Ecological Assessment & Management Plan

City of Monona Woodland Park

Dane County
Wisconsin
December 2006

TAYLOR CONSERVATION LLC

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Prepared by

Scott O. Taylor
Taylor Conservation, LLC.
3328 Chicago Ave.
Madison WI. 53714
Phone: (608) 444-7483
Fax: (608) 241-9369
Email: sotaylor@taylorconservation.com

Submitted to

City of Monona, Parks and Recreation Committee
c/o Heidi Krueger, Park and Recreation Director
5211 Schluter Rd.
Monona, WI. 53716
Phone: (608) 222-4167
Email: mrcdirector@ci.monona.wi.us

Executive Summary

In September and October of 2006 Scott Taylor of Taylor Conservation LLC conducted an ecological assessment of the City of Monona's Woodland Park. The Ecological Assessment & Management Plan records results of the field visit and provides a plan to guide management actions necessary to preserve and enhance diversity of plant and animal species in the Park. Priority actions are enumerated on page 18.

Woodland Park consists of 16 acres of mature oak forest. A well-maintained trail system reaches all parts of the Park, providing ample public access. Two native American mounds sit on the hilltop. They belong to the Tompkins-Brindler Mound Group, dating to the Late Woodland Stage (1500-700 years before present) of archaeological history. The Park is mostly surrounded by urban lands but it adjoins a large tract of open lands to the east – those of the Aldo Leopold Nature Center and Madison's Edna Taylor Conservation Park. The Park together with these areas probably form one large ecosystem because of the movement of animals and seed among them.

To restore oak woodland on the west side of the Park (Natural Community 2), volunteers have spent many hours cutting non-oak trees, primarily black locust and black cherry, and killing invasive exotics, primarily garlic mustard and buckthorn. Oak woodlands and savannas were widespread in southern Wisconsin before European settlement. Much of our native plant and animal diversity is associated with them. Hence, restoring these communities is an effective way to preserve and enhance biodiversity in Wisconsin.

The invasive exotic species, garlic mustard and buckthorn, remain the principal threats to biodiversity in Woodland Park. These plants are capable of outcompeting most native species. If not controlled, they could suppress native herbs, shrubs and tree seedlings in coming decades until they completely dominate the Park. If work begun by volunteers is not continued, the area they restored will probably eventually revert to dominance by garlic mustard and buckthorn. Other invasive species noted were honeysuckle, black locust and Norway maple. However, these do not pose threats as immediate as garlic mustard and buckthorn.

The open area in the northwest corner of the Park (i.e. Natural Community 3) was the site of large-scale black locust removal. To the author's knowledge, the black locusts were not killed with herbicides after being cut. The root systems are probably still alive and capable of sprouting young trees. Before you re-establish any type of vegetation here, you will probably need to stop mowing, allow existing vegetation to re-grow and kill it with herbicides. It is unlikely that continued mowing will adequately control whatever aggressive, undesirable vegetation is present.

The Ecological Assessment divides the Park into 3 "natural communities", areas with relatively uniform vegetative structure and plant species composition, and describes them. The Management Plan recommends options for managing natural communities. The options are usually listed in order from the most basic actions to more complicated, expensive ones.

Location of Woodland Park

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I. Introduction

Overview of Woodland Park

Woodland Park is a mature forest occupying a drumlin – an isolated, oval-shaped hill formed by mounded glacial deposits (Figures 1&2). The drumlin is oriented southwest-to-northeast; its southeast slope is much steeper than the northwest slope. The large mature trees are primarily oaks – white oaks, black oaks, bur oaks and red oaks; the smaller, younger trees are mostly non-oak species – black cherry, shagbark hickory, box elder, American elm and black locust. Many of the large oaks have died or are showing signs of decline. It is likely that oak wilt, a fungal disease spread by beetles, has killed many of them. Moreover, the oaks have not been reproducing; as they die, they will probably be replaced by non-oak trees leading to dramatic changes in the forest ecosystem.

The forest of the northwest slope (Natural Community 2) has been heavily altered by management activities aimed at restoring oak woodland, a vegetative community that was widespread before European settlement. Volunteers cut most of the small non-oak trees in this area to allow more sunlight and foster grasses and wildflowers characteristic of oak communities. Volunteers and contractors have also cut and sprayed with herbicides invasive exotic species, primarily buckthorn and garlic mustard. The east side of the Park has not been managed as much and therefore contains more small non-oak trees and invasive exotics.

An area in the northwest corner of the Park dominated by black locusts was cleared to restore an oak savanna. Large, scattered oaks were retained and turf grasses were sown to hold soil and beautify the site for the short term. Unlike the rest of the Park, this area is almost completely open. The City is currently managing this area by regular mowing.

Geology & Soils

The landscape surrounding the Park and the City of Monona is dominated by glacial deposits from the last glacial period, the Wisconsin Stage (70,000-10,000 years before present). In this period, the Laurentide Ice Sheet, which once covered most of northern North America, reshaped southeastern Wisconsin by scouring ridges and valleys and depositing a thick layer of glacial drift, which is material consisting of a mix of sand, silt, clay, gravel and rocks. Glacial drift formed a diversity of landforms, some quite rugged, such as terminal moraines along the margins of glaciers where debris was deposited (sensu Kettle Moraine State Forest), and others more gentle, like ground moraines spread somewhat evenly over the landscape where they were deposited directly beneath the ice sheet (Shultz 1986).

The landscape surrounding Monona is a ground moraine consisting of sandy loam-textured material, meaning it has sand, silt and clay but sand predominates. Several drumlins comprised of the same material are scattered around the ground moraine (Mickelson & McCartney 1979). They were created beneath the glacier as the creeping ice sheet amassed the underlying drift into oval-shaped landforms. Thus formed by flowing ice, drumlins in this area are oriented in the southwest-to-northeast direction of glacial movement, as is the drumlin occupied by Woodland Park.

After the glacier retreated north, fine sediments that had filled the Mississippi Valley were lofted by westerly winds and deposited across Wisconsin in a blanket ranging from several inches to 4 feet in depth (Hole 1976). This silty material is known as "loess". Consequently many soils of this region contain surface layers of silt, rich in nutrients and having excellent moisture retention.

The soils of Woodland Park formed in loess at the surface and sandy loam glacial drift at greater depths (Figure 3). They are deep and well-drained, creating good growing conditions for a wide range of plants (Glocker & Patzer 1978). In general, the soils are probably deeper in the low areas and become progressively thinner upslope to the ridgetop since much of the loess-derived surface layer probably washed down-slope over the millennia; hence, the ridgetop and upper slopes are probably somewhat poorer in nutrients and moisture retention than the lower slopes.

Table 1. Soils of Woodland Park. Source: Soil Survey of Dane County.

Soil Series	Landscape position in Woodland Park	Drainage Class	Depth
Kidder loam (KdD2)	Ridgetop & East Slope	Well-Drained	Deep
McHenry silt loam (MdC2)	West Slope	Well-Drained	Deep
St. Charles silt loam (ScB)	Base of West Slope	Well-Drained	Deep

Watershed

Woodland Park is in the Yahara River-Lake Monona watershed. There is probably very little surface runoff of rainwater in the Park since the forest canopy intercepts rainfall, allowing it to percolate slowly into the ground. However, a gully was noted on the west slope, in the Oak Woodland natural community; it originated at the top of the hill where there was a large spigot at the base of one of the water towers.

Presettlement Vegetation of Surrounding Landscape

Before Europeans arrived, south central Wisconsin was mostly open country, dominated by prairies and oak savannas (Finley 1951). Grasses, wildflowers and widely scattered oaks were the principal vegetation. Low, poorly drained areas contained extensive marshes, sedge meadows and wet prairies. The Presettlement Vegetation Map of the area surrounding the City of Monona shows that oak communities were prevalent in the area surrounding Woodland Park (Appendix 3).

For millennia, fire checked the growth of forests and kept the landscape open. Fires were probably ignited by native Americans (Curtis 1959). Areas that burned often and contained few barriers to the spread of fire, like lakes, rivers and marshes, were usually treeless prairies, rich in grass and forb species. Areas that burned less frequently developed into oak savannas and woodlands. An area with less than 50% tree cover is considered a savanna; a woodland has more than 50% cover but still less than 100%. Like the prairie, these oak communities contained a high diversity of grass and forb species. Bur oaks and white oaks were the dominant tree species in this landscape since their thick bark protected them from fire. Also, oak seedlings readily resprout after being top-killed by a fire. This prepares them for a

growth spurt once released from fire (Johnson 1993). Areas that were completely protected from fire, usually on the leeward sides of lakes and major rivers, developed into sugar maple-basswood forests.

Following European settlement, wildfires sharply diminished and eventually halted. No longer suppressed by fire, oak seedling-sprouts grew rapidly and formed closed-canopy oak forests within a generation (Curtis 1959). Also, fire-sensitive hardwood tree species began spreading and displacing oak trees. Lands that were prairies or savannas are now mostly wooded, farmed or built upon, so that only 0.5% of the original area covered by prairie and only 0.01% of the area covered by savanna in Wisconsin still exists (WI DNR 1995).

Present Day Landscape

Woodland Park is located in the "Southeast Glacial Plains" ecological landscape, which consists entirely of glacial deposits from the most recent glacial period (WI DNR 1999). Ecological landscapes are large regions that share broadly similar geology, climate and natural vegetation. Consequently, they often also have relatively uniform land use patterns. They are subdivided into landtype associations (LTA). The LTA of the Conservancy is "Dane-Jefferson Drumlins and Lakes" (LTA:222Ke08). It consists of glacial deposits like ground moraine with drumlins, outwash plains and old glacial lake plains. Owing to the fertility of the soils and the prevalence of gently sloping land, agriculture is the dominant land use/land cover in this LTA, comprising approximately 50% of it. Urban areas are 7% of the LTA. Grasslands and wetlands together comprise another 22%. Forests account for 11% (WI DNR 1999).

Oak forests are still very common in this region, although many are gradually converting to shade-tolerant hardwoods, like sugar maple, red maple, American elm, basswood, shagbark hickory and white ash; young oaks do not compete well against these species.

Forest Insect Pests & Diseases

Gypsy moth and oak wilt are two potential threats to the health of the dominant forest trees in Woodland Park.

Gypsy Moth

The gypsy moth, an insect from Europe, has entered Wisconsin and currently inhabits eastern parts of the state. It is present in Dane County in low numbers. During population outbreaks, the gypsy moth's caterpillars severely defoliate hardwoods and occasionally conifers. Defoliation stresses trees and can result in mortality, especially when coupled with other stresses, like drought, old age or overcrowding. Leaves of oaks, aspens, and birches are favored by the gypsy moth. Walnuts, maples, hickories, cherries, pines and elms are also eaten by the caterpillars but are less favored.

Since the oaks in Woodland Park are probably very old, they may be quite vulnerable to a gypsy moth outbreak; it is likely that many would die if one occurred.

Oak Wilt

Oak wilt is a fungal disease that infects oak trees through fresh wounds. It is spread by sap-feeding beetles. Once a tree is infected, its vascular system becomes damaged and it can no longer transport water and nutrients. A diseased oak can infect neighboring oaks as the fungus spreads underground through root grafts. This mechanism results in "pockets" of dead and dying oaks. Red oaks are more susceptible to the disease than white oaks. To prevent oak wilt infection of your oak trees, avoid pruning oaks between April 1st and October 1st; this is when the beetles that spread the disease are most active.

It is likely that some of the dead oaks noted had died of oak wilt. Prevalence of the more resistant white oaks has probably prevented large oak wilt pockets from forming.

Park Management Philosophy

The City should develop a philosophy to guide Park management. This is simply a set of principles that form a basis for the goals, objectives and actions in each natural community. These principles will help the City choose between alternative management goals; they will also explain and justify City actions to public stakeholders and any other interested parties. Here are examples of management principles the City might consider:

1) To protect and increase native plant and animal species diversity.
   (This is the basis for control of invasive exotic species, like garlic mustard and buckthorn, which usually suppress diversity by out-competing most native plant species.)

2) To contribute to the biological diversity of the greater landscape.
   (This justifies focusing efforts on restoration of habitats that are regionally rare or declining, such as oak woodlands with diverse, native ground-layer vegetation).

3) To enhance wildlife viewing opportunities for park visitors.
   (This justifies any management action that results in continued or increased use of the Park by animals. For examples, planting fruit-bearing shrubs in forest openings, establishing native wildflowers that attract butterflies or retaining standing dead trees and coarse woody debris for wildlife food and shelter.)

Principles of Ecological Restoration

Management recommendations in this document are guided by the principles of ecological restoration: "an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability" (Society for Ecological Restoration International Science & Policy Working Group 2004). Usually, ecological restoration attempts to re-create the historic conditions of an ecosystem.

Since European arrival, many natural areas in Wisconsin have changed dramatically. Often, ecosystems originally rich in plant and animal species have become biologically degraded through loss of species and structural changes to habitat. This is the result of factors like cessation of fire, invasion of aggressive, exotic species and landscape-scale fragmentation of ecosystems. Woodland Park has undoubtedly suffered from all of these forces. Restoration

tries to reverse these impacts and return ecosystems to an approximation of pre-European settlement conditions.

The response of degraded ecosystems to restoration treatments is difficult to predict. Therefore, restoration practitioners commonly embrace an experimental approach to their work, termed "adaptive management". This approach requires constant monitoring of restoration results and flexible work-plans. Information gained from monitoring the response of an ecosystem to a restoration treatment is used to refine subsequent treatments. Hence, the recommended actions in the management plan should not be view as a fixed program, but only as a starting point.

Ecological restoration is usually a dynamic, long-term process requiring copious labor and patience. On public lands, it is most successful when there is broad community involvement. Partnerships between government agencies and local, volunteer-based "Friends" groups whose mission is the restoration of the natural area can be very effective.

The Natural Heritage Inventory & State Natural Areas

The Natural Heritage Inventory (NHI) is a system for locating and documenting occurrences of rare species and natural communities. It is part of an international system coordinated by the organization, NatureServe. In Wisconsin, it is managed by a partnership between the Nature Conservancy and the Endangered Resources Program of the DNR. Planners and resource managers use the NHI to determine the likelihood of occurrence of rare species in areas affected by development or land management activities. The NHI is *not* a complete catalogue of the locations of the state's rare species. There could be rare species in Woodland Park that are not documented by the NHI. Species listed in the NHI are categorized as one of the following:

Special Concern: Any species whose population is suspected to be declining, but scientific evidence is insufficient to prove this.

Threatened: "Any species which appears likely, within the foreseeable future, on the basis of scientific evidence to become endangered." (WI DNR, Bureau of Endangered Resources).

Endangered: "Any species whose continued existence as a viable component of this state's wild animals or wild plants is determined by the Department to be in jeopardy on the basis of scientific evidence." (WI DNR, Bureau of Endangered Resources).

"Threatened" and "Endangered" are statutory designations, affording legal protection to species designated as such. "Special Concern" is only advisory; species with this designation currently have no legal protection.

The following species list is based on a search of the on-line NHI database for the congressional township, T-7-N, R-10-E. Only township-level NHI data is publicly available on this database. City staff members were provided with the results of a NHI search done by the staff of the DNR Bureau of Endangered Resources for the Woodland Park and

surrounding lands. This information is exempt from state open records statutes and shall not be made available to the public. It may include records for occurrences of species that are not included below.

Species	Status	Suitable Habitats
Fish		
Lake Sturgeon (*Acipenser fulvescens*)	Special Concern	Lakes
Lake Herring (*Coregonus artedi*)	Special Concern	Lakes
Plants		
Yellow Giant Hyssop (*Agastache nepetoides*)	Threatened	Open Woods
Short's Rock-Cress (*Arabis shortii*)	Special Concern	Moist Woods
Prairie False-Dandelion (*Nothocalais cuspidata*)	Special Concern	Prairie
Slim-Stem Small-Reedgrass (*Calamagrostis stricta*)	Special Concern	Wet Meadows, Marshes
Adder's-Tongue (*Ophioglossum pusillum*)	Special Concern	Forest & Prairies

The NHI also catalogues all of the native plant communities in the state that are recognized by ecologists. Much of Wisconsin's landscape is now covered by plant communities comprised of exotic species from Europe and Asia; consequently many areas do not correspond to any NHI-recognized natural communities. The natural communities of Woodland Park show similarities to the NHI communities, Southern Dry and Southern Dry-Mesic Forests, since they are dominated by white and black oaks. However the herb-layer vegetation probably shows little resemblance to well-preserved native communities due to the long prevalence of invasive exotic species in the Park.

State Natural Areas (SNA's) preserve intact examples of native habitats that typify Wisconsin's pre-European settlement-era landscape. There are almost 400 SNA's in Wisconsin covering nearly 150,000 acres. Two SNA's in western Dane County contain examples of NHI communities present in Woodland Park: New Observatory Woods (SNA #28) and Olson Oak Woods (SNA #157) have examples of Southern Dry and Southern Dry-Mesic forests. Both sites have species-rich herb layer vegetation that could serve as a model for restoring Woodland Park. The vegetative structure – i.e. the numbers and arrangement of trees, saplings, shrubs and herbs – could also serve as a guidepost for restoration in the Park.

II. Ecological Assessment of Woodland Park: Natural Community Descriptions

Natural Community 1: Oaks & Mixed Hardwoods (12 Acres)

This natural community occupied the majority of the Park. It covered all of the southeast slope, the ridgetop and the north and south ends of the northwest slope. The southeast slope was quite steep with slopes ranging from 12-20%; the northwest slope was less than 12% and became nearly flat at its base. Two long, narrow native American mounds occupied the ridgetop (Figure 1). They belong to the Tompkins-Brindler Mound Group, dating to the Late Woodland Stage (1500-700 years before present) of archaeological history. This community was divided into 3 management units (Figure 1).

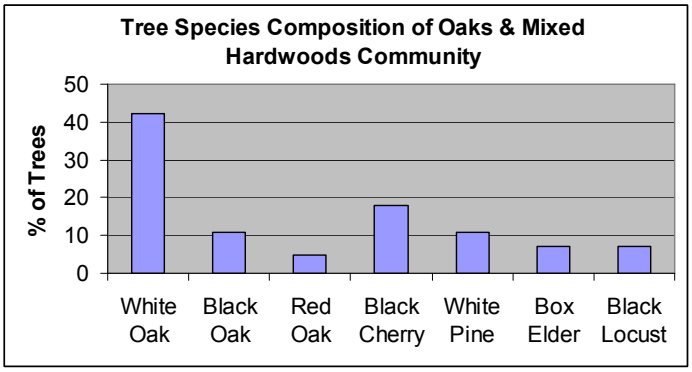
Large white oaks (*Quercus alba*) overwhelmingly dominated this community; most were larger than 20 inches in diameter. Black oaks (*Quercus velutina*) and red oaks (*Quercus rubra*) were also present in significant numbers. Many large, mature oaks were declining, as suggested by the presence of large dead branches in the upper crowns. Many more had already died, creating numerous openings in the forest canopy. Some of the oaks may have died of oak wilt, a fungal disease spread by beetles that infects the tree's vascular system, causing loss of foliage and tree death.

Most of the smaller, younger trees were non-oak species. Black cherry (*Prunus serotina*) was the most abundant species besides white oak (Figure 7). Other trees noted were box elder (*Acer negundo*), black locust (*Robinia pseudoacacia*), shagbark hickory (*Carya ovata*), white pine (*Pinus strubus*), red pine (*Pinus resinosa*) and Norway spruce (*Picea abies*). One large Norway maple (*Acer platanoides*) was observed. The pines and spruces were probably planted. The absence of young oaks suggests the forest will eventually become dominated by non-oak species, primarily black cherry.

Black locust is an invasive tree native to the southern Appalachians and Ozarks. It was introduced to Wisconsin for its fuel-wood value and its ability to stabilize soils by forming dense clones via root-sprouts. Locust clones can out-compete native vegetation. Also, black locust's nitrogen-fixing ability could make a site more favorable for other invasive species, which tend to be nitrogen-demanding (Von Holle et al. 2006).

Norway maple, a tree from Europe widely planted as a street tree, can also be invasive. It often reproduces aggressively and its seedlings are very shade tolerant; they can out-compete other hardwood seedlings in the understory.

Figure 7.



(Data based on 5 wedge-prism sample plots. Only trees >4 inches in diameter were counted.)

The oaks in Unit 2 (Figure 1) were more widely spaced than elsewhere and had open-grown forms; they were surrounded by smaller black cherries and box elders. This area was probably once an open savanna, unlike the rest of the Park which was a more closed woodland (>50% canopy cover).

The shrub layer of Unit 1 was dominated by buckthorn (*Rhamnus cathartica*). Buckthorn is an invasive exotic species that was introduced to North America as an ornamental shrub and has since become naturalized. It's berries are consumed by birds who subsequently transport the seed over long distances, establishing new colonies. It's leaves emerge earlier and stay green later than most native plants; hence, with a longer growing season, buckthorn easily out-competes most native herbs, shrubs and tree seedlings to form dense thickets, as it has in Unit 1.

Young cherries and box elders are poised to replace mature oaks.

There were few shrubs of any type in Units 2 and 3. However, honeysuckle (*Lonicera X bella*), another invasive exotic, dominated some parts of Unit 2 (Figure 6). Shrubs of other species were very few and scattered.

The herb layer was dominated by stickseed (*Hackelia virginiana*), woodbine (*Parthenocissus quinquefolia*), bittersweet nightshade (*Solanum dulcamara*), enchanter's nightshade (*Circaea lutetiana*) and garlic mustard (*Allialaria petiolata*). Garlic mustard is an invasive exotic species. It is biennial, shade-tolerant and reproduces rapidly in the undisturbed forest understory, out-competing many native species. It was abundant only in Unit 1 (Figure 4); however, without active suppression in this

area, it will likely spread and eventually dominate the rest of the Park. Garlic mustard seed is spread on the shoes of humans and the feet and fur of animals.

Natural Community 2: White Oak Woodland (2.5 Acres)

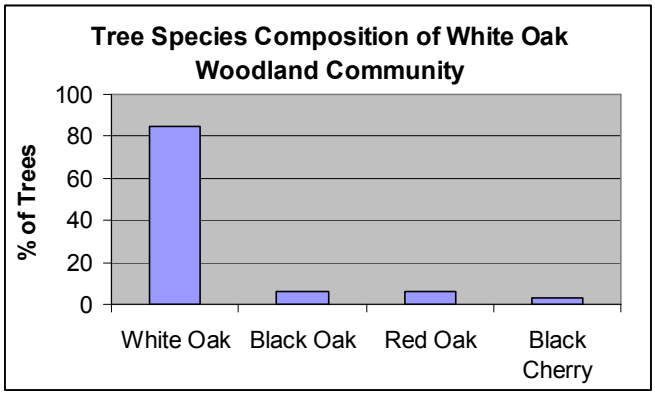
This community occupied the northwest slope; it was wedged between the two segments of the Morningside Trail (Figures 1&2). Slope steepness was between 2 and 12%.

The White Oak Woodland has been the focus of volunteer work during the last 10 years that was intended to restore oak woodland vegetation. The current plant species composition and vegetative structure of this community reflects those efforts. Volunteers and contractors have cut invasive brush and small trees, probably mostly buckthorn and black cherry, and nearly eradicated garlic mustard by foliar herbicide spraying. Consequently, this community contrasts sharply with Natural Community 1 in lacking an understory of brush and small trees and being largely free of garlic mustard.

Open Understory of the White Oak Woodland.

Very large white oaks – the majority more than 20 inches in diameter and some greater than 30 inches – dominated this community. A small number of the oaks had died standing and others showed signs of decline, like large dead branches. Small numbers of black locusts and trees that may have been Norway maples were noted near Monona Drive (Figure 6; it was not determined whether a group of young trees were Norway maples or sugar maples, late spring is the optimal time to identify them.). Some of the sapling-locusts were probably root sprouts from mature locusts that had been cut in the neighboring Oak Savanna community.

Figure 8.



(Data based on 3 wedge-prism sample plots. Only trees >4 inches in diameter were counted.)

There was virtually no shrub or sapling layer in this community. The herb layer was dominated by white snakeroot (*Eupatorium rugosum*), clearweed (*Pilea pumila*), bittersweet nightshade (*Solanum dulcamara*), pokeweed (*Phytolacca Americana*) and a species of *Prenanthes*, probably white lettuce (*Prenanthes alba*). Only a very small number of scattered garlic mustard plants were noted.

Natural Community 3: Oak Savanna (1.5 Acres)

This community occupied a flat area at the base of the northwest slope (Figure 1). Black locusts were removed from this site to restore an oak savanna. It is now completely open with the exception of several large (>18 inches in diameter), scattered bur oaks and white oaks with open-grown form, indicating that this area was open before locusts became established.

Open-Grown Oaks & Mowed Grasses.

A large silver maple and an American elm were also noted. There were small groups of black cherry and shagbark hickory saplings.

The entire site was seeded to turf grasses (blue grass and perennial rye grass) following locust removal and it has been mowed regularly by the City ever since. Black locust seedlings and saplings were present in unmowed areas around trees, suggesting there are still seed and/or living roots of black locusts on the site. A dense stand of locust saplings fringed the south side of the Oak Savanna (Figure 6) in Natural Community 2.

Since the herb-layer vegetation was mowed, the only herbs identified were blue grass (*Poa pratensis*), dandelion (*Taraxacum officinale*) and Canada thistle (*Cirsium arvense*).

Plant Species List

The Park was visited twice in late September and mid October. Fifty-six species of vascular plants were noted. All species of shrubs and trees were probably observed but many species of herbs were probably missed, especially spring and summer-blooming wildflowers. Hence, the species list provided is probably incomplete. Plant species were identified using the author's general knowledge and field guides. Plant species nomenclature follows that of the Wisconsin State Herbarium.

Species	Growth Form	Native or Alien
White oak (*Quercus alba*)	Deciduous Tree	Native
Black oak (*Quercus velutina*)	Deciduous Tree	Native

Red oak (*Quercus rubra*)	Deciduous Tree	Native
Bur oak (*Quercus macrocarpa*)	Deciduous Tree	Native
Black cherry (*Prunus serotina*)	Deciduous Tree	Native
Black locust (*Robinia pseudoacacia*)	Deciduous Tree	Alien (native to the southern U.S.)
Shagbark hickory (*Carya ovata*)	Deciduous Tree	Native
Box elder (*Acer negundo*)	Deciduous Tree	Native
White ash (*Fraxinus Americana*)	Deciduous Tree	Native
Silver maple (*Acer saccharinum*)	Deciduous Tree	Native
Sugar maple (*Acer saccharum*)	Deciduous Tree	Native
American elm (*Ulmus Americana*)	Deciduous Tree	Native
Hackberry (*Celtis occidentalis*)	Deciduous Tree	Native
Catalpa (*Catalpa speciosa*)	Deciduous Tree	Alien (native elsewhere in U.S.)
Norway maple (*Acer platanoides*)	Deciduous Tree	Alien
White pine (*Pinus strobes*)	Coniferous Tree	Native
Red pine (*Pinus resinosa*)	Coniferous Tree	Native
Norway spruce (*Picea abies*)	Coniferous Tree	Alien
White pine (*Pinus strobes*)	Coniferous Tree	Native
Buckthorn (*Rhamnus cathartica*)	Shrub	Alien
Honeysuckle (*Lonicera X bella*)	Shrub	Alien
Blackberry (*Rubus allegheniensis*)	Shrub	Native
Prickly ash (*Zanthoxylum americanum*)	Shrub	Native
Red osier dogwood (*Cornus stolonifera*)	Shrub	Native
High-bush cranberry (*Viburnum opulus*)	Shrub	Native
Black raspberry (*Rubus occidentalis*)	Shrub	Native
Elderberry (*Sambucus Canadensis*)	Shrub	Native
Chokecherry (*Prunus virginiana*)	Shrub	Native
Wild black currant (*Ribes americanum*)	Shrub	Native
Frost grape (*Vitis riparia*)	Vine	Native
Woodbine (*Parthenocissus quinquefolia*)	Vine	Native
Enchanter's nightshade (*Circaea lutetiana*)	Herb	Native
Stickseed (*Hackelia virginiana*)	Herb	Native
Bittersweet nightshade (*Solanum dulcamara*)	Herb	Alien
White snakeroot (*Eupatorium rugosum*)	Herb	Native
American pokeweed (*Phytolacca Americana*)	Herb	Native
Clearweed (*Pilea pumila*)	Herb	Native
Cleavers (*Galium aparine*)	Herb	Native
Jack-in-the-pulpit (*Arisaema triphyllum*)	Herb	Native
Beggar-ticks (*Bidens vulgatus*)	Herb	Native
Solomon's plume (*maianthemum racemosa*)	Herb	Native
Burdock (*Arctium minus*)	Herb	Alien
Wild strawberry (*Fragraria virginiana*)	Herb	Native
Wood anemone (*Anemona quinquefolia*)	Herb	Native
White vervain (*Verbana urticifolia*)	Herb	Native

Wild coffee (*Triosteum perfoliatum*)	Herb	Native
Jumpseed (*Polygonum virginianum*)	Herb	Native
White avens (*Geum canadense*)	Herb	Native
Wild geranium (*Geranium maculatum*)	Herb	Native
Bloodroot (*Sanguinaria Canadensis*)	Herb	Native
Wild ginger (*Asarum canadense*)	Herb	Native
Solomon's seal (*Polygonatum biflorum*)	Herb	Native
Lady fern (*Athyrium filix-femina*)	Fern	Native
Dandelion (*Taraxacum officinale*)	Herb	Alien
Blue grass (*Poa pratensis*)	Herb	Alien
Canada thistle (*Cirsium arvense*)	Herb	Alien

Wildlife Habitat Values of Woodland Park

Ecological Interactions with Neighboring Lands

The wildlife habitat value of the Park stems from vegetative composition and structure in the Park itself *and* from the presence of other natural areas adjacent to the Park. The fields, shrublands, woods and water of the open lands east of the park – those of the Aldo Leopold Nature Center and Edna Taylor Conservation Park – certainly host many populations of insects, birds and mammals, some of whom may partially meet their need for food, cover and space by utilizing the Park. Mammals such as deer, fox, coyotes, raccoons, opossums and skunks or birds such as hawks and owls could nest in one area and forage in the other. The proximity of Woodland Park to other open space lands probably enhances its wildlife habitat value very significantly.

The presence of Woodland Park probably enhances song bird diversity of surrounding neighborhoods since it offers more diversity of food sources and nesting cover than is found in a typical urban setting. Songbirds could use habitats inside and outside of the Park, possibly permitting the coexistence of a greater range of species. Nonetheless, the urban surroundings will probably limit the range of bird species that can inhabit the Park since aggressive birds that thrive in the city, like blue jays and European starlings, could displace less common birds that might otherwise inhabit open oak woods, like red-headed woodpeckers and eastern bluebirds (Ehrlich et al. 1988).

Use by Migratory Birds

Woodland Park could be an important stopover site for migratory songbirds during spring and fall migrations. Oak forests would be especially attractive to migrants since oak trees support relatively large numbers of foliage insects that many birds prey on (Ewert & Hamas 1996). The Park could be especially important to migrants in the spring when food sources can be scarce. Even birds that require large tracts of forest to breed could still make use of small tracts like Woodland Park for stopover sites during migration.

Some Key Habitat Components of the Park

1. Standing dead trees, fallen logs and decay cavities in large, old trees. Standing dead trees and decay cavities are used for nesting by many birds and mammals, like woodpeckers,

chickadees, raccoons, squirrels and bats. Standing dead trees and fallen logs are readily colonized by insects, which then become a food source for birds and mammals. Fallen logs provide nesting sites for small mammals and cover for salamanders, who seek the cool, moist conditions beneath them.

2. Mast-producing tree species. The acorns produced by oaks are a critical, high-energy food source for white-tailed deer, woodpeckers, squirrels and blue jays. The fleshy fruit produced by the black cherries are an important summer food source for birds. The large oaks will probably continue to produce acorns for many decades, but as the oaks die and are replaced by other species (or are not replaced at all), there will be fewer acorns for wildlife, possibly making winter survival more difficult for some animals. The abundance of black cherries and their fruit will probably increase in coming decades.

3. Layered vegetation. The layered forest vegetation in Natural Community 1, consisting of shrub, sapling, small tree and mature tree layers, creates a diversity of nesting and foraging niches for songbirds and can result in greater songbird diversity than a community with less structure. The presence of dense buckthorn colonies in Unit 1, however, may not benefit bird diversity; some researchers have found that birds nesting in buckthorn may be more vulnerable to predators (Schmidt & Whelen 1999).

III. Management Plan

Introduction

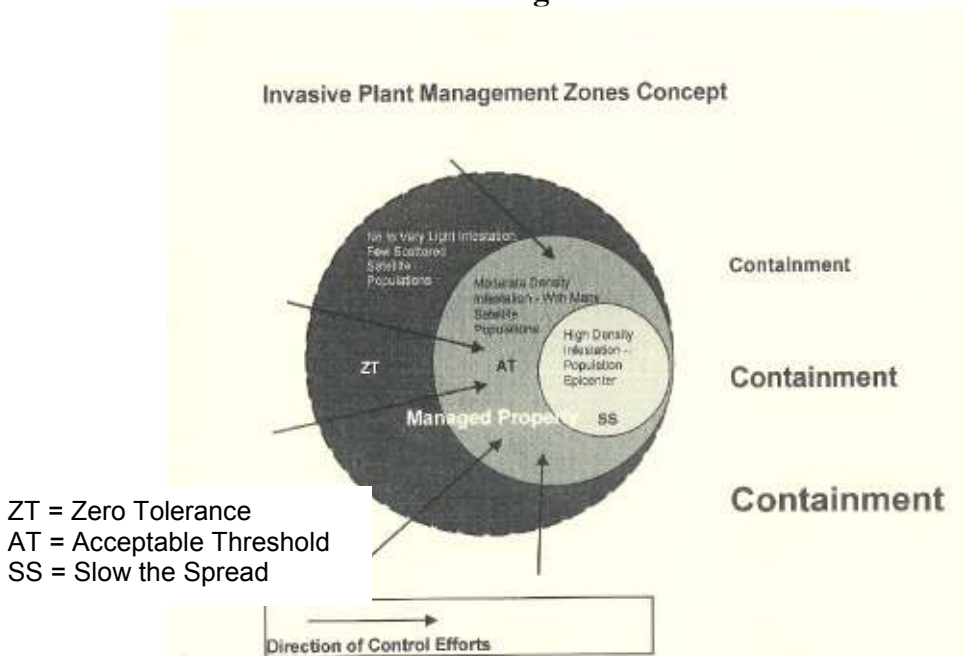
The management plan recommends actions focused on control of invasive exotic species and restoration of native plant communities. Management actions are based on goals and objectives which should have their foundation in the management philosophy adopted by the City. Several options are proposed for each community. Options specify a "target community". A target community is the natural community that ecological restoration attempts to re-create. It can be maintenance of the existing community or re-creation of one of the likely historic communities for the site, such as an oak savanna. Simply maintaining the existing community can still enhance biodiversity and ecosystem health if invasive species are controlled or if it is diversified with shrub and tree plantings. Options are presented in order of priority and simplicity.

The City is legally liable for impacts to State-listed threatened and endangered plant and animal species that may be present in the park (State Statute 29.604). Yellow Giant Hyssop, a threatened species, is likely to be present in the Park. The City should have a qualified consultant or volunteer search the woods for this plant in mid-summer when it flowers. In general, avoid harming this or other protected species by (1) only spraying herbicide during the dormant season, (2) hand-pulling invasives rather than spraying during summer (taking caution to avoid excessive soil disturbance), (3) only burning part of a site at one time (this protects invertebrates), and (4) only burning in spring and fall when most natives are dormant. Contact the DNR Bureau of Endangered Resources to learn more about how to mitigate the impact of management activities on protected species.

General Guidelines for Control of Invasive Plant Species

Figure 9 shows a conceptual model used by natural areas managers in Wisconsin to control invasives. This model depends on the completion of an inventory, such as been done in the preparation of this plan, so that the locations of both high-infestation areas (SS zone) and smaller satellite colonies (ZT and AT zones) of invasives are known. Management actions are dictated by which zone a site is in (see Appendix 2 for details). The invasive control strategy recommended in this plan relies on this model. For example, areas with very low numbers and scattered satellite colonies of an invasive plant, like garlic mustard, are Zero Tolerance zones (ZT) and should receive every form of control: (1) scouting and early detection, (2) sanitation of equipment and (3) education of park users to slow seed dispersal, (4) periodic mowing or burning and (5) hand-pulling or herbicide treatments to eradicate the undesirable plants. Areas with heavy infestations are Slow-the-Spread zones (SS) and should simply be contained or their areas shrunk by eradicating seedlings and mature plants around their margins. This model should be applied separately for each species of invasive plant since each has its own pattern of distribution in the park.

Figure 9.



Source: Wisconsin Department of Natural Resources, 2005 Urban Forest Workshop.

The most problematic invasive species noted were **buckthorn** and **garlic mustard**. **Honeysuckle** and **black locust** form dense colonies but are not likely to spread rapidly in the shady woodland environment; if the City creates more open habitat by pursuing futher oak savanna restoration, these species could increase in abundance and require more control. **Norway maple** has potential to become invasive; it should be monitored carefully. Do not confuse Norway maple with sugar maple (*Acer saccharum*), of which one large, seed-producing tree was noted in Natural Community 2 (Figure 6).

For **buckthorn**, most of Unit 1 of Natural Community 1 is a SS zones. Units 2 and 3 and Natural Communities 2 and 3 should be considered a ZT zones since buckthorn is either absent or present in small enough colonies to make eradication feasible.

For **garlic mustard**, most of Unit 1 of Natural Community 1 is a SS zones. Unit 2 could be ZT or AT depending on how much effort the City wishes to spend. Unit 3 and Natural Communities 2 and 3 should be ZT zones; these areas are largely free of garlic mustard thanks to past efforts of volunteers and contractors. However, new colonies will probably show up.

Black locust and **honeysuckle** colonies should be managed as SS zones unless you wish to destroy the existing colonies. Those areas can then be treated as ZT or AT zones depending on how much effort you wish to spend.

If young **Norway maples** are observed (you should verify the species of the young maples in Natural Community 2, Figure 6), the entire Park should be managed as an AT zone. Managing the Park as a ZT zone for this species would also be appropriate.

Volunteer Involvement

Adult and youth volunteers can perform most of the recommended management actions in this plan. Basic plant identification skills are needed for controlling invasive species. Volunteers must be able to identify invasive species in different growth stages, e.g. garlic mustard as both 1st year and 2nd year plants and buckthorn as both seedlings and shrubs. However, herbicide applications and prescribed burning should be done by trained professionals or very experienced and well-trained volunteers. The City should hire a qualified prescribed burn contractor to conduct burns until City staff or volunteers gain extensive training and experience. See "Resources" section for prescribed burn training opportunities.

The following activities can be done by adults and youth volunteers:

1. Hand-pull garlic mustard.
2. Torch 1st year garlic mustard plants.
3. Cut and pile brush (professional herbicide applicators will have to treat the cut stumps afterward).
4. Scout the Park for new colonies of invasive species - garlic mustard, buckthorn and Norway maple.
5. Shrub and tree planting, installing tree tubes and cages to protect seedlings from deer browse, mulching or cutting competing vegetation around seedlings.
6. Hand-scattering native seed.
7. Monitoring survival of planted shrubs and trees.
8. Monitoring for presence of native grasses and forbs following removal of invasive brush, canopy thinning or seeding.

Most herbicide labels specify that workers are not allowed to reenter an herbicide application site until after 4 to 12 hours. Nonetheless, adults and children participating in management activities may want to allow more time than this to minimize the chance of exposure to herbicides.

Monitoring

Monitoring will be necessary to learn whether management actions are achieving desired objectives. Two levels of monitoring are recommended:

1. "Walk through" monitoring. An ecologist or forester, or a trained volunteer, simply walks a site making observations and gathering subjective impressions. This approach should be used for scouting for new colonies of invasives, like garlic mustard, or for evaluating the response of understory vegetation to the removal of invasive brush or tree canopy reduction.

2. Sampling vegetation in fixed-area plots. This approach should be used for sampling the abundance of buckthorn and garlic mustard following control efforts in Natural Community 1 or for sampling native grass and herb cover following oak savanna/woodland restoration work anywhere in the Park. Place plots either randomly or systematically, but make sure some plots are located in all parts of the

site. The more plots you sample, the more accurate your estimates of plant cover will be.

Use circular 1/100th acre plots (11'10" radius) to sample shrubs or tree saplings. Plot boundaries can be established with a rope and plastic tent stakes. Determine arial cover of a species by projecting the outline of the plants' foliage, as viewed from above, onto the ground and estimating what percentage of the plot the projection area covers. Use circular 1/1,000th acre plots (3'6" radius) to sample herbs.

Establish permanent fixed-area plots to track changes in vegetation over time, following a management action, like buckthorn removal. Mark permanent plots with steel posts and brightly colored markers. Relocate them using a hand-held GPS receiver if necessary.

Management Priorities

There may be more management actions recommended than the City will have resources to complete in the near future. Consequently priority actions are enumerated below:

High Priority Actions		
Action	***Natural Community-Management Unit***	***Rational***
Continue spraying & burning to control garlic mustard. Conduct annual scouting for all invasives and do spot control of invasives as needed in subsequent years.	Natural Community 1-Units 2 & 3 Natural Community 2	Continue existing control program that has proven effective.
Kill locust re-sprouts & any other invasive species. Re-seed with native grasses and wildflowers *or* turf grasses.	Natural Community 3.	Prepare site for re-seeding of native species; improve aesthetics in a publicly visible location.
Install signs at trailheads informing public of efforts to control invasives and how to prevent their spread.	All trailheads.	Increase public awareness and reduce spread of garlic mustard by Park users.
Priority Actions		
Action	***Natural Community-Management Unit***	***Rational***
Plant oak seedlings and protect them from deer and rabbit browse until well-established.	Natural Community 1-Units 1, 2 & 3. Natural Communities 2 & 3.	Regenerate the oak savanna/woodland tree canopy as mature trees die.

Control buckthorn and garlic mustard.	Natural Community 1-Unit 1.	Restore native biodiversity to understory vegetation.
Kill remaining black locust colonies.	Natural Community 1-Units 2 & 2. Natural Community 2.	Restore native biodiversity to understory vegetation.
Kill remaining honeysuckle colonies.	Natural Community 1-Units 1 & 2.	Restore native biodiversity to understory vegetation.
Release young hickories from competition; open-up crowns of mature white pines.	Natural Community 1	Promote the vigor and health of long-lived tree species that provide wildlife food and nesting cover.
Plant native fruit-bearing shrubs.	Native Community 1 (in former honeysuckle colonies)	Provide food and nesting cover for birds and mammals.

Natural Community 1: Oaks & Mixed Hardwoods

Acreage	Unit 1-5.5 acres; Unit 2-4 acres; Unit 3-2.5 acres
Topographic Position	Southeast (Unit 1) & Northwest-facing Hillsides (Units 2&3)
Slope Steepness	12-20% (Unit 1); 2-12% (Units 2&3)
Drainage	Well drained
Soil Texture	Silt loam
Soil Depth	Deep
Site Moisture Status	Dry-Mesic (all Units)

Option 1:

(*Target Community: Oaks & Mixed Hardwoods*)

Goal: Complete the eradication of garlic mustard and buckthorn in Units 2 and 3 and halt its further spread.

This option continues the control of garlic mustard and buckthorn that has already begun in Units 2 and 3, on the northwest slope. However it neglects control of the heavy garlic mustard and buckthorn infestations in Unit 1 and the honeysuckle and black locust colonies in Units 1 and 2. Under this option, Unit 1 could gradually become a buckthorn monotype as trees die and the heavy shade created by buckthorn inhibits tree seedling establishment. Garlic mustard in Unit 1 would also probably eventually out-compete most of the native herbaceous vegetation leading to a garlic mustard monotype in the herb layer.

Colonies of garlic mustard and buckthorn seedlings will probably reappear annually in Units 2 and 3 due to seeds stored in the soil and dispersal of seeds by humans and animals; annual spot-control of garlic mustard and any other invasive species will be probably be necessary indefinitely. Early detection and control will prevent new colonies from expanding and creating infestations that are expensive to control. You should also monitor for increasing abundance of Norway maple.

Many buckthorn seedlings covered the Native American mounds on the ridgetop (Figure 1). Before manipulating the vegetation on the mounds in any way, contact the Office of the State Archaeologist for advice (http://www.wisconsinhistory.org/archaeology/osa/).

Objectives:

- ✓ Garlic Mustard and buckthorn are completely absent from Units 2 and 3.

Actions:

1. Hand pull or spray with appropriate herbicide second-year garlic mustard and buckthorn seedlings in late fall, winter (only spray when warmer than 38 degrees), or early spring.
2. Kill the small first-year garlic mustard seedlings in late spring or early summer by burning them with a hand-held torch, conducting a prescribed burn over the entire unit or spraying with herbicide. Continue steps 1 and 2 annually until garlic mustard is completely eradicated.

3. Post signs at trailheads explaining control of invasives and discouraging off-trail walking so seeds of invasives have less chance being spread by shoes. Place boot brushes at trailheads to limit spread of seed of invasives, particularly garlic mustard, into or outside of the Park.

Monitoring:

- ✓ Conduct "walk through" inventories annually in fall or spring to find new garlic mustard, buckthorn and Norway maple colonies.

Option 2:

(*Target Community: Oaks & Mixed Hardwoods*)

Goal: Eradicate buckthorn and garlic mustard from throughout Natural Community 1.

This option extends the work being done in Units 2 and 3 to Unit 1, where it is also badly needed. Eradicating garlic mustard and buckthorn from Unit 1 will be time consuming and expensive. Successful buckthorn control requires killing of mature shrubs *and* killing seedlings released after shrub removal; this will require at least 2 growing seasons, if not more. Do not kill buckthorns from more area than you can afford to do follow-up treatments on or you might just release a new cohort of seedlings. Garlic mustard will likewise require several years of control as seed stored in the soil will continue to germinate.

Cut buckthorns can be piled and burned so debris does not interfere with subsequent management activities. Burn them when snow cover is present to reduce risk of a wildfire. Alternatively, brush piles may be left for wildlife cover (see Appendix 4 for brush pile building guidelines).

Consider killing the honeysuckle and black locust colonies while you are cutting and herbicide-treating the buckthorn. However, controlling these species should be a much lower priority than buckthorn and garlic mustard. Do outreach and education to the neighbors on the north property line before removing honeysuckle from this area. If desired, replace the honeysuckles along the property line with native fruit-bearing shrubs, like grey dogwood, red osier dogwood, high-cranberry, hazelnut, ninebark or nannyberry.

Objectives:

- ✓ Buckthorn shrubs are completely absent.
- ✓ Honeysuckle shrubs and black locust trees are completely absent.
- ✓ Garlic mustard and buckthorn seedlings are present in fewer than 5 percent of $1/100^{th}$ acre sample plots.

Actions:

1. Kill buckthorn and honeysuckle shrubs by cutting and herbiciding the cut stumps or by herbiciding the basal bark in fall or winter. Kill black locusts by girdling and applying herbicide to girdle-cut. Hand-pull or spray with appropriate herbicide

second-year garlic mustard in late fall, winter (only spray when warmer than 38 degrees), or early spring.
2. Return the following spring and foliar-treat buckthorn and honeysuckle seedlings and 1st year garlic mustard with herbicide, or conduct a prescribed burn to kill them.
3. Continue the cycle of foliar spraying and burning until the abundance of garlic mustard and buckthorn seedlings is sharply diminished.
4. Scout the site annually in fall or spring to locate and kill new colonies of buckthorn and garlic mustard.
5. Post trailhead signs and boot brushes as explained under Action 3, Option 1.

Monitoring:

- ✓ Using sample plots or "walk through" inventories, monitor annually in fall or spring for survival and spread of buckthorn, garlic mustard, honeysuckle and locust.

Option 3:

(*Target Community: Oak Savanna/Woodland*)

Goal: Open the forest canopy, retain mature oaks and re-establish diverse, native herbaceous vegetation.

This option requires opening the canopy by cutting the majority of non-oak trees and conducting regular prescribed burns. This lets enough sunlight to the ground to support a diversity of native grasses and wildflowers typical of oak communities. This is essentially the same approach as was already taken by volunteers in Natural Community 2. Control of garlic mustard and buckthorn, as per Options 1 and 2, should be substantially complete before you pursue this option. Planting red oak and white oak seedlings should be done so that there are young oaks available to replace mature ones as they die.

Opening the canopy does not guarantee that native vegetation will reemerge. Seeding may be required. You should wait until at least 3 years after opening the canopy and conducting prescribed burns to observe the species composition of the understory before you consider seeding to obtain native oak savanna vegetation.

Objectives:

- ✓ Canopy cover of mature trees is ≤ 80%.
- ✓ >90% of grass, forb and shrub cover is of native species, many of them grasses and wildflowers characteristic of oak woodlands and savannas.
- ✓ >80% of planted tree and shrub seedlings survive to become saplings (> 3 feet tall).

Actions:

1. Open up the forest canopy by killing all box elders, black locusts and the large majority of black cherries that are larger than 2 inches in diameter by girdling, basal bark treatment with appropriate herbicide, or cutting and herbiciding cut stumps. Use woody debris to create brush piles for wildlife cover or pile and burn it in the winter when snow cover is present (**Note:** brush piles for wildlife cover should be protected from fire; although this will increase the effort involved in prescribed burning.).

2. Conduct annual prescribed burns for three years to control undesirable small woody plants, e.g. honeysuckles, buckthorn, black locusts and box elder saplings. Thereafter, conduct burns on 3-5 year intervals.
3. If characteristic oak savanna grasses and wildflowers are not increasing in abundance after three years of prescribed burning, hand-broadcast seed of native oak savanna grasses and forbs in the late fall. Late fall broadcast seedings, or "frost seedings", are effective since the action of rainfall, melting snow and the freeze-thaw cycle embed the seed into the soil. If possible, use local genotype seed, collected from similar dry-mesic sites. Allow these plants to develop for 2 full growing seasons before burning again.
4. Plant as many as 100 white oak or red oak seedlings per acre. Obtain the largest bare-root seedlings available (usually 18 to 36 inches tall). Plant them in canopy openings and protect them from deer browse and competing vegetation until they are well established. Also protect seedlings from fire until they are well established.

Monitoring:

- ✓ Conduct "walk-through" inventories or use sample plots annually after canopy thinning (Action 1) to monitor for the presence of native grasses and wildflowers typical of oak woodlands and savannas.
- ✓ Monitor the survival of planted trees and shrubs annually for at least 3 years after planting.

Option 4:

(*Target Community: Mixed Hardwood Forest*)

Goal: Establish young trees and native shrubs.

Planting trees will regenerate the forest as existing mature trees continue to age and die. There are already many openings in the canopy that providing growing space for young trees. This option assumes that you have completed the bulk of garlic mustard and buckthorn control work described under Options 1 and 2. You could pursue this option in some parts of this community and not others; for example, encourage mixed hardwoods in Unit 1 and maintain an oak forest in Units 2 and 3. This would increase habitat diversity in the Park as a whole.

A mixed hardwood forest should *not* be managed with fire since many of the recommended tree species for planting – shagbark hickory, basswood, white ash, red maple, sugar maple and white pine – are sensitive to fire. Absence of fire allows planting of native shrubs that would add much biological and structural diversity to the woods – they provide bird nesting habitat and their fruit and buds serve as a wildlife food source. Shrubs should be planted in the sunniest areas.

Since you will not do prescribed burns under this option, you are limited to hand-pulling, spraying and flaming with a torch to control new colonies of invasives.

The emerald ash borer is a wood-boring beetle that kills all species of ash within 1 to 3 years of infestation. As of December of 2006, it has not been seen in Wisconsin but it has been observed in nearby parts of Illinois and will likely arrive to Wisconsin soon.

Due to the anticipated impact of this insect, no more than 10% of tree seedlings used for plantings should consist of ash species.

Objectives:

- ✓ >80% of planted tree and shrub seedlings survive to become saplings (> 3 feet tall).

Actions:

1. Plant as many as 200 tree seedlings per acre. Obtain the largest bare-root seedlings available (usually 18 to 36 inches tall). Plant them in canopy openings and protect them from deer browse and competing vegetation until they are well-established. Select tree species that tolerate partial shade: red oak, white oak, sugar maple, red maple, white ash, green ash, shagbark hickory, white pine or basswood.
2. Plant scattered clumps of native shrub seedlings like grey dogwood, red osier dogwood, high-cranberry, hazelnut, ninebark or nannyberry. Protect seedlings from deer browse and control competing vegetation until seedlings are well-established, in 3-5 years.

Monitoring:

- ✓ Monitor the survival of planted trees and shrubs annually for at least 3 years after planting.

Natural Community 2: Oak Woodland

Acreage	2.5 acres
Topographic Position	Northwest-facing Slope
Slope Steepness	2-12%
Drainage	Well drained
Soil Texture	Silt loam
Soil Depth	Deep
Site Moisture Status	Dry-Mesic

Option 1

(*Target Community: Oak Woodland*)

Goal: Halt the spread of garlic mustard, buckthorn and Norway maple; kill remaining black locusts.

This option continues the control of garlic mustard and buckthorn that has already been done by volunteers, and eradicates the small group of black locusts by Monona Drive and the locust saplings on the border with Natural Community 3(Figure 6).

Colonies of garlic mustard and buckthorn seedlings will probably reappear annually as a result of seeds in the soil and dispersal by humans and animals; annual spot-control of these and any other invasive species will be probably be necessary indefinitely. Early detection and control will prevent new colonies from expanding and creating infestations that are expensive to control.

In the spring, determine whether the maples near Monona Drive are Norway maples or sugar maples (Figure 6). If they are Norway maples, begin annual monitoring to find if their seedlings are increasing in abundance and require control.

Objectives:

- ✓ Garlic Mustard, buckthorn and black locust is completely absent from Natural Community 2.

Actions:

1. Hand pull or spray with appropriate herbicide second-year garlic mustard and buckthorn seedlings in late fall, winter (only spray when warmer than 38 degrees), or early spring.
2. Kill the small first-year garlic mustard seedlings in late spring or early summer by burning them with a hand-held torch or conducting a prescribed burn over the entire unit. Continue steps 1 and 2 annually to control new colonies until garlic mustard is completely eradicated.
3. Post signs at trailheads explaining control of invasives and discouraging off-trail walking so seed of invasives has less chance of being spread by shoes. Place boot brushes at trailheads to limit spread of seed of invasives, particularly garlic mustard, into or outside of the Park.

4. Kill black locust saplings by foliar spraying during full leaf-out (mid-summer). Kill black locusts > 4 inches in diameter by girdling; treat the girdle-cuts with appropriate herbicide.

Monitoring:

- ✓ Conduct "walk through" inventories of site annually in fall or spring to find garlic mustard and buckthorn colonies; visit site in early summer to find black locust and Norway maple seedlings and saplings.

Option 2:

(*Target Community: Oak Woodland*)

Goal: Establish young oaks and native grasses and wildflowers.

This option satisfies the need to replace mature oaks as they die and to increase herb layer diversity. Many of the large, dominant oaks were starting to decline and no young trees were available to replace them. Seedlings of white oaks or red oaks would be suited to this site. Plant a smaller number of shagbark hickories if you wish. Like acorns, hickory nuts are valuable food for wildlife, particularly squirrels. Planted tree seedlings must be protected from fire until they are well-established.

Volunteers killed invasives and conducted burns with the hope of restoring greater diversity to herb-layer flora. Before re-seeding with native herbaceous species, the City must determine whether satisfactory diversity has been achieved. Retain a qualified consultant or volunteer to evaluate the herb layer diversity before re-seeding by making at least three site visits during different times of the growing season.

Objectives:

- ✓ >90% of grass, forb and shrub cover is of native species, many of them grasses and wildflowers characteristic of oak savannas and woodlands.
- ✓ >80% of planted tree and shrub seedlings survive to become saplings (> 3 feet tall).

Actions:

1. If oak savanna grasses and wildflowers are not present in satisfactory numbers, hand-broadcast seed of native oak savanna grasses and forbs in the late fall. Late fall broadcast seedings, or "frost seedings", are effective since the action of rainfall, melting snow and the freeze-thaw cycle embed the seed into the soil. If possible, use local genotype seed, collected from similar dry-mesic sites. Allow these plants to develop for 2 full growing seasons before burning again.
2. Plant as many as 100 oak seedlings per acre. Obtain the largest bare-root seedlings available (usually 18 to 36 inches tall). Plant them in canopy openings and protect them from deer browse and competing vegetation until they are well established. Also protect seedlings from fire until well established.
3. Continue conducting prescribed burns at 3-5 year intervals.

Monitoring:

- ✓ Conduct "walk-through" inventories or use sample plots to monitor for the presence of native grasses and wildflowers typical of oak woodlands and savannas.
- ✓ Monitor the survival of planted trees and shrubs annually for at least 3 years after planting.

Option 3:

(*Target Community: Mixed Hardwood Forest*)

Goal: Establish young trees and native shrubs.

This option is a very different course than the one already taken in the Oak Woodland. It creates a shady, closed-canopy forest of fire-sensitive trees and shrubs. Hence, it is only desirable if you wish to end prescribed burning. However, it will still be important to control invasives and prescribed burns will no longer be an available tool if you chose this option. You will have to rely on herbicides, hand-pulling or spot-burning with a torch to kill new colonies of garlic mustard, buckthorn, Norway maple and black locust.

Objectives, actions and monitoring steps are identical to those of Option 3 for Natural Community 1.

Natural Community 3: Oak Savanna

Acreage	1.5 acres
Topographic Position	Nearly-Level Base of Slope
Slope Steepness	0-2%
Drainage	Well drained
Soil Texture	Silt loam
Soil Depth	Deep
Site Moisture Status	Dry-Mesic

Option 1:

(*Target Community: Oak Savanna with Native Grasses & Wildflowers*)

Goal: Control invasive species and establish native grasses and wildflowers and young oaks.

This option requires killing the surviving root systems of the black locusts that were already cut, together with any other invasives that may be present, followed by seeding the site with native grasses and wildflowers. Because the site had just been mowed before the field visit, invasive species could be present that were not observed. Moreover, the abundance of locust root sprouts and seedlings will not be known until you stop mowing and natural vegetation re-grows. You will have to reevaluate the site for the presence and abundance of invasives after cessation of mowing.

Establishing native grasses and wildflowers will take several years of spraying and mowing. Hence, this option is not a "quick fix" for improving the aesthetics of a very publicly visible area. However, once established, native wildflowers produce a multitude of colorful flowers from late spring until October; grasses add texture and color to the site starting mid-summer and lasting well into winter. Successful completion of this option could be extremely satisfying to your public.

If desired, plant 10 to 30 red oak or white oak seedlings or balled-and-burlapped trees per acre after the native grasses and wildflowers have become established to ensure the future presence of oaks on this site. If you plant trees, be sure to include some species in the wildflower mix that are tolerant of partial shade. You must protect the seedlings from fire until they are well-established.

Objectives:

- ✓ >90% of grass and forb cover is of native species typical of a dry-mesic oak savanna.
- ✓ >80% of planted tree seedlings survive to become saplings (> 3 feet tall).

Actions:

1. Stop mowing and allow vegetation to grow until late spring. Spray entire site with herbicide to completely kill existing vegetation. You may have to spot-spray locust re-sprouts with a different herbicide than is used for herbaceous plants. You should repeat this treatment two more time during the same growing season (e.g. again in mid-summer and early fall). Establish a cover crop, like annual rye, in early fall to

prevent erosion during the winter. You will probably need to do herbicide treatments for another year before seeding. Do not plant natives until you have successfully controlled existing vegetation, especially black locust, garlic mustard and buckthorn.

2. Broadcast or drill in seed of native grasses and wildflowers, preferably of local genotypes, in October or November of the final year of herbicide treatments. Or drill in seed the following spring, before July. If seed is broadcast in the spring, the soil must be dragged or tilled *very lightly* first, and then packed following seeding to ensure good seed-to-soil contact. This is not needed for late fall broadcast seedings, or "frost seedings", since the action of rainfall, melting snow and the freeze-thaw cycle embed the seed into the soil.
3. Mow weeds to a height of 6 inches in the planted area every 4-6 weeks during the *first* post-planting growing season. Mowing lower than 6 inches may result in harm to young, developing prairie plants. Spot-spray herbicide as needed to control any undesirable plants.
4. Mow, burn or spot-spray during the *second* post-planting growing season depending on conditions noted during monitoring.
5. Begin burning every 1-3 years starting the *third* post-planting growing season, if there is enough fuel. Spring burns will achieve better control of undesirable exotic species than fall burns.

Monitoring:

- ✓ Conduct "walk through" inventories 3 weeks after each herbicide treatment to evaluate the response of vegetation, especially invasive species like black locust, garlic mustard and buckthorn.
- ✓ Conduct "walk through" inventories or use sample plots to evaluate the establishment of prairie plants in the second post-planting growing season and the survival and spread of invasives.
- ✓ Monitor for fuel load (e.g. abundance of dead grasses) beginning in the third post-planting growing season to determine feasibility of prescribed burning.
- ✓ Monitor the survival of planted trees annually for at least 3 years after planting.

Option 2:

(*Target Community: Oak Savanna with Turf Grasses*)

Goal: Kill black locust root-sprouts and other invasives; re-seed with turf grasses.

This option is a relatively quick, low-maintenance and aesthetically acceptable alternative to both continued mowing, as the City is currently doing, and establishing native grasses and wildflowers. As with Option 1, you must stop mowing to be able to kill existing vegetation, particularly black locust root-sprouts, before you can seed the site with turf grasses.

The City has already planted a turf grass mix consisting of blue grass and perennial rye grass; however, this option recommends a "no-mow" seed mix, comprised primarily of slow-growing fescue grass varieties. This type of turf grass can be mowed only once or twice during the growing season, if at all. It provides an appearance intermediate between closely mowed turf grasses and relatively unkempt native vegetation. Unlike native grasses and

wildflowers, no-mow grass is not managed with fire. Do not bring in topsoil before seeding turf grass; it could contain seeds and rhizomes of undesirable species.

If desired, plant 10-30 oak seedlings or balled-and-burlapped trees to ensure the future presence of oaks in this area.

Objectives:

- ✓ >95% of plant cover is planted turf grass.
- ✓ >80% of planted tree seedlings survive to become saplings (> 3 feet tall).

Actions:

1. Follow Action 1 of Option 1.
2. Broadcast seed of desired turf grass mix following supplier's instructions.
3. Following successful establishment of turf, spot-spray any undesirable or invasive broad-leaved species that reemerge with a broad-leaved-specific herbicide.

Monitoring:

- ✓ Conduct "walk through" inventories following establishment of turf grasses to check for survival and spread of invasive species.
- ✓ Monitor the survival of planted trees annually for at least 3 years after planting.

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VII. Glossary

Biodiversity: The variety of organisms present in a community or habitat, in taxonomic and genetic terms.

Crown (of a tree): The volume of space occupied by the living branches and foliage of a tree.

Decay cavity: A hollow area in a tree trunk that formed as a result of wood-rotting fungi. It usually forms beneath a surface wound or a branch stub.

Dominance: The prevalence of a plant species, or group of plant species, in a community or habitat, which determines the character of the community or habitat.

Ecosystem: A natural community of plants and animals together with the physical environment they inhabit, functioning as an integrated whole.

Ecosystem Health: The condition of an ecosystem in which the biological and physical processes that comprise it are maintained within a "normal" range of variability.

Forb: A broad-leaved, herbaceous plant, i.e. not grass-like or woody.

Habitat: The dwelling place of a species or natural community that provides the conditions necessary for life.

Herb layer: Low-growing, non-woody vegetation, consisting of both broad leaved herbs and grasses.

Herptile: A reptile or an amphibian.

Invasive: Describes a plant or animal species with the habit of colonizing a community or habitat and displacing those species already present until it becomes dominant. Invasives are often non-native, i.e. **exotic**, and can dramatically reduce native biodiversity.

Local genotype: The genetic makeup of members of a species that reside in the same region.

Natural Community: All of the populations of species that share an ecosystem or a habitat.

Main canopy: The uppermost layer of vegetation, comprised of the dominant plant species.

Mast: Nuts and berries consumed by wildlife and considered crucial to their survival due to potentially high levels of fat, protein and carbohydrates.

Monotype: A site comprised of a single species, often an invasive species. Oftentimes it has displaced a more diverse plant community that previously existed on the site.

Regeneration: This refers to tree seedlings and saplings that are expected to replace canopy trees as they die or are harvested.

Suppression: The process by which one organism impedes the growth and development of another by consuming the bulk of vital resources, as when a fast growing trees shades and robs soil moisture from a neighboring slow-growing tree.

Top-Kill: The death of above-ground plant tissue, due to fire, herbivory or human removal, that leaves below-ground tissue, e.g. roots and rhizomes, alive and able to re-grow stems and foliage.

Understory: In a plant community, the space beneath the main canopy occupied by suppressed individuals or individuals of species inherently shorter than the dominant species. For example, the tree saplings, shrubs and forbs growing beneath mature forest trees.

VIII. Figures

Appendix 1: Resources

The Blue Mounds Area Project – A non-profit organization based in Mt. Horeb, WI. that promotes native biodiversity in southwestern Wisconsin.

Find their website here: *http://www.bluemounds.org/*

C.D. Besadny Conservation Grant Program – This program provides small grants for natural resource projects. Grants must be matched by cash or in-kind donations.

Learn more at the website of the Natural Resource Foundation of Wisconsin:
http://www.nrfwis.org/

Going Native: A Prairie Restoration Handbook for Minnesota Landowners – An *extremely* useful guide to planting a prairie published by the Minnesota Department of Natural Resources.

Find it here: *http://files.dnr.state.mn.us/assistance/backyard/prairierestoration/goingnative.pdf*

Graham-Martin Foundation – This organization makes gifts of native grass and wildflower seed to municipalities, homeowners, schools and non-profit organizations. Contact Agrecol Corporation for details: (608) 226-2544.

Invasive Plants Association of Wisconsin (IPAW) Website – This has much information about invasive plants and their control in Wisconsin. It also has a link to a List Serv that is frequented by many professional ecological restoration practitioners.

Find it here: *http://www.ipaw.org/*

Native Plant Nurseries and Restoration Consultants in Wisconsin – This DNR website has a current list of nurseries and consultants.

Find the website here: *http://www.dnr.state.wi.us/org/land/er/invasive/info/nurseries.htm#wisc*

Natural Resource Conservation Service (NRCS) landowner assistance programs – The Wildlife Habitat Incentives Program (WHIP) provides funds to landowners for habitat work. The Environmental Quality Incentives (EQIP) program provides funds for habitat work in some counties.

Find their websites here:
WHIP - *http://www.wi.nrcs.usda.gov/programs/whip.html*
EQIP - *http://www.wi.nrcs.usda.gov/programs/eqip.html*

The Nature Conservancy Invasive Species Initiative Website – This website contains a comprehensive manual to invasive species control techniques. It contains extensive information about herbicide use.

Find it here: *http://tncweeds.ucdavis.edu/handbook.html*

Partners for Fish and Wildlife Program – This US Fish and Wildlife program assists landowners with habitat restoration.

Find their website here: *http://www.fws.gov/midwest/WisconsinPartners/*

Pheasants Forever – This non-profit organization is dedicated to the protection and enhancement of pheasant and other wildlife populations. They plant prairies and conduct prescribed burns for private landowners.

Find their website here: *http://www.pheasantsforever.org/index.php*

The Prairie Enthusiasts – This non-profit organization is dedicated to the management and protection of native prairies and savannas. One of their goals is to assist public agencies in prairie and savanna restoration.

Find their website here: *http://www.theprairieenthusiasts.org/*

A Prairie Primer – a UW Extension publication that discusses the ecology of native prairies and provides prairie planting instructions.

Find it here: *http://cecommerce.uwex.edu/pdfs/G2736.PDF*

Wisconsin Prescribed Fire Council – An organization dedicated to promoting the wise use of prescribed fire. They provide training opportunities.

Find their website here: *http://prescribedfire.org/*

Wisconsin State Herbarium – A museum of dried, labeled plants. It has the world's largest collection of Wisconsin's plants. The herbarium website is an excellent source of information about the life history and ecology of plants found in Wisconsin.

Find their website here: *http://www.botany.wisc.edu/herbarium/*

Wisconsin State Nursery Program – The state nurseries raise seedlings of trees and shrubs for distribution to landowners as bare-root seedlings.

Find their website here: *http://www.dnr.state.wi.us/org/land/forestry/Nursery/*

Wisconsin Urban Forestry Grant Program – Provides 50% cost-sharing of approved costs up to $25,000 annually for urban forest and natural area inventory, planning and management.

Find the website here: *http://dnr.wi.gov/org/land/Forestry/UF/grants/index.htm*

Wisconsin Woodland Owners Association – An organization that organizes educational workshops for the benefit of woodland owners. Topics like control of invasives, tree planting and sustainable timber management are discussed.

Find the website here: *http://www.wisconsinwoodlands.org/*

The Woodland School – They offer a wide range of day-long classes for landowners and public land managers related to stewardship of natural areas. Classes include topics like plant identification, chainsaw safety and prescribed burning.

Find the website here: *http://www.thewoodlandschool.org/*

Appendix 2: Invasives Control Guidelines

Appendix 3: Map of Presettlement Vegetation

Appendix 4: Fact Sheets