

LAKESHORE NATURE PRESERVE MANAGEMENT DRAFT REPORT
FOR
WILLOW CREEK WOODS MANAGEMENT UNIT 2

Prepared for Lakeshore Nature Preserve

By

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2/23/09 (v2)

Statement of Purpose:

This document outlines a plan for the management of Willow Creek Woods, Unit 2 (Figure 1). At the site scale Willow Creek Woods adds variety to the plant community matrix along the Lakeshore Path, while at a larger scale Willow Creek Woods contributes to the diversity of natural communities within the Lakeshore Nature Preserve. In this report, existing conditions are reviewed, management constraints outlined, and management options identified. Adaptive management frames these proposed Willow Creek Woods restoration activities to provide insight into site dynamics and to generate useful information applicable to future projects.

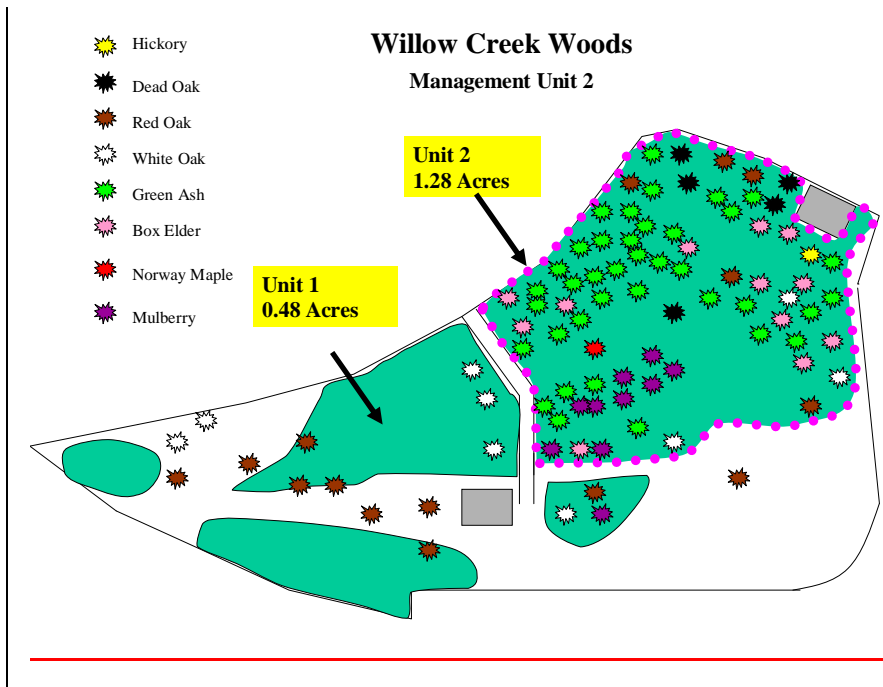


Figure 1. Management Units associated with Willow Creek Woods

Goals for a Management Plan:

Our primary goal is to restore and manage Willow Creek Woods as an aesthetically pleasing assemblage of oaks and compatible herbaceous, graminoid (grass and sedge), and woody plant species that structurally resembles oak savanna. We further seek to restore ecosystem structure, function and service (SFS) and community composition following the guiding principles outlined in the Master Plan and working within the limits imposed by archaeological conditions and proximity to intensively used university facilities. Willow Creek Woods provides ecosystem services associated with nutrient retention & cycling, soil stabilization, water infiltration, archeological preservation, historic community configuration, open woodland avian habitat and views of University Bay and surrounding campus natural areas. Consistent with these goals the plan proposes completing the following activities during the period 2009-2012:

- 1) Reduce/remove undesirable woody species;
- 2) Introduce/plant desirable species to increase functional diversity;
- 3) Retain and protect existing oaks and other desirable woody and herbaceous species;
- 4) Install a native deciduous shrub screen that will mitigate any visual impacts associated with nearby buildings;
- 5) Establish a long-term maintenance regime that maintains ecosystem SFS and community structure.

In summary, our long-term goals are to create an aesthetically pleasing open woodland-savanna landscape that preserves soil resources, protects and highlights unique cultural attributes, and is consistent with the Lakeshore Nature Preserve Master Plan.

Proposed Use Policy

1. Willow Creek Woods will offer a passive educational experience for Lakeshore Path visitors while highlighting and protecting associated archeological features.
2. Willow Creek Woods will provide visitors an aesthetically pleasing view and a quiet green space to observe University Bay. Students, faculty, staff and visitors use Willow Creek Woods for wildlife viewing, respite and renewal.
3. Seasonal maintenance required at Willow Creek Woods should not create unusual or exceptional management obligations for Lakeshore Preserve staff.
4. No structures other than for seating and interpretation will be introduced to the site.

Objectives

Our principal objectives during 2009-2012 are to manage Willow Creek Woods so that:

1. Greater than 90% of species in the canopy, understory, and ground layer are desirable native species.
2. Canopy cover for the entire site is less than 50%, but varies between specific locations from 0% to 100% and is predominantly provided by *Quercus* and *Carya* species.
3. Ground-layer vegetation covers greater than 90% of soils
4. Precipitation is infiltrated onsite reducing run-off potential by nearly 100%

Project Overview

Willow Creek Woods is approximately 3.11 acres in size; Unit 2 is approximately 1.28 acres in size. The most significant features associated with Willow Creek Woods are the archeological attributes. The Wisconsin Historical Society's "Archeological Site Inventory" has identified Willow Creek Woods as an ancient seasonal settlement site and a "Catalogued Burial Site". This latter designation triggers statutory requirements that constrain site preparation and management activities. The following guidelines are designed to protect archeological features:

- Fire and foliar herbicide applications are not desirable restoration tools for this site.
- Stump herbicide treatments are localized and acceptable.
- Soil compaction and disturbance are to be avoided as much as possible. Using tractors and other heavy machinery for site preparation and maintenance is unacceptable unless the ground is frozen sufficiently to prevent damage.
- Planting small plants and light raking is acceptable.
- Use of a weed wrench is acceptable.
- Tree or shrub planting will occur in shallow holes that require minimal disturbance to the soil profile, so as to avoid disturbance to the archaeological resource.
- Stump grinding is acceptable but care is required not to disturb adjacent soil.
- Persistent presence of stumps is aesthetically acceptable.

Project Overview

The most pressing threat to Willow Creek Woods is erosion due to exposed soils. This results from a lack of ground layer vegetation which was eliminated by intense shade, resource competition and possible allelopathic effects, all the result of recent invasion/regeneration by undesirable tree and shrub species. Restoration activities to protect archeological features need to focus on re-establishing ground layer vegetation. This will be accomplished by eliminating undesirable woody species to reduce shade intensity, resource competition and potential allelopathic effects that hinder ground layer establishment.

The first step in restoration of Willow Creek Woods Unit 2 is removal of undesirable understory and canopy species. The second step establishes a functionally diverse ground layer vegetation community. The third step establishes a long term maintenance regime that maintains desired functional diversity. This will provide desirable ecosystem SFS and community composition.

Current Status of Willow Creek Woods

The current site is negatively impacted by undesirable understory and canopy species. Canopy release to protect a small number of desirable oak and hickory trees occurred in 2006. Concern now shifts to the bare soils that dominate Unit 2. Species richness analysis conducted here in the summer of 2007 identified only 17 plant species including trees, shrubs, herbs and grasses; ground layer vegetation is dominated by 3 plant species. Bare earth (exposed soils) comprised 60% of ground surface area. Weathering and erosion has eliminated the "O" (organic) horizon from the soil substrate. In summary, biodiversity of Willow Creek Woods has decreased from a potential maximum of 232 species¹ to just 17 species, soils are bare and eroding, and desirable ecosystem SFS and community composition are lacking.

The following figures provide descriptions of current vegetation associated with Unit 2. Figure 2 summarizes the tree species and diameters in centimeters at breast height (dbh). Figure 3 describes ground layer vegetation. Figure 4 enumerates the actual number of tree species on site.

¹ Curtis, J. 1959. The Vegetation of Wisconsin. University of Wisconsin Press

Tree Species Numbers / DBH

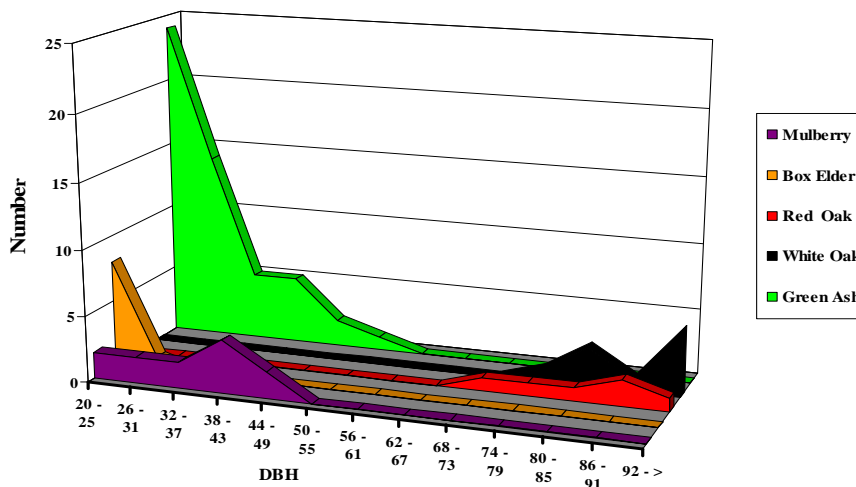


Figure 2. Number of Tree by Species (Y-Axis) and Diameter at Breast Height (DBH) in cm (X-axis).

Ground Layer Vegetation

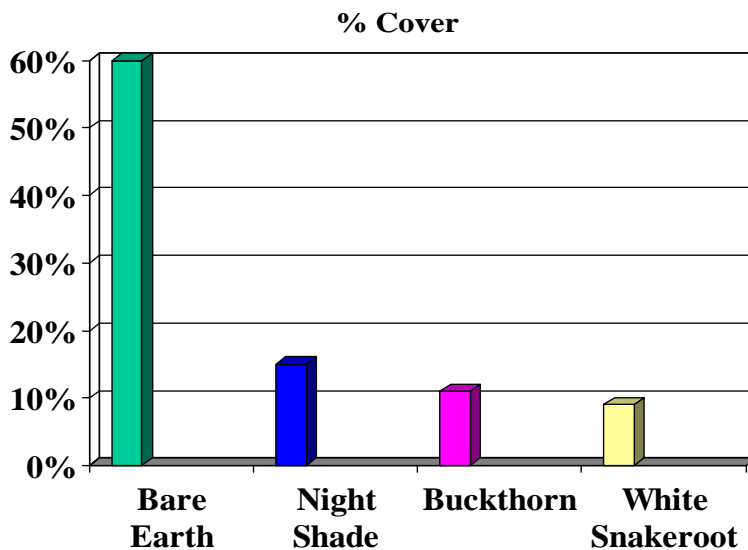


Figure 3. Ground Layer Vegetation by Percent Cover

Tree Species / Numbers

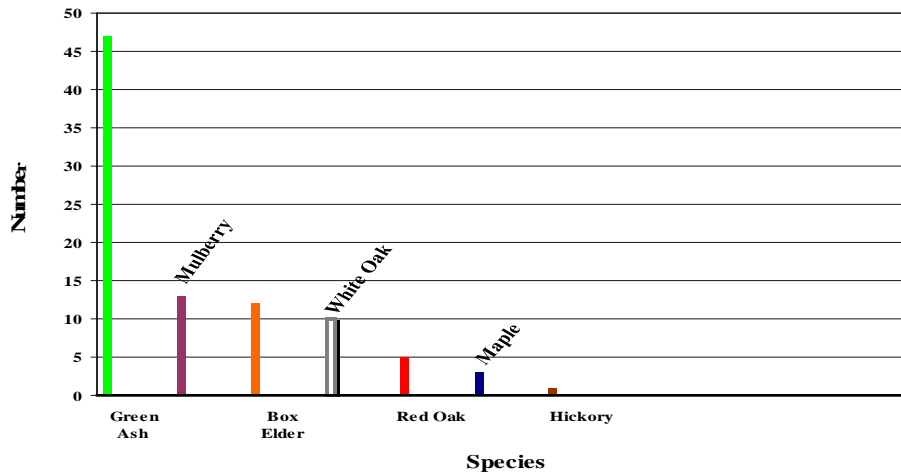


Figure 4. Number of Trees by Species

ACTIVITIES

Removal of all undesirable woody species in one single operation is considered esthetically undesirable as it will result in a “clear cut” appearance that may distress visitors and reduce support for the Preserve. Additionally, removal of debris and standing biomass could exhaust gift funding. We are proposing a strategy that will help reduce costs and avoid abrupt landscape change. Completion to a desirable and sustainable condition is dependent on labor costs.

The proposal is to remove undesirable species over a 3-year period, compatible with labor availability and finances. Year one removes undesirable understory woody species, allowing some sunlight to reestablish ground layer vegetation. Year two removes 50% of existing undesirable tree species, creating an open woodland condition. Year three removes additional undesirable tree species dependent on public perception, finances and achievement of ecological objectives. Removals will occur during winter months to minimize soil disturbance. Cut stumps will be treated with a glyphosate herbicide at rates equivalent to 25% active ingredient. The bulk of the biomass from cut trees and shrubs will be removed from site to reduce visual impacts and minimize unnecessary nutrient inputs from decaying biomass. Short term maintenance during the establishment phase will consist of three annual mowing and weeding procedures to combat undesirable species re-invasion. The site is to be

seeded several times with a savanna seed mix in order to achieve adequate ground cover. When conditions are appropriate for seeding, exposed soils will be lightly raked to create a friable seed bed; disturbance of soil is not to exceed ¼ inch. Except for some logs left for biological enhancement, excess detritus will be raked and removed in order to facilitate seed germination and reduce excess nutrient inputs. The site is to be seeded with a multiple-species savanna seed mix designed to rapidly stabilize soils and provide a durable vegetation matrix for subsequent management procedures. Seeding is to be supplemented by wildflower, fern, shrub, and tree plantings. Appendix 1 lists appropriate species and ratios of species to be included in a desirable seed mix. Adaptive management plots will be established and are left unseeded to monitor potential regeneration from existing seed-banks. The following outlines a chronological sequence to achieve management goals and objectives.

Year 1 (2009): Undesirable understory species (stems < than 5" dbh) and hazard trees are removed. Site appears as an open woodland, allowing gradual transition to conditions suitable for ground-layer establishment to satisfy objective 3. Removal occurs during winter to avoid soil disturbance. Woody material is hauled off site. Some woody debris not in conflict with maintenance mowings is left in place. Exposed soils are lightly raked and seeded with a savanna mix (Appendix 1). Adaptive management plots to monitor seed bank potentials are established. Site is mowed and weeded three times during summer 2009. Leaf litter is mulched with mowers or removed from site. Strategic weeding occurs in May, June, and July to prevent seed production and dispersal of undesirable species. Additional seed application occurs in fall.

Year 2 (2010): Establish open canopy structure by strategically removing 50% of the undesirable canopy trees. Tree removal will increase ground level light conditions around existing oaks and hickories to facilitate establishment of plant species requiring increased light. The removals will result in woody plant density being reduced 50% in as uniform a manner as possible. Removal occurs under frozen ground conditions that will avoid soil disturbance. Woody material is hauled off site. Some woody debris not in conflict with maintenance mowings is left in place. The primary objective remains soil stabilization. Eroding soils are immediately stabilized by seeding or erosion control mats. Entire site is fall seeded with a savanna seed mix. Adaptive management plots are monitored for soil erosion, seed bank and undesirable species recruitment. The site is mowed and weeded three times during summer 2010. Additional oak-hickory plantings are installed while respecting archaeology limitations. A native deciduous shrub screen is installed to mitigate visual impacts associated with nearby buildings.

Year 3 (2011): Additional undesirable tree species are removed. Third-year removals are dependent on accomplishment of ecological outcomes as determined by site conditions and public perceptions of vegetation change. Unit 2 is monitored for soil erosion and desirable and undesirable species recruitment. Eroding soils continue to be

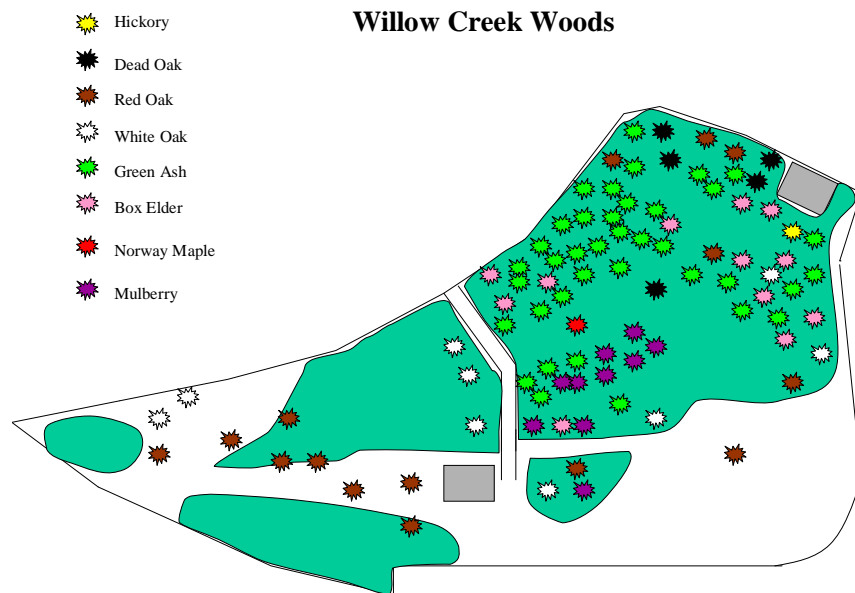
stabilized via seeding or erosion control mats. Entire site is fall seeded with a savanna seed mix. Seeding is to be supplemented by wildflower and fern plantings. Entire site including the adaptive management plots continue to be monitored for soil erosion, seed bank response, and undesirable species recruitment. Entire unit is mowed and weeded three times during summer 2011. Oak-hickory and shrub screen plantings are monitored and when necessary enhanced.

Adaptive Management Plots: Adaptive management plots will assess potential for recruitment from seed banks while aiding the monitoring of impacts of any site preparation procedures. The site will be divided into two treatments. One treatment will include light soil preparation (hand raking) and seeding. The other treatment will involve no raking or seeding. The sites will be monitored for recruitment and erosion.

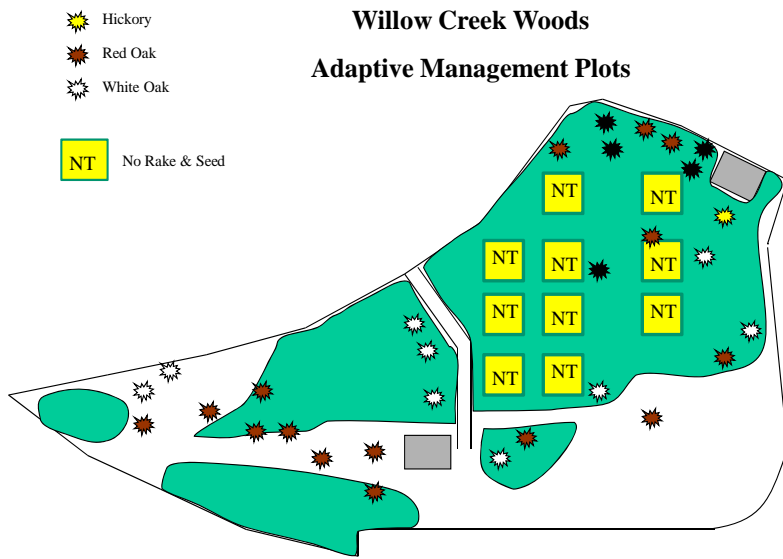
Long Term Management: Ecosystem (SFS) and community composition is ultimately achieved by long term management. A comprehensive strategic management plan maintains desired functional groups which in turn provide desired ecosystem services. Several abiotic and biotic factors maintained historic savanna SFS and configuration including drought, wet periods, cold winters, fire and grazing. One question for Willow Creek Woods managers is how to maintain desired ecosystem SFS and community configuration without fire and grazing. In addition, climate change predictions suggest that cool season periodicity may increase by 14 -21 days with a doubling of reactive nitrogen inputs. Lack of fire and grazing, increased cool season periodicity and increased available nitrogen could facilitate the return of buckthorn, green ash, and box elder without continued maintenance.

A strategic long-term management regime maintains desired functional diversity, suppresses undesirable species, and reduces the potential for excess nitrogen inputs. Fire and grazing can be replaced by a strategic mowing regime that maintains desired ecosystem SFS and community configuration and suppresses undesirable species. A robust cool season plant community maintained by mowing will offer invasion resistance through resource competition. Finally, occasional biomass removal, i.e. haying, for feedstock utilization will reduce potentially excessive nitrogen levels which in turn will help suppress undesirable species invasion. Strategic mowing can support a complex functionally diverse desirable plant community.

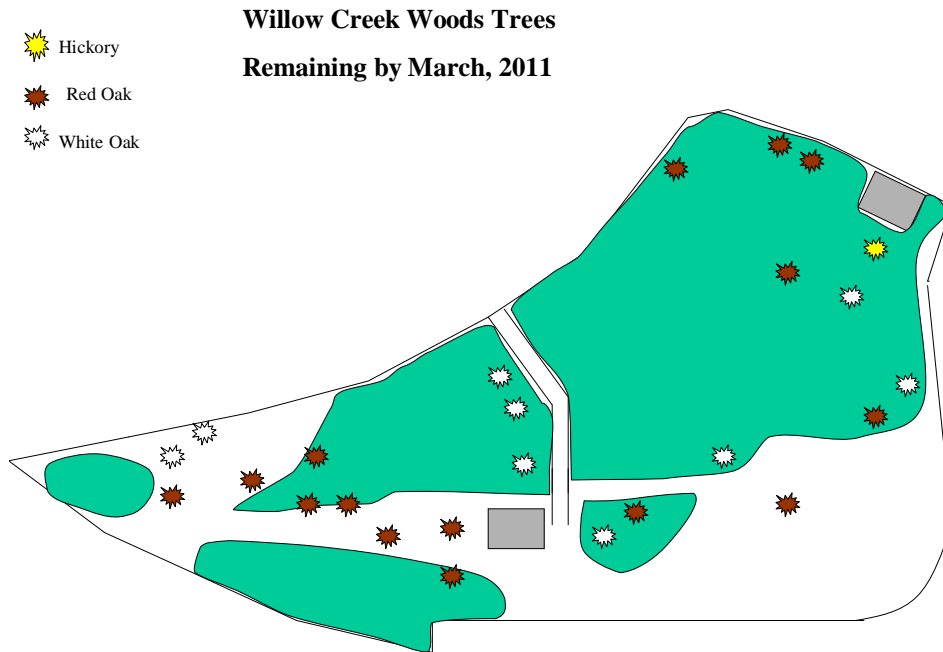
Willow Creek Woods Unit 2



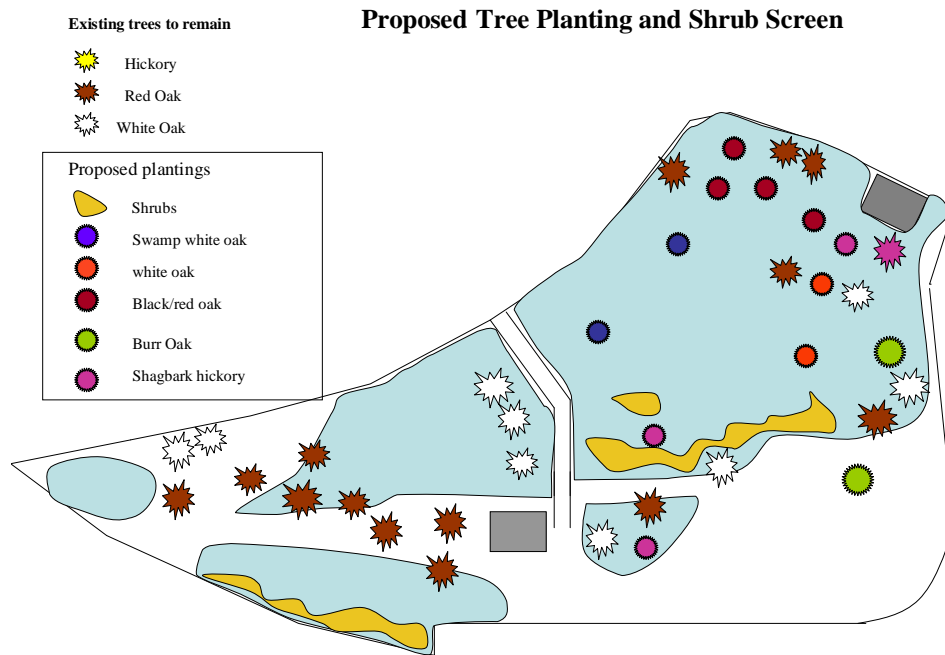
1. 2008 Woodland Configuration showing location of large trees



2. Location of adaptive management plots.



3. 2011 configuration following removal of all undesirable trees.



4. Plan for eventual planting of new trees and shrubs

Summary: Through strategic removal of undesirable species, re-establishment of desirable species, and establishment of a long-term maintenance regime, desirable ecosystem structure and function and service and community configuration can be restored and maintained in Willow Creek Woods management Unit 2. Long term monitoring coupled to adaptive management techniques will guide restoration procedures and help elucidate trends and patterns of vegetation response applicable to additional Lakeshore Nature Preserve projects.

Appendix 1: Plant Species List for Willow Creek Woods

The following list represents species suitable and available for Willow Creek Woods.

Price \$930.00 for a one-time installation procedure. However, we will plant less seed pre-season but over several seasons. Therefore the above price is an estimate. The actual price for three seed installments will cost approximately \$1,300.00

Oz 225.

Forb Oz = 42

Graminiod Oz = 185

Genus Species	Common Name	Seeds/Oz	Cost/Oz	Order/1 oz	Plants
Anemone canadensis	Canada anemone	8,000	15	1	
Anemone cylindrica	thimbleweed	26,000	60	1	
Anemone virginiana	tall Thimbleweed	28,000	40	1	
Antennaria plantaginifolia	pussytoes	275,000	200	0.25	
Aquilegia canadensis	columbine	3,800	50	1	
Aster azureus	sky Blue Aster	80,000	15	0.5	
Aster ericoides	heath Aster	200,000	100	0.25	
Aster laevis	smooth Aster	55,000	15	0.5	
Aster lateriflorus	calico Aster	250,000	40	0.25	
Aster novae-angliae	New England Aster	66,000	10	0.5	
Aster sagittifolius	arrow-leaf Aster	135,000	8	0.25	
Aster shortii	shorts aster	60,000	50	0.25	
Baptisia leucantha	white Wild Indigo	1,700	8	1	
Campanula americana	tall Bell Flower	170,000	25	0.25	
Coreopsis palmata	stiff tickseed	10,000	15	2	
Desmodium canadense	showy ticktrefoil	5,500	5	1	

Genus Species	Common name	Seeds/Oz	\$/Oz	Order/Oz	Plants
Desmodium glutinosum	Pointedleaf ticktrefoil	840	40	1	
Echinacea pallida	Pale coneflower	5,200	5	3	
Eryngium yuccifolium	Rattle snake master	7,500	6	2	
Eupatorium purpureum	Sweet joe pye weed	42,000	15	1	
Euphorbia corollata	Flowering spurge	8,000	60	0.1	
Fragaria virginiana	Virginia strawberry	0	0		
Galium boreale	Norhtern bedstraw	70,000	40	1.25	10 plants/\$30.00
Gentiana andrewsii	Bottle gentian	280,000	30	0.5	
Gentiana flavida	Cream gentian	140,000	5	2	
Geranium maculatum	Wild geranium	5,000	80	1	
Geum aleppicum	Yellow avens	20,000	20	0.5	
Helianthus strumosus	Woodland sunflower	4,200	40	1	
Heliopsis helianthoides	Smooth oxeye	63,000	2	1	
Impatiens pallida	Pale touch-me-not	1,600	30	0.5	
Isopyrum biternatum	False rue anemone	11,000	0		
Monarda fistulosa	Wild bergamot	70,000	8	1	72 plants / 20 colonies
Petalostemun candidu.	White prairie clover	19,000	2	2	
Petalostemun purpurea	Purple prairie clover	15,000	4	2	
Phlox divaricata	Woodland phlox	12,500	0		
Phryma leptostachya	Lopseed	22,000	15	0.5	72 plants / 3-5 groupings
Polemonium reptans	Jacobs ladder	18,000	80	0.25	
Polygonatum biflorum	Solomon's seal	800	20	1	Fire Dependent
Polygonum virginianum	Wood Knotweed	3,500	20	1	
Prenanthes alba	Rattlesnake root	18,000	40	0.25	
Ratibida pinnata	Prairie coneflower	30,000	3	2	
Rudbeckia hirta	Black-eyed Susan	92,000	3	1	
Rudbeckia laciniata	Golden glow	14,000	15	0.5	
Rudbeckia triloba	Brown-eyed Susan	34,000	3	3	
Silphium integrifolium	Rosinweed	1,200	8	1	
Silphium laciniatum	Compass plant	660	6	1	
Silphium perfoliatum	Cup plant	1,400	6	1	
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Silphium terebinthinace.	Prairie dock	1,000	20	1	
Sisyrinchium campestre	Prairie blue-eyed	45,000	60		
Smilacina racemosa	Solomon's Plume	400	15	1	72 plants
Solidago flexicaulis	Zigzag goldenrod	84,000	100	0.1	
Solidago rigida	Stiff Goldenrod	41,000	4	1	
Solidago speciosa	Showy goldenrod	95,000	20	1	
Thalictrum dioicum	Early meadow-rue	7,300	30	1	
Tradescantia ohiensis	Spiderwort	8,000	20	1	
Veronicastrum virginicum	Culver's root	800,000	25	0.25	
Zizia aurea	Golden Alexander	11,000	6	2	
Shrubs					
Ceanothus americanus	New Jersey tea	7600	50		32 plants
Physocarpus opulifolius	Prairie nine bark	34000	6		32 plants

Genus Species	Common Name	Seeds/Oz	\$/Oz	Order/Oz	Plants
Gramminioids		Gramminioids			
Agropyron trachycaulum	Slender wheat grass	6900	2	8	
Agrostis alba	Red top			8	
Andropogon gerardii	Big bluestem	10000	2	4	
Andropogon scoparius	Little bluestem	15000	2	16	
Bouteloua curtipendula	Sideoats grama	6000	2	8	
Bromus kalmii	Prairie brome	8000	2	8	
Bromus purgans	Wood chess	7600	15	4	
Calamagrostis canadensis	Bluejoint grass	280000	60	0.25	
Carex bicknellii	Bicknell's sedge	17000	20	0.25	
Carex crinita	fringed sedge	23000	20	0.25	
Carex rosea	Rose wood sedge	84000	12	1	
Carex sprengeii	Sprengel's sedge	10000	30	0.5	
Elymus canadensis	Canada wildrye	5200	2	8	
Elymus villosus	Silky wildrye	5500	8	8	
Elymus virginicus	Virginia wildrye	4200	2	4	
Eragrostis spectabilis	Purple lovegrass	280000	50	0.25	
Festuca rubra	Red fescue			128	
Festuca obtuse	Nodding fescue	20000	40	4	
Hystrix patula	Bottlebrush grass	7600	15	4	on site collection
Muhlenbergia racemosa	Marsh muhly	80000	5	5	on site collection
Panicum virgatum	Switch grass	14000	2	4	
Poa compressa	Canada blue grass			4	
Poa pratensis	Kentucky blue grass			32	
Sorghastrum nutans	Indiangrass	12000	2	8	
Sporobolus heterolepis	Northern dropseed	16000	20	2	
Stipa spartea	Porcupine grass	680	8	2	