Historical Analysis and Map of Vegetation Communities, Land Covers, and Habitats of Wilmington State Park New Castle County, Delaware

Brandywine, Christina and Red Clay Creek Watersheds

Submitted to:

Delaware State Parks
Delaware Division of State Parks
89 Kings Highway
Dover, DE 19901

Completed by:

Robert Coxe, Ecologist

Delaware Natural Heritage and Endangered Species Program
Wildlife Section, Delaware Division of Fish and Wildlife
Department of Natural Resources and Environmental Control
4876 Hay Point Landing Road
Smyrna, DE 19977

November 16, 2012

Table of Contents

CHAPTER 1: INTRODUCTION AND METHODS

Setting of Wilmington State Park

Wilmington State Park is located in northern New Castle County, Delaware (Figure 1.1) in the northern part of the City of Wilmington. The State Park totals 345 acres and is divided into two sections, the Main Section and the Valley Garden and Hobbs Section. The Main Section is located within the Brandywine Creek watershed while the Valley Garden and Hobbs Section is in the Red Clay Creek watershed.

Figure 1.1. Location of Wilmington State Park

Soils and Geology of Wilmington State Park

Underlying Geology[1]

Wilmington State Park is located in the Piedmont physiographic province of Delaware on the Fall line of Brandywine Creek.

The southern limit of the Main Section is located on the Fall Line at the Market Street bridge in Wilmington. In this area the park barely reaches the Delaware Bay Group and Alluvial deposits from Brandywine Creek. Going further upstream into the Piedmont the park covers mostly Brandywine Blue Gneiss but also a little bit of Rockford Park Gneiss in the upper reaches. The Delaware Bay Group dates to the Upper Pleistocene and is described as "grayish brown silt overlying a fine to medium silty quartz sand." Alluvial deposits date from the Holocene Period and are described as "brown, light yellow-orange, and gray fine to coarse quartz sand, silt, clay, and fine to medium gravel." Brandywine Blue Gneiss is a Piedmont formation and underlies most of the Main Section. It dates from the Ordovician Period and is described as "medium to coarse grained granulites and gneisses composed of plagioclase, quartz, othropyroxene, clinopyroxene, brown-green hornblende, magnetite, and ilmenite." Rockford Park Gneiss is found in the upper parts of the section near the highest point in Wilmington, Delaware. It dates from the Ordovician Period and is described as "fine-grained mafic and fine-to medium grained felsic gneisses interlayered on the decimeter scale."

The Valley Garden-Hobbs Section is located in the Red Clay and Christina River drainages, north of the Fall Line and is totally in the Piedmont. Faulkland Gneiss, Barley Mill Gneiss, and the Wissahickon Formation underlie this section. Faulkland Gneiss dates from the Ordovician Period and is described as "predominantly fine- to coarse-grained amphibolites and quartz amphibolites with minor felsic rocks, probably metavolcanic." Barley Mill Gneiss also dates from the Ordovician Period and is described as "coarse-grained, foliated tonalite gneiss." The Wissahickon Formation is one of the larger formations in the Piedmont of Delaware and underlies most of the section. It dates from the Cambrian to Ordovician Periods and is described as "interlayered psammitic and politic gneiss with amphibolite."

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

Soils

One soil, Neshaminy-Montalto Silt Loam, is prominent in the park and covers 302 acres. Other minor soils include Glenelg Loam (122 acres), Hatboro-Codorus Complex (109 acres), Brinklow-Blocktown Complex (93 acres), Neshaminy Silt Loam (92 acres), and Gaila Loam (80 acres).

Main Section Soils

Neshaminy-Montalto Silt Loams (97 acres) is the main soil in the Main Section. Other minor soils include Udorthents (49 acres), Neshaminy Silt Loam (33 acres), and Delanco-Codorus-Hatboro Complex (26 acres).

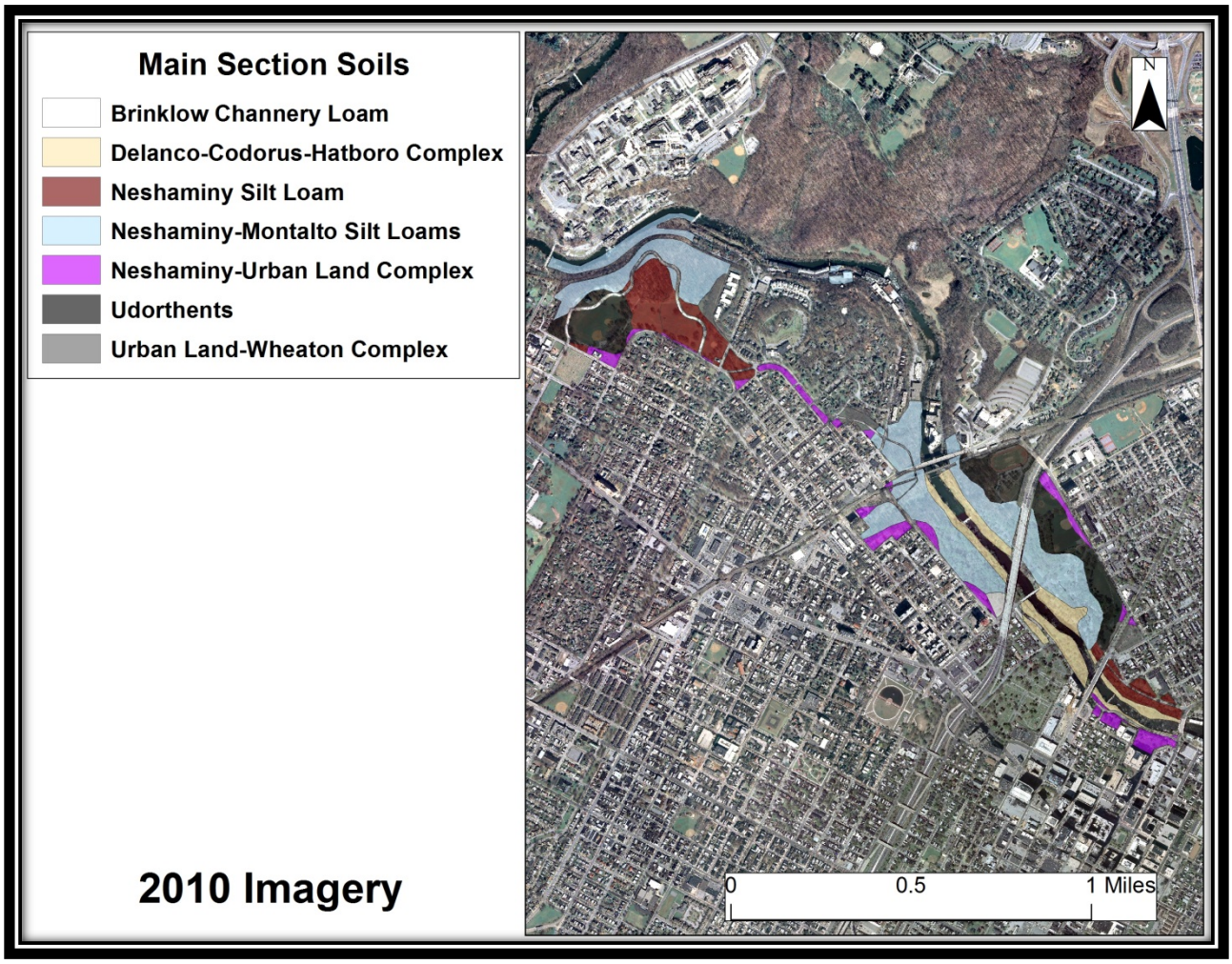


Figure 1.2. Main Section Soils

Valley Garden-Hobbs Section Soils

Glenelg Loam (100 acres) is the main soil in the Valley Garden-Hobbs Section. Other soils are very minor and include Glenville Silt Loam (5 acres) and Hatboro-Codorus Complex (5 acres).

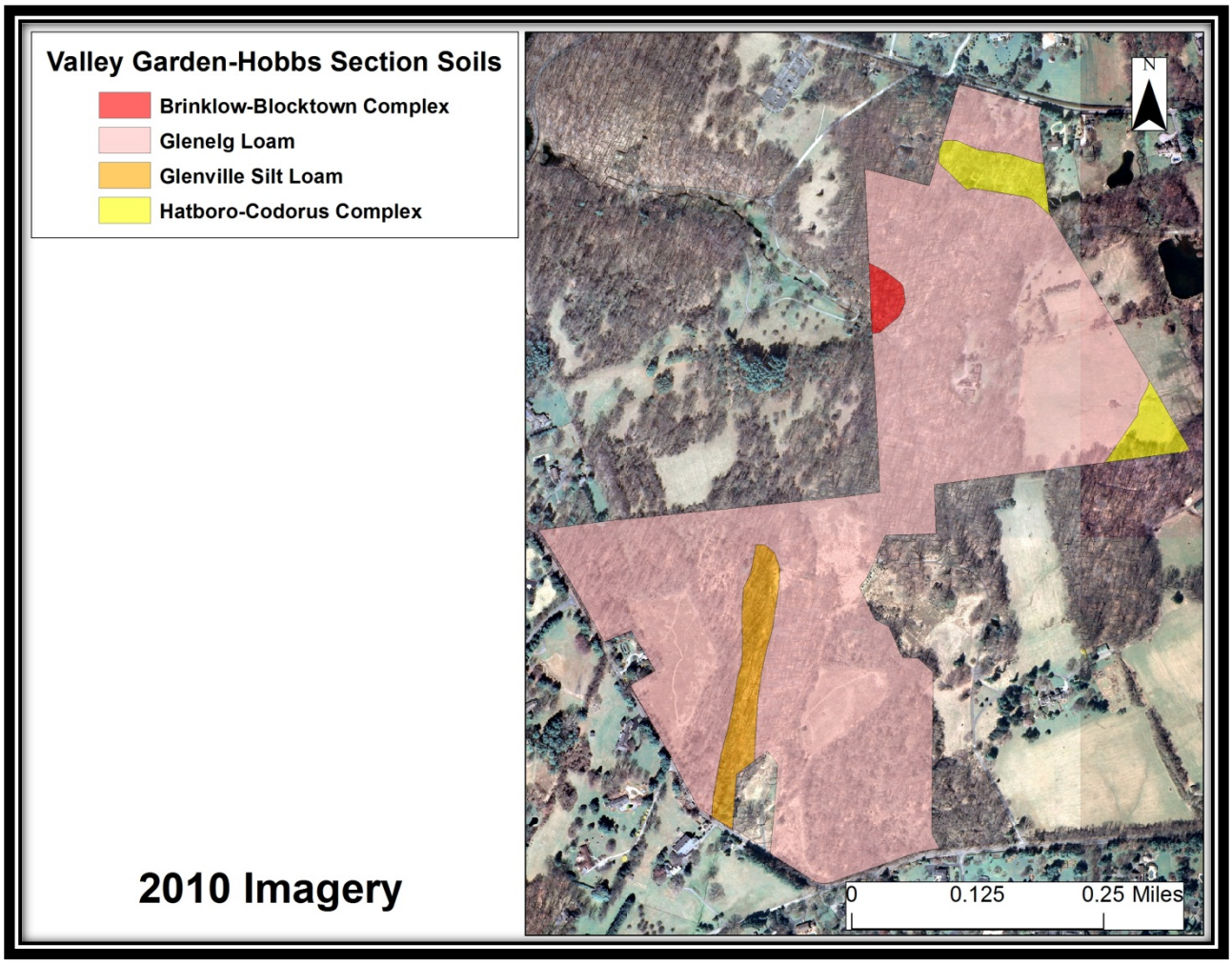


Figure 1.3. Valley Garden-Hobbs Section Soil Map

Elevation

Elevations at Wilmington State Park range from sea level at the Market Street Bridge on Brandywine Creek to 350 feet at the Valley Garden-Hobbs Property.

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 Wilmington State Park based on 1954, 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 park.
4. Produce Ecological Integrity Assessments (EIAs) for vegetation communities that are ranked S2 or higher.

Surveys were conducted during 2006 and2007 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 1954, 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 communities are provided 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 description.

Analysis of Historical Imagery

Historical imagery of Wilmington State Park from 1954 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, 48, 53, and 56 year time frame. Changes in the respective vegetation communities and land covers are discussed in the descriptions while broader changes are discussed in the wildlife area discussion. There is more imagery available (1937, 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 access area 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 community at Wilmington State Park included in the EIA analysis is listed in Table 2.3.

Forest Block Analysis

Current forest blocks within or partially within the state park 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 (Table 2.4). A block is defined as contiguous forest habitat that is contained with 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

[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.

habitat or in agricultural use. These blocks were determined for future planning in regards to improving and increasing forest interior habitat.

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, FOREST BLOCKS, AND GENERAL OBSERVATIONS

Summary of Findings from this study

1. **Vegetation Communities:** Eight vegetation communities and four land covers were found at Wilmington State Park. Cultivated Lawn (113 acres) is the largest vegetation community, followed by Northern Piedmont Mesic Oak-Beech Forest with 93 acres. Impervious Surface (29 acres) is the largest land cover.

2. **Rare Plants:** Thirteen rare plants are known to exist in Wilmington State Park (Table 2.1).

Scientific Name	Common Name	Rank	Last Observed
Cunila oreganoides	Common Dittany	S2	???
Cystopteris tenuis	Bladderfern	S1	2001
Danthonia compressa	Flattened Oatgrass	S2	???
Elymus hystrix	Bottle-brush Grass	S2	???
Euonymus atropupureus	Wahoo	S1	???
Heteranthera dubia	Grassleaf Mud-plantain	S2	1995
Ionactis linariifolius	Flaxleaf Aster	S2	???
Ostrya virginiana	Eastern Hop Hornbeam	S2	1990
Sanicula trifoliata	Large-fruited Sanicle	S1.1	1989
Smilax hispida	Halbeard-leaf Greenbrier	S1	1991
Thalictrum dioicum	Early Meadow-rue	S1	???
Veronica americana	American Speedwell	S1	1988
Woodsia obtusa spp. *obtusa*	Blunt-lobe Woodsia	S1	1991

Table 2.1. Rare Plants at Wilmington State Park

3. **Rare Animals:** Six rare animals are known to exist in Wilmington State Park (Table 2.2).

Scientific Name	Common Name	Rank	Last Observed
Atildes halesus	Great Purple Hairstreak	S1	1982
Battus philenor	Pipevine Swallowtail	S2	1893
Boloria selene myrina	Myrina fritillary	S1	1904
Libytheana carinenta	American Snout	SH	???
Polygonia progne	Gray Comma	SH	1942
Sphinx franckii	Franck's Sphinx	SH	???

Table 2.2. Rare Animals at Wilmington State Park

Ecological Integrity Assessment (EIA)

One vegetation community, Central Appalachian Dry-Mesic Chestnut Oak Northern Red Oak Forest, is ranked S2 or higher. It is summarized in Table 2.3.

Table 2.3. EIA Vegetation Communities located in Wilmington State Park

Community Map	Community Name/EIA Score	Description
	**Wilmington 1** **Central Appalachian Dry-Mesic Chestnut Oak Northern Red Oak Forest** **(51.6 acres)** **EIA = 2.61 (C rank)**	This slopes forest is located in the Rockford Park area of Wilmington.

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 predators[5]. 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.

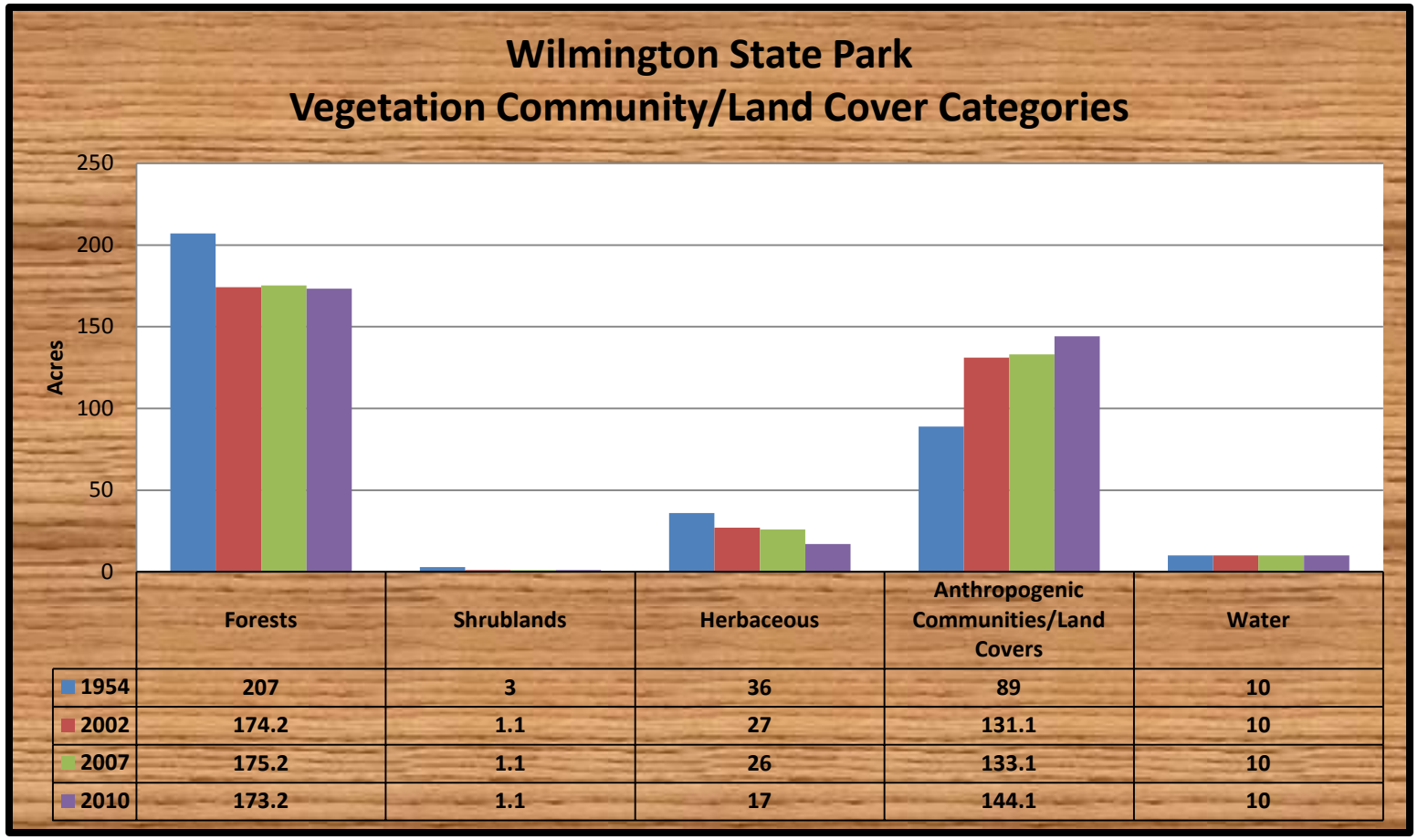
Analysis of Forest Blocks at Wilmington State Park

One forest block is present that is more than 100 acres in size and are located in whole or part in the park (Table 2.4). 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.

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

Table 2.4. Forest Blocks located in whole or part in Wilmington State Park

Forest Block Map	Block Name/Acreage	Description
	**Wilmington A** **Current Block = 124 acres (4 acres interior)** **Potential Block = 437 acres (107 acres interior)**	Wilmington A covers a wooded area north of Hillside Road. It is bounded by Campbell Road on the north, Kennett Pike on the east, Hillside Road on the south, and Hillside and Centerville Road on the west. 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. Red Clay Creek drains this block. Currently this block contains 4 acres of interior habitat. Potentially this block could be 437 acres in size and contain 107 acres of interior habitat.



	Forests	Shrublands	Herbaceous	Anthropogenic Communities/Land Covers	Water
1954	207	3	36	89	10
2002	174.2	1.1	27	131.1	10
2007	175.2	1.1	26	133.1	10
2010	173.2	1.1	17	144.1	10

Figure 3.1. Wilmington State Park Vegetation Categories/Land Covers (1954, 2002, 2007, and 2010)

Wilmington State Park Broad Trends (Figure 3.1): Forest is the most vegetation community type in Wilmington State Park, followed closely by Anthropogenic Communities/Land Covers. Since the park is located in an urban area anthropogenic communities/land covers have been increasing through time cutting some into the forested area.

Natural Capital (Table 3.1)

Wilmington State Park is perhaps the most urbanized park in the Delaware State Park system. As such it is subject to the conversion of its land to anthropogenic communities/land covers which do not have any natural capital value. Because of these conversions, the capital of the park has gradually declined over the years.

Table 3.1. Natural Capital of Wilmington State Park

Year	Natural Capital (in 2012 dollars)
1954	$107,485/year
2002	$91,377/year
2007	$91,213/year
2010	$89,523/year

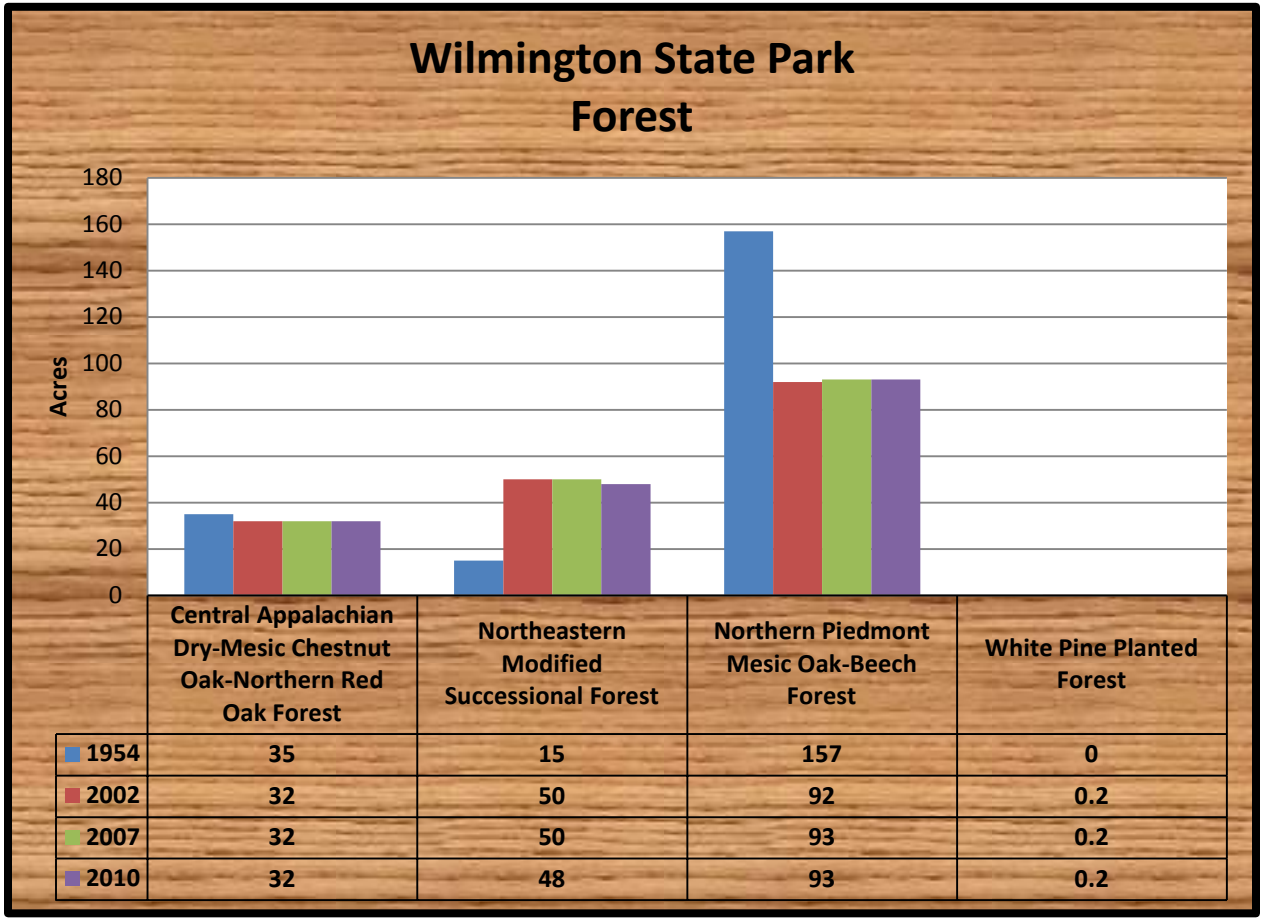


Figure 3.2. Forest at Wilmington State Park (1954, 2002, 2007, and 2010)

Wilmington State Park Forest (Figure 3.2): Northern Piedmont Mesic Oak-Beech Forest is the most common forest community, followed by Northeastern Modified Successional Forest. On the whole Northeastern Modified Successional Forest has been increasing while Northern Piedmont Mesic Oak-Beech Forest has been decreasing. Exotic invasive species can gradually convert the Northern Piedmont Mesic Oak-Beech Forest (native type forest) to Northeastern Modified Successional Forest as they spread.

Natural Capital (Table 3.2)

Capital of forest has shown a gradual downward trend as forests are converted to anthropogenic communities/land covers.

Table 3.2. Natural Capital of Wilmington State Park Forest	
Year	**Natural Capital (in 2012 dollars)**
1954	$39,144/year
2002	$32,960/year
2007	$32,941/year
2010	$32,563/year

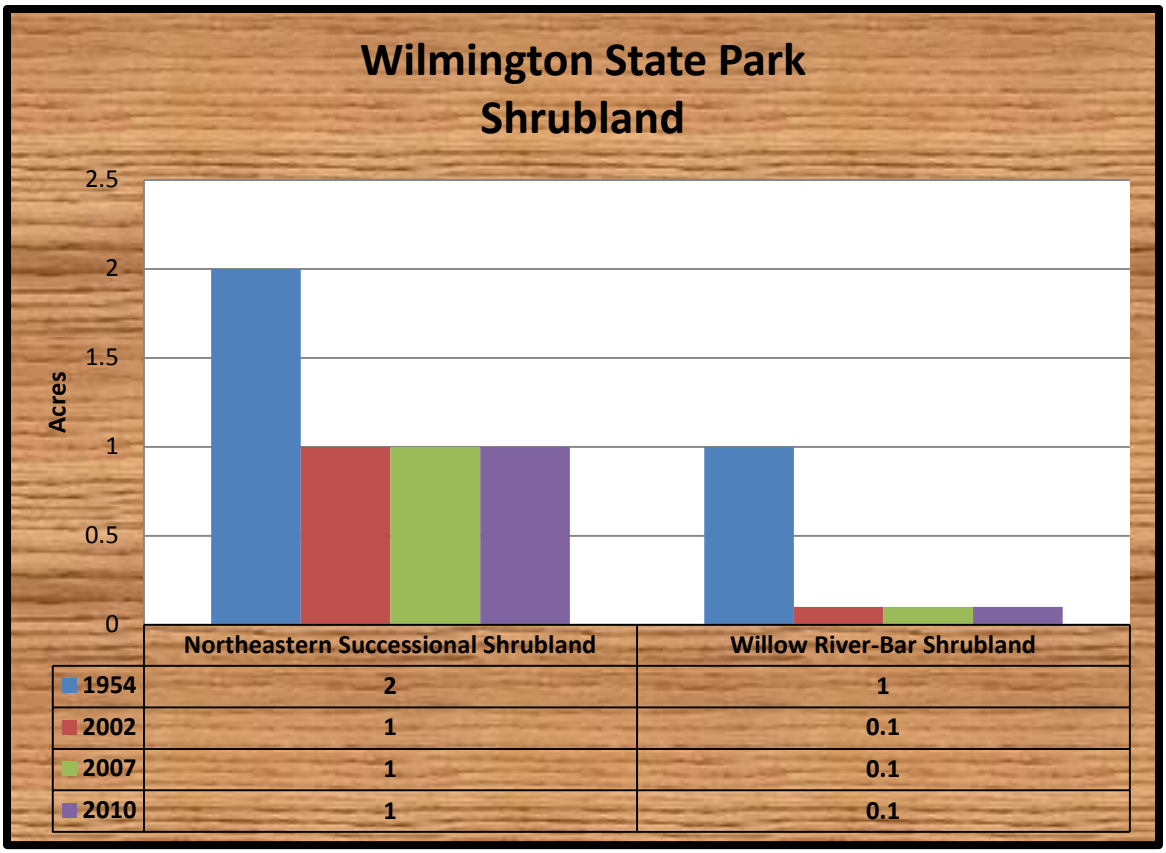


Figure 3.3. Shrubland at Wilmington State Park (1954, 2002, 2007, and 2010)

Wilmington State Park Shrubland (Figure 3.3): Northeastern Successional Shrubland is the most common shrubland in the park out of two shrublands. Wilmington State Park is one of the few locations for Willow River-Bar Shrubland in the state.

Natural Capital (Table 3.3)

Capital of shrubland is greatly reduced from its 1954 high and has remained the same since 2002.

Table 3.3. Natural Capital of Wilmington State Park Shrubland	
Year	**Natural Capital (in 2012 dollars)**
1954	$9,572/year
2002	$1,132/year
2007	$1,132/year
2010	$1,132/year

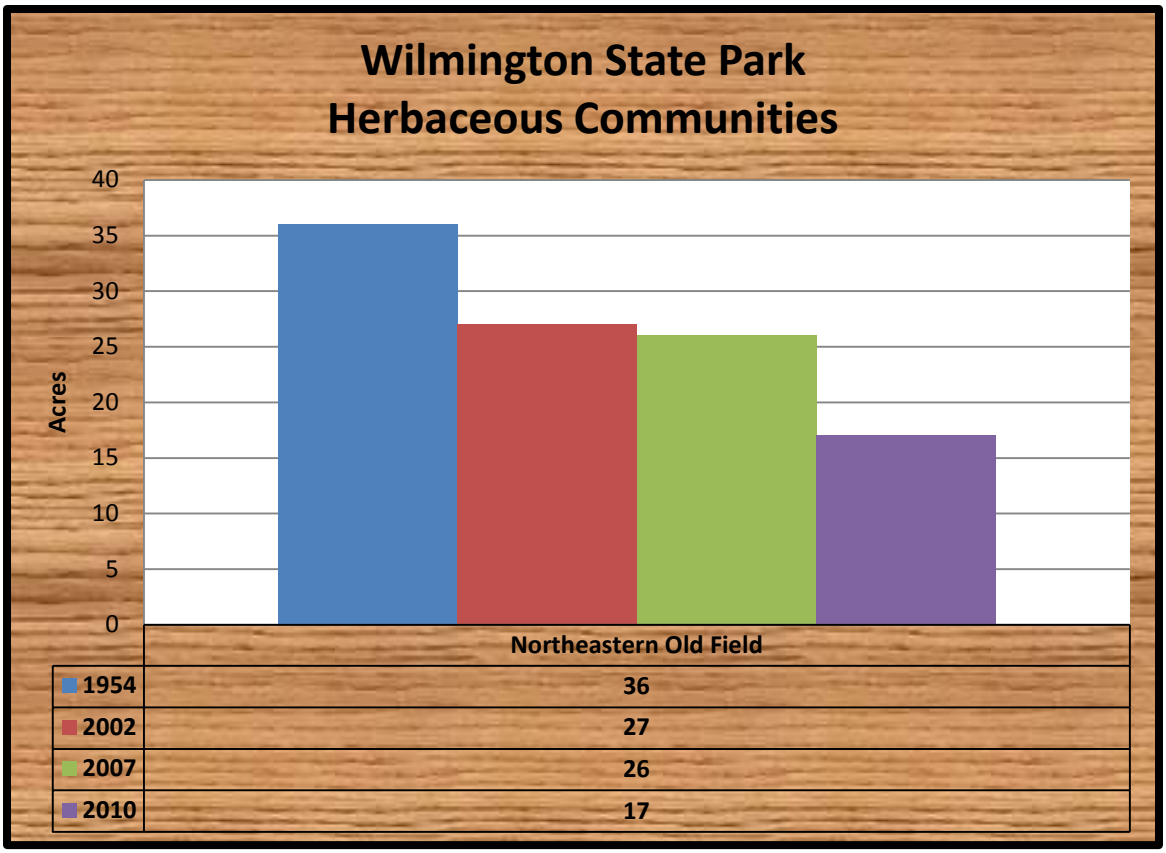


Figure 3.4. Herbaceous Communities at Wilmington State Park (1954, 2002, 2007, and 2010)

Wilmington State Park Herbaceous Communities (Figure 3.4): Northeastern Old Field is the only herbaceous community and has been decreasing as it matures to shrubland or is converted to cultivated lawn.

Natural Capital (Table 3.4)

Capital of herbaceous communities has declined steadily throughout the study period.

Table 3.4. Natural Capital of Wilmington State Park Herbaceous Communities	
Year	**Natural Capital (in 2012 dollars)**
1954	$5,303/year
2002	$3,934/year
2007	$3,788/year
2010	$2,477/year

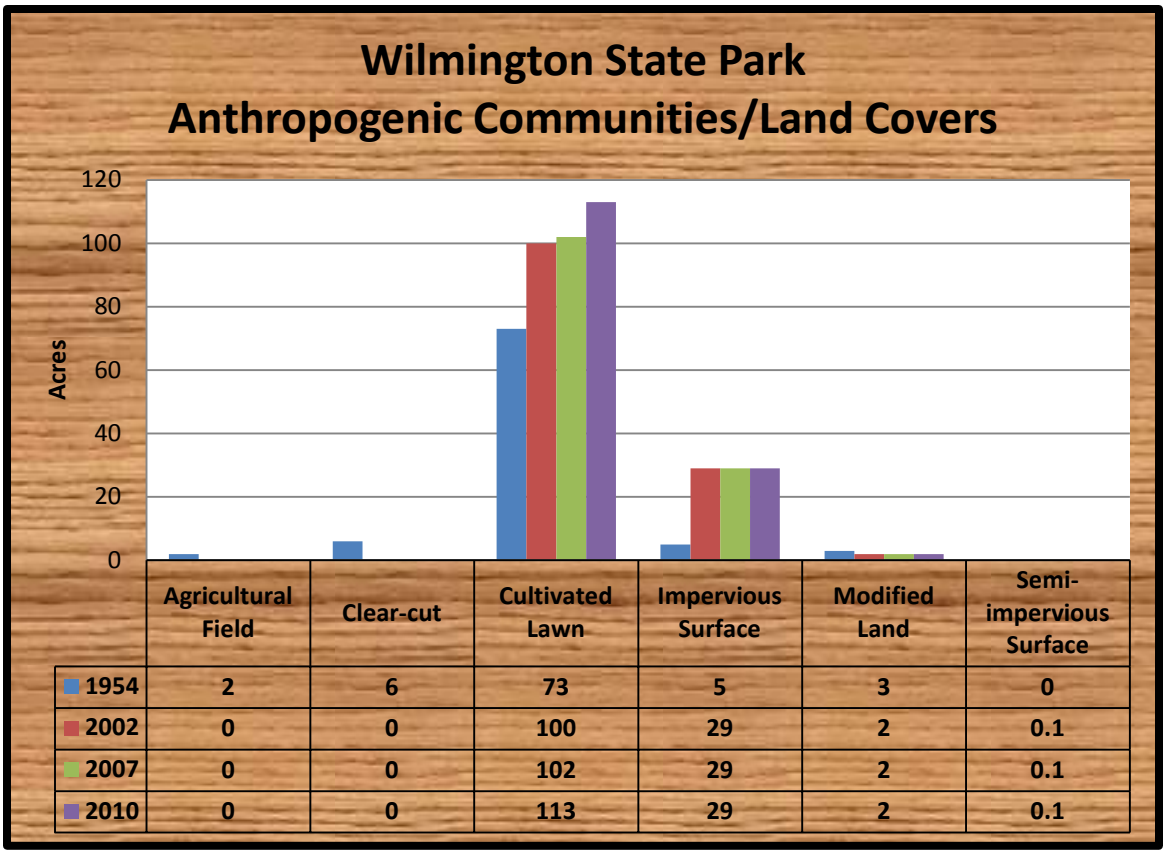


Figure 3.5. Anthropogenic Communities/Land Covers at Wilmington State Park (1954, 2002, 2007, and 2010)

Wilmington State Park Anthropogenic Communities/Land Covers (Figure 3.5): Cultivated lawn is the largest anthropogenic community/land cover, followed by impervious surface. Both of these communities and land covers have been increasing in time.

Natural Capital (Table 3.5)

Agricultural field is the only Anthropogenic Community/Land Cover with any capital value. It was present in 1954, but is no longer present in the park.

Table 3.5. Natural Capital of Wilmington State Park Anthropogenic Communities/Land Covers	
Year	**Natural Capital (in 2012 dollars)**
1954	$115/year
2002	$0/year (not present)
2007	$0/year (not present)
2010	$0/year (not present)

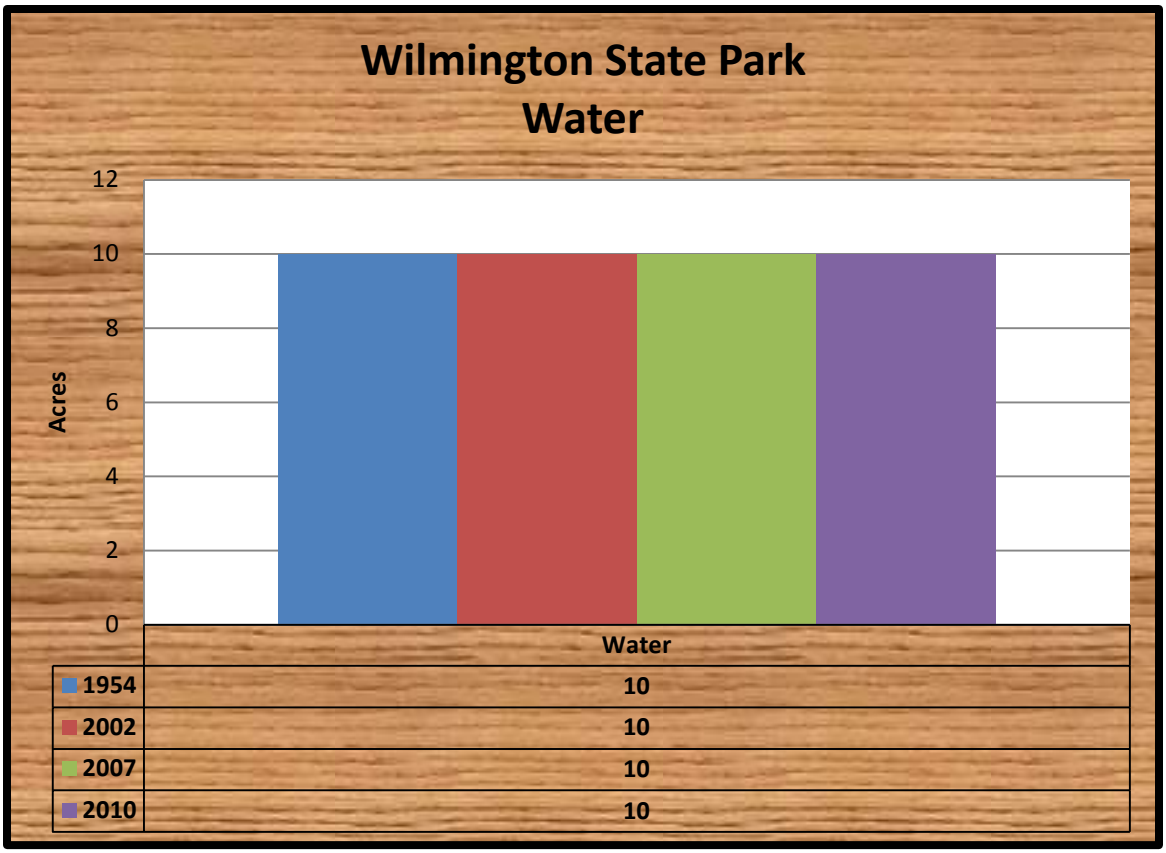


Figure 3.6. Water at Wilmington State Park (1954, 2002, 2007, and 2010)

Wilmington State Park Water (Figure 3.6): The amount of water in Wilmington State Park has stayed consistent since 1954. The water coverage is the main stem of Brandywine Creek and a canal that runs along the south bank.

Natural Capital (Table 3.6)

Water which includes the main stem of Brandywine Creek has remained at the same acreage and capital throughout the study period.

Table 3.6. Natural Capital of Wilmington State Park Water	
Year	**Natural Capital (in 2012 dollars)**
1954	$53,351/year
2002	$53,351/year
2007	$53,351/year
2010	$53,351/year

CHAPTER 4: VEGETATION COMMUNITIES/LAND COVERS BY SECTION

1. Main Section

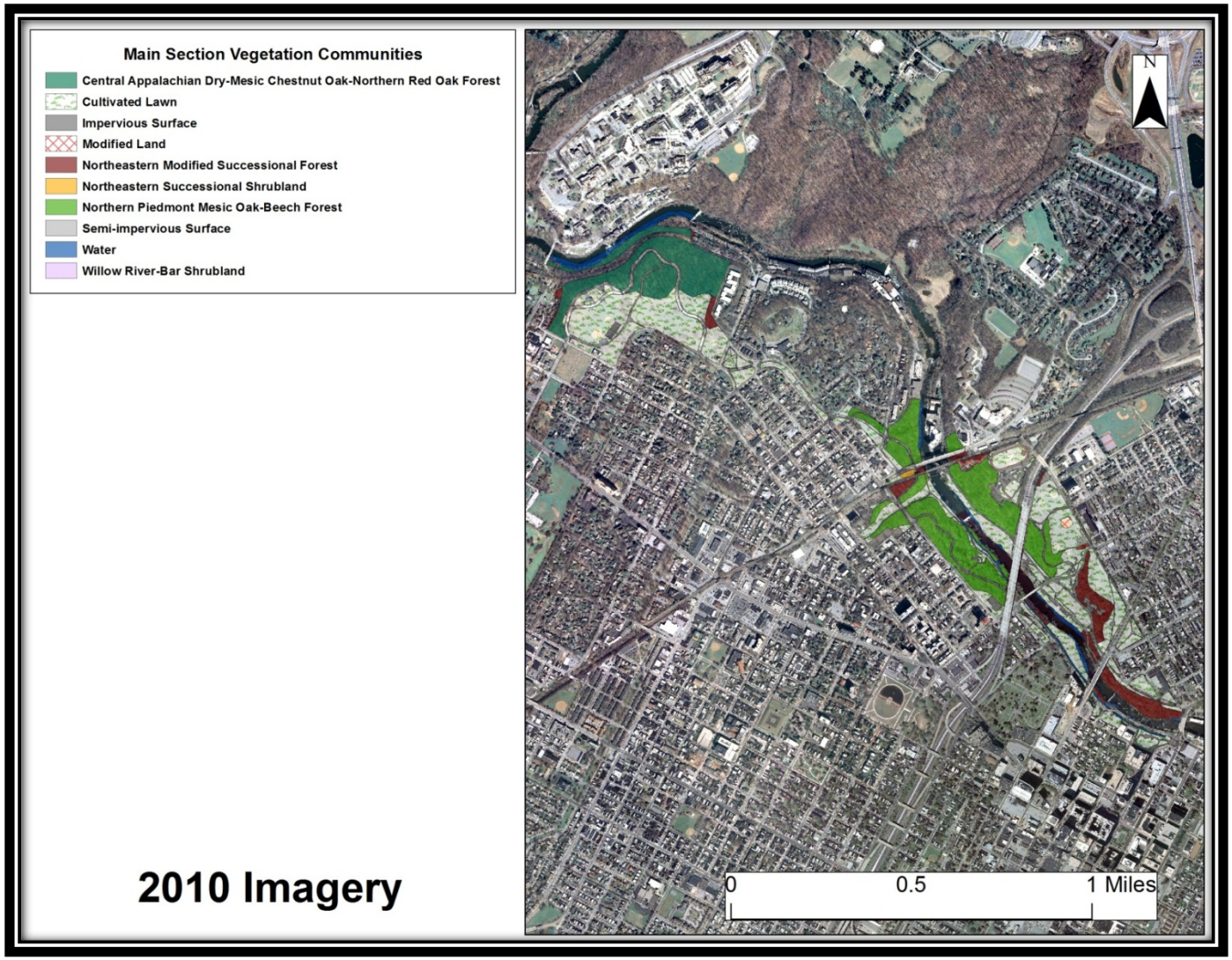


Figure 4-1.1. 2010 Vegetation Community Map of the Main Section

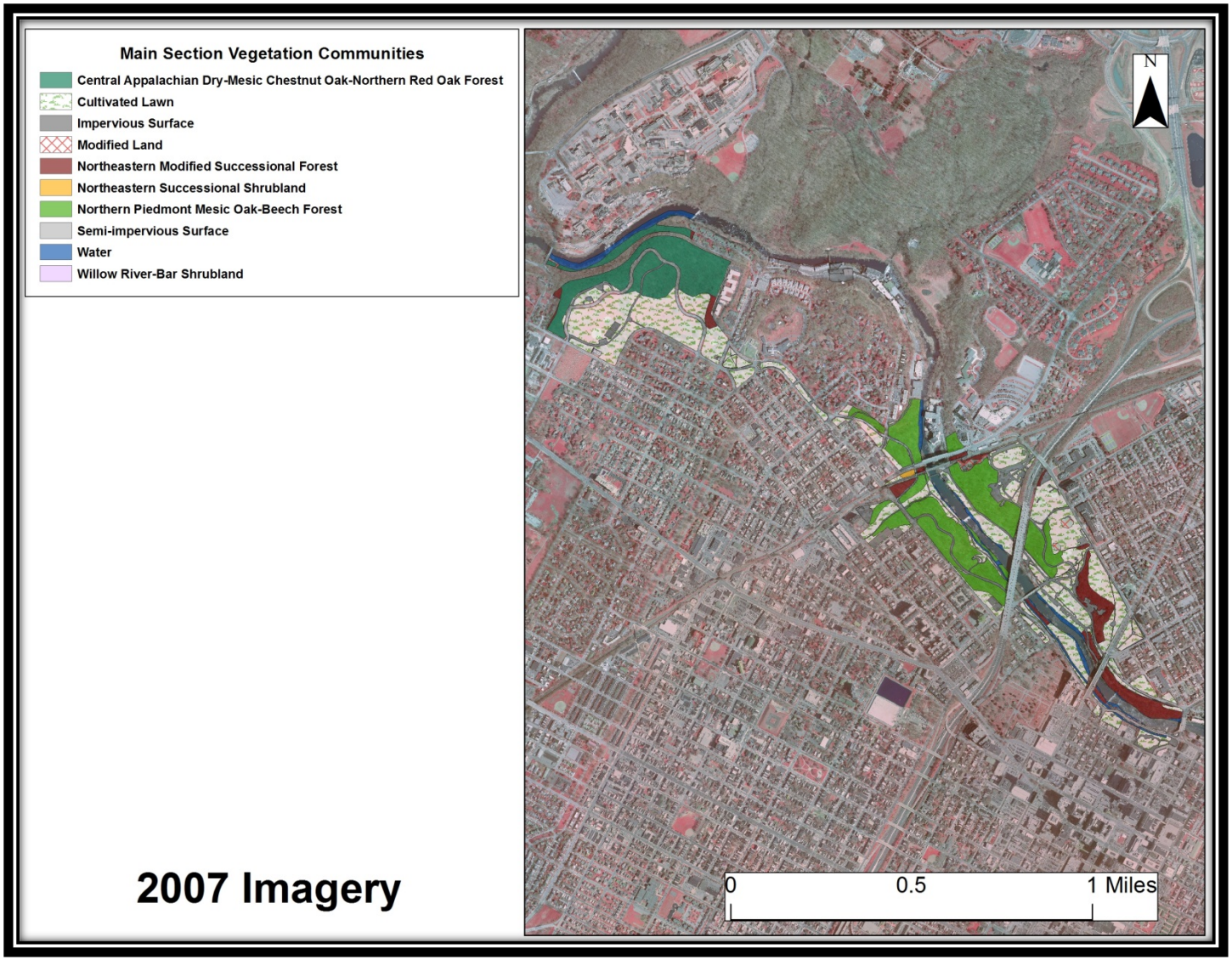


Figure 4-1.2. 2007 Vegetation Community Map of the Main Section

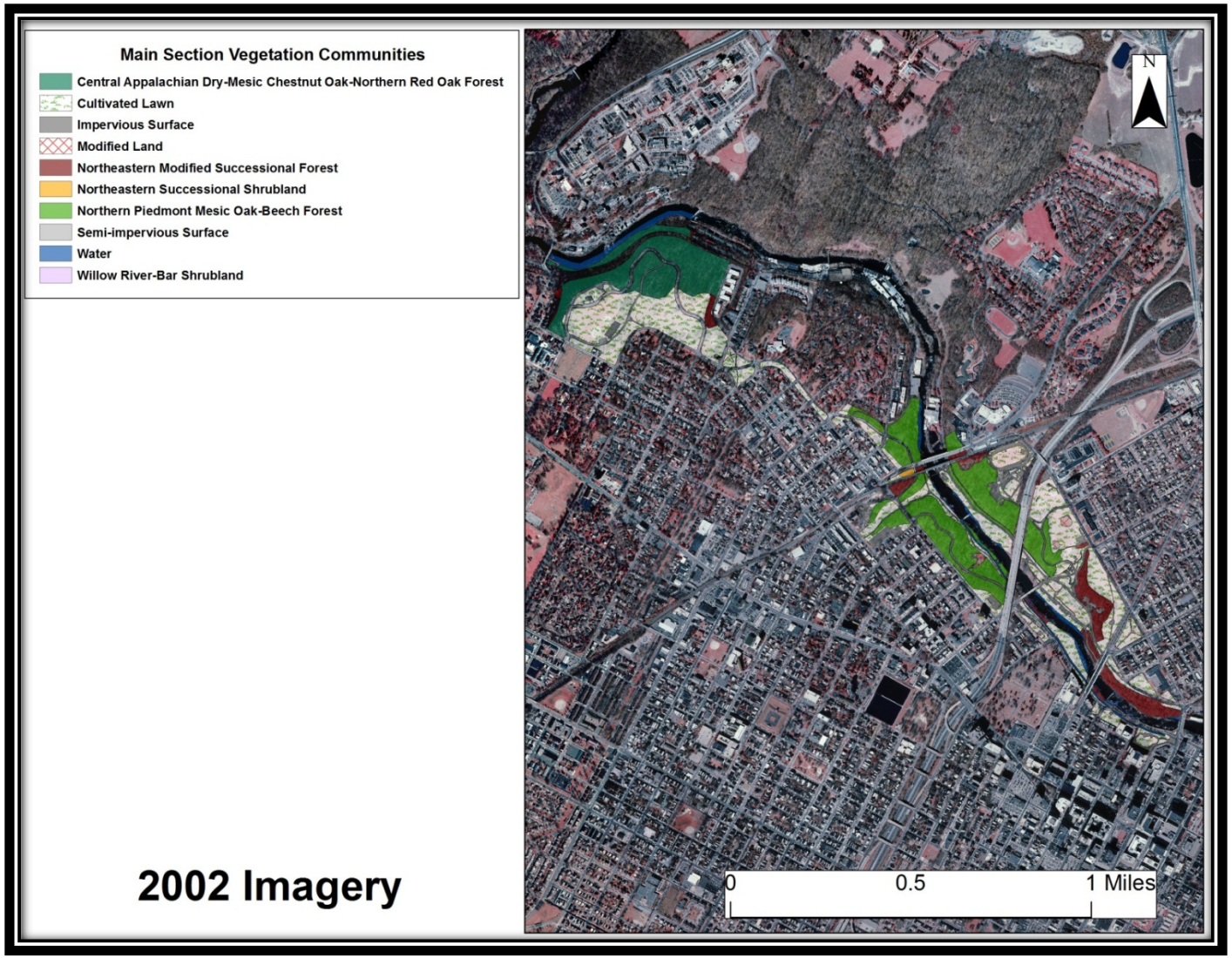


Figure 4-1.3. 2002 Vegetation Community Map of the Main Section

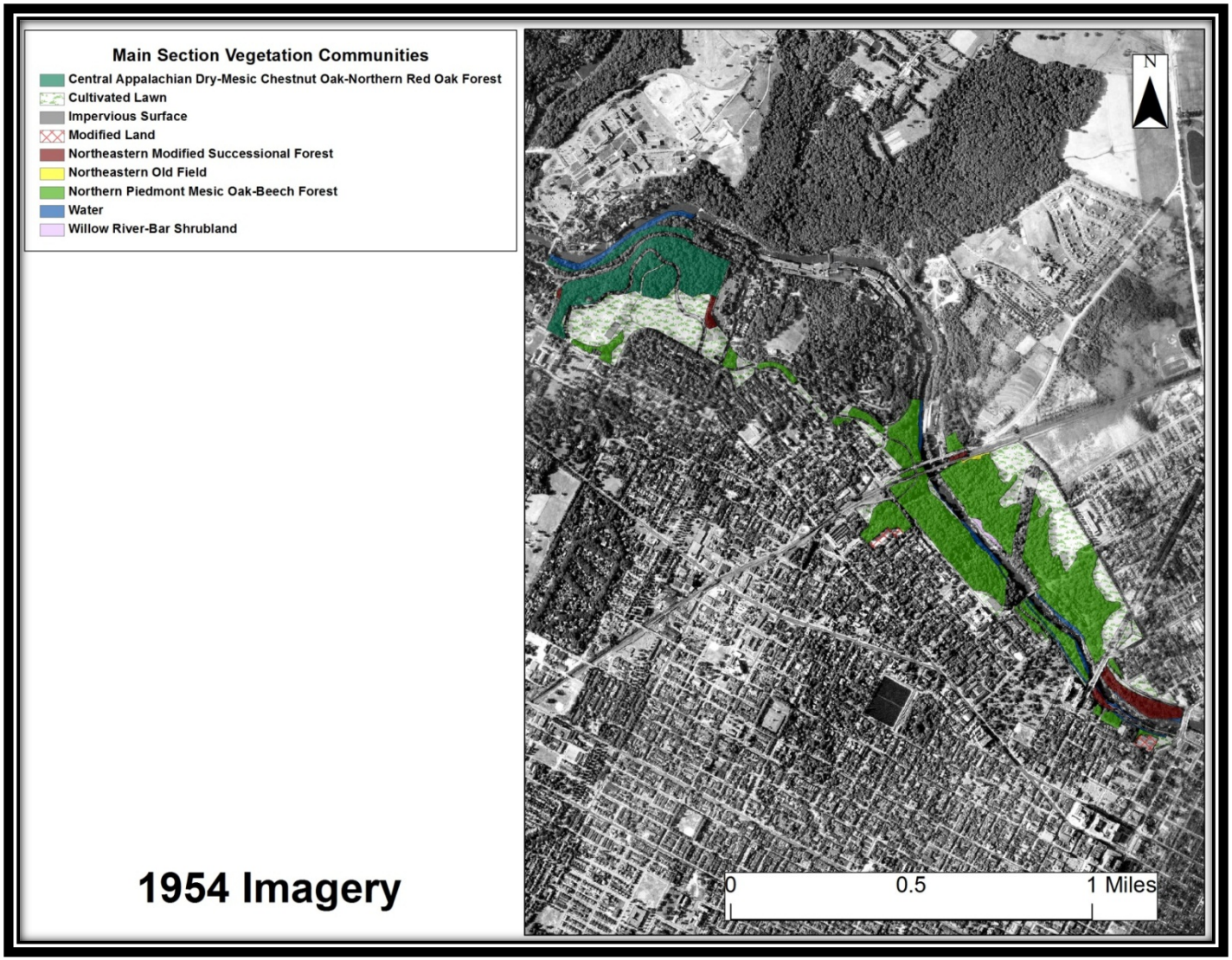
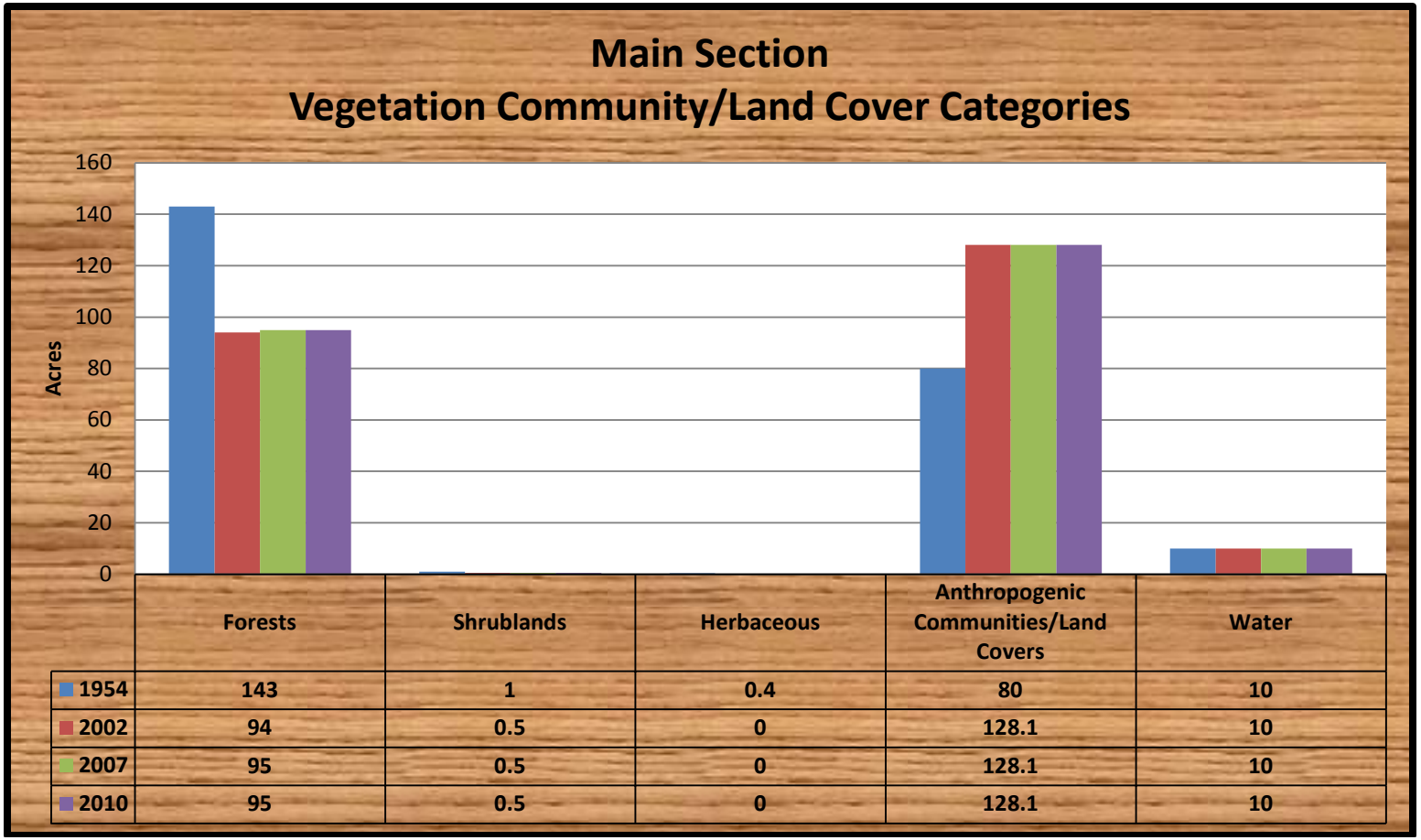


Figure 4-1.4. Vegetation Community Map of the Main Section



	Forests	Shrublands	Herbaceous	Anthropogenic Communities/Land Covers	Water
1954	143	1	0.4	80	10
2002	94	0.5	0	128.1	10
2007	95	0.5	0	128.1	10
2010	95	0.5	0	128.1	10

Figure 4-1.5. Main Section Vegetation Community/Land Cover Categories (1954, 2002, 2007, and 2010)

Main Section Categories (Figure 4-1.5): Anthropogenic Communities/Land Covers are the most vegetation types in the Main Section, followed by forest. The Main Section is the most urbanized of the sections.

Natural Capital (Table 4-1.1)

Natural capital of the Main Section has decreased overall since 1954 as the park becomes more urbanized. The anthropogenic communities/land covers in the park do not have any natural capital value, therefore any development subtracts from the overall capital of the park.

Table 4-1.1. Natural Capital of the Main Section	
Year	**Natural Capital (in 2012 dollars)**
1937	$89,732/year
2002	$72,113/year
2007	$72,302/year
2010	$72,302/year

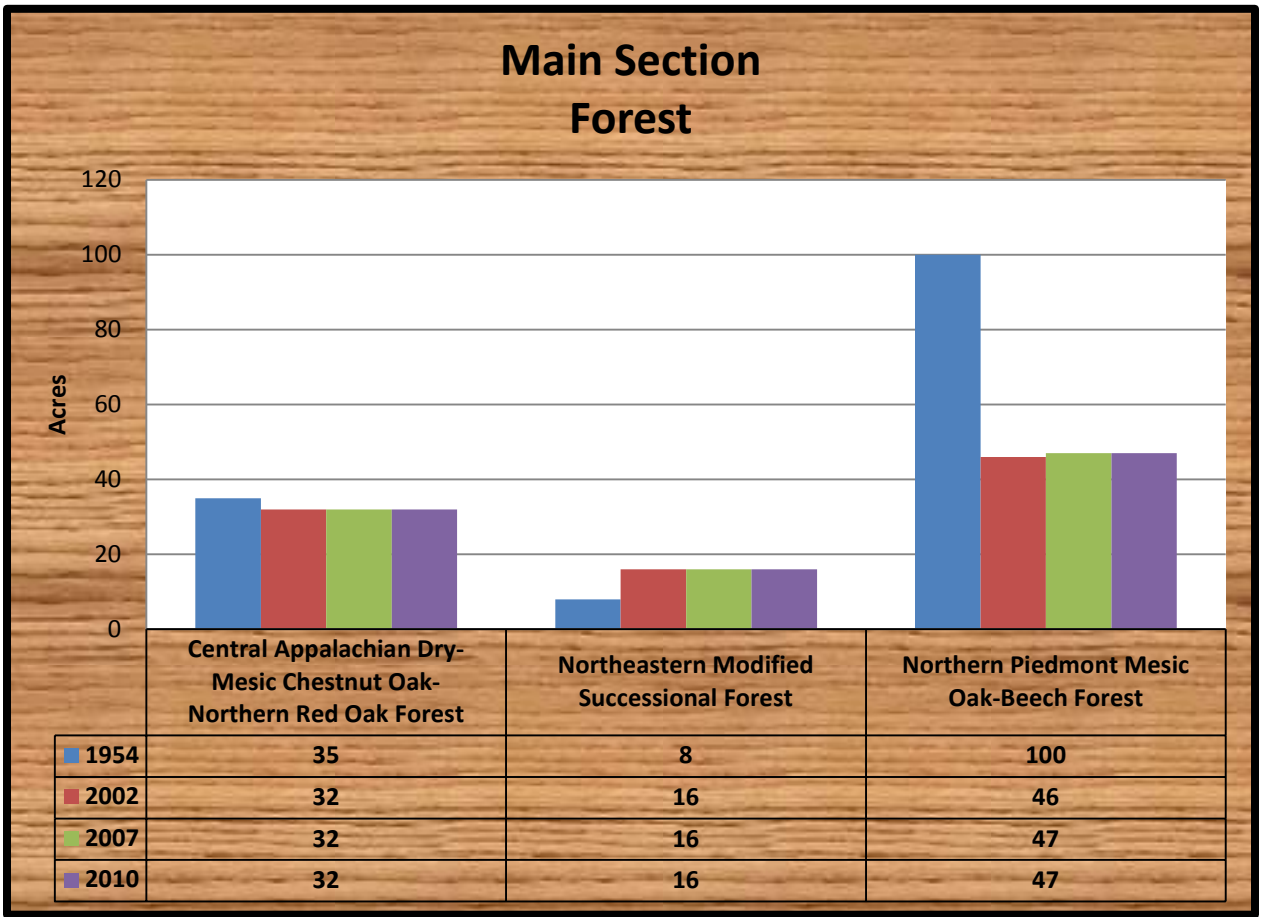


Figure 4-1.6. Main Section Forest (1954, 2002, 2007, and 2010)

Main Section Forest (Figure 4-1.6): Northern Piedmont Mesic Oak-Beech Forest is the most forest type in the Main Section. Central Appalachian Dry Mesic Chestnut Oak-Northern Red Oak Forest follows a close second and Wilmington State Park is one of the few locations for this community in the state.

Natural Capital (Table 4-1.2)

Natural capital of Main Section forest has decreased overall since 1954 due to development despite a lot of the former field areas becoming forest.

Table 4-1.2. Natural Capital of Main Section Forest	
Year	**Natural Capital (in 2012 dollars)**
1954	$27,041/year
2002	$17,775/year
2007	$17,965/year
2010	$17,965/year

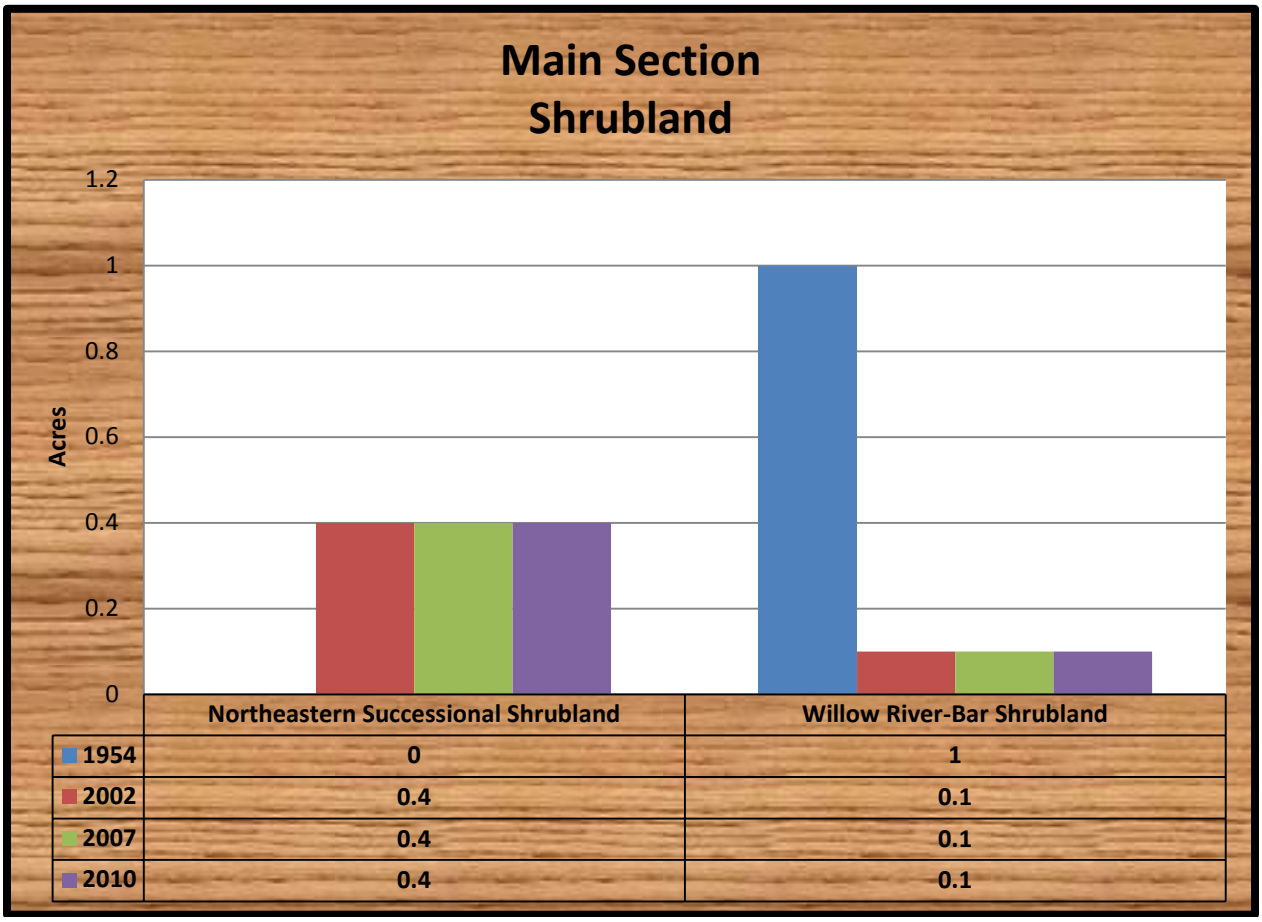


Figure 4-1.7. Main Section Shrubland (1954, 2002, 2007, and 2010)

Main Section Shrubland (Figure 4-1.7): Northeastern Successional Shrubland is the largest shrubland out of two in the Main Section. Willow River-Bar Shrubland has decreased since 1954 and could be due to a wall that is present on the side of Brandywine Creek preventing it from migrating on the creek bank.

Natural Capital (Table 4-1.3)

Natural capital of Main Section shrubland has greatly reduced being driven by losses to Willow River-Bar Shrubland.

Table 4-1.3. Natural Capital of Main Section Shrubland	
Year	**Natural Capital (in 2012 dollars)**
1954	$9,281/year
2002	$986/year
2007	$986/year
2010	$986/year

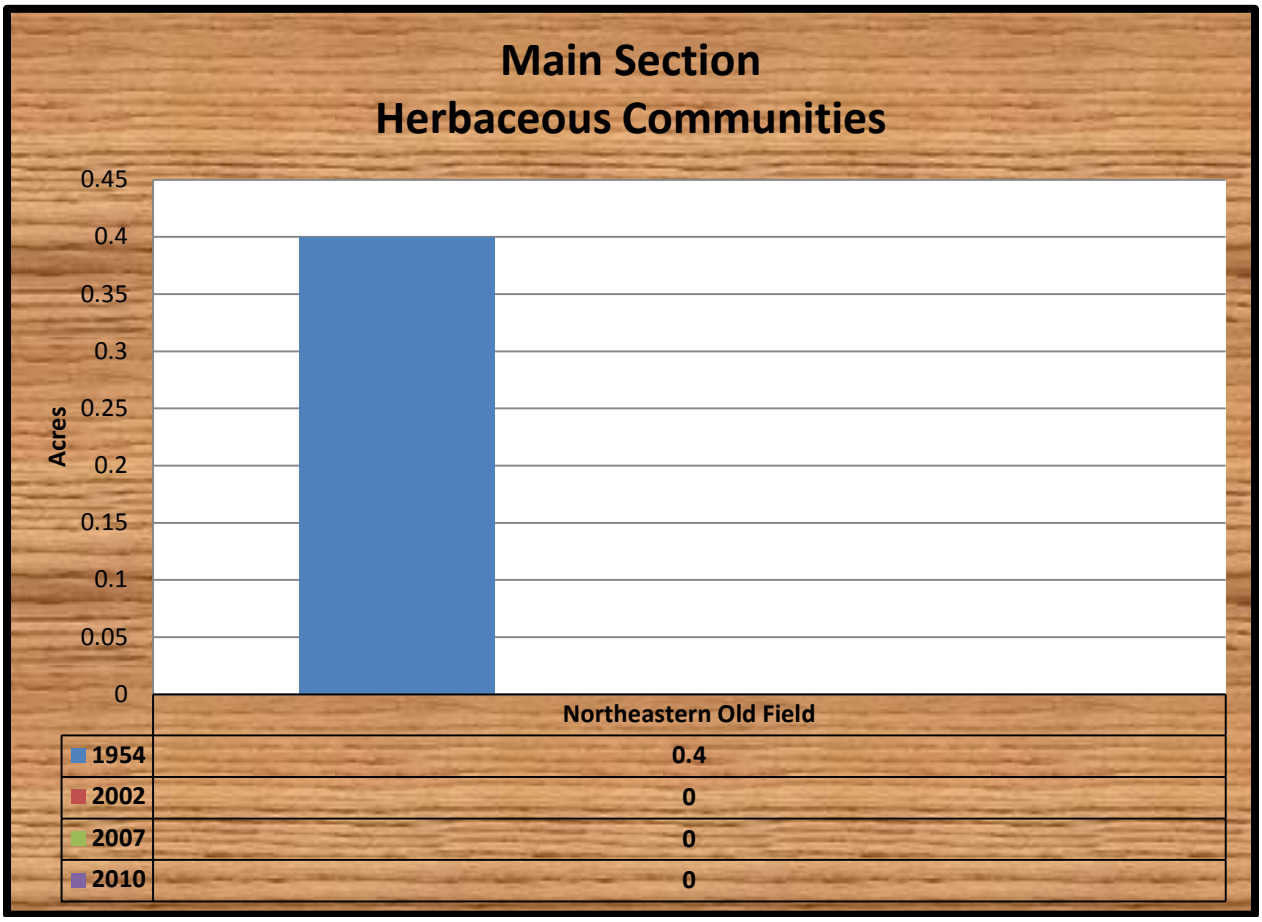


Figure 4-1.8. Main Section Herbaceous Communities (1954, 2002, 2007, and 2010)

Main Section Herbaceous Communities (Figure 4-1.8): Northeastern Old Field was the only herbaceous community present in 1954 and has since disappeared from the Main Section.

Natural Capital (Table 4-1.8)

Herbaceous Communities were present in 1954, but since 2002 are no longer present in the park.

Table 4-1.8. Natural Capital of Main Section Herbaceous Communities	
Year	**Natural Capital (in 2012 dollars)**
1954	$58/year
2002	$0/year (not present)
2007	$0/year (not present)
2010	$0/year (not present)

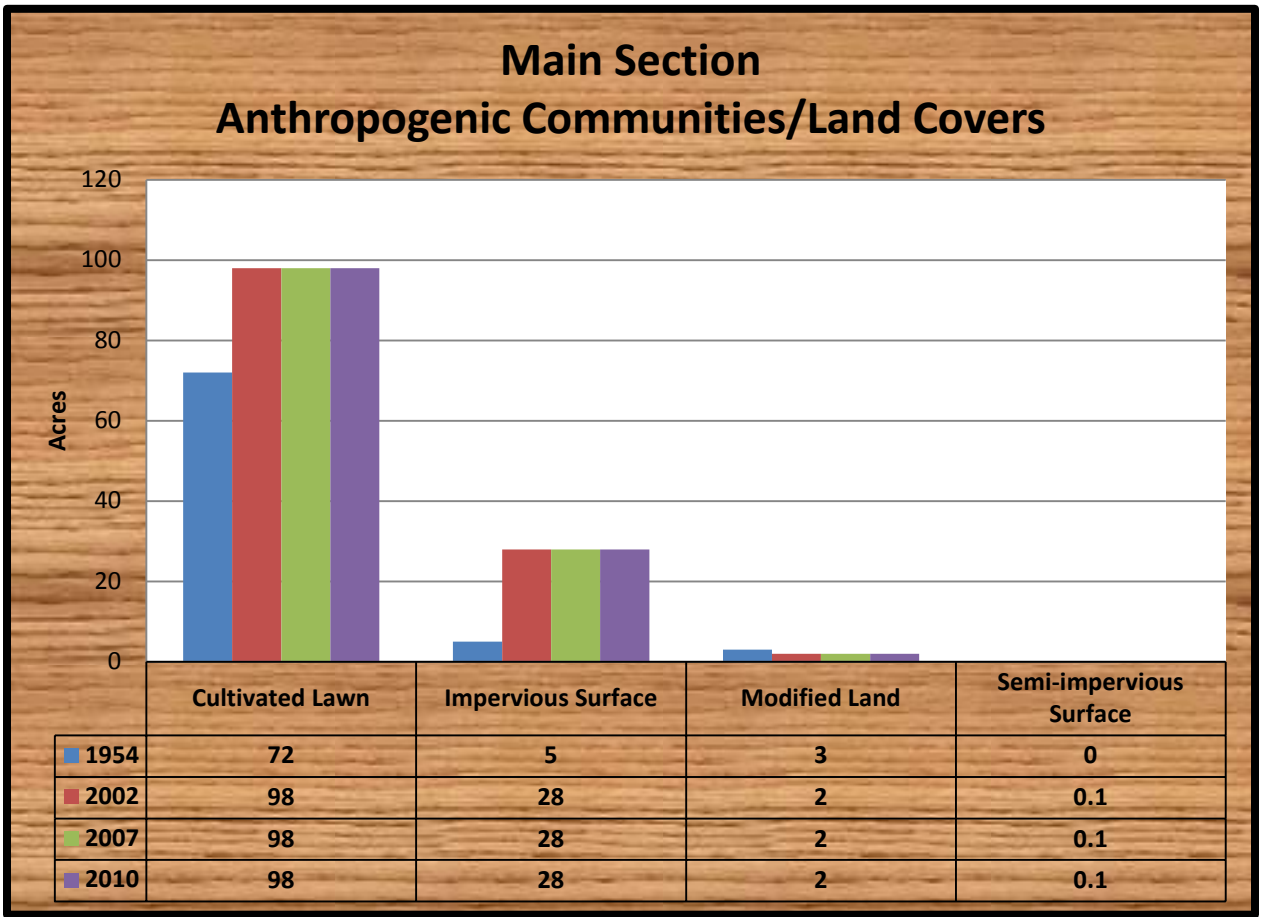


Figure 4-1.9. Main Section Anthropogenic Communities/Land Covers (1954, 2002, 2007, and 2010)

Main Section Anthropogenic Communities/Land Covers (Figure 4-1.9): Cultivated Lawn is the most common anthropogenic community, followed by the related impervious surface.

Natural Capital

None of the anthropogenic communities/land covers in the Main Section have any natural capital value.

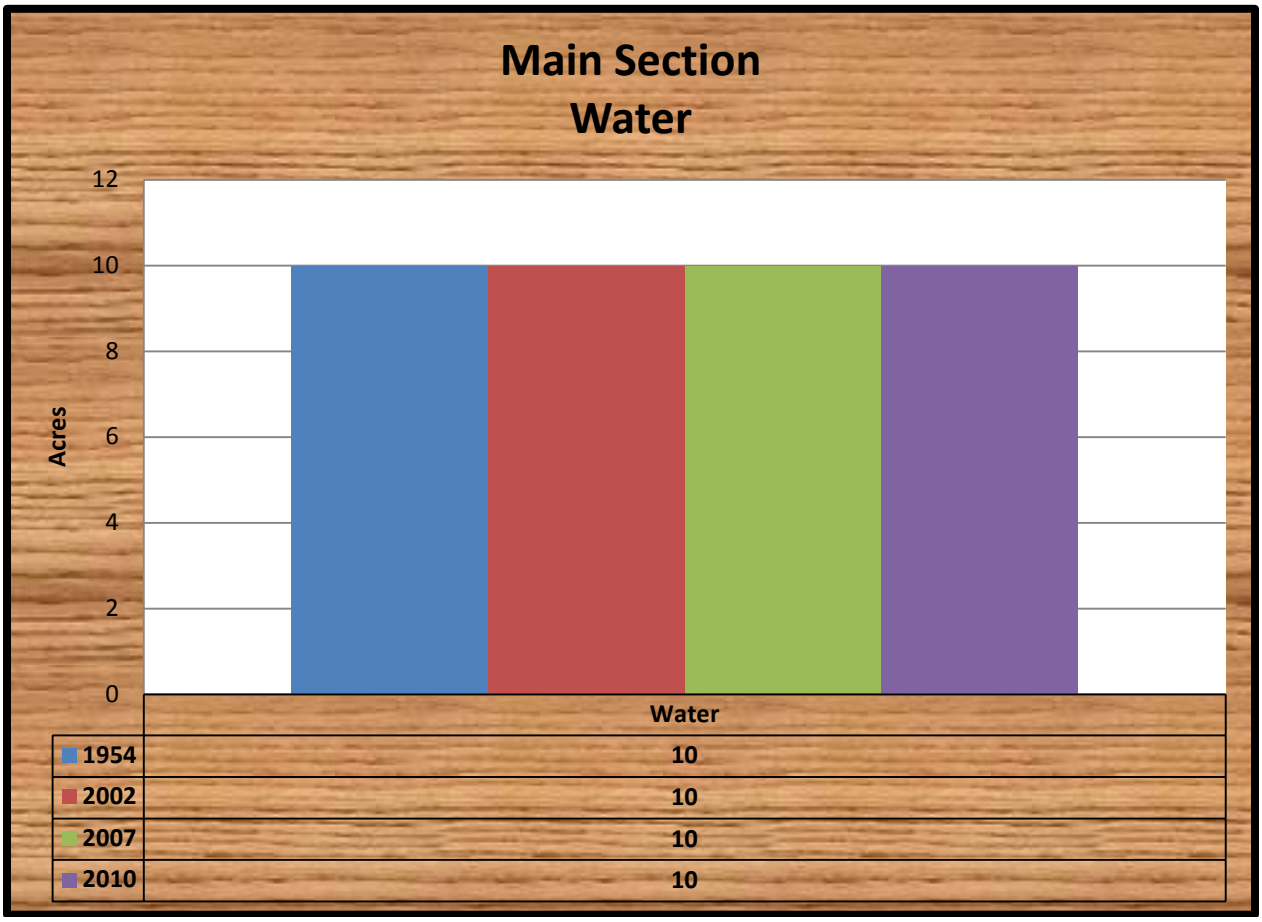


Figure 4-1.10. Main Section Water (1954, 2002, 2007, and 2010)

Main Section Water (Figure 4-1.10): Water, includes the main stem of Brandywine Creek and a canal that runs along the south side. The acreage of water has been stable at 10 acres through the study period.

Natural Capital (Table 4-1.12)

Since the acreage has been stable, the capital of water in the Main Section has remained constant since 1954.

Table 4-1.12. Natural Capital of Main Section Water	
Year	**Natural Capital (in 2012 dollars)**
1954	$53,351/year
2002	$53,351/year
2007	$53,351/year
2010	$53,310/year

2. Valley Garden and Hobbs Section

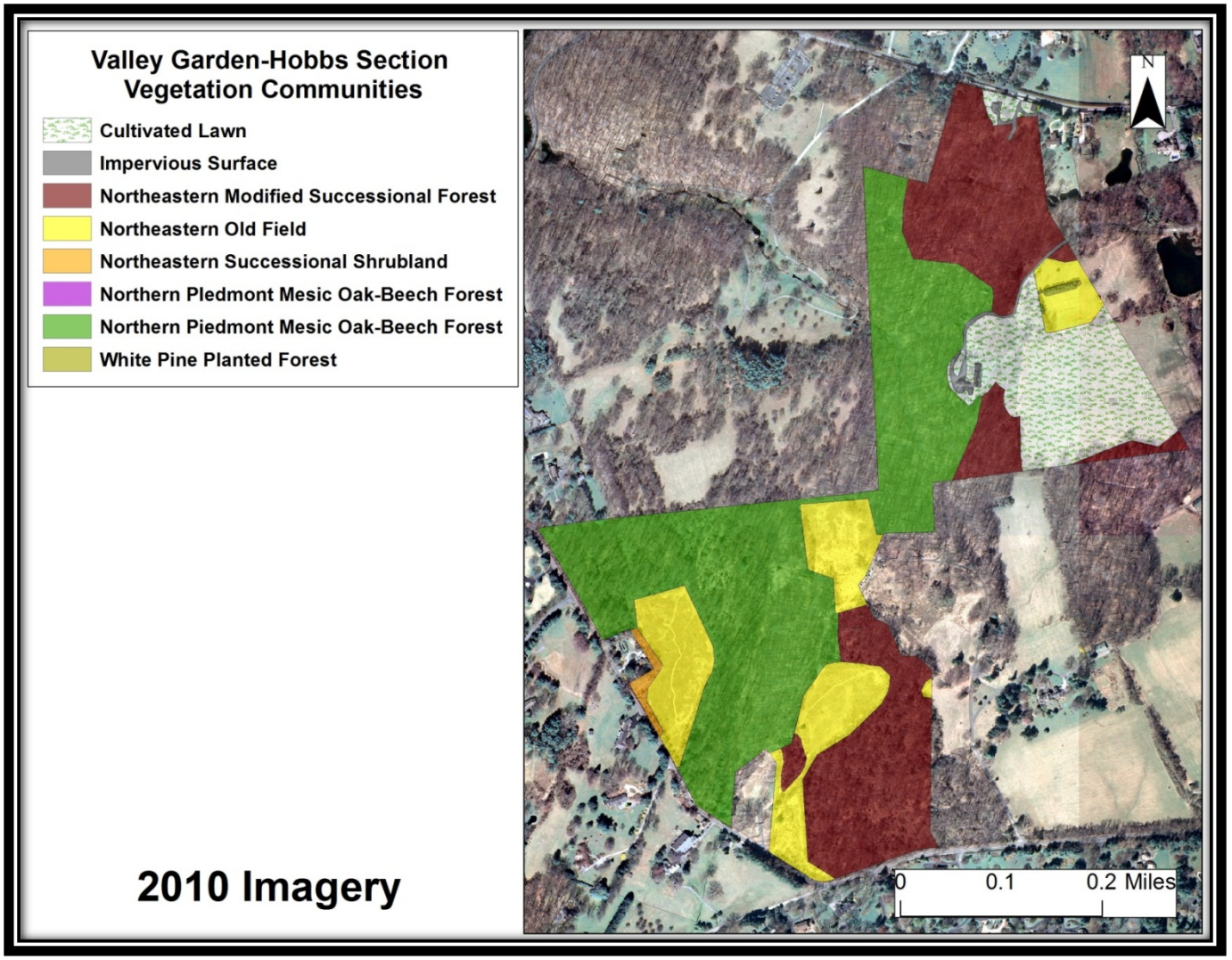


Figure 4-2.1. 2010 Vegetation Community Map of the Valley Garden-Hobbs Section

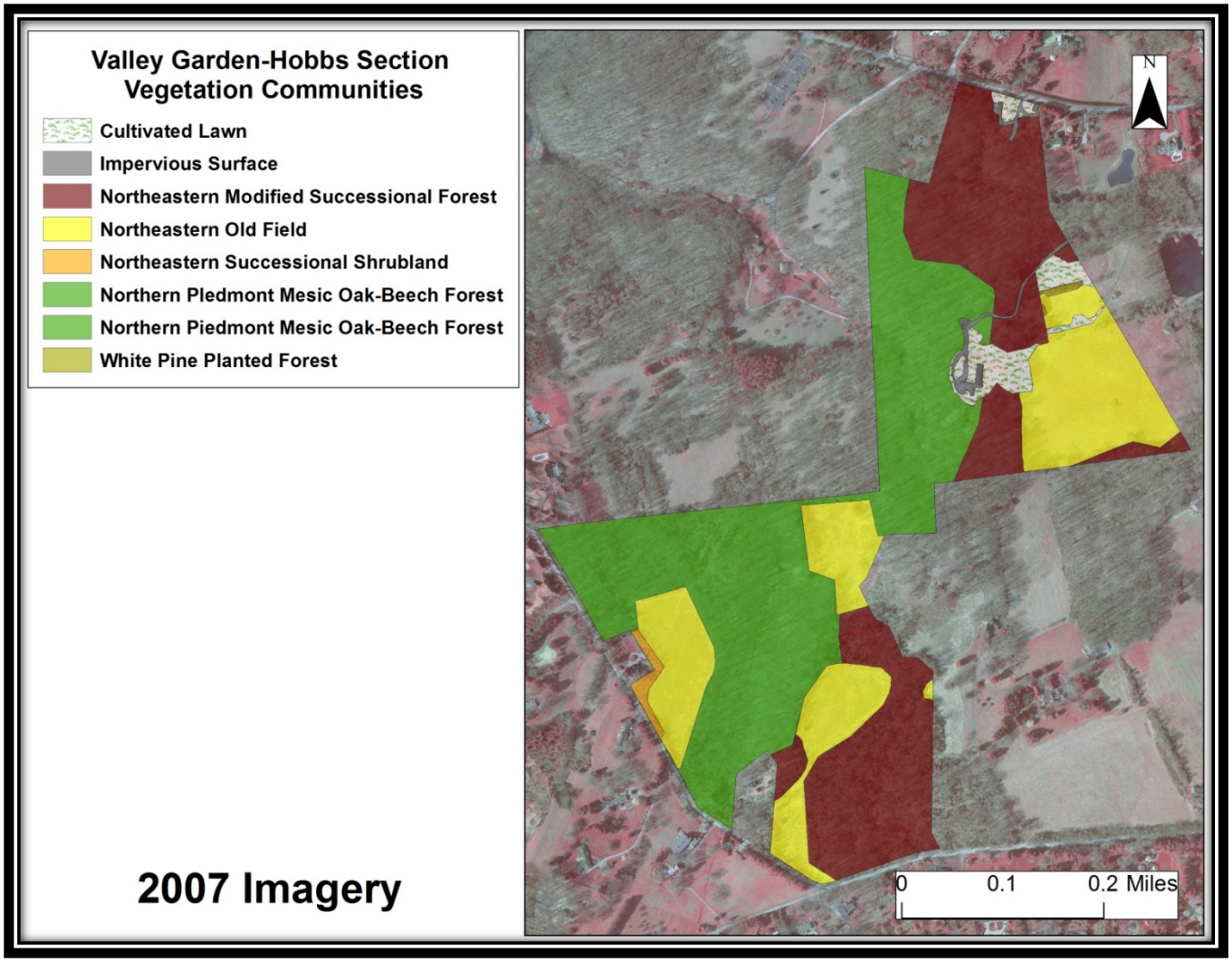


Figure 4-2.2. 2007 Vegetation Community Map of the Valley Garden-Hobbs Section

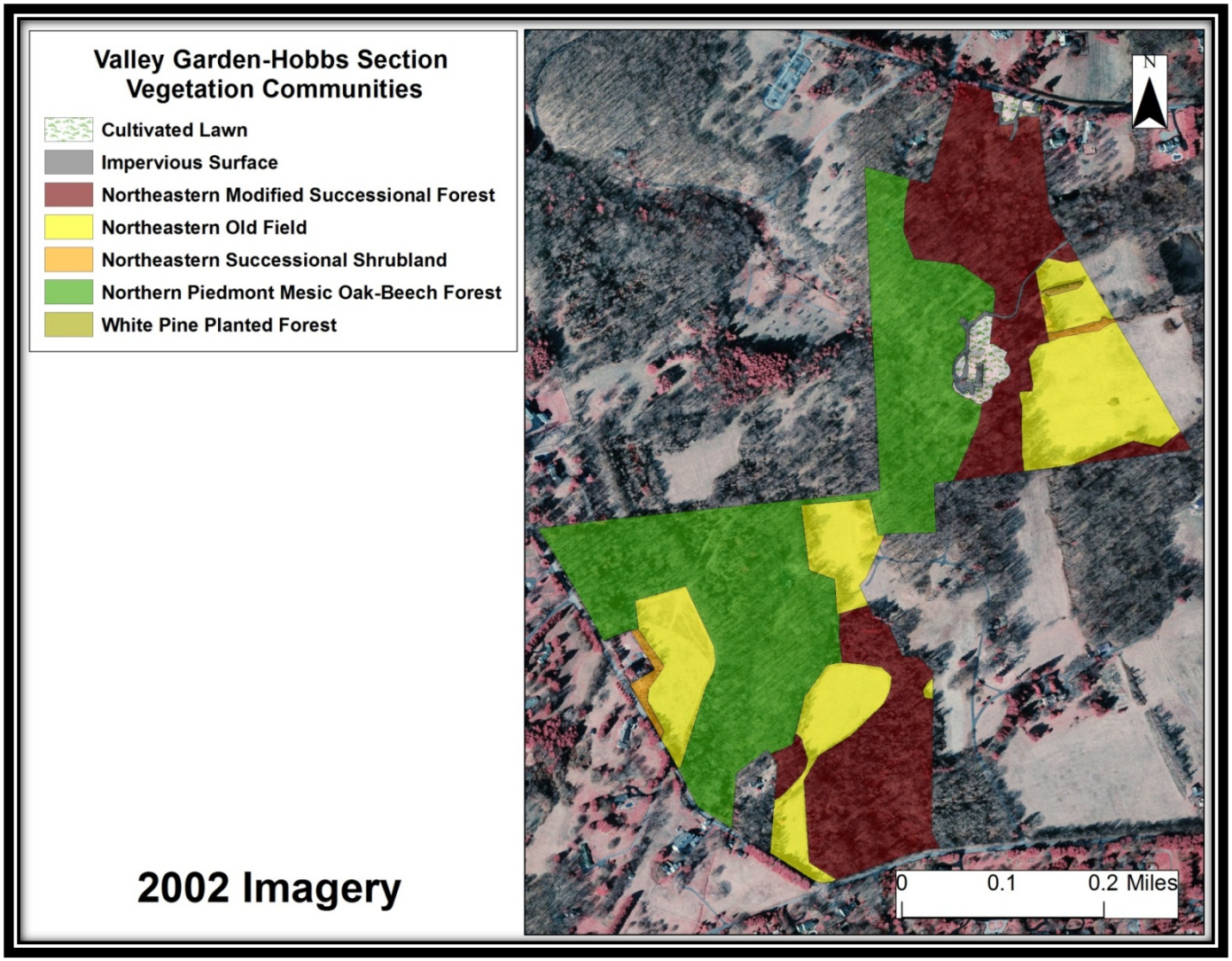


Figure 4-2.3. 2002 Vegetation Community Map of the Valley Garden-Hobbs Section

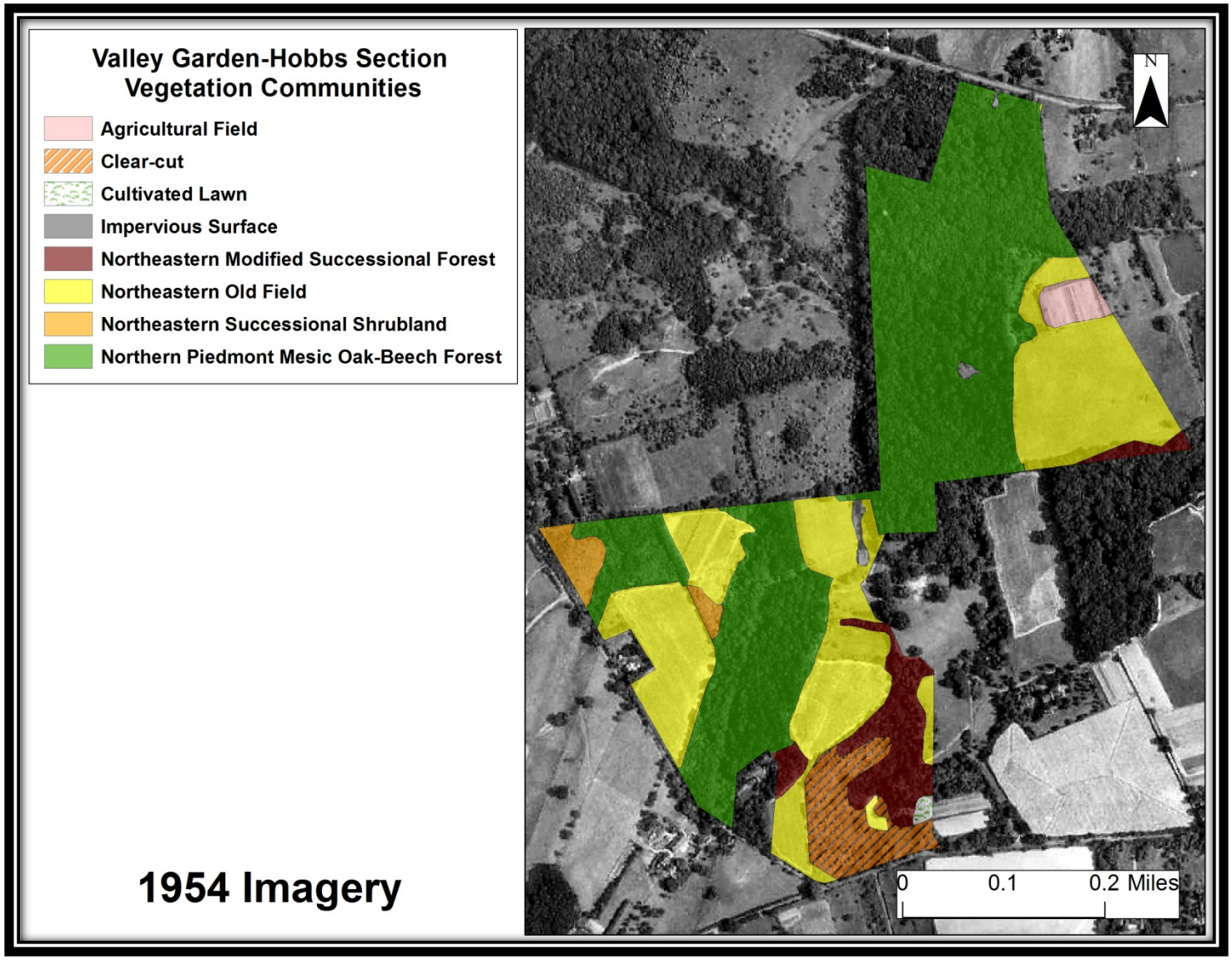


Figure 4-1.4. 1954 Vegetation Community Map of the Valley Garden-Hobbs Section

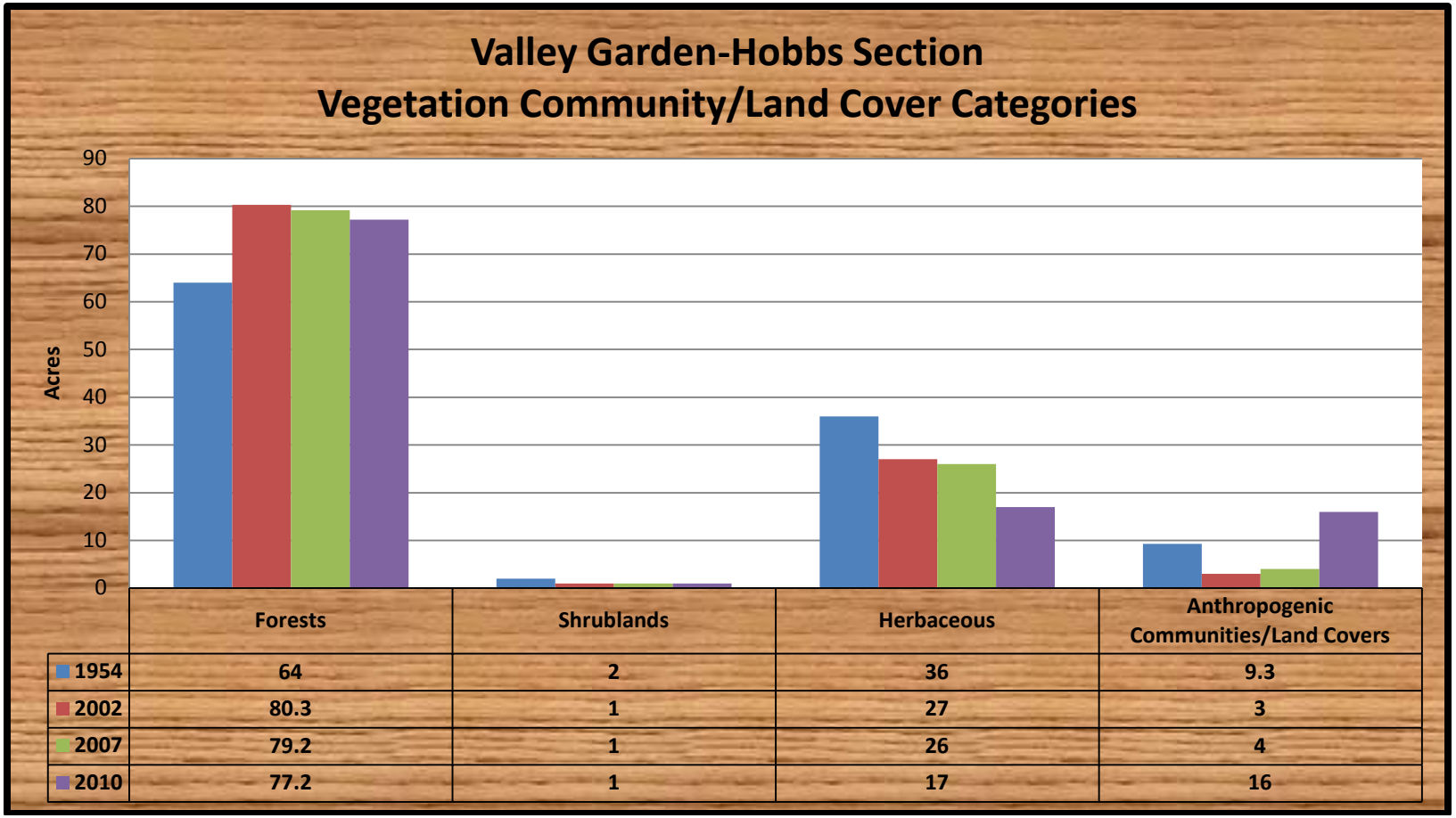


Figure 4-2.4. Valley Garden-Hobbs Section Vegetation Community/Land Cover Categories (1954, 2002, 2007, and 2010)

Valley Garden-Hobbs Section Vegetation Community/Land Covers (Figure 4-2.4): Forest is the most vegetation type in the Valley Garden-Hobbs Section, followed distantly by herbaceous communities. A lot the herbaceous communities were recently converted to Anthropogenic communities/land covers in the park in the 2007 to 2010 period.

Natural Capital (Table 4-2.1)

Capital in the Valley Garden-Hobbs Section had roughly increased to the 2002-2007 period and has since decreased due to conversion to anthropogenic communities/land covers.

Table 4-2.1. Natural Capital of the Valley Garden-Hobbs Section	
Year	**Natural Capital (in 2012 dollars)**
1954	$17,754/year
2002	$19,264/year
2007	$18,911/year
2010	$17,221/year

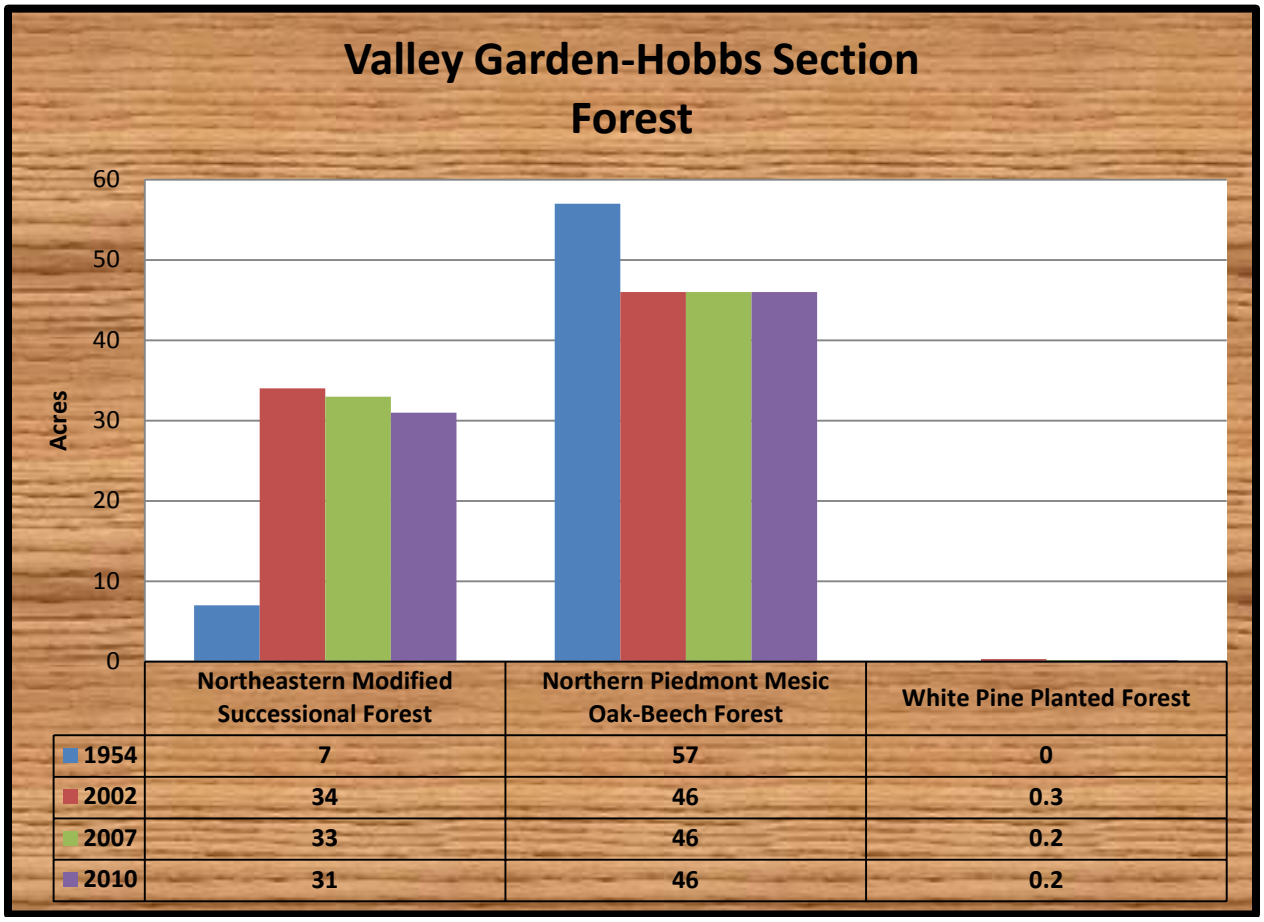


Figure 4-2.5. Valley Garden-Hobbs Section Forest (1954, 2002, 2007, and 2010)

Valley Garden-Hobbs Section Forest (Figure 4-2.5): Northern Piedmont Mesic Oak-Beech Forest is the most common forest type, followed by Northeastern Modified Successional Forest.

Natural Capital (Table 4-2.2)

Capital of forest in the Valley-Garden-Hobbs Section has increased overall since 1954, but saw a slight decrease in the 2007 to 2010 period due to development of anthropogenic communities/land covers.

Table 4-2.2. Natural Capital of Valley Garden-Hobbs Section Forest	
Year	**Natural Capital (in 2012 dollars)**
1954	$12,102/year
2002	$15,185/year
2007	$14,977/year
2010	$14,599/year

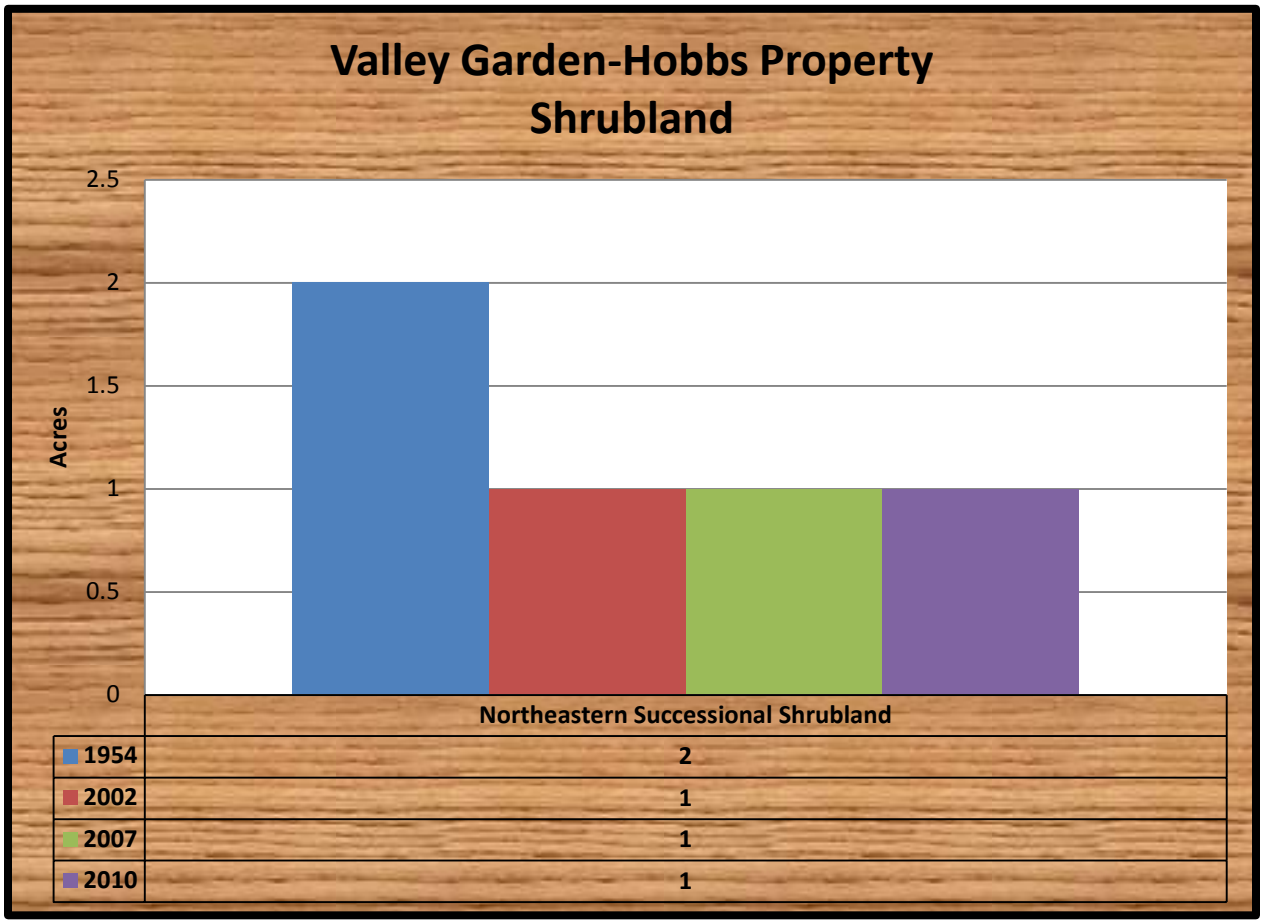


Figure 4-2.6. Valley Garden-Hobbs Section Shrubland (1954, 2002, 2007, and 2010)

Valley Garden-Hobbs Section Shrubland (Figure 4-2.6): Northeastern Successional Shrubland is the only shrubland present in the Valley Garden-Hobbs Section. It has lost one acre since 1954, but has been stable in the 2002-2010 period.

Natural Capital (Table 4-2.3)

Natural capital of shrubland in the Valley Garden-Hobbs Section has decreased with the loss of the acre.

Table 4-2.3. Natural Capital of Valley Garden-Hobbs Section Shrubland	
Year	**Natural Capital (in 2012 dollars)**
1954	$291/year
2002	$146/year
2007	$146/year
2010	$146/year

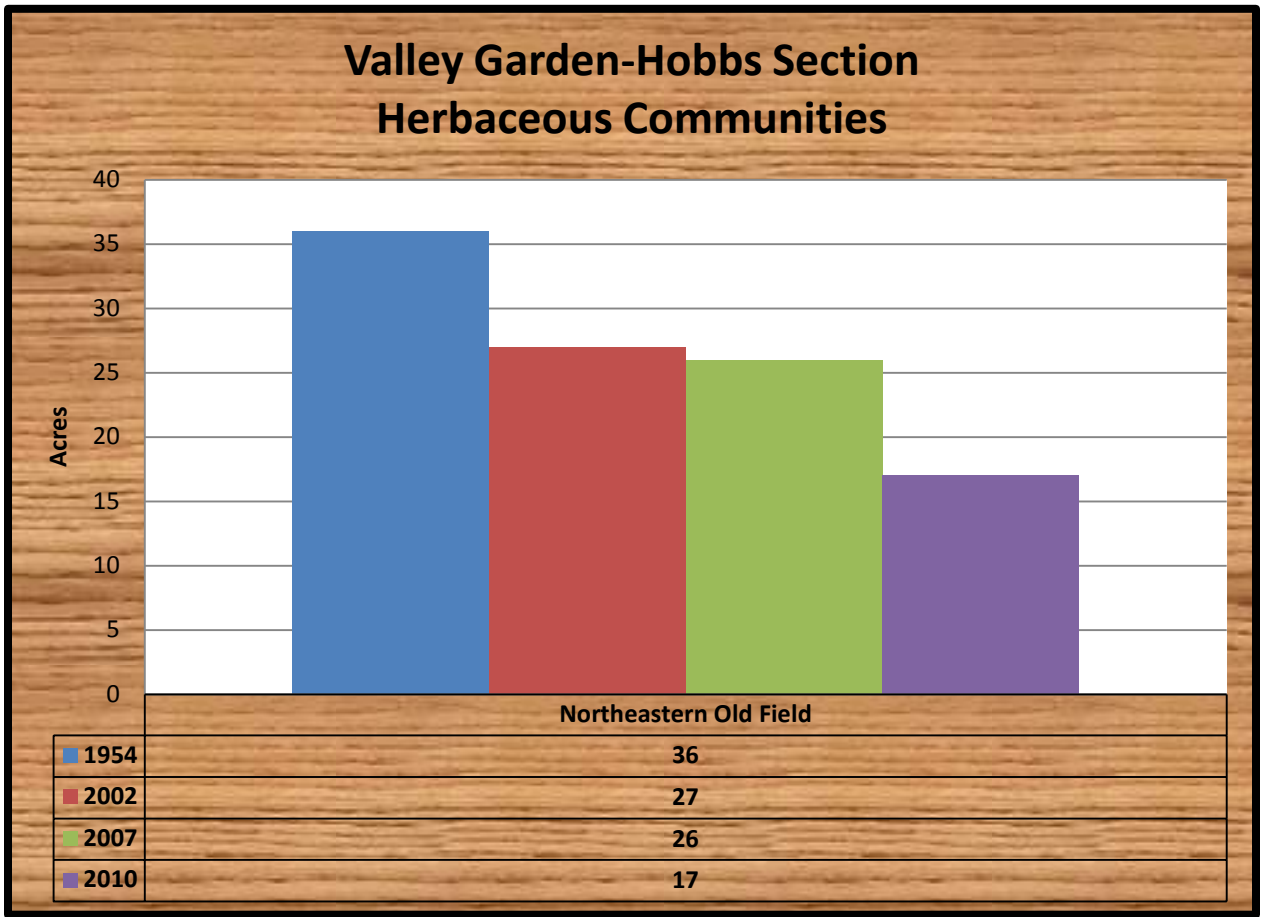


Figure 4-2.7. Valley Garden-Hobbs Section Herbaceous Communities (1954, 2002, 2007, and 2010)

Valley Garden-Hobbs Section Herbaceous Communities (Figure 4-2.7): Northeastern Old Field is the only herbaceous community and has been decreasing in amount since 1954 with maturation to forest communities.

Natural Capital (Table 4-2.4)

Natural capital of herbaceous communities in the Valley Garden-Hobbs Section has decreased with the decreasing acreage. Since most of it has gone to forestland, this has resulted in an increase in overall capital for the park.

Table 4-2.4. Natural Capital of Valley Garden-Hobbs Section Herbaceous Communities	
Year	**Natural Capital (in 2012 dollars)**
1954	$5,245/year
2002	$3,934/year
2007	$3,788/year
2010	$2,477/year

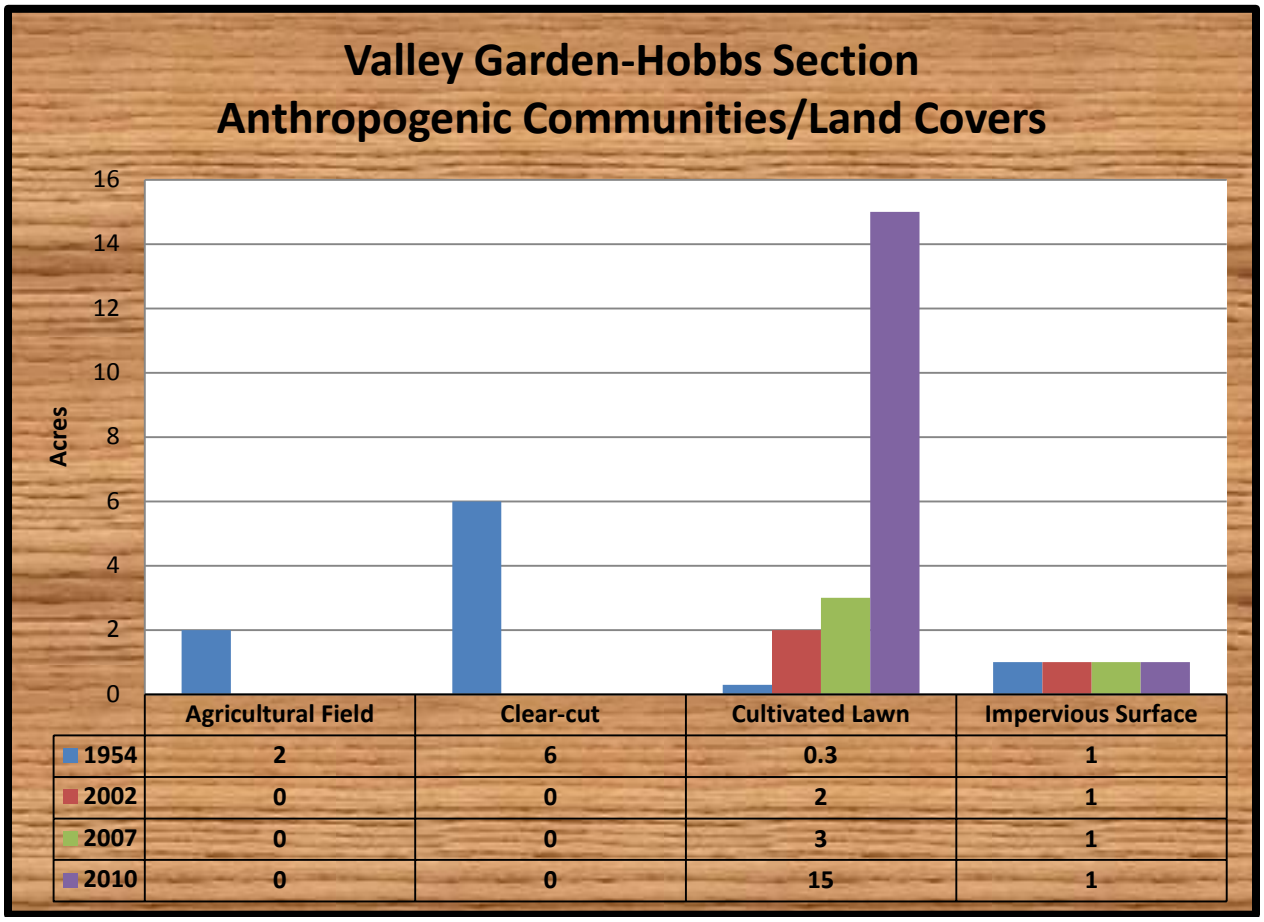


Figure 4-2.8. Valley Garden-Hobbs Section Anthropogenic Communities/Land Covers (1954, 2002, 2007, and 2010)

Valley Garden-Hobbs Section Anthropogenic Communities/Land Covers (Figure 4-2.8): Cultivated lawn is the largest anthropogenic community/land cover in the Valley Garden-Hobbs Section, followed distantly by impervious surface. Cultivated lawn has increased markedly in the 2007-2010 period.

Natural Capital (Table 4-2.5)

Agricultural field is the only anthropogenic community/land cover with any capital value in the Valley Garden-Hobbs Section. Since it is no longer present there is no capital currently.

Table 4-2.5. Natural Capital of Valley Garden-Hobbs Section Anthropogenic Communities/Land Covers

Year	Natural Capital (in 2012 dollars)
1954	$115/year
2002	$0/year (not present)
2007	$0/year (not present)
2010	$0/year (not present)

CHAPTER 5: DESCRIPTIONS AND ANALYSIS OF THE VEGETATION COMMUNITIES

Eight vegetation communities and four land covers were noted in the survey (Figures 4-1.1-1.4, 4-2.1-2.4). 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. Central Appalachian Dry Mesic-Chestnut Oak-Northern Red Oak Forest (CEGL006057)—32 acres
2. Cultivated Lawn (CEGL008462)—113 acres
3. Northeastern Modified Successional Forest (CEGL006599)—48 acres
4. Northeastern Old Field (CEGL006107)—17 acres
5. Northeastern Successional Shrubland (CEGL006451)—1 acre
6. Northern Piedmont Mesic Oak-Beech Forest (CEGL006921)—93 acres
7. White Pine Planted Forest (CEGL007178)—0.2 acres
8. Willow River-Bar Shrubland (CEGL006065)—0.1 acres

The land covers include:

1. Impervious Surface—29 acres
2. Modified Land—2 acres
3. Semi-impervious Surface— 0.1 acres
4. Water—10 acres

Central Appalachian Dry Mesic-Chestnut Oak-Northern Red Oak Forest **[32 acres (Figure 5.1, Tables 5.1-5.2)] G5 S1**

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

Description

This forested community is located on slopes above Brandywine Creek in the Rockford Park area. Northern red oak (*Quercus rubra*), chestnut oak (*Quercus prinus*), black birch (*Betula lenta*), tuliptree (*Liriodendron tulipifera*), and American beech (*Fagus grandifolia*) compose the canopy of this forest. The understory includes red maple (*Acer rubrum*), wild black cherry (*Prunus serotina*), spicebush (*Lindera benzoin*), black birch (*Betula lenta*), witch-hazel (*Hamamelis virginiana*), and Norway maple (*Acer plantanoides*). The shrub and vine layer is composed of English ivy (*Hedera helix*), Oriental bittersweet (*Celastrus orbiculatus*), maple-leaf viburnum (*Viburnum acerifolium*), privet (*Ligustrum sinense*), arrow-wood (*Viburnum dentatum*), and poison ivy (*Toxicodendron radicans*). Herbs in this community include white wood aster (*Eurybia divaricata*), woodland goldenrod (*Solidago caesia*), sessile bellwort (*Uvularia sessilifolia*), wild sarsaparilla (*Aralia nudicaulis*), smooth solomon's seal (*Polygonatum biflorum*), Jack-in-the-pulpit (*Arisaema triphyllum*), and Virginia creeper (*Parthenocissus quinquefolia*).

All of the examples of this community in the park are in mature condition with good layer definition and dbh's ranging from 1 foot to 2.5 feet.

Analysis of Condition at Wilmington State Park

In 2010, about 32 acres of the 35 acres present as Central Appalachian Dry-Mesic Chestnut Oak-Northern Red Oak Forest still existed. The rest had become 2 acres of cultivated lawn, 1 acre of impervious surface, 0.2 acres of Northeastern Modified Successional Forest, and 0.1 acres of Modified Land (Table 5.1). Since 1954, Central Appalachian Dry-Mesic Chestnut Oak-Northern Red Oak Forest has not expanded.

Table 5.1. What was once Central Appalachian Dry Mesic-Chestnut Oak-Northern Red Oak Forest in 1954 has become X in 2010

X	**Acreage**
Central Appalachian Dry-Mesic Chestnut Oak-Northern Red Oak Forest	32 acres
Cultivated Lawn	2 acres
Impervious Surface	1 acre
Northeastern Modified Successional Forest	0.2 acres
Modified Land	0.1 acres

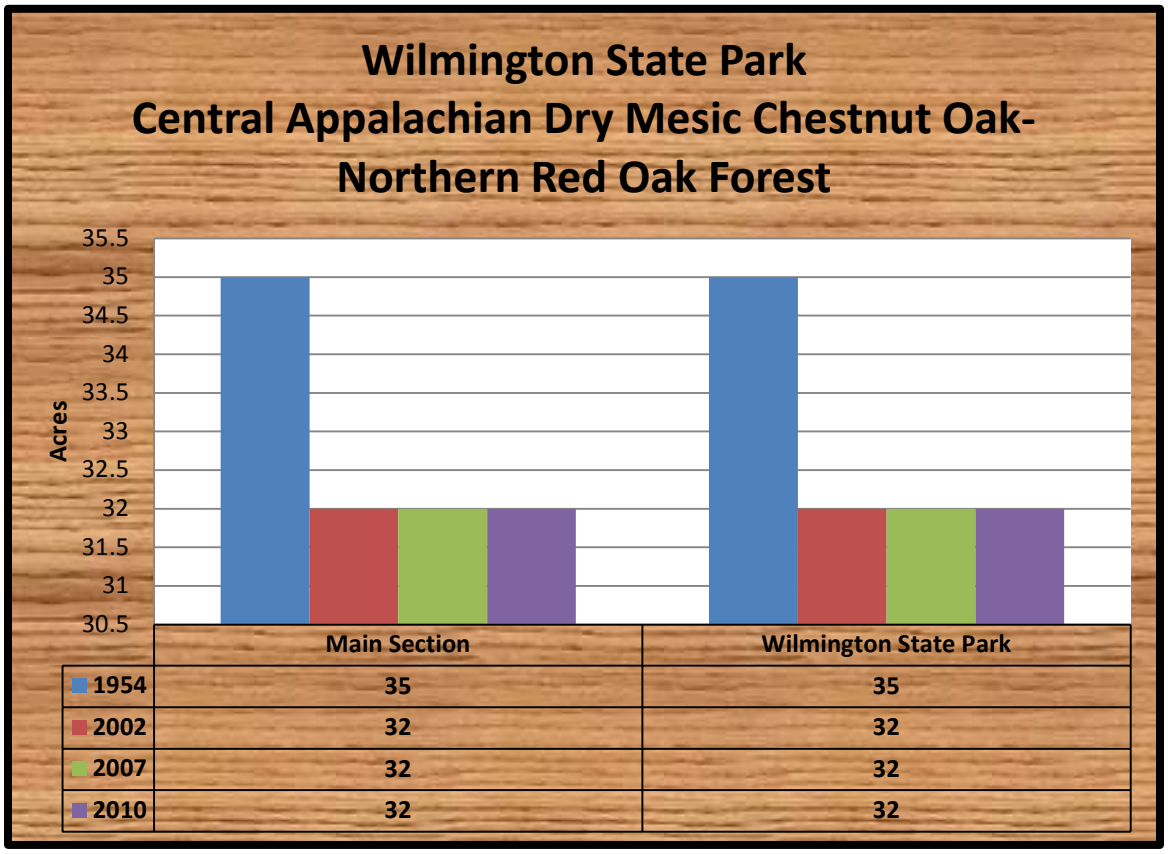


Figure 5.1. Central Appalachian Dry Mesic Chestnut Oak-Northern Red Oak Forest at Wilmington State Park (1954, 2002, 2007, and 2010)

Natural Capital (Table 5.2)

Capital of Central Appalachian Dry-Mesic Chestnut Oak-Northern Red Oak Forest has declined with the loss of acreage. Most of this acreage has resulted in a capital loss as these areas are converted to anthropogenic use.

Table 5.2. Natural Capital of Central Appalachian Dry-Mesic Chestnut Oak-Northern Red Oak Forest	
Year	**Natural Capital (in 2012 dollars)**
1954	$6,619/year
2002	$6,051/year
2007	$6,051/year
2010	$6,051/year

Cultivated Lawn **[113 acres (Figure 5.2, Tables 5.3-5.4)]** **GNA SNA**

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

Description

This community is located primarily along roadsides, sidewalks, and buildings in the park. It is composed mostly of tall fescue (*Festuca arundinacea*) and other ornamental grasses and shrubs.

Analysis of Condition at Wilmington State Park

In 2010, 62 acres of the 113 acres of cultivated lawn present in 1954 still existed. The rest had become 8 acres of impervious surface, 1 acre of Northeastern Modified Successional Forest, 1 acre of Northern Piedmont Mesic Oak-Beech Forest, and 0.5 acres of Modified Land (Table 5.3). Since 1954, cultivated lawn has been developed in 35 acres of Northern Piedmont Mesic Oak-Beech Forest, 12 acres of Northeastern Old Field, 2 acres of Central Appalachian Dry-Mesic Chestnut Oak-Northern Red Oak Forest, and 1 acre of Modified Land (Table 5.4).

Table 5.3. What was once Cultivated Lawn in 1954 has become X in 2010	
X	**Acreage**
Cultivated Lawn	62 acres
Impervious Surface	8 acres
Northeastern Modified Successional Forest	1 acre
Northern Piedmont Mesic Oak-Beech Forest	1 acre
Modified Land	0.5 acres

Table 5.4. Cultivated Lawn has migrated into X since 1954	
X	**Acreage**
Cultivated Lawn	62 acres
Northern Piedmont Mesic Oak-Beech Forest	35 acres
Northeastern Old Field	12 acres
Central Appalachian Dry-Mesic Chestnut Oak-Northern Red Oak Forest	2 acres
Modified Land	1 acre
Other communities/land covers	1 acre

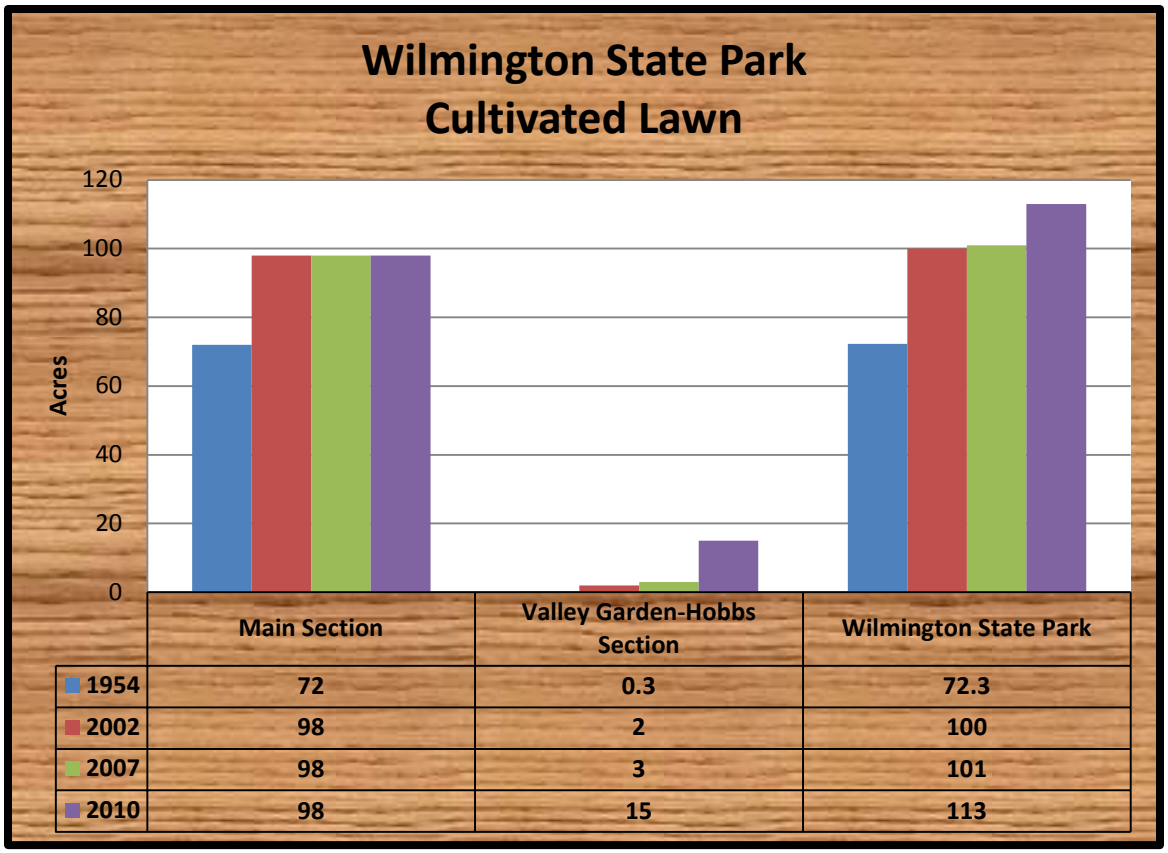


Figure 5.2. Cultivated Lawn at Wilmington State Park (1954, 2002, 2007, and 2010)

Natural Capital

Cultivated Lawn does not have any natural capital value.

Northeastern Modified Successional Forest **[47 acres (Figure 5.3, Tables 5.5-5.7)] GNA SNA**

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

Description

This forested community is characterized by dense tangles and thickets of exotic invasive plant species. The canopy of this community in the park can be variable but it is often found in the floodplain and includes box-elder (*Acer negundo*), tuliptree (*Liriodendron tulipifera*), Norway maple (*Acer plantanoides*), wild black cherry (*Prunus serotina*), and Northern red oak (*Quercus rubra*). The understory includes smaller members of the canopy plus sweetgum (*Liquidambar styraciflua*), tree-of-heaven (*Ailanthus altissima*), slippery elm (*Ulmus rubra*), and white oak (*Quercus alba*). The shrub and vine layer is dense with multiflora rose (*Rosa multiflora*), Morrow's honeysuckle (*Lonicera morrowii*), winged euonymus (*Euonymus alata*), poison ivy (*Toxicodendron radicans*), and common greenbrier (*Smilax rotundifolia*). The herb layer often includes pokeweed (*Phytolacca americana*), garlic mustard (*Alliaria petiolata*), stinging nettle (*Urtica dioica*), common blue violet (*Viola sororia*), burdock (*Arctium minus*), English Ivy (*Hedera helix*), and periwinkle (*Vinca minor*).

Analysis of Condition at Wilmington State Park

In 2010, about 14 acres of the 15 acres of Northeastern Modified Successional Forest still existed in the park. The remaining acre had become 0.5 acres of cultivated lawn, 0.2 acres of Northeastern Old Field, 0.2 acres of water, and 0.2 acres of Impervious Surface (Table 5.5). Since 1954, Northeastern Modified Successional Forest has converted 23 acres of Northern Piedmont Mesic Oak-Beech Forest, grown into 6 acres of clear-cut, 3 acres of Northeastern Old Field, and 1 acre of cultivated lawn (Table 5.6).

Table 5.5. What was once Northeastern Modified Successional Forest in 1954 has become X in 2010

X	**Acreage**
Northeastern Modified Successional Forest	14 acres
Cultivated Lawn	0.5 acres
Northeastern Old Field	0.2 acres
Water	0.2 acres
Impervious Surface	0.2 acres

Table 5.6. Northeastern Modified Successional Forest has migrated into X since 1954	
X	**Acreage**
Northern Piedmont Mesic Oak-Beech Forest	23 acres
Northeastern Modified Successional Forest	14 acres
Clear-cut	6 acres
Northeastern Old Field	3 acres
Cultivated Lawn	1 acre
Other communities/land covers	0.2 acres

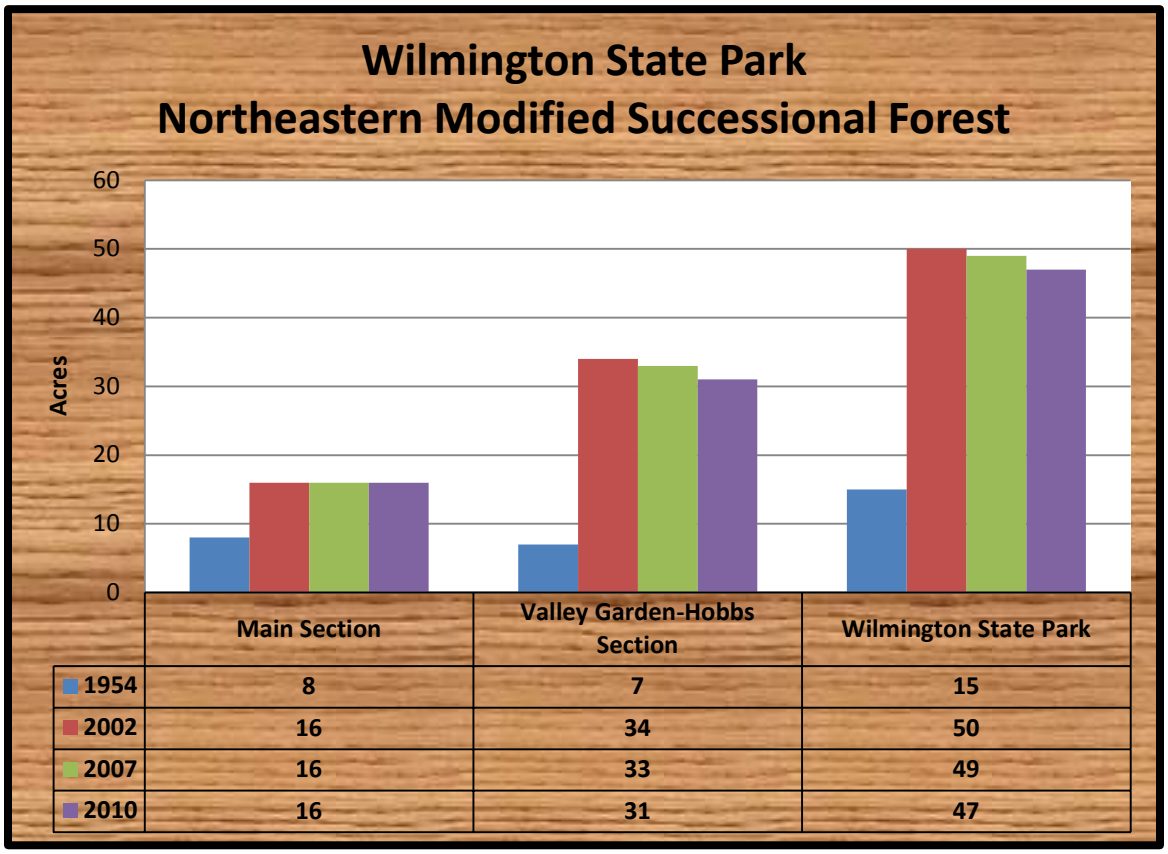


Figure 5.3. Northeastern Modified Successional Forest at Wilmington State Park (1954, 2002, 2007, and 2010)

Natural Capital (Table 5.7)

Capital of Northeastern Modified Successional Forest has increased markedly since 1954 with the spread of exotic invasive plant species. In 2002 to 2010 period, however, there has been a decrease with conversions to anthropogenic use.

Table 5.7. Natural Capital of Northeastern Modified Successional Forest	
Year	**Natural Capital (in 2012 dollars)**
1954	$2,837/year
2002	$9,455/year
2007	$9,266/year
2010	$8,888/year

Northeastern Old Field **[17 acres (Figure 5.4, Tables 5.8-5.10)] GNA SNA**

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

Description

This community is located primarily along roadsides, and buildings in the park. It is composed mostly of tall fescue (*Festuca arundinacea*) with other ornamental grasses and shrubs.

Analysis of Condition at Wilmington State Park

In 2010, about 15 acres of the 36 acres of Northeastern Old Field from 1954 still existed. The rest had become 12 acres of cultivated lawn, 6 acres of Northern Piedmont Mesic Oak-Beech Forest, 3 acres of Northeastern Modified Successional Forest, and 1 acre of Northeastern Successional Shrubland (Table 5.8). Since 1954, Northeastern Old Field has come into 1 acre of agricultural field, 0.4 acres of impervious surface, and 0.2 acres of Northeastern Modified Successional Forest (Table 5.9).

Table 5.8. What was once Northeastern Old Field in 1954 has become X in 2010	
X	**Acreage**
Northeastern Old Field	15 acres
Cultivated Lawn	12 acres
Northern Piedmont Mesic Oak-Beech Forest	6 acres
Northeastern Modified Successional Forest	3 acres
Northeastern Successional Shrubland	1 acre

Table 5.9. Northeastern Old Field has migrated into X since 1954	
X	**Acreage**
Northeastern Old Field	15 acres
Agricultural Field	1 acre
Impervious Surface	0.4 acres
Northeastern Modified Successional Forest	0.2 acres

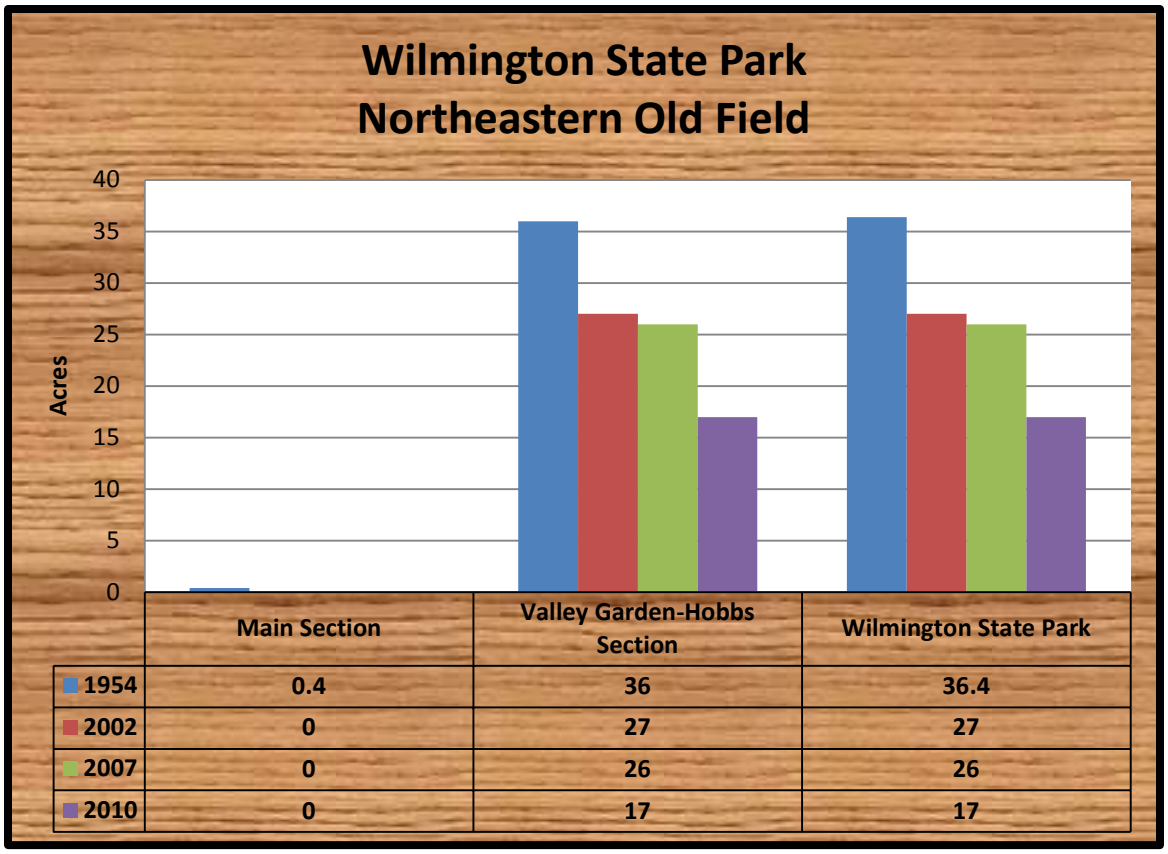


Figure 5.4. Northeastern Old Field at Wilmington State Park (1937, 2002, 2007, and 2010)

Natural Capital (Table 5.10)

Capital of Northeastern Old Field has been gradually decreasing as these fields mature to shrubland and forest, and places that could become this community, such as agricultural field, disappear.

Table 5.10. Natural Capital of Northeastern Old Field	
Year	**Natural Capital (in 2012 dollars)**
1954	$5,303/year
2002	$3,934/year
2007	$3,788/year
2010	$2,477/year

Northeastern Successional Shrubland **[1 acre (Figure 5.5, Tables 5.11-5.12)] GNA SNA**

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

Description

Analysis of Condition at Wilmington State Park

All of the 2 acres of Northeastern Successional Shrubland present in 1954 has become Northern Piedmont Mesic Oak-Beech Forest. Since 1954, this community has grown into one acre of Northeastern Old Field and converted 0.4 acres of Northern Piedmont Mesic Oak-Beech Forest, likely through another community (Table 5.11).

Table 5.11. Northeastern Successional Shrubland has migrated into X since 1954	
X	**Acreage**
Northeastern Old Field	1 acre
Northern Piedmont Mesic Oak-Beech Forest	0.4 acres

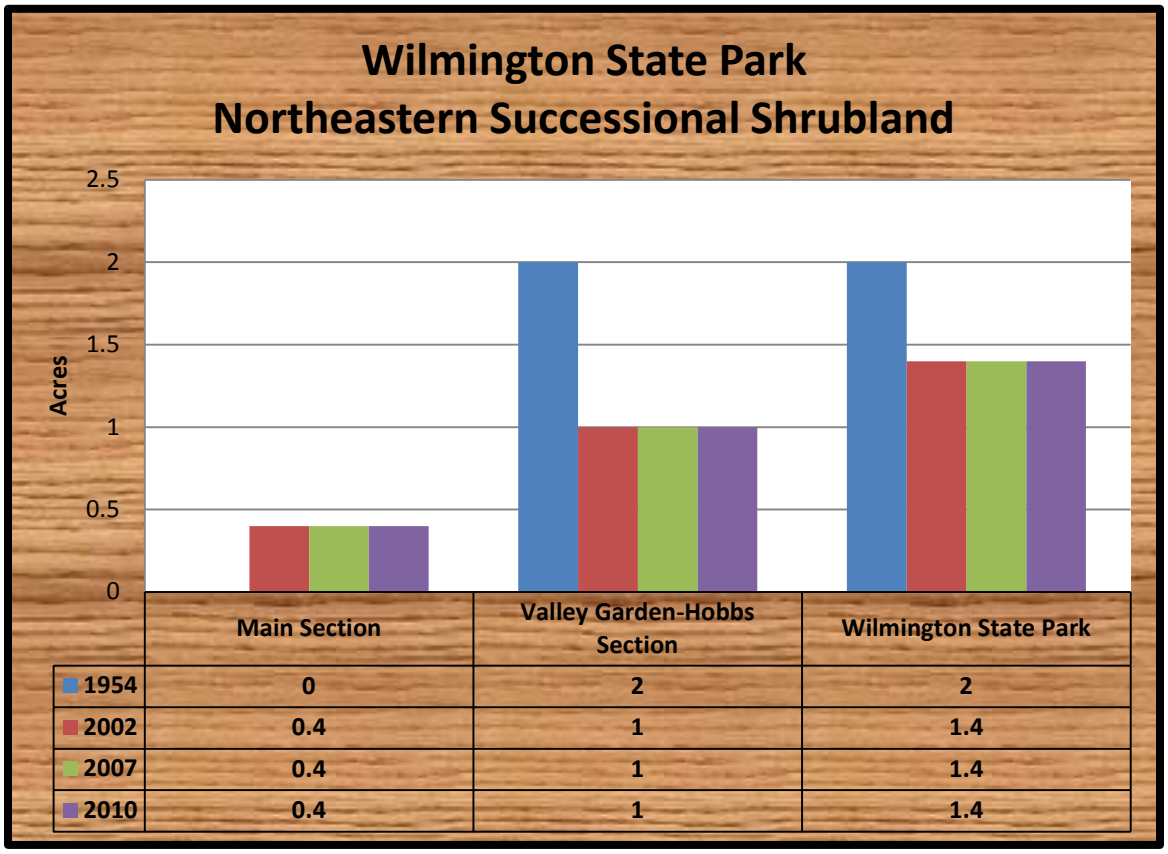


Figure 5.5. Northeastern Successional Shrubland at Wilmington State Park (1954, 2002, 2007, and 2010)

Natural Capital (Table 5.12)

Capital in Northeastern Successional Shrubland has decreased with a loss in acreage since 1954.

Table 5.12. Natural Capital of Northeastern Successional Shrubland	
Year	**Natural Capital (in 2012 dollars)**
1954	$291/year
2002	$204/year
2007	$204/year
2010	$204/year

Northern Piedmont Mesic Oak-Beech Forest **[93 acres (Figure 5.6, Tables 5.13-5.15)] G5 S5**

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

Description

This community often occurs in slopes above Brandywine Creek that are not in the Rockford Park area. Canopy associates include tuliptree (*Liriodendron tulipifera*), American beech (*Fagus grandifolia*), black oak (*Quercus velutina*), white oak (*Quercus alba*), northern red oak (*Quercus rubra*), and a few sycamore (*Platanus occidentalis*). The understory contains bladdernut (*Staphylea trifoliata*), box-elder (*Acer negundo*), blackgum (*Nyssa sylvatica*), witch-hazel (*Hamamelis virginiana*), and basswood (*Tilia americana*). Poison ivy (*Toxicodendron radicans*), wineberry (*Rubus pheonicalasius*), summer grape (*Vitis aestivalis*), arrow-wood (*Viburnum dentatum*), and Oriental bittersweet (*Celastrus orbiculatus*) compose the shrub and vine layer. Common herbs include white wood aster (*Eurybia divaricata*), mayapple (*Podophyllum peltatum*), burdock (*Arctium minus*), enchanter's nightshade (*Circaea lutetiana*), Canadian clearweed (*Pilea pumila*), and orange-spotted jewelweed (*Impatiens capensis*).

Analysis of Condition at Wilmington State Park

In 2010, about 83 acres of the 157 acres present as Northern Piedmont Mesic Oak-Beech Forest in 1954 were still present. The rest had become 35 acres of Cultivated Lawn, 23 acres of Northeastern Modified Successional Forest, 14 acres of Impervious Surface, and 1 acre of Modified Land (Table 5.13). Since 1954, Northern Piedmont Mesic Oak-Beech Forest has grown from 6 acres of Northeastern Old Field, 2 acres of Northeastern Successional Shrubland, 1 acre of cultivated lawn, and 1 acre of water (Table 5.14).

Table 5.13. What was once Northern Piedmont Mesic Oak-Beech Forest in 1954 has become X in 2010

X	Acreage
Northern Piedmont Mesic Oak-Beech Forest	83 acres
Cultivated Lawn	35 acres
Northeastern Modified Successional Forest	23 acres
Impervious Surface	14 acres
Modified Land	1 acre
Other communities/land covers	1 acre

Table 5.14. Northern Piedmont Mesic Oak-Beech Forest has migrated into X since 1954	
X	**Acreage**
Northern Piedmont Mesic Oak-Beech Forest	83 acres
Northeastern Old Field	6 acres
Northeastern Successional Shrubland	2 acres
Cultivated Lawn	1 acre
Water	1 acre

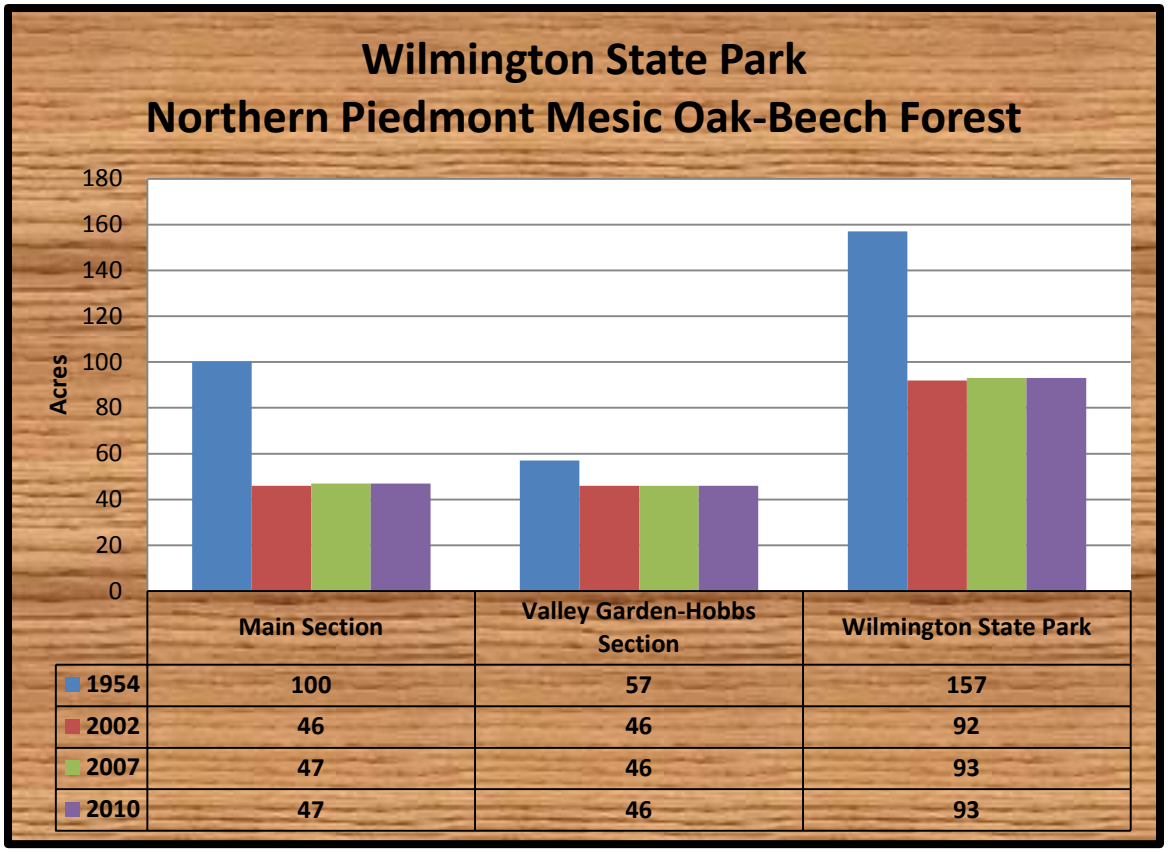


Figure 5.6. Northern Piedmont Mesic Oak-Beech Forest (1954, 2002, 2007, and 2010)

Natural Capital (Table 5.15)

Capital in Northern Piedmont Mesic Oak-Beech Forest has declined with a decrease in acreage. Most of the decreases are to anthropogenic uses that do not have any capital value resulting in an overall decrease for the park.

Table 5.15. Natural Capital of Northern Piedmont Mesic Oak-Beech Forest	
Year	**Natural Capital (in 2012 dollars)**
1954	$29,689/year
2002	$17,397/year
2007	$17,586/year
2010	$17,586/year

White Pine Planted Forest **[0.2 acres (Figure 5.7, Tables 5.16-5.17)] GNA SNA**

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

Description

This planted forest is composed nearly entirely of white pine (*Pinus strobus*).

Analysis of Condition at Wilmington State Park

White Pine Planted Forest was not present in 1954 and since populated 0.2 acres of agricultural field (Table 5.16).

Table 5.16. White Pine Planted Forest has migrated into X since 1954	
X	**Acreage**
Agricultural Field	0.2 acres

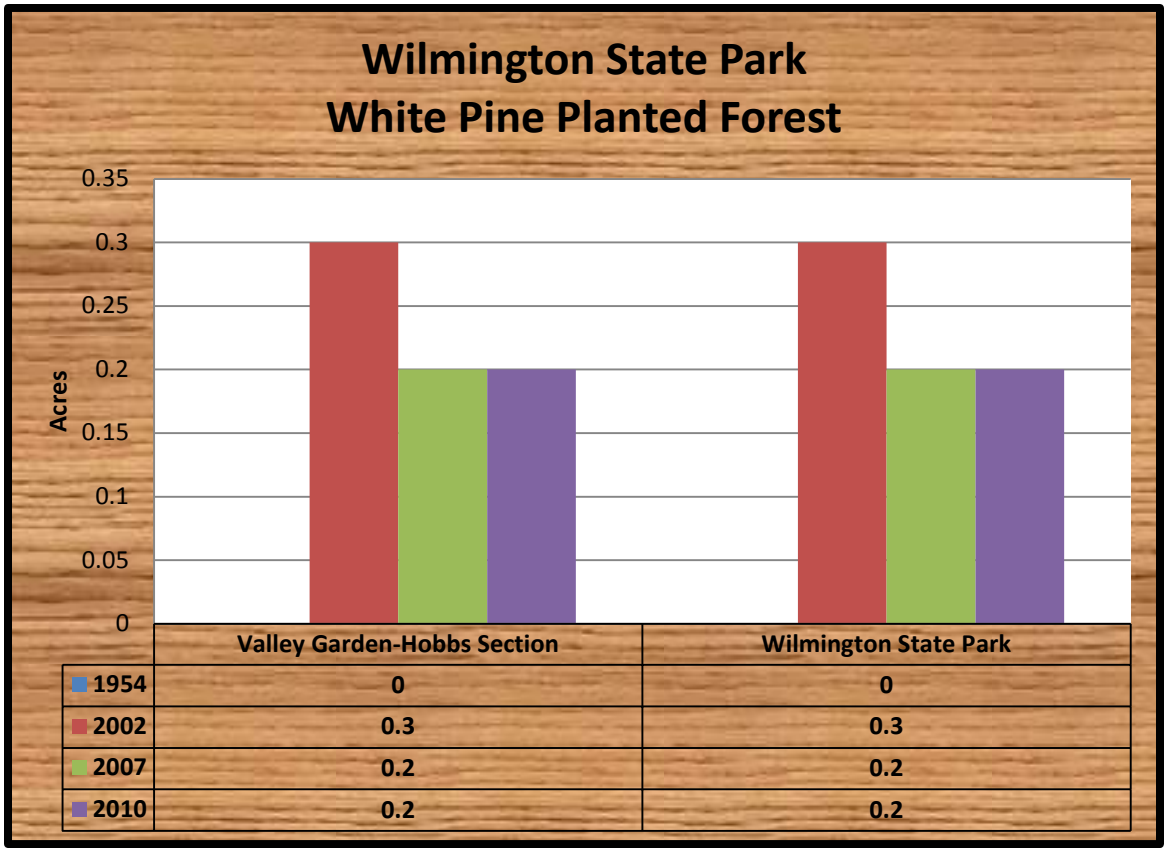


Figure 5.7. White Pine Planted Forest at Wilmington State Park (1954, 2002, 2007, and 2010)

Natural Capital (Table 5.17)

Capital of White Pine Planted Forest constitutes a very small amount of the total capital of the park. Its appearance resulted in a small capital increase for the park. Since its appearance it has decreased slightly.

Table 5.17. Natural Capital of White Pine Planted Forest	
Year	**Natural Capital (in 2012 dollars)**
1954	$0/year (not present)
2002	$57/year
2007	$38/year
2010	$38/year

Willow River-Bar Shrubland **[0 acres (Figure 5.8, Tables 5.18-5.19)] GNA SNA**

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

Description

This shrubland is located on rock scour areas on the riverbank of Brandywine Creek. Black willow (*Salix nigra*) along with a very few sycamore (*Platanus occidentalis*) are the only woody species in these communities. Herbs include sneezeweed (*Helenium autumnale*), Japanese knotweed (*Polygonum cuspidatum*), and cardinal flower (*Lobelia cardinalis*).

Analysis of Condition at Wilmington State Park

Only about a tenth of the Willow River-Bar Shrubland present in 1954 still existed in 2010. The rest had become 0.5 acres of cultivated lawn, 0.3 acres of water, and 0.1 acres of Modified Land (Table 5.18). This community has not migrated since 1954 resulting in the large losses.

Table 5.18. What was once Willow River-Bar Shrubland in 1954 has become X in 2010

X	Acreage
Cultivated Lawn	0.5 acres
Water	0.3 acres
Modified Land	0.1 acres
Willow River-Bar Shrubland	0.1 acres

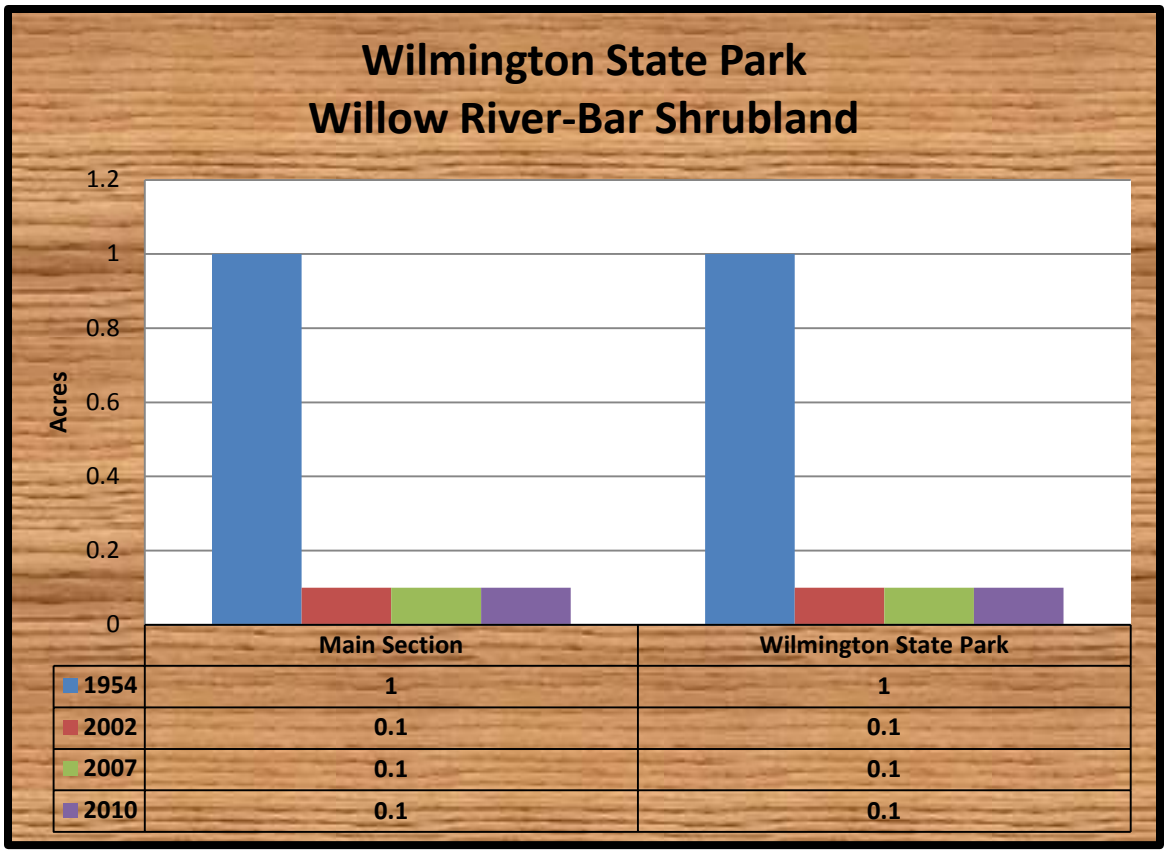


Figure 5.8. Willow River-Bar Shrubland at Wilmington State Park (1954, 2002, 2007, and 2010)

Natural Capital (Table 5.19)

Capital of Willow River-Bar Shrubland has decreased quite a bit along with its acreage.

Table 5.19. Natural Capital of Willow River-Bar Shrubland	
Year	**Natural Capital (in 2012 dollars)**
1954	$12,292/year
2002	$1,229/year
2007	$1,229/year
2010	$1,229/year

CHAPTER 6: 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 it effects can also be seen in the impoundments.

The land covers include:

1. Impervious Surface—29 acres
2. Modified Land—2 acres
3. Semi-impervious Surface— 0.1 acres
4. Water—10 acres

Impervious Surface **[29 acres, (Figure 6.1, Tables 6.1-6.2)]**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

Description

In Wilmington State Park this cover type consists of buildings, roads, tennis courts, and other surfaces that are impervious to the flow of water.

Analysis of Condition at Wilmington State Park

About 5 acres of the 6 acres of impervious surface present in 1954 was still present in 2010. The rest had become 0.4 acres of Northeastern Old Field and 0.2 acres of Cultivated lawn (Table 6.1). Since 1954, impervious surface has been developed in 14 acres of Northern Piedmont Mesic Oak-Beech Forest, 8 acres of cultivated lawn, 2 acres of modified land, 1 acre of Central Appalachian Dry-Mesic Chestnut Oak-Northern Red Oak Forest, and 0.2 acres of Northeastern Modified Successional Forest (Table 6.2).

Table 6.1. What was once Impervious Surface in 1954 has become X in 2010	
X	**Acreage**
Impervious Surface	5 acres
Northeastern Old Field	0.4 acres
Cultivated Lawn	0.2 acres

Table 6.2. Impervious Surface has migrated into X since 1954	
X	**Acreage**
Northern Piedmont Mesic Oak-Beech Forest	14 acres
Cultivated Lawn	8 acres
Impervious Surface	5 acres
Modified Land	2 acres
Central Appalachian Dry-Mesic Chestnut Oak-Northern Red Oak Forest	1 acre
Northeastern Modified Successional Forest	0.2 acres

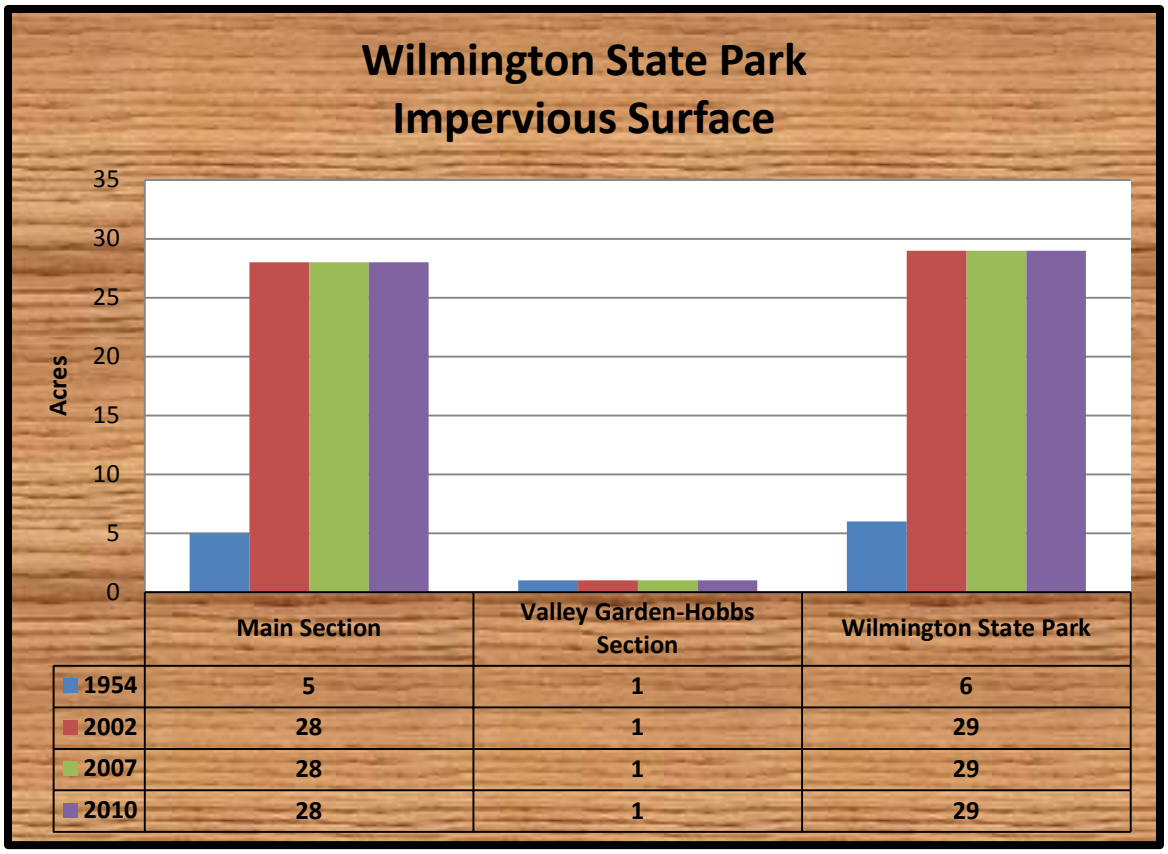


Figure 6.1. Impervious Surface at Wilmington State Park (1954, 2002, 2007, and 2010)

Natural Capital

Impervious Surface does have any natural capital value.

Modified Land **[2 acres, (Figure 6.2, Tables 6.3-6.4)]**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

Description

Modified Land includes those places that have been stripped of vegetation and contain bare earth. Often they preclude development or are waste areas.

Analysis of Condition at Wilmington State Park

Only 0.1 acres of the 3 acres of Modified Land that existed in 1954 was still present in 2010. The rest had become 2 acres of impervious surface and 1 acre of cultivated lawn (Table 6.3). Since 1954, modified land has been developed in 1 acre of Northern Piedmont Mesic Oak-Beech Forest, 0.5 acres of cultivated lawn, 0.1 acres of Central Appalachian Dry-Mesic Chestnut Oak-Northern Red Oak Forest, and 0.1 acres of Willow River-Bar Shrubland (Table 6.4).

Table 6.3. What was once Modified Land in 1954 has become X in 2010	
X	**Acreage**
Impervious Surface	2 acres
Cultivated Lawn	1 acre
Modified Land	0.1 acres

Table 6.4. Modified Land has migrated into X since 1954	
X	**Acreage**
Northern Piedmont Mesic Oak-Beech Forest	1 acre
Cultivated Lawn	0.5 acres
Central Appalachian Dry-Mesic Chestnut Oak-Northern Red Oak Forest	0.1 acres
Willow River-Bar Shrubland	0.1 acres

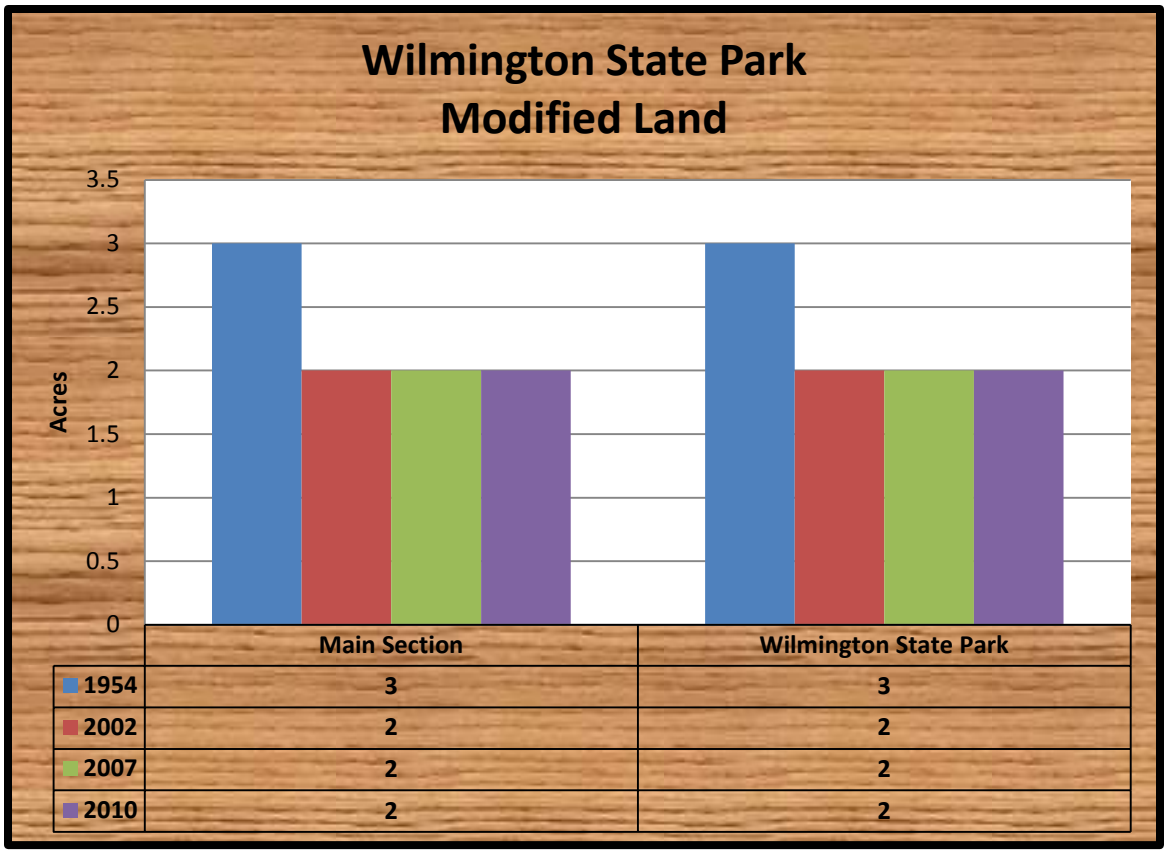


Figure 6.2. Modified Land at Wilmington State Park (1954, 2002, 2007, and 2010)

Natural Capital

Modified Land does not have any natural capital value.

Semi-impervious Surface **[0.1 acres, (Figure 6.3)]**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

Description

This land cover is composed of surfaces such as limestone trails that are semi-permeable to the passage of water.

Analysis of Condition at Wilmington State Park

The entire Semi-impervious surface in the park came from 0.1 acres of Northern Piedmont Mesic Oak-Beech Forest.

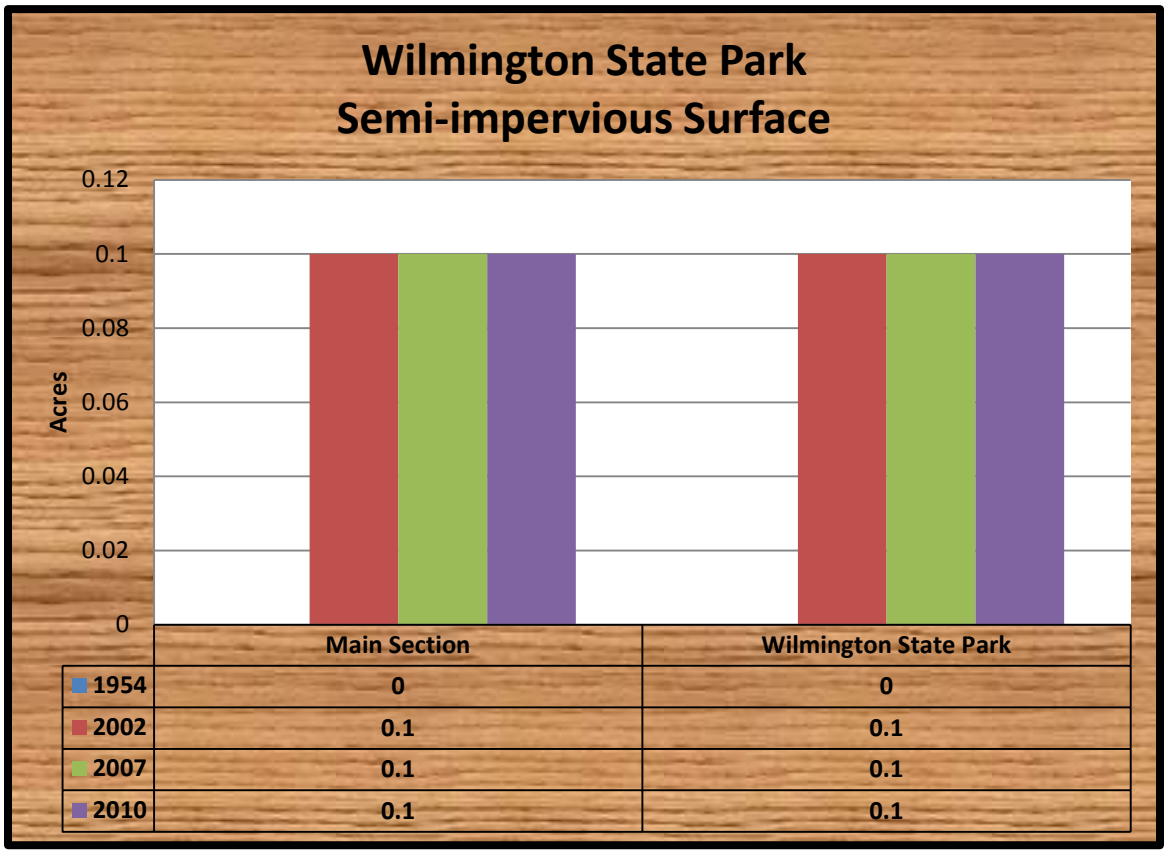


Figure 6.3. Semi-impervious Surface at Wilmington State Park (1954, 2002, 2007, and 2010)

Natural Capital

Semi-impervious Surface does not have any natural capital value.

***Water* [10 acres, (Figure 6.4, Tables 6.5-6.7)]**

DEWAP: Piedmont Streams
NHC: No Equivalent Classification

Description

Water in Wilmington State Park includes the main stem of Brandywine Creek and a canal on the south side of the creek.

Analysis of Condition at Wilmington State Park

All of the water present in 1954 was still present in 2010 with the addition of less than an acre of Northern Piedmont Mesic Oak-Beech Forest (Table 6.5). Since 1954, water has covered 1 acre of Northern Piedmont Mesic Oak-Beech Forest, 0.3 acres of Willow River-Bar Shrubland, and 0.2 acres of Northeastern Modified Successional Forest (Table 6.6).

Table 6.5. What was once Water in 1954 has become X in 2010	
X	**Acreage**
Water	10 acres
Northern Piedmont Mesic Oak-Beech Forest	1 acre

Table 6.6. Water has migrated into X since 1954	
X	**Acreage**
Water	10 acres
Northern Piedmont Mesic Oak-Beech Forest	1 acre
Willow River-Bar Shrubland	0.3 acres
Northeastern Modified Successional Forest	0.2 acres

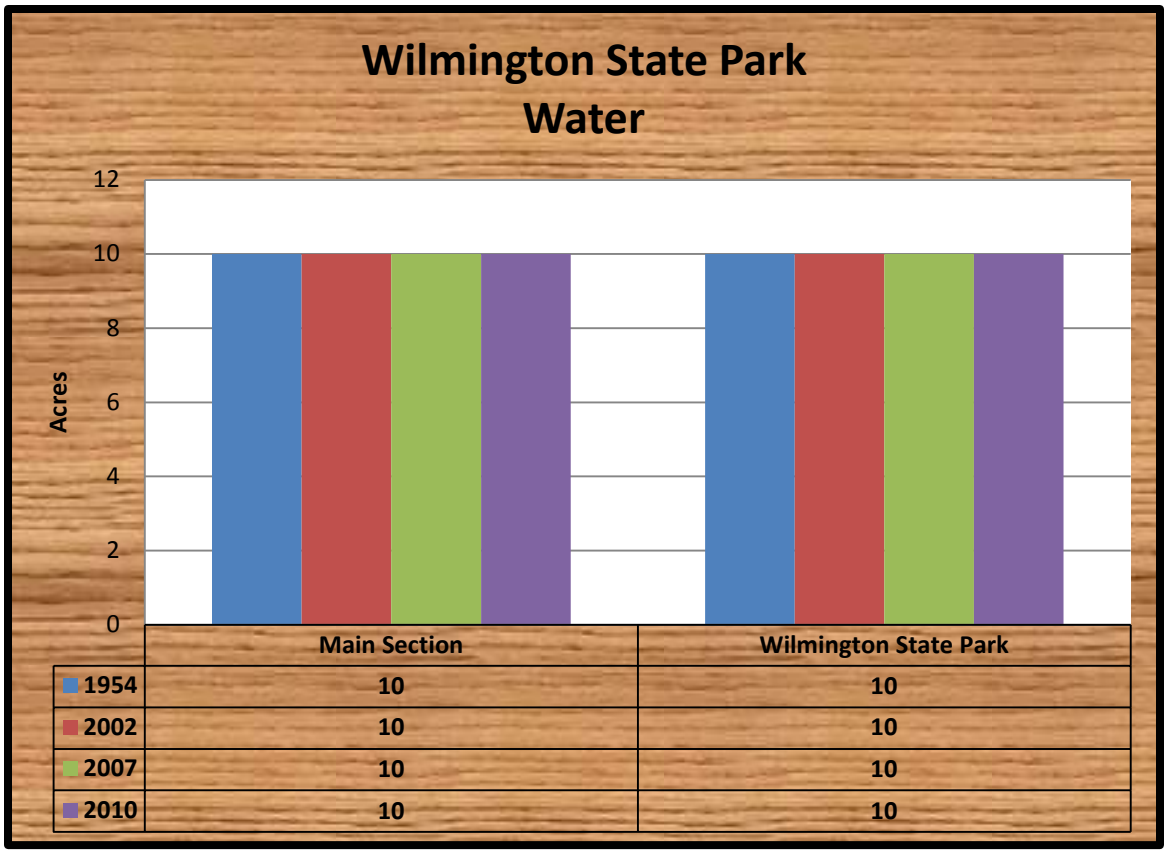


Figure 6.1. Water at Wilmington State Park (1954, 2002, 2007, and 2010)

Natural Capital (Table 6.7)

Capital of water has stayed the same along with its acreage.

Table 6.7. Natural Capital of Water	
Year	**Natural Capital (in 2012 dollars)**
1954	$53,351/year
2002	$53,351/year
2007	$53,351/year
2010	$53,351/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 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