

Historical Analysis and Map of Vegetation Communities, Land Covers, and Habitats of Flint Woods Nature Preserve New Castle County, Delaware

Brandywine Creek Watershed

Submitted to:

Delaware State Parks
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Table of Contents

Chapter 1: Introduction and Methods	3
Setting of Flint Woods Nature Preserve	3
Soils and Geology of Flint Woods Nature Preserve	5
Underlying Geology.....	5
Soils.....	5
Discussion of vegetation communities in general and why they are important in management	6
Purpose of the Study	6
Vegetation Community and Land Cover Surveys	7
Analysis of Historical Imagery	7
Forest Block Analysis	7
Chapter 2: Results of Forest Blocks and General Observations	8
Summary of Findings from this study	8
1. Vegetation Communities:.....	8
2. Rare Plants:	8
3. Rare Animals:.....	8
Forest Block Analysis	9
Analysis of Forest Blocks at Flint Woods Nature Preserve.....	9
Chapter 3: Broad Trends at Flint Woods Nature Preserve	12
Chapter 4: Descriptions and Analysis of the Vegetation Communities	23
Chapter 5: Descriptions and Analysis of the Land Covers	36
Appendix I: State rare vegetation ranking criteria.....	39
Appendix II: SGCN in Key Wildlife Habitats.....	40

CHAPTER 1: INTRODUCTION AND METHODS

Setting of Flint Woods Nature Preserve

Flint Woods Nature Preserve is located in northern New Castle County, Delaware (Figure 1.1). The Nature Preserve totals 137 acres in one tract. The preserve is wholly within the Brandywine Creek watershed.

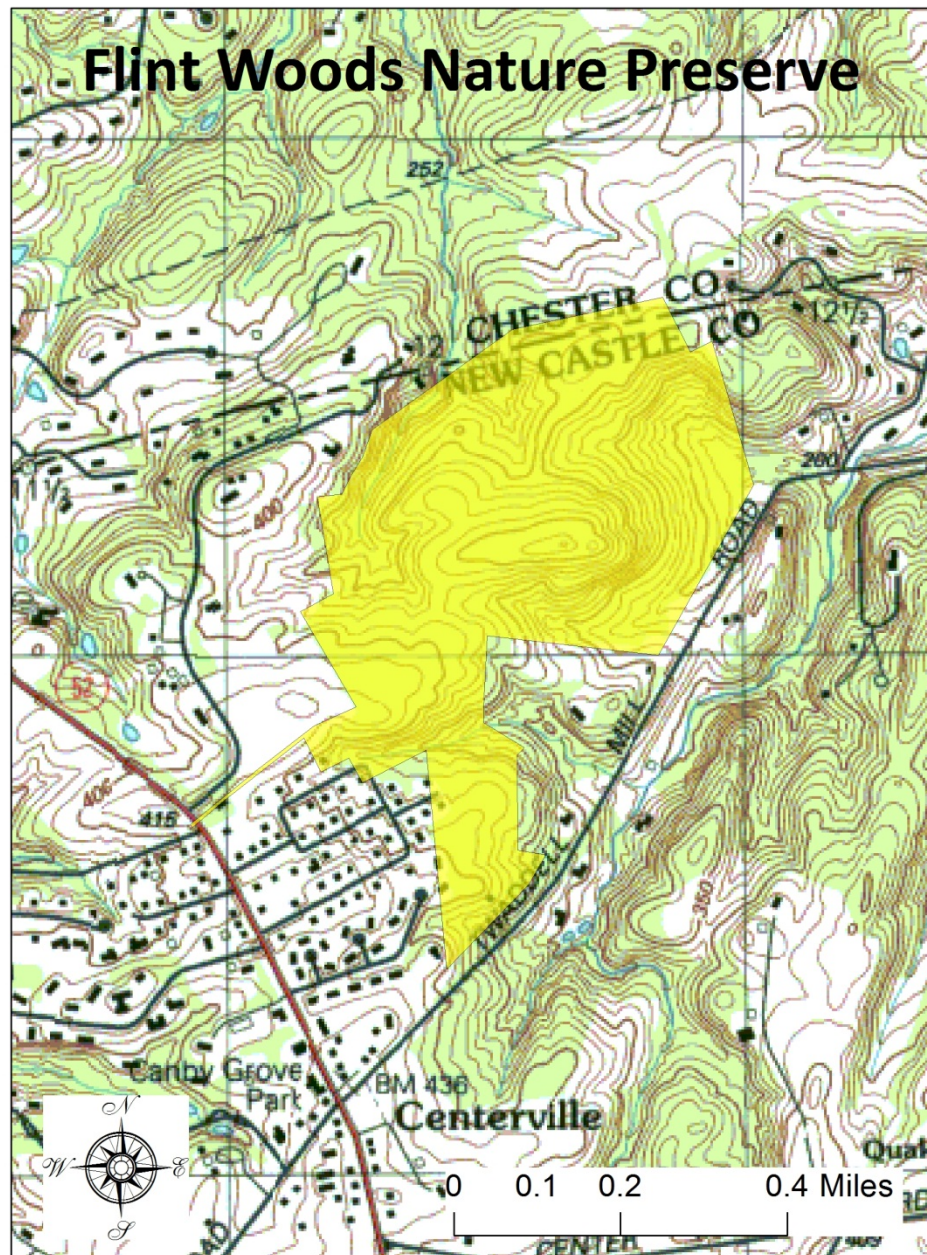


Figure 1.1. Location of Flint Woods Nature Preserve

Soils and Geology of Flint Woods Nature Preserve

Underlying Geology

Flint Woods Nature Preserve is located in the Piedmont physiographic province of Delaware and is underlain by the Wissahickon Formation. This formation is described as “interlayered psammitic and polytic gneiss with amphibolite.”¹

Soils

Two soils are prominent in the nature preserve and include Gaila Loam (45 acres) and Manor Loam (37 acres) . Other minor soils include Glenelg Loam and Glenville Silt Loam. Flint Woods Nature Preserve ranges in elevation from 270 feet near Twaddell Mill Road to 420 feet near the center of the preserve.

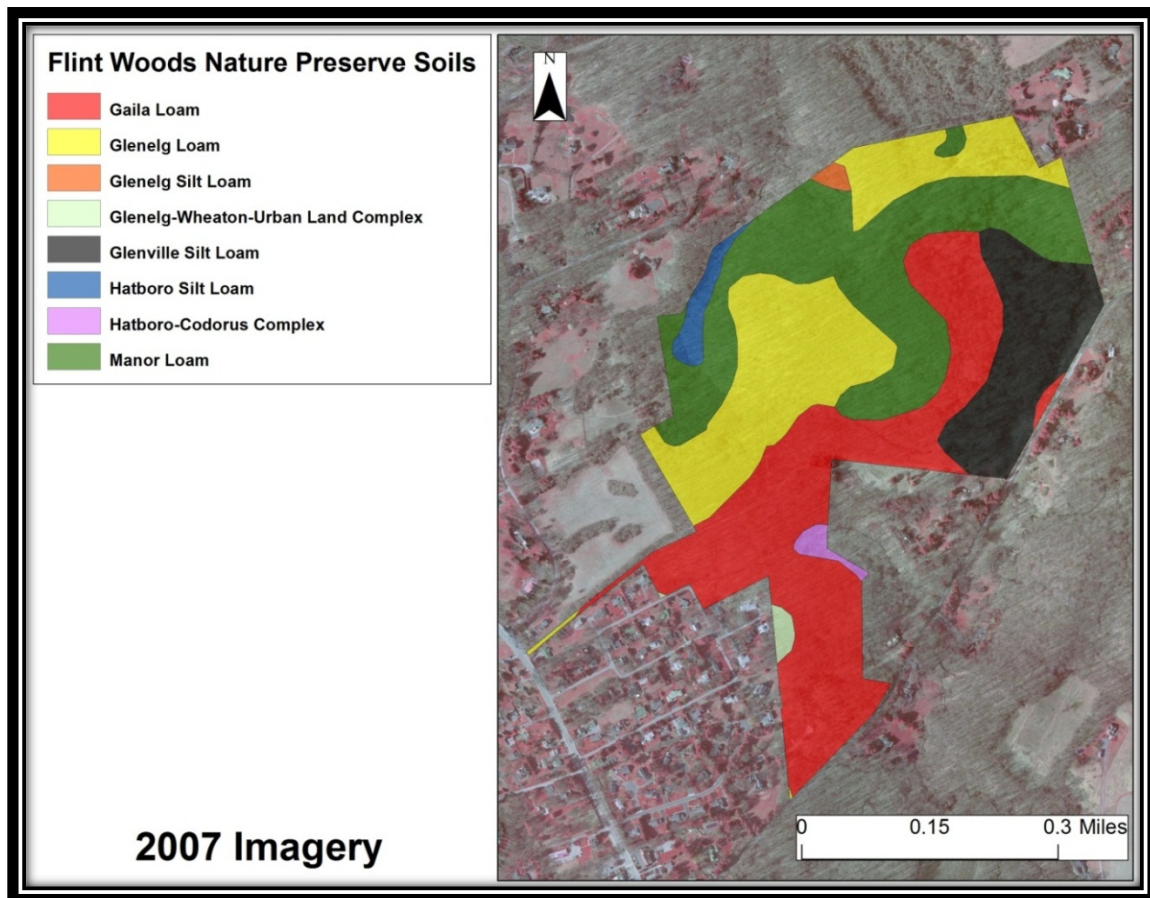


Figure 1.2. Flint Woods Nature Preserve Soil Map

¹ Ramsey, Kelvin W. 2005. Geologic Map of New Castle County, Delaware. Delaware Geological Survey, Geologic Map Series No. 13.

Discussion of vegetation communities in general and why they are important in management

While Natural Communities provide the optimal habitats and structure that are needed for animals to exist, vegetation communities provide an approximation of natural communities. The differences in the vegetation communities are governed by non-biotic factors and biotic factors. Non-biotic factors include things such as geology (soil type, availability of moisture, and exposure), climate, and fire regime. Biotic factors include: number and amount of predators and prey, biodiversity of the community and presence and absence of contributors to ecosystem health such as ants, fungi and bacteria and size of forest blocks. Historically these factors have not changed much other than changes brought about by larger climate shifts. Since the time of modern European settlement of Eastern North America (i.e. from about 1600 A.D.), physical factors such as fire regime and moisture availability have changed and nearly all of the biotic factors have changed resulted in a markedly different landscape today than what the original settlers saw. Today, instead of having Natural Communities, we have Vegetation Communities, which only approximate Natural Communities and are essentially artificial shells of what they could be.

Purpose of the Study

This study was conducted with the following goals in mind:

1. Classify and map vegetation communities, land covers, and assess habitat conditions for Species of Greatest Conservation Need (SGCN)[as defined in the Delaware Wildlife Action Plan (DEWAP)] for Flint Woods Nature Preserve based on 1937, 2002, 2007, and 2010 aerial imagery and field observations.
2. Use the maps above to determine changes in the vegetation communities over time.
3. Determine the forest blocks located within or partially within the nature preserve.
4. Produce Ecological Integrity Assessments (EIAs) for vegetation communities that are ranked S2 or higher.

Surveys were conducted during 2007 by Robert Coxe, an Environmental Scientist with the Delaware Natural Heritage and Endangered Species Program (DNHESP) within the Delaware Division of Fish and Wildlife, Department of Natural Resources and Environmental Control (DNREC).

Vegetation Community and Land Cover Surveys

Vegetation communities and land covers were determined by qualitative analysis using observations made in the field and aerial photo-interpretation using 1937, 2002, 2007, and 2010 aerial imagery. Vegetation communities are named according to the *Guide to Delaware Vegetation Communities*² which follows the National Vegetation Classification System (NVCS). The NVCS classifies vegetation on a national scale for the United States and is linked to international vegetation classification. The NVCS helps provide a uniform name and description of vegetation communities found throughout the country and helps determine relative rarity. Descriptions of the vegetation communities are provided in Chapter 4 and of land covers in Chapter 5. A crosswalk to the Delaware Wildlife Action Plan (DEWAP) and the Northeast Habitat Classification (NHC) is provided at the top of each individual description.

Analysis of Historical Imagery

Historical imagery of Flint Woods Nature Preserve from 1937 and 2002, 2007 and current imagery from 2010 were examined. A vegetation community map was produced for each year in order to compare vegetation and land cover change over a 5, 65, 70, and 73 year time frame. Changes in the respective vegetation communities and land covers are discussed in the descriptions while broader changes are discussed in the nature preserve discussion. There is more imagery available (1954, 1961, 1968, 1992, and 1997) but these sets were not used due to geo-registration problems in the image tiles.

Forest Block Analysis

Current forest blocks within or partially within the nature preserve that are greater than 100 acres were mapped. Each current block is described for current total acres and current forest interior habitat, potential acres, potential forest interior habitat, vegetation communities currently present, and major drainage (Figure 2.1, Table 2.3). A block is defined as contiguous forest habitat that is contained within 30 feet of non-forested and is the method used by the Maryland's Strategic Forest Lands Assessment.³ Forest interior is forested area that is 100m from a forest edge. Potential blocks were extended out to areas of noncontiguous habitat (such as roads, power line right-of-ways, and developed areas) that were considered to be immovable. Most of the area that could be reverted to forest is currently old field habitat or in agricultural use. These blocks were determined for future planning in regards to improving and increasing forest interior habitat.

² Coxe, Robert. 2010. Guide to Delaware Vegetation Communities-Summer 2010 Edition. Unpublished report.

³ Maryland Department of Natural Resources. 2003. Strategic Forest Lands Assessment. Co-op Project between Maryland Department of Natural Resources, Watershed Services, and Maryland Forest Service. 40 p.

CHAPTER 2: RESULTS OF FOREST BLOCKS AND GENERAL OBSERVATIONS

Summary of Findings from this study

1. **Vegetation Communities:** Five vegetation communities and one land cover were found at Flint Woods Nature Preserve. Northeastern Modified Successional Forest (121 acres) is the largest vegetation community, followed by Northern Piedmont Mesic Oak-Beech Forest with 11 acres. Impervious surface (0.2 acres) is the largest and only land cover.
2. **Rare Plants:** Two rare plants are known to exist in Flint Woods Nature Preserve (Table 2.1).

Scientific Name	Common Name	Rank	Last Observed
<i>Carex gynandra</i>	Nodding Sedge	S2	?
<i>Sphenopholis pensylvanica</i>	Swamp Wedgescale	S1	1993

Table 2.1 Rare Plants at Flint Woods Nature Preserve

3. **Rare Animals:** One rare animal is known to exist in Flint Woods Nature Preserve (Table 2.2).

Scientific Name	Common Name	Rank	Last Observed
<i>Catharus fuscescens</i>	Veery	S2B	1996

Table 2.2 Rare Animals at Flint Woods Nature Preserve

Forest Block Analysis

Importance of Forest Blocks

Forest blocks are important for a number of animals such as bobcat and neo-tropical migratory birds which nest in forest interiors (those places that are 100 meters from the edge of a forest). Many neotropical migratory birds are considered to be breeders in forest interior areas. Due to development, road building, which causes fragmentation, agricultural fields and other non-forest land uses, habitats for these birds are increasingly being eliminated leading to reductions in populations. Predators are better able to get the birds in small woodlands and edge habitats. In Ontario it was found that 80% of the neo-tropical bird nests in small woodlands (<100 ha) were lost to predators⁴. Nests in interior forests are less susceptible to predation and are not taken over by cowbirds, which is another hazard on edge habitats. Examples of birds that may be affected by a lack of large forest tracts include Barred Owl, Black and White Warbler, Worm-Eating Warbler, Acadian Flycatcher, Ovenbird, Kentucky Warbler, Red-Shouldered Hawk and many others.

Management of state parks has traditionally favored recreational uses, which require cultivated lawns and edges running counter to the habitat needed for forest interior birds. Protecting forest interior birds runs contrary to the idea that artificially created edges creates more diversity. While this technique creates more diversity of some aggressive species it diminishes the populations of other species.

In protecting forest blocks, those blocks which are circular contain the most interior area per unit area. The next best shape is a square and linear configurations produce the least forest interior due to shape.

A study by Robbins et al. (1989) showed that most forest interior species require a forest of at least 150 ha (370 acres) in size. Very few forest tracts in Delaware are at least this size, one of the more notable being the Great Cypress Swamp.

Analysis of Forest Blocks at Flint Woods Nature Preserve

One forest block is present that is more than 100 acres in size and are located in whole or part in the preserve (Table 2.3). All forest blocks are bounded by a road, agricultural field, or other non-forested habitat. These areas are considered to be barriers to the passage of forest dwelling wildlife. A description is provided for this forest block.

⁴ Ontario Landowner Resource Centre. 2000. Conserving the Forest Interior: A threatened wildlife habitat. Ontario Ministry of Natural Resources.

Table 2.3. Forest Blocks located in whole or part in Flint Woods Nature Preserve

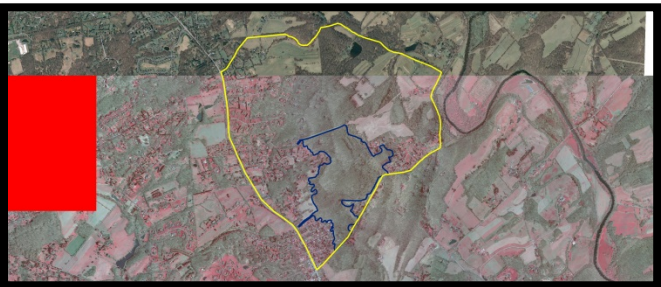
Forest Block Map	Block Name/Acreage	Description
	Flint Woods A Current Block = 208 acres (83 acres interior) Potential Block = 1,317 acres (1,092 acres interior)	Flint Woods A is located in Delaware and Pennsylvania. It is bounded by Twaddell Mill Road on the south, Kennett Pike (DE 52) on the west, Hillendale Road on the north, and Creek Road on the east. Three vegetation communities are located within this block and include Northeastern Modified Successional Forest, Northern Piedmont Mesic Oak-Beech Forest, and White Pine Planted Forest. A tributary to Brandywine Creek drains the block. Currently this block contains 83 acres of interior habitat. Potentially this block could be 1,317 acres and contain 1,092 acres of interior habitat.



Figure 2.1. Flint Woods Nature Preserve Forest Blocks

CHAPTER 3: BROAD TRENDS AT FLINT WOODS NATURE PRESERVE

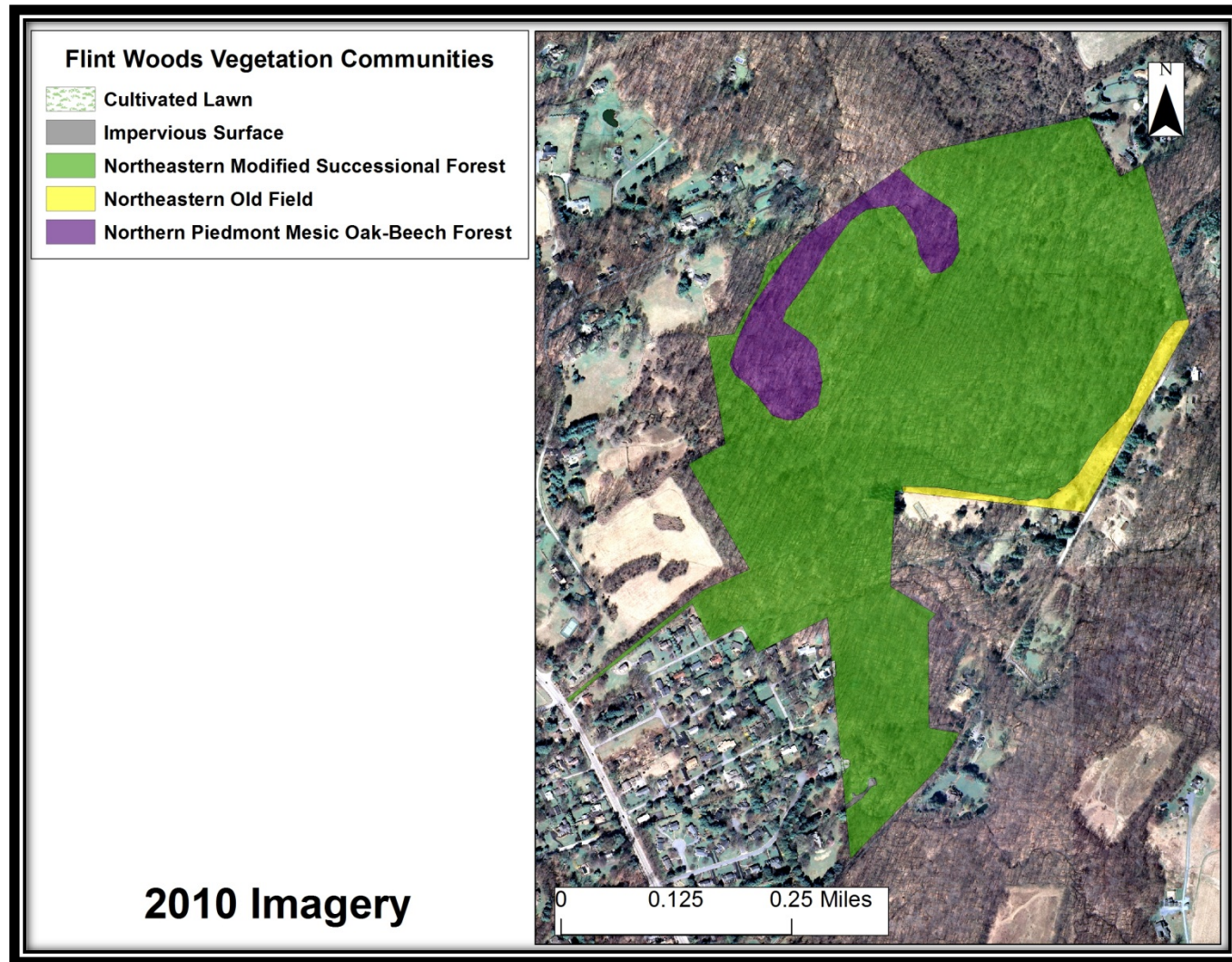


Figure 3.1. 2010 Vegetation Community map of Flint Woods Nature Preserve

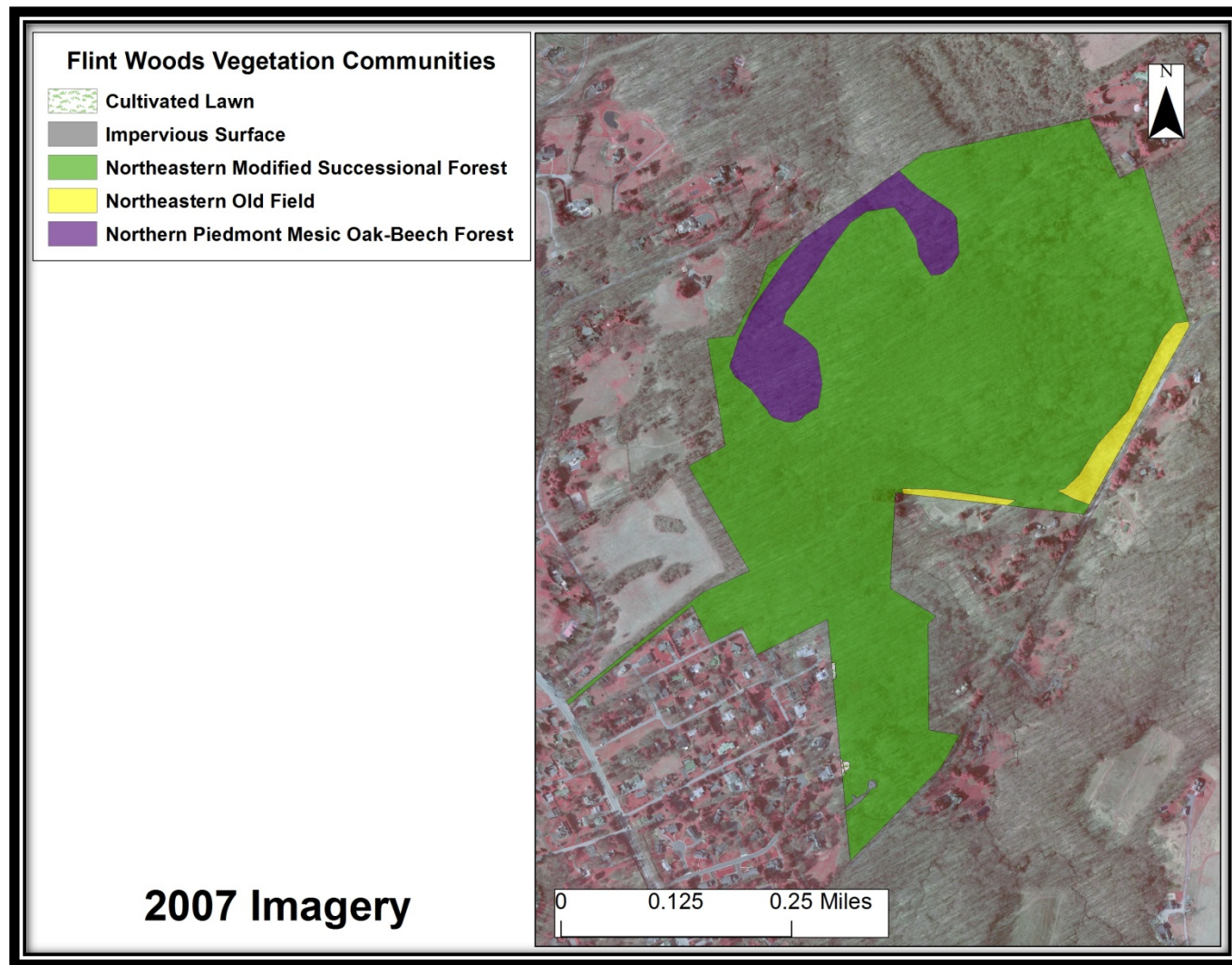


Figure 3.2. 2007 Vegetation Community map of Flint Woods Nature Preserve

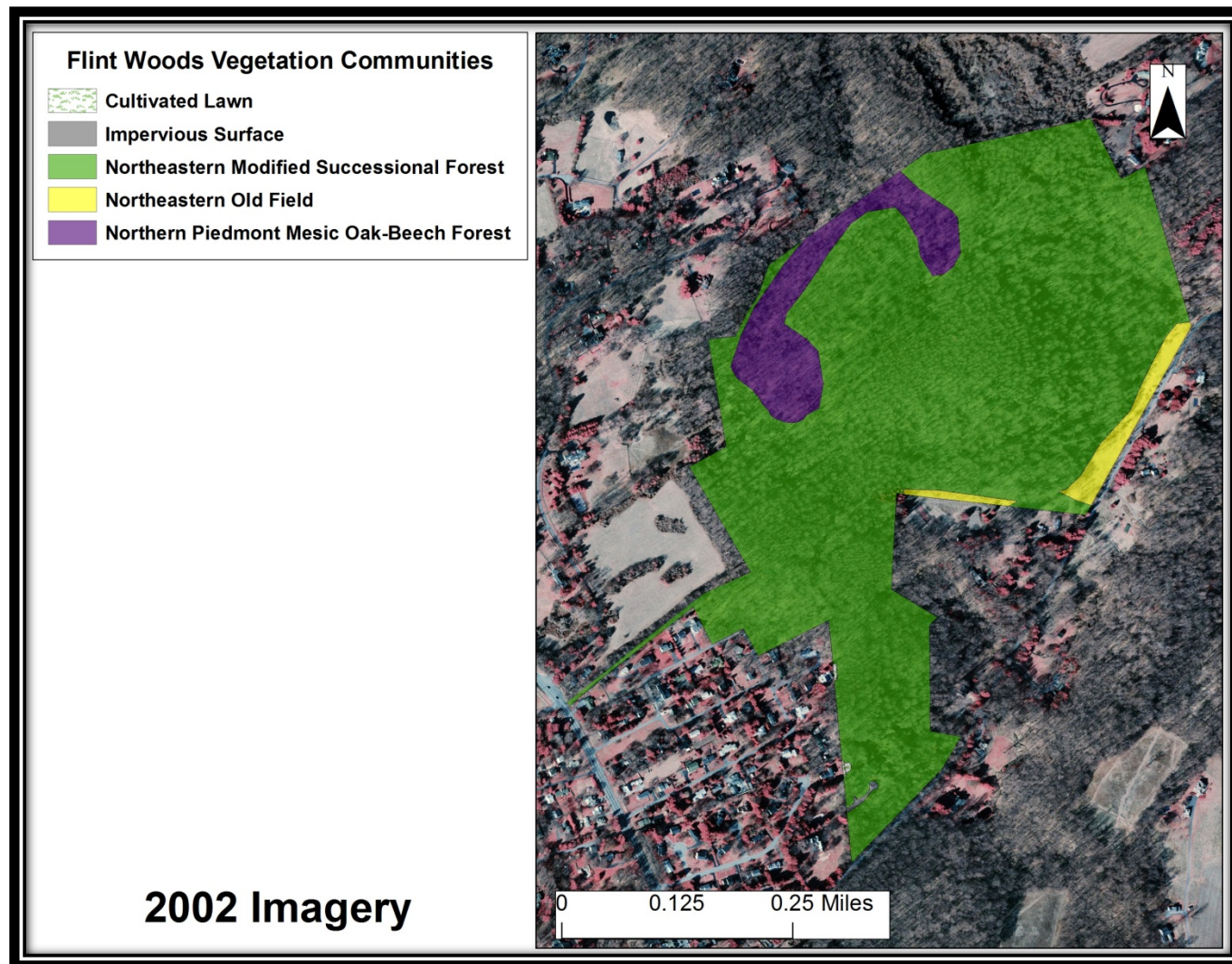


Figure 3.3. 2002 Vegetation Community map of Flint Woods Nature Preserve

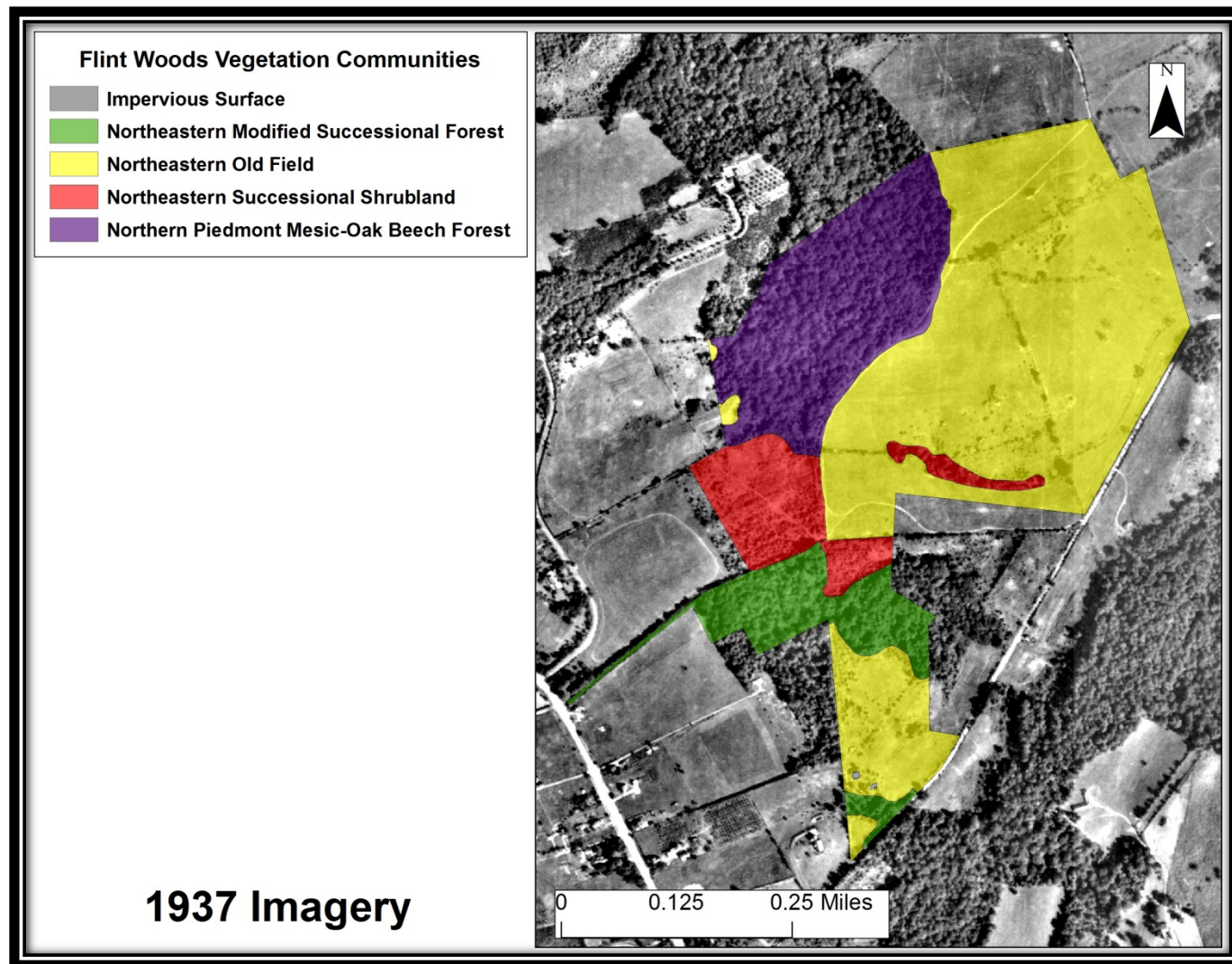


Figure 3.4. 1937 Vegetation Community map of Flint Woods Nature Preserve

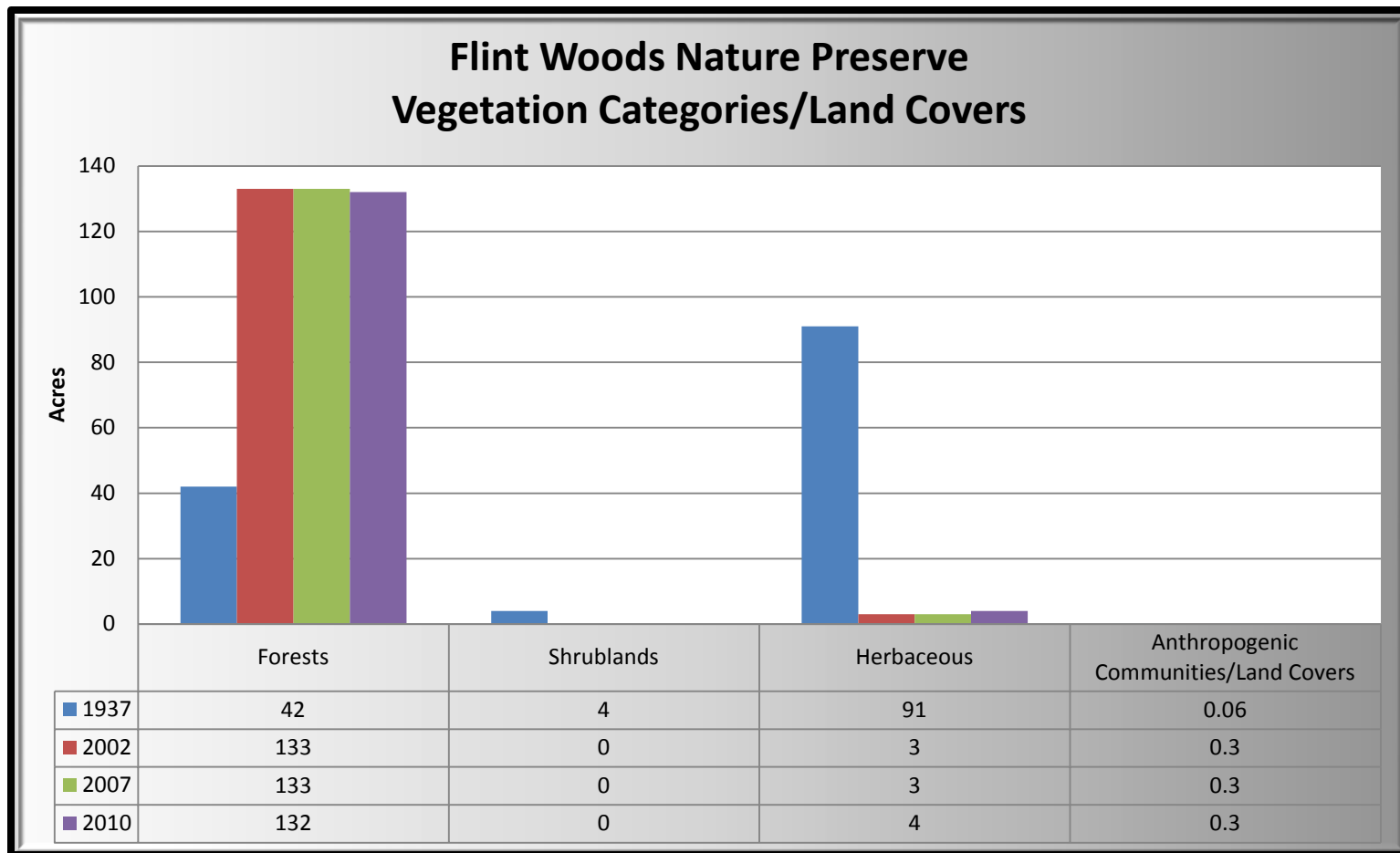


Figure 3.5. Flint Woods Nature Preserve Vegetation Categories/Land Covers (1937, 2002, 2007, and 2010)

Flint Woods Nature Preserve Broad Trends (Figure 3.1): Forests compose the most area in Flint Woods Nature Preserve and have been stable in recent times. Herbaceous communities (Northeastern Old Field) were once prominent in 1937 but have succeeded to become today's forests.

Natural Capital (Table 3.1)

Natural capital of the Flint Woods Nature Preserve has gradually increased with the maturation of successional communities.

Table 3.1. Natural Capital of Flint Woods Nature Preserve	
Year	Natural Capital (in 2012 dollars)
1937	\$21,784/year
2002	\$25,587/year
2007	\$25,587/year
2010	\$25,733/year

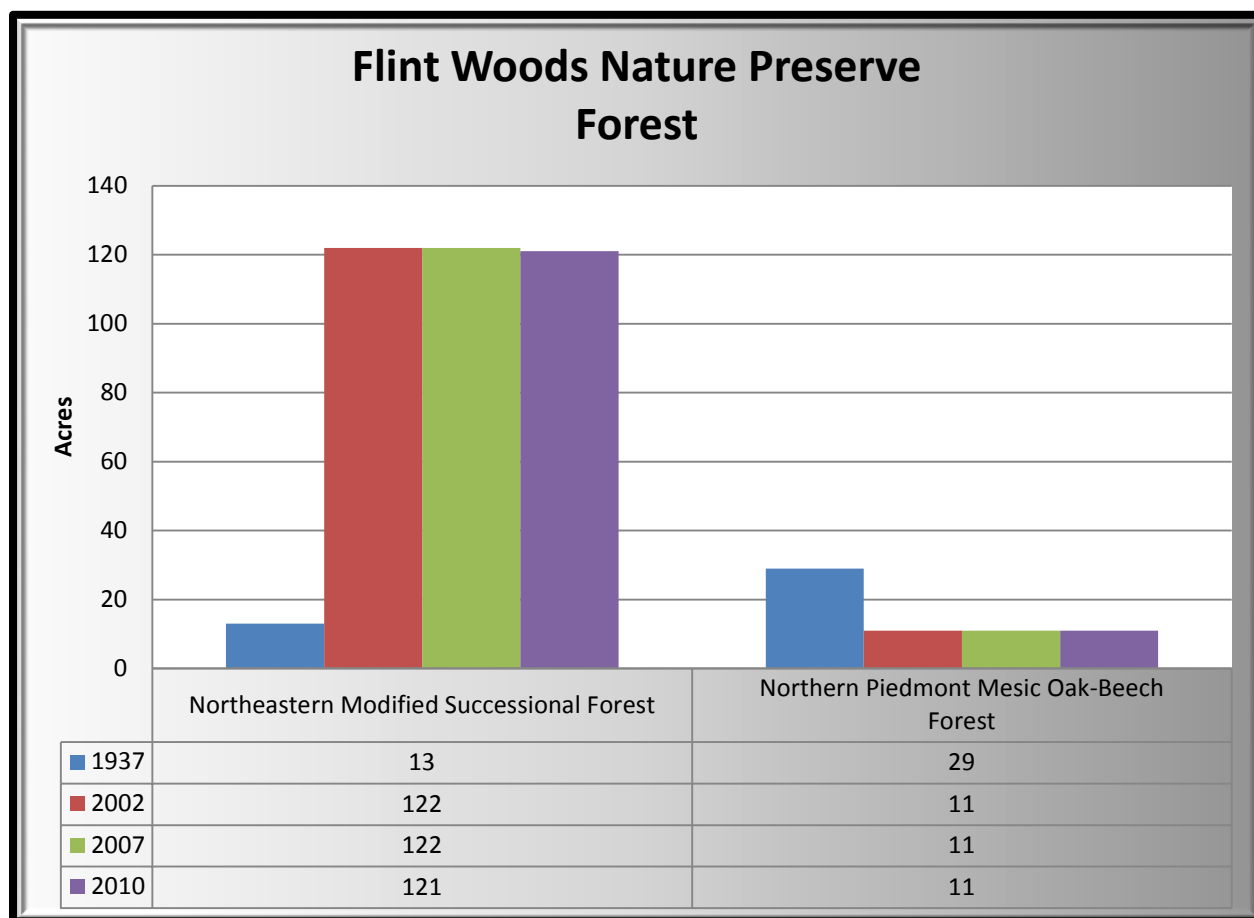


Figure 3.6. Forest at Flint Woods Nature Preserve (1937, 2002, 2007, and 2010)

Flint Woods Nature Preserve Forest (Figure 3.6): Two forest types, Northeastern Modified Successional Forest and Northern Piedmont Mesic Oak-Beech Forest, are present in the preserve. Northeastern Modified Successional Forest is the most prominent of these and favors a Successional Tuliptree Forest and could be this type if the exotic invasive plant species were removed. Some of the Northern Piedmont Mesic Oak-Beech Forest has declined likely as a result of being invaded by exotic plant species and converting to Northeastern Modified Successional Forest.

Natural Capital (Table 3.2)

Natural capital of forest has increased in the preserve since 1937 and has been stable from 2002-2010.

Table 3.2. Natural Capital of Flint Woods Nature Preserve Forest	
Year	Natural Capital (in 2012 dollars)
1937	\$7,942/year
2002	\$25,510/year
2007	\$25,510/year
2010	\$25,510/year

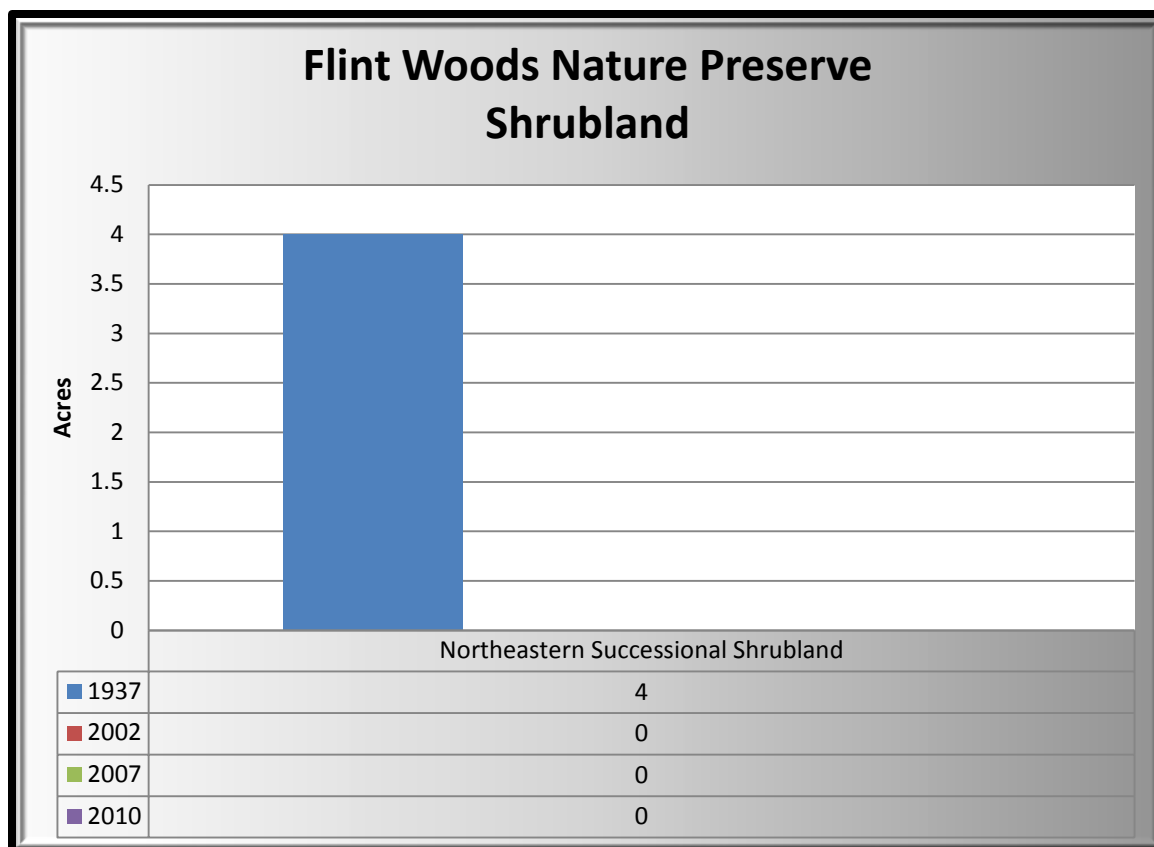


Figure 3.7. Shrubland at Flint Woods Nature Preserve (1937, 2002, 2007, and 2010)

Flint Woods Nature Preserve Shrubland (Figure 3.7): Northeastern Successional Shrubland is historic to the preserve and has succeeded to forestland.

Natural Capital (Table 3.2)

Shrubland does have any natural capital in the preserve. The capital from this community has been transferred to forest resulting in a capital increase for the preserve.

Table 3.2. Natural Capital of Flint Woods Nature Preserve Shrubland	
Year	Natural Capital (in 2012 dollars)
1937	\$583/year
2002	\$0/year (not present)
2007	\$0/year (not present)
2010	\$0/year (not present)

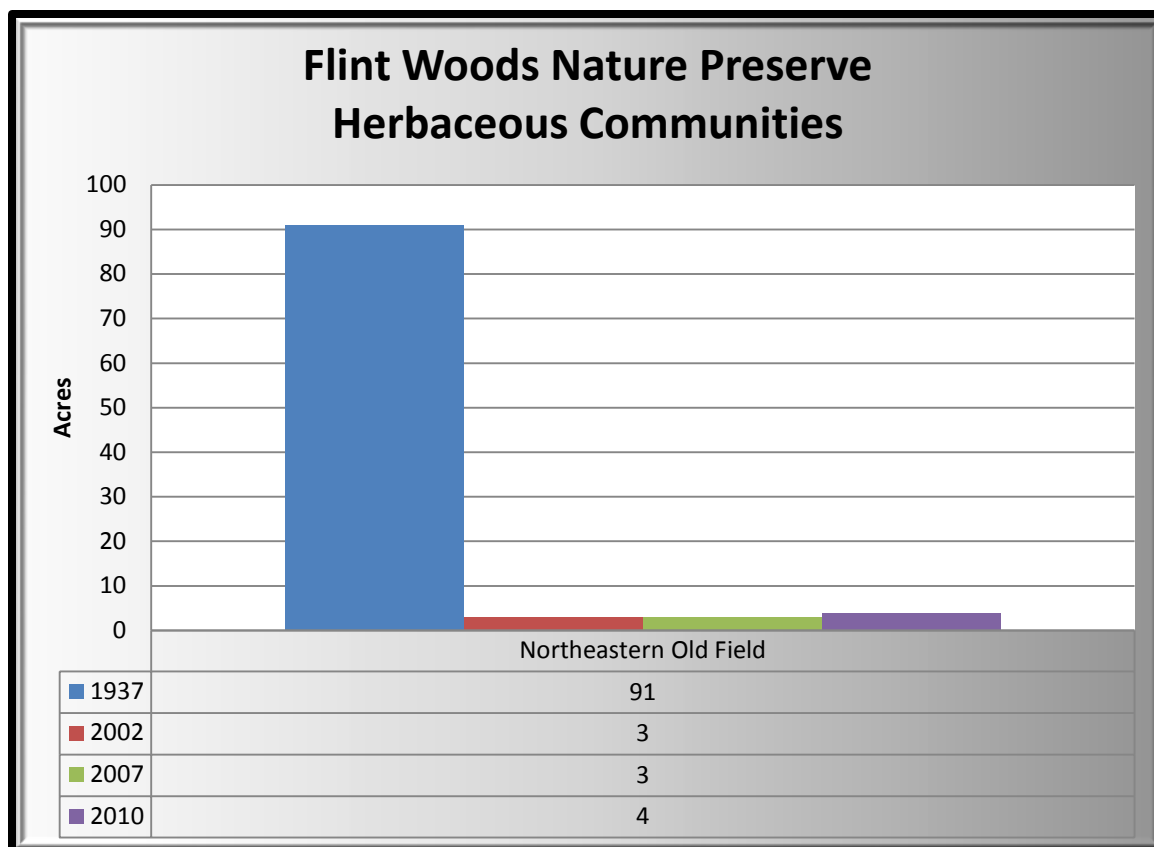


Figure 3.8. Herbaceous Communities at Flint Woods Nature Preserve (1937, 2002, 2007, and 2010)

Flint Woods Nature Preserve Herbaceous Communities (Figure 3.8): Northeastern Old Field was once prominent in the preserve and now exists as a small area near Twaddell Mill Road. Most of the area that was once this habitat has succeeded to forestland.

Natural Capital (Table 3.2)

Capital of herbaceous communities has gone down greatly with the maturation of these communities to forests resulting in a capital increase for the preserve.

Table 3.2. Natural Capital of Flint Woods Nature Preserve Herbaceous Communities	
Year	Natural Capital (in 2012 dollars)
1937	\$13,259/year
2002	\$437/year
2007	\$437/year
2010	\$583/year

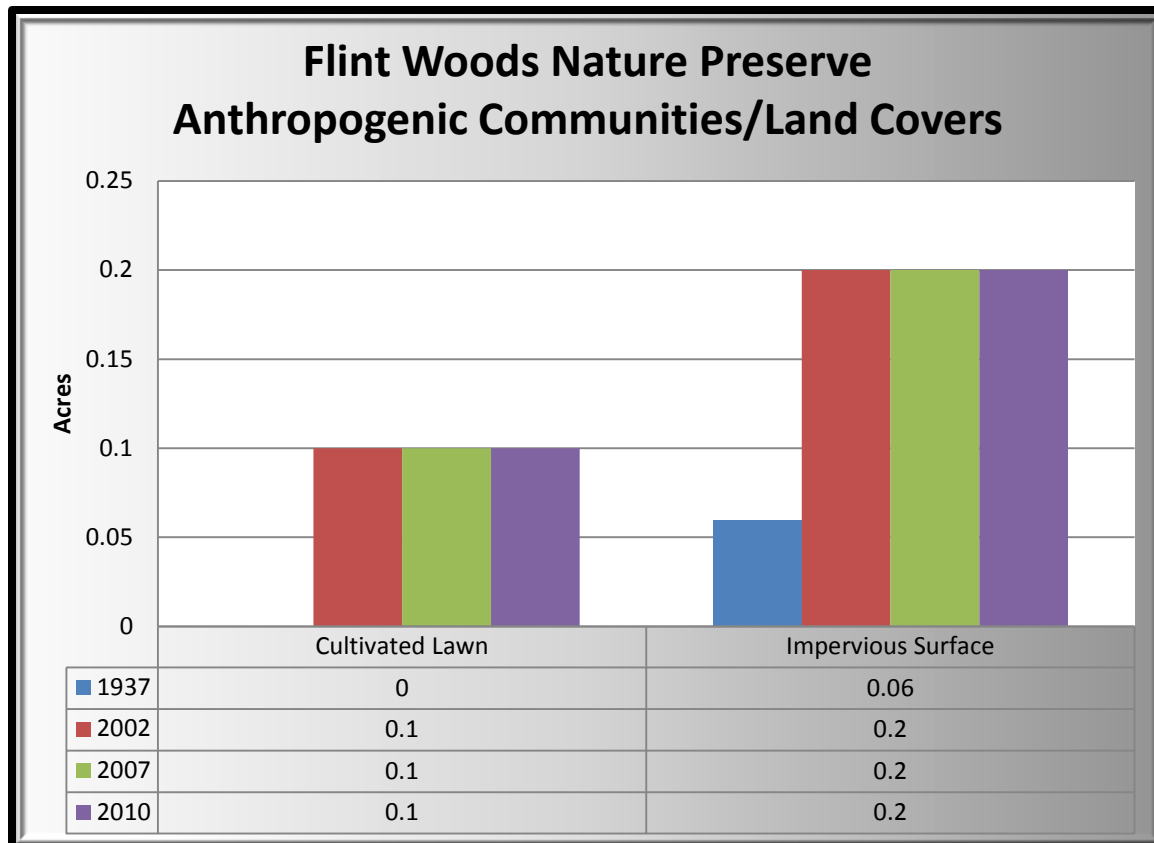


Figure 3.9. Anthropogenic Communities/Land Covers at Flint Woods Nature Preserve (1937, 2002, 2007, and 2010)

Flint Woods Nature Preserve Anthropogenic Communities/Land Covers (Figure 3.9):

Anthropogenic communities constitute a very small part of the preserve and are composed of cultivated lawn and impervious surface.

Natural Capital

None of the anthropogenic communities/land covers in the Flint Woods Nature Preserve have any natural capital value.

CHAPTER 4: DESCRIPTIONS AND ANALYSIS OF THE VEGETATION COMMUNITIES

Five vegetation communities and one land cover were noted in the survey (Figures 3-6). Below is a list of the vegetation communities present in 2010 and historical in previous years and descriptions. The National Vegetation Classification (NVC) Association number is given with the vegetation community and their approximate acreage in the project area. Names of communities correspond with the common names as given in the NVC and the Guide to Delaware Vegetation Communities.

The vegetation communities include:

1. Cultivated Lawn (CEGL008462)—0.1 acres
2. Golden-saxifrage Forested Seep (CEGL006193)—~ 1 acre (located within and described in the Northern Piedmont Mesic Oak-Beech Forest)
3. Northeastern Modified Successional Forest (CEGL006599)—121 acres
4. Northeastern Old Field (CEGL006107)—4 acres
5. Northern Piedmont Mesic Oak-Beech Forest-(CEGL006921)—11 acres

Historical vegetation communities include:

1. Northeastern Successional Shrubland (CEGL006451)—4 acres (1937)

The land covers include:

1. Impervious Surface—0.2 acres

Cultivated Lawn [0.1 acres (Figure 2.1, Table 4.1)] GNA SNA

DEWAP: No Equivalent Community
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

This community is composed of ornamental grasses and other plants and located on the edge of Twaddell Mill Road. It composed mostly of tall fescue (*Festuca arundinacea*).

Analysis of Condition at Flint Woods Nature Preserve

Cultivated lawn was not present in 1937 and has since taken up a small amount of the preserve. All of that present in 2010 came from the conversion of Northeastern Old Field.

Table 4.1. Cultivated Lawn has migrated into X or remained since 1937	
X	Acreage
Northeastern Old Field	0.1 acres

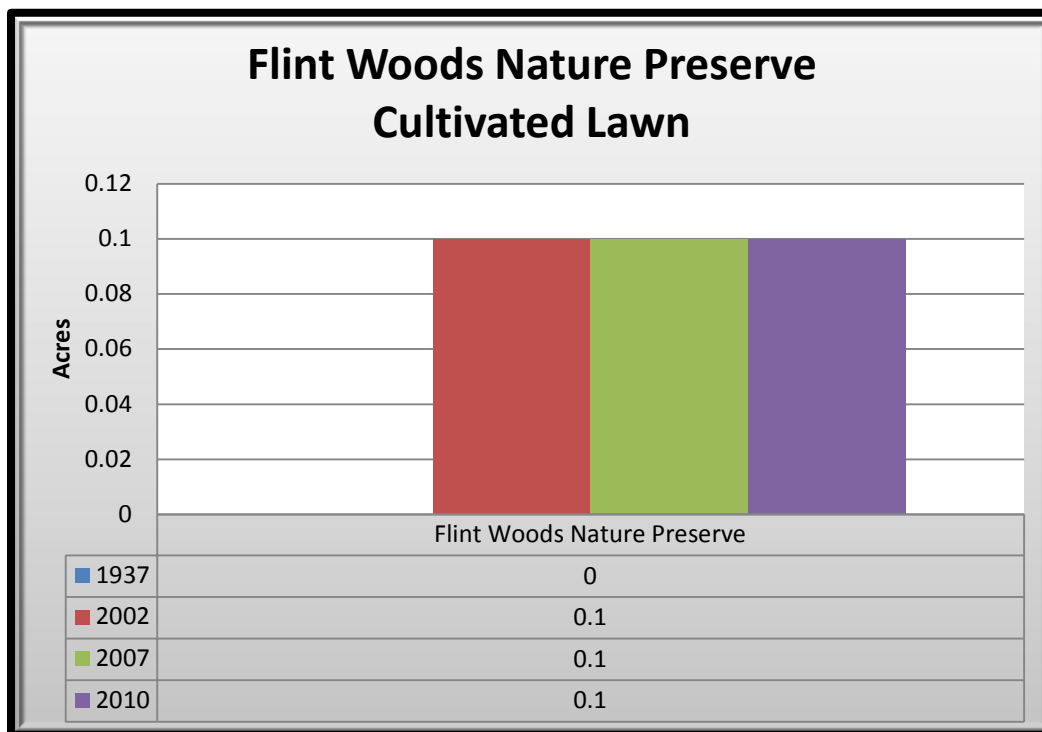


Figure 4.1. Cultivated Lawn at Flint Woods Nature Preserve (1937, 2002, 2007, and 2010)

Natural Capital

Cultivated lawn does not have any natural capital value.

DEWAP: Piedmont Upland Forests
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

This forested community is the most common in the preserve. It is essentially a Successional Tuliptree Forest that has been invaded by exotic invasive plant species. Tuliptree (*Liriodendron tulipifera*) dominates the canopy and is associated by American beech (*Fagus grandifolia*), white oak (*Quercus alba*), black walnut (*Juglans nigra*), and lower places sycamore (*Platanus occidentalis*). Understory species include spicebush (*Lindera benzoin*), sassafras (*Sassafras albidum*), red maple (*Acer rubrum*), bitternut hickory (*Carya cordiformis*), mockernut hickory (*Carya alba*), and a few flowering dogwood (*Cornus florida*) and black gum (*Nyssa sylvatica*). The shrub and vine layer is filled with exotic invasive plants and aggressive natives such as privet (*Ligustrum sinensis*), blackberry (*Rubus* sp.), Oriental bittersweet (*Celastrus orbiculatus*), multiflora rose (*Rosa multiflora*), Siebold's viburnum (*Viburnum seiboldii*), winged euonymus (*Euonymus alatus*), and summer grape (*Vitis aestivalis*). Herbs are plentiful, but some of the common ones include jumpseed (*Polygonum virginianum*), jack-in-the-pulpit (*Arisaema triphyllum*), Virginia creeper (*Parthenocissus quinquefolia*), downy agrimony (*Agrimonia pubescens*), fireweed (*Erechtites hieracifolia*), enchanter's nightshade (*Circaea lutetiana*), and Japanese stiltgrass (*Microstegium vimineum*).

Analysis of Condition at Flint Woods Nature Preserve

All of the Northeastern Modified Successional Forest that was present in 1937 was still present in 2010, with a very small amount (within the rounding error) going to impervious surface (Table 4.2). Since 1937, Northeastern Modified Successional Forest has grown up from 77 acres of Northeastern Old Field and 13 acres of Northeastern Successional Shrubland, and has spread into 18 acres of Northern Piedmont Mesic Oak-Beech Forest (Table 4.3).

Table 4.2. What was once Northeastern Modified Successional Forest in 1937 has become X or remained in 2010	
X	Acreage
Northeastern Modified Successional Forest	13 acres
Impervious Surface	0.1 acres

Table 4.3. Northeastern Modified Successional Forest has migrated into X or remained since 1937	
X	Acreage
Northeastern Old Field	77 acres
Northern Piedmont Mesic Oak-Beech Forest	18 acres
Northeastern Successional Shrubland	13 acres
Northeastern Modified Successional Forest	13 acres

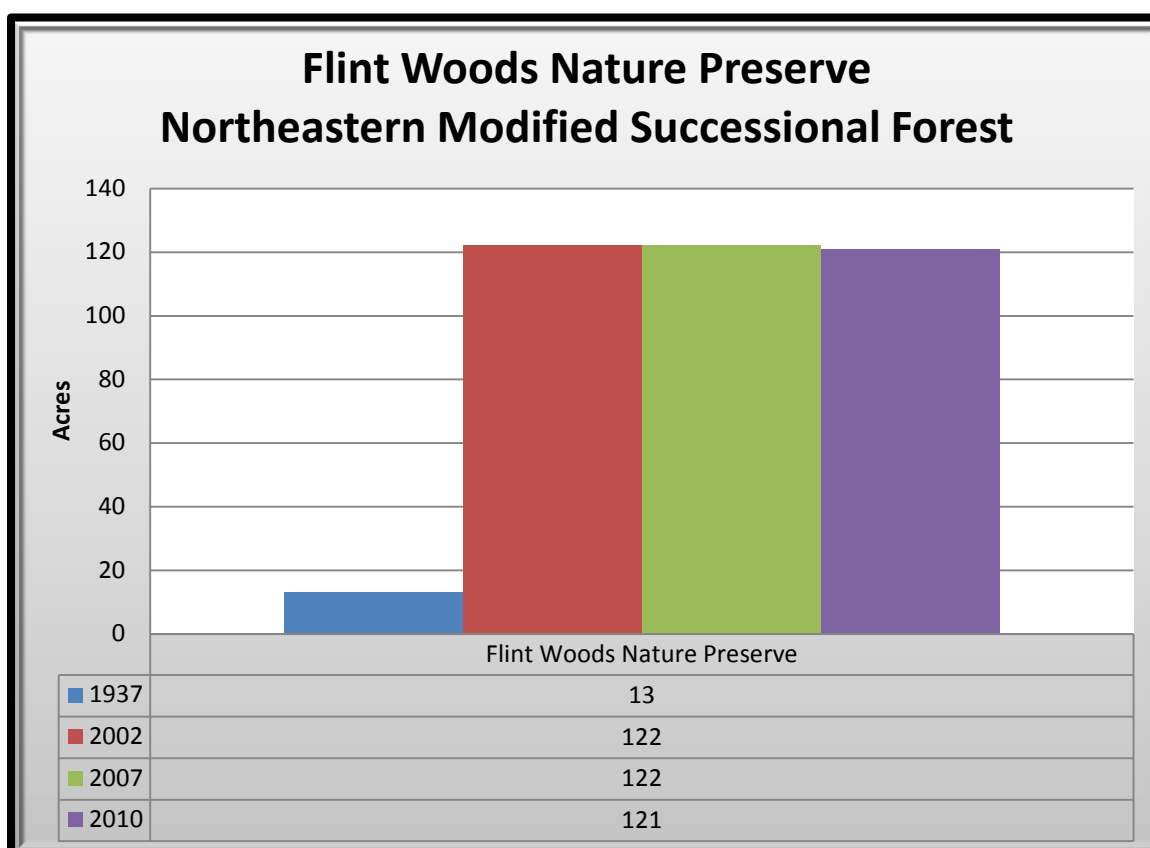


Figure 4.2. Northeastern Modified Successional Forest (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.4)

Natural capital of Northeastern Modified Successional Forest has gained as it has grown and spread in the preserve. A slight decline was noticed from 2007 to 2010.

Table 4.4. Natural Capital of Northeastern Modified Successional Forest	
Year	Natural Capital (in 2012 dollars)
1937	\$2,458/year
2002	\$23,070/year
2007	\$23,070/year
2010	\$22,881/year

Northeastern Old Field [4 acres (Figure 4.3, Tables 4.5-4.7)] GNA SNA

**DEWAP: Early Successional Upland Habitats
NHC: Semi-natural/Altered Vegetation and Conifer Plantations**

Description

This community is located adjacent to a road in a low area. Common species in the field include purple-top (*Tridens flavus*), broom-sedge (*Andropogon virginicus*), red-top panicgrass (*Panicum rigidulum*), rough-leaf goldenrod (*Solidago rugosa*), Canada goldenrod (*Solidago canadensis*), ground ivy (*Glechoma hederacea*), New York ironweed (*Vernonia novaboracensis*). A scattered coverage of multiflora rose (*Rosa multiflora*) and autumn olive (*Elaeagnus umbellata*) is present.

Analysis of Condition at Flint Woods Nature Preserve

Most of the Northeastern Old Fields present in 1937 have become Northeastern Modified Successional Forest (77 acres). Only 4 acres of the field present in 1937 was still present in 2010. Other fields have grown into 0.4 acres of Northern Piedmont Mesic Oak-Beech Forest and 0.1 acres of cultivated lawn (Table 4.5). Since 1937, Northeastern Old Field has not migrated into any other areas in the preserve (Table 4.6).

Table 4.5. What was once Northeastern Old Field in 1937 has become X or remained in 2010	
X	Acreage
Northeastern Modified Successional Forest	77 acres
Northeastern Old Field	4 acres
Northern Piedmont Mesic Oak-Beech Forest	0.4 acres
Cultivated Lawn	0.1 acres

Table 4.6. Northeastern Old Field has migrated into X or remained since 1937	
X	Acreage
Northeastern Old Field	4 acres

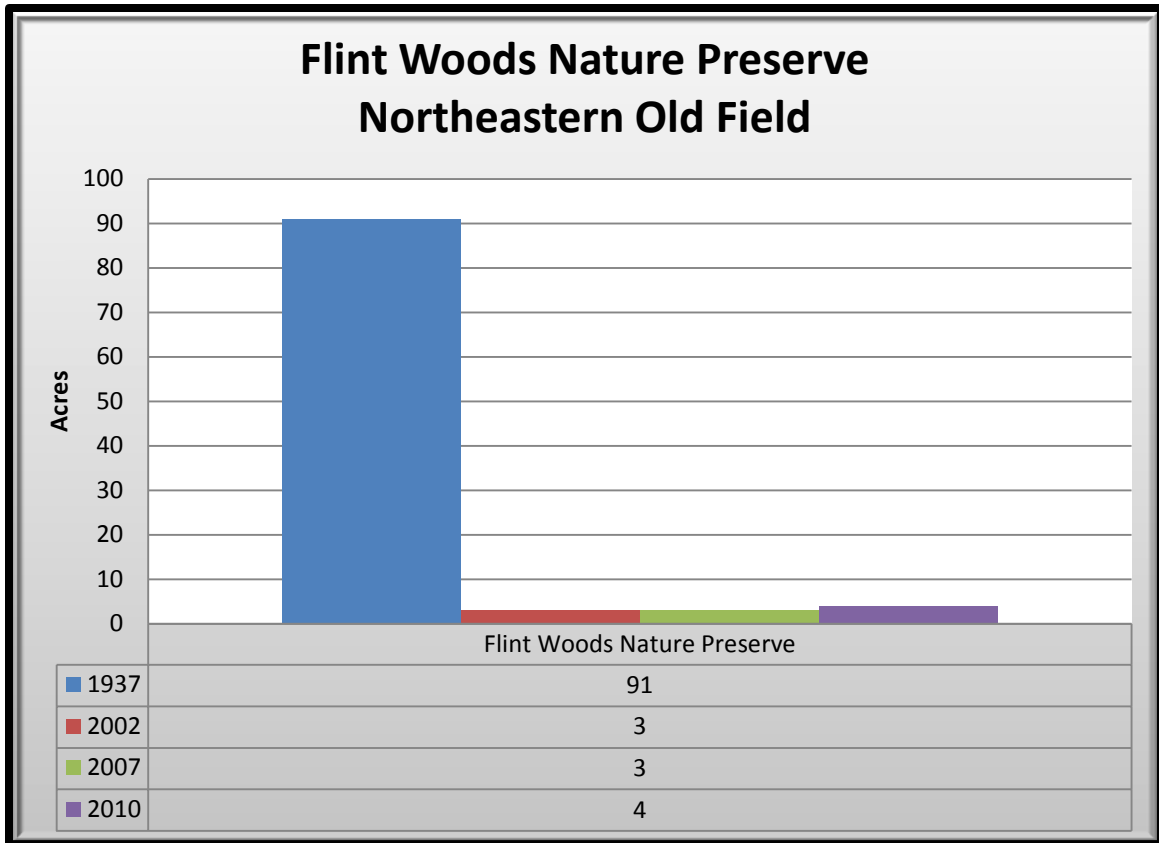


Figure 4.3. Northeastern Old Field at Flint Woods Nature Preserve (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.7)

Capital of Northeastern Old Field has decreased markedly by succeeding to forest since 1937. Recently however there was a slight uptick in capital with an increase in acreage.

Table 4.7. Natural Capital of Northeastern Old Field	
Year	Natural Capital (in 2012 dollars)
1937	\$13,259/year
2002	\$437/year
2007	\$437/year
2010	\$583/year

**DEWAP: Shrub/Brush Early Successional Upland Habitats
NHC: Semi-natural/Altered Vegetation and Conifer Plantations**

Description

This community no longer exists in the preserve so an accurate species cannot be obtained. Often this community is composed of aggressive native and exotic shrub species such as blackberry (*Rubus* sp.), multiflora rose (*Rosa multiflora*), autumn olive (*Elaeagnus umbellata*), Japanese honeysuckle (*Lonicera japonica*), and privet (*Ligustrum sinense*).

Analysis of Condition at Flint Woods Nature Preserve

This community was present in the preserve in 1937 but has since succeeded to Northeastern Modified Successional Forest (Table 4.8).

Table 4.8. What was once Northeastern Successional Shrubland in 1937 has become X or remained in 2010	
X	Acreage
Northeastern Modified Successional Forest	13 acres

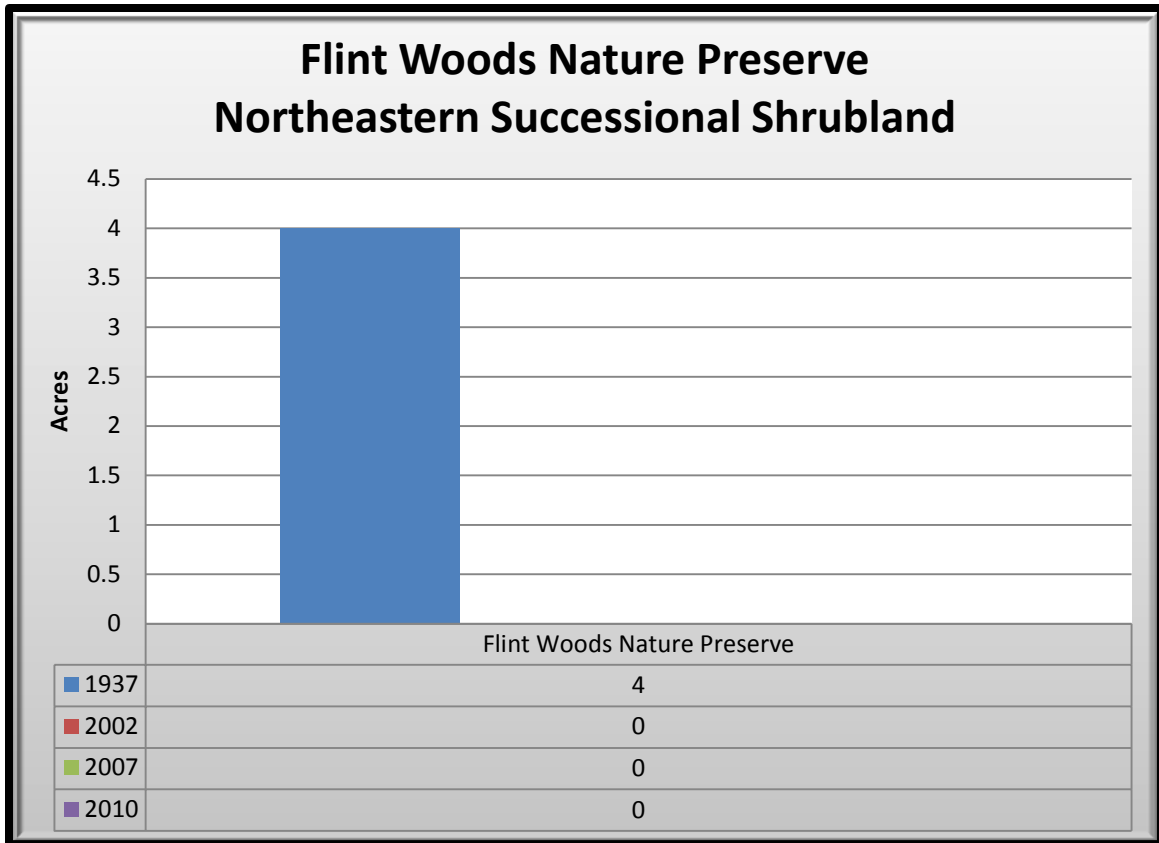


Figure 4.4. Northeastern Old Field at Flint Woods Nature Preserve (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.9)

All of the Northeastern Successional Shrubland present in 1937 has succeeded to Northeastern Modified Successional Forest.

Table 4.9. Natural Capital of Northeastern Successional Shrubland	
Year	Natural Capital (in 2012 dollars)
1937	\$583/year
2002	\$0/year (not present)
2007	\$0/year (not present)
2010	\$0/year (not present)

DEWAP: Piedmont Upland Forests
NHC: Northeastern Interior Dry-Mesic Oak Forest

Description

This community is located at the north end of the property near the stateline with Pennsylvania. American beech (*Fagus grandifolia*) is prominent in the canopy and associated by northern red oak (*Quercus rubra*), red maple (*Acer rubrum*), and white oak (*Quercus alba*). Understory species include witch-hazel (*Hamamelis virginiana*), black gum (*Nyssa sylvatica*), spicebush (*Lindera benzoin*), American hornbeam (*Carpinus caroliniana*), and black walnut (*Juglans nigra*). The shrubs and vines in this community are not thick or dense like that found in the Northeastern Modified Successional Forest. Typical species in this layer include elderberry (*Sambucus canadensis*) in wetter places, maple-leaf viburnum (*Viburnum acerifolium*), pinxter flower (*Rhodendron periclymenoides*), lowbush blueberry (*Vaccinium pallidum*), and white-leaf greenbrier (*Smilax glauca*). Privet (*Ligustrum sinensis*) and Japanese barberry (*Berberis thunbergii*) were among the few invasives encountered.

(Golden Saxifrage Seep)—this community is located within the Northern Piedmont Mesic Oak-Beech Forest in a seepage near the Delaware and Pennsylvania state line. The seepage covers about 1 acre and is dominated by golden saxifrage (*Chrysosplenium americanum*), and associated by Canadian clearweed (*Pilea pumila*), wetland violet (*Viola cucullata*), jack-in-the pulpit (*Arisaema triphyllum*), skunk cabbage (*Symplocarpus foetidus*), orange spotted jewelweed (*Impatiens capensis*), drooping sedge (*Carex prasina*), hooked buttercup (*Ranunculus recurvatus*), and Japanese stiltgrass (*Microstegium vimineum*).

Analysis of Condition at Flint Woods Nature Preserve

Eleven acres of the original 29 acres from 1937 was still present in 2010. The rest of the acreage has become Northeastern Modified Successional Forest (18 acres) with the spread of exotic invasive plant species (Table 4.9). Since 1937, this forest has grown from 0.4 acres of Northeastern Old Field (Table 4.10).

Table 4.9. What was once Northern Piedmont Mesic Oak-Beech Forest in 1937 has become X or remained in 2010	
X	Acreage
Northeastern Modified Successional Forest	18 acres
Northern Piedmont Mesic Oak-Beech Forest	11 acres

Table 4.10. Northern Piedmont Mesic Oak-Beech Forest has migrated into X or remained since 1937	
X	Acreage
Northern Piedmont Mesic Oak-Beech Forest	11 acres
Northeastern Old Field	0.4 acres

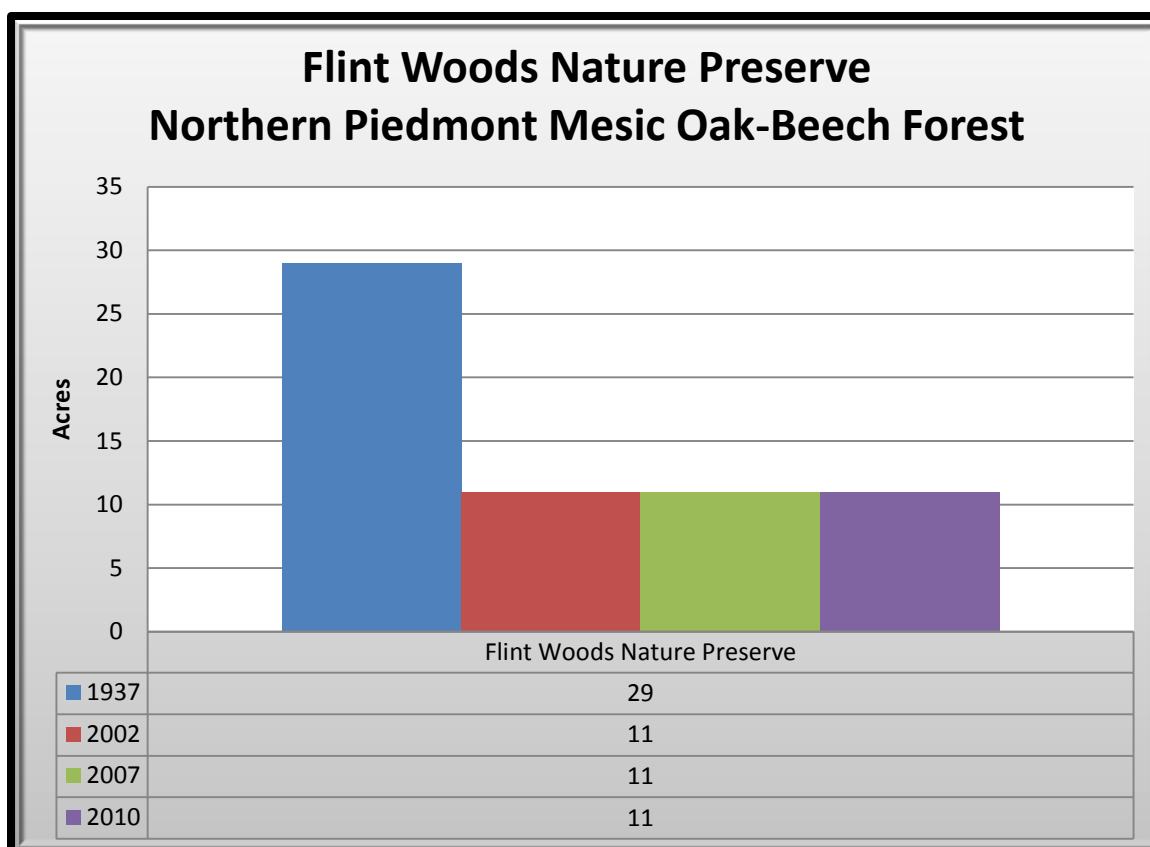


Figure 4.5. Northern Piedmont Mesic Oak-Beech Forest at Flint Woods Nature Preserve (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.11)

The capital of Northern Piedmont Mesic Oak-Beech Forest has decreased and stabilized since 1937. It is projected to remain the same or increase in the future with efforts to control the exotic invasive plant species.

Table 4.11. Natural Capital of Northern Piedmont Mesic Oak-Beech Forest	
Year	Natural Capital (in 2012 dollars)
1937	\$5,484/year
2002	\$2,080/year
2007	\$2,080/year
2010	\$2,080/year

CHAPTER 5: DESCRIPTIONS AND ANALYSIS OF THE LAND COVERS

Land covers are those areas such as agricultural fields or places that do not contain vegetation communities but still cover ground surface. In terms of sea-level rise, water is most important but its effects can also be seen in the impoundments.

The land covers include:

1. Impervious Surface—0.2 acres

Impervious Surface [0.2 acres, (Figure 5.1, Tables 5.1-)]

DEWAP: No Equivalent Classification

NHC: No Equivalent Classification

Description

In Flint Woods Nature this cover type consists of road which is impervious to the flow of water.

Analysis of Condition at Flint Woods Nature Preserve

About half of the impervious surface from 1937 remained in 2007. The rest had become 0.04 acres of Northeastern Modified Successional Forest (Table 5.1). Since 1937, impervious surface has been developed in 0.1 acres of Northeastern Modified Successional Forest and 0.04 acres of Northeastern Old Field (Table 5.2).

Table 5.1. What was once Impervious Surface in 1937 has become X or remained in 2010	
X	Acreage
Northeastern Modified Successional Forest	0.04 acres
Impervious Surface	0.03 acres

Table 5.2. Impervious Surface has migrated into X or remained since 1937	
X	Acreage
Northeastern Modified Successional Forest	0.1 acres
Northeastern Old Field	0.04 acres
Impervious Surface	0.03 acres

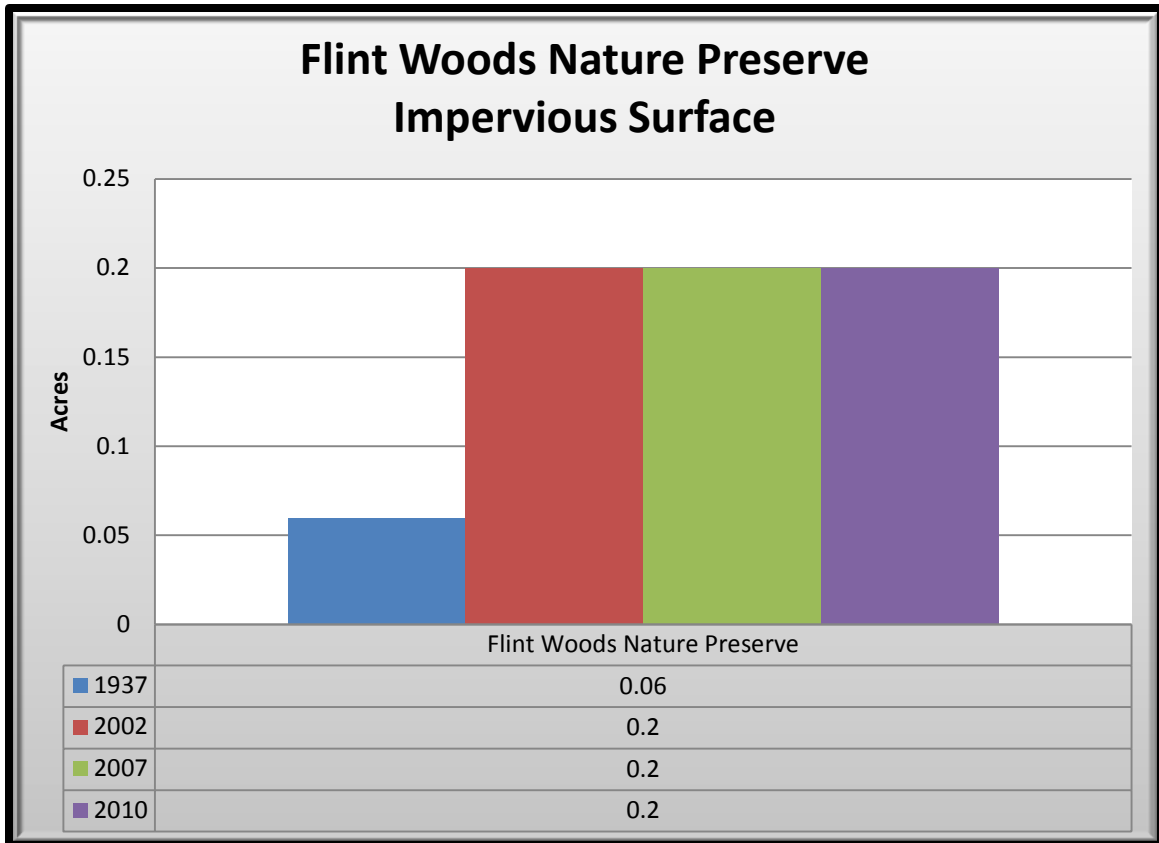


Figure 5.1. Impervious Surface at Flint Woods Nature Preserve (1937, 2002, 2007, and 2010)

APPENDIX I: STATE RARE VEGETATION RANKING CRITERIA

Ranks are based on a system developed by The Nature Conservancy and Natureserve to measure the relative rarity of vegetation communities within a given state. State rarity ranks are used to prioritize conservation and protection efforts so that the rarest of vegetation communities receive immediate attention. The primary criteria for ranking vegetation communities are the total number of documented occurrences with consideration given to the total number of occurrences and total amount of acreage in the state. Ranks for vegetation communities are updated annually and are based on current knowledge and mapping being done for the Guide to Delaware Vegetation Communities.

State Rank

- S1** Extremely rare (i.e., typically 5 or fewer occurrences statewide), or may be susceptible to extirpation because of other threats to its existence.
- S1.1** Only a single occurrence or population of the species is known to occur. (this rank is only applied to plants.)
- S2** Very rare, (i.e., typically 6 to 20 occurrences statewide), or may be susceptible to extirpation because other threats to its existence.
- S3** Rare to uncommon, not yet susceptible to extirpation but may be if additional populations are destroyed. Approximately 21 to 100 occurrences statewide.
- S4** Common, apparently secure in the state under present conditions.
- S5** Very common, secure in the state under present conditions.
- SH** Historically known, but not verified for an extended period (usually 15+ years); there are expectations that the species may be rediscovered.
- SX** Extirpated or presumed extirpated from the state. All historical locations and/or potential habitat have been surveyed.
- SU** Status uncertain within the state. Usually an uncommon species which is believed to be of conservation concern, but there is inadequate data to determine the degree of rarity.
- SNR** Unranked
- SNA** Not Applicable
- SW** Weedy vegetation or vegetation dominated by invasive alien species (this rank is only applied to natural communities).
- SM** Vegetation resulting from management or modification of natural vegetation. It is readily restorable by management or time and/or the restoration of original ecological processes (this rank is only applied to natural communities).

APPENDIX II: SGCN IN KEY WILDLIFE HABITATS

SGCN Species expected in Early Successional Upland Habitats			
Species	Common Name	Class	Tier
<i>Nicrophorus americanus</i>	American burying beetle	Insect	1
<i>Callophrys irus</i>	frosted elfin	Insect	1
<i>Papaipema maritima</i>	maritime sunflower borer moth	Insect	1
<i>Terrapene carolina</i>	Eastern box turtle	Reptile	1
<i>Lampropeltis triangulum</i>	milk snake	Reptile	1
<i>Branta canadensis</i>	Canada goose (migratory)	Bird	1
<i>Circus cyaneus</i>	Northern harrier	Bird	1
<i>Bartramia longicauda</i>	upland sandpiper	Bird	1
<i>Scolopax minor</i>	American woodcock	Bird	1
<i>Asio flammeus</i>	short-eared Owl	Bird	1
<i>Chordeiles minor</i>	common nighthawk	Bird	1
<i>Lanius ludovicianus</i>	loggerhead shrike	Bird	1
<i>Dendroica discolor</i>	prairie warbler	Bird	1
<i>Ammodramus henslowii</i>	Henslow's sparrow	Bird	1
<i>Cincindela scutellaris</i>	festive tiger beetle	Insect	2
<i>Atrytonopsis hianna</i>	dusted skipper	Insect	2
<i>Satyrrium liparops</i>	striped hairstreak	Insect	2
<i>Satyrrium liparops strigosum</i>	stiped hairstreak	Insect	2
<i>Callophrys gryneus</i>	juniper hairstreak	Insect	2
<i>Speyeria aphrodite</i>	aphrodite fritillary	Insect	2
<i>Speyeria idalia</i>	regal fritillary	Insect	2
<i>Boloria bellona</i>	meadow fritillary	Insect	2
<i>Paratrea plebeja</i>	trumpet vine sphinx	Insect	2
<i>Calyptra canadensis</i>	Canadian owlet	Insect	2
<i>Acronicta rubricoma</i>	a dagger moth	Insect	2
<i>Papaipema rigida</i>	rigid sunflower borer moth	Insect	2
<i>Cirrhophanus triangulifer</i>	a noctuid moth	Insect	2
<i>Schima septentrionalis</i>	a noctuid moth	Insect	2
<i>Plegadis falcinellus</i>	glossy ibis	Bird	2
<i>Cygnus columbianus</i>	tundra swan	Bird	2
<i>Coragyps atratus</i>	black vulture	Bird	2
<i>Colinus virginianus</i>	Northern bobwhite	Bird	2
<i>Pluvialis squatarola</i>	black-bellied plover	Bird	2
<i>Coccyzus erythrophthalmus</i>	black-billed cuckoo	Bird	2
<i>Chaetura pelagica</i>	chimney swift	Bird	2
<i>Colaptes auratus</i>	Northern flicker	Bird	2
<i>Empidonax minimus</i>	least flycatcher	Bird	2
<i>Tyrannus tyrannus</i>	Eastern kingbird	Bird	2
<i>Toxostoma rufum</i>	Brown thrasher	Bird	2

<i>Dendroica pensylvanica</i>	Chestnut-sided warbler	Bird	2
<i>Icteria virens</i>	Yellow-breasted chat	Bird	2
<i>Pipilo erythrophthalmus</i>	Eastern towhee	Bird	2
<i>Spizella pusilla</i>	field sparrow	Bird	2
<i>Pooecetes gramineus</i>	vesper sparrow	Bird	2
<i>Passerculus sandwichensis</i>	savannah sparrow	Bird	2
<i>Ammodramus savannarum</i>	grasshopper sparrow	Bird	2
<i>Dolichonyx oryzivorus</i>	bobolink	Bird	2
<i>Cryptotis parva</i>	least shrew	Bird	2