Title: **Characterization and Assessment of the Floristic Resources in Evansburg State Park, Montgomery County, Pennsylvania.**

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Abstract:

The central feature of Evansburg State Park is a 12.9 kilometer stretch of Skippack Creek that from a very focused perspective looks much the way it did three centuries ago before European settlers arrived. However, just beyond the narrow fringe of riparian vegetation the landscape is fragmented into small parcels of regenerated forest surrounded by agricultural land, shrub thickets, suburban development, and a well-developed network of roads. The floristic resources of the park are greatly stressed by a variety of competing uses making it difficult for the native vegetation to recover and regain its natural diversity.

The lack of baseline documentation for the floristic resources has hindered the ability of land managers to develop a coordinated long-term strategy for the rehabilitation of the native flora. For this study, extensive field data collection occurred simultaneously with community mapping, the development of vegetation classifications, an assessment of the quality of regenerated forests, and an analysis of recovery potential. This report offers a fairly thorough assessment of the botanical and ecological value of the site and provides specific recommendations towards the restoration of natural habitat.

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INTRODUCTION

As the largest public park space in Montgomery County, Pennsylvania, Evansburg State Park offers visitors a surprising degree of solitude and tranquility within an area experiencing rapid development and urbanization. As of 2003 the park accounted for 10% of the countywide acreage of protected open space, 24% of the total recreational area, and approximately 3% of the remaining forested areas. After undergoing nearly a century of indiscriminate land use transformations leading to noticeable changes in the composition of its vegetation, the park is long overdue for a comprehensive evaluation of the ecological functioning of its plant communities. This project was developed to document the current condition of the park's flora and offer site specific recommendations for the preservation of the natural plant communities and restoration of disturbed areas.

PHYSIOGRAPHIC SETTING

LOCATION - Situated in south-central Montgomery County, Evansburg State Park is a 3,349 acre oasis surrounded by scattered farms, suburban developments, and the historic communities of Skippack, Creamery, Evansburg, Providence Square, and Arcola. The narrow park follows the course of Skippack Creek for 12.9 kilometers stretching along the valley between Quarry Road on the north and Lewis Road to the south. It is located predominately within the townships of Lower Providence and Skippack, with the upper and eastern-most reaches extending into Worcester, Towamencin, and Lower Salford townships (Appendix 1).

HYDROLOGY, CLIMATE, AND ECOREGION - The 144.5 square kilometer (35,707 acre) watershed of Skippack Creek is one of 3 major tributaries to the Perkiomen watershed which drains into the Schuylkill River near Audubon, PA and Valley Forge National Historical Park. This 4th order stream is characterized by low base flow and frequent flooding. As of 2002 water quality in the main stem of the creek is impaired for aquatic life (The Conservation Fund, 2002; PA DEP, 2005), however some of the creek's key tributaries are still able to fully support indigenous flora and fauna. (US EPA, 2005). In April 2005 the US EPA approved Total Maximum Daily Loads (TMDLs) to reduce siltation and nutrient loading across the watershed.

Climatic variation in the area is minimal with slight differences in temperature and precipitation occurring relative to changes in the topography and elevation. The entire park is located within the Southeastern Piedmont Climate Division (#3603) which is characterized by moderate temperatures and humidity (PennState, 2005). The local National Weather Service station at Graterford, PA (#3437) reports an average temperature of 50.8 °F and average rainfall of 40.71 inches (103 cm) annually.

The area is included in the Northern Piedmont ecoregion which extends from southern Virginia to central New Jersey. The Northern Piedmont ecoregion is a transitional region of low rounded hills, irregular plains, and open valleys that lies between the low mountains to the northwest and the flat coastal plain to the east. Land cover throughout the ecoregion is dominated by agricultural and forested areas with urban land cover increasing rapidly. Oak–hickory forests are pervasive across the region,

but highly variable in extent and position in the landscape. Prior to the arrival of the chestnut blight in the first decade of the 20th century (PA Chestnut Tree Blight Commission, 1915) the American chestnut (*Castanea dentata*) was an equally important species in this ecoregion to the extent that these forests were known as oak-chestnut forests (Braun, 1950).

GEOLOGY, TOPOGRAPHY, AND SOILS - The park is situated in the Gettysburg-Newark Triassic Lowlands section of the Piedmont physiographic province which is comprised predominately of non-carbonate sedimentary rocks with occasional intrusions of igneous diabase rock. The most extensive bedrock formations in the park belong to two of the three major geologic formations formed in the Mesozoic Era. The northern three-fifths of the park, approximately the area above Germantown Avenue, are underlain by the reddish-brown shales, siltstones, and sandstones of the Brunswick Formation; grey shales of the Lockatong Formation underlie the region of the park south of Ridge Pike. As a result of some irregularities in the contour of the contact surface between these two formations this order is reversed in the area between Germantown and Ridge Pike where a small tongue of the Brunswick extends into the older Lockatong. A third rock type present is a dike of igneous diabase material that was intruded vertically between the softer sedimentary deposits of the Brunswick Formation during the Jurassic period. This dike appears as an L-shaped, erosion resistant ridge near the intersection of Stump Hall and Grange Roads (Appendix 2).

Many of the surface features noted throughout the park are shaped by the underlying geology. The easily erodible Brunswick shale leads to the formation of a smooth, shallow valley, while the more variable Lockatong allows for the development of moderate ridges creating a topography of low, rolling hills. Even so, topographical variation within the park boundaries is relatively insignificant with elevation fluctuating only 70 meters. The highest elevation is 100 m above sea level at the southeastern corner of the park and the lowest elevation of 30 m above sea level occurs in the floodplain of the creek where it exits the park.

Both the underlying geology and the topography are key factors that have influenced the development of a diverse range of soils throughout the park. A total of 14 soil series are present in the park with the Landsdale-Penn-Readington association being predominant. The most significant concern across all capability classes is the potential erodibility of the soil. The following soils are particularly sensitive to rapid changes in any single factor affecting their development: *Floodplain and Alluvial Soils, Wetlands, and Stony Land.*

Figure 1 – Bird's-eye-view of Collegeville in 1894 by T. M. Fowler. Source: http://lcweb2.loc.gov/ammem/pmhtml/panhome.htm

CULTURAL INFLUCENCES

SITE HISTORY AND LAND USE - Rapid changes in the Skippack Valley landscape began to occur not long after the land was granted to William Penn in 1681 by King Charles II. While no evidence exists of any permanent European settlements prior to this date,

members of the Unami tribe of the Lenni Lenape inhabited the valley well before the arrival of the first Dutch Mennonites in 1702. The land along Skippack Creek was settled by 31 families between the years 1704-1727. Of the 81 households counted in the 1756 census, 50 were recorded as farmers by trade and just over one-third of the total acreage was already reported to be cleared and under cultivation (Heckler, 1990). This close-knit community maintained a largely agrarian lifestyle for the next two centuries (Figure 1). Of these early activities obvious visible traces remain. The most conspicuous is the extensive patchwork of farms that were predominant in Skippack township until the mid-1900's (Appendix 3). Only one of the 7 original mill buildings is currently standing, however the channels of many of the mill races can still be found throughout the park. Also, numerous residential homes, some dating to the era of the original settlers, are scattered throughout the park.

In the late 1960's the land was purchased by the Pennsylvania Department of Forests and Waters with the goal of preserving open space, but plans were soon announced for the construction of a high dam to create a 1,120 acre lake providing both recreational opportunities and a future water supply. The flooding of the valley was contested immediately by local residents who were concerned about the destruction of over 200 historic buildings and the corresponding impact on the rich cultural traditions of the area. Combined efforts by a citizens' action group, county officials, and political figures effectively stalled the lake project by securing an official listing for the Evansburg Historic District on the National Register of Historic Places in 1972. Due to both a lack of funds and community consensus relatively few improvements have been made to the site since it opened to the public as a park in 1979. A master plan for the park developed in 1985 paid little attention to the preservation of natural resources in favor of widespread development of recreational and interpretive facilities. Ironically, the historic properties that served to save the land from flooding continue to deteriorate and be demolished while the natural features endure and remain as alluring as in the past (Figure 2).

Figure 2 – "On the Skippack Creek.". Photographed 9/11/1898 by F.D. Edmunds. Source: The Historical Society of Pennsylvania.

CURRENT UTILIZATION - Human activity in the park still clearly reflects the recent transition from an isolated agrarian community to a multi-use protected natural area. Major usage categories are residential, agricultural, and recreational. Numerous facilities and trails are maintained in support of a variety of recreational opportunities that include hiking, fishing, biking, picnicking, horseback riding, skiing, golfing, and hunting. Interspersed throughout the park are 523 acres of cultivated fields that are seeded with a variety of grasses or herbaceous species as agricultural crops or wildlife habitat. With the exception of the 89 acres devoted to a manicured golf course, all of these activities and features are widely distributed across the landscape creating a highly diverse pattern of land use.

CHARACTERIZATION AND ASSESSMENT OF THE FLORISTIC RESOURCES

SURVEY AND ANALYSIS METHODOLOGY

Both qualitative and quantitative methods were employed to document floristic diversity and provide an overall assessment of forested areas in the park. Exploration of the site began on May 21, 2004 to obtain an overview of the park's physical resources. During this visit and all subsequent visits detailed field notes were taken as to the identification of all vegetation, site conditions, and community delineation data. Identification and nomenclature of the flora follow The Plants of Pennsylvania (Rhoads and Block, 2000) with natural community classifications based on the Terrestrial and Palustrine Plant Communities of Pennsylvania (Fike, 1999). Fieldwork commenced on a regular basis on July 8, 2004 and continued, on average, twice weekly through November 22, 2004. From December 2004 through April 2005 site visits were made at a minimum of once monthly to complete the collection of quantitative data and inventory spring ephemerals.

Floristic Diversity and Plant Communities

In an effort to record all species present and provide a detailed description of the plant communities, a systematic plan was developed that divided the park into 21 sections following boundaries such as roads and waterways. This strategy created manageable units of study and increased the likelihood of thorough coverage. Within each section a search was guided by professional judgment based on information gathered in advance from topographic maps and aerial photos. Survey intensity was primarily determined by the density of vegetation, but was also influenced by indications of recent disturbance and/or the uniqueness of the substrate material. Vegetation was identified to the species level in the field where possible. Important specimens such as those representing species of special concern or recently established invaders were collected and deposited in the herbarium at the Morris Arboretum (MOAR). Individual points of occurrence and boundaries between different community types were documented using a hand-held GPS receiver.

Products of the floristic survey include: 1) a complete inventory of all species occurring within the park boundaries, and 2) narrative descriptions for all distinct plant communities accompanied by a digital map produced in GIS ArcView (ESRI, 2004) by digitizing polygons underlaid by either digital ortho-quarter quad (DOQQ) aerial images or USGS 7.5 minute digital raster graphic (DRG) topographic map for the Collegeville and Landsdale quadrangles. National Aerial Photography Program (NAPP), Digital Orthophoto Quadrangles (DOQ's) and Color –Infrared (CIR) aerial photos were also used to aid in the accurate delineation of community boundaries. Accuracy of the community delineations was confirmed through direct field observation.

A primary consideration throughout the inventory phase of the project was the identification and documentation of plant populations classified as endangered, threatened, or rare by the Pennsylvania Natural Heritage Program (PNHP). In addition to diligent and extensive field observation, a search for pre-existing information was incorporated into the project through interviews with park personnel, a review of

herbarium records at the Academy of Natural Sciences in Philadelphia (PH) and the Morris Arboretum (MOAR); and a search of the PNHP database.

Quality Assessment

A second goal of the project was to provide an accurate evaluation or assessment of natural areas in the park in order to identify the most ecologically valuable areas and prioritize efforts to manage or maintain sites of high floristic significance. A total of 17 sites was selected for sampling based on an evaluation made by field personnel. Areas reflecting a more advanced successional stage, minimal disturbance levels, or a higher percentage of native vegetation were chosen as worthy of further study. Transects (Appendix 4) were established in each area and the following data were recorded: 1) trees – trunk diameter at breast height (DBH) was measured in centimeters using a diameter tape for all woody vegetation greater than 12 cm in diameter, and 2) shrubs/understory - total percent cover was recorded for each species present greater than 1 meter in height but less than 12 cm in diameter.

The sampling methods employed were selected to provide information on several different parameters of community composition and structure. These methods were determined to be best suited for use in areas of non-uniform topography and varying densities of vegetation. Tree populations were sampled using the point-quarter method. A straight line of either 50 or 100 meters in length was measured and subdivided at 10 m intervals beginning at the 3 m mark to produce a series of quadrants. Within each quadrant the closest living tree of greater than 12cm DBH was found and its location along the transect, species, and DBH were recorded. The shrub/understory layer was sampled using three 100 m^2 circular plots per 50 m located randomly along each transect such that there was no overlap between successive plots. Within each plot every woody plant greater than 1 meter tall was identified and percent cover was recorded for each species. Herbaceous vegetation was not sampled because of the limited sampling season.

Analysis Indices

For each community sampled an array of indices was developed to substantiate the community characterizations and allow for the objective comparison of communities. Using standard measures of abundance a profile was created for each site to assess the quality of each forest community. A combination of these indices was translated into a priority score (P) for each site by calculating the sum of NQR plus FQI (native). The significance and development of each index is described below:

Relative Importance Value (RIV) – By measuring relative dominance this score provides information as to the contribution of each species to the community composition. Frequency (how often the species occurs or its distribution), density (how many or the number of individuals), and cover (how much or the area occupied by an individual) were used to construct relative values of each parameter for each species. For trees, an overall rank (RIV) was arrived at by averaging the three relative values, whereas an RIV for understory vegetation was calculated as an average of relative frequency and relative cover since density could not determined from the data collected.

Species Richness (SR) – This absolute measure of diversity refers to the number of species present in a specified area. This information is inherent to the sampling

method selected since all individuals must be identified to the species level. It expresses the extent of variety within the community, but does not gauge abundance.

Percent Introduced - As a percentage of the total number of species recorded this value quantifies the number of species that are introduced or non-native.

Mean Coefficient of Conservatism ($\bar{C}$) - Coefficients of conservatism are representative of a species' fidelity to an unaltered landscape (Swink and Wilhem, 1994). A range of predetermined values is used to differentiate between species responses to varying degrees of habitat degradation. Generalist species are those that are not restricted to a specific habitat and are likely to be found almost anywhere. Conservative species are those that are sensitive to altered ecological conditions and display a high affinity for undisturbed habitat. Coefficients of conservatism were obtained from the February 25th draft version of the Bowman's Hill Wildflower Preserve FQAI worklist (2005). Coefficients used ranged from -3 for highly invasive or adventive species such as multiflora rose (*Rosa multiflora*) to 7 for a conservative species such as bladdernut (*Staphylea trifolia*). A mean coefficient of conservatism was arrived at by averaging the values for all species in each community sampled. A lower mean coefficient of conservatism signifies a greater dominance by disturbance tolerant species.

Floristic Quality Index (FQI) - An extension of the mean coefficient of conservatism, this index multiplies $\bar{C}$ by the square root of the number of taxa present to allow for comparison across sites. This index reports a higher value for an area exhibiting minimal human impact as indicated by a greater number of native species that display a high degree of ecological specialization (Swink and Wilhem, 1994). As recommended by Taft et al. (1997), this study calculated two separate FQI's; one for native species only and a second inclusive of all species documented in the transect.

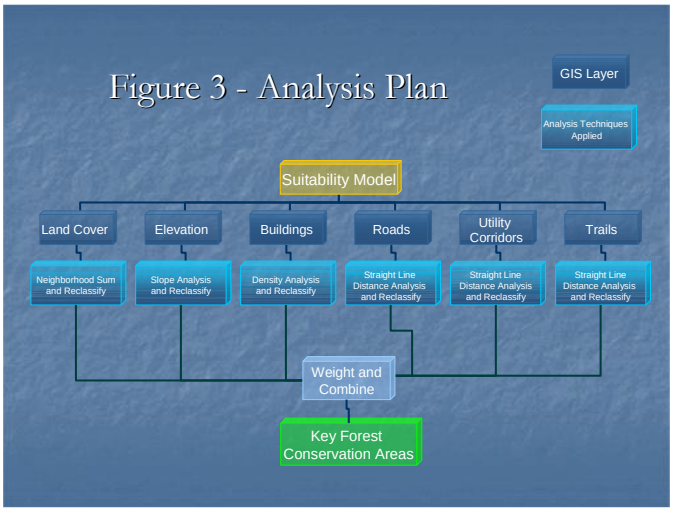
Natural Quality Rating (NQR) – This multi-criteria, rapid assessment approach follows that outlined by Norris and Farrar (2001) to evaluate the natural quality of hardwood forests in the upper Midwest. A measure of overall woodland quality ranging from 0-20 was achieved by summing scores in three major categories: tree size, structure, and dominance. A total of 6 criteria were scored to reflect qualities associated with mature natural forest cover. For descriptive purposes Norris and Farrar defined 4 natural quality levels corresponding to the following scoring subdivisions: Highly Natural = 17-20, Moderately Natural = 14-16, Moderately Altered = 10-13, and Highly Altered = 0-9. Appendix 5 provides a copy of the worksheet used to calculate NQR values along with notations as to how scores were derived. As with the FQI, the goal of the evaluation is to compare the current vegetation to that of pre-settlement conditions using disturbance indicators; however the NQR index incorporates more structural elements than the FQI which focuses on community composition.

Wetness Index (W) - Calculated as an average of coefficients assigned to wetland indicator classifications, this index provides basic information as to the predominance of wetland species at each site. Coefficients of wetness follow those assigned by Wilhelm (1992) to the 11 standard wetland categories. Values range from 5 (UPL) to -5 (OBL).

Priority Score (P) – Developed over the course of this project, this composite scoring system assists in ranking sites based on the combination of two complimentary indices. Expressed mathematically P = NQR + FQI (native species). This composite score sums the value of two independent scoring methods that give value to nativity, species dominance, and structural characteristics of the site.

Spatial Analysis

A suitability analysis was performed using GIS analysis techniques to identify and prioritize opportunities for restoration. The following variables were derived from established landscape and disturbance principles of conservation biology (Dale et al., 2000): matrix influence, slope, building density, distance to roads, utility corridors, or trails. Values for each of these variables were classified on a 1-10 scale with 10 being the optimal condition for conservation of the natural habitat. The final analysis consisted of a weighting and summing of these factors (Figure 3). Each factor was weighted as follows: Forest Patch – 25%, Slope – 10%, Building Density – 20%, Roads - 20%, Utility Corridors – 15%, Trails – 10%. Data layers were acquired from the following sources: *Land Cover* - US Geological Survey National Land Cover Data (1992), *Elevation* - PA Department of Environmental Protection Spatial Data Access (1998), and *Buildings, Roads, and Trails* – personal communication of October 7, 2004 with J. Johns, PA Department of Conservation and Natural Resources, Bureau of State Parks. A new layer was created for utility corridors from information available in both DOQ photos and DRG topographic maps.



RESULTS

Diversity Inventory – Five hundred and forty-five (545) vascular plant species from 116 families and 337 genera have been identified in the park (Table 1). Families with the greatest representation of individual taxa are Asteraceae (60), Poaceace (44), Roseaceae (32), Cyperaceae (26), Polygonaceae (18), Lamiaceae (16), Fabaceae (15), and Caprifoliaceae (14). Additional species would be discovered by an equally thorough survey of the park during the spring and early-summer months for spring ephemeral and early flowering species. Appendix 6 provides a comprehensive list of each species encountered, including nativity, federal and state endangered status, and prior inclusion in published floras of Montgomery County as enumerated below.

Table 1 – Summary of Floristic Diversity

	Native (N)	**Introduced (I)**	**Total**	**PNHP listed**	**New to Mont. Co. Flora***
Aquatics	13	2	15	0	1 (N)
Ferns	17	0	17	0	1 (N)
Grasses,Sedges, & Rushes	57	19	76	0	5 (3N/2I)
Wildflowers	112	170	282	1 PE	12 (3N/9I)

Trees/Shrubs	97	58	155	2 PT	27 (3N/24I)
Totals	296	249	545	3	46 (11N/25I)

PE = potentially endangered, PT = potentially threatened
*Indicates number of species not previously included in published floras of Montgomery County. N = native, I = introduced. See Appendix 6 for species information.

In addition to a previous floristic survey (Commonwealth of Pennsylvania, 2003) conducted entirely within the park, a number of other botanical resources are available for Montgomery County. Bean (1884) was the first to publish a comprehensive enumeration of the indigenous and naturalized flora in a chapter of his history of Montgomery County. Almost 100 years later Wherry (1972) assembled a "Check-list of the Flora of Montgomery County, Pennsylvania"; successive updates were published by Newbold (1978, 1979); McCabe and Newbold (1980); and Newbold and Holt (1986). Besides these two published catalogs, the online database of the Pennsylvania Flora Project (www.paflora.org) provides an extensive compilation of records from herbaria across Pennsylvania.

The number of species found over the course of this study is almost identical to the previous park specific survey (545 as compared to 541), even without the full inclusion of the spring-flowering species. A richness potential of 733 plant species is predicted for the park based on the inclusion of species previously enumerated in the 2003 Draft Resource Management Plan (Commonwealth of Pennsylvania), but not re-documented by this study. Such a high count can result from a number of factors including the introduction of non-natives after a disturbance event or a great diversity of environments.

Of the 545 taxa represented, over 45% are introduced species. The greatest majority of these exotics appear in the herbaceous or wildflower communities which comprise a significant part of the early successional vegetation. In comparison, the Wherry and Newbold check-lists report that only 33% of the documented species are thought to be introduced. A review of species new to the Montgomery County flora, as compared to those included in the Wherry and Newbold survey, reveals that approximately 54% of the new species recorded are of non-native origin. In contrast to the known non-native species these newly recognized species seem to be predominately woody trees and shrubs.

Only two species of concern were documented in the park. Early buttercup (*Ranunculus fascicularis*) is considered to be endangered at the state level and persists as a naturally occurring population of 30-50 individuals. The second, Canadian yew (*Taxus canadensis*), is on the state watch list and was only found in small numbers in the vicinity of the Hemlock–Northern Hardwood Forest. Two additional species, American holly (*Ilex opaca*) and umbrella magnolia (*Magnolia tripetala*), are listed as potentially threatened by the Pennsylvania Natural Heritage Program (PNHP). However, the individuals encountered in the park do not represent naturally occurring populations, but rather horticultural plantings of native species and as such do not warrant special protection. Full details regarding the status of early buttercup and Canadian yew are provided in the following section of this report and in Appendix 7.

Species of Special Concern - Numerous sources revealed the presence of early buttercup (*Ranunculus fascicularis*) as a known rare species in the park for at least the past 88 years. A collection dating to 1917 was found in the PH herbarium with additional collections made in 1986 (MOAR) & 1998 (PNHP). It cannot be confirmed whether current collections are from the same location as the historic populations, however it is clear that the post-1986 records all reference locations within half a mile of each other on the steep bank along the West side of Skippack Creek between the bridge at Mill Road and the picnic areas opposite the park office on May Hall Road.

The population surveyed in 2004 and 2005 was confined to an area approximately $100ft^2$ in size. This population appears to be stable and recent PNHP records reveal an increase in density as follows: 3 individuals on April 21, 1984, 6 on April 16, 1985, 11-50 on May 4, 1986, not re-located in 1998, 20-30 on May 21, 2004, and at least 62 plants on April 13, 2005. Twenty-two of those documented in 2005 were in flower. A dense colony of lesser celandine is currently growing within ½ meter of the southern edge of the early buttercup area.

Records procured from PNHP also revealed the existence of a second population farther south along the Mill Race Trail where it crosses a small tributary to Skippack Creek after merging with the Skippack Creek Trail. In May of 1986, 10 plants were observed and in 1998 14 plants were located on April 28th. On April 13, 2005 only one plant was found at this site. The individual was seen in flower in the dense cover of a multiflora rose bush. This occurrence is intensely threatened by autumn olive (*Elaeagnus umbellata*) and multiflora rose (*Rosa multiflora*) and is likely to be eliminated in the near future by competition from these invaders.

Early buttercup is currently ranked G5 indicating a secure species that is common, typically widespread, and abundant. In Pennsylvania, the species is ranked as potentially endangered; a status assigned to species in imminent danger of extinction or extirpation throughout their range in the state. Between 1889 and 1951 collections of early buttercup were made in 11 counties across Pennsylvania. Post-1950's collections are limited to Centre, Monroe, and Montgomery counties. These local populations are especially valuable as analysis of the historical distribution of early buttercup across the state suggests an overall decline in the frequency of occurrences.

A second species requiring special conservation measures is Canadian yew (*Taxus canadensis*). This is a naturally occurring shrub of northern coniferous and hardwood forests and is generally an indicator of cool, moist, mature forest conditions. Two small, discrete populations were discovered on the steep slope forested by the Hemlock–Northern Hardwood community. Slightly further downstream a second population of less than half a dozen individuals was observed growing near an old quarry site. Within the park Canadian yew occurs only in the Hemlock-Northern Hardwood community, which occurs as a single stand thereby magnifying the threat to this species. Canadian yew is apparently secure on a global scale (G5), but is imperiled to some degree in 9 states at the southern end of its range. In Pennsylvania it is currently on the PNHP watch list because its range is becoming increasingly restricted and it is believed to be in danger of suffering a severe decline in its population mainly due to increased herbivory and habitat loss. Historically it is widespread throughout the state and efforts within the last 15 years to document occurrences of the species have found populations in at least 7 counties in the

southeastern portion of the state. Appendix 8 includes locations for each of these fragile populations.

Table 2 - Summary of Plant Communities					
	Acreage				
	Count	***Minimum***	***Maximum***	***Average***	***Total***
Terrestrial Forests					
Dry Oak Heath	1	5.8	5.8	5.8	5.8
Hemlock - Northern Hardwood	1	2.3	2.3	2.3	2.3
Red Maple	2	2.1	20.7	11.4	22.8
Red Oak - Mixed Hardwood	31	0.5	51.6	9.1	281.0
Sugar Maple - Basswood	7	0.2	4.9	3.2	22.5
Tuliptree – Beech - Maple	3	2.5	30.1	13.3	40.0
Palustrine Forests					
Bottomland Oak - Mixed Hardwood	30	0.2	17.2	4.9	146.1
Silver Maple Floodplain Forest	7	0.2	6.4	2.8	19.4
Sycamore - Box Elder	37	0.1	21.8	5.1	187.1
Terrestrial Woodlands					
Virginia Pine - Mixed Oak	1	1.7	1.7	1.7	1.7
Palustrine Woodlands					
Red Maple - Mixed Shrub	1	2.9	2.9	2.9	2.9
Palustrine Shrublands					
Black Willow Scrub/Shrub	6	0.4	4.9	1.6	9.6
Terrestrial Herbaceous Openings					
Calcareous Opening/Cliff	1	0.2	0.2	0.2	0.2
Herbaceous Wetlands					
Herbaceous Marsh/Wet Meadow	8	0.4	3.8	1.2	9.5
Skunk Cabbage Forest Seep	1	0.6	0.6	0.6	0.6
Aquatic Habitats					
Aquatic Species	6	0.3	46.7	13.1	78.4
Anthhropogenic (Managed or Disturbed Habitats)					
Cultivated/Managed Field	50	0.8	38.3	10.5	523.7
Forest Fringe - Roadside Vegetation	49	0.3	35.5	3.8	188.4
Landfill	1	56.4	56.4	56.4	56.4
Plantation Forest	20	0.6	14.0	5.6	112.1
Quarry	1	3.4	3.4	3.4	3.4
Recreational Field	8	1.0	60.1	14.0	112.2
Successional Forest	18	0.6	35.6	7.2	128.7
Successional Woodland	74	0.2	108.0	18.1	1,339.4

Utility Corridor	11	0.2	9.8	2.5	27.3
Warm Season Grasslands	1	9.6	9.6	9.6	9.6

Summary and Description of Plant Communities - Concurrent with the floristic inventory, vegetation classifications for the park were created according to commonly occurring associations between individual species in similar habitat conditions. Using aerial photo interpretation and field observation, 26 plant communities were identified (Table 2) and mapped (Appendix 8). Of these, 16 are based on naturally occurring associations as described by Fike (1999) and the rest are anthropogenically influenced habitats that reflect variations in the frequency or intensity of disturbance.

Seventy-five percent of the park's acreage is comprised of anthropogenically influenced habitats. The single largest plant community in the park at 1,339.4 acres is early successional vegetation (Successional Woodland) which is typically characterized by a dense thicket of weedy forbs, shrubs, and vines. Eastern red cedar *(Juniperus virginiana*) is frequently the most common native component of these areas, but the majority of the vegetation usually consists of invasive species such as multiflora rose (*Rosa multiflora*) and autumn olive (*Elaeagnus umbellata*). This community type occurs throughout the park and occupies areas of shallow to moderate slopes that were previously farmed. This community type also displays the greatest variation in patch size ranging from 0.2 to 108 acres.

Fields that are actively cultivated or managed for agricultural purposes or as wildlife habitat also contribute significantly to the man-made landscape of the park. Covering over 523 acres this is the second largest community type overall although more than one-third of these areas are less than 5 acres in size. Generally, fields appear in clusters throughout the length of the park and host a large variety of agricultural weeds such Canada thistle (*Cirsium arvense*), brown knapweed (*Centaurea jacea*), jimsonweed (*Datura stramonium*), and horse-nettle (*Solanum carolinense*).

While the Forest Fringe-Roadside Vegetation community has the lowest average acreage it is the most extensive and continuous community type with the exception of the natural aquatic community. While the average size for this community is only 3.8 acres, it stretches over 188 acres closely paralleling the current and historic road infrastructure of the park. This linear community reaches into every corner of the park and creates extensive heavily trafficked edges along many of the other community types serving as vector for the introduction of roadside weeds such as blue chicory (*Cichorium intybus*) and crown vetch (*Coronilla varia*) into neighboring communities. This community also includes the numerous landscaped yards within the park boundaries thereby increasing opportunities for horticultural escapees to penetrate the landscape.

Natural communities within the park are typically limited to steep or moderately steep slopes or true bottomland areas in the floodplain of the creek. The most common terrestrial forest type is the Red Oak-Mixed Hardwood Forest association which covers 281 acres and represents some of the most mature forest in the park. Some of the largest examples of individual oaks were found within these areas and were documented as follows: chestnut oak (*Quercus montana*), 132 cm DBH in sampling transect 6; black oak (*Quercus velutina*), 98.1 cm DBH in transect 14; and red oak (*Quercus rubra*), 100.6 cm DBH in transect 1. All but two of these forested patches are less than 20 acres in size. A second oak-dominated community is the Bottomland Oak - Mixed Hardwood Forest type that occurs in very small pockets in the central area of the park. Together with the

Red Oak community they constitute 13% of the total area in the park, however they do not typically adjoin each other and therefore remain as scattered, isolated patches.

Another natural community that contains trees of notable size is the Sycamore-Box Elder Palustrine Forest association. The largest individual sycamore (*Platanus occidentalis*) found was a double-trunked specimen measuring 230 cm DBH that was documented in transect 7. Within the same vicinity a silver maple (*Acer saccharinum*) was recorded at 180.5 cm DBH. The Sycamore-Box Elder community is closely linked to the broad expanse of the floodplain and shows regular signs of disturbance due to flooding. Many of the smaller shrubs and trees are permanently angled in the direction of flow while larger trees often have trunk wounds or cavities caused by water scouring.

Two additional relatively small and infrequently occurring communities are distinctly dependent on the hydrology of the park. Eight Herbaceous Marsh/Wet Meadow areas and one Skunk Cabbage Forest Seep are located in depressions within the floodplain or in shallow areas adjacent to small tributaries.

Several unique natural communities tied to geologic features exist in various locations and are represented by a single stand or site. The smallest of these is the Calcareous Opening/Cliff community dominated by ferns and herbaceous plants that cling to the prominent cliff face in the Lockatong formation at the south end of the park. In the same locale atop this stony outcrop the Dry Oak-Heath Forest community persists on thin dry soils. The Hemlock-Northern Hardwood Forest community is restricted to the more nutrient rich diabase dike. This community type typically is found north of the Piedmont region, but can occur on steep slopes.

Narrative descriptions were developed to describe the distinctive composition and dominant components of each community type (Appendix 9). Site specific modifications to Fike's (1999) standard descriptions for natural communities were made from field observations by the research team and are noted accordingly. To further depict the character of the natural communities, relative importance data collected from the field transects are included for the 7 communities that were sampled. The reported quantitative data reflects an average of RIV values for the most dominant species across all transects sampled that pertain to a specific community type.

Conservation Status of Regenerated Forest Communities - Natural forest cover in the park is currently limited to 727 acres, or 22%, of the total area of the park. Historically, the regional landscape was heavily forested by a dense canopy dominated by oak and chestnut. However, by the late 1800's this extensive regional forest dwindled to as little as 1% cover as a result of changes associated with post-settlement landuse (Matlack, 1997). Currently, natural forest cover in the park is roughly equivalent to that across Montgomery County, but significantly less than the 58% forest cover existing within the state of Pennsylvania (US Forest Service, 2004).

Although there are no old-growth remnants remaining within the park it is important to preserve and protect those regenerated patches that exhibit characteristics most similar to pre-settlement conditions. Mature forests provide critical habit for interior species as well as important ecological functions such as regulation of streamflow and hydrologic processes, nutrient cycling, soil development and protection; carbon sequestration, and maintenance of atmospheric quality. Once lost these forested areas are

difficult to recover because of the complexity of human influenced factors affecting their regeneration that often extend in time scale beyond the control of any single generation.

Using an array of complementary indices as described in the section on methodology, existing forested areas were evaluated based on compositional and structural qualities attributed to naturally occurring, intact, and undisturbed forests. A combined approach was adopted in recognition of the fact that no single indicator can provide a reliable assessment of the natural biological legacies preserved within a forested area. Table 3 provides a summary of the scores calculated for all 17 transects sampled.

Taken as a whole, the natural forested areas in the park display a reasonable resemblance to an unaltered forest in terms of structure and dominance, but are tending towards a homogenous composition that is highly tolerant of disturbance in the landscape. With the exception of the Hemlock–Northern Hardwood community the mean coefficient of conservatism is typically low, ranging only from 1.71 – 3, across the remaining 16 transects indicating that the majority of the park is comprised of generalist species that are fairly tolerant of high levels of disturbance.

Table 3 - Summary of Quality Indices									
	Assessment Parameters								
Transect Number	Transect Length (m)	*Species Richness*	*% Introduced*	*Mean C (native species)*	*FQI (native species)*	*Mean C (all)*	*FQI (all)*	*NQR*	*Mean Wetness*
Silver Maple Floodplain Forest									
5	50	7	0%	1.71	4.54	1.71	4.52	15	-1.29
16	50	5	0%	1.8	4.02	1.8	4.01	17	-0.2
Sycamore - Box Elder Floodplain Forest									
7	100	11	0%	2.73	9.05	2.73	9.04	18	-0.55
11	100	9	11%	3	8.49	2.33	6.99	13	-0.44
17	100	11	9%	2.5	7.91	2	6.63	13	0.91
Bottomland Oak - Mixed Hardwood Forest									
12	100	18	22%	2.36	8.83	1.38	5.85	15	1.47
Tuliptree – Beech - Maple Forest									
9	50	9	22%	2.57	6.80	1.33	3.99	17	1.5
13	100	23	30%	1.875	7.50	0.65	3.12	11	2.16
Red Oak – Mixed Hardwood Forest									
2	100	20	15%	3	12.37	2.4	10.73	17	1.5
6	100	22	23%	2.47	10.18	1.45	6.80	14	1.17
8	100	14	14%	2.08	7.21	1.42	5.31	15	1.5
14	100	20	25%	2.13	8.25	1.2	5.37	14	2.43
Sugar Maple - Basswood Forest									
3	50	8	12.5%	2	5.27	1.375	3.89	14	2.14
4	50	16	18.8%	2.69	9.70	1.625	6.50	15	2.13
10	100	11	18%	2.22	6.66	1.36	4.51	18	1.6
15	100	8	25%	2.5	6.12	1.625	4.60	15	2.33
Hemlock - Northern Hardwood Forest									
1	100	3	0%	6	10.39	6	10.39	16	4
Average Scores									
		13	**13.8%**	**3**	**8**	**2**	**6**	**15**	**1**

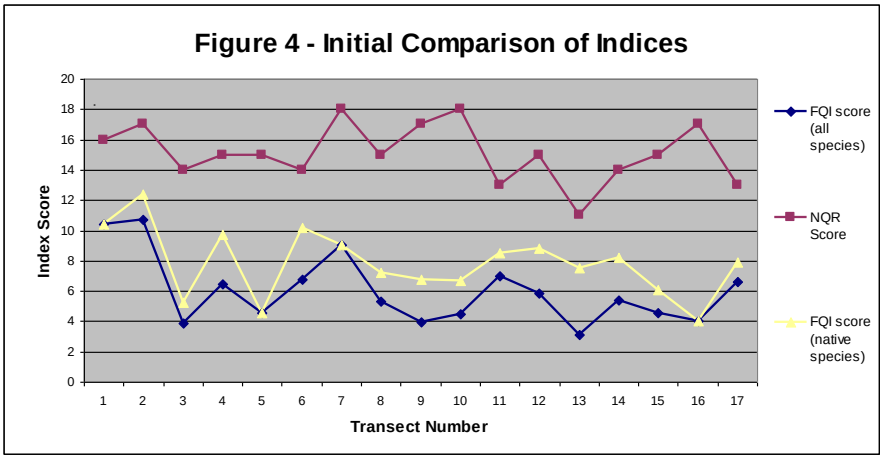
Perhaps the most indicative measure is the rapid-assessment NQR score which evaluates the naturalness of the area based on multiple criteria related to maturity, structural diversity, and dominance patterns, including an indicator of disturbance based on the presence of particular woody exotic invaders. The average score of 15 translates to a natural quality level of "moderately natural". As well, the percent of invasive species is fairly low (13.8%) as in contrast to the more recently or heavily disturbed areas of the park which are overrun with invasive species.

Species diversity appears to be low, but this is partly due to the fact that herbaceous species were excluded from the sampling inventory for the sake of expediency and to allow for year round sampling. While this number alone does not provide any truly meaningful assessment of the transects, it does provide a point of comparison between transects and offers baseline information as a reference point for future monitoring. Any further decline in the number of species over time would certainly be indicative of further degradation at any particular site.

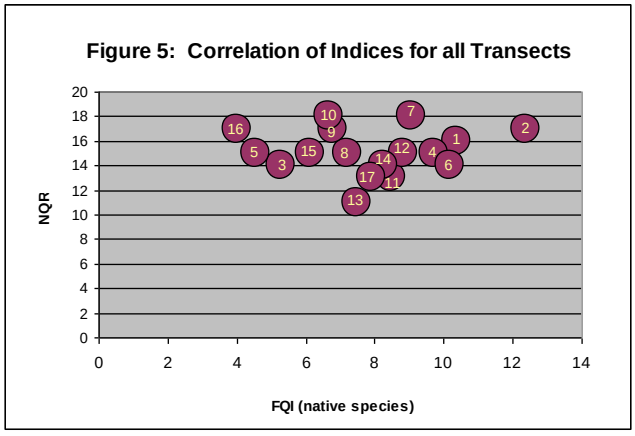
The FQI scores of 8 (native species only) and 6 (all species) are also atypically low. Generally, scores range between 10-50 with a score of 20 or less designating a site of low conservation value and 10 or less was considered severely degraded sites. Due to the exclusion of herbaceous layer data and a relatively small sampling area these values are severely diminished and therefore the data is only useful in comparing these 17 sites. However, the mean C is less affected and a score of 3 indicates that the forest is composed almost entirely of generalist species that are able to persist under some duress.

Lastly, the wetness index of 1 suggests that the forested areas are dominated by species that are almost equally likely to occur in wetlands as in non-wetland areas. As expected, generalist species that are tolerant of habitat degradation are typically tolerant of a range of other environmental conditions such as soil moisture. This low score may also reflect a balance of communities that are dependent on floodplain conditions and those that favor upland areas.

Information from individual sites can be analyzed in a similar manner in order to identify high quality sites and prioritize management efforts to protect or restore valuable forest habitat. Preliminary evaluation of the data focused on a comparison of the indices for each transect based on the degree of congruence between scores in relation to community averages (Figure 4) as a way to gauge overall health of each transect. This comparison reveals a similarity of results for 9 of the 17 transects such that 3 groups of approximately equivalent status can be recognized. Consistently high scores were reported for transects 1, 2 and 7; consistently moderate scores for 4, 8, 12, and 14; and below average scores for transects number 3 and 13. The scores for transects 5, 6, 8, 9, 10, 11, 15, 16 were inconsistent and generated both high and low values across the three indices.



Even though a simple comparison of the indices can provide an initial sorting of the data, it cannot provide a method to hierarchically rank the sites in order of naturalness because of the overall lack of agreement among the various indices. Figure 5 graphically depicts the degree of correlation between the NQR and FQI (native species) as a measure of the reliability of either score. A trendline for the data series lies nearly horizontal reflecting the absence of almost any correlation



between the two values. When quantified the correlation coefficient equals 0.025. This lack of correlation means that neither score can be relied upon as an overall indicator of forest health for each transect, but rather a method must be adopted to generate a composite result that reflects the cumulative information included within multiple parameters. The goal of such a scoring system would be to establish a hierarchical rank for each site in order to prioritize management efforts while accounting for transects that appear to have no relationship between its indices.

The value of using a multi-criteria approach in evaluating vegetative decline was recognized by Taft, et al. (1997). Following this approach, a combination of scores from each site can be used to produce a reliable estimate of areas that are most representative of unaltered or pre-settlement conditions. For this project a model was developed to acknowledge sites with a high NQR and FQI (native) as being the least degraded. A final priority score was arrived at by calculating the sum of the NQR and FQI (native). The calculated priority scores for each transect are reported in Table 4.

Table 4 – Sites Ranked by Combined Priority Score
(see Appendix 10 for geographic representation of site rankings)

Conservation Status	Priority Score	Community Type	Transect Number
1	29.37	Red Oak - Mixed Hardwood	2
2	27.05	Sycamore - Box Elder	7
3	26.39	Hemlock - Northern Hardwood	1
4	24.70	Sugar Maple - Basswood	4
5	24.66	Sugar Maple - Basswood	10
6	24.18	Red Oak - Mixed Hardwood	6
7	23.83	Bottomland Oak - Mixed Hardwood	12
8	23.80	Tuliptree – Beech - Maple	9
9	22.25	Red Oak - Mixed Hardwood	14*
10	22.21	Red Oak - Mixed Hardwood	8
11	21.49	Sycamore - Box Elder	11
12	21.12	Sugar Maple - Basswood	15
13	21.02	Silver Maple	16
14	20.91	Sycamore – Box Elder	17
15	19.54	Silver Maple	5
16	19.27	Sugar Maple - Basswood	3
17	18.50	Tuliptree – Beech - Maple	13

* unique stand of oaks based on composition (see discussion text for detail)

All seven community types documented within the park are not equally distributed in this hierarchy. The top four sites represent unique communities, but an attempt to include a site from each community type would require inclusion of the top 76% of the sites. For the most part the presence of a large specimen tree is a closely linked to high overall quality. In the final analysis the difference in transect length did not appear to play a significant role in the final score.

As illustrated in Appendix 10, the forested sites are located predominantly on steep slopes or in the floodplain of the main stem of Skippack creek. This finding is consistent with Matlack's (1997) research on the location of remnant forest communities in the suburban landscape. Matlack concluded that the distribution of modern forests is determined mostly by local site conditions such that areas not conducive to agricultural production such as steep sided stream valleys retain a greater continuity of forest cover. In the park there does not appear to be any relationship between high quality sites and either an upland or lowland position.

The preservation of high quality natural forest sites is particularly important as not only do they provide unique and valuable wildlife habitat, but also serve as the primary source of seed for adjacent successional areas. Concerted effort should be made to protect all remaining stands of natural forest, but particular attention should be focused on the top six sites as prime examples of high quality regenerated forest.

Site 1 is particularly important because it is the last remaining stand of the Hemlock-Northern Hardwood type. Site 14 is significant because of the unique composition of oaks that are present. Research using witness trees (historic property line markers) as a measure of pre-settlement forest composition found that the original forests of southeastern Pennsylvania were dominated by black oak (*Quercus velutina*), white oak (*Quercus alba*), hickory (*Carya spp*.), and chestnut (*Castanea spp*.) trees (Mikan et al., 1994; Black and Abrams, 2001). While the modern forest reflects a greater composition of red oak (*Quercus rubra*) in response to environmental changes, including the decline of American chestnut (*Castanea dentata*), the alteration of fire regimes, and an increase in herbivory, earlier forests reflected a much different composition. Although site number 14 was characterized as a Red Oak-Mixed Harwood community, the co-dominants in the canopy are white oak (39%), pignut hickory (24%), and black oak (13%). This stand may truly represent the last remnant of nearly original forest in the park and thus warrants immediate conservation measures. The low conservation status of this site is somewhat misleading as the NQR score failed to meet a more favorable disturbance indicator category by only 1% cover. If that had not been the case the NQR would have been 2 points higher moving the site into 6th position instead of 9th.

One potential problem with this assessment is the relative lack of information that was included in the NQR score regarding the regeneration of canopy species. Virtually no discrimination between sites was possible using the method as developed by Norris and Farrar (2001). While their evaluation criteria does include a component on the natural dominance of subcanopy species, it assumes that there will be a minimum of 25% cover and there is no opportunity to differentiate sites based on a difference in degrees of cover by tree species in the subcanopy. Only 11 of the 17 sites have any tree species in the subcanopy with greater than 25% relative cover. Trees that did achieve 25% relative cover are limited to 4 species: American beech (*Fagus grandifolia*), red ash (*Fraxinus pennsylvanica*), box elder (*Acer negundo*), and sugar maple (*Acer saccharum*). Sugar maple (*Acer saccharum*) is overwhelmingly the most prevalent subcanopy species, achieving greater than 25% relative cover in 7 out of the 17 transects and showing no fidelity to any single community type. Oak seedlings and saplings are noticeably absent from the understory. Red oak (*Quercus rubra*) is the only oak species found in the understory layer and is present in just 3 of the 17 transects sampled; percent cover ranged from <1–3%. As noted by Abrams et al. (1995) the original oak forests are experiencing

a compositional shift in the forest canopy over time. Forests originally dominated by American chestnut and white oak swung towards a red oak and black oak canopy and are now evolving to a forest composed of red maple, sugar maple, and beech. The understory component of the park's forest clearly supports this observation.

Forested areas in the park are vulnerable to a number of threats as discussed in the following section and under current conditions a complete restoration to pre-settlement condition is unlikely to occur. Areas of critical concern are 1) depleted understory and herbaceous layers and 2) increasing biomass of invasive species. Recovery can best be assisted by restocking the understory with native plants appropriate to the current successional stage. Already an apparent shift in the composition of the study area is evident and the introduction of new species is certain to persist. At best recovery is limited to rehabilitation of the community to a condition somewhat similar to the original structure, but distinctly different in composition. It is reasonable to attempt to achieve a healthy level of homeostasis by accommodating the continuum of change in forest composition while controlling for extreme adverse events.

Suitability Analysis and Restoration Potential - In a heavily fragmented landscape it is important to think in a larger scale for long-term planning. Moving beyond species or patch level conservation to a landscape approach can serve to restore the environmental gradients between various ecosystems. For this reason a suitability analysis was performed using GIS techniques to develop a conservation planning tool for the entire park. As outlined in the spatial analysis subsection of survey methodology, an analysis plan was developed with the goal of providing a prescriptive approach to maximize conservation efforts. Data from six classic disturbance variables were classified and summarized to create a suitability map (Appendix 11). The entire landscape was evaluated and ranked on a scale of 1-10, with 10 being the highest a score and indicative of a high value site that is more likely to remain free of future disturbances. For the most part the optimal conservation areas follow the stream corridor; incorporating many of the specific sites already targeted for protection. This analysis reveals an excellent opportunity for the restoration of an extended riparian corridor that would link many of the existing forest fragments.

SIGNIFICANT FACTORS AFFECTING THE REGENERATION OF NATURAL COMMUNITIES

HERBIVORY - Both the quantity and quality of forest vegetation throughout the park is severely impacted as a result of herbivory by white-tailed deer (*Odocoileus virginianus*). White-tailed deer are attracted to the park because of the favorable habitat created by the mosaic of fields and forest that provide an optimal balance of forage and shelter. Porter et al. (1994) estimated that greater than 60 deer/km^2 might occupy such areas of mixed land cover.

The density of the current deer population was not estimated as part of this study, however groups ranging in size from 1-6 individuals were encountered on several occasions across a variety of habitats. Further evidence of their presence was confirmed by the widespread and abundant occurrence of fecal pellets. The overall problem is

exacerbated by access along the Skippack Creek corridor that serves to connect the park with Valley Forge National Park which hosts a sizeable, unmanaged deer herd.

Numerous effects have been studied with relation to deer browse, but the most damaging relative to this park are the exhaustion of understory vegetation and associated changes in wildlife habitat (Stewart, 2001; Latham et al., 2005); decline in the reproductive success of plants causing a loss of species richness (Horsley et al., 2003; Latham et al., 2005), and potentially irreversible changes in natural succession of the forest community (Palmer et al., 2004; Cote et al., 2004). Vegetation patterns observed throughout the park are clearly indicative of intense browsing over extended periods of time.

Highly nutritious, flowering herbaceous species constitute the majority of the white-tail's diet in spring and summer. As the herb cover is reduced or eliminated a dense cover of ferns, grasses, and sedges develops. The park-wide inventory at Evansburg documented 375 species of ferns, grasses, sedges, and forbs; of which 25% is comprised of ferns, grasses, and sedges. Density of the herbaceous cover was not documented, but it was observed that many herbaceous forest species are extremely limited in their distribution and abundance while ferns, grasses, sedges, and unpalatable species such as garlic mustard (*Alliaria petiolata*) dominate the herbaceous layer as would be expected under intense browsing pressure from deer.

Woody understory species as sampled in the 17 transects also reflect intense selective browsing. Mature understory species were generally limited to unpalatable species such as spice bush (*Lindera benzoin*) or those that are more tolerant of browse such as multiflora rose (*Rosa multiflora*). Out of 17 transects these two species were present in over 65% of the sites and typically accounted for 10-25% of the understory vegetation. Elsewhere in the park, favored species such as Canadian yew (*Taxus canadensis*) are reduced in size to less than 30 cm tall and appeared only on steep rocky slopes. A well-defined browse line is not noticeable because of the prolific presence of non-native species including autumn olive (*Elaeagnus umbellata*), winged euonymous (*Euonymus alatus*), and obtuse-leaved privet (*Ligustrum obtusifolium*) which are not preferred foods for deer. In general there is a severe paucity of tree saplings (under 12 cm DBH and over 1 meter high) leading to a potential recruitment delay in canopy regeneration. Sapling species were also typically limited to less favored vegetation such as hickories (*Carya spp*.), box elder (*Acer negundo*), and black cherry (*Prunus serotina*). Preferred browse species such as oaks, with possibly the exception of red oak (*Quercus rubra*), and eastern hemlock (*Tsuga canadensis*) were noticeably absent from the understory.

The current deer population is abnormally high after a century of protective legislation, a relative absence of predators, and widespread changes in land use that have favored their population growth. The negative impact of this ecosystem imbalance can be observed directly in the composition and structure of plant communities as well as indirectly by the decline of other wildlife dependent on forest habitat. Future forest habitat management should be based on a balanced approach which suggests that deer densities should not exceed 20 per forested mi^2 or 640 acres in order to not surpass the carrying capacity of the ecosystem (Jones et al., 1993)

COMPETITION FROM INVASIVE SPECIES - A second process affecting the establishment and regeneration of natural communities is the competitive plant–plant interactions between native and exotic species. Research on these interactions has continued to expand and within the last few decades has increasingly focused on the causes and consequences of the prolific spread of exotic species. The term invasive species is typically applied to plants that naturalize to the detriment of the native community (Richardson et al., 2000). Of greatest concern is the subset of invasive plants known as transformers which comprise only about 10% of all invasive species but significantly alter the "character, condition, form or nature of ecosystems over a substantial area" (Richardson et al., 2003).

Much research has focused on the specific biological characteristics of particular species that make them successful invaders while other studies have centered on the characteristics that make a community more invasible such as those that have experienced an alteration as the result of a disturbance event (Hobbs and Huenneke, 1992). Environmental disturbance typically causes a plant community to revert to an earlier successional stage which serves to encourage colonization by new species. The potential impact of invasive species is wide ranging and poses multiple threats through direct competition or predation; or indirectly through some level of habitat disruption, hybridization, or other altered ecosystem processes. Typical changes within an ecosystem include reduced biodiversity, altered hydrologic, soil, or fire conditions; disruption of natural succession, displacement of native species, dissemination of disease, and the dilution of genetic resources.

According to The Nature Conservancy's Invasive Species database (2005), the flora in the park contains 73 known invasive plants, representing 13% of the park's vegetation. A significant number of these are early successional species or agricultural weeds that would be eliminated as tree cover develops. A large number of the invasive shrubs in the park have formed dense thickets in the open successional areas. Species such as multiflora rose (*Rosa multiflora*), autumn olive (*Elaeagnus umbellata),* and Amur honeysuckle (*Lonicera maackii*) are spreading rampantly throughout the park, effectively excluding many other species and retarding the development of a tree canopy. The herbaceous layer is also dominated by invasives such as lesser celandine (*Ranunculus ficaria*), Japanese stilt grass (*Microstegium vimineum*), and garlic mustard (*Alliaria petiolata*).

Once established, invasive species are difficult to control because of their aggressive growth habits, however a variety of control technologies are typically available including biological, mechanical, and chemical. The selection of which approach to follow is guided by many factors such as the extent of the infestation and the resources available. In the case of well established populations, self-distributing biological control methods is the most cost-effective way to achieve eradication, whereas mechanical or chemical measures are affordable and adequate to combat localized populations.

For the three widely distributed invasive shrubs previously mentioned, biological control mechanisms are currently only known to exist for multiflora rose (*Rosa multiflora*). The presence of this shrub in the post-agrarian landscape is no surprise as the plant was popularized as a living fence after the USDA approved the planting of multiflora rose on farmland in 1952 as erosion control, wildlife habit, and a durable

windbreak. Already an infestation of rose rosette disease (RRD) is spreading within the multiflora rose population in the park. This viral disease can be transmitted by either the eriophyid mite (*Phyllocoptes fructiphilus)* or grafting. Once infested, plants are usually killed within 48 months. It is estimated that within 10 years RRD will have effectively reduced the multiflora rose population in the eastern US by 90%. Since a number of ornamental rose species are susceptible to the disease carried by airborne mites, the spread of RRD should not be actively augmented in areas with adjacent plantings of ornamental roses. A second natural enemy of multiflora rose is also thought to be present in Pennsylvania. The host specific multiflora rose seed chalcid (*Megastigmus aculeatus var. nigroflavus*) destroys 90-95% of developing seed which is consumed by the growing larvae that emerges from eggs laid in the fruit. At present, this tiny wasp is not commercially available, however many sites in the northeastern US are currently infested and the disease will spread naturally via birds or other animals that ingest the infected seed and carry it to new locations. Natural dissemination throughout the entire eastern US is expected to occur within 20-30 years (Van Driesche et al., 2002). Active transport of the wasp by humans would only hasten the eventual decline of multiflora rose.

Of particular concern are isolated populations of eight species that are known to be aggressive invaders of disturbed habitats. Because these species are currently limited to a few isolated individuals or a small localized populations in the park immediate attention is warranted to prevent them from spreading further. These as yet manageable species include: five-leaf akebia *(Akebia quinata*), porcelain berry (*Ampelopsis brevipedunculata*), Japanese angelica-tree (*Aralia elata*), purple loosestrife (*Lythrum salicaria*), common reed (*Phragmites australis*), Japanese knotweed (*Polygonum cuspidatum*), Callery pear (*Pyrus calleryana*), and black swallow wort (*Vincetoxicum nigrum*). Information on the location of these species is provided in Appendix 12 and details about their natural history and a variety of control options is available online at http://www.paflora.org/DRIPP.html.

As with the rebound in the deer population, the prolific spread of invasive plant species is fueled by rapid changes in landscape. Both populations benefit from conditions created by the removal of forest canopy. However, invasive plants receive a secondary benefit from the presence of the deer which are more likely to favor native species that are either simply more abundant or palatable, thus reducing plant-plant competition for the invader.

ANTHROPOGENIC LANDSCAPE DISTURBANCE - Perhaps the greatest threat to both the survival of individual species and ecosystem functioning are changes occurring in the landscape as the result of human activity. In an effort to quantify the factors responsible for the rapid decline in biodiversity, Wilcove et al. (1998) examined the extent to which various human activities pose a threat to species continuity. Their results clearly define habit degradation and destruction as the primary culprit, contributing to the endangerment of 81% of plant species. Secondarily, alien species were shown to affect 57% of imperiled plant species through direct competition or predation. While plants are adapted to and even reliant upon many natural disturbance regimes, accelerated human alternation of the environment can be devastating to plant communities. The destruction of habitat, altered disturbance regimes, and over-utilization of natural resources by humans are clearly the most significant long-term threats to ecosystem health.

Direct exploitation of the vegetative resources of the park occurred mostly in the 18th and 19th centuries as the early settlers cleared the land for cropland, pasture, and to build homes. Portions of the once extensive forest were rapidly removed to support these human activities until the forest was reduced to small patches surrounded by urban or suburban land uses. These disconnected fragments are especially vulnerable to microclimatic changes occurring at their exposed edges and are limited in their ability to transfer nutrients and propagules across an artificial boundary, thus affecting the migration and expansion of species into adjacent areas. The most extensive fragmentation effects in the park are associated with roads and agricultural or recreational use of land. Wildlife is also negatively affected by the fragmentation of the landscape, especially when their habitat is destroyed or mobility limited. In turn, this indirectly affects the sustainability of the forest as seed dispersal and pollination relationships are altered. Both size and shape of the forest patch are important in the sustainability of both the plant and wildlife communities. Forest interior habitat changes with both size and shape, whereas edge effects are influenced to a greater extent by shape alone (Yahner, 2000). None of the forested areas in the park have any significant amount of interior habitat based on the requirement of 300 ft of transition zone necessary to protect an intact forest interior.

The park's forest cover is broken into 119 patches averaging 6.5 acres in size. The most fragmented of these are the palustrine communities which represent almost one-half of the naturally forested areas and average only 4.3 acres in size. These areas are contained within the natural floodplain of the creek and are important in regulating the hydrologic services of the watershed. As determined by the GIS suitability analysis described previously these palustrine communities are the most likely areas to benefit from conservation efforts that could serve to re-establish a corridor of continuous forest cover.

Floodplain covers approximately 627 acres in the park along the creek and its main tributaries. The floodplain provides a unique environment that supports the 5 distinct plant communities associated with the Palustrine Forest, Woodlands, and Shrubland community groups. The floodplain provides a variety of ecosystem functions including flood control, filtration, and groundwater recharge. These functions are maximized by the maintenance of a natural vegetative or riparian buffer. Depending on the nature of the surrounding land cover, this streamside habitat should consist of 100-300 feet (30-90 meters) of undisturbed or mature riparian forest. For the most part a forested buffer extending only 100 feet (30 m) on either side of the creek exists for the entire reach within park boundaries as determined by a GIS overlay of the existing plant communities. Because of the heavy nutrient loading and sedimentation concerns along with the ecologically valuable forest habitat a 300 foot (90 m) buffer is considered to be ideal. Within a 300 foot (90 m) buffer zone only 26% of the area is covered by mature forest with 16% maintained as cultivated or recreational fields. The greatest portion, 43%, is covered by successional vegetation.

Wetland function is also highly disrupted by human activity such as development and agriculture. Fragile wetland areas are frequently destroyed or severely degraded to the extent that they are no longer able to support the shrub and herbaceous plants that are restricted to this habitat. Along with the continuous floodplain these areas are particularly important in flood control and aquifer recharge. Inland herbaceous wetlands

represent only 0.2% of the park's acreage, but each site contains a diverse assemblage of plants and provides unique wildlife habitat.

Another significant change that occurred as the result of agrarian activity was the increase in cleared land which quickly formed the matrix around remaining forest fragments. Much of this land was purposely maintained as hay meadows or livestock pasture. These activities also engulfed any native grasslands that were present to a small extent prior to European settlement. Statewide native grasslands covered approximately 5% of landscape (PA DCNR, 2002) and were dominated by hardy, late maturing species such as Indian grass (*Sorghastrum nutans*), Switchgrass (*Panicum virgatum*), big bluestem (*Andropogon gerardii*), and little bluestem (*Schizachyrium scoparium*).

The term warm season grasses is applied to these species as they thrive in the hot, dry summer months and are typical of the eastern US prairie ecosystem. Grasslands are important wildlife habitat and forage for a number of birds, butterflies, small mammals, and larger grazing animals, as well as contributing significantly to CO_2 sequestration. Warm season grasses can flourish on poor, thin, acidic soils and require little soil amendments to produce abundant above-ground biomass and extensive root systems making them highly effective in controlling erosion and nutrient runoff. They are especially good buffers around wetlands for this reason.

These grasslands are typically slow to establish, but once created they require little maintenance. To encourage the survival of ground nesting birds and control woody vegetation mowing with the blade raised to 6 inches (15.2 cm) or higher should be done only every 1-3 years in late August. While there is no direct evidence that native grasslands were part of the historic landscape at this site, they are ecologically important in the matrix of natural habitat.

SPECIFIC MANAGEMENT RECOMMENDATIONS

A comprehensive list of specific management actions related to the broad themes of protecting mature forest, controlling invasives, and achieving ecosystem balance is provided below. The points are presented in a loose sequence of priority that is not meant to imply any degree of order-dependent success. Any individual measure can be implemented as resources permit. See appendix 12 for a map to accompany the following points.

1. Protect and monitor the potentially endangered early buttercup (*Ranunculus fascicularis*). Competitive species such as lesser celandine (*Ranunculus ficaria*) should be removed immediately. Close adjacent trail or fence the area to remove threat of accidental disturbance from hikers. Monitor tree canopy and shrub cover over time to insure that the species is not shaded out.
2. Immediately implement control measures for the 8 invasive species that are in the early stages of population development. At present these species have a high likelihood of being fully eradicated if control measures are instituted in the next 1-2 years. Details for implementation are provided online at www.paflora.org/DRIPP.html.
3. Reduce overall amount of forest edge by allowing additional areas of cultivated or managed lands to revert to natural cover. Target areas for reforestation are identified on the management map in Appendix 12. These areas significantly

decrease the forest edge – interior habitat ratio of adjacent forested areas. As well all are at least partially contained in the natural floodplain.

4. Restore the natural floodplain of the watershed by allowing cultivated or managed lands that are fully or partially contained within a 300' buffer zone to revert to either natural cover or warm season grasslands. Specific areas that impact the floodplain are identified on the management map in Appendix 12. The second field south of Skippack Pike and north of Stump Hall Road is strongly recommended for unmanaged succession because of the diverse community of natural early successional wetland obligate or facultive species already established.
5. Remain informed on status of biological control for multiflora rose (*Rosa multiflora*). Consult with pest management specialists and augment spread of rose seed chalcid (*Megastigmus aculeatus var. nigroflavus*) if appropriate.
6. Use ranking of prioritized forest sites (Table 4 and Appendices 8 and 10) to guide implementation of the following restoration techniques.
    - Remove invasives where possible from interior forest habitat and forest edges and replace with native species.
    - Advance the forest edge into adjacent open or successional areas by replanting with native shrubs and trees.
    - Seal the edge with barrier such as linear brush piles, fences, or native hedge.
6. Reduce deer density by expanding sport hunting and/or augmenting hunting with sharp-shooter culling in all areas of the park.
7. Thin monoculture plantation forest stands and replant with mixed hardwood or conifer species as appropriate to stabilize the community by diversifying stand age and composition. All plantation forests are identified on the accompanying map in Appendix 12.
8. Protect remaining white oak stand (priority site 9 on management map) and encourage regeneration towards pre-settlement oak forest cover. In addition to item 6 (reducing deer density), selective thinning of generalist and non-native species should be initiated along with an equal extent of replanting with stock of local provenance if possible.
9. Convert an additional 150 acres of managed fields to low-maintenance warm season grassland to reach pre-settlement balance of approximately 5% grassland cover. Recommended fields for conversion identified on the management map in Appendix 12. These 3 fields, totaling 35.3 acres, all drain towards two wetlands habitats. Additional acreage suitable for conversion is that identified in point 4 under floodplain restoration.
10. Protect wetland communities from unnecessary disturbance or hydrologic change.
11. Obliterate and revegetate closed roads such as Hedrick Road and Lewis Road. Keep trails narrow if incorporated into an existing trail system.
12. Continue efforts to prevent further soil erosion from cultivated fields. Most of the soils in the park are highly erodible by nature and easily damaged by agricultural activities. All areas under current cultivation appear to be applying standard erosion control practices such as contour strip-cropping, maintaining grassed

diversion terraces and waterways, and rotating fields out of production periodically.

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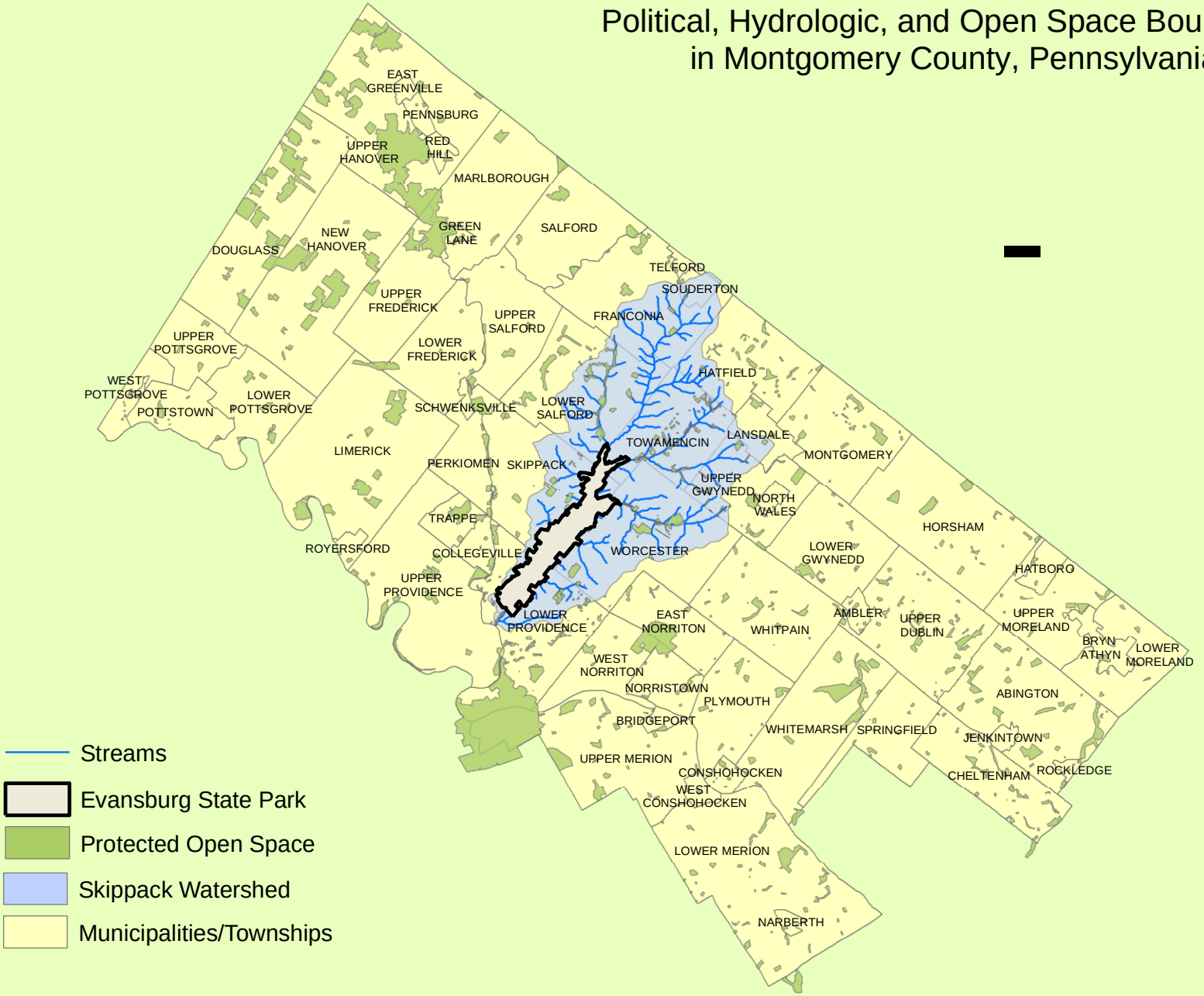
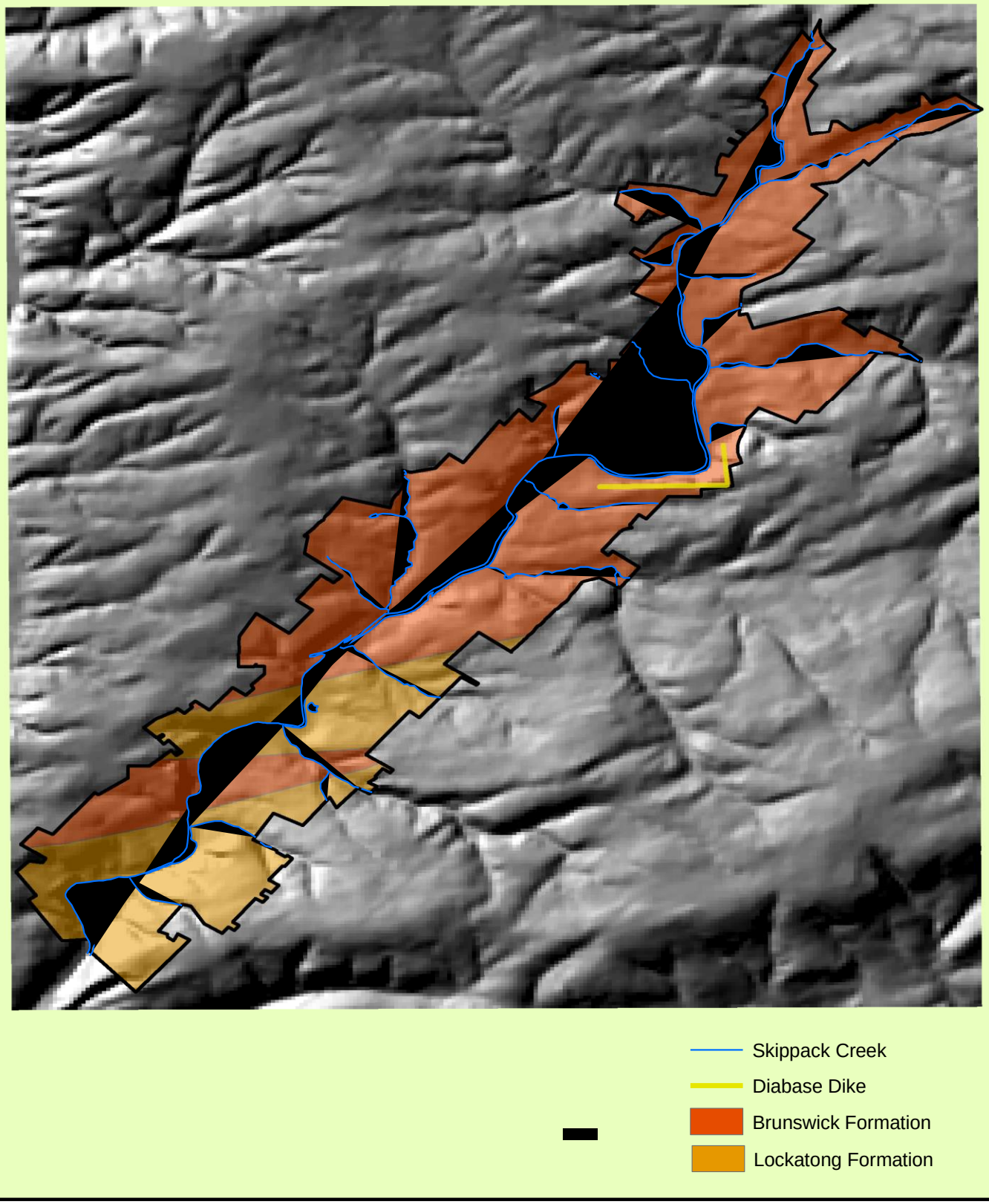
Political, Hydrologic, and Open Space Boundaries in Montgomery County, Pennsylvania



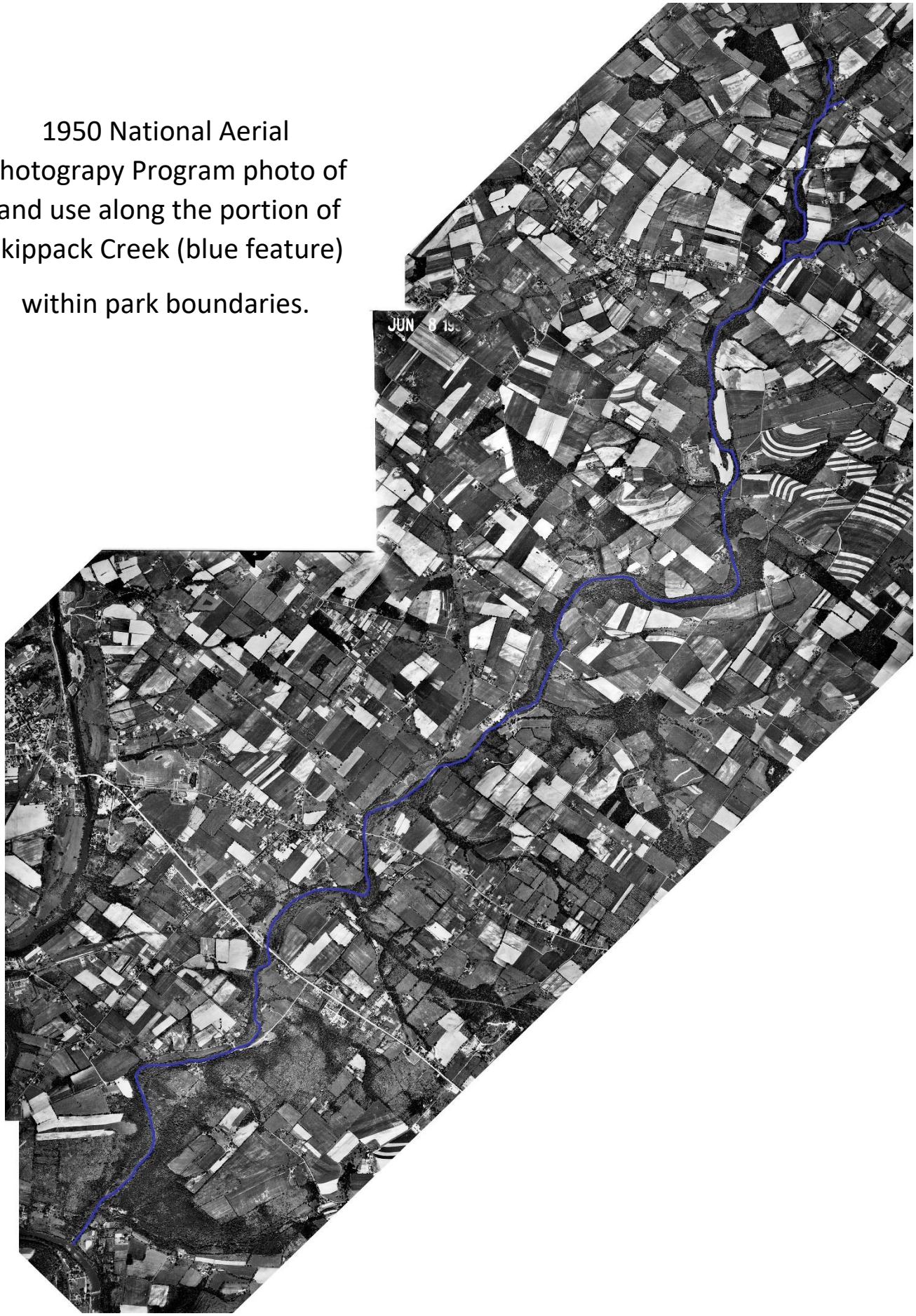
APPENDIX 2 – Geology and Topography

Geologic Formations



APPENDIX 3 – Historic Aerial Photo

1950 National Aerial Photograpy Program photo of land use along the portion of Skippack Creek (blue feature) within park boundaries.



APPENDIX 4 – Transect Locations

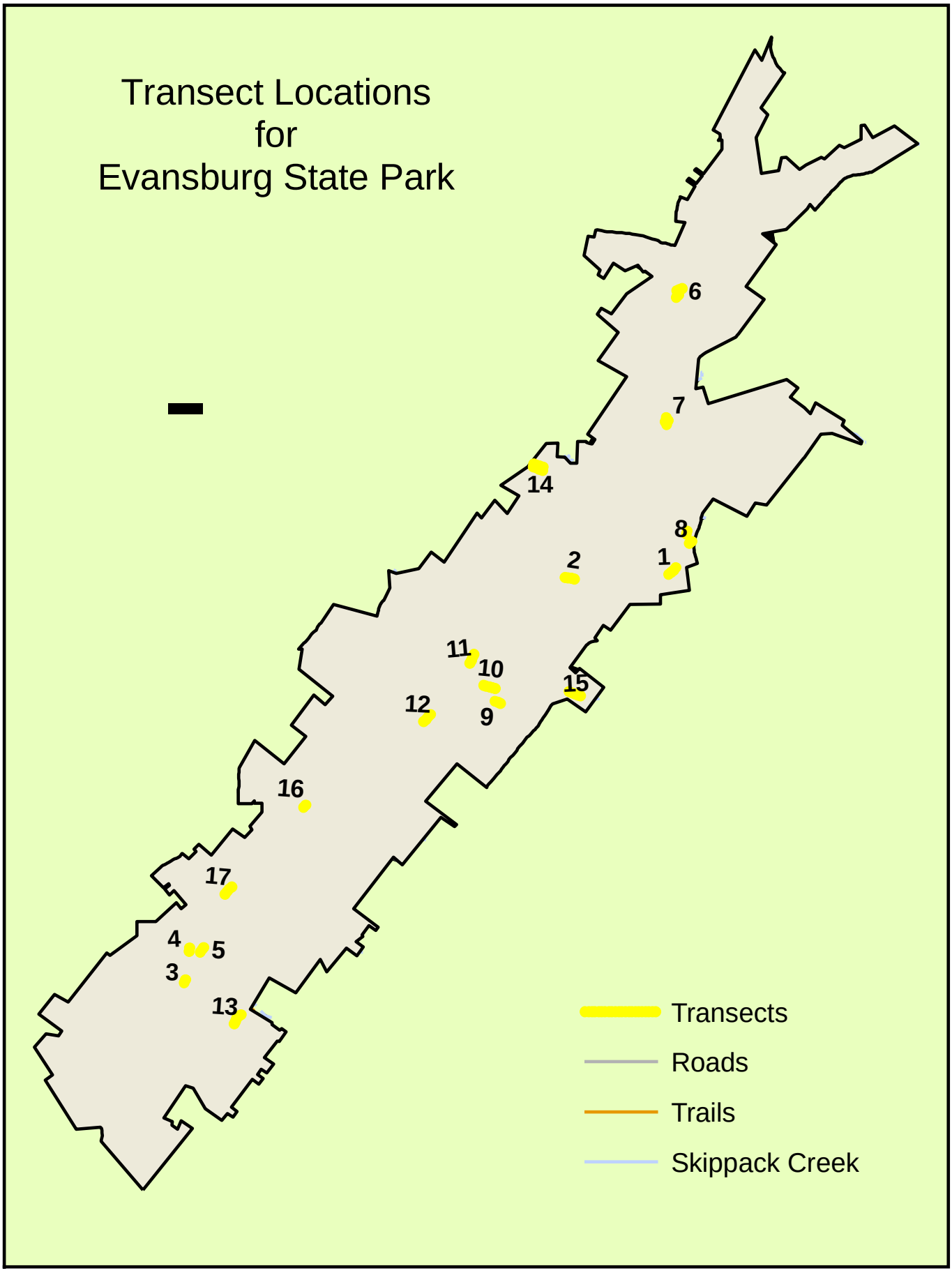


Table 1. Method used for the natural quality evaluation of forests in northeast Iowa. Points are assigned for each of three major categories: tree size (T), structure (8), and dominance (D). These are summed to yield a natural quality rating (Q), which ranges from 0 to 20 points. High values of Q indicate high congruence with mature forest communities developed in the absence of recent (last 75 years) human-induced disturbance; low values indicate high levels of recent human-induced disturbance.

TREE SIZE *(Used DBH of largest tree at each point along the transect)*

4 Mean dbh (of the largest tree in each quadrant) at least 50 cm
3 Mean dbh between 40 and 49 cm
2 Mean dbh between 30 and 39 cm
I Mean dbh between 20 and 29 cm
0 Mean dbh less than 20 cm
T= _____

STRUCTURE *(Observed in field)*

Trees (woody vegetation> 2 m in height, excluding vines):
3 Two layers (canopy and subcanopy) present with at least 50% cover and clearly distinguished
I Only one layer (canopy or subcanopy) present with at least 50% cover OR both layers present but not clearly distinguished
0 Neither canopy or subcanopy with at least 50% cover

_____

Shrubs (woody vegetation between 0.5 m and 2 m in height): *(Used relative cover of shrub species only from vegetation over 1 meter in height and less than 12cm DBH)*
3 Between 1 % and 10% cover
2 Between 11 % and 50% cover
I Less than 1 % cover
0 More than 50% cover

S = _____ (sum of scores)

DOMINANCE

Canopy trees with crowns exposed to open sky: *(Evaluated dominance from trees with relative cover greater than 25%)*
4 All species with at least 25% cover are naturally dominant in the given habitat a
2 Some (but not all) of the species with at least 25% cover are naturally dominant in the given habitat
0 None of the species contributing at least 25% canopy cover are naturally dominant in the given habitat

_____

Subcanopy (woody vegetation> 2 m in height and beneath the canopy or in a canopy gap): *(Evaluated based on tree species in shrub layer – vegetation over 1 meter in height and less than 12cm DBH)*
2 All species with at least 25% cover are naturally dominant in the given habitat a
I Some (but not all) of the species with at least 25% cover are naturally dominant in the given habitat
0 None of the species contributing at least 25% canopy cover are naturally dominant in the given habitat

Shrub/Seedlings (woody vegetation between 0.5 m and 2 m in height): *(Used relative cover of indicator species below)*
4 Cover by disturbance indicators less than 1% b
3 Cover by disturbance indicators between I % and 10%
I Cover by disturbance indicators between 11 % and 25%
0 Cover by disturbance indicators more than 25%

_____

D = _____ (sum of scores)

Q = _____ (T + S + D)

a See Table 2 for lists of naturally dominant species for canopy and subcanopy on ridgetops, slopes, and bottomland habitats in northeast Iowa. If no species are recorded as dominant (at least 25% cover) on the survey form for the given forest layer and habitat, score 3 points if at least 75% of the listed species are natural residents; 2 points if between 50% and 74% of the species are natural residents; and 0 points if less than 50% of the species are natural residents.

b When scoring the shrub/seedling dominance category, consider the following species to be disturbance indicators: *Berberis* spp., non-native *Lonicera* species, *Ribes missouriense, Rhamnus cathartica, Rosa multiflora, Rubus* spp., and *Zanthoxylum americanum.* (In addition, *Celastrus orbiculatus, Elaeagnus umbellata, Euonymus alatus, and Ligustrum* spp. were also included in this category)

APPENDIX 6– Comprehensive Floristic Inventory

COMMON NAME	SCIENTIFIC NAME	Native or Introduced	Federal Status	State Status	Wherry 1971-1986
Aquatic Plants					
Broad leaved water plantain	Alisma subcordatum	N	N	N	Y
Water-starwort	Callitriche heterophylla	N	N	N	Y
Water-starwort	Callitriche terrestris*	N	N	N	Y
Common waterweed	Elodea nuttallii*	N	N	N	Y
Duckweed	Lemna minor	N	N	N	Y
Marsh-purslane, Water-purslane	Ludwigia palustris	N	N	N	Y
Eurasian water-milfoil	Myriophyllum spicatum*	I	N	N	Y
Spatterdock, Yellow pond-lily	Nuphar advena*	N	N	N	Y
Dotted smartweed, Water smartweed	Polygonum punctatum	N	N	N	Y
Curly pondweed	Potamogeton crispus*	I	N	N	Y
Longleaf pondweed	Potamogeton nodosus*	N	N	N	Y
Pondweed	Potamogeton pusillus*	N	N	N	N
Wapato, Duck potato	Sagittaria latifolia	N	N	N	Y
Greater duckweed, Water-flaxseed	Spirodela polyrhiza	N	N	N	Y
Common cat-tail	Typha latifolia	N	N	N	Y
Ferns and Fern Allies					
Ebony spleenwort	Asplenium platyneuron	N	N	N	Y
Maidenhair spleenwort	Asplenium trichomanes*	N	N	N	Y
Lady fern	Athyrium filix-femina var. angustum	N	N	N	Y
Cut-leaved grape fern	Botrychium dissectum	N	N	N	Y
Fragile fern	Cystopteris fragilis*	N	N	N	Y
Hay scented Fern	Dennstaedtia punctilobula	N	N	N	Y
Spinulose wood fern	Dryopteris carthusiana*	N	N	N	Y
Evergreen wood fern, Fancy fern	Dryopteris intermedia*	N	N	N	Y
Marginal wood fern	Dryopteris marginalis*	N	N	N	Y
Hickey's ground pine	Lycopodium hickeyi*	N	N	N	N
Flat branched ground pine	Lycopodium obscurum	N	N	N	Y
Ostrich fern	Matteuccia struthiopteris	N	N	N	Y
Sensitive fern	Onoclea sensibilis	N	N	N	Y
Polypody, Rockcap	Polypodium virginianum*	N	N	N	Y
Christmas fern	Polystichum acrostichoides	N	N	N	Y
New York fern	Thelypteris noveboracensis	N	N	N	Y
Blunt-lobed woodsia	Woodsia obtusa*	N	N	N	Y
Fungi					
Sulfur shelf, Chicken of the woods	Laetiporus sulphureus	-	-	-	-

COMMON NAME	SCIENTIFIC NAME	Native or Introduced	Federal Status	State Status	Wherry 1971-1986
Turkey tail	Trametes versicolor	-	-	-	-
Grasses and Sedges					
Autumn bent, Upland bent	Agrostis perennans	N	N	N	Y
Big bluestem, Turkeyfoot	Andropogon gerardii	N	N	N	Y
Broom-sedge	Andropogon virginicus	N	N	N	Y
Sweet vernalgrass	Anthoxanthum odoratum	I	N	N	Y
Hairy chess	Bromus commutatus	I	N	N	Y
Smooth brome	Bromus inermis	I	N	N	Y
Sedge	Carex amphibola var. rigida*	N	N	N	Y
Sedge	Carex appalachica*	N	N	N	N
Sedge	Carex blanda*	N	N	N	Y
Sedge	Carex bushii	N	N	N	Y
Sedge	Carex cephalophora*	N	N	N	Y
Sedge	Carex communis*	N	N	N	Y
Short hair sedge	Carex crinita var. crinita	N	N	N	Y
Sedge	Carex digitalis*	N	N	N	Y
Sedge	Carex festucacea	N	N	N	Y
Sedge	Carex frankii	N	N	N	Y
Sedge	Carex gracillima	N	N	N	Y
Sedge	Carex laxiculmis var. laxiculmis*	N	N	N	Y
Sedge	Carex leptonervia*	N	N	N	N
Sedge	Carex lurida	N	N	N	Y
Pennsylvania sedge	Carex pensylvanica*	N	N	N	Y
Broad-leafed sedge	Carex platyphylla*	N	N	N	Y
Sedge	Carex radiata*	N	N	N	Y
Sedge	Carex sparganioides	N	N	N	Y
Sedge	Carex stipata	N	N	N	Y
Sedge	Carex swanii*	N	N	N	Y
Sedge	Carex virescens*	N	N	N	Y
Sedge	Carex vulpinoidea	N	N	N	Y
Sedge	Carex willdenovii*	N	N	N	Y
Wood reedgrass	Cinna arundinacea	N	N	N	Y
Umbrella sedge	Cyperus microiria	I	N	N	N
False nutsedge	Cyperus strigosus	N	N	N	Y
Orchard grass	Dactylis glomerata	I	N	N	Y
Poverty-grass	Danthonia spicata	N	N	N	Y
Southern crabgrass	Digitaria ciliaris	I	N	N	N
Northern crabgrass	Digitaria sanguinalis	I	N	N	Y
Barnyard grass	Echinochloa crusgalli	I	N	N	Y
Barnyard grass, Cockspur	Echinochloa muricata	N	N	N	Y
Wright's spike rush	Eleocharis obtusa	N	N	N	Y
Bottlebrush grass	Elymus hystrix	N	N	N	Y
Riverbank wild rye	Elymus riparius	N	N	N	Y

COMMON NAME	SCIENTIFIC NAME	Native or Introduced	Federal Status	State Status	Wherry 1971-1986
Virginia wild rye	Elymus virginicus	N	N	N	Y
Lovegrass	Eragrostis minor	I	N	N	Y
Purple lovegrass, Tumblegrass	Eragrostis spectabilis	N	N	N	Y
Nodding fescue	Festuca obtusa*	N	N	N	Y
Fowl mannagrass	Glyceria striata*	N	N	N	Y
Velvet grass	Holcus lanatus	I	N	N	Y
Sharp fruited rush	Juncus acuminatus	N	N	N	Y
Soft rush	Juncus effusus	N	N	N	Y
Soft rush	Juncus effusus var. solutus	N	N	N	Y
Path rush	Juncus tenuis	N	N	N	Y
Cutgrass, Whitegrass	Leersia virginica*	N	N	N	Y
Field woodrush	Luzula multiflora*	N	N	N	Y
Stiltgrass	Microstegium vimineum	I	N	N	Y
Muhly	Muhlenbergia sp.	N	N	N	Y
Panic grass	Panicum acuminatum	N	N	N	Y
Deer-tongue grass	Panicum clandestinum	N	N	N	Y
Panic grass	Panicum commutatum*	N	N	N	N
Smooth panic grass	Panicum dichotomiflorum	N	N	N	Y
Witchgrass	Panicum gattingeri	N	N	N	Y
Switchgrass	Panicum virgatum	N	N	N	Y
Reed canary grass	Phalaris arundinacea	N	N	N	Y
Timothy	Phleum pratense	I	N	N	Y
Common reed	Phragmites australis	N	N	N	Y
Annual bluegrass	Poa annua	I	N	N	Y
Kentucky bluegrass	Poa pratensis	I	N	N	Y
Rough bluegrass	Poa trivialis*	I	N	N	Y
Little bluestem	Schizachyrium scoparium	N	N	N	Y
Giant foxtail	Setaria faberi	I	N	N	Y
Yellow foxtail	Setaria pumila	I	N	N	Y
Indian grass	Sorghastrum nutans	N	N	N	Y
Broom-corn, Milo	Sorghum bicolor var. bicolor	I	N	N	Y
Prairie wedgegrass	Sphenopholis obtusata var. obtusata*	N	N	N	Y
Purpletop	Tridens flavus	N	N	N	Y
Six-weeks fescue	Vulpia octoflora var. glauca*	N	N	N	Y
Corn	Zea mays	I	N	N	Y
Lichens					
NA	Cladonia coniocrea	-	-	-	-
NA	Cladonia ochrochlora	-	-	-	-
Stippleback or leather lichen	Dermatocarpon luridum	-	-	-	-
Common greenshield lichen	Flavoparmelia caperata	-	-	-	-
Powdery-axil bristle lichen	Myelochroa aurulenta	-	-	-	-
Trees, Shrubs, and Woody Vines					
White fir	Abies concolor*	I	N	N	N

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Box elder	Acer negundo	N	N	N	Y
Japanese maple	Acer palmatum	I	N	N	Y
Norway maple	Acer platanoides	I	N	N	Y
Red maple, Swamp maple	Acer rubrum	N	N	N	Y
Silver maple	Acer saccharinum	N	N	N	Y
Sugar maple, Rock maple	Acer saccharum	N	N	N	Y
Ohio buckeye	Aesculus glabra	N	N	N	N**
Tree-of-heaven	Ailanthus altissima	I	N	N	Y
Mimosa, Silktree	Albizia julibrissin	I	N	N	N
Shadbush, Serviceberry, Juneberry	Amelanchier arborea	N	N	N	Y
Smooth shadbush, Smooth serviceberry	Amelanchier laevis	N	N	N	Y
Porcelain berry	Ampelopsis brevipedunculata*	I	N	N	Y
Japanese angelica-tree	Aralia elata	I	N	N	N
Japanese barberry	Berberis thunbergii	I	N	N	Y
River birch	Betula nigra*	N	N	N	Y
European white birch	Betula pubescens	I	N	N	Y
Paper-mulberry	Broussonetia papyrifera	I	N	N	Y
Trumpet-vine, Trumpet-creeper	Campsis radicans	N	N	N	Y
Hornbeam, Ironwood	Carpinus caroliniana	N	N	N	Y
Bitternut hickory	Carya cordiformis	N	N	N	Y
Pignut hickory	Carya glabra	N	N	N	Y
Shagbark hickory	Carya ovata	N	N	N	Y
Mockernut hickory	Carya tomentosa	N	N	N	Y
Catalpa, Cigar-tree	Catalpa speciosa	I	N	N	N
Oriental bittersweet	Celastrus orbiculatus	I	N	N	Y
Hackberry, Sugarberry	Celtis occidentalis	N	N	N	Y
Eastern redbud, Judas-tree	Cercis canadensis	N	N	N	Y
Sweet autumn clematis	Clematis terniflora	I	N	N	Y
Virgin's bower, Sweet autumn clematis	Clematis virginiana*	N	N	N	Y
Kinnikinik, Red willow	Cornus amomum	N	N	N	Y
Flowering dogwood	Cornus florida	N	N	N	Y
American filbert, Hazelnut	Corylus americana	N	N	N	Y
Beaked hazelnut	Corylus cornuta	N	N	N	Y
Cockspur hawthorne	Crataegus crus-galli	N	N	N	Y
Fanleaf hawthorne	Crataegus flabellata*	N	N	N	N
Chinese yam, Cinnamon-vine	Dioscorea batatas*	I	N	N	Y
Wild yam, Colic-root	Dioscorea villosa	N	N	N	Y
Autumn olive	Elaeagnus umbellata	I	N	N	Y
Winged euonymous	Euonymus alatus	I	N	N	Y
Burning bush, Wahoo	Euonymus atropurpureus	N	N	N	Y

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Wintercreeper	Euonymus fortunei*	I	N	N	N
American beech	Fagus grandifolia	N	N	N	Y
Forsythia	Forsythia suspensa	I	N	N	Y
White ash	Fraxinus americana	N	N	N	Y
Red ash	Fraxinus pennsylvanica	N	N	N	Y
Black huckleberry	Gaylussacia baccata	N	N	N	Y
Honey-locust	Gleditsia triacanthos	N	N	N	Y
Kentucky coffee tree	Gymnocladus dioica	N	N	N	Y
Witch hazel	Hamamelis virginiana	N	N	N	Y
English ivy	Hedera helix	I	N	N	Y
Panicled hydrangea, Peegee hydrangea	Hydrangea paniculata	I	N	N	N
Japanese holly	Ilex crenata	I	N	N	N
American holly	Ilex opaca	N	N	PT	Y
Winterberry, Black-alder	Ilex verticillata	N	N	N	Y
Butternut	Juglans cinerea	N	N	N	Y
Black walnut	Juglans nigra	N	N	N	Y
Eastern red-cedar	Juniperus virginiana	N	N	N	Y
Mountain laurel	Kalmia latifolia	N	N	N	Y
European larch	Larix decidua	I	N	N	N
Japanese larch	Larix kaempferi	I	N	N	N
Mountain dog-laurel	Leucothoe walteri	I	N	N	N
Obtuse-leaved privet	Ligustrum obtusifolium*	I	N	N	Y
Spicebush	Lindera benzoin	N	N	N	Y
Sweetgum	Liquidambar styraciflua	N	N	N	Y
Tuliptree, Yellow-poplar	Liriodendron tulipifera	N	N	N	Y
Japanese honeysuckle	Lonicera japonica	I	N	N	Y
Amur honeysuckle	Lonicera maackii	I	N	N	Y
Morrow's honeysuckle	Lonicera morrowii*	I	N	N	Y
Osage-orange	Maclura pomifera*	I	N	N	Y
Saucer magnolia	Magnolia soulangeana	I	N	N	N
Umbrella tree	Magnolia tripetala	N	N	PT	Y
Sweet crabapple	Malus coronaria	N	N	N	Y
Crabapple	Malus sp.	I	N	N	Y
White mulberry	Morus alba	I	N	N	Y
Sourgum, Blackgum, Tupelo	Nyssa sylvatica	N	N	N	Y
Hop-hornbeam	Ostrya virginiana	N	N	N	Y
Virginia creeper. Woodbine	Parthenocissus quinquefolia*	N	N	N	Y
Mock-orange	Philadelphus coronarius	I	N	N	Y
Mock orange	Philadelphus inodorus var. grandiflorus*	I	N	N	Y
Ninebark	Physocarpus opulifolius	N	N	N	Y
Norway spruce	Picea abies	I	N	N	N
Colorado blue spruce	Picea pungens	I	N	N	N

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Lily of the valley bush	Pieris japonica	I	N	N	N
Short leaf pine, Yellow pine	Pinus echinata	N	N	N	Y
Norway pine, Red pine	Pinus resinosa	N	N	N	N
Eastern white pine	Pinus strobus	N	N	N	Y
Scots pine	Pinus sylvestris	I	N	N	N
Virginia pine	Pinus virginiana	N	N	N	Y
London plane	Platanus acerifolia	I	N	N	Y
Sycamore, Buttonwood, Planetree	Platanus occidentalis	N	N	N	Y
Hardy orange, Trifoliate orange	Poncirus trifoliata	I	N	N	Y
Bigtooth aspen	Populus grandidentata	N	N	N	Y
Quaking aspen	Populus tremuloides	N	N	N	Y
Sweet cherry	Prunus avium	I	N	N	Y
Black cherry	Prunus serotina	N	N	N	Y
Choke cherry	Prunus virginiana	N	N	N	Y
Callery pear	Pyrus calleryana*	I	N	N	N
White oak	Quercus alba	N	N	N	Y
Swamp white oak	Quercus bicolor	N	N	N	Y
Scarlet oak	Quercus coccinea	N	N	N	Y
Chestnut oak	Quercus montana	N	N	N	Y
Pin oak	Quercus palustris	N	N	N	Y
Northern red oak	Quercus rubra	N	N	N	Y
Black oak	Quercus velutina	N	N	N	Y
Buckthorn	Rhamnus cathartica*	I	N	N	Y
Rosebay	Rhododendron maximum	N	N	N	Y
Pinxter-flower	Rhododendron periclymenoides	N	N	N	Y
Jetbead	Rhodotypos scandens	I	N	N	Y
Smooth sumac	Rhus glabra	N	N	N	Y
Staghorn sumac	Rhus typhina	N	N	N	Y
Wild black current	Ribes americanum	N	N	N	Y
Wild gooseberry	Ribes rotundifolium	N	N	N	N
Black locust	Robinia pseudoacacia	N	N	N	Y
Multiflora rose	Rosa multiflora	I	N	N	Y
Swamp rose	Rosa palustris	N	N	N	Y
Common blackberry	Rubus allegheniensis	N	N	N	Y
Southern dewberry	Rubus enslenii*	N	N	N	Y
Prickly dewberry, Northern dewberry	Rubus flagellaris	N	N	N	Y
Black-cap, Black raspberry	Rubus occidentalis	N	N	N	Y
Blackberry	Rubus pensilvanicus*	N	N	N	Y
Wineberry	Rubus phoenicolasius	I	N	N	Y
Black willow	Salix nigra	N	N	N	Y
American elder	Sambucus canadensis	N	N	N	Y

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Sassafras	Sassafras albidum	N	N	N	Y
Catbrier, Greenbrier	Smilax rotundifolia	N	N	N	Y
Japanese pagoda tree	Sophora japonica	I	N	N	N
Bridal wreath spiraea	Spiraea prunifolia	I	N	N	N
Bladdernut	Staphylea trifolia	N	N	N	Y
Coralberry, Indian-currant	Symphoricarpos orbiculatus	N	N	N	Y
Common lilac	Syringa vulgaris	I	N	N	Y
English yew	Taxus baccata	N	N	N	N**
Canadian yew	Taxus canadensis*	N	N	N	Y
Arborvitae, Northern white cedar	Thuja occidentalis	I	N	N	N
American basswood, Whitewood	Tilia americana	N	N	N	Y
Poison ivy	Toxicodendron radicans	N	N	N	Y
Canada hemlock	Tsuga canadensis	N	N	N	Y
American elm, White elm	Ulmus americana	N	N	N	Y
Chinese elm	Ulmus parviflora	I	N	N	
Siberian elm	Ulmus pumila	I	N	N	N
Red elm, Slippery elm	Ulmus rubra	N	N	N	Y
Low sweet blueberry, Sheep laurel	Vaccinium angustifolium	N	N	N	Y
Highbush blueberry	Vaccinium corymbosum	N	N	N	Y
Lowbush blueberry	Vaccinium pallidum	N	N	N	Y
Deerberry	Vaccinium stamineum*	N	N	N	Y
Maple-leaved viburnum	Viburnum acerifolium	N	N	N	Y
Southern arrow-wood	Viburnum dentatum	N	N	N	Y
Linden viburnum	Viburnum dilatatum	I	N	N	N
Guelder rose	Viburnum opulus*	I	N	N	Y
Black-haw	Viburnum prunifolium	N	N	N	Y
Northern arrow-wood	Viburnum recognitum*	N	N	N	Y
Tea viburnum	Viburnum setigerum	I	N	N	N
Siebold viburnum	Viburnum sieboldii*	I	N	N	N
Black swallow wort	Vincetoxicum nigrum	I	N	N	Y
Frost grape	Vitis vulpina*	N	N	N	Y
Chinese wisteria	Wisteria sinensis	I	N	N	N
Wildflowers/Herbaceous Plants					
Velvet leaf, Butter-print	Abutilon theophrastii	I	N	N	Y
Three seeded mercury	Acalypha rhomboidea	N	N	N	Y
Three seeded mercury	Acalypha virginica	N	N	N	Y
Common yarrow, Milfoil	Achillea millefolium	I	N	N	Y
Goutweed	Aegopodium podagraria	I	N	N	Y
Small fruited agrimony	Agrimonia microcarpa	N	N	N	Y
Southern agrimony	Agrimonia parviflora	N	N	N	Y
Downy agrimony	Agrimonia pubescens*	N	N	N	Y

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Woodland agrimony	Agrimonia rostellata*	N	N	N	Y
Carpet bugleweed	Ajuga reptans	I	N	N	Y
Five-leaf akebia	Akebia quinata	I	N	N	Y
Garlic mustard	Alliaria petiolata	I	N	N	Y
Wild leek, Ramp	Allium tricoccum	N	N	N	Y
Field garlic, Scallions	Allium vineale	I	N	N	Y
Tumbleweed	Amaranthus albus*	N	N	N	Y
Palmer's amaranth	Amaranthus palmeri*	I	N	N	N
Amaranth	Amaranthus powellii	I	N	N	Y
Spiny amaranth	Amaranthus spinosus	I	N	N	Y
Common ragweed	Ambrosia artemisiifolia	N	N	N	Y
Giant ragweed	Ambrosia trifida	N	N	N	Y
Hog peanut	Amphicarpa bracteata	N	N	N	Y
Scarlet pimpernel	Anagallis arvensis	I	N	N	Y
Indian-hemp	Apocynum cannabinum	N	N	N	Y
Wild columbine	Aquilegia canadensis	N	N	N	Y
Wild sarsaparilla	Aralia nudicaulis	N	N	N	Y
Spikenard	Aralia racemosa	N	N	N	Y
Common burdock	Arctium minus	I	N	N	Y
Green dragon	Arisaema dracontium	N	N	N	Y
Jack-in-the-pulpit	Arisaema triphyllum	N	N	N	Y
Sweet wormwood, Annual wormwood	Artemisia annua	I	N	N	Y
Common mugwort	Artemisia vulgaris	I	N	N	Y
Wild ginger	Asarum canadense	N	N	N	Y
Swamp milkweed	Asclepias incarnata	N	N	N	Y
Common milkweed	Asclepias syriaca	N	N	N	Y
Garden asparagus	Asparagus officinalis	I	N	N	Y
Seashore orach	Atriplex littoralis	N	N	N	N
Early wintercress	Barbarea verna	I	N	N	Y
Spanish needles	Bidens bipinnata	N	N	N	Y
Bur-marigold, Stick-tight	Bidens cernua	N	N	N	Y
Beggar-ticks, Stick-tights	Bidens frondosa	N	N	N	Y
Tickseed sunflower	Bidens polylepis	I	N	N	Y
Beggar ticks, Stick tights	Bidens vulgata*	N	N	N	Y
False nettle	Boehmeria cylindrica	N	N	N	Y
Bindweed, Morning glory	Calystegia silvatica var. fraterniflora	N	N	N	N
Shepherd's purse	Capsella bursa-pastoris	I	N	N	Y
Toothwort	Cardamine concatenata	N	N	N	Y
Hairy bittercress	Cardamine hirsuta	I	N	N	Y
Pennsylvania bittercress	Cardamine pensylvanica	N	N	N	Y
Brown knapweed	Centaurea jacea*	I	N	N	Y
Common mouse-ear chickweed	Cerastium fontanum	I	N	N	Y

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Nodding chickweed	Cerastium nutans	N	N	N	Y
Slender chervil, Spreading chervil	Chaerophyllum procumbens*	N	N	N	Y
Spotted spurge, Milk-purslane	Chamaesyce maculata	N	N	N	Y
Eyebane	Chamaesyce nutans	N	N	N	Y
Greater celandine, Swallowwort	Chelidonium majus	I	N	N	Y
Turtlehead	Chelone glabra	N	N	N	Y
Lamb's quarters	Chenopodium album	I	N	N	Y
Pipsissewa, Spotted wintergreen	Chimaphila maculata	N	N	N	Y
Ox-eye daisy	Chrysanthemum leucanthemum	I	N	N	Y
Blue chicory, Blue-sailors	Cichorium intybus	I	N	N	Y
Enchanter's nightshade	Circaea lutetiana	N	N	N	Y
Canada thistle	Cirsium arvense	I	N	N	Y
Field thistle	Cirsium discolor	N	N	N	Y
Spring-beauty	Claytonia virginica	N	N	N	Y
Spider-flower	Cleome hasslerana	I	N	N	Y
Wild basil	Clinopodium vulgare	I	N	N	Y
Coincya	Coincya monensis	I	N	N	N
Horse balm, Stoneroot	Collinsonia canadensis	N	N	N	Y
Bastard toadflax	Comandra umbellata*	N	N	N	Y
Asiatic dayflower	Commelina communis	I	N	N	Y
Poison hemlock	Conium maculatum	I	N	N	Y
Field bindweed	Convolvulus arvensis	I	N	N	Y
Horseweed	Conyza canadensis	N	N	N	Y
Crown-vetch	Coronilla varia	I	N	N	Y
Honewort, Wild chervil	Cryptotaenia canadensis	N	N	N	Y
Blue waxweed, Clammy cuphea	Cuphea viscosissima	N	N	N	Y
Common dodder	Cuscuta gronovii var. gronovii*	N	N	N	Y
Kenilworth ivy	Cymbalaria muralis	I	N	N	Y
Jimson weed	Datura stramonium	I	N	N	Y
Queen Anne's lace, Wild carrot	Daucus carota	I	N	N	Y
Hoary tick-trefoil	Desmodium canescens	N	N	N	Y
Tick-trefoil	Desmodium paniculatum	N	N	N	Y
Tick-trefoil	Desmodium perplexum	N	N	N	Y
Deptford pink	Dianthus armeria	I	N	N	Y
Bush honeysuckle	Diervilla lonicera	N	N	N	Y
Common teasel	Dipsacus sylvestris	I	N	N	Y
Indian strawberry	Duchesnea indica	I	N	N	Y
Prickly cucumber, Wild balsam-apple	Echinocystis lobata	N	N	N	Y
Elsholtzia	Elsholtzia ciliata	I	N	N	Y
Beechdrops	Epifagus virginiana	N	N	N	Y

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Purple leaved willow-herb	Epilobium coloratum	N	N	N	Y
Fireweed, Pilewort	Erechtites hieraciifolia	N	N	N	Y
Daisy fleabane	Erigeron annuus	N	N	N	Y
Daisy fleabane	Erigeron philadelphicus	N	N	N	Y
Daisy fleabane, Whitetop	Erigeron strigosus	N	N	N	Y
Yellow trout lily	Erythronium americanum	N	N	N	Y
Joe-pye weed	Eupatorium fistulosum	N	N	N	Y
Boneset	Eupatorium perfoliatum	N	N	N	Y
White snakeroot	Eupatorium rugosum	N	N	N	Y
Late eupatorium	Eupatorium serotinum	I	N	N	N
White wood aster	Eurybia divaricata (Aster divaricatus)	N	N	N	Y
Grass leaved goldenrod, Flat-topped goldenrod	Euthamia graminifolia	N	N	N	N
False mermaid	Floerkea proserpinacoides	N	N	N	Y
Snowdrop	Galanthus nivalis	I	N	N	N
Small flowered quickweed	Galinsoga parviflora	I	N	N	Y
Quickweed	Galinsoga quadriradiata	I	N	N	Y
Bedstraw, Cleavers, Goosegrass	Galium aparine	N	N	N	Y
White bedstraw, Wild madder	Galium mollugo	I	N	N	Y
Cleavers, Marsh bedstraw	Galium obtusum	N	N	N	Y
Sweet woodruff	Galium odoratum	I	N	N	N
Sweet-scented bedstraw	Galium triflorum	N	N	N	Y
Biennial gaura	Gaura biennis	N	N	N	Y
Wood geranium	Geranium maculatum	N	N	N	Y
White avens	Geum canadense	N	N	N	Y
Herb-bennet, Rough avens	Geum laciniatum	N	N	N	Y
Gill-over-the-ground, Ground ivy	Glechoma hederacea	I	N	N	Y
Fragrant cudweed	Gnaphalium obtusifolium	N	N	N	Y
Beggar’s lice, Stickseed	Hackelia virginiana	N	N	N	Y
American pennyroyal, Pudding-grass	Hedeoma pulegioides	N	N	N	Y
Jerusalem artichoke	Helianthus tuberosus*	I	N	N	Y
Orange day-lily	Hemerocallis fulva	I	N	N	Y
Dame's rocket	Hesperis matronalis	I	N	N	Y
Mud plantain	Heteranthera reniformis*	N	N	N	Y
Alum root	Heuchera americana	N	N	N	Y
Rose-of-Sharon	Hibiscus syriacus	I	N	N	Y
Flower of the hour	Hibiscus trionum	I	N	N	Y
King devil	Hieracium caespitosum	I	N	N	Y
Hawkweed	Hieracium paniculatum	N	N	N	Y
Rattlesnake-weed	Hieracium venosum	N	N	N	Y
Blue plantain lily	Hosta ventricosa	I	N	N	Y

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Japanese hops	Humulus japonicus*	I	N	N	Y
Virginia waterleaf	Hydrophyllum virginianum	N	N	N	Y
Dwarf St. John's-wort	Hypericum mutilum	N	N	N	Y
Shrubby St. John's-wort	Hypericum perforatum	I	N	N	Y
Spotted St. John's-wort	Hypericum punctatum	N	N	N	Y
Jewelweed, Touch-me-not	Impatiens capensis	N	N	N	Y
Pale jewelweed,Touch-me-not	Impatiens pallida	N	N	N	Y
Ivy leaved morning glory	Ipomoea hederacea	I	N	N	Y
Blue lettuce	Lactuca biennis	N	N	N	Y
Wild lettuce	Lactuca canadensis	N	N	N	Y
Prickly lettuce	Lactuca serriola	I	N	N	Y
Wood nettle	Laportea canadensis	N	N	N	Y
Nipplewort	Lapsana communis	I	N	N	Y
Bush clover	Lespedeza cuneata	I	N	N	Y
Butter-and-eggs	Linaria vulgaris	I	N	N	Y
False pimpernel	Lindernia dubia var. dubia*	N	N	N	Y
Common flax	Linum usitatissimum	I	N	N	Y
Indian tobacco	Lobelia inflata	N	N	N	Y
Great blue lobelia	Lobelia siphilitica	N	N	N	Y
Bird's-foot trefoil	Lotus corniculatus	I	N	N	Y
Water horehound	Lycopus americanus*	N	N	N	Y
Bugleweed, Water horehound	Lycopus uniflorus	N	N	N	Y
Fringed loosestrife	Lysimachia ciliata	N	N	N	Y
Creeping-charlie, Moneywort	Lysimachia nummularia	I	N	N	Y
Purple loosestrife	Lythrum salicaria	I	N	N	Y
Rose mallow, Musk mallow	Malva moschata	I	N	N	Y
Pineapple weed	Matricaria matricarioides	I	N	N	Y
Yellow sweet clover	Melilotus officinalis	I	N	N	Y
Field mint	Mentha arvensis	N	N	N	Y
Virginia bluebell	Mertensia virginiana	N	N	N	Y
Allegheny monkey-flower	Mimulus ringens	N	N	N	Y
Partridge berry	Mitchella repens	N	N	N	Y
Horsemint, Wild bergamot	Monarda fistulosa	N	N	N	Y
Indian pipe	Monotropa uniflora	N	N	N	Y
Wild forget-me-not	Myosotis laxa	N	N	N	Y
Forget-me-not, Water scorpion-grass	Myosotis scorpioides	I	N	N	Y
Evening primrose	Oenothera biennis	N	N	N	Y
Star-of-Bethlehem	Ornithogalum umbellatum	I	N	N	Y
Sweet-cicely	Osmorhiza claytonii	N	N	N	Y
Aniseroot	Osmorhiza longistylis	N	N	N	Y
Common yellow wood sorrel	Oxalis stricta	N	N	N	Y
Violet wood sorrel	Oxalis violacea*	N	N	N	Y
Japanese pachysandra	Pachysandra terminalis	I	N	N	N

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Pellitory	Parietaria pensylvanica*	N	N	N	Y
Forked chickweed	Paronychia canadensis*	N	N	N	Y
Tall white beardtongue	Penstemon digitalis	N	N	N	Y
Ditch stonecrop	Penthorum sedoides	N	N	N	Y
Perilla	Perilla frutescens	I	N	N	Y
Summer phlox	Phlox paniculata	N	N	N	Y
Lopseed	Phryma leptostachya	N	N	N	Y
Clammy ground cherry	Physalis heterophylla	N	N	N	Y
Ground cherry	Physalis subglabrata	N	N	N	Y
Pokeweed	Phytolacca americana	N	N	N	Y
Clearweed, Coolwort, Richweed	Pilea pumila	N	N	N	Y
English plantain, Ribgrass	Plantago lanceolata	I	N	N	Y
Broad-leaved plantain, Whiteman's foot	Plantago major	I	N	N	Y
Rugel's plantain, Broad-leaved plantain	Plantago rugelii	N	N	N	Y
Mayapple, Mandrake	Podophyllum peltatum	N	N	N	Y
Solomon's seal	Polygonatum biflorum	N	N	N	Y
Solomon's seal	Polygonatum pubescens	N	N	N	Y
Doorweed, Knotgrass	Polygonum arenastrum*	I	N	N	N
Halberd leaf tearthumb	Polygonum arifolium	N	N	N	Y
knotweed	Polygonum aviculare	I	N	N	Y
Low smartweed	Polygonum caespitosum	I	N	N	Y
Black bindweed, Nimble-will	Polygonum convolvulus	I	N	N	Y
Japanese knotweed, Mexican bamboo	Polygonum cuspidatum	I	N	N	Y
Erect knotweed	Polygonum erectum*	N	N	N	Y
Dock-leaf smartweed, Willow weed	Polygonum lapathifolium	I	N	N	Y
Kiss-me-over-the-garden-gate, Prince's feather	Polygonum orientale	I	N	N	Y
Smartweed, Pinkweed	Polygonum pensylvanicum	N	N	N	Y
Lady's thumb, Heart's ease	Polygonum persicaria	I	N	N	Y
Tearthumb, Scratch-grass	Polygonum sagittatum	N	N	N	Y
Climbing false buckwheat	Polygonum scandens	N	N	N	Y
Jump seed	Polygonum virginianum	N	N	N	Y
Strawberry-weed	Potentilla norvegica	N	N	N	Y
Sulfur cinquefoil	Potentilla recta	I	N	N	Y
Old-field cinquefoil	Potentilla simplex	N	N	N	Y
Rattlesnake root	Prenanthes altissima*	N	N	N	Y
Heal-all, Self-heal	Prunella vulgaris	I	N	N	Y
Mountain mint	Pycnanthemum virginianum	N	N	N	Y
Small-flowered crowfoot	Ranunculus abortivus	N	N	N	Y

COMMON NAME	SCIENTIFIC NAME	Native or Introduced	Federal Status	State Status	Wherry 1971-1986
Common meadow buttercup, Tall meadow buttercup	Ranunculus acris	I	N	N	Y
Bulbous buttercup	Ranunculus bulbosus	I	N	N	Y
Early buttercup, Tufted buttercup	Ranunculus fascicularis*	N	N	PE	Y
Lesser celandine, Pilewort	Ranunculus ficaria	I	N	N	Y
Creeping yellowcress	Rorippa sylvestris*	I	N	N	Y
Black eyed susan	Rudbeckia hirta var. pulcherrima	N	N	N	Y
Cutleaf coneflower	Rudbeckia laciniata	N	N	N	Y
Peach-leaved dock, Tall dock	Rumex altissimus*	N	N	N	Y
Curly dock	Rumex crispus	I	N	N	Y
Bitter dock	Rumex obtusifolius	I	N	N	Y
Bloodroot, Red puccoon	Sanguinaria canadensis	N	N	N	Y
Canadian sanicle, Snakeroot	Sanicula canadensis	N	N	N	Y
Salad burnet	Sanguisorba minor	I	N	N	N
Bouncing-bet, Soapwort	Saponaria officinalis	I	N	N	Y
Early saxifrage	Saxifraga virginiensis	N	N	N	Y
Eastern figwort, Carpenter's square	Scrophularia marilandica	N	N	N	Y
Mad-dog skullcap	Scutellaria lateriflora	N	N	N	Y
Orpine	Sedum sarmentosum*	I	N	N	Y
Common groundsel	Senecio vulgaris	I	N	N	Y
Northern wild senna	Senna hebecarpa	N	N	N	Y
Bur cucumber	Sicyos angulatus	N	N	N	Y
Prickly sida, False mallow	Sida spinosa	I	N	N	Y
White campion	Silene latifolia	I	N	N	Y
Blue-eyed grass	Sisyrinchium angustifolium	N	N	N	Y
False Solomon's seal	Smilacina racemosa	N	N	N	Y
Black nightshade	Solanum americanum	N	N	N	Y
Horse-nettle	Solanum carolinense	N	N	N	Y
Trailing nightshade or bittersweet	Solanum dulcamara	I	N	N	Y
Black nightshade	Solanum nigrum	I	N	N	Y
Bluestem goldenrod, Wreath goldenrod	Solidago caesia	N	N	N	Y
Canada goldenrod	Solidago canadensis	N	N	N	Y
Zigzag goldenrod	Solidago flexicaulis	N	N	N	Y
Smooth goldenrod	Solidago gigantea	N	N	N	Y
Early goldenrod	Solidago juncea	N	N	N	Y
Wrinkle leaf goldenrod	Solidago rugosa	N	N	N	Y
Spiny-leaved sow-thistle	Sonchus asper	I	N	N	Y
Common sow thistle	Sonchus oleraceus	I	N	N	Y
Creeping hedge nettle	Stachys tenuifolia	N	N	N	Y
Common chickweed	Stellaria media	I	N	N	Y

COMMON NAME	SCIENTIFIC NAME	Native or Introduced	Federal Status	State Status	Wherry 1971-1986
Purple stemmed aster	Symphyotrichum puniceum var. puniceum (Aster puniceus)	N	N	N	Y
Blue wood aster	Symphyotrichum cordifolium (Aster cordifolius)	N	N	N	Y
Panicled aster	Symphyotrichum lanceolatum ssp. Lanceolatum (Aster lanceolatus)	N	N	N	Y
Calico aster	Symphyotrichum lateriflorum (Aster lateriflorus)	N	N	N	Y
New England aster	Symphyotrichum novae-angliae (Aster novae-angliae)	N	N	N	Y
Heath aster	Symphyotrichum pilosum var. pilosum ('Aster pilosus)	N	N	N	Y
Skunk cabbage	Symplocarpus foetidus	N	N	N	Y
Common dandelion	Taraxacum officinale	I	N	N	Y
Wild germander, Wood sage	Teucrium canadense	N	N	N	Y
Tall meadow rue	Thalictrum pubescens	N	N	N	Y
Frenchweed, Field pennycress	Thlaspi arvense	I	N	N	Y
Low hop-clover	Trifolium campestre	I	N	N	Y
Alsike clover	Trifolium hybridum	I	N	N	Y
Red clover	Trifolium pratense	I	N	N	Y
Venus' looking glass	Triodanis perfoliata	N	N	N	Y
Moth mullein	Verbascum blattaria	I	N	N	Y
Common mullein, Flannel-plant	Verbascum thapsus	I	N	N	Y
Blue vervain, Simpler's joy	Verbena hastata	N	N	N	Y
White vervain	Verbena urticifolia	N	N	N	Y
New York ironweed	Vernonia noveboracensis	N	N	N	Y
Ivy-leaved speedwell	Veronica hederifolia	I	N	N	Y
Common speedwell, Gypsyweed	Veronica officinalis	N	N	N	Y
Neckweed, Purslane speedwell	Veronica peregrina	N	N	N	Y
Thyme-leaved speedwell	Veronica serpyllifolia	I	N	N	Y
Slender vetch	Vicia tetrasperma	I	N	N	Y
Common periwinkle, Creeping myrtle	Vinca minor	I	N	N	Y
American dog violet	Viola labradorica*	N	N	N	Y
Downy yellow violet	Viola pubescens var. pubescens	N	N	N	Y
Common blue violet	Viola sororia	N	N	N	Y
Common cocklebur	Xanthium strumarium	N	N	N	N**
Adam's needle	Yucca flaccida	I	N	N	N
Golden alexander	Zizia aurea	N	N	N	Y
* specimen on deposit at Morris Arboretum Herbarium (MOAR)					
** species previously documented in Montgomery County by Bean in 1884					

APPENDIX 7

Detailed Information on Species of Special Concern

Early or tufted buttercup
Ranunculus fascicularis Muhl. Ex J.M. Bigelow
Buttercup family (Ranunculaceae)

State status: Pennsylvania endangered
Global status: G5

DESCRIPTION

This small, low growing herbaceous perennial is easily spotted in April and May when the 5-7 petaled yellow flowers are in bloom. Each solitary flower is about 5 cm wide and grows on an erect stalk above the basal rosette of leaves. The compound leaves are highly variable in form, but are generally toothed and deeply lobed. They are typically clustered near the end of a 15-30.5 cm long petiole. Roots are short, tapering, and tuberous. The overall form is very similar to hispid buttercup (*Ranunculus hispidus)* which has longer, non-tuberous roots and hairy stems.

Source: http://www.missouriplants.com

HABITAT

The species is typically found on dry, open sites such as upland woods, exposed rock outcrops, prairies, and roadsides. It is partial to calcareous soils and may be found with other calciphiles on rocky slopes or ledges.

RANGE

Early or tufted buttercup is native to the United States and is widely distributed in 32 states across the eastern and central portions of the country as well as in 2 Canadian provinces. In 10 of these 34 states or provinces it is considered imperiled to some degree.

Source: http://biology.smsu.edu/Herbarium/Plants

MANAGEMENT ISSUES

While early buttercup seems to be tolerant of moderate disturbance, it can easily be shaded out by successional growth or out-competed by aggressive invaders. At present, two isolated populations are known to exist in the park within approximately 182 meters of each other along the Mill Race trail where it joins the Skippack Creek trail near the cul-de-sac of the main picnic area off Mayhall Road opposite the park office. Each population is located in a successional forest community that contains a high number of invasive species such as lesser celandine, stiltgrass, multiflora rose, and autumn olive. Active removal of these invasive species, close monitoring of canopy development, and protection from increased or destructive trail use is recommended in order to sustain viable habitat for the species.

Canadian yew
Taxus canadensis L.
Yew family (Taxaceae)

State status: Watch list
Global status: G5

DESCRIPTION

Canadian yew is a rhizomatous, spreading evergreen shrub that grows to about 1 meter tall. Its flat green needles have a short stalk at the base and are arranged in flat rows on each side of the twig. The seeds are covered with a cup-shaped red aril.

HABITAT

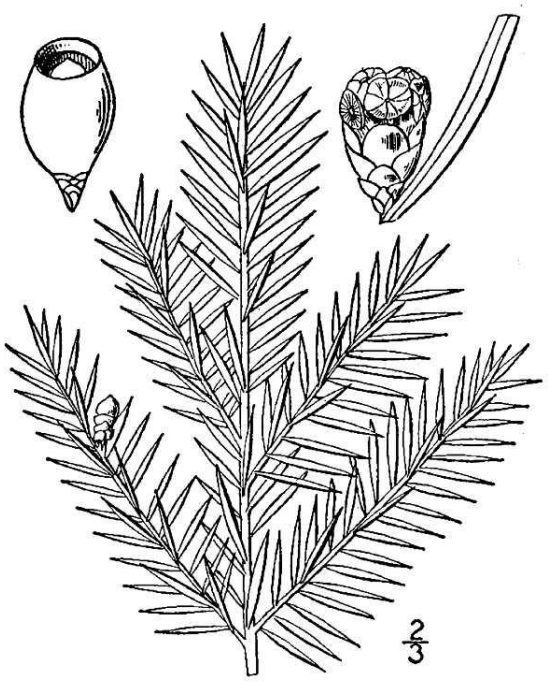
Our native yew grows on cool, moist forested slopes, usually with a conifer component in the canopy. At Evansburg Park it is found on a steep north-facing slope under mixed conifer and hardwood tree cover.

RANGE

In Pennsylvania Canadian yew was once fairly common on cool, shaded north-facing slopes across the state. However, it has declined in many areas due to browsing by over-abundant deer. Its total range extends from Newfoundland and Labrador to Manitoba, and south to Virginia, Kentucky, and Iowa. It is ranked as critically imperiled or imperiled (S1 or S2) in New Jersey, Maryland, North Carolina, Illinois, Indiana, Tennessee, West Virginia, and Kentucky.

TRADITIONAL USES

Several Native American tribes used preparations of Canadian yew to treat rheumatism, gynecological problems, colds, and fever. All parts of this plant contain alkaloids that are poisonous to humans, but apparently not to deer.

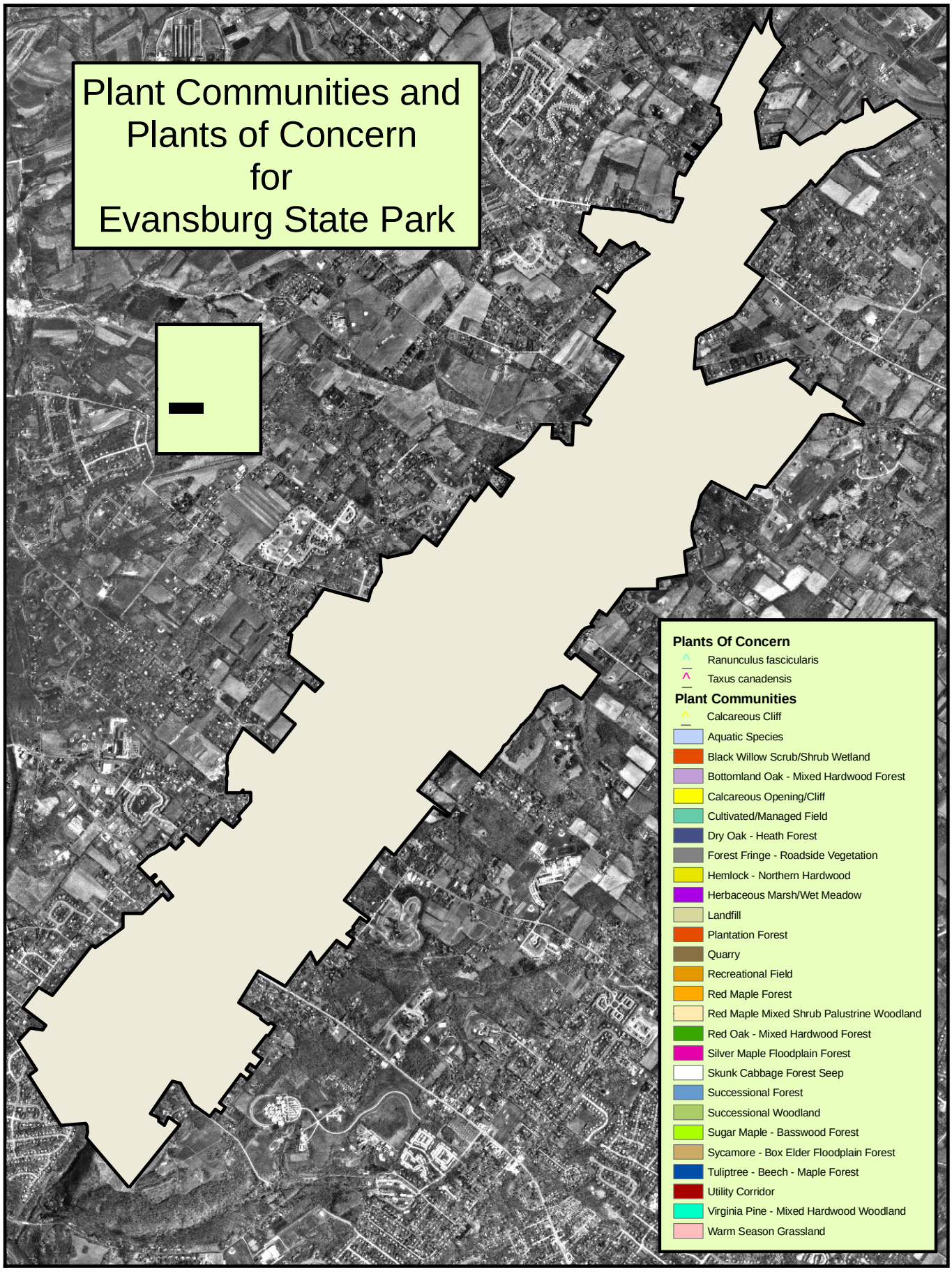


Source:

MANAGEMENT ISSUES

The decline of eastern hemlock due to infestation by hemlock woolly adelgid and elongate hemlock scale threatens the stand of native yew at Evansburg. As hemlock cover thins and dies, growing conditions for the shade-tolerant yew will change as well. Over browsing by deer is an increasing problem as the slow growing Canadian yew is a highly preferred winter browse species. When observed at Evansburg in the fall of 2004, all yews had been browsed so heavily that no single stem exceeded 30 cm in height and no seeds were present.

APPENDIX 8 – Plant Communities Map


Plant Communities and
Plants of Concern
for
Evansburg State Park
Plants Of Concern
Ranunculus fascicularis
Taxus canadensis
Plant Communities
Calcareous Cliff
Aquatic Species
Black Willow Scrub/Shrub Wetland
Bottomland Oak - Mixed Hardwood Forest
Calcareous Opening/Cliff
Cultivated/Managed Field
Dry Oak - Heath Forest
Forest Fringe - Roadside Vegetation
Hemlock - Northern Hardwood
Herbaceous Marsh/Wet Meadow
Landfill
Plantation Forest
Quarry
Recreational Field
Red Maple Forest
Red Maple Mixed Shrub Palustrine Woodland
Red Oak - Mixed Hardwood Forest
Silver Maple Floodplain Forest
Skunk Cabbage Forest Seep
Successional Forest
Successional Woodland
Sugar Maple - Basswood Forest
Sycamore - Box Elder Floodplain Forest
Tuliptree - Beech - Maple Forest
Utility Corridor
Virginia Pine - Mixed Hardwood Woodland
Warm Season Grassland

APPENDIX 9 - Plant Community Descriptions

TERRESTRIAL FORESTS

Dry Oak–Heath – The solitary example of this community type is found upslope on a moderately dry, rocky site although it would generally occur on drier more acidic soils. However, the presence of conifers, an ericaceous shrub layer, and a somewhat sparse herbaceous layer confirms its identification. The most common trees are upland oaks such as chestnut oak *(Quercus montana)*, white oak (*Quercus alba*), red oak *(Quercus rubra*) and scarlet oak *(Quercus coccinea*). Other hardwoods may include sassafras *(Sassafras albidum*), red maple *(Acer rubrum*), hickories *(Carya spp.*), and scattered individuals of Virginia pine (*Pinus virginiana*). The predominantly ericaceous shrub layer is diagnostic for this community and includes lowbush blueberry (*Vaccinium pallidum*), low sweet blueberry *(Vaccinium angustifolium*), deerberry *(Vaccinium stamineum*), maple-leaved viburnum (*Viburnum acerifolium*), and black huckleberry *(Gaylussacia baccata*). The herbaceous layer is typically depauperate, but is comprised of a number of characteristic species such as pipissewa *(Chimaphila maculata*), wild sarsaparilla *(Aralia nudicaulis*), spikenard *(Aralia racemosa*), ebony spleenwort *(Asplenium platyneuron*), bastard toadflax *(Comandra umbellata*), and hay scented fern *(Dennstaedtia punctilobula*).

Hemlock (White Pine) –Northern Hardwood – As is typical, this forest group is found on a north-facing, steep, rocky slope which in this case is formed by an intrusive dike of erosion resistant diabase. This forest group is dominated by a mixture of conifers and hardwoods that include Canada hemlock (*Tsuga canadensis*) in strong association with chestnut oak (*Quercus montana*), and northern red oak *(Quercus rubra)* such that the hardwood component of this community leans heavily towards the Dry White Pine(Hemlock)-Oak Forest type. Canada hemlock (*Tsuga Canadensis*) is significant component of this community and may account for as much as 56% of the canopy. Oak species are roughly equivalent co-dominants with each species contributing as much as 20% to the community. Other hardwoods such as American beech (*Fagus grandifolia*), sugar maple *(Acer saccharum*), and red maple *(Acer rubrum*) are present, but in limited numbers. However, the non-ericaceous shrub layer is the element that truly distinguishes this community from the Dry White Pine (Hemlock)-Oak Forest type. Witch hazel *(Hamamelis virginiana*), rosebay rhododendron (*Rhododendron maximum*), and maple-leaved viburnum *(Viburnum acerifolium*) are the shrubs most commonly found in the understory. The sparse herbaceous layer is dominated by ferns such as Christmas fern *(Polystichum acrostichoides*), marginal wood fern *(Dryopteris marginalis*), and hay scented fern *(Dennstaedtia punctilobula*) along with white wood aster *(Eurybia divaricata*) and Hickey's ground pine *(Lycopodium hickeyi*).

Red Maple – Almost pure stands of red maple *(Acer rubrum*) are found as early- to mid-successional forests in 2 areas in the park. While each is close in proximity and similar in understory composition to either a successional forest type or red oak mixed hardwood community this young forest exhibits a canopy overwhelmingly dominated by red maple. Other hardwoods such as white ash *(Fraxinus americana*) and black cherry *(Prunus serotina*) may be present in very limited numbers. The shrub layer varies greatly depending on the environmental conditions of the site and its disturbance history, but it typically contains spicebush (*Lindera benzoin*), viburnums *(Viburnum spp.*), multiflora rose (*Rosa multiflora*), eastern red cedar (*Juniperus virginiana*), and/or crabapple *(Malus sp.*). The herbaceous layer is also highly

variable and may contain any of the following: Jack-in-the-pulpit *(Arisaema triphyllum*), white avens *(Geum canadense*), smartweeds *(Polygonum spp.*), Virginia creeper *(Parthenocissus quinquefolia*), Japanese stiltgrass (*Microstegium vimineum*), and poison ivy (*Toxicodendron radicans).*

Red Oak–Mixed Hardwood – Of the natural communities in the park this is the most commonly occurring type based on the number of acres involved. It is characterized by a species rich composition of hardwoods that occur on fairly mesic sites. This community is noted for the presence of northern red oak *(Quercus rubra*) as a dominant (up to 24%) or co-dominant species along with other hardwood species. Collectively the hickories, including bitternut hickory *(Carya cordiformis*), shagbark hickory *(Carya ovata*), pignut hickory (*Carya glabra*,) may account for as much as 14%, along with American beech *(Fagus grandifolia*) contributing up to 15%, and white ash *(Fraxinus americana*)at roughly 15%. Scattered or clustered individuals of white oak *(Quercus alba*), black oak *(Quercus velutina*), red maple *(Acer rubrum*), sugar maple (*Acer saccharum*), hop-hornbeam (*Ostrya virginiana*), sourgum (*Nyssa sylvatica*), and/or tuliptree *(Liriodendron tulipifera*) may be intermingled with the canopy dominants. At higher elevations chestnut oak (*Quercus montana*) may become an important component of the tree canopy. As well, conifers such as eastern white pine *(Pinus strobus*) or Canada hemlock *(Tsuga canadensis*) may be present, but provide less than 25% of the total cover so as to distinguish this community from a coniferous forest type. Tree species of note in the understory include American beech (*Fagus grandifolia*) up to 17% relative importance as well as American elm *(Ulmus americana)* and flowering dogwood (*Cornus florida*) which both occupy approximately 6% of the subcanopy. The understory typically includes blackhaw *(Viburnum prunifolium*), southern arrowwood *(Viburnum dentatum*), maple-leaved viburnum *(Viburnum acerifolium*), ironwood (*Carpinus caroliniana)*, witch-hazel *(Hamamelis virginiana*), spicebush *(Lindera benzoin*), shadbush *(Amelanchier arborea*), and burning bush *(Euonymus alatus*). Of these, spicebush and the viburnums are most abundant, each contributing about 13% to the shrub layer. The herbaceous layer can be highly variable, but representative species include Christmas fern *(Polystichum acrostichoides*), white wood aster *(Eurybia divaricata*), blue stem goldenrod *(Solidago caesia*,), false Solomon's seal *(Smilacina racemosa*), Virginia creeper *(Parthenocissus quinquefolia*), and wood ferns *(Dryopteris spp.*) along with a variety of sedges.

Sugar Maple–Basswood - A distinct pseudo-riparian community that is strongly dominated by the combination of sugar maple *(Acer saccharum*) and basswood (*Tilia americana*) exists in a few places throughout the park. Sugar maple is the largest component of both the canopy and understory contributing between 39-47% of each forest layer. White ash (*Fraxinus americana*) may contribute as much as 22% to the canopy and even surpasses basswood as the co-dominant at some sites. Other hardwoods such as northern red oak *(Quercus rubra*) and black cherry *(Prunus serotina*) may be present in limited numbers. The thin subcanopy/understory often includes flowering dogwood *(Cornus florida*), ironwood (*Carpinus caroliniana*), spicebush *(Lindera benzoin*) up to 10%, bladdernut *(Staphylea trifolia*), and maple-leaved viburnum *(Viburnum acerifolium*) with a rich herbaceous layer represented by bloodroot *(Sanguinaria canadensis*), yellow trout lily *(Erythronium americanum*), anise root *(Osmorhiza longistylis*), mayapple *(Podophyllum peltatum*), Solomon's seal *(Polygonatum pubescens*), small-flowered crowfoot *(Ranunculus abortivus*), and golden Alexander (*Zizia aurea*).

Tuliptree–Beech–Maple **–** This early-to mid-successional community is typically restricted to north-facing, mid-to lower slope sites. Tuliptree *(Liriodendron tulipifera*) is notably dominant,

occupying as much as 50% of the canopy. Maple species including sugar maple *(Acer saccharum*) or red maple *(Acer rubrum*) contribute between 8-14% each. Other canopy species such as American beech (*Fagus grandifolia*), or hickories *(Carya spp.*) may be interspersed, but the relative absence of oaks distinguishes this type from the oak communities even though they contain many other similar species both in the canopy and shrub layers. White ash (*Fraxinus americana*) can account for as much as 18% of the canopy. Common understory trees and shrubs include sugar maple (*Acer saccharum*), flowering dogwood *(Cornus florida*), viburnums *(Viburnum spp.*), spicebush (Lindera benzoin), and winged euonymus *(Euonymus alatus*). Although sugar maple (*Acer saccharum*) dominates about a third of the understory vegetation, multiflora rose (*Rosa multiflora*) is often prevalent in this young forest and can contribute as much as 15% to the vegetative cover, with spicebush (*Lindera benzoin*) accounting for 12% and the viburnums collectively representing 6% of the shrub layer. Herbaceous species are those typical of a mixed hardwood forest with the addition of flat branched ground pine (*Lycopodium obscurum*) which has not been recorded elsewhere in the park.

PALUSTRINE FORESTS

Bottomland Oak–Mixed Hardwood – This palustrine community is a composite of two communities described by Fike; the Bottomland Oak to acknowledge the strong oak component and the Mixed Mesophytic Forest to reflect the rich hardwood aspect while noting the complete lack of usual mesophytic co-dominants such as tuliptree *(Liriodendron tulipifera*) and American beech (*Fagus grandifolia*). Frequently this community type intergrades with the Sycamore-Box Elder community, but is generally found on moist soils at slightly higher elevations and is not typically in immediate vertical proximity to the river. The forest canopy is dominated by a mixture of bottomland oaks such as swamp white oak *(Quercus bicolor*) and pin oak *(Quercus palustris*) in association with other mesophytic terrestrial hardwoods including northern red oak *(Quercus rubra*), red maple *(Acer rubrum*), red ash *(Fraxinus pennsylvanica*), white ash *(Fraxinus americana*), black cherry *(Prunus serotina*), shagbark hickory *(Carya ovata*), sugar maple *(Acer saccharum*), black walnut *(Juglans nigra*), American elm *(Ulmus americana*), and red elm *(Ulmus rubra*). Oak species may account for as much as 36% of the canopy with red maple (*Acer rubrum*) having equal if not greater importance. The shrub and herbaceous layers are less diverse than a true mesophytic forest with common species such as northern arrow-wood *(Viburnum recognitum*), spicebush *(Lindera benzoin*), privet *(Ligustrum obtusifolium*), winterberry *(Ilex verticillata*), Amur honeysuckle *(Lonicera maackii*), multiflora rose *(Rosa multiflora*), Jack-in-the-pulpit *(Arisaema triphyllum*,), white snakeroot *(Eupatorium rugosum*), white avens *(Geum canadense*), spring beauty *(Claytonia virginica*), Japanese honeysuckle *(Lonicera japonica*), southern agrimony *(Agrimonia parviflora*), poison ivy *(Toxicodendron radicans*), and Japanese stilt grass *(Microstegium vimineum*) in greatest abundance. As much as 12-21% of the understory layer may also be accounted for by tree species such as sugar maple (*Acer saccharum*), bitternut hickory (*Carya cordiformis)*, and black cherry (*Prunus serotina*). Spicebush (Lindera benzoin) is the most significant single component of the understory equaling approximately 21% of the total vegetation.

Silver Maple Floodplain Forest – This forest type occurs sporadically in small, discrete locations throughout the park and is distinctly dominated by a canopy of silver maple *(Acer saccharinum*) with a very limited number of individuals of box elder *(Acer negundo*), river birch *(Betula nigra*), American elm *(Ulmus americana*), red elm *(Ulmus rubra*), red ash *(Fraxinus pennsylvanica*), white ash *(Fraxinus americana*), and black walnut *(Juglans nigra*). Within this

simplified community the maples together account for as much as 79% of the tree cover. Box elder (Acer negundo) is also heavily represented in the understory occupying approximately 42% of the cover, with bitternut hickory (Carya cordiformis) and red ash (Fraxinus pennsylvanica) providing approximately 16% & 26% respectively. Associated shrubs include red willow *(Cornus amomum*), spicebush *(Lindera benzoin*), and multiflora rose *(Rosa multiflora*). Spicebush is the dominant shrub and accounts for about 13% of the layer. Common herbs coupled with this community type are jewelweed *(Impatiens capensis*), pale jewelweed *(Impatiens pallida*), clear weed *(Pilea pumila*), jumpseed *(Polygonum virginianum*), and Japanese stilt grass *Microstegium vimineum*).

Sycamore–Box Elder Floodplain Forest – Occurring almost continuously along the edge of Skippack Creek and often extending into the floodplain, this distinct low lying palustrine community is found on soils that generally remain moist throughout the year and are subject to seasonal or periodic flooding. The community is characterized by a co-dominance of sycamore (*Platanus occidentalis*) and box- elder *(Acer negundo*) each contributing between 20-30% of the canopy. Other species present include American elm (*Ulmus Americana),* red elm *(Ulmus rubra*), silver maple *(Acer saccharinum*), bitternut hickory *(Carya cordiformis*), shagbark hickory *(Carya ovata*), red ash *(Fraxinus pennsylvanica*), white ash *(Fraxinus americana*), basswood *(Tilia americana*) and river birch *(Betula nigra).* White ash and American elm may each contribute as much as 11-17% each to the canopy layer with other species contributing to a lesser degree. Box elder (*Acer negundo*) accounts for as much as 66% of the understory/shrub content of this community. Sugar maple (*Acer saccharum*), spicebush (*Lindera benzoin*), and multiflora rose *(Rosa multiflora*) each contribute in the range of 11-18% to the understory. Ironwood (*Carpinus caroliniana*) and crabapple (*Malus sp.*) are also frequently present in the understory along with a variety of other shrubs including northern arrow-wood *(Viburnum recognitum*) and Amur honeysuckle *(Lonicera maackii*). Common herbaceous species include jewelweed *(Impatiens capensis*), pale jewelweed *(Impatiens pallida*), clearweed *(Pilea pumila*), wood-nettle *(Laportea canadensis*), false nettle *(Boehmeria cylindrica*), sensitive fern *(Onoclea sensibilis*), ostrich fern *(Matteuccia struthiopteris*), wild chervil (*Cryptotaenia canadensis*), mayapple *(Podophyllum peltatum*), lesser celandine *(Ranunculus ficaria*), poison-ivy *(Toxicodendron radicans*), jumpseed *(Polygonum virginianum*), and Japanese stilt grass *(Microstegium vimineum*).

TERRESTRIAL WOODLANDS

Virginia Pine-Mixed Hardwood – This community type is represented by a single stand found on a dry shale slope with a southern exposure. Canopy gaps are common in this woodland community allowing small areas of herbaceous flora to readily establish creating a patchy vegetative matrix. Virginia pine *(Pinus virginiana*) in combination with eastern red cedar *(Juniperus virginiana*) comprises the conifer component and contributes to roughly half of the relative canopy cover. Typical hardwood associates include white ash *(Fraxinus americana*) and red maple *(Acer rubrum*) along with assorted oak and hickory species.

PALUSTRINE WOODLANDS

Red Maple-Mixed Shrub – Exemplified by a single stand in the park this community type is characterized by a diverse shrub and herbaceous layer growing in saturated soil conditions and topped or surrounded by a relatively thin canopy of mostly red maple *(Acer rubrum*). Other

facultative wetland tree species such as swamp white oak *(Quercus bicolor*), pin oak *(Quercus palustris*), and red ash *(Fraxinus pennsylvanica*) may be mixed into the canopy as well. A prominent shrub layer exists in the canopy gaps and contains such species as red willow *(Cornus amomum*), spicebush *(Lindera benzoin*), winterberry *(Ilex verticillata*), and swamp rose *(Rosa palustris*). The composition of the herbaceous plant material is quite varied and generally includes jewelweeds *(Impatiens spp.*), false nettle *(Boehmeria cylindrical*), sensitive fern *(Onoclea sensibilis*), arrow-leaved tearthumb (*Polygonum sagittatum*), halberd-leaved tearthumb *(Polygonum arifolium*), duck potato *(Sagittaria latifolia*), great blue lobelia (*Lobelia siphilitica*), fowl mannagrass *(Glyceria striata*), orange day lily *(Hemerocallis fulva*), dame's rocket *(Hesperis matronalis*), moneywort *(Lysimachia nummularia*), lesser celandine *(Ranunculus ficaria*), skunk cabbage *(Symplocarpus foetidus*), and poison-ivy (*Toxicodendron radicans).*

PALUSTRINE SHRUBLANDS

Black Willow Scrub/Shrub Wetland – Following the full extent of Skippack Creek this community type occurs along the scoured banks and rocky point bars of the stream as well as in occasional interior wetlands. If present, the shrub layer is represented by black willow *(Salix nigra*) and red willow (*Cornus amomum*) with herbaceous species dominating the vegetation. Abundant species include reed canary grass *(Phalaris arundinacea*), low smartweed *(Polygonum caespitosum*), pinkweed *(Polygonum pennsylvanicum*), willow weed *(Polygonum lapathifolium*), lady's thumb *(Polygonum persicaria*), water smartweed *(Polygonum punctatum*), Asiatic dayflower *(Commelina communis*), shrubby St. John's-wort *(Hypericum perforatum*), spotted St. John's-wort *(Hypericum punctatum*), jewelweed *(Impatiens capensis*), and Japanese hops *(Humulus japonicus*). Frequently this community is too small to map and therefore may appear on the accompanying vegetation map to consist of disconnected fragments rather than an uninterrupted border along the creek.

TERRESTRIAL HERBACEOUS OPENINGS

Calcareous Opening/Cliff – A the Southern most end of the park a steep cliff face supports a distinct community of calciphiles such as wild columbine *(Aquilegia canadensis*), evergreen wood fern (*Dryopteris marginalis*), maidenhair spleenwort *(Asplenium trichomanes*), and early saxifrage *(Saxifraga virginiensis*).

HERBACEOUS WETLANDS

Herbaceous Marsh/Wet Meadow – A limited number of these isolated wetlands are scattered throughout the park occurring mostly as inland features that remain continually moist because of their close proximity to a first order tributary of Skippack Creek. The vegetation is a highly variable composition of grasses, forbs, and shrubs. This description incorporates aspects of both a Mixed Forb Marsh and Wet Meadow as described by Fike (1999). These areas are commonly dominated by reed canary grass *(Phalaris arundinacea*) in association with a mix of species including arrow-leaved tearthumb *(Polygonum sagittatum*), halberd-leaved tearthumb *(Polygonum arifolium*), jewelweeds *(Impatiens spp*.), smartweeds *(Polygonum spp.*), sensitive fern *(Onoclea sensibilis*), soft rush *(Juncus effuses*), New York ironweed *(Vernonia noveboracensis*), beggar ticks *(Bidens spp*.), Pennsylvania bittercress *(Cardamine pensylvanica*), wood reedgrass *(Cinna arundinacea*), common dodder *(Cuscuta gronovii var. gronovii*), purple-leaved willow herb *(Epilobium coloratum*), bugleweed *(Lycopus uniflorus*), clearweed *(Pilea*

pumila), panicled aster *(Symphyotrichum lanceolatum ssp. lanceolatum*), swamp milkweed *(Asclepias incarnata*), and mad-dog skullcap *(Scutellaria lateriflora*) along with assorted sedges. A few shrubs such as red-willow *(Cornus amomum*) or northern arrowwood *(Viburnum recognitum*) may be interspersed among the herbaceous species.

Skunk Cabbage Forest Seep – This small wetland is unique in that it occurs in a surface depression within a forest community and yet remains wet for most of the year due to a high water table. This specific wetland is notably dominated by skunk cabbage *(Symplocarpus foetidus*) with no other single species present in any significant numbers. As a group ferns are the most common associates in this damp, shady habitat.

AQUATIC HABITATS

Aquatic Species – This community type is inclusive of all emergent and submersed, rooted vegetation that is either immediately adjacent to open water or fully rooted in the benthic substrate. The most commonly occurring species are common waterweed *(Elodea nuttallii*), Eurasian milfoil *(Myriophyllum spicatum*), spatterdock *(Nuphar advena*), and mud plantain *(Heteranthera reniformis*).

ANTHROPOGENIC (Managed or Disturbed) HABITATS

Cultivated/Managed Field – This community type is widely represented throughout the park and is dominated by species associated with recent agricultural activities. As a result of rotating usage of fields this group includes planted crops as well as agricultural weeds and old field successional species. While there is tremendous diversity in this community it is typically dominated by members of the Poaceae (grass) and Asteraceae (aster) families. Commonly seen grass species include big bluestem *(Andropogon gerardii*), broom sedge *(Andropogon virginicus*), smooth brome *(Bromus inermis*), (orchard grass *(Dactylis glomerata*), crabgrass *(Digitaria spp.*), barnyard grass *(Echinochloa muricata*), smooth panic grass *(Panicum dichotomiflorum*), switch grass *(Panicum virgatum*), timothy *(Phleum pretense*), Kentucky bluegrass *(Poa pratensis*), little bluestem *(Schizachyrium scoparium var. scoparium*), foxtails *(Setaria spp.*), broomcorn *(Sorghum bicolor var. bicolor*), purpletop *(Tridens flavus*), and corn *(Zea mays*). Including the Asters, the usual herbaceous species observed in association with the grasses were common yarrow *(Achillea millefolium*), field garlic *(Allium vineale*), common ragweed *(Ambrosia artemisiifolia*), Indian hemp *(Apocynum cannabinum*), common burdock *(Arctium minus*), common mugwort *(Artemisia vulgaris*), common milkweed *(Asclepias syriaca*), early wintercress (*Barbarea verna*), beggar-ticks *(Bidens spp.*), bindweed *(Calystegia silvatica ssp. fraterniflora*), brown knapweed *(Centaurea jacea*), Canada thistle *(Cirsium arvense*), field bindweed *(Convolvulus arvensis*), *Conyza canadensis var. canadensis* (horseweed), *Daucus carota* (Queen Anne's lace), *Desmodium spp.* (tick-trefoil), fireweed *(Erechtites hieraciifolia*), daisy fleabane *(Erigeron annuus*), grass leaved goldenrod *(Euthamia graminifolia*), bedstraw *(Galium spp.*), fragrant cudweed *(Gnaphalium obtusifolium*), St. John's wort *(Hypericum spp.*), soft rushes *(Juncus spp.*), bush clover *(Lespedeza cuneata*), Indian tobacco *(Lobelia inflata*), Allegheny monkey flower *(Mimulus ringens*), ground cherries *(Physalis spp.*), plantains *(Plantago spp.*), kiss-me-over-the-garden-gate *(Polygonum orientale*), heal-all *(Prunella vulgaris ssp. vulgaris*), multiflora rose *(Rosa multiflora*), blackberries *(Rubus spp.*), black-eyed Susan (*Rudbeckia hirta var. pulcherrima*), peach-leaved dock *(Rumex altissimus*), prickly sida *(Sida spinosa*), horse nettle *(Solanum carolinense*), goldenrods

(Solidago spp.), asters *(Symphyotrichum spp.*), clovers *(Trifolium spp.*), and common cocklebur (*Xanthium strumarium var. canadense*).

Forest Fringe–Roadside Vegetation – This type is similar to the Utility Corridor community, but reflects an even greater level of disturbance events due to increased human activity. It is widely seen throughout the park along roadways and abandoned roadbeds, as well as in parking lots, home sites, and other private facilities. This community type is dominated by invasive shrubs that often include escaped ornamentals and extremely diverse herbaceous vegetation of a weedy nature. Typical shrubs include autumn olive *(Elaeagnus umbellata*), staghorn sumac *(Rhus typhina*), and multiflora rose *(Rosa multiflora*). The most abundant herbaceous species present are ragweed *(Ambrosia spp.*), wormwood (*Artemesia annua*), beggar-ticks *(Bidens spp*.), lamb's quarters *(Chenopodium album*), blue chicory *(Cichorium intybus*), Queen Anne's lace *(Daucus carota*), grass leaved goldenrod *(Euthamia graminifolia*), beggar's lice *(Hackelia virginiana*), evening primrose *(Oenothera biennis*), foxtails *(Setaria spp.*), goldenrods *(Solidago spp.*), clovers *(Trifolium spp.*), mulleins *(Verbascum spp.*), crown vetch *(Coronilla varia*) and vervains *(Verbena spp*.).

Plantation Forest – Several nearly monospecific stands of perfectly aligned, evenly spaced trees are common throughout the park. Both evergreen conifers such as eastern white pine *(Pinus strobus*), and Norway spruce *(Picea abies*) are typical as well as hardwoods such as ash (*Fraxinus sp*.). Although clearly left untended in recent years these dense stands typically exclude native species from becoming established in these areas. Beneath the dense evergreen canopies undergrowth is often sparse, but when present it is dominated by exotic species such as Amur honeysuckle *(Lonicera maackii*), Japanese honeysuckle (*Lonicera japonica*), ebony spleenwort *(Asplenium platyneuron*), Japanese stiltgrass *(Microstegium vimineum*), moneywort *(Lysimachia nummularia*), and common blue violet (*Viola sororia).*

Recreational Field – This grass dominated community is specifically maintained for the purpose of providing areas for organized athletic activities and other recreational pursuits. It is distinguished from other open upland areas by a high frequency of close mowing and the control of broad leaved plants.

Successional Forest – This type is descriptive of those successional areas that have begun to develop tree cover greater than 60% and are thus beginning to shade out the dense shrub layer that is present in the successional woodland community. Tree cover is predominantly composed of white ash *(Fraxinus americana*) and red maple *(Acer rubrum*), however other tree species present at an earlier successional stage may remain as part of this community to some degree. The understory, shrub, and herbaceous layers are typically very similar in composition to that of the successional woodland, however they are less vigorous and significantly reduced in density.

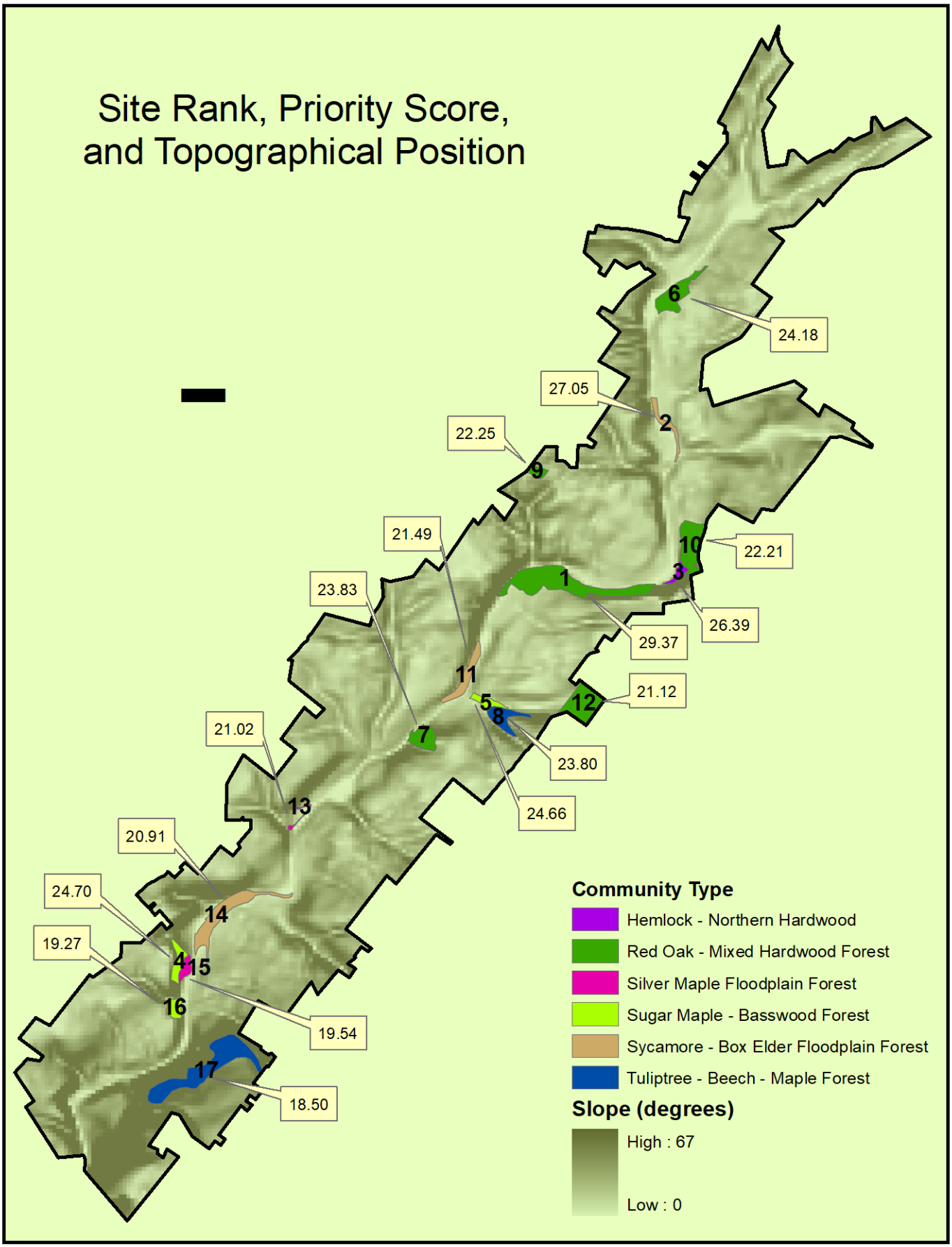
Successional Woodland – This early successional community type is typical in areas that were previously cleared and have been allowed to re-vegetate within the last 20-30 years and is typically dominated by early successional or introduced species. The exact composition and successional stage is highly variable throughout the park, but predominant in these areas as young canopy species are black walnut *(Juglans nigra*), Norway maple *(Acer platanoides*), eastern red cedar (*Juniperus virginiana*), red elm *(Ulmus rubra*), white ash *(Fraxinus americana*), red maple *(Acer rubrum*), sassafras *(Sassafras albidum*), and black cherry *(Prunus serotina*). Tree cover is usually sparse (less than 60% cover) allowing for a thick understory or

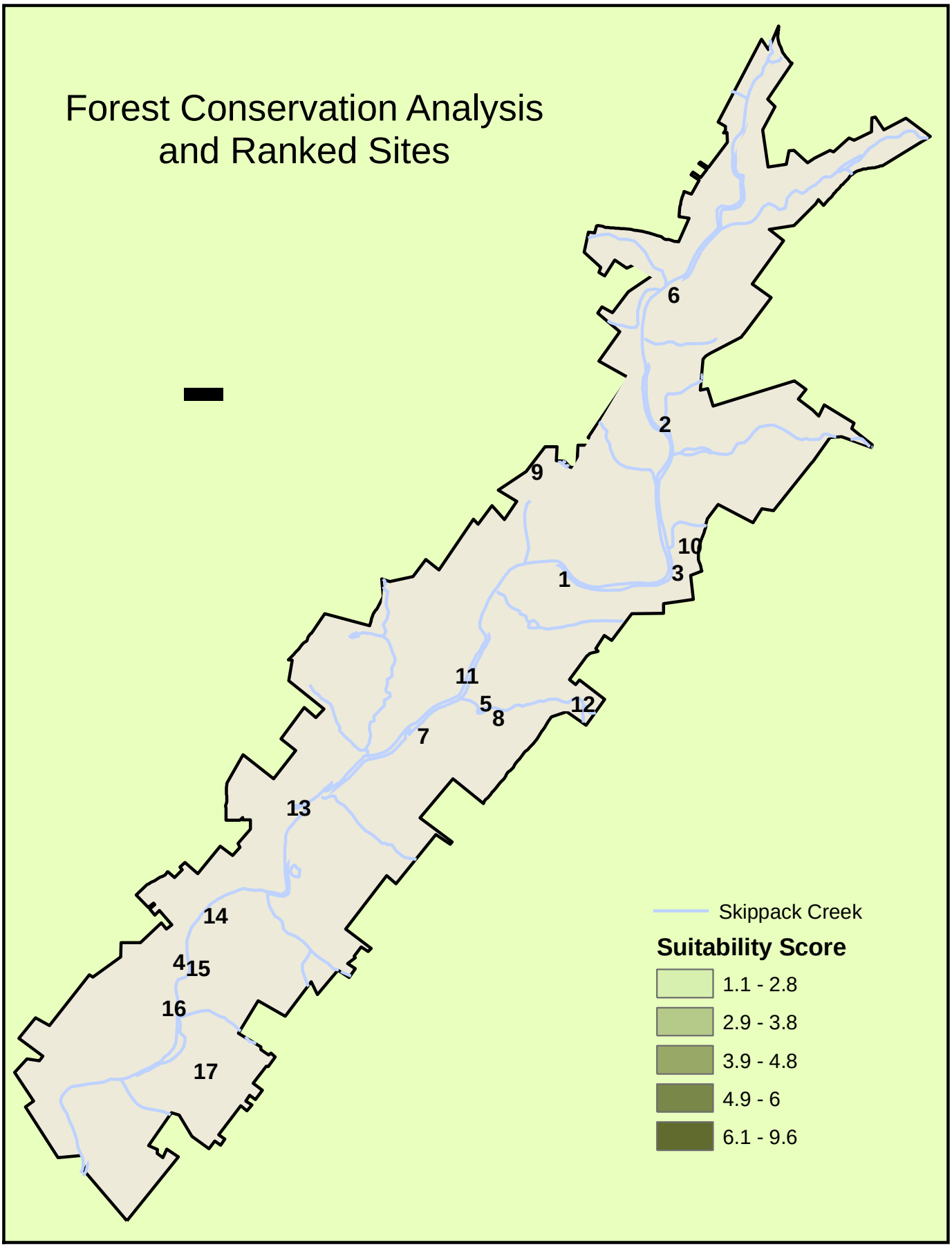
shrub layer to develop into a dense shrub thicket. Shrub species may vary widely, but frequent associates are crabapple *(Malus domestica*), privet *(Ligustrum obtusifolium*), autumn olive *(Elaeagnus umbellata*), and Amur honeysuckle *(Lonicera maackii*). Herbaceous vegetation is typically dominated by exotic species and includes old field cinquefoil *(Potentilla simplex*), heal-all *(Prunella vulgaris*), lesser celandine *(Ranunculus ficaria*), Virginia creeper *(Parthenocissus quinquefolia*), poison ivy *(Toxicodendron radicans*), garlic mustard *(Alliaria petiolata*), Asiatic bittersweet *(Celastrus orbiculatus*), pokeweed *(Phytolacca americana*), blackberries *(Rubus spp.,*), grapes *(Vitis spp*.), climbing false buckwheat *(Polygonum scandens*), Indian tobacco *(Lobelia inflata*), and Japanese honeysuckle (*Lonicera japonica).*

Utility Corridor – Lengthy artificial meadows are found wherever utility corridors bisect park property. Right-of-way maintenance regimens typically rely on mechanical grass mowing (as much as five times a year) and trimming of trees resulting in a persistent coverage of forbs, grasses, sedges and young shrubs. Herbaceous vegetation includes numerous species in the following genera: *Panicum, Carex, Solidago, Cirsium, Rumex, and Verbena.*

Warm Season Grassland – This community is distinctly noted for its tall grass cover dominated by an almost uniform mix of big bluestem *(Andropogon gerardii*), Indian grass (*Sorghastrum nutans*), and switch grass *(Panicum virgatum*). A fourth grass little bluestem *(Schizachyrium scoparium*) is sporadically present. Herbaceous cover is dominated by Indian hemp *(Apocynum cannabinum*) and poison ivy *(Toxicodendron radicans*) with woody species such as multiflora rose *(Rosa multiflora*) and blackberry (*Rubus pensilvanicus)* frequently becoming well established.

APPENDIX 10 – Topographic Position of Prioritized Sites


Site Rank, Priority Score,
and Topographical Position
6
24.18
27.05
2
22.25
9
21.49
10
22.21
3
1
23.83
26.39
29.37
11
5
12
21.12
8
21.02
7
23.80
24.66
13
20.91
24.70
14
19.27
4
15
16
19.54
17
18.50
Community Type
Hemlock - Northern Hardwood
Red Oak - Mixed Hardwood Forest
Silver Maple Floodplain Forest
Sugar Maple - Basswood Forest
Sycamore - Box Elder Floodplain Forest
Tuliptree - Beech - Maple Forest
Slope (degrees)
High : 67
Low : 0


Forest Conservation Analysis
and Ranked Sites
6
2
9
10
3
1
11
5
8
12
7
13
14
4
15
16
17
Skippack Creek
Suitability Score
1.1 - 2.8
2.9 - 3.8
3.9 - 4.8
4.9 - 6
6.1 - 9.6

APPENDIX 12 – Management Map