 2005, Pruka and Faber-Langendoen 1997).

DESCRIPTION AND ANALYSIS OF CURRENT CONDITIONS: AN OVERVIEW

Introduction

This section presents and interprets the collected information that pertains to the Park as a whole and relates this information to Park management. Individual survey units are described and discussed in detail in the next section (Descriptions of Individual Survey Units, page 34).

Summary of Completed Restoration and Management Work

During the fall of 2004, the Town contracted with BioLogic Environmental Consulting to remove invasive trees and shrubs in order to reduce their abundance and to “daylight” mature oak trees. The work was done in the South Grassland, including the west fence line, along the south and southwest edges of the East Woodland Subunit, and along the west fence line in the North Grassland. Honeysuckle was the primary target in all areas, with lesser amounts of buckthorn, box elder, multiflora rose, and some black cherry also removed. Cut stems were treated with Garlon 4 herbicide (25%) in basal bark oil to prevent resprouting.

A second round of invasive tree and shrub removal was done by BioLogic during December 2005. This work focused on the vineyard, the east side of the West Woodland Subunit (on both sides of the main trail), and the north edge of the East Woodland Subunit. Honeysuckle, black locust, and buckthorn were the primary targets, although other species were also removed. Only the eastern two-thirds of the vineyard were cleared due to budget constraints.

During the second round of removal the stems were cut higher than normal because of a ten-inch snow cover. This caused two problems the following spring. The first was neighbor concern about the “unsightliness” of the cut stems and the possible risk if visitors walked off-trail and tripped on the stems. The second problem was a higher than normal resprout rate. These problems were addressed by cutting the stems, including the resprouts, to a lower height during June. Resprouts from this cutting were foliar sprayed during August using Transline herbicide for the black locust and Krenite herbicide, a brush inhibitor, for the other species.

A few neighbors expressed concern about the removal of the invasive shrubs from the western property line and the resulting loss of privacy screening, although others, including Jerry Goth, supported the removal. The neighbors were also concerned that all of the grapes had been killed when the vineyard was cleared. However, many grape vines were observed while doing the fieldwork for this report, indicating this is not the case. (See the Cultural Features section on page 12 for a more detailed discussion of the history and status of the vineyard.)

The leafy spurge patch in the South Grassland was spot sprayed during September 2004 with Plateau herbicide and June 2006 with Krenite herbicide. While the size of the patch and the number of plants within the patch have been reduced, eradication will require several additional years of timely treatment.

Prior to the work done by BioLogic, the Town had cleared invasive trees and shrubs in many areas of the Park (the source of the large brush pile in the North Grassland), established a trail system that's still used, and installed, landscaped, and signed the parking area. The Town also planted a prairie in the North Grassland.

A Brief History of the Goth Family and Goth Park

Jerry Goth, the great grandson of Jurgen and Fredericke Goth, provided the following history of the Goth family and their Goth Park tenure. Jerry lived on the Westphal farm, located immediately west of the Goth farm, from 1955 to 1959.

Carl and Sophie Goth were the first owners of the property. They acquired the property sometime between 1847 and 1849 after Carl immigrated to the United States from Germany. The original farmstead was 141 acres and continued east from the current Park boundary until just east of the current Goth Road. Carl and Sophie lived in a cabin on the east end of the property and farmed the land (Figure 6). They lived on the farm until their deaths in 1904.

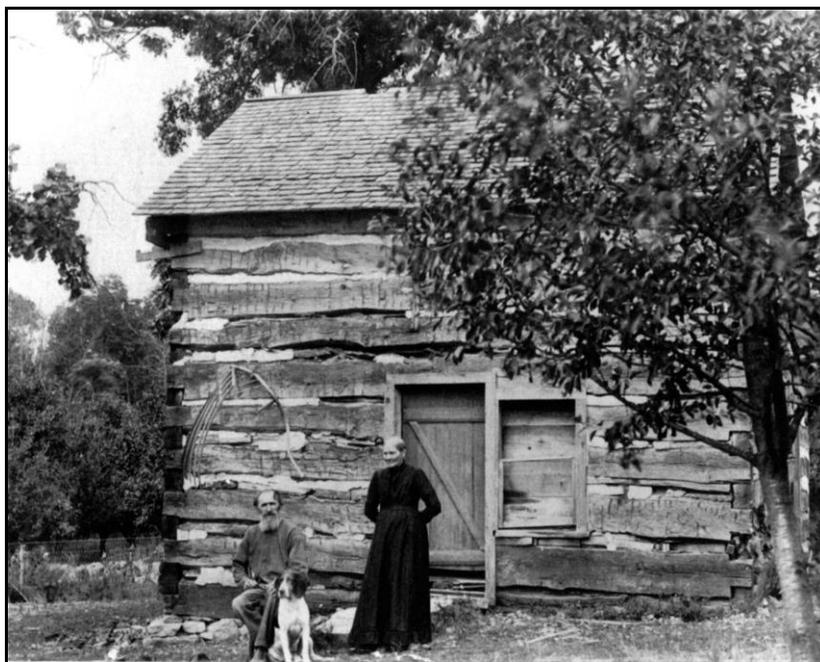


Figure 6. Carl and Sophie Goth in Front of Their Cabin
(photo provided by Jerry Goth).

Jurgen Goth and his wife Fredericke Grant later lived on the farm with Carl and Sophie. Jurgen was Carl's nephew. Jurgen and Fredericke lived in their own cabin, which was located at the top of the hill where the East and West Woodland Subunits join. Presumably, Jurgen and Carl farmed together. Jurgen apparently also kept cows along Black Earth Creek north of the present day Blackhawk ski jump in an area with public access to water. Jurgen and Fredericke lived and worked on the farm until they moved to Verona about 1860.

Martin Goth, Carl's eldest son, inherited the farm after Carl's death. Martin and his wife Mabel farmed the property and lived on site, until his death (date unknown).

Royce Goth gifted the land for the Park to the Town (Town of Middleton 2003).

Cultural Features

A parking lot that accommodates about eight to ten vehicles is located at the north end of the Park adjacent to West Old Sauk Road (Figure 7). The parking area has signs outlining Park rules.

Interconnected walking trails crisscross the Park (Figure 7). Connections in the northwest and southeast corners of the Park provide access to adjacent neighborhoods. The North and South Grassland trails are mowed. The Woodland trails are narrower and are either bare ground or are mulched with wood chips. The trails also provide maintenance vehicle access.

Five benches are located in the Park (Figure 7). One of the two benches at the south end of the vineyard is off its base and needs repair. Bluebird boxes are interspersed throughout both Grassland areas, although at least one in the North Grassland has been swallowed-up by black locust.

Of historic and aesthetic interest is a grape vineyard located in the northwest corner of the South Grassland (Figure 7). Jerry Goth suggested a farmer named Rice might have planted the grapes sometime in the early to

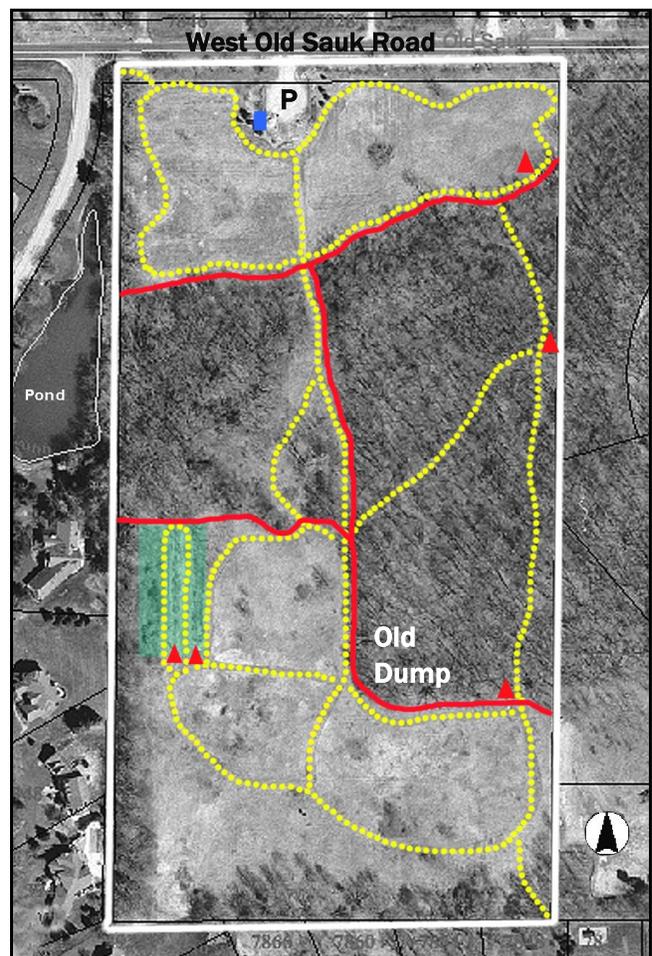


Figure 7. Cultural Features.

Yellow dotted lines are hiking trails, green shading is the grape vineyard, red triangles are benches, blue rectangle is the picnic table, P is the parking area, other features as labeled.

mid-1960s (pers. comm., October 26, 2006). The vineyard is visible for the first time in the 1968 air photo. It consists of, or more accurately consisted of, three double rows of grapes (six rows total) separated by mowed paths. The entire vineyard was severely overgrown with honeysuckle, buckthorn, box elder, black locust, and other trees and shrubs making it difficult to recognize as a vineyard and to see the grapes prior to the December 2005 clearing of the eastern four rows.

The clearing uncovered the original wood trellis posts and wire in all three double rows (Figure 8). Unfortunately, it also revealed that all of the grapes in the western double row had been smothered to death by the dense growth of honeysuckle and other trees and shrubs. The grapes in the other rows were alive and grew vigorously during the 2006-growing season in response to the tree and shrub removal, although they would benefit from reconstruction of the trellis.

Several apple trees on the edges of the Woodland still bear fruit and may be relicts from the days when the property was farmed.



Figure 8. Cleared (l) and Uncleared (r) Vineyard. Note Grapes and Trellis Poles in Cleared Area and the Lack of Grapes in the Uncleared Area.

Soils

According to the Dane County Soil Survey (Glocker and Patzer 1978) and Dane County Interactive Mapping Application (DCiMap 2003), six soil types are present (Figure 9, Table 1). Three of the six are considered highly erodible (Glocker and Patzer 1978, DCiMap 2003) although no appreciable erosion was observed.

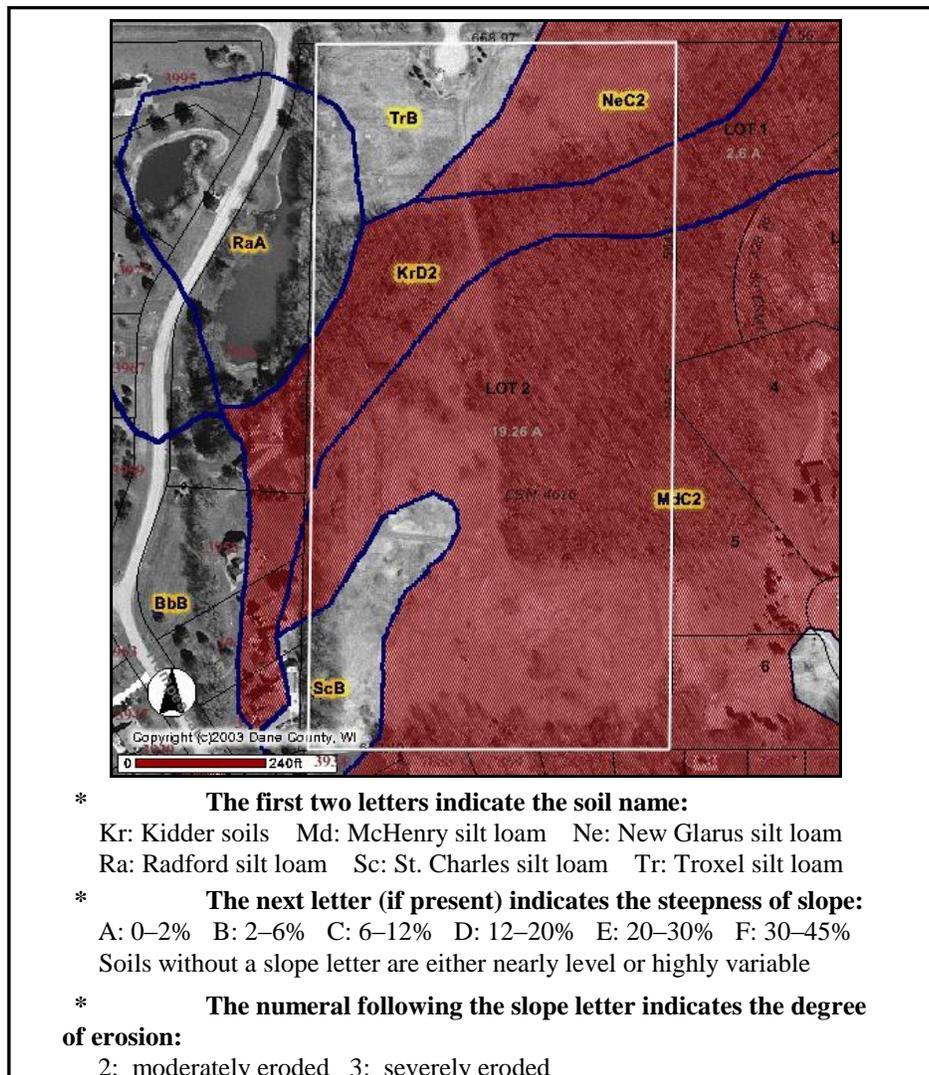


Figure 9. Goth Park Soil Types (DCiMap 2003). White line is Park boundary. Yellow-highlighted letters and numbers are map unit symbol. Olive green lines are soil type boundaries. Red shading shows highly erodible soils.

Table 1. Goth Park Soil Types.

Map Unit Symbol	Acreage	Soil Type	Description
KrD2	2.5	Kidder soils, 10-20 % slopes, eroded	Surface texture varies from silt loam to loam to sandy loam. Well-drained, moderately droughty, moderate permability, medium fertility, highly erodible.
MdC2	11.6	McHenry silt loam, 6 to 12 % slopes, eroded	Well-drained, medium available water capacity, moderately permeable, medium fertility, severe erosion hazard.
NeC2	2.5	New Glarus silt loam, 6 to 12 % slopes, eroded	Well-drained, 20-40 inches to soft bedrock, low available water capacity, highly erodible, not prime farmland.
RaA	0.4	Radford silt loam, 0 to 3 % slopes	Somewhat poorly drained, frequently flooded, very high available water capacity, moderately erodible, prime farmland if drained.
ScB	1.3	St. Charles silt loam, 2 to 6 % slopes	Well-drained, high available water capacity, moderately permeable, high fertility, moderate erosion hazard.
TrB	2.3	Troxel silt loam, 1 to 3 % slopes	Moderately well-drained, very high available water capacity, low erosion risk, prime farmland.

Topography

Goth Park's topography is heavily influenced by the passage of the Johnstown Moraine diagonally through the western portion of the Park (Mickelson 1983). The Johnstown Moraine is a low, sometimes indistinct ridge that marks the endpoint of the glacier associated with the late Wisconsin glaciation period in Dane County, which took place about 13,000 to 15,000 years ago. Because of the Park's glacial history, it features a distinctive, undulating type of terrain known as *ground moraine* created by the deposition of soil, rocks, and boulders beneath a glacier.

In addition to the Johnstown Moraine and ground moraine, the Park also features five kettle holes (Figure 10) that add topographic interest to the Park. Kettle holes, a typical feature of ground moraine, are depressions formed when soil, rocks, and other debris emanating from a melting glacier buries large blocks of ice. When the buried ice blocks melt, the ground subsides creating the kettle hole. The Park's largest and deepest kettle hole is approximately 20 feet deep and is in the southwest corner of the East Woodland Subunit.

The kettle holes add topographic interest to the Park and offer an opportunity to provide landscape interpretation.

As evidenced by debris and confirmed by Jerry Goth, the largest kettle hole was used as a local dump for neighboring farms at least into the mid to late 1950s (pers. comm., October 26, 2006). Additionally, the south and west sides of the kettle are lined with boulders removed from the adjacent South Grassland while it was an active farm field. Boulders are a common occurrence in ground moraine.

Jerry Goth also remembers a small, seasonal pond located northeast of the grape vineyard. This pond was likely a shallow kettle hole that filled with runoff from the adjacent fields in the spring.

Although most of the Park has the typical rolling topography of ground moraine, some areas are steeper than 12 percent slope (Figure 10). The highest point, approximately 1,188 feet above sea level, is located along the east property line (Figure 10). The lowest point, approximately 1,136 feet, is in the northwest corner of the property. Thus, there is approximately 52 feet of relief on the property.

Aspect¹ in the North Grassland is predominantly northwest. The South Grassland and Woodland have all possible aspects due to their varied topography and the presence of kettle holes (DCiMap 2003).

¹ Aspect refers to the direction the surface of the ground faces, e.g., a hillside with a west aspect faces to the west.

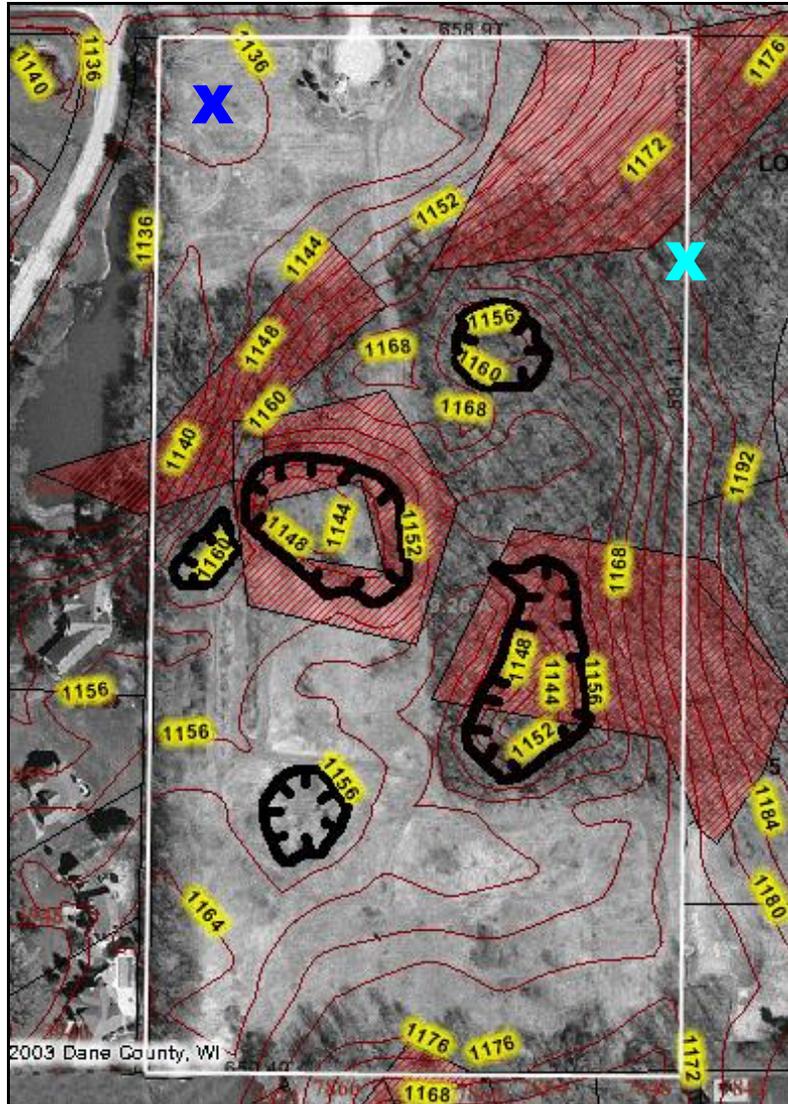


Figure 10. Goth Park Topography (DCiMap 2003). White line is Park boundary. Solid red lines are 4' contour lines. Yellow highlighted numbers are elevation (feet). Red cross-hatching indicates slope \geq 12 percent. Thick black lines are depressions (kettle holes). Dark blue "X" is lowest spot in Park. Light blue "X" is highest spot in Park.

Aerial Photographs

Analysis of a chronosequence of aerial photographs from 1937 (the earliest year available in Wisconsin) to 2005 reveals numerous changes to the Park and the surrounding landscape, most of which are typical of the changes that are occurring throughout the southern Wisconsin landscape (Figure 11).

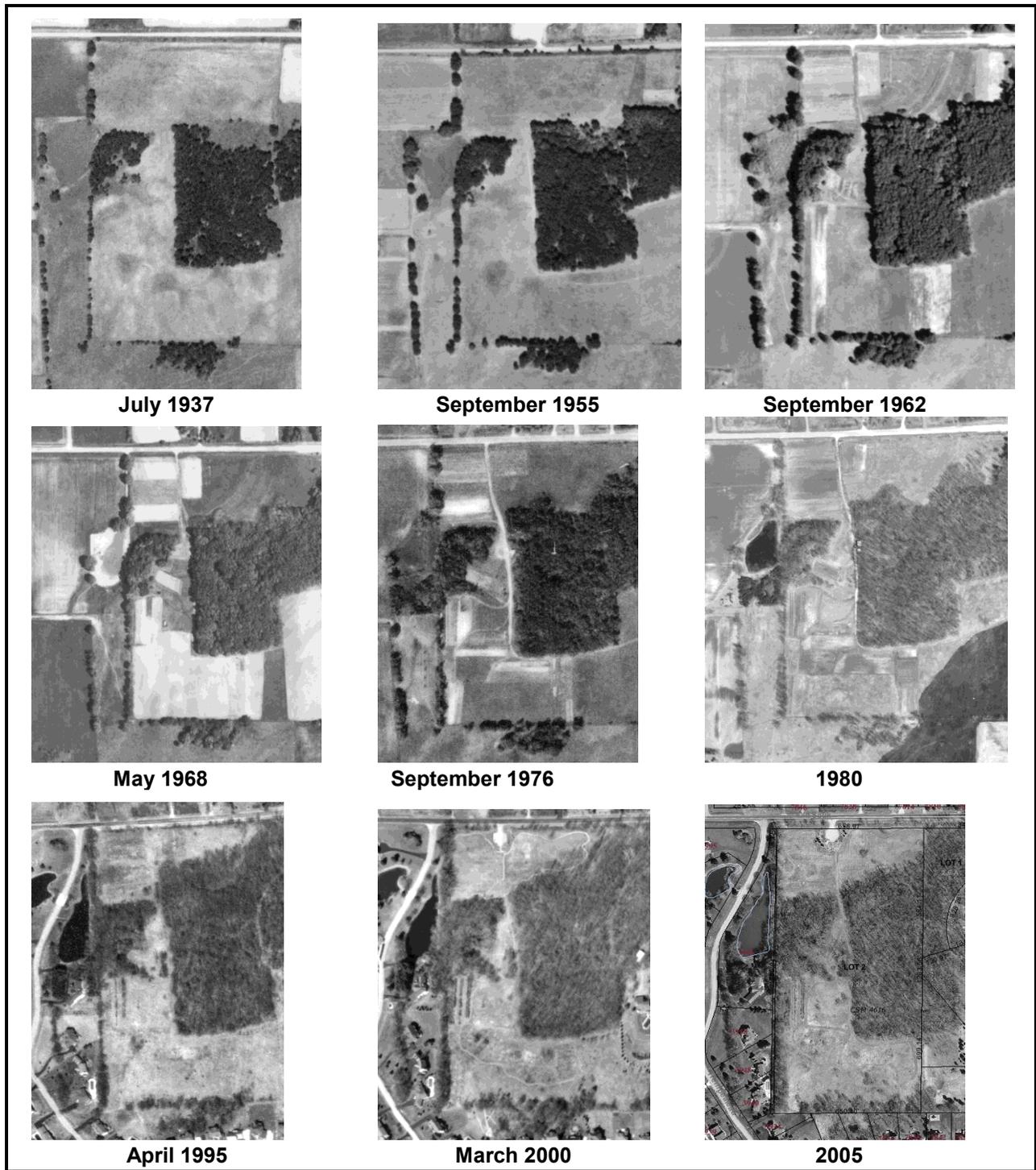


Figure 11. Aerial Photographs of Goth Park From 1937 to 2005. Property lines not shown so vegetation can be seen.

One of the most noticeable changes is the increased tree cover. In the 1937 photo there are two discrete tree-covered areas separated by open grassland: a smaller area in the west central portion of the property (more or less the West Woodland Subunit) and a much larger area in the east half of the property (more or less the East Woodland Subunit). Also note that in the 1937 photo the northeast corner of the East Woodland Subunit is treeless.

Subsequent photos show both Subunits expanding, with the most rapid expansion beginning after 1980, which coincides with the end of farming. The expansion is most noticeable along the north side of the East Subunit, and along the east and north sides of the West Subunit, although it also occurs toward the southwest onto private land. By 2005 the two Subunits have joined to form a nearly contiguous canopy. Trees have also filled-in the open area at the northeast corner of the East Subunit and have expanded northward nearly half way to Old Sauk Road, primarily due to the spread of black locust, an invasive species.

One of the most noticeable changes is the increased tree cover.

The density of the tree canopy also changes overtime. In the 1937 photo there are noticeable gaps and individual trees are visible. However, by the 1960s the gaps have closed and individual trees are difficult to distinguish, presumably due to the growth of additional trees, such as box elder, elm, and other species.

Tree cover and density similarly change along the property lines. Trees dot the west and south property lines in the 1937 to 1980 photos and are generally recognizable as individuals. Most likely, these are the large oak trees still present today. Overtime, the space between the trees fills-in and the width of the tree-covered area increases, especially between 1980 and 2000. By 2000 the west property line is completely tree and shrub covered, and the trees and shrubs are expanding toward the center of the property, with some already dotting the interior of the open grasslands. By 1995 the overgrown west property line has overtaken much of the vineyard.

The new growth along the property lines is a mixture of young trees, such as box elder and black cherry, and invasive shrubs, such as honeysuckle and buckthorn. Although many of the oak trees visible in the 1937 air photo remain, many have lost their lower branches because of shading (trees typically self-prune lower branches when they don't receive enough sunlight). This is most apparent on the oak trees at the north end of the west property line.

Two factors likely contributed the most to the increased tree and shrub cover – the invasive nature of black locust, buckthorn, and honeysuckle and the site's agricultural history. According to Jerry Goth the entire property was regularly grazed by livestock (pers. comm., October 26, 2006). Livestock often eat tree and shrub seedlings as fast as they appear without directly affecting established trees. Consequently, new trees and shrubs can't get established while livestock remain. Once the cattle were removed the tree and shrub seedlings were finally able to survive, grew rapidly, filled the canopy gaps and expanded into the grassland areas.

Another significant and easily noticed change is the suburbanization of the surrounding land that began in earnest during the late 1980s and continues today.

In the photos from 1937 to 1976 a wetland of approximately one to two acres is visible at about

the midpoint of the western property line. Most of the wetland is on the adjacent property, but a portion extends into the Park. Jerry Goth remembers this as an ephemeral wetland, i.e., a wetland that holds water in the spring and after heavy rain, but is otherwise dry (pers. comm., October 26, 2006). Apparently, excavation of the pond on the adjacent property, done during the late 1970s or 1980, caused the Park's portion of the pond to go dry.

Diseases

Dutch Elm Disease

Although not verified by laboratory testing, it's very likely Dutch Elm Disease (DED) is present based on the presence of dead elm trees (Figure 12, Figure 13). There are about a dozen dead trees, either as a single tree or in small groups.

DED is a vascular disease caused by either of two closely related species of fungi: *Ophiostoma ulmi* (Buism.) Nannf. and *Ophiostoma novo-ulmi* Brasier (Haugen 1998). Once the fungus infects a tree its vascular system becomes clogged, the leaves wilt, and the tree dies, although some infected trees survive. Disease progression may occur rapidly, killing the tree in one growing season, or it may progress

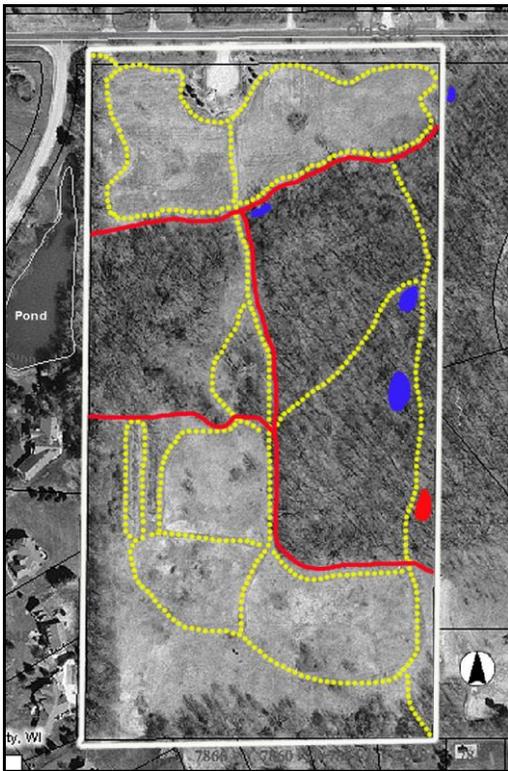


Figure 12. Location of Dead Elm (blue highlight) and Dead Oak (red highlight).



Figure 13. Dead Elm Trees in the Woodland.

gradually over a period of several years. Trees infected via root grafts tend to die faster because the fungus is carried throughout the tree by the vascular system.

DED spreads from tree to tree by two mechanisms: root grafts between nearby trees and over longer distances by two species of beetles: the native elm bark beetle and the smaller European elm bark beetle. In Wisconsin, the native elm bark beetle is more likely than the European bark beetle to spread DED because it is better able to survive cold winter temperatures. Root graft spread of DED is a very significant cause of tree death in urban forests where elms are closely spaced.

Oak Wilt

A small group of recently dead oak trees in the southeast corner of the Woodland suggests that oak wilt is present in the Park (Figure 12). This conclusion is bolstered by the presence of oak wilt on the adjacent property, which was diagnosed by laboratory testing during 2005 (pers. comm., Peter Szachnowski, adjacent landowner, Sept. 12, 2006). That landowner trenched around the affected oaks to sever root grafts between healthy and infected trees to try to prevent the pathogen from spreading.

Oak wilt is a disease caused by the fungus *Ceratocystis fagacearum*. It primarily targets and kills oak trees, but affects other species as well (Rexrode and Brown 1983, Cummings and Martin 2001). The fungus is believed to be native to Wisconsin.

All oak species found in Wisconsin are susceptible, but not equally. Species in the “red oak group” are most susceptible. This group, which has pointed leaf tips, includes red, black, northern pin, and scarlet oak. Species in the “white oak group” are less vulnerable than the red oak group, but are not immune. This group, which has rounded leaf tips, includes white, bur, chinquapin, and swamp white oak. Bur, white, red, and black oak grow in Goth Park (Figure 14).

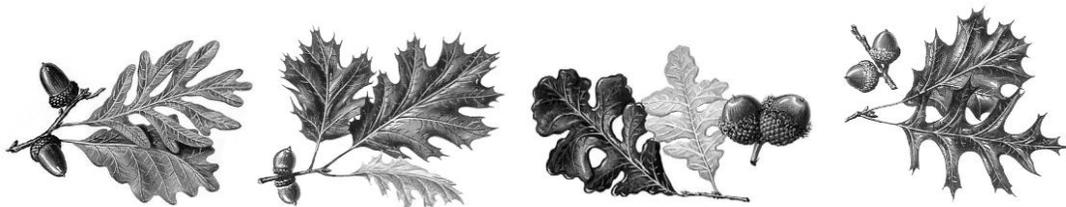


Figure 14. Oak Species in Goth Park: White, Red, Bur, and Black (l to r).

Fungal mats, known as “pressure pads,” often develop under the bark of trees that have died from oak wilt. As these pads form they push the bark outward causing it to crack. The dead oak trees in the Woodland have fungal mats and cracked bark. The fermenting fungal mat produces a sweet odor that attracts beetles. These beetles pick up oak wilt fungal spores on their bodies and legs as they feed on the fungal mat through the cracked bark. The beetles then fly to a

healthy tree, feed on sap flowing from a wound, and infect the tree. The fungus also spreads underground when the roots of an infected tree graft onto the roots of a healthy tree. Typically, the disease spreads outward from the first point of infection causing a circular shaped zone of dead oak trees.

The primary infection period is in the spring when new vessel wood is forming, although infection can occur anytime the tree is growing. For this reason, pruning or damaging any oak tree should be avoided throughout the growing season. Symptoms occur as early as May. Typically, the leaves turn dull green or bronze, appear water soaked, wilt, and then turn yellow or brown. Heavy defoliation accompanies leaf wilting and discoloration. The disease progresses rapidly, and some trees die within one or two months after the onset of symptoms. Most die within a year.

Hazard Trees

While a detailed hazard tree survey is beyond the scope of this report, there are several dead trees located close enough to a trail to pose a potential safety hazard (Figure 15). The hazard tree at the east end of the North Grassland (a dead elm) is on adjacent private property, but is close enough to the trail to be a concern.

It's likely that additional hazard trees will develop as the trees killed by oak wilt and Dutch elm disease disintegrate.

Adjacent Land Use

It is important to consider adjacent land uses and the potential impact(s) they can have on Goth Park because diseases, invasive species, and other problems don't respect property lines.

The west and south borders of the Park abut residences in the Pheasant Point and Sauk Point Estates neighborhoods that were established about 15 to 20 years ago. The properties abutting the Park's eastern border are under development. To date the development includes a cul-de-sac, several surveyed lots, and one house in the south half of the area, and the start of construction during 2006 of two houses in the north half. Trees have been cleared from the lots where the houses are being built and it's expected that both houses will be visible to Park visitors, to one degree or another.

The fencerows along the west and south sides of the Park harbor a high number of invasive



Figure 15. Hazard Trees (red ovals).

species, especially shrubs, such as buckthorn, honeysuckle, and multiflora rose. This is also true of the east side, but to a lesser degree. Many of these invasive species continue onto adjacent properties for some distance.

Vegetation

Historic Plant Community Classification

Based on the 1833 and 1834 Wisconsin public land survey records, it appears Middleton Township, including Goth Park, historically was primarily oak savanna with several large areas of prairie (Figure 16) (<http://digi.lib.wisc.edu/SurveyNotes/>). In fact, oak savanna and prairie were the dominant plant communities in central and western Dane County prior to the arrival of the early white settlers (Ellarson 1949, Curtis 1959).

The 1834 survey notes describe the Goth Park area as “rolling and second rate, timber[ed] [with] bur, white, and black oak [with an] undergrowth [of] grass.” Bur and white oak are the classic trees of oak savanna. “Second rate” refers to the suitability of the land for agriculture. The land was probably considered second rate because of its rolling topography and because of the rocks and boulders left by the glacier.

Jerry Goth remembers pasque flower, leadplant, and shooting star – prairie and savanna species – growing on the

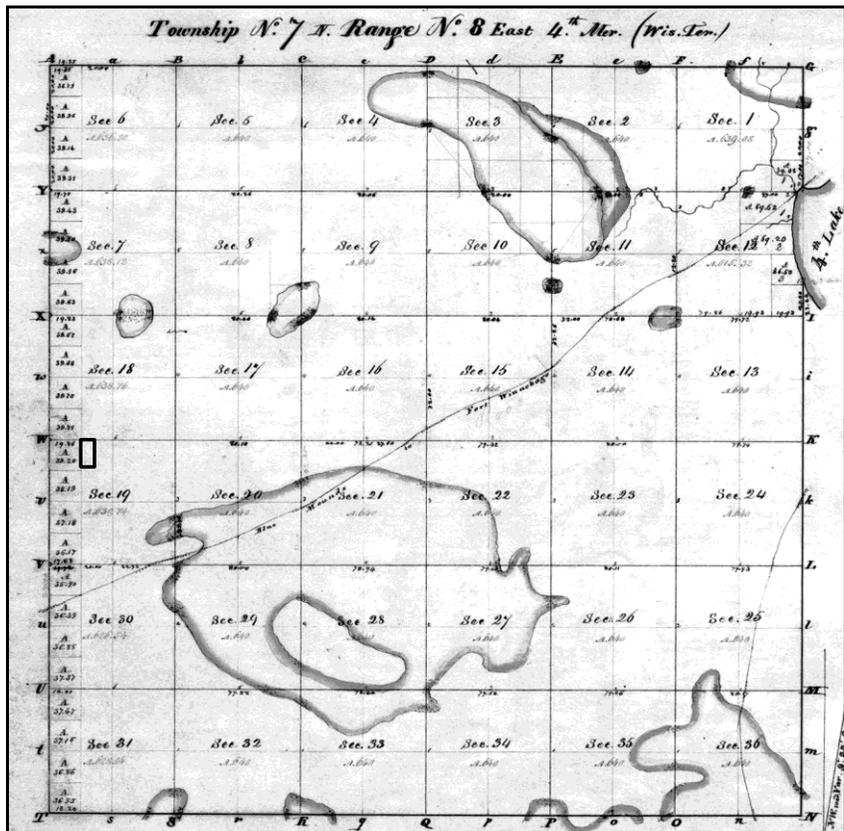


Figure 16. 1834 Public Land Survey Map of Township 7 North, Range 8 East.

Goth Park is within the black rectangle in Section 19. Shaded areas are prairie except for the area east of Section 12 labeled “4th Lake,” which is Lake Mendota. The diagonal line between Section 12 and Section 30 is the road from Blue Mounds to Fort Winnebago (near Portage). The line between Section 24 and Section 36 is an “Indian trail.” West Old Sauk Road forms the north border of Section 19, Timber Lane the west border, and Midtown Road the south border.

property into the mid- to late 1950s. This bolsters the idea that the area was formerly oak savanna and prairie.

Current Plant Community Classification

In 2006, the North and South Grasslands are most accurately classified as *old field* (Table 2). The Woodland has converted (succeeded) from oak savanna to *southern dry-mesic forest* (Table 2) because it has been heavily invaded by a variety of trees and shrubs not normally associated with savanna, including box elder, slippery and American elm, black cherry, apple, ash, buckthorn, and honeysuckle. Although many of the original oak savanna trees remain, very few oak savanna groundlayer plants remain due to extensive grazing, excessive shade, lack of fire, and the effects of exotic (non-native) species.

Table 2. Summary Characteristics of the Major Plant Communities at Goth Park (Adapted from Curtis 1959 and Sample and Mossman 1997).

Community Type	Distinguishing Characteristics	Community Stability and Successional Trend	Location at Goth Park
Southern Mesic Forest	Typically strongly dominated by sugar maple with lesser amounts of basswood, red oak, and ironwood. Closed canopy produces deep shade throughout the summer. Flowering groundlayer plants are predominantly spring blooming in order to utilize the sunlight available before the canopy closes. Shrub density is typically low, but may include gooseberry, bladdernut, and witch hazel. Usually found on rich soil.	Very stable. Not prone to fire because of the shady, moist conditions and because maple leaves decompose quickly thereby removing the primary fuel source.	None at current time, however, in the absence of disturbance most of the Woodland Unit could succeed to this type.
Southern Dry-mesic Forest	An intergrade between dry and mesic forests with some characteristics of each. Red and white oak are the most important tree species, but sugar maple, basswood, red elm, black oak, and white ash may also be common. The canopy is less dense than in a mesic forest and typically contains numerous gaps. Fewer spring blooming plants in favor of summer and fall bloomers. Shrub density and diversity is typically very high and thickets are common.	Usually succeeded by mesic forest in the absence of major disturbance such as fire, severe drought, or windstorm.	Woodland Unit.
Oak Savanna	A fire adapted, mostly open community with widely spaced bur, white, or black oak trees. Tree spacing is such that there is more sun than shade. Grasses dominate the groundlayer, but forb ¹ diversity is typically very high. Peak blooming period is during the summer, but the blooming period begins during spring and continues until fall. Currently extremely rare in Wisconsin.	Very stable in the presence of fire otherwise slowly invaded by dry-mesic or mesic forest.	Historically, the entire property. Currently, only portions of the Woodland Unit and some fence lines have oak savanna trees, but lack the groundlayer.
Old Field	Former agricultural field typically dominated by non-native grasses, such as Kentucky bluegrass, brome, and quack, but also containing native and exotic forbs. Height varies with species and soil type. Less than 5% woody cover. Usually deliberate wildlife plantings, conservation reserve plantings (CRP), retired hayfields, or retired pastures.	Converts to shrubland and then to forest in the absence of mowing, fire, or other brush control.	North Grassland, South Grassland

¹ A forb is a herbaceous nongrassy annual, biennial, or perennial plant. Often loosely used to indicate a wild flower.

The conversion of oak savanna to forest, often with an intermediate oak woodland stage, is a common occurrence in southern Wisconsin and an interesting

It's very likely that Goth Park was once much more open and savanna-like, then became more woodland-like as fire was suppressed, and is now being converted into forest by the arrival of shade tolerant and fire intolerant trees.

story that mixes ecology and human interaction with the landscape.

Prior to the arrival of the earliest white settlers, oak savannas were kept free of invading trees and brush by frequent fires. However, the settlers suppressed fire to protect their crops, livestock, dwellings, and even their own lives. This had the inadvertent effect of allowing more trees and shrubs to become established. Cochrane and Iltis (2000) write “Unfarmed savannas, except very dry or very wet ones, were changed into closed-canopy forests within two to three decades [following fire suppression]....”

They attributed this to “the successional replacement of ...the dominant oaks by other shade tolerant/fire intolerant² trees and shrubs,” such as maple, basswood, elm, and ash. These species are relatively fast growing and shade tolerant compared to oak, but are easily fire-killed.

Sometimes the oak savanna converted to oak woodland or oak forest when fire was stopped, rather than a forest of sugar maple, basswood, elm, and ash. The explanation for this transformation is due to the presence of *oak grubs*. Oak grubs are short, multi-stem oak trees a few feet tall that look more like a shrub than a tree. They’re created when an oak sapling or seedling has its top (aboveground portion) repeatedly killed by fire, or sometimes grazing, while the roots survive. When fire or grazing is stopped the grubs grow rapidly into trees from their already strong root system.

Number of Species Observed

One hundred and twenty-nine species were identified (Table 3, Figure 17, and Appendix I for a full species list). This is a moderate number, and is fairly typical for a 20-acre site with just two plant community types and a long agricultural history. Agricultural use, including grazing, generally decreases the number of native species and increases the number of exotic species. Small sites tend to have fewer species because there is less environmental variation.

It should be noted that additional species might have been observed had the surveying started earlier in the growing season.

Table 3. Number And Proportion Of Native And Exotic Species In All Survey Units By Lifeform.

Life-form	Native Species		Exotic Species		Total Number
	Number	%	Number	%	
Trees	15	75	5	25	20
Shrubs	12	75	4	25	16

² Shade tolerant refers to a plant’s ability to successfully to grow in continual shade. Fire intolerant species are unable to survive a fire, usually because they have thin bark or unable to resprout.

Vines	6	67	3	33	9
Graminoids ¹	5	39	8	61	13
Forbs (flowers)	38	55	31	45	69
Ferns	2	100	0	0	2
Total	78	60.5	51	39.5	129

¹ Grasses, sedges, and other non-forb, grass-like plants.

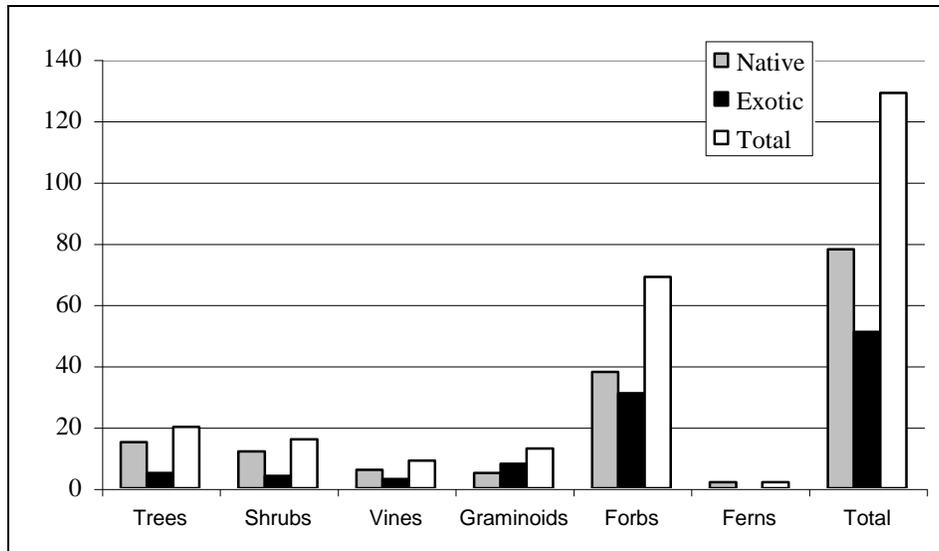


Figure 17. Number Of Native and Exotic Species In All Survey Units By Lifeform.

Species distribution varies between survey units: The Woodland has more species than the North and South Grasslands – 97 compared to 73 and 59, respectively (Table 4, Figure 18). Most of this difference is due to the higher number of tree, shrub, and forb species in the Woodland.

The Woodland also has a higher proportion of native species than the Grasslands (Table 4, Figure 18). This isn't unexpected since the Grasslands were planted with non-native agricultural species. Also, although the Woodland was grazed, it was never plowed, allowing some of the native groundlayer species to survive.

The North Grassland has nine more native species and 14 more species overall than the South Grassland, yet they have essentially equal proportions of native species (Table 4, Figure 18). Some of the boost in native species in the North Grassland is due to the prairie planting done by the Town, although the abundance of these species is low.

Table 4. Number And Proportion Of Native And Exotic Species In Each Survey Unit.

Survey Unit	Native Species		Exotic Species		Total Number
	Number	%	Number	%	
North Grassland	41	56.2	32	43.8	73
Woodland	67	69.1	30	30.9	97
South Grassland	32	54.2	27	45.8	59

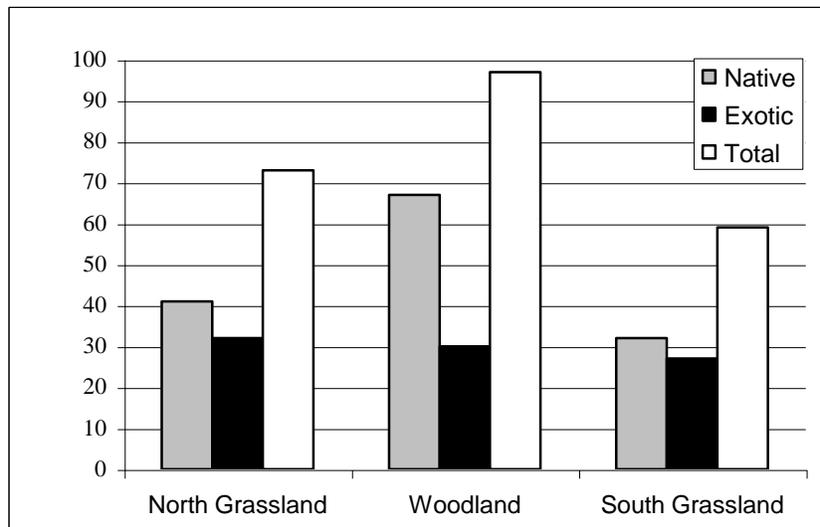


Figure 18. Number Of Native and Exotic Species In Each Survey Unit.

Endangered, Threatened, and Special Concern Species

No endangered, threatened, or species concern plants or animals were observed³.

Exotic–Native Species Relationships

Property-wide, 78 of the 129 observed species (61%) are native, a relatively low proportion. If only herbaceous species (graminoids, forbs, and ferns) are considered the number of native species drops to 45 out of 84 (54%), reflecting the influence the 15 native tree species and 12 native shrubs species have on the native species count.

It's important to note that the number of species or the percentage of native/exotic species does not fully indicate the diversity or health of an area. Rather, it's also important to consider the relative *density* (number of individuals) and *cover*⁴ of the exotic and native

³ Based on the Wisconsin Department of Natural Resources, Natural Heritage Working List (WDNR 2004).

⁴ Cover is the vertical aerial projection on the ground of the above ground portion of a species or, more simply, the amount of horizontal space a plant occupies when viewed from directly above.

species. This is because it is typically better to have a high number of exotic species with low density and low cover than it is to have a low number of exotic species with high density and cover. High exotic species density and cover typically cause the loss of native species.

Although not directly measured, the overall density and cover of the exotic species greatly exceeds that of the native species throughout both Grassland units, due primarily to the dense growth of exotic grasses, but also due to the abundance of invasive shrubs along the property lines. Exceptions occur, but on a very small scale, such as within a gray dogwood patch.

The density and cover of the exotic species in the Woodland is slightly higher than the native species, due primarily to the abundance of black locust in the north end and the presence of exotic shrubs throughout the unit. Again, exceptions occur. For example at the south end of the East Subunit where the exotic shrubs were removed and oak trees and native shrubs are abundant.

It is also important to consider the *type* of exotic species that are present. This is important because some exotic species are relatively benign and rarely displace more desirable native species, while others quickly become so abundant that they cause a significant loss of native species and disrupt normal ecological processes. The latter is called an **invasive species**.

Invasive Species

Invasive species nearly always warrant special management attention because they cause severe ecological damage. The best approach is to prevent a small number of plants from becoming a major infestation through periodic monitoring and quick removal of all detected plants.

It is important to note that a species can be invasive in one plant community but not in another.

It is important to note that a species can be invasive in one plant community (habitat type) but not in another. For example, wild parsnip is primarily invasive in sunny habitats but is rarely a significant concern in shady habitats.

The 12 observed invasive species are discussed in Table 5. *This list is specific to Goth Park and is based on species behavior, current abundance, and the site's current and projected environmental conditions. It should not be used to assess other sites.*

While only three of the 12 (buckthorn, honeysuckle, and black locust) are sufficiently widespread and abundant to be causing an appreciable loss of desirable species, they all have this potential and their presence is a significant concern. The 12 observed invasive species are individually discussed below. Each species is illustrated in Figure 19.

Table 5. Observed Invasive Species.

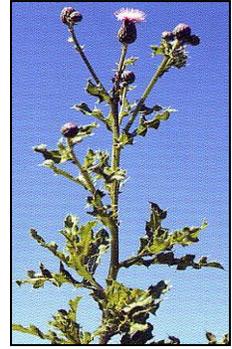
Common Name	Scientific Name	Location ¹	Abundance
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Forbs			
Garlic Mustard	<i>Alliaria petiolata</i>	NG: one plant found at edge of large brush pile. W: small patch on east side of main trail just before it forks at top of hill.	Low.
Canada Thistle	<i>Cirsium arvense</i>	NG, SG, and W: scattered throughout.	Medium-low, more abundant in NG and SG than W.
Leafy Spurge	<i>Euphorbia esula</i>	SG: one large patch in south central area.	Low.
White and Yellow Sweet Clover	<i>Melilotus alba</i> , <i>Melilotus officinalis</i>	NG: scattered throughout.	Low.
Wild Parsnip	<i>Pastinaca sativa</i>	NG: scattered throughout, but most abundant in the east half. SG: scattered throughout north half (east of vineyard).	Medium.
Shrubs			
Honeysuckle	<i>Lonicera spp.</i>	NG and SG: scattered clumps or individuals. Also along fencerows, sometimes as thickets. W: dense thickets on north edge and center.	Medium to high.
Common Buckthorn	<i>Rhamnus cathartica</i>	NG: few scattered plants near shadier edges. W: throughout, but most abundant in north half, especially northeast corner under black locust canopy.	NG: Low, may have been kept in check by mowing. W: High, abundant as subcanopy tree, some to 25' tall.
Multiflora Rose	<i>Rosa multiflora</i>	NG, W, SG: scattered individuals.	Low.
Trees			
Norway Maple	<i>Acer platanoides</i>	W, northeast corner.	Low, sapling sized tree.
Black Locust	<i>Robinia psuedoacacia</i>	NG: Two large clones in the east half. SG: mixed in north end of vineyard, partially cleared. W: central and northeast portion, the two large clones in the NG originate here.	NG and W: High, forms discrete clones with little to no native understory. SG: Low, only one relatively sparse clone.
Grasses			
Reed Canary Grass	<i>Phalaris arundinacea</i>	NG: discrete patches in southwest corner. SG: discrete patches in east-southeast portion. W: east side of East Subunit at top of hill near main trail. Surrounding the pond on private land to west of Park.	NG and SG: Low. W: Low, only a few small, scattered clumps. High on adjacent properties around ponds.

¹ NG is the North Grassland, SG is the South Grassland, and W is the Woodland.



Garlic Mustard in Flower (l) and an Infestation (r) (UWEX 2000).



(l) Canada Thistle Plant with Male (l) and Female (r) Flowers. (r) Canada Thistle Plant and Inflorescence (Doll 2001).



Leafy Spurge.



Wild Parsnip.



Bell's Honeysuckle.



White (l) and Yellow (r) Sweet Clover.



Multiflora Rose (Doll 2001).



Black locust trees (E. J. Czarapata).



Common Buckthorn with Fruit (UWEX 2001).



Reed Canary Grass Detail (l) and in Goth Park (r).



Norway maple leaf (l) and fruit (r) (Paul Wray).

Figure 19. Goth Park Invasive Species.

Garlic Mustard

Garlic mustard is a shade-loving, biennial, herbaceous plant. At maturity it ranges from 12 to 48 inches in height. Crushed leaves and stems emit a garlic odor, facilitating the identification of non-flowering plants. It was introduced from Europe as a culinary herb and has since spread throughout northeastern and midwestern United States. Once established it forms a tall, dense stand that excludes all other species. Seed production is prolific – often several hundred or more seeds per plant. Seed viability in the soil is approximately seven years.

Luckily, there is little garlic mustard in the Park. There is one plant at the western edge of the large brush pile in the North Grassland. It was probably moved there with the brush. There is also a small patch of garlic mustard located east of the main trail as it runs through the center of the Woodland, at the top of the hill, just before it forks. Flowering plants in this patch were pulled, bagged, and removed in Summer 2006, but additional nonflowering plants are present and will require attention in 2007. With regular monitoring and immediate removal when found, it should be possible to keep garlic mustard from becoming a problem in the Park.

Canada Thistle

Canada thistle is a spiny, branching, perennial forb that can grow to five feet tall. Despite its name, it is native to Europe, not Canada. It grows in clonal patches of either female or male plants; only female plants produce seeds. It spreads by wind-borne seed and by lateral root growth. It prefers sunny areas and typically requires soil disturbance to become established.

It is scattered throughout the Park, but in low abundance.

Leafy Spurge

Leafy spurge is a deep-rooted, herbaceous perennial. It is native to Eurasia, but has been in the United States for nearly 200 years. It is a noxious weed in Wisconsin. The small, green, inconspicuous flower is surrounded by two large yellow-green bracts that are often mistakenly thought to be the flower. It's invasive because it starts growing early in the spring, has an extensive and deep root system laden with dormant buds, spreads rapidly vegetatively and by seeds, which are explosively dispersed up to 15 feet, and because it is allelopathic⁵. It prefers sunny areas and will grow in all soil types, except where wet.

Leafy spurge is confined to an approximately 0.2 acre patch in the South Grassland. Abundance within the patch is moderate and it grows with other vegetation. Herbicide treatments in 2004 and 2006 have reduced its abundance, but additional treatments will be required to eliminate it.

Wild Parsnip

Wild parsnip is a short-lived perennial. It typically spends one or more years as a basal

⁵ Release of toxic substances by one plant species to suppress the growth of another plant species.

rosette. Then, when conditions are favorable, it grows up to seven feet tall, flowers, produces seeds, and dies. It spreads primarily by seeds. Preventing seed production by mowing or pulling eliminates it. Wild parsnip causes phytophotodermatitis: when the sap of the plant contacts skin in the presence of sunlight a chemical reaction takes place causing a rash or blister.

Wild parsnip is scattered throughout the North Grassland, but is most abundant in the east half. It is also scattered in the north portion of the South Grassland, east of the vineyard.

White and Yellow Sweet Clover

White and yellow sweet clover are very similar in appearance, the primary difference being flower color (i.e., white versus yellow), although yellow sweet clover is shorter and blooms earlier than the white. Both are biennial legumes. Growing to five feet tall during the second year, sweet clover often forms large, dense stands that eliminate other species via shading and possibly allelopathy. Once established, it persists via seeds. One plant can produce 250,000 seeds and the seeds may remain viable for thirty or more years.

White and yellow sweet clover are present in the North Grassland, but their abundance is low and recent mowing has prevented seed production.

Honeysuckle

Honeysuckle is a dense, upright growing shrub that usually has numerous stems. It can grow to 10 feet in height in either shade or sun. Fragrant pink, white, or yellow flowers appear in spring and are followed by red, yellow, or orange berries. Birds and other animals eat the fruit and disperse the seeds. Honeysuckle is one of the first shrubs to leaf-out in the spring and one of the last to lose its leaves in the fall. This gives it a strong competitive edge which it exploits at the expense of native flora. Left uncontrolled honeysuckle frequently forms dense thickets with bare soil underneath. Honeysuckle is native to Asia and Europe and was introduced to the United States as an ornamental landscape plant.

Honeysuckle occurs as scattered individuals or in small clumps in the interior of the North and South Grasslands, mostly in low abundance. It also grows in the fencerows along the west and south sides of the Park, where it sometimes forms dense thickets. Honeysuckle abundance is especially high in the north edge and center of the Woodland. Management in 2004 and 2005 has reduced honeysuckle abundance in select areas of the Park, but additional effort will be required to eliminate it.

Common Buckthorn

Common buckthorn is a shade-loving shrub. It grows as tall as 30 feet with a stem diameter of 10 inches. Female buckthorn produce prolific quantities of green-black fruit during the fall. Male buckthorn produce only pollen. Like honeysuckle, birds eat the fruit and disperse the seeds. Also like honeysuckle, buckthorn is one of the first shrubs to leaf-out in the spring and one of the last to lose its leaves in the fall, making it a very strong competitor. It forms dense thickets with bare soil underneath.

Buckthorn plants are scattered in the North Grassland, but they have been kept small by mowing. Unfortunately, buckthorn is abundant in the north half of the Woodland especially under the black locust tree canopy where it almost becomes a subcanopy tree, with some reaching 25 feet tall.

Multiflora Rose

Multiflora rose is a dense spreading shrub with arching canes armed with stout recurved thorns. Mature plants may reach eight feet tall. It is typically found in sunny environments. It was introduced into the United States from Japan in 1886 for use as a rootstock for cultivated roses and was soon thereafter widely promoted for wildlife food, for preventing soil erosion, and as a “living fence.” It is now naturalized throughout most of the Midwest. One plant can produce up to 500,000 seeds per year and the seeds may remain viable for as long as 20 years. Birds often eat the rose hips (the fruit containing the seeds), thereby dispersing the seeds long distances.

Although multiflora rose is in all areas of the Park, its abundance is low and most of the plants are relatively small.

Black Locust

Black locust, a member of the pea family, is a thorny tree that grows up to 80 feet tall. It produces pea-like blooms that turn to many-seeded pods, but the tree commonly reproduces vegetatively from underground rhizomes to create dense clones. Black locust likes sun and well-drained soils. It is native to Southern Appalachia and the Ozarks and was introduced to Wisconsin in the early 1900s for erosion control.

Black locust abundance is very high in the north end of the East Woodland Subunit, where it comprises more than 70 percent of the canopy. Black locust abundance is also very high in the east half of the North Grassland, where there are two large clones. One clone looks like it was mowed recently and is mostly less than four feet tall. The other is 15 to 20 feet tall and covers a significant area. Both clones originate from the nearby locust growing in the Woodland. Left unchecked, the locust will eventually cover the entire North Grassland. Black locust is also present on the adjacent properties east of the Park.

Norway Maple

Norway maple is widely planted as a street and yard tree because of its ability to grow in compacted, droughty soils across a wide range of soil pH. These characteristics make Norway maple an aggressive invader in many parts of the northeastern United States, including Wisconsin. Norway maple, with its wide leaves distributed evenly along each branch, casts a very dense shade. Unlike many other tree species, such as oak, it can establish and grow in dense shade. Therefore, once a population is started it typically replaces less shade tolerant trees and reduces groundlayer diversity.

Norway maple abundance is low, with just one young tree found in the northeastern portion of the Woodland. It's possible there are other trees on neighboring properties, but this isn't

known.

Reed Canary Grass

Reed canary grass is a sod forming perennial that can grow to nine feet in height. It is found most often in sunny wetlands, but also grows in sunny upland areas. Reed canary grass spreads rapidly, both by seeds and creeping rhizomes. Because of its tall height, dense growth, and rapid spread it nearly always extirpates other species as it spreads, resulting in a dense monoculture with little or no value to wildlife. It is native to Europe and Asia and was brought to United States during the 1800s for agricultural use and for erosion control.

Reed canary grass occurs mostly as relatively small, discrete monotypic patches in the North and South Grasslands. It is most abundant in the western half of the North Grassland. It also occurs in the Woodland as scattered small patches, for example near the east edge of the West Subunit. The perimeter of the pond on the adjacent property west of Goth Park has an abundance of reed canary grass and is likely the seed source for the reed canary grass in the Park. This suggests that seed dispersal into the Park will be an ongoing problem.



DESCRIPTIONS OF INDIVIDUAL SURVEY UNITS

~~restrict burning to dump areas, but limit flame height~~

~~control Euonymus, remove from other areas of property and replace with native shrub or noninvasive hort shrub~~

Introduction

The purpose of this section is to present and interpret the data collected that is specific to each of the three survey units and to provide a detailed description of each unit. An overview of each unit's management needs is also provided.

North Grassland

Air photos indicate this area was in agriculture from 1937 until about the time it became part of Goth Park, although agricultural use actually started much earlier than 1937, probably in the mid-1800s. According to Jerry Goth, a farmer named Rice established a 'pick-your-own' strawberry patch in the west half of this area during the mid-1950s. (This may be the same farmer that planted the grape vineyard in the South Grassland.) The strawberry patch is visible in the 1962 through 1980 air photos.

The vegetation is best described as a dense mix of cool season⁶ exotic grasses with a variety of native and exotic forbs, i.e., old field. The exotic grasses include smooth brome, Kentucky bluegrass, orchard grass, timothy, reed canary grass, and yellow foxtail. All are commonly planted for agricultural use. The highly invasive reed canary grass is present in scattered monotypic patches in the western half of the grassland. It is also present along the edges of the constructed pond on the adjacent property west of the Park. Canada wild rye is the only native grass found in the North Grassland.



Figure 20. Looking West across the North Grassland.

There are twenty native forbs, compared to 18 exotic forbs, a nearly equal percentage (Table 6 and Appendix I). The majority of the native forbs are common species (in southern Wisconsin) that are usually associated with sunny and disturbed habitats. Examples include giant and common ragweed, daisy fleabane, common milkweed, common evening primrose, common cinquefoil, pilose aster, and Canada and tall goldenrod.

Table 6. Number and Proportion of Native and Exotic Species.

Life-form	Native Species		Exotic Species		Total Number
	Number	%	Number	%	
Trees	9	82	2	18	11
Shrubs	8	67	4	33	12
Vines	3	60	2	40	5
Graminoids	1	14	6	86	7
Forbs (flowers)	20	53	18	47	38
Ferns	0	0	0	0	0
Total	41		32		73

There are also a few native prairie forbs, such as New England aster, black-eyed Susan, and bee balm. These species and purple coneflower, a prairie species not native to Wisconsin, and the Canada wild rye grass likely originated from an earlier prairie planting done by the Town, although little of the planting remains. A few savanna species, such as calico aster, white

⁶ Cool season grasses are grasses that grow most actively in the spring and fall when air and soil temperatures are relatively cool. Conversely, most prairie grasses are warm season grasses and grow most actively during the summer.

snakeroot, and rough-leaved sunflower occur near the Woodland edge and in the fencerows where they receive the mixture of sun and shade they prefer.

Of the 20 native forbs, only the two species of goldenrod, Canada and tall, are abundant. Unfortunately, this is undesirable because both are often considered invasive. Both spread by rhizomes and both are allelopathic. Jerry Goth remembers pasque flower and shooting star, two conservative native prairie/savanna species, growing in the southwest corner of this unit. These species were not observed during the survey and have likely been extirpated.

Five of the 18 exotic forb species present are invasive: garlic mustard, wild parsnip, white and yellow sweet clover, and Canada thistle. The remainder are relatively common weeds (in southern Wisconsin) that prefer sunny habitats and thrive on disturbance, such as burdock, bull thistle, curly dock, mullein, and dandelion, or are agricultural species, such as red and white clover.

Wild parsnip is the most abundant of the five invasive forbs. It occurs throughout the field, but is especially abundant in the eastern half. White and yellow sweet clover and Canada thistle are scattered throughout the field. A single, nonflowering garlic mustard plant was found on the northwest corner of the large brush pile in the center of the field.

All three of the Park's invasive shrub species are present: buckthorn, honeysuckle, and multiflora rose. Buckthorn and honeysuckle were abundant along the north and west edges of the field (fence lines) before being removed by BioLogic and the Town during 2004 and 2005. These shrubs were stressing the large, mature bur oak trees and were suppressing the growth of desirable native shrubs, such as elderberry. Buckthorn, honeysuckle, and multiflora rose remain as scattered, mostly short, individuals in the interior of the grassland.

Although 11 tree species occur, most grow near the edges of the field. Nine of the 11 are native, including box elder, shagbark hickory, black walnut, black cherry, American elm, ash, and bur, red, and black oak. Box elder is generally considered weedy and undesirable, although it is native.

Large bur oak with spreading crowns and low growing branches are scattered along the west fence line (Figure 21). Presumably, these are the trees visible in the 1937 air photo. Although invasive shrubs were removed from beneath the oak trees in 2004 the trees are likely still being stressed by the box elder and black cherry growing through their branches.



Figure 21. Open Grown Oak Trees in West Fence Line Crowded by Cherry and Other Trees.

The west end of the grassland has a number of healthy, well-formed bur oak saplings. Presumably, they are the offspring of the mature bur oak in the nearby fence line.

The two exotic tree species present are black locust and white mulberry. White mulberry is mostly restricted to the fencerows as relatively small saplings. It is not a significant concern at present, although it can sometimes be invasive.

Conversely, black locust is highly invasive and is a significant concern. It spreads primarily by underground rhizomes, but also by seed. As noted in the invasive species discussion (page 32), there are two large clones. The smaller clone appears to have been mowed recently and is less than four feet tall. The other and larger clone is 15 to 20 feet tall and has engulfed a bluebird house and bench that, presumably, had been placed in the open (Figure 22). It is expanding northward from the Woodland into the eastern half of the field and has already crept almost half of the distance from the Woodland to West Old Sauk Road. Left unchecked, it will eventually cover the entire field.



Figure 22. Bench Overgrown by Black Locust.

Primary Management Needs

1. Control invasive species, especially black locust, buckthorn, and honeysuckle to prevent them from overtaking the field.
2. Remove box elder, cherry, and other trees from beneath the large bur oak along the west fence line to prolong their life and to allow visitors to view the impressive trees.
3. Remove/burn the brush pile. Make sure the garlic mustard plant at the edge of the pile is destroyed.
4. Consider restoring the field to prairie.

Woodland

The Woodland is a relatively young dry-mesic forest comprised of a mixture of white, bur, red, and black oak, black walnut, slippery and American elm, black cherry, shagbark hickory, box elder, hackberry, and black locust. In all, there are 18 tree species of which 13 are native (Table 7 and Appendix I). Of all these species, the oak trees are clearly the oldest and largest and reflect the area's oak savanna history.



Figure 23. Mature Oak Trees With Open Grown Form at the South Subunit (l) and in the Western Subunit (r).

Table 7. Number and Proportion of Native and Exotic Species.

Life-form	Native Species		Exotic Species		Total Number
	Number	%	Number	%	
Trees	13	72	5	28	18
Shrubs	11	73	4	27	15
Vines	6	86	1	14	7
Graminoids	5	71	2	29	7
Forbs (flowers)	30	63	18	37	48
Ferns	2	100	0	0	2
Total	67		30		97

The oak savanna history is most noticeable in two areas: along the south edge of the Eastern Subunit and in much of the Western subunit. These are the areas where large, mature oak trees, many with an open grown form, are the most abundant (Figure 23). Unfortunately, most of the oak trees in the western half are difficult to see because they are intermixed with a dense growth of other trees, including exotic Norway spruce. Conversely, the oak trees along the south edge of the East Subunit are relatively easy to see because they were freed from invasive trees and shrubs during 2004 and because their branches grow over the adjacent walking trail. Overall, though, most of the unit's trees have a woodland- or forest-grown form, suggesting this area has been heavily tree-covered for some time.

The areas with open grown oak trees strongly contrast with the north end of the Eastern Subunit. Here, mature oak trees are absent and the canopy is comprised primarily of the invasive black locust with lesser amounts of hackberry, ash, elm, and box elder (Figure 24). Fortunately, the black locust doesn't seem to be regenerating beneath its own dense canopy, probably because it prefers full sunlight. Rather, most of its spread is from vegetative growth (root suckers) into adjacent open (sunny) areas.



Figure 24. North End of Woodland With Black Locust Canopy.

There is ample evidence of oak regeneration with oaks of various size classes throughout most of the Woodland. This is important because it indicates that oak will continue to be a part of the Woodland. They are especially abundant near the sunnier edges (oak seedlings and saplings require abundant sunlight to survive) and where mature oak trees provide a seed source.

Numerous, well-rotted stumps indicate that some logging has occurred, probably decades ago. Jerry Goth suggested these trees might have been white oak that was logged to make fence posts when the area was first settled (pers. comm., October 26, 2006).

The Woodland has fifteen shrub species. Eleven are native and four are exotic. Three of the four exotic shrubs are invasive: buckthorn, honeysuckle, and multiflora rose. The other exotic shrub is European highbush cranberry, a horticultural escapee that provides berries for wildlife, although the berries are less nutritious and desirable than the native American highbush cranberry.

Buckthorn and honeysuckle are a significant management concern.

Of the three invasive shrubs, multiflora rose is the only one that isn't a significant long-term concern because it prefers sunny habitats and therefore isn't likely to become abundant. Buckthorn and honeysuckle, however, are already a significant concern. They occur throughout the Woodland, often at a high enough abundance to have caused the partial or complete loss of the herbaceous groundlayer and to be suppressing oak and other tree regeneration. They are most abundant in the north and northeast parts of the Woodland, where they form a dense and impenetrable thicket (Figure 25). A portion of this thicket was cleared during December 2005, but the majority remains.

Native shrubs present include gray dogwood, hazelnut, chokecherry, smooth and staghorn sumac, prickly gooseberry, wild rose, prickly ash, common elderberry, blackberry, and red and black raspberry. All are a welcome component of the Woodland and provide valuable food for wildlife. However, their abundance is very low compared to the invasive shrubs. The exception is the brambles (raspberry and blackberry), which are moderately abundant, especially beneath canopy gaps. Although brambles are native they can be invasive (Figure 25).



Figure 25. Dense Buckthorn (background) and Brambles (foreground).

Most of the native shrubs are more typically associated with sunny habitats (or grow best in sunny habitats), rather than shady habitats, providing further evidence that the Woodland was once more open. Consequently, most are restricted to the sunnier edges or the semi-open area at the center of the Woodland (along the east edge of the West Subunit). Prickly gooseberry and common elderberry are the only two shrubs present that are typically associated with shady habitats, although common elderberry also grows in sunny habitats.

There are seven vine species, six are native and one is exotic. Native vines include hog peanut, American bittersweet, Virginia creeper, carrion flower, poison ivy, and riverbank grape. All are relatively common (in southern Wisconsin) and provide valuable wildlife food. The exotic vine is nightshade, but it is not abundant or a particular concern.

There are 37 native herbaceous groundlayer species (forbs, ferns, graminoids). Thirty are forbs, two are ferns, and five are graminoids. They are a mixture of forest (shade) species, sun-loving (prairie) species, and a few savanna species (mixed sun and shade). Overall, however, their abundance and diversity is relatively low. This may be an aftereffect from years of cattle grazing.

Examples of the forest species include agrimony, Jack-in-the-pulpit, enchanter's nightshade, fragrant bedstraw, sweet Cicely, lopseed, large-leaved shinleaf, lady fern, and woodfern.

Prairie species include common milkweed, New England aster, horsetweed, fireweed, bee balm, and Canada and tall goldenrod. They occur primarily in the semi-open area along the east edge of the West Subunit or near the sunnier Woodland edges.

The low number of native herbaceous species may be an aftereffect from years of grazing.

Savanna species include wild geranium, calico aster, white snakeroot, false Solomon's seal, and white vervain. These species may owe their continued presence to the past cattle grazing that kept the Woodland somewhat open. Unfortunately, none are very abundant.

Three native grasses are present: Canada wild rye, witch grass, and wild timothy, as well as several native sedges, including Pennsylvania sedge. None are very abundant. Pennsylvania sedge is

more common in sunny habitats and is considered a species favored by grazing. The Canada wild rye was seeded on the bare soil created by the burn piles during the December 2005 invasive shrub clearing.

There are 20 exotic herbaceous groundlayer species (forbs, ferns, graminoids), of which four are an invasive species. Eighteen are forbs and two are graminoids. All but one of the 18 exotic forbs (garlic mustard) are common species (in southern Wisconsin) that prefer full sunlight. Most thrive on disturbance. Many are agricultural weeds or common lawn plants such as velvet leaf, lamb's quarter, yellow rocket, Canada thistle, creeping Charlie, dandelion, red and white clover, and Queen Anne's lace. Their presence is further confirmation that the Woodland was once more open and sunny, partly due to the long grazing history.

Four of the exotic groundlayer species are invasive within the context of Goth Park: garlic mustard, Canada thistle, wild parsnip, and reed canary grass. Of these, garlic mustard is of greatest concern because it is adapted to shady habitats and because it spreads very quickly due to prolific seed production. Its restricted distribution (one patch) will make it relatively easy to control, assuming action is taken immediately and continues until it is eradicated. The other invasive species are of lesser concern in the Woodland because the shade reduces their vigor and limits their spread and because their abundance is low. Nevertheless, they still warrant prompt attention.

Primary Management Needs

1. Continue removing woody invasive species, especially black locust, buckthorn, and honeysuckle, to prevent them from overtaking the entire Woodland. If there are time/budget constraints, focus first on areas beneath oak trees to prolong their life and make them more visible.
2. Continue controlling garlic mustard so it doesn't spread throughout the Park.
3. Remove hazard trees.
4. Consider oak savanna restoration.

South Grassland

Like the North Grassland, this area appears to be an abandoned pasture or hay field and is also best classified as an *old field* (Figure 26). As might be expected for an old pasture or hay field, cool season exotic grasses are dominant and account for the majority of the herbaceous vegetation. Smooth brome grass and Kentucky bluegrass are especially abundant. No native grasses or sedges were observed, the only survey unit where this occurred.

Reed canary grass, an invasive species, is present. It is restricted to three smaller patches near the east side and one patch on the north side of the grape vineyard. Only reed canary grass grows within each patch, all other species have been eliminated.



Figure 26. South Grassland Looking Northwest Toward Vineyard.

While the number of exotic and native forbs is nearly equal, 16 verses 14 (Table 8 and Appendix I), the density and cover of the exotic species greatly exceeds the native species throughout the unit. The exotic forbs are a

mixture of common weeds typically associated with agricultural land and sunny, disturbed habitats, such as burdock, bull and Canada thistle, Queen Anne’s lace, goat’s beard, dandelion, and mullein, and a smaller number of agricultural legumes, such as red and white clover.

Unfortunately, the list also includes three invasive forbs: leafy spurge, Canada thistle, and wild parsnip. Leafy spurge is the most abundant, covering about 0.2 acres. Wild parsnip is most abundant east of the vineyard and Canada thistle is scattered throughout the field, but neither is especially abundant.

Table 8. Number and Proportion of Native and Exotic Species.

Life-form	Native Species		Exotic Species		Total Number
	Number	%	Number	%	
Trees	11	92	1	8	12
Shrubs	3	50	3	50	6
Vines	4	80	1	20	5
Graminoids	0	0	6	100	6
Forbs (flowers)	14	47	16	53	30
Ferns	0		0		0
Total	32		27		59

Despite the dominance and abundance of the exotic species there are 14 native forbs. They include common milkweed, pilose aster, calico aster, fireweed, daisy fleabane, false sunflower, evening primrose, prairie cinquefoil, white vervain, and Canada goldenrod. However, their abundance is low, especially relative to the non-native herbaceous species. The exception is Canada goldenrod, a native species that can be invasive in sunny habitats. It is already very abundant and covers large areas of the field. If left unchecked it will continue spreading.

Jerry Goth remembers leadplant, a short prairie shrub, growing near the south end of the west fence line beneath bur oak trees in the mid- to late-1950s. Leadplant was not observed during the

survey and likely has been extirpated.

As the historic air photos indicate, the field is rapidly being invaded by a variety of trees and shrubs. In fact, there are 12 tree and six shrub species present, a high number for an area that was essentially treeless except along the perimeter only 20 years ago. They include invasive species, such as buckthorn, honeysuckle, multiflora rose, and black locust, and a variety of native trees and shrubs, such as black cherry, oak, shagbark hickory, black walnut, red cedar, box elder, gray dogwood, and brambles.



Figure 27. Tree and Shrub Growth along South Grassland Edge (background) and Interior (foreground).

While most of the invasion is occurring along the perimeter of the south and west sides, some species have already reached the interior of the field (Figure 27). For example, there are several pockets of black cherry saplings several inches in diameter and numerous bur and white oak saplings, especially near the south edge of the East Woodland Subunit. Honeysuckle was much more abundant prior to removal during 2004. Most likely, trees and shrubs will cover the entire field in 15 to 25 years unless there is management intervention.

The condition of grape vineyard located at the northwest corner of the field is discussed in the Cultural Features section (page 12).

Primary Management Needs

1. Continue removing woody invasive species, especially black locust, buckthorn, and honeysuckle to prevent them from overtaking the entire field.
2. Continue spraying the leafy spurge so it won't spread.
3. Repair the trellis system in grape vineyard.
4. Consider restoring the field to prairie.



OBJECTIVES AND RECOMMENDATIONS

~~restrict burning to dump areas, but limit flame height~~

~~control *Euonymus*, remove from other areas of property and replace with native shrub or noninvasive hort shrub~~

Introduction

Sound land management is based on an understanding of current conditions, a set of objectives describing the desired conditions, and numerous ecological principles. The current condition of the Park has been discussed and the objectives are outlined later in this section. The ecological principles used to formulate the management recommendations are discussed below.

1. It is best not to think of the property as the “North Grassland,” the “South Grassland,” and the “Woodland.” Rather, it is far better to remember that the site functions as a whole and to consider the effects one area has on the other areas and how individual areas can be managed in concert to achieve larger, property-wide goals that could not be achieved by managing on a piecemeal basis.
2. Management for one species or habitat type is nearly always management against other species or habitat types. For instance, one plot of land cannot be managed simultaneously for grassland birds and forest interior birds. Therefore, effective management attempts to produce as diverse a spectrum of habitat types as possible in order to attract and accommodate as many species as possible *within the constraints imposed by the site*. Sometimes it will be necessary to select and manage for one habitat type.
3. A large tract of the same habitat type is better than a smaller tract. This is because many species require large areas of relatively homogenous habitat, especially wildlife. One large tract is better than two smaller tracts even if the total acreage is the same because smaller tracts have a higher proportion of *edge* relative to *interior*. Tracts with a high proportion of edge are more susceptible to invasion by weeds and therefore harder to maintain.

4. Historically, natural ecological processes maintained the landscape and promoted ecological health without human intervention. For instance, fire used to sweep across the landscape for hundreds of miles killing brush, rejuvenating many plant communities, and allowing oak to regenerate. Currently, however, many natural ecological processes are unable to maintain the landscape and promote ecosystem health because the landscape is too fragmented. Consequently, human intervention in the form of directed management is required. Benign neglect generally creates more problems than it solves and results in the loss of species and their habitats.

Desired Future Condition

A *desired future condition* statement is a broad statement that expresses a vision of a site's future character.

Desired future condition statement for Goth Park: Goth Park hosts a variety of native plant communities, such as prairie and oak savanna, to the extent possible within the limitations associated with its size, urban location, the surrounding land use, and the available resources. Exotic and invasive species abundance is minimized to protect and encourage native flora and fauna. Cultural artifacts, such as the vineyard, are preserved. Visitors have safe, educational and recreational opportunities that enhance their understanding and appreciation of the Park's cultural and natural history.

Objectives and Recommendations

Objectives are concise, but general statements that describe a specific component of a site's desired future condition. They are the basis for developing *recommendations*. *Recommendations* are specific actions undertaken to achieve a given objective. They can be short- or long-term and can be either ongoing or completed in a single event.

Objectives and recommendations are first presented in outline form to provide an overview. Recommendations are then discussed in detail in the following section. The objectives and recommendations presented are compatible with the Town's 2003 Outdoor Recreation Plan.

Objective 1: Protect and Restore Native Plant Communities

Native plant communities are protected, enhanced, and/or restored, to the extent possible given the limitations of size, urban location, surrounding land use, and available resources. Exotic and invasive species abundance is minimized to protect native flora and fauna.

Short Term

- Recommendation 1. Control exotic species.
- Recommendation 2. Prevent the spread of oak wilt.
- Recommendation 3. Leave standing dead trees when they aren't a safety hazard.

Long Term

- Recommendation 4. Restore the Woodland to oak savanna.
- Recommendation 5. Restore the North and/or South Grassland to prairie.
- Recommendation 5 (alternate). Restore the North Grassland to prairie and allow the South Grassland to convert to forest or oak savanna.

Objective 2: Provide for Visitor Safety and Enjoyment

Community access and recreational use compatible with natural resource protection is encouraged. Visitors are provided with educational opportunities. Public safety is protected.

Short Term

- Recommendation 1. Remove hazard trees.
- Recommendation 2. Maintain benches.
- Recommendation 3. Repair vineyard trellis system.
- Recommendation 4. Maintain high parking lot visibility to discourage inappropriate and illegal activities.
- Recommendation 5. Burn the brush pile in the North Grassland.
- Recommendation 6. Maintain but do not expand the existing trail system.

Long Term

- Recommendation 7. Use interpretive signs to tell the Park's cultural and natural history.

Objective 3: Minimize Impacts to Adjoining Neighborhoods

The Town strives to be a good neighbor by minimizing the impacts of Park development and use on adjoining neighborhoods.

Short Term

- Recommendation 1. Consider providing replacement screening as invasive trees and shrubs are removed from fence lines.

Long Term

- Recommendation 2. Post "Private Lands Beyond" signs, if needed.

Objective 4: Utilize External Funding and Partnerships

Public and private funds are obtained for development, restoration, and management. Partnerships are developed with organizations and individuals.

Short Term

- Recommendation 1. Obtain External Funding.

Long Term

- Recommendation 2. Link with other organizations.
- Recommendation 3. Create a "Friends of Goth Park" group.

MANAGEMENT RECOMMENDATIONS

Introduction

Natural resource management plans need to be flexible because the resources they seek to manage constantly change, because new information is often obtained, new technologies are developed, and new insights reached. Consequently neither this nor any other management plan should be viewed as conclusive or absolute. Instead, it should be viewed for what it is: a blueprint providing information, guidance, and a starting point for the ongoing process of ecologically based, thoughtful land stewardship.

Land restoration and management requires monitoring to provide feedback on the effectiveness of the activities and to discover new information. Careful and diligent monitoring and evaluation will allow appropriate and necessary changes to be made to the management plan, a process known as *adaptive management*. Changes should be made in consultation with all interested parties and a qualified ecologist.

While this report references the need to control or remove invasive species, providing specific “how-to” information for every species is beyond the scope of this report. Instead, the reader is referred to the following websites that provide a wealth of detailed information on this topic:

1. **The Wisconsin Department of Natural Resources:** Identification and control recommendations for many Wisconsin invasive species, and a discussion of management techniques, <<http://www.dnr.state.wi.us/org/land/er/invasive/index.htm>>.
2. **The Global Invasive Species Initiative:** Hosted by The Nature Conservancy, this site provides identification and control information for a large number of invasive species, plus information on techniques, including selecting and safely using herbicides, and an extensive link section, <<http://tncweeds.ucdavis.edu/links.html>>.
3. **EXTOXNET (EXTension TOXicology NETwork).** “Objective, science-based information about pesticides – written for the non-expert,” <<http://extoxnet.orst.edu/>>.
4. **Invasive Plant Association of Wisconsin (IPAW).** IPAW’s mission is to “promote better stewardship of Wisconsin’s natural resources by advancing the understanding of invasive plants and encouraging the control of their spread,” <<http://www.ipaw.org>>.

The recently published *Invasive Plants of the Upper Midwest: An Illustrated Guide to Their Identification and Control* (Czarapata 2005) is highly recommended as an up to date and comprehensive reference text.

Objective 1: Protect and Restore Native Plant Communities

Native plant communities are protected, enhanced, and/or restored, to the extent possible given the limitations of size, urban location, surrounding land use, and available resources. Exotic and invasive species abundance is minimized to protect native flora and fauna.

Short Term

Recommendation 1: Control exotic species.

Eradicating invasive and exotic species is a significant challenge that will require several years of unbroken effort. Expect this and do not be discouraged by it. Fortunately, eradication isn't always necessary. A more realistic goal is to reduce exotic species abundance to a level where the natives can successfully compete against them, and then maintain their abundance at or below this level.

Table 9 lists the level of management concern for all of the observed exotic species. The 12 invasive species are of greatest concern. Fortunately, some of them, such as reed canary grass and Norway maple, have a very limited distribution and the abundance of buckthorn, honeysuckle, multiflora rose, and black locust has already been reduced in select areas of the property.

Although invasive species pose the greatest and most immediate threat, don't ignore the other exotic species. Prompt control while their abundance is low prevents the loss of additional native species and negates the need for an intensive control effort at a later date.

Exotic species must be controlled or native species will continue to be lost and it will be extremely difficult for any introduced flowers and grasses to survive.

Weed control requires a variety of methods because their abundance and distribution varies across the site, because perennial weeds require different treatment than annual and biennial weeds, and because native and exotic species are frequently mixed together. Useful methods include herbicide, mowing, burning, and pulling.

In general, herbicides are effective on all types of weeds, but are an especially efficient tool for controlling perennial weeds, including woody species, and for large areas lacking either any native species or any native species worth saving. Herbicides can be applied to individual plants (spot application) or broadcast applied. Herbicide should only be applied by qualified individuals. The reed canary grass patches are a prime candidate for control via herbicide (discrete, monotypic patches of a perennial species).

Mowing (or cutting) is most effective for annual and biennial species. Annual and biennial species are identified in Table 9. Highly selective mowing can be done with a string trimmer or a brush saw and is especially useful when native and exotic species are mixed together. Examples of species that can be controlled by mowing include burdock, Queen Anne's lace, wild parsnip, bull thistle, and sweet clover.

Table 9. Exotic Species Management Concern Level¹.

Scientific Name	Common Name	Management Concern Level			Comments
		Low	Med.	High	
Forbs					
<i>Abutilon theophrasti</i>	Velvet leaf	X			Annual, agricultural weed.
<i>Achillea millefolium</i>	Yarrow	X			Perennial.
<i>Alliaria petiolata</i>	Garlic mustard			X	Invasive species, biennial.
<i>Arctium minus</i>	Burdock		X		Biennial, agricultural weed.
<i>Asparagus officinalis</i>	Asparagus	X			Perennial, edible.
<i>Barbarea vulgaris</i>	Yellow rocket	X			Biennial, agricultural weed.
<i>Cannabis sativa</i>	Hemp	X			Annual.
<i>Chenopodium album</i>	Lamb's quarter	X			Annual.
<i>Chicorium intybus</i>	Chicory	X			Perennial.
<i>Cirsium arvense</i>	Canada thistle			X	Invasive species, perennial.
<i>Cirsium species.</i>	Thistle		X		Biennial.
<i>Cirsium vulgare</i>	Bull thistle		X		Biennial.
<i>Daucus carota</i>	Queen Anne's lace		X		Biennial, can become abundant.
<i>Echinacea purpurea</i>	Purple coneflower	X			Perennial, not native in Wisconsin
<i>Euphorbia esula</i>	Leafy spurge			X	Invasive species, perennial.
<i>Glechoma hederacea</i>	Creeping Charlie	X			Perennial, common lawn weed.
<i>Hieracium species</i>	Hawkweed	X			Perennial.
<i>Hypericum perforatum</i>	Common St. Johnswort	X			Perennial.
<i>Leonurus cardiaca</i>	Motherwort	X			Perennial.
<i>Melilotus alba</i>	White sweet clover			X	Invasive species, biennial.
<i>Melilotus officinalis</i>	Yellow sweet clover			X	Invasive species, biennial.
<i>Nepeta cataria</i>	Catnip	X			Perennial.
<i>Pastinaca sativa</i>	Wild parsnip			X	Invasive species, short lived perennial.
<i>Prunella vulgaris</i>	Heal all	X			Perennial.
<i>Rumex crispus</i>	Curly dock		X		Perennial.
<i>Solanum sarrachoides</i>	Hairy nightshade	X			Perennial.
<i>Taraxacum officinale</i>	Dandelion	X			Perennial, common lawn weed.
<i>Tragopogon species</i>	Goat's beard	X			Mostly biennial.
<i>Trifolium pratense</i>	Red clover		X		Perennial, agricultural legume.
<i>Trifolium repens</i>	White clover		X		Perennial, agricultural legume.
<i>Verbascum thapsus</i>	Common mullein		X		Biennial.
Grasses					
<i>Bromus inermis</i>	Smooth brome grass	X			Perennial, agricultural grass.
<i>Dactylis glomerata</i>	Orchard grass	X			Perennial, agricultural grass.
<i>Elytrigia repens</i>	Quack grass	X			Perennial, agricultural grass.
<i>Miscanthus species</i>	Silver grass	X			Perennial, horticultural species.
<i>Phalaris arundinaceae</i>	Reed canary grass			X	Invasive species, perennial.
<i>Phleum pratense</i>	Timothy	X			Perennial (short lived), agricultural grass.
<i>Poa pratensis</i>	Kentucky bluegrass	X			Perennial, turf and agricultural grass.
<i>Setaria glauca</i>	Yellow foxtail	X			Annual, agricultural grass/weed.
Vines					
<i>Solanum dulcamara</i>	Nightshade	X			Perennial.
<i>Vicia sativa</i>	Spring vetch	X			Perennial.
<i>Vitis sp.</i>	Grape	X			Perennial, horticultural variety, planted.
Trees					
<i>Acer platanoides</i>	Norway maple			X	Invasive species.
<i>Morus alba</i>	White mulberry		X		Can be invasive in sunny habitats.

Table 9. Exotic Species Management Concern Level¹, continued.

Scientific Name	Common Name	Management Concern Level			Comments
		Low	Med.	High	
Trees, continued					
<i>Picea abies</i>	Norway spruce		X		Large tree, fire hazard in oak savanna.
<i>Pyrus malus</i>	Apple	X			Has wildlife value.
<i>Robinia pseudoacacia</i>	Black locust			X	Invasive species.
Shrubs					
<i>Lonicera sp.</i>	Honeysuckle			X	Invasive species.
<i>Rhamnus cathartica</i>	Common buckthorn			X	Invasive species.
<i>Rosa multiflora</i>	Multiflora rose			X	Invasive species.
<i>Viburnum opulus</i>	Highbush cranberry	X			Has wildlife value.

¹Based on current abundance, ability to spread and cause ecological harm given the environmental conditions, and the difficulty of control. This list is specific to Goth Park and should not be used to assess other sites.

Pulling is most effective for treating annual, biennial, and shallow rooted perennial species, including shrub seedlings, when they aren't too abundant. Garlic mustard, sweet clover, and buckthorn and honeysuckle seedlings are examples of species that are easily pulled, although the task quickly becomes daunting if the area is large. Like mowing, pulling offers a chemical free option for weed control.

Burning is effective on many types of weeds and can treat large areas relatively quickly, but requires special training and equipment. Effectiveness for some species, such as sweet clover and cool season exotic grasses, strongly depends on timing. It should be noted that burning can also stimulate weed seed germination, especially legumes, such as sweet clover.

Reducing weed abundance when native and exotic species are mixed together will be challenging. This situation rules out any type of broadcast herbicide application, although spot applications are still possible. The use of semi-specific herbicides, such as broadleaf-only or grass-only, is one possible solution.

Another solution is early spring and late fall herbicide application. At this time, many of the exotics are growing, but most of the natives are dormant. This type of treatment is especially effective for garlic mustard, the seedlings and resprouts of buckthorn and honeysuckle, and many grasses, including reed canary grass.

When native and exotic species are mixed together, you'll need to make a case-by-case evaluation to determine whether or not the quality and quantity of the natives makes them worth saving or whether it would simply be easier and more efficient to kill everything and start anew.

Invasive and exotic species must be controlled or they will spread, native species will continue to be extirpated, and it will be extremely difficult for introduced flowers and grasses to survive because of the stiff competition they'll face. Removing exotic and invasive species paves the way for introducing native species.

Recommendation 2: Prevent the spread of oak wilt.

Oak wilt is a concern because it could possibly kill most or all of the oak trees in the Park, eliminating the possibility of oak savanna restoration and significantly altering the Park's character.

There are two oak wilt management options: (1) allowing the disease to run its course and (2) active management to prevent the disease from spreading.

Allowing the disease to run its course is the cheapest and easiest method, but has unknown consequences. Most likely the disease will spread to healthy trees throughout the Park and neighboring properties.

Active management is more likely to prevent the spread of oak wilt, but will be much more labor intensive and costly and may be beyond the Town's budget. To be successful it must prevent the spread of the disease aboveground *and* underground:

1. Preventing underground spread.
 - A. A trencher or vibratory plow is used to sever and/or prevent root connections between healthy and infected trees. This barrier needs to be at least four feet deep to be effective. Placing the barrier the proper distance away from the infected area is critical. This distance varies with soil type and tree diameter. Eliminating root grafts is the most effective way to stop the spread of oak wilt.
2. Preventing aboveground spread.
 - A. Do not harvest, prune, or otherwise wound oak trees between April 1 and October 15. Trees wounded during this time will bleed sap and may attract oak wilt carrying insects. Be especially careful to avoid nicking oak trees while removing hazard trees, maintaining trails, controlling invasive species, and during other activities.
 - B. Remove all oak trees within the root trench barrier.
 - a. A suitable root barrier must be in place before dead trees are removed (see number 1A above). Water tension released when trees are cut permits fluids to rapidly move to uninfected trees through root grafts.
 - b. Remove all healthy trees and all dead trees that still have the bark attached from within the barrier since these are the trees that can develop the pressure pads that attract the beetles that spread the disease. Dead trees with loose bark do not have to be removed because they can no longer produce pressure pads, but you may wish to remove them for safety reasons.
 - c. The infected and healthy trees that were removed with attached bark should be stacked and covered with a thick plastic tarp and the edges tightly sealed to the ground (trenching preferred) to prevent insects from reaching the fungal mats. They can also be piled and burned.
 - d. Treat stumps with a herbicide to prevent resprouting to break the disease cycle.

- C. Investigate the use of *Alamo*[®] (propiconazole), a systemic fungicide, in consultation with an arborist or county forester. *Alamo*[®] has shown some effectiveness in preventing root graft infections for up to three years in red and white oaks and as a treatment method for lightly infected white oaks, but not red or black oaks. It is relatively expensive, however.

Additional information on identifying and controlling oak wilt is available from the WDNR at <http://www.dnr.state.wi.us/org/land/forestry/fh/oakWilt/> and the US Department of Agriculture Forest Service at http://www.na.fs.fed.us/fhp/ow/states/wi/ow_prevent.shtm. Information on the use and effectiveness of *Alamo* is available at http://ncrs.fs.fed.us/pubs/rn/rn_nc390.pdf.

Dutch elm disease, the other disease that's present, isn't considered a significant concern because the loss of elm trees from the Park will not hamper oak savanna or prairie restoration. Information on identifying and controlling Dutch elm disease is available from University of Wisconsin Extension Publication 2392, Dutch Elm Disease in Wisconsin (877-947-7827 or on line at <http://learningstore.uwex.edu>) and from the US Department of Agricultural on line at http://www.na.fs.fed.us/spfo/pubs/howtos/ht_ded/ht_ded.htm.

Recommendation 3: Leave standing dead trees when they aren't a safety hazard.

Some of the standing dead trees, also known as snag trees, in the Woodland should be left to provide habitat and food for wildlife unless they are a safety hazard or will contribute to the spread of oak wilt. Forty-six species of birds, 25 species of mammals, and numerous species of reptiles and amphibians in Wisconsin are dependent on snags (WDNR n.d.).

There are two types of snag trees—hard and soft, both are present in the Park. Hard snags have rotten centers, a solid exterior, and usually have some limbs still attached. Hard snags make excellent den trees. Soft snags have soft, decayed wood and have usually lost their branches. Soft snags are excellent foraging sites for insect eating birds and make excellent nest sites for cavity nesting birds such as woodpeckers and black-capped chickadees.

Forty-six species of birds, 25 species of mammals, and numerous species of reptiles and amphibians in Wisconsin are dependent on snags.

If desired, snag trees can be created by girdling or basal bark herbiciding an appropriate tree. Try to select as large a tree as possible since a large tree benefits a greater number and variety of species than a small tree. Trees that are deformed, diseased, or are crowding an oak tree are the best candidates. Select a tree away from the trail.

Allowing fallen trees to decompose in situ facilitates nutrient recycling and provides important food and shelter for a wide variety of wildlife. For example, downed rotting logs provide excellent shelter for salamanders, moles, shrews, millipedes, and other wildlife of all sizes. Hollow logs are often used as dens.

Long Term

Recommendation 4: Restore the Woodland to Oak Savanna.

The majority of the Woodland is amenable to oak savanna restoration. Oak savanna restoration is listed as a planned activity for Goth Park in Appendix I in the 2003 Town of Middleton Outdoor Recreation Plan.

When European settlers began arriving in Wisconsin there was an estimated 5.5 million acres of oak savanna. Beginning almost immediately savannas were cleared and plowed for agriculture, used (or over-used) for pasture, and invaded by brush and trees because of fire suppression. Currently, less than 500 of the original 5.5 million acres of oak savanna remain, making it “extraordinarily rare” (WDNR 2005, WDNR 1995). Goth Park offers a wonderful opportunity to help restore this lost part of Wisconsin’s biological heritage.

Less than 500 of the original 5.5 million acres of oak savanna remain.

Because there will be variations in the density of the tree canopy across the Woodland as you restore oak savanna there will be a mixture of light conditions which will likely include savanna, woodland, and prairie. There will also be light variations due the extra light entering the savanna from the adjacent Grassland. Areas with different light conditions can be planted with different species, boosting the site’s overall diversity and more closely mimicking nature.

Savanna restoration requires five steps:

1. Structural restoration: removing unwanted trees and shrubs to create appropriate light conditions. Some of this was completed during 2004 and 2005.
2. Exotic species control.
3. Groundlayer enhancement: stimulating the growth and spread of existing native species and adding missing species.
4. Securing the long-term presence of oak trees.
5. On-going management.

Each step is discussed in detail below.

Step 1: Remove Unwanted Trees and Shrubs to Create Appropriate Light Conditions.

As previously discussed, the Woodland has been heavily invaded by black locust, black cherry, box elder, elm, honeysuckle, buckthorn, and other trees and shrubs, creating dense shade that has eliminated much of the native herbaceous groundlayer. Removing invasive shrubs and thinning the canopy will reestablish an appropriate savanna tree density, thereby creating the appropriate savanna light conditions.

Appropriate light conditions will stimulate the native plants that have been suppressed by dense shade, may trigger seed germination of latent native species, and will facilitate the survival of the existing oak

Restoring appropriate light conditions will invigorate herbaceous plants and protect the mature oak trees.

saplings and seedlings. It will also invigorate the mature oak trees by reducing the competition they face for light, nutrients, water, and space. This will make them more resistant to disease and insect attack, preserve what's left of their open and woodland growth form, and increase their life span.

The goal should be to eventually remove all of the trees and saplings that aren't oak or shagbark hickory. However, it may be permissible to preserve a scattering of trees other than oak and hickory *if* they have a canopy that mimics an open grown oak that casts appropriate shade, and *if* they don't impinge upon an existing oak or hickory. Such a tree is referred to as a *nurse tree* since it is used to temporarily provide savanna light conditions, but will eventually be removed once there are oak or hickory trees capable of replacing it. Remember, savanna light conditions are a mixture of sun and shade with the location and proportion of each changing throughout the day as the sun tracks across the sky.

Initiate clearing in the areas with the highest proportion of oak trees – along the south edge of the Eastern Subunit and much of the Western subunit – and work outward from there. Canopy conditions (percent closure and composition) should be periodically assessed to see how “on-track” the structural restoration is and to assure the best choice of trees are being removed and left.

Cutting was the method used during 2004 and 2005 to thin the canopy. However, there are alternate methods that offer advantages over cutting. They are especially appropriate when only a moderate number of trees need to be cleared.

Fire is an alternate method for thinning the canopy. It will be slower than mechanical methods, but more cost effective.

One alternate method is the basal bark application of an appropriate herbicide, such as Garlon 4 (Triclopyr). With basal bark applications, the herbicide is applied in a band around the trunk near the base of the tree. The chemical is absorbed through the bark and translocated to the roots where it kills the tree. The advantage of this method is that it is much faster than cutting and that the tree dies slowly. Slowly opening the canopy is often advantageous because it reduces the risk of a vigorous weed response. The disadvantage is that the dead trees remain in place until they eventually fall, sometimes creating aesthetic and safety concerns.

Fire is another alternate method for thinning the canopy. Fire is more cost effective than manually cutting the trees, but it's slower because it will require several burns done over several years. However, as noted above, opening the canopy slowly has its advantages. Disadvantages of fire include the hazard associated with standing dead trees and the possibility that some species will resprout, such as black locust. Additionally, fire won't kill some trees either because they are too large or because there isn't enough ground fuel to create a hot enough fire.

While thinning the canopy be sure to preserve all oak and shagbark hickory trees, saplings, and seedlings. Oak and shagbark hickory are the primary trees of oak savanna and the future of the savanna relies on their presence. Take care to avoid damaging oak, including breaking

branches or nicking the bark, while removing unwanted trees since damage invites insects, oak wilt, and other diseases. This is especially important during the growing season.

Wintertime removal of trees when the ground is frozen or snow covered is preferred because there is less risk of disturbing and compacting the soil, which invites weeds and damages tree roots, because there is less risk of oak wilt if an oak is accidentally damaged, and because there is less risk of weeds being spread by equipment and personnel. Additionally, work is easier and faster because leaves are absent so there is less volume of material and less weight. Herbicides, which are required to prevent resprouting, are still effective when properly chosen and applied.

Options for disposing of the cut material include piling and leaving to decay, burning, chipping, and off-site removal. The best option is to eliminate as much of the cut material as possible by any of the three latter options. This is because the savanna is relatively small and there will be a large volume of material, because some people find piles visually objectionable, and because piles are a hazard during prescribed burns. Eliminating as much of the cut material as possible also provides suitable sanitation that helps control the spread of buckthorn and honeysuckle seeds and the spread of Dutch elm disease, especially if the elm are removed while the bark is still attached.

It is unrealistic to expect the herbaceous groundlayer to recover on its own.

Note the need to retain dead trees for wildlife (see Recommendation 3, Leave standing dead trees, page 47).

Step 2: Control Invasive and Exotic Species. This extremely important component is discussed on page 47 under Objective 1, Recommendation 1, Control exotic species. Remember, invasive and exotic species must be controlled or they will spread, native species will continue to be extirpated, and it will be extremely difficult for any introduced flowers and grasses to survive because of the stiff competition they'll face.

Step 3: Encourage Existing Native Groundlayer Species and Add Missing Species. The existing native oak woodland and savanna species will benefit from the tree, invasive shrub, and weed removal and begin to flower and start spreading. There is also the possibility that unseen species will appear from the seed bank or from suppressed live plants. However, because very few woodland and savanna forbs and only one grass were detected and because of the Woodland's extensive grazing history it is unrealistic to expect the herbaceous groundlayer will recover on its own. Consequently, it will be necessary to add the missing species in order to regain a full compliment of species.

However, before adding any species it is recommended that you finish removing the trees and shrubs as outlined above and that you diligently control the herbaceous weeds for a full growing season, at a minimum. Areas that remain overly weedy after one growing season of weed control should be prepared for a second growing season before they're planted. This will create the conditions necessary for the survival of the species you'll be adding. Inspection will allow you to determine when the herbaceous species can be planted, not any

specific timetable.

It is also recommended that you do at least one controlled burn prior to planting as part of your weed control and site preparation activities. Fire removes the leaf litter which increases the likelihood the seeds you're sowing will contact the soil and reduces the risk that the seedlings will be smothered. Fire also stimulates dormant native seeds to germinate, although it can also stimulate dormant weed seeds. Fire provides some control of tree and shrub resprouts and seedlings, possibly negating the need to use chemicals. And, fire will remove some of the slash and other debris left from the tree and shrub removal making it easier to control herbaceous weeds and introduce seeds.

Remember – it is crucial to achieve adequate control of the weeds before planting any herbaceous species because the weeds will suppress or prevent the growth of the desirable plants and because it is much more difficult to control weeds when they're mixed with desirable plants.

Table 10 provides a list of the forb, grass, sedge, and shrub species appropriate for reintroduction. The list emphasizes species that are:

1. Appropriate for the expected light conditions.
2. Appropriate for the soil types.
3. Commercially available.
4. Moderately priced, although some expensive species are included.
5. Likely to grow from seed.
6. Known to have historically grown in this area of Wisconsin⁷.

The recommended species are a mixture of savanna (mixed sun and shade), prairie (sun), and woodland/forest (shade) species. This is because the site is expected to have a variety of light conditions due to differences in aspect, canopy cover, and nearness to the adjacent Grassland Units. The light preference for each recommended species is indicated and should be considered when selecting species for planting.

It isn't necessary to plant all of the listed species. Nor is it necessary to plant a given species over the entire site. For example, expensive species, such as shooting star, and short stature species, such as Jacob's ladder, can be spot sown near a trail edge where they will be seen and enjoyed.

⁷ Some otherwise suitable species did not historically occur in the Middleton area and therefore aren't included.

Table 10. Species Recommended for Oak Savanna Planting.

Special Planting Instructions	Light ¹			Scientific Name	Common Name	Flower Color	Flower Period	Height	Comments
	SH	PS	FS						
Grasses and Sedges									
Don't over plant			X	<i>Andropogon gerardii</i>	Big Bluestem			3-8'	Tall; purple tinged foliage; sod former
			X	<i>Bouteloua curtipendula</i>	Side-oats Grama			2-3'	Short stature; orange "flower"
Especially recommended	X	X		<i>Brachyelytrum erectum</i>	Long-awned Wood Grass			2-3'	Fine texture; not aggressive; does best in light shade
		X	X	<i>Bromus kalmii</i>	Prairie Brome			1-3'	Fine texture
Especially recommended		X		<i>Bromus pubescens</i>	Hairy Wood Chess			2-5'	Slightly fuzzy seed heads
Spot plant-expensive		X		<i>Carex bicknellii</i>	Copper-shouldered Oval Sedge			1-3'	Oval shaped flowers at tips of stems
Spot plant-expensive	X	X	X	<i>Carex blanda</i>	Common Wood Sedge			3-6"	Broad leaves; grows readily
Spot plant-expensive		X	X	<i>Carex cephalophora</i>	Oval-headed Sedge			6-16"	Greenish-yellow seedhead
Spot plant-expensive	X	X	X	<i>Carex pensylvanica</i>	Common Oak Sedge			6-12"	Fine texture; will spread; foliage usually yellow-green
Spot plant-expensive	X	X		<i>Carex radiata</i>	Eastern Star Sedge			6-8"	Very fine texture; grows in clumps
Spot plant-expensive	X	X		<i>Carex sprengei</i>	Long-beaked Sedge			1-2'	Seed heads dangle from ends of stems
		X	X	<i>Elymus canadensis</i>	Canada Wild Rye			3-6'	Short lived; cool season; curly seed head
Especially recommended	X	X		<i>Elymus hystrix</i>	Bottlebrush Grass			3'	Seed head looks like a bottlebrush
Especially recommended		X	X	<i>Elymus villosus</i>	Silky Wild Rye			1-3'	Cool season; clump forming
Especially recommended		X	X	<i>Elymus virginicus</i>	Virginia Wild Rye			2-4'	Cool season; clump forming
Especially recommended	X	X	X	<i>Muhlenbergia racemosa</i>	Upland Wild Timothy			2-3'	Fine texture foliage
Don't over plant		X	X	<i>Panicum virgatum</i>	Switch Grass			3-6'	Tall, but fine textured
		X	X	<i>Schizachyrium scoparium</i>	Little Bluestem			2-3'	Fine texture; white feathery seed head
		X	X	<i>Sorghastrum nutans</i>	Indian Grass			3-6'	Rich golden brown feather-like seed head
Spot plant-expensive		X	X	<i>Sporobolus heterolepis</i>	Prairie Dropseed			2-4'	Forms arching mounds; elegant; fragrant
Forbs									
Especially recommended	X	X		<i>Actaea rubra</i>	Red Baneberry	Wht	J	1-2'	Gum drop shaped flower; bright red berries; attractive foliage
Especially recommended		X		<i>Agastache nepetoides</i>	Yellow Giant Hyssop	Yel	J J A S	5-6'	Wisconsin Threatened; easily from seed
Especially recommended		X		<i>Agastache scrophulariaefolia</i>	Purple Giant Hyssop	Purp	J A S O	4-6'	Tall plant with lots of thimble shaped flowers
	X	X	X	<i>Allium canadense</i>	Wild Garlic	Pink	M J J	6-20"	Can divide the edible bulb; butterfly plant
Especially moist areas		X		<i>Anemone canadensis</i>	Canada Anemone	Wht	M J	6-18"	Will slowly spread; low-growing; mace-like seed head
Especially recommended		X	X	<i>Anemone cylindrica</i>	Thimbleweed	Wht	J J	2-3'	Silky petals; thimble shaped seed head
Spot plant	X	X		<i>Anemone quinquefolia</i>	Wood Anemone	Wht	A M	3"	Early spring bloomer; forms patches
		X	X	<i>Anemone virginiana</i>	Thimbleweed	Wht	J J	2-4'	Thimble shaped seed head
Especially recommended		X	X	<i>Aquilegia canadensis</i>	Wild Columbine	Red & yel	A M J	1-3'	Butterfly plant; self sows
Spot plant	X	X		<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	Grn	A M J J	1-2'	Unique flower shape; red berry cluster in fall

Table 10. Species Recommended for Oak Savanna Planting.

Special Planting Instructions	Light ¹			Scientific Name	Common Name	Flower Color	Flower Period	Height	Comments
	SH	PS	FS						
Spot plant		X		<i>Asclepias exaltata</i>	Poke Milkweed	Wht	J A	2-4'	Savanna specialist
Forbs, continued									
Especially recommended		X		<i>Asclepias purpurascens</i>	Purple Milkweed	Purp	J J	2-4'	Wisconsin Threatened; savanna specialist; butterfly plant
		X	X	<i>Asclepias syriaca</i>	Common Milkweed	Crn-pink	J A S	2-3'	Butterfly plant; very showy; monarch larvae food source
Especially recommended		X	X	<i>Asclepias tuberosa</i>	Butterfly Weed	Org	J J A	2-3'	Butterfly plant; very showy; monarch larvae food source
		X	X	<i>Aster azureus</i>	Sky Blue Aster	Blue	S O	1-4'	Sky blue color; butterfly plant
Especially recommended		X	X	<i>Aster cordifolius</i>	Heart-leaved Aster	Blue	A S O	2-4'	Leaves are heart-shaped
		X	X	<i>Aster laevis</i>	Smooth Aster	Blue	A S O	3-5'	Butterfly plant; foliage is smooth; butterfly plant
Near edges		X	X	<i>Aster lateriflorus</i>	Calico Aster	Wht-blue	A S O	1-3'	Arching form; lots of small flowers
		X	X	<i>Aster novae-angliae</i>	New England Aster	Purp-blue	A S O	2-5'	Butterfly plant; very showy; late season color
Don't over plant		X	X	<i>Aster pilosus</i>	Frost Aster	Wht	S O	2-5'	Butterfly plant; abundant, small flowers; can be weedy
Especially recommended		X	X	<i>Aster sagittifolius</i>	Arrow-leaved Aster	Blue	A S O	2-4'	Leaves are arrow-shaped; fall color
	X	X		<i>Aster shortii</i>	Short's Aster	Blue	A S O	2-3'	Small flowers, but showy
		X		<i>Astragalus canadensis</i>	Canada Milk Vetch	Crn-yel	J J A	1-4'	Pea-like flowers held above foliage; legume
Especially recommended		X	X	<i>Cacalia atriplicifolia</i>	Pale Indian Plantain	Wht	J A S	3-6'	Leaves white underneath; red stem; distinctive foliage
		X		<i>Cacalia muhlenbergii</i>	Great Indian Plantain	Wht	J A S	5-7'	Wisconsin special concern
Especially recommended		X	X	<i>Campanula americana</i>	Tall Bellflower	Blue	J A S	3-5'	Biennial; butterfly plant; flowers star-like
		X		<i>Coreopsis palmata</i>	Stiff Coreopsis	Yel	J J A	12-30"	Butterfly plant; spreads
Don't over plant		X	X	<i>Desmodium canadense</i>	Canada Tick-trefoil	Purp	J A	3-5'	Nitrogen fixer; aggressive
Spot plant-expensive		X	X	<i>Dodecatheon meadia</i>	Shooting Star	Lav-wht	A M J	4-6"	Flower looks like a shooting star; spreads slowly
Especially recommended		X	X	<i>Echinacea pallida</i>	Pale Purple Coneflower	Lav	J J	2-4'	Butterfly plant; threatened in WI
		X		<i>Eryngium yuccifolium</i>	Rattlesnake Master	Wht	J A S	3-5'	Attracts many insects; butterfly plant
Especially recommended		X	X	<i>Eupatorium purpureum</i>	Sweet Joe Pye Weed	Pink	J A S	3-8'	Aromatic; flowers in open domes; butterfly plant
Don't over plant		X	X	<i>Eupatorium rugosum</i>	White Snakeroot	Wht	J A	2-4'	Can be weedy; annual
Spot plant-expensive		X		<i>Euphorbia corollata</i>	Flowering Spurge	Wht	J J A	2-4'	Seed head explodes to disperse seeds
	X	X	X	<i>Fragaria virginiana</i>	Wild Strawberry	Wht	M J J	3-8"	Wildlife food; will spread; produces edible fruit
Spot plant-expensive		X		<i>Geranium maculatum</i>	Wild Geranium	Lav-purp	A M J J	1-2'	Very showy; will spread; shade tolerant
Especially recommended		X		<i>Helianthus divaricatus</i>	Woodland Sunflower	Yel	J A S	3-5'	Flowers like small sunflowers; birds eat the seeds
Especially recommended		X		<i>Helianthus strumosus</i>	Pale-leaved Sunflower	Yel	J A S	3-5'	Flowers like small sunflowers; birds eat the seeds
Don't over plant		X	X	<i>Heliopsis helianthoides</i>	Ox Eye Sunflower	Yel	J J A S	2-5'	Forms clumps; butterfly plant
		X	X	<i>Kuhnia eupatorioides</i>	False Boneset	Crn-Wht	A S	2-4'	Erect stem with flat flower cluster; gray-green foliage
		X		<i>Lactuca canadensis</i>	Wild Lettuce	Yel	J A	3-6'	Flowers turn purple with age; dark green foliage
		X	X	<i>Lespedeza capitata</i>	Roundhead Bush Clover	Crn-Grn	A S O	3-4'	Interesting winter texture; nitrogen fixer
Especially recommended		X		<i>Liatris aspera</i>	Blazing Star	Purp	J A S	2-3'	Very showy; butterfly plant
		X	X	<i>Monarda fistulosa</i>	Bergamot	Lav	J A S	2-4'	Butterfly and humming bird plant; aromatic

Table 10. Species Recommended for Oak Savanna Planting.

Special Planting Instructions	Light ¹			Scientific Name	Common Name	Flower Color	Flower Period	Height	Comments
	SH	PS	FS						
Don't over plant			X	<i>Oenothera biennis</i>	Common Evening Primrose	Yel	J J A S	2-6'	Biennial; interesting wintertime texture
	X	X		<i>Osmorhiza claytonii</i>	Sweet Cicely	Wht	M J	1-3'	Fern-like foliage; flowers are very small; long, black seeds
Forbs, continued									
		X	X	<i>Parthenium integrifolium</i>	Wild Quinine	Wht	J J A S	2-3'	Flat topped flower clusters somewhat like a cauliflower head
Especially recommended		X	X	<i>Penstemon digitalis</i>	Smooth Penstemon	Wht-pur	J J	2-4'	Leaf finely toothed; readily self sows
			X	<i>Petalostemum candidum</i>	White Prairie Clover	Wht	J J A	1-3'	Butterfly plant; legume; fine texture
Near trail edges			X	<i>Petalostemum purpurea</i>	Purple Prairie Clover	Purp	J J A	12-18"	Butterfly plant; legume; fine texture
Especially recommended	X	X		<i>Phlox divaricata</i>	Woodland Phlox	Blue	A M	1-2'	Spreads by rhizomes to form dramatic patches
Especially recommended	X	X		<i>Podophyllum peltatum</i>	May Apple	Wht	A M	1-2'	Apple-like fruit; unique, very large, umbrella-like leaf
Near trail edges		X	X	<i>Polemonium reptans</i>	Jacobs Ladder	Lav-blue	A M J	8-12"	Bell shaped flowers; divided foliage
		X	X	<i>Polygonatum biflorum</i>	Solomon's Seal	Yel	J J	2-5'	Arching form with hanging flowers; blue-black berries
		X	X	<i>Polygonatum canaliculatum</i>	Great Solomon's Seal	Yel	M J J	2-4'	Arching form with hanging flowers; blue-black berries
		X	X	<i>Potentilla arguta</i>	Prairie Cinquefoil	Yel	J A S	12-40"	Lower leaves feather-divided
		X	X	<i>Pycnanthemum virginianum</i>	Mountain Mint	Wht	J A S	20-36"	Aggressive; aromatic; butterfly plant
		X	X	<i>Ratibida pinnata</i>	Yellow Coneflower	Yel	J A S	3-5'	Short-lived colonizer; butterfly plant; aromatic seed head
Don't over plant		X	X	<i>Rudbeckia hirta</i>	Black-eyed Susan	Yel	J J A S O	2-3'	Biennial; pioneer; butterfly plant
		X	X	<i>Rudbeckia subtomentosa</i>	Sweet Black Eyed Susan	Yel	A S O	3-6'	Large, downy flower heads; butterfly plant
Don't over plant		X	X	<i>Rudbeckia triloba</i>	Branched Coneflower	Yel	J A S O	2-4'	Short-lived; butterfly plant; very showy
		X	X	<i>Silphium integrifolium</i>	Rosin Weed	Yel	J A S	4-8'	Tall; unbranched; birds eat seeds
Don't over plant			X	<i>Silphium laciniatum</i>	Compass Plant	Yel	J J A S	5-9'	Prairie giant; butterfly and bird plant
Don't over plant			X	<i>Silphium perfoliatum</i>	Cup Plant	Yel	J A S	5-9'	Birds drink from leaf "cups"; butterfly plant
Don't over plant			X	<i>Silphium terebinthinaceum</i>	Prairie Dock	Yel	J A S	5-8'	Taproots reach 9-12' deep; butterfly and bird plant
		X	X	<i>Smilacina racemosa</i>	False Solomon's Seal	Wht	J J	2-3'	Arching form; flower cluster at tip; red berries
Especially recommended		X		<i>Solidago flexicaulis</i>	Zig Zag Goldenrod	Yel	A S O	2-3'	Stem zig-zags; fall color; will spread
Don't over plant		X	X	<i>Solidago rigida</i>	Stiff Goldenrod	Yel	A S O	1-5'	Butterfly plant; roots penetrate to 15'
		X	X	<i>Solidago speciosa</i>	Showy Goldenrod	Yel	A S O	1-4'	Butterfly plant; one of the showiest
Especially recommended		X		<i>Solidago ulmifolia</i>	Elm-leaved Goldenrod	Yel	A S O	2-3'	Leaves shaped like elm leaves; will spread
Especially recommended		X		<i>Taenidia integerrima</i>	Yellow Pimpernel	Yel	J	2-3'	Savanna specialist; flowers in umbels; uncommon
Especially recommended		X		<i>Teucrium canadense</i>	Germander	Pink	J A	18-30"	Aromatic; will spread
		X	X	<i>Thalictrum dioicum</i>	Early Meadowrue	Yel-grn	A M	8-20"	Light green, delicate foliage
Especially recommended		X	X	<i>Tradescantia ohiensis</i>	Spiderwort	Blue	M J	2-4'	Butterfly plant; forms arching clumps
Especially recommended	X	X		<i>Triosteum aurantiacum</i>	Horse Gentian	Yel-grn	M J J	2-3'	Leaves clasp stem; bright orange berry-like seed pod
Don't over plant		X	X	<i>Verbena stricta</i>	Hoary Vervain	Blue	J A S	3-6'	Butterfly plant
		X		<i>Verbena urticifolia</i>	White Vervain	Wht	J A	3-5'	Flower in a terminal spike
		X	X	<i>Vernonia fasciculata</i>	Ironweed	Purp	J A S	4-6'	Butterfly plant; very showy; rich color

Table 10. Species Recommended for Oak Savanna Planting.

Special Planting Instructions	Light ¹			Scientific Name	Common Name	Flower Color	Flower Period	Height	Comments
	SH	PS	FS						
Especially recommended		X	X	<i>Veronicastrum virginicum</i>	Culver's Root	Wht	J J A	3-6'	Long flower spike; butterfly plant
Especially recommended			X	<i>Zizia aurea</i>	Golden Alexanders	Yel	A M J	1-3'	Butterfly plant
Shrubs and Vines									
Especially recommended		X	X	<i>Amorpha canescens</i>	Lead Plant	Purp & gold	J J A	30-40"	Shrub; butterfly plant; gray-green foliage
		X	X	<i>Ceanothus americanus</i>	New Jersey Tea	Wht	J J A	18-36"	Shrub; butterfly plant; large clusters of flowers
Especially recommended		X	X	<i>Celastrus scandens</i>	American Bittersweet	Wht	M J	to 25'	Vine; bright orange fruit
		X	X	<i>Clematis virginiana</i>	Wild Clematis	Wht	J J A	to 15'	Vine; seeds have long fuzzy appendage
Don't over plant		X	X	<i>Corylus americana</i>	American Hazelnut	Yel	J J	4-10'	Shrub; forms thickets; produces nuts
Especially recommended		X	X	<i>Diervilla lonicera</i>	Bush Honeysuckle	Yel	J J	6-20"	Shrub; a native honeysuckle; not aggressive
		X	X	<i>Physocarpus opulifolius</i>	Ninebark	Wht	J J	3-10'	Shrub; ball-like flowers; flaky bark
Don't over plant		X	X	<i>Prunus americana</i>	Wild Plum	Wht	M J	6-10'	Shrub; forms thickets; produces plums eaten by wildlife
		X	X	<i>Rosa blanda</i>	Early Prairie Rose	Pink	J J	3-5'	Shrub; butterfly plant; red rose hips in fall
		X	X	<i>Rosa caroliniana</i>	Pasture Rose	Pink	J J A	2-4'	Shrub; butterfly plant; red rose hips in fall
	X	X	X	<i>Sambucus canadensis</i>	Elderberry	Wht	J A	5-10'	Shrub; edible purple-black fruit; wildlife food
		X	X	<i>Viburnum lentago</i>	Nannyberry	Wht	M J	8-15'	Shrub; large flower clusters; blue-black fruit; fall color
Especially recommended	X	X		<i>Viburnum rafinesquianum</i>	Arrowwood Viburnum	Wht	M J	8-15'	Shrub; large flower clusters; blue-black fruit
		X	X	<i>Viburnum trilobum</i>	Highbush Cranberry	Wht	M J	to 12'	Shrub; attractive flowers; red fruit; wildlife food

1: SH is daylong shade (forest light conditions); PS is a mixture of sun and shade (savanna light conditions); FS is full or nearly full sun (prairie light conditions).

The recommended species can be introduced either as seeds or plants. Seeds have the advantage of being relatively inexpensive and quick to plant. Also, nurseries have a larger selection of seeds than plants. Their disadvantage is that they take several years to become a noticeable plant, at least to the untrained eye. Also, some species may not bloom for four or more years after planting.

Plants produce quicker results, often blooming the first year. However, they cost much more than seeds and they require much more time and effort to plant. They also require frequent watering until they are established and may require protection from deer.

Seeds can be sown during either fall or spring, although fall is usually preferred because the forb seeds receive the cold period they require to break dormancy during the winter so that they are ready to grow the following spring. Following a burn is an ideal time to plant because bare soil is exposed, facilitating good seed-soil contact.

Seeds can be sown during either the fall or the spring, although fall is usually preferred.

Fall seeding is usually done after the soil has cooled sufficiently so that none of the seeds will germinate that fall, but before the ground freezes or is snow covered. Most fall plantings in southern Wisconsin are done during late October and November.

Springtime seeding is usually done between mid-May and mid-June, although May is usually preferred because the cooler temperatures and frequent rains produce a moist soil that enhances germination and seedling survival. Spring plantings have the advantage of allowing one more round of weed control to be done before planting because the weeds will be actively growing before the planting date arrives.

Transplants are usually best planted in spring, typically after mid-May so that the risk of frost damage is minimized, although they can also be planted in the fall.

It may be necessary to add additional seeds or plants if the density and diversity of the first seeding/planting is less than expected due to weather, weeds, or other factors. Usually it is acceptable to replant only the missing or under-abundant species, rather than the full seed mix used for the first planting.

Sound ecological management indicates that only *native* species from a *local* source (local ecotype) should be used. A nursery that specializes in native plants is preferred. This ensures the species planted are adapted to the local growing conditions and protects locally occurring populations of the same species from genetic contamination. This is especially important for rare, threatened, and endangered species. Appendix II contains a list of sources for southern Wisconsin native seeds, plants, trees, and shrubs.

Use only native species obtained locally.

Step 4: Protect the Existing Oak Trees and Encourage Regeneration. Oak is a disappearing resource throughout southern Wisconsin. The culprit? Shade. Oak trees are unable to reproduce in their own shade because oak seedlings and saplings require abundant sunlight to grow (Lorimer 1993, Will-Wolf and Roberts 1993). Conversely, the seedlings of

ash, sugar maple, basswood, and many other species thrive in shade. Consequently, oak is slowly being replaced by more shade-tolerant species throughout the southern Wisconsin landscape.

This process is already in motion in the Woodland as evidenced by the lack of oak seedlings and saplings in the shadiest areas. Fortunately, however, there are saplings and seedlings near the sunny edges and scattered in other areas.

It is important to preserve the existing oak seedlings and saplings and to encourage new ones, so there will be a "next generation" to replace the existing oak trees when they die.

It is important to preserve the oak seedlings and saplings and to encourage new ones so that there will be a "next generation" ready to replace the existing oak trees when they die. The same is true for shagbark hickory.

Removing the unwanted trees and shrubs as outlined above in Step 1 will create light conditions favorable for the growth and survival of existing and future oak seedlings and saplings. The next step is to ensure there will be oak seedlings and saplings *throughout* the savanna.

Acorns can be collected and either planted directly in suitable locations (the easiest method), grown in a container and then transplanted, or saplings can be purchased from native plant nurseries. Bur and white oak are preferred since they are the typical species of oak savanna and are more resistant to oak wilt than red and black oak. Bur oak is especially suitable for areas with drier soil.

Step 5: Maintain the Desired Conditions Once They're Achieved. Management does not stop once the desired conditions have been achieved. Weeds will continue arriving via wind, water, and wildlife, weed seeds in the soil will grow, and leaf litter will accumulate, suppressing low-growing native plants, such as shooting star.

Oak savanna is a fire-adapted community. Thus, fire will be an important management tool. It will be beneficial to conduct an annual spring or fall burn for three to five years after seeding the herbaceous species. The burns will speed establishment of the native species, help control weeds and brush, remove the leaf litter that can inhibit seed germination and hamper native seedling survival, and stimulate native seed production.

After the initial "burn in" period of annual burns, a typical recommendation is to divide the savanna into two or three burn units and burn them on a rotating basis, typically three to four times per ten years on a random basis. This pattern can be altered to achieve specific management objectives. For instance, a unit may be burned several years in a row to control buckthorn seedlings or garlic mustard.

You should expect that on-going control of weeds will be needed. This can be done by burning, cutting, pulling, or spot spraying.

Rotational burning minimizes the loss of beneficial insects, damage to ground nesting

animals, and limits the loss of fire sensitive species because they can move between burned and unburned portions of the savanna. Using trails and other natural breaks to separate burn units will reduce the effort required to conduct a burn and make it safer.

You should expect that on-going spot control (mowing, pulling, spraying) of buckthorn, honeysuckle, thistle, garlic mustard, and other weeds will be needed. Even if these species were eradicated from the savanna before planting, a highly unlikely scenario, it's very likely they will eventually reappear because they are present on surrounding properties and in the seed bank. Periodic inspections will allow you to detect problems while they are small and easy to correct.

Recommendation 5: Restore the North and/or South Grassland to prairie.

The North and South Grasslands are amenable to prairie restoration. Prairie will attract a greater variety of wildlife, be more aesthetically pleasing than the existing vegetation, and offer more options for environmental interpretation.

Prairie restoration requires three steps:

1. Site preparation to eliminate unwanted vegetation and prepare a suitable seedbed.
2. Sowing seeds of the prairie species.
3. Post-planting management.

Step 1: Site Preparation. Start by removing trees and shrubs, except for oak and hickory, which often grow in prairie in low density. Their removal facilitates subsequent herbaceous weed removal. Next, conduct a controlled burn to remove the thatch, kill weed seeds, and expose bare soil, which triggers weed seed germination. After the site has greened-up with weeds following the burn, it should be sprayed with a nonselective herbicide, such as glyphosate (e.g., RoundUp).

Subsequent weed growth can be killed using either herbicide or light soil tillage, or a combination, which is typically the most effective. Repeat the process of allowing the field to green up and then spraying or tilling until the weeds are under control. Expect to treat for a full growing season, possibly two, before planting can occur and be willing to delay the planting until the weeds are under control.

If soil erosion becomes a concern during site preparation you can sow a cover crop of annual rye grass. Use three to four pounds per acre of annual rye grass for a spring or late summer seeding and four to six pounds per acre for a fall (dormant) seeding.

Step 2: Planting. Because of their relatively large size, both areas will best be seeded using a seed drill or other mechanical means. Table 11 has a list of suggested species. Selection criterion follows that listed for the oak savanna species (page 57). See the oak savanna planting instructions (page 57) for details on timing and technique.

Table 11. Species Recommended for Prairie Planting.

Special Planting Instructions	Scientific Name	Common Name	Flower Color	Flower Period	Height	Comments
				A M J J A S O		
Grasses and Sedges						
Don't over plant	Andropogon gerardi	Big Bluestem			3-8'	Tall; purple tinged foliage; sod former
	Bouteloua curtipendula	Side-oats Grama			2-3'	Short stature; orange "flower"
	Bromus kalmii	Prairie Brome			1-3'	Fine texture
Spot plant	Carex blanda	Common Wood Sedge			3-6"	Broad leaves; grows readily
	Elymus canadensis	Canada Wild Rye			3-6'	Short lived; cool season; curly seed head
Don't over plant	Panicum virgatum	Switch grass			3-6'	Tall, but fine textured
Seed heavily	Schizachyrium scoparium	Little Bluestem			2-3'	Fine texture; white feathery seed head
	Sorghastrum nutans	Indian Grass			3-6'	Rich golden brown feather-like seed head
Spot plant	Sporobolus heterolepis	Prairie Dropseed			2-4'	Forms arching mounds; elegant; fragrant
Forbs						
	Allium canadense	Wild Garlic	Pink	M J J	6-20"	Can divide the edible bulb; butterfly plant
	Anemone cylindrica	Thimbleweed	Wht	J J	2-3'	Silky petals; thimble shaped seed head
Especially recommended	Aquilegia canadensis	Wild Columbine	Red & yel	A M J	1-3'	Butterfly plant; showy
	Asclepias syriaca	Common Milkweed	Crn-pink	J A S	2-3'	Butterfly plant; showy; monarch larvae food source
Especially recommended	Asclepias tuberosa	Butterfly Weed	Org	J J A	2-3'	Butterfly plant; very showy; monarch larvae food source
Especially recommended	Aster azureus	Sky Blue Aster	Blue	A S O	1-4'	Sky blue color; butterfly plant
Especially recommended	Aster laevis	Smooth Aster	Blue	A S O	3-5'	Butterfly plant; smooth foliage; butterfly plant
	Aster novae-angliae	New England Aster	Purp-blue	A S O	2-5'	Butterfly plant; very showy; late season color
Don't over plant	Aster pilosus	Frost Aster	Wht	S O	2-5'	Butterfly plant; lots of small flowers; aggressive
	Astragalus canadensis	Canada Milk Vetch	Crn-yel	J J A	1-4'	Pea-like flowers held above foliage; legume
	Cacalia atriplicifolia	Pale Indian Plantain	Wht	J A S	3-6'	Leaves white underneath; red stem; distinctive foliage
	Campanula americana	Tall Bellflower	Blue	J A S	3-5'	Biennial; butterfly plant; flowers star-like
	Coreopsis palmata	Stiff Coreopsis	Yel	J J A	12-30"	Butterfly plant; spreads
Spot plant	Dodecatheon meadia	Shooting Star	Lav-wht	A M J	4-6"	Flower looks like a shooting star; spreads slowly
Especially recommended	Echinacea pallida	Pale Purple Coneflower	Lav	J J	2-4'	Butterfly plant; threatened in WI
	Eryngium yuccifolium	Rattlesnake Master	Wht	J A S	3-5'	Attracts many insects; butterfly plant
Near trail edges	Euphorbia corollata	Flowering Spurge	Wht	J J A	2-4'	Seed head explodes to disperse seeds
Expensive, spot plant	Geranium maculatum	Wild Geranium	Lav-purp	A M J J	1-2'	Very showy; can spread; shade tolerant
Plant near trail edges	Geum triflorum	Prairie Smoke	Red	A M J	4-10"	Low-growing; seed head look like smoke
Don't over plant	Heliopsis helianthoides	Ox Eye Sunflower	Yel	J J A S	2-5'	Forms clumps; butterfly plant
	Kuhnia eupatorioides	False Boneset	Crn-Wht	A S	2-4'	Erect stem with flat flower cluster; gray-green foliage

Table 11. Species Recommended for Prairie Planting.

Special Planting Instructions	Scientific Name	Common Name	Flower Color	Flower Period	Height	Comments
				A M J J A S O		
	<i>Lespedeza capitata</i>	Round-headed Bushclover	Crn-Grn	A S O	1-4'	Interesting winter texture; nitrogen fixer
Especially recommended	<i>Liatis aspera</i>	Blazing Star	Purp	J A S	2-3'	Very showy; butterfly plant
Forbs, continued						
	<i>Monarda fistulosa</i>	Bergamot	Lav	J A S	2-4'	Butterfly and humming bird plant; aromatic
Driest areas	<i>Monarda punctata</i>	Dotted Mint	Crn & purp	J A	6-30"	Biennial; flowers small but very showy; butterfly plant
	<i>Penstemon digitalis</i>	Smooth Penstemon	Wht-pur	J J	2-4'	Leaf finely toothed; readily self sows
	<i>Petalostemum candidum</i>	White Prairie Clover	Wht	J J A	1-3'	Butterfly plant; legume
Near trail edges	<i>Petalostemum purpurea</i>	Purple Prairie Clover	Purp	J J A	12-18"	Butterfly plant; legume
	<i>Potentilla arguta</i>	Prairie Cinquefoil	Yel	J A S	12-40"	Lower leaves feather-divided
	<i>Ratibida pinnata</i>	Yellow Coneflower	Yel	J A S	3-5'	Butterfly plant; aromatic seed head
Don't over plant	<i>Rudbeckia hirta</i>	Black-eyed Susan	Yel	J J A S O	2-3'	Biennial; pioneer; butterfly plant
Don't over plant	<i>Rudbeckia triloba</i>	Branched Coneflower	Yel	J A S O	2-4'	Butterfly plant; very showy
Don't over plant	<i>Silphium integrifolium</i>	Rosin Weed	Yel	J A S	4-8'	Tall; unbranched; birds eat seeds
Don't over plant	<i>Silphium laciniatum</i>	Compass Plant	Yel	J J A S	4-8'	Prairie giant; awesome; butterfly and bird plant
Don't over plant	<i>Silphium perfoliatum</i>	Cup Plant	Yel	J A S	4-8'	Birds drink from leaf "cups"; butterfly plant
Don't over plant	<i>Silphium terebinthinaceum</i>	Prairie Dock	Yel	J A S	4-8'	Taproots reach 9-12' deep; butterfly & bird plant
Don't over plant	<i>Solidago rigida</i>	Stiff Goldenrod	Yel	A S O	1-5'	Butterfly plant; roots penetrate to 15'
	<i>Solidago speciosa</i>	Showy Goldenrod	Yel	A S O	1-4'	Butterfly plant; one of the showiest
Especially recommended	<i>Tradescantia ohiensis</i>	Spiderwort	Blue	M J	2-4'	Butterfly plant; forms arching clumps
Don't over plant	<i>Verbena stricta</i>	Hoary Vervain	Blue	J A S	3-6'	Butterfly plant
	<i>Vernonia fasciculata</i>	Ironweed	Purp	J A S	4-6'	Butterfly plant; very showy; rich color
	<i>Veronicastrum virginicum</i>	Culver's Root	Wht	J J A	3-6'	Long flower spike; butterfly plant
Especially recommended	<i>Zizia aurea</i>	Golden Alexanders	Yel	A M J	1-3'	Butterfly plant
Shrubs						
Especially recommended	<i>Amorpha canescens</i>	Lead Plant	Purp & gold	J J A	30-40"	Shrub; butterfly plant; gray-green foliage
Difficult from seed	<i>Ceanothus americanus</i>	New Jersey Tea	Wht	J J A	18-36"	Butterfly plant; large clusters of flowers

Step 3: Post-planting management. Post-planting management attempts to discourage weed growth and encourage the species you planted. Examples of management activities include mowing, burning, pulling weeds, spot herbicide application, and adding extra species. Post-planting management is extremely important and should be planned before planting.

The most important management need during the first year is mowing. Mowing prevents weeds from setting seeds and prevents excessive shading of small seedlings. Failure to mow properly will put the restoration at risk. Mow to a height of three to five inches when the weeds are eight to ten inches high for the first mowing. This cutting height will not harm the native seedlings because they will still be very short. Repeat this mowing pattern throughout the entire growing season, except that you may need to raise the cutting height for later mowings.

The most important management need the first year is mowing.

Spot weeding, by hand or with an herbicide, is only recommended if you are very sure of your target. Pulling weeds may cause enough soil disturbance to kill tiny prairie seedlings, but may be okay if soil disturbance is minimized and any disturbed soil is gently firmed afterward.

Typically the entire planting should be burned for several consecutive years once there is sufficient fuel, which is typically after two or three years of growth. After this initial period the prairie should be divided into several burn units and the units burned on a rotating basis, as discussed for the oak savanna.

Recommendation 5 (alternate): Restore the North Grassland to prairie and allow the South Grassland to convert to forest or oak savanna.

The South Grassland is rimmed by trees and there are already a mixture of trees, such as black cherry and oak, in the interior. Consequently, it may be easier and less costly to allow and assist the field to convert to forest or oak savanna. This would involve selective removal of undesirable shrubs and trees, such as box elder, now and as they appear, and perhaps some tree planting to hasten the conversion.

Objective 2: Increase Visitor Safety and Enjoyment

Community access and recreational use compatible with natural resource protection is encouraged. Visitors are provided with educational opportunities. Public safety is protected.

Short Term

Recommendation 1: Remove hazard trees.

Hazard trees identified in Figure 15 on page 21 should be removed to protect visitor safety. As previously noted, standing dead trees located away from trails may be left for their wildlife value.

Recommendation 2: Maintain benches.

The broken bench at the south end of the grape vineyard should be repaired for aesthetic reasons and to prevent further damage that might necessitate replacement.

Recommendation 3: Repair the vineyard trellis system.

Repairing or replacing the remnants of the vineyard trellises will invigorate the grapes and make them more visible. There are many trellis styles and many methods for training grapes to grow on a trellis. An excellent reference is University of Wisconsin Extension Publication A1656, Growing Grapes in Wisconsin. It can be ordered by phone at 877-947-7827. It is also available on line at <http://learningstore.uwex.edu/pdf%5CA1656.pdf>.

Recommendation 4: Maintain high parking lot visibility to discourage inappropriate and illegal activities.

Keep the parking lot perimeter and nearby fence line along West Old Sauk Road free from obstructions (large signs, trees, shrubs, etc.) to enhance visitor safety by making the area more visible from West Old Sauk Road.

Recommendation 5: Burn the brush pile in the North Grassland.

While the large brush pile in the North Grassland is not an ecological concern, and in fact provides some wildlife benefits, a few neighbors have aesthetic objections to its presence. If desired, the pile can be burned anytime there is snow cover. Expect that it will take more than a day burn completely and that it will likely be necessary to push in unburned material several times.

Recommendation 6: Maintain but do not expand the existing trail system.

The existing trail system already provides visitors with a variety of distance and habitat options. Adding additional trails is not recommended because it will cause habitat fragmentation, make it easier for invasive species to spread, and increase maintenance costs.

Long Term

Recommendation 7: Use interpretive signs to tell the Park's cultural and natural history.

Enhancing visitors' understanding of the Park's cultural history, natural features, and management will enrich their visit. Interpretive signs are one way to accomplish this. Interpretive signs may also allay concerns about tree and shrub removal by explaining why and how this is being done and the benefits.

High quality interpretive signs are available from Badger State Industries in Waupun, Wisconsin. Contact the Madison sales office at (608) 240-5200 for more information.

Signs purchased from Badger State Industries need to be enclosed in a frame and the frame mounted on a post. Best-Ex, Inc. in Baraboo, Wisconsin (800-356-4882 or www.best-exfab.com) makes powder coated aluminum frames to fit any size sign. The frames have tamper proof screws and a solid back. They are available with a variety of sleeves to fit onto different types of mounting posts, e.g., a wooden 4" X 4" post or a metal post. The sleeves hold the sign at a 45-degree angle for easy viewing. Consider using metal posts because they are less likely to be damaged by fire during prescribed burns.

Objective 3: Minimize Impacts to Adjoining Neighborhoods

The Town strives to be a good neighbor by minimizing the impacts of Park development and use on adjoining neighborhoods.

Short Term

Recommendation 1: Consider providing replacement screening as invasive trees and shrubs are removed from fence lines.

As previously discussed, a few neighbors objected to the loss of screening associated with the removal of buckthorn, honeysuckle, box elder, and other trees and shrubs from the western fence line. One way to mitigate this concern is to replace the lost screening using

native trees and shrubs. However, the Town needs to consider if providing replacement screening sets a precedent for other areas of the Town, e.g., other parks, hiking trails, retention ponds, etc.

The amount of replacement screening required was determined by BioLogic Environmental Consulting in June 2006 and conveyed to the Town in a report entitled *Goth Park: Invasive Shrub Removal With Replacement Screening*. The results of that report won't be repeated here. Rather, a copy is provided in Appendix III.

The Town needs to consider if providing replacement screening sets a precedent.

Long Term

Recommendation 2: Post “Private Lands Beyond” signs if needed.

Many park managers post “Private Lands Beyond” signs along their park perimeter to discourage visitors from straying beyond park boundaries. In essence, they are a no trespassing sign placed for the benefit of adjoining landowners. The Town may wish to consider using this type of sign to allay possible neighbor concerns about visitors straying in their yards.

Objective 4: Utilize External Funding and Partnerships

Public and private funds are obtained for development, restoration, and management. Partnerships are developed with organizations and individuals.

Short Term

Recommendation 1: Obtain External Funding.

Table 12 provides a list of possible funding sources for trail maintenance, management plan development, hazard tree assessment, vegetation management and restoration, and other activities.

Table 12. Funding Opportunities.

Grant (Source)	Intent	\$	Match	Due	Contact Information
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		Avail.	Reqd.	Date	
Aids For The Acquisition And Development Of Local Parks (WDNR)	Helps buy land or easements and develop or renovate local park and recreation facilities for nature-based outdoor recreation purposes.	Varies	No	May 1	http://www.dnr.state.wi.us/org/caer/cfa/LR/Stewardship/localparks.html
Recreation Trails Program (WDNR)	Development and maintenance of recreational trails and trail-related facilities for both motorized and non-motorized recreational trail uses.	Varies	Up to 50%	May 1	http://dnr.wi.gov/org/caer/cfa/LR/SECTION/rectrails.html
Madison Community Foundation (Local)	Preserve and restore natural resources. Involve citizens in the stewardship of natural resources.	Varies	No	Jan. 16, July 15 (2006 dates)	http://www.madisoncommunityfoundation.org/
C.D. Besadny Conservation Grant (Natural Resources Foundation of WI)	Natural resource projects and programs at a small-scale, local level (<\$10K).	\$100 to \$1,500	50:50	Jan 15	http://www.wisconservation.org/index.php?page=About_the_Program
Urban Forestry Grant (WDNR)	Projects that improve a community's capacity to manage its trees, e.g. management plans, inventories, hazard tree assessment, training, tree planting, maintenance, and removal.	\$1,000 to \$25,000	50:50	June (letter of intent)	http://www.dnr.state.wi.us/org/land/forestry/uf/grants/
Plant Dane! (Graham-Martin Foundation, Dane County)	Provide native seeds and plants for rain gardens and restoration projects. Municipalities are not eligible for 2007, but friends groups can apply on their behalf.		50:50	Dec. 29, 2006	http://www.danewaters.com/business/PlantDane.aspx
EE-Link	Environmental education grant clearing house.				http://eelink.net/grants-eespecificresources.html

Long Term

Recommendation 2: Link with other organizations.

Explore cooperative arrangements with other conservation organizations and civic groups that can supply seeds, plants and other materials, and labor. Examples include:

1. Dane County Parks (<http://www.countyofdane.com/lwrp/parks/>).
2. Wisconsin Department of Natural Resources.
3. US Fish and Wildlife Service.
4. The Prairie Enthusiasts (<http://www.theprairieenthusiasts.org/>).
5. Pheasants Forever (<http://www.pheasantsforever.org/>).
6. Madison Chapter of the Wild Ones, a not-for-profit educational organization promoting “environmentally sound landscaping practices to encourage

biodiversity....” Information on Wild Ones is available at www.for-wild.org.

7. Boy-, Girl-, and Eagle Scouts.

Recommendation 3: Create a “Friends of Goth Park” group.

Friends groups can supply labor and are often able to apply for grants that municipalities can't. Also, members tend to spend time in the Park and are able to spot problems while they are small and easily managed.

IMPLEMENTATION SCHEDULE

Table 13 provides a suggested implementation schedule for the previously outlined activities. The schedule spreads out labor and material costs and allows resources to be focused, increasing the likelihood of success. It also provides the opportunity to “learn as you go.” Nevertheless, the schedule is only a suggestion based on the assumptions listed below. You should adapt it to meet your needs and resources.

Assumptions used to develop Table 13 include:

1. Staggered implementation timing to spread out effort and cost.
2. Invasive species control (herbaceous and woody) will be done across the Park to prevent weeds from moving between areas.
3. It’s best to delay the planting phase of prairie and savanna restoration until the weeds are under control.
4. Cost per unit area decreases as the size of the area being treated or restored increases. Thus, other things being equal, it is best to treat as large an area as resources allow.

Table 13. Implementation Schedule.

Objective and Recommendations	Year ^{1, 2}						Comments
	2007	2008	2009	2010	2011	2012-2016	
Obj. 1: Protect and Restore Native Plant Communities							
R 1: Control exotic species	N S W	N S W	N S W	N S W	N S W	N S W	Start with invasive species, especially shrubs and locust, then other exotic species.
R 2: Prevent the spread of oak wilt	N S W	N S W	N S W	N S W	N S W	N S W	Monitor for new infections and take action as needed.
R 3: Leave standing dead trees	W	W	W	W	W	W	Except when they could spread oak wilt or are a safety hazard.
R 4: Restore the Woodland to oak savanna		W	W	W			Exotic species control (R 1) starts the process, then thin canopy and seed.
R 5: Restore North and/or South Grassland to prairie			S N	S N	S N	S N	Exotic species control (R 1) starts the process.
R 5 (alt): Allow South Grassland to convert to forest or oak savanna	S	S	S	S	S	S	Remove invasives, plant trees, maintain.
Obj. 2: Provide for Visitor Safety and Enjoyment							
R 1: Remove hazard trees	N S W						Monitor for new hazard trees.
R 2: Maintain benches	S						Repair broken bench near vineyard.
R 3: Repair vineyard trellis system	S						Will need periodic maintenance.
R 4: Maintain high parking lot visibility	All years						
R 5: Burn North Grassland brush pile	N						While ground is snow covered.
R 6: Maintain but do not expand trail system	All years, all areas						
R 7 Install interpretive signs	N S W	N S W	N S W				Signs explaining rationale for tree and shrub removal may allay public concerns.
Obj. 3: Minimize Impacts to Adjoining Neighborhoods							
R 1: Provide replacement screening	N S W	N S W	N S W	N S W	N S W	N S W	Plant as needed or wait and plant all affected areas at one time.
R 2: Post "Private Lands Beyond" signs	anytime as needed						Omit if not a concern.
Obj. 4: Utilize External Funding and Partnerships							
R 1: Obtain external funding	All years, all areas						
R 2: Link with other organizations	All years, all areas						
R 3: Create a Friends of Goth Park group	As soon as possible						

¹ Year when the indicated activity should be initiated. ² Letter indicates work area: N is North Grassland; W is Woodland; S is South Grassland.

ESTIMATED COSTS

Assumptions and Caveats

Table 14 provides a cost estimate for the materials and activities that are expected to be required during the next five years, assuming the Table 13 schedule is followed. Costs beyond five years aren't included because they are difficult to estimate because they depend on what has and hasn't been done in the preceding years and the success of those activities.

The Table is based on 2006 prices from a variety of local contractors and vendors, which are subject to change without notice, with moderate increases in subsequent years. **The Table assumes all of the work will be done by contractors, rather than Town personnel.** Use of Town personnel may reduce the cost of some activities.

Seed cost can be difficult to estimate because of annual fluctuations in production. Seed cost also varies with the quality of the seed mix that's planted. Factors influencing seed mix cost include:

1. Proportion of grasses and forbs (the grass to forb ratio). Grasses are relatively inexpensive (\$5 to \$40 per pound) while forbs are relatively expensive (\$10 to \$150 per ounce).
2. Seeding rate. The higher the seeding rate (seeds per square foot), the higher the cost.
3. Size of planting area. Most seeds are sold on a tiered pricing system – the more you buy, the less expensive they are per unit weight.
4. The species selected. Species that are easy for nurseries to grow and that produce lots of seed are inexpensive. Others, such as many of the woodland and savanna species, are more difficult to grow and are more expensive.

One way to reduce the cost of the seed mix is to plant a forb-rich mix in the most visible areas and a less showy, less expensive mix in less visible areas.

Shrub and tree cost is highly variable depending on size and vendor. For example, from one vendor, a bur oak seedling in a five-gallon pot is approximately \$20, a 1.5-inch caliper (diameter) sapling four to six feet tall is \$90, and a 2-inch caliper sapling five to eight feet tall is \$140. Shrub cost is also variable with price differences of 200 percent not uncommon depending on age, size, number purchased, and vendor. You will need to weigh the benefits of the faster results provided by larger nursery stock against their higher purchase, transport, and installation cost.

Table 14. Estimated Cost.

Labor	Year					Comments
	2007	2008	2009	2010	2011	
Control woody invasive species.	12,000	6,000	3,000	1,000		Property-wide.
Control herbaceous invasive species.	2,250	1,750	1,000	750	750	Spurge, Canada thistle, parsnip, garlic mustard, reed canary grass.
Repair trellis.	550					Assumes posts need replacing.
Install interpretive signs.		150				3 signs and frames. Could be done any year.
Install private lands beyond signs.		200				12 signs on metal post. Could be done any year.
Oak savanna restoration: site preparation, planting, post-planting management.		3,000	1,000	600	1,200	7 acres. Plant in 2008. Delay planting until brush is cleared. Burn in 2011.
Plant supplemental oak trees in oak savanna.				400		If needed. Delay until after oak savanna is seeded and first burn.
Prairie restoration, North and South Grassland: Site preparation (burn, spray, till), plant, post-planting management.			2,350	2,600	800	12 acres. Start after savanna is planted. Plant in fall 2010. Could do only one area. Mowing and spot weed control in 2011.
Shrub screening.		9,500				Time and materials, per June 2006 assessment.
Labor Total	14,800	20,600	7,350	5,350	2,750	
Materials	2007	2008	2009	2010	2011	
Herbicide (Garlon, Glyphosate, etc.).	450	300	300	150	150	
Trellis: posts, spreaders, wire.	200					Assumes posts are replaced, simple wire stringers.
Oak trees for oak savanna.				3,200		40 - 1.25inch caliper trees @ \$80 per tree. May not be needed.
Oak savanna seed mix.		5,600				7 acres @ \$800/acre, could use less expensive mix.
Prairie seed mix.				9,000		12 acres @ \$750/acrs, could use less expensive mix.
Interpretive signs and frames (3).		210				3 signs, frames, and posts at \$70.
Private lands beyond signs.			228			12 signs and metal posts at \$19.
Materials Total	650	6,110	528	12,350	150	
YEAR TOTAL	\$ 15,450	\$ 26,710	\$ 7,878	\$ 17,700	\$ 2,900	

SUMMARY

Goth Park is a mixture of old field (former agricultural fields dominated by cool season grasses with a variety of native and nonnative forbs) and dry-mesic forest that was formerly oak savanna. The dry-mesic forest formed when the oak savanna was invaded by non-savanna trees and shrubs (box elder, elm, ash, etc.) that closed the canopy. The closed canopy casts deep shade, resulting in the loss of many of the native species typically found in oak savanna that prefer lighter conditions.

The Park is home to 78 native species, including 38 forb (wildflower) species, 15 tree species, 12 shrub species, 5 graminoid (grass, sedge, rush) species, 2 fern species, and 6 vine species. In addition to the 78 native species, there are 51 exotic species. No endangered, threatened, or special concern plants or animals were observed.

The Park's unique ecological, cultural, and geologic history and the opportunity for ecological restoration of rare oak savanna and prairie, coupled with a wealth of opportunities for public education, clearly indicate it is a unique and valuable resource worthy of thoughtful stewardship.

It is equally clear, however, that the Park does not exist in a vacuum. Internal and external threats are altering the Park's valued character and its ecological quality. Invasive species infestations, such as buckthorn, honeysuckle, and black locust, and excessive shade caused by box elder, elm, and other non-savanna species are extirpating desirable species. Oak wilt is likely present and additional residential development is underway on the Park's east side.

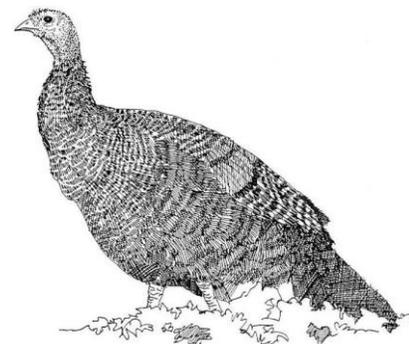
With proper forethought and action you will be able to protect this wonderful resource from the negative influences threatening it, build upon the strong ecological base that already exists, and restore rare oak savanna and prairie for the use and enjoyment of Town residents and prairie and savanna dependant wildlife.



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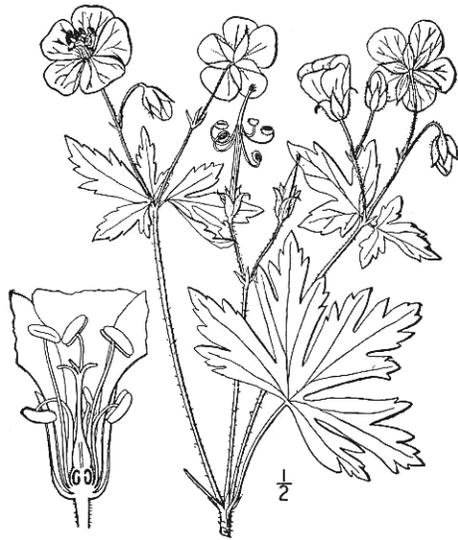
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APPENDIX I

ANNOTATED LIST OF OBSERVED SPECIES



Wild Geranium (*Geranium maculatum*)

Scientific Name	Common Name	Native or Exotic	Invasive Species	North Grassland	Woodland	South Grassland	Comments
Forbs							
<i>Abutilon theophrasti</i>	Velvet leaf	E			X		Annual weed
<i>Achillea millefolium</i>	Yarrow	E		X		X	Some varieties are native
<i>Agrimonia gryposepala</i>	Agrimony	N			X	X	Forest and savanna species
<i>Alliaria petiolata</i>	Garlic mustard	E	X	X	X		Biennial, prefers shade
<i>Ambrosia artemisiifolia</i>	Common ragweed	N		X			Can be invasive in sunny habitats
<i>Ambrosia trifida</i>	Giant ragweed	N		X			Can be invasive in sunny habitats
<i>Arctium minus</i>	Burdock	E		X	X	X	Can be invasive, agricultural weed
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	N			X		Forest species, uncommon in Park
<i>Asclepias syriaca</i>	Common milkweed	N		X	X	X	Prairie and savanna species
<i>Asparagus officinalis</i>	Asparagus	E		X		X	Edible
<i>Aster lateriflorus</i>	Calico aster	N		X	X	X	Savanna species
<i>Aster novae-angliae</i>	New England aster	N		X	X		Probably planted
<i>Aster pilosus</i>	Pilose aster	N		X	X	X	Can be weedy
<i>Barbarea vulgaris</i>	Yellow rocket	E			X		Agricultural weed, biennial
<i>Cannabis sativa</i>	Hemp (marijuana)	E			X		Annual
<i>Chenopodium album</i>	Lamb's quarter	E			X		Annual
<i>Chicorium intybus</i>	Chicory	E		X			
<i>Circaea lutetiana</i>	Enchanter's nightshade	N			X		Forest and savanna species
<i>Cirsium arvense</i>	Canada thistle	E	X	X	X	X	Perennial, prefers full sun
<i>Cirsium sp.</i>	Thistle	E			X		Biennial
<i>Cirsium vulgare</i>	Bull thistle	E		X		X	Biennial
<i>Conyza canadensis</i>	Horseweed	N			X	X	Annual, can be weedy
<i>Daucus carota</i>	Queen Anne's lace	E		X	X	X	Biennial, can be invasive
<i>Echinacea purpurea</i>	Eastern purple coneflower	E		X	X		Native to SW USA, not native in WI
<i>Erechtites hieracifolia</i>	Fireweed	N		X	X	X	Annual, spreads with disturbance
<i>Erigeron annuus</i>	Daisy fleabane	N		X	X	X	Annual, can be weedy
<i>Eupatorium rugosum</i>	White snake root	N		X	X		Savanna species, can be weedy
<i>Euphorbia esula</i>	Leafy spurge	E	X			X	One patch in South Grassland
<i>Galium triflorum</i>	Fragrant bedstraw	N			X		Forest species
<i>Geranium maculatum</i>	Wild geranium	N			X		Savanna species
<i>Geum canadense</i>	White avens	N		X	X		Forest species, species can be weedy
<i>Glecoma hederacea</i>	Creeping Charlie	E			X		Common lawn weed
<i>Gnaphalium obtusifolium</i>	Old-field balsam	N			X		Annual
<i>Hackelia virginiana</i>	Beggar's lice	N			X		Seeds transported by people and other animals
<i>Helianthus strumosus</i>	Rough-leaved sunflower	N		X			Savanna species
<i>Heliopsis helianthoides</i>	False sunflower	N				X	Prairie species, probably planted
<i>Hieracium species</i>	Hawkweed	E			X	X	
<i>Hypericum perforatum</i>	Common St. Johnswort	E		X		X	
<i>Leonurus cardiaca</i>	Motherwort	E			X		Perennial
<i>Melilotus alba</i>	White sweet clover	E	X	X			Prefers sunny habitats
<i>Melilotus officinalis</i>	Yellow sweet clover	E	X	X			Prefers sunny habitats
<i>Monarda fistulosa</i>	Bee balm	N		X	X		Prairie species, probably planted
<i>Nepeta cataria</i>	Catnip	E			X		Perennial
<i>Oenothera biennis</i>	Common evening primrose	N		X		X	Biennial
<i>Osmorhiza claytonii</i>	Sweet Cicely	N			X		Forest species
<i>Osmorhiza longistylis</i>	Long-styled sweet Cicely	N			X		Forest species, damper soil than <i>O. claytonii</i>
<i>Oxalis stricta</i>	Yellow wood sorrel	N		X	X	X	

Scientific Name	Common Name	Native or Exotic	Invasive Species	North Grassland	Woodland	South Grassland	Comments
Forbs, continued							
<i>Pastinaca sativa</i>	Wild parsnip	E	X	X	X	X	Prefers sunny habitats
<i>Phryma leptostachya</i>	American lopseed	N			X		Forest species
<i>Pilea pumila</i>	Clearweed	N			X		Stem is translucent
<i>Potentilla arguta</i>	Prairie cinquefoil	N				X	Prairie species, may have been planted
<i>Potentilla simplex</i>	Common cinquefoil	N		X		X	
<i>Prunella vulgaris</i>	Heal all	E			X		
<i>Pyrola elliptica</i>	Large-leaved shin-leaf	N			X		Savanna species
<i>Ranunculus abortivus</i>	Small flowered crowfoot	N			X		Forest and savanna species
<i>Rudbeckia hirta</i>	Black-eyed Susan	N		X	X		Prairie species, probably planted
<i>Rumex crispus</i>	Curly dock	E		X			Agricultural weed, most common in sunny habitats
<i>Smilacina racemosa</i>	False Solomon's seal	N			X		
<i>Solanum sarrachoides</i>	Hairy nightshade	E				X	
<i>Solidago canadensis</i>	Canada goldenrod	N		X	X	X	Can be invasive
<i>Solidago gigantea</i>	Tall goldenrod	N		X	X		Can be invasive
<i>Taraxacum officinale</i>	Dandelion	E		X	X	X	Common lawn weed
<i>Tragopogon species</i>	Goat's beard	E				X	
<i>Trifolium pratense</i>	Red clover	E		X	X	X	Agricultural legume
<i>Trifolium repens</i>	White clover	E		X		X	Agricultural legume
<i>Urtica dioica</i>	Stinging nettle	N		X			Stinging plant
<i>Verbascum thapsus</i>	Common mullein	E		X		X	Biennial, weed of sunny habitats
<i>Verbena urticifolia</i>	White vervain	N			X	X	Savanna species
<i>Viola sp.</i>	Wild violet	N		X	X		Forest species
Ferns and Fern Allies							
<i>Athyrium filix-femina</i>	Lady fern	N			X		Forest species
<i>Dryopteris species</i>	Woodfern	N			X		Forest species
Vines							
<i>Amphicarpaea bracteata</i>	Hog peanut	N			X		
<i>Celastrus scandens</i>	American bittersweet	N			X	X	There is a native and a non-native species in WI
<i>Parthenocissus quinquefolia</i>	Virginia creeper	N		X	X	X	
<i>Smilax herbacea</i>	Carrion flower	N			X		Wildlife food
<i>Solanum dulcamara</i>	Nightshade	E		X	X		
<i>Toxicodendron radicans</i>	Poison ivy	N		X	X	X	Causes blisters
<i>Vicia sativa</i>	Spring vetch	E		X			
<i>Vitis riparia</i>	Riverbank grape	N		X	X	X	Wildlife food
<i>Vitis sp.</i>	Grape	E				X	In grape vineyard, likely a horticultural variety
Grasses and Sedges							
<i>Bromus inermis</i>	Smooth brome grass	E		X	X	X	Co-dominant grass in North and South Grasslands
<i>Carex pensylvanica</i>	Pennsylvania sedge	N			X		Common species in Wisconsin
<i>Carex spp.</i>	Sedge	N			X		
<i>Dactylis glomerata</i>	Orchard grass	E		X			Agricultural grass, short-lived perennial
<i>Elymus canadensis</i>	Canada wild rye	N		X	X		Prairie and savanna species, probably planted
<i>Elytrigia repens</i>	Quack grass	E				X	Agricultural grass
<i>Miscanthus sp.</i>	Silver grass	E				X	Ornamental grass, one clump in South Grassland
<i>Muhlenbergia species</i>	Wild timothy	N			X		

Scientific Name	Common Name	Native or Exotic	Invasive Species	North Grassland	Woodland	South Grassland	Comments
Grasses and Sedges, continued							
<i>Panicum capillare</i>	Witch grass	N			X		
<i>Phalaris arundinaceae</i>	Reed canary grass	E	X	X	X	X	Patches in North and South Grasslands
<i>Phleum pratense</i>	Timothy	E		X			Common pasture grass
<i>Poa pratensis</i>	Kentucky bluegrass	E		X		X	Co-dominant grass in North and South Grasslands
<i>Setaria glauca</i>	Yellow foxtail	E		X		X	Annual, can be weedy
Trees							
<i>Acer negundo</i>	Box elder	N		X	X	X	Can be invasive
<i>Acer platanoides</i>	Norway maple	E	X		X		Grows in sun or shade
<i>Carya ovata</i>	Shagbark hickory	N		X	X	X	Savanna species
<i>Celtis occidentalis</i>	Hackberry	N			X		Uncommon on site
<i>Fraxinus pennsylvanica</i>	Green ash	N		X	X	X	
<i>Juglans nigra</i>	Black walnut	N		X	X	X	Wildlife food source
<i>Juniperus virginiana</i>	Red cedar	N				X	Evergreen, shade intolerant
<i>Morus alba</i>	White mulberry	E		X	X		Can be invasive, wildlife food
<i>Picea abies</i>	Norway spruce	E			X		Evergreen, probably planted
<i>Populus deltoides</i>	Cottonwood	N			X		Most abundant near grape vineyard
<i>Populus tremuloides</i>	Quaking aspen	N				X	Clone in NE corner of South Grassland
<i>Prunus serotina</i>	Black cherry	N		X	X	X	Common in Park, grows fast, wildlife food source
<i>Pyrus malus</i>	Apple	E			X		Wildlife food source, may have planted by Goth
<i>Quercus alba</i>	White oak	N			X	X	Savanna species, wildlife food source
<i>Quercus macrocarpa</i>	Bur oak	N		X	X	X	Savanna species, wildlife food source
<i>Quercus rubra</i>	Red oak	N		X	X	X	Savanna species, wildlife food source
<i>Quercus velutina</i>	Black oak	N		X	X	X	Savanna species, wildlife food source
<i>Robinia pseudoacacia</i>	Black locust	E	X	X	X	X	Dominant in parts of Woodland
<i>Ulmus americana</i>	American elm	N		X	X		Susceptible to Dutch elm disease
<i>Ulmus rubra</i>	Slippery elm	N			X		Susceptible to Dutch elm disease
Shrubs							
<i>Cornus racemosa</i>	Gray dogwood	N		X	X	X	Wildlife food source, can be aggressive
<i>Corylus americana</i>	Hazelnut	N			X		Wildlife food source, prairie and savanna species
<i>Lonicera sp.</i>	Honeysuckle	E	X	X	X	X	Abundant in Woodland and South Grassland
<i>Prunus virginiana</i>	Choke cherry	N		X	X		Wildlife food source
<i>Rhamnus cathartica</i>	Common buckthorn	E	X	X	X		Abundant in Woodland
<i>Rhus glabra</i>	Smooth sumac	N			X		Can be weedy
<i>Rhus typhina</i>	Staghorn sumac	N		X	X		Can be weedy
<i>Ribes cynosbati</i>	Prickly gooseberry	N		X	X		Wildlife food source
<i>Rosa multiflora</i>	Multiflora rose	E	X	X	X	X	Uncommon in Park
<i>Rosa spp.</i>	Wild rose	N		X			Uncommon in Park, wildlife food source
<i>Rubus alleghaniensis</i>	Blackberry	N		X	X	X	Wildlife food source, can be invasive
<i>Rubus idaeus</i>	Red raspberry	N			X		Wildlife food source, can be invasive
<i>Rubus occidentalis</i>	Black raspberry	N		X	X	X	Wildlife food source, can be invasive
<i>Sambucus canadensis</i>	Elderberry	N		X	X		Wildlife food source
<i>Viburnum opulus</i>	European highbush cranberry	E		X	X	X	Wildlife food source
<i>Zanthoxylum americanum</i>	Prickly ash	N			X		Uncommon in Park, can be invasive

APPENDIX II

NATIVE PLANT NURSERIES

If a nursery cannot state that their plants are “nursery-propagated” then they may have been collected from the wild. Reputable nurseries will tell you the source of their seeds and plants. Ask to assure the source if you intend to purchase nursery-propagated plants or seed obtained from local sources.

This list was compiled by the Bureau of Endangered Resources, Wisconsin Department of Natural Resources (WDNR). This list does not imply any endorsement or recommendation by the WDNR or BioLogic. For a larger list, see the WDNR website:
<http://dnr.wi.gov/org/land/er/invasive/info/nurseries.htm>.

Agrecol carries seeds and plants for over 120 species of native grasses and wildflowers for prairie, savanna, wetland, and woodlands. Contact: 2918 Agricultural Drive, Madison, WI 53718. 608-223-3575.

BioLogic Environmental Consulting, LLC carries woodland, wetland, prairie, and savanna plants and seeds. Contact: 2505 Richardson Street, Fitchburg, WI 53711. 608-277-9960.

Great Lakes Nursery Company sells native trees and shrubs. Contact: 1002 Hamilton Street, Wausau, WI. 888-733-3564.

Oak Prairie Farm produces certified native prairie, savanna, and wetland seeds and plants. Contact: W4642 Hwy 33, Pardeeville, WI 53954. 800-894-3884.

Possibility Place offers native trees and shrubs, including oak, at wholesale prices. Contact: 7548 W. Monee-Manhattan Rd., Monee, IL 60449, phone 708.534.3988, catalog available at www.possibilityplace.com.

Prairie Future Seed Co. has native prairie, savanna, wet meadow, fen, and woodland plants and seeds of primarily southeastern genotype. Contact: W255 N9286 Tomahawk Dr., Menomonee Falls, WI 53052. 262-820-0221.

Reeseville Ridge Nursery deals mainly with native trees and shrubs. Also specializes in custom propagation of woody plants. Contact: P.O. Box 171, 309 South Main Street, Reeseville, WI 53579. 414-927-3291. <http://www.wegrowit.com/Reeseville/ReesevilleRidgeCatalog.htm>

Taylor Creek Nursery has seeds, plants, trees, and shrubs for prairie, savanna, and wetland. Contact: Route 3, Smith Road, P.O. Box 256, Brodhead, WI 53520. 608-897-8547.

APPENDIX III
GOTH PARK: INVASIVE SHRUB REMOVAL
WITH REPLACEMENT SCREENING

Goth Park: Invasive Shrub Removal With Replacement Screening

Prepared for the Town of Middleton

by Michael P. Anderson

June 2006

Introduction

The purpose of this report is to provide:

1. An assessment of the current composition and structure of the wooded edges along Goth Park's west and south property lines.
2. Recommendations for removing invasive woody species from the wooded edges.
3. Recommendations for providing replacement screening after invasive species removal.
4. An estimated cost for replacing the invasive species with native species.
5. An assessment of the grape arbor area and recommendations for its management.

Methods

A June 3, 2006 visit was made to the Park to determine the current composition of the vegetation along the south and west property lines and to determine the amount of screening that might be required following the removal of invasive trees and shrubs from these areas.

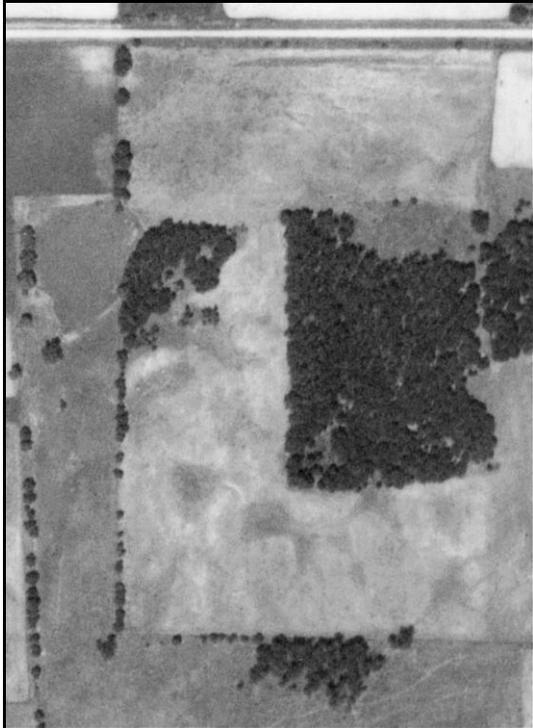
Assessed areas were placed into one of three "screening requirement categories:"

1. **No screening needed:** Existing screening expected to be adequate after invasive species removal.
2. **Supplemental screening needed:** A mixture of adequate and inadequate screening after invasive species are removed.
3. **Full screening needed:** Little or no screening after invasive species removal.

Other factors considered, besides the density and structure of the vegetation, include the distance from a walking trail (a shorter distance requires greater screening), topography (a hill can provide screening), and the amount of screening on the adjacent private property.

Historic Conditions

Inspection of historic air photos from 1937 to 2005 reveals the brushy nature of the property line (especially the west property line) has developed mostly since the early 1990s, i.e., within the last 10 to 15 years (Figure 1). An exception is the west end of the south property line, which has been open since at least 1937.



1937



1987



1995



2005

Figure 1. Woody Growth Along Goth Park Property Lines, 1937 to 2005.

Prior to 1995, when buckthorn, honeysuckle, and the other woody species became established, the property line fencerows were most likely composed primarily of trees of varying heights and widths. Many of these trees remain today, although many have lost their lower branches because of shading (trees typically self-prune lower branches when they don't receive enough sunlight). Examples include oak (especially at the north end of the western property line), hickory, and black cherry.

Current Conditions

Figure 2 provides the locations of the three screening requirement categories along the south and west property lines. Table 1 provides summary information for each category.

Table 1. Summary Information for Each Screening Requirement Category.

Category	Color in Figure 2	Lineal Feet	%
None	Green	346	18
Supplemental	Yellow	1,076	56
Full	Red	500	26

Areas in the *None* category have a variety of trees and shrubs with a variety of heights and growth forms in a high density enough to provide adequate screening after invasive species removal. For example, trees with horizontally growing branches and shrubs with an upright (vertical) growth form. Consequently, no additional screening is needed.

Areas in the *Supplemental* category typically have a compliment of trees and shrubs that provide some screening, but will require supplemental planting to fill gaps or to compensate for the loss of lower tree branches caused by excessive shading.

Areas in the *Full* category lack a meaningful level of screening either because they are associated with historically open (treeless) areas that have filled in with invasive species or because the dense growth of invasive species has resulted in the loss of lower tree branches and other vegetation.

It should be noted that no practical amount of vegetative screening will provide full sound protection from lawn mowers, leaf blowers, or even human voices at a normal conversational level.

The inspection of the grape arbor area revealed a large number of vines that will easily fill the arbor area by the end of the 2006 growing season.



Figure 2. Screening Requirement Category Locations.

Recommendations

Desired Future Condition

It is desirable to have a goal or set of goals in mind when initiating management. The goal(s) provide a target and allow measurement of progress towards the target. A suggested goal for Goth Park is to: Remove woody and herbaceous invasive species from the Park and promote the growth of native species.

Invasive Shrub Removal

As the historic air photos reveal, the majority of the invasive shrubs (predominantly honeysuckle, buckthorn, and black locust) are relatively recent arrivals. Nevertheless, they have already caused ecological harm and will continue doing so. Examples include the loss of native species, the loss of lower tree branches caused by shading, and increased soil erosion associated with bare ground. Consequently, their removal is recommended to prevent further harm to Goth Park and their spread to neighboring properties.

Removal can be done anytime except during spring when there is heavy sap flow from cut stems which washes away the herbicide needed to prevent resprouting and suckering. Although staggering removal within a given area over a number of years with concurrent replacement planting will minimize the apparent effects of removal, this approach is not recommended because it increases the total effort required, because it places the smaller, newly planted trees and shrubs at risk while the surrounding area is cleared, because it allows invasive species to continue spreading, and because it delays replacement planting, ultimately increasing the amount of time before the newly planted trees and shrubs mature.

Cut material should be burned or otherwise removed from the work area rather than piled for aesthetic reasons.

Replacement Trees and Shrubs

Native shrubs and trees should be planted to replace the invasive species that are removed in order to maintain a minimum level of visual screening. In addition to providing screening the native shrubs and trees will also provide significantly better habitat and food for wildlife, and a more diverse flower and fruit display for the neighbors to enjoy. The diversity of flowers and fruits attracts a greater variety of wildlife, especially birds, but also beneficial insects and butterflies.

Suggestions for suitable native shrubs are provided in Table 2, along with information on their growth form and habits. The best screening will be provided by planting a variety of shrubs with a variety of growth forms. This will also maximize wildlife use.

A specific planting plan cannot be provided at this time because the species selected and the quantities of each will be determined by factors not currently known, such as the amount of invasive shrub removal that will occur and the resulting light conditions and the Town's budget.

Table 2. Recommended Replacement Shrubs and Trees.

Scientific Name	Common Name	Flower	Light ¹	Height	Width	Comments
Shrubs						
<i>Cornus alternifolia</i>	Pagoda Dogwood	White	PS	15'	10-15'	Horizontal branching structure; blue-black fruit eaten by wildlife; maroon-red fall color; moderate growth rate.
<i>Cornus racemosa</i>	Gray Dogwood	White	PS, FS	6-10'	3-8'	Forms thickets by rhizomes (multi-stem); black berries on red stems eaten by wildlife; erect growth form, flowers best in sun, but will grow in light shade.
<i>Corylus americana</i>	American Hazelnut	Yellow	PS, FS	6-10'	6-10'	Forms thickets by rhizomes (multi-stem); has nuts eaten by wildlife; erect growth form; woodland and savanna shrub.
<i>Crataegus spp.</i>	Hawthorn	White	PS, FS	6-15'	15-25'	Has long thorns; wildlife food source; good nectar source; crown spreads widely into a tree-shape; avoid cultivars; single stem.
<i>Hamamelis virginiana</i>	Witch Hazel	Yellow	PS, FS	6-15'	10-15'	Flowers in late fall; yellow fall color; open and airy growth form is attractive, but won't provide a lot of screening.
<i>Prunus americana</i>	Wild Plum	White	PS, FS	10-15"	5-10'	Forms thickets by rhizomes; multi-stem; good wildlife food; very hardy.
<i>Sambucus canadensis</i>	Elderberry	White	SH, PS, FS	5-10'	5-8'	Edible purple-black fruit; multi-stem; wildlife food; doesn't spread; flowers and fruits best in full sun.
<i>Viburnum acerifolium</i>	Maple Leaf Viburnum	Cream	SH	4-6'	4-6'	Creamy-white flowers; black berries eaten by wildlife; red fall color; single stem growth form with spreading crown.
<i>Viburnum lentago</i>	Nannyberry	White	PS, FS	10-15'	8-12'	Large flowers; blue-black fruit; single stem, vase-shape growth form; fall color.
<i>Viburnum rafinesquianum</i>	Arrowwood Viburnum	White	SH, PS	8-15'	8-12'	Large attractive flowers; blue-black fruit; attractive form (single stem); does not spread.
<i>Viburnum trilobum</i>	Highbush Cranberry	White	PS, FS	6-12'	6-8'	Flowers in May; red fruit in fall; multi-stem; avoid cultivars and the European highbush cranberry.
Trees						
<i>Ostrya virginiana</i>	Ironwood		SH	20-30'	20-30'	Fast growing; very shade tolerant; yellow fall color; plant close together for effective screening.
<i>Quercus spp.</i>	Red, white, bur oak		FS	40-80'	40-80'	Slow growing; needs full sun to become established; acorns are highly desired by wildlife.

¹ SH = daylong shade; PS = mixture of sun and shade; FS = full sun or nearly full sun.

Estimated Cost

The estimated materials cost provided in Table 3 is based on the following assumptions:

1. "Full screening" areas will require one tree or shrub per 8 lineal feet, on average. Actual distance will vary with the species and whether it is a tree or shrub.
2. "Supplemental screening" areas will require one tree or shrub per 20 lineal feet, on average. Actual distance between species will vary greatly depending on existing vegetation conditions and species.
3. Prices are based on the Possibility Place Nursery 2006 Wholesale catalog¹, which has all of the recommended species.
4. Shrubs are sold in five-gallon plastic pots with several price breaks depending on the number of a given species ordered. A middle price was used to calculate cost and is based on an order of 10 to 19 of a given species. Add \$2/shrub when ordering in a quantity of 1 to 9 for a given species or subtract \$2/shrub when ordering more than 19.
5. Trees are sold in either five-gallon plastic pots (less expensive) or based on their diameter (significantly more expensive). Table 3 is based on a 1.5-inch diameter tree, the smallest of several available sizes. For larger diameter trees add \$50/tree.
6. Shipping, delivery, or pick-up cost for trees and shrubs is not included.
7. Labor to plant, mulch, and water trees (after planting and weekly thereafter for two months) is not included. However, a half hour per tree or shrub for planting, mulching, and watering is a conservative estimate when travel to and from the Park, loading and unloading, determining planting locations, and other factors are considered.

Table 3. Estimated Materials Cost.

Screening Requirement Category	Lineal Feet	Trees			Shrubs			Total Cost
		No. Needed	\$/tree	Cost	No. Needed	\$/shrub	Cost	
None	346	0		0	0		0	\$0
Supplemental	1,076	10	95	950	44	13	660	\$1,610
Full	500	13	95	1,235	50	13	750	\$1,985
Total Materials Cost								\$3,595

Summary

Invasive shrub removal is very important for the long-term ecological health of Goth Park. Neighbor concerns about the loss of privacy screening can be addressed at a materials cost of about \$1.50 for the Supplemental areas and \$4.00 for the Full areas.

¹ Possibility Place Nursery, 7548 W. Monee-Manhattan Rd., Monee, IL 60449, phone 708.534.3988, catalog available on line at www.possibilityplace.com.