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

Christina River and White Clay Creek Watersheds

Submitted to:

Delaware State Parks
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CHAPTER 1: INTRODUCTION AND METHODS

Setting of White Clay Creek State Park

White Clay Creek State Park is located in northern New Castle County, Delaware (Figure 1) in the Piedmont physiographic province. The park totals 3,398 acres, and has been divided into four sections for mapping and discussion. These sections include the East Section (1,723 acres), Judge Morris Section (527 acres), South Section (134 acres), and the West Section (1,014 acres). The park is mostly located within the White Clay Creek watershed with a small sliver of the west side in the Christina River watershed.

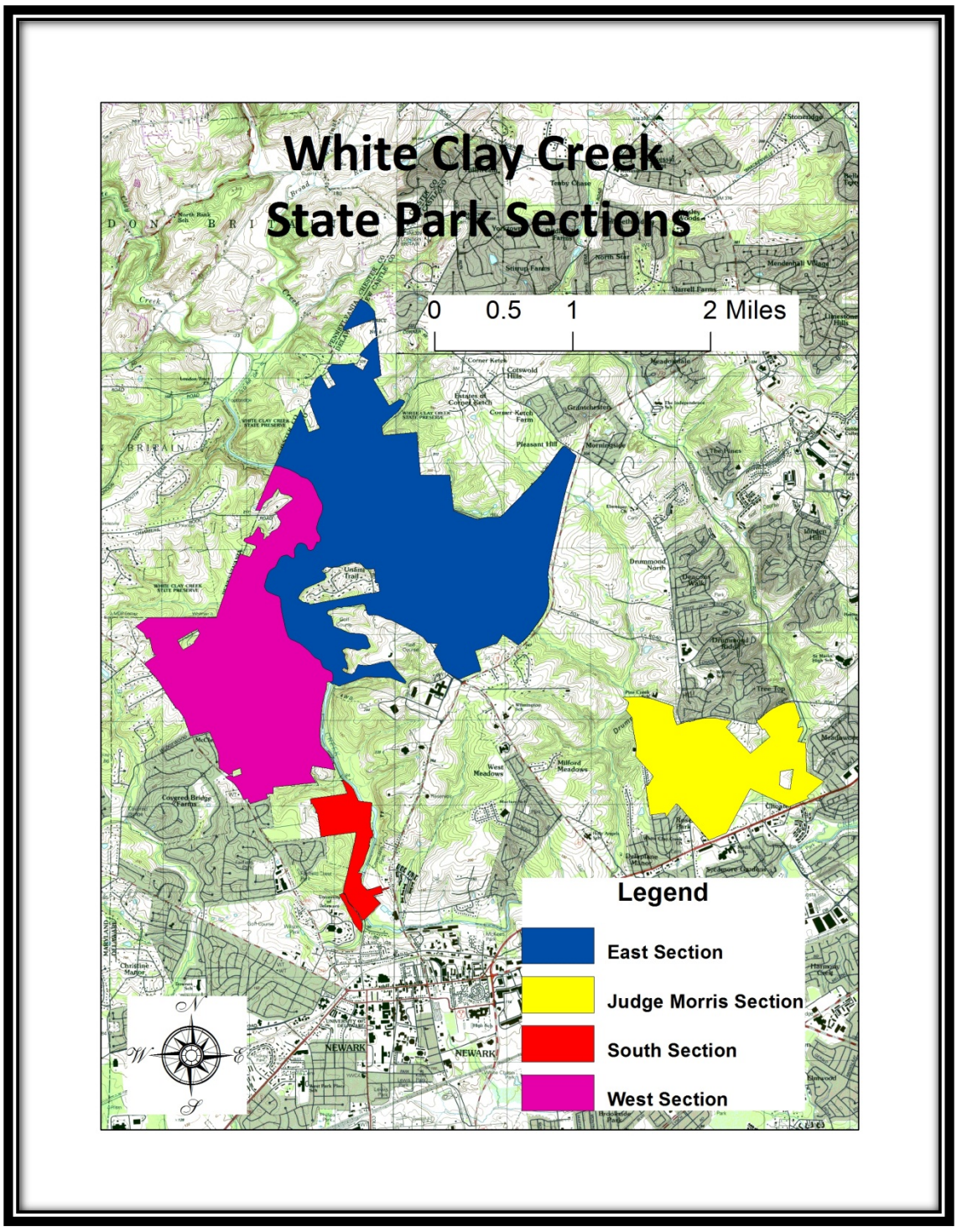


Figure 1.1. White Clay Creek State Park Sections

History and Formation of White Clay Creek State Park

Early History of the Land

White Clay Creek was named for the white clay that lines the banks of the stream. The state park is the location (Bryan Farm at the time) of the start of the Mason-Dixon Line going west to form the boundary between Maryland and Pennsylvania.

Formation of White Clay Creek State Park

White Clay Creek State Park was in part established in 1968 and renamed for Walter S. Carpenter in 1975. In 1995 the park was joined into the larger White Clay Creek State Park containing the Walter S. Carpenter, Jr. Recreation Area, White Clay Creek Preserve, and Du Pont properties.

Soils and Geology of White Clay Creek State Park[1]

Underlying Geology

White Clay Creek State Park is located in the Piedmont physiographic province of Delaware. Most of the park is underlaid by either Wissahickon Gneiss or pegmatite. The floodplains of the creek are underlaid by Alluvial Deposits. Small sections of the park are underlain by Cockeysville Marble, the Setters Formation, and the Old College Formation.

The Wissahickon Formation dates from the Cambrian to Ordovician Period and is described as an interlayered psammitic and politic gneiss with amphibolite. The pegmatite dates from the lower Paleozoic and is described as a coarse to very coarse grained granitic pegmatite with tourmaline crystals. Cockeysville Marble is located in the northeastern part of the park, dates from the Cambrian to Ordovician Period and is described as a predominantly pure, coarsely crystalline, blue-white dolomite marble interlayered with calc-schist. The Setters Formations lines the southern edge of the Cockeysville Marble, dates from the Cambrian to Ordovician Periods, and is described as “an impure quartzite and garnet-sillimanite-biotite-microcline schist.” The Old College Formation is located in a small area at the south end of the park near where White Clay Creek flows out of the park. It dates from the middle Pleistocene and is described as “reddish-brown to brown clayey silt, silty sand to sandy silt, and medium to coarse quartz sand with pebbles.” The 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.”

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

Soils

Four soils are prominent in White Clay Creek State and include Glenelg Loam (1,032 acres), Gaila Loam (697 acres), Brinklow Channery Loam (412 acres), and Glenelg Silt Loam. Other more minor soils include Glenville Silt Loam, Brinklow-Blocktown Complex, Comus Silt Loam, Hatboro-Codorus Complex, and Delanco-Codorus-Hatboro Complex. Elevations at White Clay Creek State Park range from about 65 feet where White Clay Creek flows out of the park to 370 at the north end of the park near the stateline.

East Section Soils

The East Section has four prominent soils including Glenelg Loam (534 acres), Gaila Loam (514 acres), Brinklow-Channery Complex (207 acres), and Glenville Silt Loam (181 acres). Other minor soils include Glenelg Silt Loam (81 acres), Comus Silt Loam (77 acres), and Delanco-Codorus Hatboro Complex (66 acres).

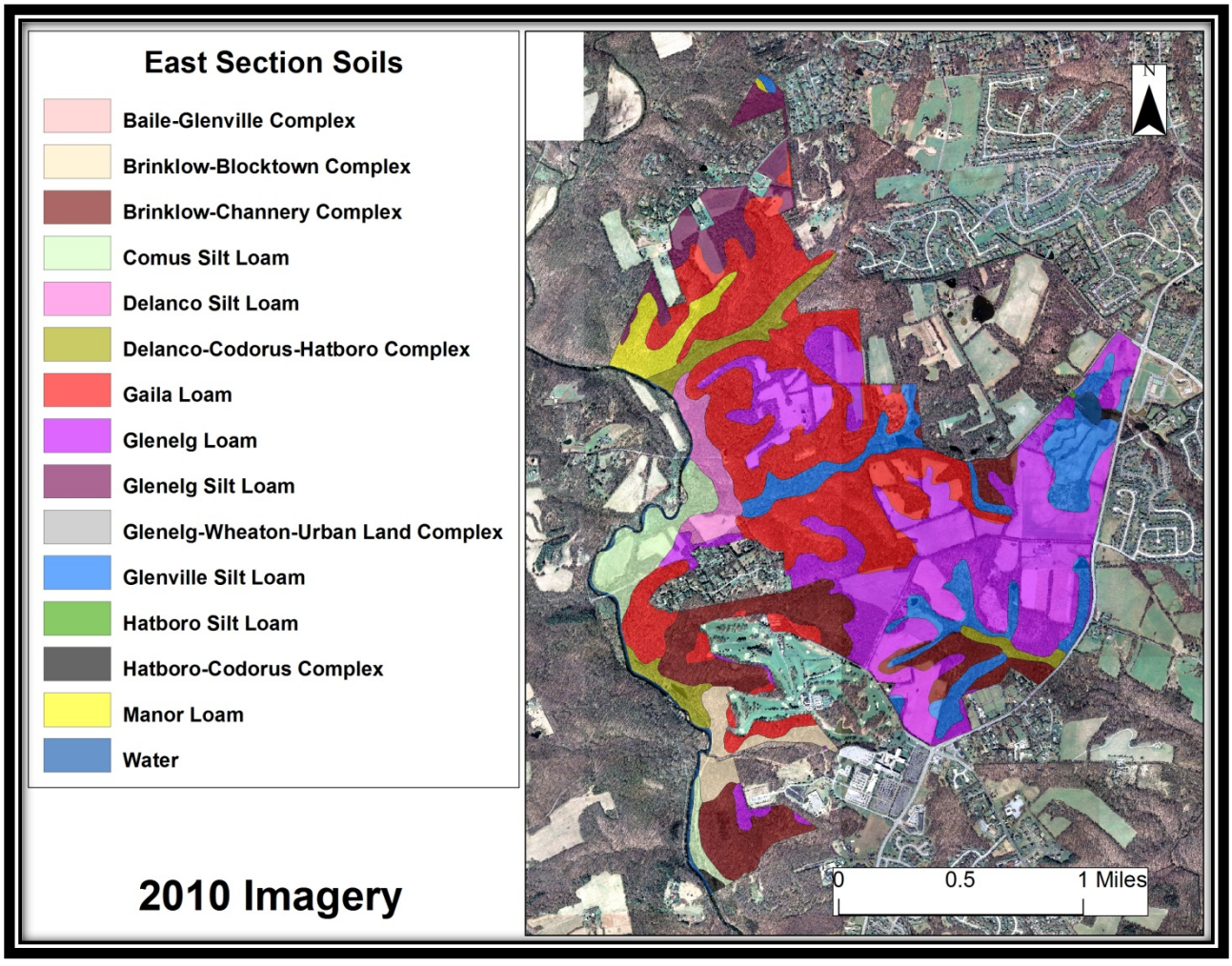


Figure 1.2. East Section Soils

Judge Morris Section Soils

Two soils are prominent in the Judge Morris Section and include Glenelg Loam (163 acres) and Brinklow Channery Loam (152 acres). One other soil, Elsinboro Silt Loam (63 acres) is a minor soil in the section.

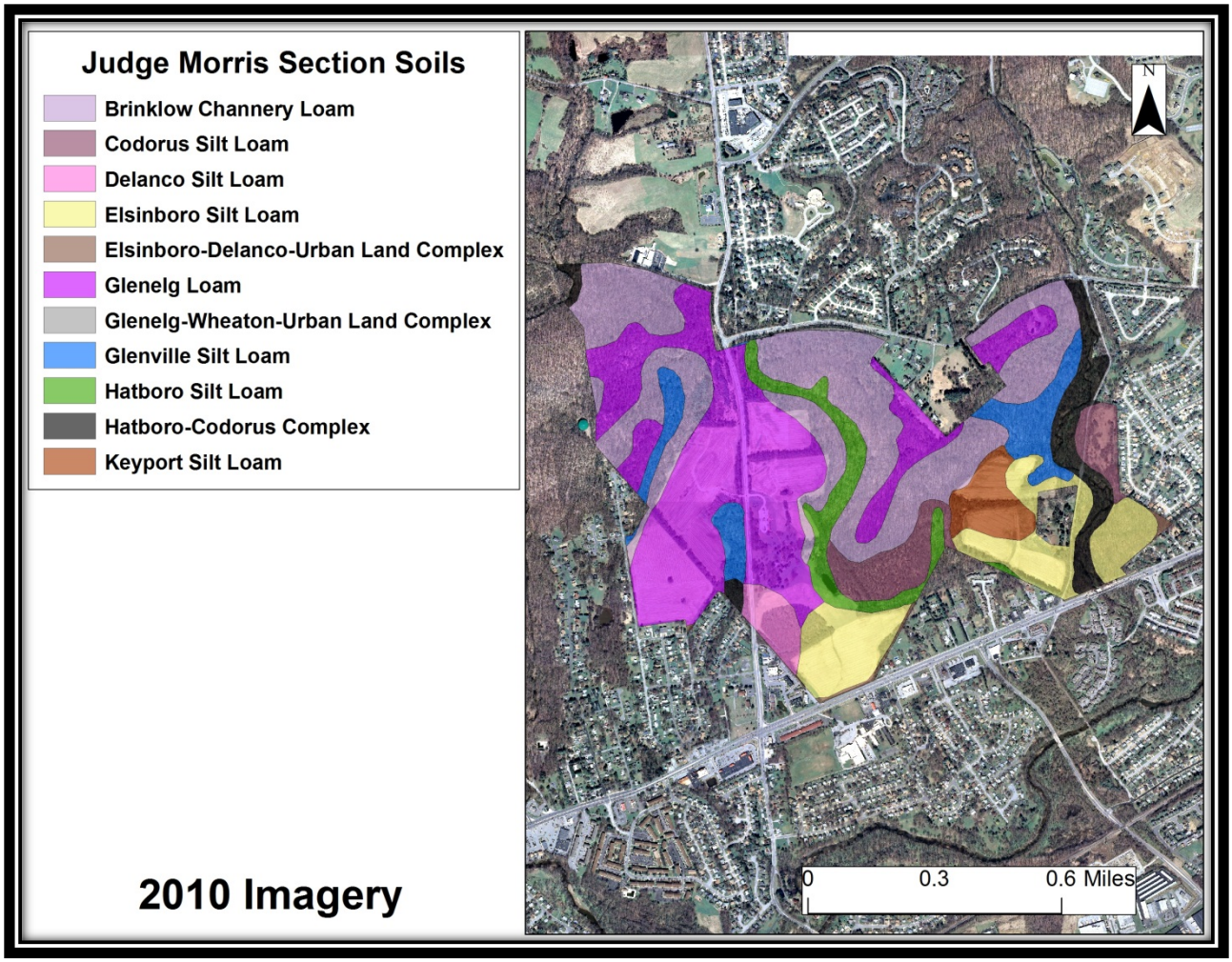


Figure 1.3. Judge Morris Section Soils

South Section Soils

Hatboro-Codorus Complex (57 acres) is the most prominent soil in the South Section. Two other soils, Gaila Loam (26 acres) and Elsinboro Silt Loam (19 acres) are minor soils in the section.

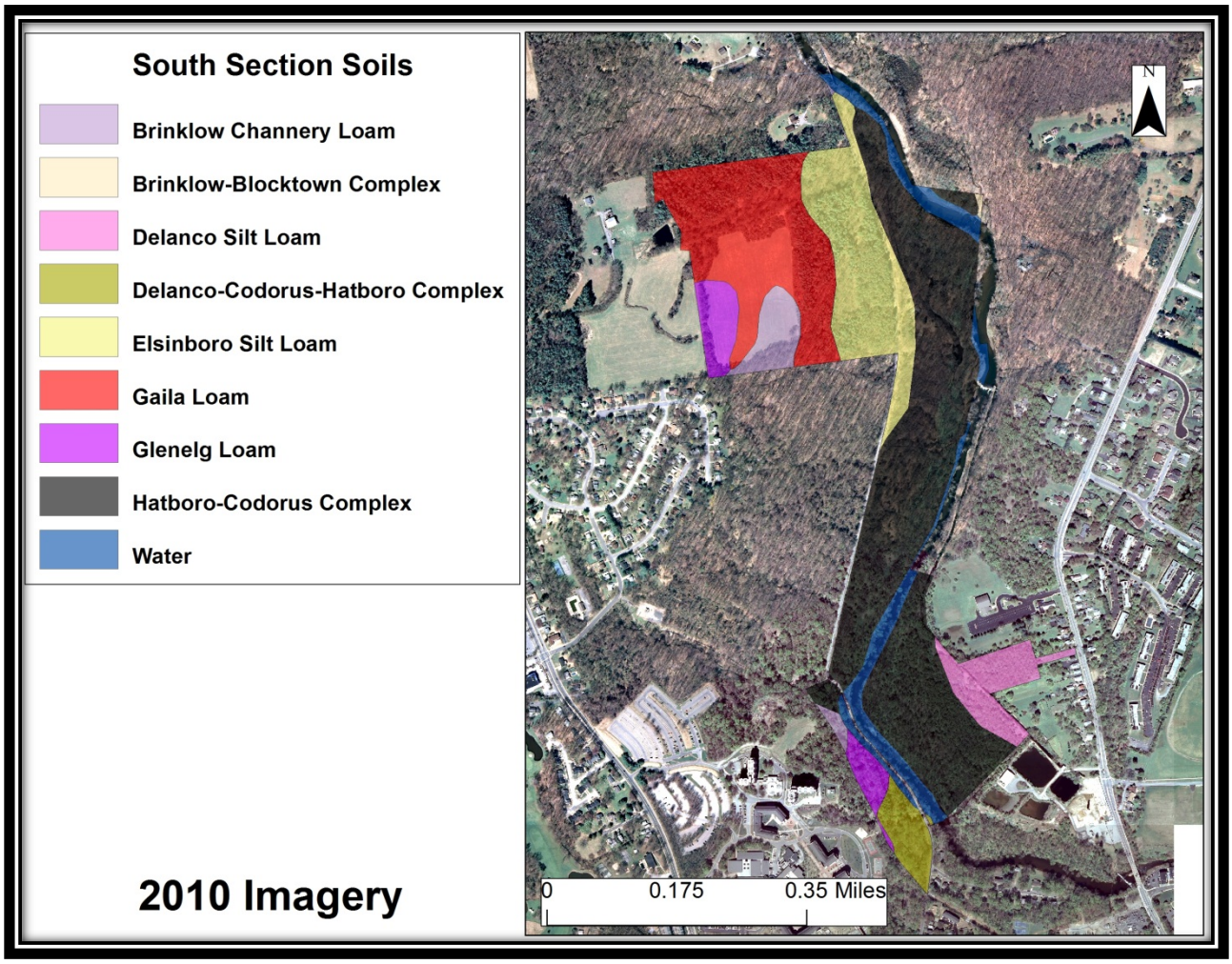


Figure 1.4. South Section Soils

West Section Soils

Glenelg Loam, with 330 acres is the most prominent soil in the West Section. Other minor soils include Gaila Loam (157 acres), Glenelg Silt Loam (146 acres), and Brinklow-Blocktown Complex (101 acres).

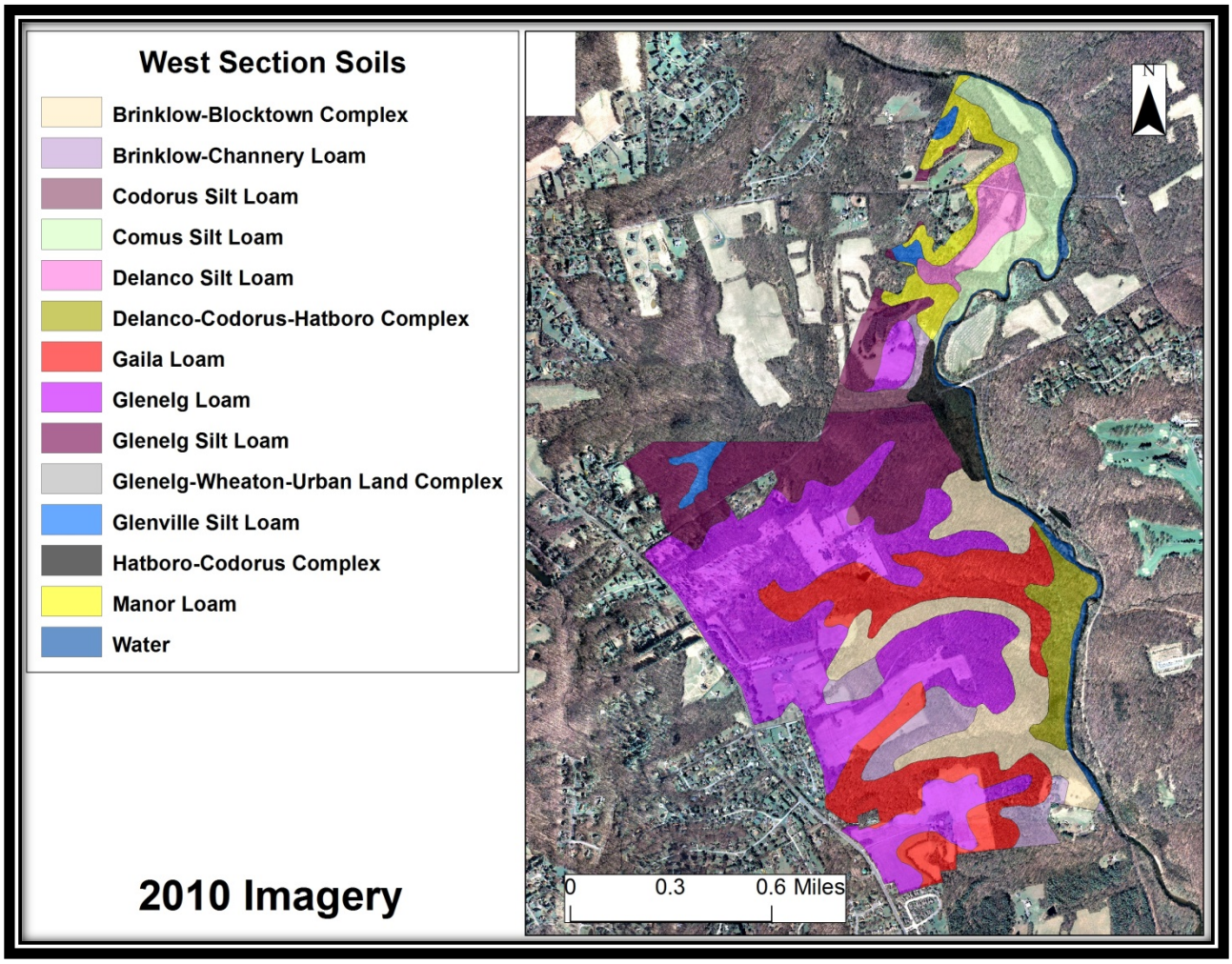


Figure 1.5. West Section Soils

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 White Clay Creek State Park based on 2002, 2007, and 2010 aerial imagery and field observations.
2. Use the maps above to determine changes in the vegetation communities over time in the park.
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 2011 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 2002, 2007, and 2010 imagery. Vegetation communities are named according to the *Guide to Delaware Vegetation Communities* [2] which follows the National Vegetation Classification System (NVCS). The NVCS classifies vegetation on a national scale for the United States and is linked to international vegetation classification. The NVCS helps provide a uniform name and description of vegetation communities found throughout the country and helps determine relative rarity. Descriptions of the vegetation communities are provided in Chapter 5 and of the land covers in Chapter 6. A crosswalk to the Delaware Wildlife Action Plan (DEWAP) and the Northeast Habitat Classification is provided at the top of individual community description.

Analysis of Historical Imagery

Historical imagery of White Clay Creek State Park from 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 3, 5, and 8 year time frame. Changes in the respective vegetation communities and land covers are discussed in the descriptions while broader changes are discussed in the section and park discussion. There is more imagery available (1937, 1954, 1961, 1968, 1992, and 1997) but these sets were not used due to geo-registration problems in the image tiles and image duplication.

Ecological Integrity Assessment (EIA)

An EIA was conducted for those communities in the state park 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 White Clay Creek State Park included in the EIA analysis are listed in Table 2.3 and depicted in Figures 2.1-2.3.

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 and depicted in Figure 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

[2] Coxe, Robert. 2011. Guide to Delaware Vegetation Communities-Fall 2011 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.

currently old field 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. Calculating the natural capital provides a consistent way to compare wildlife areas and state parks as far as value. Even if you do not agree with the values, it still provides a relative measure of the areas.

[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:** Twenty-three vegetation communities and eight land covers were found at White Clay Creek State Park. Northeastern Modified Successional Forest (1,736 acres) is the largest vegetation community, followed by Northern Piedmont Mesic Oak-Beech Forest with 264 acres. Agricultural Field (295 acres) is the largest land cover followed by water (45 acres).

2. **Rare Plants:** Sixty-three rare plants are known to exist in White Clay Creek State Park (Table 2.1).

Scientific Name	Common Name	Rank	Last Observed
Agalinus tenuifolia	Slender False-foxglove	S1	1988
Agastache nepetoides	Yellow Giant Hyssop	S2	1991
Agrimonia striata	Woodland Agrimony	S2	1993
Angelica atropurpurea	Great Angelica	S1.1	1997
Aplectrum hyemale	Puttyroot	S1	1997
Boechera canadensis	Sicklepod	S2	1999
Arisaema dracontium	Green Dragon	S2	1999
Asclepias exaltata	Poke Milkweed	S2	1997
Asclepias purpurascens	Purple Milkweed	S2	1999
Botrychium matricarifolium	Chamomile Grapefern	S1	1997
Bromus latiglumis	Riverbank Brome	S1.1	1999
Calystegia spithamaea ssp. *spithamaea*	Low Bindweed	S1	1997
Cardamine rotundifolia	Roundleaf Water-cress	S1.1	1997
Carex bromoides	Brome-like Sedge	S2	1989
Carex bushii	Bush's Sedge	S2	1997
Carex gracilescens	Slender Sedge	S2	?
Carex granularis	Meadow Sedge	S3	1999
Carex gynandra	A Sedge	S2	1997
Carex sparganioides	Bur-reed Sedge	S2	1989
Carex squarrosa	Squarrose Sedge	S3	1994
Carex torta	Twisted Sedge	S2	1994
Carex trichocarpa	Hairy-fruit Sedge	S2	1997
Carex willdenowii	Willdenow's Sedge	S1	1997
Cerastium nutans	Nodding Chickweed	S1	1988
Chamaelirium luteum	Devil's-bit	S1	1998
Corydalis flavula	Yellow Corydalis	S1.1	1999
Cunila oreganoides	Common Dittany	S2	1997
Cuscuta polygonorum	Smartweed Dodder	SU	1999
Cyperus squarrosus	Umbrella-sedge	SU	1999

Cystopteris protrusa	Lowland Brittle-fern	S2	1998
Cystopteris tenuis	Bladderfern	S1	1997
Hylodesmum glutinosum	Large Tick-trefoil	S2	1999
Dichanthelium yadkinense	A Panic Grass	S1	1999
Dryopteris celsa	Log Wood Fern	S2	?
Elymus hystrix	Bottle-brush Grass	S2	1999
Euonymus atropurpureus	Wahoo	S1	1999
Eurybia schreberi	Schreber's Aster	S2	2000
Galium asprellum	Rough Bedstraw	S2	1999
Gentiana andrewsii	Fringe-top Bottle Gentian	S1.1	2003
Geum laciniatum var. *laciniatum*	Rough Avens	S3	1997
Heliopsis helianthoides	Ox-Eye	S1	1998
Isotria verticillata	Large Whorled Pogonia	S3	2011
Lilium canadense ssp. *canadense*	Canada Lily	S2	1987
Liparis lilifolia	Large Twayblade	S2	1999
Hypopithys monotropa	American Pinesap	S2	1999
Muhlenbergia tenuiflora	Slender Muhly	S2	1999
Orobanche uniflora	One-flowered Broomrape	S3	1999
Platanthera peramoena	Purple Fringeless Orchid	S1	2003
Poa cuspidate	Bluegrass	S2	1999
Polygonatum biflorum var. *commutatum*	Giant Solomon's Seal	S3	2000
Pyrola elliptica	Shinleaf	S2	2003
Quercus muehlenbergii	Chinquapin Oak	SU	?
Schoenoplectus purshianus	Weakstalk Bulrush	S2	?
Scirpus atrovirens	Woolgrass Bulrush	S1	1999
Scirpus expansus	Red-stem Bulrush	S2	1999
Spiraea alba var. *alba*	Narrow-leaf Meadow-sweet	S1	1997
Spiranthes cernua	Nodding Ladies' tresses	S1	?
Thalictrum dioicum	Early Meadow-rue	S1	1999
Trichophorum planifolium	Bashful Bulrush	S2	1997
Trillium cernuum	Nodding Trillium	S2	1999
Triosteum aurantiacum var. *aurantiacum*	Coffee Tinker's-weed	S1	1988
Vernonia glauca	Broadleaf Ironweed	S3	1999
Viola rotundifolia	Roundleaf Violet	S2	1993
Woodsia obtusa ssp. *obtusaa*	Blunt-lobe Woodsia	S1	1998
Zannichellia palustris	Horned Pondweed	S2	1993

Table 2.1. Rare Plants at White Clay Creek State Park

3. **Rare Animals:** Seventeen rare animals are known to exist in White Clay Creek State Park (Table 2.2).

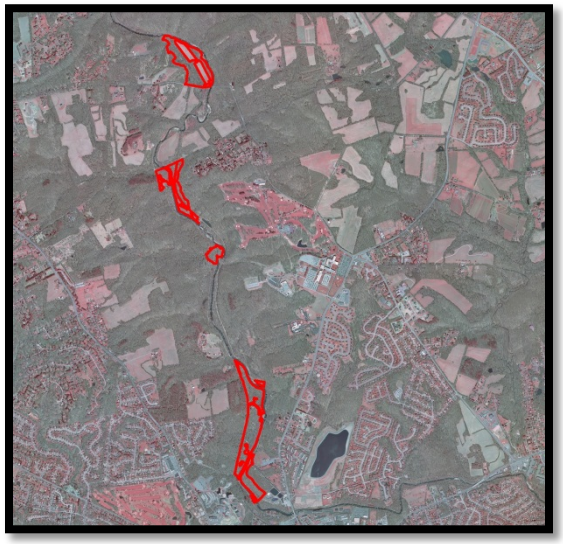
Scientific Name	Common Name	Rank	Last Observed
Ambystoma maculatum	Spotted Salamander	S2	1997
Buteo lineatus	Red-shouldered Hawk	S2B, S3N	1999
Buteo platypterus	Broad-winged Hawk	S1B	1996
Coccyzus erythropthalmus	Black-billed Cuckoo	S1B	1978
Cordulegaster erronea	Tiger Spiketail	S2	2003
Dendroica dominica	Yellow-throated Warbler	S2B	1999
Euphyes conspicua	Black Dash	S1	1999
Eurycea longicauda	Longtail Salamander	S1	2001
Gomphus villosipes	Unicorn Clubtail	S2	1999
Macromia illinoiensis	Illinois River Cruiser	S2	1999
Notorus insignis	Margined Madtom	S2	1989
Parula americana	Northern Parula	S1B	2000
Setophaga ruticilla	American Redstart	S1B	2000
Strix varia	Barred Owl	S2	2001
Stylogomphus albistylus	Least Clubtail	S2	1999
Vireo gilvus	Warbling Vireo	S2B	1999
Wilsonia citrina	Hooded Warbler	S1B	2000

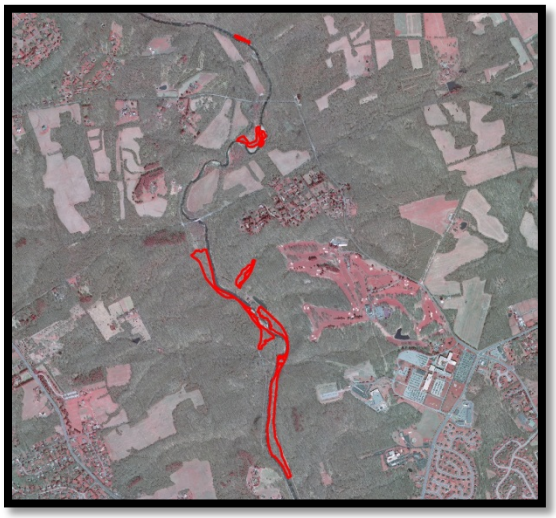
Table 2.2. Rare Animals at White Clay Creek State Park

Ecological Integrity Assessment (EIA)

Five vegetation communities are ranked S2 or higher. These include Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp, Green Ash-Mixed Hardwood Floodplain Forest, Northeastern Coastal Plain/Piedmont Oak Beech/Heath Forest, Riverine Floodplain Forest, and Smooth Alder Swamp. These areas are mapped by tract in Figures 2.1-3 and summarized in Table 2.3.

Table 2.3. EIA Vegetation Communities located in White Clay Creek State Park

Community Map	Community Name/EIA Score	Description
	**White Clay 1** **Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp (1.3 acres)** **EIA = 3.48 (B- rank)**	This floodplain forest community is located in the floodplain of White Clay Creek south of Wedgewood Road.
	**White Clay 2** **Green Ash-Mixed Hardwood Floodplain Forest (107 acres)** **EIA = 3.35 (C+ rank)**	This floodplain forest is located in the floodplain of White Clay Creek throughout the park.
	**White Clay 3** **Northeastern Coastal Plain/Piedmont Oak Beech/Heath Forest (13.5 acres)** **EIA = 3.46 (B- rank)**	This upland forest community is located in the northeastern part of the park.

Community Map	Community Name/EIA Score	Description
	**White Clay 4** **Riverine Floodplain Forest (27.2 acres)** **EIA = 3.41 (C+ rank)**	This floodplain forest alternates with the Green Ash-Mixed Hardwood Forest in the floodplain of White Clay Creek through the park.
	**White Clay 5** **Smooth Alder Swamp (1.2 acres)** **EIA = 3.24 (C rank)**	This shrubland is located in a floodplain depression next to a steep slope.

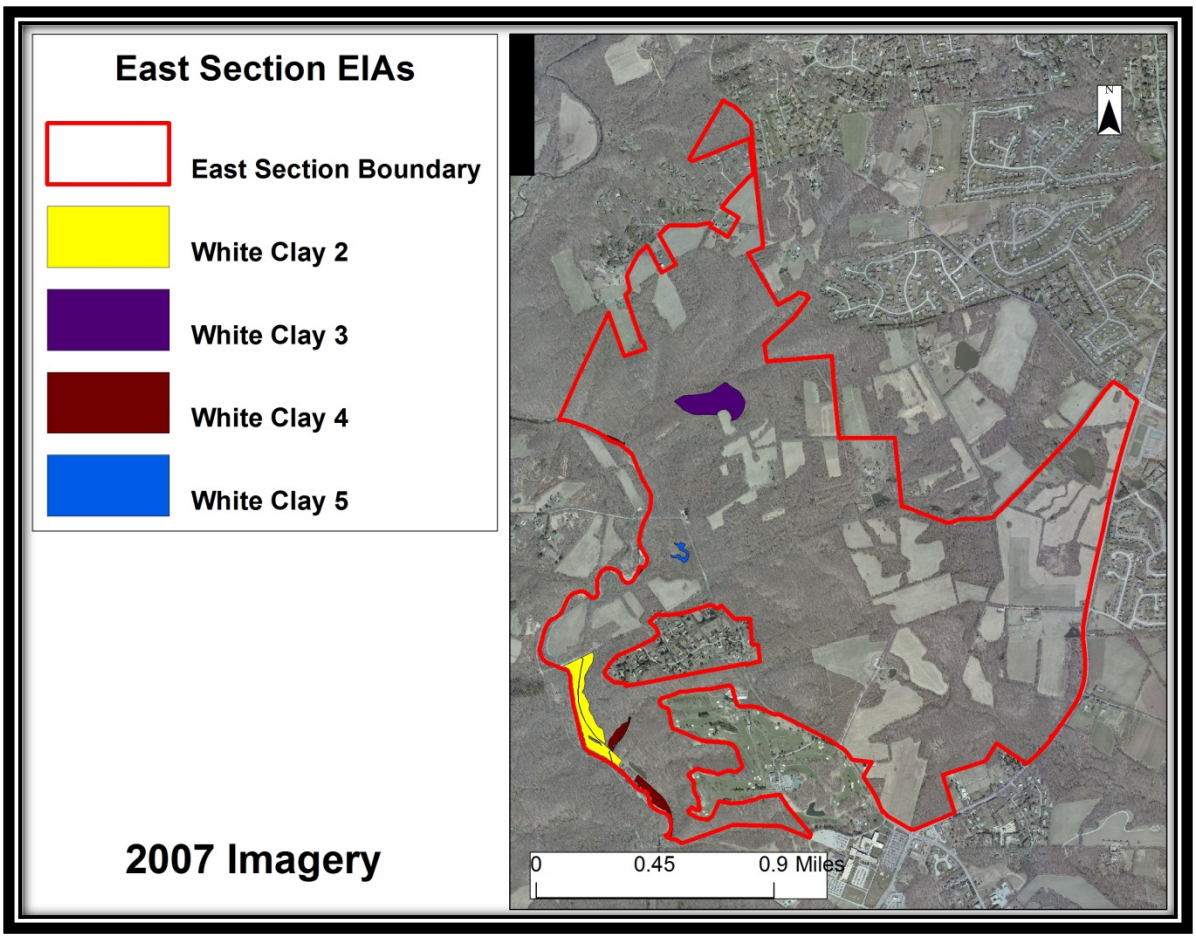


Figure 2.1. East Section EIA Communities

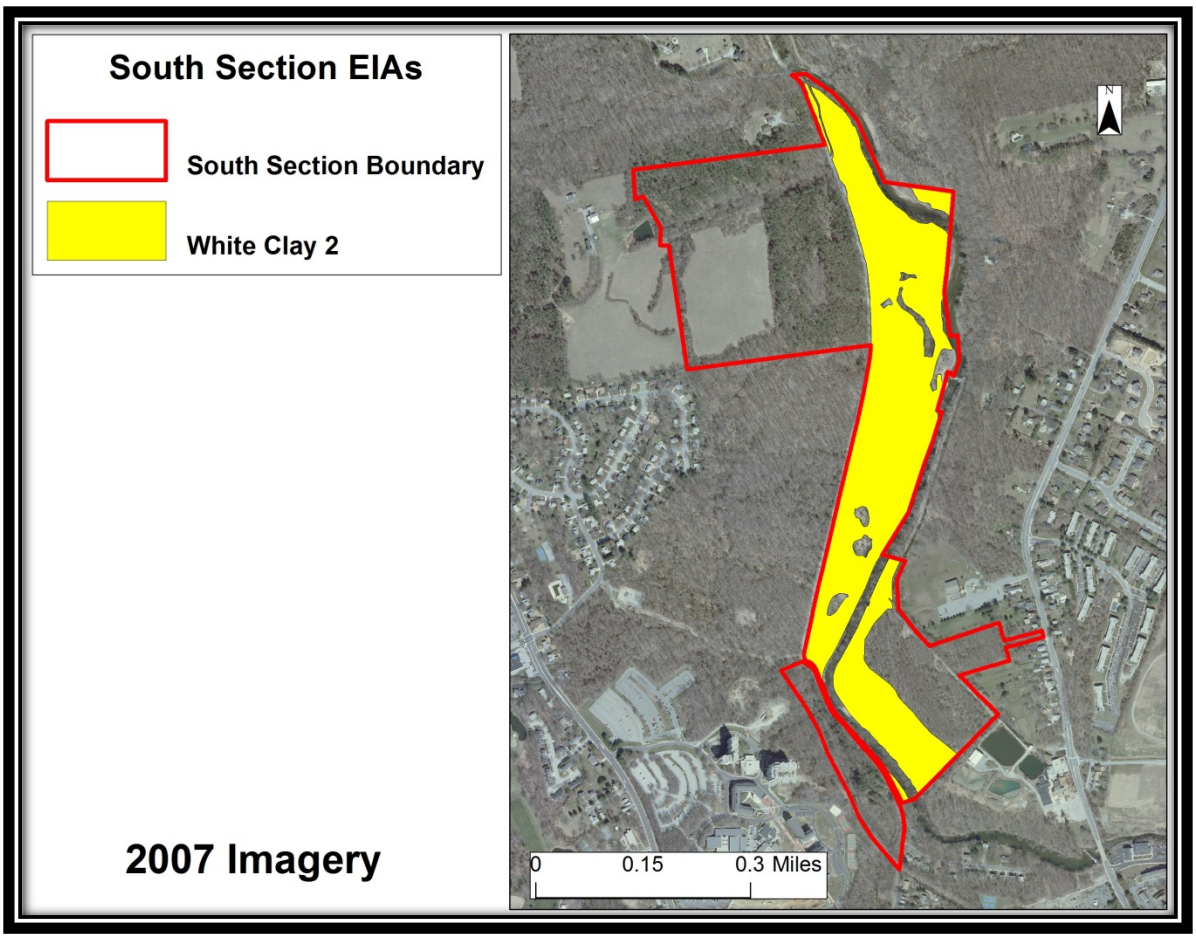


Figure 2.2. South Section EIA Communities

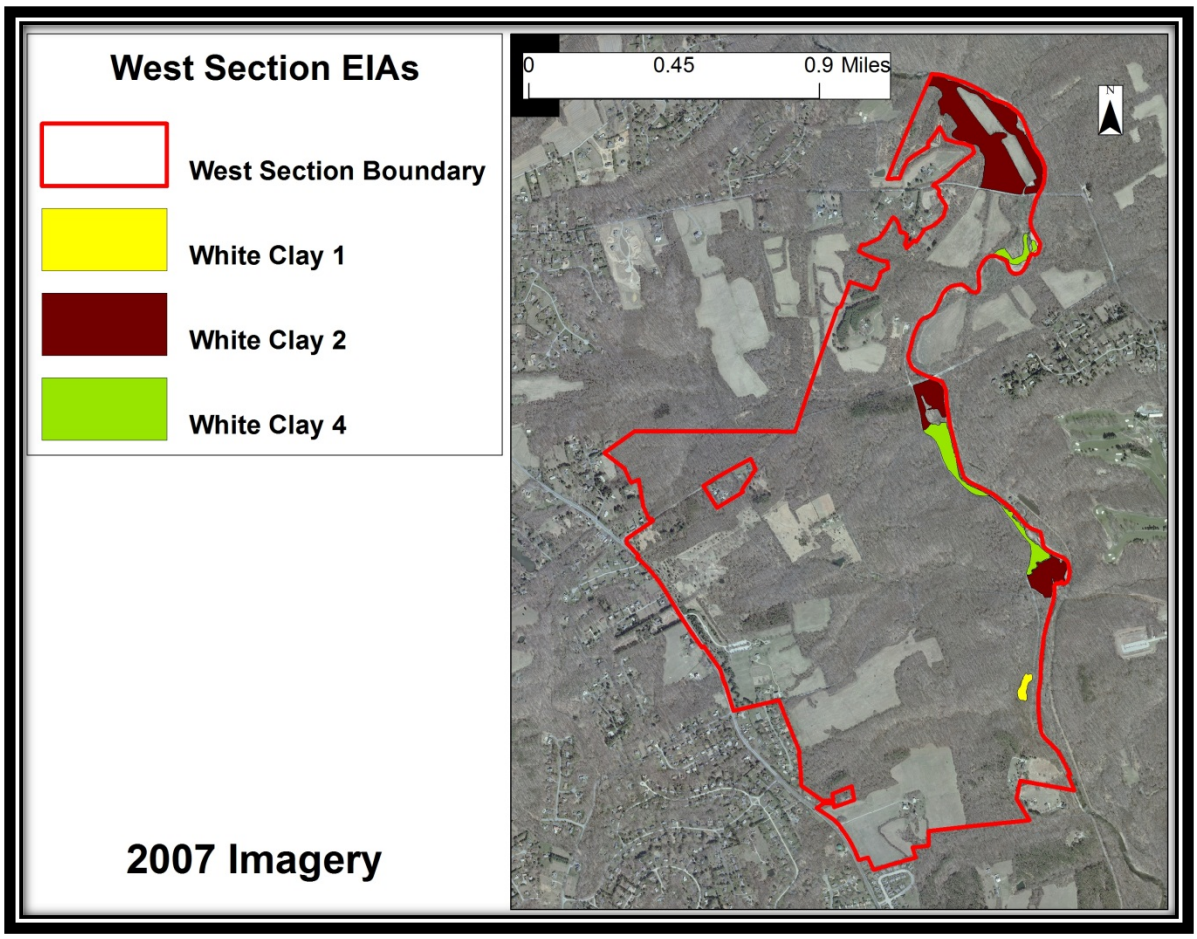


Figure 2.3. West Section EIA Communities

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,

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

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 White Clay Creek State Park

Eleven forest blocks are present that are more than 100 acres in size and are located in whole or part in White Clay Creek State park (Table 2.4 and Figure 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. Descriptions are provided for each forest block in Table 2.4.

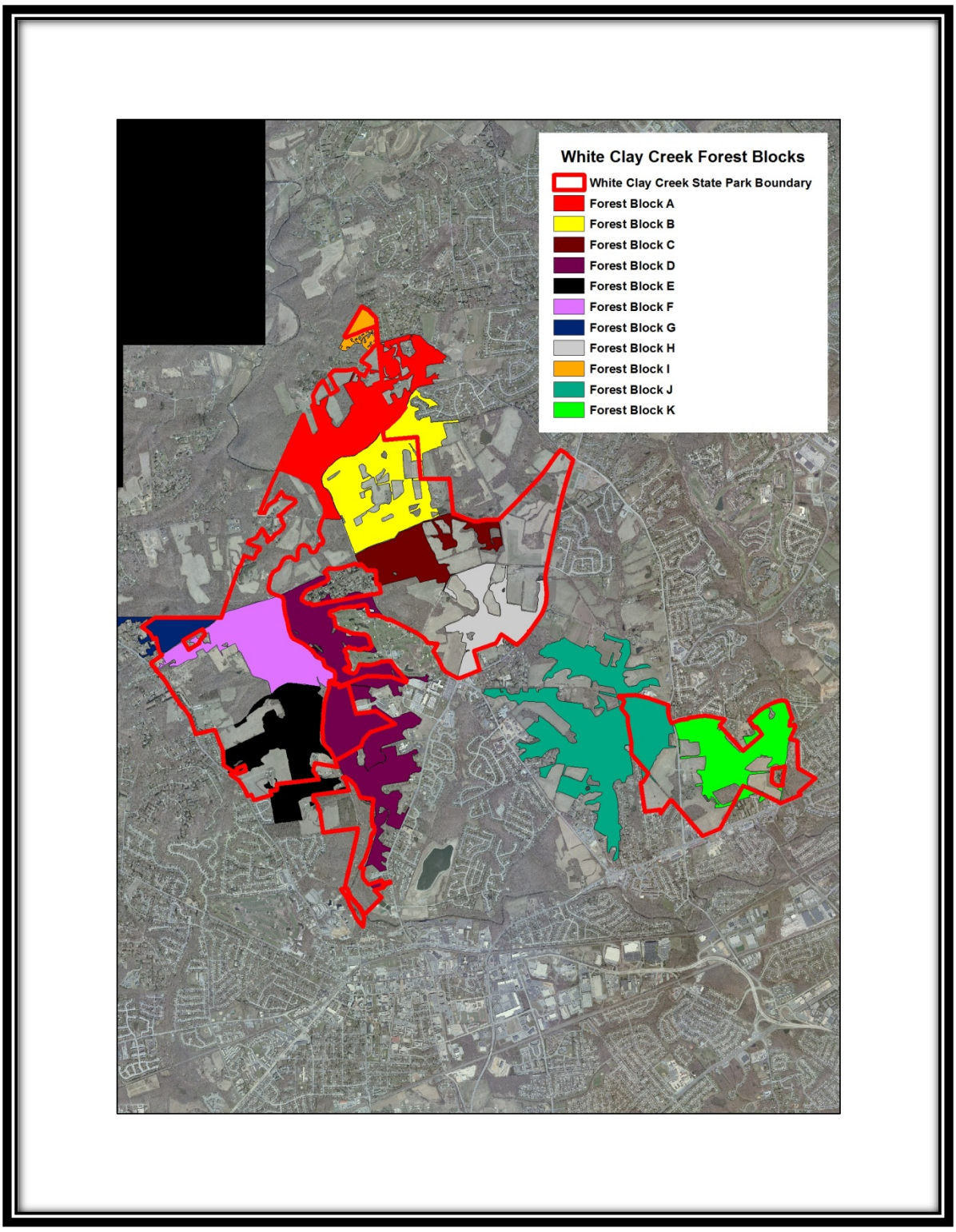
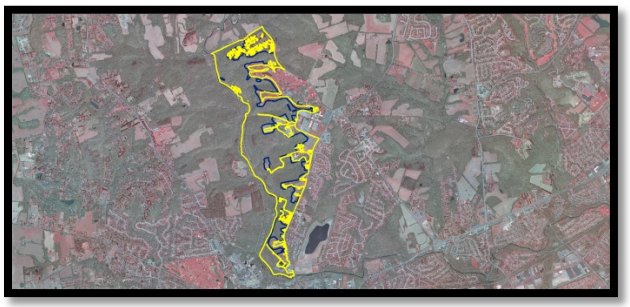
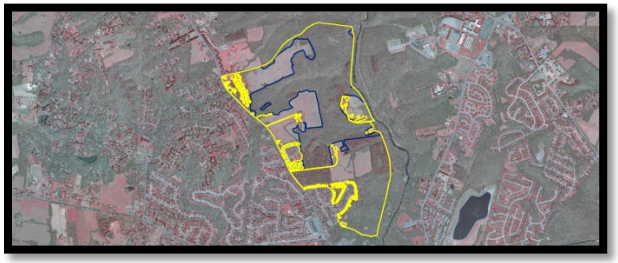
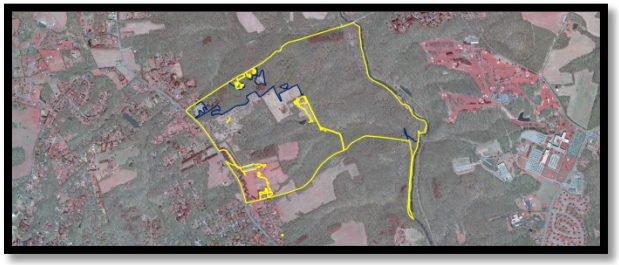


Figure 2.4. White Clay Creek State Park Forest Blocks

Table 2.4. Forest Blocks located in whole or part in White Clay Creek State Park

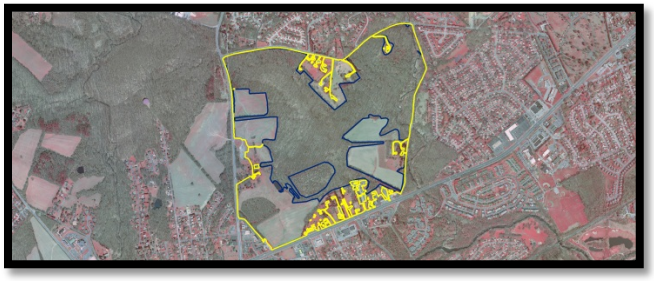
Forest Block Map	Block Name/Acreage	Description
	**White Clay Creek A** **Current Block = 298 acres (78 acres interior)** **Potential Block = 422 acres (220 acres interior)**	White Clay Creek A is located at the north end of the park and is bounded by Corner Ketch Road on the north, agricultural field on the east, Doe Run Road and Chambers Rock Road on the south, and White Clay Creek on the west. Four vegetation communities are located within this block and include Northeastern Modified Successional Forest, Northern Piedmont-Mesic Oak-Beech Forest, Red Spruce Planted Forest, and White Pine Planted Forest. A tributary to White Clay Creek is the main drainage for this block. Currently this block contains 78 acres of interior habitat. Potentially this block could be 422 acres in size and contain 220 acres of interior habitat.
	**White Clay Creek B** **Current Block = 303 acres (49 acres interior)** **Potential Block = 415 acres (248 acres interior)**	White Clay Creek B is located in the northwestern part of the park and is bounded by Doe Run Road on the north, development and Corner Ketch Road on the east, Pleasant Hill Road on the south, and Thompson Station Road on the west. Three vegetation communities are within this block and include Eastern Hemlock Planted Forest, Northeastern Modified Successional Forest, and Northern Piedmont Mesic Oak-Beech Forest. A tributary to White Clay Creek is the main drainage for this block. Currently this block contains 49 acres of interior habitat. Potentially this block could be 415 acres in size and contain 248 acres of interior habitat.

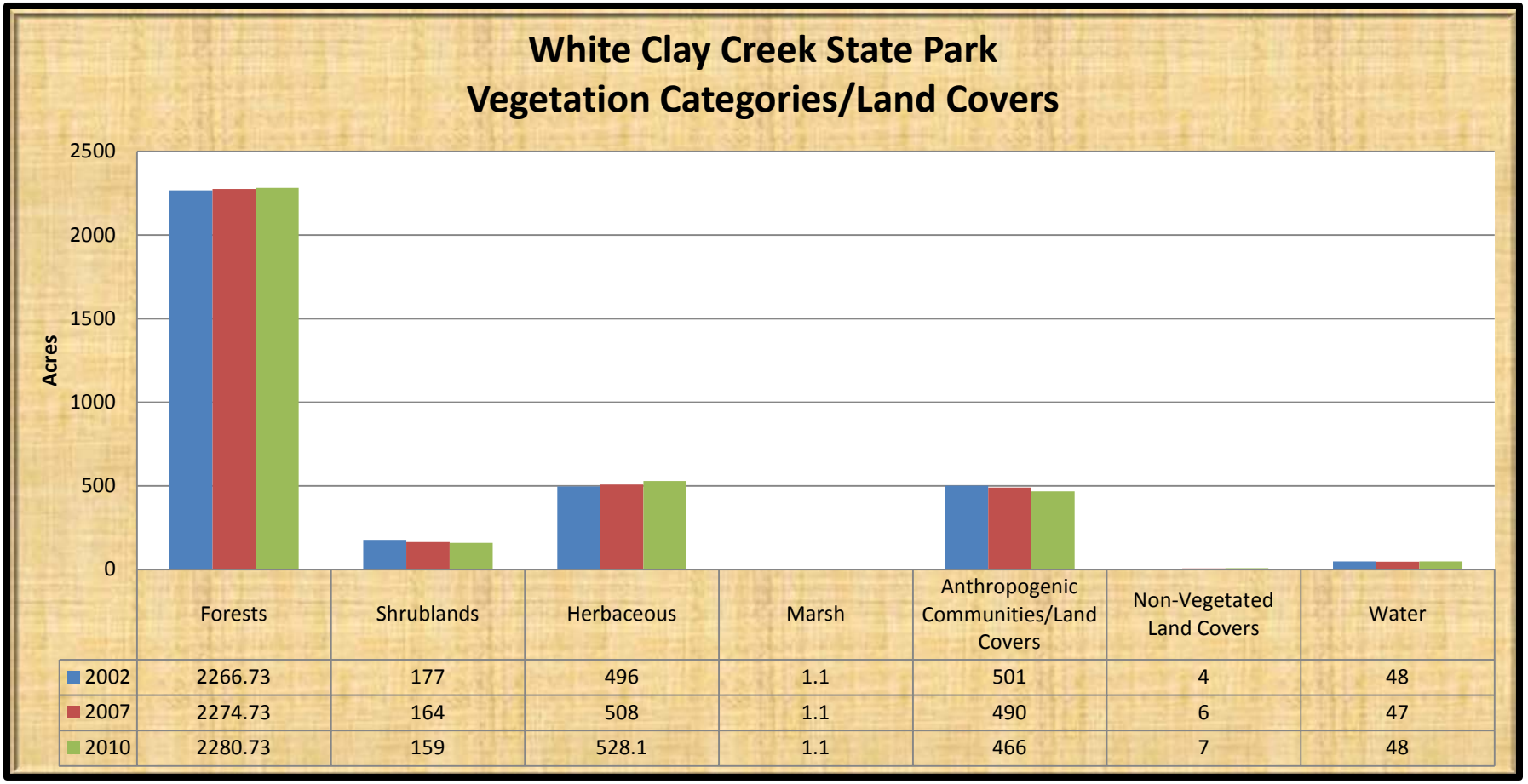
Forest Block Map	Block Name/Acreage	Description
	**White Clay Creek C** **Current Block = 156 acres (42 acres interior)** **Potential Block = 334 acres (212 acres interior)**	White Clay Creek C is located in the middle of the park east of Thompson Station Road. It is bounded by Pleasant Hill Road on the north, fields on the east, Fairhill School Drive on the south, and Thompson Station Road on the west. Two vegetation communities are located within this block and include Northeastern Modified Successional Forest and Northern Piedmont Mesic Oak-Beech Forest. Two tributaries to White Clay Creek drain this block. Currently this block contains 42 acres of interior habitat. Potentially this block could be 334 acres in size and contain 212 acres of interior habitat.
	**White Clay Creek D** **Current Block = 486 acres (101 acres interior)** **Potential Block = 710 acres (175 acres interior)**	White Clay Creek D covers the south end of the park east of White Clay Creek. It is bounded on the north by Hopkins Road, on the east by Thompson Station Road and a developed area, and on the south and west by White Clay Creek. Six vegetation communities are located within this block and include Green Ash-Mixed Hardwood Floodplain Forest, Northeastern Modified Successional Forest, Northern Piedmont Mesic Oak-Beech Forest, Riverine Floodplain Forest, Successional Tuliptree Forest, and Virginia Pine Successional Forest. White Clay Creek drains this block. Currently this block contains 101 acres of interior habitat. Potentially this block could be 710 acres in size and contain 175 acres of interior habitat.

Forest Block Map	Block Name/Acreage	Description
	**White Clay Creek E** **Current Block = 249 acres (74 acres interior)** **Potential Block = 554 acres (263 acres interior)**	White Clay Creek E covers the south end of the park west of White Clay Creek. It is bounded by Wedgewood Road on the north, Tri-Valley Trail on the east, an unnamed road on the south, and New London Road on the west. Four vegetation communities are located within this block and include Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp, Early to Mid-Successional Loblolly Pine Forest, Northeastern Modified Successional Forest, and Northern Piedmont Mesic Oak-Beech Forest. White Clay Creek and its tributaries are the main drainages for the block. Currently this block contains 74 acres of interior habitat. Potentially this block could be 554 acres in size, and contain 263 acres of interior habitat.
	**White Clay Creek F** **Current Block = 237 acres (108 acres interior)** **Potential Block = 448 acres (233 acres interior)**	White Clay Creek F is located in the western part of the park in the Carpenter Recreation area. It is bounded by Hopkins Bridge Road on the north, White Clay Creek on the east, Wedgewood Road on the south, and New London Road on the west. Six vegetation communities are located within this block and include Green Ash-Mixed Hardwood Floodplain Forest, Northeastern Modified Successional Forest, Northern Piedmont Mesic Oak-Beech Forest, Red Spruce Planted Forest, Riverine Floodplain Forest, and White Pine Planted Forest. White Clay Creek and its tributaries drain this block. Currently this block contains 108 acres of interior habitat. Potentially this block could be 448 acres in size and contain 233 acres of interior habitat.

Forest Block Map	Block Name/Acreage	Description
	**White Clay Creek G** **Current Block = 85 acres (10 acres interior)** **Potential Block = 240 acres (46 acres interior)**	White Clay Creek G is located partly in Pennsylvania at the north end of the park. The numbers given include just the Delaware portions. It is bounded by the Delaware stateline on the north, White Clay Creek on the east, Chambers Rock Road on the south, and New London Road on the west. Four vegetation communities are located within this block and include Northeastern Modified Successional Forest, Northern Piedmont Mesic Oak-Beech Forest, Riverine Floodplain Forest, and White Pine Planted Forest. White Clay Creek and its tributaries drain this block. Currently this block contains 10 acres in interior habitat in Delaware. Potentially it could be 240 acres in size and contain 46 acres of interior habitat in Delaware.
	**White Clay Creek H** **Current Block = 159 acres (24 interior acres)** **Potential Block = 339 acres (189 interior acres)**	White Clay Creek H is located at the east end of the park and is bounded by Fairhill School Road on the north, Paper Mill Road on the east, and Thompson Station Road on the south and west. Two vegetation communities are located within this block and include Northeastern Modified Successional Forest and Northern Piedmont Mesic Oak-Beech Forest. A tributary to White Clay Creek drains this block. Currently this block contains 24 acres of interior habitat. Potentially this block could be 339 acres in size and contain 189 acres of interior habitat.

Forest Block Map	Block Name/Acreage	Description
	**White Clay Creek I** **Current Block = 32 acres (0 acres interior)** **Potential Block = 78 acres (0 acres interior)**	White Clay Creek I is located at the north end of the park and extends into Pennsylvania. The Delaware portion is bounded by the stateline in the north, Jobs Lane on the east, Corner Ketch Road on the south, and Great Circle 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 Successional Tuliptree Forest. A tributary to White Clay Creek drains this block. Currently this block contains no acres of interior habitat in Delaware. Potentially this block could be 78 acres in size in Delaware but still would contain no interior acres in Delaware.
	**White Clay Creek J** **Current Block = 500 acres (144 acres interior)** **Potential Block = 1,041 acres (538 acres interior)**	White Clay Creek J is located at the west end of the Judge Morris Section and includes the Middle Run Natural Area. It is bounded by Fox Den Road on the north, Polly Drummond Road on the east, developed area on the south, and Possum Park 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 Successional Tuliptree Forest. A tributary to White Clay Creek drains this block. Currently this block contains 174 acres of interior habitat. Potentially it could be 1,041 acres in size and contain 538 acres of interior habitat.

Forest Block Map	Block Name/Acreage	Description
	**White Clay Creek K** **Current Block = 211 acres (55 acres interior)** **Potential Block = 383 acres (190 acres interior)**	White Clay Creek K is located on the east side of the Judge Morris Section. It is bounded by Old Coach Road on the north, Upper Pike Creek Road on the east, agricultural field and development on the south, and Polly Drummond Road on the west. Two vegetation communities are located within this block and include Northeastern Modified Successional Forest and Northern Piedmont Mesic Oak-Beech Forest. A tributary to Pike Creek drains this block. Currently this block contains 55 acres of interior habitat. Potentially it could be 383 acres in size and contain 190 acres of interior habitat.



	Forests	Shrublands	Herbaceous	Marsh	Anthropogenic Communities/Land Covers	Non-Vegetated Land Covers	Water
2002	2266.73	177	496	1.1	501	4	48
2007	2274.73	164	508	1.1	490	6	47
2010	2280.73	159	528.1	1.1	466	7	48

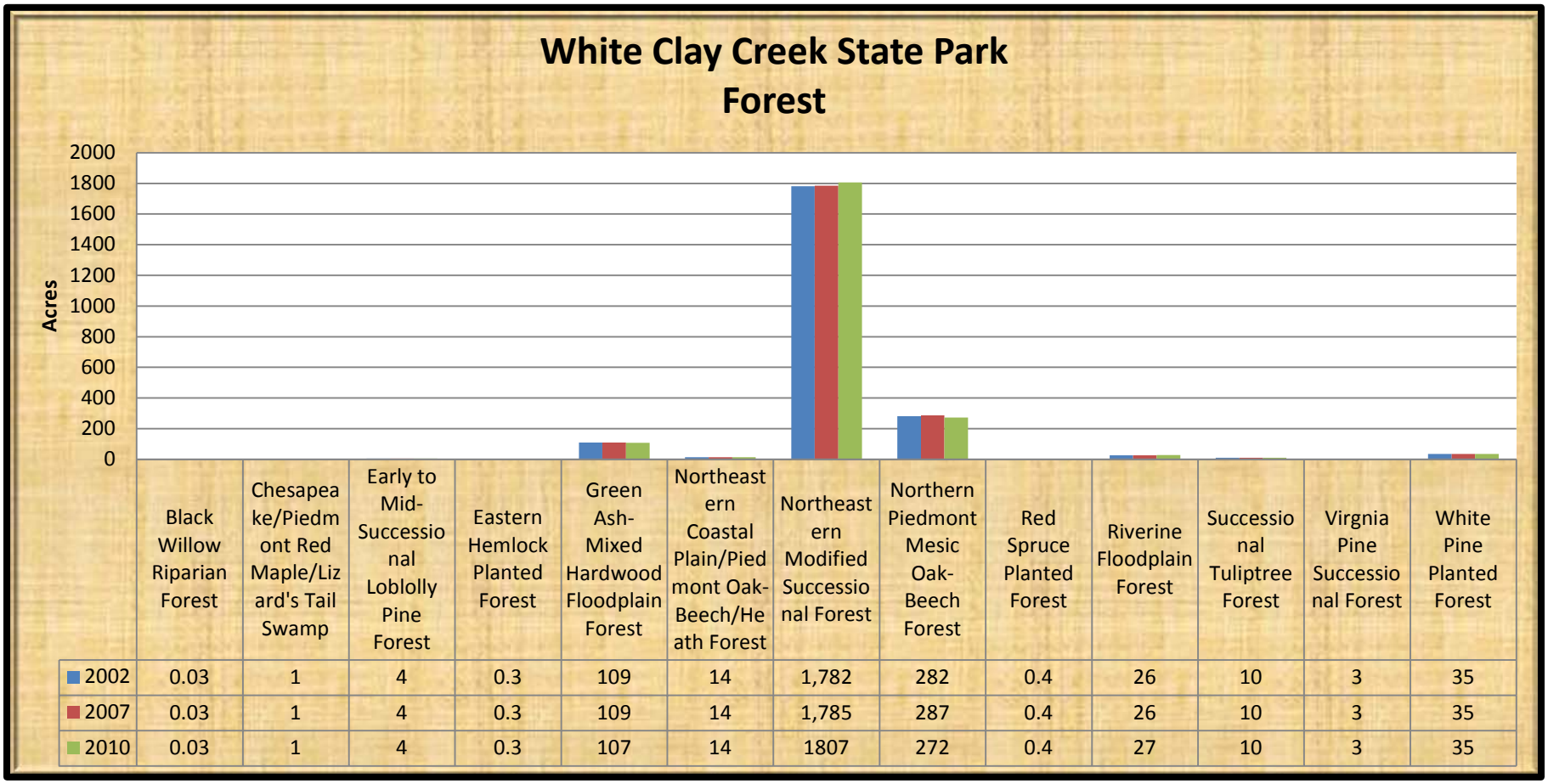
Figure 3.1. White Clay Creek State Park Vegetation Categories/Land Covers (2002, 2007, and 2010)

White Clay Creek State Park Broad Trends (Figure 3.1): White Clay Creek State Park is roughly 2/3 forested with herbaceous and anthropogenic communities mixed in. Total amounts of forests have increased slightly as shrublands succeed to forest. Anthropogenic communities in the form of agricultural fields have decreased somewhat leading to an upsurge in herbaceous communities.

Natural Capital (Table 3.1)

The natural capital of White Clay Creek State Park has decreased overall and is driven by losses in forested wetlands due to excess water and invasion by exotic invasive plant species.

Table 3.1. Natural Capital of White Clay Creek State Park	
Year	**Natural Capital (in 2012 dollars)**
2002	$2,541,685/year
2007	$2,523,564/year
2010	$2,518,663/year



	Black Willow Riparian Forest	Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp	Early to Mid-Successional Loblolly Pine Forest	Eastern Hemlock Planted Forest	Green Ash-Mixed Hardwood Floodplain Forest	Northeastern Coastal Plain/Piedmont Oak-Beech/Heath Forest	Northeastern Modified Successional Forest	Northern Piedmont Mesic Oak-Beech Forest	Red Spruce Planted Forest	Riverine Floodplain Forest	Successional Tuliptree Forest	Virgnia Pine Successional Forest	White Pine Planted Forest
2002	0.03	1	4	0.3	109	14	1,782	282	0.4	26	10	3	35
2007	0.03	1	4	0.3	109	14	1,785	287	0.4	26	10	3	35
2010	0.03	1	4	0.3	107	14	1807	272	0.4	27	10	3	35

Figure 3.2. Forest at White Clay Creek State Park (2002, 2007, and 2010)

White Clay Creek State Park Forest (Figure 3.2): Northeastern Modified Successional Forest is the most common forested community by far in White Clay Creek State Park followed remotely by Northern Piedmont Mesic Oak-Beech Forest. Northeastern Modified Successional Forest continues to increase in the park as exotic invasive plants species continue to spread. Northern Piedmont Mesic Oak-Beech Forest and Green Ash-Mixed Hardwood Forest, which follows in third, have both decreased in acreage since 2002.

Natural Capital (Table 3.2)

Forestland capital has decreased since 2002 and appears to be the result of exotic invasive plant species invading the landscape.

Table 3.2. Natural Capital of White Clay Creek State Park Forest	
Year	**Natural Capital (in 2012 dollars)**
2002	$2,073,736/year
2007	$2,075,439/year
2010	$2,064,660/year

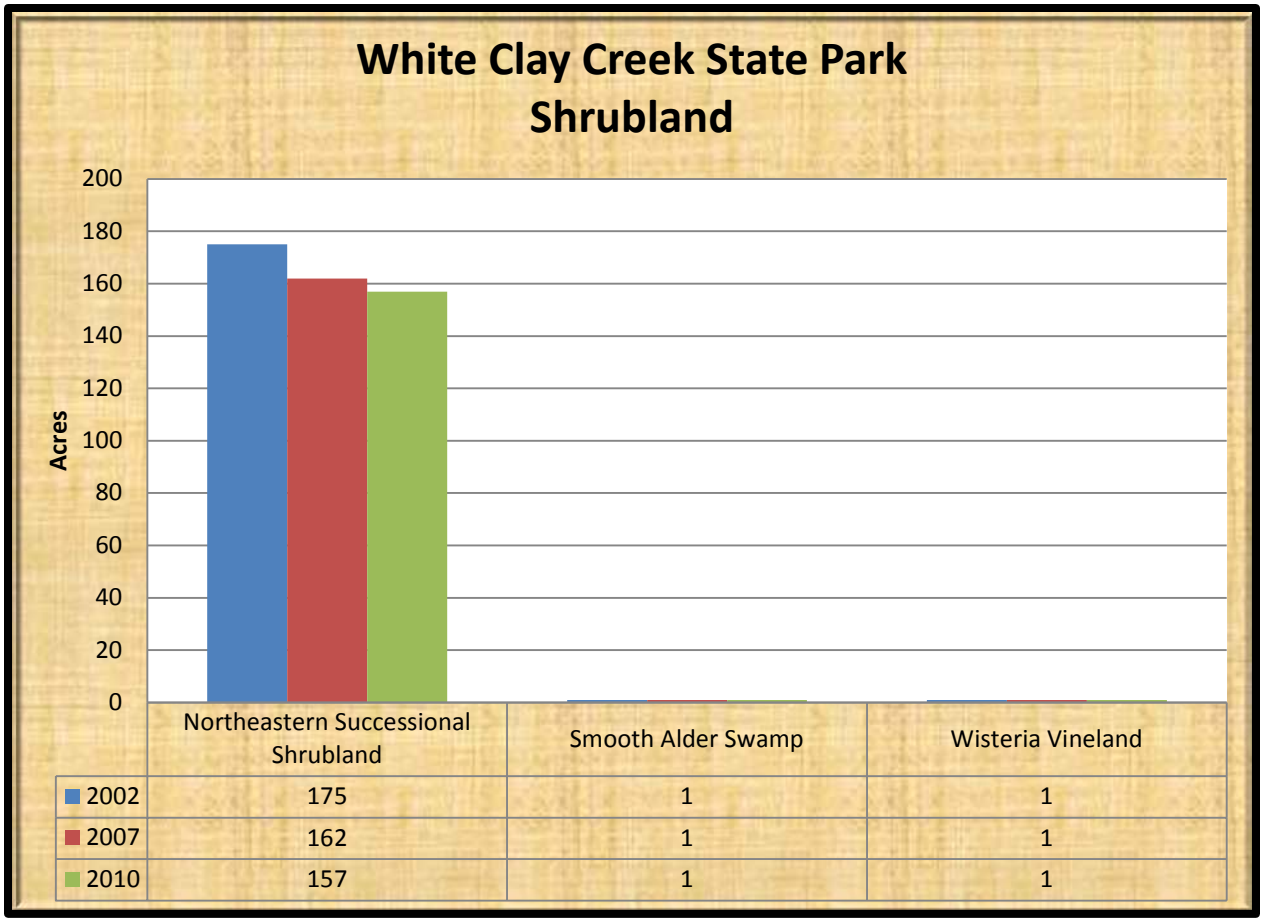


Figure 3.3. Shrubland at White Clay Creek State Park (2002, 2007, and 2010)

White Clay Creek State Park Shrubland (Figure 3.3): Northeastern Successional Shrubland is the only shrubland except for two acres that are other communities. Northeastern Successional Shrubland has been decreasing as it succeeds to forested communities, generally Northeastern Modified Successional Forest.

Natural Capital (Table 3.3)

Shrubland capital has been transferred to forest community has these communities (Northeastern Successional Shrubland) matures to forest.

Table 3.3. Natural Capital of White Clay Creek State Park Shrubland	
Year	**Natural Capital (in 2012 dollars)**
2002	$31,631/year
2007	$30,320/year
2010	$29,431/year

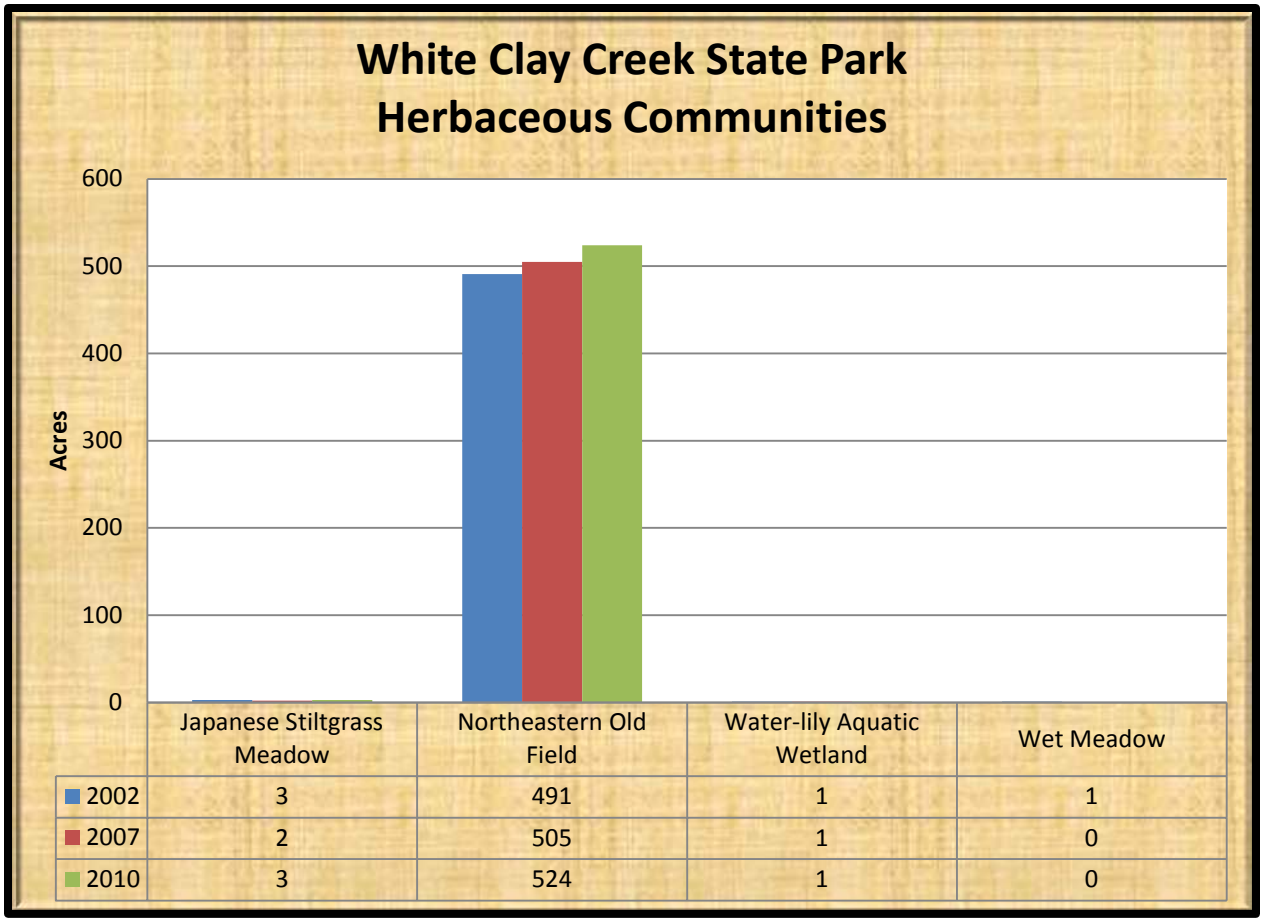


Figure 3.4. Herbaceous Communities at White Clay Creek State Park (2002, 2007, and 2010)

White Clay Creek State Park Herbaceous Communities (Figure 3.4): Northeastern Old Field is the prominent herbaceous community in White Clay Creek State Park. The other communities cover only 4 acres collectively. Northeastern old field has been increasing in acreage as more agricultural fields are taken out of service.

Natural Capital (Table 3.4)

The loss of wet meadow acreage between 2002 and 2007, resulted in an overall capital loss for herbaceous communities. The addition of Northeastern Old Field acreage however has brought the capital back up.

Table 3.4. Natural Capital of White Clay Creek State Park Herbaceous Communities	
Year	**Natural Capital (in 2012 dollars)**
2002	$85,670/year
2007	$78,574/year
2010	$81,284/year

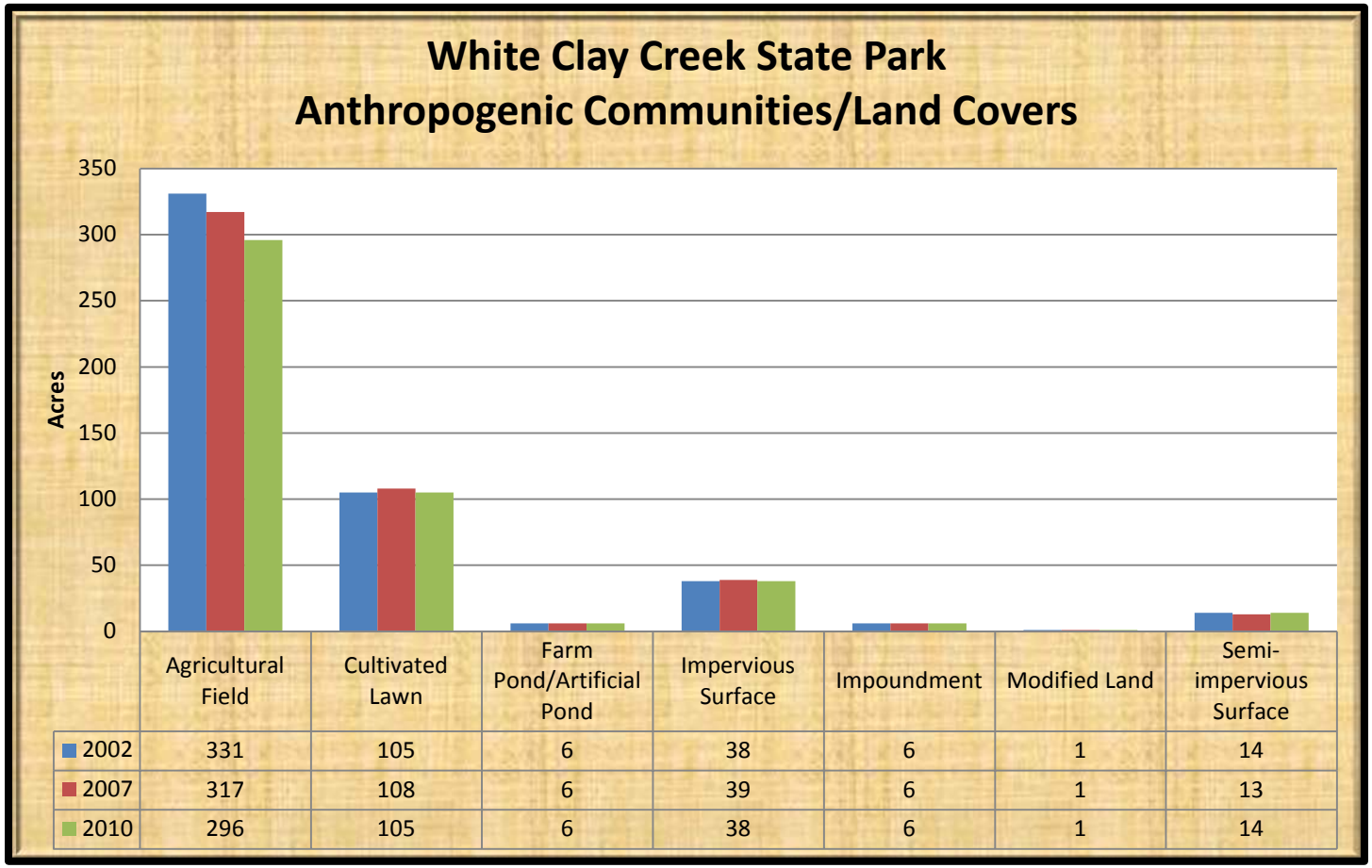


Figure 3.5. Anthropogenic Communities/Land Covers at White Clay Creek State Park (2002, 2007, and 2010)

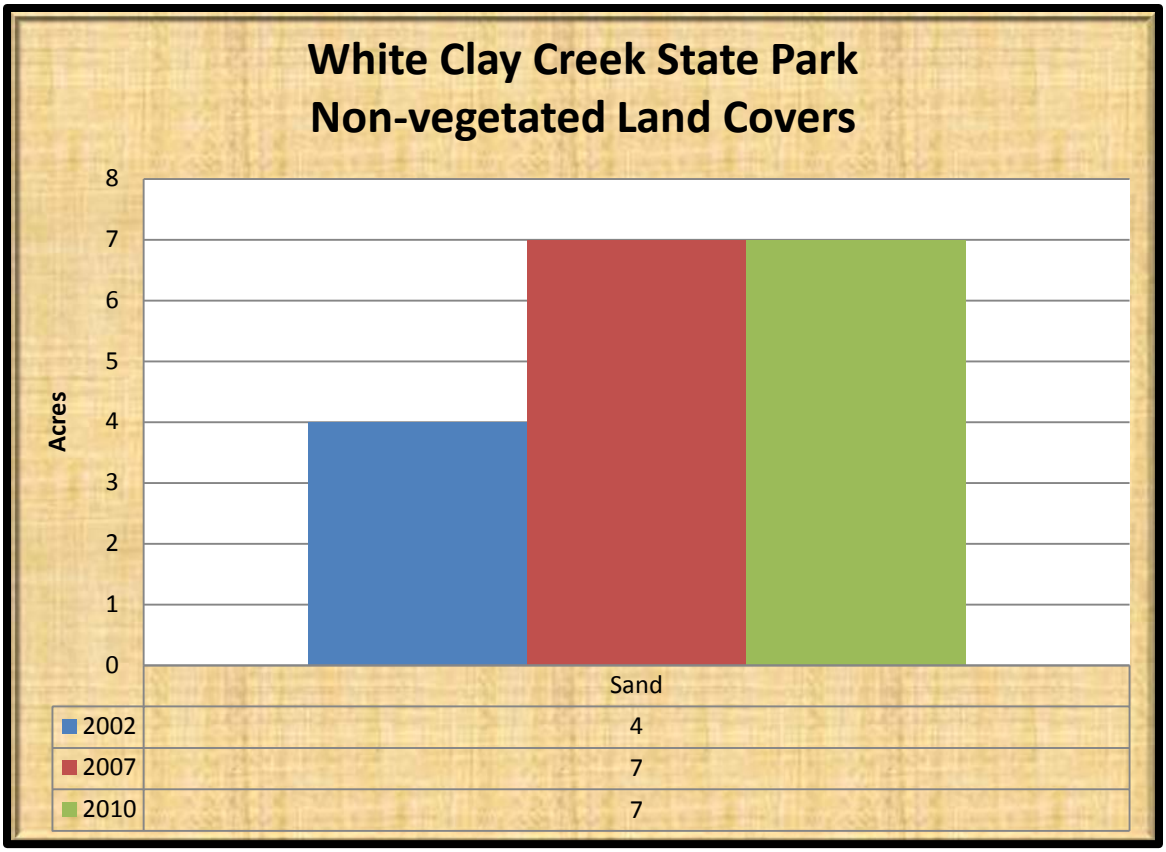
White Clay Creek State Park Anthropogenic Communities/Land Covers (Figure 3.5):
Agricultural fields are the most common anthropogenic communities in White Clay Creek State Park followed by Cultivated Lawn. Impervious surface follows a distant third. Agricultural field has been decreasing while cultivated lawn and impervious surface have been stable.

Natural Capital (Table 3.5)

Anthropogenic community/land cover value has been gradually decreasing as the Agricultural fields in the park are abandoned.

Table 3.5. Natural Capital of White Clay Creek State Park Anthropogenic Communities/Land Covers

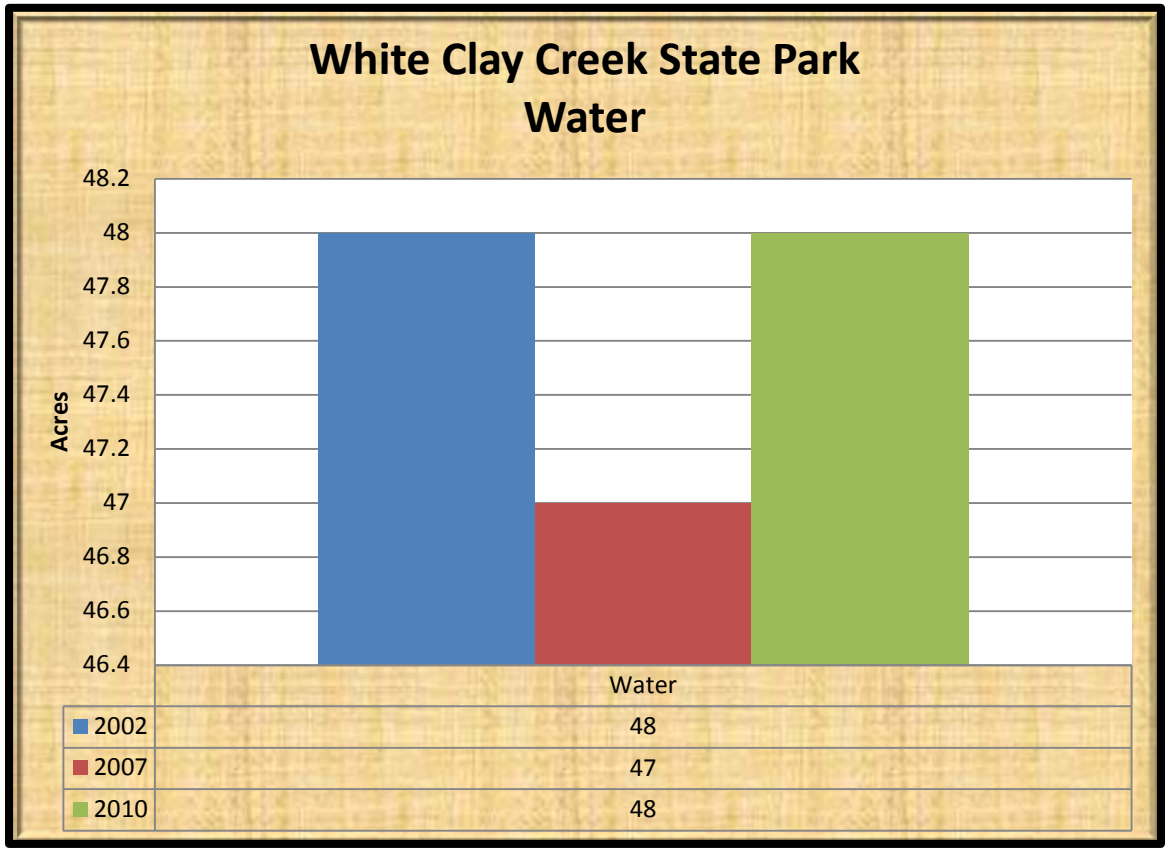
Year	Natural Capital (in 2012 dollars)
2002	$88,299/year
2007	$87,553/year
2010	$86,275/year



White Clay Creek State Park Non-vegetated Communities (Figure 3.5): Sand is the only on-vegetated land cover in the park. It generally located on sandbars in White Clay Creek and Pike Creek.

Natural Capital (Table 3.5)

Sand does not have any natural capital value.



White Clay Creek State Park Water (Figure 3.6): Water has roughly been stable in amount over the study period.

Natural Capital (Table 3.5)

Capital of water has been generally stable through the study period.

Table 3.5. Natural Capital of White Clay Creek State Park Water	
Year	**Natural Capital (in 2012 dollars)**
2002	$261,420/year
2007	$250,750/year
2010	$256,085/year

CHAPTER 4: VEGETATION COMMUNITIES BY SECTION

1. East Section

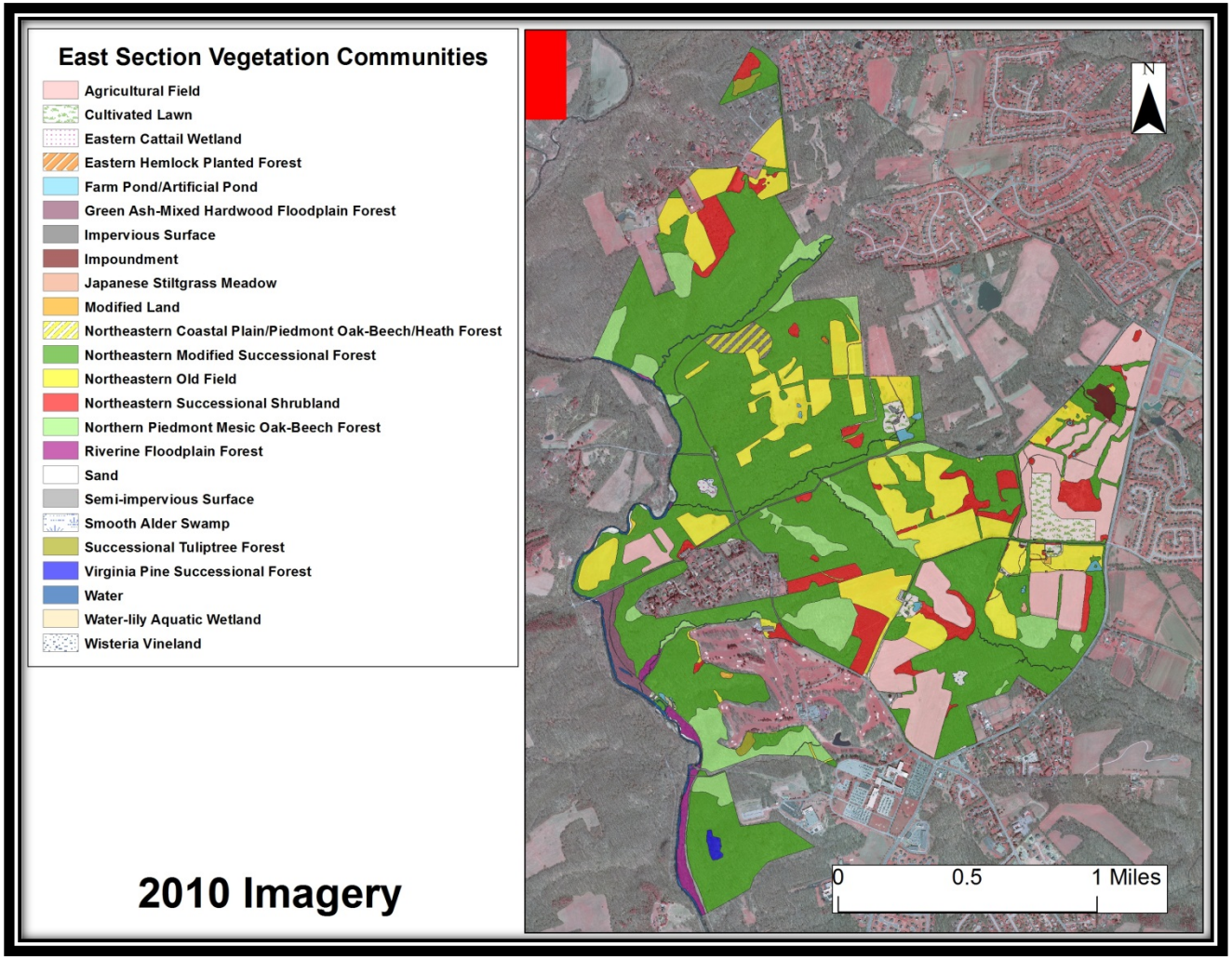


Figure 4-1.1. 2010 Vegetation Community map of the East Section

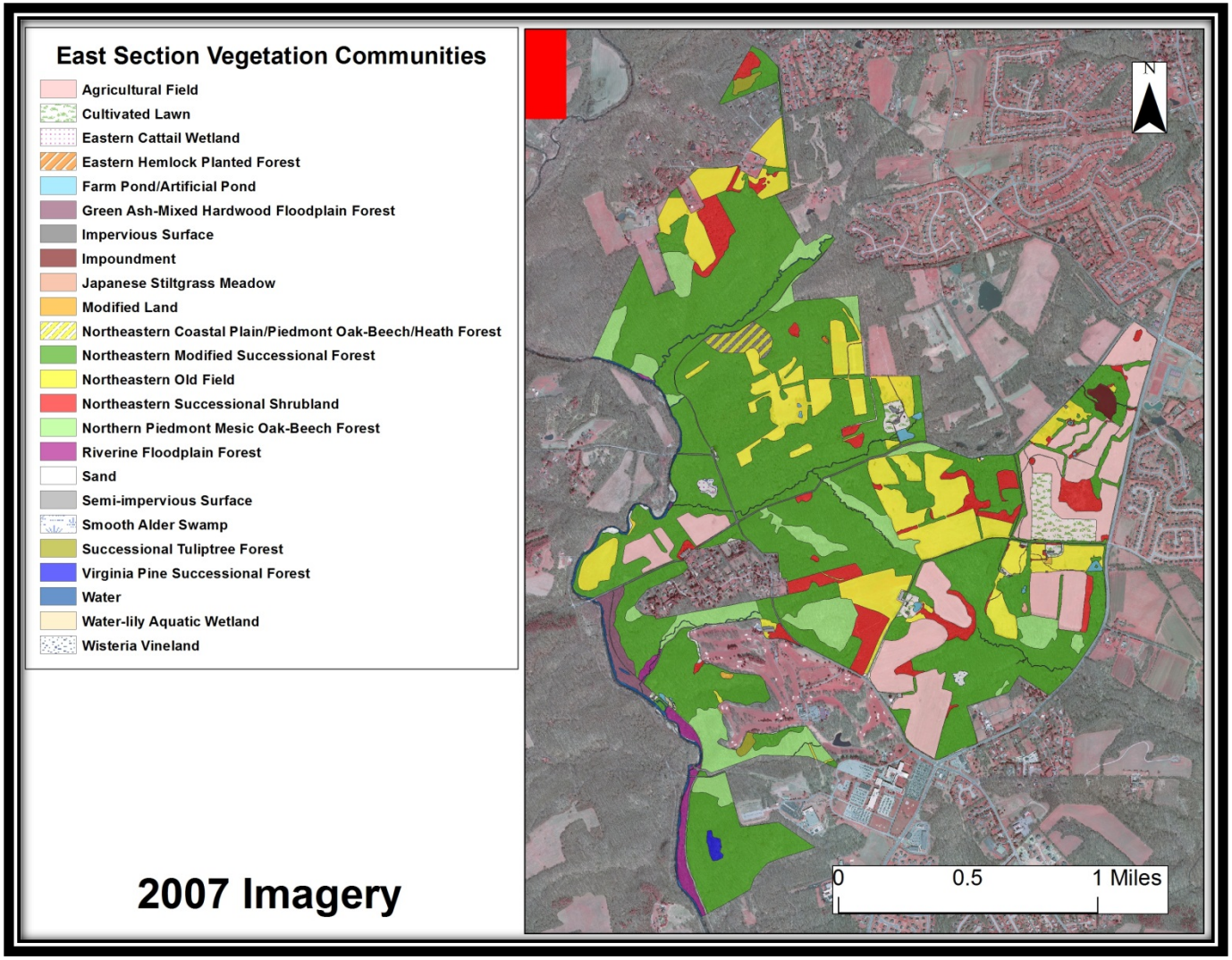


Figure 4-1.2. 2007 Vegetation Community map of the East Section

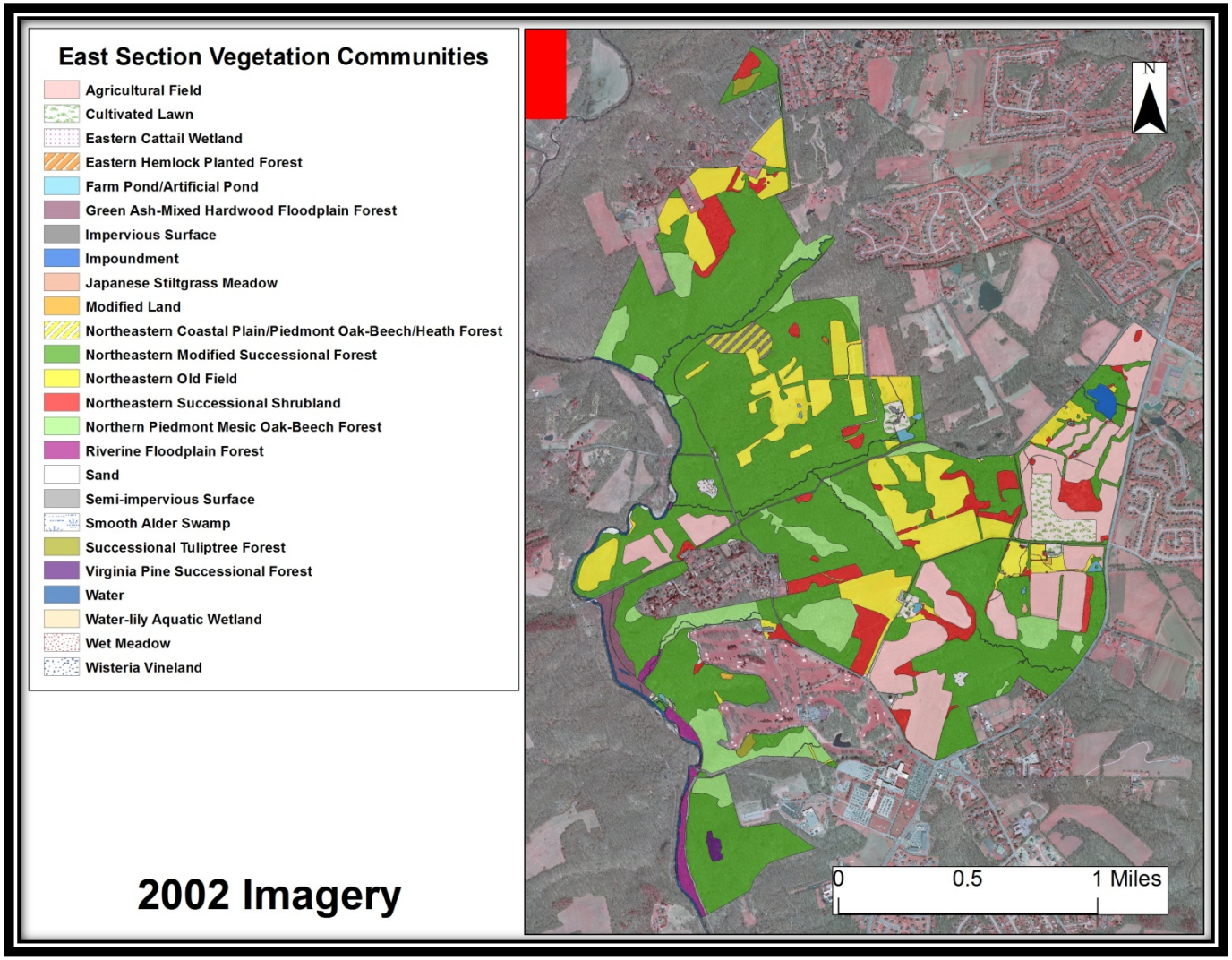
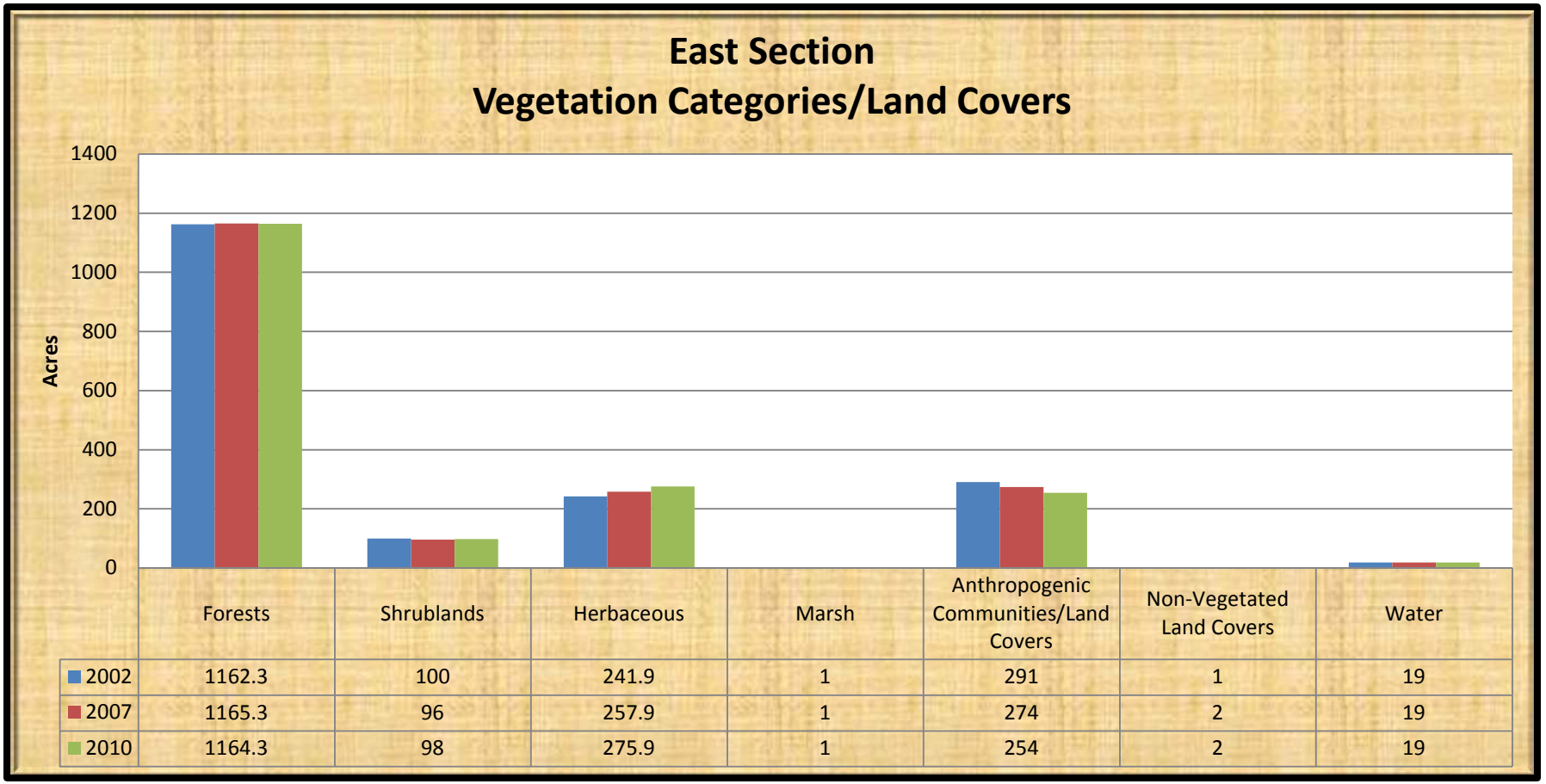


Figure 4-1.3. 2002 Vegetation Community map of the East Section



	Forests	Shrublands	Herbaceous	Marsh	Anthropogenic Communities/Land Covers	Non-Vegetated Land Covers	Water
2002	1162.3	100	241.9	1	291	1	19
2007	1165.3	96	257.9	1	274	2	19
2010	1164.3	98	275.9	1	254	2	19

Figure 4-1.4. East Section Vegetation Categories/Land Covers (2002, 2007, and 2010)

East Section Broad Trends (Figure 4-1.4): The east section like most of the park is primarily forested with anthropogenic communities/land covers coming in a close second. A number of Northeastern Old Fields are present in this section as well. Most of the categories have been stable with some gain of herbaceous communities and a loss of anthropogenic communities.

Natural Capital (Table 4-1.1)

Natural capital in the East Section has been going down from 2002 to 2010.

Table 4-1.1. Natural Capital of the East Section	
Year	**Natural Capital (in 2012 dollars)**
2002	$852,162/year
2007	$844,367/year
2010	$833,890/year

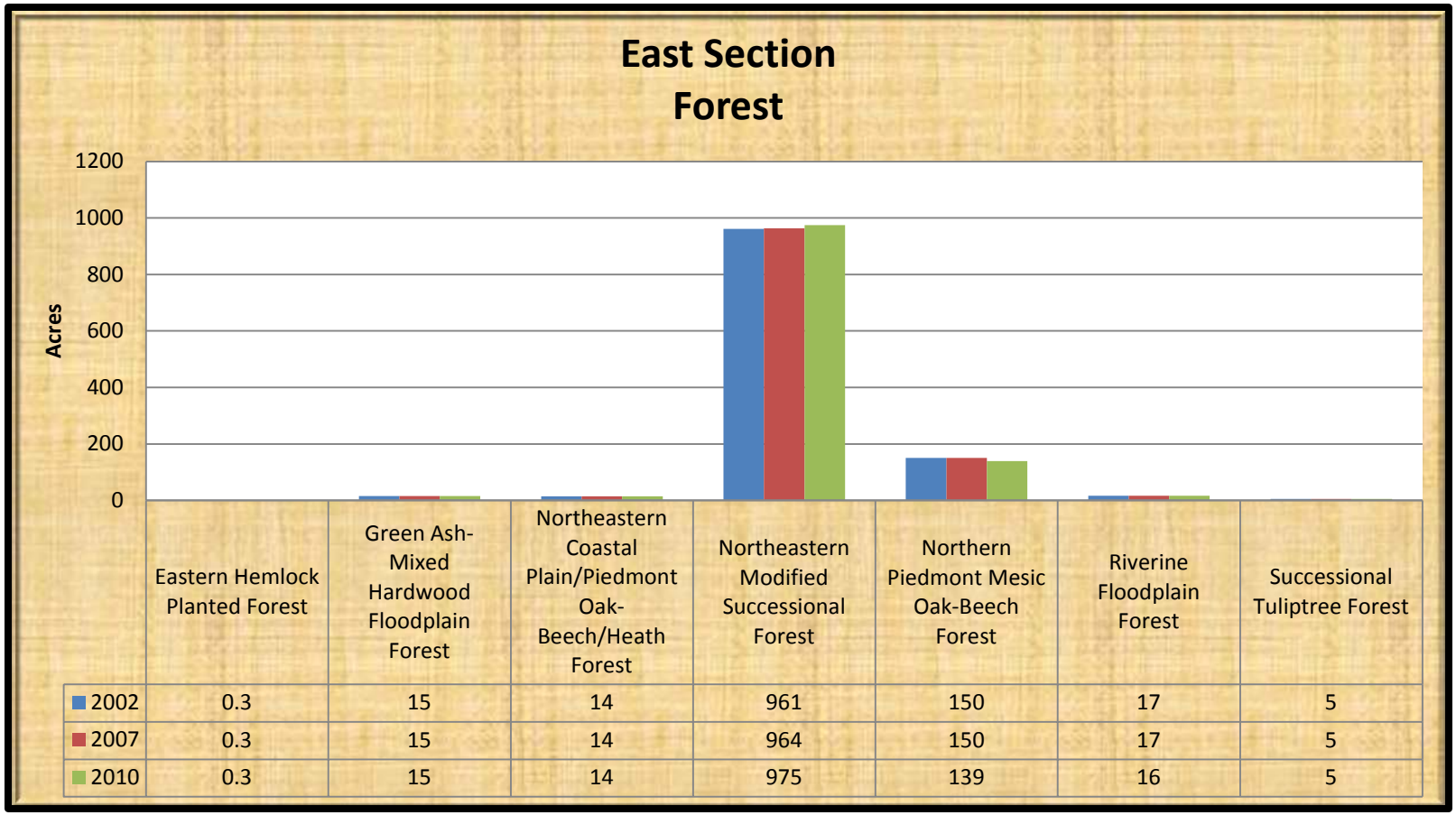


Figure 4-1.5. East Section Forest (2002, 2007, and 2010)

East Section Forest (Figure 4-1.5): Northeastern Modified Successional Forest is the most forest community in the east section and has increased in acreage since 2002. Northern Piedmont Mesic Oak-Beech Forest follows in size and has decreased as Northeastern Modified Successional Forest has taken over.

Natural Capital (Table 4-1.2)

Forest capital for the East Section has been falling with invasion by exotic invasive plants in wetland forest communities.

Table 4-1.2. Natural Capital of East Section Forest	
Year	**Natural Capital (in 2012 dollars)**
2002	$607,068/year
2007	$607,635/year
2010	$595,344/year

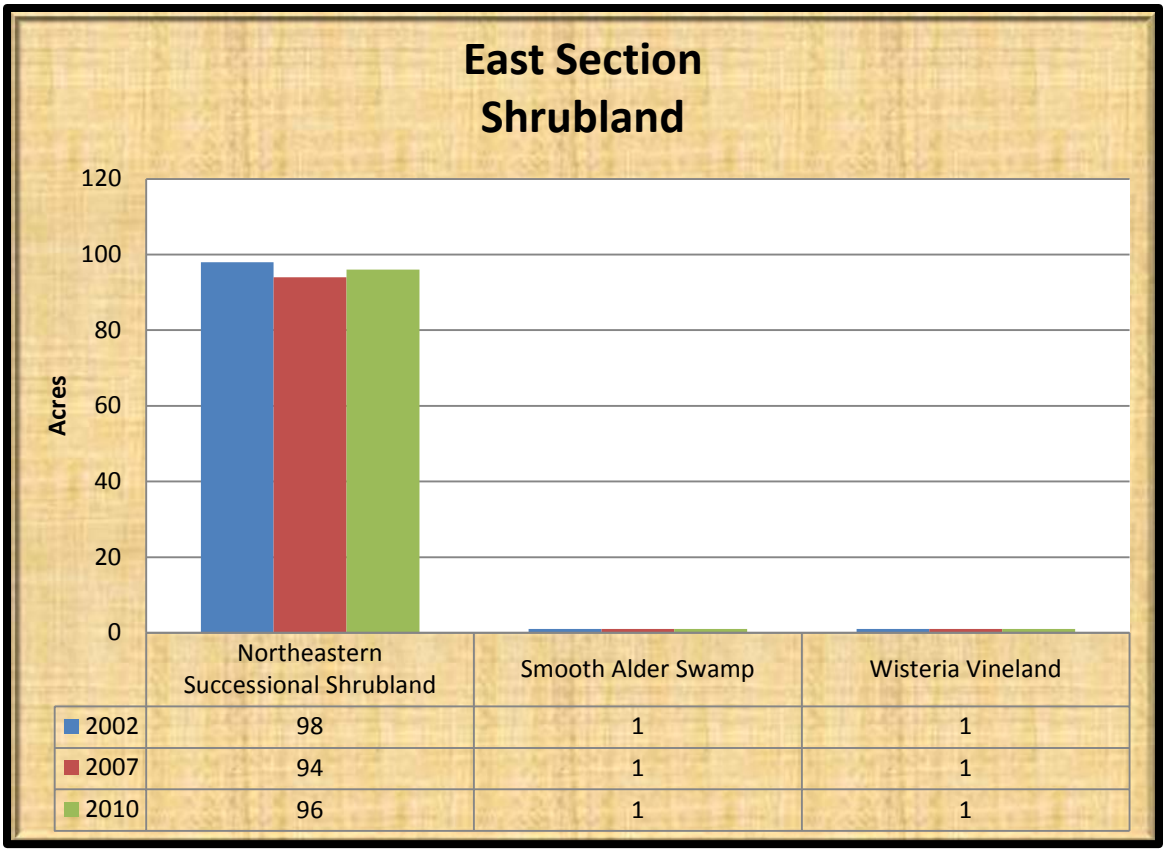


Figure 4-1.6. East Section Shrubland (2002, 2007, and 2010)

East Section Shrubland (Figure 4-1.6): Northeastern Successional Shrubland is the most common shrubland in the east section. The other two shrublands cover 2 acres combined.

Natural Capital (Table 4-1.3)

Shrubland capital has fallen slightly overall over the study period.

Table 4-1.3. Natural Capital of East Section Shrubland	
Year	**Natural Capital (in 2012 dollars)**
2002	$23,705/year
2007	$23,123/year
2010	$23,414/year

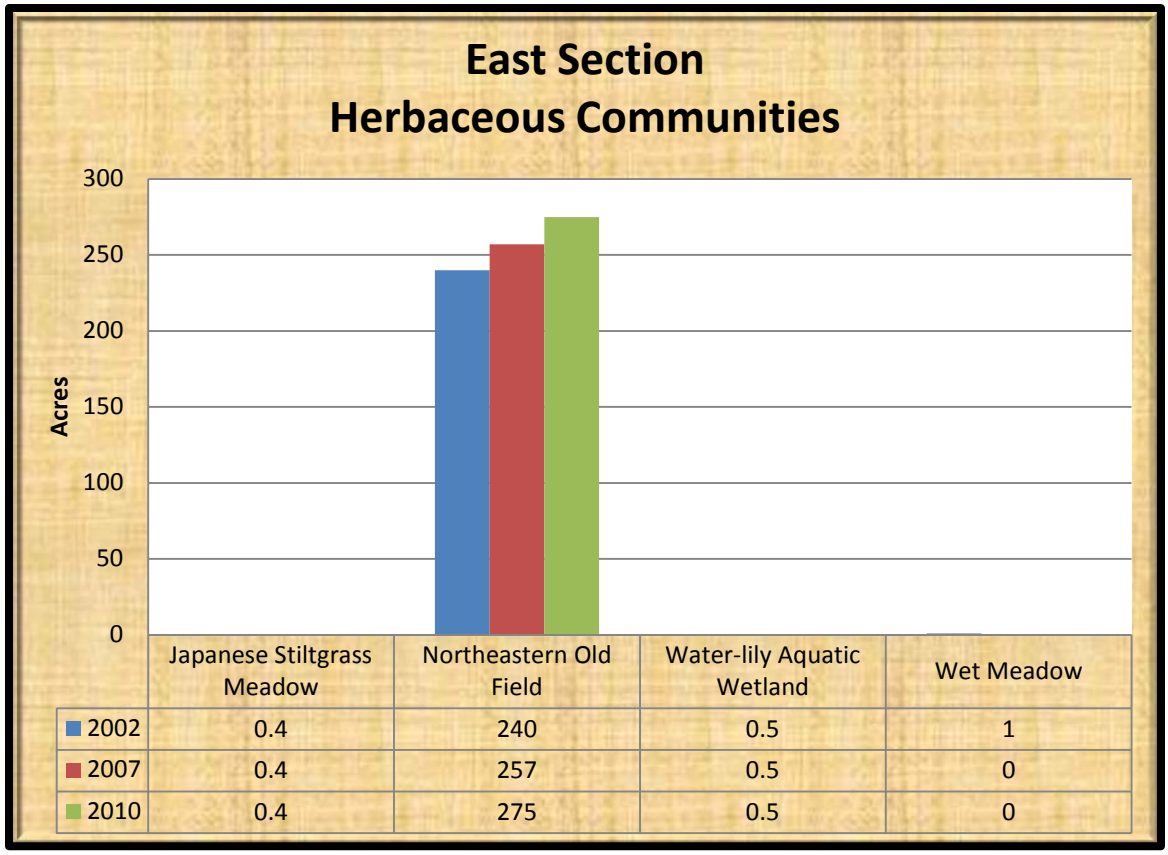


Figure 4-1.7. East Section Herbaceous Communities (2002, 2007, and 2010)

East Section Herbaceous Communities (Figure 4-1.7): Northeastern Old Field is the most common herbaceous community in the east section. A wet meadow that was present in 2002 has converted into an Eastern Cattail Marsh.

Natural Capital (Table 4-1.4)

Herbaceous community capital has fallen slightly overall over the study period.

Table 4-1.4. Natural Capital of East Section Herbaceous Communities	
Year	**Natural Capital (in 2012 dollars)**
2002	$48,948/year
2007	$42,144/year
2010	$44,766/year

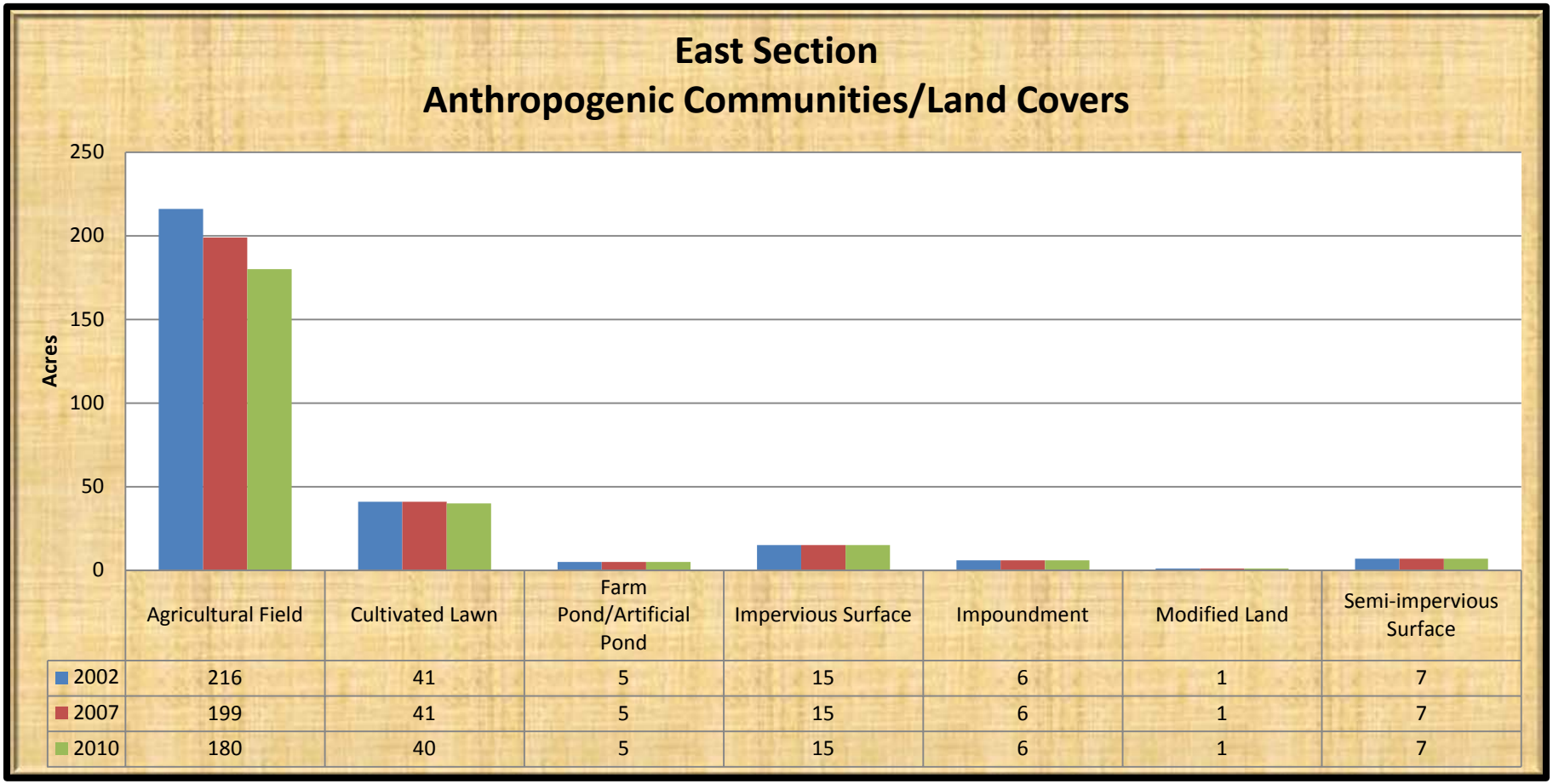


Figure 4-1.8. East Section Anthropogenic Communities/Land Covers (2002, 2007, and 2010)

East Section Anthropogenic Communities/Land Covers (Figure 4-1.8): Agricultural field is the largest anthropogenic community, followed by cultivated lawn.

Natural Capital (Table 4-1.5)

Agricultural Field and Ponds/Impoundments are the only anthropogenic communities/land covers with any capital value in the east section. Abandonment of agricultural fields has reduced the capital in area and has resulted in a transfer to herbaceous communities.

Table 4-1.5. Natural Capital of East Section Anthropogenic Communities/Land Covers	
Year	**Natural Capital (in 2012 dollars)**
2002	$71,074/year
2007	$70,099/year
2010	$69,009/year

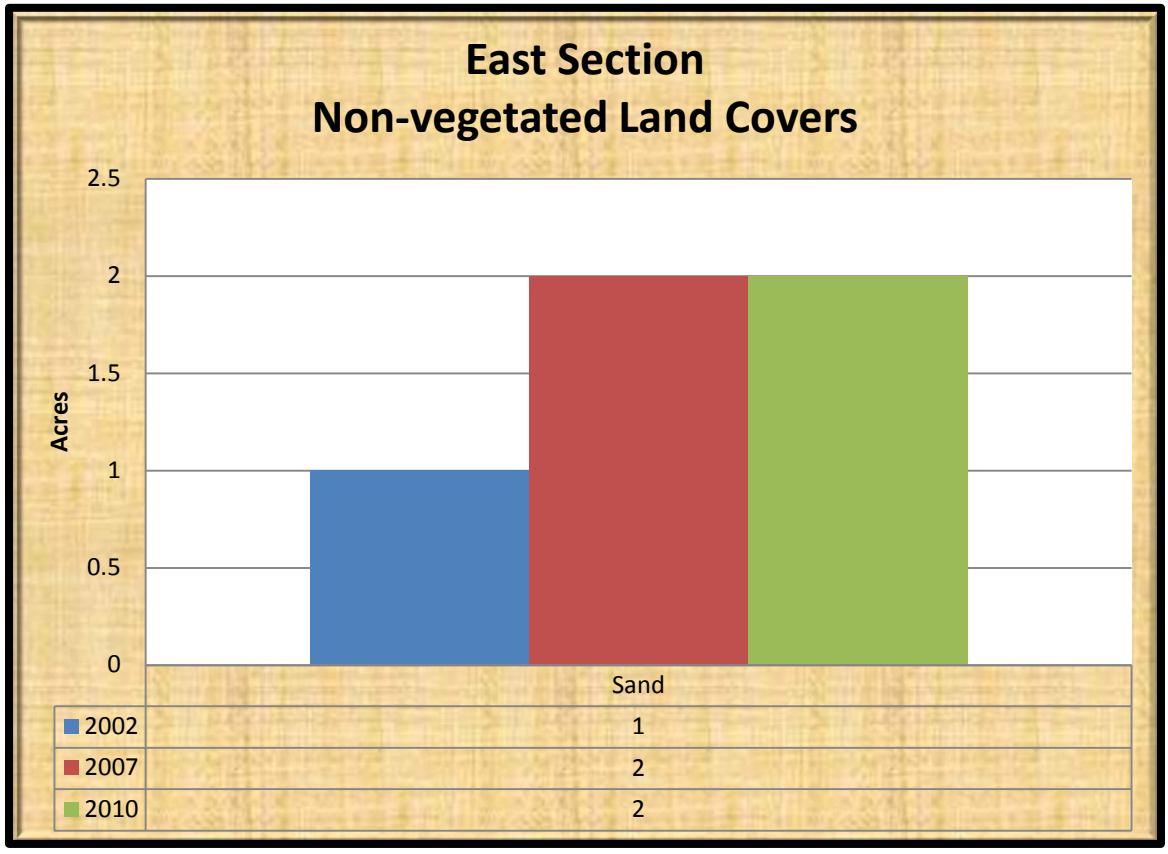


Figure 4-1.9. East Section Non-vegetated Land Covers (2002, 2007, and 2010)

East Section Non-vegetated Land Covers (Figure 4-1.9): Sand is the only non-vegetated land cover and is present in the stream channel of White Clay Creek.

Natural Capital

None of the Non-vegetated land covers in the East Section have any natural capital value.

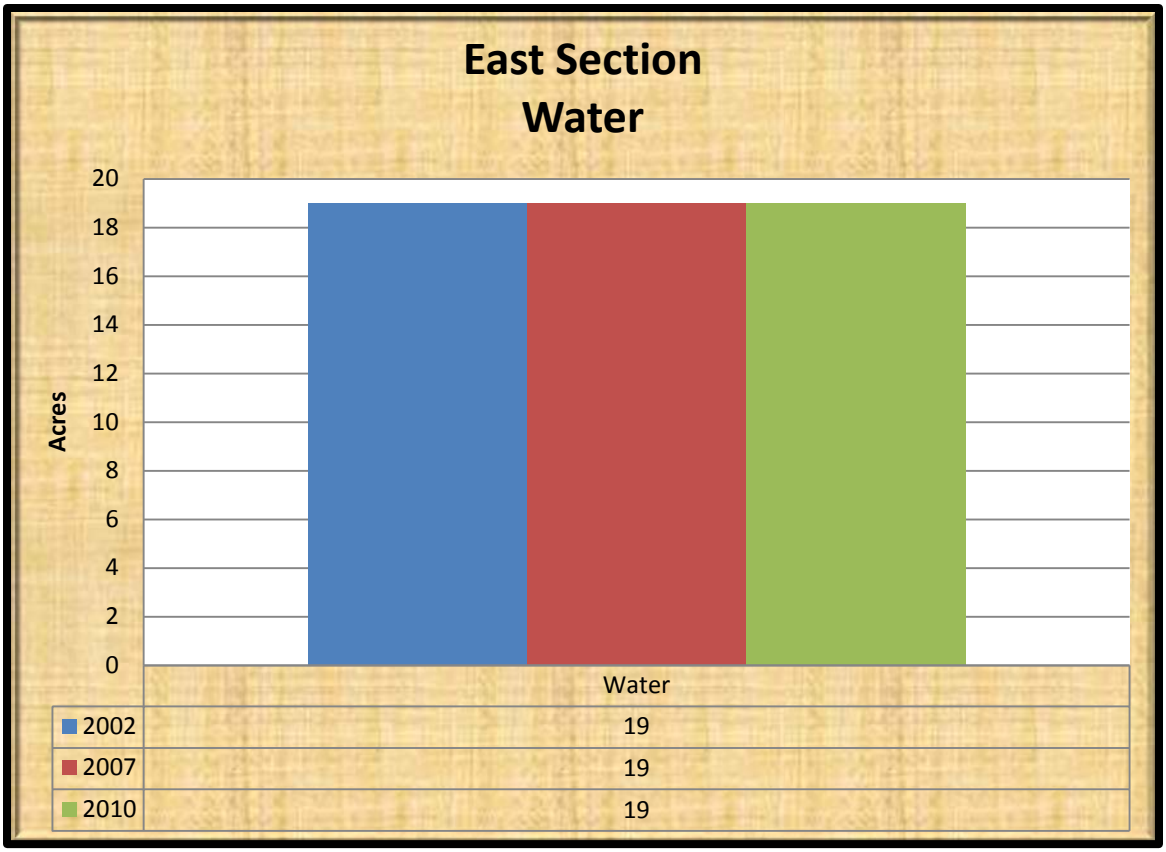


Figure 4-1.10. East Section water coverage (2002, 2007, and 2010)

East Section water coverage (Figure 4-1.10): The amount of water present in White Clay Creek has stayed the same during the study period.

Natural Capital (Table 4-1.6)

Water capital has stayed the same through the study period.

Table 4-1.6. Natural Capital of East Section Water	
Year	**Natural Capital (in 2012 dollars)**
2002	$101,367/year
2007	$101,367/year
2010	$101,367/year

2. Judge Morris Section

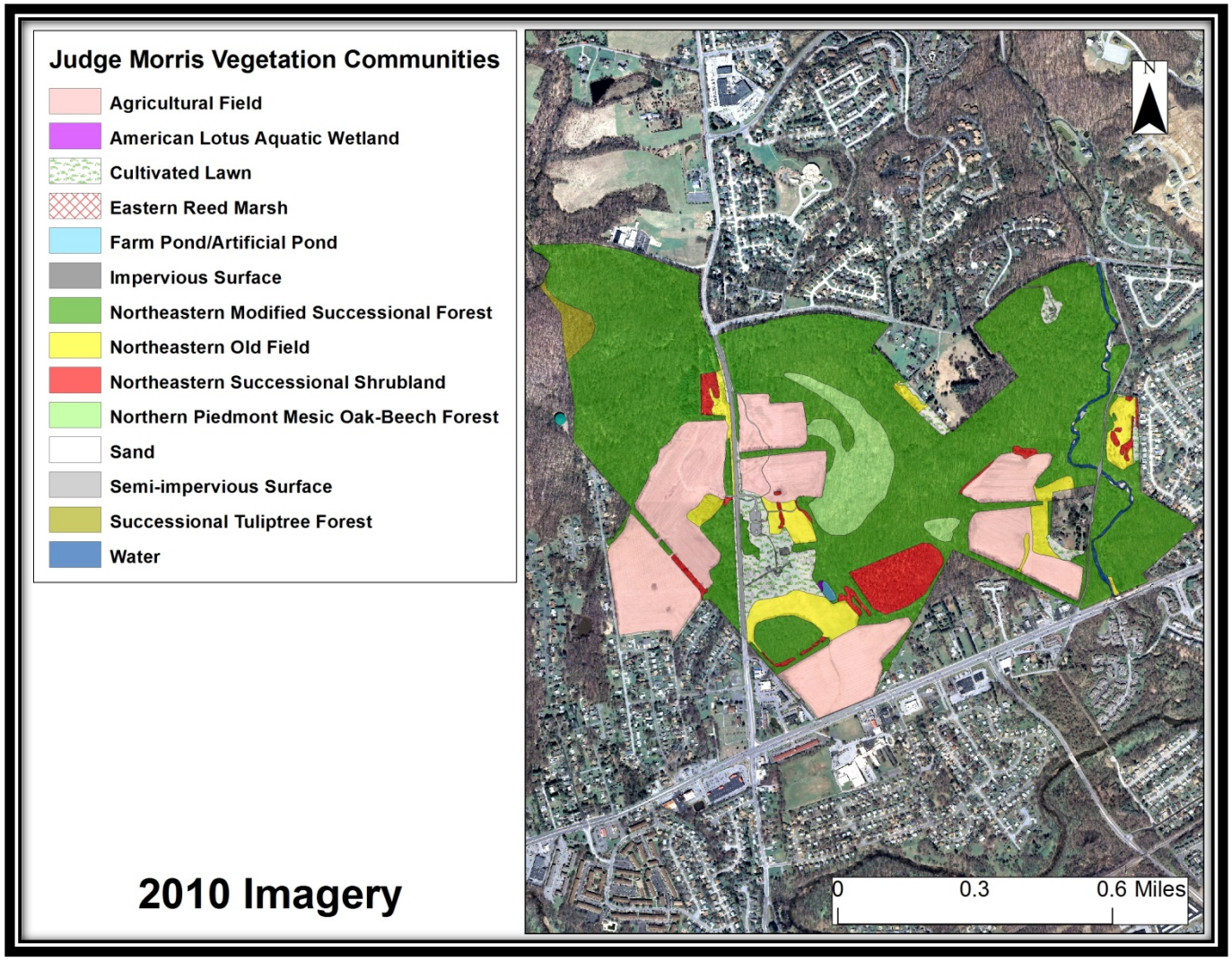


Figure 4-2.1. 2010 Vegetation Community map of the Judge Morris Section

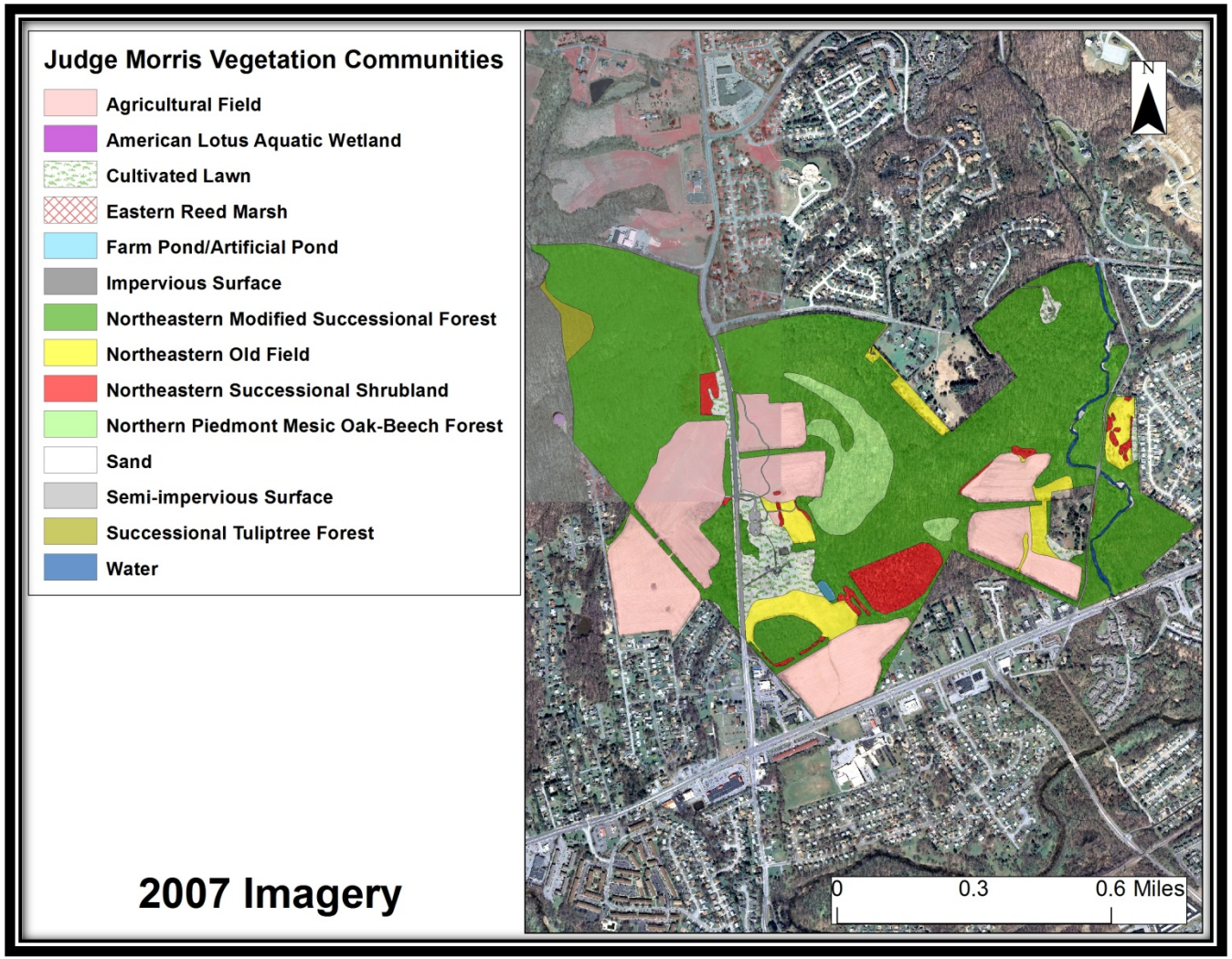


Figure 4-2.2. 2007 Vegetation Community map of the Judge Morris Section

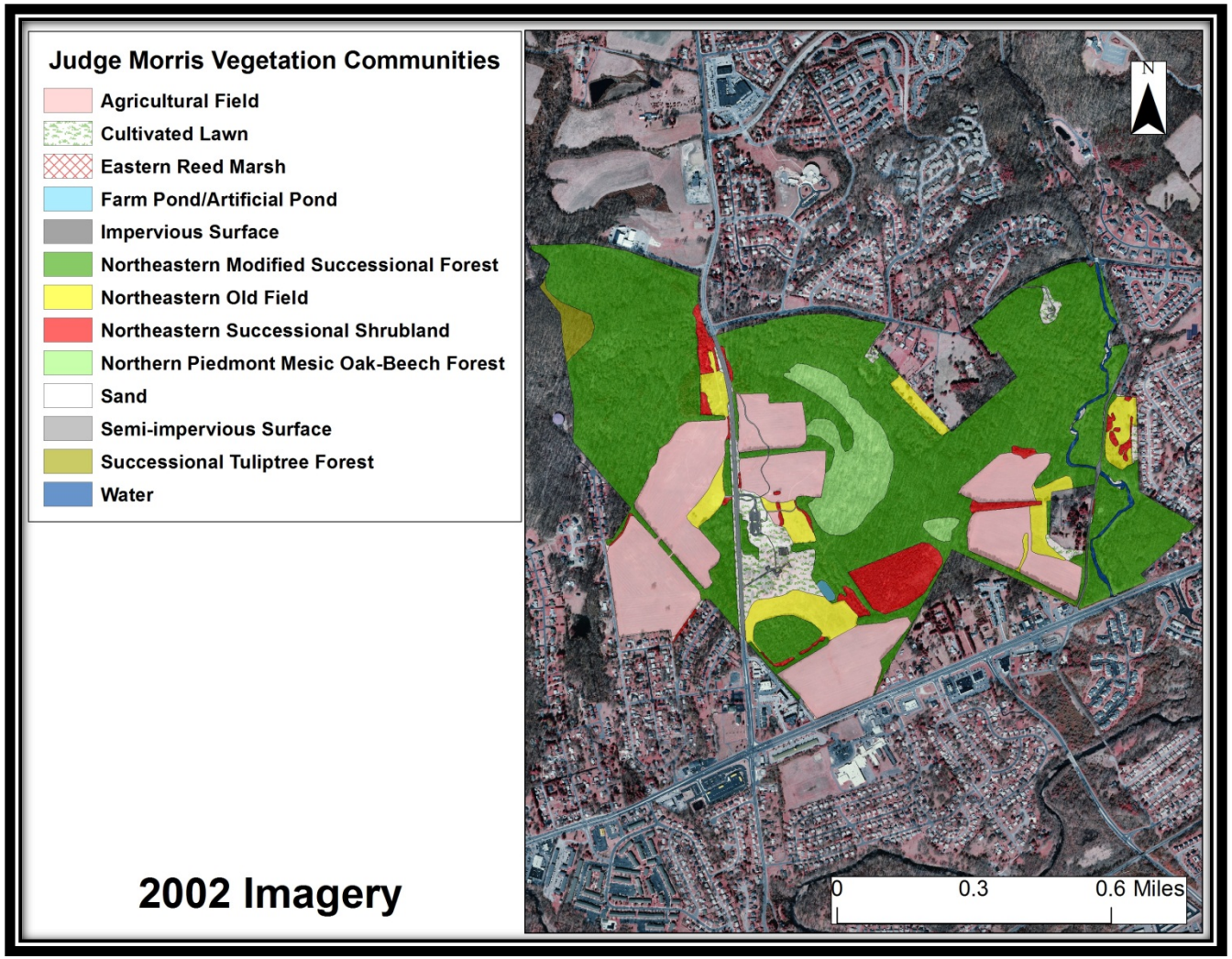
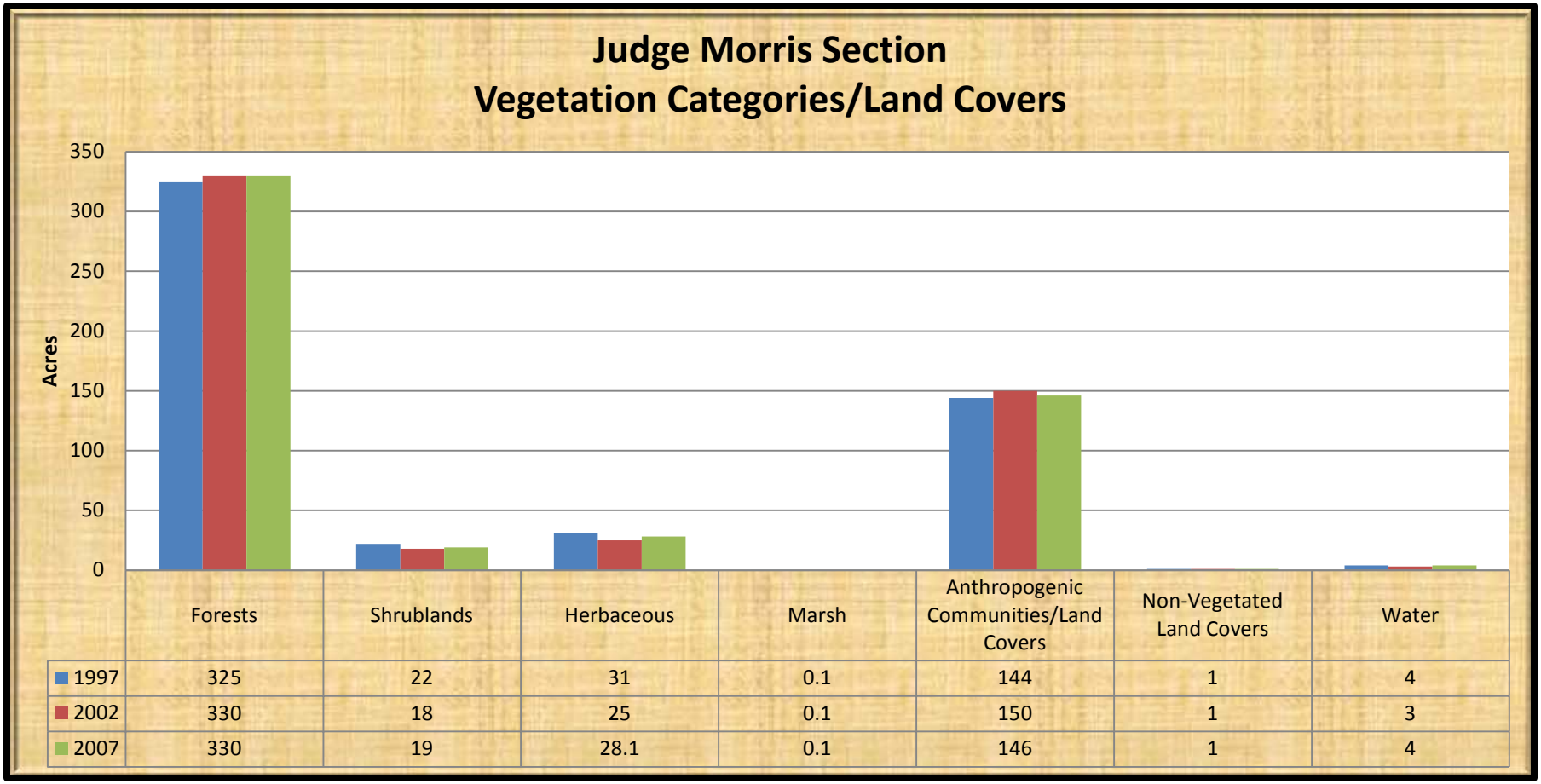


Figure 4-2.3. 2002 Vegetation Community map of the Judge Morris Section



	Forests	Shrublands	Herbaceous	Marsh	Anthropogenic Communities/Land Covers	Non-Vegetated Land Covers	Water
1997	325	22	31	0.1	144	1	4
2002	330	18	25	0.1	150	1	3
2007	330	19	28.1	0.1	146	1	4

Figure 4-2.4. Judge Morris Section Vegetation Community/Land Cover Categories (2002, 2007, and 2010)

Judge Morris Section Broad Trends (Figure 4-2.4): Forests are the most prominent vegetation community type in the Judge Morris Section followed by Anthropogenic Communities/Land Covers.

Natural Capital (Table 4-2.1)

Capital for the Judge Morris Section has been increasing with an increase in forest and herbaceous communities.

Table 4-2.1. Natural Capital of the Judge Morris Section	
Year	**Natural Capital (in 2012 dollars)**
2002	$102,329/year
2007	$109,468/year
2010	$116,313/year

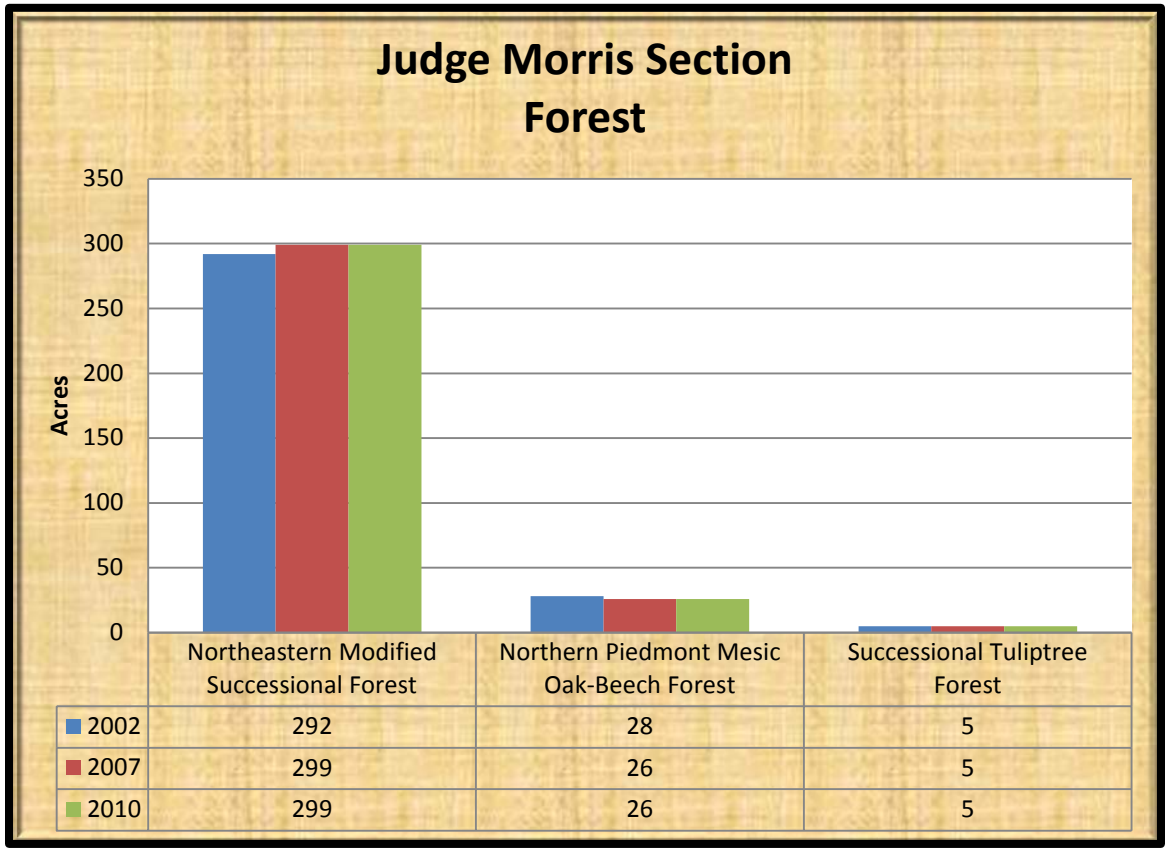


Figure 4-2.5. Judge Morris Section Forest (2002, 2007, and 2010)

Judge Morris Section Forest (Figure 4-2.5): Mirroring the rest of the park, Northeastern Modified Successional Forest is the most common forested community in the Judge Morris Section. The other two communities, Northeastern Piedmont Mesic Oak-Beech Forest and Successional Tuliptree Forest, cover about 30 acres in aggregate.

Natural Capital (Table 4-2.2)

Forest capital has increased with an increase in forest acreage.

Table 4-2.2. Natural Capital of Judge Morris Section Forest	
Year	**Natural Capital (in 2012 dollars)**
2002	$61,458/year
2007	$62,403/year
2010	$62,403/year

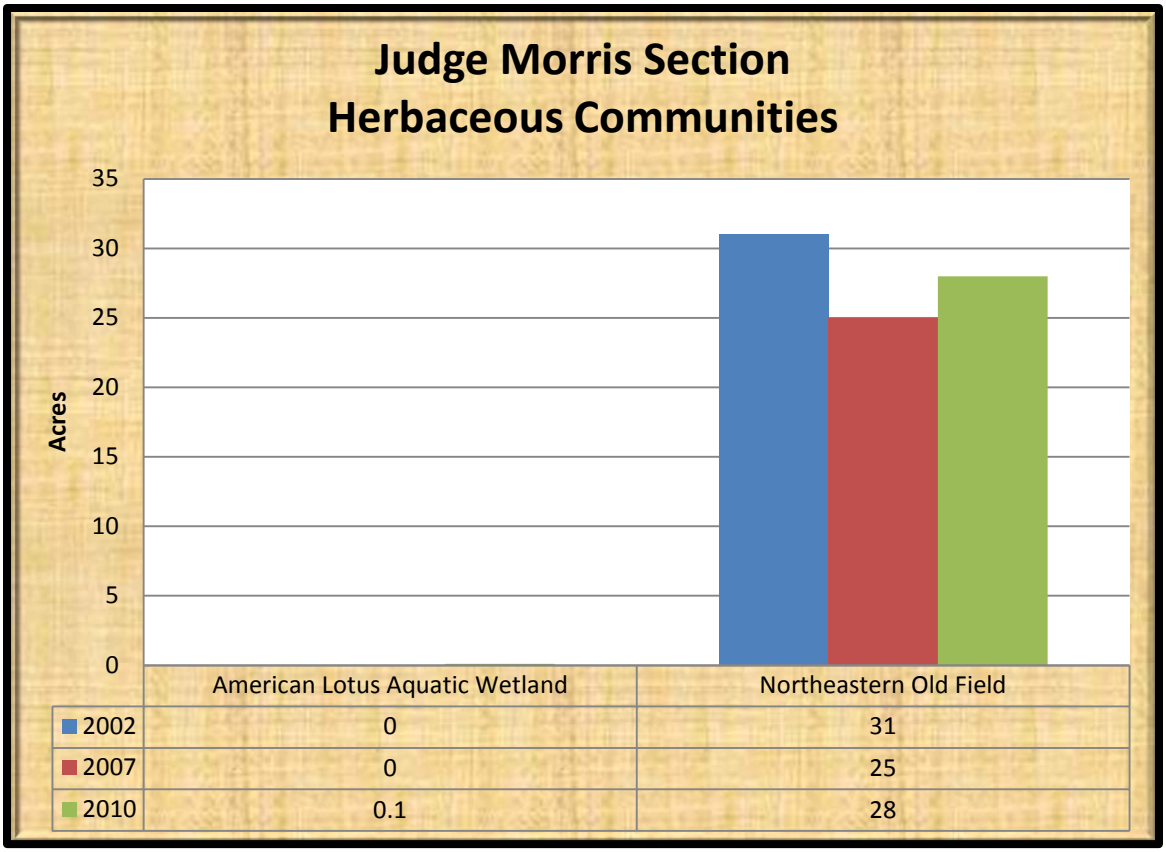


Figure 4-2.6. Judge Morris Section Herbaceous Communities

Judge Morris Section Herbaceous Communities (Figure 4-2.6): Northeastern Old Field is the most common herbaceous community. An American Lotus Aquatic Wetland has established in a pond, likely through some seed tossed in it.

Natural Capital (Table 4-2.3)

Herbaceous community capital has increased with the appearance of a wetland in a pond.

Table 4-2.3. Natural Capital of Judge Morris Section Herbaceous Communities	
Year	**Natural Capital (in 2012 dollars)**
2002	$4,517/year
2007	$3,643/year
2010	$5,008/year

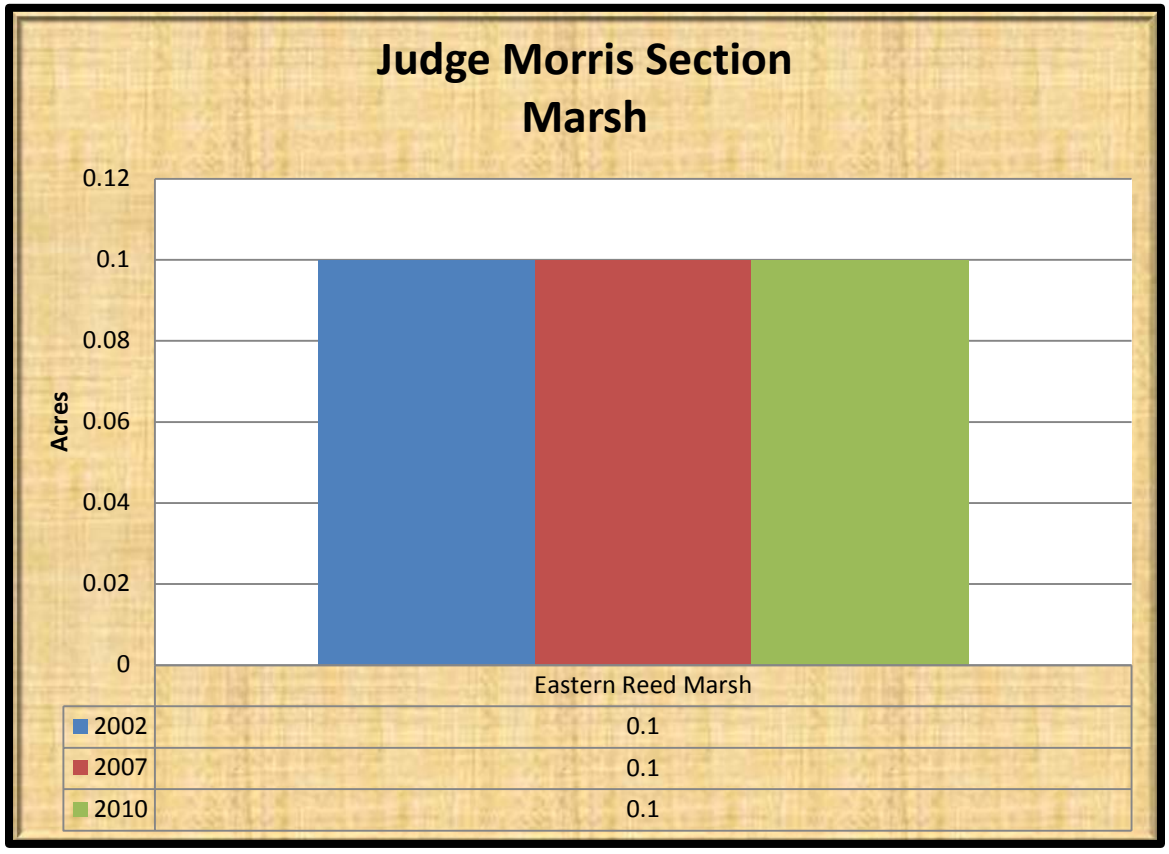


Figure 4-2.7. Judge Morris Section Marsh (2002, 2007, and 2010)

Judge Morris Section Marsh (Figure 4-2.7): Eastern Reed Marsh is the only marsh type in the Judge Morris Section and is located at the north end.

Natural Capital (Table 4-2.4)

Natural capital of marsh in the Judge Morris Section has remained the same over the study period.

Table 4-2.4. Natural Capital of Judge Morris Section Marsh	
Year	**Natural Capital (in 2012 dollars)**
2002	$928/year
2007	$928/year
2010	$928/year

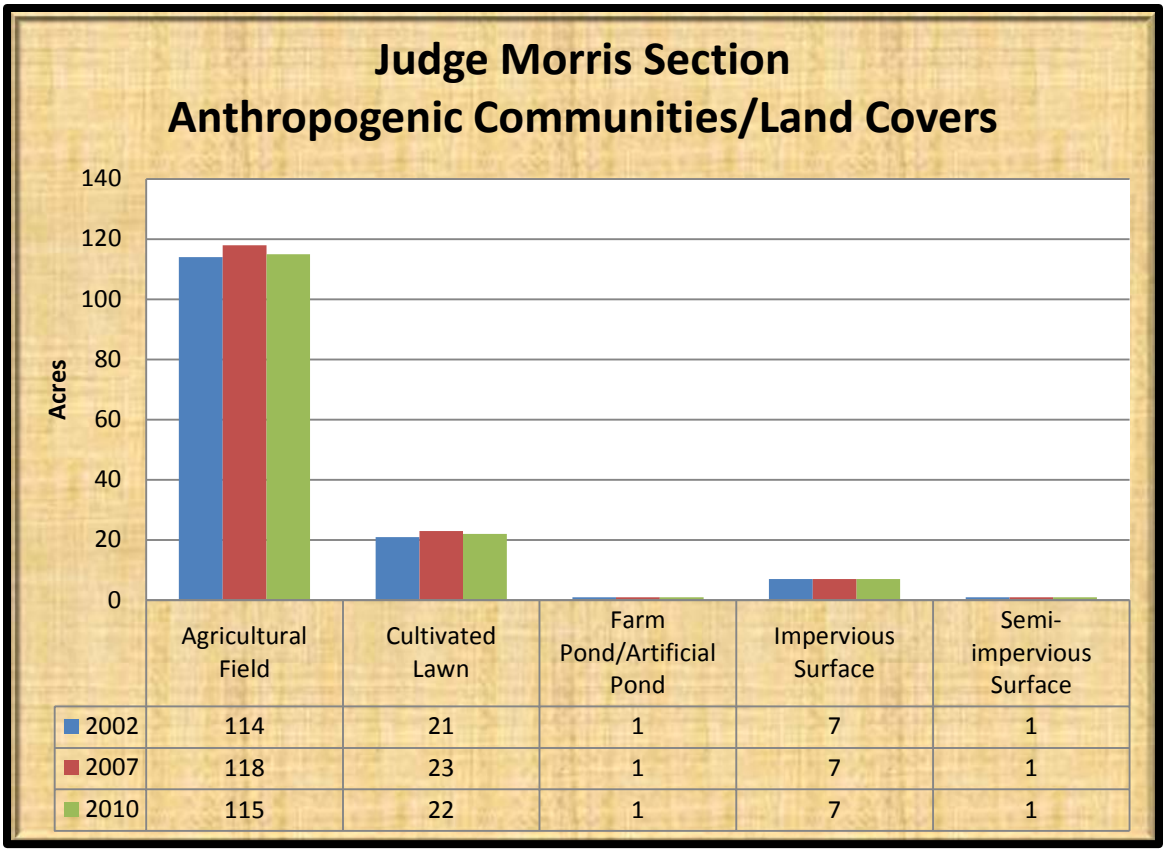


Figure 4-2.8. Judge Morris Section Anthropogenic Communities/Land Covers (2002, 2007, and 2010)

Judge Morris Section Anthropogenic Communities/Land Covers (Figure 4-2.8): Agricultural Field is the most common anthropogenic community in the Judge Morris Section followed by cultivated lawn.

Natural Capital (Table 4-2.5)

Agricultural field and Farm Pond/Artificial Pond are the only anthropogenic communities/land covers with natural capital value in the Judge Morris Section. The capital has generally been oscillating with acreage in agricultural field.

Table 4-2.5. Natural Capital of Judge Morris Section Anthropogenic Communities/Land Covers

Year	Natural Capital (in 2012 dollars)
2002	$11,873/year
2007	$12,102/year
2010	$11,930/year

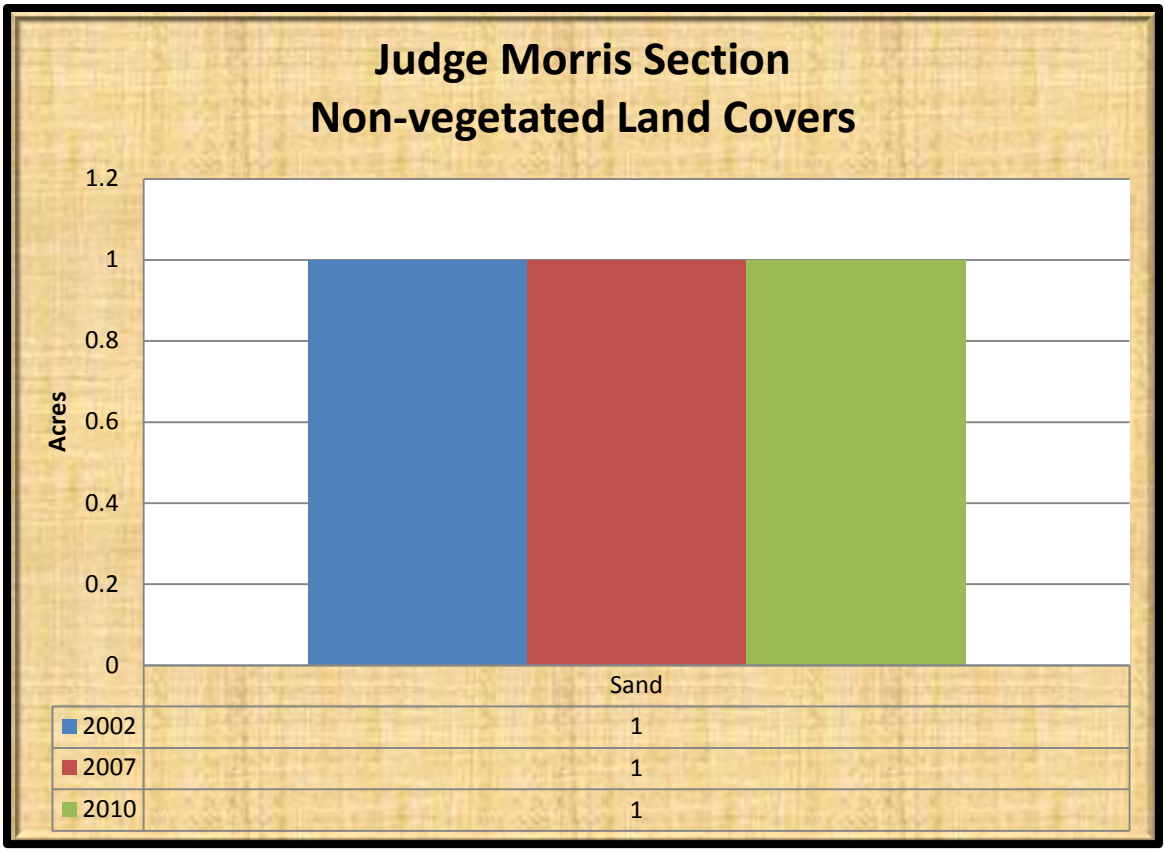


Figure 4-2.9. Judge Morris Section Non-vegetated Communities (2002, 2007, and 2010)

Judge Morris Section Non-vegetated Communities (Figure 4-2.9): Sand that is present in sandbars in Pike Creek is the only non-vegetated community in the Judge Morris Section.

Natural Capital

None of the Non-vegetated land covers in the Judge Morris Section have any natural capital value.

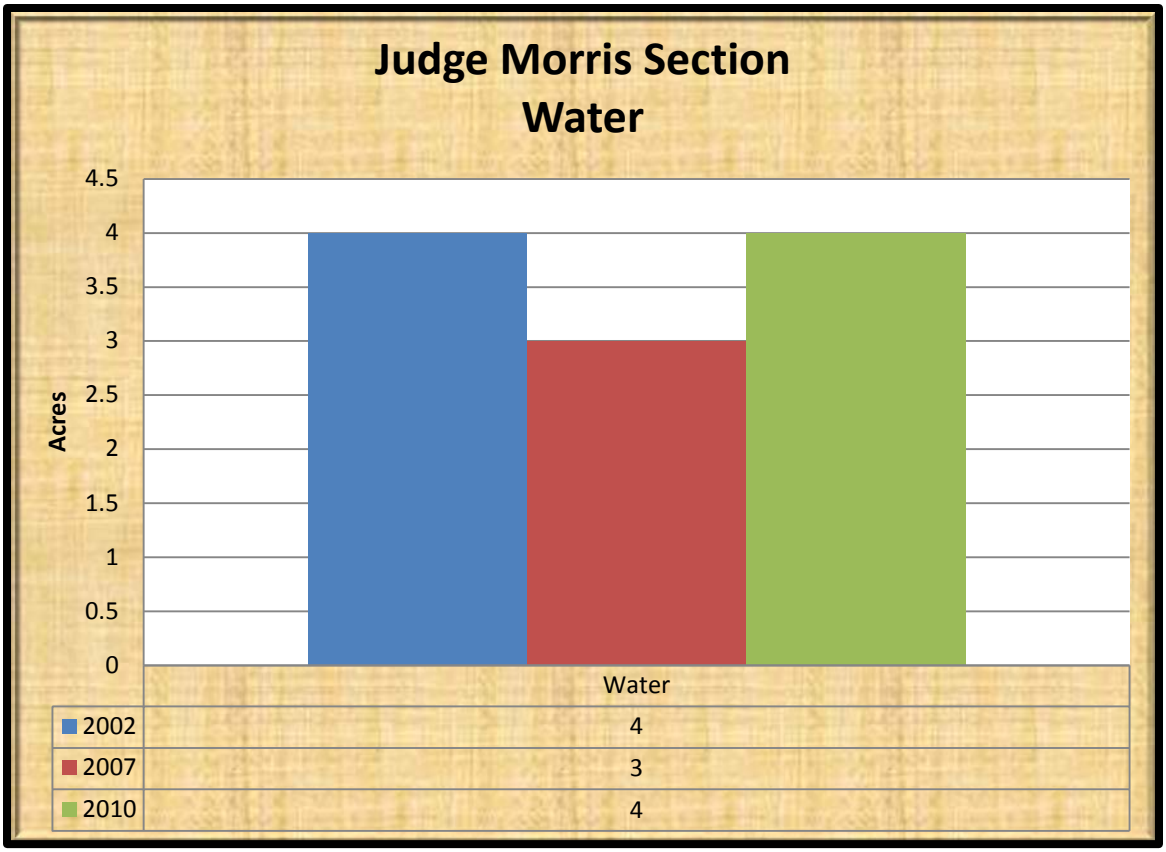


Figure 4-2.10. Judge Morris Section Water (2002, 2007, and 2010)

Judge Morris Section Water (Figure 4-2.10): Water surface in the creek has been roughly stable through the study period.

Natural Capital (Table 4-2.6)

The capital and acreage of water has oscillated some with deposition of sand bars in Pike Creek.

Table 4-2.6. Natural Capital of Judge Morris Section Water	
Year	**Natural Capital (in 2012 dollars)**
2002	$21,340/year
2007	$16,005/year
2010	$21,340/year

3. South Section

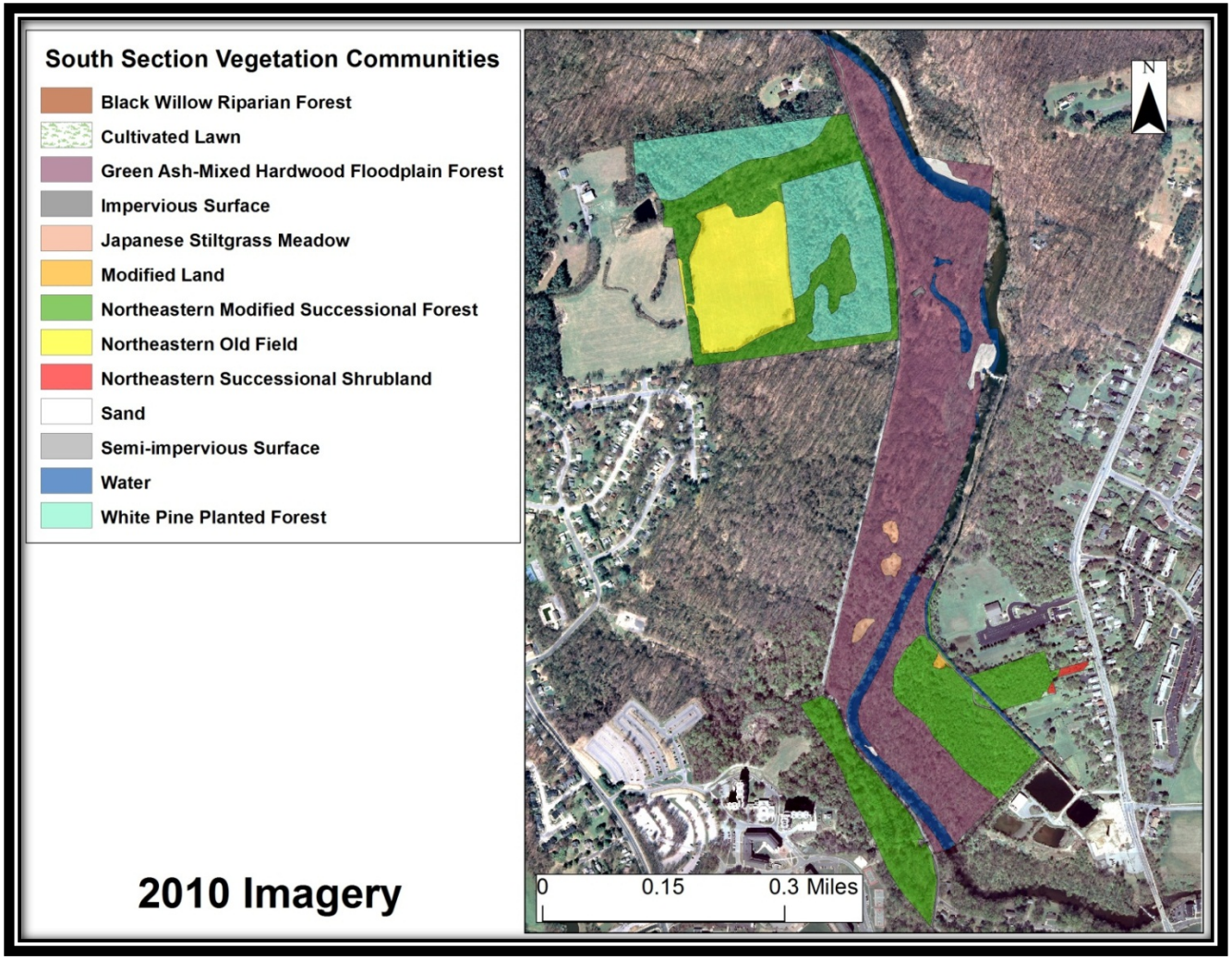


Figure 4-3.1. 2010 Vegetation Community map of the South Section

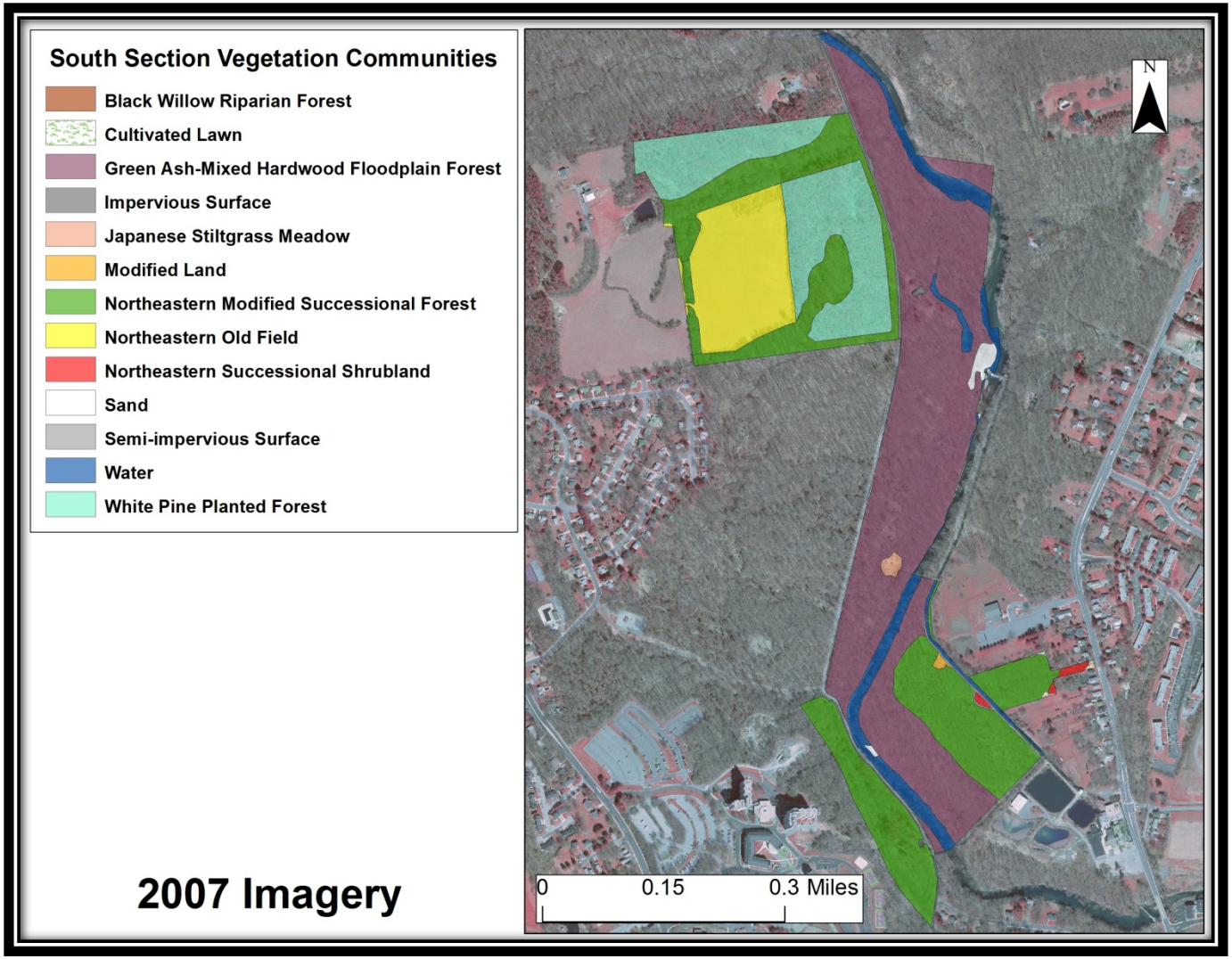


Figure 4-3.2. 2007 Vegetation Community map of the South Section

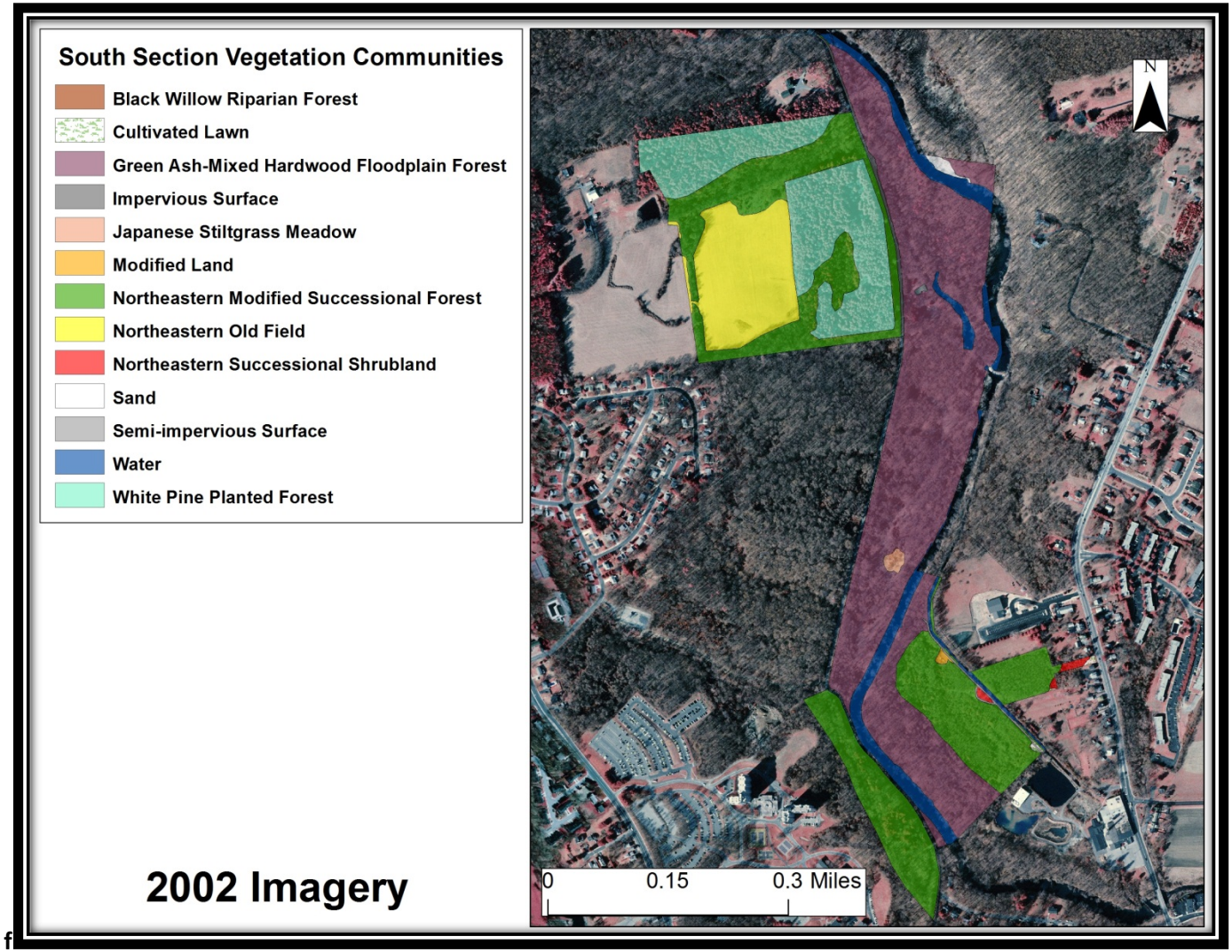


Figure 4-3.3. 2002 Vegetation Community map of the South Section

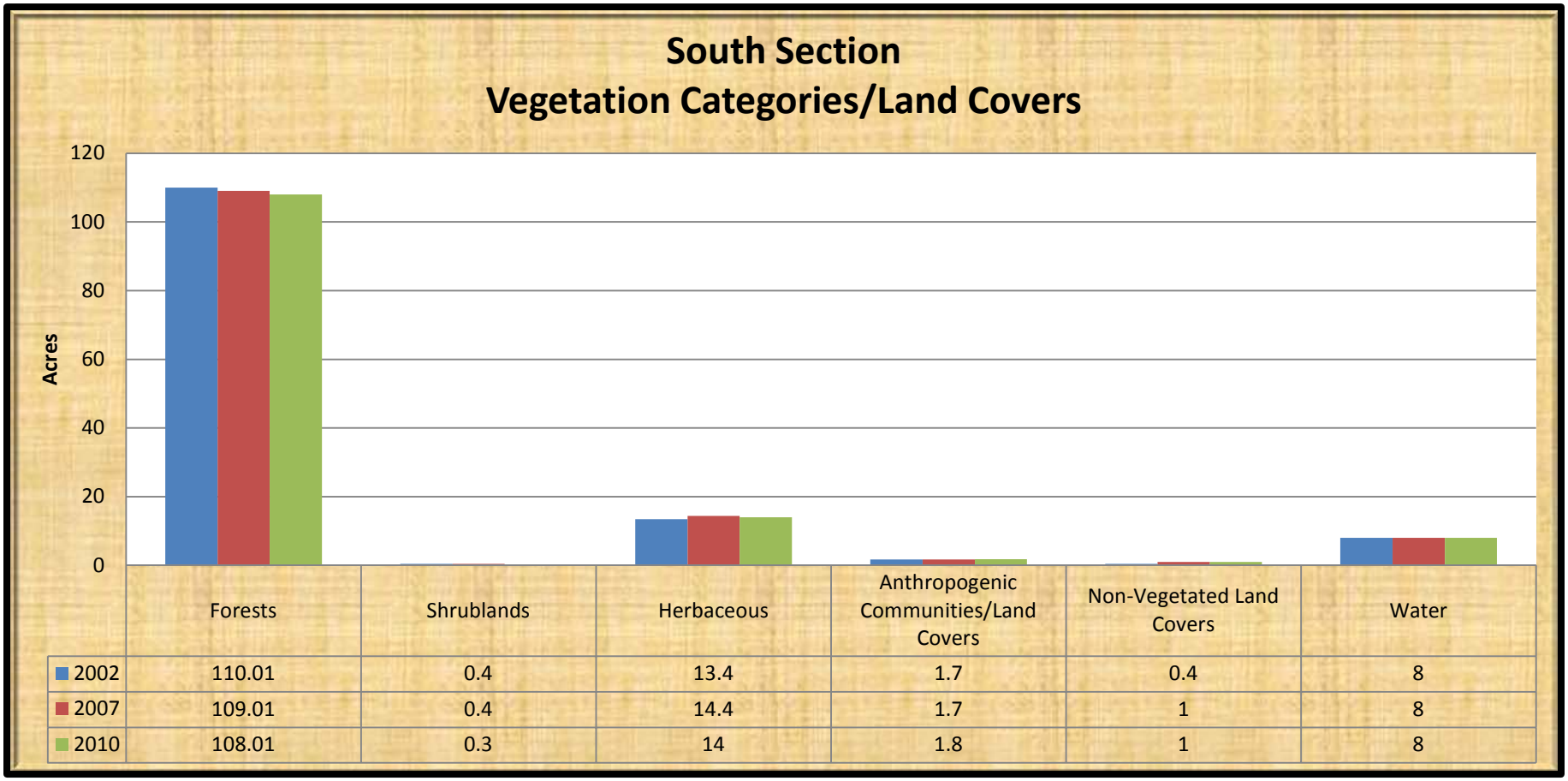


Figure 4-3.4. South Section Vegetation Communities/Land Covers (2002, 2007, and 2010)

South Section Broad Trends (Figure 4-3.4): The South Section occupies a thin section along White Clay Creek at the very south end of the park. Forest is the most common category in this section followed by a few herbaceous communities in the form of Northeastern Old Field.

Natural Capital (Table 4-3.1)

The natural capital of the South Section has decreased with losses in forestland and shrubland acreage.

Table 4-3.1. Natural Capital of the South Section	
Year	**Natural Capital (in 2012 dollars)**
2002	$719,145/year
2007	$719,102/year
2010	$694,634/year

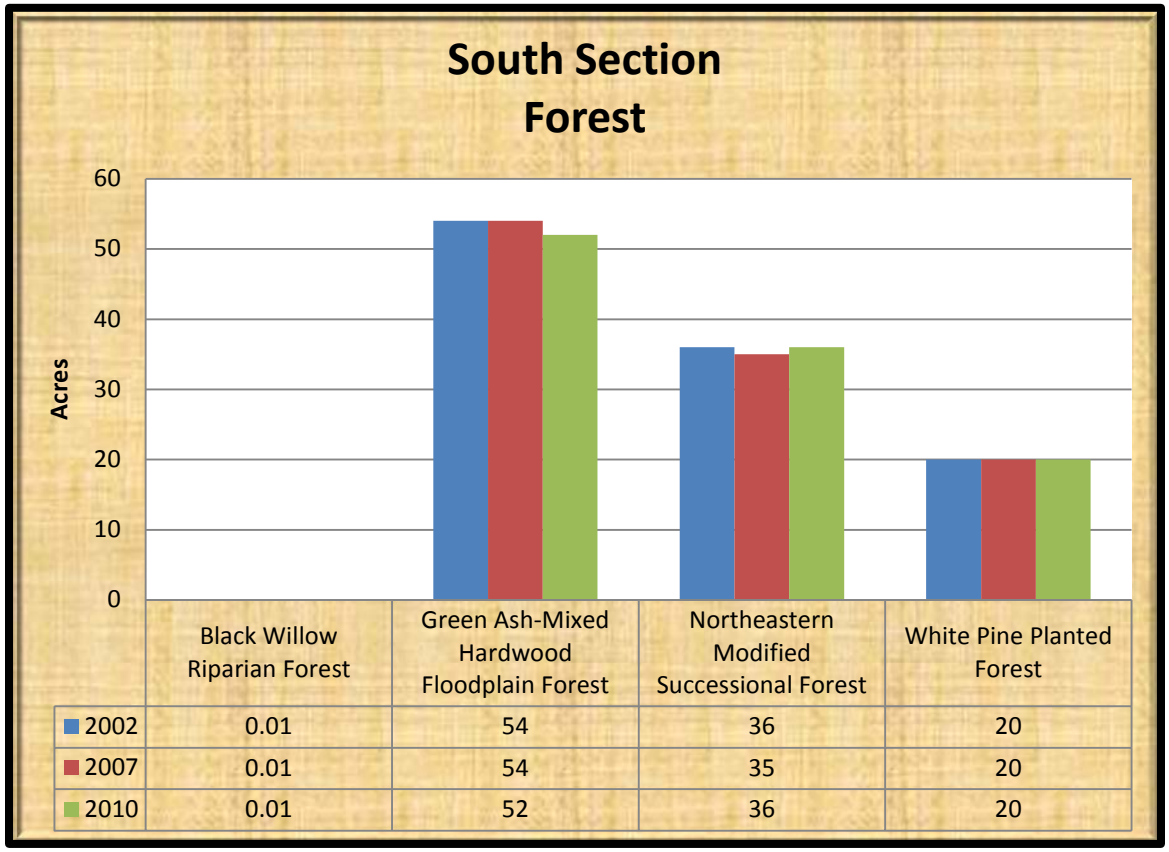


Figure 4-3.5. South Section Forest (2002, 2007, and 2010)

South Section Forest (Figure 4-3.5): Green Ash-Mixed Hardwood Floodplain Forest is the most common forest type in the south section, followed by Northeastern Modified Successional Forest. A lot of the Green Ash-Mixed Hardwood Floodplain Forest is degraded and may in time convert to Northeastern Modified Successional Forest.

Natural Capital (Table 4-3.2)

The loss of Green Ash-Mixed Hardwood Floodplain Forest has propelled a decrease in the capital of forest in the South Section.

Table 4-3.2. Natural Capital of South Section Forest	
Year	**Natural Capital (in 2012 dollars)**
2002	$674,454/year
2007	$674,264/year
2010	$649,871/year

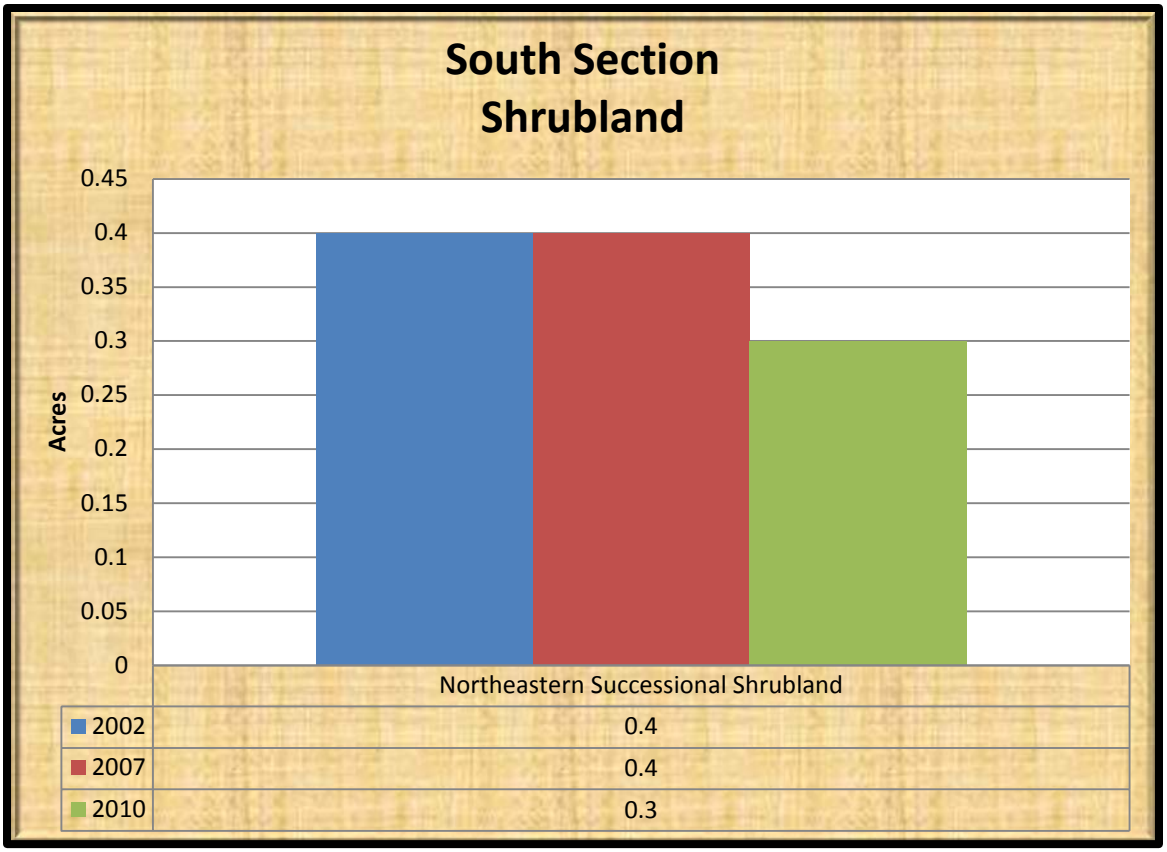


Figure 4-3.6. South Section Shrubland (2002, 2007, and 2010)

South Section Shrubland (Figure 4-3.6): Northeastern Successional Shrubland is the only shrubland present in the South Section and has decreased through succession.

Natural Capital (Table 4-3.3)

A slight decrease in the shrub acreage of the South Section has caused a slight decrease in the capital.

Table 4-3.3. Natural Capital of South Section Shrubland	
Year	**Natural Capital (in 2012 dollars)**
2002	$58/year
2007	$58/year
2010	$44/year

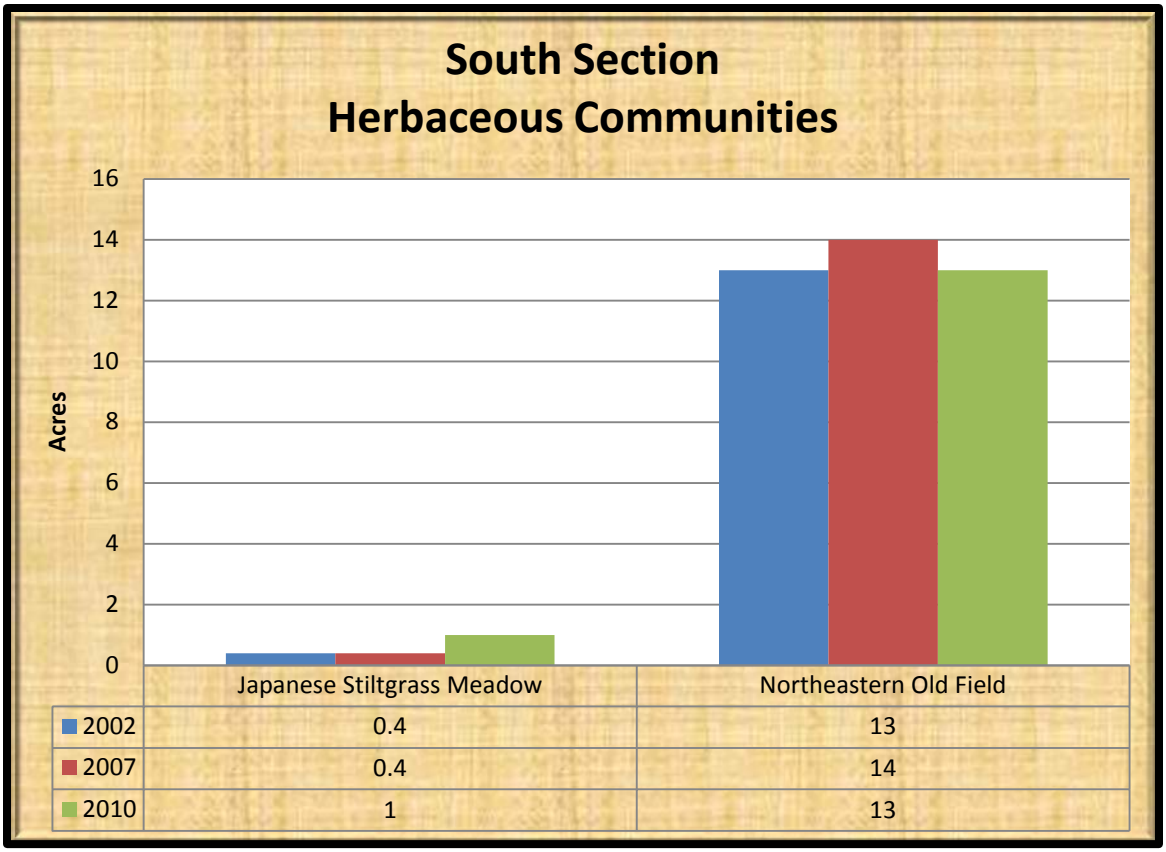


Figure 4-3.7. South Section Herbaceous Communities (2002, 2007, and 2010)

South Section Herbaceous Communities (Figure 4-3.7): Northeastern Old Field is the largest herbaceous community in the South Section. Japanese stiltgrass (*Microstegium vimineum*), which dominates the Japanese Stiltgrass Meadow, is gaining a foothold in this section over time.

Natural Capital (Table 4-3.4)

Natural capital of herbaceous communities in the South Section has increased since 2002 with an increase in Japanese Stiltgrass Meadow acreage.

Table 4-3.4. Natural Capital of South Section Herbaceous Communities	
Year	**Natural Capital (in 2012 dollars)**
2002	$1,952/year
2007	$2,098/year
2010	$2,040/year

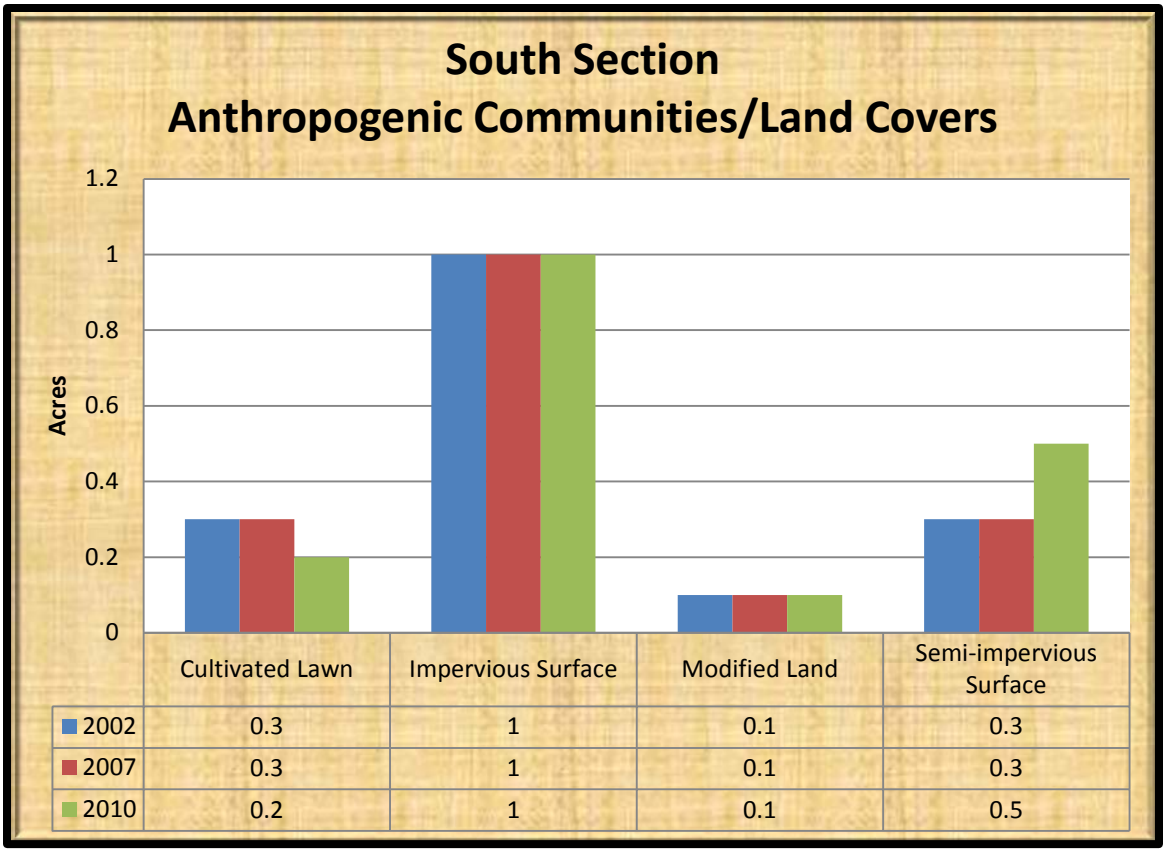


Figure 4-3.8. South Section Anthropogenic Communities/Land Covers (2002, 2007, and 2010)

South Section Anthropogenic Communities/Land Covers (Figure 4-3.8): Anthropogenic communities are not very prominent in this section and impervious surface associated with roads is the largest type.

Natural Capital

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

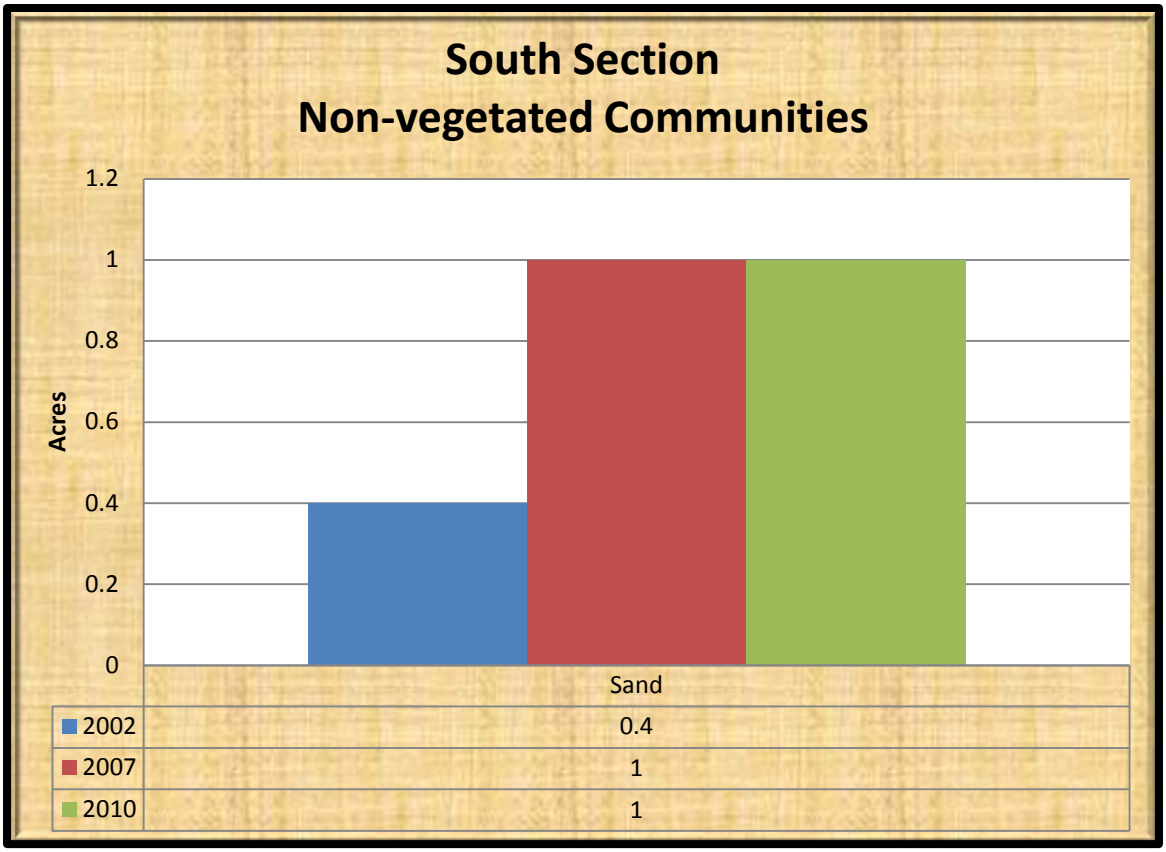


Figure 4-3.9. South Section Non-vegetated Land Covers (2002, 2007, and 2010)

South Section Non-vegetated Land Covers (Figure 4-3.9): Sand that is present in White Clay Creek is the only non-vegetated land cover in the South Section. The amount of sand in White Clay Creek has been increasing and could be due to runoff higher in the watershed.

Natural Capital

Sand does not have any natural capital value.

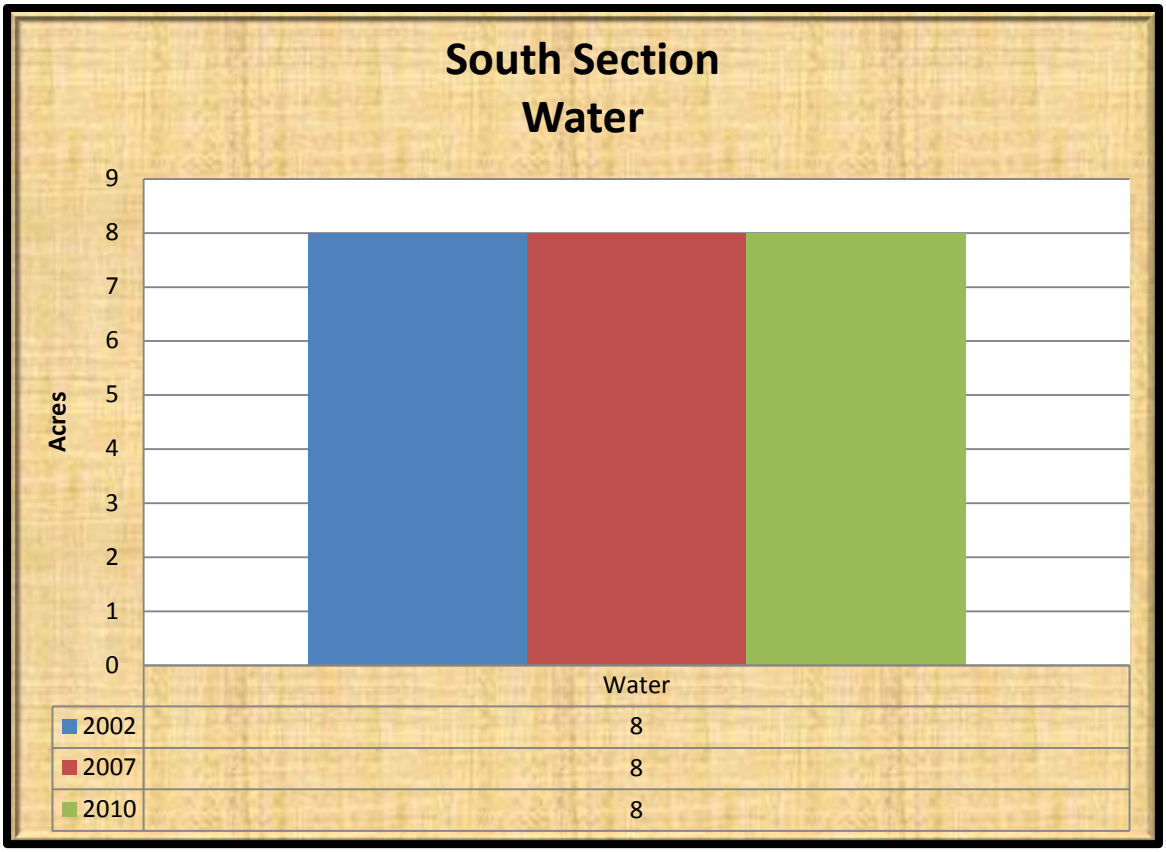


Figure 4-3.10. South Section Water (2002, 2007, and 2010)

South Section Water (Figure 4-3.10): The amount of water acreage has been stable in the study period.

Natural Capital (Table 4-3.5)

The capital of the water has stayed the same throughout the study period as has its acreage.

Table 4-3.5. Natural Capital of South Section Water	
Year	**Natural Capital (in 2012 dollars)**
2002	$42,681/year
2007	$42,681/year
2010	$42,681/year

4. West Section

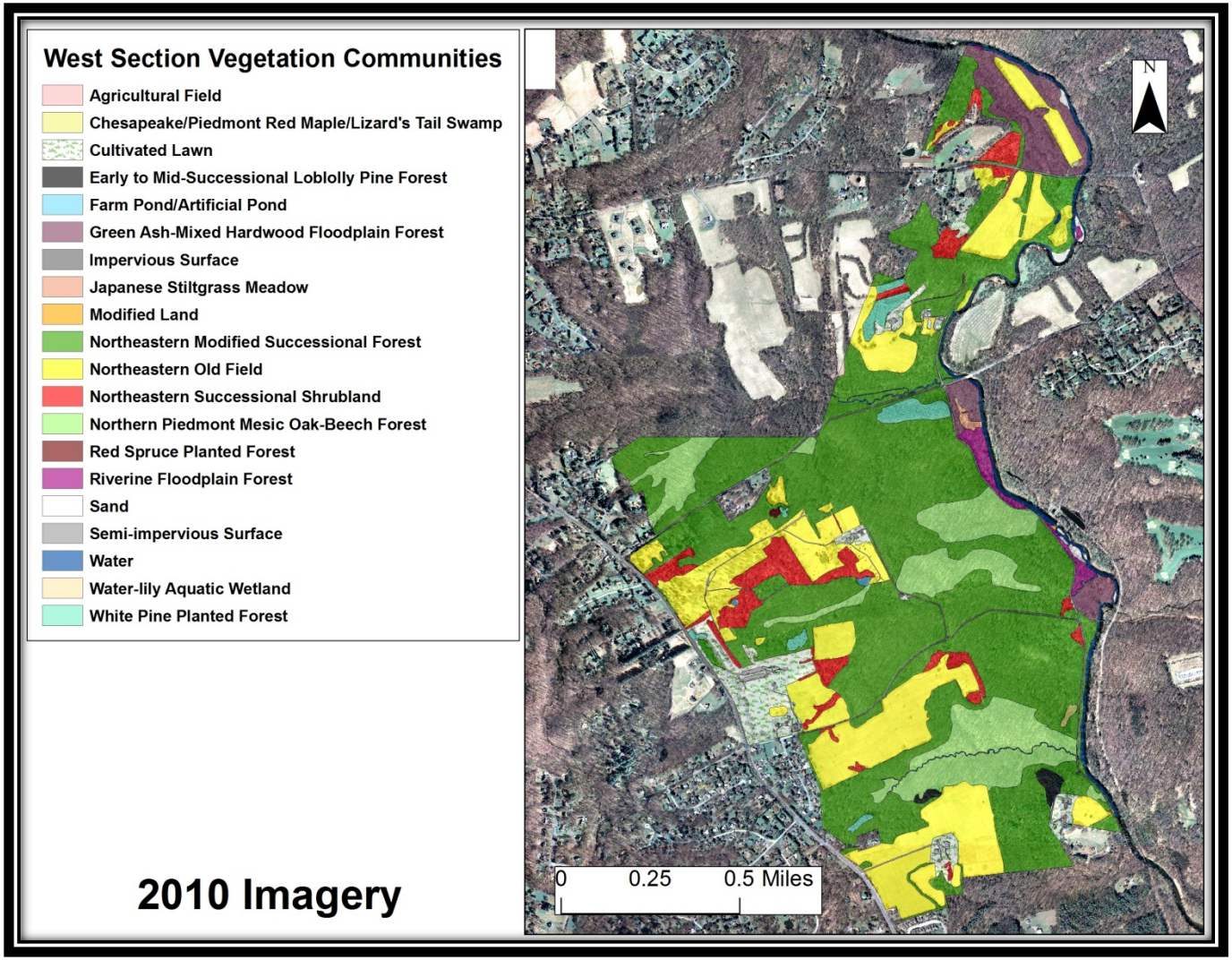


Figure 4-4.1. 2010 Vegetation Community map of the West Section

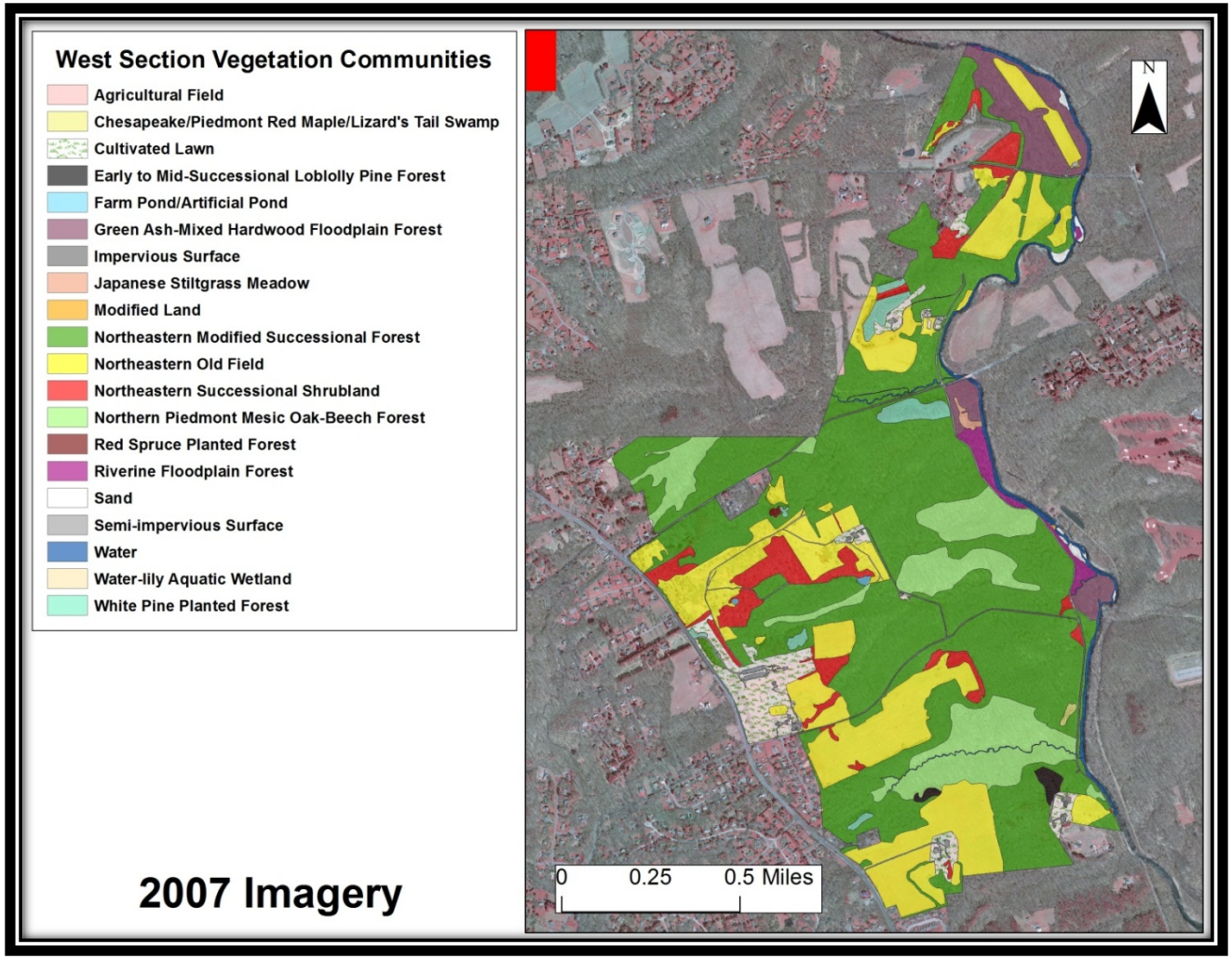


Figure 4-4.2. 2007 Vegetation Community map of the West Section

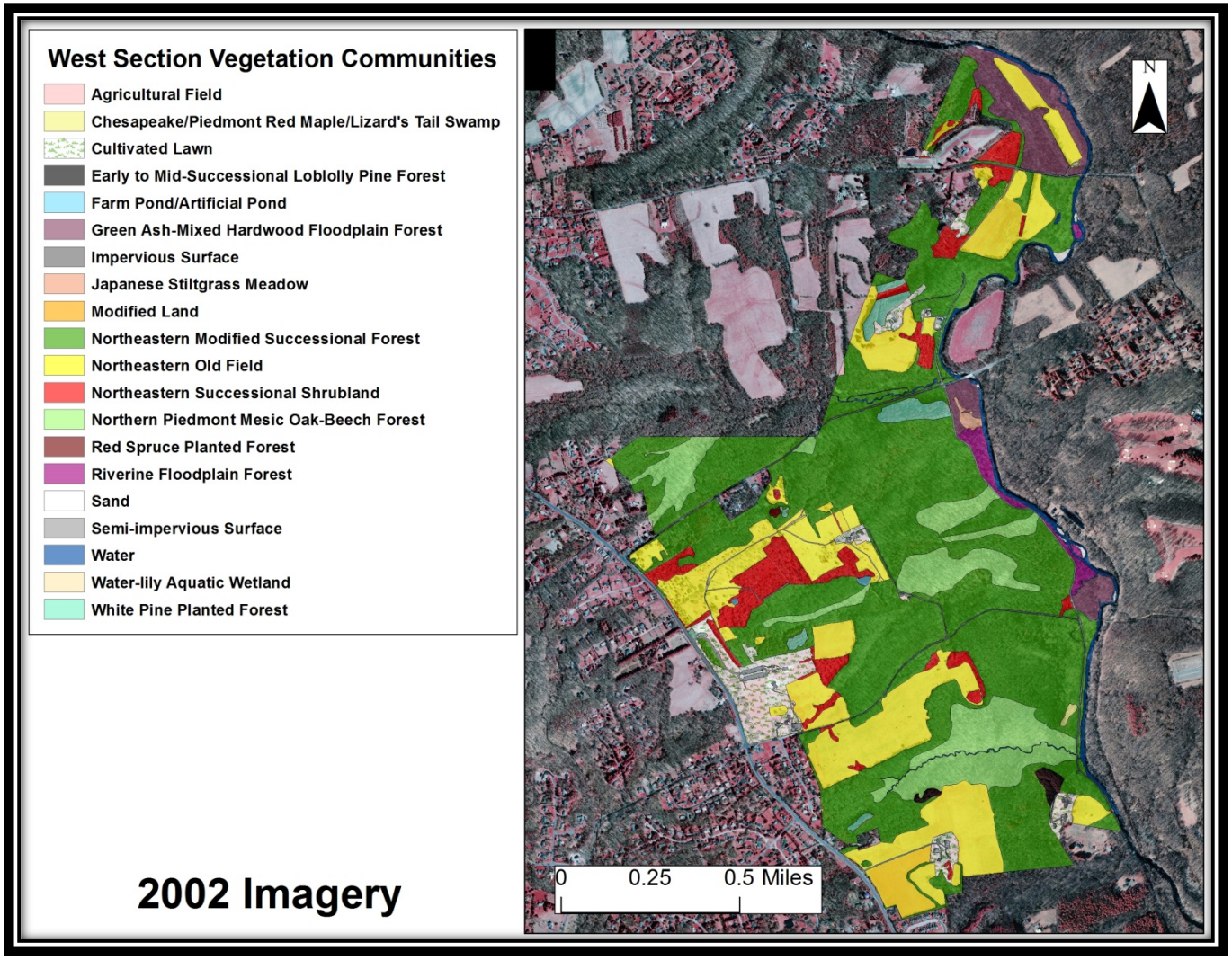
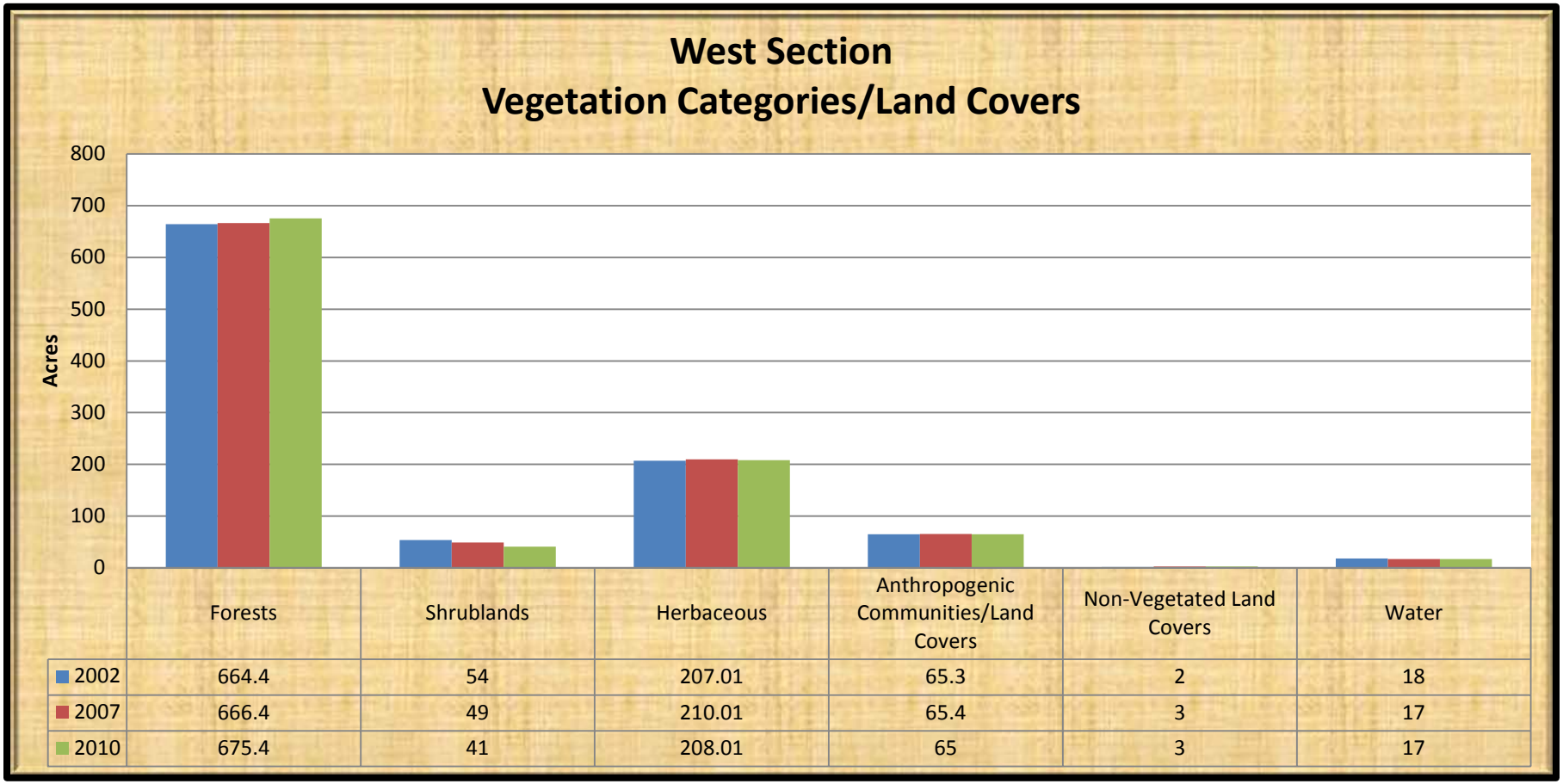


Figure 4-4.3. 2002 Vegetation Community map of the West Section



	Forests	Shrublands	Herbaceous	Anthropogenic Communities/Land Covers	Non-Vegetated Land Covers	Water
2002	664.4	54	207.01	65.3	2	18
2007	666.4	49	210.01	65.4	3	17
2010	675.4	41	208.01	65	3	17

Table 4-4.4. West Section Vegetation Communities/Land Covers (2002, 2007, and 2010)

West Section Broad Trends (Figure 4-4.4): The west section is primarily forested with a few fields interspersed between.

Natural Capital (Table 4-4.1)

Natural capital of the West Section has increased with gains in forestland.

Table 4-4.1. Natural Capital of the West Section	
Year	**Natural Capital (in 2012 dollars)**
2002	$870,325/year
2007	$904,381/year
2010	$930,553/year

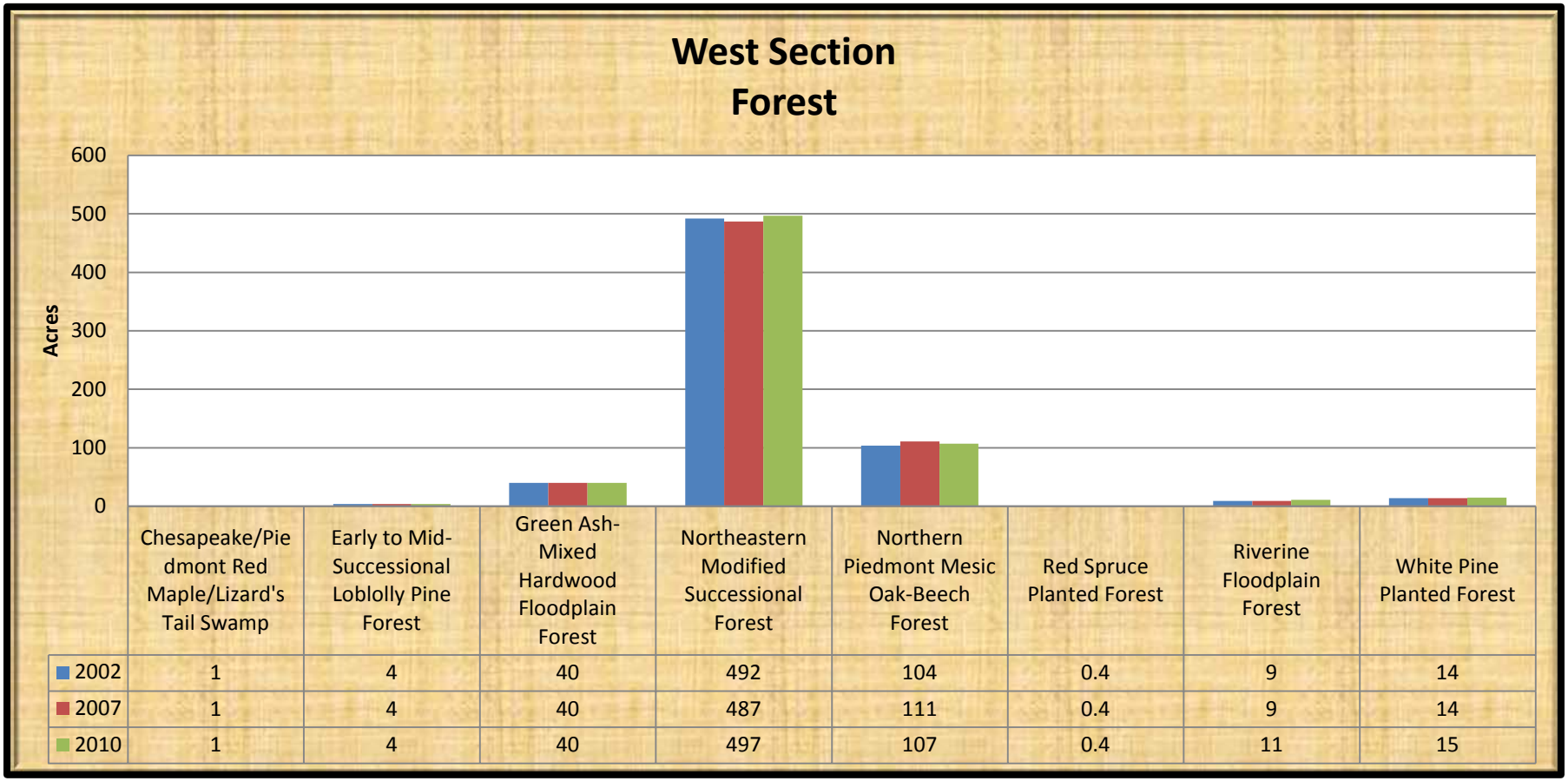


Figure 4-4.5. West Section Forest (2002, 2007, and 2010)

West Section Forest (Figure 4-4.5): Northeastern Modified Successional Forest is the most common forest type and has overall increased over time. Northern Piedmont Mesic Oak-Beech Forest is the second most common forest type and has increased slightly over the study period.

Natural Capital (Table 4-4.2)

Capital of forest has increased with gains in Northeastern Modified Successional Forest, White Pine Planted Forest, and Riverine Floodplain Forest.

Table 4-4.2. Natural Capital of West Section Forest

Year	Natural Capital (in 2012 dollars)
2002	$730,758/year
2007	$731,136/year
2010	$757,043/year

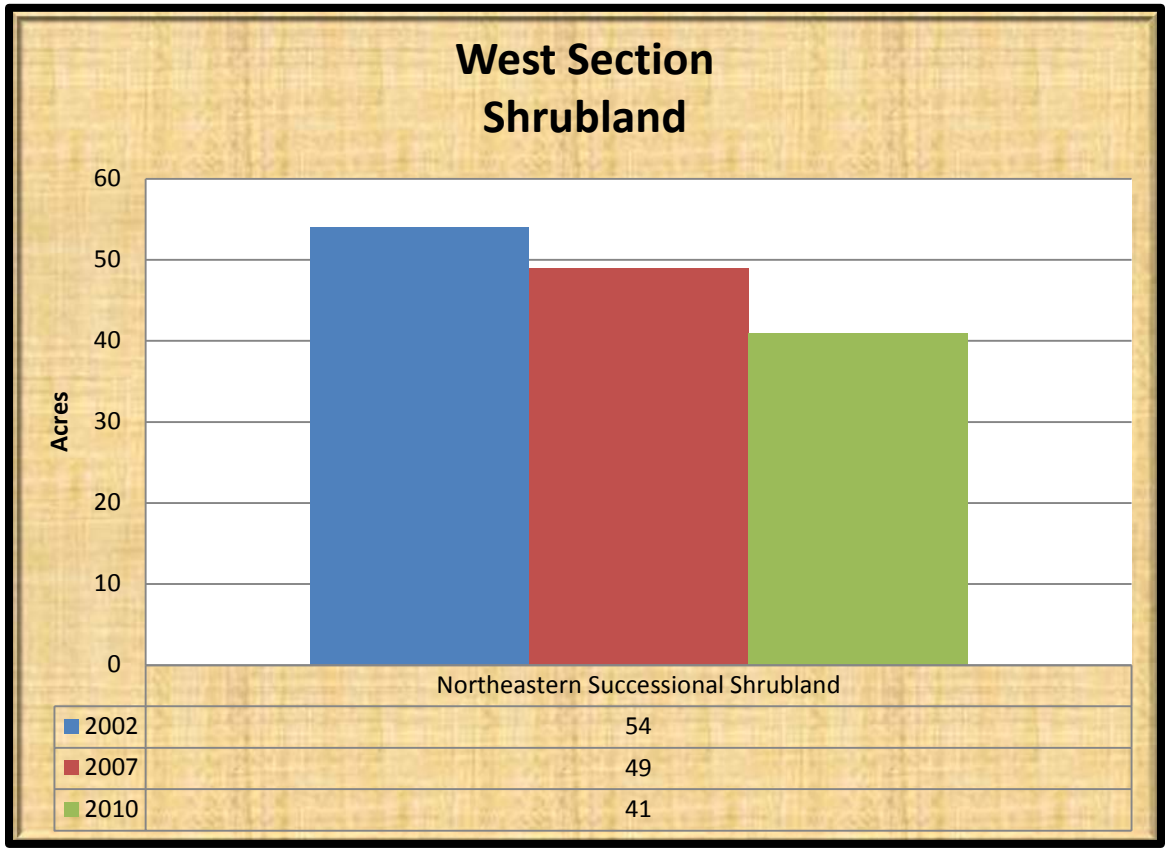


Figure 4-4.6. West Section Shrubland (2002, 2007, and 2010)

West Section Shrubland (Figure 4-4.6): Like the other sections in the park, Northeastern Successional Shrubland is the only shrubland present. It has been decreasing as it succeeds to more mature types.

Natural Capital (Table 4-4.3)

Capital of the shrubland has been decreasing and the balance has transferred to forest.

Table 4-4.3. Natural Capital of West Section Shrubland	
Year	**Natural Capital (in 2012 dollars)**
2002	$7,868/year
2007	$7,139/year
2010	$5,974/year

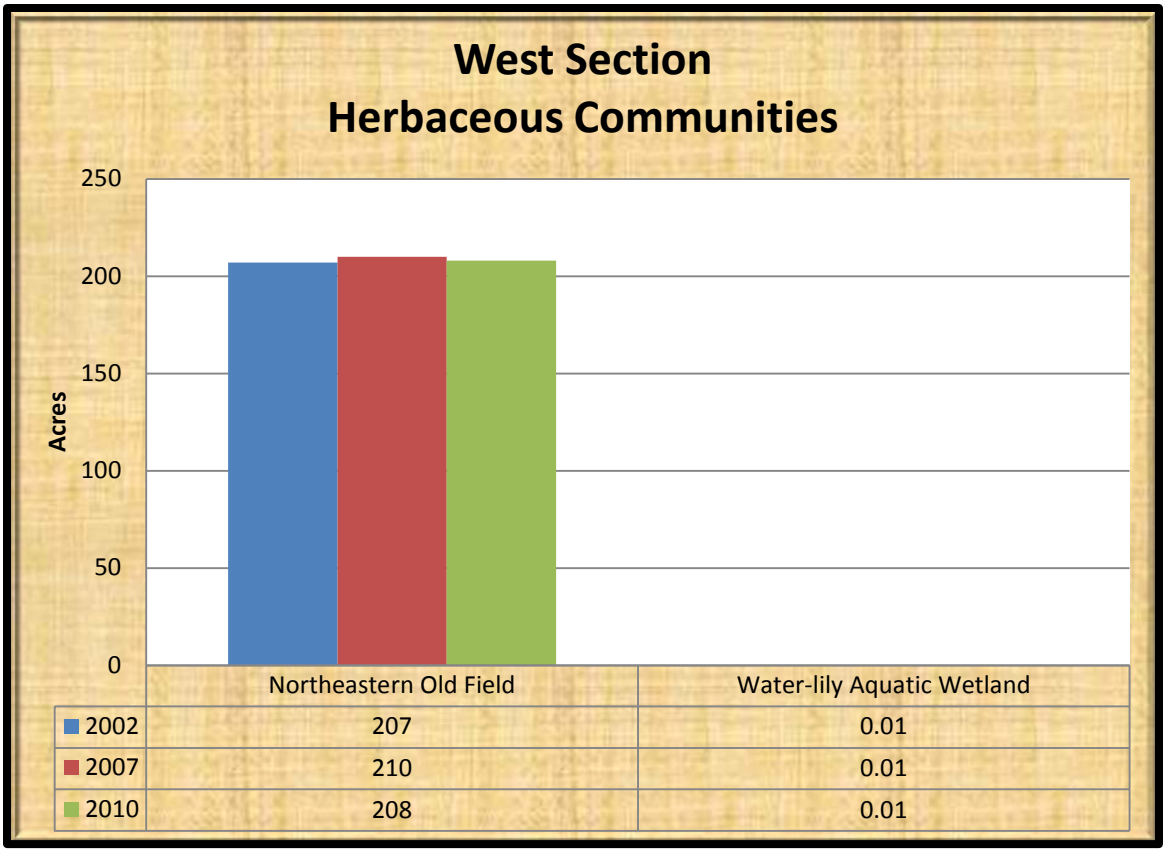


Figure 4-4.7. West Section Herbaceous Communities (2002, 2007, and 2010)

West Section Herbaceous Communities (Figure 4-4.7): Northeastern Old Field is the most common herbaceous community in this section.

Natural Capital (Table 4-4.4)

Northeastern Old Field capital and acreage has oscillated during the study period as these fields mature and agricultural fields are abandoned.

Table 4-4.4. Natural Capital of West Section Herbaceous Communities	
Year	**Natural Capital (in 2012 dollars)**
2002	$30,253/year
2007	$30,690/year
2010	$30,398/year

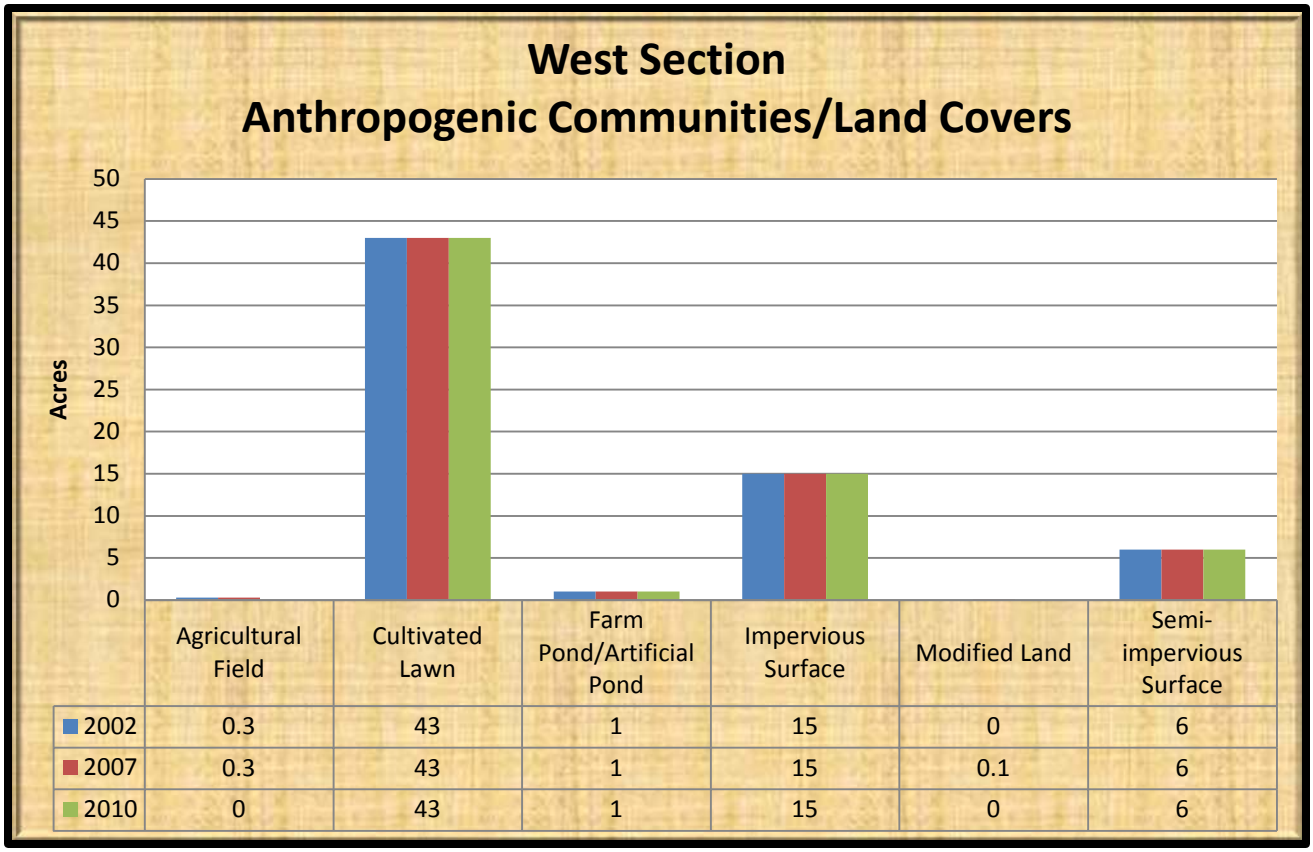


Figure 4-4.8. West Section Anthropogenic Communities/Land Covers (2002, 2007, and 2010)

West Section Anthropogenic Communities/Land Covers (Figure 4-4.8): Cultivated lawn that is located in the Walter S. Carpenter Recreation area is the most common anthropogenic community followed by related impervious surface areas.

Natural Capital (Table 4-4.5)

Agricultural field and Farm Pond/Artificial Pond are the only anthropogenic communities/land covers with any natural capital value. They have gone down slightly with the disappearance of agricultural field.

Table 4-4.5. Natural Capital of West Section Anthropogenic Communities/Land Covers	
Year	**Natural Capital (in 2012 dollars)**
2002	$5,352/year
2007	$5,352/year
2010	$5,335/year

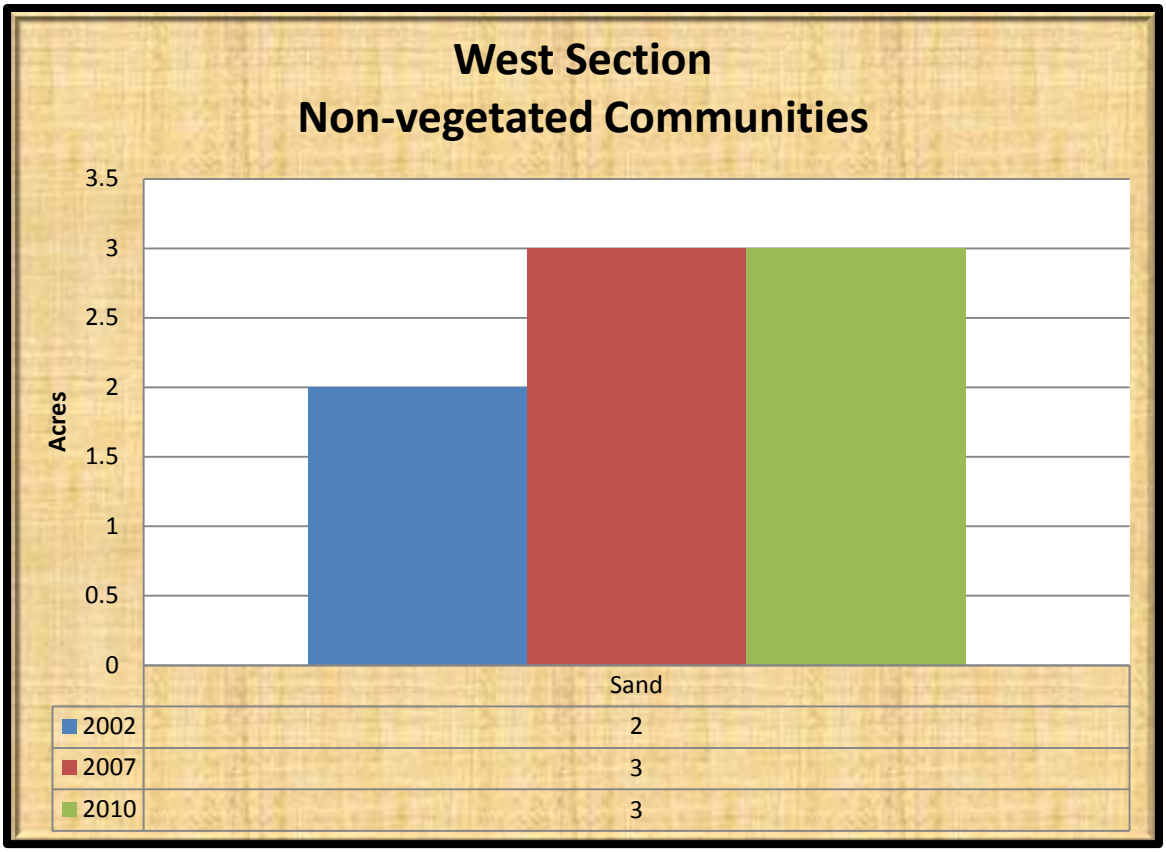


Figure 4-4.9. West Section Non-vegetated Communities (2002, 2007, and 2010)

West Section Non-vegetated Communities (Figure 4-4.9): Sand that is present in White Clay Creek is the only non-vegetated land cover present in the West Section.

Natural Capital

None of the Non-vegetated land covers in the West Section have any natural capital value.

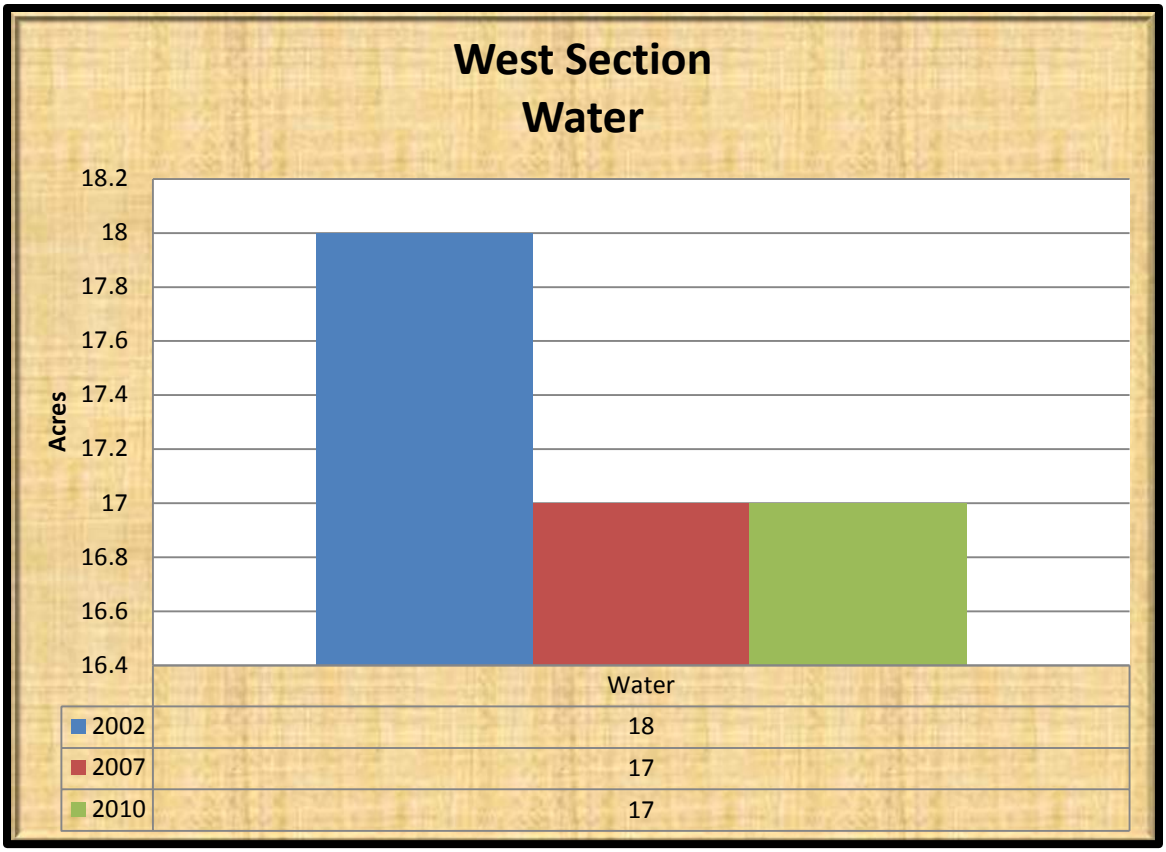


Figure 4-4.10. West Section Water (2002, 2007, and 2010)

West Section Water (Figure 4-4.10): Water surface in White Clay Creek has been stable in amount through the study period.

Natural Capital (Table 4-4.6)

Capital of water has decreased slightly with a loss in acreage. This resulted in an overall capital loss for the section.

Table 4-4.6. Natural Capital of West Section Water	
Year	**Natural Capital (in 2012 dollars)**
2002	$96,032/year
2007	$90,697/year
2010	$90,697/year

CHAPTER 5: DESCRIPTIONS AND ANALYSIS OF THE VEGETATION COMMUNITIES

Twenty-three vegetation communities and eight land covers were noted in the survey (Figures 6-17). Below are the descriptions of the vegetation communities. 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. American Lotus Aquatic Wetland (CEGL004323)—0.1 acres
2. Black Willow Riparian Forest (CEGL002103)—0.01 acres
3. Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp (CEGL006606)—1 acre
4. Cultivated Lawn (CEGL008462)—105 acres
5. Early to Mid-Successional Loblolly Pine Forest (CEGL006011)—4 acres
6. Eastern Cattail Wetland (CEGL006153)—1 acre
7. Eastern Hemlock Planted Forest (No NVC)—0.3 acres
8. Eastern Reed Marsh (CEGL004141)—0.1 acres
9. Green Ash-Mixed Hardwood Floodplain Forest (CEGL006575)—107 acres
10. Japanese Stiltgrass Meadow (No NVC)—1.5 acres
11. Northeastern Coastal Plain/Piedmont Oak-Beech/Heath Forest (CEGL006919)—14 acres
12. Northeastern Modified Successional Forest (CEGL006599)—1,736 acres
13. Northeastern Old Field (CEGL006107)—524 acres
14. Northeastern Successional Shrubland (CEGL006451)—156 acres
15. Northern Piedmont Mesic Oak-Beech Forest-(CEGL006921)—264 acres
16. Red Spruce Planted Forest (CEGL004758)—0.4 acres
17. Riverine Floodplain Forest (CEGL006036)—17 acres
18. Smooth Alder Swamp (CEGL005082)—1 acre
19. Successional Tuliptree Forest (CEGL007220)—10 acres
20. Virginia Pine Successional Forest (CEGL002591)—3 acres
21. Water-lily Aquatic Wetland (CEGL002386)—0.5 acres
22. White Pine Planted Forest (CEGL007178)—35 acres
23. Wisteria Vineland (CEGL008568)—1 acre

***American Lotus Aquatic Wetland* [0.1 acres (Figures 5.1-5.2, Table 5.1)] GNA SNA**

DEWAP: No Equivalent Classification
NHC: Northern Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh

Description

Figure 5.1. American Lotus Aquatic Wetland (Judge Morris Section)

This aquatic community is located in a pond in the Judge Morris Section and is apparently a new community. It putatively formed from seed that was thrown in the pond which took hold and covers about half of the pond. The community is composed solely of American lotus (*Nelumbo lutea*).

Analysis of Condition at White Clay Creek State Park

While American lotus is a native species in Delaware is a not native to the Piedmont and this occurrence could be considered an introduction to the park. It is likely that this occurrence will spread to cover the whole pond in time. Since 2002 it has covered 0.1 acres of former Farm Pond/Artificial Pond and because of this no historical analysis was completed.

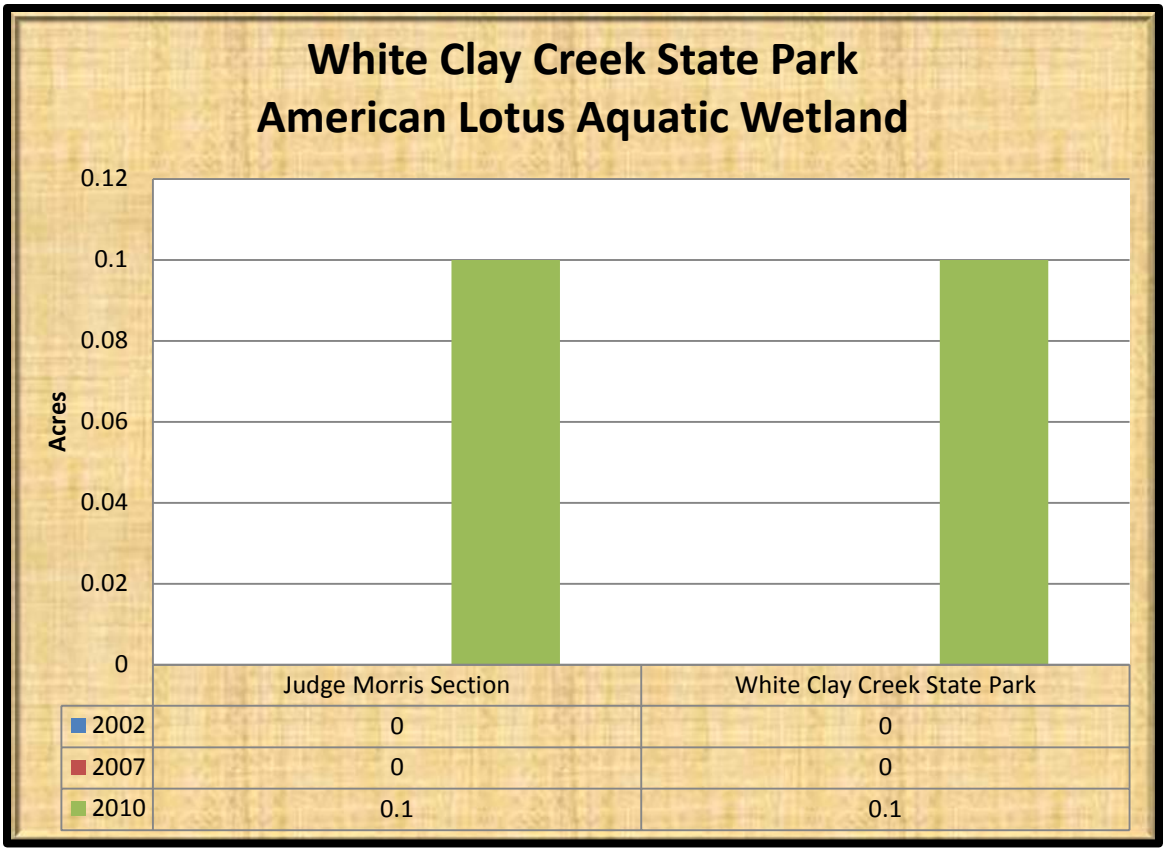


Figure 5.2. American Lotus Aquatic Wetland at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.1)

American Lotus Aquatic Wetland is a recent arrival to the pond in the Judge Morris Section. It currently accounts for $928 in capital.

Table 5.1. Natural Capital of American Lotus Aquatic Wetland	
Year	**Natural Capital (in 2012 dollars)**
2002	$0/year (not present)
2007	$0/year (not present)
2010	$928/year

Black Willow Riparian Forest **[0.01 acres (Figure 5.3-5.4, Table 5.2)]** **G4 S1**

DEWAP: Forested Floodplains and Riparian Swamps
NHC: North-Central Interior Floodplain

Description

This community is located for the most part outside of the park but the park boundary barely nicks the edge of it. This community is located a wet area on the east floodplain of White Clay Creek and is composed of a canopy of black willow (*Salix nigra*), green ash (*Fraxinus pennsylvanica*), and a rather open understory of multiflora rose (*Rosa multiflora*) and poison ivy (*Toxicodendron radicans*). The herbaceous layer is dominated heavily by Japanese stiltgrass (*Microstegium vimineum*), and associated by stinging nettle (*Urtica dioica*), wood reed (*Cinna arundinacea*), pickerelweed (*Pontederia cordata*), skunk cabbage (*Symplocarpus foetidus*), and arrow-leaf tearthumb (*Polygonum arifolium*).

Figure 5.3. Black Willow Riparian Forest (South Section)

Analysis of Condition at White Clay Creek State Park

While the amount present in the park is miniscule and a trend cannot be deciphered from the evidence here, the community outside of the park appears to be stable but may being invaded by multiflora rose (*Rosa multiflora*) and Japanese stiltgrass (*Microstegium vimineum*).

Because of the small area covered by this forest within the park and the fact that it has not changed, a change analysis was not completed.

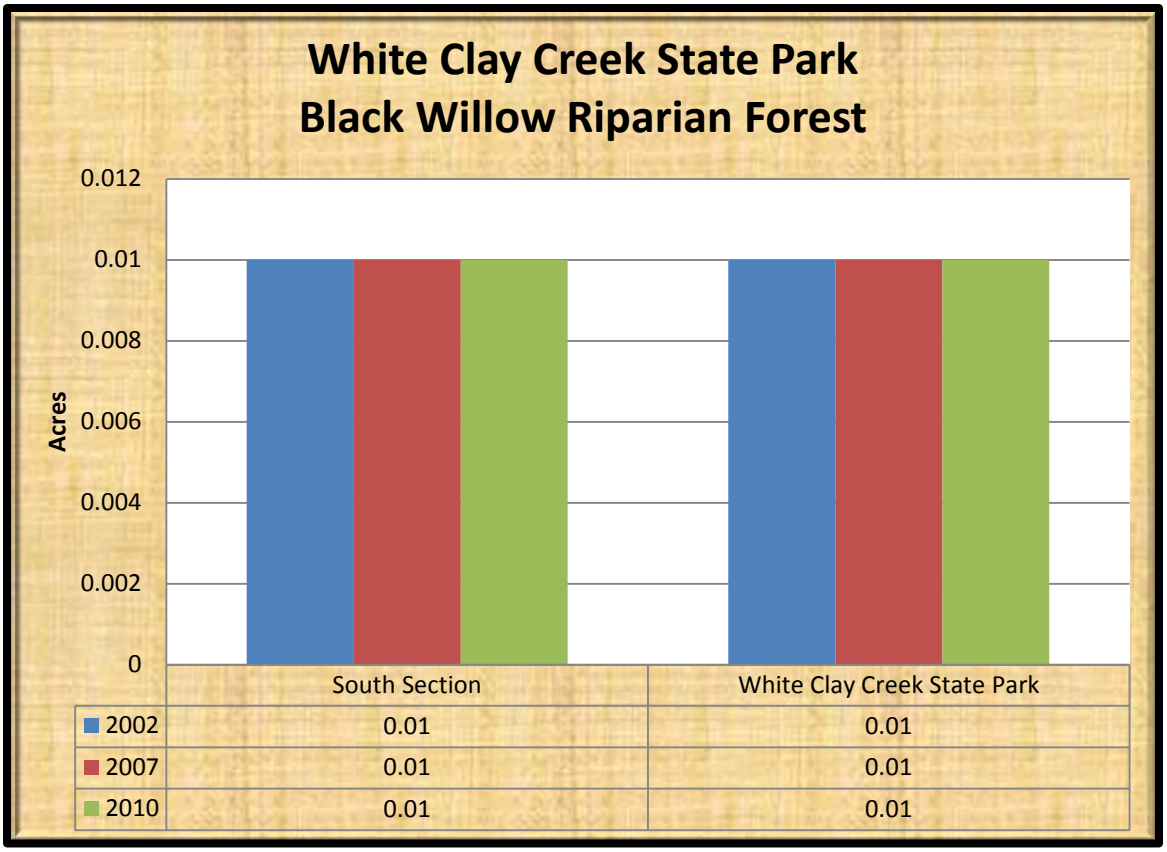


Figure 5.4. Black Willow Riparian Forest at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.2)

Capital of Black Willow Riparian Forest has remained the same throughout the study period.

Table 5.2. Natural Capital of Black Willow Riparian Forest	
Year	**Natural Capital (in 2012 dollars)**
2002	$123/year
2007	$123/year
2010	$123/year

Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp **[1 acre (Figures 5.5-5.6, Tables 5.3-5.5)]**
GNR S3

DEWAP: Forested Floodplains and Riparian Swamps
NHC: Northern Atlantic Coastal Plain Basin Swamp and Wet Hardwood Forest

Description

One occurrence of this community is located on the west floodplain of White Clay Creek south of Wedgewood Road. Typified by a canopy of red maple (*Acer rubrum*) that is associated by tuliptree (*Liriodendron tulipifera*), green ash (*Fraxinus pennsylvanica*), and a few sycamore (*Platanus occidentalis*). Understory species include smaller members of the canopy plus black walnut (*Juglans nigra*) and spicebush (*Lindera benzoin*). The shrub and vine layer contains Oriental bittersweet (*Celastrus orbiculatus*), Japanese barberry (*Berberis thunbergii*), and multiflora rose (*Rosa multiflora*). Common herbs include stinging nettle (*Urtica dioica*), mile-a-minute (*Polygonum perfoliatum*), enchanter's nightshade (*Circaea lutetiana*), Christmas fern (*Polystichum acrostichoides*), sensitive fern (*Onoclea sensibilis*), mild water pepper (*Polygonum hydropiperoides*), Canadian clearweed (*Pilea pumila*), and wood reed (*Cinna arundinacea*).

Figure 5.5. Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp (South Section)

The one example in the park is in late successional state with some organization of layers but also some invasion by exotic invasive plant species.

Analysis of Condition at White Clay Creek State Park

This community has been noted in past Natural Heritage surveys pre-dating the study period. During the period of study (2002-2010) it has been stable in size, however, there are a lot of exotic invasive species located next to it and they could potentially invade given the amount of moisture and disturbance present.

All of the Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp that was present in 2002 was present in 2010 (Table 5.3). Since 2002 this community has converted 0.5 acres of Northeastern Modified Successional Forest (Table 5.4). Since this number is within the rounding error it does not appear as an addition in Table 5.3.

Table 5.3. What was once Chesapeake/Piedmont Red Maple-Lizard's Tail Swamp in 2002 has become X in 2010	
X	**Acreage**
Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp	1 acre

Table 5.4. Chesapeake/Piedmont Red Maple-Lizard's Tail Swamp has migrated into X since 2010	
X	**Acreage**
Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp	1 acre
Northeastern Modified Successional Forest	0.5 acres

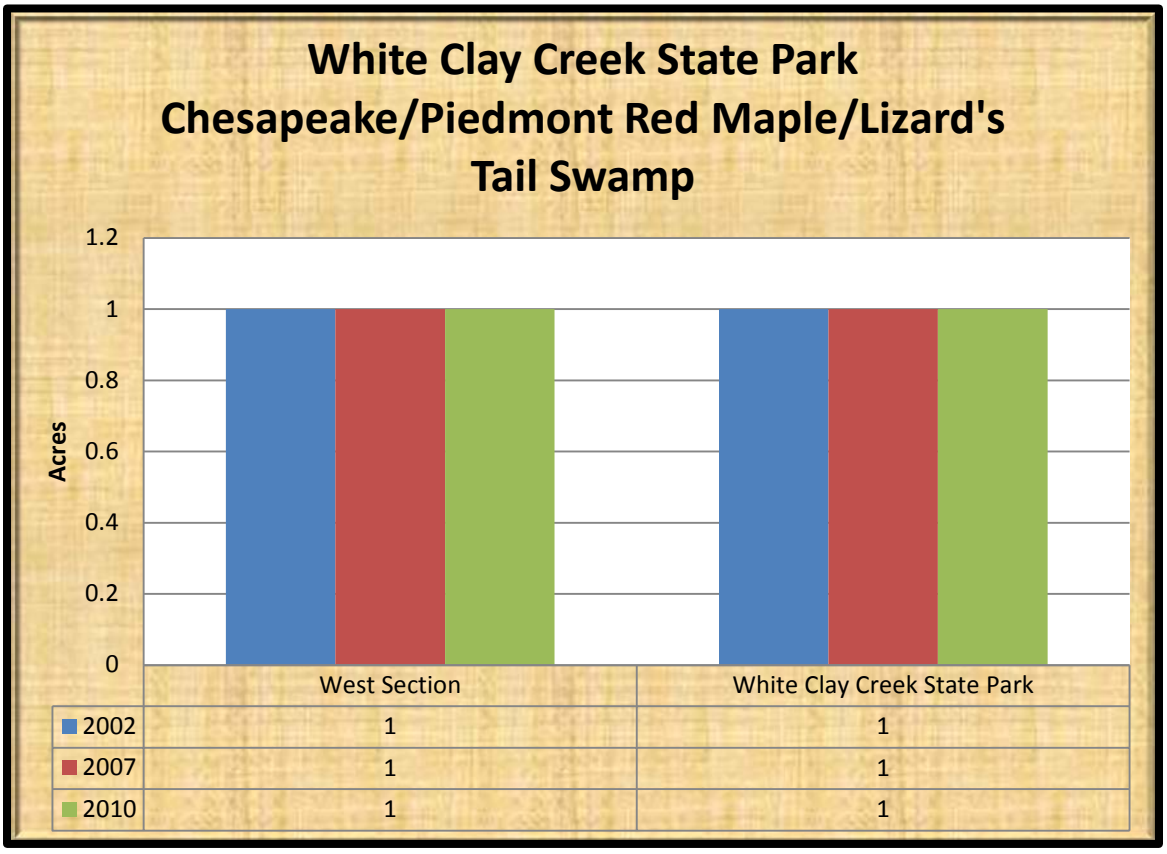


Figure 5.6. Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.5)

Acreage and capital of Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp has remained the same through the study period.

Table 5.5. Natural Capital of Chesapeake/Piedmont Red Maple/Lizard's Tail Swamp	
Year	**Natural Capital (in 2012 dollars)**
2002	$12,292/year
2007	$12,292/year
2010	$12,292/year

Cultivated Lawn **[105 acres (Figure 5.7, Tables 5.6-5.7)] GNA SNA**

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

Description

This community is composed of ornamental lawn grasses such tall fescue (*Festuca rubra*) and scattered ornamental shrubs. It is often associated with impervious surfaces.

Analysis of Condition at White Clay Creek State Park

As various activities take place in the park the amount of cultivated lawn has gone up and down by about 2 acres in the study period. This community is not of conservation significance.

Of the original 105 acres present in 2002, 101 acres were present in 2010. The other acres became Northeastern Old Field (2 acres), Northeastern Modified Successional Forest (1 acre), Northeastern Successional Shrubland (0.3 acres), and Impervious surface (0.2 acres) (Table 5.6).

Since 2002, Cultivated Lawn has migrated into several other communities resulting in no net gain of acreage due to the losses above. Some of these communities include Northeastern Old Field (3 acres), Northeastern Modified Successional Forest (1 acre), Northeastern Successional Shrubland (0.5 acres), and Agricultural field (0.2 acres) (Table 5.7).

Table 5.6. What was once Cultivated Lawn in 2002 has become X in 2010

X	Acreage
Cultivated Lawn	101 acres
Northeastern Old Field	2 acres
Northeastern Modified Successional Forest	1 acre
Northeastern Successional Shrubland	0.3 acres
Impervious Surface	0.2 acres
Other communities/land covers	0.3 acres

Table 5.7. Cultivated Lawn has migrated into X since 2002	
X	**Acreage**
Cultivated Lawn	101 acres
Northeastern Old Field	3 acres
Northeastern Modified Successional Forest	1 acre
Northeastern Successional Shrubland	0.5 acres
Agricultural Field	0.2 acres
Other communities/land covers	0.2 acres

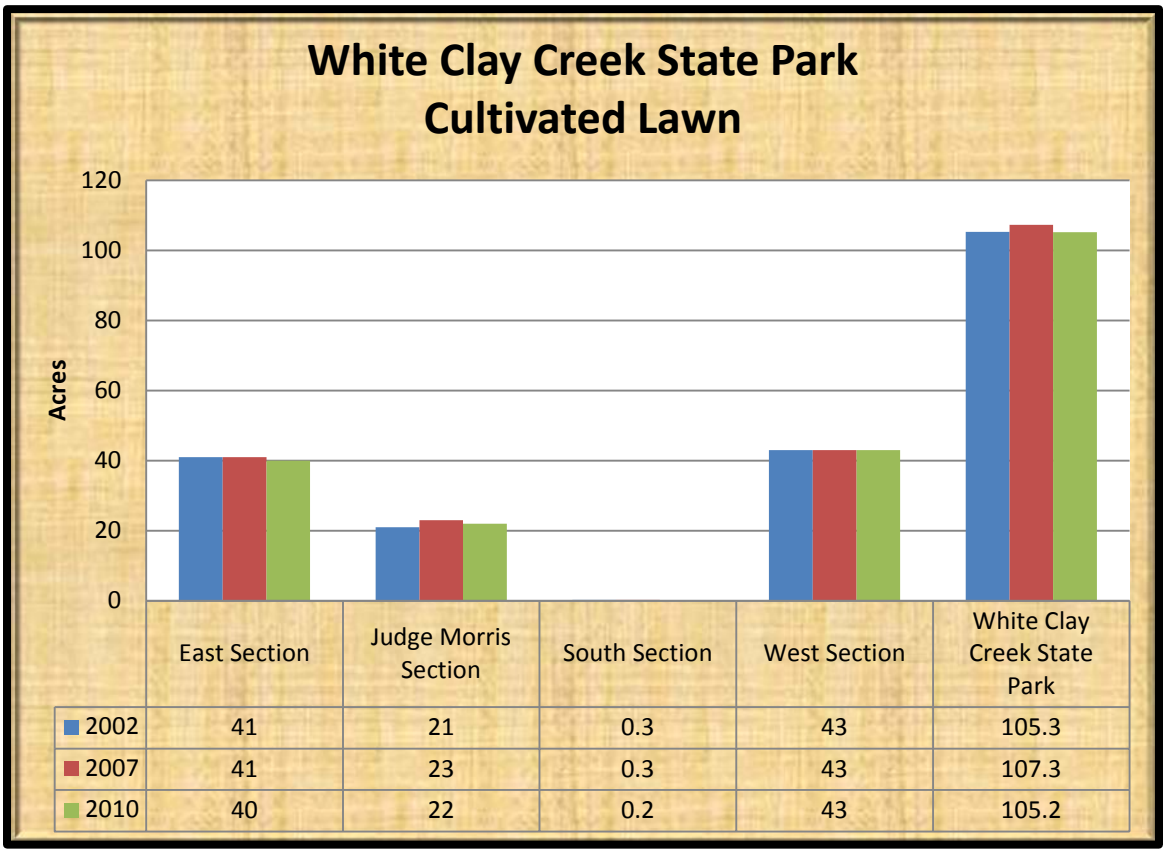


Figure 5.7. Cultivated Lawn at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital

Cultivated lawn does not have any natural capital value.

Early to Mid-Successional Loblolly Pine Forest **[4 acres (Figures 5.8-5.9, Tables 5.8-5.10)]**
GNA SNA

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

Description

The primary species of this community, loblolly pine (*Pinus taeda*) is north of its native range in White Clay Creek State Park. All of the occurrences present in the park were either planted or have escaped from planted areas. As such in the park this community is an artificial community, whereas, further south in Kent and Sussex Counties, this community would be a natural part of successional processes.

Figure 5.8. Early to Mid-Successional Loblolly Pine Forest (South Section)

In this community, loblolly pine (*Pinus taeda*) dominates a canopy overtopping an understory of red maple (*Acer rubrum*) and sweetgum (*Liquidambar styraciflua*). The rest of the layers are similar to the Northeastern Modified Successional Forest.

Analysis of Condition at White Clay Creek State Park

This community has not changed in the study period. Since this community is naturally found to the south of the park it is unknown whether warming temperatures from climate change will cause this community to spread in the park and may become a natural feature of the park in places that are undergoing succession. Since this community appears to be unchanged in acreage (Tables 5.8-5.9) and extent a change analysis was not completed.

Table 5.8. What was once Early to Mid-Successional Loblolly Pine Forest in 2002 has become X in 2010	
X	**Acreage**
Early to Mid-Successional Loblolly Pine Forest	4 acres

Table 5.9. Early to Mid-Successional Loblolly Pine Forest has migrated into X since 2002	
X	**Acreage**
Early to Mid-Successional Loblolly Pine Forest	4 acres

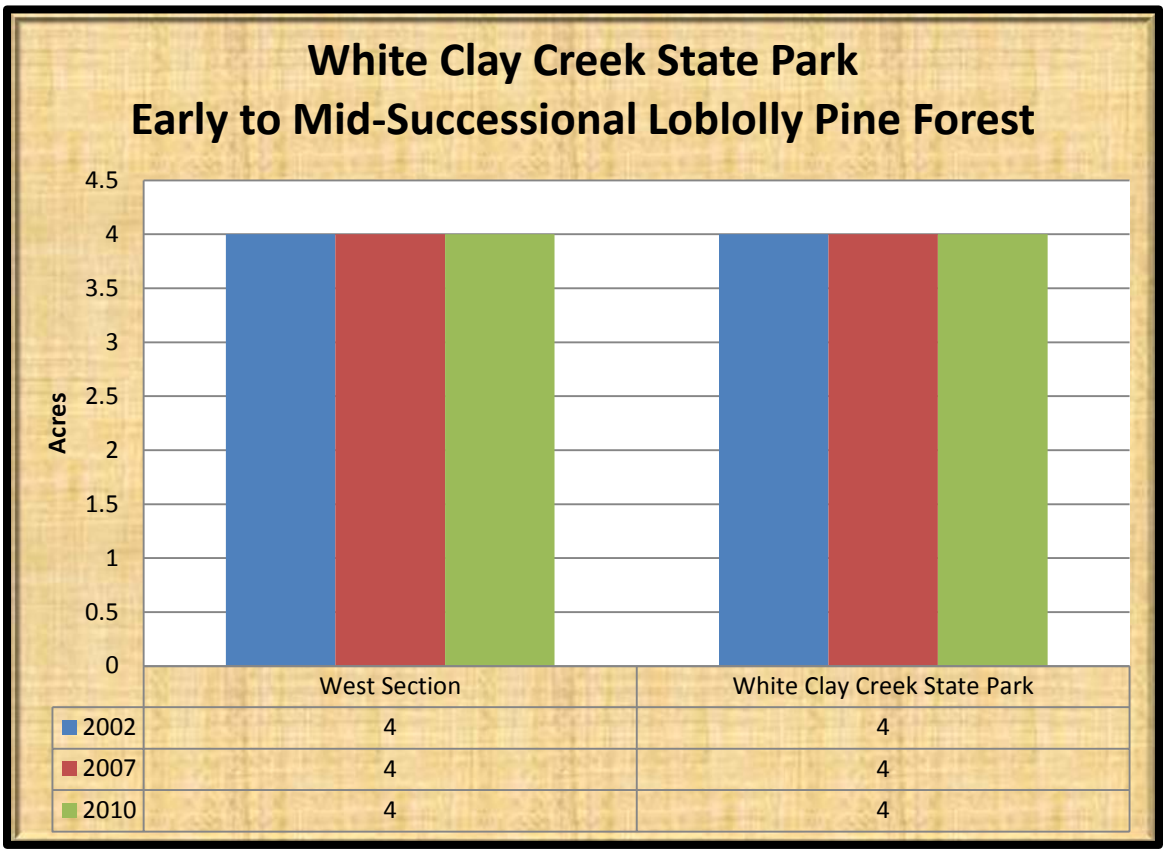


Figure 5.9. Early to Mid-Successional Loblolly Pine Forest at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.10)

The amount of Early to Mid-Successional Loblolly Pine Forest has stayed the same throughout the study period and therefore the capital has remained the same also.

Table 5.10. Natural Capital of Early to Mid-Successional Loblolly Pine Forest	
Year	**Natural Capital (in 2012 dollars)**
2002	$756/year
2007	$756/year
2010	$756/year

Eastern Cattail Wetland **[1 acre (Figures 5.10-5.11, Tables 5.11-5.13)] G5 S4**

DEWAP: Streamside Herbaceous Wetlands
NHC: Laurentian-Acadian Freshwater Marsh

Description

Figure 5.10. Eastern Cattail Wetland (East Section)

Eastern cattail wetland is located in a floodplain depression that was once dominated by sensitive fern (*Onoclea sensibilis*). The wetland is now dominated by eastern cattail (*Typha latifolia*) and most of the sensitive fern is now gone.

Analysis of Condition at White Clay Creek State Park

All of the acreage present in 2002 is still present in 2007 (Table 5.11). Since 2002, this community has taken over a Wet Meadow (0.4 acres) (Table 5.12) resulting in its elimination from the park. The amount however is within the rounding error making it appear that this community has no net change.

Table 5.11. What was once Eastern Cattail Wetland in 2002 has become X in 2010	
X	**Acreage**
Eastern Cattail Wetland	1 acre

Table 5.12. Eastern Cattail Wetland has migrated into X since 2002	
X	**Acreage**
Eastern Cattail Wetland	1 acre
Wet Meadow	0.4 acres

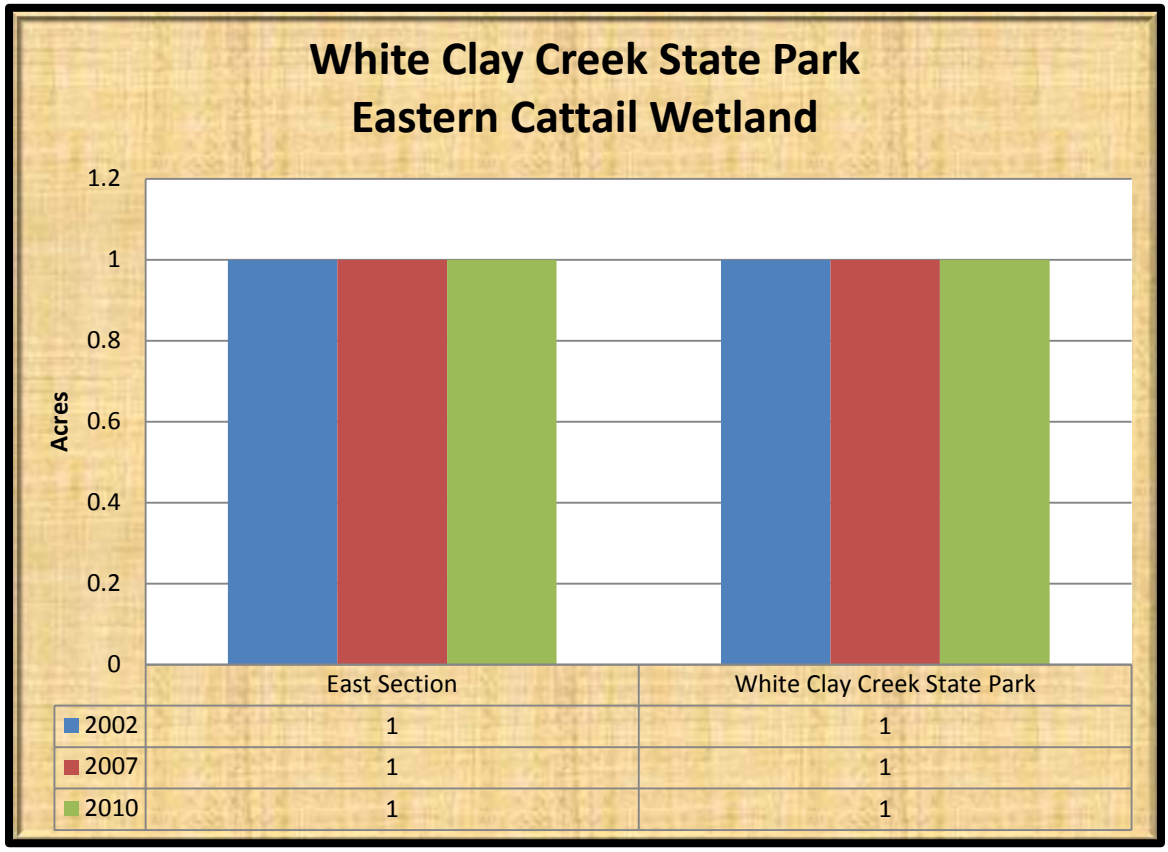


Figure 5.11. Eastern Cattail Wetland at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.13)

The amount of Eastern Cattail Wetland has been constant through the study period and therefore the capital has remained the same.

Table 5.13. Natural Capital of Eastern Cattail Wetland	
Year	**Natural Capital (in 2012 dollars)**
2002	$9,281/year
2007	$9,281/year
2010	$9,281/year

Eastern Hemlock Planted Forest **[0.3 acres (Figures 5.12-5.13, Table 5.14)]**

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

Description

Figure 5.12. Eastern Hemlock Planted Forest (East Section)

One small area of planted eastern hemlock (*Tsuga canadensis*) is located in the park. The canopy is dominated totally by eastern hemlock with no understory underneath, likely due to the acidity of the needles.

Analysis of Condition at White Clay Creek State Park

This community is a planted forest and has not moved from its original planting site or changed since 2002, therefore no historical analysis has been completed for it.

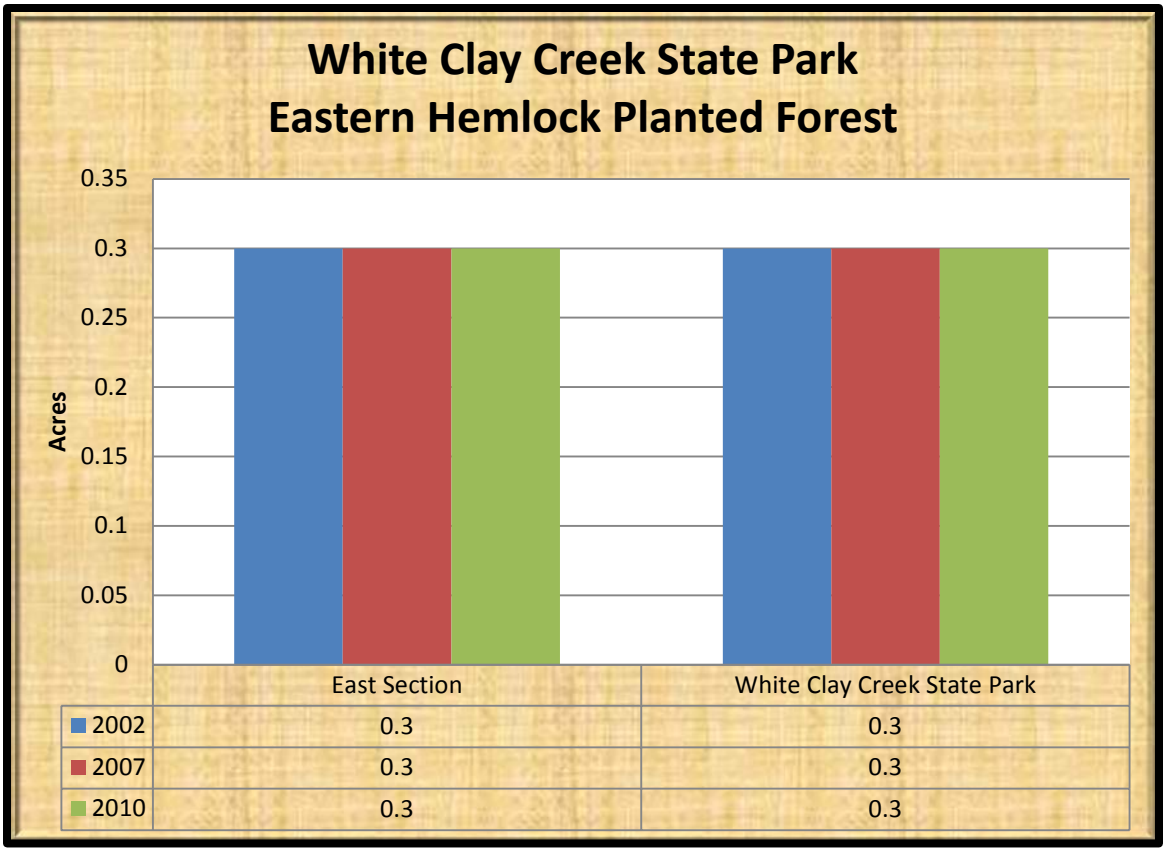


Figure 5.13. Eastern Hemlock Planted Forest at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.14)

Capital of Eastern Hemlock Planted Forest has remained the same throughout the study period.

Table 5.14. Natural Capital of Eastern Hemlock Planted Forest	
Year	**Natural Capital (in 2012 dollars)**
2002	$756/year
2007	$756/year
2010	$756/year

Eastern Reed Marsh **[0.1 acres (Figure 5.14, Table 5.15)]**

DEWAP: Streamside Herbaceous Wetlands
NHC: Semi-natural/Altered vegetation and Conifer Plantations

Description

One eastern reed marsh is located in the Judge Morris Section of the park along a tributary to Pike Creek. This community is dominated totally by common reed (*Phragmites australis*).

Analysis of Condition at White Clay Creek State Park

Like a lot of other communities, Eastern Reed Marsh has not changed during the study period and therefor no change analysis was completed for it.

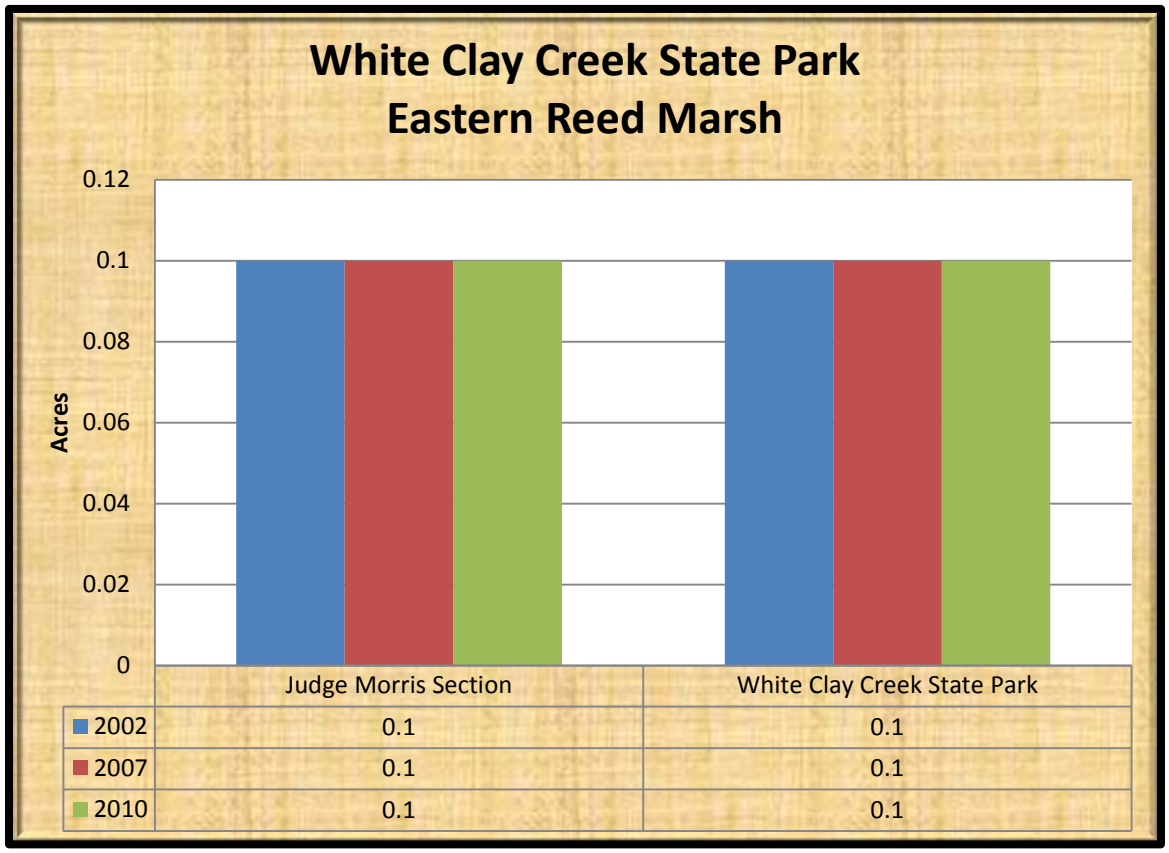


Figure 5.14. Eastern Reed Marsh at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.15)

The acreage of Eastern Reed Marsh has not changed over the study and therefore the capital has not changed either.

Table 5.15. Natural Capital of Eastern Reed Marsh	
Year	**Natural Capital (in 2012 dollars)**
2002	$599/year
2007	$599/year
2010	$599/year

Green Ash-Mixed Hardwood Floodplain Forest **[107 acres (Figures 5.15-5.16, Tables 5.15-5.17)]**
GNR S2

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

Description

Green Ash-Mixed Hardwood Floodplain Forest is located in the floodplain of White Clay Creek in tandem with the Riverine Floodplain Forest. Green ash (*Fraxinus pensylvanica*) is a dominant or co-dominant species with black walnut (*Juglans nigra*), tuliptree (*Liriodendron tulipifera*), and a few sycamore (*Platanus occidentalis*) overtopping an understory of red maple (*Acer rubrum*), box-elder (*Acer negundo*), and spicebush (*Lindera benzoin*). The shrub and vine layer is very similar to that in the Northeastern Modified Successional Forest and the examples in White Clay Creek State Park walk the border towards a modified successional forest. Species in this layer include multiflora rose (*Rosa multiflora*), poison ivy (*Toxicodendron radicans*), autumn olive (*Elaeagnus umbellata*), and Oriental bittersweet (*Celastrus orbiculatus*). Common herbs are Christmas fern (*Polystichum acrostichoides*), Japanese stiltgrass (*Microstegium vimineum*), mile-a-minute (*Polygonum perfoliatum*), stinging nettle (*Urtica dioica*), Virginia smartweed (*Polygonum virginianum*), and one seed bur-cucumber (*Sicyos angulata*).

Figure 5.15. Green Ash-Mixed Hardwood Floodplain Forest (East Section)

Most of the examples of this community in the park are late successional or mature but most contain a dense understory of exotic invasive plants, retarding the succession.

Analysis of Condition at White Clay Creek State Park

This community is has been mostly stable during the study period but could be imperiled by the exotic invasive plant species, especially Japanese Stiltgrass (*Microstegium vimineum*). A lot of the examples of this community are already marginally this community trending towards a Northeastern Modified Successional Forest. Just south of Hopkins Bridge Road on the west floodplain is an area that has been flooded and invaded by Japanese stiltgrass. It is unknown what caused this flooding but it is the cause of the losses observed during the study period (2002-2010).

Most of the Green Ash-Mixed Hardwood Forest from 2002 remained in 2007 with a net loss of 2 acres to sand (1 acre), Japanese Stiltgrass Meadow (1 acre), water (0.4 acres), and Semi-impervious Surface (0.1 acres) (Table 5.15).

Since 2002 this community migrated very little into 0.1 acres each of water, sand, and Japanese Stiltgrass Meadow (Table 5.16) resulting in a net loss of 2 acres for the community by 2007.

Table 5.15. What was once Green Ash-Mixed Hardwood Floodplain Forest in 2002 has become X in 2010	
X	**Acreage**
Green Ash-Mixed Hardwood Floodplain Forest	107 acres
Sand	1 acre
Japanese Stiltgrass Meadow	1 acre
Water	0.4 acres
Semi-impervious Surface	0.1 acres

Table 5.16. Green Ash-Mixed Hardwood Floodplain Forest has migrated into X since 2002	
X	**Acreage**
Green Ash-Mixed Hardwood Floodplain Forest	107 acres
Water	0.1 acres
Sand	0.1 acres
Japanese Stiltgrass Meadow	0.1 acres

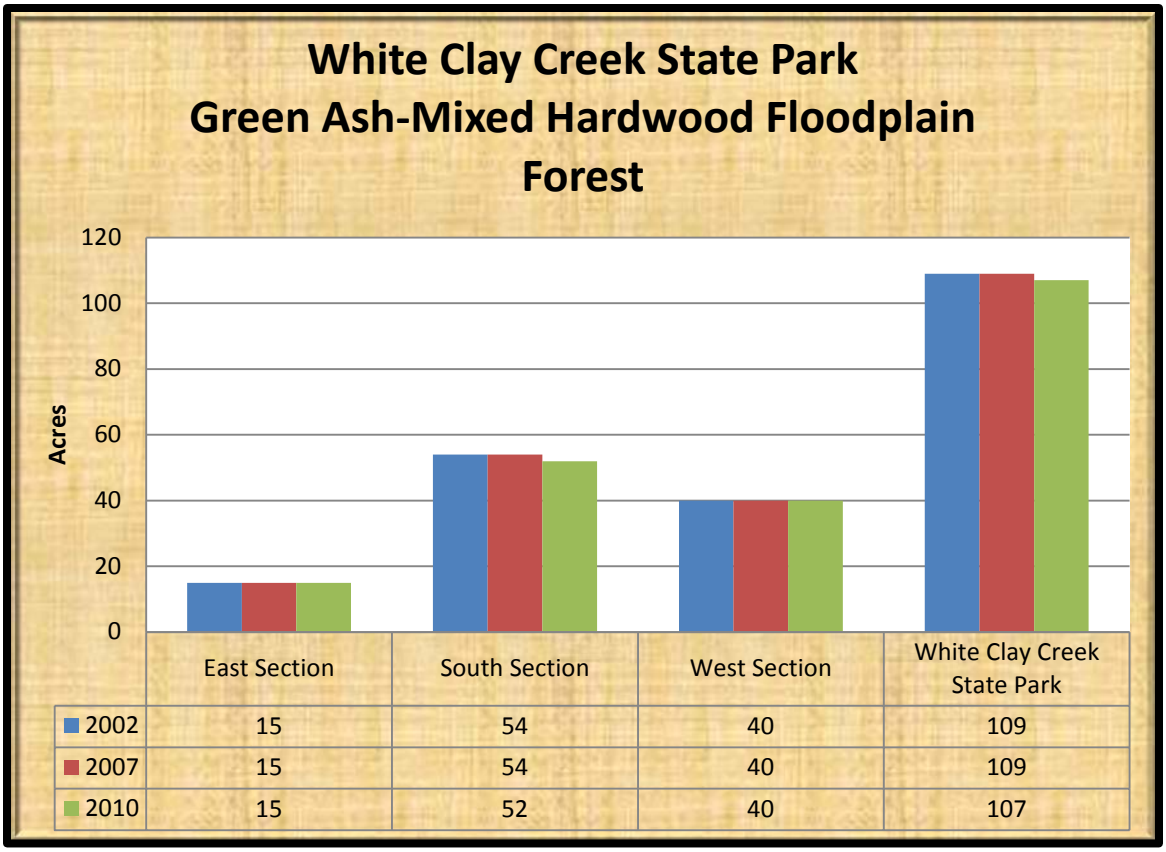


Figure 5.16. Green Ash-Mixed Hardwood Floodplain Forest at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.17)

The capital of Green Ash-Mixed Hardwood Floodplain Forest has decreased slightly with erosion of the banks of White Clay Creek. This capital was lost to sand and Japanese Stiltgrass Meadow.

Table 5.17. Natural Capital of Green Ash-Mixed Hardwood Floodplain Forest	
Year	**Natural Capital (in 2012 dollars)**
2002	$20,612/year
2007	$20,612/year
2010	$20,234/year

Japanese Stiltgrass Meadow **[4 acres (Figures 5.17-5.18, Tables 5.18-5.20)] GNA SNA**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

Description

Figure 5.17. Japanese Stiltgrass Meadow (West Section)

This community has established in part of the western floodplain of White Clay Creek where Green Ash-Mixed Hardwood Floodplain Forest used to be resulting a marked increase in the 2002 to 2007 period. This community is composed nearly entirely of Japanese stiltgrass (*Microstegium vimineum*) with an admixture of halbeard-leaf tearthumb (*Polygonum arifolium*) and rice-cut grass (*Leersia oryzoides*).

Analysis of Condition at White Clay Creek State Park

This community has increased during the study period owing to increases in the West and South Sections. A small amount (0.1 acres) was lost to Green Ash-Mixed Hardwood Floodplain Forest (Table 5.18) and there has been no migration since 2002 (Table 5.19).

Table 5.18. What was once Japanese Stiltgrass Meadow in 2002 has become X in 2010	
X	**Acreage**
Japanese Stiltgrass Meadow	2 acres
Green Ash-Mixed Hardwood Floodplain Forest	0.1 acres

Table 5.19. Japanese Stiltgrass Meadow has migrated into X since 2002	
X	**Acreage**
Japanese Stiltgrass Meadow	3 acres

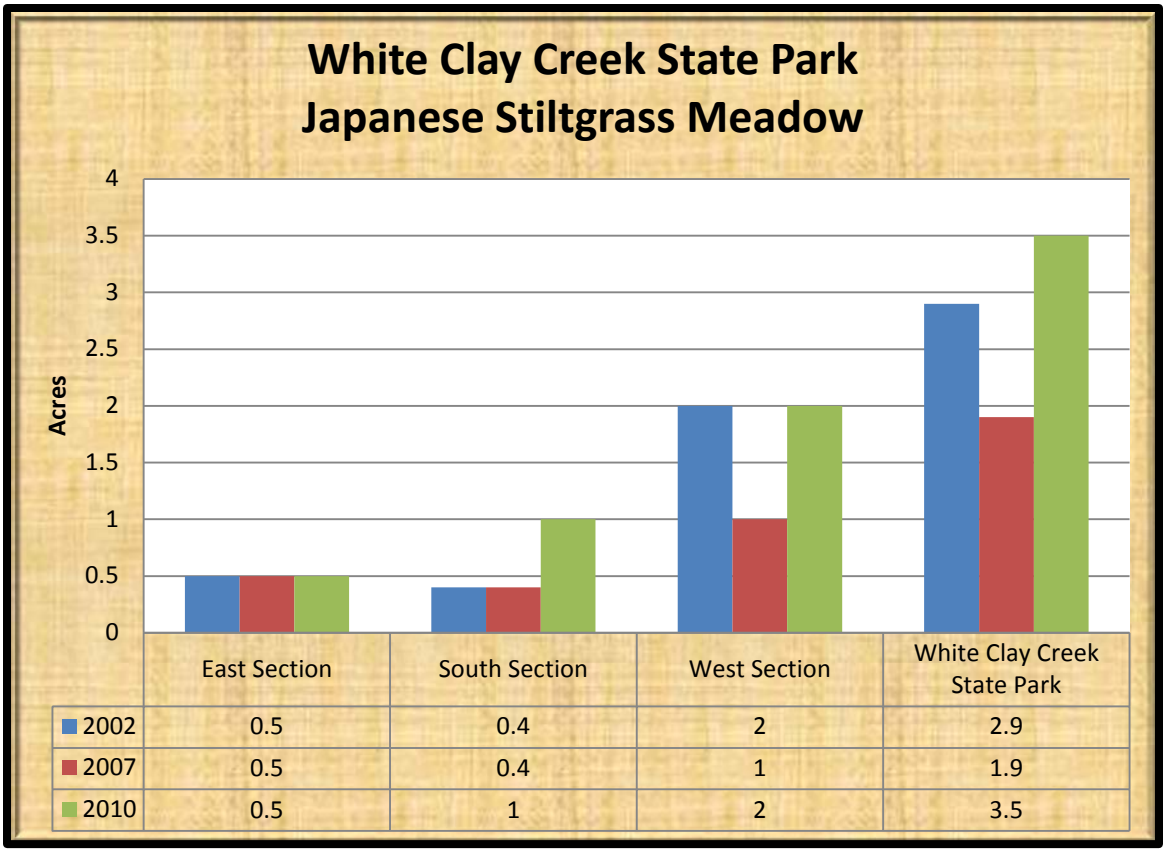


Figure 5.18. Japanese Stiltgrass Meadow at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.20)

Japanese Stiltgrass Meadow has oscillated in amount, which could be due to its location on the creek bank.

Table 5.20. Natural Capital of Japanese Stiltgrass Meadow	
Year	**Natural Capital (in 2012 dollars)**
2002	$423/year
2007	$277/year
2010	$510/year

Northeastern Coastal Plain/Piedmont Oak-Beech/Heath Forest **[14 acres (Figures 5.19-5.20, Table 5.21)] GNR S1**

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

Description

This community occurs on a north-facing slope in the east section and contains a canopy of chestnut oak (*Quercus prinus*), red maple (*Acer rubrum*), tuliptree (*Liriodendron tulipifera*), black oak (*Quercus velutina*), white oak (*Quercus alba*), and northern red oak (*Quercus rubra*). The understory is composed of smaller members of the canopy plus American beech (*Fagus grandifolia*). The shrub layer is dominated by mountain laurel (*Kalmia latifolia*) with scattered multiflora rose (*Rosa multiflora*). No herbs were noted for this community.

Figure 5.19. Northeastern Coastal Plain/Piedmont Oak-Beech/Heath Forest (East Section)

The one example of this community in the park is mature and shows good layering. The average dbh is 1.5 to 2 feet.

Analysis of Condition at White Clay Creek State Park

This community has been stable in location and acreage during the study period leading to no change analysis being conducted. It is expected to be so in the near future but it is unknown whether the exotics nearby will start to invade reducing it and converting it to Northeastern Modified Successional Forest.

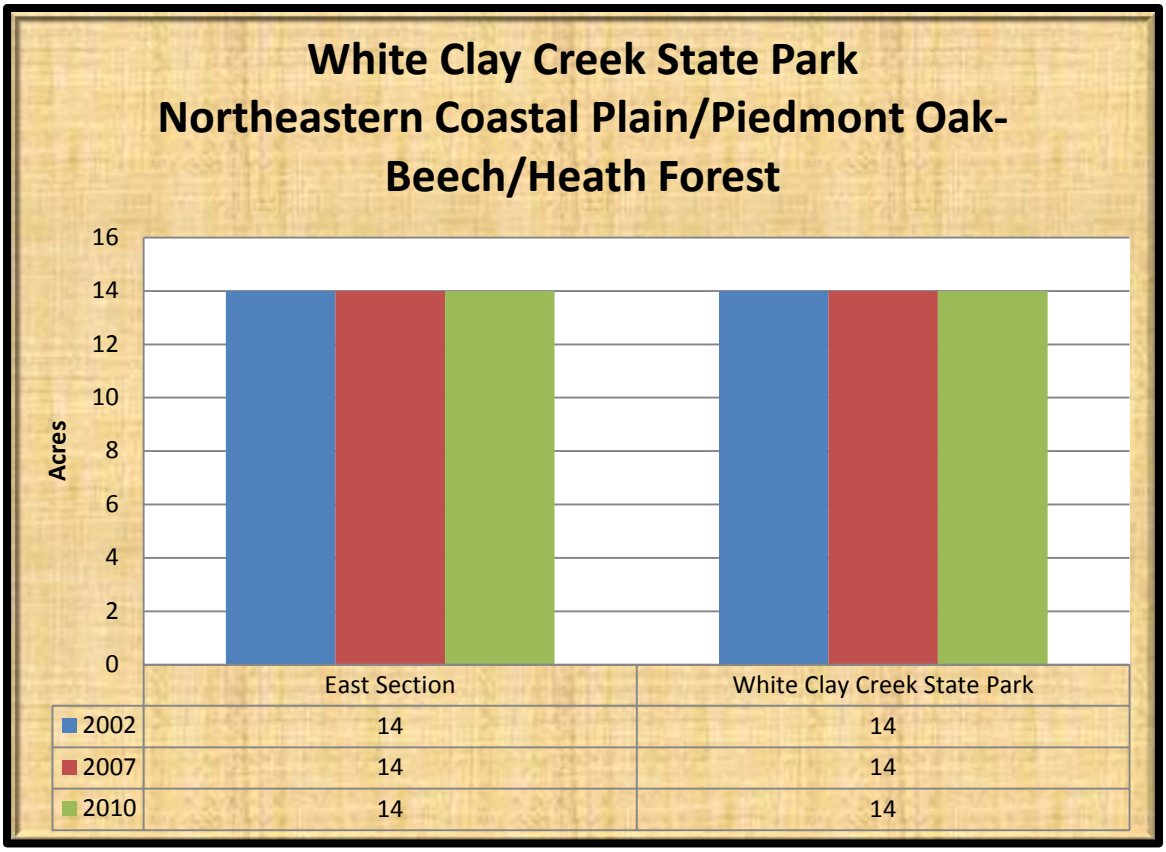


Figure 5.20. Northeastern Coastal Plain/Piedmont Oak-Beech/Heath Forest at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.21)

This community has been stable in acreage and capital during the study period.

Table 5.21. Natural Capital of Northeastern Coastal Plain/Piedmont Oak-Beech/Heath Forest

Year	Natural Capital (in 2012 dollars)
2002	$2,647/year
2007	$2,647/year
2010	$2,647/year

Northeastern Modified Successional Forest **[1,736 acres (Figures 5.21-5.22, Tables 5.22-5.24)]**
GNA SNA

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

Description

This forest has canopy of native tree species with an understory of exotic invasive species and is unfortunately for native diversity the most common forest community in the park. Common canopy associates include tuliptree (*Liriodendron tulipifera*), red maple (*Acer rubrum*), wild black cherry (*Prunus serotina*), sycamore (*Platanus occidentalis*), black walnut (*Juglans nigra*), white ash (*Fraxinus americana*), and sweetgum (*Liquidambar styraciflua*). Understory associates include Norway maple (*Acer palmatum*), spicebush (*Lindera benzoin*), tree-of-heaven (*Ailanthus altissima*), smooth sumac (*Rhus glabra*), sassafras (*Sassafras albidum*), black locust (*Robinia pseudoacacia*), and flowering dogwood (*Cornus florida*). The shrub and vine layer is thick and includes summer grape (*Vitis aestivalis*), multiflora rose (*Rosa multiflora*), Oriental bittersweet (*Celastrus orbiculatus*), Japanese honeysuckle (*Lonicera japonica*), autumn olive (*Elaeagnus umbellata*), poison ivy (*Toxicodendron radicans*), wineberry (*Rubus pheonicalasius*), common greenbrier (*Smilax rotundifolia*), Siebold's viburnum (*Viburnum seiboldii*), morrow's honeysuckle (*Lonicera morrowii*), and privet (*Ligustrum sinense*). Common herbs include white snakeroot (*Eupatorium rugosum*), Japanese stiltgrass (*Microstegium vimineum*), pokeweed (*Phytolacca americana*), dropseed (*Phyrma leptostachya*), white wood aster (*Eurybia divaricata*), thicket sedge (*Carex abscondita*), New York fern (*Thelypteris novaboracensis*), partridgeberry (*Mitchella repens*), and enchanter's nightshade (*Circaea lutetiana*).

Figure 5.21. Northeastern Modified Successional Forest (West Section)

Analysis of Condition at White Clay Creek State Park

This community has gradually increased over the study period owing to the exotic invasive species that make it up spreading into new habitat. Given the characteristics of the species composing it, it is likely that this community will continue to spread through the park.

Of the original 1,781 acres of this community in 2002 only 1,763 still remained of this community in 2010. The other acres became Northern Piedmont Mesic Oak-Beech Forest (9 acres), Northeastern Old Field (4 acres), Riverine Floodplain Forest (2 acres), and Northeastern Successional Shrubland (2 acres) (Table 5.22). Some of these changes may have been part of efforts to remove exotic invasive plant species returning the communities to their natural state.

Due to the spread of exotic invasive plant species, this community migrated more than most communities resulting in abnormally high numbers for eight years of change. Most of the changes are due to succession with the aggressive exotics taking advantage of the situation. Some of the communities that became this type include Northeastern Successional Shrubland (22 acres), Northern Piedmont Mesic Oak-Beech Forest (20 acres), and one acre each of Northeastern Old Field and Cultivate Lawn (Table 5.23).

Table 5.22. What was once Northeastern Modified Successional Forest in 2002 has become X in 2010

X	Acreage
Northeastern Modified Successional Forest	1,763 acres
Northern Piedmont Mesic Oak-Beech Forest	9 acres
Northeastern Old Field	4 acres
Riverine Floodplain Forest	2 acres
Northeastern Successional Shrubland	2 acres
Other communities/land covers	4 acres

Table 5.23. Northeastern Modified Successional Forest has migrated into X since 2002

X	Acreage
Northeastern Modified Successional Forest	1,763 acres
Northeastern Successional Shrubland	22 acres
Northern Piedmont Mesic Oak-Beech Forest	20 acres
Northeastern Old Field	1 acre
Cultivated Lawn	1 acre
Other communities/land covers	0.4 acres

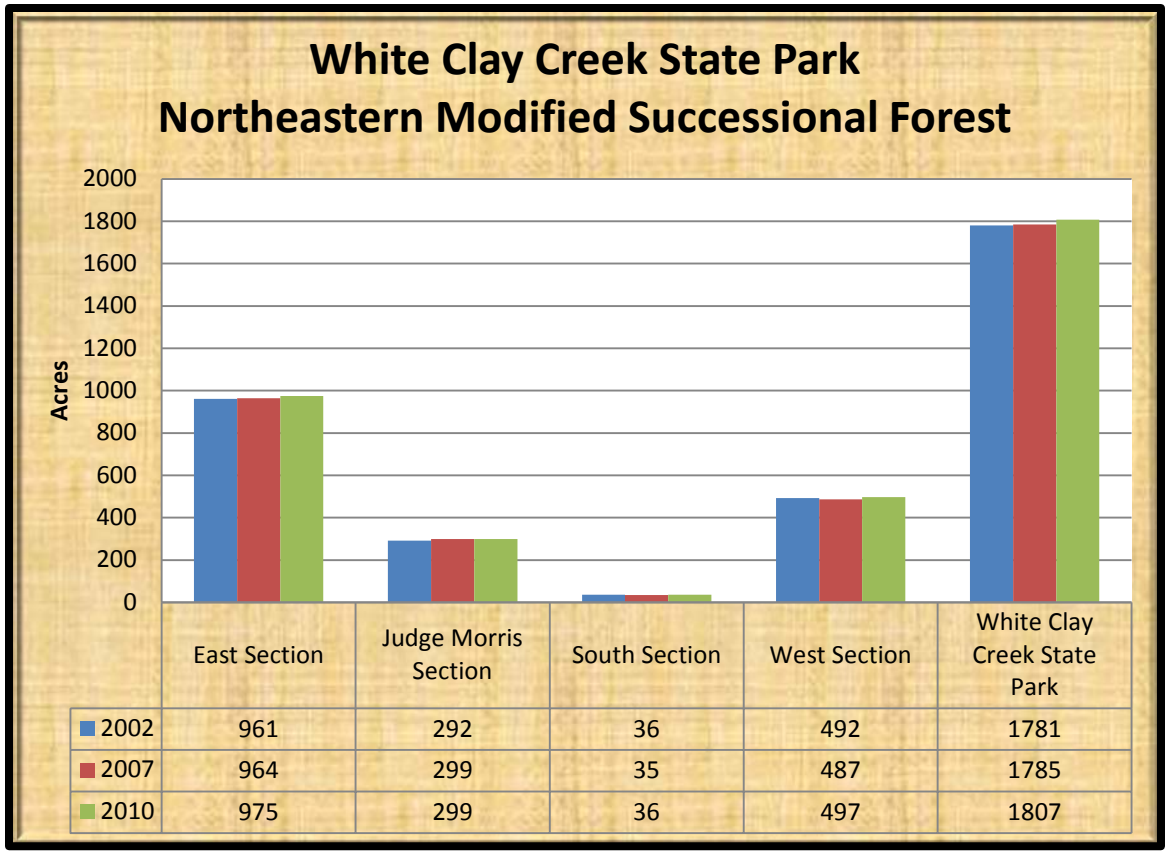


Figure 5.22. Northeastern Modified Successional Forest at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.24)

Northeastern Modified Successional Forest has been increasing in acreage and capital as the species contained within it invade new communities and transfer their capital.

Table 5.24. Natural Capital of Northeastern Modified Successional Forest

Year	Natural Capital (in 2012 dollars)
2002	$336,787/year
2007	$337,544/year
2010	$341,704/year

Northeastern Old Field **[524 acres (Figures 5.23-5.24, Tables 5.25-5.27)]GNA SNA**

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

Description

Northeastern Old Fields often occupy areas that have been recently abandoned from agriculture and places that have been pastured for some time. Some of the areas that are classed as this community can be considered native prairies for Delaware. For description purposes, two variants are described below.

Native Prairie Type

The prairie type of this community could be considered to be a native grassland that would have been present at the time of early European settlement. These grasslands are dominated by little bluestem (*Schizachyrium scoparium*) that is associated by sweet vernal grass (*Anthoxanthum odoratum*), rough hawkweed (*Hieracium scabrum*), gray goldenrod (*Solidago nemoralis*), grass-leaf flat-top goldenrod (*Euthamia graminifolia*) and thin hairy rough-leaf goldenrod (*Solidago rugosa*).

Figure 5.23. Northeastern Old Field-typical type (West Section)

Typical Northeastern Old Field

Most of the other fields are the typical type of Northeastern Old Field with red fescue (*Festuca rubra*), red clover (*Trifolium pratense*), Queen Anne's lace (*Daucus carota*), sweet vernal grass (*Anthoxanthum odoratum*), orchard grass (*Dactylis glomerata*), and rough bluegrass (*Poa trivialis*).

Analysis of Condition at White Clay Creek State Park

This community has been increasing in the park owing to the abandonment of agricultural areas and some reclamation from cultivated lawns.

In 2010, 480 acres of the original 491 acres of this community from 2002 still existed. In the eight years since 5 acres have matured into Northeastern Successional Shrubland, 3 acres into cultivated lawn, and 1 acre each to Northeastern Modified Successional Forest, and Agricultural Field (Table 5.25).

Since 2002, 36 acres of agricultural field has been abandoned and became this community along with 4 acres of Northeastern Modified Successional Forest, and 2 acres each of cultivated lawn, and Northeastern Successional Shrubland (Table 5.26).

Table 5.25. What was once Northeastern Old Field in 2002 has become X in 2010	
X	**Acreage**
Northeastern Old Field	480 acres
Northeastern Successional Shrubland	5 acres
Cultivated Lawn	3 acres
Northeastern Modified Successional Forest	1 acre
Agricultural Field	1 acre
Other communities/land covers	1 acre

Table 5.26. Northeastern Old Field has migrated into X since 2002	
X	**Acreage**
Northeastern Old Field	480 acres
Agricultural Field	36 acres
Northeastern Modified Successional Forest	4 acre
Cultivated Lawn	2 acres
Northeastern Successional Shrubland	2 acres
Other communities/land covers	1 acre

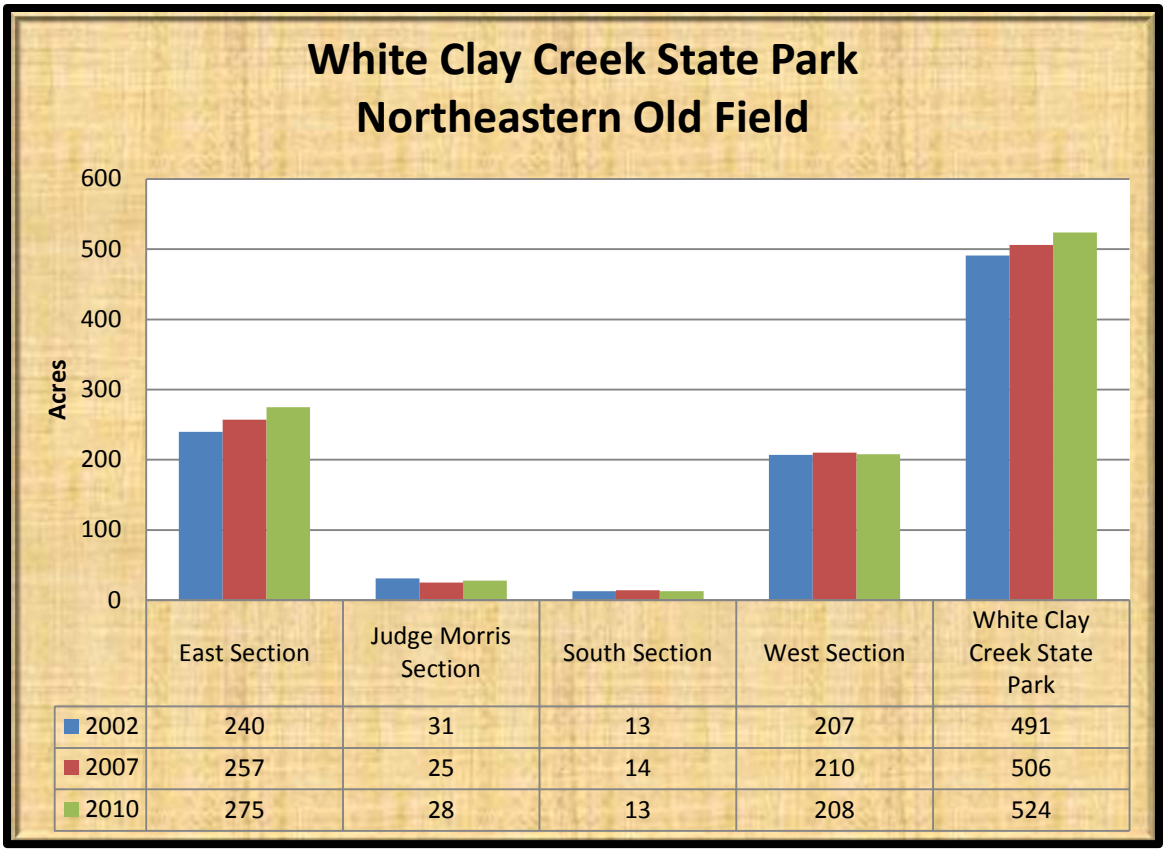


Figure 5.24. Northeastern Old Field at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.27)

Northeastern Old Field has been increasing acreage and capital since more agricultural field has been abandoned.

Table 5.27. Natural Capital of Northeastern Old Field	
Year	**Natural Capital (in 2012 dollars)**
2002	$71,539/year
2007	$73,724/year
2010	$76,347/year

Northeastern Successional Shrubland **[156 acres (Figures 5.25-5.26, Tables 5.28-5.30)] GNA SNA**

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

Description

Figure 5.25. Northeastern Successional Shrubland (Judge Morris Section)

Northeastern Successional Shrubland is often composed of a combination of native and exotic invasive shrubs. In White Clay Creek State Park it is more the latter. Common species in this community include Japanese honeysuckle (*Lonicera japonica*), Oriental bittersweet (*Celastrus orbiculatus*), blackberry (*Rubus* sp.), tree-of-heaven (*Ailanthus altissima*), wineberry (*Rubus pheonicalasius*), pokeweed (*Phytolacca americana*), sassafras (*Sassafras albidum*), and Virginia creeper (*Parthenocissus quinquefolia*).

Analysis of Condition at White Clay Creek State Park

This community has been declining over the study period mainly from succession to Northeastern Modified Successional Forest and some elimination from cutting.

A lot of the 174 acres present as Northeastern Successional Shrubland in 2002 have succeeded to more mature communities by 2010 leaving 149 acres left. The other acres went to Northeastern Modified Successional Forest (22 acres), Northeastern Old Field (2 acres), and 1 acre each of Northern Piedmont Mesic Oak-Beech Forest, and Cultivated Lawn (Table 5.28).

Since 2002 this community has declined in acreage but has still managed to migrate into 5 acres of Northeastern Old Field which matured to this community, 2 acres of Northeastern Modified Successional Forest, and 0.3 acres each of agricultural field and cultivated lawn (Table 5.29).

Table 5.28. What was once Northeastern Successional Shrubland in 2002 has become X in 2010	
X	**Acreage**
Northeastern Successional Shrubland	149 acres
Northeastern Modified Successional Forest	22 acres
Northeastern Old Field	2 acres
Northern Piedmont Mesic Oak-Beech Forest	1 acre
Cultivated Lawn	1 acre
Other communities/land covers	0.2 acres

Table 5.29. Northeastern Successional Shrubland has migrated into X since 2002	
X	**Acreage**
Northeastern Successional Shrubland	149 acres
Northeastern Old Field	5 acres
Northeastern Modified Successional Forest	2 acres
Agricultural Field	0.3 acres
Cultivated Lawn	0.3 acres

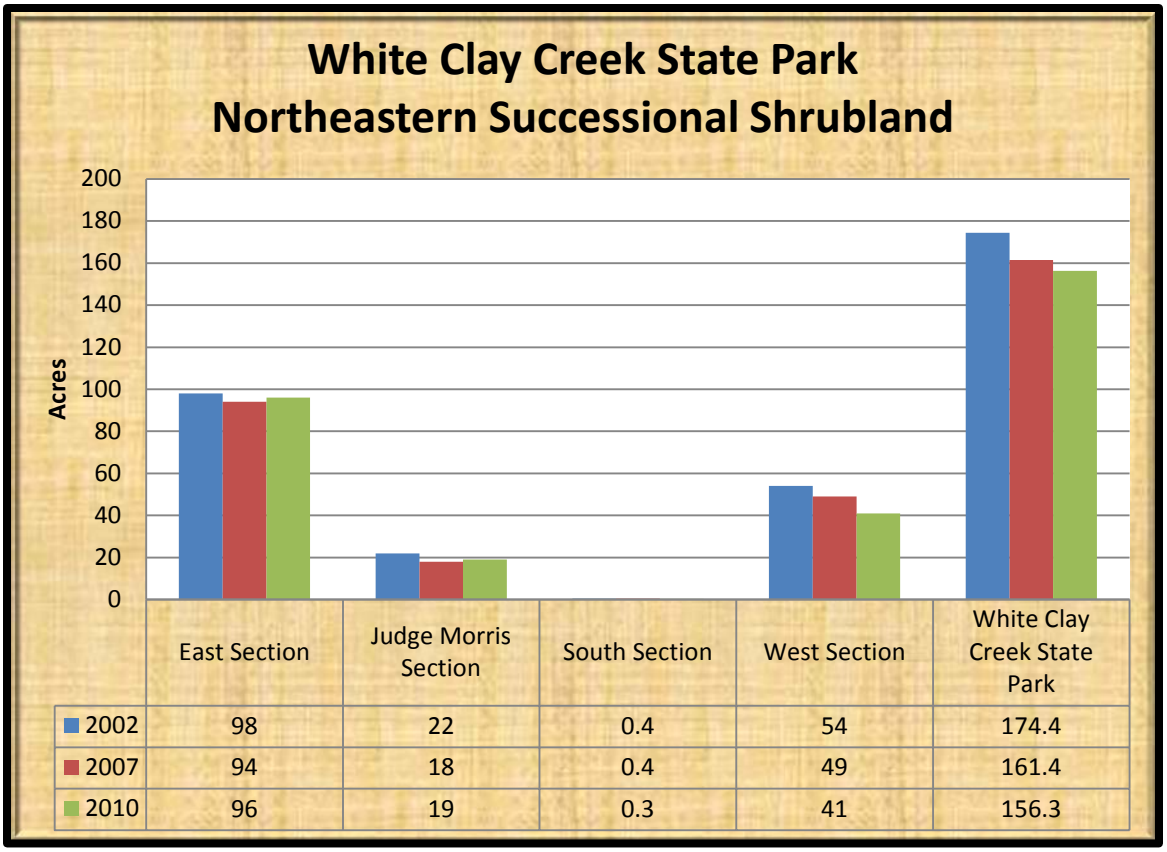


Figure 5.26. Northeastern Successional Shrubland at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.30)

Northeastern Successional Shrubland has been gradually declining as it matures into forested communities.

Table 5.30. Natural Capital of Northeastern Successional Shrubland	
Year	**Natural Capital (in 2012 dollars)**
2002	$25,410/year
2007	$23,516/year
2010	$22,773/year

Northern Piedmont Mesic Oak-Beech Forest **[264 acres (Figures 5.27-5.28, Tables 5.31-5.33)]**
G5 S5

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

Description

Northern Piedmont Mesic Oak-Beech Forest is the most common forested community in the Piedmont region of Delaware. The presence of American beech (*Fagus grandifolia*) in the canopy is characteristic for this community and is associated by tuliptree (*Liriodendron tulipifera*), white oak (*Quercus alba*), and northern red oak (*Quercus rubra*). Understory species include smaller members of the canopy plus spicebush (*Lindera benzoin*) and mockernut hickory (*Carya alba*). The shrub and vine layer is composed of maple-leaf viburnum (*Viburnum acerifolium*), Siebold's viburnum (*Viburnum seiboldii*), Morrow's honeysuckle (*Lonicera morrowii*), multiflora rose (*Rosa multiflora*), common greenbrier (*Smilax rotundifolia*), poison ivy (*Toxicodendron radicans*), and wineberry (*Rubus pheonicalasius*). Common herbs in this community include enchanter's nightshade (*Circaea lutetiana*), beech drops (*Epifagus grandifolia*), white wood aster (*Eurybia divaricata*), Virginia smartweed (*Polygonum virginianum*), jack-in-the-pulpit (*Arisaema triphyllum*), pokeweed (*Phytolacca americana*), New York Fern (*Thelypteris novaboracensis*), dropseed (*Phyrma leptostachya*), and thicket sedge (*Carex abscondita*).

Figure 5.27. Northern Piedmont Mesic Oak-Beech Forest (West Section)

Generally most examples of this community in the park are mature with average diameters of 1.5 to 2 feet. Some of these communities have more open understories than would be expected due to deer browsing.

Analysis of Condition at White Clay Creek State Park

Overall this community has declined through the study as more of this community is invaded by exotic invasive plant species and converted to Northeastern Modified Successional Forest. Aggressive control of exotic species would reclaim some this community and make it more common in the park.

Given the above only 262 acres from 2002 still existed in the park in 2010. Twenty acres converted to Northeastern Modified Successional Forest and 0.2 acres went to Northeastern Old Field (Table 5.31).

Since 2002 9 acres of Northeastern Modified Successional Forest became this community showing some signs of exotic invasive plant species control but there was still a net loss of this community. Another 1 acre of Northeastern Successional Shrubland matured to this community (Table 5.32).

Table 5.31. What was once Northern Piedmont Mesic Oak-Beech Forest in 2002 has become X in 2010	
X	**Acreage**
Northern Piedmont Mesic Oak-Beech Forest	262 acres
Northeastern Modified Successional Forest	20 acres
Northeastern Old Field	0.2 acres

Table 5.32. Northern Piedmont Mesic Oak-Beech Forest has migrated into X since 2002	
X	**Acreage**
Northern Piedmont Mesic Oak-Beech Forest	262 acres
Northeastern Modified Successional Forest	9 acres
Northeastern Successional Shrubland	1 acre

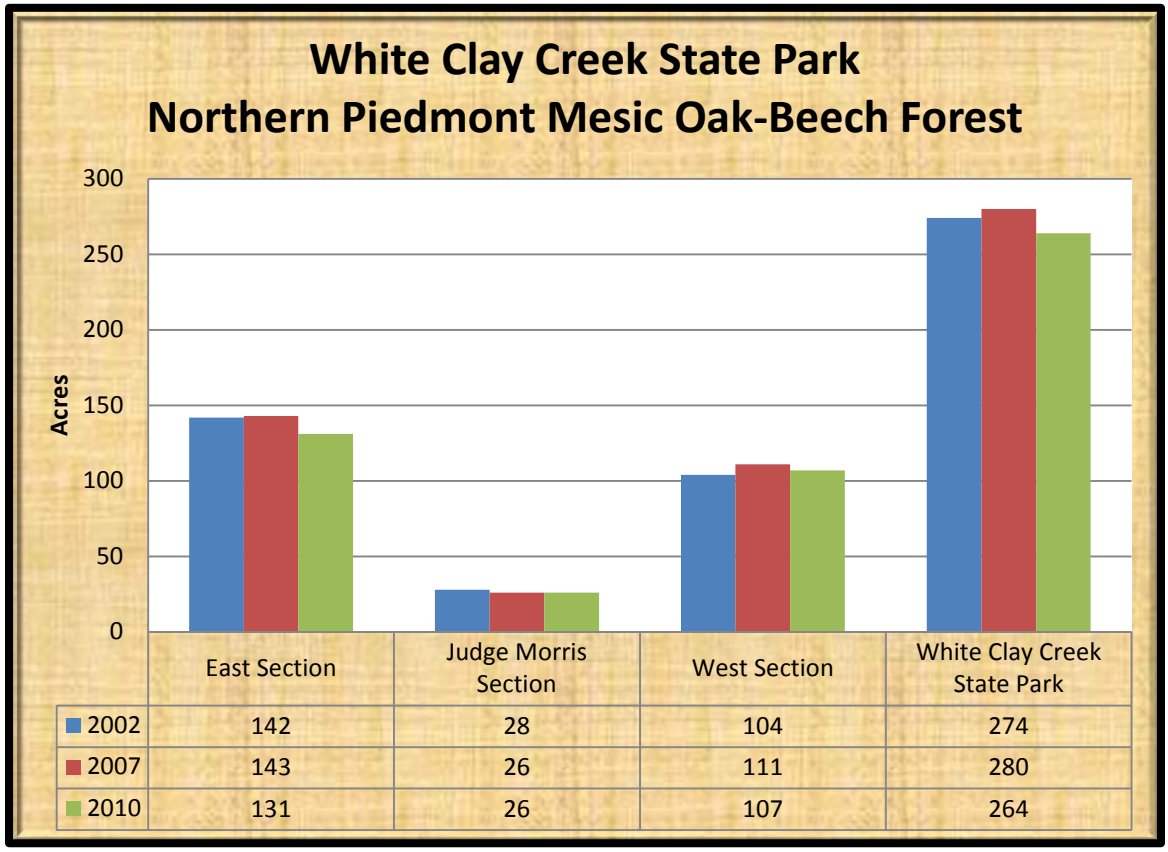


Figure 5.28. Northern Piedmont Mesic Oak-Beech Forest at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.33)

Northern Piedmont Mesic Oak-Beech Forest has been largely declining due to invasions from exotic invasive plant species.

Table 5.33. Natural Capital of Northern Piedmont Mesic Oak-Beech Forest	
Year	**Natural Capital (in 2012 dollars)**
2002	$51,813/year
2007	$52,948/year
2010	$49,922/year

Red Spruce Planted Forest **[0.4 acres (Figure 5.29-5.30, Table 5.34)] GNA SNA**

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

Description

Figure 5.29. Red Spruce Planted Forest (West Section)

This community is a planted forest composed entirely of planted red spruce (*Picea rubens*) with no understory underneath.

Analysis of Condition at White Clay Creek State Park

Red Spruce Planted Forest has remained stable in amount and location through the study period. Because of this no change analysis was conducted.

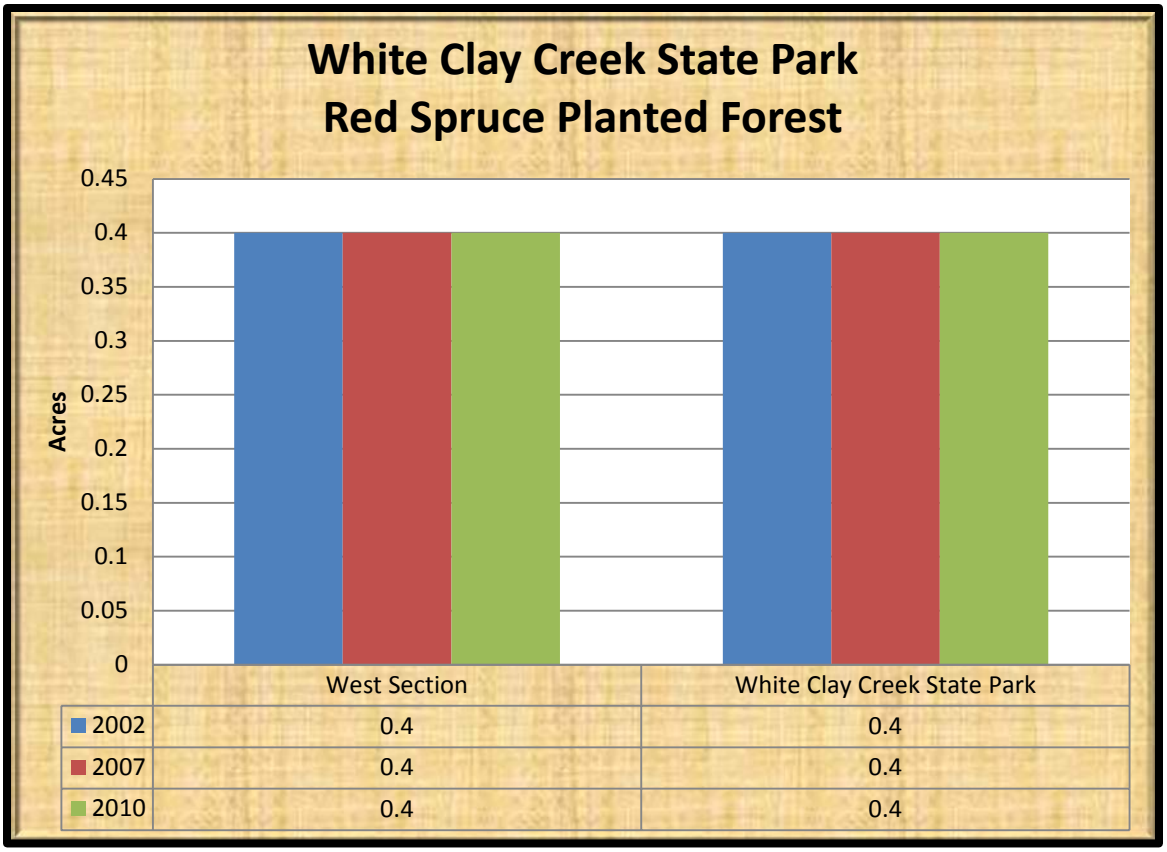


Figure 5.30. Red Spruce Planted Forest at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.34)

Capital of Red Spruce Planted Forest has remained the same since the acreage has not changed.

Table 5.34. Natural Capital of Red Spruce Planted Forest	
Year	**Natural Capital (in 2012 dollars)**
2002	$76/year
2007	$76/year
2010	$76/year

Riverine Floodplain Forest **[17 acres (Figures 5.31-5.32, Tables 5.35-5.37)] GNR S2**

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

Description

This forested community is found in the floodplain of White Clay Creek and some of the larger tributaries. Sycamore (*Platanus occidentalis*) and tuliptree (*Liriodendron tulipifera*) share a canopy overtopping box-elder (*Acer negundo*), bitternut hickory (*Carya cordiformis*), spicebush (*Lindera benzoin*), and wild black cherry (*Prunus serotina*). The shrub and vine layer is composed of mostly of exotic invasive species such as multiflora rose (*Rosa multiflora*), wineberry (*Rubus phoenicolasius*), Oriental bittersweet (*Celastrus orbiculatus*), and autumn olive (*Elaeagnus umbellata*). Poison ivy (*Toxicodendron radicans*) is also in this layer. Ground ivy (*Glechoma hederacea*), beefsteak plant (*Perilla frutescens*), Japanese stiltgrass (*Microstegium vimineum*), bloodroot (*Sanguinaria canadensis*), stinging nettle (*Urtica dioica*), and Pennsylvania smartweed (*Polygonum pensylvanicum*) compose the herbaceous layer.

Figure 5.33. Riverine Floodplain Forest (East Section)

These communities are older successional but remain in a state of succession due to the disturbance conditions of the floodplain.

Analysis of Condition at White Clay Creek State Park

This community has increased slight in the study period, likely by reclaiming so ground from exotic invasive species that are prevalent in the floodplains.

Since 2002, about one acre each has been lost to water (White Clay Creek) and sand leaving 25 acres of the 2002 acres present in 2010. Another 0.1 acres was lost to semi-impervious surface in a trail. The numbers do not equal due to whole number rounding (Table 5.35).

Since 2002 this community has increased by 1 acre and migrated into 2 acres of Northeastern Modified Successional Forest via exotic invasive plant removal efforts. One acre of semi-impervious surface became this community through trail abandonment. Sedimentation gained another 0.2 acres of this forest from former water area (Table 5.36).

Table 5.35. What was once Riverine Floodplain Forest in 2002 has become X in 2010	
X	**Acreage**
Riverine Floodplain Forest	25 acres
Water	1 acre
Sand	1 acre
Semi-impervious Surface	0.1 acres

Table 5.36. Riverine Floodplain Forest has migrated into X since 2002	
X	**Acreage**
Riverine Floodplain Forest	25 acres
Northeastern Modified Successional Forest	2 acres
Semi-impervious Surface	1 acre
Water	0.2 acres

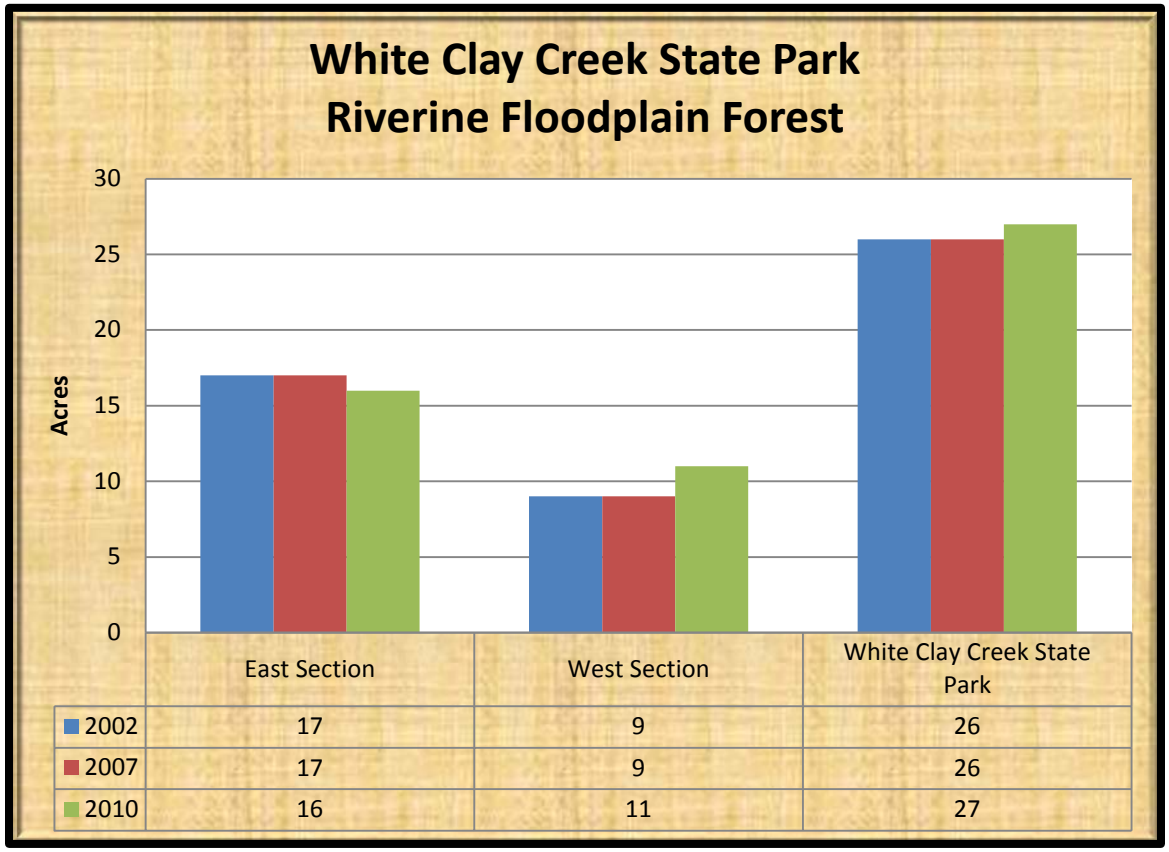


Figure 5.34. Riverine Floodplain Forest at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.37)

Capital of Riverine Floodplain Forest has gone up slightly with an increase in acreage.

Table 5.37. Natural Capital of Riverine Floodplain Forest	
Year	**Natural Capital (in 2012 dollars)**
2002	$319,579/year
2007	$319,579/year
2010	$331,871/year

Smooth Alder Swamp **[1 acre (Figures 5.35-5.36, Tables 5.38)]** **G4G5 S1**

DEWAP: Shrub Swamps
NHC: Laurentian-Acadian Wet Meadow-Shrub Swamp

Description

This wetland community is located in a depressional wetland that is situated at the base of a slope near Thompson Mill Road. This wetland has a scattered canopy of red maple (*Acer rubrum*) with an occasional black willow (*Salix nigra*). The shrub layer is dense in places and composed of smooth alder (*Alnus serrulata*), multiflora rose (*Rosa multiflora*), Japanese honeysuckle (*Lonicera japonica*), arrowwood (*Viburnum dentatum*), poison ivy (*Toxicodendron radicans*), and a few blackberry (*Rubus* sp.). The herbaceous layer is fairly diverse with water pepper (*Polygonum hydropiperoides*), false nettle (*Boehmeria cylindrica*), Japanese stiltgrass (*Microstegium vimineum*), halberd-leaf tearthumb (*Polygonum sagittatum*), arrow-leaf tearthumb (*Polygonum arifolium*), Canadian clearweed (*Pilea pumila*), orange spotted jewelweed (*Impatiens capensis*), asymmetrical fringe sedge (*Carex crinita*), sensitive fern (*Onoclea sensibilis*), and three-square bulrush (*Schoenoplectus americanus*).

Figure 5.35. Smooth Alder Swamp (East Section)

Analysis of Condition at White Clay Creek State Park

This community has remained at the same acreage and location during the study period and is not likely to increase in the near future. Because of the above a change analysis was not conducted.

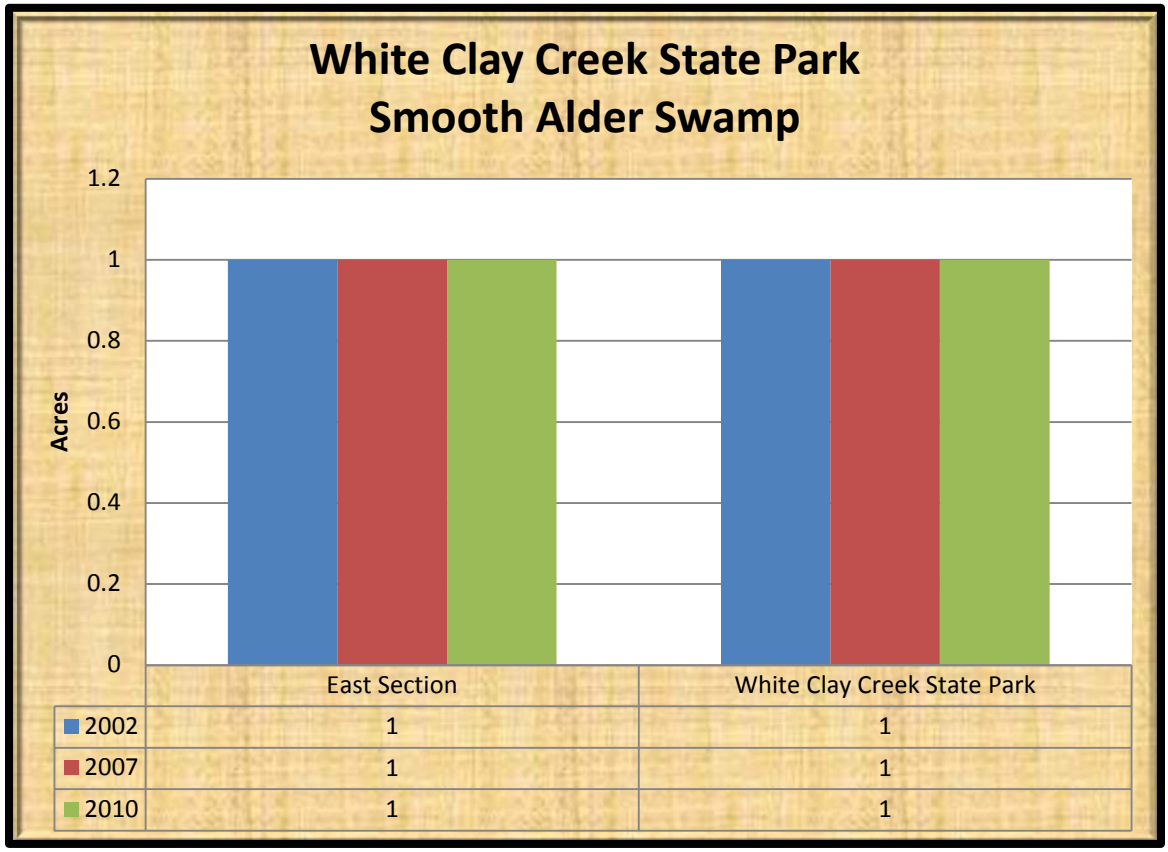


Figure 5.36. Smooth Alder Swamp at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.38)

Capital of Smooth Alder Swamp has not changed over the study period.

Table 5.38. Natural Capital of Smooth Alder Swamp	
Year	**Natural Capital (in 2012 dollars)**
2002	$9,281/year
2007	$9,281/year
2010	$9,281/year

Successional Tuliptree Forest **[10 acres (Figures 5.37-5.38, Tables 5.39-5.41)] GNA SNA**

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

Description

This successional forest community is dominated by tuliptree (*Liriodendron tulipifera*) with an understory of American beech (*Fagus grandifolia*) and spicebush (*Lindera benzoin*). The shrub layer is composed of invasive exotic species such as Japanese Barberry (*Berberis thunbergii*) and wineberry (*Rubus phoenicolasius*). The herbaceous layer is dominated by Japanese stiltgrass (*Microstegium vimineum*), and associated by broad beech fern (*Phegopteris hexagonoptera*), Christmas fern (*Polystichum acrostichoides*), white wood aster (*Eurybia divaricata*), and bearded short-husk (*Brachylyletrum erectum*).

Figure 5.37. Successional Tuliptree Forest (Judge Morris Section)

Analysis of Condition at White Clay Creek State Park

This community is often invaded by exotic invasive plant species and has historically been the origin of a lot of the Northeastern Modified Successional Forest around the park. During the study the acreage of this community was stable in extent and location (Table 5.37), perhaps showing that a lot of this community that is susceptible has been converted. In the short term future it will likely stay this way but it may decline somewhat and convert to Northeastern Modified Successional Forest in the long term if exotic invasive plant species are not controlled.

Since 2002 this community has migrated into 0.1 acres of cultivated lawn but this amount does not register on the table due to whole number rounding (Table 5.38).

Table 5.39. What was once Successional Tuliptree Forest in 2002 has become X in 2010	
X	**Acreage**
Successional Tuliptree Forest	10 acres

Table 5.40. Successional Tuliptree Forest has migrated into X since 2002	
X	**Acreage**
Successional Tuliptree Forest	10 acres
Cultivated Lawn	0.1 acres

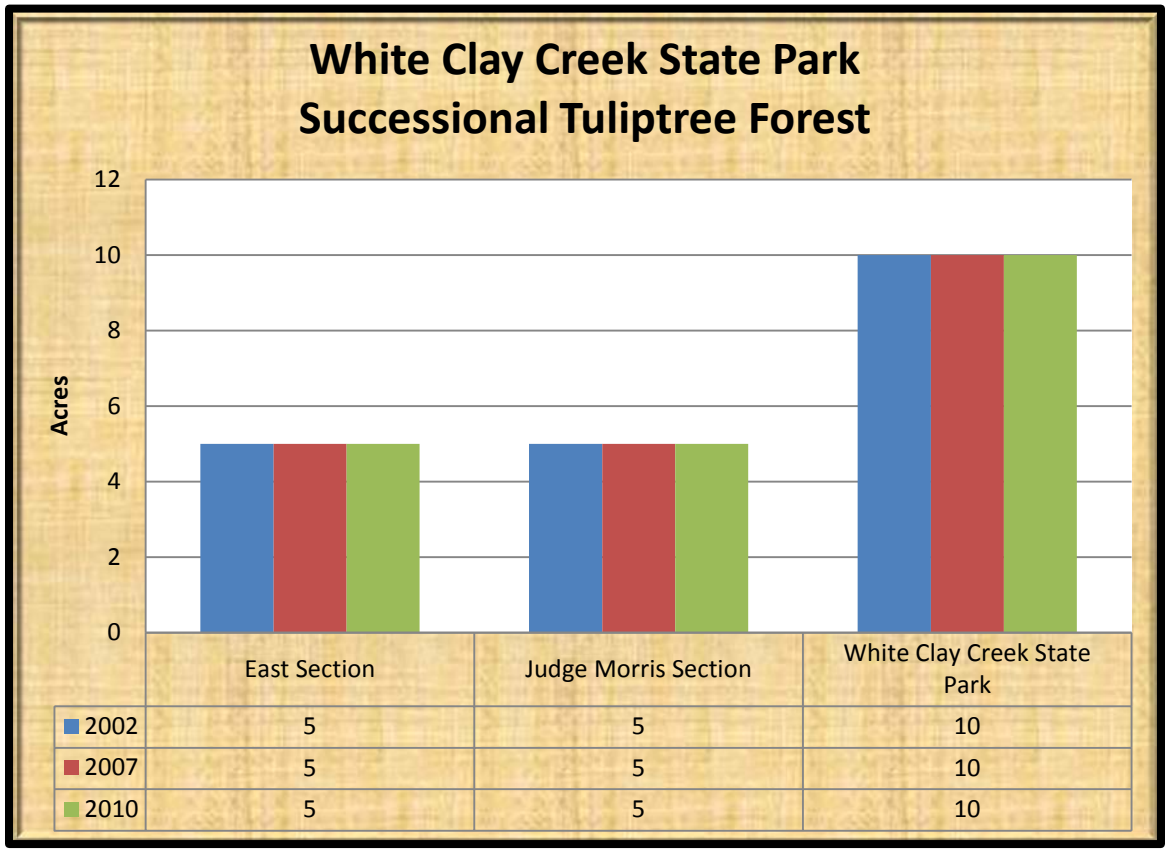


Figure 5.38. Successional Tuliptree Forest at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.41)

Capital of Successional Tuliptree Forest has not changed during the study period.

Table 5.41. Natural Capital of Successional Tuliptree Forest	
Year	**Natural Capital (in 2012 dollars)**
2002	$1,891/year
2007	$1,891/year
2010	$1,891/year

Virginia Pine Successional Forest **[3 acres (Figures 5.39-5.40, Table 5.42)] GNA SNA**

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

Description

Virginia Pine Successional Forest is found on a west facing slope in the Eastern Section. Virginia pine (*Pinus virginiana*) is dominant and associated by northern red oak (*Quercus rubra*) in the canopy. Understory associates include red maple (*Acer rubrum*), sassafras (*Sassafras albidum*), and tuliptree (*Liriodendron tulipifera*). The shrub and vine layer includes common greenbrier (*Smilax rotundifolia*) and wineberry (*Rubus phoenicolasius*). Japanese stiltgrass (*Microstegium vimineum*) was the only herb observed in this community.

Figure 5.39. Virginia Pine Successional Forest (East Section)

Analysis of Condition at White Clay Creek State Park

The habitat for this community is limited to the ponds and wetlands in which is it found. It may expand in some of the ponds in the future. Since it did not expand or change its location during the study period, no change analysis was conducted.

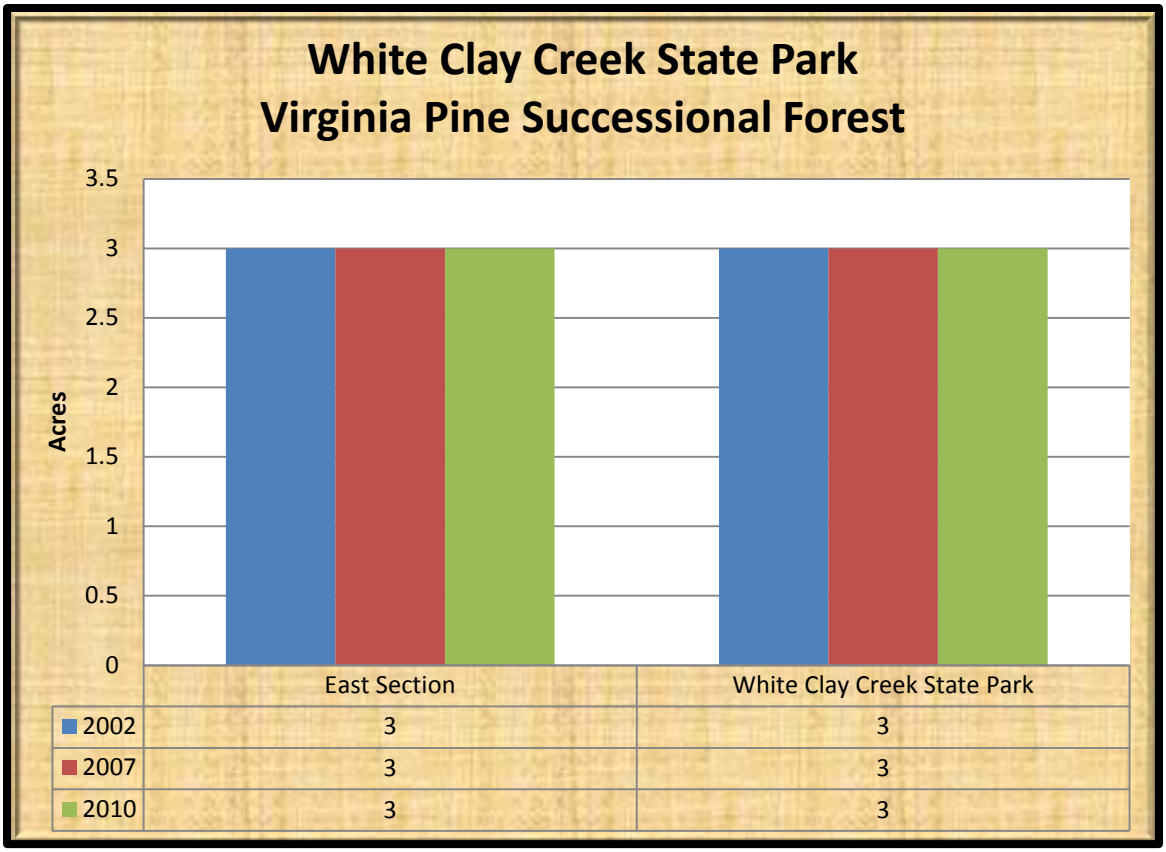


Figure 5.40. Virginia Pine Successional Forest at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.42)

Capital of Virginia Pine Successional Forest has not changed during the study period.

Table 5.42. Natural Capital of Virginia Pine Successional Forest	
Year	**Natural Capital (in 2012 dollars)**
2002	$567/year
2007	$567/year
2010	$567/year

Water-lily Aquatic Wetland **[0.5 acres (Figures 5.41-5.42, Table 5.43)]** **G4G5 S?**

DEWAP: Riverine Aquatic and Submerged Vegetation
NHC: Laurentian-Acadian Freshwater Marsh

Description

Figure 5.41. Water-lily Aquatic Wetland (East Section)

Two areas of Water-lily Aquatic Wetland are present in the park, one in pond near a sewer pump station and one in an old meander scar. Water-lily (*Nuphar lutea*) is the most common species with buttonbush (*Cephalanthus occidentalis*), black willow (*Salix nigra*), and halbeard-leaf tearthumb (*Polygonum sagittatum*) on the edge.

Analysis of Condition at White Clay Creek State Park

The habitat for this community is limited to the ponds and wetlands in which is it found. It may expand in some of the ponds in the future. Since it did not expand or change its location during the study period, no change analysis was conducted.

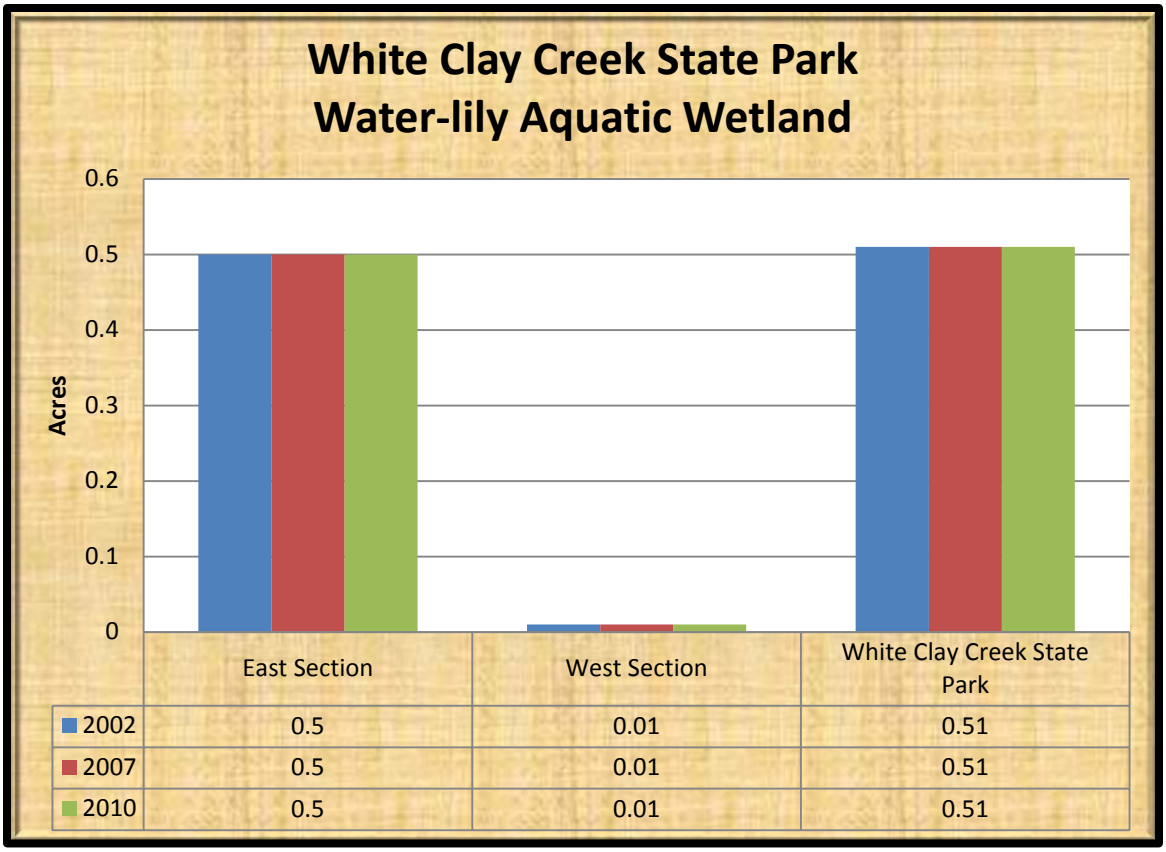


Figure 5.42. Water-lily Aquatic Wetland at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.43)

Capital of Water-lily Aquatic Wetland has not changed during the study period.

Table 5.43. Natural Capital of Water-lily Aquatic Wetland	
Year	**Natural Capital (in 2012 dollars)**
2002	$4,734/year
2007	$4,734/year
2010	$4,734/year

White Pine Planted Forest **[35 acres (Figures 5.42-5.43, Tables 5.44-5.46)] GNA SNA**

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

Description

Several areas of White Pine Planted Forest are located within the park, in the west and south sections. In these areas white pine (*Pinus strobus*) is the dominant species in the canopy and associated by tuliptree (*Liriodendron tulipifera*) and a few American beech (*Fagus grandifolia*). Spicebush (*Lindera benzoin*) was the only understory species noted. The shrub and vine layer is composed primarily of wineberry (*Rubus phoenicolasius*) and Oriental bittersweet (*Celastrus orbiculatus*). Herbaceous species include Canadian clearweed (*Pilea pumila*), stinging nettle (*Urtica dioica*), mile-a-minute (*Polygonum perfoliatum*), water pepper (*Polygonum hydropiperoides*), orange-spotted jewelweed (*Impatiens capensis*), and partridgeberry (*Mitchella repens*).

Figure 5.42. White Pine Planted Forest (West Section)

Analysis of Condition at White Clay Creek State Park

This community is planted and does not generally expand out from the original planted footprint. During the study period it has expended somewhat by 1 acre with all 2002 being present in 2010 (Table 5.44) and into Northeastern Old Field (0.5 acres) and cultivated lawn (0.1 acres) (Table 5.45).

Table 5.44. What was once White Pine Planted Forest in 2002 has become X in 2010	
X	**Acreage**
White Pine Planted Forest	35 acres

Table 5.45. White Pine Planted Forest has migrated into X since 2002	
X	**Acreage**
White Pine Planted Forest	35 acres
Northeastern Old Field	0.5 acres
Cultivated Lawn	0.1 acres

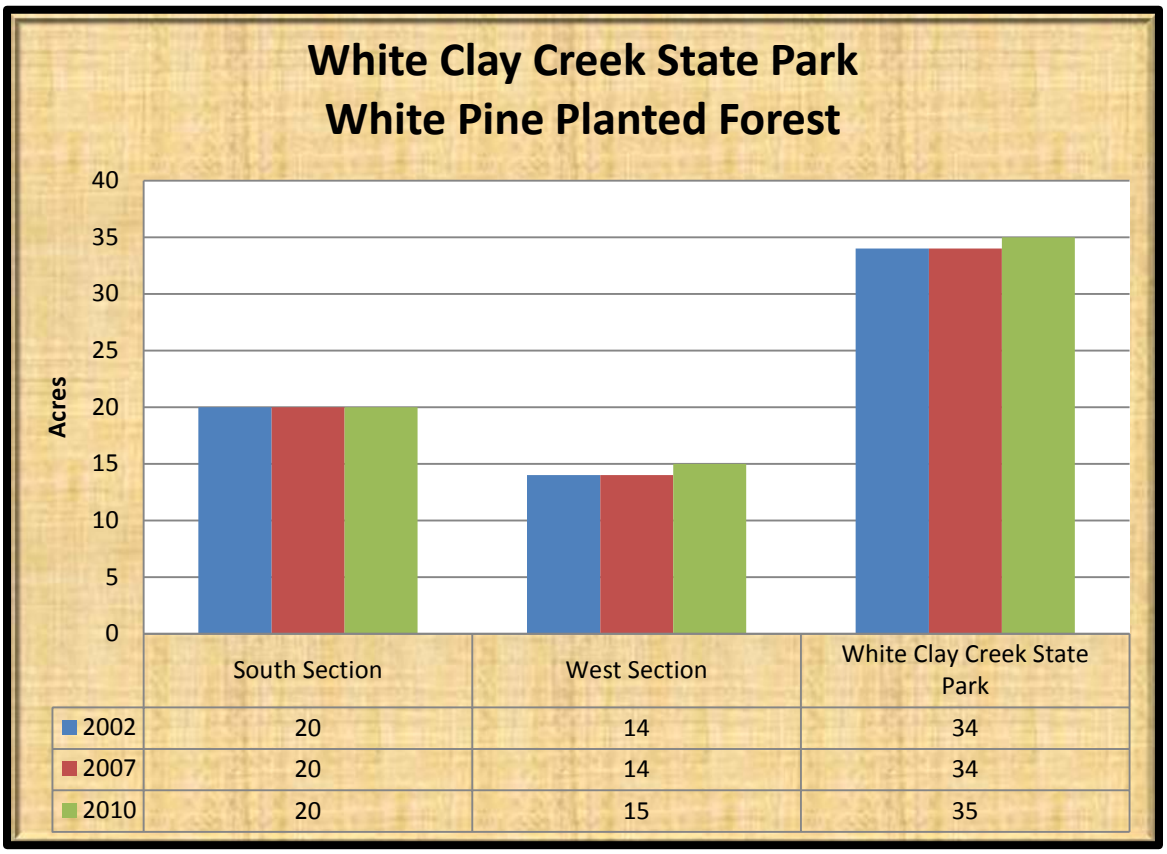


Figure 5.43. White Pine Planted Forest at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.46)

Capital of White Pine Planted Forest has increased slightly with an uptick in acreage.

Table 5.46. Natural Capital of White Pine Planted Forest	
Year	**Natural Capital (in 2012 dollars)**
2002	$6,429/year
2007	$6,429/year
2010	$6,619/year

Wisteria Vineland **[1 acre (Figure 5.44-5.45, Table 5.47)]** **GNA SNA**

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

Description

An area covering about one acre is present on the east side that is covered in wisteria (*Wisteria sinensis*). Other species present in the vineland include tree-of-heaven (*Ailanthus altissima*), catalpa tree (*Catalpa speciosa*), tuliptree (*Liriodendron tulipifera*), pokeweed (*Phytolacca americana*), spicebush (*Lindera benzoin*), and stinging nettle (*Urtica dioica*).

Figure 5.44. Wisteria Vineland

Analysis of Condition at White Clay Creek State Park

This vineland has been stable in acreage and location over the study period and has not changed therefore a change analysis was not completed. Some of the wisteria was spreading into the adjacent wooded area and this community may increase in size somewhat in the future but not likely by much. Because of the lack of discernible change, no analysis was completed.

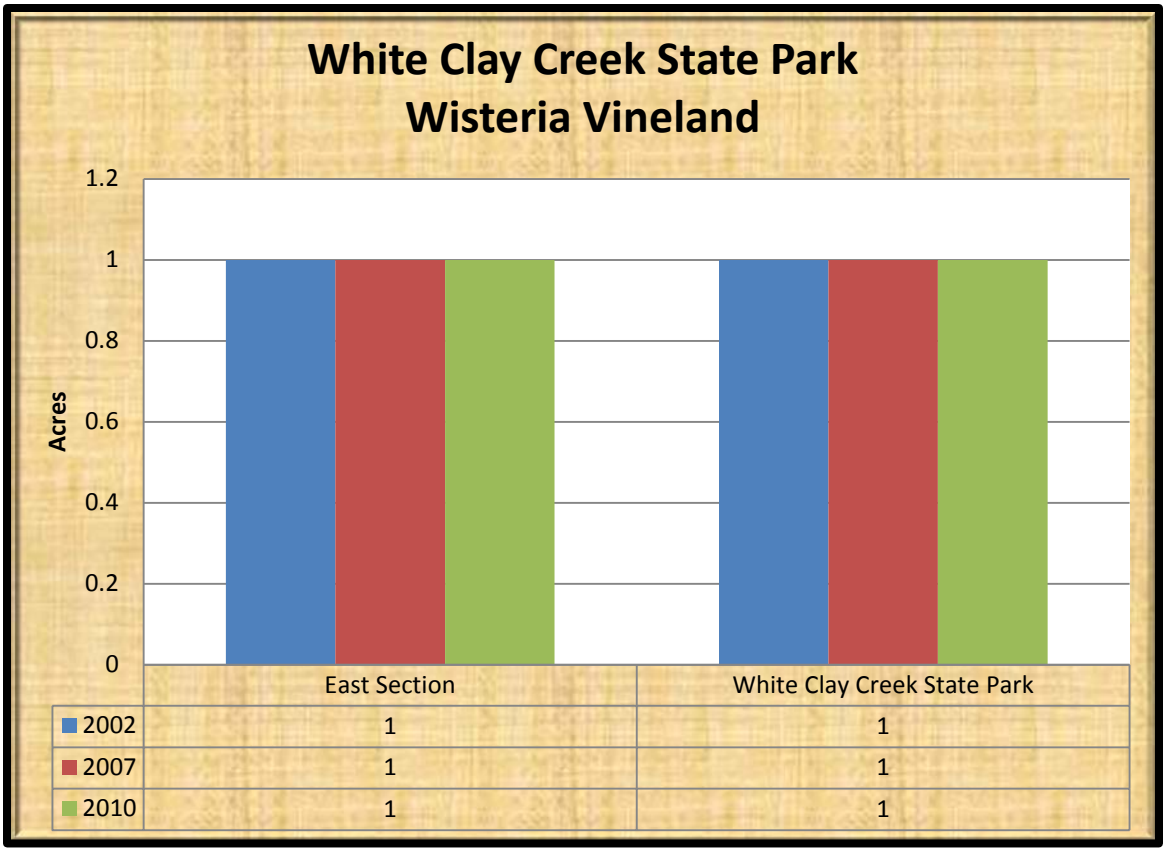


Figure 5.45. Wisteria Vineland at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 5.47)

Capital of Wisteria Vineland has not changed during the study period.

Table 5.47. Natural Capital of Wisteria Vineland	
Year	**Natural Capital (in 2012 dollars)**
2002	$146/year
2007	$146/year
2010	$146/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. Agricultural Field—295 acres
2. Farm Pond/Artificial Pond—7 acres
3. Impervious Surface—38 acres
4. Impoundment—6 acres
5. Modified Land—1.1 acres
6. Sand—7 acres
7. Semi-impervious Surface—12 acres
8. Water—45 acres

Agricultural Field **[296 acres, (Figure 6.1, Tables 6.1-6.3)]**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

Description

Agricultural fields include places that are planted with an agricultural crop such as corn.

Analysis of Condition at White Clay Creek State Park

Agricultural fields have undergone a gradual decline since 2002 as more fields are taken out of production and are restored to more natural habitat. Because of these changes only 294 acres of the original 330 acres from 2002 existed in 2010. The other acres have grown in Northeastern Old Field (36 acres), Northeastern Successional Shrubland (0.3 acres), and cultivated lawn (0.2 acres) (Table 6.1).

Since 2002 1 acre of Northeastern Old Field has been reconverted to agricultural use along with 0.2 acres of Northeastern Successional Shrubland (Table 6.2).

Table 6.1. What was once Agricultural Field in 2002 has become X in 2010	
X	**Acreage**
Agricultural Field	294 acres
Northeastern Old Field	36 acres
Northeastern Successional Shrubland	0.3 acres
Cultivated Lawn	0.2 acres

Table 6.2. Agricultural Field has migrated into X since 2002	
X	**Acreage**
Agricultural Field	294 acres
Northeastern Old Field	1 acre
Northeastern Successional Shrubland	0.2 acres

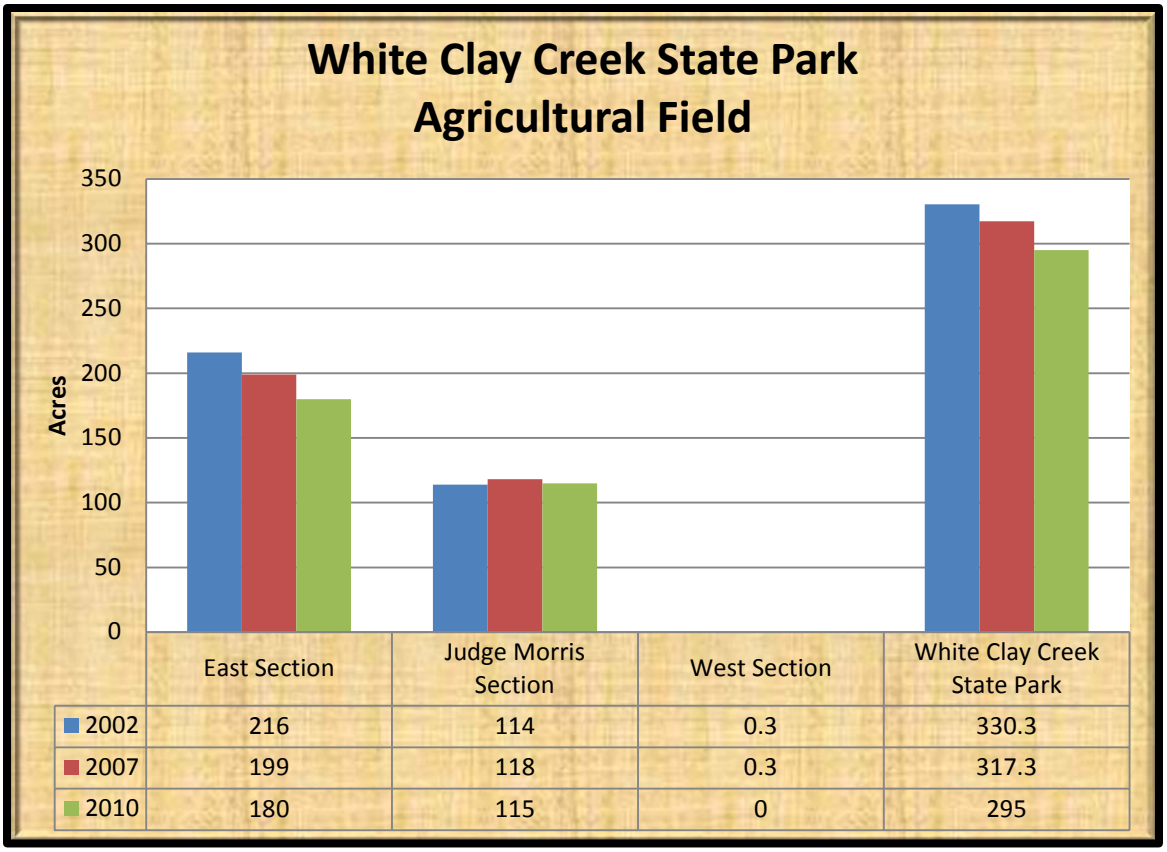


Figure 6.1. Agricultural Field at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 6.3)

Agricultural field capital has been going down with the abandonment of the fields, transferring the capital to herbaceous communities.

Table 6.3. Natural Capital of Agricultural Field	
Year	**Natural Capital (in 2012 dollars)**
2002	$18,943/year
2007	$18,197/year
2010	$16,918/year

Farm Pond/Artificial Pond **[6 acres, (Figure 6.2, Tables 6.4-6.6)]**

DEWAP: Impoundment
NHC: No Equivalent Classification

Description

Farm pond acreage has remained the same since 2002.

Analysis of Condition at White Clay Creek State Park

While the farm ponds remain at the same acreage in time, the coverage by vegetation changes. While it appears that all of the 2002 acres were present in 2010 (Table 6.4), one pond has had an invasion of American Lotus Aquatic Vegetation resulting in a 0.1 acre decline in area. No ponds have been developed since 2002 (Table 6.5).

Table 6.4. What was once Farm Pond/Artificial Pond in 2002 has become X in 2010	
X	**Acreage**
Farm Pond/Artificial Pond	6 acres
American Lotus Aquatic Wetland	0.1 acres

Table 6.5. Farm Pond/Artificial Pond has migrated into X since 2002	
X	**Acreage**
Farm Pond/Artificial Pond	6 acres

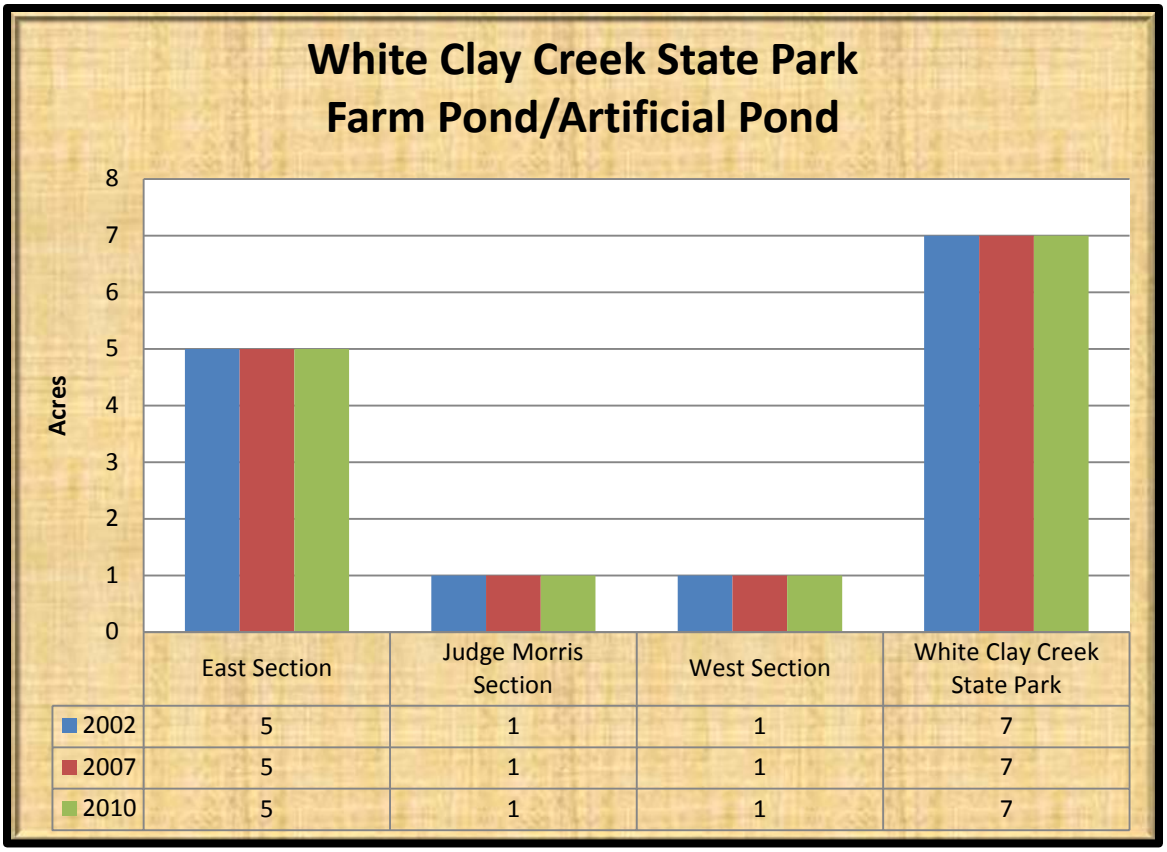


Figure 6.2. Farm Pond/Artificial Pond at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 6.6)

Capital of Farm Pond/Artificial Pond has not changed during the study period.

Table 6.6. Natural Capital of Farm Pond/Artificial Pond	
Year	**Natural Capital (in 2012 dollars)**
2002	$37,346/year
2007	$37,346/year
2010	$37,346/year

Impervious Surface **[38 acres, (Figure 6.3, Tables 6.7-6.8)]**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

Description

The acreage of impervious surface has remained roughly the same since 2002.

Analysis of Condition at White Clay Creek State Park

Impervious surface will likely remain stable in the future as long as there are no new developments. During the study period it has remained at the same amount with some losses and some additions including 0.4 acres that became semi-impervious surface and 0.1 acres that became cultivated lawn (Table 6.7). Since 2002 impervious surface has been placed in 0.3 acres of Northeastern Modified Successional Forest, 0.2 acres of cultivated lawn, and semi-impervious surface (0.2 acres) (Table 6.8).

Table 6.7. What was once Impervious Surface in 2002 has become X in 2010	
X	**Acreage**
Impervious Surface	38 acres
Semi-impervious Surface	0.4 acres
Cultivated Lawn	0.1 acres

Table 6.8. Impervious Surface has migrated into X since 2002	
X	**Acreage**
Impervious Surface	38 acres
Northeastern Modified Successional Forest	0.3 acres
Cultivated Lawn	0.2 acres
Semi-impervious Surface	0.2 acres

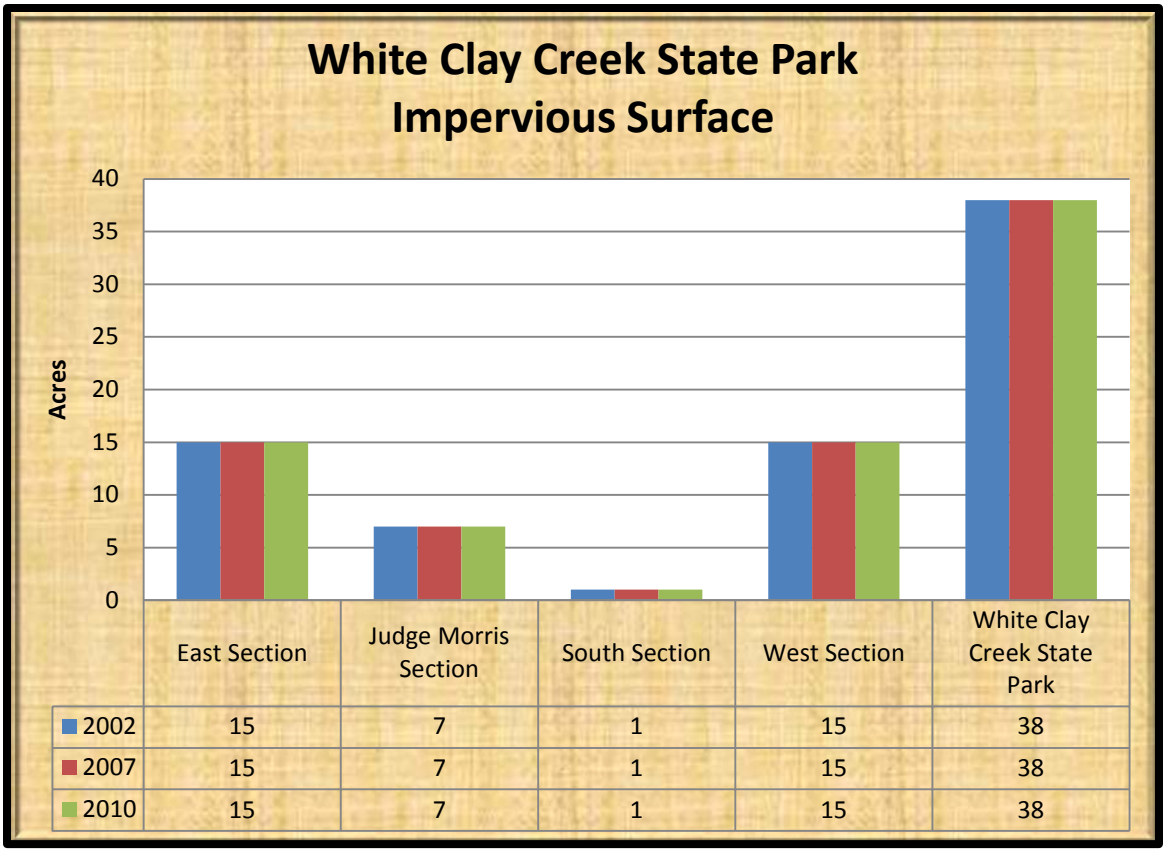


Figure 6.3. Impervious Surface at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital

Impervious surface does not have any capital value.

Impoundment **[6 acres, (Figure 6.4, Table 6.9)]**

DEWAP: Impoundment
NHC: No Equivalent Classification

Description

This land cover covers water bodies that are greater than 5 acres in size.

Analysis of Condition at White Clay Creek State Park

Only one impoundment is present in White Clay Creek State Park it is expected to be present in the future and has not changed in extent or acreage. Because of this no change analysis was conducted.

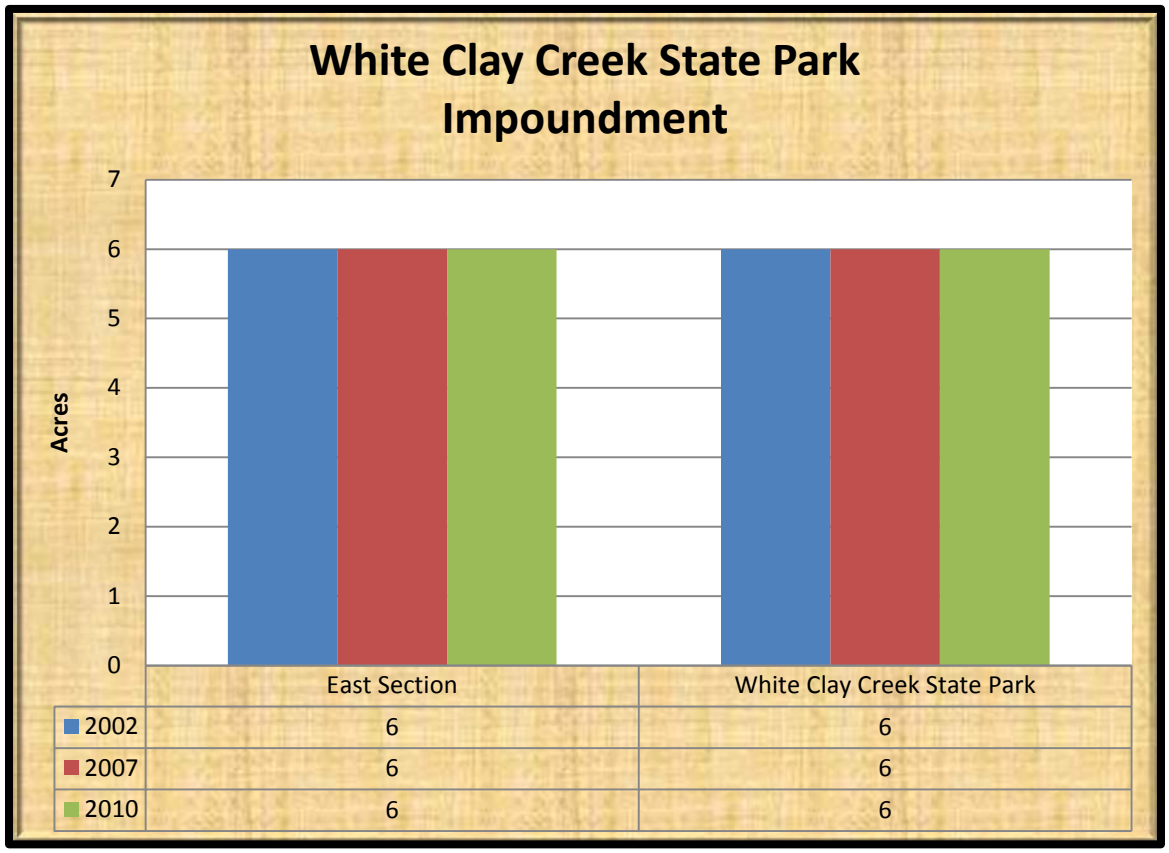


Figure 6.4. Impoundment at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 6.9)

Capital of Impoundment has not changed during the study period.

Table 6.9. Natural Capital of Impoundment	
Year	**Natural Capital (in 2012 dollars)**
2002	$32,011/year
2007	$32,011/year
2010	$32,011/year

Modified Land **[1 acre, (Figure 6.5)]**

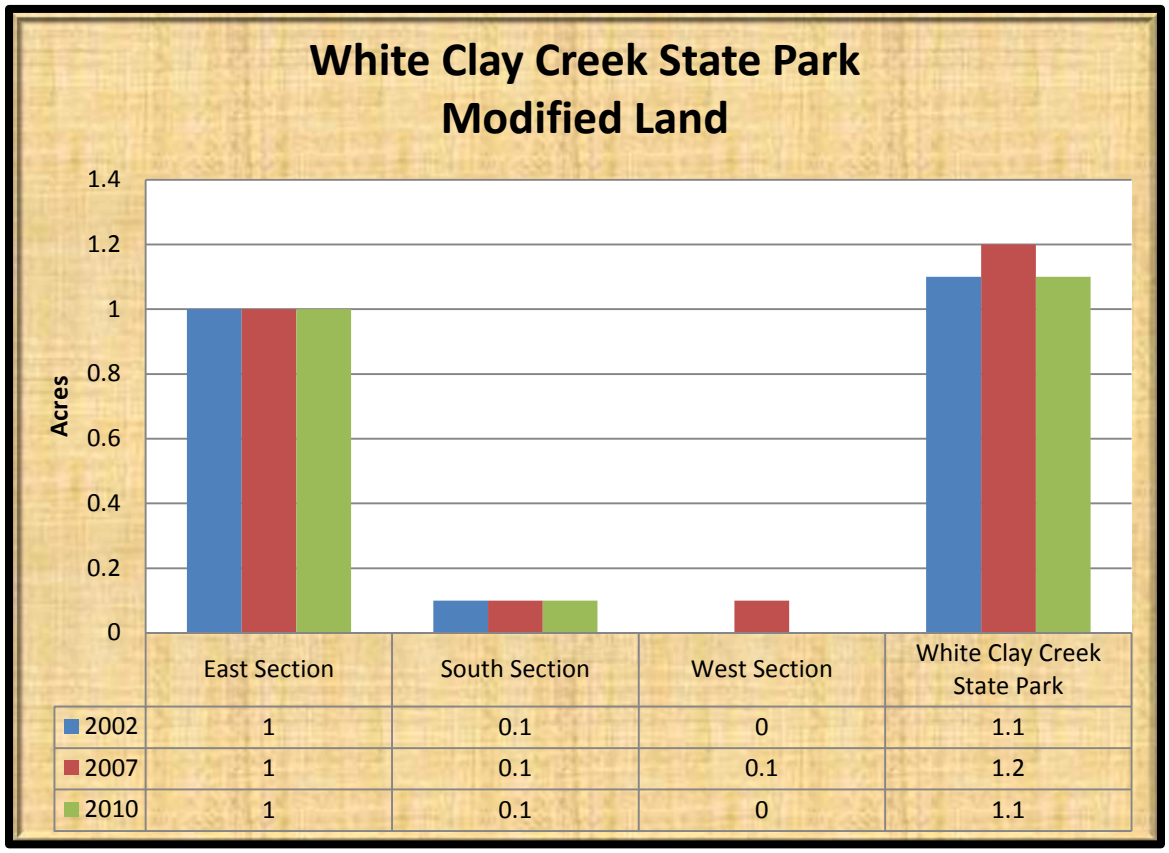
DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

Description

This land cover comprises non-vegetated that have been cleared either for future construction or for other uses.

Analysis of Condition at White Clay Creek State Park

The amount of modified land in the park as whole has varied over time slightly and it is expected that this land cover will come and go as projects are completed. Because of the small amount of land involved no change analysis was conducted for this land cover.



	East Section	South Section	West Section	White Clay Creek State Park
2002	1	0.1	0	1.1
2007	1	0.1	0.1	1.2
2010	1	0.1	0	1.1

Figure 6.5. Modified Land at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital

Modified land does not have any capital value.

***Sand* [7 acres, (Figure 6.6, Tables 6.10-6.11)]**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

Description

This non-vegetated land cover is located within the stream corridor of White Clay Creek. As the banks erode and sediment is drawn into the stream this land cover will vary over time.

Analysis of Condition at White Clay Creek State Park

This land cover has increased in acreage since 2002 and is likely the result of more development either through sediment or flash flooding from impervious surface area causing more bank erosion releasing more sediment.

Only 3 acres of the original 4 acres from 2002 were present in 2007. Since this time 1 acre of water and 0.1 acres of Green Ash-Mixed Hardwood Floodplain Forest has been covered by sand (Table 6.10).

The amount of sand coverage has increased since 2002 with a gain of 3 acres. This increase has come from water (2 acres), Green Ash-Mixed Hardwood Floodplain Forest (1 acre), Riverine Floodplain Forest (1 acre), and 0.5 acres of Northeastern Modified Successional Forest (Table 6.11).

Table 6.10. What was once Sand in 2002 has become X in 2010	
X	**Acreage**
Sand	3 acres
Water	1 acre
Green Ash-Mixed Hardwood Forest	0.1 acres

Table 6.11. Sand has migrated into X since 2002	
X	**Acreage**
Sand	3 acres
Water	2 acres
Green Ash-Mixed Hardwood Forest	1 acre
Riverine Floodplain Forest	1 acre
Northeastern Modified Successional Forest	0.5 acres

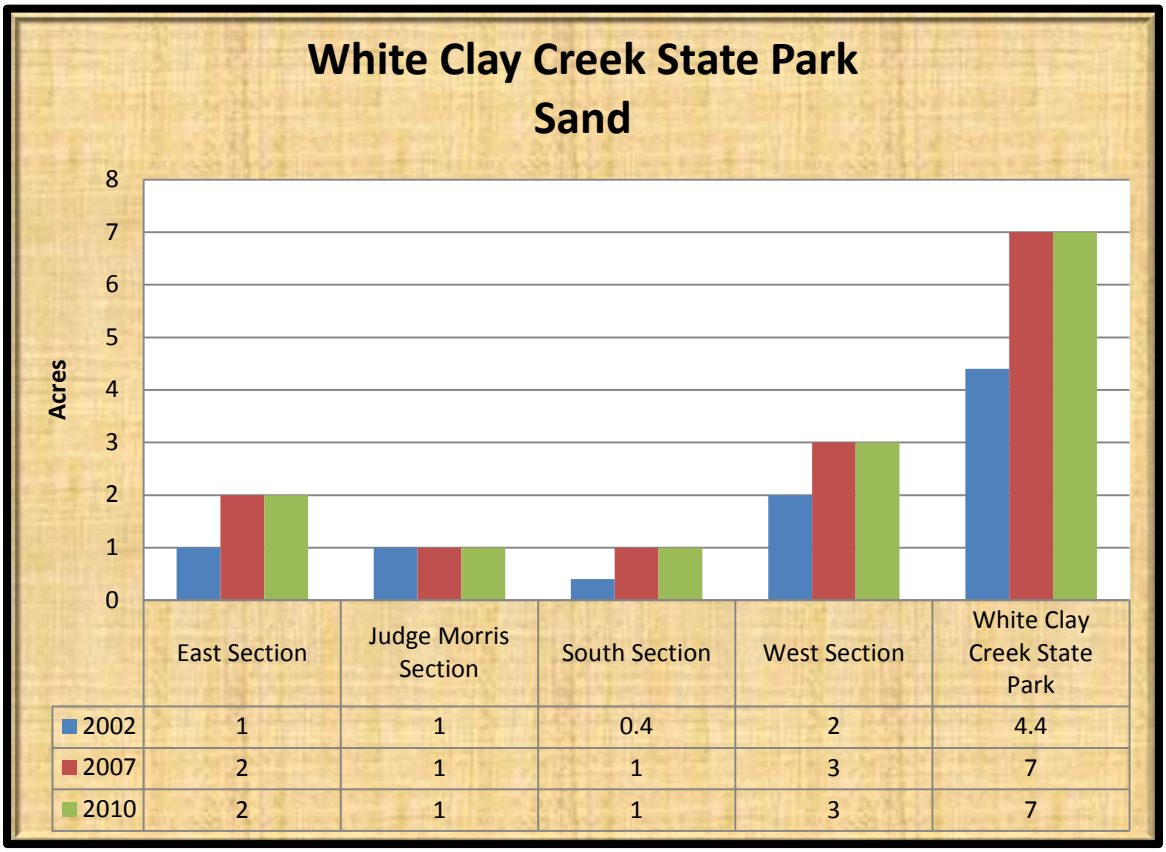


Figure 6.6. Sand at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital

Sand does not have any natural capital.

Semi-impervious Surface **[11 acres, (Figure 6.7, Table 6.12-6.13)]**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

Description

This land cover includes dirt roads and other places where the soil is compacted but not paved such as trails.

Analysis of Condition at White Clay Creek State Park

This land cover has barely increased over the study period but has increased nonetheless. All of the 2002 acreage of Semi-impervious was present in 2010 with some of the acreage converting to Riverine Floodplain Forest (1 acre), Northeastern Old Field (0.3 acres), and Impervious Surface (0.2 acres) (Table 6.12).

Since 2002, Semi-impervious surface has been placed in 1 acre of Northeastern Modified Successional Forest, 0.4 acres of impervious surface, 0.1 acres of Green Ash-Mixed Hardwood Floodplain Forest, and 0.1 acres of cultivated lawn (Table 6.13).

Table 6.12. What was once Semi-impervious Surface in 2002 has become X in 2010

X	Acreage
Semi-impervious Surface	12 acres
Riverine Floodplain Forest	1 acre
Northeastern Old Field	0.3 acres
Impervious Surface	0.2 acres

Table 6.13. Semi-impervious Surface has migrated into X since 2002

X	Acreage
Semi-impervious Surface	12 acres
Northeastern Modified Successional Forest	1 acre
Impervious Surface	0.4 acres
Green Ash-Mixed Hardwood Forest	0.1 acres
Cultivated Lawn	0.1 acres
Other communities/land covers	0.1 acres

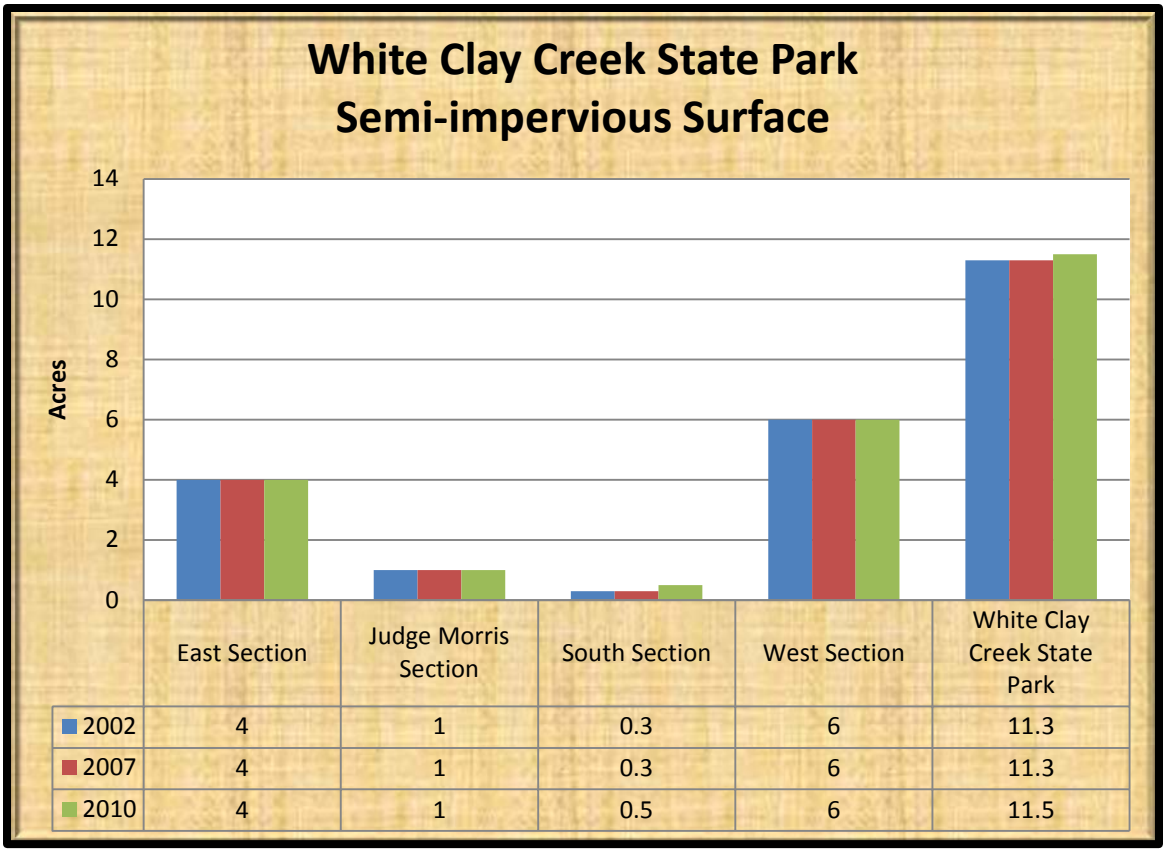


Figure 6.7. Semi-impervious Surface at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital

Semi-impervious Surface does not have any capital value.

***Water* [45 acres, (Figure 6.8, Tables 6.14-6.16)]**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

Description

This land cover includes the water that is present in White Clay Creek and its tributaries.

Analysis of Condition at White Clay Creek State Park

There is no clear trend for the acreage of water in the park. The amount of acreage has gone down with more sand being deposited in the creek but has recently gone back up one acre in the 2002-2007 time period.

Most of what was water (46 acres) in 2002 was still water in 2010 (45 acres). The remainder has become sand (2 acres), Northeastern Modified Successional Forest (0.4 acres), Riverine Floodplain Forest (0.2 acres), and Green Ash-Mixed Hardwood Forest (0.1 acres) (Table 6.15).

Since 2002, water has covered 1 acre of Riverine Floodplain Forest, 1 acre of Sand, and 0.4 acres of Green Ash-Mixed Hardwood Floodplain Forest (Table 6.16).

Table 6.14. What was once Water in 2002 has become X in 2010	
X	**Acreage**
Water	45 acres
Sand	2 acres
Northeastern Modified Successional Forest	0.4 acres
Riverine Floodplain Forest	0.2 acres
Green Ash-Mixed Hardwood Floodplain Forest	0.1 acres

Table 6.15. Water has migrated into X since 2002	
X	**Acreage**
Water	45 acres
Riverine Floodplain Forest	1 acre
Sand	1 acre
Green Ash-Mixed Hardwood Floodplain Forest	0.4 acres

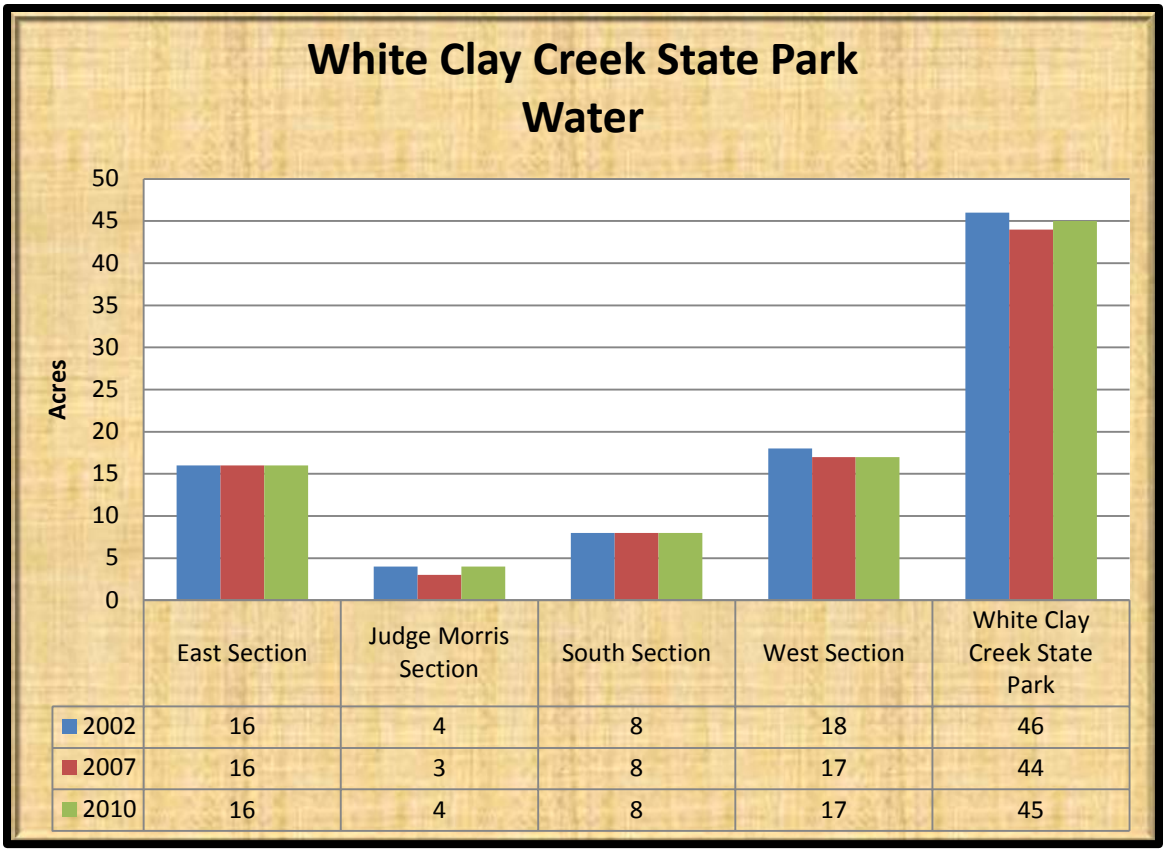


Figure 6.8. Water at White Clay Creek State Park (2002, 2007, and 2010)

Natural Capital (Table 6.16)

Capital of water has oscillated with the deposition of sediments and the erosion of sediments.

Table 6.16. Natural Capital of Water	
Year	**Natural Capital (in 2012 dollars)**
2002	$245,415/year
2007	$234,744/year
2010	$240,080/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 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 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 Riverine Aquatic and Submerged Vegetation			
Species	**Common Name**	**Class**	**Tier**
Atildes halesus	Great purple hairstreak	Insect	2
Manduca jasminearum	Ash sphinx	Insect	2
Acronicta connecta	A noctuid moth	Insect	2
Papaipema stenocelis	Chain fern borer moth	Insect	2