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

Red Clay Creek Watershed

Submitted to:

Delaware State Parks
Delaware Division of State Parks
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CHAPTER 1: INTRODUCTION AND METHODS

Setting of Auburn Heights Nature Preserve

Auburn Heights Nature Preserve is located in northern New Castle County, Delaware (Figure 1.1) and totals 189 acres in one tract. The preserve is wholly within the Red Clay Creek watershed.

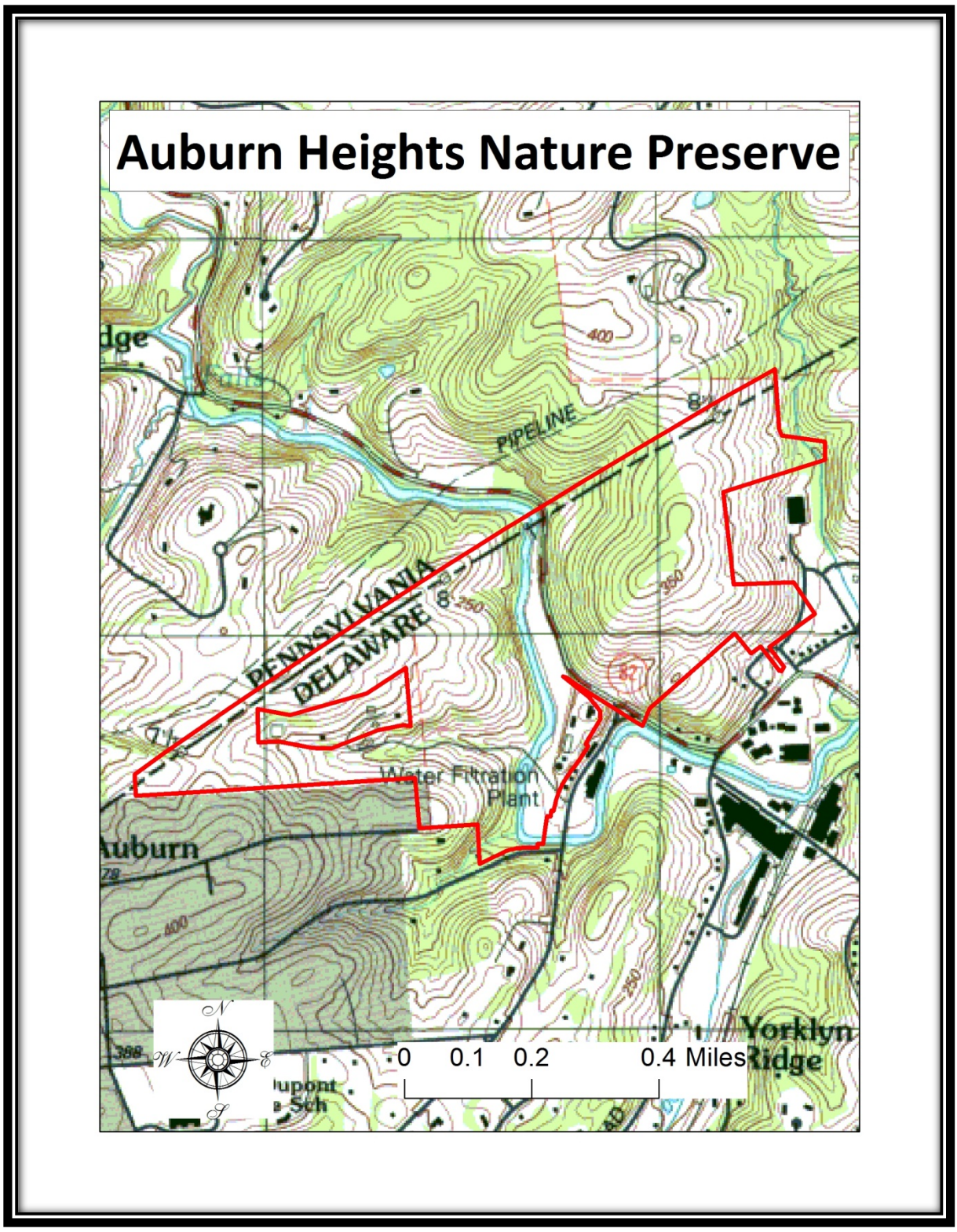

Figure 1.1. Location of Auburn Heights Nature Preserve

History and Formation of Auburn Heights Nature Preserve

Early History of the Land[1]

Auburn Heights is the location of a mansion that was built above the Marshall Brothers Paper Mill in Yorklyn, Delaware in 1897 by Israel and Elizabeth Marshall. The mill stayed with the family until the mid-1950's. One of the sons became a dealer for the Stanley Motor Carriage Company and had an interest in steam cars. Today people come to Auburn Heights to see the steam cars and the land around the house.

Formation of Auburn Heights Nature Preserve

The Auburn Heights Preserve was donated to the state in November 2008 by Tom and Ruth Marshall.

Soils and Geology of Auburn Heights Nature Preserve

Underlying Geology[2]

Auburn Heights Nature Preserve is located in the Piedmont physiographic province of Delaware. Most of the preserve is underlaid by Baltimore Gneiss with a small sliver of Cockeysville Marble going through the south side. The floodplain of Red Clay Creek is underlaid by alluvial deposits.

Baltimore Gneiss is one of the oldest rocks in Delaware and dates to the Precambrian. It is described as "granitic gneiss with swirling leucosomes and irregular biotite-rich restite layers." Cockeysville Marble is located in this one area is described as "a pure crystalline, blue-white dolomite marble interlayered with calc-schist." Alluvial deposits along Red Clay Creek are the youngest rocks and consist of "brown, light yellow-orange, and fine to coarse quartz sand, silt, clay, and fine to medium gravel."

Soils

Two soils are prominent in the nature preserve and include Glenelg Silt Loam (74 acres) and Gaila Loam (49 acres) (Figure 1.2). Other minor soils include Hatboro-Codorus Complex (25 acres), Brinklow Channery Loam (13 acres), and Manor Loam (13 acres). Auburn Heights Nature Preserve ranges in elevation from 172 feet where Red Clay Creek flows out of the preserve to about 360 feet on the hill at the north end of the preserve.

[1] http://destateparks.com/attractions/auburn-heights/index.asp

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

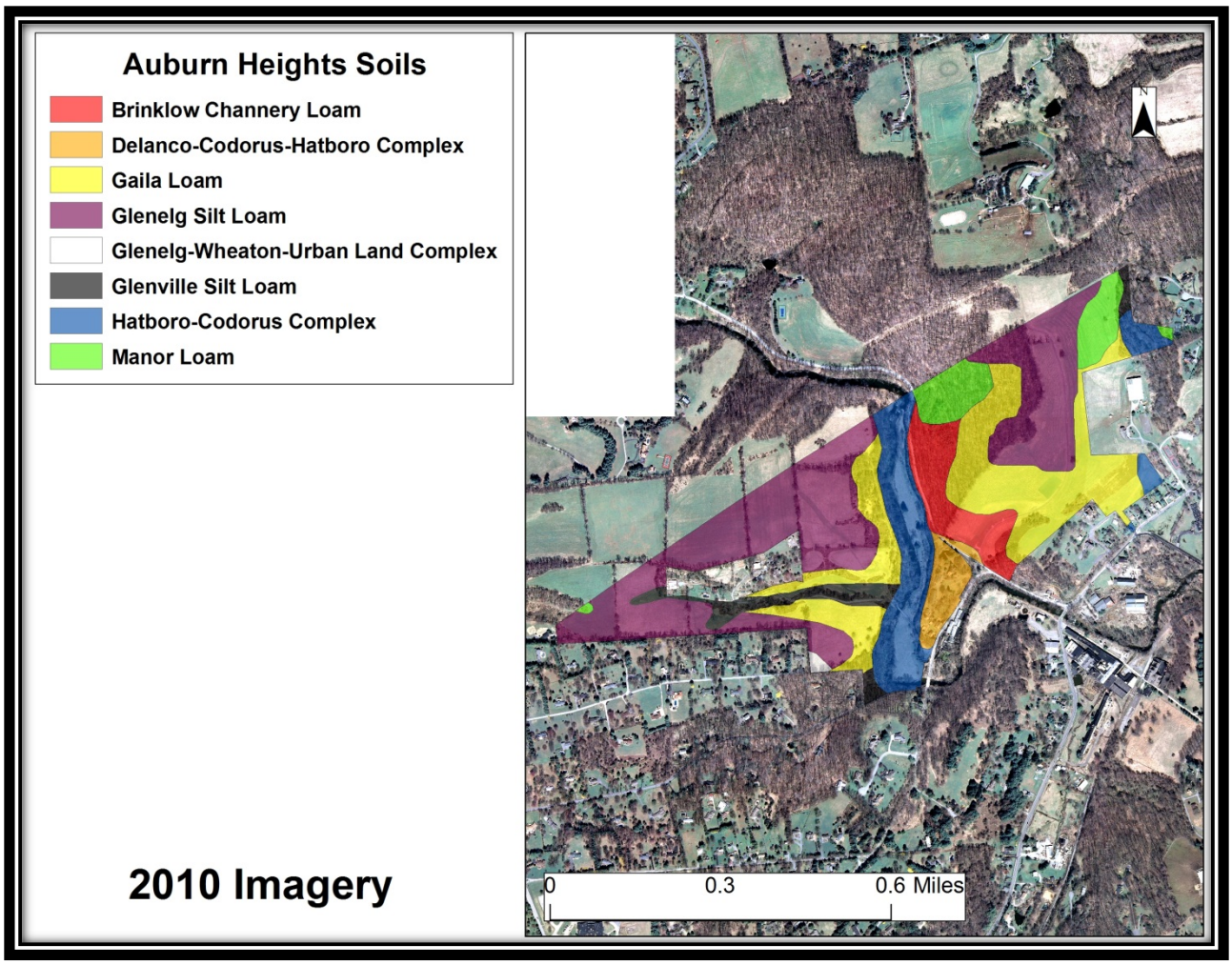

Figure 1.2. Auburn Heights Nature Preserve Soil Map

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 Auburn Heights 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* [3]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 the land covers in Chapter 5. Crosswalks to the Delaware Wildlife Action Plan (DEWAP) and the Northeast Habitat Map (NHC) are provided at the top of each description.

Analysis of Historical Imagery

Historical imagery of Auburn Heights 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.

Ecological Integrity Assessment (EIA)

An EIA was conducted for those communities in the property that are ranked S2 or higher in Delaware. EIAs are an analysis being developed by Natureserve to determine the relative quality of vegetation communities across North America. Using Natural Heritage methodology, communities are ranked according to rarity (Appendix I). The vegetation communities at the Auburn Heights Property that are included in the EIA analysis are listed in Table 2.3.

[3] Coxe, Robert. 2010. Guide to Delaware Vegetation Communities-Summer 2010 Edition. Unpublished report.

Natural Capital Analysis

The natural capital of each vegetation community was determined using a table in Costanza, et al.[4] The values from the table were calculated per acre of the vegetation community and then adjusted using an inflation calculator (DollarTimes.com) from 1994 values to 2012 values. Using these methods the following values were obtained:

Estuaries (water): $9,247/acre/year

Temperate Forest (Upland forests): $122/acre/year

Wetlands

-General (not as below): $5,988/acre/year

-Tidal Marsh: $4,046/acre/year

-Swamps/floodplains: $7,930/acre/year

Lakes (Impoundments): $3,442/acre/year

Cropland: $37/acre/year

Grassland/fields: $94/acre/year

Open Ocean: $102/acre/year

Values were rounded off to the nearest whole dollar.

[4] Costanza, Robert, et al. 1997. The value of the world's ecosystem services and natural capital. Nature 387:253-260.

CHAPTER 2: RESULTS OF EIAS AND GENERAL OBSERVATIONS

Summary of Findings from this study

1. **Vegetation Communities:** Nine vegetation communities and six land covers were found at Auburn Heights Nature Preserve. Northeastern Old Field (108 acres) is the largest vegetation community, followed by Northern Piedmont Mesic Oak-Beech Forest with 26 acres. Water (5 acres) is the largest land cover.

2. **Rare Plants:** Nine rare plants are known to exist in Auburn Heights Nature Preserve (Table 2.1).

Scientific Name	Common Name	Rank	Last Observed
Aplectrum hyemale	Puttyroot	S2	1992
Bromus pubescens	Hairy Wood Brome Grass	S2	2003
Hydrastis canadensis	Golden-Seal	S1	1998
Monotropa hypopithys	American Pinesap	S2	1994
Muhlenbergia sobolifera	Cliff Muhly	S2	2003
Orobanche uniflora	One-flowered Broomrape	S3	1992
Panax quinquefolius	American Ginseng	S2	1998
Poa cuspidata	Bluegrass	S2	1992
Vernonia glauca	Broadleaf Ironweed	S2	1998

Table 2.1 Rare Plants at Auburn Heights Nature Preserve

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

Scientific Name	Common Name	Rank	Last Observed
Catharus fuscescens	Veery	S2B	1996

Table 2.2 Rare Animals at Auburn Heights Nature Preserve

Ecological Integrity Assessment (EIA)

Two vegetation communities are ranked S2 or higher and include Riverine Floodplain Forest and Willow River-Bar Shrubland. These areas are summarized in Table 2.3.

Table 2.3. EIA Vegetation Communities located in the Auburn Heights Nature Preserve

Community Map	Community Name/EIA Score	Description
	**Auburn Heights 1** **Riverine Floodplain Forest (6.3 acres)** **EIA = 2.98 (C rank)**	This floodplain forest community is located the floodplain of Red Clay Creek.
	**Auburn Heights 2** **Willow River-Bar Shrubland (0.1 acres)** **EIA = 2.81 (C rank)**	This stunted/scour community is located on sandbars in Red Clay Creek.

CHAPTER 3: BROAD TRENDS AT AUBURN HEIGHTS NATURE PRESERVE

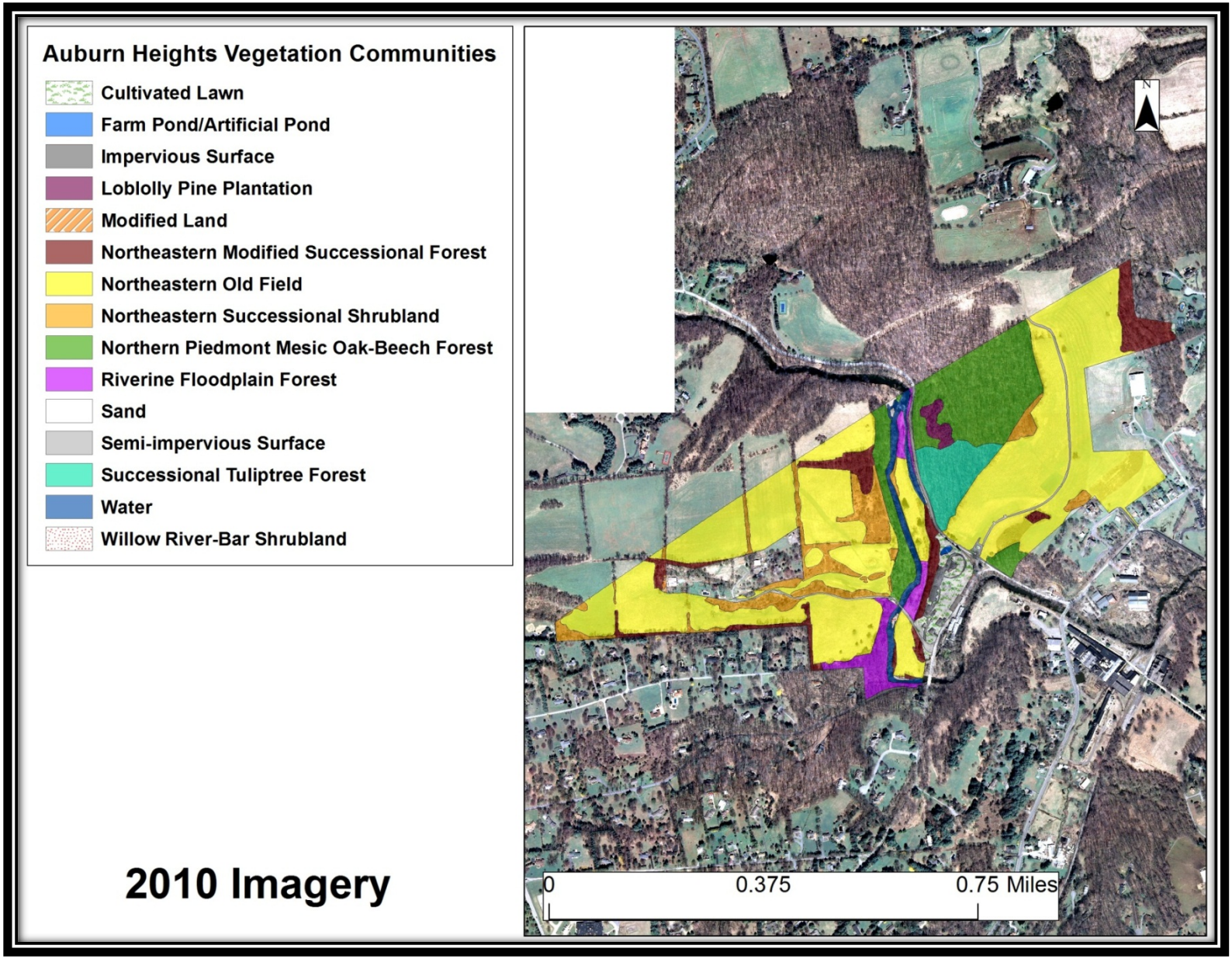

Figure 3.1. 2010 Vegetation Community Map of the Auburn Heights Nature Preserve

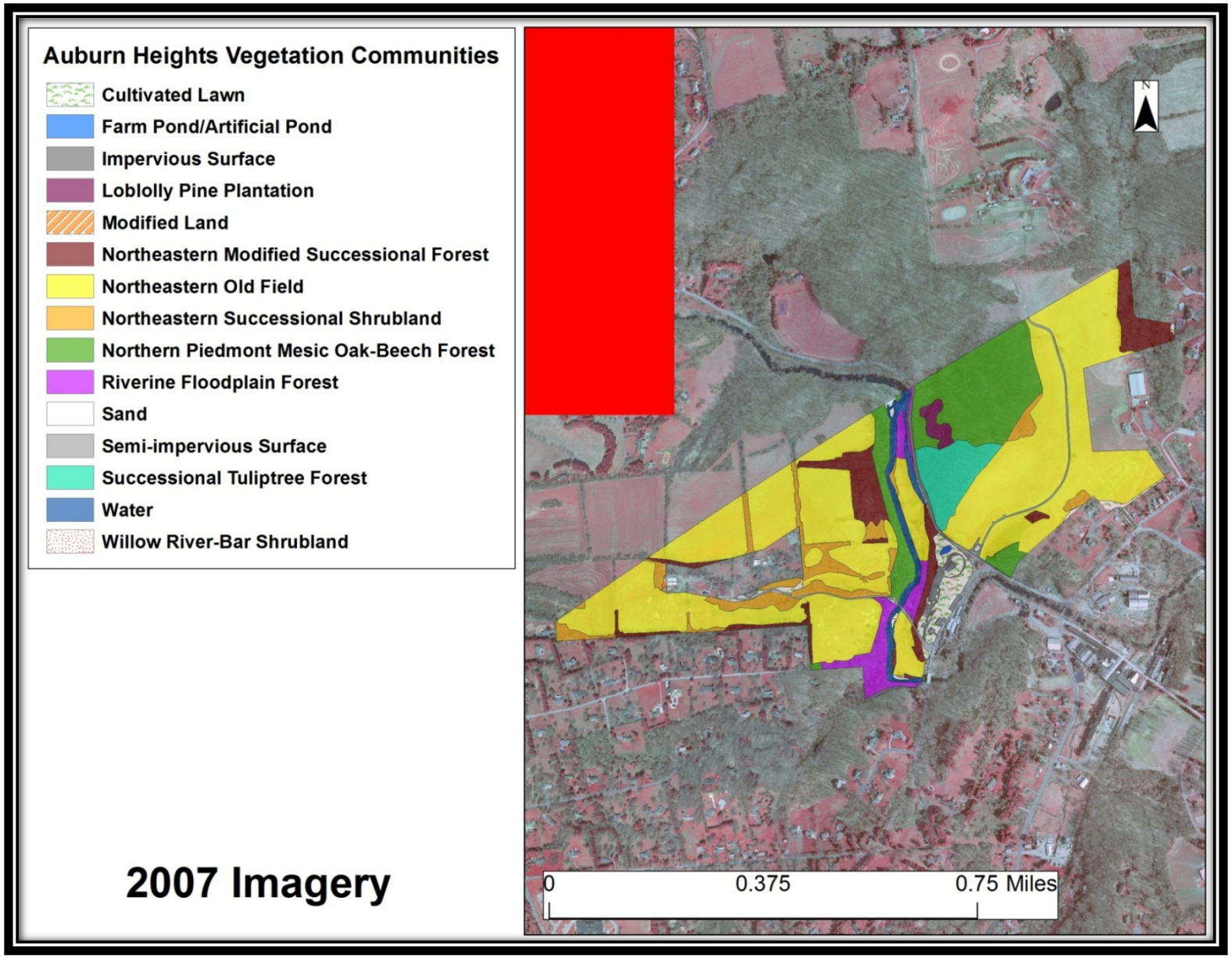

Figure 3.2. 2007 Vegetation Community Map of the Auburn Heights Nature Preserve

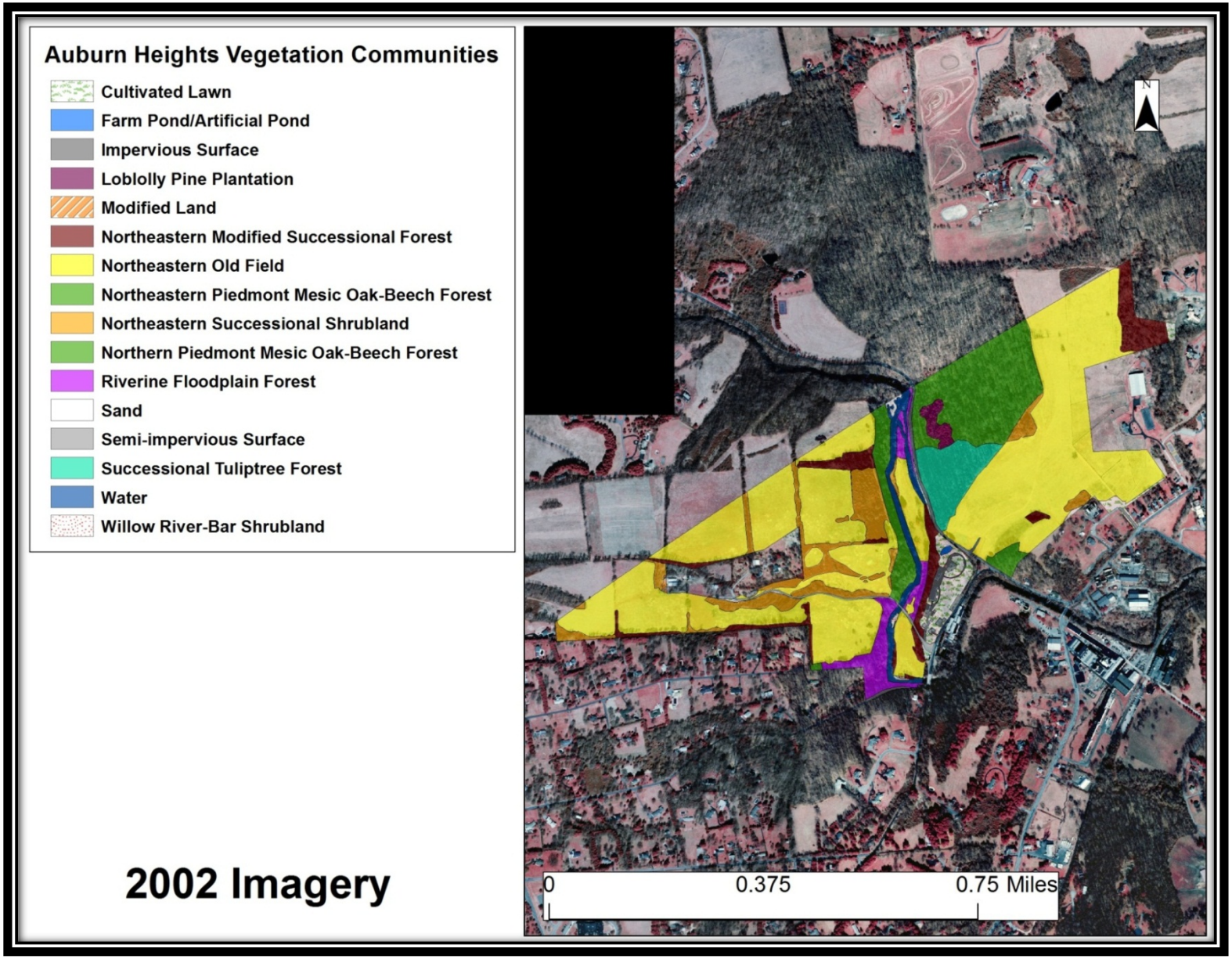

Figure 3.3. 2002 Vegetation Community Map of the Auburn Heights Nature Preserve

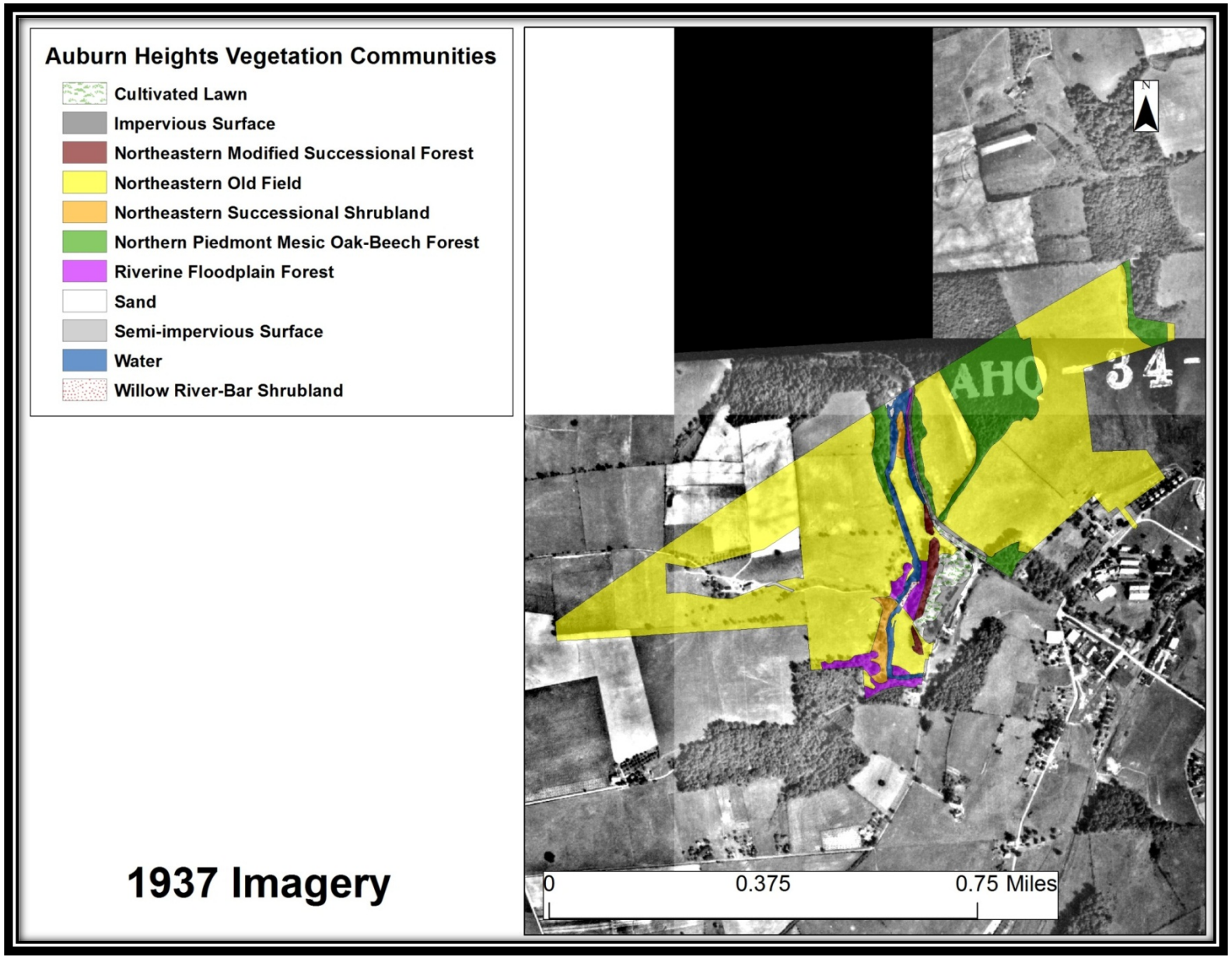

Figure 3.4. 1937 Vegetation Community Map of the Auburn Heights Nature Preserve

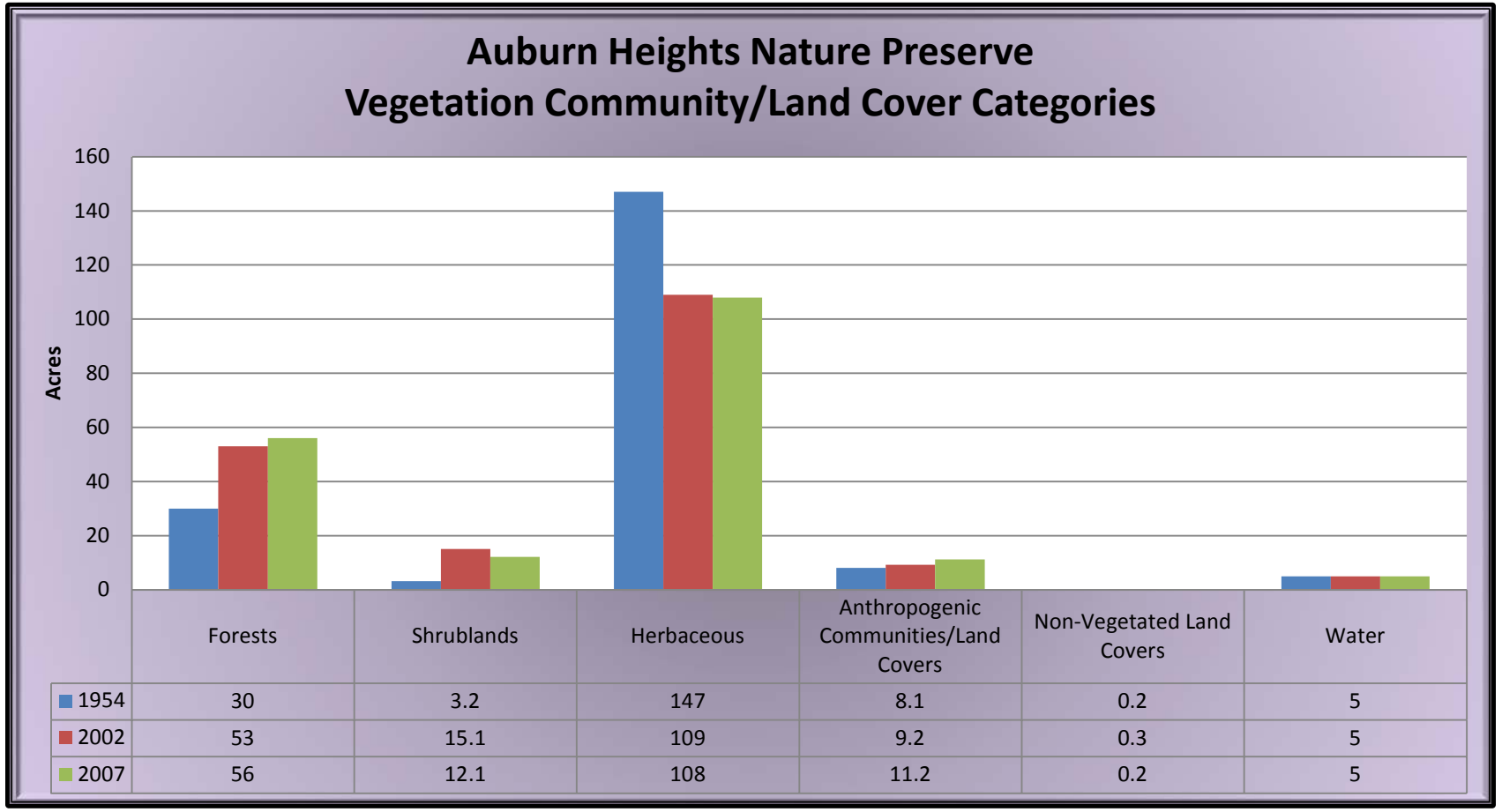

Figure 3.5. Auburn Heights Nature Preserve Vegetation Categories/Land Covers (1937, 2002, 2007, and 2010)

Auburn Heights Nature Preserve Broad Trends (Figure 3.5): Herbaceous Communities in the form of Northeastern Old Field compose the most area in Auburn Heights Nature Preserve. Forests have been increasing through time as shrublands mature into them.

Natural Capital (Table 3.1)

Natural capital of Auburn Heights Nature Preserve has been gradually increasing due in part to increases in forestland.

Table 3.1. Natural Capital of Auburn Heights Nature Preserve	
Year	**Natural Capital (in 2012 dollars)**
1937	$114,745/year
2002	$127,927/year
2007	$127,912/year
2010	$128,014/year

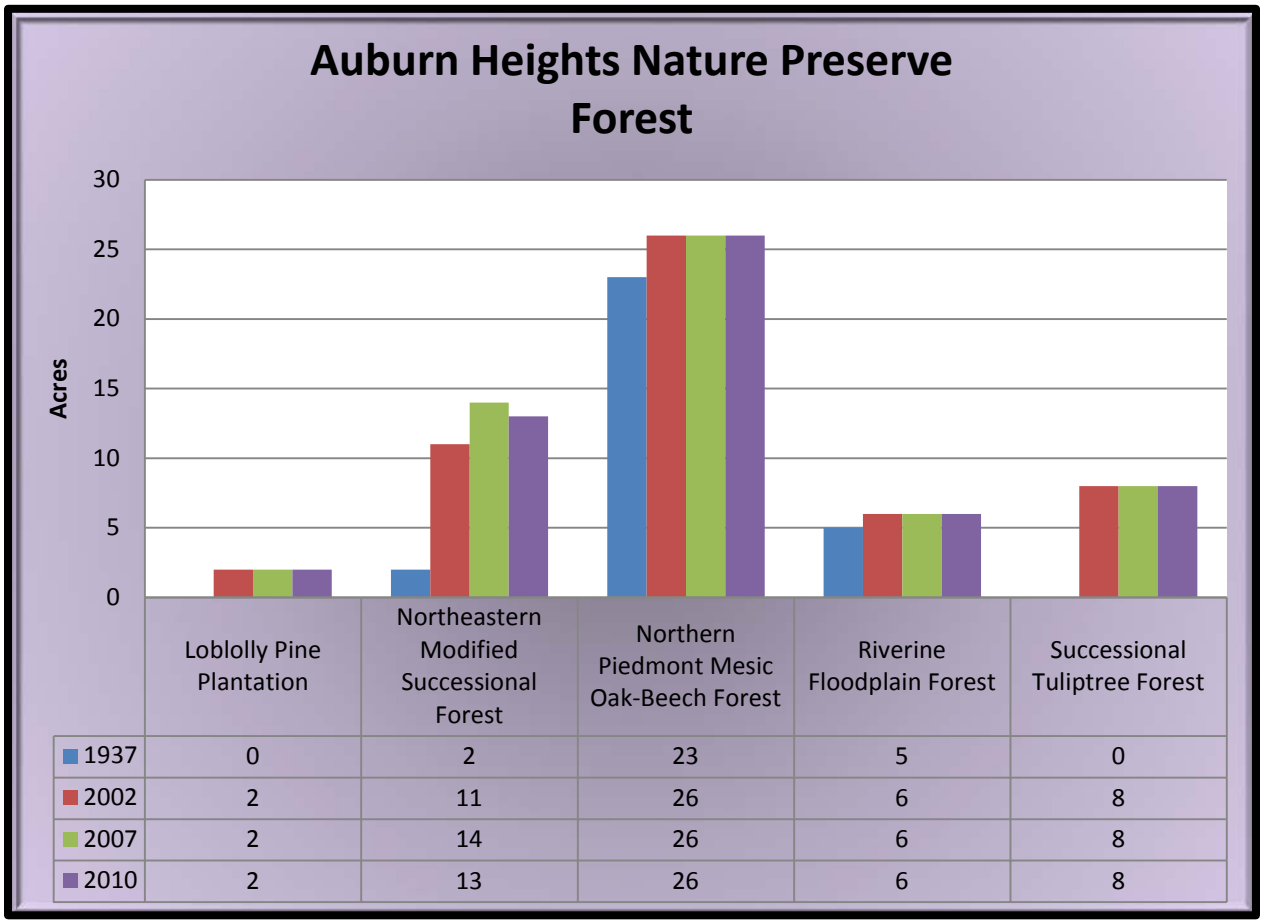

Figure 3.6. Forest at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

Auburn Heights Nature Preserve Forest (Figure 3.6): Northeastern Piedmont Mesic Oak-Beech Forest is the most common forest community in the Auburn Heights Nature Preserve and the Piedmont of Delaware. Northeastern Modified Successional Forest is the second most common.

Natural Capital (Table 3.2)

Forest capital has increased overall since 1937, but has decreased recently because of a loss in acreage of Northeastern Modified Successional Forest.

Table 3.2. Natural Capital of Auburn Heights Nature Preserve Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$66,185/year
2002	$82,637/year
2007	$83,204/year
2010	$83,015/year

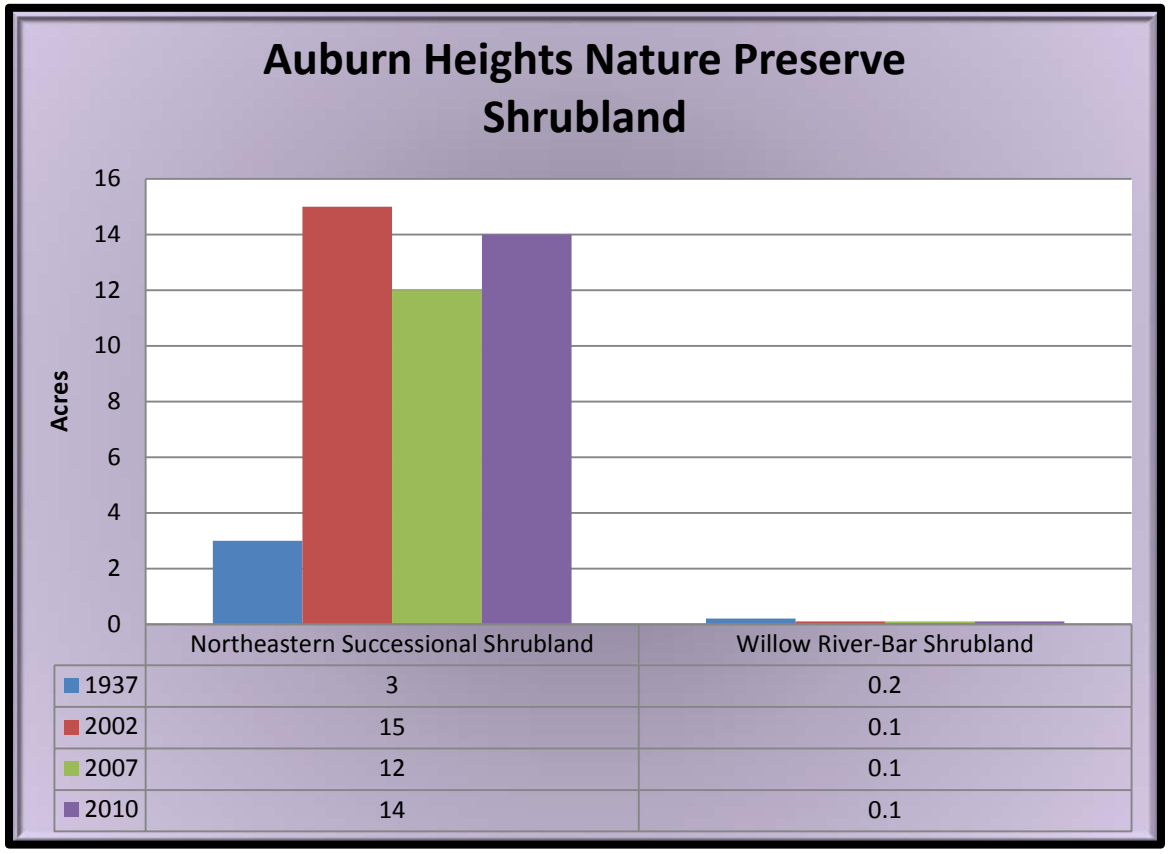

Figure 3.7. Shrubland at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

Auburn Heights Nature Preserve Shrubland (Figure 3.7): Northeastern Successional Shrubland is the most common shrubland in Auburn Heights Nature Preserve.

Natural Capital (Table 3.3)

Shrubland has increased overall since 1937, but has declined recently because of the shrubland maturing into forest. This trend will likely continue.

Table 3.3. Natural Capital of Auburn Heights Nature Preserve Shrubland	
Year	**Natural Capital (in 2012 dollars)**
1937	$466/year
2002	$2,200/year
2007	$1,763/year
2010	$2,054/year

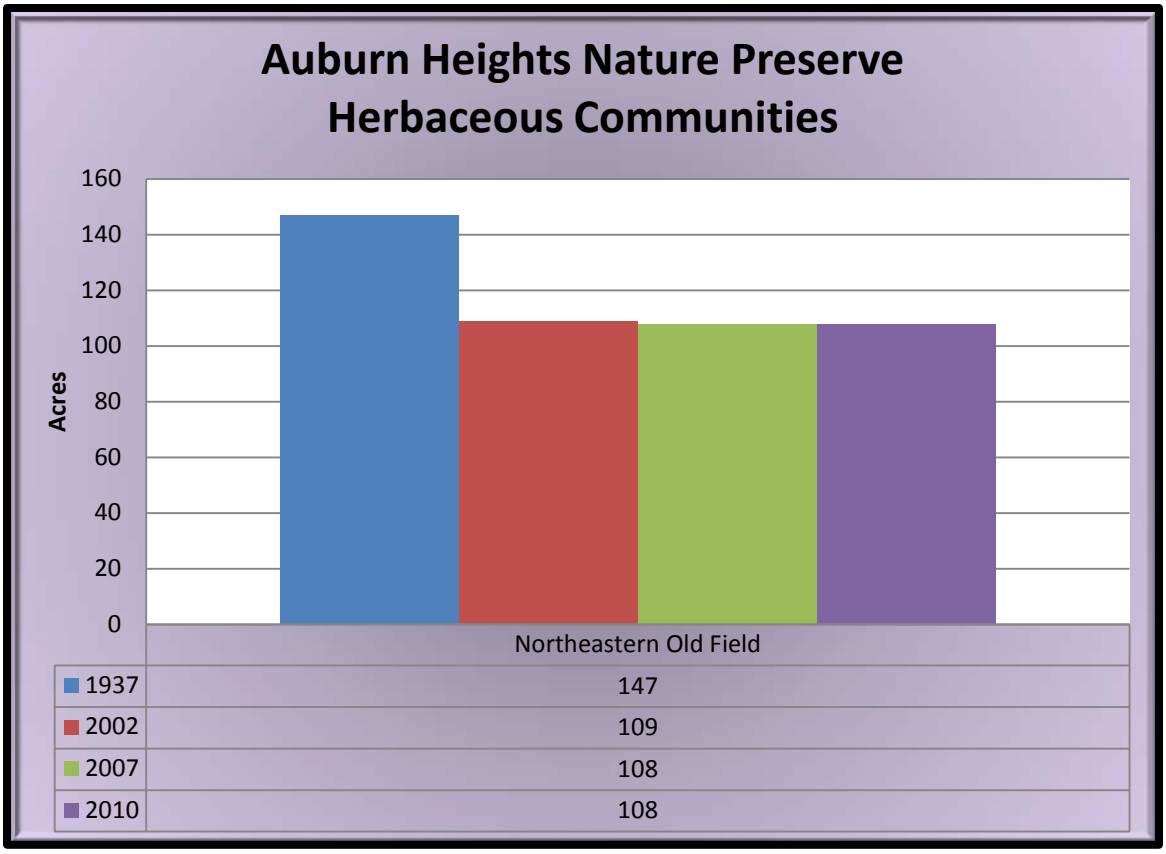

Figure 3.8. Herbaceous Communities at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

Auburn Heights Nature Preserve Herbaceous Communities (Figure 3.8): Northeastern Old Field is the only Herbaceous Community present in the Auburn Heights Nature Preserve.

Natural Capital (Table 3.4)

Capital of herbaceous communities has decreased as these communities mature into shrubland and forest.

Table 3.4. Natural Capital of Auburn Heights Nature Preserve Herbaceous Communities	
Year	**Natural Capital (in 2012 dollars)**
1937	$21,418/year
2002	$15,881/year
2007	$15,736/year
2010	$15,736/year

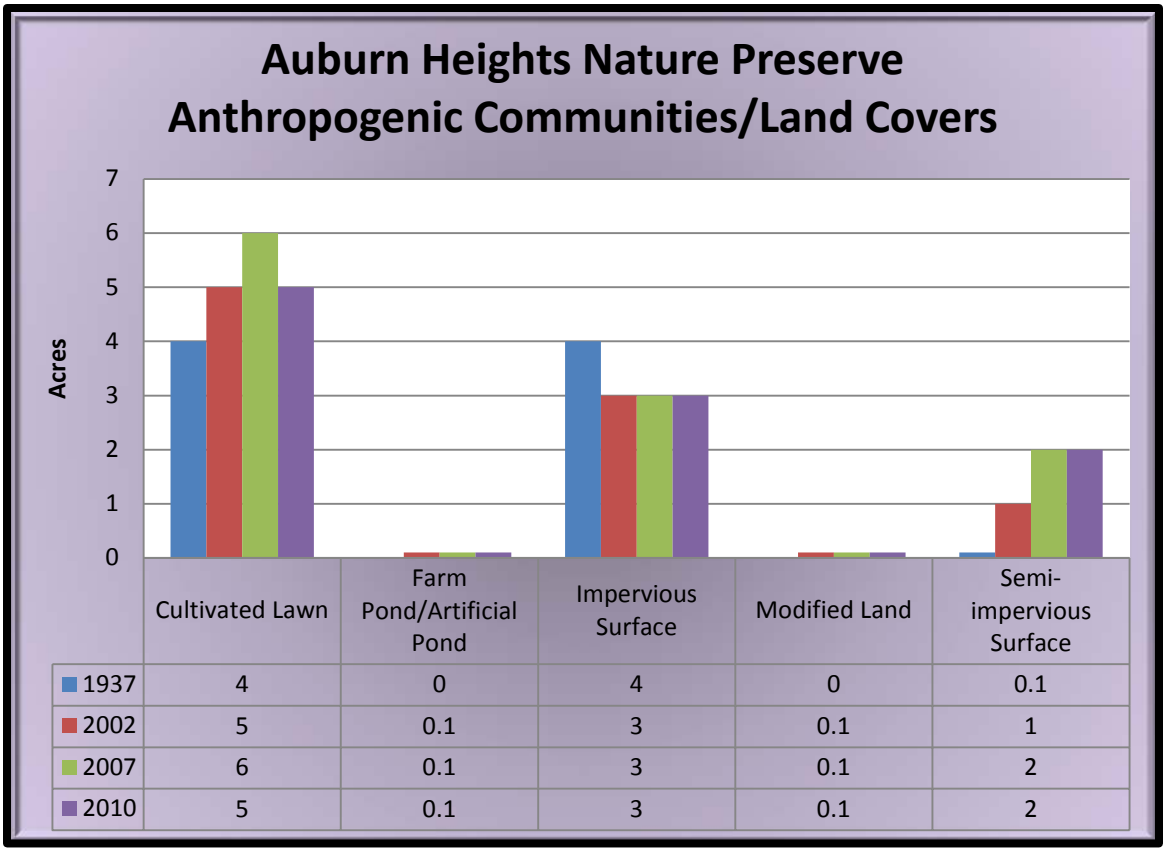

Figure 3.9. Anthropogenic Communities/Land Covers at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

Auburn Heights Nature Preserve Anthropogenic Communities/Land Covers (Figure 3.9): Cultivated Lawn is the largest Anthropogenic Community/Land Cover, followed distantly by Semi-impervious Surface.

Natural Capital (Table 3.5)

Farm Pond/Artificial Pond is the only Anthropogenic Community/Land Cover with natural capital value. It was not present in 1937 and has since gained $534 in capital.

Table 3.5. Natural Capital of Auburn Heights Nature Preserve Anthropogenic Communities/Land Covers	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$534/year
2007	$534/year
2010	$534/year

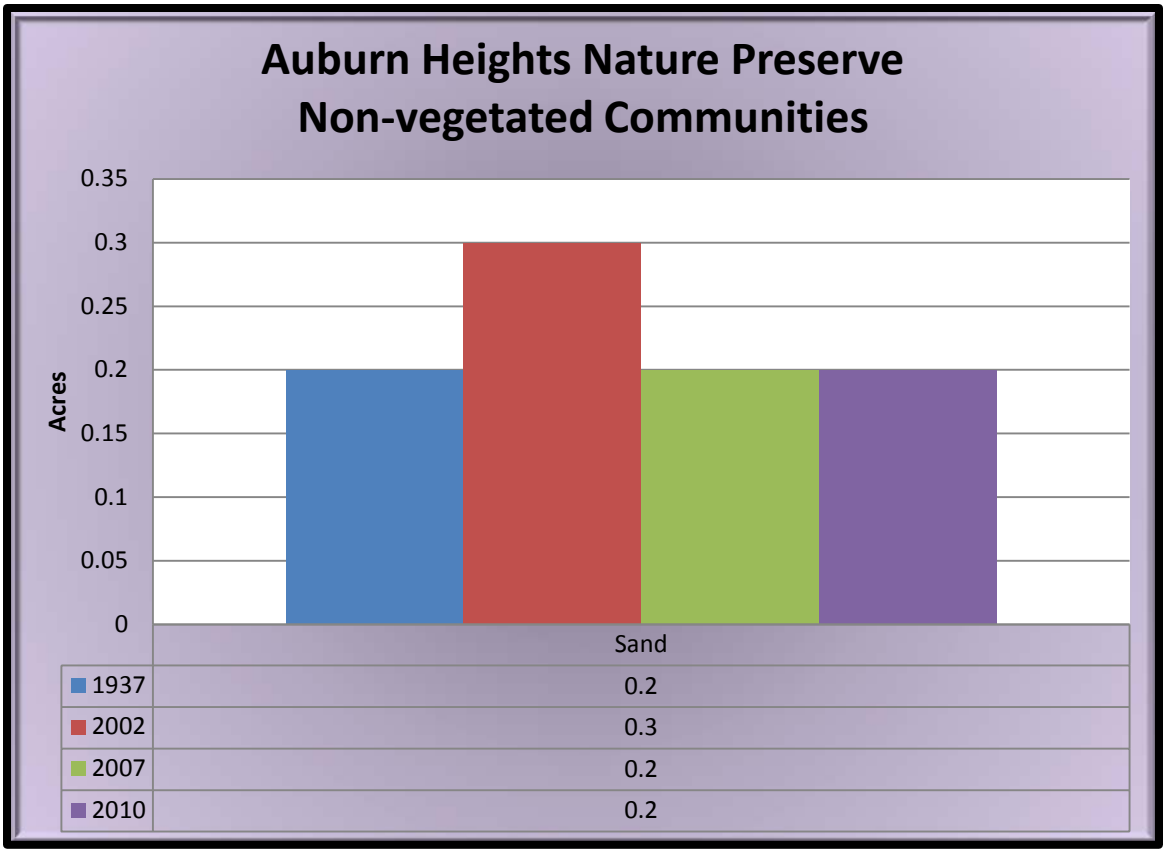

Figure 3.10. Non-vegetated Land Covers at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

Auburn Heights Nature Preserve Non-vegetated Land Covers (Figure 3.10): Sand is the only Non-vegetated land cover present in the Auburn Heights Nature Preserve.

Natural Capital

None of the Non-vegetated communities has any natural capital value.

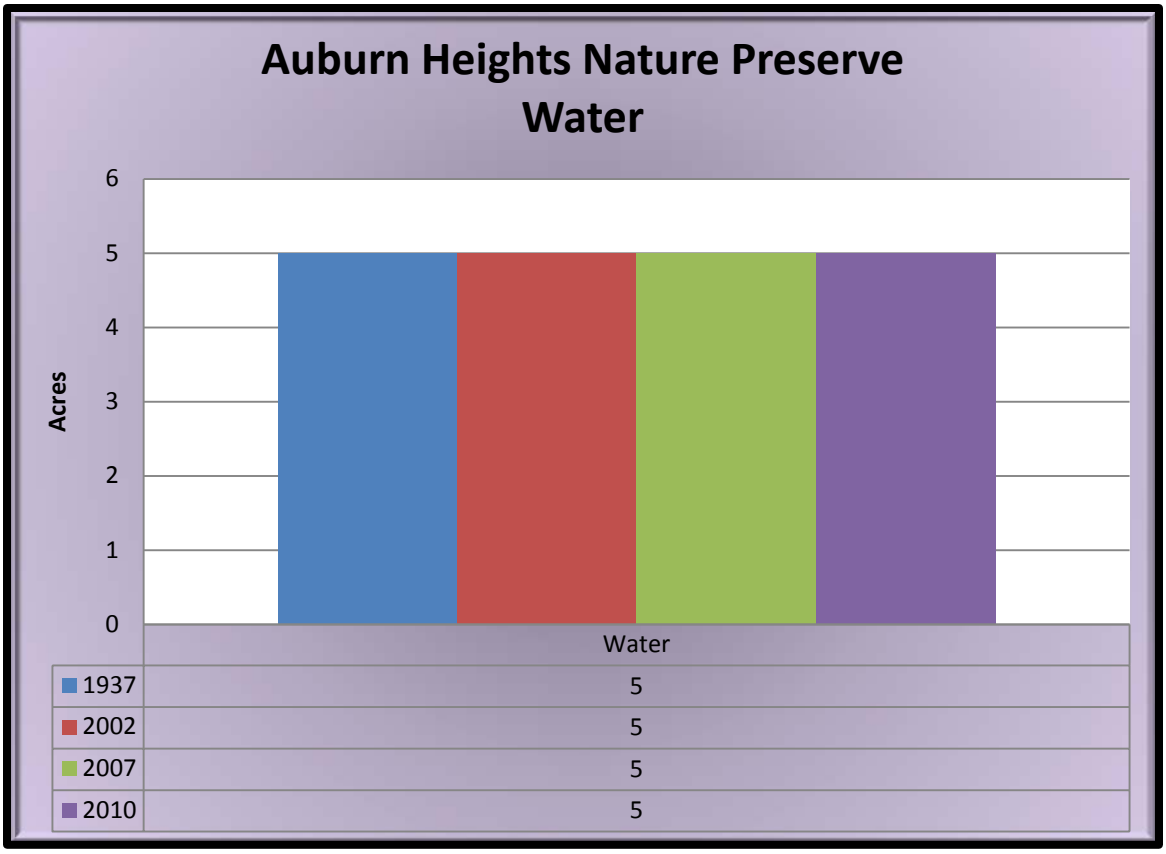

Figure 3.11. Water at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

Auburn Heights Nature Preserve Water (Figure 3.11): Water acreage has stayed the same during the study period.

Natural Capital (Table 3.6)

Capital of water has stayed the same through the study period as has its acreage.

Table 3.6. Natural Capital of Auburn Heights Nature Preserve Water	
Year	**Natural Capital (in 2012 dollars)**
1937	$26,676/year
2002	$26,676/year
2007	$26,676/year
2010	$26,676/year

CHAPTER 4: DESCRIPTIONS AND ANALYSIS OF THE VEGETATION COMMUNITIES

Nine vegetation communities and six land covers were noted in the survey (Figures 3.1-3.4). 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)—5 acres
2. Loblolly Pine Plantation (CEGL007179)—2 acres
3. Northeastern Modified Successional Forest (CEGL006599)—13 acres
4. Northeastern Old Field (CEGL006107)—108 acres
5. Northeastern Successional Shrubland (CEGL006451)—14 acres
6. Northern Piedmont Mesic Oak-Beech Forest-(CEGL006921)—26 acres
7. Riverine Floodplain Forest (CEGL006036)—6 acres
8. Successional Tuliptree Forest (CEGL007220)—8 acres
9. Willow River-Bar Shrubland (CEGL006065)—0.1 acres

The land covers include:

1. Farm Pond/Artificial Pond—0.1 acres
2. Impervious Surface—0.2 acres
3. Modified Land—0.1 acres
4. Sand—0.2 acres
5. Semi-impervious Surface—2 acres
6. Water—5 acres

Cultivated Lawn **[5 acres (Figure 4.1, Tables 4.1-4.2)] GNA SNA**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

Description

This community is composed of ornamental grasses and other plants and is mostly located around the buildings on the preserve and roadsides. It is composed mostly of tall fescue (*Festuca arundinacea*) and other ornamental plants in the nursery trade.

Analysis of Condition at Auburn Heights Nature Preserve

About half of the cultivated lawn present in 1937 was present in 2010. The rest had become 1 acre of impervious surface and 0.3 acres of Northeastern Old Field (Table 4.1). Since 1937, cultivated lawn has been planted in 2 acres of former impervious surface, 1 acre of Northeastern Old Field, and 0.1 acres of Northeastern Successional Shrubland (Table 4.2).

Table 4.1. What was once Cultivated Lawn in 1937 has become X or remained in 2010	
X	**Acreage**
Cultivated Lawn	2 acres
Impervious Surface	1 acre
Northeastern Old Field	0.3 acres

Table 4.2. Cultivated Lawn has migrated into X or remained since 1937	
X	**Acreage**
Cultivated Lawn	2 acres
Impervious Surface	2 acres
Northeastern Old Field	1 acre
Northeastern Successional Shrubland	0.1 acres

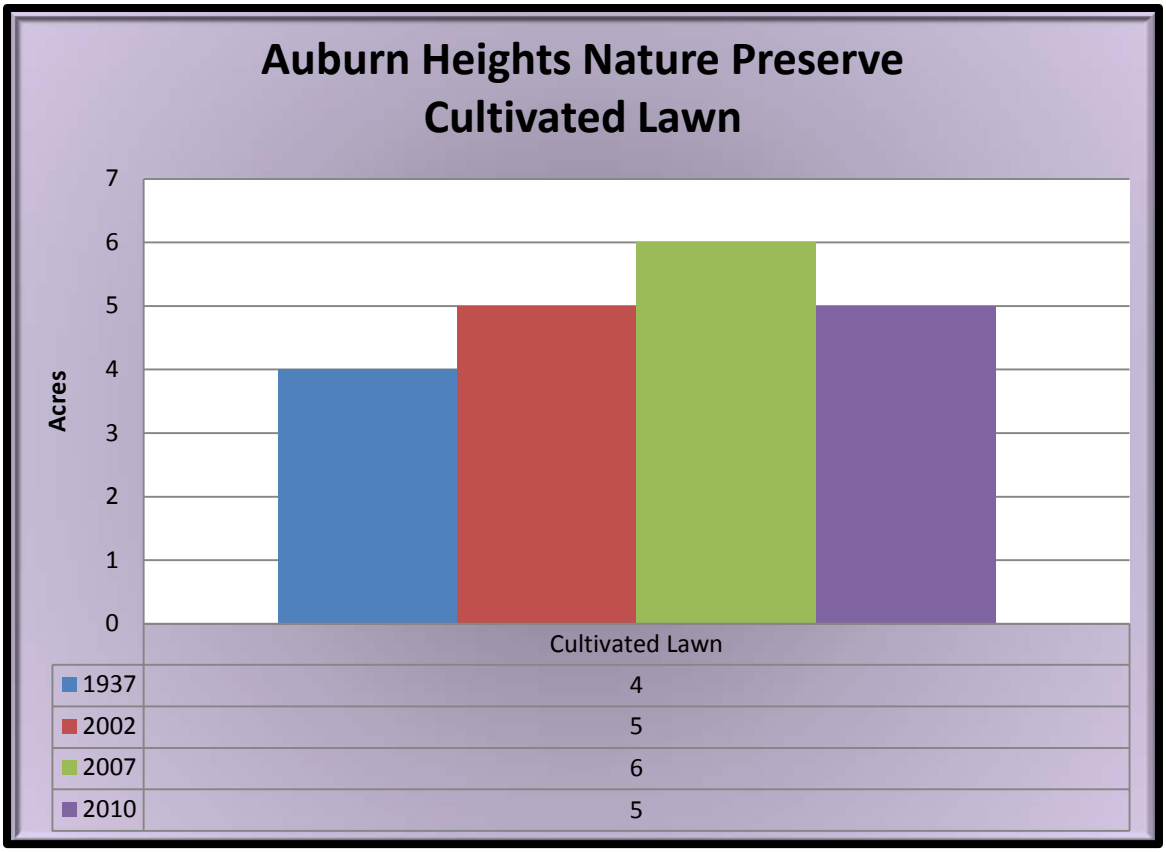

Figure 4.1. Cultivated Lawn at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

Natural Capital

Cultivated Lawn does not contain any natural capital value.

Loblolly Pine Plantation **[2 acres (Figure 4.2, Tables 4.3-4.4)] GNA SNA**

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

Description

This is dense collection of loblolly pine (*Pinus taeda*) adjacent to a Successional Tuliptree Forest. Other than the loblolly pine in the canopy the understory is essentially the same as the Successional Tuliptree Forest. Loblolly pine (*Pinus taeda*) is unusual in the Piedmont.

Analysis of Condition at Auburn Heights Nature Preserve

This community was not present in 1937 and has since grown into 2 acres of Northeastern Old Field (Table 4.3).

Table 4.3. Loblolly Pine Plantation has migrated into X or remained since 1937

X	**Acreage**
Northeastern Old Field	2 acres

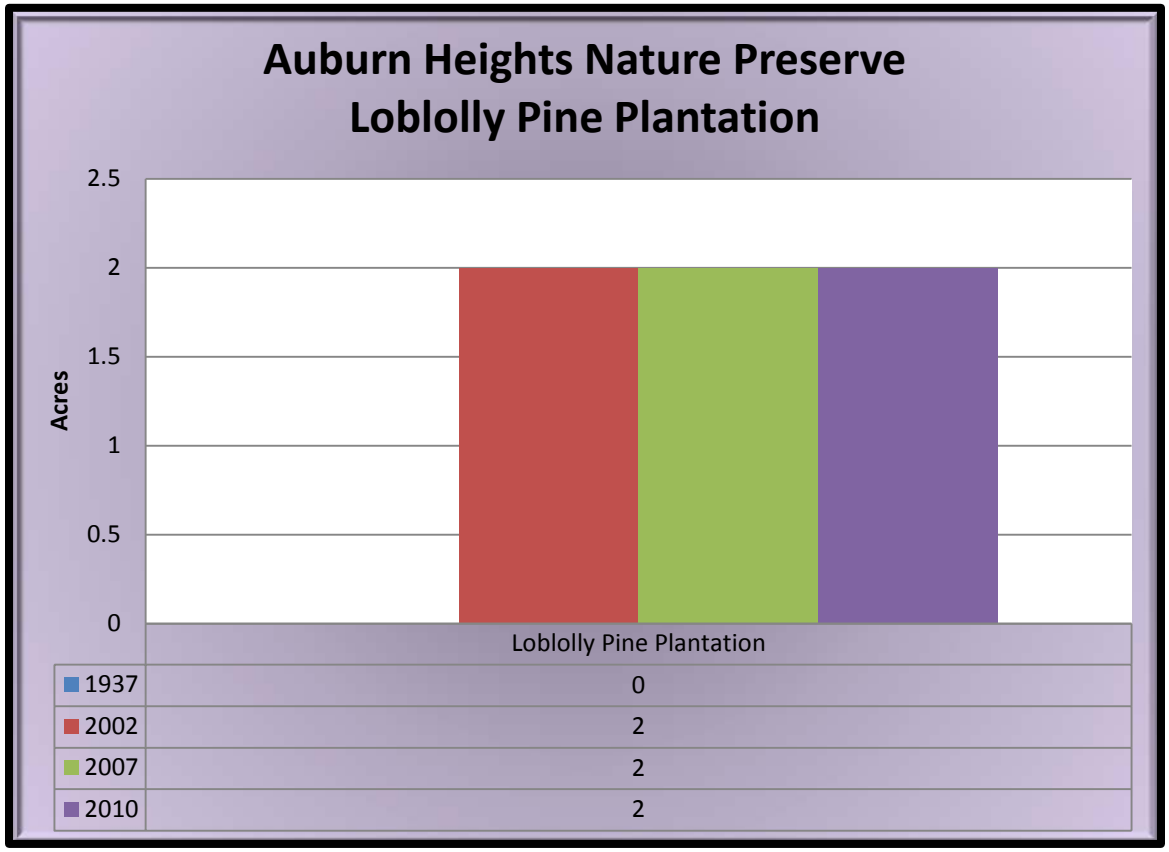

Figure 4.2. Loblolly Pine Plantation at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.4)

Loblolly Pine Plantation was not present in 1937 and has since acquired $378 in capital, resulting in a net capital gain for the preserve.

Table 4.4. Natural Capital of Loblolly Pine Plantation	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$378/year
2007	$378/year
2010	$378/year

Northeastern Modified Successional Forest **[13 acres (Figure 4.3, Tables 4.5-4.7] GNA SNA**

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

Description

The canopy of this community is dominated by a combination of tuliptree (*Liriodendron tulipifera*), red maple (*Acer rubrum*), black walnut (*Juglans nigra*) and black locust (*Robinia pseudoacacia*). The understories have smaller members of the canopy plus sassafras (*Sassafras albidum*), wild black cherry (*Prunus serotina*) and spicebush (*Lindera benzoin*). The shrub and vine layers are often quite dense and include multiflora rose (*Rosa multiflora*), Oriental bittersweet (*Celastrus orbiculatus*), Chinese privet (*Ligustrum sinense*) and Japanese honeysuckle (*Lonicera japonica*). Common herbs include garlic mustard (*Alliaria petiolata*) and Japanese stiltgrass (*Microstegium vimineum*) to almost the exclusion of all else.

Analysis of Condition at Auburn Heights Nature Preserve

All of the Northeastern Modified Successional Forest present in 1937 was still present in 2007 (Table 4.5). Since 1937, this community has increased in acreage to 13 acres by growing into 8 acres of Northeastern Old Field, invading 2 acres of Northern Piedmont Mesic Oak-Beech Forest, and expanding into 0.1 acres of water (Table 4.6).

Table 4.5. What was once Northeastern Modified Successional Forest in 1937 has become X or remained in 2010	
X	**Acreage**
Northeastern Modified Successional Forest	2 acres

Table 4.6. Northeastern Modified Successional Forest has migrated into X or remained since 1937	
X	**Acreage**
Northeastern Old Field	8 acres
Northern Piedmont Mesic Oak-Beech Forest	2 acres
Northeastern Modified Successional Forest	2 acres
Water	0.1 acres

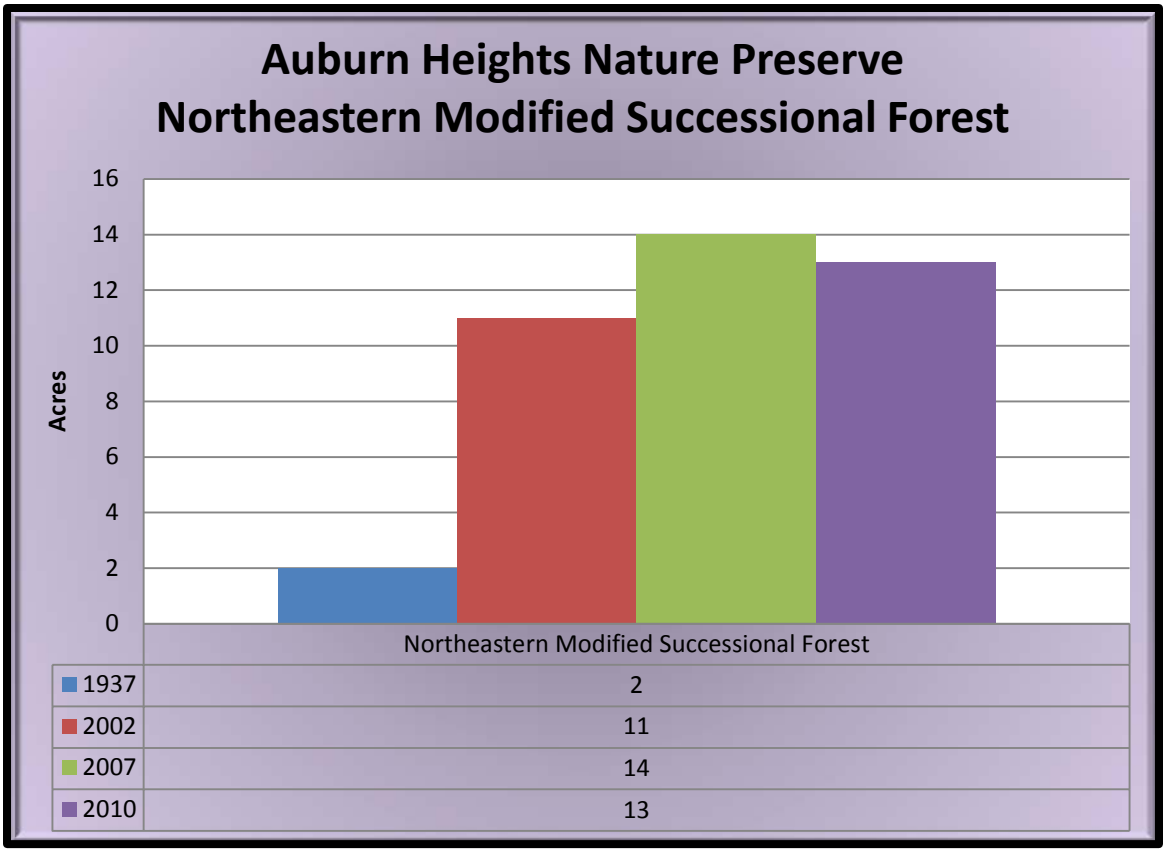

Figure 4.3. Northeastern Modified Successional Forest at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.7)

Capital of Northeastern Modified Successional Forest has increased overall since 1937, with a slight decrease in the recent period. The recent decrease may be because of invasive species eradication efforts that are ongoing in the preserve.

Table 4.7. Natural Capital of Northeastern Modified Successional Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$378/year
2002	$2,080/year
2007	$2,647/year
2010	$2,458/year

Northeastern Old Field **[108 acres (Figure 4.4, Tables 4.8-4.10] GNA SNA**

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

Description

This community is present in the higher parts of the site. Most of the fields in the Red Clay Creek valley are maintained perpetually in this state by annual mowing and haying. Kentucky fescue (*Festuca arundinacea*) is the typical dominant species of this community. Other associates may be white clover (*Trifolium pratense*), queen anne's lace (*Daucus carota*), sweet vernal grass (*Anthoxanthum odoratum*), orchard grass (*Dactylis glomerata*), common velvet grass (*Holcus lanatus*) and redtop panicgrass (*Panicum agrostoides*).

Analysis of Condition at Auburn Heights Nature Preserve

About 107 acres of the 147 acres present as Northeastern Old Field in 1937 still remained in 2010. The rest of the acreage had grown into 14 acres of Northeastern Successional Shrubland, 8 acres of Northeastern Modified Successional Forest, 6 acres of Northern Piedmont Mesic Oak-Beech Forest, and 6 acres of Successional Tuliptree Forest (Table 4.8). Since 1937, this community has declined, likely due to the maturation to other communities. It has expanded, however, into 0.3 acres of impervious surface, 0.3 acres of cultivated lawn, 0.2 acres of Riverine Floodplain Forest, and 0.2 acres of Northern Piedmont Mesic Oak-Beech Forest (Table 4.9).

Table 4.8. What was once Northeastern Old Field in 1937 has become X or remained in 2010	
X	**Acreage**
Northeastern Old Field	107 acres
Northeastern Successional Shrubland	14 acres
Northeastern Modified Successional Forest	8 acres
Northern Piedmont Mesic Oak-Beech Forest	6 acres
Successional Tuliptree Forest	6 acres
Other vegetation communities/land covers	5 acres

Table 4.9. Northeastern Old Field has migrated into X or remained since 1937	
X	**Acreage**
Northeastern Old Field	107 acres
Impervious Surface	0.3 acres
Cultivated Lawn	0.3 acres
Riverine Floodplain Forest	0.2 acres
Northern Piedmont Mesic Oak-Beech Forest	0.2 acres
Other vegetation communities/land covers	0.1 acres

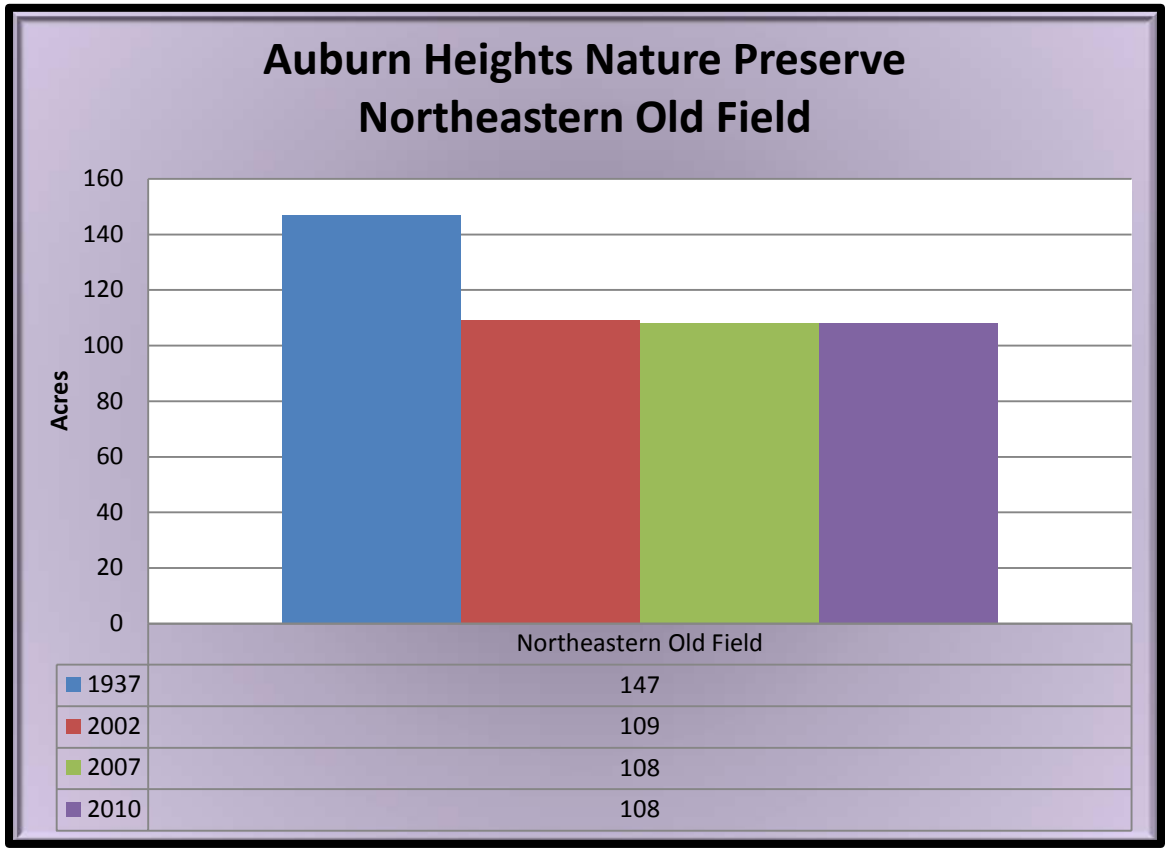

Figure 4.4. Northeastern Old Field at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.10)

Capital of Northeastern Old Field has declined since 1937, with a lot of the former fields maturing into shrubland and forest communities.

Table 4.10. Natural Capital of Northeastern Old Field	
Year	**Natural Capital (in 2012 dollars)**
1937	$21,418/year
2002	$15,881/year
2007	$15,736/year
2010	$15,736/year

Northeastern Successional Shrubland **[14 acres (Figure 4.5, Tables 4.11-4.13] GNA SNA**

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

Description

This community is essentially the same as the Northeastern Modified Successional Forest excepting the canopy. It contains a similar assortment of species in both the shrub and herb layers.

Analysis of Condition at Auburn Heights Nature Preserve

None of the Northeastern Successional Shrubland present in 1937 was still present in 2010. It had become 3 acres of Riverine Floodplain Forest and 0.1 acres of cultivated lawn (Table 4.11). Since 1937, Northeastern Successional Shrubland has grown by growing into 14 acres of Northeastern Old Field, and converting 0.3 acres of Northern Piedmont Mesic Oak-Beech Forest, and 0.1 acres of Semi-impervious Surface (Table 4.12).

Table 4.11. What was once Northeastern Successional Shrubland in 1937 has become X or remained in 2010	
X	**Acreage**
Riverine Floodplain Forest	3 acres
Cultivated Lawn	0.1 acres

Table 4.12. Northeastern Successional Shrubland has migrated into X or remained since 1937	
X	**Acreage**
Northeastern Old Field	14 acres
Northern Piedmont Mesic Oak-Beech Forest	0.3 acres
Semi-impervious Surface	0.1 acres

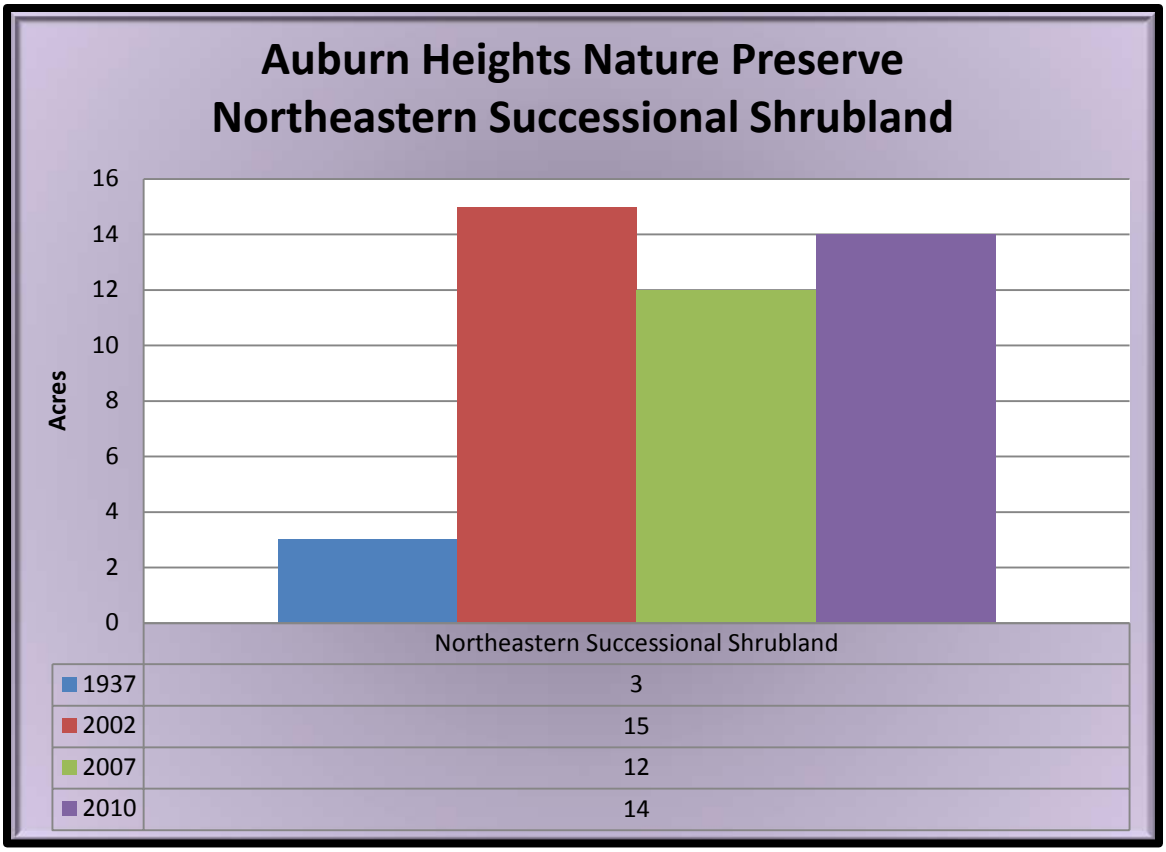

Figure 4.5. Northeastern Successional Shrubland at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.13)

Capital of Northeastern Successional Shrubland has oscillated as this community matures into forest and new shrublands are formed. Overall since 1937 it has increased.

Table 4.13. Natural Capital of Northeastern Successional Shrubland	
Year	**Natural Capital (in 2012 dollars)**
1937	$437/year
2002	$2,186/year
2007	$1,748/year
2010	$2,040/year

Northern Piedmont Mesic Oak-Beech Forest **[26 acres (Figures 4.6-4.7, Tables 4.14-4.16)]**
G5 S5

DEWAP: Piedmont Upland Forest
NHC: Central Appalachian Dry Oak-Pine Forest

Description

This community is located on slopes in the preserve that have not been invaded by exotic invasive plant species in large amount. Canopy species include tuliptree (*Liriodendron tulipifera*), American beech (*Fagus grandifolia*), northern red oak (*Quercus rubra*), red maple (*Acer rubrum*), and a few Virginia pine (*Pinus virginiana*). The understory contains smaller members of the canopy plus green ash (*Fraxinus pennsylvanica*), bitternut hickory (*Carya cordiformis*), black walnut (*Juglans nigra*), blackgum (*Nyssa sylvatica*), and box elder (*Acer negundo*). The shrub and vine layer contains poison ivy (*Toxicodendron radicans*), Japanese barberry (*Berberis thunbergii*), multiflora rose (*Rosa multiflora*), blackberry (*Rubus* sp.), privet (*Ligustrum vulgare*), and Oriental bittersweet (*Celastrus orbiculatus*). Common herbs include Christmas fern (*Polystichum acrostichoides*), white wood aster (*Eurybia divaricata*), jack-in-the-pulpit (*Arisaema triphyllum*), broad beech fern (*Phegopteris hexagonoptera*), Japanese stiltgrass (*Microstegium vimineum*), and false nettle (*Boehmeria cylindrica*).

Figure 4.6. Northern Piedmont Mesic Oak-Beech Forest

Analysis of Condition at Auburn Heights Nature Preserve

Nineteen of the 23 acres present in 1937 were still present in 2010. The rest of the acreage had become 2 acres of Northeastern Modified Successional Forest by invasion of exotic invasive plant species, 2 acres of Successional Tuliptree Forest, 0.3 acres of Northeastern Successional Shrubland, and 0.2 acres of Northeastern Old Field (Table

Table 4.14. What was once Northern Piedmont Mesic Oak-Beech Forest in 1937 has become X or remained in 2007	
X	**Acreage**
Northern Piedmont Mesic Oak-Beech Forest	19 acres
Northeastern Modified Successional Forest	2 acres
Successional Tuliptree Forest	2 acres
Northeastern Successional Shrubland	0.3 acres
Northeastern Old Field	0.2 acres

Table 4.15. Northern Piedmont Mesic Oak-Beech Forest has migrated into X or remained since 1937	
X	**Acreage**
Northern Piedmont Mesic Oak-Beech Forest	19 acres
Northeastern Old Field	6 acres
Riverine Floodplain Forest	1 acre
Water	0.3 acres

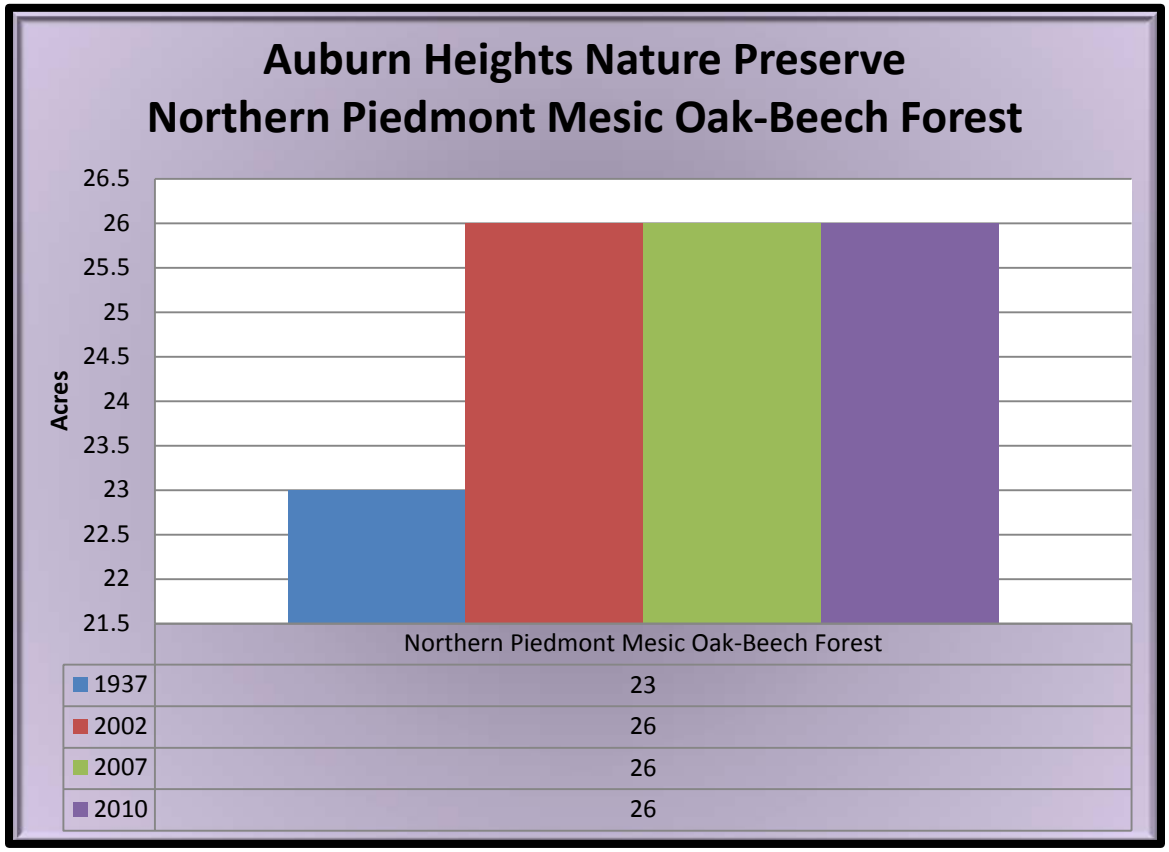

Figure 4.7. Northern Piedmont Mesic Oak-Beech Forest at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.16)

Capital of Northern Piedmont Mesic Oak-Beech Forest has increased with its expansion in acreage.

Table 4.16. Natural Capital of Northern Piedmont Mesic Oak-Beech Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$4,349/year
2002	$4,917/year
2007	$4,917/year
2010	$4,917/year

Riverine Floodplain Forest **[6 acres (Figure 4.8, Tables 4.17-4.19] G4? S2**

DEWAP: Forested Floodplains and Riparian Swamps
NHC: Central Appalachian River Floodplain

Description

This stunted community is found in the narrow floodplain of Red Clay Creek. The canopy is composed primarily of sycamore (*Platanus occidentalis*) and black walnut (*Juglans nigra*). Understory species include box-elder (*Acer negundo*), sycamore, and black locust (*Robinia pseudoacacia*). No shrubs were noted in this community and common herbs included orange-spotted jewelweed (*Impatiens capensis*), Japanese hops (*Humulus japonicus*), halbeard-leaf tearthumb (*Polygonum arifolium*), beefsteak plant (*Perilla frutescens*), mile-a-minute (*Polygonum perfoliatum*), curly dock (*Rumex crispus*), pale spike lobelia (*Lobelia spicata*), and Japanese stiltgrass (*Microstegium vimineum*).

Analysis of Condition at Auburn Heights Nature Preserve

Three acres of the five acres of Riverine Floodplain Forest present in 1937 was still present in 2010. The rest had become 1 acre of Northern Piedmont Mesic Oak-Beech Forest, 0.2 acres of water, and 0.2 acres of Northeastern Old Field (Table 4.17). Since 1937, Riverine Floodplain Forest has increased by one acre by growing from 3 acres of Northeastern Successional Shrubland and 0.2 acres of Northeastern Old Field (Table 4.18).

Table 4.17. What was once Riverine Floodplain Forest in 1937 has become X or remained in 2010

X	**Acreage**
Riverine Floodplain Forest	3 acres
Northern Piedmont Mesic Oak-Beech Forest	1 acre
Water	0.2 acres
Northeastern Old Field	0.2 acres

Table 4.18. Riverine Floodplain Forest has migrated into X or remained since 1937

X	**Acreage**
Riverine Floodplain Forest	3 acres
Northeastern Successional Shrubland	3 acres
Northeastern Old Field	0.2 acres

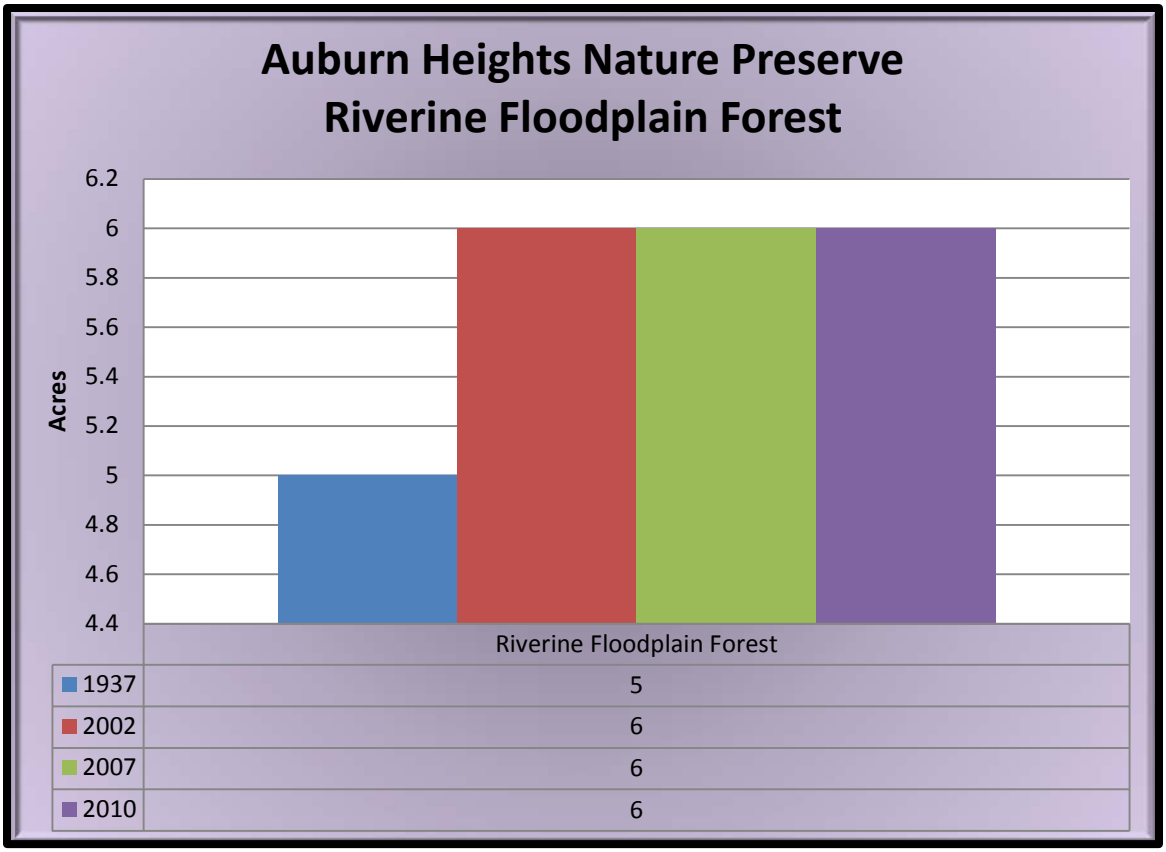

Figure 4.8. Riverine Floodplain Forest at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.19)

Capital of Riverine Floodplain Forest has increased with the maturation of shrubland communities into it.

Table 4.19. Natural Capital of Riverine Floodplain Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$61,458/year
2002	$73,749/year
2007	$73,749/year
2010	$73,749/year

Successional Tuliptree Forest **[8 acres (Figures 4.9-4.10, Tables 4.20-] GNA SNA**

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

Description

In this successional forested community, Tuliptree (*Liriodendron tulipifera*) is dominant in the canopy and associated by red maple (*Acer rubrum*). Understory species include spicebush (*Lindera benzoin*), mockernut hickory (*Carya alba*), American beech (*Fagus grandifolia*) and black gum (*Nyssa sylvatica*). Multiflora rose (*Rosa multiflora*), privet (*Ligustrum vulgare*) and raspberry (*Rubus* spp.) are common shrubs, while poison ivy (*Toxicodendron radicans*), oriental bittersweet (*Celastrus orbiculatus*) and summer grape (*Vitis aestivalis*) are common vines. The rich herb layer contains numerous species including horsebalm (*Collinsonia canadensis*), common blue violet (*Viola sororia*), white wood aster (*Eurybia divaricata*), garlic mustard (*Alliaria petiolata*), enchanter's nightshade (*Circaea lutetiana*), wild ginger (*Asarum canadense*) and American lopseed (*Phyrma leptostachya*).

Figure 4.9. Successional Tuliptree Forest

Analysis of Condition at Auburn Heights Nature Preserve

Successional Tuliptree Forest was not present in 1937 and has since grown from 6 acres of Northeastern Old Field, 2 acres of Northern Piedmont Mesic Oak-Beech Forest, and 0.1 acres of impervious Surface (Table 4.20).

Table 4.20. Successional Tuliptree Forest has migrated into X or remained since 1937	
X	**Acreage**
Northeastern Old Field	6 acres
Northern Piedmont Mesic Oak-Beech Forest	2 acres
Impervious Surface	0.1 acres

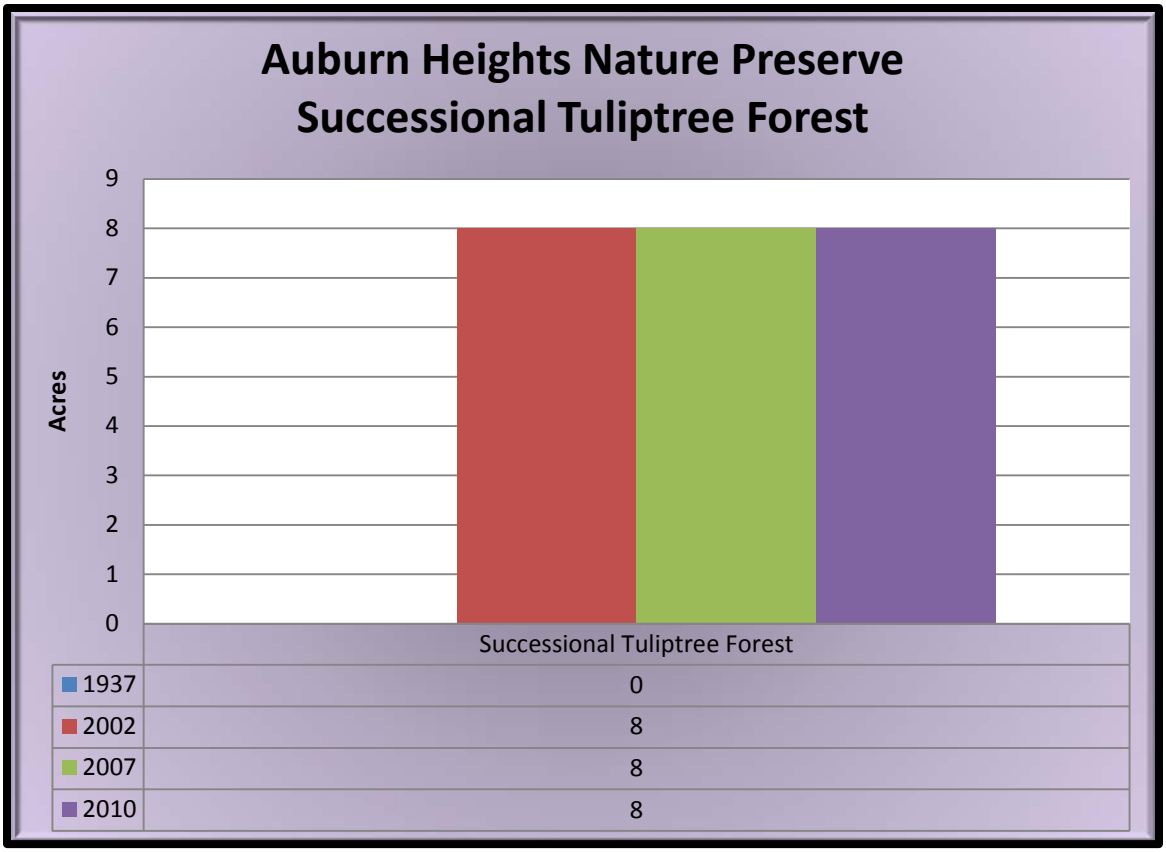

Figure 4.10. Successional Tuliptree Forest at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.21)

Successional Tuliptree Forest capital has remained at the same amount since 2002.

Table 4.21. Natural Capital of Successional Tuliptree Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$1,513/year
2007	$1,513/year
2010	$1,513/year

Willow River-Bar Shrubland **[0.1 acres (Figures 4.11-4.12, Tables 4.22-4.24] GNA SNA**

DEWAP: Piedmont Stream Valley Wetlands
NHC: Central Appalachian Stream and Riparian

Description

This shrub/low forest community is located on a gravelly sandbar of Red Clay Creek. Sycamore (*Platanus occidentalis*) and black willow (*Salix nigra*) co-dominate the canopy and are associated by a few box elder (*Acer negundo*). Black willow forms the understory. The only shrub noted was multiflora rose (*Rosa multiflora*). Herbs are sparse and include beefsteak plant (*Perilla frutescens*), mild water-pepper (*Polygonum hydropiperoides*), giant ragweed (*Ambrosia artemisiifolia*), purple loosestrife (*Lythrum salicaria*), dotted smartweed (*Persicaria punctata*), Japanese stiltgrass (*Microstegium vimineum*), straw-colored flatsedge (*Cyperus strigosus*), field mint (*Mentha arvensis*), monkey flower (*Mimulus ringens*), yellow-seed false pimpernel (*Lindernia dubia*), and white vervain (*Verbena hastata*).

Figure 4.11. Willow River-Bar Shrubland

Analysis of Condition at Auburn Heights Nature Preserve

All of the Willow River-Bar Shrubland from 1937 has become water (Table 4.22). Since 1937, this community has populated 0.1 acres of Northeastern Old Field (Table 4.23).

Table 4.22. What was once Willow River-Bar Shrubland in 1937 has become X or remained in 2007	
X	**Acreage**
Water	0.2 acres

Table 4.23. Willow River-Bar Shrubland has migrated into X or remained since 1937	
X	**Acreage**
Northeastern Old Field	0.1 acres

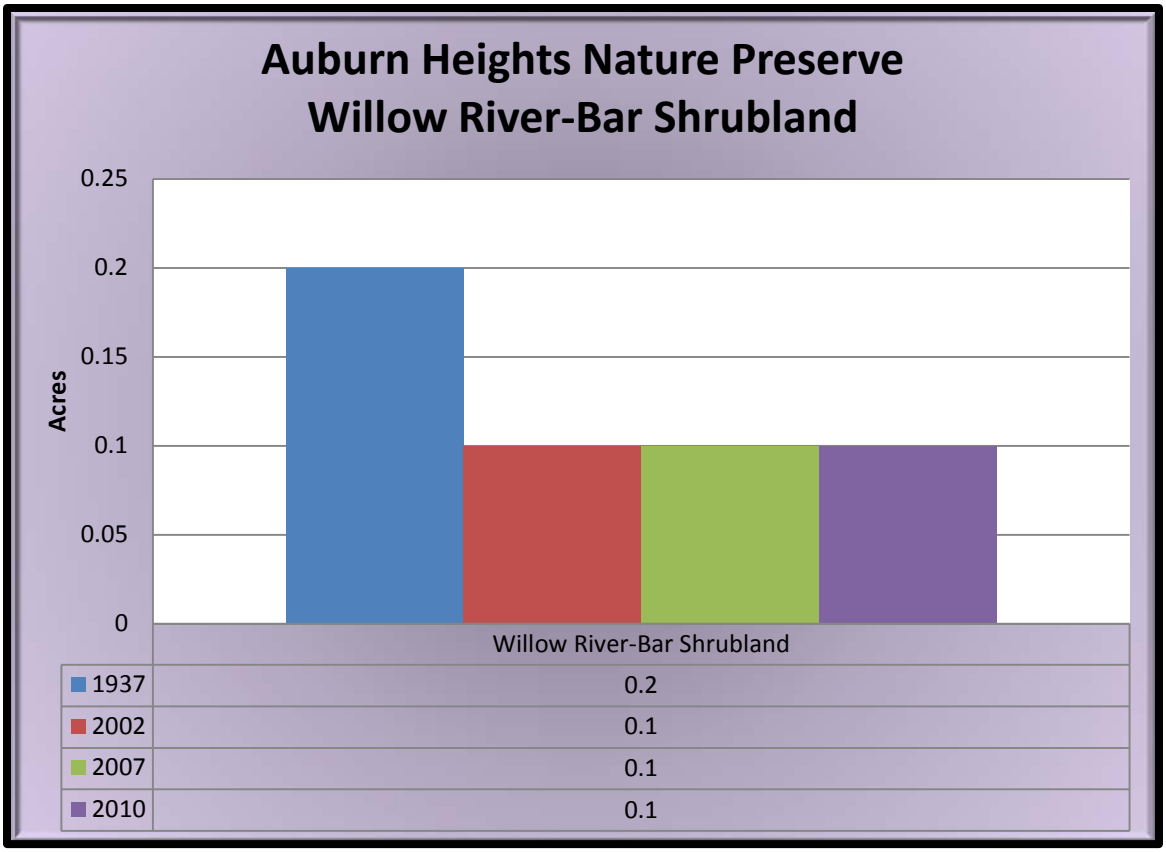

Figure 4.12. Willow River-Bar Shrubland at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

Natural Capital (Table 4.21)

Willow River-Bar Shrubland has decreased its capital with a reduction in acreage since 1937.

Table 4.21. Natural Capital of Willow River-Bar Shrubland	
Year	**Natural Capital (in 2012 dollars)**
1937	$2,458/year
2002	$1,229/year
2007	$1,229/year
2010	$1,229/year

CHAPTER 5: DESCRIPTIONS AND ANALYSIS OF THE LAND COVERS

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

1. Farm Pond/Artificial Pond—0.1 acres
2. Impervious Surface—3 acres
3. Modified Land—0.1 acres
4. Sand—0.2 acres
5. Semi-impervious Surface—2 acres
6. Water—5 acres

Farm Pond/Artificial Pond **[0.1 acres, (Figure 5.1, Tables 5.1-5.2)]**

DEWAP: Impoundment
NHC: No Equivalent Classification

Description

Farm Pond/Artificial Pond includes water bodies that are less than 5 acres in size.

Analysis of Condition at Auburn Heights Nature Preserve

One pond is present in the Auburn Heights Preserve near the house. It was developed from a Northeastern Old Field present in 1937.

Table 5.1. Farm Pond/Artificial Pond has migrated into X or remained since 1937	
X	**Acreage**
Northeastern Old Field	0.1 acres

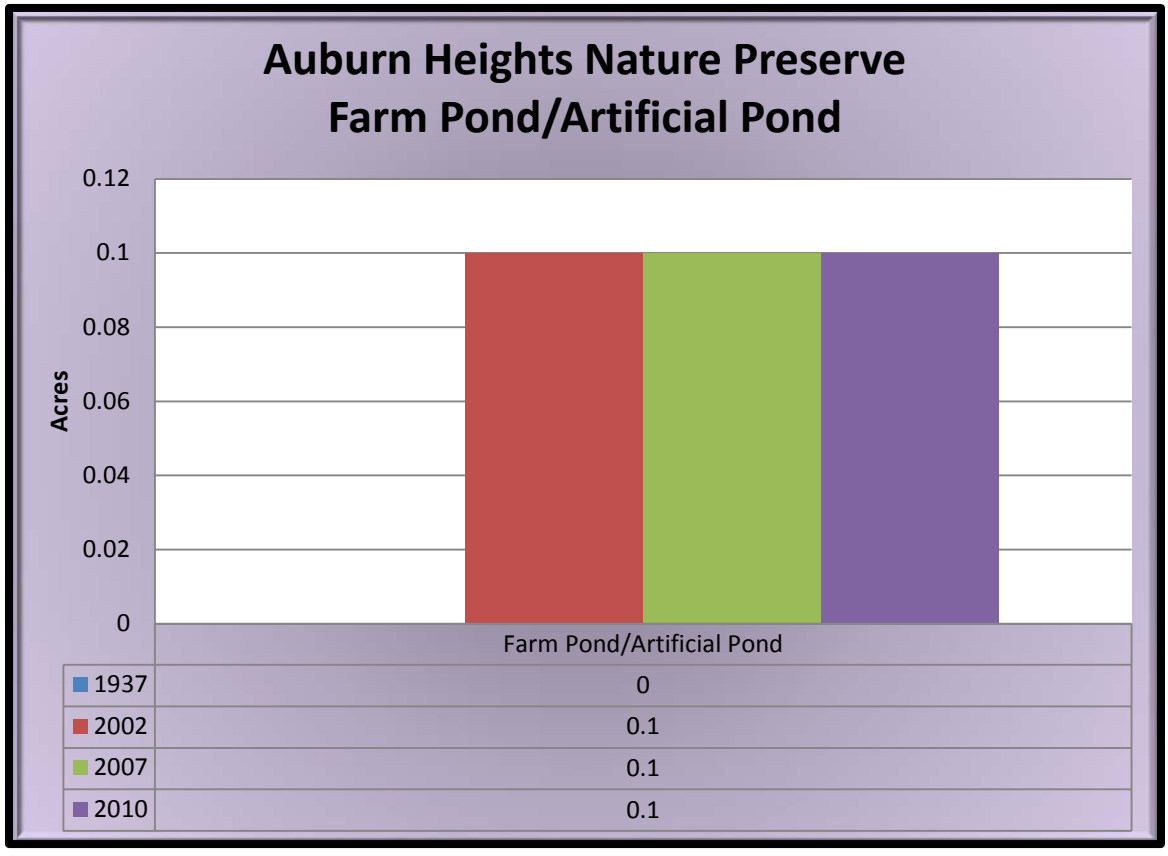

Figure 5.1. Farm Pond/Artificial Pond at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

Natural Capital (Table 5.2)

Capital of Farm Pond/Artificial Pond has stayed the same since 2002. It was not present in 1937.

Table 5.2. Natural Capital of Farm Pond/Artificial Pond	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$534/year
2007	$534/year
2010	$534/year

Impervious Surface **[3 acres, (Figure 5.2, Tables 5.3-5.4)]**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

Description

In Auburn Heights Nature Preserve this cover type consists of road which is impervious to the flow of water.

Analysis of Condition at Auburn Heights Nature Preserve

Only half of the impervious surface present in 1937 was still present in 2010. The rest had become 2 acres of cultivated lawn, 0.3 acres of Northeastern Old Field, and 0.1 acres of Successional Tuliptree Forest (Table 5.3). Since 1937, impervious surface area has decreased but it has still been developed on 1 acre of cultivated lawn and 0.3 acres of Northeastern Old Field (Table 5.4).

Table 5.3. What was once Impervious Surface in 1937 has become X or remained in 2010	
X	**Acreage**
Impervious Surface	2 acres
Cultivated Lawn	2 acres
Northeastern Old Field	0.3 acres
Successional Tuliptree Forest	0.1 acres

Table 5.4. Impervious Surface has migrated into X or remained since 1937	
X	**Acreage**
Impervious Surface	2 acres
Cultivated Lawn	1 acre
Northeastern Old Field	0.3 acres

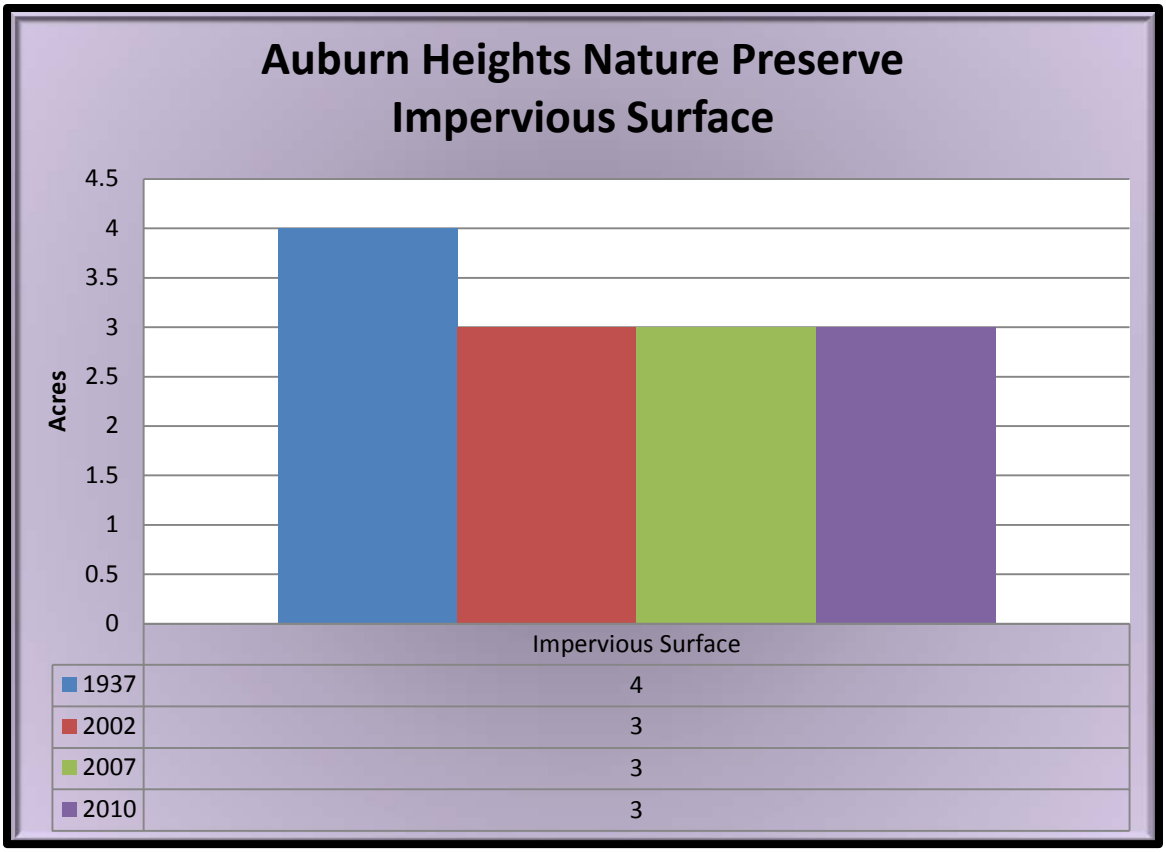

Figure 5.2. Impervious Surface at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

Modified Land **[0.1 acres, (Figure 5.3, Table 5.5)]**

Description

Modified land includes those areas have been cleared of vegetation artificially.

Analysis of Condition at Auburn Heights Nature Preserve

Modified land was not present in 1937 and has since been developed in 0.1 acres of Northeastern Old Field (Table 5.4).

Table 5.5. Modified Land has migrated into X or remained since 1937	
X	**Acreage**
Northeastern Old Field	0.1 acres

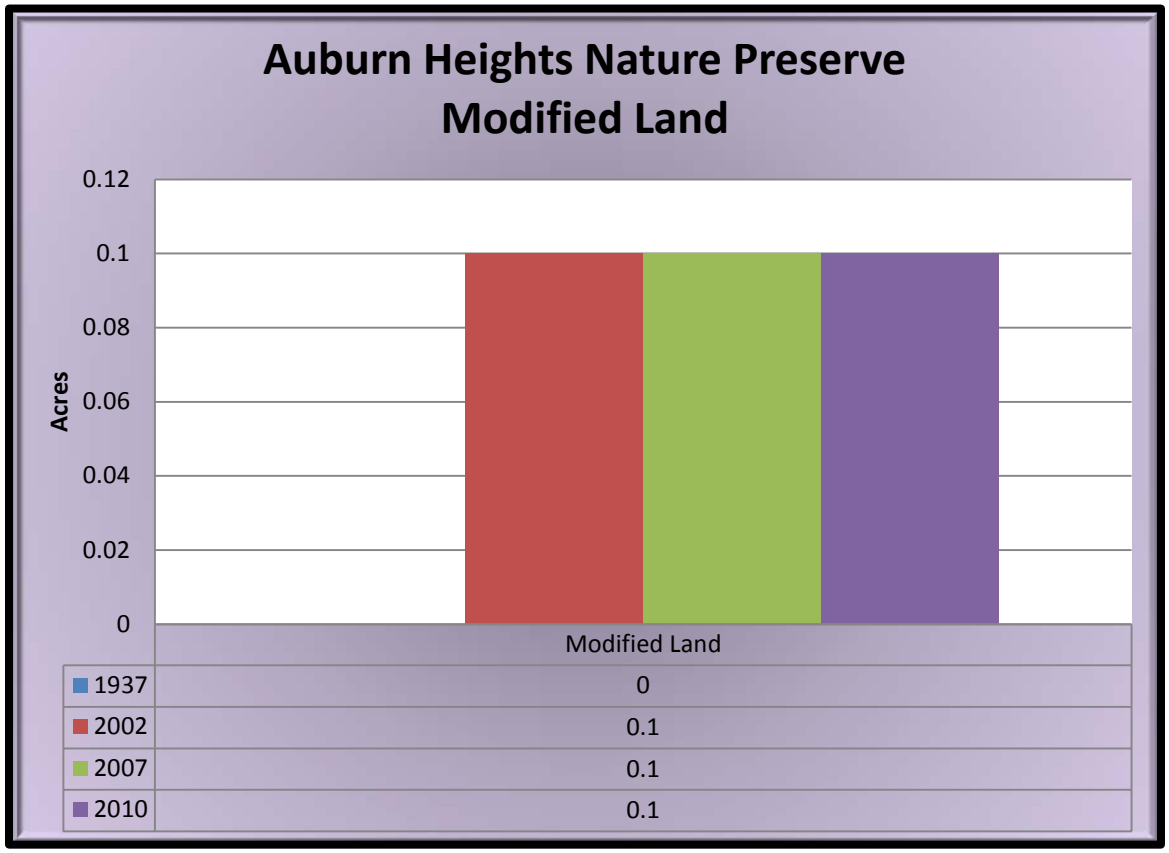

Figure 5.3. Modified Land at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

***Sand* [0.2 acres, (Figure 5.4, Tables 5.6-5.7)]**

Description

Analysis of Condition at Auburn Heights Nature Preserve

All of the sand present in 1937 was still present in 2010 (Table 5.6). Since 1937, this land cover has increased by filling 0.1 acres of water (Table 5.7).

Table 5.6. What was once Sand in 1937 has become X or remained in 2010	
X	**Acreage**
Sand	0.2 acres

Table 5.7. Sand has migrated into X or remained since 1937	
X	**Acreage**
Sand	0.2 acres
Water	0.1 acres

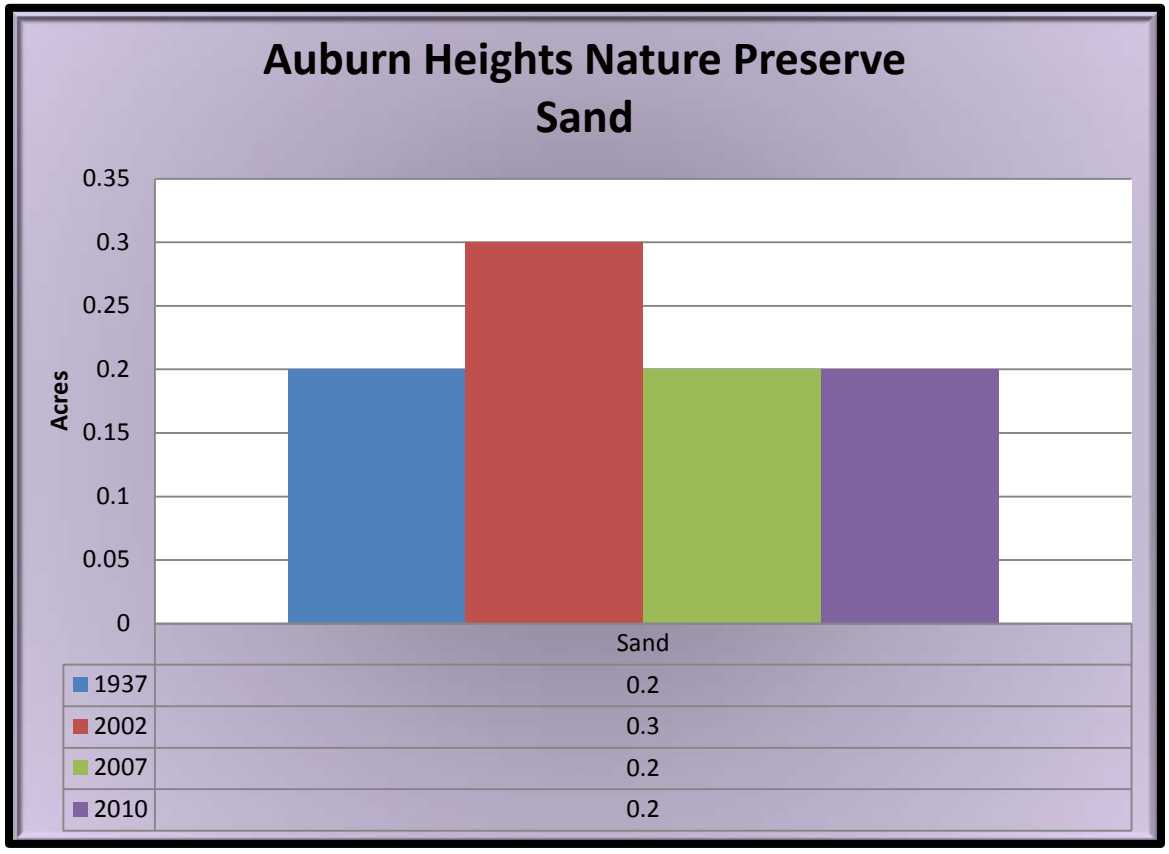

Figure 5.4. Sand at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

Semi-impervious Surface **[2 acres, (Figure 5.5, Tables 5.8-5.9)]**

Description

Semi-impervious surface includes those areas that are semi-impervious to the passage of water.

Analysis of Condition at Auburn Heights Nature Preserve

None of the semi-impervious surface from 1937 was still present in 2010. What was this community have become 0.1 acres of Northeastern Successional Shrubland and 0.1 acres of Northeastern Old Field (Table 5.8). Since 1937, Semi-impervious surface has been developed in 2 acres of Northeastern Old Field (Table 5.9).

Table 5.8. What was once Semi-impervious Surface in 1937 has become X or remained in 2010	
X	**Acreage**
Northeastern Successional Shrubland	0.1 acres
Northeastern Old Field	0.1 acres

Table 5.9. Semi-impervious Surface has migrated into X or remained since 1937	
X	**Acreage**
Northeastern Old Field	2 acres

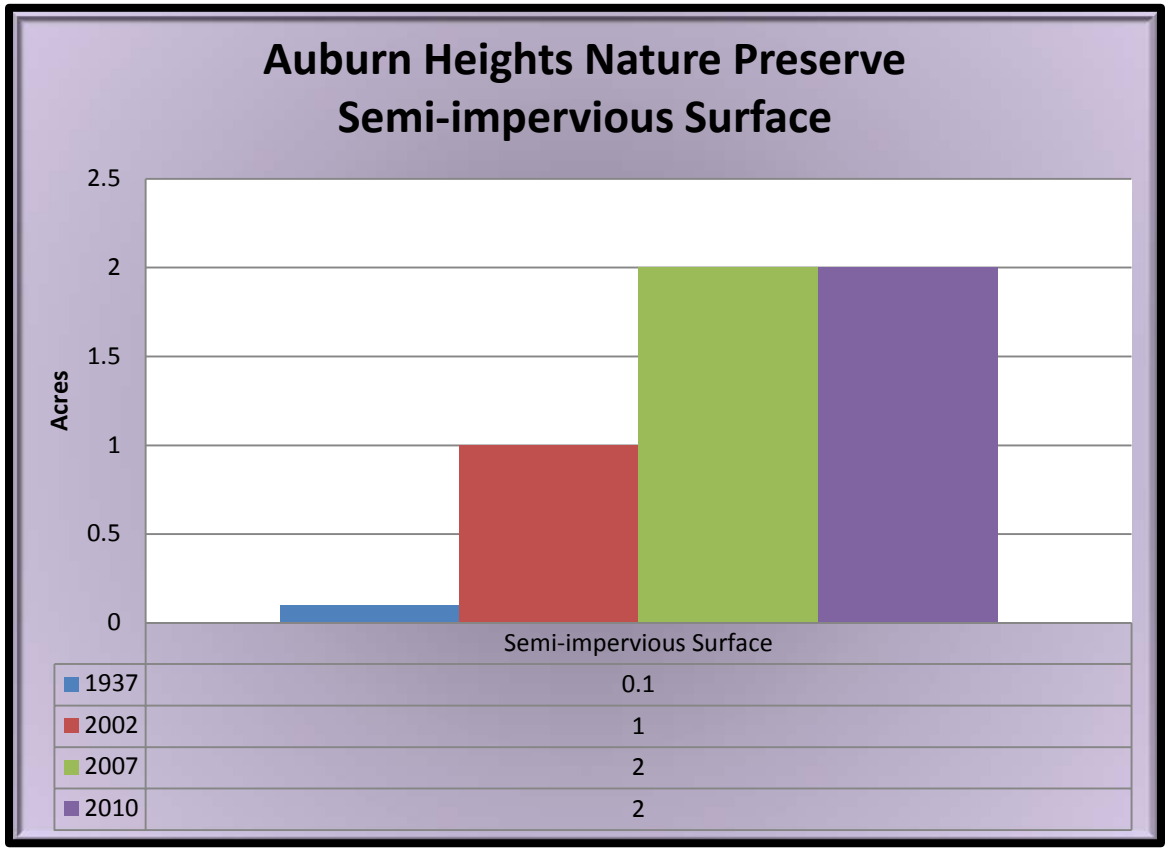

Figure 5.5. Semi-impervious Surface at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

***Water* [5 acres, (Figure 5.6, Tables 5.10-5.11)]**

Description

Water includes the open water surface of the main stem of Red Clay Creek.

Analysis of Condition at Auburn Heights Nature Preserve

About four acres of the five acres of water present in 1937 were still present in 2010. The rest had become 0.3 acres of Northern Piedmont Mesic Oak-Beech Forest, 0.1 acres of Northeastern Old Field, 0.1 acres of Northeastern Modified Successional Forest, and 0.1 acres of sand (Table 5.10). Since 1937, water has covered 0.2 acres of Riverine Floodplain Forest and 0.2 acres of Willow River-Bar Shrubland (Table 5.11).

Table 5.10. What was once Water in 1937 has become X or remained in 2010	
X	**Acreage**
Water	4 acres
Northern Piedmont Mesic Oak-Beech Forest	0.3 acres
Northeastern Old Field	0.1 acres
Northeastern Modified Successional Forest	0.1 acres
Sand	0.1 acres

Table 5.11. Water has migrated into X or remained since 1937	
X	**Acreage**
Water	4 acres
Riverine Floodplain Forest	0.2 acres
Willow River-Bar Shrubland	0.2 acres

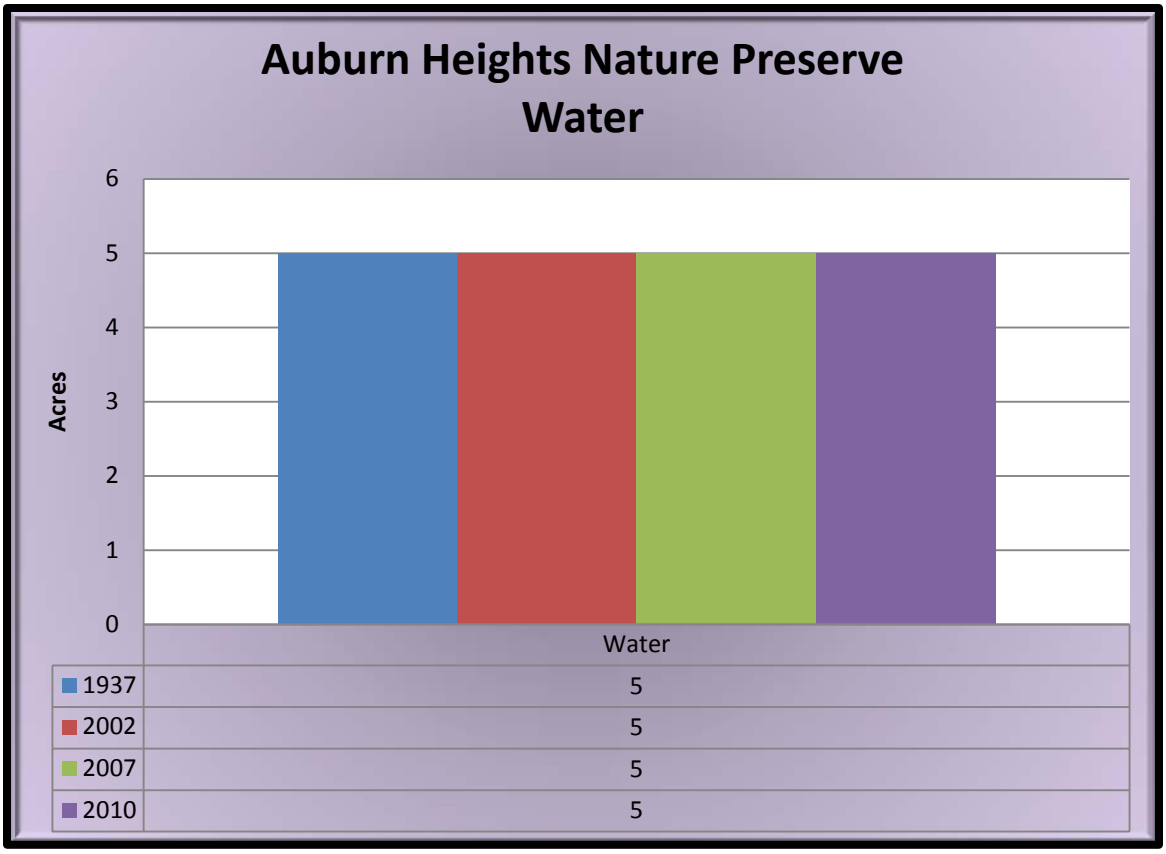

Figure 5.5. Semi-impervious Surface at Auburn Heights Nature Preserve (1937, 2002, 2007, and 2010)

Natural Capital (Table 5.12)

Capital of water has stayed the same through the study period in spite of the fact that is has moved around.

Table 5.12. Natural Capital of Water	
Year	**Natural Capital (in 2012 dollars)**
1937	$26,676/year
2002	$26,676/year
2007	$26,676/year
2010	$26,676/year

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 SPECIES EXPECTED FOR KEY WILDLIFE HABITATS

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

Passerculus sandwichensis	savannah sparrow	Bird	2
Ammodramus savannarum	grasshopper sparrow	Bird	2
Dolichonyx oryzivorus	bobolink	Bird	2
Cryptotis parva	least shrew	Bird	2

SGCN Species expected in Impoundments			
Species	**Common Name**	**Class**	**Tier**
Podilymbus podiceps	Pied-billed grebe	Bird	1
Branta canadensis	Canada goose (migratory)	Bird	1
Anas rubripes	American black duck	Bird	1
Pandion haliaetus	osprey	Bird	1
Actitus macularia	Spotted sandpiper	Bird	1
Cygnus columbianus	Tundra swan	Bird	2
Anas platyrhynchos	mallard	Bird	2
Anas clypeata	Northern shoveler	Bird	2
Aythya valisneria	canvasback	Bird	2
Aythya marila	Greater scaup	Bird	2
Aythya affinis	Lesser scaup	Bird	2
Bucephala albeola	bufflehead	Bird	2
Lophodytes cucullatus	Hooded merganser	Bird	2
Pluvialis squatarola	Black-bellied plover	Bird	2
Himantopus mexicanus	Black-necked stilt	Bird	2
Catoptrophorus semipalmatus	willet	Bird	2
Calidris pusilla	Semipalmated sandpiper	Bird	2
Calidris alpina	dunlin	Bird	2

SGCN Species expected in Piedmont Forested Floodplains and Riparian Swamps			
Species	**Common Name**	**Class**	**Tier**
Satyrium kingi	King's hairstreak	Insect	1
Clemmys guttata	Spotted turtle	Reptile	1
Terrapene carolina	Eastern box turtle	Reptile	1
Nerodia erythrogaster	Plainbelly water snake	Reptile	1
Nycticorax nyticorax	Black crowned night-heron	Bird	1
Nyctanassa violacea	yellow-crowned night-heron	Bird	1
Buteo platypterus	Broad-winged hawk	Bird	1
Melanerpes erythrocephalus	Red-headed woodpecker	Bird	1
Hylocichla mustelina	Wood thrush	Bird	1
Parula americana	Northern parula	Bird	1
Setophaga ruticella	American redstart	Bird	1
Limnothlypis swainsonii	Swainson's warbler	Bird	1
Amblyscirtes aesculapius	Lace-winged roadside-skipper	Insect	2
Libytheana carinenta	American snout	Insect	2
Anacamptodes pergracilis	Cypress looper	Insect	2
Chloropteryx tepperaria	Angle winged emerald moth	Insect	2
Manduca jasminearum	Ash sphinx	Insect	2

Dolba hyloeus	Black alder or pawpaw sphinx	Insect	2
Haploa colona	A tiger moth	Insect	2
Orgyia detrita	A tussock moth	Insect	2
Catocala unijuga	Once-married underwing	Insect	2
Catocala praeclara	Praeclara underwing	Insect	2
Parapamea buffaloensis	A borer moth	Insect	2
Papaipema stenocelis	Chain fern borer moth	Insect	2
Gomphaeschna antilope	Taper-tailed darner	Insect	2
Gomphaeschna furcillata	Harlequin darner	Insect	2
Sympetrum ambiguum	Blue-faced meadowhawk	Insect	2
Enallagma weewa	Blackwater bluet	Insect	2
Hemidactylum scutatum	Four-toed salamander	Amphibian	2
Pseudotriton montanus montanus	Mud salamander	Amphibian	2
Hyla chrysoscelis	Cope's gray treefrog	Amphibian	2
Rana virgatipes	Carpenter frog	Amphibian	2
Opheodrys aestivus	Rough green snake	Reptile	2
Thamnophis sauritus	Eastern ribbon snake	Reptile	2
Agkistrodon contortix	copperhead	Reptile	2
Ardea herodias	Great blue heron	Bird	2
Casmerodius albus	Great egret	Bird	2
Egretta thula	Snowy egret	Bird	2
Egretta caerulea	Little blue heron	Bird	2
Egretta tricolor	Tricolored heron	Bird	2
Bubulcus ibis	Cattle egret	Bird	2
Plegadis falcinellus	Glossy ibis	Bird	2
Buteo lineatus	Red-shouldered hawk	Bird	2
Strix varia	Barred owl	Bird	2
Vireo flavifrons	Yellow-throated vireo	Bird	2
Protonotaria citrea	Prothonotary warbler	Bird	2
Helmitheros vermivorus	Worm-eating warbler	Bird	2
Oporornis formosus	Kentucky warbler	Bird	2
Piranga olivacea	Scarlet tanager	Bird	2
Icterus galbula	Baltimore oriole	Bird	2
Lasionycteris noctivagans	Silver-haired bat	Mammal	2
Nycticeius humeralis	Evening bat	Mammal	2

SGCN Species expected in Piedmont Stream Valley Wetlands			
Species	**Common Name**	**Class**	**Tier**
Poanes massasoit	Mulberry wing	Insects	1
Euphyes conspicua	Black dash	Insects	1
Papaipema eupatorii	Eupatorium borer moth	Insects	1
Glyptemys muhlenbergii	Bog turtle	Reptiles	1
Euphyes dion	Dion skipper	Insects	2
Boloria selene	Silver-bordered fritillary	Insects	2
Boloria selene myrina	Myrina fritillary	Insects	2
Euphydryas phaeton	Baltimore checkerspot	Insects	2
Satyrodes eurydice	Eyed brown	Insects	2

Arctonicta connecta	A noctuid moth	Insects	2
Parapamea buffaloensis	A borer moth	Insects	2
Cordulegaster erronea	Tiger spiketail	Insects	2
Cordulegaster bilineata	Brown spiketail	Insects	2
Libellula flavida	Yellow-sided skimmer	Insects	2
Sympetrum semicinctum	Band-winged meadowhawk	Insects	2
Eurycea longicauda	Longtail salamander	Amphibians	2
Regina septemvittata	Queen Snake	Reptiles	2
Thamnophis sauritus	Eastern Ribbon Snake	Reptiles	2