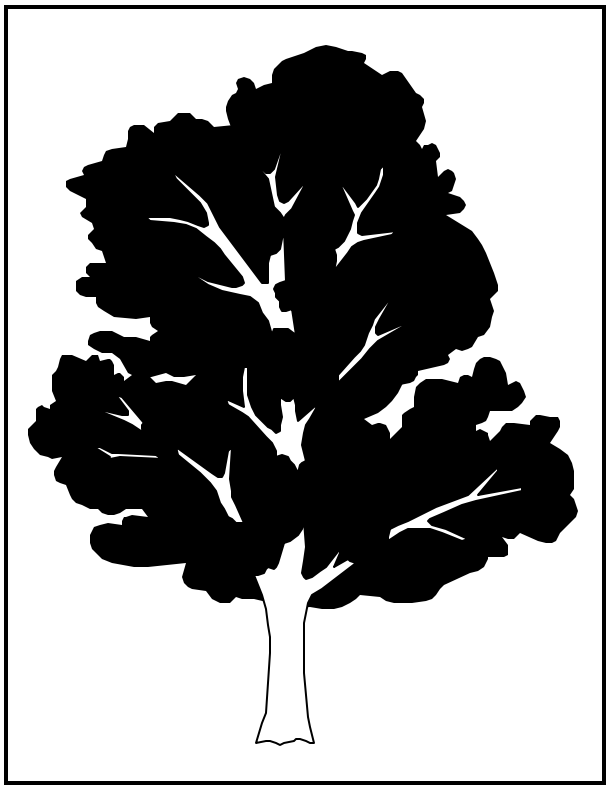
Rush Oak Openings Unit Management Plan



July 13, 1998

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Acknowledgments

This plan could not have been completed without the help and input from many groups and individuals. I would like to personally thank the following for their assistance:

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Gretchen Helfinstine	DEC Bureau of Public Forest Resources
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Kenneth Johnson	Conservation Research Institute
Timothy & Joan Kelley	Adjoining landowners
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Introduction

Rush Oak Openings, located in southern Monroe County contains a globally rare plant community commonly referred to as an "oak opening" or "oak savannah". This site is the only known intact oak opening remaining in New York State. Oak Openings were very common in the Midwest (where the prairie met eastern forests) prior to European settlement. Rush Oak Openings is the easternmost remaining oak opening.

Oak openings are composed of native prairie grasses and associated plants usually surrounded by oak/hickory forests. Characteristic species are Indian grass, a.k.a. buffalo grass (Sorghastrum nutans), little bluestem grass (Schizachyrium scoparium), thimbleweed (Anemone cylindracea), butterfly-weed (Asclepias tuberosa), wild bergamot (Monarda fistulosa), chinquapin oak (Quercus muhlenbergii) and other oaks (Quercus spp.), and hickories (Carya spp.). The woods buffalo[7] (Bison bison var. athabascae), now extirpated from the United States, was once a prominent mammal habituating oak openings. Elk[8] (Cervus canadensis) were also a feature of Oak Opening communities. The mix of forest and grassland provided a habitat similar to areas in the Rocky mountain regions.

Oak Openings are maintained by periodic burning. Historically, fires were set by Native Americans or caused by lightning strikes. Oak Openings can be variable in size, from just an acre to several thousand acre complexes.

Pioneer accounts include descriptions such as:"[Oak] Openings about Bloomfield so clear of trees and bushes, that in many places deer could be seen from half to three quarters of a mile off." [4] "The oaks forming open thin groves, or being present as scattered clumps or individuals, with the ground being occupied by grasses and other herbaceous vegetation." "A short distance to the west [of Toledo, Ohio] were hills of sand upon which only oak trees grew, and so sparse were the trees (that) a wagon could be driven in any direction through the patches of forest without need of hewing a path."[6]. "Goioguen [Cayuga Co.] is the fairest country that I have seen in America. It is a tract situated between two lakes, and not exceeding four leagues in width, consisting of almost uninterrupted plains, the woods bordering which are extremely beautiful." [4]

The site at Rush also contains an area of limestone woodland, which has unusual geological features, and two plant species which are rare in New York, goose foot corn salad (Valerianella chenopodifolia) and Nebraska sedge (Carex jamesii).

Although this unit management plan is specific only to state land, it is our intent to encourage and support adjoining owners in the stewardship of their properties.

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Unit Information

A. Property location:

The DEC owns 228 acres in the township of Rush, Monroe Co., The property is divided into two areas. The east area with road frontage on Honeoye Falls- 5 Points Rd.. is known as the Quinn Tract. The west area with road frontage on West Henrietta Rd.. (U.S. Rt. 15) is known as the Goff Tract.

B. Historical Perspectives:

Prior to European settlement, Oak Openings were quite common throughout the Midwest states extending eastward into western N.Y., and Ontario , Canada. Local historical accounts indicate Oak Openings were found throughout the length of Genesee Valley, Irondequoit Creek drainage, plus Victor, Perinton, East Rochester, Chili, Wheatland, Mendon, LeRoy, Bloomfield and Honeoye Falls. Other areas of the Southern Tier may also have contained "Prairie" like communities. It is likely the "Wadsworth Oaks", listed in the NYS Historic Tree Registry, were at one time part of an Oak Opening Community. Local historical accounts are described further in articles "An Ecological Survey of the Vegetation of Monroe County, New York" and "Central and Western New York Natural History Trivia", Appendix Nos 4 & 5.

Oak Openings are fire dependent plant communities similar to the prairies of the plains states. Although some of the fires were likely due to lightening strikes, the Native American Indians had a profound effect on the maintenance and enhancement of this plant community. Native Americans routinely set fires for a variety of purposes, to keep land clear for their agriculture, to

clear areas for village sites (open areas around villages had fewer mosquitos and other insect pests, were less damp and safer, since enemies could not attack by surprise), and to drive game for hunting. "Among the early events that now occur to me, was the firing of lands by the Indians for the purpose of taking game... they set a train of fire which enclosed and area of about seven miles square, of the oak openings between the Canascraga [Canaseraga Creek] and Conesus Lake."[4]. It is also likely Indians understood the wildlife habitat benefits of Oak Openings. These areas would have produced much more game (food) than old growth forests.

This area of western New York was first surveyed in 1792 as part of the Phelps and Gorham Purchase . European settlement began in earnest about 1800. Early pioneers found Oak Openings easy spots to settle compared to areas of old growth forests. Trees did not have to be cleared for agriculture, there was ready pasture for animals, and plentiful game. This made survival the first couple winters much easier until a good cabin could be constructed and additional land cleared for agriculture. Intensive agriculture and pasturing, plus the introduction of non-native species (such as white sweet clover, and cool season grasses for forage) destroyed most of the Oak Opening plant communities. "Drainage, fire suppression [in the last 50 years], urban development, and agriculture have all played a part in changing the landscape."[6].

Historical accounts of both the Goff and Quinn family [9 &10]. indicate the site at Rush was burned from time to time for both agricultural purposes and possibly by accident. The Quinn family tried leasing the land for pasture, but found it too hard to maintain fences [the soils were not well suited for good pasture either]. The fact that the property was not intensively farmed helped preserve the Oak Opening plant community. Raymond Goff did ditch the creek bed to improve drainage. [Beavers have now altered this drainage, probably back to its original level].

Recent recognition of the rarity and importance of maintaining remaining oak openings for both biological and historical reasons prompted the Nature Conservancy to begin acquisition efforts at the Rush site. In 1988 12 acres were purchased. In 1990 as part of the 1986 Environmental Quality Bond Act, the DEC acquired 123 acres from the Quinn family. In 1997, with the assistance of the Nature Conservancy and the Environmental Protection Fund, the DEC purchased an additional 105 acres from the Goff/Spink family.

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Natural Resources

A. Physical

1. Geology

Rush Oak Opening is located within the Erie–Ontario section of the Central Lowlands province (see Natural Regions Map). The Central Lowlands is a vast plain covering 650,000 square miles extending from the Appalachian highlands to the Great Plains. A covering of glacial deposits conceals underlying rock formations and a subsurface structure of easily–eroded shales.

Approximately 390 to 450 million years ago, this entire region was covered by a shallow inland sea. The shells of animals living and dying in this sea formed layers of limestone while sedimentary mud and silt formed shale. As a result, the bedrock of western New York state resembles a chocolate layer "cake": thick shale "cake" separated by thin dolomitic limestone "frosting." This formation is slanted to the south and where each rock layer intersects the surface, an east-west band can be seen. The Onondaga limestone running between the towns of Rush and Avon forms one of these bands.

At least four separate glacial periods are known to have occurred across the region. The most recent began approximately 125,000 years ago, and at its peak extended south across New York and into Pennsylvania. The southern front of the ice sheet finally ended near the current location of the Ohio and Missouri Rivers. It is this glacier and the lakes that covered this region immediately after its retreat (10,000–12,000 years before present) that are responsible for the characteristic land forms and topography throughout Monroe County.

The Erie–Ontario section is further distinguished by a plain of glacial till deposited during the most recent ice age. The plain is interrupted by morainal ridges arranged in arcs south of the present Lake Ontario. These land forms were created either directly from debris carried by the ice sheet, from sediment carried in meltwater leaving the glacier, or from sediment that filled the lakes that formed in front of retreating glacial ice.

2. Soils

Past Glaciers and bedrock formations have greatly influenced the soil conditions on the property. The soils are *extremely* variable, sometimes with major changes in just a few feet. This is reflected in the U.S.D.A. Soil Conservation Service Soil Survey of Monroe Co., N.Y. , which identifies 14 different soil types on the property. Benson soils and Rock Land are of special interest, due to their high ph and shallow excessively drained soil. A soils map page 44 and detailed description are listed in appendix 3.

3. Terrain

The terrain consists of rolling lands. The west boundary along Rt.. 15 is the east slope of a low glacial drumlin. Elevations range from a low of 610' to a high of 660' above sea level. Slopes do not exceed 15%. Page 43 shows a 7.5 minute topographic view.

4. Water/Wetlands/Watersheds

Since this area overlies part of the Onondaga escarpment there are no major aquifers at this location. Water is confined to surface wetlands, three of which are DEC regulated wetlands. (see Wetlands map page 46) Drainage from wetlands is via seasonal streams and ditches dug for agricultural purposes. The site is located on a sub-basin watershed divide. The east portion of the property flows to Honeoye Creek, and the west portion drains directly to the Genesee River.

B. Biological

1. Vegetation

There are three major ecological communities at Rush Oak Openings tracked by the NYS Natural Heritage Program. Each community is assigned an "element rank" consisting of a combined global rank and state rank. The global rank reflects the rarity of the element throughout the world and the state rank reflects the rarity within New York State. (see appendix 1 for definitions)

a. Oak Openings (a.k.a. Oak savannahs). Rank G2 S1

b.Limestone woodland. Rank G3G4 S2S3

c.Wetlands

I. Shallow emergent marsh. Rank G5 S5

II.Shrub swamp. Rank G5 S5

III. Sedge meadow. Rank G5 S4

IV. Silver maple-ash swamp. Rank G3G4 S2S3

2. Wildlife

Animal diversity is high in productive systems. Primary productivity is high in both prairie and savanna, and it is readily available to animals. Diversity within a certain taxa (birds, herptiles, invertebrates) is correlated with structural heterogeneity, which is relatively high in oak ecosystems (sun and shade, open and canopy).

Invertebrates

This group must have been the largest component of biodiversity on oak ecosystems, yet very little is known about their characteristic habitats, their natural assemblages, or their current status. Many insects are very selective in their food choices; as host plants declined so have the invertebrates. It is likely that many invertebrate species of oak ecosystems were lost or are rare. In one thirteen–year study it was concluded that as many as one–fourth of the prairie– and savanna–inhabiting species depend on remnant habitat for survival. Habitat specificity was highest among certain groups such as flower moths (*Shinia* spp.) and root boring moths (*Papaipema* spp.). Ohio has completed a state–wide survey of all the Lepidoptera species. The oak savanna communities support that state's largest assemblages of imperiled moths and butterflies.

Several species of butterflies have been reported from Rush Oak Openings during recent surveys. On July 25 & 26 the following species were recorded: black swallowtail, spicebush swallowtail, cabbage white, clouded sulfur, orange sulfur, hickory hairstreak, eastern bluetail, great spangled fritillary, pearl crescent, baltimore, mourning cloak, white admiral, common wood nymph, monarch, silver–spotted skipper, northern broken dash, delaware, broad–winged skipper, and dun skipper.

Conservation of invertebrates offers special management challenges. Fire appears to at once improve and maintain critical habitat, while damaging populations. Some say the solution may be to manage a patchwork of sites, i.e., burning half every year. Population size within a patch may fluctuate greatly, perhaps declining after a fire, but recolonization quickly rebuilds the population.

Herptiles

Savanna fires can benefit herptiles in two ways: by creating a heterogeneous habitat for thermal regulation and by increasing the quantity and diversity of food. Many herptiles require complex habitats of wetlands and uplands. Researchers describe landscape heterogeneity as very important for maintaining amphibian and reptile diversity.

Birds

It is estimated that in prairie–savanna–woodland landscapes about 100 breeding species regularly occurred in presettlement Wisconsin. For the entire prairie forest transition, 84 breeding species have been found, ten of which are listed as threatened or endangered in at least one Midwestern state: golden winged warbler, Lark Sparrow, loggerhead shrike, long–eared owl, merlin, and prairie warbler. Many savanna birds are now common birds of cities, suburbs, and farms (blue jay, black–capped chickadee, American robin), while other savanna birds are rare or decreasing (barn owl, Cooper's hawk). Only one savanna bird has gone extinct, the passenger pigeon, but other birds have been extirpated from large portions of their previous ranges within the Midwest. In some areas the American turkey was extirpated, but reintroduction has been successful. Some birds known from Rush Oak Opening include: Eastern Bluebirds, Wild Turkey, Scarlet Tanager, Cuckoo, Cooper's Hawk, and the Ruby–throated Hummingbird.

Mammals

Many mammal species that were once a part of the oak ecosystems are still doing well, including the fox squirrel, cottontail rabbit, woodchuck, and white–tailed deer. They are abundant in or around our cities, suburbs and farms. At Rush Oak Openings, deer and wild turkey are now over abundant and are causing damage to plant species which are an important part of the plant communities located on the property. Hunting is actively encouraged to help control animal populations. Others, such as, the timber wolf, bison, elk, bobcat, and black bear, have been extirpated from large areas of their former range or have had their numbers greatly reduced. The loss of these predators and grazers has had serious repercussions throughout the system.

Other life forms

Very little is known about the diversity, distribution, and abundance within oak ecosystems of fungi, slime molds, lichens, algae, protozoans, and other small organisms, all of which are as crucial to system integrity as the larger, more readily understood organisms. The role of the human being and his culture on oak ecosystems may be the least understood of all.

3. Fisheries.

There are no water bodies in this management unit capable of supporting fish.

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Cultural Resources

A. Visual and Aesthetics

The area around Rush Oak Openings can be characterized as rural agriculture mixed with low intensity residential housing. However, downtown Rochester is only 12 miles north of Rush, and development pressure will continue to increase within the Town of Rush.

There are no locations for elevated scenic overlooks, but areas of grassland are beautiful in late summer/fall when the grass has matured and turned a yellow/gold color. Late spring (May-June) and summer many wild flowers bloom in grassland areas, creating a colorful display. The top of the hillside along West Henrietta Rd. provides a nice view of the cattail marsh in the Goff Tract.

B. Man-made facilities

There are no man made facilities remaining at Rush Oak Openings other than remnant stone walls, and a Niagara Mohawk power transmission line.

C. Zoning

The Town of Rush has designated Rush Oak Openings as Open space/Conservation area.

D. Archeological

Although no known archeological sites are located at Rush Oak Openings, it is likely the area was extensively used by Native Americans. Mrs. Doris Spink has flintstones her father found on the farm years ago. [9] Totiacton, a large Indian village, destroyed by the French in 1689, lies 3.5 miles northeast of Rush Oak Openings.

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Management & Policy

A. Past Management

1. Administrative

Since acquiring the Quinn property in 1990, the DEC has marked the boundary lines, removed the original farmhouse structure (which was in poor condition and a safety hazard), installed a gate to control vehicle access, and constructed a six car parking area on Honeoye Falls - 5 Points Rd..

2. Resource

Management activities have focused on maintaining and improving the health, vigor and species composition of the Oak Opening ecological community. Emphasis was placed on the grassland component, which was nearly gone at the time of acquisition. Fire control in the past 40 years combined with natural plant succession had caused may grassland areas to revert to shrub and forest. Due to lack of funding and manpower, management efforts have improved some areas while other locations are rapidly evolving into other plant communities. Invasive exotic plants are also making restoration of the plant community difficult. These competing plants are not easy to control by mechanical methods.

Permanent monitoring points were established in 1991 to measure changes in vegetation. Sample points were randomly located. The grassland/brush areas are sampled using 10 meter transect lines. Woodland sample areas are measured using prism plots to monitor trees, combined with 300th acre (6.8' radius) vegetation plots to measure understory plants.

Since acquisition a combination of methods has been employed to try and restore the Oak Opening grassland complex. The primary focus was on two main components. 1. Reverse plant succession. Plant species targeted for control; grey dogwood, red osier dogwood, Malus spp., Cretagous spp., aspen, ash, cherry, maples, wild grape. 2. Control invasive exotic plant species. Plant species targeted for control; honeysuckle, white sweet clover, garlic mustard, black swallowort.

Control methods employed to date are prescribed fire, brush hogging, brush cutting, chain saw girdling, chain saw felling, mowing, and hand pulling plants. The following is a chronological list of management activities. Locations are mapped in appendix .

Winter 1990-1991
- Fire breaks constructed with John Deere 450 bulldozer.
- brush hogged portions of areas 2 & 3.

Spring 1991
-prescribed burn in portions of areas 1, 3 & 4.

Spring 1992
-prescribed burn in portions of areas 1, 2, 3 & 4.

Spring 1993
-prescribed burn in portions of areas 1,2,3,4 & 5.
-August 1993 mowed portion of area 2 for white sweet clover

Spring 1994
-prescribed burn in portions of areas 2 & 3.
-cut brush w/ power brush saw and girdled trees in portion of area 3.

Summer 1994
-hand pulled white sweet clover by volunteers.

Spring 1995
-prescribed burns in portions of areas 1,2, & 3.

Summer 1995
-Cut brush w/power brush saw and felled trees in area 2.
-hand pulled white sweet clover by volunteers.

Spring/Summer/Fall 1996
-cut brush and felled trees in area 4 by DEC and volunteers
-hand pulled white sweet clover and swallowort
-constructed fire break south side of areas 2 & 3.

Spring 1997
-prescribed burn in portions of areas 2,3, & 4.

Summer 1997
-mowed portions of area 2 for white sweet clover. (August)
-hand pulled garlic mustard and white sweet clover by volunteers in areas 3 & 6.

3. Information & Education

Information and education efforts have been limited by a lack of staff and funding. There have been a few printed articles in magazines/newsletters and newspapers plus one news story on local television and radio programs. Recently, the Nature Conservancy has sponsored several on site tours for their membership and local residents. Some local college classes have visited on field trips.

4. Recreation

Only low impact recreational use has been encouraged due to the unique nature of this property and potential conflicts with recreational activities which may be detrimental to the plant community. Hiking, nature study, orienteering and hunting are permitted at this location. It should be noted that hunting actually helps some plant species. Some wildlife species including deer and turkey feed on plants which make up the oak opening ecosystem. High population levels of deer and turkey can destroy some plant species.

Other recreational activities such as horseback riding, mountain bikes, ATV's, camping/picnicking have not been encouraged due to the potential impact of soil compaction, increased erosion and introduction of invasive plants on the plant community.

B. Future Management Goals and Objectives

1. Biological

The unique nature and global rarity of Oak Opening communities is the driving force behind the primary goals and objectives for management of this area. The ultimate goal is to strive to restore the plant community and appearance of the area to pre-European settlement conditions and allow natural processes to maintain this community. There are practical limitations to this ultimate condition. Removing stone walls and hedgerows would be expensive and potentially disturb desirable plant species. Fires must be carefully controlled to avoid damage to adjoined properties. This necessitates construction and maintenance of fire breaks. Invasive exotic species are now present which may require special control measures. Since we have very little historical data or information, no one can be positive what the exact appearance of this area was. Since most ecological communities are dynamic, the area may have changed over time. With these constraints, it may be best to measure achievement of goals and objectives by the increase (hopefully) of plant and animals species known to be components of these ecological communities.

2. Administrative

The recent acquisition of the Goff tract in November 1997 will require establishing and marking boundaries. In addition, a parking area may be proposed for the new road frontage, on West Henrietta Rd. A logical parking site would be on Niagara Mohawk property since the area must remain free of obstructions to the transmission lines. A parking area would help save line maintenance.

Existing right of way access trail accoss Niagara Mohawk needs upgrading to facilitate all season access to the property. This would also provide improved access for Niagara Mohawk's transmission line maintenance. It would be desirable to install a water control structure in wetland on Niagara Mohawk property. This will regulate water levels, protect the proposed

access trail, and limit potential flooding downstream. Cooperative agreements will be required, since the control structure cannot be built on state land. An Article 24 Wetlands permit will be required by the DEC.
Appendix 12 contains proposed design specifications for these projects.

Niagara Mohawk also owns a strip of land 100 feet wide , bounding the north property line which does not currently have a power transmission line. This area contains some oak opening community and sedge meadow community. The DEC would like to propose acquiring this property by gift or establishing a management agreement with Niagara Mohawk Power Company.
Map on page 45 shows the location of this area.

Fire breaks will also need to be constructed on the Goff tract.

3. Information & Education

Future information and education efforts will concentrate on nature interpretation, understanding Oak Opening Ecosystems and management techniques, plus an increase in media exposure.

a. Currently there are no nature interpretation materials or facilities at Rush Oak Openings. An information kiosk with informational brochures / guides would be helpful for visitors to the property. Specific information markers at key features have been suggested but the logistics of markers ability to withstand fires, natural weathering, and vandalism have not been resolved. Any site markers should not be visually distracting. Specific nature trails may be able to be coordinated with administrative access and firebreaks without undue threat to the plant community.

b. Publicity efforts will focus on the unique character and global rarity of oak opening ecosystems. It is hoped these efforts will increase public awareness and support for oak openings and the management of rare or unusual plant communities. Specific ideas include magazine articles, the "Sunday edition" of local newspapers, and television coverage of prescribed burns. One potential outcome of public awareness is increased recreational use to a level which negatively impacts the plant communities.

4. Recreation

Recreation is a secondary benefit to the primary goals and objectives stated above. Low impact recreation is encouraged as long as the significant plant communities are not damaged. Hiking, nature study, hunting, cross country skiing are compatible uses for Oak Openings. Other recreational uses normally allowed on other state DEC lands will be restricted. Horseback riding, snowmobiling, and handicapped ATV access are not compatible with other goals and objectives.

C. Management objectives/Restoration plan

In the summer of 1997, the Rush Oak Openings was evaluated by the Conservation Research Institute. The project team consisted of leading authorities in Oak Opening plant communities and specialists in restoration technology. A grant was obtained from the Environmental Protection Agency to prepare management recommendations and a restoration plan for Rush Oak Openings. Their initial report [subject to modifications as part of the unit management planning process] combined with the Fire Management Plan will be the basis for setting priorities and planning management actions.

1. Restoration

Ecological restoration is the process of recovering and managing converted or disturbed ecosystems with respect to the following criteria: biodiversity, structural properties, dynamic biological and abiotic processes, historical character, and cultural practices. SOCIETY FOR ECOLOGICAL RESTORATION

On–site restoration activities can be grouped into three categorical features: structural, functional, and compositional. Structural features generally consist of the removal/reduction of invasive species, both native and adventive, as well as contemporary human artifacts (e.g., fences, junk piles, abandoned buildings, etc.). Structural features also include the incorporation of trails, roads, visual buffers, and signage. Functional features on a local scale include the restoration of ecosystem functions such as hydrology and prescribed fire. Compositional features include the reintroduction of native species (flora and fauna), and the preservation and management of existing features for critical habitat. Off–site factors to consider include: increased visitation, native seed source, invasive seed sources, ambient watershed development, the incorporation of the site into a macrosite or connection corridor, and incompatible land use (legal restrictions, zoning, and easements). Although the recognition and consideration of all these factors are important, the emphasis of this report is on the restoration of functional and compositional features at Rush Oak Opening.

Every site at which restoration is undertaken differs with respect to features that effect plant distribution and establishment. A short list of variables includes: past use, soil development, soil disturbance, existing plant community structure, dormant seeds in the seed bank, moisture characteristics, temperature distribution, snow cover, and susceptibility to fall and spring frost. It is impossible to measure or understand the effect of all these variables on plant distributions. Despite this, restoration ecologists can have excellent success with evaluating sites, prescribing treatments, and restoring native plant communities. This can be achieved because knowledge of ecological process, historical vegetation, and the willingness to adapt and refine prescriptions in response to observation (monitoring) is sufficient to restore a site. Fundamental to the success of each restoration project is a willingness to reassess land management practices in light of new data and preliminary results.

At Rush Oak Opening, the implementation of a restoration and management plan will:

- prevent the disappearance of oak opening remnants,

- increase the diversity of native plants and animals through the provision of high–quality habitat or reintroduction,
- reduce and possibly eliminate invasive species,
- reduce overstocked native woody species, and
- reinstate fire to fire–maintained communities.

The closer management comes to reinstating the processes that supported a particular system, the healthier the restoration becomes.

a. Restoration activities

A variety of activities will be used in the habitat restoration at Rush Oak Opening. These are discussed below without regard for any specific site. None of these alternatives are "stand alone" methods of restoration; a combination of these restoration activities is usually required. More specific activities tailored to identified problem species will be discussed in section 3.3.

Do Nothing

Over time, old fields, openings, and woodlands, with their associated floras, will shade out due to the growth of woody shrubs and trees. Where woody shrubs and trees form a closed canopy in areas such as these, little herbaceous ground flora or oak reproduction will be evident. The resulting degradation of oak openings and oak woodlands will include the loss of many native plant species, some of which are considered rare in New York. Doing nothing, by choice, indecision, or default is an approach to land management that can have negative consequences whether intended or not. Doing nothing is not a safe or controlled approach at this site.

Brush and Tree Removal

Young seedlings and sprouts of woody plants can be pulled when the ground is moist enough to allow for the removal of the root system along with the above ground parts. If possible, pull when the target plant is clearly visible and while native plants are still dormant. Hand pulling in high–quality natural areas can create conditions advantageous to invasive species by causing the soil to be disturbed. Be sure to tamp down the disturbed soil to reduce this possibility.

Most shrubs will resprout if the roots are not completely removed, but digging out larger brush is labor intensive. Stems of shrubs and trees can be physically removed by cutting. Cut shrubs or trees off, flat, not on an angle, at or near the ground level. Many deciduous trees and shrubs will resprout if a herbicide is not applied after cutting. If herbicide use is not desirable, resprouts can be cut until the food supplies are depleted, but this may take numerous cuttings and many years. Loppers can be used on stems up to 2 inches in diameter or a hand saw on stems 2–8 or even 10 inches in diameter. A gas–powered chainsaw is more efficient for larger stems (8–10 inches and up).

Some areas that have been intensely invaded and overgrown with dense brush are likely to need mechanical clearing using larger equipment (hydro–ax, seppi). Other less intensely invaded areas

that may still have remnant prairie species can be cleared using a walk–behind brush–hog or by hand clearing, depending on the extent of invasion and the sensitivity of the site. The best time for activities that require machinery is during the winter when the ground is frozen; there is less chance for the soil to be disturbed. Be prepared to follow–up with herbicide treatments, seeding of desired native species, and subsequent burns.

One of the best ways to control large woody plants is by girdling. Species that resprout, such as aspen, black locust, and willow can be controlled using this method if herbicides are used in conjunction with girdling. It is also effective on cherry, ash, and maple, without the need for herbicide. Girdling involves cutting the phloem (inner bark) but leaving the xylem (sapwood) intact. The roots busily nourish the top, but the tops send no nourishment to the roots, out which then die. Girdling can be done any time of the year, but it is the easiest and the most effective in late spring or early summer. The tree will take a year or two to die and will continue to provide habitat for a variety of animals until it falls.

Before beginning the shrub or tree removal process, determine the areas that will be cleared, have seeds ready to plant, and be prepared to burn the site in a year or two. Small amounts of brush can be scattered in grassy areas where fire and decay will eventually consume it. However, large amounts should be piled and later removed, chipped, or burned. Brush piles should be placed strategically, perhaps around a large undesirable tree or on a spot covered with invasive species. After a brush pile has burned, the soil will be somewhat sterilized and should be planted with native species before invasive plants become established. Most brush piles will burn better after they have cured for a six month to a year. In the mean time, they will provide wildlife habitat. While a brush pile is burning, cutting can take place close by and the green stems placed immediately on the burning pile, eliminating the need for another pile.

Grazing, Mowing, and Haying

Since settlement, pasturing in some areas has maintained savanna–like groves of open–grown oak trees, but the native ground layer flora have been mostly replaced by Eurasian species. Deer herds and other grazers are known to decrease the regeneration of some woody plants and light pasturing has preserved certain native herbs while keeping areas free of brush and tree saplings. These places sometimes have great potential for ecosystem recovery.

This type of management can be used in areas where burning would be difficult, but it should not be considered a substitute for burning. Grazing, mowing, and haying can maintain the structure of oak communities but it does not slow succession toward old field in the herbaceous layer. Once these activities cease, woody species rapidly establish themselves in the community.

Mowing should be done in late fall or winter to minimize impacts on herbaceous species. Haying will have the same effect as mowing but the removal of the hay, if done often, can result in the

mining of important soil nutrients and the disturbance of ground–nesting birds. Mowing, timed to prevent seed production can control some weedy species such as white sweet clover (*Melilotus alba*).

Exotic Species Control

Many herbaceous plants such as dandelion (*Taraxacum officinale*) and Queen Anne's lace (*Daucus carota*) do not last long in a natural area where the natural processes are being restored. However, others such as sweet clovers (*Melilotus* sp.), garlic mustard (*Alliaria petiolata),* swallowwort (*Vincetoxicum nigrum*), and purple loosestrife (*Lythrum salicaria*) can become serious problems and can out compete and replace many native species. The appropriate control methods will depend on the condition of the site, characteristics of the problem species, and available resources.

Removal priority should be given to species whose inhabitancy pose the greatest threats: those that replace keystone species, reduce native species diversity, significantly alter community structure or ecosystem function, or persist indefinitely as sizable, reproducing (sexually or clonally) spreading populations.

Vigilant monitoring of natural areas can result in early detection of new occurrences or increases in invasive species that then can be controlled more easily. Remove exotic species when they appear and have a contingency for implementing new control methods as they become available. Also, the removal of exotic species is critical at the beginning of a restoration project when everything that can enhance the conditions for the return of native plants should be undertaken. Opportunistic native and exotic species are poised to invade newly opened areas rapidly.

The time needed to control exotic species depends on the species and the methods used for their control. Some exotics, such as Queen Anne's lace (*Daucus carota)* and dandelion (*Taraxacum officinale*) do not need any control because they will yield gradually once natural processes have returned and native plants have had several years to compete under the restored conditions. In good quality remnant habitat, the reintroduction of fire and patience may be preferable to the use of herbicide or limited labor resources. Hand pulling may be best when the infestation is small and committed workers are available. In cases of aggressive exotic species, such as purple loosestrife (*Lythrum salicaria*), garlic mustard (*Alliaria petiolata*), swallowwort (*Vincetoxicum rossicum*), or common buckthorn (*Rhamnus cathartica*), gaining control of or eliminating them as soon as possible is best. With these species, control measures may be needed for many years, especially for a persistent seed bank.

Chemical use may be justified when invasive species are pervasive and persistent in the natural community, and when effective nonchemical control methods are not known or do not adequately curb invasive species populations. Herbicides should only be applied by those who have had training in the application of the various types of herbicides and understand the management risks involved.

Most annual or biennial broadleaf plants can be cut near ground level at or near the time of flowering but before seed or fruit develops. Cut stems must be removed from the site if flowers on the stem threaten to produce viable seeds. Unfortunately, rootstocks of many perennial species

can respond by sending up new stems. Some weeds can be controlled by strategically timed burning or mowing, but during certain times of the growing season these techniques can be hard on some of the plant or animal species to be protected.

Choice of control methods represents tradeoffs. With all invasive species, the most effective control technique is the early recognition of their appearance and the immediate removal of isolated plants before they begin to produce seed. Whatever methods are used, the rule of thumb should be to use those that cause the least possible damage to native species and communities.

Species Reintroduction

As discussed earlier, a central component of restoration is the replacement of native species that are missing from the area. Reintroduction of species is not a requisite component in some areas where a good representation of native species already exists. In other areas, the reintroduction will speed restoration and enhance the aesthetics. However, species reintroduction into areas without any management or restoration of the ecological processes that sustain it will not be successful. Also, in order for native species to thrive and form an integral and important part of a plant community, the appropriate habitat must exist. The reintroduction of native species may make the difference between a successful recovery and none at all.

Before resources are spent on securing plants or seeds off–site, it is best to determine which and to what extent native species remain in the system. Remnant native species may be present but not evident due to fire suppression, heavy shade, leaf litter accumulation. Desirable species may "reappear" in newly cleared or burned areas in several ways: perennial plants may be present as rhizomes in the soil, understory plants of low vigor, or viable seeds may be dormant in the soil.

In newly opened areas that were badly degraded and it is has been determined that native species diversity is low, having seed available for planting into the soil is important. The seed mix should include a "fuel species"—those that will carry a fire. Without native plants and fire, a newly restored area can quickly revert to what it was, or worse!

Given the scale of the project at Rush Oak Opening, strategies to meet the need for native seed should be developed. A well–organized seed gathering, processing, and mixing program is very helpful for a successful long–term restoration. Volunteers, are very helpful for locating seed sources, compiling lists of needed seeds, identifying the plants, knowing when the seeds are ready to be gathered, compiling the various community–based seed, and holding processing parties.

Another valuable source of hard to find seeds can be developed using off–site volunteer gardens. Desirable species that occur at low abundance levels can be targeted for enhanced seed production. A few seeds can be collected on site and grown by volunteers in gardens. Upon maturation, seeds are collected from these plants and returned to the site. Many people would love to help restore a natural area, but are unable to for various reasons. Raising rare plants in their yard, with the agreement that all the seeds are collected and returned to nature, can be a very rewarding activity.

Seed Collecting Strategies

To capture genetic variation, harvest seed from a diversity of local populations. Seed should be collected from plants with a variety of conditions, early and late bloomers, robust and depauperate. Avoid collecting only from plants that look the best.

Local genotypes will be the most likely to succeed in the long term, but it is important not to diminish a local source just because it is close, when there is another just outside a predetermined range. A general rule of thumb is not to collect more than 50% of seed from a population; this is especially important if the plant is an annual.

The timing of seed collection is very important. Some seeds will be consumed by insects, birds, and rodents. Other seeds will be actively ejected by the plant or blown by the wind.

Seeds often require cleaning, husking, dewinging, or debearding. Removing the chaff can reduce the bulk for handling and storage and remove moist material that may cause mold formation. Picking the seed as clean as possible can help the processing procedure later. Seeds can be cleaned by passing them through screens sized to allow the seed to fall through leaving the chaff on top. There may still be seed left in the chaff, so it can be saved for spreading later. Fleshy seed pods should be thoroughly dried before processing. These techniques have been well developed in the Chicago area where volunteers organize seed collecting and seed cleaning and processing parties.

The seeds of many plants have specific storage and stratification needs. Some plants do well grown from seed, but others need to be introduced as seedlings. Some can be sown as soon as they are gathered, others need special treatments such as stratification or scarification. Although some seeds exhibit multiple dormancy mechanisms and need to be cold or moist stratified, other seeds may have their best germination potential at the moment they reach maturity. For seeds that need storage, proper storage conditions are critical to maintaining seed viability over time. The two most important factors are seed moisture content and seed temperature. Seed storage must be in containers that protect it from rodents, birds, and insects. Stored seeds should be labeled with detailed information. Minimally it should include the date of collection and where it was collected.

Prescribed Fire

> *"The evidence for aboriginal burning in nearly every landscape in North America is so conclusive, and the consequences of fire suppression so visible, that it seems fantastic that a debate about whether Indians used broadcast fire or not should ever have taken place."* FIRE IN AMERICA. A CULTURAL HISTORY OF WILDLAND AND RURAL FIRE. Steven Pyne. 1982.

There is little evidence for determining what was the "natural" fire regime. Both people and lightening played critical roles in establishing and maintaining oak ecosystems. In the oak woodlands around the world, people have regularly set fires for at least the last 5,000 years. Oaks have certain characteristics that make them more resistant to fire than other woody species: thick bark, the ability to stump sprout, and resistance to rotting after scarring. Paleobotanical studies consistently reveal oak pollen to be associated with deposits of charcoal.

Oak ecosystems depend upon frequent (annual to about once a decade) fires for the preservation and maintenance of their structure and biodiversity for several reasons. Fire increases vegetative productivity, flowering, native species diversity, and suppresses fire–intolerant exotic species that are less adapted to survive periodic fire. In grassy communities, fine fuels (herbaceous plant debris) often accumulate faster than they can decompose. The annual buildup of the litter layer makes it difficult for herbaceous species to germinate and grow. Without fire in woodlands, native woody species become overstocked and nonnative trees and shrubs begin to invade. This creates such intense shade that oaks are unable to reproduce and the herbaceous ground layer, adapted to a more open canopy, cannot grow. Eventually, without a ground layer flora, the hydrology and redox factors are altered and the soil begins to erode, carrying with it seeds, spores, and nutrients.

Overall, annual burning should include all tracts that will carry a fire except those areas noted in section 3.2. yearly evaluation is important in order to determine follow–up activity, such as overseeding or herbiciding resprouts, and to determine the extent to which native biodiversity is burgeoning and weeds are diminishing. Once a significant groundcover and diversity has been reestablished, fire return intervals can probably be relaxed to once every 1–3 years. It is also important to burn across community lines for natural vs. unnatural community boundary demarcation. The focus should be on blending the management units into one interacting ecosystem.

At the beginning of a restoration program, the fuel present in woodlands is considerably different from that which originally maintained these communities. In particular, more woody growth in the form of live stems, dead standing stems and woody debris on the ground is present. Fine fuels (dead grasses, sedges, and forbs), which previously formed the main source of fuel for fires, are lacking. Initially, these conditions will result in fires that may have “hot spots” that burn for longer periods around sources of accumulated woody fuel or unburned areas due to a lack of continuous cover of fine fuels. As the fine fuel becomes established, fires will burn more quickly and fewer hot spots will be present.

Spring burns can carry irregularly through areas influenced by a high spring water table. This “patchy” fire coverage leaves refugia for invertebrates and other species, and may permit oak seedling establishment. Late spring burns may cause greater harm to woody plants than fall burns. Fall fires will burn wet prairies and marshes that were too moist to burn in the spring. Fall was the typical time for presettlement Indian–set fires, virtually the sole source of ignition, since dry lightening was rare to absent during the fall and spring burn windows.

It should be recognized that fire in woodlands is quite different from fires in grassy openings. Prairie grass fires are often characterized by longer flame lengths and shorter resident time. When burning through the patchy distribution of fine fuels and dried leaves in a contemporary woodland, under the appropriate prescription, the small and slow–moving fires are often difficult to keep alight.

A burn policy should include a public education strategy to increase the understanding and awareness of the critical need for prescribed fire in natural areas. Prescribed burn training programs for resource management at all levels should be expanded, upgraded, and intensified.

b. Management Priorities

Most restoration efforts on complicated sites need to set priorities. As mentioned previously, the first priority should be to secure the best areas first, and work out from there. As resources and person power allow, other more degraded areas can be tackled. One rule of thumb is that the more degraded the area, the more time it will take, the more it will cost, and the less thorough it will be. Whatever the condition, restoration of a site requires a long–term commitment to active management. Always the underlying premise for restoration is the thought of what is best for the ecosystem in order for it to thrive.

The following sections describe restoration alternatives specifically for the major plant communities found at Rush Oak opening. The communities have been grouped according to the ecological process that most maintains them.

Hydrologically Maintained Communities – Wetlands

Button bush swamp, woodland swamps, vernal pool, sedge meadow, and marsh. The critical factor in the continued health of wetlands is the maintenance of a stable hydrology. We recommend a watershed study to determine the extent to which these lands are threatened by altered hydrology (i.e., ditches, watershed development) and by increased or polluted surface runoff from ambient lands.

Historically, fire probably was not a big factor in most of the wetland, with the exception of the sedge meadow and marsh, but keeping fire totally out is also not necessary. The entire sedge meadow should be burned occasionally to reduce the duff layer and prevent the establishment of invasive weeds. Fire should burn right up to the edge of the swamps and then allowed to drift into those areas that are still hydrated. The swamp on the southern and eastern edge of the DEC property has some areas (to the far east) that have been denatured and now has some exposed peat. These areas should be protected from fire until the groundwater hydrology has been restored and is evident that there is no longer any dehydrated soil or peat. Burning through drained swamps could result in the burning of organic soil and peat fires that are devastating and difficult to control.

Management of the button bush swamp is somewhat dependent upon the restoration of the surrounding woodland. When woodlands around open wetlands are too shaded, the soil–stabilizing ground layer flora is lost and silt begins to erode into the wetland, eventually threatening the stability of the swamp. Maintaining a more open canopy by selective clearing will prevent this and the wetland will be healthier.

Fire Maintained Communities – Woodlands

Limestone Woodland. This woodland ranges from a high–quality woods in the east, becoming more degraded toward the west. A high priority should be to reestablish the natural fire regime throughout the limestone woods. Labor resources should be concentrated on the eastern portion

by selectively removing some trees to open the canopy and the immediate removal of any aggressive exotic species. It is important to contain the front of garlic mustard (and other exotics) moving in from the west, being sure to scout for and entirely remove small vanguard populations. As the eastern portion is stabilized, the restoration effort should continue to the west. Some areas on the western edge may need mechanical clearing as described below (see Dense Brush, section).

Fire Maintained Communities – Openings

Oak Openings and surrounding oak woods. The oak openings and the surrounding woodlands require annual burn management that allows the fire to continue from the open areas into the woodland. The "edge" of the woodland and openings should be blended to allow for a more natural interaction of the plants and animals that live there. Most of the remnant oak openings at Rush Oak Opening are very high–quality and should be restored using hand tools. Thinning small trees and brush should be done by hand. Large trees that are directly threatening a desirable oak can be girdled. The canopy should be opened to achieve average ground light levels of 5–15% of available light as measured by a light meter in the middle of the day during the summer. When selecting trees for removal, be sure to preserve a full range of size classes, leaving a few downed logs per acre and a few standing dead trees for wildlife habitat.

Dense Brush (Spinks tract south and along the main path and other isolated pockets). Areas heavily infested with brush are likely to need some mechanical clearing. Less dense brushy areas that still have some prairie remnant can be brush hogged. In either case, follow–up with careful herbicide application to the stumps. In these areas, it is important to plant seeds that include a fuel matrix soon after it is cleared. Being able to carry a fire within 1–2 years to aid in the control of resprouts is important for these areas. If left too long without a fire, the clearing will have to be repeated. Some of these areas are so badly degraded that they will require immense amounts of resources. It may be better to spend those resources securing and expanding the highest quality areas first. Of course, if any of these areas are threatening an important resource or critical habitat, the priorities would change.

Goff–Spinks tract (old fields). The agricultural areas to the west can be planted to wet–mesic prairie (a mixture of prairie grasses and forbs that have a broad habitat requirements). If any of the recently cultivated areas used the herbicide "Atrozene" (commonly used in cornfields), the prairie planting will have to be delayed for two to three years to allow the herbicide to dissipate. These areas can provide an important buffer area to the more sensitive natural areas while providing a seed source for future restorations.

c. Potential Problem Species

Listed below are the major invasive species found at Rush Oak Opening. Beyond the section on native shrubs, the balance of the species are all highly aggressive alien invaders.

Native Shrubs

Were native shrubs an integral part of the original community? Do they approximate densities of original conditions? Answers to these questions vary with each site. At Rush Oak Opening, native gray dogwood is among the most aggressive of the shrubs invading open areas. When historic evidence suggests that a particular savanna or prairie had fewer shrubs, most restorationists are comfortable reducing the extent of native shrub population. Before doing this however, pay attention to the animals that utilize the shrubby areas and consider providing for their habitat needs on–site or elsewhere when undertaking restoration work.

Common Buckthorn (*Rhamnus cathartica*)

Common buckthorn is a tall shrub or small tree that can reach 20 feet high and 10 inches in diameter. Introduced to North America as ornamentals, they were planted as hedgerows. Common buckthorn readily invades unburned prairies and savannas. It aggressively competes by shading out native herbs and shrubs. Although glossy buckthorn (*Rhamnus frangula*) has yet to be found at Rush Oak Opening, it frequently invades wetland communities (fens, wet prairies, and sedge meadows) as well as upland sites. Buckthorns produce fruit eaten by birds, and the severe laxative effect of the fruit distributes the seeds. These shrubs also resprout prolifically from cut or damaged stems.

Burning: Prescribed burns in early spring and fall can kill seedlings (especially first year growth) and some larger stems. However, for complete control, annual burning may need to continue for 5 or 6 or more years depending on the extent of establishment and the seed bank. One or two burns stimulate resprouts. It is generally difficult to burn in dense buckthorn stands as the understory is typically well–shaded, allowing for little fuel build–up.

Mechanical: In high–quality sites where chemical control is a concern, small patches of plants up to 0.5 inch diameter can be pulled up when the soil is moist. Larger plants 0.5 to 1.5 inch diameter can be dug or pulled using a weed wrench. Disturbed soil should be tamped down to minimize reseeding. Buckthorns are vigorous resprouters so, girdling or cutting stems will not be effective unless followed by an application of glyphosphate herbicide. In wetlands, restoring artificially lowered water table to its historical levels will often kill glossy buckthorn.

Chemical: Chemical control is best done in the fall when most native plants are dormant but buckthorn is still actively growing. This lessens the risk of affecting nontarget species. Buckthorn remains green and easily recognizable far into the fall and early winter. Fall is the best time to cut and treat stumps but winter application of chemicals has also been effective. Cut stems level close to the ground. Immediately apply Garlon 3A or Roundup (50% concentration) to stumps. In wetlands, use Rodeo for cut –stump treatment Resprouts should be cut again and painted with a 1.5% glyphosphate application. On severely disturbed sites or buffer sites, as a supplemental method, use Garlon 4 as a dormant–season basal–bark treatment, cut stems and then spray resprouts with Garlon 4 or spray foliage with Rodeo.

Bush Honeysuckles (*Lonicera tatarica*, and various hybrids)

Native to Asia and eastern Europe, bush honeysuckles are dense, upright, deciduous shrubs (3–10 feet in height) with shallow roots that have a broad tolerance of various moisture and habitats. They thrive in sunny, upland habitats, including forest edges, roadsides, pastures and abandoned fields. Woodlands are the most affected and are particularly vulnerable if the habitat is already disturbed. They can also be found in fens, bogs, and along lakeshores. The widespread distribution is aided by birds, which consume the fruit and disperse the seeds over long distances. Seedlings establish in sparse vegetation and are usually found growing under tall shrubs or trees where birds perch and deposit seeds. Their vigorous growth inhibits development of native shrub and ground layer species, eventually entirely replacing native species by shading and depleting soil moisture and nutrients. Easily spotted in spring and fall because they leaf out 1–2 weeks before native shrubs and keep their leaves longer into the fall.

Burning: Spring burns may kill seedlings and top–kill larger plants. Resprouts may occur, so annual burning for 5 or more years will be needed.

Mechanical: Small– to medium–sized plants can be pulled or dug in spring when the soil is moist. Soil should be tamped down to prevent reseeding. In sensitive areas, this type of removal will disturb the soil and may lead to more invasions, in which case it should be avoided.

Chemical: After cutting the stems at the base, treat the stumps with Roundup or Rodeo. Two cuts per year may be needed, one early spring followed by another in early fall. Cuts made in winter will result in vigorous resprouting when the plant comes out of dormancy if they are not followed up with herbicide treatment. Roundup or Rodeo can be applied as a foliar spray just after the flowers bloom (usually June). Krenite can also be used as a foliar spray. Both mechanical and chemical treatments must be repeated for at least 3–5 years.

Black Locust (*Robinia pseudoacacia*)

Black locust is a leguminous, deciduous tree that grows from 30–80 feet tall and is native to the slopes and forest margins of Southern Appalachia and the Ozarks. It has shallow roots and often spreads by underground rhizomes. They typically form multiple stemmed clones and are slow to leaf out. It is frequently found in upland prairies, savannas, roadsides, old fields, and woodlots. It prefers humid climates with sandy, loamy, well–drained soils in open sunny locations. Black locust produces abundant seeds but it typically reproduces vegetatively by stump sprouting and spontaneous root suckering from extensive root systems. Sprouting shoots and interconnecting fibrous roots form extensive, dense groves of clones. Damage to roots or stems stimulates vigorous sprouting, root suckering, and lateral spread. Black locust commonly occurs in disturbed habitats like pastures, degraded woods, thickets, old fields, and roadsides. Because dense clonal stands shade out most understory vegetation, they must be eliminated.

Burning and Mechanical: Burning and mowing only temporarily controls the spread. Mowing actually seems to promote seed germination, and burning and cutting stimulates sprouting and clonal spread. Girdling without chemical application is ineffective because it kills the stem but does not prevent suckering formation. Bulldozing may be an option on severely disturbed

lands.

Chemical: Because black locust is difficult to control due to rapid growth and clonal spread management has concentrated on chemical control with variable success. Apply Garlon 3A or Roundup immediately to cut stumps and girdled stems. This treatment works best when applied in late summer, early fall, or during the dormant season. Basal–bark treatment can be used by applying Garlon 4 in a band at least 6 inches all around the trunk approximately 12 inches above the ground, but may lead to resprouting. For small isolated plants or thick patches less than 5 feet in height (such as those resulting from cutting or fire) Krenite or Roundup can be applied as a foliar spray. To be effective, every branch or stem must be sprayed (with Roundup, treat all leaves) because missed stems will leaf out. Foliar application, however, should not be applied in high–quality natural areas because it is a nonselective herbicide. Whatever control measure is used, a follow–up treatment is usually required.

Garlic Mustard (*Alliaria petiolata*)

Garlic mustard was introduced by early settlers presumably for medicinal and cooking purposes garlic mustard is a cool season biennial herb that ranges from 12–48 inches in height. First–year plants consist of a rosette of 3–4 round, scallop–edged, dark–green leaves. These rosettes remain green throughout the winter making it possible to check for its presence throughout the year. Second year plants generally produce 1–2 stems, which has numerous small white flowers that have four separate petals and then dies after producing seeds. Hundreds of seeds per plant are produced within days of initial flowering. These seeds can lie dormant for 20 months before germination and may remain viable for five years. Garlic mustard grows in upland and floodplain forests, savannas, yards, and along roadsides. It typically invades shaded areas, but will occasionally be found in full sun. It can readily spread into high–quality woodlands where it can displace most native herbaceous flora within ten years. There are two modes of spread: an advancing front and satellite populations possibly facilitated by small mammals.

Burning: Intense fall or early spring burns that thoroughly burns the site. Any unburned plants should be pulled or cut before flowering. Three to five years of annual burning may be required.

Mechanical: Minor infestations can be eradicated by hand pulling at or before the onset of flowering. The upper half of the root must be removed to stop buds at the root crown from sending up new flower stalks. Flower stalks can be cut as close to the ground as possible (even a couple of inches above ground is not effective) when garlic mustard is in full flower. Cutting before this time may promote resprouting. In large, heavily infested areas, a scythe, monofilament weed whip, or brush cutter can be used. Remove the cut or pulled plants from the area that may still produce viable seeds. It is essential that the area be monitored and plants removed every year for at least five years after the initial control effort. A combination of spring burning, hand pulling, and cutting flowering stems works well.

Chemical: Severe infestations can be controlled by spraying 2% solution of Roundup, an amine formulation of 2,4–D, or a 1% solution of Mecamine during spring or fall when most native vegetation is dormant but garlic mustard remains green. Garlic mustard will grow as long as there is no snow cover and the temperature is above 35EF. Do not use 2,4–D or Mecamine in high–quality natural areas.

Sweet clovers (*Melilotus alba* and *M. officinalis*)

Native to Asia and Europe, white sweet clover is a leguminous biennial plant that was introduced in the late 1600's for honey production. Sweet clovers grow well in direct sun and partial shade. They seem to prefer calcareous or loamy soils and are most often found in open disturbed, upland habitats. This plant is strictly vegetative the first year and can be found in late summer. In the second year, plants flower from late May through September, set seed and die. The small hardy seeds can remain viable in the soil for as many as thirty years! Sweet clovers are fire–influenced, aggressive, weedy plants that produce populations with high rates of fluctuation. Burning produces excellent growing conditions by scarifying the seeds and stimulating germination. During the year following a burn, many flowering plants will generally emerge.

Burning: It is possible to reduce sweet clover by burning two years in a row. A hot, complete burn early the first year (before green–up, early to mid April) to stimulate germination and a hot, complete burn the following year in early to mid May. If burning is conducted before the buds are developed, the plants will resprout. Heavily infested areas may need this burning sequence repeated after two years. The fire can be of low intensity—just enough to touch the stems. For small patches a flame gun (torch) may be used when the vegetation is damp to avoid burning the surrounding prairie. Another burn strategy is to mow later in the summer, allow the plants to dry, and then burn. This can be stressful to the native vegetation and insects, so it should not be done every year.

Mechanical: Small patches of sweet clover can be hand pulled when the soil is damp. It is important to remove the root portion or the plant will resprout. Plants can be cut low to the ground after the lower leaves have died and up to the early stages of flowering. If the plant has set seed, they must be removed from the area. Conducting annual inspections to remove scattered individual plants will be necessary. Habitats adjacent to managed areas should also be inspected. Due to the long viability of the seeds, sweet clover must be managed on a nearly continuous basis.

Chemical: Sweet clover can be managed using strategic burning and mechanical controls, and should not require chemical use.

Swallowwort *(Vincetoxicum rossicum)*

Swallowwort is a native of Europe and was first documented in the eastern U.S. in 1890's. It has

spread from there into Ontario, Michigan, Wisconsin, and Missouri. The seeds are windblown and swallowwort seems to prefer limestone influenced soils. It can tolerate full shade to full sun and quickly forms a monotypic stand. It can out compete garlic mustard!

Mechanical: Dig out entire root crown. It is important to get it all due to its ability to resprout prolifically from the roots.

Chemical: Larger patches require herbicide control. Round–up should be used at the same rate as for milkweeds.

Burning: No information is available on the impacts of burning in swallowwort.

d. Monitoring Guidelines

A basic monitoring program should answer a simple but very important question: Should the current management or restoration practices be continued or should they be modified? Results from monitoring should help the restorationist evaluate movement toward or away from the goals of restoration and thus help revise restoration priorities.

First, identify the restoration goals clearly. Restoration implies that an area is going to change from what it is now to what the restorationist has determined is best for the site. Stating what is meant by success and the objectives of monitoring clearly and concisely will help determine monitoring methods and set work priorities. It is terribly frustrating, after several years of monitoring, to realize that the information gathered does not reveal very much about the progress toward the restoration goal.

The time and effort needed to pursue a productive monitoring program is dependant on a couple of factors. First, how large of a population, or of an area, will be tracked? If, for example, there are only 50 individuals of a rare species on site, it is most effective to census the entire population. Alternatively, to track the decline of an invasive weed over several hundred acres collect some samples that are (as a group) representative of the entire area.

Determine how much change is important. If the goals are qualitative — e.g. you want to see a hundredfold increase in a certain species — it is not necessary to collect data that enables you to detect a 5% change in abundance. Unfortunately, most monitoring programs fail in the other direction. Often, restorationists want to be able to detect relatively small changes (e.g., 10% change); yet they collect only the coarsest information leaving them unable to detect the desired changes.

Four questions should be asked before undertaking monitoring — and your restoration; (1) What is the species or area of interested, (2) What are the restoration goals for that species or area, and what does success look like, (3) What are the indicators of change that can be measured, and (4) What kind of change and how much of it needs to occur (over what period) before the restoration is deemed successful.

For the most part, the only sampling tools needed are a map, a quadrat frame, a measuring tape, a compass, data recording supplies, and a guide to the plants in your area. Prairies, savannas, and

woodlands contain the bulk of their vegetative species richness in the groundcover layer. The sampling techniques discussed below concentrate on the measurement of cover, frequency, and quality of the groundcover. This is where the most sensitive measurements for both quantitative and qualitative vegetation changes in the restoration will be found.

For an overall picture of the plant community, start with a complete inventory. Plants should be recorded at least twice during the growing season, once early enough for the spring flora and a second time late enough for the fall flora. Be sure to record as many species as possible over the entire site so that you capture the full floristic variety.

While inventories are useful, they do not show which species are increasing and decreasing, or which are common and which are rare. Measuring such floristic changes over time can best be achieved through quantitative sampling repeated at various intervals. When done efficiently, sampling provides a picture of the entire population or area with a minimum of time and effort. However, when done poorly, sampling can lead to inaccurate conclusions. There are two types of errors that can occur with monitoring, "sampling errors" and "nonsampling errors."

Nonsampling errors are the result of human activity, such as flawed transcription and recording of data, or incorrect and inconsistent plant identification. Therefore, it is very important that the sampling methods be clearly defined so that they can be repeated over time by different people. Defining the methods clearly will help reduce nonsampling error and problems due to changes in monitoring personnel.

Sampling errors result from chance and are inevitable in all sampling studies. Such errors result from the heterogeneity of the natural world. Any small plot cannot truly represent all the variability found within a much larger area. As a result, the information from a single sample can be far from representative of the larger population. However, a collection of these samples can, when analyzed appropriately, give a very accurate picture of the population as a whole. One thing is certain about the gathering of data and its subsequent analysis: differences in sampled units will occur. A decision will have to be made whether these differences are significant, informative, or merely reflective of sampling error.

When to sample depends largely on the questions being asked. If the interest concerns the recovery of the fall flora in a degraded savanna, sample in the fall. If you are interested in the recovery of a sedge meadow, sample in late spring or early summer when the sedges are easily identifiable. How often to sample also depends on the questions being asked. A plant community that changes slowly does not need to be sampled as often as one that changes more quickly. For example, you may want to sample the groundcover in a savanna every year or two, but sampling the trees needs to be done no more often than once every five to ten years. It will also be valuable to conduct baseline (prerestoration) sampling to document the condition of the site before restoration begins.

The information resulting from sampling can help address questions about the composition of the vegetative community. Two approaches commonly are used to measure vegetation, plots and transects. Plots are usually large sampling areas that typify the site to be monitored and are often permanently marked. Transects are typically a series of small plots (quadrats). Use some caution when permanently marking plots and transects because repetitive trampling may cause a change

in the vegetation that is not representative of the site as a whole (*i.e.*, it creates non–sampling error).

There are many methods for placing sampling plots and transects. In many cases, it is best to use a random sampling technique in which every spot within the study area has an equal and independent chance of being chosen. However, most restoration areas contain a variety of relevant landscape features that can be left unsampled if plots or transects are placed by using a simple random method. To avoid this, use what is called a stratified random sampling method. This method refers to a sampling strategy in which the study area is subdivided into units (strata) based on habitat criteria that may not be randomly distributed and are unlikely to change over time, such as community type, soil type, topography, population of a rare plant, and the like. The sampling plots or transects are then placed randomly within each stratum.

When sampling a defined stratum it is important to achieve a good interspersion of samples. For example, placing a plot in the center of a shrinking population or habitat may not reveal changes in size until the problem becomes quite advanced. If the plan is to establish several sampling plots within a stratum, overlay a grid system on the site where the grid units are the size of the plot and then randomly select units to sample. If the sampling is to be done by transects, divide the stratum into predetermined strips of a given width, such as 10–25m, and then randomly place the transect within the strip.

The number of samples do not have to be equal in each stratum, but can be in proportion to the size, the number of target plants, or the amount of variability in each stratum. The number of samples should be sufficiently numerous as to achieve a representative amount of plant frequency and coverage data. Too few quadrats can result in a large sampling error from year to year and some of the more subtle floristic changes may be missed. Too many quadrats make the sampling too burdensome to continue on a regular basis. Consider starting with a greater number of quadrats for the initial baseline sampling, such as 75 or more, and then take random subsets of 50, or 40, or 30, etc. to determine when the measurements of interest begin to differ significantly from the larger baseline sampling.

Placement of quadrats along a transect can be determined by randomly selecting a point between a predetermined pacing interval. For example, it was decided that 50 quadrats was sufficient to sample a particular prairie. The sampling interval selected was one to ten paces and a random number between one and ten was chosen, such as seven; the first quadrat is then placed seven paces from the start of the transect. The next random number is chosen, six, placing the next quadrat six paces from the first. The third random number is four and the quadrat is placed four paces later, and so on until 50 quadrats have been sampled.

There may be times when regular spacing of quadrats gives more helpful feedback. A fixed spacing between quadrats works best when mapping changes in plant communities across a shade gradient, detail the coverage of a particular disturbance, or correlate vegetation to soil moisture or some other factor. For example, to detect changes in the extent of a community or encroachment, place quadrats from one area into another. Spacing and number of quadrats is especially important in this instance because too few quadrats widely spaced may fail to detect any change in the community soon enough. To incorporate randomness into a method using regular spacing, place the first quadrat randomly along the transect and then proceed using fixed

spacing. This will give the same results as random spacing of quadrats, as long as there is not a regular pattern to the variation in the vegetation, which is generally true for midwestern grasslands.

Plot and quadrat shapes are usually round or quadrangular. Plots commonly range from 0.1ha to 1ha. Sizes of quadrat frames typically range from $0.1m^2$ to $1m^2$. For prairie systems, the most efficient quadrat is a square, 0.5m on a side ($0.25m^2$). This size is small enough that all the plants in the quadrat can be seen in one field of vision and more samples can be established per unit time. The larger the quadrat frame, the more difficult it becomes to see all the plants at once, the harder it is to determine an accurate cover value, and the more time it takes. Quadrats that are too small will require an excessive number of samples to describe the variability present in most grassland systems. A $0.25m^2$ square quadrat frame can be constructed from ½" by ½" wood or ½" PVC pipe, 0.5m on a side. One side of the quadrat can be left off so that it will fit easily around bulky plants; and if the joints are hinged, the quadrat can be folded for easy carrying. A $1m^2$ hoop can be made by buying a 3.14m length of stiff, flexible tubing (*e.g.*, PVC pipe), putting a snugly fitting dowel in one end, bending it into a circle, and pushing the two ends together over the dowel. The hoop can be opened to fit around bulky plants.

When monitoring a natural community using quadrats, record a complete list of all species present in each quadrat and, if desired, their estimated cover. "Cover" is defined as the ground area covered by the vertical projection of the above–ground plant parts. It is important to consider what is included in the cover estimate. For example, will plants not rooted in the quadrat, but which arch over it, such as vines, shade from overhead saplings, or big herbs be included? Record the decision about what is to be included as part of the cover estimate so it can be repeated consistently with future sampling.

Percent cover is the estimated percent of cover for each species in the quadrat, while cover classes lump percent cover estimates into broader measures such as: 1 = 1–10%, 2 = 11–30%, 3 = 31–50%, and 4 = 51–100%. If the abundance of the species is to be integrated, a cover/abundance coefficient can be assigned that combines an estimated cover with an estimated distribution and abundance within the quadrat. For example, give each species in a quadrat a cover abundance coefficient from 1 to 5 as follows:

1 = species consisting of one to few stems in only one quarter of the quadrat.
2 = species occupying 1 to 2 quarters and numbering several stems.
3 = species occupying 2 to 3 quarters with cover and density notable in each.
4 = species occupying 3 to 4 quarters with a regular density throughout.
5 = restricted to species that dominate the entire quadrat.

Do not get bogged down trying to be extremely precise with the cover values. As long as the values are applied consistently, the results will be useful and generally repeatable.

Cover estimate is one measure used to determine a species' importance relative to all other species in the sample area. Another measure of importance is derived from a species' frequency, which is the number of quadrats in which a particular species occurred. Relative frequency is calculated by dividing the frequency of one species by the total frequency of all species. Relative cover is calculated by dividing the total cover of one species by the total cover of all the species. The relative importance value (RIV) of a species is figured by adding the relative frequency (RFRQ) and relative cover (RCOV) together (RIV 200). Some people find it clearer to divide this

number by two (RIV 100).

An important thing to remember about a table of relative importance values is that the rank of a species will not remain the same throughout the growing season or from year to year. Rank is, in part, a factor of the plant's structure and is influenced by the year's weather, herbivory, mortality, reproduction, etc. The relative importance of a certain plant species may drop when more species are added, or rise if species drop out, even though the plant's absolute cover and frequency remain the same. If vegetation is to be evaluated based on changes in the cover of certain species, it is important to sample the plots or transects at the same time of the year, using the same cover value guidelines. Remember, the RIV rankings are like a "snapshot" of the restoration at the time of sampling.

Restorationists must make value–based decisions concerning the management and floristic direction of their work. It is not sufficient to know if the numbers of certain plants are increasing or decreasing; it is also important to evaluate whether those changes are positive or negative. Nor is it sufficient merely to distinguish between native and exotic species. It is crucial to know whether these are the native species that can coalesce into functioning communities that will form a part of a sustainable ecosystem. If certain native plant species can be correlated with ecological integrity, then their presence would be an indicator of system health or quality. How can changes in quality be measured quantitatively?

Floristic Quality Assessment (FQA) can be used to analyze both site inventory lists and samples (see Appendix II). It allows anyone with the requisite botanical experience to obtain similar results. Essentially, FQA allows the restorationist to reduce a complex pattern of change to a few "key statistics" that are sensitive enough to codify responses indicative of the plant community or ecosystem as a whole.

The monitoring process is only half finished after spending many, often hot, hours or years sampling. Now it is time to make sense of all that good information to answer questions. If the monitoring program had clear goals, if answerable questions were asked, and if the data were collected in a way that it contains the necessary information, this part of monitoring will be exciting and rewarding. Remember, an important goal in restoration monitoring is to find those items that can help confirm if the restoration is on the right track, or to find those that will cause changes in the application of restoration techniques. The data can also be used to look for trends and to make sense of relationships and variations in the ecosystem. Also, scrounging through data looking for unanticipated trends is a good way to look for new questions. But keep in mind that long–term directional changes will be complicated by seasonal and annual variations and sampling error, and that the ecosystem, with its resident species, is adjusting in many complex ways to changed management.

Monitoring data often do not show any statistically significant differences between years even though subtle long–term trends seem quite apparent. In other cases, restoration produces positive changes that are so dramatic that sampling will not be needed to know that positive change has occurred. But when monitoring data is needed to help determine whether the efforts are effective, it may be a good idea to consult a statistician in order to objectively analyze the changes. It is important to remember that ecological knowledge, statistical inference, and informed intuition all play a role in the interpretation of the changes that take place in the

management of restoration areas. We are only able to measure those things in the ecosystem that we have the technology, labor, time, and money to measure. There are many ecosystem properties that we are unable to measure at the moment, but are just as important to the overall successful functioning of the system. The goal for restorationists or land managers should be to design monitoring programs that will help them track the progress of a restoration toward a dynamic, diverse community in which all or most of the resident native plants and animals are able to flourish and reproduce indefinitely.

2. Fire Management

PRESCRIBED FIRE PLAN

RUSH OAK OPENINGS
TOWN OF RUSH MONROE COUNTY

Goals

The purpose of the burn is to re-establish and maintain the fire dependent grasses and associated oak-hickory forests that make this area unique. Previous burns have begun this process.

Objectives

The fire is expected to control the thin-barked species of brush and trees which are competing with the desired vegetation. The target species to be controlled are primarily grey dogwood, honeysuckle, timothy, aspen and sugar maple. Any single fire is expected to impact 20% of the target species on the property. No detrimental effects are anticipated from the fire.

A. Fire unit description. Quinn Oak Openings is located south of the Honeoye Falls-Five Points Road in the Town of Rush, Monroe County. The areas to be burned are flat pockets of prairie grasses (Fuel Model 3) which are surrounded by areas of brush (Fuel Model 5). The limiting factors for this burn involve the surrounding brush, since fire intensity drops off sharply when the fire reaches these fuels. Average fuel loadings are in the one ton per acre range.

B. Weather information: To accomplish the objective of controlling competitive species, it will be necessary to carry out the burn during a period of optimal burning conditions. This is most likely to occur from March 1 to April 15 or Oct 20 to Dec 1. A period of three days of warm, dry weather should precede during the burn. Weather monitoring will be supplied by WOKR TV 13 meteorologists for forecasts and possible temperature inversions which may affect smoke dispersal. Site weather data will be measured by Forest Ranger personnel.

C. Fire prescription is limited by maximum flame length in Fuel Model 5 of four (4) feet.

Temperature 40 F - 80 F
Relative Humidity 20% -50%
Winds 0-10 MPH - Ideal wind direction is west to northwest
Fuel moisture (1 hour) 2% - 14%
Head Flame Length 0 - 4 feet
Back Fire Flame Length 0 -1 feet
Rate of Spread 0 - 15 ch/hr
Back Fire Rate of Spread - N/A Values too low to be significant
Scorch Height - N/A
Maximum Spotting Distance 0 - .1 mile

D. Personnel needed:

1 Regional Forest Ranger
2 Forest Rangers
2 Foresters
2 Fire Wardens
10 Volunteers from local fire departments, Fire Wardens, The Nature Conservancy, and DEC (most have experience on previous prescribed burns).

The Forest Rangers will fill the positions of Incident Commander, Operations Section Chief, and Strike Team Leader.

One Forester will act as the Information Officer, and the other as a specialist for silvicultural purposes.

Volunteers will be divided in two crews, with Fire Wardens as supervisors.

E. Equipment:

2 Attack trucks, 4x4, with slip-ons
1 ATV for patrol
6 Portable radios
2 Drip torches w/ fuel
Assorted hand tools and chain saws to equip crews
2 Portable pumps with accessories.

F. Preparation: Fire lanes are cleared and mowed every fall. Preceding the burn date, leaves will be removed from fire lanes using a leaf blower (note: a foam proportioner would eliminate the need for this time-consuming activity). Research and monitoring plots have been established, 30 meter transect lines in grass and brush areas, permanent prism plots in the woodland, plus fixed photo locations on the property.

G. Protection of Special Features: There are no sensitive features on the property other than the oak opening community which is fire dependent. Attached is an Article 24 Freshwater Wetlands Permit, required to burn in the adjacent area to Wetland RU-17.

H. Smoke Management: This area is rural in character, and the nearest dwelling which is likely to be affected is ½ mile distant, separated by woodland which will reduce wind velocity and allow smoke to disperse upward. Experience has shown there is little smoke generated during burns, since the grasses burn with nearly complete combustion. Small burn units control the amount of smoke generated at any given period in the day. Attached is approval granted by the Monroe County Department of Health.

I. Pre-Fire coordination and Public Involvement: The Bureau of Forest Resource Management is responsible for coordination with other interested parties such as Nature Conservancy, neighbors, and town officials. Media contacts are handled by the Information Officer.

J. Fire Day Notification: Forest Ranger staff contacts the Monroe County Fire Coordinator

(currently Ed Riley), Phone 716-442-6810, and the Rush Fire Department. The Silvicultural Specialist double-checks this contact. The County Fire Coordinator, in turn, contacts the appropriate 911 agencies, including the sheriffs's department.

K. Public and Personnel Safety: The area has no major safety hazards. Careful supervision, training and planning should prevent injuries. Personnel assisting with the burn will be required to wear long pants, long sleeve shirts, leather gloves, work boots (non-steel toe), and hard hats. Personnel operating drip torches will have NOMEX clothing and eye protection, in addition to above items. Public or media is not allowed on the area unless under the direct supervision of the Information Officer. In the event of an accident, first aid will be administered at the site and, if necessary, assistance will be requested by radio. Transportation will be provided by Rush Volunteer Ambulance Corps to Strong Memorial Hospital, Rochester, nine miles north via Five points Road and State Route 15.

L. Communications:

Incident Commander - George Ezzo	607-776-2165
Information Officer - Jim Peek	607-776-2165
Operations Chief - Jim Carpenter	607-522-3323
Silvicultural Specialist - Mark Keister	716-226-2466
Nature Conservancy - Andy Zepp	716-546-8030

M. Briefing Guidelines and Supervision:

The Incident Commander will be in charge of all firing decisions. Personnel will be briefed in their responsibilities, and the plan of firing based on an analysis of weather and site conditions. The Incident Commander will base "go/no-go" decisions on the "go/no-go" checklist.

N. Test Fire: A 5 meter square area will be test burned to check in fuel moisture is low enough to ensure a suitable burn and weather conditions are favorable to predict fire behavior.

O. Firing, Containment, Mop-Up and Patrol: Firing will be carried out using the strip-head fire technique, using drip torches. Containment will be accomplished using fire lanes extra margin of safety. Fire lanes will be patrolled by crew members with Indian tanks, fire rakes and brooms. Mop-up will begin immediately after each sector is burned and will continue until the fire is completely extinguished. One final inspection of the burn area will be done by the silvicultural Specialist following completion of burning for the day.

P. Contingency: Should a fire escape, attack trucks will be strategically placed to respond immediately to any problem area. In addition, two shallow water impoundments have been constructed at each end of the area to supply water to the portable pumps for use in combating any escape, as well as assisting with any needs during the prescribed fire. The Rush Fire Department will be on standby as an added precaution. As stated previously, the Incident Commander will be in charge of all suppression activities.

Q. Monitoring and Evaluation (see also Item F.): To be performed on an annual basis by Nature Conservancy and DEC Forestry staff.

R. Rehabilitation: No clean-up or erosion control is needed.

S. Costs:

Plan, permits, and approvals:	15 man days,	$ 4500 plus benefits
Annual fire line maintenance:	1 man day	$ 250 inc. equipment
Equipment use & depreciation:	2 days	$ 248
Personnel	2 days	
1 Assoc. Forester		$ 320
2 Sr. Foresters		$ 600
1 Regional Ranger		$ 370
2 Forest Rangers		$ 540
1 Sr. Forester		$ 220
TOTAL		$7048

Volunteers are not figured into costs, but without their help, the burn would be extremely expensive.999

GO/NO-GO CHECK LIST

(A "No" to any item means "Stop")

1. Are all fire prescription specifications met?

2. Are all smoke management prescription specifications met?

3. Is fire weather forecast favorable?

4. Are all necessary personnel on hand?

5. Have all personnel had a safety briefing?

6. Is all required equipment in place?

7. Has test fire responded as expected?

Computer models of fire specifications may be obtained upon request.

Supporting Documentation
(*may be obtained upon request)

1. Article 24 Freshwater Wetlands Permit.*
2. Approval from Monroe County Department of Health.*
3. Waivers (3) for permission to burn within 75 feet of property line.*
4. Long Form Environmental Impact Statement.*
5. SEQR Review and Negative Deceleration of Non-Significance.*
6. Natural Heritage Ranking - Ecological and historical significance.
7. Go/No-Go Checklist.

Plan prepared by:

_____
Mark Keister
Senior Forester

_____
George Ezzo
Captain - NYS Forest Rangers

_____
Daniel W. Weller, Chief Date
Bureau of Forest Resource Management

_____
Edward F. Jacoby, Superintendent Date
Bureau of Forest Protection and Fire Management

_____
Robert H. Bathrick, Director Date
Division of Lands and Forests

3. Work Schedule/Fiscal Needs

Currently the Bureau of Public Lands has an extremely limited budget for the management of all DEC lands under the bureau's jurisdiction.

Funding is primarily derived from:

- services in lieu of payment during commercial sales of forest products. (These services are limited to the specific location where the sale occurs.)
- Capital construction account (State Legislature General Fund monies)
- Rehabilitation & Improvement (R&I) account (State Legislature General Fund monies)
- Stewardship - Special Revenue Other (SRO) account. Note: The primary sourse of revenue for the SRO account is from commercial sales of forest products listed above.

Allocations from these accounts must be spread among all the areas within the region. This means there is no specific budget for management of an individual site. Funding is distrubuted based upon priorities for all areas within the region. Accomplishments listed in the work schedule may not be met due to lack of funds combined with higher priority projects on other areas within the region.

The following table lists planned activities for the next 10 years. Note: NC = Nature Conservancy

Work Schedule				
ACTION	STARTING DATE	COMPLETION DATE	RESPONSIBILITY	ESTIMATED COST / INCOME
Inventory	6/30/98	4/30/99	State Forests (Gretchen)	
Management agreement w/ Niagara Mohawk Power	5/1/98	8/1/98	State Forests	
Upgrade access road &Construct water control structure, Goff tract	8/1/98	12/31/98	State Forests	$6500.
Update Prescribed Burn Plan	9/1/98	3/15/99	State Forests/Ranger Division	
Construct Firebreaks on Goff Tract	7/1/98	3/15/99	NC & volunteers	

Mowing/Brush hogging white sweet clover	7/1/98	Annual inspection	DEC Division of Operations	$30/ac. 10yr.total $1500.
Monitoring Program	N/A	Annual	NC	
Cut Scotch pine, apple, thornapple Field #1, Goff Tract	6/1/98	10/1/99	State Forests	
Restore Field #9 , Goff Tract	6/1/99	10/1/00	State Forests & NC	$150/ac Total $2250
Interpretive & Education Walks Brouchures	12/31/98	1/1/01	NC & State Forests	$5000.
Monitor & Control of Swallowwort Garlic Mustard	5/1/98	Annual	NC	
Manage Overstory Canopy	5/1/98	10/31/04	Volunteers/ Commercial Sales/ State Forests Staff	$50/ac (income)
Restore Field #8, Goff Tract Hydro-ax /herbicide area# Quinn Tract	6/1/00	6/1/01	State Forests, US Fish & Wildlife, NC	$550/ac Total $11000.
Seed Collection	9/15/98	Annual	NC	
Restore Field #11, Goff Tract	3/15/06*	6/30/07	State Forests & NC	$100/ac Total $1200.
				$27450 Total

D. Policy

1. The laws, regulations, and policies listed provide guidelines within which this plan is prepared.

Environmental Conservation Laws (ECL)

- Article 8 - Envronmental Quality Review
- Article 9 - Lands and Forests
- Article 11 - Fish and Wildlife
- Article 15 - Water Resources
- Article 23 - Mineral Resources
- Article 24 - Freshwater Wetlands
- Article 33 - Pesticides
- Article 71 - Enforcement

New York Code Rules and Regulations (NYCRR)

- Chapter I - Fish and Wildlife
- Chapter II - Lands and Forests
- Chapter III - Air Resources
- Chapter IV - Quality Services
- ChapterV - Resource Management Services
- Chapter VI - State Environmental Quality Review
- Chapter X - Division of Water Resources

Department Policies

- Temporary Revocable Permeits
- Motor Vehicle Use
- Timber Management
- Unit Management Plannning
- Pesticides
- Prescribed Burning
- Inventory
- Acquisition
- Road Construction

Monroe County Sanitary Code

- Open Burning Control

2. Because this property was purchased with funding from 1986 EQBA- Exceptional Forest Category and Environmental Protection Fund - Small projects category, specific rules and regulations do not exist in Lands and Forest, Title 6 NYCRR, part 190. This issue will be addressed within the unit management plan public hearings. Rules and regulations drafted for Rush Oak Openings will be submitted to the State Legislature for action.

3. Proposed rules and regulations - Rush Oak Openings

Title 6 Codes, Rules & Regulations, State of New York
Chapter II Lands and Forests, Part 190.11 , Environmentally sensitive lands.
proposed- (b.) *Rush Oak Openings*. Those lands in the Town of Rush, Monroe County described in "Boundary Description of Rush Oak Openings on file in the central and region 8 offices of the department. Specific regulations for Rush Oak Openings are set forth in this subdivision and supersede the general regulations enumerated in sections 190.0-190.9 in the event of a conflict.

1. fires are prohibited at all times, except prescribed fires as directed by the department;

2. camping is prohibited;

3. the use of snowmobiles is prohibited;

4. the riding or other use of horses is prohibited;

5. bicycles are prohibited;

6. parking of motor vehicles permitted in designated sites only;

5

Public Participation

Public involvement is considered an integral part of the Unit Management planning process.

DEC believes it is important to exchange information with those interested in management of DEC lands or are directly affected by the actions and decisions that are made. In creating an initial contact list groups and individuals were identified in the following categories:

- Adjacent landowners
- Local government
- Forest related associations
- Environmental associations
- Wildlife associations
- Economic interests
- Media Press Release

DEC used the contact list to announce the upcoming planning process, and encourage those with concerns, comments, suggestions or special interests to attend an informational meeting held January 23, 1997 at Rush Town Hall or submit written comments to the department. Comments received at that public meeting plus written comments received were taken into consideration in the formulation of this plan.

The draft Unit Management Plan is distributed for review to:

- Rush Library and Town Clerk
- Honeoye Falls Village Clerk
- Rush/ Henrietta Library
- DEC, Region 8 Headquarters, Avon
- DEC, Region 8 Suboffice, Bath
- Nature Conservancy, Western NY Region, Rochester

The next public meeting is scheduled for 7:00pm August 25, 1998 at the Rush Town Hall.

After public review of the draft, the final plan will be completed and made available to anyone who requests it. A response summary to the comments and questions received on the draft plan is in Appendix # *(to be added*) of this document.

DEC will report on its progress toward implementing the plan in five years. The public will be notified by direct contact and by media press release. Comments from interested parties will be accepted by DEC prior to any revisions to the existing plan. If interest warrents, public meetings will be held.

6

Maps

Location

Management Units

Topographic

Soils

Proposed Niagara Mohawk Acquisition

DEC Regulated Wetlands/plus/Vegetation Control

Prescribed Fire/Year of most recent burn

Agricultural Lease

7

Appendices

APPENDIX I: HERITAGE PROGRAM ELEMENT RANKS

Communities and rare species are the mapping units or "elements" of the Heritage inventory. Each community and species element is assigned and "element rank" consisting of a combined global and state rank. The global rank reflects the rarity of the element throughout the world and the state rank reflects the rarity within New York State (The Nature Conservancy 1982). Global ranks for communities are not currently standardized by The Nature Conservancy, so the ranks listed in the community descriptions are estimated global ranks. — ECOLOGICAL COMMUNITIES OF NEW YORK STATE. Carol Reschke, 1990.

GLOBAL RANKS – reflects the rarity of the element throughout the world.

G1 = Critically imperiled throughout its range due to extreme rarity (5 or fewer occurrences, o very few remaining individuals, acres, or miles of stream) or extremely vulnerable to extinction due to biological factors.

G2 = Imperiled throughout its range due to rarity (6 – 20 occurrences, or very few remaining individuals, acres, or miles of stream) or highly vulnerable to extinction due to biological factors.

G3 = Either very rare throughout its range (21 – 100 occurrences), with a restricted range (but possibly locally abundant), or vulnerable to extinction due to biological factors.

G4 = Apparently secure throughout its range (but possibly rare in parts of its range).

G5 = Demonstrably secure throughout its range (however it may be rare in certain areas).

TU = Status of the subspecies or variety unknown.

STATE RANKS – reflects the rarity within New York State.

S1 = Typically 5 or fewer occurrences, very few remaining individuals, acres, or miles of stream, or especially vulnerable to extirpation in New York State for other reasons.

S2 = Typically 6 – 20 occurrences, few remaining individuals, acres, or miles of stream, or very vulnerable to extirpation in New York State for other reasons.

S3 = Typically 21 – 100 occurrences, limited acreage, acres, or miles of stream New York State.

S4 = Apparently secure in New York State.
S5 = Demonstrably secure in New York State.
SH = No extant sites known in New York but it may be rediscovered.

APPENDIX II: RUSH OAK VEGETATION

This appendix includes a listing of the rare, threatened and endangered plant species and an inventory of the plants recorded from Rush Oak Opening to date. The vegetation inventory was compiled from two sources, the three–day site visit by Conservation Research Institute staff in July 1997 and the monitoring surveys done since the early 1990's. Even with the combination of these three sources, the list of plant species is still not complete. Each list was recorded in a short period of time and only once during the growing season. It is likely that many more species will be added to this list as a more comprehensive seasonal inventory is undertaken and restoration is implemented.

Table 1 lists the status of ranked plant species known from Rush Oak Opening. Categories were derived from the list provided by the New York Heritage Program's Biological Conservation Database (BCD) last revised in March 1997. See Appendix I for the definitions of the Heritage Program Element Ranks.

Table 1. Rare, Threatened, and Endangered Species

SCIENTIFIC NAME	COMMON NAME	GLOBAL	STATE	STATE	COUNTY
Allium burdickii	wild leek	G4 G5	SH	U	
Aster puniceus firmus	cornel–leaved aster	G5 T5[1]	S1?[2]	U	P[3]
Blephilia ciliata	downy wood mint	G5	S1	T	
Carex hitchcockiana	Hitchcock's sedge	G5	S2	U	P
Carex jamesii	Nebraska sedge	G5	S2	U	C[4]
Carex molesta	troublesome sedge	G4	S2	R	P
Carex seorsa	weak stellate sedge	G4	S2	R	
Desmodium ciliare	little–leaf tick–trefoil	G5	S2 S3	T	C
Desmodium obtusum	beggar–lice	G4 G5	S1	U	C
Equisetum laevigatum	smooth scouring rush	G5	SH	U	
Galium concinnum	shining bedstraw	G5	SH	U	P
Juncus brachycarpus	short–fruited rush	G4 G5	S1	U	
Lilium michiganense	Michigan lily	G5	S1	E	P
Solidago rugosa sphagnophila	tall hairy goldenrod	G5 TU[5]	SH	U	
Trillium flexipes	nodding trillium	G5	S1	V	C
Valerianella chenopodifolia	goosefoot corn salad	G5	S1	U	C
Viola nephrophylla	northern bog violet	G5	S1	R	P

[1] T = refers to the rarity of the subspecific taxon, not the rarity of the species as a whole.

[2] ? = an identification question exists about known occurrences. It also indicates the rank presumably corresponds to actual occurrences even though the information has not yet been documented in heritage files or historical records.

[3] P = the plant has been documented by a specimen more than 15 years old (probable).

[4] C =the plant is known to exist in the county (confirmed).

[5] TU = Status of the subspecies or variety unknown.

Table 2. Physiognomic Assessment

	NATIVE		ADVENTIVE	
PHYSIOGNOMY	#	%	#	%
Total Species	331	81.1%	77	19.1%
Tree	40	9.8%	5	1.2%
Shrub	22	5.4%	6	1.5%
Vine	7	1.7%	1	0.2%
Forb	169	41.4%	57	14.0%
Grass	22	5.4%	9	2.2%
Sedge	51	12.5%	--	--

Table 2 reflects the vegetational physiognomic

categories of all the species recorded from Rush oak opening. It shows the total number and percent of native and adventive species and the number and percent in each category.

Table 3 shows the Floristic Quality Assessment (FQA) of Rush Oak Opening using the version developed for southern Ontario. This system was first developed by Gerould Wilhelm for the Chicago region in 1979 to evaluate natural remnant quality. In 1994, M. Oldham, W. Bakowsky, and D. Sutherland developed a version for the portion of Ontario south of the Precambrian Shield (excluding Manitoulin Island). Essentially, this evaluation is based upon the assignation of a "coefficient of conservatism" of between 0 and 10 to each native species in a defined region. "Conservative" plants that typify an advanced successional phase of a native community or exhibit a high degree of fidelity to specific habitat types are assigned high values. Those species with a broad range of ecological tolerances that occur in a variety of disturbed habitats are assigned lower values.

Although, this particular checklist was developed specifically for southern Ontario, and realizing that the further away one gets from the defined area the decreasingly valid the applied values become, the proximity of western New York to southern Ontario and the strong relationship between the western New York flora and that of southern Ontario, deemed the use of Ontario's coefficient of conservatism values acceptable. The results will give an indication of the quality of Rush Oak Opening. The FQA database for Ontario was compiled by combining the checklists of Riley (1989), Cuddy (1991), and Oldham (1993). Nomenclature largely follows Morton & Venn (1990).

Floristic quality assessment (FQA) is based on the concept of species conservatism. Conservatism is defined by the confidence one has about how restricted a species is to high–quality remnant habitats, those natural areas with intact presettlement structure, composition, and processes. Native plants of an area exhibit an observable range of conservatism. Some are ubiquitous and commonly found in degraded or ruderal conditions. Others are restricted to highly specific remnant habitats, such as marl flats, bogs, or sedge turfs in savannas.

To assess floristic quality quantitatively using FQA, native plants are given coefficients of conservatism (C) that range from 0 to 10. When analyzing an inventory, the mean C of the entire list of native plants will be informative about the floristic quality of the site. If your site has a large proportion of conservative plants, the mean C is higher; if it is degraded, the mean C will be lower. Often in relatively high–quality plant communities that are being managed, the mean C will tend to remain stable, while the total number of species may increase, decrease or remain the same. What a change in species richness means in terms of floristic quality is measured by calculating a floristic quality index (FQI). The FQI is calculated by multiplying the mean C by the square root of the total number of native species recorded (FQI = $C\sqrt{n}$). Because the FQI takes into account the number of species along with the mean C, it incorporates species richness and quality so that floristic diversity is integrated as a qualitative measurement. As management causes change to take place, the mean C and the FQI will reflect the extent to

which conservative species are being recruited and the floristic quality is improving.

A range of conservatism can be demonstrated by considering three plants from a tallgrass prairie: common ragweed *(Ambrosia artemisiifolia*), wild bergamot (*Monarda fistulosa*), and prairie lily (*Lilium philadelphicum*). There is little disagreement among botanists concerning the level of conservatism these plants exhibit. The ragweed can be found in all types of degraded sites, from roadsides and vacant lots to disturbed areas in high–quality prairies. There would be no confidence that the presence of this plant would indicate a remnant habitat; it would not be considered at all conservative. The bergamot, on the other hand, is fairly sensitive to habitat degradation and is restricted to sites with at least some natural remnant quality; therefore, compared to ragweed, wild bergamot is considered a relatively conservative plant. The lily is considered a highly conservative plant because it is narrowly restricted to high–quali prairie, savanna, or fen remnants. Note that a plant's conservatism is described not by its restrictedness to specific plant communities but rather to high–quality remnants in a particular region.

Only the native plants of an area are assigned C values, because these native species represent the distillation of thousands of years of local natural selection. These species reflect the effect of sustained inhabitancy at a particular site, with its individual variations of substrate, moisture, slope, aspect, and vicissitudes of seasonal and yearly fluctuations. Communities consisting of a high ratio of conservative to non–conservative plants reflect relative stability within the natural fluctuation that is characteristic of healthy biological systems. The presence of a large proportion of adventive species and non–conservative natives suggests an area that has been degraded by overgrazing, plowing, soil removal, fire–suppression, and the like.

It is possible to improvise rankings. Beginning with the values on the Ontario list and enlisting the help of a person (or even better, a group of people) with a thorough knowledge of a region's native flora and its ecology, a spectrum of conservatism rankings can be derived. Coefficients are assigned to each native taxon using the guiding philosophy that the assignations reflect only the relative conservatism of each species to remnant habitats within the context of the region under consideration, and without specific regard to rareness, showiness, wildlife amenities, etc. When two or more experienced botanists have assigned different coefficients fo a given area, an averaging of their values may provide improved precision.

It is possible to begin with a simplified conservatism scale of zero, five, and ten. A zero would indicate native species most commonly found in recently disturbed areas; ten would apply to species restricted to high–quality remnants; and five would cover all the rest. Referring to our previous example, common ragweed would rate zero, wild bergamot a five, and prairie lily a

ten.

If you attempt to assign coefficients in this way you will quickly discover that there are species with conservatism values intermediate between zero and five, and between five and ten. Once you have assigned the coefficients, begin to fine tune them by adjusting the coefficients to refle species behavior in your defined geographic area by splitting out threes and sevens. With continued observation of the plants in your area, continue the fine tuning until you have a full range of C values from zero to ten.

In theory, C values could be objectively determined by sampling in areas of varying quality (as determined by some objective method). Such an ambitious task, however, has not yet been carried out. Thus, the existing FQA systems all depend on the subjective judgement of independent, experienced botanists who assigned the coefficients. However, the FQA process has an advantage over most other community quality assessment methods in that, once the numbers are assigned, subsequent use of the system, including the qualitative comparisons between areas or within areas over time, is entirely objective and repeatable.

Table 3 shows the number of species present, the mean coefficient of conservatism, and the floristic quality index (FQI) of the plants recorded at Rush Oak Opening to date. These are calculated separately for natives and then including the adventive species (W/Adventives). The FQI is derived by multiplying mean C by the square root of the number of species. If the FQI registers in the middle 30's or higher, or if the mean C is 3.5 or higher, it is relatively certain that there is sufficient native character in this site to be important in terms of a regional natural area perspective.

Table 3. Floristic Quality Assessment
FQI = Floristic Quality Index
C = Coefficient of Conservatism

NATIVE SPECIES	331
Total Species	408
NATIVE MEAN C	5.24
W/Adventives	4.25
NATIVE FQI	95.42
W/Adventives	85.92

Each species in the following tabulation of plant species is preceded by its coefficient of conservatism and followed by its physiognomy, common name, and plant community association. Native taxa are species believed to have been present in New York before settlement. Adventives, shown in ALL CAPS, include species that have entered the region since settlement and therefore are not integral to any presettlement community.

C	Scientific Name	Physiognomy	Common Name	Oak Opening	Oak Woods	Limestone Woods	Swamp Forest	Vernal Pond	Sedge Meadow	Shrub Swamp	Old Field	Shrub Land
0	*Acer negundo*	Tree	box elder									X
7	*Acer nigrum*	Tree	black maple		X	X	X					
4	*Acer rubrum*	Tree	red maple				X					
5	*Acer saccharinum*	Tree	silver maple				X					
4	*Acer saccharum*	Tree	sugar maple		X	X	X					
*	*ACHILLEA MILLEFOLIUM*	Forb	yarrow	X							X	
6	*Actaea pachypoda*	Forb	white baneberry		X	X						
7	*Adiantum pedatum*	Fern	maidenhair fern			X						
2	*Agrimonia gryposepala*	Forb	tall agrimony		X						X	
7	*Agrimonia pubescens*	Forb	soft agrimony		X	X						
*	*AGROPYRON REPENS*	Grass	quack grass								X	
7	*Agropyron trachycaulum*	Grass	slender wheat grass	X								
*	*AGROSTIS GIGANTEA*	Grass	redtop	X							X	X
3	*Alisma plantago-aquatica*	Forb	water plantain					X				
*	*ALLIARIA PETIOLATA*	Forb	garlic mustard		X							
9	*Allium burdickii*	Forb	wild leek		X							
7	*Allium tricoccum*	Forb	wild leek		X	X						
*	*ALLIUM VINEALE*	Forb	field garlic								X	
0	*Ambrosia artemisiifolia*	Forb	common ragweed								X	X
5	*Amelanchier arborea*	Tree	Juneberry			X						
4	*Amphicarpaea bracteata*	Forb	hog peanut		X							
3	*Anaphalis margaritacea*	Forb	pearly everlasting								X	
3	*Anemone canadensis*	Forb	meadow anemone									
7	*Anemone cylindrica*	Forb	thimbleweed	X								

C	Scientific Name	Physiognomy	Common Name	Oak Opening	Oak Woods	Limestone Woods	Swamp Forest	Vernal Pond	Sedge Meadow	Shrub Swamp	Old Field	Shrub Land
4	*Anemone virginiana*	Forb	thimbleweed		X						X	
3	*Antennaria neglecta*	Forb	cat's foot	X								
2	*Antennaria plantaginifolia*	Forb	smooth pussytoes	X								
*	*ANTHOXANTHUM ODORATUM*	Grass	sweet vernal grass								X	
3	*Apocynum androsaemifolium*	Forb	spreading dogbane	X								
3	*Apocynum cannabinum*	Forb	Indian hemp								X	
5	*Aquilegia canadensis*	Forb	wild columbine		X	X						
7	*Arabis canadensis*	Forb	sickle-pod			X						
5	*Arabis laevigata*	Forb	smooth bank cress		X							
*	*ARCTIUM MINUS*	Forb	common burdock								X	
5	*Arisaema triphyllum*	Forb	Jack-in-the-pulpit		X	X	X					
*	*ARTEMISIA VULGARIS*	Forb	mugwort								X	
6	*Asarum canadense*	Forb	wild ginger		X	X						
8	*Asclepias exaltata*	Forb	poke milkweed		X							
6	*Asclepias incarnata*	Forb	swamp milkweed						X			
10	*Asclepias quadrifolia*	Forb	four-leaved milkweed		X							
0	*Asclepias syriaca*	Forb	common milkweed								X	
8	*Asclepias tuberosa*	Forb	butterfly-weed	X								
*	*ASPARAGUS OFFICINALIS*	Forb	asparagus								X	
6	*Asplenium platyneuron*	Fern	ebony spleenwort		X	X						
9	*Asplenium rhizophyllum (Camptosorus*	Fern	walking fern			X						
5	*Aster cordifolius*	Forb	heart-leaved aster			X						
10	*Aster divaricatus*	Forb	white wood aster		X							
4	*Aster ericoides*	Forb	heath aster	X								

C	Scientific Name	Physiognomy	Common Name	Oak Opening	Oak Woods	Limestone Woods	Swamp Forest	Vernal Pond	Sedge Meadow	Shrub Swamp	Old Field	Shrub Land
7	*Aster laevis*	Forb	smooth aster	X								
3	*Aster lateriflorus*	Forb	calico aster		X							
5	*Aster macrophyllus*	Forb	big-leaved aster		X	X						
2	*Aster novae-angliae*	Forb	New England aster	X								
4	*Aster pilosus*	Forb	hairy aster	X							X	X
9	*Aster prenanthoides*	Forb	crooked aster									
6	*Aster puniceus firmus*	Forb	cornel-leaved aster						X		X	
8	*Aster undulatus*	Forb	undulate-leaved aster		X							
6	*Aster sagittifolius*	Forb	arrow-leaved aster	X								
4	*Athyrium filix-femina*	Fern	lady fern		X	X						
10	*Aureolaria virginica*	Forb	downy false foxglove		X							
*	*BERBERIS THUNBERGII*	Shrub	Japanese barberry		X							
*	*BERTEROA INCANA*	Forb	hoary alyssum								X	
2	*Bidens cernua*	Forb	nodding bur marigold						X	X		
10	*Blephilia ciliata*	Forb	downy wood mint	X							X	
4	*Boehmeria cylindrica*	Forb	false nettle				X	X	X			
5	*Botrychium virginianum*	Fern	rattlesnake fern		X	X						
7	*Brachyelytrum erectum*	Grass	long-awned wood grass			X						
*	*BROMUS INERMIS*	Grass	Hungarian brome								X	
7	*Bromus pubescens*	Grass	Canada brome		X							
4	*Calamagrostis canadensis*	Grass	blue-joint grass						X			
10	*Calamintha arkansana*	Forb	low calamint	X								
5	*Caltha palustris*	Forb	marsh marigold				X	X		X		
2	*Calystegia sepium (Convolvulus s.)*	Forb	hedge bindweed	X							X	X

C	Scientific Name	Physiognomy	Common Name	Oak Opening	Oak Woods	Limestone Woods	Swamp Forest	Vernal Pond	Sedge Meadow	Shrub Swamp	Old Field	Shrub Land
8	*Campanula americana*	Forb	tall bellflower		X							
5	*Carex aggregata*	Sedge	sedge		X							
7	*Carex albursina*	Sedge	sedge		X	X						
10	*Carex atlantica (C. howei)*	Sedge	sedge						X			
4	*Carex aurea*	Sedge	sedge	X								
3	*Carex blanda*	Sedge	sedge		X	X					X	
7	*Carex brevior*	Sedge	sedge								X	
7	*Carex bromoides*	Sedge	sedge				X	X				
10	*Carex careyana*	Sedge	sedge		X							
5	*Carex cephalophora*	Sedge	sedge		X	X						
6	*Carex communis*	Sedge	sedge		X	X						
5	*Carex comosa*	Sedge	sedge							X		
3	*Carex cristatella*	Sedge	sedge				X	X				
7	*Carex digitalis*	Sedge	sedge		X	X						
5	*Carex flava*	Sedge	sedge						X			
4	*Carex gracillima*	Sedge	sedge		X							
3	*Carex granularis*	Sedge	sedge						X	X	X	
8	*Carex grisea (C. amphibola turgida)*	Sedge	sedge		X	X	X					
5	*Carex hirtifolia*	Sedge	sedge		X							
6	*Carex hitchcockiana*	Sedge	Hitchcock's sedge		X							
6	*Carex interior*	Sedge	sedge						X			
6	*Carex intumescens*	Sedge	sedge				X	X				
8	*Carex jamesii*	Sedge	Nebraska sedge		X	X						
5	*Carex lacustris*	Sedge	sedge						X			

C	Scientific Name	Physiognomy	Common Name	Oak Opening	Oak Woods	Limestone Woods	Swamp Forest	Vernal Pond	Sedge Meadow	Shrub Swamp	Old Field	Shrub Land
4	*Carex lanuginosa (C. pellita)*	Sedge	sedge						X			
7	*Carex laxiculmis*	Sedge	sedge			X						
5	*Carex laxiflora*	Sedge	sedge		X							
6	*Carex lupulina*	Sedge	sedge				X					
5	*Carex molesta*	Sedge	sedge	X							X	
7	*Carex muehlenbergii*	Sedge	sedge		X							
6	*Carex normalis*	Sedge	sedge		X							
9	*Carex oligocarpa*	Sedge	sedge		X							
5	*Carex pedunculata*	Sedge	sedge			X						
5	*Carex pensylvanica*	Sedge	sedge	X	X	X						
7	*Carex plantaginea*	Sedge	sedge		X							
4	*Carex radiata (C. rosea)*	Sedge	sedge				X					
9	*Carex retroflexa*	Sedge	sedge								X	
5	*Carex retrorsa*	Sedge	sedge				X					
5	*Carex rosea (C. convoluta)*	Sedge	wood sedge		X	X						
8	*Carex scabrata*	Sedge	sedge			X						
10	*Carex seorsa*	Sedge	weak stellate sedge				X	X				
5	*Carex sparganioides*	Sedge	sedge	X			X	X				
3	*Carex stipata*	Sedge	sedge				X	X			X	
4	*Carex tenera*	Sedge	sedge		X							
5	*Carex tribuloides*	Sedge	sedge				X	X				
3	*Carex vulpinoidea*	Sedge	sedge				X				X	
6	*Carex woodii*	Sedge	sedge		X							
6	*Carpinus caroliniana*	Tree	hornbeam		X	X						

C	Scientific Name	Physiognomy	Common Name	Oak Opening	Oak Woods	Limestone Woods	Swamp Forest	Vernal Pond	Sedge Meadow	Shrub Swamp	Old Field	Shrub Land
6	*Carya cordiformis*	Tree	bitternut hickory		X							
9	*Carya glabra (C. ovalis)*	Tree	pignut hickory		X							
6	*Carya ovata*	Tree	shagbark hickory		X	X					X	
6	*Caulophyllum thalictroides (C. giganteum)*	Forb	blue cohosh		X							
3	*Celastrus scandens*	Vine	climbing bittersweet									X
8	*Celtis occidentalis*	Tree	hackberry		X	X						
*	*CENTAUREA JACEA*	Forb	brown knapweed								X	
*	*CENTAUREA NIGRA*	Forb	black knapweed								X	
*	*CENTAURIUM PULCHELLUM*	Forb	branching centaury								X	
7	*Cephalanthus occidentalis*	Shrub	button bush							X		
8	*Cerastium arvense strictum*	Forb	field chickweed		X							
*	*CHRYSANTHEMUM LEUCANTHEMUM*	Forb	ox-eye daisy	X							X	X
*	*CICHORIUM INTYBUS*	Forb	chicory								X	X
5	*Cicuta bulbifera*	Forb	water hemlock						X			
7	*Cinna arundinacea*	Grass	wood reedgrass				X					
3	*Circaea lutetiana*	Forb	enchanter's-nightshade		X	X	X					
*	*CIRSIUM ARVENSE*	Forb	Canadian thistle								X	X
10	*Cirsium hillii*	Forb	Hill's thistle	X								
4	*Clinopodium vulgare*	Forb	wild basil		X							
8	*Collinsonia canadensis*	Forb	richweed			X						
6	*Comandra umbellata*	Forb	bastard toadflax	X								
9	*Conopholis americana*	Forb	squawroot		X	X						
*	*CONVOLVULUS ARVENSIS*	Forb	field bindweed								X	
0	*Conyza canadensis (Erigeron c.)*	Forb	horseweed								X	X

C	Scientific Name	Physiognomy	Common Name	Oak Opening	Oak Woods	Limestone Woods	Swamp Forest	Vernal Pond	Sedge Meadow	Shrub Swamp	Old Field	Shrub Land
6	*Cornus alternifolia*	Tree	alternate-leaved dogwood			X						
5	*Cornus amomum (C. obliqua)*	Shrub	silky dogwood				X		X			
7	*Cornus florida*	Tree	flowering dogwood		X							
2	*Cornus foemina (C. racemosa)*	Shrub	gray dogwood							X	X	X
*	*CORONILLA VARIA*	Forb	crown vetch								X	
4	*Crataegus holmesiana*	Tree	hawthorn		X							
4	*Crataegus punctata*	Tree	dotted hawthorn									X
5	*Cystopteris bulbifera*	Fern	bulblet fern			X						
7	*Cystopteris fragilis*	Fern	fragile fern		X							
*	*DACTYLIS GLOMERATA*	Grass	orchard grass								X	
5	*Danthonia spicata*	Grass	poverty oat grass	X	X							
*	*DAUCUS CAROTA*	Forb	Queen Anne's lace	X							X	X
5	*Desmodium canadense*	Forb	showy tick-trefoil	X								
10	*Desmodium ciliare*	Forb	hairy tick-trefoil		X							
10	*Desmodium cuspidatum*	Forb	smooth-bracted tick-trefoil		X							
6	*Desmodium glutinosum*	Forb	clustered-leaved		X	X						
6	*Desmodium paniculatum dillenii*	Forb	panicled tick-trefoil		X							
8	*Desmodium paniculatum*	Forb	panicled tick-trefoil	X	X							
*	*DIANTHUS ARMERIA*	Forb	deptford pink								X	
*	*DIPSACUS SYLVESTRIS*	Forb	common teasel								X	
5	*Dryopteris intermedia*	Fern	evergreen woodfern		X							
5	*Dryopteris marginalis*	Fern	marginal woodfern		X	X						
*	*ELAEAGNUS UMBELLATA*	Shrub	autumn olive								X	X
4	*Eleocharis erythropoda*	Sedge	spike rush				X		X	X		

C	Scientific Name	Physiognomy	Common Name	Oak Opening	Oak Woods	Limestone Woods	Swamp Forest	Vernal Pond	Sedge Meadow	Shrub Swamp	Old Field	Shrub Land
6	*Eleocharis smallii*	Sedge	spike rush						X			
6	*Epifagus virginiana*	Forb	beech drops			X						
*	*EPIPACTIS HELLEBORINE*	Forb	helleborine		X	X						
0	*Equisetum arvense*	Fern	common horsetail			X					X	
7	*Equisetum fluviatile*	Fern	water horsetail							X		
2	*Equisetum hyemale*	Fern	scouring rush								X	
7	*Equisetum laevigatum*	Fern	smooth scouring rush								X	
0	*Erigeron annuus*	Forb	annual fleabane	X							X	
1	*Erigeron philadelphicus*	Forb	marsh fleabane				X		X		X	
7	*Erigeron pulchellus*	Forb	Robin's plantain			X						
0	*Erigeron strigosus*	Forb	daisy fleabane	X								
3	*Eupatorium maculatum*	Forb	spotted Joe-pye weed						X			
2	*Eupatorium perfoliatum*	Forb	common boneset						X	X		
5	*Eupatorium rugosum*	Forb	white snakeroot		X	X						
*	*EUPHORBIA CYPARISSIAS*	Forb	cypress spurge								X	
0	*Euphorbia maculata*	Forb	blunt–leaved spurge								X	
*	*FESTUCA ARUNDINACEA*	Grass	tall fescue								X	
6	*Festuca obtusa*	Grass	nodding fescue		X	X						
4	*Fragaria vesca*	Forb	woodland strawberry			X						
2	*Fragaria virginiana*	Forb	wild strawberry	X	X	X					X	
4	*Fraxinus americana*	Tree	white ash		X	X					X	X
7	*Fraxinus nigra*	Tree	black ash				X					
3	*Fraxinus pennsylvanica*	Tree	red ash				X				X	X
4	*Galium aparine*	Forb	annual bedstraw	X	X	X					X	X
7	*Galium boreale*	Forb	northern bedstraw	X								

C	Scientific Name	Physiognomy	Common Name	Oak Opening	Oak Woods	Limestone Woods	Swamp Forest	Vernal Pond	Sedge Meadow	Shrub Swamp	Old Field	Shrub Land
7	*Galium circaezans*	Forb	white wild licorice		X							
9	*Galium concinnum*	Forb	shining bedstraw		X	X						
*	*GALIUM MOLLUGO*	Forb	white bedstraw								X	
9	*Galium pilosum*	Forb	hairy bedstraw	X								
4	*Galium triflorum*	Forb	fragrant bedstraw		X	X						
4	*Gaura biennis*	Forb	biennial gaura								X	
8	*Gentiana crinita*	Forb	fringed gentian						X			
6	*Geranium maculatum*	Forb	wild geranium		X	X						
*	*GERANIUM ROBERTIANUM*	Forb	Herb Robert		X	X						
2	*Geum aleppicum*	Forb	yellow avens						X			
3	*Geum canadense*	Forb	white avens		X	X	X				X	X
4	*Geum laciniatum*	Forb	rough avens					X			X	
3	*Gleditsia triacanthos*	Tree	honey locust								X	X
5	*Glyceria grandis*	Grass	reed manna grass							X		
8	*Glyceria septentrionalis*	Grass	floating manna grass							X		
3	*Glyceria striata*	Grass	fowl manna grass		X	X	X	X	X			
6	*Hamamelis virginiana*	Shrub	witch hazel		X	X						
*	*HEMEROCALLIS FULVA*	Forb	orange day lily								X	
6	*Hepatica acutiloba*	Forb	sharp-lobed hepatica		X							
*	*HESPERIS MATRONALIS*	Forb	dame's rocket								X	
*	*HIERACIUM CAESPITOSUM (H. PRATENSE)*	Forb	king devil								X	
7	*Hieracium scabrum*	Forb	rough hawkweed	X	X							
10	*Hieracium venosum*	Forb	rattlesnake weed			X						
9	*Hybanthus concolor*	Forb	green violet		X							
*	*HYPERICUM PERFORATUM*	Forb	common St. John's-wort								X	

C	Scientific Name	Physiognomy	Common Name	Oak Opening	Oak Woods	Limestone Woods	Swamp Forest	Vernal Pond	Sedge Meadow	Shrub Swamp	Old Field	Shrub Land
5	*Hystrix patula*	Grass	bottlebrush grass		X	X						
5	*Ilex verticillata*	Shrub	Michigan holly				X	X				
4	*Impatiens capensis*	Forb	spotted touch-me-not				X	X	X	X		
5	*Iris virginica*	Forb	blue flag				X	X	X	X		
6	*Juglans cinerea*	Tree	butternut			X						
5	*Juglans nigra*	Tree	black walnut		X						X	
6	*Juncus acuminatus*	Forb	sharp-fruited rush						X			
5	*Juncus alpinoarticulatus (J. alpinus)*	Forb	rush	X								
10	*Juncus brachycarpus*	Forb	short-fruited rush						X			
1	*Juncus dudleyi*	Forb	Dudley's rush	X							X	
0	*Juncus tenuis*	Forb	path rush		X						X	
3	*Leersia oryzoides*	Grass	rice cut grass							X		
2	*Lemna minor*	Forb	small duckweed							X		
4	*Lemna trisulca*	Forb	star duckweed							X		
*	*LEONURUS CARDIACA*	Forb	motherwort								X	
*	*LEPIDIUM CAMPESTRE*	Forb	field cress								X	
7	*Lilium michiganense*	Forb	Michigan lily		X							
8	*Lilium philadelphicum*	Forb	wood lily	X								
*	*LINARIA VULGARIS*	Forb	butter-and-eggs								X	
6	*Lindera benzoin*	Shrub	spicebush			X	X			X		
3	*Lobelia inflata*	Forb	Indian tobacco		X							
*	*LONICERA MORROWII*	Shrub	Morrow's honeysuckle		X							
*	*LONICERA X BELLA*	Shrub	showy bush honeysuckle		X							
*	*LOTUS CORNICULATA*	Forb	birdfoot trefoil								X	
6	*Luzula multiflora*	Forb	common wood rush		X							

C	Scientific Name	Physiognomy	Common Name	Oak Opening	Oak Woods	Limestone Woods	Swamp Forest	Vernal Pond	Sedge Meadow	Shrub Swamp	Old Field	Shrub Land
4	*Lycopus americanus*	Forb	common water horehound	X			X	X	X	X		
4	*Lysimachia ciliata*	Forb	Fringed loosestrife								X	
7	*Lysimachia thyrsiflora*	Forb	tufted loosestrife						X			
5	*Malus coronaria*	Tree	American crab	X								
*	*MALUS PUMILA*	Tree	apple								X	
5	*Matteuccia struthiopteris*	Fern	Ostrich fern				X					
*	*MEDICAGO LUPULINA*	Forb	black medick								X	
*	*MEDICAGO SATIVA*	Forb	alfalfa								X	
*	*MELILOTUS ALBA*	Forb	white sweet-clover								X	X
*	*MELILOTUS OFFICINALIS*	Forb	yellow sweet-clover								X	X
3	*Mentha arvensis*	Forb	wild mint						X			
6	*Mimulus ringens*	Forb	monkey-flower					X	X	X		
5	*Mitella diphylla*	Forb	bishop's cap			X						
6	*Monarda fistulosa*	Forb	wild bergamot	X							X	
10	*Moneses uniflora*	Forb	one-flowered pyrola		X							
*	*MORUS ALBA*	Tree	white mulberry		X						X	X
10	*Morus rubra*	Tree	red mulberry			X						
5	*Muhlenbergia frondosa*	Grass	common satin grass		X							
0	*Oenothera biennis*	Forb	common evening-primrose	X							X	
4	*Onoclea sensibilis*	Fern	sensitive fern				X					
7	*Osmunda cinnamomea*	Fern	cinnamon fern				X	X				
7	*Osmunda regalis*	Fern	royal fern				X	X				
4	*Ostrya virginiana*	Tree	hop hornbeam		X	X						
0	*Oxalis stricta*	Forb	yellow wood-sorrel	X	X						X	
8	*Panicum clandestinum*	Grass	panic grass		X						X	

C	Scientific Name	Physiognomy	Common Name	Oak Opening	Oak Woods	Limestone Woods	Swamp Forest	Vernal Pond	Sedge Meadow	Shrub Swamp	Old Field	Shrub Land
2	*Panicum implicatum*	Grass	panic grass	X							X	
6	*Panicum latifolium*	Grass	broad-leaved panic grass		X	X						
8	*Panicum sphaerocarpon*	Grass	round-fruited panic grass	X								
3	*Parthenocissus inserta*	Vine	thicket creeper								X	X
6	*Parthenocissus quinquefolia*	Vine	Virginia creeper		X	X	X					X
*	*PETASITES JAPONICUS (P. HYBRIDUS)*	Forb	butterfly dock								X	
*	*PHLEUM PRATENSE*	Grass	Timothy								X	
7	*Phlox divaricata*	Forb	woodland phlox		X	X						
0	*Phragmites australis (P. communis)*	Grass	giant reed								X	
6	*Phryma leptostachya*	Forb	lopseed		X	X						
3	*Physalis heterophylla*	Forb	clammy ground-cherry								X	
3	*Phytolacca americana*	Forb	pokeweed		X						X	
*	*PINUS SYLVESTRIS*	Tree	Scotch pine									X
*	*PLANTAGO LANCEOLATA*	Forb	English plantain	X							X	
1	*Plantago rugelii*	Forb	red-stalked plantain								X	
*	*POA COMPRESSA*	Grass	Canada bluegrass	X							X	X
5	*Poa palustris*	Grass	fowl meadow grass					X	X		X	
*	*POA PRATENSIS*	Grass	Kentucky bluegrass	X	X	X						
5	*Podophyllum peltatum*	Forb	May apple	X	X							
7	*Polygala verticillata*	Forb	whorled milkwort	X	X							
5	*Polygonatum pubescens*	Forb	downy Solomon seal			X						
5	*Polygonum amphibium*	Forb	water smartweed						X	X		
6	*Polygonum virginianum (Tovara v.)*	Forb	jumpseed		X	X					X	X
5	*Polystichum acrostichoides*	Fern	Christmas fern		X	X						
4	*Populus deltoides*	Tree	cottonwood				X				X	

C	Scientific Name	Physiognomy	Common Name	Oak Opening	Oak Woods	Limestone Woods	Swamp Forest	Vernal Pond	Sedge Meadow	Shrub Swamp	Old Field	Shrub Land
5	*Populus grandidentata*	Tree	large-toothed aspen		X	X						
2	*Populus tremuloides*	Tree	quaking aspen	X							X	
*	*POTENTILLA RECTA*	Forb	rough-fruited cinquefoil	X							X	
3	*Potentilla simplex*	Forb	common cinquefoil	X	X							
6	*Prenanthes alba*	Forb	white lettuce		X							
5	*Prunella vulgaris lanceolata*	Forb	heal-all	X							X	
6	*Prunus americana*	Tree	American wild plum	X								X
3	*Prunus pensylvanica*	Tree	pin cherry		X							X
3	*Prunus serotina*	Tree	wild black cherry									
2	*Prunus virginiana*	Shrub	choke cherry		X	X						
5	*Pyrola elliptica*	Forb	large-leaved shinleaf		X							
6	*Quercus alba*	Tree	white oak		X	X						
8	*Quercus bicolor*	Tree	swamp white oak				X	X				
9	*Quercus muhlenbergii*	Tree	chinquapin oak	X	X	X						
9	*Quercus palustris*	Tree	pin oak				X					
6	*Quercus rubra*	Tree	red oak		X	X						
2	*Ranunculus abortivus*	Forb	small-flowered buttercup		X	X						
*	*RANUNCULUS ACRIS*	Forb	common buttercup								X	
4	*Ranunculus recurvatus*	Forb	hooked crowfoot				X	X				
*	*RHAMNUS CATHARTICA*	Tree	common buckthorn		X						X	X
7	*Rhus glabra*	Tree	smooth sumac								X	X
5	*Rhus radicans (Toxicodendron r.)*	Vine	poison-ivy		X						X	X
1	*Rhus typhina*	Tree	staghorn sumac								X	X
4	*Ribes americanum*	Shrub	wild black currant								X	
*	*ROBINIA PSEUDOACACIA*	Tree	black locust	X							X	X

C	Scientific Name	Physiognomy	Common Name	Oak Opening	Oak Woods	Limestone Woods	Swamp Forest	Vernal Pond	Sedge Meadow	Shrub Swamp	Old Field	Shrub Land
6	*Rosa carolina*	Shrub	pasture rose	X								
*	*ROSA MULTIFLORA*	Shrub	multiflora rose								X	X
2	*Rubus allegheniensis*	Shrub	common blackberry		X	X	X				X	X
4	*Rubus flagellaris*	Shrub	common dewberry	X							X	X
2	*Rubus occidentalis*	Shrub	black raspberry		X						X	X
4	*Rubus pubescens*	Forb	dwarf raspberry			X						
0	*Rudbeckia hirta*	Forb	black-eyed Susan	X							X	
*	*RUMEX ACETOSELLA*	Forb	sheep sorrel								X	
*	*RUMEX CRISPUS*	Forb	curly dock								X	
7	*Rumex verticillatus*	Forb	water dock							X		
4	*Salix bebbiana*	Shrub	Bebb's willow						X	X		
3	*Salix discolor*	Shrub	pussy willow						X	X		
4	*Salix eriocephala*	Shrub	willow				X		X			
*	*SALIX PURPUREA*	Shrub	purple-osier willow								X	
5	*Sambucus canadensis*	Shrub	elderberry			X	X	X	X	X	X	X
5	*Sanguinaria canadensis*	Forb	bloodroot		X	X						
7	*Sanicula canadensis*	Forb	black snakeroot		X							
*	*SAPONARIA OFFICINALIS*	Forb	bouncing bet								X	
6	*Sassafras albidum*	Tree	sassafras		X							
7	*Schizachyrium scoparium (Andropogon s.)*	Grass	little bluestem grass	X								
3	*Scirpus atrovirens*	Sedge	bulrush								X	
4	*Scirpus cyperinus*	Sedge	woolgrass				X	X	X	X		
3	*Scirpus pendulus*	Sedge	bulrush					X			X	
7	*Senecio aureus*	Forb	golden ragwort				X					
*	*SILENE ARMERIA*	Forb	sweet William catchfly								X	

C	Scientific Name	Physiognomy	Common Name	Oak Opening	Oak Woods	Limestone Woods	Swamp Forest	Vernal Pond	Sedge Meadow	Shrub Swamp	Old Field	Shrub Land
*	*SILENE CSEREI*	Forb	glaucous campion								X	
*	*SILENE PRATENSIS*	Forb	white catchfly								X	
6	*Sisyrinchium angustifolium*	Forb	stout blue-eyed-grass	X						X		
4	*Sium suave*	Forb	water-parsnip				X					
4	*Smilacina racemosa*	Forb	false Solomon's seal		X	X						
6	*Smilax ecirrhata*	Forb	upright carrion-flower		X	X						
6	*Smilax hispida (S. tamnoides)*	Vine	bristly green-brier		X	X						
*	*SOLANUM DULCAMARA*	A Vine	bittersweet nightshade				X		X		X	X
1	*Solidago altissima*	Forb	tall goldenrod								X	
8	*Solidago bicolor*	Forb	silverrod		X	X						
5	*Solidago caesia*	Forb	blue-stemmed goldenrod			X						
2	*Solidago graminifolia*	Forb	grass-leaved goldenrod	X								
3	*Solidago juncea*	Forb	early goldenrod	X								
2	*Solidago nemoralis*	Forb	old-field goldenrod	X							X	
8	*Solidago patula*	Forb	swamp goldenrod						X			
4	*Solidago rugosa*	Forb	rough goldenrod				X		X			
8	*Sorghastrum nutans*	Grass	Indian grass	X								
6	*Sphenopholis intermedia*	Grass	slender wedge grass	X	X	X			X			
10	*Spiranthes lacera gracilis*	Forb	slender ladies'-tresses	X								
4	*Spirodela polyrhiza*	Forb	great duckweed							X		
7	*Staphylea trifolia*	Shrub	bladdernut			X						
*	*STELLARIA GRAMINEA*	Forb	starwort								X	
7	*Symplocarpus foetidus*	Forb	skunk-cabbage				X					
*	*TARAXACUM OFFICINALE*	Forb	common dandelion	X							X	X
5	*Thalictrum dioicum*	Forb	early meadow-rue		X	X						

C	Scientific Name	Physiognomy	Common Name	Oak Opening	Oak Woods	Limestone Woods	Swamp Forest	Vernal Pond	Sedge Meadow	Shrub Swamp	Old Field	Shrub Land
7	*Thelypteris noveboracensis*	Fern	New York fern		X	X						
5	*Thelypteris palustris*	Fern	marsh fern				X	X	X			
6	*Tiarella cordifolia*	Forb	foamflower			X						
4	*Tilia americana*	Tree	basswood		X	X					X	
*	*TRAGOPOGON DUBIUS*	Forb	goat's beard								X	
*	*TRAGOPOGON PORRIFOLIUS*	Forb	salsify								X	
*	*TRAGOPOGON PRATENSIS*	Forb	common goat's beard								X	
*	*TRIFOLIUM HYBRIDUM*	Forb	alsike clover								X	
*	*TRIFOLIUM PRATENSE*	Forb	red clover								X	
*	*TRIFOLIUM REPENS*	Forb	white clover								X	
10	*Trillium flexipes*	Forb	drooping trillium		X	X						
6	*Triodanis perfoliata (Specularia p.)*	Forb	Venus's looking glass	X							X	
7	*Triosteum aurantiacum (T. perfoliatum.)*	Forb	horse gentian		X							
9	*Triosteum perfoliatum*	Forb	horse gentian		X							
3	*Typha angustifolia*	Forb	narrow-leaved cat-tail							X		
3	*Typha latifolia*	Forb	broad-leaved cat-tail							X		
3	*Ulmus americana*	Tree	American elm	X								
2	*Urtica dioica gracilis*	Forb	nettle							X		
4	*Utricularia vulgaris*	Forb	great bladderwort							X		
6	*Uvularia grandiflora*	Forb	large-flowered bellwort		X	X						
8	*Vaccinium corymbosum*	Shrub	highbush blueberry						X			
*	*VALERIANA OFFICINALIS*	Forb	garden heliotrope	X							X	
10	*Valerianella chenopodifolia*	Forb	goosefoot corn salad						X			
*	*VERBASCUM THAPSUS*	Forb	common mullein								X	
4	*Verbena hastata*	Forb	blue vervain						X	X		

C	Scientific Name	Physiognomy	Common Name	Oak Opening	Oak Woods	Limestone Woods	Swamp Forest	Vernal Pond	Sedge Meadow	Shrub Swamp	Old Field	Shrub Land
4	*Verbena urticifolia*	Forb	white vervain		X						X	
*	*VERONICA ANAGALLIS-AQUATICA*	Forb	water speedwell							X		
*	*VERONICA OFFICINALIS*	Forb	common speedwell								X	
0	*Veronica serpyllifolia*	Forb	thyme-leaved speedwell								X	
10	*Veronicastrum virginicum*	Forb	Culver's root	X	X							
6	*Viburnum acerifolium*	Shrub	maple-leaved			X						
4	*Viburnum lentago*	Shrub	nanny berry			X	X	X			X	
7	*Viburnum recognitum (V. dentatum lucidum)*	Shrub	smooth arrowwood							X	X	X
*	*VICIA TETRASPERMA*	Forb	sparrow vetch								X	
*	*VINCETOXICUM NIGRUM (CYNANCHUM N.)*	Forb	black swallowwort								X	
7	*Viola fimbriatula*	Forb	violet	X								
7	*Viola nephrophylla*	Forb	northern bog violet						X			
9	*Viola palmata*	Forb	wood violet		X							
4	*Viola sororia*	Forb	common blue violet		X	X					X	
7	*Vitis aestivalis*	Vine	summer grape		X							
0	*Vitis riparia*	Vine	riverbank grape	X	X		X				X	X
5	*Waldsteinia fragarioides*	Forb	barren strawberry		X							
3	*Zanthoxylum americanum*	Shrub	prickly-ash		X						X	

APPENDIX III: SOILS

U.S. Department of Agriculture
Soil Conservation Service
Cornell University Agricultural Experiment Station
Monroe County

The underlying limestone at Rush Oak Opening is the Onondaga Formation.

BENSON SERIES

BcB – Benson channery loam, 0–8% slopes, pasture, woodland, slight hazard of erosion.
These shallow soils formed in glacial till dominated by limestone and have bedrock within 20 inches of the surface. The surface layer and the subsoil contain a large amount of flat stone fragments. Permeability is moderate and because of very low to moderate water availability due to shallowness the soils are droughty.

COLONIE SERIES

CoB – Colonie loamy fine sand, 0–6% slope, pasture, woodland
CoC – Colonie loamy fine sand, 6–12%slope, woodland
This level to gently sloping soil is the dominant Colonie soil in Monroe County. It occupies the beach and sandbar areas with old glacial lakes and the tops of the deltaic deposits associated with the outflow channels of these lakes. This soil normally contains a few inclusions of other soils. Tends to lack moisture. This soil is droughty and susceptible to soil blowing.

EEL SERIES

Ee – Eel silt loam, woodland
Moderately well–drained soils that are level or nearly level and formed in material that was recently deposited on flood plains. They occur along many of the larger streams or in broad shallow basins, are flooded annually in the spring, and regularly receive fresh soil material deposited by floodwater.
ElB – Elnora loamy fine sand, 2–6% slopes
These soils formed in water–laid or windblown deposits of fine sand on areas that were formerly deltas, sandbars, or beaches in old glacial lakes. They are deep, moderately well drained and wet in spring and droughty in dry seasons; can be subject to soil blowing.

HONEOYE SERIES

HnB – Honeoye silt loam, 3–8%slopes
Consists of deep, well–drained, nearly level to strongly sloping soils. They formed in high–lime

glacial till that is largely derived from gray limestones and shale with a small quantity of red Medi
sandstone. Seasonal high water table rarely rises to within 30 inches of the soil.

LAMSON SERIES

Lm – Lamson very fine sandy loam, 0–2% slopes

Deep, poorly drained and very poorly drained soils formed in medium– to high–lime, water–sorte material dominated by fine and very fine sand. They are found in the level depressions of old glacial lakes and have restricted outlets for surface runoff. A seasonal high water table is at or nearly at the surface and remains for long periods.

LIMA SERIES

LoB – Lima and Cazenovia silt loams, limestone substratum, 0–6% slope

Deep, moderately well–drained soils on the till plains, formed in high–lime glacial till dominated l limestone and shale. Moderately shallow to firm glacial till. Bedrock can be within 42–72 inches the surface. A seasonal high water table rises to within 18 to 24 inches of the surface but does not generally persist for any appreciable length of time.

LYONS SERIES

Ly – Lyons silt loam

Deep, poorly drained to very poorly drained soils that are level or nearly level. These soils developed in medium–textured, calcareous glacial till derived mainly from limestone ans sandston They are found on the till plain in depressions or along drainageways. Subject to ponding.

MINOA SERIES

Mn – Minoa very fine sandy loam, 0–2% slopes

Deep, somewhat poorly drained, medium–textured soils formed in lacustrine fine sand, very fine sand, and silt with small quantities of clay. They have slow runoff or occupy depressions that receive runoff.

MUCK

Mr – Muck, deep

Deep to shallow, very poorly drained, organic soils developed in depressions or old glacial swamps from woody and fibrous plant remains. They have a high seasonal water table and are ponded for prolonged periods.

PALMYRA SERIES

PaB – Palmyra gravelly fine sandy loam. 3–8% slopes

Deep, well–drained to excessively well–drained soils. They are nearly level to very steep soils developed in glacial outwash deposits of stratified sand and gravel with a high limestone content. Found on kames, eskers, and terraces in old glacial outwash valleys and along major streams.

ROCK LAND

Ro – Rock land

Areas of rock outcrop and very shallow soils. Generally 70–80% exposed bedrock and in the remaining part the soil material is less than 10 inches deep.

SUN SERIES

St – Sun loam, moderately shallow variant

Poorly drained to very poorly drained soils formed in calcareous, gravelly, glacial till that is underlain by hard rock at a depth ranging from 20 to 40 inches. They have a prolonged high water table at or near the surface and generally are ponded at times.

WASIAC SERIES

WfA – Wassaic fine sandy loam, 0–4% slopes

WfB – Wassaic fine sandy loam

Moderately deep, well drained and moderate well drained soils occupying relatively flat areas on the till plains They are underlain by hard rock at a depth ranging from 20 to 40 inches A seasonal; water Table ranges to within 18 to 24 inches of the surface during some seasons and the depth of bedrock ranges from 20 to 40 inches making these soils subject to draughtiness during the dry seasons.

WAYLAND SERIES

Wg – Wayland silt loam, 0–3% slopes

Deep, poorly drained and very poorly drained soils formed in recently deposited alluvial material and are subject to periodic flooding. They are found on first bottoms, principally along the major creek s and streams, in the old oxbows of former stream channels, or in the lower depressions on flood plains. At this site bedrock is within 20 – 40 inches of the surface.

***Appendix IV*:** CENTRAL & WESTERN NEW YORK NATURAL HISTORY TRIVIA

***Appendix V*:** AN ECOLOGICAL SURVEY OF THE VEGETATION OF MONROE COUNTY, NEW YORK

Appendix VI: MANAGEMENT OF PRAIRIES AND SAVANNA REMNANTS OF THE KITTY TODD PRESERVE

Appendix VII: BUFFALO IN NEW YORK STATE

Appendix VIII: MAMMALS OF NEW YORK, PAST AND PRESENT; MISSING NEW YORKERS

Appendix IX: HISTORY OF GOFF TRACT

Appendix X: HISTORY OF QUINN TRACT

Appendix XI: HERBICIDE LABELS

Appendix XII: DESIGN SPECIFICATIONS

a:Proposed upgrade, Niagara Mohawk right of way access, Goff Tract
b.Water control structure