National Park Service
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Natural Resource Stewardship and Science

# Vegetation Classification and Mapping

## *Big Thicket National Preserve*

Natural Resource Report NPS/BITH/NRR—2024/2621





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# Vegetation Classification and Mapping

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Natural Resource Report NPS/BITH/NRR—2024/2621

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January 2024

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Please cite this publication as:

Ley, M., T. Baldvins, H. Pilkington, D. Jones and K. Anderson. 2024. Vegetation classification and mapping project: Big Thicket National Preserve. Natural Resource Report NPS/BITH/NRR—2024/2621. National Park Service, Fort Collins, Colorado. https://doi.org/10.36967/2299254

NPS 175/192398, January 2024

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# Executive Summary

The Big Thicket National Preserve (BITH) vegetation inventory project classified and mapped vegetation within the administrative boundary and estimated thematic map accuracy quantitatively.

National Park Service (NPS) Vegetation Mapping Inventory Program provided technical guidance. The overall process included initial planning and scoping, imagery procurement, vegetation classification field data collection, data analysis, imagery interpretation/classification, accuracy assessment (AA), and report writing and database development. Initial planning and scoping meetings took place during May, 2016 in Kountze, Texas where representatives gathered from BITH, the NPS Gulf Coast Inventory and Monitoring Network, and Colorado State University.

The project acquired new 2014 orthoimagery (30-cm, 4-band (RGB and CIR)) from the Hexagon Imagery Program. Supplemental imagery for the interpretation phase included Texas Natural Resources Information System (TNRIS) 2015 50 cm leaf-off 4-band imagery from the Texas Orthoimagery Program (TOP), Farm Service Agency (FSA) 100-cm (2016) and 60 cm (2018) National Aerial Imagery Program (NAIP) imagery, and current and historical true-color Google Earth and Bing Maps imagery. In addition to aerial and satellite imagery, 2017 Neches River Basin Light Detection and Ranging (LiDAR) data was obtained from the United States Geological Survey (USGS) and TNRIS to analyze vegetation structure at BITH.

The preliminary vegetation classification included 110 United States National Vegetation Classification (USNVC) associations. Existing vegetation and mapping data combined with vegetation plot data contributed to the final vegetation classification. Quantitative classification using hierarchical clustering and professional expertise was supported by vegetation data collected from 304 plots surveyed between 2016 and 2019 and 110 additional observation plots. The final vegetation classification includes 75 USNVC associations and 27 park special types including 80 forest and woodland, 7 shrubland, 12 herbaceous, and 3 sparse vegetation types.

The final BITH map consists of 51 map classes. Land cover classes include five types: pasture / hay ground agricultural vegetation; non – vegetated / barren land, borrow pit, cut bank; developed, open space; developed, low – high intensity; and water. The 46 vegetation classes represent 102 associations or park specials. Of these, 75 represent natural vegetation associations within the USNVC, and 27 types represent unpublished park specials. Of the 46 vegetation map classes, 26 represent a single USNVC association/park special, 7 map classes contain two USNVC associations/park specials, 4 map classes contain three USNVC associations/park specials, and 9 map classes contain four or more USNVC associations/park specials. Forest and woodland types had an abundance of *Pinus taeda*, *Liquidambar styraciflua*, *Ilex opaca, Ilex vomitoria*, *Quercus nigra*, and *Vitis rotundifolia*. Shrubland types were dominated by *Pinus taeda*, *Ilex vomitoria*, *Triadica sebifera*, *Liquidambar styraciflua*, and/or *Callicarpa americana*. Herbaceous types had an abundance of *Zizaniopsis miliacea*, *Juncus effusus*, *Panicum virgatum*, and/or *Saccharum giganteum*.

The final BITH vegetation map consists of 7,271 polygons totaling 45,771.8 ha (113,104.6 ac). Mean polygon size is 6.3 ha (15.6 ac). Of the total area, 43,314.4 ha (107,032.2 ac) or 94.6% represent

natural or ruderal vegetation. Developed areas such as roads, parking lots, and campgrounds comprise 421.9 ha (1,042.5 ac) or 0.9% of the total. Open water accounts for approximately 2,034.9 ha (5,028.3 ac) or 4.4% of the total mapped area. Within the natural or ruderal vegetation types, forest and woodland types were the most extensive at 43,022.19 ha (106,310.1 ac) or 94.0%, followed by herbaceous vegetation types at 129.7 ha (320.5 ac) or 0.3%, sparse vegetation types at 119.2 ha (294.5 ac) or 0.3%, and shrubland types at 43.4 ha (107.2 ac) or 0.1%.

A total of 784 AA samples were collected to evaluate the map's thematic accuracy. When each AA sample was evaluated for a variety of potential errors, a number of the disagreements were overturned. It was determined that 182 plot records disagreed due to either an erroneous field call or a change in the vegetation since the imagery date, and 79 disagreed due to a true map classification error. Those records identified as incorrect due to an erroneous field call or changes in vegetation were considered correct for the purpose of the AA. As a simple plot count proportion, the reconciled overall accuracy was 89.9% (705/784). The spatially-weighted overall accuracy was 92.1% with a Kappa statistic of 89.6%. This method provides more weight to larger map classes in the park. Five map classes had accuracies below 80%. After discussing preliminary results with the parl, we retained those map classes because the community was rare, the map classes provided desired detail for management or the accuracy was reasonably close to the 80% target. When the 90% AA confidence intervals were included, an additional eight classes had thematic accruacies that extend below 80%.

In addition to the vegetation polygon database and map, several products to support park resource management include the vegetation classification, field key to the associations, local association descriptions, photographic database, project geodatabase, ArcGIS .mxd files for map posters, and aerial imagery acquired for the project. The project geodatabase links the spatial vegetation data layer to vegetation classification, plot photos, project boundary extent, AA points, and PLOTS database sampling data. The geodatabase includes USNVC hierarchy tables allowing for spatial queries of data associated with a vegetation polygon or sample point. All geospatial products are projected using North American Datum 1983 (NAD83) in Universal Transverse Mercator (UTM) Zone 15 N. The final report includes methods and results, contingency tables showing AA results, field forms, species list, and a guide to imagery interpretation. These products provide useful information to assist with management of park resources and inform future management decisions.

Use of standard national vegetation classification and mapping protocols facilitates effective resource stewardship by ensuring the compatibility and widespread use throughout NPS as well as other federal and state agencies. Products support a wide variety of resource assessments, park management and planning needs. Associated information provides a structure for framing and answering critical scientific questions about vegetation communities and their relationship to environmental processes across the landscape.

# Acknowledgments

The success of this project would not have been possible without support and contributions by various entities and individuals, including the NPS staff at Big Thicket National Preserve, Gulf Coast Inventory and Monitoring Network, and Karl Brown and Tammy Cook at the Vegetation Mapping Inventory Program. A special thanks to Jeff Bracewell, Whitney Granger, and Jane Carlson from the Gulf Coast Inventory and Monitoring Network and Mike Hughes from BITH for providing boat support that was critical for project success. Additional thanks goes to the Big Thicket Association for providing support and lodging facilities.

The authors thank Colorado State University staff for effort and expertise in field data collection, botanical identification, data development, and deliverable review: Amy Burzynski; Barb Maynard; Ian Scott; and the vegetation classification and accuracy assessment field crews - Ian Medeiros, Elizabeth Shadle, Samantha Byerley, Christina Nicely, Kaleb Ashton, Logan Ferguson, Brett Lambert, Victor Ma, Jordan Pow, and Olivia Willoughby.

# Introduction

Vegetation inventory and mapping is one of the 12 basic inventories mandated by the NPS Natural Resources Inventory and Monitoring Guidelines issued in 1992. In 2016, the NPS awarded a cooperative agreement to Colorado State University's Center for Environmental Management of Military Lands (CEMML) and the Colorado Natural Heritage Program (CNHP) to develop a study plan for Big Thicket Natinoal Preserve (BITH) and implement the inventory described in the study plan. Expertise provided by CNHP, CEMML, BITH staff, Gulf Coast Inventory and Monitoring Network (GULN), and the National Park Service Vegetation Mapping Inventory (VMI) Program ultimately contributed to the successful completion of the project.

CNHP was primarily responsible for collecting standardized plot data, classifying data into vegetation types through analysis and expert opinion, writing the field key to vegetation associations, managing plot data, performing the AA, and report writing. CEMML was responsible for acquiring imagery, developing a mapping model based on limitations of the imagery and interpretation, classifying and delineating vegetation polygons from imagery, developing an imagery interpretation guide, report writing and database development. Staff from BITH, GULN, and the VMI Program provided logistical and technical support, helped coordinate and facilitate fieldwork, and reviewed and evaluated draft data and reports.

## Planning and Scoping

For the initial planning and scoping meetings, CSU staff traveled to Kountze, Texas and met with BITH and GULN staff and NPS VMI program managers, as well as other interested agencies and subject matter experts. A scoping meeting with park staff and other stakeholders took place on May 2, 2016, followed by a field tour on May 3, 2016. The participants of the scoping meeting included:

David Jones, CSU, CEMML

Joe Stevens, CSU, CNHP

Tom Baldvins, CSU, CNHP

Tammy Cook, NPS, I&M

DW Ivans, NPS, Prescribed Fire Specialist

Cynthia Worthington, NPS, Fire Effects Monitor

Ryan Desliu, NPS, Environmental Protection Specialist

Jeff Bracewell, NPS, Gulf Coast I&M Network

Wendy Ledbetter, TNC, Forest Program Manager

Group discussion at the scoping meetings included defining the project area boundary, evaluating the existing sources of vegetation data and availability of existing imagery/maps, and discussing

logistical issues such as work schedule, land access, stakeholders, and opportunities for in-kind park support.

### NPS Vegetation Mapping Inventory Program

Since 1994, the National Park Service (NPS) Vegetation Mapping Inventory (VMI) Program has led an effort to classify, describe, and map existing vegetation of national park units for the NPS Inventory and Monitoring (I&M) Division. The VMI program aims to classify and map vegetation at over 270 national park units across the United States and territories, and provides baseline ecological data for park resource managers, creates data in a regional and national context, and provides opportunities for future inventory, monitoring, and research activities (FGDC 1997, Grossman et al. 1998). The VMI program brings botanists, imagery interpreters, cartographers, and ecologists together during a multi-year project to describe and map existing vegetation types within park boundaries. The preliminary map product is then statistically evaluated to assess the map accuracy before releasing a final comprehensive classification and map.

The NPS I&M program has developed general guidelines for the development and delivery of vegetation map products. The guidelines are detailed in the "12-Step Guidance for NPS Vegetation Inventories" (NPS 2013) and include the following:

1) Review existing data and "best practices" to develop a brief proposal.
2) Plan and scope to gather the detailed information needed to develop the study plan.
3) Develop and submit a detailed study plan for approval of funding.
4) Collect field plot data (for the ecological classification).
5) Develop vegetation classification, vegetation type descriptions, and field key.
6) Develop mapping model (calibration).
7) Acquire and prepare imagery.
8) Analyze and classify imagery.
9) Prepare GIS project.
10) Validate thematic accuracy of map products.
11) Conduct formal accuracy assessment (AA).
12) Deliver final reports, GIS database, and required products.

A project proposal (steps 1-3) was prepared for the Big Thicket National Preserve (BITH) vegetation inventory project by Colorado State University (CSU) in 2016. This project supports the remaining steps. All final products are consistent with the following VMI Program standards and guidance:

- National Vegetation Classification Standard (FGDC 1997, FGDC 2008)
- Spatial Data Transfer Standard (FGDC 1998a)
- Content Standard for Digital Geospatial Metadata (FGDC 1998b)
- United States National Map Accuracy Standards (USGS 1999)
- Integrated Taxonomic Information System

- Program-defined standards for map attribute accuracy and minimum mapping unit (MMU)
- Vegetation Mapping Inventory Program 12-Step Guidance

The products derived from these efforts include:

Spatial Data:

- Map classification data
- Spatial database of vegetation communities
- Field plot data from the classification and AA phases from over 950 locations
- Metadata for spatial databases
- Map files to produce maps at various scales/sizes and levels of thematic detail
- Quantitative AA of spatial data

Vegetation Information:

- Vegetation classification: list of communities present
- Dichotomous field key of vegetation classes
- Formal description for each vegetation class
- Field photos of vegetation classes
- Field data in database format

NPS vegetation inventory projects classify and map park vegetation using a combination of plot and observation point data, legacy plot data and imagery, field reconnaissance, and photo/image interpretation. The specific protocols and standards for large parks were used and are described in the NPS/Biological Resources Division (BRD) program documents (TNC and ESRI 1994, NPS 2013).

### The United States National Vegetation Classification (USNVC) and National Vegetation Classification Standard (NVCS)

Use of the U.S. National Vegetation Classification (USNVC) (USNVC 2020) is central to supporting the NPS mapping program. The USNVC:

- Is based upon current vegetation.
- Uses a systematic approach to classify vegetation along a continuum.
- Emphasizes natural and existing vegetation.
- Uses a combined physiognomic-floristic hierarchy.
- Identifies vegetation units based on both qualitative and quantitative data.
- Is appropriate for mapping at multiple scales.

Use of a standardized national vegetation classification and mapping protocol facilitates effective resource stewardship by ensuring compatibility and widespread use of the information throughout the NPS, as well as by other federal and state agencies. Vegetation data and associated information

support a wide variety of resource assessment, park management, planning needs, and provide a structure for framing and answering critical scientific questions about vegetation communities and their relationship to environmental processes across the landscape.

The USNVC was largely developed and implemented by The Nature Conservancy (TNC) and NatureServe in conjunction with the network of Natural Heritage Programs from 1980 to 2000. The USNVC is maintained and updated by the joint efforts of NatureServe, the Federal Geographic Data Committee (FGDC), and the Ecological Society of America (http://usnvc.org/). These organizations participate in ongoing classification refinements that are reviewed both locally and nationally.

The FGDC released Version 2 of the National Vegetation Classification Standard (NVCS) in 2008, representing a major revision (FGDC 2008). This project uses Version 2 as its classification standard. Version 2 of the USNVC treats natural/ruderal vegetation and cultural vegetation as two separate hierarchies. Classification criteria utilized by the USNVC system include three upper levels that emphasize physiognomy of natural and ruderal communities (e.g., semi-natural or nonnative), three middle levels that integrate biogeography and floristics, and two lowest levels are based solely on floristics (Figure 1) (USNVC 2020).

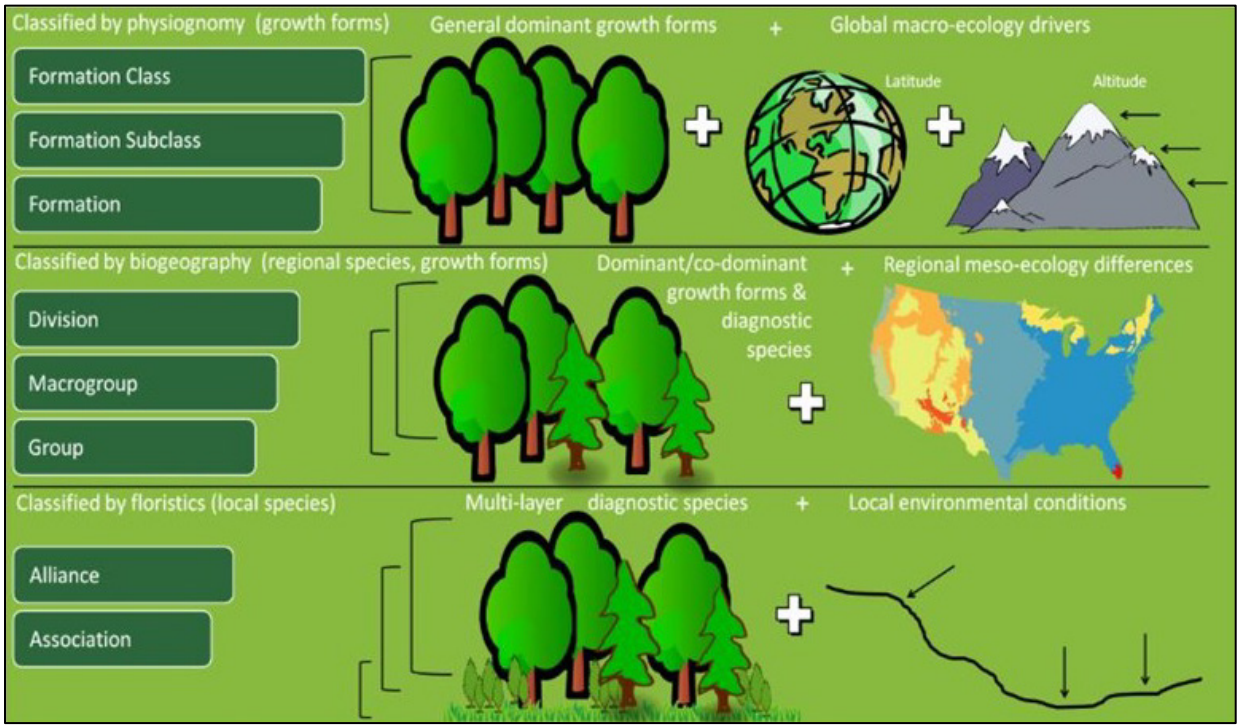



**Figure 1.** USNVC hierarchy and classification criteria (USNVC 2020).

Alliances and associations are based on species dominance in the uppermost vegetation layer and indicator species consistently found in some types but absent in others. Alliance names are generally based on the dominant/diagnostic species in the uppermost stratum of the vegetation with up to four diagnostic species. Associations are grouped under alliances and are the most specific classification unit. Associations define a distinct plant composition that repeats across the landscape. Alliances

typically include numerous associations while associations only occur under one alliance. Table 1 provides criteria and examples of vegetation classification using the 2008 hierarchy for natural vegetation.

**Table 1.** USNVC (2020) hierarchy criteria and examples of classified types.

| Level (level criteria) | Hierarchy for Natural Vegetation | Vegetation Classification Criteria | Ecological Context | Scientific Name | Colloquial Name |
|---|---|---|---|---|---|
| Upper Levels (Predominantly physiognomy) | 1) Formation Class | Broad combinations of general dominant growth forms. | Basic temperature (energy budget), moisture, and substrate/aquatic conditions. | 1: Mesomorphic Tree Vegetation Class | Forest & Woodland |
| | 2) Formation Subclass | Combinations of general dominant and diagnostic growth forms. | Global macroclimatic factors driven primarily by latitude and continental position, or overriding substrate/aquatic conditions. | 1.B: Temperate & Boreal Forest & Woodland Subclass | Temperate & Boreal Forest & Woodland |
| | 3) Formation | Combinations of dominant and diagnostic growth forms. | Global macroclimatic factors as modified by altitude, seasonality of precipitation, substrates, and hydrologic conditions. | 1.B.1: Warm Temperate Forest & Woodland Formation | Warm Temperate Forest & Woodland Formation |
| Middle Levels (Physiognomy, biogeography, and floristics) | 4) Division | Combinations of dominant and diagnostic growth forms and a broad set of diagnostic plant species that reflect biogeographic differences. | Continental differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes. | 1.B.1.Na: Southeastern North American Forest & Woodland | Southeastern North American Forest & Woodland |
| | 5) Macrogroup | Combinations of moderate sets of diagnostic plant species and diagnostic growth forms that reflect biogeographic differences. | Sub-continental to regional differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes. | M007: *Pinus palustris* / *Aristida stricta* Woodland | Longleaf Pine Woodland |
| | 6) Group | Combinations of relatively narrow sets of diagnostic plant species, including dominants and co-dominants, broadly similar composition, and diagnostic growth forms. | Regional mesoclimate, geology, substrates, hydrology and disturbance regimes. | G008: *Pinus clausa* / *Quercus geminata – Quercus myrtifolia* Scrub Forest & Woodland Group | Sand Pine Scrub Forest & Open Woodland |
| Lower Levels (Predominantly floristics) | 7) Alliance | Diagnostic species, including some from the dominant growth form or layer, and moderately similar composition. | Regional to subregional climate, substrates, hydrology, moisture/ nutrient factors, and disturbance regimes. | A3117: *Pinus clausa* Scrub Woodland Alliance | Sand Pine Scrub Woodland |
| | 8) Association | Diagnostic species, usually from multiple growth forms or layers, and more narrowly similar composition. | Topo-edaphic climate, substrates, hydrology, and disturbance regimes | CEGL003554: *Pinus clausa* / *Quercus geminata – Quercus myrtifolia – Conradina canescens* Woodland | Panhandle Sand Pine Dune Scrub |

Associations are generally named using uppermost stratum-dominant vegetation species, lower strata-dominant species, or a diagnostic species of any stratum. The species nomenclature for all alliances and associations follows that of Kartesz (1999). For more information on the USNVC see Grossman et al. (1998). Documentation from NatureServe (2006) describes the naming and syntax for all USNVC names:

- A hyphen ("-") separates names of species occurring in the same stratum.
- A forward slash ("/") separates names of species occurring in different strata.
- Species that occur in the uppermost stratum are listed first, followed successively by those in lower strata.
- Order of species names generally reflects decreasing levels of dominance, constancy, or indicator value.
- Parentheses around a species name indicates the species is less consistently found either in all associations of an alliance, or in all occurrences of an association.
- Association names include the dominant species of the significant strata, followed by the class in which they are classified (e.g., "Forest," "Woodland," or "Herbaceous" vegetation).
- Alliance names also include the physiognomic class (e.g., "Forest," "Woodland," "Herbaceous"), but are followed by the word "Alliance" to distinguish them from associations.

Additional information is available at the National Vegetation Classification Standard website http://usnvc.org/, the FGDC (Federal Geographic Data Committee) website http://www.fgdc.gov/standards/projects/FGDC-standards-projects/vegetation, and the NatureServe Explorer website http://explorer.natureserve.org/classeco.htm.

# Project Setting

## Location and Administrative Setting

Big Thicket National Preserve is located in southeast Texas between the Trinity and Neches rivers in the Gulf Coastal Plain physiographic province. Preserve headquarters is located near Kountze, Texas. The following fifteen preserve management units are scattered across Hardin, Polk, Tyler, Jasper, Orange, Jefferson, and Liberty counties near the towns of Beaumont, Kountze, Livingston, and Silsbee, Texas: Beaumont, Beech Creek, Big Sandy Creek, Big Sandy Creek Corridor, Canyonlands, Hickory Creek Savannah, Jack Gore Baygall and Neches Bottom, Lance Rosier, Little Pine Island-Pine Island Bayou Corridor, Loblolly, Lower Neches River Corridor, Menard Creek Corridor, Turkey Creek, Upper Neches River Corridor, Lower Neches River Corridor, and Village Creek Corridor (Figure 2).

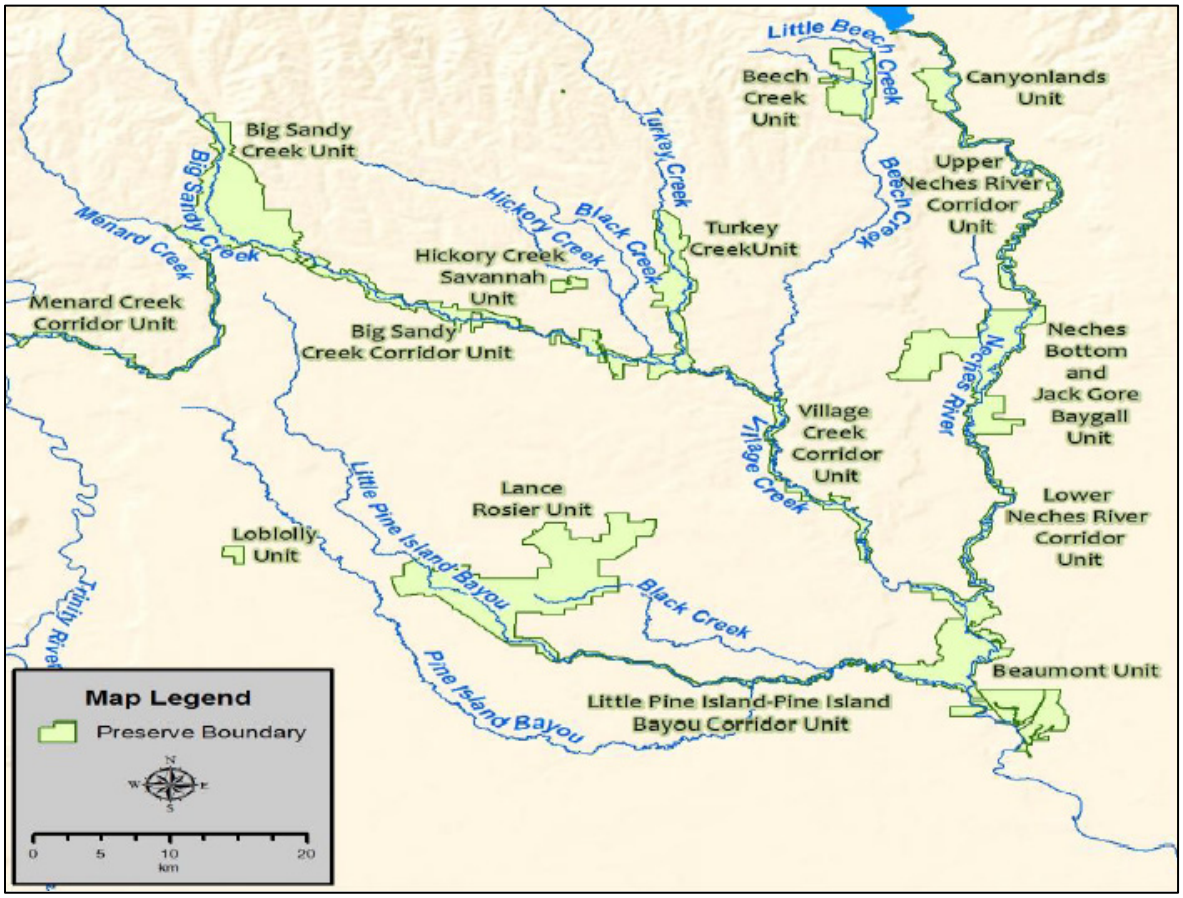



**Figure 2.** Management units at BITH (from Nadeau et al. 2016).

Several reports describing the ecological importance and vastness of the Big Thicket were completed in the early 1900s. In 1927, East Texas Big Thicket Association (ETBTA) was established to reserve, for prosperity, a portion of the Big Thicket in its natural state. The cornerstone of that effort was 18,000 acres leased by R.E. Jackson in the southeast corner of Polk County for this purpose. The ETBTA eventually lost momentum and ceased to exist; the discovery of large deposits of oil in Polk

County in 1936 and 1942, the onset of WWII increasing the demand for lumber, and land newly-acquired by the federal government in the region for a national forest dealt some finishing blows to the association and its mission. The second Big Thicket Association was formed in 1964. Further efforts and proposals to protect the area continued until the preserve was created (NPS 2021).

On October 11, 1974 Congress declared 34,216 ha (84,550 ac) of the Big Thicket a National Park Service unit and one of the first national preserves in the United States. Since 1974, NPS has added acreage to the preserve through donations, purchases from the Kirby Lumber Company, and additional acreage creating the Big Sandy/Village Creek Corridor unit and Canyonlands unit. Today the preserve protects 45,832 ha (113,253 ac) of what was once a contiguous 1,416,400 ha (3,500,000 ac) of swamps, bayous, floodplains, flatwoods, and uplands referred to collectively as the "Ecological Big Thicket" (Watson 2006).

Big Thicket National Preserve is "dedicated to preserving, conserving, protecting, and enhancing the integrity of the natural and ecological systems in the Big Thicket" (Public Law 93-439). While a national preserve retains many of the functionalities and protections of a national park, it also allows for a certain level of resource extraction. The preserve receives an average of 100,000 recreational visitors each year who hunt, fish, boat, hike, and enjoy nature (Thornberry-Ehrlich 2018). NPS oversees management of the preserve by facilitating cooperation among the Big Thicket Association, Thicket of Diversity, Big Thicket National Heritage Trust, Western National Parks Association, National Parks and Conservation Association, National Park Foundation, Texas Parks and Wildlife Department, USGS National Wetlands Research Center, The Conservation Fund, The Nature Conservancy of Texas, Texas-Louisiana Longleaf Pine Taskforce, local governments, and private landowners. The partners work together to conserve BITH and other lands within the region from land-use conversions (including agricultural uses and forest plantations), alteration of disturbance regimes such as fire, environmental pollution, and habitat fragmentation.

## Land Use History[1]

Early European settlers in the region used "Big Thicket" to refer to the dense, nearly impenetrable forest. The rivers and creeks were some of the only early means of moving through the area. Historically the woods were a meat market, acting as an ideal hunting landscape for various American Indian tribes. Prior to the 1880s, a scattered population of European American inhabitants existed in small settlements and cabins living off subsistence farming, fishing, and hunting game. It was not until the lumber industry began to extract resources from the area, building roads, rails and townships as they went, that awareness of the Big Thicket grew.

### *Timber Extraction*

The extraction of lumber from the Big Thicket started in the early 1800s and is one of the first major industries to take root in the area. Because of the thick understory and frequent flooding in the bottoms, early lumber extraction was limited to areas near rivers, whereby logs were skidded to the

[1] Adapted from NPS (2021)

rivers and then floated downstream. The rise in logging to meet regional and national demands resulted in the establishment of major sawmills in larger cities on the Gulf Coast, while smaller mills existed to support local needs. The lumber industry in the Big Thicket changed drastically with the expansion of the railroad and saw its boom in what is known as the "Bonanza Era" lasting from roughly 1880 to 1930. This boom was fueled by extensive state land grants to railroad companies and investments by the lumber industry. Expansion of the railroads extended tree harvesting further from the rivers and company towns grew around larger sawmills off the coast, while smaller camps and towns became established deeper in the Big Thicket. By 1907, Texas had the third-largest lumber industry in the US, with most of that lumber coming from the Big Thicket region.

Lumber companies used a "cut-out and get-out" method of logging, leaving a "forest of stumps" in their wake. However, this practice was employed at relatively small scales and the climate promoted fairly rapid regrowth, and allowed for sustainment of relatively high levels of biodiversity. By 1920, profitable supplies of lumber had been exhausted. Coupled with the Great Depression, most of the lumber companies went bankrupt or left for the Pacific Northwest. The year 1932 saw the lowest lumber production since 1880. However, during the 1930s, the New Deal-era investments by the federal government helped to promote marketable second growth stands through brush management, fire suppression and seedling planting. During this same time, the new practice of clearcutting began to alter the landscape and impact biodiversity further through the wholesale clearing, burning and replanting of areas to pine monotypes such as loblolly pine (*Pinus taeda*) that were then harvested and replanted on 15-25 year cycles. By 1940, timber output in the region was recovering, and clearcutting remains a dominant timber practice in the region. Given the lumbering industry history, the forests at Big Thicket National Preserve have almost all been logged at least once since 1880, although occasional old-growth trees or small stands still exist in the most remote and inaccessible portions of the preserve.

The lumber industry still thrives in the region and adjacent to the preserve, and has become an important regional conservation partner; some lumber companies have set aside acreage for special protections, especially in hardwood bottomlands (e.g., the Lance Rosier Unit), where forested swamps and oxbows are susceptible to floods and access is difficult. Private and non-profit organizations such as the Nature Conservancy and others are also actively engaged in protecting and restoring the ecosystem through prescribed fire, stream and river protection, and promotion of animal and plant habitats.

### *Oil and Gas Production*

When the preserve was established in 1974, subsurface mineral rights were privately-held and Congress did not authorize the federal acquisition of these rights. Oil and gas exploration and extraction, therefore, continue in and around the preserve, under the oversight of preserve staff who are required to ensure that such activities will not compromise preserve values. Today there are four non-federal oil and gas operations within the preserve, about 35 directional wells that were horizontally directional drilled from outside the preserve to locations beneath the preserve, and around 100 oil and gas pipeline segments that run through the preserve. These activities carry

environmental concerns that preserve staff carefully monitor and mitigate, balancing industry and conservation.

### Physiographic Setting

Most of Big Thicket National Preserve is within the South Central Plains Level III ecoregion, with a small piece of the preserve on the edge of the Western Gulf Coastal Plain (Figure 3) (Griffith 2004). USEPA (2013) describes the South Central Plains ecoregion:

> *Locally termed the "piney woods", this region of mostly irregular plains represents the western edge of the southern coniferous forest belt. Once blanketed by a mix of pine and hardwood forests, much of the region is now in loblolly and shortleaf pine plantations. Only about one sixth of the region is in cropland, primarily within the Red River floodplain, while about two thirds of the region is in forests and woodland. Lumber, pulpwood, oil and gas production are major economic activities.*

USEPA (2013) describes the Western Gulf Coastal Plain ecoregion:

> *The principal distinguishing characteristics of the Western Gulf Coastal Plain are its relatively flat coastal plain topography and mainly grassland potential natural vegetation. Inland from this region the plains are older, more irregular, and have mostly forest or savanna-type vegetation potentials. Largely because of these characteristics, a higher percentage of the land is in cropland than in bordering ecological regions. Urban and industrial land uses have expanded greatly in recent decades, and oil and gas production is common.*

The topography in the southern BITH units is fairly flat, draining gradually to the Gulf of Mexico from the north toward the southeast. Big Sandy Unit in the northwest part of the preserve ranges in elevation from 45 m (150 ft) to 82 m (270 ft). Upland communities predominate in Big Sandy, with floodplain habitat near Big Sandy Creek. Beech Creek Unit is between Big Sandy and Canyonlands in the northeast part of the preserve and has an elevation ranging from 43 m (141 ft) to 62 m (203 ft). Canyonlands in the far northeast has rolling hills and cliffs along the Neches River, which runs the eastern length of the unit. Lance Rosier in the southwest has an elevation of about 23 m (76 ft) and consists primarily of flatwoods. Jack Gore Baygall and Neches Bottom located south of Canyonlands along the Neches River has an abundance of sloughs and baygalls. Beaumont Unit is nearly at sea level and located in the southeast portion of the preserve with numerous sloughs and swamps influenced by Gulf tidal saltwater (Watson 2006).

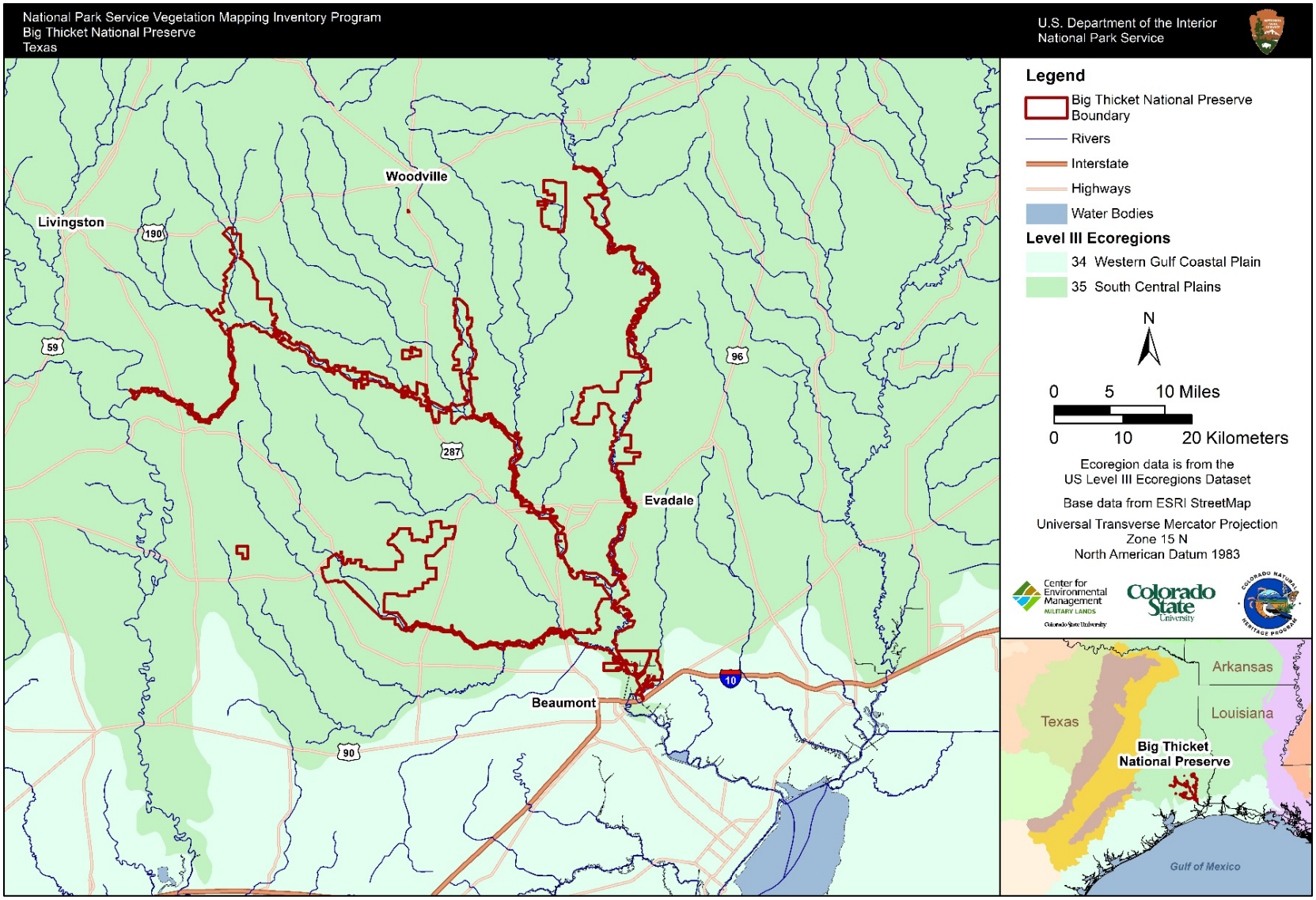



**Figure 3.** Level III Ecoregions at BITH (USEPA 2013). BITH is located in eastern Texas within the South Central Plains and Western Gulf Coastal Plain ecoregions. (Data sources: US Level III Ecoregions (USEPA), ESRI StreetMap, NPS administrative boundary)

## Climate

Proximity to the Gulf of Mexico moderates the climate of the preserve, which is classified as humid subtropical with a mean annual temperature of 21°C (70°F) (Thornberry-Ehrlich 2018). Kountze, Texas, which is centrally located in BITH, has an average monthly minimum temperature of 3.3°C (38°F) in January and an average maximum of 34.4°C (94°F) in August (US Climate Data 2020). The average annual rainfall of 135 cm (53 in) is evenly distributed through the year. The difference between average rainfall in March, typically the driest month, and April, typically the wettest month, is only 5 cm (Marks and Harcombe 1981). Climate extremes include droughts in the summer. Tropical storms and hurricanes most typically occur between June and November, peaking in August and September and most heavily affecting coastal areas.

The frost-free growing season occurs from March to November with an average of 210 days in the northern extent of the preserve and 240 days in the south. An average of 20 frost days occur each year and snow accumulates in trace amounts about once every 10 years (Marks and Harcombe 1981).

## Geology

The Gulf Coastal Plain of Texas is underlain by very deep sediments. During the Pleistocene (2.6 – 11,700 years ago) sea levels fluctuated as the climate cycled between ice ages that caused sea levels to drop and interglacial warming that caused sea levels to rise. This coastal rising and falling contributed to sediment accumulation on the Coastal Plain for at least 250 million years (Thornberry-Ehrlich 2018). The stabilization of the coastline during the Holocene (11,700 years ago to present) allowed for deposits of sand and clay to collect (Thornberry-Ehrlich 2018). During the Holocene, the current major rivers of the Big Thicket also began to meander, depositing alluvium along their floodplains.

Five Pleistocene geologic formations are located in the Big Thicket National Preserve: Beaumont, Bentley, Lissie, Montgomery, and Willis. These sedimentary formations are broad and level, consisting of silty and loamy material. The more recent Deweyville and Alluvium formations, developed when rivers dissected the landscape, are also present (Deshotel 1978). Deweyville formation consists of sands, silts, and clays with thin soil development. Clay and loam alluvium occurs next to streams.

## Soils

Soils are largely a result of the underlying geology, climate, relief, flora and fauna, and duration of soil development. Deshotels (1978) identified 48 unique soil mapping units from the Big Thicket National Preserve. Sloping uplands to nearly level soils of the north are moderately well drained with deep sandy loams primarily of the Bowie Series (Marks and Harcombe 1981). These slowly permeable soils formed from the sediments of the Coastal Plain and are slightly acidic on the surface to strongly acidic at depths past 0.3 m (1 ft) (Deshotels 1978).

Hundreds of acres of Beaumont clay from the Kirbyville and Sorter series are found toward the south where the Beaumont formation is located. These soils typically occur on flatwoods consisting of deep acidic sandy loams that drain slowly and are saturated with standing water persisting during spring and winter. The Mantachie series is common of small stream floodplain soils with poorly drained

deep loamy alluvium that is moderately permeable and usually flooded in winter and spring. Urbo series soil are found along the large river floodplains with silty clay loam soils typical of backswamps and abandoned channels (Deshotels 1978).

## Hydrology and Water Resources

Generally, the topography in BITH is subtle with gradually sloping plains that drain from the northern to the southern extent of the preserve. Five watersheds are located within the boundaries of Big Thicket National Preserve including the lower reaches of the main stem of the Neches River, Big Sandy Creek, Village Creek, Pine Island Bayou, and Menard Creek (Thornberry-Ehrlich 2018). Most of these watersheds are part of the Neches River drainage except for Menard Creek, which flows into the Trinity River.

The headwaters of the Neches River are in East Texas at the northern edge of the South Central Plains ecoregion in Van Zandt County. The river flows southeast 416 miles toward Beaumont, into Sabine Lake, and empties into the Gulf of Mexico. Collectively the river drainage is approximately 25,928 square kilometers (10,011 square miles) and encompasses much of the South Central Plains. Three impoundments alter the natural flow regimes of the Neches River: Rhine Lake Dam, Lake Palestine, and Steinhagen Reservoir (TPWD 1974). A permanent saltwater barrier was installed on the Lower Neches below the confluence of Pine Island Bayou and the Neches River, preventing tides from pushing saltwater up the river and coastal marsh species existing above the barrier. Pollution from downstream petrochemical industries have killed many organisms along the Neches (Watson 2006).

Big Sandy Creek originates in Polk County and flows southeast for 40 miles to Hardin County where it connects to Village Creek. Beech, Turkey, Hickory, Little Cypress, and Mill creeks are tributaries of Village Creek, which runs southeast for 63 miles before draining into the Neches River. White sand bars are common along Village Creek. Pine Island Bayou originates in Liberty County flowing 40 miles southeast across Hardin County and into the Neches River (Watson 2006).

## Flora and Fauna

Ecologists often refer to the Big Thicket region as an “ecotonal complex”, and is often refered to as the “biological crossroads of North America” where floras from the east and west converge (Thornberry-Ehrlich 2018, Diggs et al. 2006, Watson 2006). Ecologically the area is considered a part of the southeastern United States and is the southwestern extent of the Southeastern Mixed Forest Province and the Outer Coastal Plain Mixed Forest Province (Diggs et al. 2006). Floristically many eastern species reach their southern or southwestern limit in the BITH area due to the high precipitation and characteristic abundance of wetland habitats (MacRoberts & MacRoberts 2008a). Representing a biological border, the preserve serves as a refuge for the West Gulf Coastal Plain and protects the unique genetics of ecotonal species (MacRoberts & MacRoberts 2008a).

The Big Thicket region hosts high levels of biological diversity with some of the highest in North America due the climate, hydrology, and proximity to many ecoregions (Figure 4) (Diggs et al. 2006, MacRoberts et al. 2002, Thornberry-Ehrlich 2018, Watson 2006). Floristic diversity within BITH was likely higher prior to fire exclusion, oil and gas drilling, changes in hydrology, pine plantation

development, and loss of high-quality sites within the preserve (Watson 2006, MacRoberts et al. 2002). The value of protecting BITH remains vital to species seeking refuge in one of the few remaining ecological habitats of the West Gulf Coastal Plain.

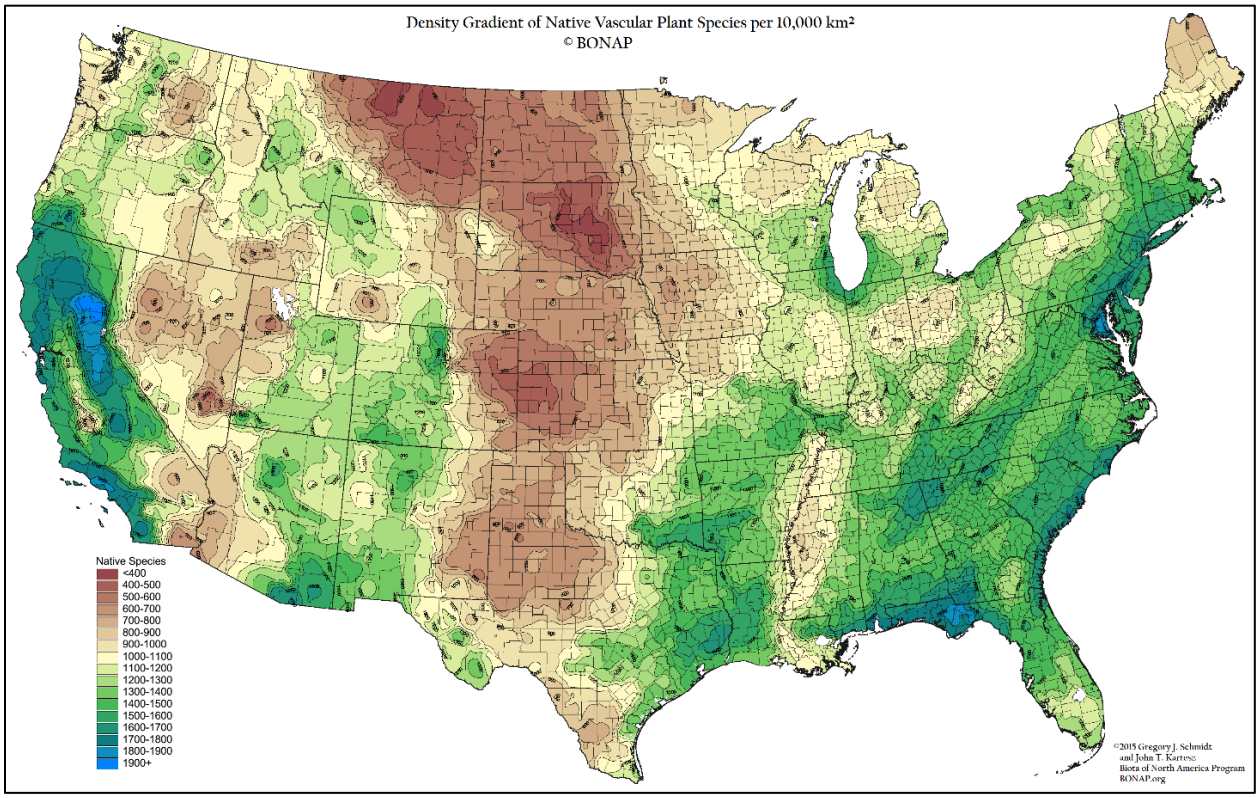



**Figure 4.** Density gradient of native vascular plant species per 10,000 km$^2$ (Kartesz 2015).

Floristics vary among BITH units and are often correlated with differences in hydrology, soil, geology, and subtle changes in topography. Background knowledge of individual BITH units is necessary for understanding the context of this research. The floristics of many of the park units have been described. Comprehensive floristic inventories have not been conducted on Neches Bottom and Jack Gore Baygall Unit, Neches River Corridor Unit, Canyonlands Unit, Pine Island and Little Pine Island Bayou Corridor, and Big Sandy Village Creek Corridor.

Big Sandy Unit located in eastern Polk County is 5,806 ha with 693 documented vascular plant taxa of which 45 are non-native (Brown et al. 2006a). Vegetation communities primarily consist of upper slope pine oak forest, mid slope oak pine forest, and lower slope hardwood pine forest. There are also pine forest, floodplain hardwood forest, floodplain hardwood pine forest, baygall, cypress-tupelo swamp, and sandhill pine forest (Harcombe and Marks 1979). Big Sandy Creek flows through the entire unit with floodplain communities surrounding its banks. Notably a few locations of yellow trumpets pitcher plant (*Sarracenia alata*) persist but are in desperate need of management (Brown et al. 2006a). Longleaf pine (*Pinus palustris*) forests occur along the eastern edge and once hosted a diverse number of herbaceous species that have been suppressed due to fire exclusion. Invasion of yaupon (*Ilex vomitoria*) and wax myrtle (*Morella cerifera*) shrub thickets have established in the

absence of fire, shading out herbaceous species and preventing regeneration of longleaf pine (Watson 2006).

Menard Creek Corridor Unit is 1,537 ha (3,798 ac) in Polk, Harden, and Liberty counties, Texas. The unit is a narrow riparian corridor on Menard Creek beginning at the southwest edge of Big Sandy Creek Unit and is located on Deweyville/Fluviatile formation with bottomland Bibb sandy loam and Hatliff fine sandy loam soils that are typically flooded (Deshotels 1978). In the northern section near Big Sandy Creek Unit, elevations reach 45 m (150 ft) and decrease to 15 m (50 ft) in the south where Menard Creek joins the Trinity River. Brown et al. (2009) conducted a vascular flora of the unit and recognized 689 taxa of which 70 were non-native. Brown et al. (2009) concluded that 12% of the Menard Creek Corridor Unit flora was distinct from other surveyed BITH units. Vegetation is primarily riparian bottomland forest, lower slope hardwood pine forest, and upper slope pine oak forest (Marks and Harcombe 1981, Brown et al. 2009).



Tuberous grasspink (*Calopogon tuberosus*) (CSU Photo)

Hickory Creek Unit of BITH is 284 ha (701 ac) located in Tyler County, Texas. Elevation across the unit is generally level at 41 m (136 ft). A vascular flora by MacRoberts et al. (2002) documented 401 unique taxa. Previously identified vegetation communities include ephemeral pond, wetland pine savanna, upland pine savanna, and baygall (Marks and Harcombe 1981). Pine savanna community was once extensive in Hickory Creek Unit, but severe fire suppression resulted in shrub thickets shading out the diverse herbaceous layer. Wetland pine savannas of Hickory Creek Unit are particularly diverse and harbor rare species; several orchids such as snowy orchid (*Platanthera nivea*), Oklahoma grasspink (*Calopogon okalhomensis*), tuberous grasspink (*Calopogon tuberosus*), and lady's tresses, (*Spiranthes* spp.) have been documented (MacRoberts et al. 2002).

Turkey Creek Unit is located centrally in BITH with a total of 3,150 ha (7,783 ac) extending along Turkey Creek. The unit is in Tyler and Hardin counties with Kountze to the south and Woodville, Texas to the north. Elevations range from 45 m (150 ft) toward the north and 15 m (49 ft) at the southern extent near Turkey Creek. The unit is known for its diverse flora, vegetation communities, and 16 distinct soil types. Vegetation communities recognized by Marks and Harcombe (1981) include sandhill pine forest, upland pine forest, upper slope pine oak forest, mid slope oak pine forest, lower slope hardwood pine forest, floodplain hardwood pine forest, cypress tupelo forest, floodplain hardwood forest, baygall/stream, and ponds. Brown et al. (2005) conducted a vascular flora and documented 691 native and 47 non-native taxa from Turkey Creek Unit. This flora identified 123 families and 388 genera with 44% of family diversity from Asteraceae, Poaceae, Cyperaceae, Fabaceae, and Euphorbiaceae. The northeast portion of the unit harbors yellow trumpets pitcher plant (*Sarracenia alata*), several orchids, and rare species (Watson 2006). Shrub thickets are extensive and many areas in the unit are in desperate need of a consistent fire regime to restore sensitive habitat.

Beech Creek Unit consists of 2,059 ha (5,088 ac) and is located in Tyler County near Spurger, Texas in the northeast corner of BITH. Generally, the unit is flat with elevation ranging from 42 m (137 ft) at the southeastern edge by Little Beech Creek up to 62 m (203 ft) toward the north. Little Beech Creek flows south along the eastern edge of the unit and Beech Creek flows southeast across the unit center into Little Beech Creek. Beech Creek Unit was included in BITH because it has extensive stands of American beech (*Fagus grandifolia*) forests. Vegetation communities in the Beech Creek unit are dominated by lower slope hardwood-pine forest, with occurrences of baygall, mid-slope oak-pine forest, floodplain hardwood-pine forest, and floodplain hardwood forest (Marks and Harcombe 1981). Brown et al. (2008a) documented 470 unique vascular plant taxa of which 52 were non-native. This flora was representative of 103 families and 229 genera with the largest genera being *Carex*, *Dichanthelium*, *Rhynchospora*, *Juncus*, *Quercus*, and *Cyperus*. Several disturbance factors to Beech Creek unit are important to recognize. Management practices to control pine bark beetle in 1975 resulted in large damage to Beech Creek Unit vegetation (Watson 2006). Hurricane Rita in 2005 severely damaged the forest communities and was responsible for the destruction of thousands of trees including many old growth beech trees (Watson 2006). Additionally, fire suppression led to thick shrub thickets shading out fire-adapted herbaceous layers (Brown et al. 2008a).

The Loblolly Unit is 222 ha (549 ac) and is located on the Beaumont formation. Elevation is nearly level at about 30 m (98.4 ft) (Brown et al. 2008b). Due to poorly drained soils, standing water typically persists for days after heavy rainfall in the flatwoods. A vascular flora conducted by Brown et al. (2008b) of the Loblolly Unit documented 305 vascular plant taxa of which 34 (11%) were non-native species. Due to the lack of prairie species and remnant prairie habitat, the unit is recognized as flatland hardwood forest (Diggs et al. 2006) (Marks and Harcombe 1981).

Lance Rosier Unit is 10,100 ha (24958 ac) located in the south-central portion of BITH in Hardin County near Kountze, Texas. Elevation is generally flat and ranges from 14 m (46 ft) to 30 m (98 ft). Little Pine Island Bayou runs along the southern part of the unit forming floodplain habitat. A vascular flora documented 612 native taxa and 62 non-native taxa (Brown et al. 2006b). This floristic

inventory consisted of 114 families and 352 genera with the largest genera groups being *Carex*, *Dichanthelium*, *Rhynchospora*, *Cyperus*, *Quercus*, and *Juncus*. Vegetation communities in Lance Rosier Unit have an abundance of lower slope hardwood pine forest, with additional wetland pine savanna, flatland hardwood forest, floodplain hardwood forest, and baygall thicket (Marks and Harcombe 1981).



Jack Gore Baygall Unit: *Taxodium distichum* swamp (CSU Photo)

The Big Thicket region includes the seven counties encompassing Big Thicket National Preserve: Hardin, Polk, Tyler, Jasper, Orange, Jefferson, and Liberty counties. The region is known for its high occurrences of rare plants and one of the most diverse concentrations of endemic species on the West Gulf Coastal Plain with a total of 69 known endemics. Presence of regional xeric sandylands account for 59% of these endemic species (MacRoberts and MacRoberts 2008b). A total of 44 global (G) and state (S) ranked species that are critically imperiled G1 and S1 with five or fewer occurrences and imperiled G2 and S2 species with 6 – 20 occurrences are from the Big Thicket ecological region (Table 2). This list represents a combination of rare species occurrences from Big Thicket National Preserve and those known from herbarium occurrences in the Big Thicket region (NPS 2020, Kartesz 2015). Eight G1 species are known to occur in the area: *Agalinis navasotensis, Cuscuta attenuata, Hibiscus dasycalyx, Leavenworthia texana, Lesquerella pallida, Spiranthes brevilabris, Spiranthes*

*floridana,* and *Yucca cernua* (Table 2). Broad vegetation types that support rare species of the region listed in order from highest to lowest occurrences are: xeric sandylands, bogs/wetland pine savannas, upland pineland, barrens, baygalls, mixed hardwood forest, swamp, and bottomland hardwood forests (MacRoberts and MacRoberts 2008b).

For the counties in the Big Thicket region, MacRoberts and MacRoberts (2009) found that 247 taxa or 7.1% of the flora are non-native species. Table 3 lists 38 non-native invasive species from Big Thicket National Preserve, eight of which are considered to have a high ecological impact: *Albizia julibrissin, Alternanthera philoxeroides, Eichhornia crassipes, Ludwigia grandiflora, Lygodium japonicum, Polypogon monspeliensis, Poncirus trifoliata,* and *Triadica sebifera* (NPS 2020).

**Table 2.** Rare vascular plant species of counties in the Big Thicket region (NPS 2020).

| Scientific Name | Common Name | Federal/State status | G Rank | S Rank |
|---|---|---|---|---|
| *Agalinis navasotensis* | Navasota False Foxglove | Rare plant watch | G1 | S1 |
| *Agrimonia incisa* | Incised groovebur | None | G2 | S2 |
| *Amorpha paniculata* | Panicled indigobush | None | G2G3 | S2 |
| *Amorpha laevigata* | Smooth False Indigo | None | G3 | S1 |
| *Bartonia verna* | Texas Screwstem | Rare plant watch | G2 | S1 |
| *Carex decomposita* | Cypress knee sedge | None | G3G4 | S1 |
| *Carex lupuliformis* | False Hop Sedge | None | G4 | S1 |
| *Cuscuta attenuata* | Marsh-elder dodder | None | G1G3 | S2 |
| *Cyperus grayioides* | Mohlenbrock's sedge | None | G3 | S3 |
| *Cypripedium kentuckiense* | Southern Lady's-slipper Orchid | Rare plant watch | G3 | S1 |
| *Echinacea atrorubens* | Topeka purple-coneflower | None | G3 | S3 |
| *Eleocharis elongata* | Slim Spikerush | None | G5 | S1 |
| *Eleocharis wolfii* | Wolf's spikerush | None | G4 | S1 |
| *Gaillardia aestivalis* | White Fire-wheel | Rare plant watch | G5T2 | S2 |
| *Helianthus occidentalis* | Shinner's sunflower | None | G5T2T3 | S2S3 |
| *Hibiscus aculeatus* | Pineland Hibiscus | None | G4 | SNR |
| *Hibiscus dasycalyx* | Neches River Rose-mallow | None | G1 | S1 |
| *Hibiscus grandiflorus* | Swamp rose-mallow | None | G4 | SNR |
| *Hibiscus striatus* | Striped Rosemallow | None | G5 | SNR |
| *Hymenoxys texana* | Texas Prairie Dawn | Endangered | G2 | S2 |

**Table 2 (continued).** Rare vascular plant species of counties in the Big Thicket region (NPS 2020).

| Scientific Name | Common Name | Federal/State status | G Rank | S Rank |
|---|---|---|---|---|
| *Leavenworthia texana* | Texas Golden Gladecress | Endangered | G1 | S1 |
| *Lesquerella pallida* | White Bladderpod | None | G1 | S1 |
| *Liatris cymosa* | Branched Gayfeater | None | G2 | S2 |
| *Liatris tenuis* | Slender Gay-feather | Rare plant watch | G3 | S3 |
| *Phlox nivalis ssp. texensis* | Texas Trailing Phlox | Endangered | G4T2 | S2 |
| *Physostegia longisepala* | Long-sepaled False Dragon-head | Rare plant watch | G2G3 | S2 |
| *Platanthera chapmanii* | Chapman's orchid | None | G2 | S1 |
| *Platanthera integra* | Yellow fringeless orchid | None | G3G4 | S1 |
| *Proserpinaca intermedia* | Mackenzie's Mermaidweed | None | G4?Q | SNR |
| *Quercus arkansana* | Arkansas oak | None | G3 | S1 |
| *Rhynchospora indianolensis* | Indianola beakrush | None | G3Q | S3 |
| *Rhynchospora macra* | Large beakrush | None | G3 | S2 |
| *Rhynchospora nitens* | Short-beaked baldrush | None | G4 | S2 |
| *Rhynchospora pinetorum* | Gale Small's Beakrush | None | T3 | SNR |
| *Rudbeckia scabrifolia* | Bog Coneflower | Rare plant watch | G3G4 | S2 |
| *Schoenolirion wrightii* | Texas sunnybell | None | G3 | S3 |
| *Silene subciliata* | Scarlet Catchfly | Rare plant watch | G3 | S3 |
| *Spiranthes brevilabris* | Texas ladies'-tresses | None | G1G2 | S1 |
| *Spiranthes eatonii* | Eaton's Ladies-tresses | None | G3 | SNR |
| *Spiranthes floridana* | Florida Ladies-tresses | None | G1 | S1 |

**Table 2 (continued).** Rare vascular plant species of counties in the Big Thicket region (NPS 2020).

| Scientific Name | Common Name | Federal/State status | G Rank | S Rank |
|---|---|---|---|---|
| *Spiranthes parksii* | Navasota Ladies'-tresses | Endangered | G3 | S3 |
| *Trillium texanum* | Texas Trillium | Rare plant watch | G2 | S2 |
| *Yucca cernua* | Nodding Yucca | None | G1 | S1 |

**Table 3.** Non-native invasive species of Big Thicket National Preserve (NPS 2020).

| Scientific name | Common name | Ecological Impact | Management Difficulty |
|---|---|---|---|
| *Albizia julibrissin* | Mimosa | high/low | medium/low |
| *Alternanthera philoxeroides* | Alligator weed | high/medium | medium |
| *Bromus catharticus* | Rescue brome | not ranked | not ranked |
| *Citrus trifoliata* | Trifoliate orange | high | high |
| *Cynodon dactylon* | Bermudagrass | medium/low | high/medium |
| *Echinochloa colonum* | Jungle ricegrass | medium/insignificant | unknown |
| *Echinochloa crusgalli* | Barnyard grass | low insignificant | unknown |
| *Eichhornia crassipes* | Common water hyacinth | high/medium | high |
| *Elaeagnus pungens* | Thorny elaeagnus | low insignificant | high/low |
| *Hedera helix* | English Ivy | medium | medium/low |
| *Iris pseudacorus* | Paleyellow iris | medium/low | high/medium |
| *Kummerowia striata* | Common lespedeza | low | medium/insignificant |
| *Lagerstroemia indica* | Crapemyrtle | low/insignificant | unknown |
| *Lespedeza cuneata* | Chinese lespedeza | medium | medium |

**Table 3 (continued).** Non-native invasive species of Big Thicket National Preserve (NPS 2020).

| Scientific name | Common name | Ecological Impact | Management Difficulty |
|---|---|---|---|
| *Ligustrum lucidum* | Glossy privet | medium/low | high/low |
| *Ligustrum sinense* | Chinese privet | medium | low |
| *Lolium arundinaceum* | Tall fescue | medium | high/medium |
| *Lolium perenne* | Italian ryegrass | medium | medium/insignificant |
| *Lonicera japonica* | Chinese honeysuckle | medium | high/medium |
| *Ludwigia grandiflora* | Primrose-willow | high | high/medium |
| *Lygodium japonicum* | Japanese climbing fern | high/medium | medium |
| *Lysimachia foemina* | Scarlet pimpernel | medium/insignificant | medium/insignificant |
| *Melia azedarach* | Chinaberry | medium/low | medium/low |
| *Melilotus indicus* | Annual yellow sweetclover | low/insignificant | high/low |
| *Morus alba* | White mulberry | medium/low | medium/low |
| *Myriophyllum aquaticum* | Brazilian watermilfoil | medium | high |
| *Paspalum notatum* | Bahia grass | unknown | unknown |
| *Perilla frutescens* | Beefsteakplant | low/insignificant | low |
| *Phyllostachys aurea* | Golden bamboo | medium/low | medium/low |
| *Poa annua* | Annual blue grass | medium/insignificant | high/low |
| *Polypogon monspeliensis* | annual rabbit's foot grass | high/low | high/medium |
| *Potentilla indica* | India | insignificant | low |
| *Pyrus calleryana* | Callery pear | low/insignificant | medium/low |
| *Rumex crispus* | Curley dock | low/insignificant | medium/low |

**Table 3 (continued).** Non-native invasive species of Big Thicket National Preserve (NPS 2020).

| Scientific name | Common name | Ecological Impact | Management Difficulty |
|---|---|---|---|
| *Sorghum halepense* | Aleppo milletgrass | medium/low | high/medium |
| *Triadica sebifera* | Tallowtree | high | high/medium |
| *Trifolium repens* | Dutch clover | medium/low | medium/insignificant |
| *Verbascum thapsus* | Common mullein | medium/low | low |
| *Vicia hirsuta* | Tiny vetch | low/insignificant | unknown |

## Current Natural Resource Management Issues[2]

A recent report by Nadeau et al. (2016) examined natural resources at BITH, focusing on resources that are especially important to park managers. The report described a number of issues that threaten important natural resources within the preserve.

### *Urban Development and Land Use*

The units of the preserve are scattered near significant and growing urban areas. Beaumont, Texas, adjacent to the Beaumont Unit, is populated by over 100,000 people (USCB 2015). The areas north of Beaumont are not densely populated, but the proximity to multiple urban and industrial centers, including Beaumont, Galveston, and Houston, has exposed the preserve to impaired water and air quality, terrestrial and aquatic disruption, and invasion by exotic plant and animal species (Cooper et al. 2004).

### *Water Threats*

Past land uses and management have impacted hydrologic patterns and water quality. Construction of dams and saltwater barriers have altered the hydrology and confined channels in some parts. Dams have impounded rivers and creeks, which impair the ability of certain fish and larval-stage freshwater mussel species to migrate up and down stream to critical spawning habitats. The altered flow regimes have also been implicated in the decline of freshwater mussels in large rivers such as the Neches River. Sources of industrial effluent can impact aquatic resources in the preserve. These sources include oil and gas production waste, sewage treatment facility effluent, paper/pulp mill effluent, as well as land use within the watersheds contributing to storm water runoff. Parking lots, streets, and bare land contribute large amounts of contaminants via runoff into creeks and rivers during storm events (Hughs et al. 1987). Saltwater intrusion due to changes in the Sabine-Neches Waterway (near the saltwater barrier) and climate change related sea-level rise is a concern. The permanent saltwater barrier has been shown to disrupt the spawning migration of paddlefish and may have contributed to the drastic decline of this species (Hughs et al. 1987, Jennings and Zigler 2000).

### *Altered Fire Regimes*

Of the total acreage of preserve land and corridors, there are between 6,070 and 8,094 ha (15,000-20,000 ac) of highly fire-dependent ecosystems (Ken Hyde, BITH Chief of Resources Management, personal communication, 2016). Over the past 100-150 years, vegetation communities and floristics within much of the Big Thicket region have undergone human-induced changes. Primarily, repeated logging, the absence of fire since the early 1900s, fire suppression, and other human activities have shifted the open pine savannas and sandhills with dense herbaceous understories to mixed pine/hardwood with dense brush understories (McHugh 2004). For the past 20-30 years, the preserve's prescribed burn program has worked to control brush that accumulated during the fire suppression era. The goal of the program is to eventually restore the longleaf pine ecosystem. So far, the removal of brush using prescribed burning has begun to convert loblolly pine stands to areas with longleaf pine seedlings and saplings (McHugh 2004). The fire-managed units in the preserve include

[2] Adapted from Nadeau et al. (2016)

Big Sandy Creek, Hickory Creek Savannah, Turkey Creek, Beech Creek, Lance Rosier, Loblolly, Big Sandy Creek Corridor and Canyonlands (McHugh 2004).

### *Invasive/exotic Animals and Plants*

Several non-native plants and animals are a significant concern to BITH managers. Chinese tallow (*Triadica sebiferum*), a deciduous invasive tree, has been implicated in the reduction of desirable forest habitat used by migratory bird species (Cooper et al. 2004). Water hyacinth (*Eichhorinia crassipes*) is an exotic invasive aquatic plant that impacts wetlands and aquatic habitats. Both the Chinese tallow tree and the water hyacinth are of particular concern in water corridors (Cooper et al. 2004). Japanese climbing fern (*Lygodium japonicum*) and trifoliate orange (*Ponicurus trifoliate*) are two recent plant invaders causing habitat impacts along forest edges and near waterways. Nine-banded armadillos (*Dasypus novemcinctus*), red imported fire ants (RIFA) (*Solenopsis invicta*), grass carp (*Ctenopharyngodon idella*), zebra mussels (*Dreissena polymorpha*), nutria (*Myocastor coypus*), feral hogs, dogs (*Canidis lupus*), and cats (*Felis catus*) are all present and pose a threat to the local ecology of the BITH units and corridors (Cooper et al. 2004).

An estimated 1.5 to 2 million feral hogs are present in Texas and have caused extensive damage to natural areas (Mapston 2004). Chavarria et al. (2007) surveyed impacts of feral hogs in BITH units with the highest reported disturbance (percentage of total unit area damaged is in parentheses): Big Sandy Creek Unit (34%), Turkey Creek Unit (28%), and Lance Rosier Unit (21%). Mesic vegetation communities had the highest concentration of feral hog impacts with 33% of wetland pine woodlands from Lance Rosier, 46% of flatwoods from Turkey Creek Unit, and 45% of floodplains from Big Sandy Creek Unit damaged by feral hogs. These results suggest that the perennial herbaceous layer in BITH has been negatively affected from feral hog disturbance.

### *Climate Change*

Global climate change (GCC) is expected to significantly impact the Gulf Coast region during this century. Some areas within the preserve are especially vulnerable to impacts from drought and sea level rise, increased flooding, saltwater intrusion into freshwater wetlands, and coastline erosion (Guntenspergen and Vairin 1998). More acute effects to the area involve increases in the severity and frequency of tropical storms (Guntenspergen and Vairin 1998, Mann and Emanuel 2006). BITH is especially concerned with losing a significant portion of the cypress-tupelo swamps due to saltwater intrusion in the portion of the Beaumont Unit below the saltwater barrier on the Neches River. Climate change may also alter the frequency, intensity, and timing of hurricanes and floods in the region (Harcombe et al. 1999).

# Vegetation Inventory and Classification

## Methods

Vegetation classification was conducted following NPS methodology presented in Lea (2011).

## Legacy Data

A variety of legacy data sources support vegetation classification. Legacy data were evaluated using the TNC and NPS (2009) framework (Table 4, Table 5).

**Table 4.** Summary of legacy data evaluation using TNC and NPS (2009) criteria.

| Category | Description |
|---|---|
| I | Data are adequate for classification and mapping (i.e., the data are geo-referenced, represent existing vegetation, and contain sufficient structural, compositional and site information to place the sample within the standard classification framework). |
| II | Data are adequate to assist in photo interpretation, photographic signature key development, or map accuracy assessment (i.e., the vegetation and site information are of lower quality, but the samples represent existing vegetation and are geo-referenced with reasonable confidence). |
| III | Data can be used for vegetation classification and characterization of a vegetation type within the park, but not for mapping or analysis because the sample is not adequately georeferenced, contains inadequate detail in the vegetation information, and/or may not represent existing vegetation at the sample location. |
| IV | Dataset was assessed and found to be not useful at any level. |
| V | Dataset was not available for assessment. |

**Table 5.** Legacy data sources and ratings for use in classification and mapping.

| Data Source Citation | Description | Legacy Data Category |
|---|---|---|
| Blanton & Associates, Inc. (2002) | Oil and Gas Impact Surveys | III |
| Dixie Environmental Services Co. (2005) | Oil and Gas Impact Surveys | III |
| Dixie Environmental Services Co. (2009) | Oil and Gas Impact Surveys | III |
| Dixie Environmental Services Co. (2013) | Oil and Gas Impact Surveys | III |
| Marks and Harcombe (1981) | Vegetation Map | III |

Preexisting data were all ranked as Category III. Vegetation surveys for Oil and Gas exploration were conducted extensively through Lance Rosier, Big Sandy Creek, Turkey Creek, and Beaumont units (Blanton and Associates 2002, DESCO 2005, 2009, 2013). These oil and gas surveys contained detailed vegetation information along with USNVC alliances and associations for specific locations. These were initially ranked as Category II and intended for use in the classification and interpretation phases. However, field crews revisited many of these locations during the project and the vegetation

at these sites had changed drastically in the past 10 to 15 years. These data were therefore ultimately classified as category III and had very limited value for mapping and interpretation.

Previous data collected by Marks and Harcombe (1981) were especially useful for this project. The broad communities described by Marks and Harcombe helped guide our classification and mapping models. However, as with the DESCO data, much of the vegetation at their study locations had changed significantly.

## Sample Design

### *Sample Size*

Based on the number of types identified by the preliminary classification, it was estimated that approximately 300 vegetation classification plots would be needed to represent approximately 110 vegetation types. Additional data from 100 to 200 observation points were targeted to support the mapping process.

### *Sampling Strata*

Accessibility and Safety Layer

Areas with deep water or the presence of dangerous species (e.g., alligators) were considered inaccessible or too hazardous for field work. Several wetland areas on the lower Neches River have deep freshwater marshes and swamps. These areas are excellent habitat for alligators and the dense vegetation makes foot travel very difficult. Due to the remoteness and hazards, field crews avoided the wetlands and observed vegetation through binoculars.

### *Plot Allocation*

To aid field crews in capturing the diversity of vegetation communities, target destinations were selected prior to field work using aerial imagery and examination of legacy sources such as Marks and Harcombe (1981) and LANDFIRE data. Opportunistic plot sampling was also a prime form of data collection. Crews located good examples in the field from a preliminary community list or recurring unique habitats and surveyed vegetation plots or collected an observation point. Randomly assigned points were treated as either vegetation classification plots or observation points.

## Vegetation Data Collection

Vegetation classification plots were sampled in the summer of 2016 by 2 two-person crews and a crew leader. Crews were housed at the Big Thicket Research Station in Saratoga, Texas.

## Plot Sampling

The goal of the vegetation classification sampling was to survey a minimum of three plots per vegetation association and to document as many vegetation types as possible within the park. Crews used project area maps with target locations and a list of 110 potential vegetation types. Since BITH is diverse with many remote regions, crew members were hired for their ability to work in variable outdoor conditions, to hike extended distances, and to make careful and effective choices to optimize route efficiency.

Crew members were provided with a field manual describing the field forms and plot sampling methodology, backcountry safety, plant species lists, standardized plant species codes, and field tablets and GPS units loaded with random and subjective plot locations to help disperse the effort across ecological types, gradients, and preserve management units.

Field forms documented the plot location, environmental attributes, vegetation attributes, and comments/notes (Table 6).

**Table 6.** Specific attributes recorded on the vegetation plot form.

| Category | Data Elements |
|---|---|
| Location Information | Plot code, plot type, survey date, surveyors, provisional community name, UTM zone and coordinates, GPS accuracy, comments, plot shape, plot dimensions, camera number, photo numbers, representativeness of the vegetation to the provisional association, and representativeness of the plot within the stand. |
| Environmental Attributes | Slope, aspect, topographic position, landform, surficial geology, Cowardin class, hydrology, soil texture, soil drainage, percent ground cover, and environmental comments. |
| Vegetation Attributes | Leaf phenology, leaf type, physiognomic class, height class, cover class, dominant species by strata, vegetation comments, species list for all species in the plot indicating stratum and cover class, and any additional species outside the plot. |

Plot locations were all located in front-country less than approximately 3 hours travel time by vehicle and foot to a plot. Many sites along the river corridors were accessed via boat. During the classification and interpretation phases GULN and BITH staff provided boat support to and from the wetland areas along the Neches River.

***Overview of the data collection and plot sampling process***

Efficient sampling required careful planning and consideration of the proximity of sampling plots to roads, trails, topography, and vegetation. Crews planned routes to collect the most plots in the most different potential vegetation types while minimizing travel time.

Crews navigated to plots via motor vehicle, boat, or foot travel using a compass and GPS-enabled tablets running Collector for ArcGIS software. After arriving at a selected site, crews examined the habitat to understand plot vegetation characteristics, determine if the plot was representative of the vegetation, and determine if the plot met the 0.5 ha (1.2 ac) minimum mapping unit size.

If the plot was too heterogeneous or too close to an ecotone, crews moved the plot center (within the standards of project methodology) to a position having more homogeneous structure and/or composition. If the plot was opportunistic, crews determined whether the plot represented a provisional community type still needing to be sampled, and if so, sampled it using either a classification plot or an observation point. Vegetation plots record canopy cover by species along with vegetation structure and environmental attributes within the 400 $m^2$ plot. Observation points document the structure, dominant species in each stratum, and environmental attributes of a dimensionless plot. Data for observation points are collected using the same forms and instructions as

for full vegetation plots, but the information gathered is less detailed. Observation points are very useful for the photo interpreters as training/reference sites.

While navigating to and from sampling locations, crew members paid attention to the vegetation types they were passing through. If they observed a new or different undocumented vegetation type, they established an opportunistic vegetation plot.

At each sampling location, plot layout and data collection followed NPS VMI Program protocols (Lea 2011). The GPS UTM coordinates of plot centers were recorded and plots were not monumented. Using the plot center as a reference, the crew laid out a plot using measuring tapes and flagging according to the size and shape specified in the field manual for that vegetation type; plots surveyed a 400 $m^2$ area. Plots consisting of forest, woodland, and shrubland vegetation were typically 20 x 20 m with plot shape adapted to best fit the existing vegetation. Circular plots with an 11.3 m radius were used in areas with dwarf shrub and herbaceous vegetation and linear 10 x 40 m plots were used to measure narrow communities such as those in riparian areas and backwater sloughs.

Following plot setup crews analyzed the vegetation structure by visually dividing vegetation into strata and recorded dominant species and percent cover in each stratum. Crews developed a comprehensive plot species list by recording the species name and canopy cover class for each stratum. Cover values were assessed using cover ranges from a twelve-category scale (Table 7). Crews selected the cover range that best represented the actual cover of the species in the stratum. The midpoint of the cover range is used for quantitative analysis.

**Table 7.** Canopy cover classes used for plot sampling.

| Cover Class | Cover Range (%) | Midpoint (%) |
|---|---|---|
| Trace | 0-1 | 0.5 |
| Present | 1-5 | 3.0 |
| 1 | 5-15 | 10 |
| 2 | 15-25 | 20 |
| 3 | 25-35 | 30 |
| 4 | 35-45 | 40 |
| 5 | 45-55 | 50 |
| 6 | 55-65 | 60 |
| 7 | 65-75 | 70 |
| 8 | 75-85 | 80 |
| 9 | 85-95 | 90 |
| 10 | >= 95 | 97.5 |

Recorded data included a relative measure of how well plot vegetation represented the surrounding vegetation as well as site environmental characteristics such as landform, slope, aspect, topographic position, soil texture, and percent ground cover.

All data were collected using iPad Pro tablets, Collector for ArcGIS, and paper field forms. Plot photos were taken with iPad cameras and linked to Collector points according to cardinal directions (north, east, south, and west). If crews were unable to take cardinal direction photos due to thick vegetation, a single representative photograph of the overall plot was taken.

Before removing plot markers, crews assigned one of the preliminary vegetation types to the plot. If the plot did not fit into a known vegetation type, the crew assigned a provisional type based on the dominant species in the top two strata. When the plot information was complete, crews navigated to the next nearest plot. Plant species recorded during plot sampling are listed in Appendix C.

## Classification

### *Data Management*

Field forms were reviewed for accuracy and completeness and data were entered into NPS PLOTS database version 4.0 (CNHP 2015). Corrections were recorded in red with the reviewer's initials and the date. Data entered into the PLOTS database were subject to a quality control process that involved examining, sorting, and querying data to locate missing or erroneous information such as misspellings, duplicate entries, or typographical errors. Plant taxa were entered into the database using the USDA NRCS PLANTS Database (USDA 2019) approved names and plant codes. Recorded species lists for each plot were compared to the field-assigned vegetation type to ensure agreement.

Each plot or observation point was labeled with the provisional classification name the crews assigned in the field. The provisional classification was a subjective classification based on the plot composition and vegetation structure.

Photos collected at vegetation and observation plots were uploaded to the BITH vegetation inventory folder and renamed using a convention indicating the park name, plot number and cardinal direction in which the photo was taken.

### *Vegetation Classification*

Vegetation plot data were classified to plant community using a combination of quantitative multivariate analysis and expert opinion. The quantitative analysis was completed using data from the 304 vegetation classification plots that passed quality control and were entered into PLOTS 4.0 database. Prior to being analyzed, observation point data that did not include detailed species and cover values were removed from the classification dataset.

A list of species and their associated cover data for the 304 vegetation classification plots was exported from the PLOTS 4.0 database. The mid-point of each cover class range was used as a discrete cover value for analysis. Since most species tend to dominate in a single stratum for a given plot each species' cover values for all strata were summed with a maximum cover of 100%. Cover class midpoints were used for all quantitative and descriptive purposes. Canopy cover values for all

strata combined was organized into a plot-by-species matrix. Text files were then imported into the multivariate statistics software package PC-ORD version 6.0 (McCune and Mefford 2011).

A *priori* breaks in the dataset were based on physiognomy (e.g., wooded, shrubland, herbaceous) of the dominant species in the uppermost strata of the plots. The divisions roughly stratified the data by physiognomic groups and simplified the analysis to prevent ecologically-unrelated community types from being compared. Plots that had only one or two strongly dominant species and that did not relate to other plots (e.g., cypress swamp with 90% *Taxodium distichum*) were separated out for analysis using qualitative expert review.

Each of the groups was analyzed using hierarchical cluster analysis applying the Sorenson (Bray-Curtis) distance measure method and group average linkage method (McCune and Grace 2002). The output of the analysis suggested natural groupings of plots for comparison with the concepts of the USNVC associations in the preliminary classification. Decisions on how to refine the dendrograph were first based on natural groupings and then manual data analysis behind the plot groupings. This analysis considered environmental characteristics of the plot and species composition, as well as the field crew provisional plot community name. When association-level classification was necessary, further group division involved examining plot data such as species composition, environmental data, and plot notes using Microsoft Access and Microsoft Excel. Using these combined data, plots were assigned to existing USNVC associations or given provisional names. Classification of observation point data to USNVC types was also based on this approach. Provisional associations, or "park specials", were created to represent associations when we were unable to confidently assign an existing USNVC type. Park special types are not currently part of the USNVC.

Field reconnaissance visits to verify map classes also identified existing USNVC associations that were not captured during the classification collection phase. These associations were documented and added to the list of associations classified in the park.

#### *Association Descriptions*

Vegetation descriptions of each association found at BITH were developed from the plot data and are referred to as "local descriptions." Included in each local description is the USNVC hierarchy placement, typical environmental setting, plots of occurrence, and vegetation composition, structure, stratum, and dominance. In comparison, the published global descriptions incorporate all known plot data across the type's entire range. Typical global types occur across a wide geographic range resulting in broader characteristic descriptions. These global environmental and vegetation descriptions were compiled for the BITH project. Local and global descriptions for BITH associations are provided in Appendix A.

#### *Field Key to the Community Types*

A dichotomous field key to communities was developed (Appendix B). The key is stratified by physiognomy and topography (sub-keys) and written to be nominally redundant for those types with confusing physiognomy and classification. Built-in redundancy enables the same association to be identified from multiple sub-keys. For instances, a type that occurs both as a shrubland or a woodland community can be found in both sub-keys for each respective physiognomic group.

## Results

A total of 102 distinct BITH vegetation communities including USNVC associations and park specials were identified. Of these associations, forest and woodland communities are the most abundant at BITH.

### *Vegetation Data Collection*

Prior to field sampling, the preliminary classification included 110 USNVC vegetation types. This list of preliminary communities was created during the development of the CSU technical proposal, based on previous field surveys and ranges of associations in Texas. Field crews provisionally assigned 59 associations from the preliminary list of USNVC associations and 51 communities that were not listed in the preliminary classification.

Over the course of the field season a total of 414 vegetation plots and observation points were established within the BITH project area (Figure 5). Of these, 304 were full vegetation plots and 110 were observation points.

A total of 614 plant species were encountered at BITH. The most common species were *Pinus taeda, Liquidambar styraciflua*, *Ilex vomitoria*, *Quercus nigra*, *Vitis rotundifolia*, *Ilex opaca*, and *Triadica sebifera*.

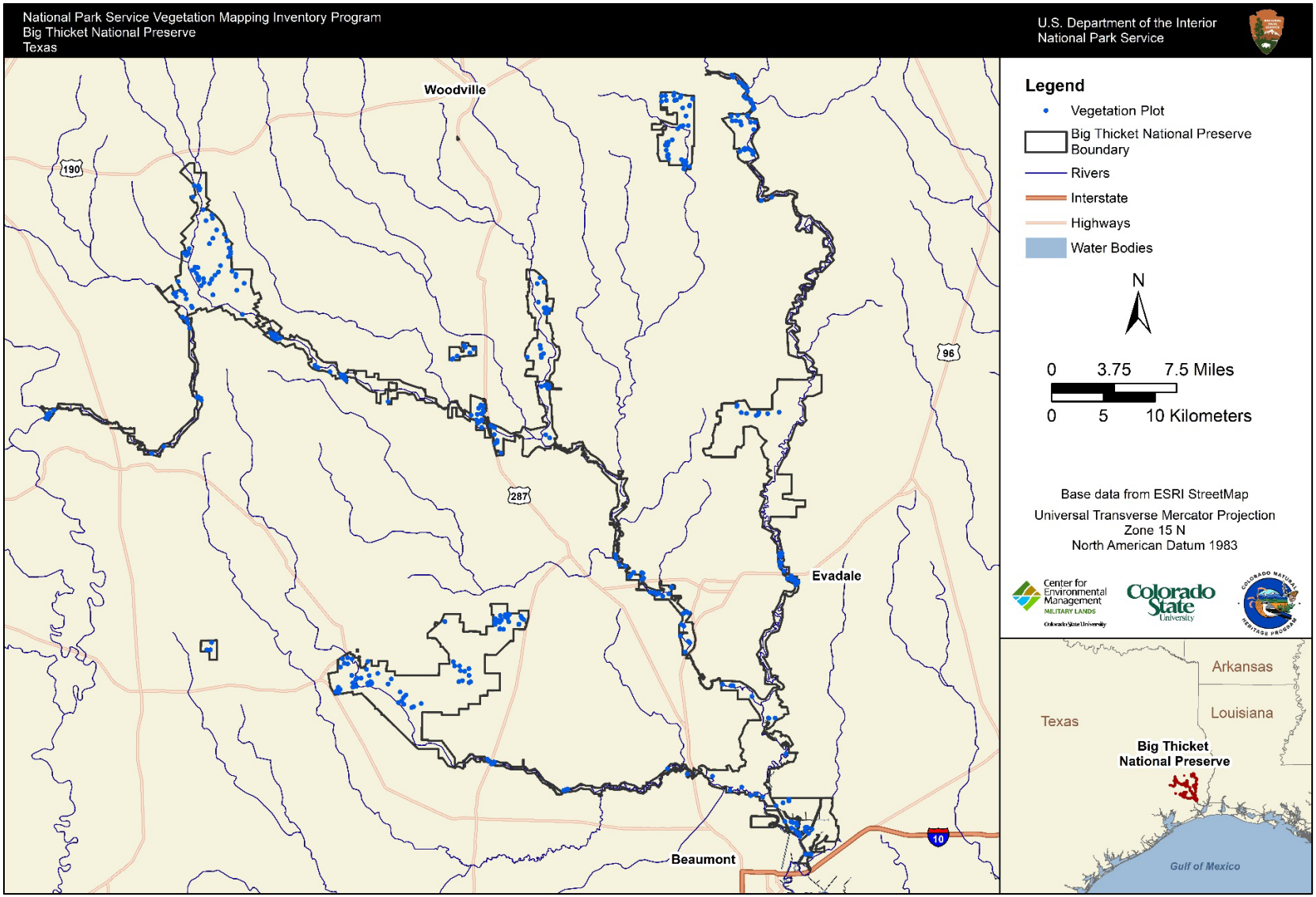



**Figure 5.** Distribution of vegetation classification plots. (Data sources: ESRI StreetMap, NPS)

***Vegetation Classification***

The vegetation classification at BITH consists of 102 associations or park specials: 80 forest or woodland, 7 shrubland, 12 herbaceous, and 3 sparse vegetation types. Currently 27 types not in the USNVC are classified as park specials. Of the 414 classification plots and points, there are 375 forest or woodland types, 10 shrubland types, 28 herbaceous types, and 1 sparse vegetation type. A complete list of vegetation classification plots and observation points and their classified vegetation community type is included in Appendix D. See Appendix A for descriptions of BITH vegetation types. In the discussion below, cultural vegetation type codes begin with "CS", USNVC vegetation types begin with "CEGL", and park specials not found in the USNVC begin with "NPSBITH".



*Hymenocaulis liriosome* (CSU photo)

Forest and woodland types at BITH were dominated by *Pinus taeda*, *Liquidambar styraciflua*, *Ilex opaca, Ilex vomitoria*, *Quercus nigra*, and *Vitis rotundifolia* (Table 8).

**Table 8.** Forest and woodland types documented at BITH.

| ELCODE | Association Name |
|---|---|
| CST007170 | *Pinus elliottii* var. *elliottii* Forest Plantation |
| CST007179 | *Pinus taeda* Forest Plantation |
| NPSBITH017 | *Pinus taeda* Regenerating Plantation Shrubland |
| CEGL007142 | *Pinus taeda* Riparian Forest |
| CEGL007069 | *Pinus taeda* - (*Pinus echinata*) - *Quercus* (*pagoda*, *phellos*) Wet Woodland |
| CEGL007715 | *Quercus michauxii* - *Quercus* (*nigra*, *pagoda*) - *Liquidambar styraciflua* - *Pinus taeda* Wet Forest |
| CEGL008587 | *Quercus stellata* - *Pinus taeda* Flatwoods Wet Forest |

**Table 8 (continued).** Forest and woodland types documented at BITH.

| ELCODE | Association Name |
|---|---|
| NPSBITH009 | *Pinus taeda* / *Ilex coriacea* - (*Cyrilla racemiflora*) Wet Flatwood Woodland |
| NPSBITH012 | *Pinus taeda* - *Magnolia grandiflora* - (*Fagus grandifolia*, *Quercus alba*, *Quercus falcata*) Flatwoods Forest |
| CEGL003530 | (*Magnolia virginiana*) / *Ilex coriacea* - *Morella caroliniensis* Seepage Bog |
| CEGL007474 | *Nyssa biflora* - *Magnolia virginiana* - *Quercus laurifolia* / *Cyrilla racemiflora* - *Rhododendron oblongifolium* Swamp Forest |
| CEGL007904 | *Magnolia virginiana* - *Nyssa sylvatica* - *Acer rubrum* / *Morella caroliniensis* / *Woodwardia areolata* Swamp Forest |
| NPSBITH018 | *Cyrilla racemiflora* Seepage Bog Shrubland |
| NPSBITH007 | *Acer rubrum* Floodplain Forest |
| CEGL004773 | *Salix nigra* / (*Cephalanthus occidentalis*) Swamp Forest |
| CEGL007410 | *Salix nigra* - (*Platanus occidentalis*, *Populus deltoides*) Southern Floodplain Forest |
| NPSBITH002 | *Betula nigra* Mixed Hardwood Riverine Forest |
| CEGL007412 | *Triadica sebifera* Ruderal Wet Forest |
| CEGL002427 | *Fraxinus pennsylvanica* - *Ulmus Americana* - *Celtis laevigata* / *Ilex decidua* Floodplain Forest |
| CEGL004753 | *Fraxinus caroliniana* Swamp Forest |
| NPSBITH013 | *Nyssa aquatica* - (*Taxodium disticum*) / *Zizaniopsis milliacea* Marsh Woodland |
| CEGL002104 | *Taxodium distichum* - *Platanus occidentalis* Edwards Plateau Floodplain Forest |
| CEGL002419 | *Nyssa aquatica* Swamp Forest |
| CEGL002421 | *Taxodium distichum* - (*Nyssa aquatica*) / *Forestiera acuminata* - *Planera aquatica* Floodplain Forest |
| CEGL007422 | *Taxodium distichum* - *Nyssa aquatic* - *Acer rubrum* / *Itea virginica* Floodplain Forest |
| CEGL007429 | *Nyssa aquatica* - *Nyssa biflora* Swamp Forest |
| CEGL002420 | *Taxodium distichum* / *Lemna minor* Floodplain Forest |
| CEGL007335 | *Platanus occidentalis* - *Liquidambar styraciflua* - (*Ulmus americana*) / (*Crataegus viridis*) Floodplain Forest |
| CEGL007370 | *Quercus phellos* - *Liquidambar styraciflua* / *Ilex decidua* - *Carpinus caroliniana* / *Lysimachia radicans* Floodplain Forest |
| CEGL007397 | *Quercus lyrata* - *Carya aquatica* Floodplain Forest |
| CEGL007804 | *Quercus laurifolia* - *Liquidambar styraciflua* - *Nyssa biflora* - *Acer rubrum* / *Sabal minor* Floodplain Forest |
| CEGL007906 | *Quercus michauxii* - *Liquidambar styraciflua* - *Quercus texana* - *Quercus lyrata* Floodplain Forest |

**Table 8 (continued).** Forest and woodland types documented at BITH.

| ELCODE | Association Name |
|---|---|
| CEGL007953 | *Quercus nigra* - *Ulmus alata* / *Ostrya virginiana* Floodplain Forest |
| CEGL007954 | *Quercus nigra* - *Quercus phellos* / *Carya myristiciformis* - *Sabal minor* / *Carex cherokeensis* Floodplain Forest |
| CEGL007984 | *Quercus nigra* - *Liquidambar styraciflua* / *Ilex opaca* - *Vaccinium fuscatum* / *Carex debilis* Floodplain Forest |
| NPSBITH006 | *Liquidambar styraciflua* Ruderal Forest |
| CEGL004638 | *Quercus nigra* Ruderal Forest |
| CEGL007845 | *Quercus alba* - *Quercus* (*michauxii*, *nigra*) / *Ilex opaca* / *Chasmanthium laxum* Forest |
| CEGL007961 | *Quercus laurifolia* - *Quercus phellos* / *Viburnum dentatum* - (*Sebastiania fruticosa*) / *Carex glaucescens* Upper West Gulf Wet Flatwoods Forest |
| CEGL007980 | *Quercus alba* - *Carya alba* / *Symplocos tinctoria* / *Mitchella repens* Forest |
| CEGL008576 | *Quercus phellos* / *Chasmanthium laxum* Wet Forest |
| CEGL003619 | *Pinus taeda* - *Quercus hemisphaerica* / *Osmanthus americanus* / *Ilex glabra* Woodland |
| CEGL004911 | *Pinus taeda* - *Liquidambar styraciflua* - *Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest |
| CEGL007899 | *Quercus pagoda* - *Liquidambar styraciflua* - *Pinus taeda* Floodplain Forest |
| CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| CEGL007910 | *Pinus taeda* - *Quercus phellos* - *Quercus nigra* Riparian Forest |
| CEGL007955 | *Pinus taeda* - (*Quercus* spp.) / *Ostrya virginiana* - *Sabal minor* Forest |
| CEGL008574 | *Fagus grandifolia* - *Quercus* (*laurifolia*, *nigra*) - *Pinus taeda* Forest |
| CEGL004713 | *Pinus echinata* - *Pinus taeda* - *Quercus* (*alba*, *falcata*, *stellata*) Forest |
| CEGL007320 | *Fagus grandifolia* - *Pinus taeda* - (*Liquidambar styraciflua*, *Magnolia grandiflora*, *Quercus alba*) Small Stream Forest |
| CEGL007525 | *Pinus taeda* - *Quercus alba* - (*Fagus grandifolia*) / *Smilax pumila* - *Mitchella repens* Forest |
| CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| CEGL007208 | *Fagus grandifolia* - *Quercus alba* / *Ilex opaca* var. *opaca* / *Athyrium filix-femina* ssp. *asplenioides* Forest |
| CEGL007872 | *Fagus grandifolia* - *Magnolia grandiflora* - *Quercus alba* / *Carpinus caroliniana* - *Ostrya virginiana* Forest |
| CEGL007959 | *Quercus alba* - *Quercus hemisphaerica* / *Prunus caroliniana* - *Persea borbonia* - *Viburnum acerifolium* Forest |
| CEGL008415 | *Quercus falcata* - *Quercus stellata* - (*Pinus taeda*) West Gulf Coastal Plain Forest |
| CEGL008581 | *Quercus alba* - *Quercus nigra* / *Ostrya virginiana* / *Sabal minor* Forest |

**Table 8 (continued).** Forest and woodland types documented at BITH.

| ELCODE | Association Name |
|---|---|
| NPSBITH024 | *Quercus michauxii* – *Quercus nigra* – *Magnolia grandiflora* Mesic Forest |
| CEGL007751 | *Quercus hemisphaerica* - *Quercus* (*falcata*, *nigra*) / *Vaccinium arboreum* / *Cnidoscolus stimulosus* Forest |
| CEGL008413 | *Quercus alba* - *Carya alba* / *Chasmanthium sessiliflorum* West Gulf Coastal Plain Forest |
| CEGL008414 | *Quercus alba* - *Quercus falcata* - *Quercus stellata* - *Nyssa sylvatica* / *Carex cherokeensis* Forest |
| CEGL002112 | *Pinus taeda* - *Quercus stellata* / *Crataegus* spp. Woodland |
| CEGL007800 | *Pinus echinata* - *Quercus stellata* - *Quercus falcata* - *Carya texana* Woodland |
| CEGL006011 | *Pinus taeda* / *Liquidambar styraciflua* - *Acer rubrum* / *Vaccinium stamineum* Ruderal Forest |
| CEGL006327 | *Pinus echinata* Ruderal Forest |
| CEGL007115 | *Pinus taeda* - *Pinus echinata* / *Chasmanthium sessiliflorum* Ruderal Forest |
| CEGL007528 | *Pinus taeda* - (*Pinus echinata*) - *Quercus falcata* - *Carya texana* / *Vaccinium arboreum* Forest |
| CEGL007947 | *Pinus echinata* - (*Pinus taeda*) - *Quercus falcata* / *Dichanthelium sphaerocarpon* Forest |
| CEGL003609 | *Pinus palustris* - *Pinus* (*echinata, taeda*) / (*Liquidambar styraciflua*) */ Schizachyrium scoparium* Ruderal Woodland |
| CEGL007162 | *Pinus palustris* / *Morella cerifera* - *Morella caroliniensis* - *Ilex coriacea* Ruderal Wet Woodland |
| CEGL008571 | *Pinus palustris* - *Pinus* (*echinata, taeda*) - *Quercus falcata* - *Carya texana* Woodland |
| NPSBITH016 | *Pinus* spp. (*taeda*, *echinata*, *elliotti*, *palustris*) Regenerating Woodland and Shrubland |
| CEGL007157 | *Pinus elliottii* - (*Pinus palustris*) / *Morella cerifera* - *Ilex coriacea* Ruderal Wet Woodland |
| CEGL007065 | *Taxodium distichum / Morella cerifera / Thelypteris palustris* Tidal Woodland |
| NPSBITH015 | *Ilex coriacea* – *Prunus caroliniana* Dense Evergreen Forest and Shrubland |
| CEGL007871 | *Quercus laurifolia* - (*Quercus nigra*, *Nyssa biflora*) / *Diospyros virginiana* Wet Forest |
| NPSBITH008 | *Acer rubrum* - (*Triadica sebifera*) / *Morella cerifera* Swamp Woodland |
| NPSBITH025 | *Nyssa biflora - Acer rubrum - (Triadica sebifera) / Morella cerifera / Saccharum giganteum* Swamp Woodland |
| NPSBITH026 | *Pinus taeda – Nyssa biflora – Magnolia virginiana / Andropogon glomeratus* Wet Woodland |
| NPSBITH027 | *Pinus taeda – Nyssa biflora – Quercus laurifolia* Circular Depression Flooded Flatwood Forest |

Shrublands only represent a small portion of the BITH. The uppermost strata of these communities were dominated by *Pinus taeda*, *Ilex vomitoria*, *Triadica sebifera*, *Liquidambar styraciflua*, and/or *Callicarpa americana* (Table 9).

**Table 9.** Shrubland types documented at BITH.

| ELCODE | Association |
|---|---|
| NPSBITH004 | *Sesbania drummondii* – (*Morella cerifera*) / *Juncus effusus* Ruderal Wet Shrubland |
| NPSBITH001 | *Quercus hemisphaerica* Shrubland |
| CEGL002191 | *Cephalanthus occidentalis / Carex* spp. - *Lemna* spp. Southern Shrub Swamp |
| CEGL003911 | *Forestiera acuminata* - (*Planera aquatica*, *Cephalanthus occidentalis*) Floodplain Scrub |
| NPSBITH010 | *Ilex vomitoria* Shrubland |
| NPSBITH022 | *Morella cerifera* - *Ilex vomitoria* Wet Meadow Shrubland |
| NPSBITH023 | *Morella cerifera – Ilex coriacea – Baccharis halimifolia* Wet Scrub Shrubland |

Herbaceous types were highly variable and included riparian, upland, and disturbed types (Table 10). The dominant species include *Zizaniopsis miliacea*, *Juncus effusus*, *Panicum virgatum*, and/or *Saccharum giganteum*.

**Table 10.** Herbaceous types documented at BITH.

| ELCODE | Association Name |
|---|---|
| CEGL004700 | *Paspalum notatum* Ruderal Grassland |
| NPSBITH005 | *Juncus effusus* Ruderal Marsh |
| CEGL004150 | *Typha latifolia* Southern Ruderal Marsh |
| NPSBITH011 | *Schoenoplectus tabernaemontani* Brackish Marsh |
| CEGL004921 | *Panicum virgatum* - *Panicum rigidulum* var. *elongatum* - *Polygonum hydropiperoides* Wet Meadow |
| CEGL004705 | *Zizaniopsis miliacea* Tidal Marsh |
| CEGL007895 | *Zizaniopsis miliacea* - *Panicum hemitomon* Tidal Marsh |
| NPSBITH003 | *Sparganium androcladum* - *Sparganium americanum* Marsh |
| NPSBITH014 | *Xyris fimbriata* Upland Marsh |
| CEGL002386 | *Nuphar advena* - *Nymphaea odorata* Aquatic Vegetation |
| CEGL003858 | *Alternanthera philoxeroides* Ruderal Aquatic Vegetation |
| CEGL007930 | *Schizachyrium scoparium* - *Rudbeckia missouriensis* - *Grindelia lanceolata* - (*Liatris mucronata*) Grassland |

Sparse communities are separated into two groups: riverine sand flats / alluvial bars, and sparse cliffs (Table 11). The extent and composition of the riverine bars are highly seasonal and subject to constant change.

**Table 11.** Sparse vegetation types documented at BITH.

| ELCODE | Association |
|---|---|
| NPSBITH019 | Riverine Sand Flats - Bars Sparse Vegetation |
| NPSBITH020 | Bare Alluvial Depositional Bar |
| NPSBITH021 | Sparse Cliff Vegetation |

### *Non-native Plant Species of Management Concern*

Of the non-native plant species present at BITH, only three were extensive enough to warrant their own communities. *Panicum notatum, Alternanthera philoxeroides*, and *Triadica sebifera* were classified and mapped as CEGL004700, CEGL003858, and CEGL007412 respectively. The largest patches of *Panicum notatum* and *Alternanthera philoxeroides* occurred along the Neches River and the Beaumont Unit, although smaller patches of *Alternanthera philoxeroides* occurred in small backwaters along other creeks and rivers. Almost all communities within mesic flatwoods and floodplains contained *Triadica sebifera*, but the communities dominated by *Triadica sebifera* were mainly located in the Beaumont Unit.

Other non-native species of concern were not as prevalent and formed minor components of the other communities. For example, trifoliate orange (*Poncirus trifoliata*) only occurred in the northern reaches of Big Sandy Creek within the *Fraxinus pennsylvanica* - *Ulmus americana* - *Celtis laevigata* / *Ilex decidua* Floodplain Forest (CEGL002427). These occurences are captured within the plot data and entered into the PLOTS database.

### *Rare Plant Species of Concern*

Vegetation communities at BITH contain a number of rare plants or species of concern (Table 2). Baygall associations such as *Nyssa biflora – Magnolia virginiana – Quercus laurifolia* / *Cyrilla racemiflora* - *Rhododendron oblongifolium* Swamp Forest (CEGL007474) and *Magnolia virginiana – Nyssa sylvatica – Acer rubrum* / *Morella caroliniensis* / *Woodwardia areolata* Swamp Forest (CEGL007904) within BITH provide ideal habitat for a number of rare orchids and other species including *Platanthera* spp. and *Apteria aphylla*. The longleaf pine (*Pinus palustris*) communities of Big Sandy Creek and Beaumont units contain rare tresses (*Spiranthes* spp.) within *Pinus palustris* / *Morella cerifera – Morella caroliniensis – Ilex coriacea* Ruderal Wet Woodland (CEGL007162).

### *Photographic Database Results*

A total of 1,783 vegetation plot photos were collected during vegetation classification field sampling. During the accuracy assessment (AA) phase four photos were taken per plot for an additional 2,931 AA photos. The total number of photos generated by the project and included in the photo dataset is 4,705. Vegetation plot photos were collected over the summer of 2016, winter 2017, and spring 2019. AA point photos were collected over the summer of 2019.

Each photo is georeferenced and can be accurately projected using ArcGIS, Google Earth, or software. The photos are incorporated into a photo viewer database accessible through ArcMap. This

allows the user to access photos and important plot data when viewing each point in ArcMap. The photo viewer database is included in the project deliverables.

# Vegetation Mapping

The mapping phase of the project included image acquisition, examination of legacy data, mapping model development that accommodates existing vegetation types within interpretable map classes, field reconnaissance, polygon classification and delineation, field verification, and database development.

## Methods

### *Map Specifications*

Mapping specifications are described below.

**Map extent**: Mapped regions included all areas inside the BITH NPS-owned boundaries. Polygons outside the NPS-owned boundaries were not mapped, visited, or sampled.

**Minimum Mapping Unit (MMU)**: A minimum mapping unit/polygon size of 0.5 ha (1.24 ac) was used by the image interpreter. Polygons smaller than the minimum mapping unit were mapped as the predominant adjacent map class. Areas of significant management importance (e.g., rare communities) were mapped below the MMU threshold for BITH.

**Thematic Accuracy:** The desired minimum thematic map class user accuracy is 80% for each class and for the map as a whole.

### *Imagery Acquisition and Data Management*

Remote-sensing imagery provides the foundation for mapping vegetation types and other land cover classes. New imagery was purchased from Hexagon Imagery Program (HxIP) for the BITH mapping project. This imagery was delivered as 2014 30 cm 4-band (RGB and CIR) high-resolution orthoimages. The imagery has a positional accuracy of ≤1.2 m. Specifications for the HxIP imagery included the following:

- Total area for new acquisition of 906 $km^2$ (350 $mi^2$)
- Cloud cover <10%
- Allowable ground sample distance of 0.4 m for 30 cm imagery

A variety of other imagery supported the project (Table 12). Additional imagery included Texas Natural Resources Information System (TNRIS) 2015 50 cm leaf-off 4-band imagery from the Texas Orthoimagery Program (TOP), Farm Service Agency (FSA) 100 cm (2016) and 60 cm (2018) National Aerial Imagery Program (NAIP) imagery, as well as current and historical true-color Google Earth and Bing Maps imagery.

**Table 12.** Specifications for imagery used for the BITH vegetation mapping project.

| Product | Data Source | Year | Resolution | Bands |
|---|---|---|---|---|
| 2018 NAIP | USDA-FSA | 2018 | 60 cm | RGB, CIR |
| 2016 NAIP | USDA-FSA | 2016 | 100 cm | RGB, CIR |
| 2015 TOP | TNRIS TOP | 2015 | 50 cm | RGB, CIR |
| 2014 HxIP | HxIP | 2014 | 30 cm | RGB, CIR |

In addition to using aerial and satellite imagery, 2017 Neches River Basin Light Detection and Ranging (LiDAR) data available from the United States Geological Survey (USGS) and TNRIS was used to analyze vegetation structure at BITH. LiDAR data were collected with an average point spacing of 70 cm for all areas at BITH. LiDAR point cloud datasets were used to analyze vegetation structure, density, and height. Digital Height Models (DHM) and Digital Elevation Models (DEM) were created to further refine breaks between different vegetation communities (e.g., forest to shrubland transition) and help inform landform position (e.g., slope forest vs. flatland forest). The use of this publicly available product drastically improved interpretation ability and map class accuracies.

### *Legacy Data*

Prior to field work CSU worked with NPS staff to identify a variety of legacy datasets and spatial data that could support vegetation classification and mapping at BITH. Legacy data were evaluated using the TNC and NPS (2009) framework (see Section 2.2 Legacy Data). Overall, legacy data were useful for classification and some mapping; however, many of the legacy data sources were outdated and had limited usefulness.

### *Map Classes and Mapping Model*

The conceptual mapping model takes the ecological classification data from the classification phase of the project and translates it into a spatial classification for mapping purposes. Choosing an appropriate mapping model has important implications for the utility and accuracy of the final map. An optimized mapping model provides the highest thematic detail while meeting required standards of accuracy. The ideal model would have the most detailed desired level of the USNVC (e.g., association or alliance) represented by a single map class.

To initiate mapping model development, an understanding of each vegetation community's type concept and type complexities was necessary. A careful review of the preliminary vegetation classification and consideration of ruderal/semi-natural vegetation and other non-vegetated land use types was performed. Preliminary vegetation classification provided a starting point for identifying potential map classes and formed the foundation for developing the mapping model. The 2017 vegetation community's classification used 2016 quantitative vegetation plot inventory data and produced a near complete list of BITH community types. Numerous collaborative meetings between CEMML and CNHP aided mapping reconnaissance, refining map classification, and documenting vegetation communities not documented during the vegetation classification phase.

The mapping model reflects interpretation limitations given the available data, imagery, time, and other resources available for field reconnaissance and verification. It incorporates challenges related to distinguishing vegetation communities and other land cover classes. Some of these challenges include the following:

- Understanding the impact of flooding from Hurricane Harvey in 2017 and how communities may have been altered.
- Physical inability to access and validate large swaths of the park due to high water levels or other access limitations.
- Identifying and mapping indeterminate and often ambiguous breaks between extremely similar vegetation communities.
- Interpreting differences between pine species and various pine-dominated communities.
- Interpreting differences between oak species and various oak-dominated communities.
- Understanding the impact of past land uses (e.g., logging, exclusion of fire) on current vegetation communities.
- Interpreting landform position and understanding its role in determining potential vegetation communities (e.g., minor differences between wet flatwood forest vs. riparian forest).
- Interpreting structural component thresholds between communities such as the difference between shrubland and woodland communities.
- Interpreting understory differences in non-herbaceous communities such as the understory components of *Pinus* or *Quercus* forest and woodlands. The use of LiDAR drastically improved our ability to map these areas accurately.

As part of the accuracy assessment (AA) analysis, the AA confusion matrix contingency table was examined to evaluate possible modifications to the mapping model due to low accuracies and confusion among types. This aggregation process is discussed in detail in Chapter 4 - *Accuracy Assessment*. Final map classes and the representative vegetation types are discussed in Section 3.2 *Results*.

#### *Imagery Interpretation*

Classification and delineation of polygons was an iterative process involving the development of preliminary map classes, field reconnaissance, and review of classified plot results. The process included the classification of preliminary polygon line work, additional field reconnaissance, map refinement, final line work and mapping model, field validation, and finalization of the map layer. This process began by initially mapping the vegetation physiognomy to segment areas dominated by trees, shrubs, herbaceous vegetation, sparse vegetation, and open water. Field reconnaissance served as the primary means to refine the physiognomic map. Unique vegetation photo-signatures for each map class were identified using vegetation inventory plot data and photos. Photo signatures supported classifying and delineating polygons at a finer level until a balance between map robustness and required thematic accuracy was achieved. Prior to AA fieldwork, mapper field reconnaissance occurred in the spring and summer of 2017, spring and fall of 2018, and spring of

2019. Reconnaissance allowed mappers to become familiar with the area's floristics and ecology, and begin to understand subtle landscape patterns and other environmental site factors influencing vegetation. To aid in the identification of communities with evident affinities for certain habitats or repeating landscape patterns, a variety of characteristics were considered including soil, geology, elevation, aspect, slope, and landform position.

Manual digitizing was used to delineate polygons, given the moderate size of the park, classification intricacies, and the ability to define classes visually. Table 12 shows imagery products used for interpretation including 30 cm 4-band HxIP imagery. Vegetation class boundaries were distinguished using differences in the imagery pattern, color, texture, and tone. Map unit classification and digitized polygon labels incorporated vegetation plot and observation point data along with legacy plot data. A minimum mapping unit of 0.5 ha was used for all map classes. Two-dimensional and three-dimensional visualization using USGS LiDAR data and Google Earth were used to better see vegetation structure and composition. Different combinations of imagery bands were occasionally used to differentiate types. Appendix G summarizes interpretation notes for BITH map classes.

### *Validation of Map Thematic Accuracy*

Whereas AA is a considerable investment in time and effort, validation is a process of more limited sampling, the objective of which is to determine whether a final draft map is accurate enough to justify field-based thematic AA of individual map classes. The results of validation primarily address the immediate needs of the map production team and project oversight team to evaluate the overall product before conducting a formal quantitative AA. Map thematic validation is important to ensure that errors in the map, the association field key, and the classification are corrected before the AA phase of the project begins.

The NPS (2013) 12-Step Guidance document recommends independent, third-party validation of the map and key prior to the AA. Map thematic validation is completed by image analysts and ecologists visiting the site together and briefly testing the map and key in the field. While some projects plan a quantitative, third-party validation, this was not done for the BITH project. The imagery interpretation team conducted four validation trips to BITH to examine certain map classes and polygons—two in Fall 2018 and two in Spring 2019. The field validation effort was not quantitative and did not involve random sampling across all map classes, but rather focused on those classes considered to have the lowest accuracy by interpreters. Validation resulted in some modifications to individual polygon boundaries, additional refinements to the map classification, and a higher level of confidence in certain classes and the map as a whole. These efforts met the intent of the guidance, and the decision was then made within the CSU team to proceed with the AA phase.

## Results

### *Map Classes*

The project objective was to map vegetation communities to the association level of the USNVC (i.e., the highest level of floristic detail), where possible. In some cases, consistent interpretation to the association level was not possible and the interpreter was obliged to include more than one association in a map class. The initial map classification going into the AA phase consisted of 46 natural and ruderal vegetated map classes, representing 102 USNVC associations or other unpublished communities defined by the project as “park specials”.

The final map classification consists of 51 map classes for BITH representing 75 USNVC natural vegetation associations, 27 unpublished park specials types, and five National Land Cover Dataset (NLCD) Level II land cover classes (Agriculture; Water; Barren; Developed, Open Space; and Developed, Low-High Intensity). Final map classes and their relationship to USNVC associations, park specials, or land cover classes are shown in Table 13.

Of the 46 vegetated map classes, 26 represent a single USNVC association or park special, seven represent two USNVC associations or park specials, four represent three USNVC associations or park specials, two represent four USNVC associations or park specials, three represent five USNVC associations or park specials, two represent six USNVC associations or park specials, one represents seven USNVC associations or park specials, and one represents nine USNVC associations or park specials. Where a map class represents a single USNVC type, the map class name is the same as the USNVC name. Where the map class represents more than one USNVC type, the map class name reflects the types included within it, and is weighted toward the type or types believed to occupy the largest acreage. Descriptions of map classes representing USNVC floristic types (e.g., associations and alliances) can be derived from the descriptions of associations and park specials presented in Appendix A.

**Table 13.** List of final BITH map classes (BITH MC###) with USNVC associations (CEGL######) and/or park special(NPSBITH###) included within them, organized by dominant vegetation physiognomy.

| Dominant Vegetation Physiogomy | BITH Map Class | USNVC Association or Park Special class |
|---|---|---|
| Herbaceous Vegetation | BITH MC101 *Paspalum notatum* Ruderal Herbaceous Grassland | CEGL004700: *Paspalum notatum* Ruderal Grassland |
| | BITH MC102 *Juncus effusus* Marsh | NPSBITH005: *Juncus effusus* Ruderal Marsh |
| | BITH MC103 *Schoenoplectus tabernaemontani* – (*Typha latifolia*) Brackish Marsh | NPSBITH011: *Schoenoplectus tabernaemontani* Brackish Marsh |
| | BITH MC103 *Schoenoplectus tabernaemontani* – (*Typha latifolia*) Brackish Marsh | CEGL004150: *Typha latifolia* Southern Ruderal Marsh |
| | BITH MC104 *Panicum virgatum - Panicum rigidulum var. elongatum - Polygonum hydropiperoides* Wet Meadow | CEGL004921: *Panicum virgatum - Panicum rigidulum* var. *elongatum - Polygonum hydropiperoides* Wet Meadow |
| | BITH MC105 *Zizaniopsis miliacea* Tidal Marsh | CEGL004705: *Zizaniopsis miliacea* Tidal Marsh |
| | BITH MC105 *Zizaniopsis miliacea* Tidal Marsh | CEGL007895: *Zizaniopsis miliacea - Panicum hemitomon* Tidal Marsh |
| | BITH MC106 Upland Seepage Marsh | NPSBITH003: *Sparganium androcladum - Sparganium americanum* Marsh |
| | BITH MC106 Upland Seepage Marsh | NPSBITH014: *Xyris fimbriata* Upland Marsh |
| | BITH MC107 Floating Aquatic Vegetation | CEGL003858: *Alternanthera philoxeroides* Ruderal Aquatic Vegetation |
| | BITH MC107 Floating Aquatic Vegetation | CEGL002386: *Nuphar advena - Nymphaea odorata* Aquatic Vegetation |
| | BITH MC108 *Schizachyrium scoparium - Rudbeckia missouriensis - Grindelia lanceolata* - (*Liatris mucronata*) Relict Grassland | CEGL007930: *Schizachyrium scoparium - Rudbeckia missouriensis - Grindelia lanceolata* - (*Liatris mucronata*) Grassland |

**Table 13 (continued).** List of final BITH map classes (BITH MC###) with USNVC associations (CEGL######) and/or park special(NPSBITH###) included within them, organized by dominant vegetation physiognomy.

| Dominant Vegetation Physiogomy | BITH Map Class | USNVC Association or Park Special class |
|---|---|---|
| Shrublands | BITH MC201 *Sesbania drummondii* – (*Morella cerifera*) / *Juncus effusus* Ruderal Wet Shrubland | NPSBITH004: *Sesbania drummondii* – (*Morella cerifera*) / *Juncus effusus* Ruderal Wet Shrubland |
| | BITH MC202 *Quercus hemisphaerica* Shrubland | NPSBITH001: *Quercus hemisphaerica* Shrubland |
| | BITH MC203 *Cephalanthus occidentalis* / *Forestiera acuminata* Southern Shrub Swamp | CEGL002191: *Cephalanthus occidentalis* / *Carex* spp. - *Lemna* spp. Southern Shrub Swamp |
| | BITH MC203 *Cephalanthus occidentalis* / *Forestiera acuminata* Southern Shrub Swamp | CEGL003911: *Forestiera acuminata* - (*Planera aquatica*, *Cephalanthus occidentalis*) Floodplain Scrub |
| | BITH MC204 *Ilex vomitoria* Shrubland | NPSBITH010: *Ilex vomitoria* Shrubland |
| | BITH MC205 *Morella cerifera* - *Ilex vomitoria* Wet Meadow Shrubland | NPSBITH022: *Morella cerifera* - *Ilex vomitoria* Wet Meadow Shrubland |
| | BITH MC206 *Morella cerifera* – *Ilex coriacea* – *Baccharis halimifolia* Wet Scrub Shrubland | NPSBITH023: *Morella cerifera* – *Ilex coriacea* – *Baccharis halimifolia* Wet Scrub Shrubland |
| Woodland and Forest | BITH MC301 Pine Forest Plantation | CST007179: *Pinus taeda* Forest Plantation |
| | BITH MC301 Pine Forest Plantation | CST007170: *Pinus elliottii* var. *elliottii* Forest Plantation |
| | BITH MC301 Pine Forest Plantation | NPSBITH017: *Pinus taeda* Regenerating Plantation Shrubland |
| | BITH MC302 *Pinus taeda* Riparian Forest | CEGL007142: *Pinus taeda* Riparian Forest |
| | BITH MC303 *Pinus taeda* – (*Pinus echinata*) Nonriverine Flatwoods Forest | CEGL007069: *Pinus taeda* - (*Pinus echinata*) - *Quercus* (*pagoda*, *phellos*) Wet Woodland |
| | BITH MC303 *Pinus taeda* – (*Pinus echinata*) Nonriverine Flatwoods Forest | CEGL008587: *Quercus stellata* - *Pinus taeda* Flatwoods Wet Forest |
| | BITH MC303 *Pinus taeda* – (*Pinus echinata*) Nonriverine Flatwoods Forest | CEGL007715: *Quercus michauxii* - *Quercus* (*nigra*, *pagoda*) - *Liquidambar styraciflua* - *Pinus taeda* Wet Forest |

**Table 13 (continued).** List of final BITH map classes (BITH MC###) with USNVC associations (CEGL######) and/or park special(NPSBITH###) included within them, organized by dominant vegetation physiognomy.

| Dominant Vegetation Physiogomy | BITH Map Class | USNVC Association or Park Special class |
|---|---|---|
| Woodland and Forest (continued) | BITH MC303 *Pinus taeda* – (*Pinus echinata*) Nonriverine Flatwoods Forest | NPSBITH009: *Pinus taeda* / *Ilex coriacea* - (*Cyrilla racemiflora*) Wet Flatwood Woodland |
| | BITH MC303 *Pinus taeda* – (*Pinus echinata*) Nonriverine Flatwoods Forest | NPSBITH012: *Pinus taeda* - *Magnolia grandiflora* - (*Fagus grandifolia*, *Quercus alba*, *Quercus falcata*) Flatwoods Forest |
| | BITH MC304 Baygall Seepage Bog | CEGL003530: (*Magnolia virginiana*) / *Ilex coriacea* - *Morella caroliniensis* Seepage |
| | BITH MC304 Baygall Seepage Bog | CEGL007474*: Nyssa biflora* - *Magnolia virginiana* - *Quercus laurifolia* / *Cyrilla racemiflora* - *Rhododendron oblongifolium* Swamp Forest |
| | BITH MC304 Baygall Seepage Bog | CEGL007904: *Magnolia virginiana* - *Nyssa sylvatica* - *Acer rubrum* / *Morella caroliniensis* / *Woodwardia areolata* Swamp Forest |
| | BITH MC304 Baygall Seepage Bog | NPSBITH018: *Cyrilla racemiflora* Seepage Bog Shrubland |
| | BITH MC305 *Acer rubrum* Floodplain Forest | NPSBITH007: *Acer rubrum* Floodplain Forest |
| | BITH MC306 Riverfront Successional Floodplain Forest | CEGL007410: *Salix nigra* - (*Platanus occidentalis*, *Populus deltoides*) Southern Floodplain Forest |
| | BITH MC306 Riverfront Successional Floodplain Forest | CEGL004773: *Salix nigra* / (*Cephalanthus occidentalis*) Swamp Forest |
| | BITH MC306 Riverfront Successional Floodplain Forest | NPSBITH002: *Betula nigra* Mixed Hardwood Riverine Forest |
| | BITH MC307 *Triadica sebifera* Ruderal Forest and Woodland | CEGL007412: *Triadica sebifera* Ruderal Wet Forest |

**Table 13 (continued).** List of final BITH map classes (BITH MC###) with USNVC associations (CEGL######) and/or park special(NPSBITH###) included within them, organized by dominant vegetation physiognomy.

| Dominant Vegetation Physiogomy | BITH Map Class | USNVC Association or Park Special class |
|---|---|---|
| Woodland and Forest (continued) | BITH MC308 *Fraxinus pennsylvanica - Ulmus americana - Celtis laevigata* / *Ilex decidua* Floodplain Forest | CEGL002427: *Fraxinus pennsylvanica - Ulmus Americana - Celtis laevigata* / *Ilex decidua* Floodplain Forest |
| | BITH MC309 *Fraxinus caroliniana* Swamp Forest | CEGL004753: *Fraxinus caroliniana* Swamp Forest |
| | BITH MC310 *Nyssa aquatic* - (*Taxodium distichum*) / *Zizaniopsis milliacea* Marsh Woodland | NPSBITH013: *Nyssa aquatica* - (*Taxodium distichum*) / *Zizaniopsis milliacea* Marsh Woodland |
| | BITH MC311 *Taxodium distichum - Nyssa aquatica* Floodplain Forest | CEGL007422: *Taxodium distichum - Nyssa aquatic - Acer rubrum* / *Itea virginica* Floodplain |
| | BITH MC311 *Taxodium distichum - Nyssa aquatica* Floodplain Forest | CEGL002419: *Nyssa aquatica* Swamp Forest |
| | BITH MC311 *Taxodium distichum - Nyssa aquatica* Floodplain Forest | CEGL002421: *Taxodium distichum* - (*Nyssa aquatica*) / *Forestiera acuminata - Planera aquatica* Floodplain Forest |
| | BITH MC311 *Taxodium distichum - Nyssa aquatica* Floodplain Forest | CEGL007429: *Nyssa aquatica - Nyssa biflora* Swamp Forest |
| | BITH MC311 *Taxodium distichum - Nyssa aquatica* Floodplain Forest | CEGL002104: *Taxodium distichum - Platanus occidentalis* Edwards Plateau Floodplain Forest |
| | BITH MC312 *Taxodium distichum/Lemna minor* Inundated Swamp Floodplain Forest | CEGL002420: *Taxodium distichum* / *Lemna minor* Floodplain Forest |
| | BITH MC313 *Quercus* spp. Mixed Hardwood Floodplain Forest | CEGL007370: *Quercus phellos - Liquidambar styraciflua* / *Ilex decidua - Carpinus caroliniana* / *Lysimachia radicans* Floodplain Forest |
| | BITH MC313 *Quercus* spp. Mixed Hardwood Floodplain Forest | CEGL007397: *Quercus lyrata - Carya aquatica* Floodplain Forest |

**Table 13 (continued).** List of final BITH map classes (BITH MC###) with USNVC associations (CEGL######) and/or park special(NPSBITH###) included within them, organized by dominant vegetation physiognomy.

| Dominant Vegetation Physiogomy | BITH Map Class | USNVC Association or Park Special class |
|---|---|---|
| Woodlad and Forest (continued) | BITH MC313 *Quercus* spp. Mixed Hardwood Floodplain Forest | CEGL007804: *Quercus laurifolia* - *Liquidambar styraciflua* - *Nyssa biflora* - *Acer rubrum* / *Sabal minor* Floodplain Forest |
| | BITH MC313 *Quercus* spp. Mixed Hardwood Floodplain Forest | CEGL007906: *Quercus michauxii* - *Liquidambar styraciflua* - *Quercus texana* - *Quercus lyrata* Floodplain Forest |
| | BITH MC313 *Quercus* spp. Mixed Hardwood Floodplain Forest | CEGL007953: *Quercus nigra* - *Ulmus alata* / *Ostrya virginiana* Floodplain Forest |
| | BITH MC313 *Quercus* spp. Mixed Hardwood Floodplain Forest | CEGL007954: *Quercus nigra* - *Quercus phellos* / *Carya myristiciformis* - *Sabal minor* / *Carex cherokeensis* Floodplain Forest |
| | BITH MC313 *Quercus* spp. Mixed Hardwood Floodplain Forest | CEGL007984: *Quercus nigra* - *Liquidambar styraciflua* / *Ilex opaca* - *Vaccinium fuscatum* / *Carex debilis* Floodplain Forest |
| | BITH MC313 *Quercus* spp. Mixed Hardwood Floodplain Forest | NPSBITH006: *Liquidambar styraciflua* Ruderal Forest |
| | BITH MC313 *Quercus* spp. Mixed Hardwood Floodplain Forest | CEGL007335: *Platanus occidentalis* - *Liquidambar styraciflua* - (*Ulmus americana*) / (*Crataegus viridis*) Floodplain Forest |
| | BITH MC314 *Quercus spp.* Wet Mixed Hardwood Flatwoods Forest | CEGL007961: *Quercus laurifolia* - *Quercus phellos* / *Viburnum dentatum* - (*Sebastiania fruticosa*) / *Carex glaucescens* Upper West Gulf Wet Flatwoods Forest |
| | BITH MC314 *Quercus spp.* Wet Mixed Hardwood Flatwoods Forest | CEGL007845: *Quercus alba* - *Quercus* (*michauxii*, *nigra*) / *Ilex opaca* / *Chasmanthium laxum* Forest |
| | BITH MC314 *Quercus spp.* Wet Mixed Hardwood Flatwoods Forest | CEGL008576: *Quercus phellos* / *Chasmanthium laxum* Wet Forest |

**Table 13 (continued).** List of final BITH map classes (BITH MC###) with USNVC associations (CEGL######) and/or park special(NPSBITH###) included within them, organized by dominant vegetation physiognomy.

| Dominant Vegetation Physiogomy | BITH Map Class | USNVC Association or Park Special class |
|---|---|---|
| Woodland and Forest (continued) | BITH MC314 *Quercus spp.* Wet Mixed Hardwood Flatwoods Forest | CEGL004638: *Quercus nigra* Ruderal Forest |
| | BITH MC314 *Quercus spp.* Wet Mixed Hardwood Flatwoods Forest | CEGL007980: *Quercus alba* - *Carya alba* / *Symplocos tinctoria* / *Mitchella repens* Forest |
| | BITH MC315 Mixed Hardwoods - *Pinus taeda* Floodplain Forest | CEGL007910: *Pinus taeda* - *Quercus phellos* - *Quercus nigra* Riparian Forest |
| | BITH MC315 Mixed Hardwoods - *Pinus taeda* Floodplain Forest | CEGL004911: *Pinus taeda* - *Liquidambar styraciflua* - *Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest |
| | BITH MC315 Mixed Hardwoods - *Pinus taeda* Floodplain Forest | CEGL007899: *Quercus pagoda* - *Liquidambar styraciflua* - *Pinus taeda* Floodplain Forest |
| | BITH MC315 Mixed Hardwoods - *Pinus taeda* Floodplain Forest | CEGL007901: *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| | BITH MC315 Mixed Hardwoods - *Pinus taeda* Floodplain Forest | CEGL008574: *Fagus grandifolia* - *Quercus* (*laurifolia*, *nigra*) - *Pinus taeda* Forest |
| | BITH MC315 Mixed Hardwoods - *Pinus taeda* Floodplain Forest | CEGL007955: *Pinus taeda* - (*Quercus* spp.) / *Ostrya virginiana* - *Sabal minor* Forest |
| | BITH MC315 Mixed Hardwoods - *Pinus taeda* Floodplain Forest | CEGL003619: *Pinus taeda* - *Quercus hemisphaerica* / *Osmanthus americanus* / *Ilex glabra* Woodland |
| | BITH MC316 *Pinus taeda* - Mixed Hardwoods Slope and Small Stream Forest | CEGL004713: *Pinus echinata* - *Pinus taeda* - *Quercus* (*alba*, *falcata*, *stellata*) Forest |
| | BITH MC316 *Pinus taeda* - Mixed Hardwoods Slope and Small Stream Forest | CEGL007320: *Fagus grandifolia* - *Pinus taeda* - (*Liquidambar styraciflua*, *Magnolia grandiflora*, *Quercus alba*) Small Stream Forest |
| | BITH MC316 *Pinus taeda* - Mixed Hardwoods Slope and Small Stream Forest | CEGL007525: *Pinus taeda* - *Quercus alba* - (*Fagus grandifolia*) / *Smilax pumila* - *Mitchella repens* Forest |

**Table 13 (continued).** List of final BITH map classes (BITH MC###) with USNVC associations (CEGL######) and/or park special(NPSBITH###) included within them, organized by dominant vegetation physiognomy.

| Dominant Vegetation Physiogomy | BITH Map Class | USNVC Association or Park Special class |
|---|---|---|
| Woodland and Forest (continued) | BITH MC316 *Pinus taeda* - Mixed Hardwoods Slope and Small Stream Forest | CEGL007903: *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| | BITH MC317: Mixed Hardwood Mesic Slope Forest | CEGL007208: *Fagus grandifolia* - *Quercus alba* / *Ilex opaca* var. *opaca* / *Athyrium filix-femina* ssp. *asplenioides* Forest |
| | BITH MC317: Mixed Hardwood Mesic Slope Forest | CEGL007872: *Fagus grandifolia* - *Magnolia grandiflora* - *Quercus alba* / *Carpinus caroliniana* - *Ostrya virginiana* Forest |
| | BITH MC317: Mixed Hardwood Mesic Slope Forest | CEGL007959: *Quercus alba* - *Quercus hemisphaerica* / *Prunus caroliniana* - *Persea borbonia* - *Viburnum acerifolium* Forest |
| | BITH MC317: Mixed Hardwood Mesic Slope Forest | CEGL008415: *Quercus falcata* - *Quercus stellata* - (*Pinus taeda*) West Gulf Coastal Plain Forest |
| | BITH MC317: Mixed Hardwood Mesic Slope Forest | CEGL008581: *Quercus alba* - *Quercus nigra* / *Ostrya virginiana* / *Sabal minor* Forest |
| | BITH MC317: Mixed Hardwood Mesic Slope Forest | NPSBITH024: *Quercus michauxii* – *Quercus nigra* – *Magnolia grandiflora* Mesic Forest |
| | BITH MC318: Mixed Hardwood Dry Upland and Slope Forest | CEGL007751: *Quercus hemisphaerica* - *Quercus* (*falcata*, *nigra*) / *Vaccinium arboreum* / *Cnidoscolus stimulosus* Forest |
| | BITH MC318: Mixed Hardwood Dry Upland and Slope Forest | CEGL008413: *Quercus alba* - *Carya alba* / *Chasmanthium sessiliflorum* West Gulf Coastal Plain Forest |
| | BITH MC318: Mixed Hardwood Dry Upland and Slope Forest | CEGL008414: *Quercus alba* - *Quercus falcata* - *Quercus stellata* - *Nyssa sylvatica* / *Carex cherokeensis* Forest |

**Table 13 (continued).** List of final BITH map classes (BITH MC###) with USNVC associations (CEGL######) and/or park special(NPSBITH###) included within them, organized by dominant vegetation physiognomy.

| Dominant Vegetation Physiogomy | BITH Map Class | USNVC Association or Park Special class |
|---|---|---|
| Woodland and Forest (continued) | BITH MC319: *Pinus* (*taeda*, *echinata*) Upland Woodland | CEGL002112: *Pinus taeda* - *Quercus stellata* / *Crataegus* spp. Woodland |
| | BITH MC319: *Pinus* (*taeda*, *echinata*) Upland Woodland | CEGL007800: *Pinus echinata* - *Quercus stellata* - *Quercus falcata* - *Carya texana* Woodland |
| | BITH MC320: *Pinus* (*taeda*, *echinata*) Upland Forest | CEGL006011: *Pinus taeda* / *Liquidambar styraciflua* - *Acer rubrum* / *Vaccinium stamineum* Ruderal Forest |
| | BITH MC320: *Pinus* (*taeda*, *echinata*) Upland Forest | CEGL006327: *Pinus echinata* Ruderal Forest |
| | BITH MC320: *Pinus* (*taeda*, *echinata*) Upland Forest | CEGL007115*: Pinus taeda* - *Pinus echinata* / *Chasmanthium sessiliflorum* Ruderal Forest |
| | BITH MC320: *Pinus* (*taeda*, *echinata*) Upland Forest | CEGL007528: *Pinus taeda* - (*Pinus echinata*) - *Quercus falcata* - *Carya texana* / *Vaccinium arboreum* Forest |
| | BITH MC320: *Pinus* (*taeda*, *echinata*) Upland Forest | CEGL007947: *Pinus echinata* - (*Pinus taeda*) - *Quercus falcata* / *Dichanthelium sphaerocarpon* Forest |
| | BITH MC321: *Pinus palustris* – (*Pinus echinata*, *taeda*, *elliottii*) Forest and Woodland | CEGL003609: *Pinus palustris* - *Pinus* (*echinata*, *taeda*) / (*Liquidambar styraciflua*) / *Schizachyrium scoparium* Ruderal Woodland |
| | BITH MC321: *Pinus palustris* – (*Pinus echinata*, *taeda*, *elliottii*) Forest and Woodland | CEGL007162: *Pinus palustris* / *Morella cerifera* - *Morella caroliniensis* - *Ilex coriacea* Ruderal Wet Woodland |
| | BITH MC321: *Pinus palustris* – (*Pinus echinata*, *taeda*, *elliottii*) Forest and Woodland | CEGL008571: *Pinus palustris* - *Pinus* (*echinata*, *taeda*) - *Quercus falcata* - *Carya texana* Woodland |
| | BITH MC322: *Pinus* spp. (*taeda*, *echinata*, *palustris*) Regenerating Woodland and Shrubland | NPSBITH016: *Pinus* spp. (*taeda*, *e*chinata, *elliotti, palustris*) Regenerating Woodland and Shrubland |
| | BITH MC323: *Pinus elliottii* var. *elliottii* Ruderal Woodland and Forest | CEGL007157: *Pinus elliottii* - (*Pinus palustris*) / *Morella cerifera* - *Ilex coriacea* Ruderal Wet Woodland |

**Table 13 (continued).** List of final BITH map classes (BITH MC###) with USNVC associations (CEGL######) and/or park special(NPSBITH###) included within them, organized by dominant vegetation physiognomy.

| Dominant Vegetation Physiogomy | BITH Map Class | USNVC Association or Park Special class |
|---|---|---|
| Woodland and Forest (continued) | BITH MC324: *Taxodium distichum* / *Morella cerifera* / *Thelypteris palustris* Tidal Woodland | CEGL007065: *Taxodium distichum* / *Morella cerifera* / *Thelypteris palustris* Tidal Woodland |
| | BITH MC325: *Ilex coriacea – Prunus caroliniana* Dense Evergreen Forest and Shrubland | NPSBITH015: *Ilex coriacea – Prunus caroliniana* Dense Evergreen Forest and Shrubland |
| | BITH MC326: *Quercus laurifolia – Nyssa biflora* Circular Depression Flooded Flatwood Forest | CEGL007871: *Quercus laurifolia* - (*Quercus nigra*, *Nyssa biflora*) / *Diospyros virginiana* Wet Forest |
| | BITH MC327: *Acer rubrum* – (*Triadica sebifera*) / *Morella cerifera* Swamp Woodland | NPSBITH008: *Acer rubrum* - (*Triadica sebifera*) / *Morella cerifera* Swamp Woodland |
| | BITH MC328: *Nyssa biflora – Acer rubrum* – (*Triadica sebifera*) / *Morella cerifera* / *Saccharum giganteum* Swamp Woodland | NPSBITH025: *Nyssa biflora - Acer rubrum* - (*Triadica sebifera*) / *Morella cerifera* / *Saccharum giganteum* Swamp Woodland |
| | BITH MC329: *Pinus taeda – Nyssa biflora – Magnolia virginiana* / *Andropogon glomeratus* Wet Woodland | NPSBITH026: *Pinus taeda – Nyssa biflora – Magnolia virginiana* / *Andropogon glomeratus* Wet Woodland |
| | BITH MC330: *Pinus taeda – Nyssa biflora – Quercus laurifolia* Circular Depression Flooded Flatwood Forest | NPSBITH027: Pinus taeda – Nyssa biflora – Quercus laurifolia Circular Depression Flooded Flatwood Forest |
| Sparse Vegetation | BITH MC401 Riverine Sparse Bar Vegetation | NPSBITH019: Riverine Sand Flats - Bars Sparse Vegetation |
| | BITH MC401 Riverine Sparse Bar Vegetation | NPSBITH020: Bare Alluvial Depositional Bar |
| | BITH MC402: Sparse Cliff Vegetation | NPSBITH021: Sparse Cliff Vegetation |
| Land Cover | LC001: Pasture/Hay Ground Agricultural Vegetation | – |
| | LC002: Non-vegetated / Barren Land, Borrow Pit, Cut Bank | – |
| | LC003: Developed, Open Space | – |
| | LC004: Developed, Low - High Intensity | – |
| | LC005: Water | – |

### *Summary Statistics*

The final BITH vegetation map consists of 7,271 polygons totaling 45,771.8 ha (113,104.6 ac). Mean polygon size is 6.3 ha (15.6 ac). Of the total area, 43,314.4 ha (107,032.2 ac) or 94.6% represent natural or ruderal vegetation. Developed open space such as roads, parking lots, and campgrounds comprises 116.1 ha (286.9 ac) or 0.3% of the total. Open water accounts for approximately 2,034.9 ha (5,028.3 ac) or 4.4% of the total mapped area.

Within the total area occupied by natural or ruderal vegetation, forest and woodland types were the most extensive at 43,022.19 ha (106,310.1 ac) or 94.0%, followed by herbaceous vegetation types at 129.7 ha (320.5 ac) or 0.3%, sparse vegetation types at 119.2 ha (294.5 ac) or 0.3%, and shrubland types at 43.4 ha (107.2 ac) or 0.1%.

### *Herbaceous Vegetation*

Herbaceous vegetation map classes occupied 0.3% (129.7 ha; 320.5 ac) of the park area and accounted for 1.0% (71 polygons) of the mapped polygons. The *Zizaniopsis miliacea* Tidal Marsh (MC105) represented the largest component of herbaceous vegetation at BITH, occupying 85.1 ha (210.3 ac) or 0.2% of the BITH area. The second most abundant herbaceous vegetation type was the Floating Aquatic Vegetation (MC107). This type occupied 22.8 ha (56.3 ac) and represented 0.05% of the BITH area. All other herbaceous types occupied a relatively minor component of the total BITH area (Table 14).

**Table 14.** Map statistics by map class for the Big Thicket National Preserve vegetation map.

| Dominant Vegetation Physiogomy | Map Class | Map Class Name | Number of Polygons | Minimum size (ha) | Maximum size (ha) | Mean size (ha) | Total area (ha) |
|---|---|---|---|---|---|---|---|
| Herbaceous Vegetation | MC101 | *Paspalum notatum* Ruderal Herbaceous Grassland | 11 | 0.50 | 2.18 | 0.82 | 8.99 |
| | MC102 | *Juncus effusus* Marsh | 2 | 0.51 | 1.40 | 0.96 | 1.91 |
| | MC103 | *Schoenoplectus tabernaemontani* – (*Typha latifolia*) Brackish Marsh | 10 | 0.50 | 1.58 | 0.77 | 7.72 |
| | MC104 | *Panicum virgatum* - *Panicum rigidulum* var. *elongatum* - *Polygonum hydropiperoides* Wet Meadow | 2 | 0.51 | 0.78 | 0.64 | 1.28 |
| | MC105 | *Zizaniopsis miliacea* Tidal Marsh | 20 | 0.58 | 22.90 | 4.25 | 85.05 |
| | MC106 | Upland Seepage Marsh | 2 | 0.63 | 0.78 | 0.70 | 1.41 |
| | MC107 | Floating Aquatic Vegetation | 23 | 0.50 | 2.43 | 0.99 | 22.81 |
| | MC108 | *Schizachyrium scoparium* - *Rudbeckia missouriensis* - *Grindelia lanceolata* - (*Liatris mucronata*) Relict Grassland | 1 | 0.53 | 0.53 | 0.53 | 0.53 |
| Shrubland | MC201 | *Sesbania drummondii* – (*Morella cerifera*) / *Juncus effusus* Ruderal Wet Shrubland | 3 | 0.15 | 4.59 | 1.92 | 5.77 |
| | MC202 | *Quercus hemisphaerica* Shrubland | 15 | 0.57 | 5.20 | 1.51 | 22.59 |
| | MC203 | *Cephalanthus occidentalis* / *Forestiera accuminata* Southern Shrub Swamp | 8 | 0.73 | 2.04 | 1.23 | 9.82 |
| | MC204 | *Ilex vomitoria* Shrubland | 4 | 0.55 | 1.19 | 0.90 | 3.60 |
| | MC205 | *Morella cerifera* - *Ilex vomitoria* Wet Meadow Shrubland | 1 | 1.01 | 1.01 | 1.01 | 1.01 |
| | MC206 | *Morella cerifera* – *Ilex coriacea* – *Baccharis halimifolia* Wet Scrub Shrubland | 1 | 0.63 | 0.63 | 0.63 | 0.63 |
| Forest and Woodland | MC301 | Pine Forest Plantation | 101 | 0.57 | 141.89 | 12.28 | 1240.67 |
| | MC302 | *Pinus taeda* Riparian Forest | 84 | 0.52 | 26.82 | 3.44 | 288.90 |

**Table 14 (continued).** Map statistics by map class for the Big Thicket National Preserve vegetation map.

| Dominant Vegetation Physiogomy | Map Class | Map Class Name | Number of Polygons | Minimum size (ha) | Maximum size (ha) | Mean size (ha) | Total area (ha) |
|---|---|---|---|---|---|---|---|
| Forest and Woodland (continued) | MC303 | *Pinus taeda* – (*Pinus echinata*) Nonriverine Flatwoods Forest | 453 | 0.50 | 1050.66 | 15.50 | 7021.61 |
| | MC304 | Baygall Seepage Bog | 159 | 0.50 | 142.24 | 5.61 | 892.40 |
| | MC305 | *Acer rubrum* Floodplain Forest | 2 | 0.70 | 0.75 | 0.72 | 1.45 |
| | MC306 | Riverfront Successional Floodplain Forest | 294 | 0.50 | 11.67 | 1.46 | 428.01 |
| | MC307 | *Triadica sebifera* Ruderal Forest and Woodland | 46 | 0.52 | 7.16 | 1.67 | 76.65 |
| | MC308 | *Fraxinus pennsylvanica* - *Ulmus americana* - *Celtis laevigata* / *Ilex decidua* Floodplain Forest | 4 | 0.62 | 3.90 | 1.82 | 7.29 |
| | MC309 | *Fraxinus caroliniana* Swamp Forest | 12 | 0.51 | 4.22 | 1.46 | 17.53 |
| | MC310 | *Nyssa aquatic* - (*Taxodium disticum*) / *Zizaniopsis milliacea* Marsh Woodland | 43 | 0.53 | 252.40 | 26.90 | 1156.53 |
| | MC311 | *Taxodium distichum* - *Nyssa aquatica* Floodplain Forest | 875 | 0.50 | 533.51 | 5.33 | 4660.66 |
| | MC312 | *Taxodium distichum*/*Lemna minor* Inundated Swamp Floodplain Forest | 10 | 0.53 | 4.90 | 1.58 | 15.75 |
| | MC313 | *Quercus* spp. Mixed Hardwood Floodplain Forest | 2184 | 0.24 | 237.62 | 4.58 | 10,011.40 |
| | MC314 | *Quercus* spp. Wet Mixed Hardwood Flatwoods Forest | 358 | 0.50 | 621.38 | 9.05 | 3240.48 |
| | MC315 | Mixed Hardwoods - *Pinus taeda* Floodplain Forest | 1158 | 0.48 | 378.70 | 5.26 | 6089.48 |
| | MC316 | *Pinus taeda* - Mixed Hardwoods Slope and Small Stream Forest | 315 | 0.31 | 217.23 | 11.29 | 3556.84 |
| | MC317 | Mixed Hardwood Mesic Slope Forest | 272 | 0.51 | 88.59 | 3.71 | 1,008.64 |
| | MC318 | Mixed Hardwood Dry Upland and Slope Forest | 41 | 0.63 | 54.32 | 8.92 | 365.54 |
| | MC319 | *Pinus* (*taeda*, *echinata*) Upland Woodland | 47 | 0.50 | 37.71 | 5.42 | 254.79 |

**Table 14 (continued).** Map statistics by map class for the Big Thicket National Preserve vegetation map.

| Dominant Vegetation Physiogomy | Map Class | Map Class Name | Number of Polygons | Minimum size (ha) | Maximum size (ha) | Mean size (ha) | Total area (ha) |
|---|---|---|---|---|---|---|---|
| Forest and Woodland (continued) | MC320 | *Pinus* (t*aeda*, *echinata*) Upland Forest | 134 | 0.25 | 199.13 | 11.33 | 1518.15 |
| | MC321 | *Pinus palustris* - (*Pinus echinata*, *taeda*, *elliotti*) Forest and Woodland | 89 | 0.50 | 144.84 | 8.51 | 757.11 |
| | MC322 | *Pinus* spp. (*taeda*, *echinata*, *palustris*) Regenerating Woodland and Shrubland | 67 | 0.50 | 32.73 | 3.85 | 257.63 |
| | MC323 | *Pinus elliotti* var. *elliotti* Ruderal Woodland and Forest | 1 | 0.65 | 0.65 | 0.65 | 0.65 |
| | MC324 | *Taxodium distichum* / *Morella cerifera* / *Thelypteris palustris* Tidal Woodland | 13 | 1.13 | 9.43 | 3.13 | 40.73 |
| | MC325 | *Ilex coriacea* – *Prunus carolinana* Dense Evergreen Forest and Shrubland | 28 | 0.39 | 13.35 | 1.94 | 54.42 |
| | MC326 | *Quercus laurifolia* - *Nyssa biflora* Circular Depression Flooded Flatwood Forest | 19 | 0.50 | 5.16 | 1.29 | 24.57 |
| | MC327 | *Acer rubrum* - (*Triadica sebifera*) / *Morella cerifera* Swamp Woodland | 3 | 0.53 | 1.28 | 0.84 | 2.53 |
| | MC328 | *Nyssa biflora* - *Acer rubrum* - (*Triadica sebifera*) / *Morella cerifera* / *Saccharum giganteum* Swamp Woodland | 1 | 4.27 | 4.27 | 4.27 | 4.27 |
| | MC329 | *Pinus taeda* – *Nyssa biflora* – *Magnolia virginiana* / *Andropogon glomeratus* Wet Woodland | 2 | 0.77 | 2.62 | 1.69 | 3.39 |
| | MC330 | *Pinus taeda* – *Nyssa biflora* – *Quercus laurifolia* Circular Depression Flooded Flatwood Forest | 19 | 0.50 | 2.68 | 1.27 | 24.04 |
| Sparse | MC401 | Riverine Sparse Bar Vegetation | 121 | 0.50 | 2.85 | 0.98 | 118.02 |
| | MC402 | Sparse Cliff Vegetation | 2 | 0.50 | 0.66 | 0.58 | 1.16 |

**Table 14 (continued).** Map statistics by map class for the Big Thicket National Preserve vegetation map.

| Dominant Vegetation Physiogomy | Map Class | Map Class Name | Number of Polygons | Minimum size (ha) | Maximum size (ha) | Mean size (ha) | Total area (ha) |
|---|---|---|---|---|---|---|---|
| Land Cover | LC001 | Pasture/Hay Ground Agricultural Vegetation | 1 | 0.52 | 0.52 | 0.52 | 0.52 |
| | LC002 | Non-vegetated / Barren Land, Borrow Pit, Cut Bank | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | LC003 | Developed, Open Space | 61 | 0.14 | 32.60 | 1.90 | 116.11 |
| | LC004 | Developed, Low - High Intensity | 80 | 0.07 | 74.23 | 3.82 | 305.81 |
| | LC005 | Water | 69 | 0.17 | 621.28 | 29.50 | 2034.93 |
| Totals | – | – | **7271** | | | | **45,771.82** |

### *Shrublands*

There are six shrubland map classes at BITH accounting for 0.01% (43.4 ha; 107.3 ac) of the park area and 0.4% (32) of the mapped polygons. The most common type, the *Quercus hemisphaerica* Shrubland (MC202) accounts for 22.6 ha (55.8 ac) or 0.05% of the park area. The second most abundant shrubland type was the *Cephalanthus occidentalis* / *Forestiera accuminata* Southern Shrub Swamp map class (MC203). This type occupied 9.8 ha (24.2 ac) and represented 0.02% of the BITH area. All other shrubland types occupied a relatively minor component of the total BITH area (Table 14).

### *Woodland and Forest*

There are 30 forest and woodland vegetation map classes at BITH occupying 94.0% (43,022 ha; 106,309.9 ac) of the park area and accounting for 94.0% (6,834) of the mapped polygons. The most abundant type was the *Quercus* spp. Mixed Hardwood Floodplain Forest (MC313), which represented 10,011.4 ha (24,738.7 ac) or 21.9% of the park. The second most abundant forest and woodland type was the *Pinus taeda* – (*Pinus echinata*) Nonriverine Flatwoods Forest map class (MC303), which occupied 7,021 ha (17,349.3 ac) and represented 15.3% of the BITH area. The next most common types (MC315 Mixed Hardwoods - *Pinus taeda* Floodplain Forest, MC311 *Taxodium distichum* - *Nyssa aquatica* Floodplain Forest, and MC316 *Pinus taeda* - Mixed Hardwoods Slope and Small Stream Forest) occupied 13.3% (6,089.5 ha; 15,047.5 ac), 10.2% (4,660.7 ha; 11,516.8 ac), and 7.8% (3,556.8 ha; 8,789.0 ac) of the park, respectively (Table 14).

### *Sparse Vegetation*

Sparse vegetation map classes comprise 0.3% (119.2 ha; 294.5 ac) of the BITH park area. Riverine Sparse Bar Vegetation (MC401) represents 118.0 ha (291.6 ac) or 0.3%, and the Sparse Cliff Vegetation (MC402) represents 1.2 ha (2.9 ac) or 0.003% of the park area (Table 14).



Example of MC402 - Sparse Cliff Vegetation at BITH (CSU photo)

### *Map Class Layer Development*

Following the AA, several fields were added to the feature class layer attribute table to facilitate basic query and display for the map data. Attribute fields in the vegetation polygon layer table include the following:

- map class code (map_class_code)
- map class name (map_class_name)
- map class translated name (map_class_translated)
- preliminary map class name (prelim_map_class_name)
- vegetation physiognomy (physiognomy)
- polygon size (ha)
- polygon size (ac)
- notes (for some polygons)
- polygon perimeter in m (shape_length)
- polygon area in $m^2$ (shape_area)

The geodatabase also links the vegetation layer to other feature classes, such as vegetation classification and AA plots and associated sampling data from the PLOTS database, plot photos, and project boundary extent. Database tables document the USNVC hierarchy and allow for spatial queries that show the multitude of data associated with a vegetation polygon or sample point. All geospatial products are projected using NAD83 in UTM Zone 15N.

# Accuracy Assessment

Accuracy Assessment (AA) is a statistical analysis of the thematic accuracy of the vegetation map. It does not evaluate the spatial accuracy of map polygon boundaries. The AA measures the degree of confusion or error between map classes presented on the map and the vegetation as sampled on the ground. It tests the ability of the map to accurately identify the patterns of the map classes on the landscape. The AA provides map users with information on the limitations of the map and its suitability for particular applications as well as informs map producers of potential sources of error and how to improve the mapping procedure (Lea and Curtis 2010). The results provide measures of overall accuracy and an estimate of the users' and producers' accuracy for each map class. Users' accuracy is the probability that map polygons correctly classify the vegetation communities as they occur on the ground. Producers' accuracy is the probability that a vegetation community is correctly identified on the map.

To produce a quantitative estimate of accuracy, random sample points stratified by map class are distributed over the map surface. Vegetation at each sample point is classified in the field and assigned a USNVC-recognized vegetation type or other local type (i.e., park special) by a field crew using the dichotomous key to plant associations of BITH. The field classifications are then compared to the associated map class designation for each location. The data are used to estimate overall accuracy and the users' and producers' accuracy of the map. Together, these identify the "confidence" of the map for the user.

Sampling design, field methods, and analysis followed guidance in Lea and Curtis (2010).

## Methods

### *Sample Design*

A stratified random sampling approach was used to allocate AA samples. Several constraints to allocation were applied. Excluded classes, buffers applied, and other allocation adjustments are described below.

**Map Classes Included/Excluded.** All natural and semi-natural vegetation classes were included. All developed land uses, cultural vegetation, and non-vegetated classes, including water, were excluded from the plot allocation.

**Accessibility and Safety Cost Surface Layer.** To maintain field crew safety and sampling efficiency, travel distances were limited to within one mile of the first two miles down any trail and within one mile from any other legal access points or corridors (e.g., roads, bridges, navigable waterways navigable by motorboats and canoes). Flooded areas with no reasonable boating access were considered inaccessible and excluded from the allocation. One stretch of the Upper Neches River Corridor Unit was also excluded for logistical purposes due to no public access and the long period that would be required to float it by canoe. Vegetation communities along this stretch were common in other units and could also be sampled above and below this stream section. Areas having steep terrain and cliffs were considered inaccessible or too hazardous for field work and were also

excluded. A cost surface using a threshold of 40+ degrees or 89 percent slope was developed using a 10-m DEM data layer.

**Buffers to Avoid Roadsides and Associated Disturbance.** Paved and unpaved park roads were buffered 25 m from the centerline and clipped from the allocation layer to avoid allocation of samples in disturbed roadside areas.

**Buffers to Promote Homogeneity within Samples.** Polygon boundaries form discrete boundaries that in the real world often consist of transitional zones (i.e., ecotones) between distinct vegetation types. A 5 to 45-m buffer was applied to polygon edges, depending on community type, to avoid ecotone boundaries (i.e., transitional areas).

**Buffers to Maintain Independence Among Observations.** A minimum buffer between AA plots equivalent to 80 m or twice the radius of a circular area of observation or 0.5 ha MMU was applied. Buffers may not always have been met due to limited allocation on some narrow islands.

Sample sizes for each evaluated map class were determined using guidance from Lea and Curtis (2010) (Table 15). Most map classes were allocated 30 points using a simple random procedure was used to allocate the points. After the plots were allocated to each map class, the points were combined into a single data layer that tracked the mapped class for each point. A total of 770 AA points and an additional 231 alternate points were allocated among the vegetated map classes (Figure 6). If a primary sample point was inaccessible and/or could not be clearly observed, a point was chosen from a sequential list of alternate points for the same map class type and then sampled. Spatial coordinates for all AA points were downloaded to GPS tablets for field sampling.

**Table 15.** Standard sample size allocations for a thematic accuracy assessment, based on map class area (from Lea and Curtis 2010).

| Map Class Abundance | Map Class Total Area* | Number of Observations per Map Class** |
|---|---|---|
| Abundant | > 50 hectares | 30 |
| Relatively Abundant | 8.33 to 50 hectares | 0.6 per hectare |
| Relatively Rare | < 8.33 hectares | 5 |

* - as measured before buffering for cost surface (access buffer) or for map class boundary buffer.

** - or as many spatially independent (non-overlapping) observation sites as map class area, MMU size, and other considerations will allow.

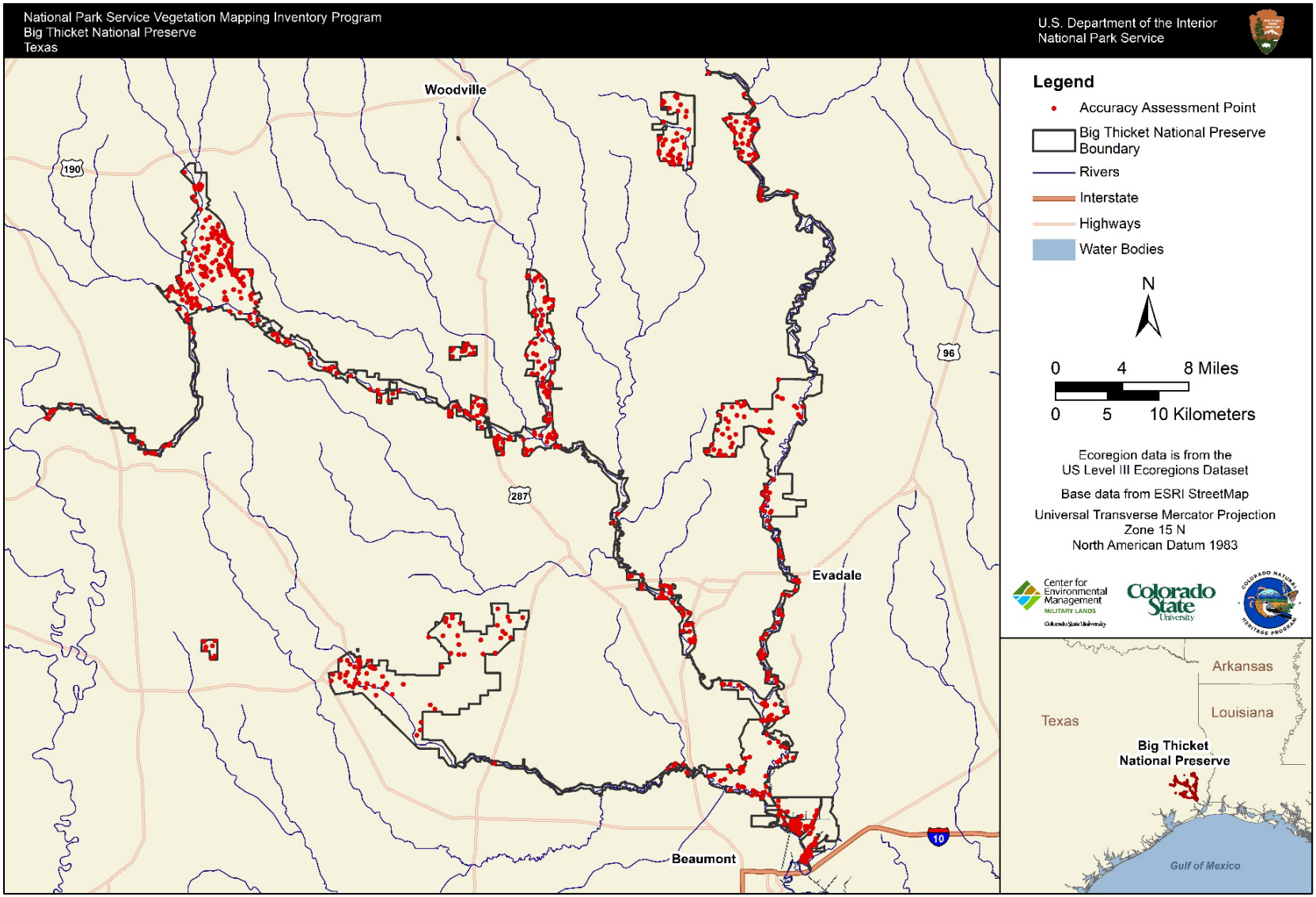



**Figure 6.** BITH AA points sampled during summer of 2018. (Data sources: ESRI Streetmap, NPS)

### *Accuracy Assessment Data Collection*

Field staff consisted of three 2-person crews and a crew leader that worked from May 28th through September 24th of 2019. All crew members had backgrounds in botany and ecology field data collection but were unfamiliar with the vegetation present at BITH. Before field sampling began, all crew members were trained in species identification, field methods and protocols, and use of the vegetation classification key

For the AA, field crews used Collector for ArcGIS to collect points and record data. Collector was created by ESRI to help smooth the workflow between data collection and office analysis. Collector allows data in the form of points, polygons, or lines to be recorded digitally on a tablet or other mobile device while in the field. The app syncs with ArcGIS online, allowing multiple users to view and edit the data in real time. Each map can be customized to fit the needs of any project by using domain-based drop-down menus and georeferenced photos. During data collection, species are chosen from a pre-generated species list, which reduces data entry errors and speeds up quality control and quality assurance procedures. Field crews used Apple iPad Pro tablets with Bad Elf Bluetooth GPS units.

Primary and alternate AA points were uploaded to ArcGIS online. These points were added to a map along with the digital data sheet, topography data, color infra-red imagery, park boundary, and road layers. Each map was used as a background image viewable on the data collection device that included locations of primary and alternate points with topographical lines overlaid on satellite imagery to aid in navigation. To avoid biasing field determinations, no information on the map class or classified association of polygons was revealed to the crews.

As with the vegetation classification plots, AA point locations were accessed using a combination of travel on roads, boat travel (supported by NPS), and foot travel, typically completed during day trips. Once a crew successfully navigated to an AA point, they evaluated the site relative to the AA criteria. The standard observational area of each point was 0.5 ha (1.24 ac), which is equivalent to the MMU size used by interpreters. If the point was notably affected by some disturbance, such as a developed site or a road, the crew attempted to move or reshape the point. If the point could not be moved or reshaped appropriately, it was rejected and replaced with an alternate point selected sequentially from the alternate point list. If the point appeared to encompass more than one distinct vegetation type (not considered an inclusion), the point was moved or reshaped. Moving and reshaping of points followed modified guidance from Lea and Curtis (2010). When a point was moved, the crew recorded the GPS coordinates of the new point center on the field form. Points that were inaccessible or deemed unsafe due to water (>1.5 m deep) or the presence of alligators were rejected and replaced with alternate points.

Once an AA point satisfied the selection criteria, the crew used the *Field Key to Community Associations/Types* (Appendix B) to assign a vegetation type. A primary or "best fit" assignment was recorded as well as a secondary or "next best" assignment. The vegetation types were either recognized USNVC types or park specials. The vegetation types were equivalent to, or nested uniquely within, a single map class. There could be many types within a single map class, but only one map class for each type. Thus, identifying the sample point vegetation type will ultimately

determine whether the correct map class has been applied. This method avoids the need to generate a separate map class key and provides the user with more information on map class composition.

In addition to assigning a vegetation type to each AA point, the crew also recorded the crew member names, date, dominant species of each stratum and their respective cover classes, cover class of each stratum, ground cover, leaf phenology of dominant stratum, whether the point was a good representation of the larger inference area, and whether the designated type was a good fit for the vegetation observed at the site. The crew also recorded the UTM coordinates of the field point center, which was especially crucial when points were moved or reshaped or the error in the GPS unit was high. They also noted any special conditions that could affect the classification of the point (e.g., recent disturbance, potential species misidentification, etc.) and took a picture from point center in each of the cardinal directions (beginning with north, and followed by east, south, and then west). These digital photos were archived according to point number and were examined during data analysis in the event of a disagreement between the mapped class and the field-assigned class.

#### *Data Quality Control*

These data underwent quality control (QC) procedures prior to and following data entry before any analyses were performed. The first QC step was review and verification of field form data. Data on the field forms were checked for completeness and to ensure that values were appropriate for the given parameter. Following entry of the data into the PLOTS database, routine QC checks of the data were completed to eliminate possible transcription errors. These checks included searching for null values, as well as checking for out of range, nonsensical, or otherwise erroneous values. After making necessary corrections, these data were imported into ArcGIS as a layer file and a data QC check was completed to ensure that the geocoding was correct for all points.

#### *Accuracy Assessment Data Analysis*

To analyze the BITH AA data, a table was created from the pertinent data fields in the PLOTS database and imported into ArcGIS. The data fields included Plot ID, Primary Association, Secondary Association, Primary Map Class, Secondary Map Class, Plot XY Coordinates, and Field XY Coordinates. The imported data were converted to a shapefile and spatially joined to the vegetation map layer. This spatial join produced a list of all sampled points, the map class of the Primary and Secondary Association identified by the field crew, and the map class of the vegetation map polygon where the point was sampled. The attribute table of the spatial join was exported from ArcGIS as a table and imported to MS Excel for further evaluation.

The data table imported to MS Excel was evaluated to identify point records where the field map class (field call) did not agree with the map class of the vegetation map (map call). Records where the primary field call was correct were considered correct and removed from the analysis. Records for which the primary field call disagreed with the mapped class but the crew had made a secondary call were then evaluated. Records for which the secondary call was correct were considered correct. The remaining records were considered incorrect and retained for further evaluation to determine the source of the disagreement and potential need for reconciliation. The analysis of this dataset provided an initial (raw) accuracy measure.

The remaining records where neither the primary nor secondary field call agreed with the map call were individually evaluated by reviewing all available data for the sample point and the map polygon. The purpose of the review was to identify the source of the disagreement between the field call and the map call, and to verify whether the error was attributable to the map call or some other factor. Verifying the source of error allows one to reconcile errors that in reality have very little to do with the accuracy of the map polygons and provides a truer measure of the map accuracy. The analysis of this dataset provided a reconciled accuracy measure. The reconciled accuracy measure remains unbiased by correcting only errors that can objectively be attributed to an erroneous field call or a change in land use or land cover between the imagery date and the AA field date.

Three potential sources of disagreement were identified prior to verifying the sources. These included cases where the disagreement was due to an erroneous map call (MC), an erroneous field call (FC), or due to recent changes in the land use or land cover (RC) (i.e., changes occurring after the imagery date). Erroneous field calls were further classified as due to a species or association identification (ID) error (FC1), a cover or density estimate error (FC2), a minimum map unit (MMU) estimate error (FC3), or a simple recording error (FC4). Any disagreement that could not objectively be attributed to something other than a map call were classified as an erroneous map call (MC). All disagreements classified as MC were retained as errors. All disagreements classified as FC1-FC4 or RC1 were considered to be correct.

The review of all disagreements included reviewing the point species lists, the sample point photos, the map polygons, and imagery of the area. Prior to starting the review, additional columns were added to the evaluation spreadsheet for “Error Classification,” “Comments/Justification,” and “Reconciled Field Call.” Error Classification is one of six codes listed above (FC1-FC4, MC1 or RC1), Comments/Justification provides a short description of what the specific issue was, and Reconciled Field Call is the post-reconciliation value assigned to the point (may remain the same or change).

Following the reconciliation, the data were arrayed in MS Excel to create an error matrix as well as a list of all map classes and associated areas (Appendix F). Map class names were categorized by the physiognomy of the type to ensure that similar types were positioned near one another in the matrix. To do this, we simply added a digit to the map class name to designate the physiognomy. The matrix and list were then copied and pasted into the NPS Contingency Table workbook (NPS 2018). For more information on the NPS Contingency Table Spreadsheet see Lea and Curtis (2010). The contingency table workbook for BITH is included in the deliverable package.

Users’ accuracy is based on the mapped classes (rows in the contingency table) and is defined as the probability that a location mapped as class x is in fact class x on the ground. Users’ accuracy is more important to map users because map users are most interested in knowing how well the map represents the types on the ground (Lea and Curtis 2010). The producers’ accuracy is based on the true vegetation class in the field (columns in the contingency table), and is defined as the probability that a location of vegetation class x in the field is correctly mapped as class x. The producers’ accuracy provides the map producer with an indication of how accurately a class may be detected wherever it occurs within the mapped area (inference area) (Lea and Curtis 2010).

### *Map Class Aggregation*

Map classes with low individual class accuracy were evaluated for possible aggregation with theother class(es) with which they were confused. The class errors were evaluated to determine the specific classes to combine to improve the accuracy. Aggregating map classes decreases the thematic resolution of the aggregated classes. Therefore, the objective is to maximize the individual class accuracies while minimizing the loss of thematic resolution of map classes. This requires identifying the correct map classes to combine and not combining more classes than is absolutely necessary to improve the accuracy to an acceptable level, consistent with park staff input. Based on consultation with BITH staff, our judgement, and needs of the park, no aggregation of map classes was needed.

## Results

The field crews collected data at 698 primary points and 86 alternate points, for a total of 784 AA points (Figure 6). The total inference area within the 45,831.65 ha (113,252.47 ac) of BITH is 43,374.16 ha (107,179.88 ac), or 94.6%. Forest and woodland communities comprise most of the area at 43,072.23 ha (106,433.80 ac) or 94% of the entire area. Open water and land use areas (roads, urban, etc.) are not included in the inference area. The inference area in each map class and the count of sample points collected across them are shown in Table 16.

**Table 16.** Count of AA sample points and inference area for each map class.

| Map Class Code | Map Class Inference Area (hectares) | Number of AA Sample Points |
|---|---|---|
| MC101 | 9 | 6 |
| MC102 | 2 | 2 |
| MC103 | 9 | 6 |
| MC104 | 1 | 2 |
| MC105 | 85 | 31 |
| MC106 | 1 | 2 |
| MC107 | 23 | 14 |
| MC108 | 1 | 1 |
| MC201 | 6 | 5 |
| MC202 | 33 | 20 |
| MC203 | 11 | 6 |
| MC204 | 2 | 2 |
| MC205 | 1 | 1 |
| MC206 | 1 | 1 |
| MC301 | 1236 | 31 |

**Table 16 (continued).** Count of AA sample points and inference area for each map class.

| Map Class Code | Map Class Inference Area (hectares) | Number of AA Sample Points |
|---|---|---|
| MC302 | 303 | 31 |
| MC303 | 102 | 32 |
| MC304 | 906 | 32 |
| MC305 | 1 | 2 |
| MC306 | 438 | 30 |
| MC307 | 82 | 30 |
| MC308 | 7 | 6 |
| MC309 | 16 | 8 |
| MC310 | 1158 | 24 |
| MC311 | 4669 | 30 |
| MC312 | 15 | 10 |
| MC313 | 9994 | 30 |
| MC314 | 3208 | 32 |
| MC315 | 6065 | 31 |
| MC316 | 3572 | 31 |
| MC317 | 1097 | 31 |
| MC318 | 285 | 31 |
| MC319 | 254 | 32 |
| MC320 | 1531 | 31 |
| MC321 | 785 | 31 |
| MC322 | 271 | 31 |
| MC323 | 1 | 1 |
| MC324 | 41 | 8 |
| MC325 | 67 | 30 |
| MC326 | 17 | 12 |
| MC327 | 3 | 3 |
| MC328 | 4 | 1 |
| MC329 | 3 | 1 |
| MC330 | 25 | 17 |

**Table 16 (continued).** Count of AA sample points and inference area for each map class.

| Map Class Code | Map Class Inference Area (hectares) | Number of AA Sample Points |
|---|---|---|
| MC401 | 118 | 33 |
| MC402 | 1 | 2 |

Prior to reconciling data collection errors, 523 samples agreed with the map classification and 261 disagreed with the map classification. As a simple plot count proportion, the overall accuracy before reconciliation was 66.7%. When the accuracy for each map class is weighted relative to the area it occupies within the park (i.e., as a proportion of the population), the initial overall accuracy was 74.3% with a Kappa accuracy of 65.5%. When each AA sample was evaluated for a variety of potential errors, a number of the disagreements were overturned, resulting in revised accuracies. It was determined that 182 plot records disagreed due to either an erroneous field call (FC1-4) or a change in the vegetation since the imagery date (RC), and 79 disagreed due to a true map classification error (MC). Those records identified as incorrect due to an erroneous field call or changes in vegetation were considered correct for the purpose of the AA.

The 79 plots ultimately identified as disagreeing with the mapped class during the QC process were attributed to map classification error (Table 17). As a simple plot count proportion, the reconciled overall accuracy was 89.9% (705/784). The spatially-weighted overall accuracy was 92.1% with a Kappa statistic of 89.6%. The overall accuracy, Kappa statistic, and upper and lower 90% confidence intervals for the initial (raw) AA data and reconciled AA data are provided in Table 18.

**Table 17.** Accuracy assessment error reconciliation summary for BITH based on simple plot count proportions (not spatially weighted).

| Accuracy Type | Category | Metric | Count | Percent |
|---|---|---|---|---|
| Initial (raw) Accuracy | Map Class Agreement | – | 523 | 67% |
| | Map Class Disagreement | – | 261 | 33% |
| Concise (reconciled) Accuracy | Map Class Agreement | – | 705 | 90% |
| | Map Class Disagreement | – | 79 | 10% |
| Evaluation Criteria | Initial Agreement | Match | 523 | 67% |
| Map Call Errors | Classification Error | MC1 | 79 | – |
| | Spatial Error | MC2 | 0 | – |
| | Total Map Call Errors | – | 79 | 10% |
| Field Call Errors | Species/Type ID Error | FC1 | 9 | 1.1% |
| | Cover Estimation Error | FC2 | 136 | 17.3% |

**Table 17 (continued).** Accuracy assessment error reconciliation summary for BITH based on simple plot count proportions (not spatially weighted).

| Accuracy Type | Category | Metric | Count | Percent |
|---|---|---|---|---|
| Field Call Errors (continued) | MMU Estimation Error | FC3 | 16 | 2% |
| | Data Recording Error | FC4 | 10 | 1.2% |
| | Total Field Call Errors | – | 171 | 22% |
| Vegetation Change Errors | Inundation | VC1 | 5 | 0.6% |
| | Mechanical Treatment | VC2 | 6 | 0.8% |
| | Chemical Treatment | VC3 | 0 | 0% |
| | Burned | VC4 | 0 | 0% |
| | Total Vegetation Change Errors | – | 11 | 1.4% |

**Table 18.** Spatially-weighted initial and reconciled overall map accuracy.

| Accuracy Type | Metric | Initial (raw) Accuracy Percent | Reconciled Accuracy Percent |
|---|---|---|---|
| General Accuracy: | Lower Limit, 90% Confidence Interval | 70.2% | 89.4% |
| | Upper Limit, 90% Confidence Interval | 78.3% | 94.8% |
| | Overall Accuracy | 74.3% | 92.1% |
| Kappa Accuracy: | Lower Limit, 90% Confidence Interval, K | 62.7% | 87.7% |
| | Upper Limit, 90% Confidence Interval, K | 68.4% | 91.4% |
| | Weighted Kappa Accuracy | 65.5% | 89.6% |

### *Map Class Accuracy*

Following review of the individual class accuracies, the classification team met with the interpretation team to discuss the results. Possible aggregation of preliminary map classes considered results of the contingency table illustrating the distribution of disagreements among types, nuances of the communities, and the locations and extents of types. Map class accuracies are shown in Table 19 and Figure 7.

Five map classes had calculated accuracies below the 80% accuracy target: MC202 *Quercus hemisphaerica* Shrubland (60.0%), MC203 *Cephalanthus occidentalis* / *Forestiera acuminata* Southern Shrub Swamp (66.7%), MC304 Baygall Seepage Bog (75.0%), MC317 Mixed Hardwood Mesic Slope Forest (64.5%), and MC325 *Ilex coriacea – Prunus caroliniana* Dense Evergreen Forest and Shrubland (70.0%). We decided to retain these map classes due to the rarity of the community (MC203), the detail provided by the map classes (MC202, MC317), or the accuracy reasonably close to the 80% target (MC304, MC325).

When the 90% confidence intervals were included, an additional eight classes had thematic accruacies that extend below 80%: MC103 *Schoenoplectus tabernaemontani* – (*Typha latifolia*) Brackish Marsh, MC302 *Pinus taeda* Riparian Forest, MC306 Riverfront Successional Floodplain Forest, MC307 *Triadica sebifera* Ruderal Forest and Woodland, MC309 *Fraxinus caroliniana* Swamp Forest, MC311 *Taxodium distichum - Nyssa aquatica* Floodplain Forest, MC318 Mixed Hardwood Dry Upland and Slope Forest, and MC330 *Pinus taeda – Nyssa biflora – Quercus laurifolia* Circular Depression Flooded Flatwood Forest (Table 19, Figure 7).

**Table 19.** Users' and producers' reconciled accuracies for each map class at BITH.

| Map Class Code | Users' Accuracy % | Lower Limit, 90% CI | Upper Limit, 90% CI | Producers' Accuracy % | Lower Limit, 90% CI | Upper Limit, 90% CI | Est. True MC Area (ha) |
|---|---|---|---|---|---|---|---|
| MC101 | 100.0 | 91.7 | 100.0 | 100.0% | 100.0% | 100.0% | 8.99 |
| MC102 | 100.0 | 75.0 | 100.0% | 100.0% | 100.0% | 100.0% | 1.91 |
| MC103 | 83.3% | 50.0% | 100.0% | 100.0% | 100.0% | 100.0% | 7.12 |
| MC104 | 100.0% | 75.0% | 100.0% | 100.0% | 100.0% | 100.0% | 1.28 |
| MC105 | 96.8% | 89.9% | 100.0% | 98.3% | 98.3% | 98.3% | 83.46 |
| MC106 | 100.0% | 75.0% | 100.0% | 100.0% | 100.0% | 100.0% | 1.41 |
| MC107 | 100.0% | 96.4% | 100.0% | 100.0% | 100.0% | 100.0% | 22.80 |
| MC108 | 100.0% | 50.0% | 100.0% | 100.0% | 100.0% | 100.0% | 0.53 |
| MC201 | 100.0% | 90.0% | 100.0% | 100.0% | 100.0% | 100.0% | 5.77 |
| MC202 | 60.0% | 39.5% | 80.5% | 100.0% | 100.0% | 100.0% | 19.52 |
| MC203 | 66.7% | 26.7% | 100.0% | 100.0% | 100.0% | 100.0% | 7.23 |
| MC204 | 100.0% | 75.0% | 100.0% | 30.8% | 30.8% | 30.8% | 5.56 |
| MC205 | 100.0% | 50.0% | 100.0% | 100.0% | 100.0% | 100.0% | 1.01 |
| MC206 | 100.0% | 50.0% | 100.0% | 100.0% | 100.0% | 100.0% | 0.63 |
| MC301 | 100.0% | 98.4% | 100.0% | 99.1% | 99.1% | 99.1% | 1247.25 |
| MC302 | 87.1% | 75.6% | 98.6% | 99.4% | 99.3% | 99.5% | 265.10 |
| MC303 | 93.8% | 85.1% | 100.0% | 96.5% | 95.5% | 97.5% | 6814.90 |
| MC304 | 75.0% | 60.8% | 89.2% | 86.0% | 85.7% | 86.3% | 790.11 |
| MC305 | 100.0% | 75.0% | 100.0% | 100.0% | 100.0% | 100.0% | 1.45 |
| MC306 | 83.3% | 70.5% | 96.2% | 99.3% | 99.1% | 99.4% | 367.43 |
| MC307 | 80.0% | 66.3% | 93.7% | 97.0% | 97.0% | 97.0% | 67.95 |
| MC308 | 100.0% | 91.7% | 100.0% | 100.0% | 100.0% | 100.0% | 7.30 |

**Table 19 (continued).** Users' and producers' reconciled accuracies for each map class at BITH.

| Map Class Code | Users' Accuracy % | Lower Limit, 90% CI | Upper Limit, 90% CI | Producers' Accuracy % | Lower Limit, 90% CI | Upper Limit, 90% CI | Est. True MC Area (ha) |
|---|---|---|---|---|---|---|---|
| MC309 | 87.5% | 62.0% | 100.0% | 72.0% | 72.0% | 72.1% | 19.65 |
| MC310 | 95.8% | 87.0% | 100.0% | 100.0% | 99.8% | 100.0% | 1110.09 |
| MC311 | 90.0% | 79.3% | 100.0% | 98.9% | 98.0% | 99.7% | 4250.40 |
| MC312 | 100.0% | 95.0% | 100.0% | 100.0% | 100.0% | 100.0% | 15.73 |
| MC313 | 93.3% | 84.2% | 100.0% | 94.4% | 93.0% | 95.8% | 9882.19 |
| MC314 | 93.8% | 85.1% | 100.0% | 87.2% | 86.6% | 87.7% | 3451.05 |
| MC315 | 93.5% | 84.7% | 100.0% | 91.8% | 90.8% | 92.8% | 6182.02 |
| MC316 | 93.5% | 84.7% | 100.0% | 94.5% | 93.9% | 95.1% | 3536.86 |
| MC317 | 64.5% | 48.8% | 80.3% | 97.5% | 97.1% | 97.8% | 725.86 |
| MC318 | 87.1% | 75.6% | 98.6% | 27.4% | 27.1% | 27.6% | 904.86 |
| MC319 | 100.0% | 98.4% | 100.0% | 99.4% | 99.4% | 99.4% | 255.76 |
| MC320 | 90.3% | 80.0% | 100.0% | 97.9% | 97.6% | 98.2% | 1412.56 |
| MC321 | 100.0% | 98.4% | 100.0% | 67.9% | 67.9% | 68.0% | 1156.00 |
| MC322 | 100.0% | 98.4% | 100.0% | 100.0% | 100.0% | 100.0% | 271.32 |
| MC323 | 100.0% | 50.0% | 100.0% | 100.0% | 100.0% | 100.0% | 0.65 |
| MC324 | 100.0% | 93.8% | 100.0% | 93.7% | 93.7% | 93.7% | 43.48 |
| MC325 | 70.0% | 54.6% | 85.4% | 100.0% | 100.0% | 100.0% | 46.73 |
| MC326 | 100.0% | 95.8% | 100.0% | 7.5% | 7.4% | 7.5% | 229.41 |
| MC327 | 100.0% | 83.3% | 100.0% | 100.0% | 100.0% | 100.0% | 2.53 |
| MC328 | 100.0% | 50.0% | 100.0% | 100.0% | 100.0% | 100.0% | 4.27 |
| MC329 | 100.0% | 50.0% | 100.0% | 100.0% | 100.0% | 100.0% | 2.62 |
| MC330 | 88.2% | 72.4% | 100.0% | 100.0% | 100.0% | 100.0% | 22.24 |
| MC401 | 100.0% | 98.5% | 100.0% | 100.0% | 100.0% | 100.0% | 118.02 |
| MC402 | 100.0% | 75.0% | 100.0% | 100.0% | 100.0% | 100.0% | 1.16 |

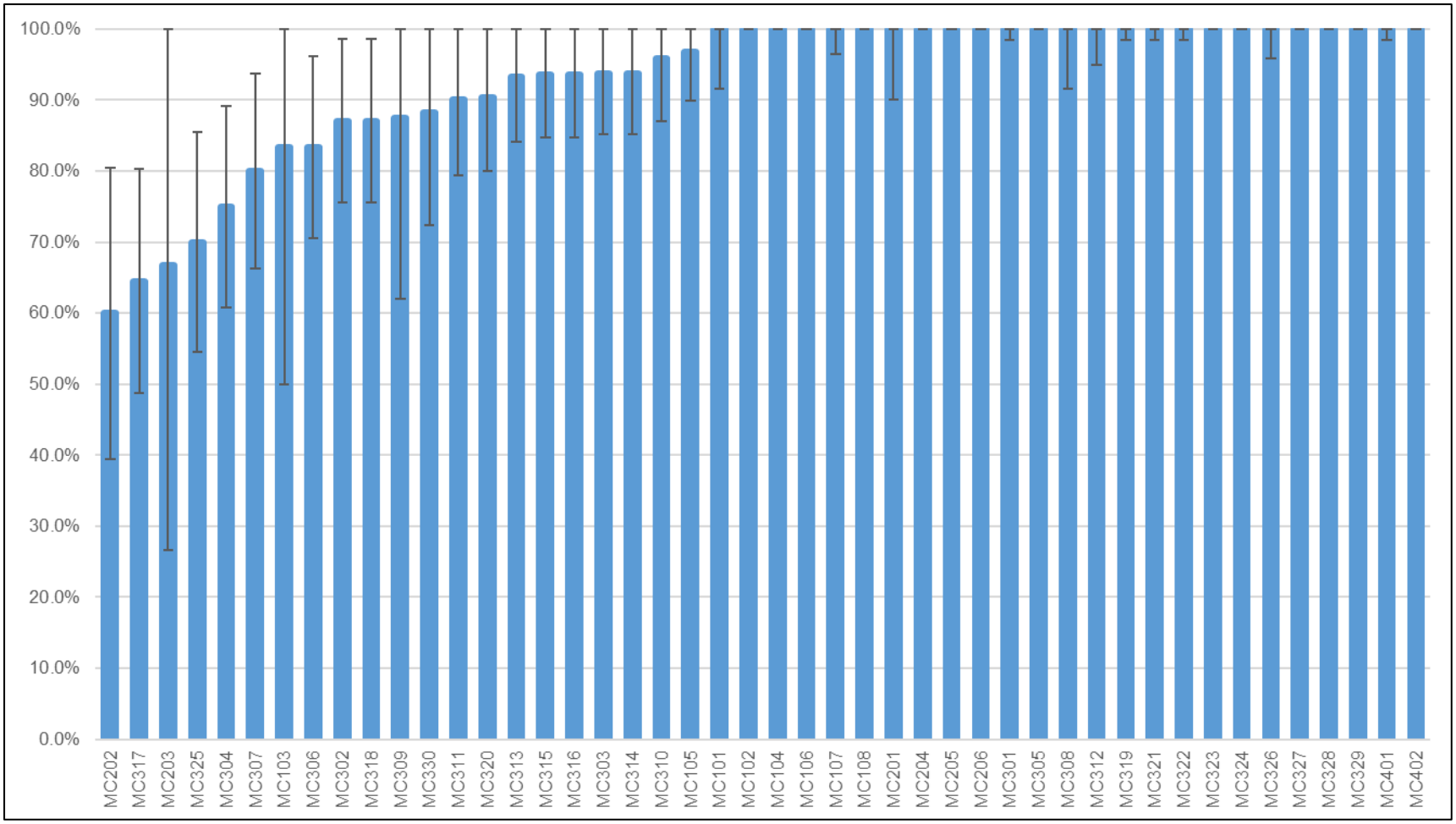



**Figure 7.** Users' accuracy and 90% confidence intervals for BITH vegetated map classes.

# Conclusions

The vegetation inventory project at BITH classified and mapped vegetation in the park-managed area. The project was conducted over a six-year period from 2016 to 2021. The thematic user's accuracy of the final map is 92.1%.

The vegetation inventory resulted in a report, a vegetation map with accuracy that generally exceeds requirements, and associated geospatial database products. The project also developed other products valuable for park resource management. They include the vegetation classification, field key to the associations, local association descriptions, and a photo viewer database. Together with the vegetation data layer, these products provide the park with an array of tools to assist in managing park resources and making informed resource management decisions.

The BITH vegetation classification and map will be helpful in managing myriad park resources. The geospatial database, map, and other products directly support managing and monitoring plant and animal habitats, examining the effects of land uses and environmental changes on vegetation over time, and evaluating the long-term effects of management activities on plant communities within the park.

# Literature Cited

Blanton and Associates, Inc. 2002. Pre-Operational and Post-Operational Vegetation Analysis within the Lance Rosier Unit of the Big Thicket National Preserve.

Brown, L.E., B.R. MacRoberts, M.H. MacRoberts, P.A. Harcombe, W.W. Pruess, I.S. Elsik, and D. Johnson. 2005. Annotated checklist of the vascular flora of the Turkey Creek unit of the Big Thicket National Preserve, Tyler and Hardin Counties, Texas. SIDA, Contributions to Botany 21(3): 1807-1827.

Brown, L.E., B.R. MacRoberts, M.H. MacRoberts, P.A. Harcombe, W.W. Pruess, I.S. Elsik, and S.D. Jones. 2006a. Annotated checklist of the vascular flora of the Big Sandy Creek Unit, Big Thicket National Preserve, Texas. SIDA, Contributions to Botany 22(1): 705-723.

Brown, L.E., P.A. Harcombe, W.W. Pruess, I.S. Elsik, B.R. MacRoberts, M.H. MacRoberts, and S.D. Jones. 2006b. Annotated checklist of the vascular flora of the Lance Rosier unit of the Big Thicket National Preserve, Hardin County, Texas. SIDA, Contributions to Botany 22(2): 1175-1189.

Brown, L.E., B.R. MacRoberts, M.H. MacRoberts, P.A. Harcombe, W.W. Pruess, I.S. Elsik, S.B. Walker. 2008a. Annotated checklist of the vascular flora of the Beech Creek unit of the Big Thicket National Preserve, Tyler County, Texas. Journal of the Botanical Research Institute of Texas 2(1):651-660.

Brown, L.E., W.W. Pruess, I.S. Elsik, B.R. MacRoberts, M.H. MacRoberts, and S.B. Walker. 2008b. Annotated checklist of the vascular flora of the Loblolly unit of the Big Thicket National Preserve, Liberty County, Texas. Journal of the Botanical Research Institute of Texas 2(2): 1481-1489.

Brown, L.E., B.R. MacRoberts, M.H. MacRoberts, and W.W. Pruess. 2009. Annotated checklist of the vascular flora of the Menard Creek corridor unit of the Big Thicket National Preserve, Polk, Liberty, and Hardin Counties, Texas. Journal of the Botanical Research Institute of Texas 3(1): 443-455.

Chavarria, P. M., R. R. Lopez, G. Bowser, and N. J. Silvy. 2007. A landscape-level survey of feral hog impacts to natural resources of the Big Thicket National Preserve. Human-Wildlife Conflicts 1(2): 199-204.

Colorado Natural Heritage Program (CNHP). 2015. PLOTS Database v. 4.0. Colorado Natural Heritage Program, Colorado State University, Fort Collins, Colorado.

Cooper, R. J., S. B. Cederbaum, and J. J. Gannon. 2004. Natural resource summary for Big Thicket National Preserve (BITH), final report. National Park Service, Warnell School of Forest Resources, University of Georgia, Athens, Georgia.

Deshotels, J. D. 1978. Soil survey for the Big Thicket National Preserve, Texas. United States Department of the Interior-National Park Service, United States Department of Agriculture-Soil Conservation Service, Texas Agricultural Experiment Station, College Station, Texas.

Diggs, G. M., B. L. Lipscomb, M. D. Reed, and R. J. O'Kennon. 2006. Illustrated flora of east Texas. Sida, Bot. Misc. 26:1-1594.

Dixie Environmental Services Co. (DESCO). 2005. Post-Operational Vegetation and Impact Assessment of the Big Sandy Creek Unit, Big Thicket National Preserve.

Dixie Environmental Services Co. (DESCO). 2009. Post-Operational Assessment of Vegetation in the Turkey Creek Unit, Big Thicket National Preserve, Hardin and Tyler Counties, Texas.

Dixie Environmental Services Co. (DESCO). 2013. Post-Operational Assessment of Vegetation in the Beaumont Unit and Other Adjacent Lands of the Big Thicket National Preserve, Hardin, Jasper, Jefferson, and Orange Counties, Texas. Magnolia, Texas.

Federal Geographic Data Committee (FGDC). 1997. National vegetation classification standard. Vegetation Subcommittee, Federal Geographic Data Committee, Reston, Virginia.

FGDC. 1998a. Content standard for digital geospatial metadata, FGDC-STD-001-1998. Federal Geographic Data Committee, Reston, Virginia.

FGDC. 1998b. Spatial data transfer standard, FGDC-STC002-1998. Federal Geographic Data Committee, Reston, Virginia.

FGDC. 2008. National vegetation classification standard (version 2). FGDC-STD-005-2008. Available at: http://www.fgdc.gov/standards/status/textstatus.html.

Griffith, G.E., S.A. Bryce, J.M. Omernik, J.A. Comstock, A.C. Rodgers, B. Harrison, and D. Bezanson. 2004. Ecoregions of Texas. U.S. Geological Survey, Reston, Virginia.

Grossman, D. H., D. Faber-Langendoen, A. S. Weakley, M. Anderson, P. Bourgeron, R. Crawford, K. Goodin, S. Landaal, K. Metzler, K. D. Patterson, M. Pyne, M. Reid, and L. Sneddon. 1998. International classification of ecological communities: terrestrial vegetation of the United States. Volume I. The National Vegetation Classification System: development, status, and applications. The Nature Conservancy, Arlington, Virginia.

Guntenspergen, G. R., and B. A. Vairin. 1998. Vulnerability of coastal wetlands in the southeastern United States: Climate change research results, 1992-1997. United States Geological Survey (USGS). Biological Science Report. National Wetlands Research Center, Lafayette, Louisiana.

Harcombe, P. A., and G. Callaway. 1997. Big Thicket National Preserve water corridors management assessment. National Park Service, Big Thicket National Preserve, Kountze, Texas.

Harcombe, P. A., and P. L.Marks. 1979. Forest vegetation of the Big Thicket National Preserve. Unpublished report: National Park Service, Santa Fe, New Mexico.

Hughs, J. C., M. D. Flora, and J. C. Woods. 1987. Big Thicket National Preserve: water quality report 1984-1986. Water Resources Report 87-2. National Park Service, Water Resources Division, Fort Collins, Colorado.

Jennings, C. A., and S. J. Zigler. 2000. Ecology and biology of paddlefish in North America: Historical perspectives, management approaches, and research priorities. Reviews in Fish Biology and Fisheries 10:167-181.

Kartesz, J. 1999. A synonymized checklist and atlas with biological attributes for the vascular flora of the United States, Canada, and Greenland, first edition. *In* J. T. Kartesz and C. A. Meacham. Synthesis of the North American Flora, version 1.0. North Carolina Botanical Garden, Chapel Hill, North Carolina.

Kartesz, J.T. 2015. The Biota of North America Program (BONAP), Taxonomic Data Center. (http://www.bonap.net/tdc). Chapel Hill, N.C. [maps generated from Kartesz, J.T. 2015. Floristic Synthesis of North America, Version 1.0. Biota of North America Program (BONAP). (in press)]

Lea, C., and A. C. Curtis. 2010. Thematic accuracy assessment procedures: National Park Service vegetation inventory, version 2.0. Natural Resource Report NPS/2010/NRR-2010/204. National Park Service, Fort Collins, Colorado.

Lea, C. 2011. Vegetation classification guidelines: National Park Service vegetation inventory, version 2.0. Natural Resource Report NPS/NRPC/NRR-2011/374. National Park Service, Fort Collins, Colorado.

MacRoberts, B.R., M.H. MacRoberts, and L.E. Brown. 2002. Annotated checklist of the vascular flora of the Hickory Creek unit of the Big Thicket National Preserve, Tyler County, Texas. SIDA, Contributions to Botany 20(2): 781-795.

MacRoberts, M. H., and B.R. MacRoberts. 2008a. The Big Thicket of Texas as floristically unique habitat. Journal of the Botanical Research Institute of Texas 2(1): 665-671.

MacRoberts, M. H., and B.R. MacRoberts. 2008b. Rare and endemic plants of the Big Thicket: a phytogeographical analysis. Journal of the Botanical Research Institute of Texas 2(1): 1475-1479.

MacRoberts, M.H., and B.R. MacRoberts. 2009. Vascular plant species richness of the Big Thicket, East Texas. Journal of the Botanical Research Institute of Texas 3(1): 401-405.

Mann, M., and Emanuel, K. 2005. Atlantic hurricane trends linked to climate change. Eos 87, 233–241. Marks, P.L., and P.A. Harcombe. 1981. Forest vegetation of the Big Thicket, Southeast Texas. Ecological Monographs 51(3): 287-305.

Mapston, M.E. 2004. Feral hogs in Texas. Texas Cooperative Extension, Wildlife Services, Texas A&M University, Texas.

McCune, B., and J. B. Grace. 2002. Analysis of ecological communities. MjM Software Design, Gleneden Beach, Oregon. Available at: www.pcord.com.

McCune, B., and M. J. Mefford. 2011. PC-ORD. Multivariate analysis of ecological data, version 6.0. MjM Software Design, Gleneden Beach, Oregon.

McHugh, D. F. 2004. Big Thicket National Preserve fire management plan. National Park Service, Big Thicket National Preserve, Kountze, Texas.

Nadeau, A. J., K. Allen, A. Davis, K. Benck, L. Meinke, S. Gardner, S. Amberg, and A. Robertson. 2016. Big Thicket National Preserve: Natural resource condition assessment. Natural Resource Report NPS/BITH/NRR—2016/1355. National Park Service, Fort Collins, Colorado.

NatureServe. 2006. NatureServe Explorer, an online encyclopedia of life, version 6.4. NatureServe, Arlington, Virginia. Available at: http://www.natureserve.org/explorer.

National Park Service (NPS). 2013. 12-Step guidance for NPS vegetation inventories – updated March 1, 2013.

NPS. 2018. Accuracy assessment contingency table worksheet, version 1.1. National Park Service. Available at: https://science.nature.nps.gov/im/inventory/veg/guidance/cfm (accessed January 18, 2018).

NPS. 2020. NPSpecies - The National Park Service biodiversity database. Available at: https://irma.nps.gov/npspecies/. (accessed January 2020).

NPS. 2021. Bith Thicket National Preserve Website - History and Culture. Available at; https://www.nps.gov/bith/learn/historyculture/index.htm (accessed March 2021).

The Nature Conservancy (TNC) and Environmental Systems Research Institute (ESRI). 1994. NBS/NPS Vegetation Mapping Program: final draft, standardized national vegetation classification system. Prepared for US Department of the Interior, National Biological Survey and National Park Service, Arlington, Virginia.

The Nature Conservancy (TNC) and National Park Service (NPS). 2009. Methodology for assessing the utility of existing data for vegetation mapping.

Texas Parks & Wildlife Department (TPWD). 1974. An Analysis of Texas Waterways. Available at: http://tpwd.texas.gov

Thornberry-Ehrlich, T. L. 2018. Big Thicket National Preserve: Geologic resources inventory report. Natural Resource Report NPS/NRSS/GRD/NRR—2018/1779. National Park Service, Fort Collins, Colorado.

U.S. Department of Agriculture Natural Resources Conservation Service (USDA NRCS). 2019. The PLANTS database National Plant Data Team, Greensboro, North Carolina. Available at: http://plants.usda.gov (accessed October 2019).

U.S. Climate Data. 2020. Climate Kountze, Texas. Available at: https://usclimatedata.com/climate/kountze/texas/united-states.

U.S. Environmental Protection Agency (USEPA). 2013. Level III ecoregions of the continental United States. National Health and Environmental Effects Research Laboratory, U.S. Environmental Protection Agency, Corvallis, Oregon.

U.S. Geological Survey (USGS). 1999. National elevation database. EROS Data Center, U.S. Geological Survey, Sioux Falls, South Dakota.

U.S. National Vegetation Classification (USNVC). 2020. United States national vegetation classification database, version 2.01. Federal Geographic Data Committee, Vegetation Subcommittee, Washington DC. Available at: http://www.usnvc.org (accessed 24 February 2020).

United State Census Bureau (USCB). 2015. Population of Beaumont, Texas. https://www.google.com/publicdata/explore?ds=kf7tgg1uo9ude_&ctype=l&strail=false&bcs=d&nselm=h&met_y=population&scale_y=lin&ind_y=false&rdim=country&idim=place:4807000:4858820:2241155&ifdim=country&hl=en&dl=en&ind=false (accessed 1 October 2015).

Watson, G. 2006. Big Thicket Plant Ecology: An Introduction, third edition. University of North Texas Press, Denton, Texas.

# Appendix A. Plant Community Descriptions

Local descriptions are based on plot data collected for this project. Global descriptions and dynamics are from the U.S. National Vegetation Classification (USNVC) website (http://usnvc.org/). Full citations for short citations provided in the global descriptions are also available at the USNVC website.

## Mapped Herbaceous Vegetation Types

### *CEGL004700 Paspalum notatum Ruderal Grassland*

Table A1 below shows the USNVC Hierarchy for CEGL004700 *Paspalum notatum* Ruderal Grassland.

**Table A1.** USNVC hierarchy for CEGL004700 *Paspalum notatum* Ruderal Grassland

| Category | Description |
|---|---|
| Class | 2 Shrub & Herb Vegetation |
| Subclass | 2.B Temperate & Boreal Grassland & Shrubland |
| Formation | 2.B.2 Temperate Grassland & Shrubland |
| Division | 2.B.2.Ne Southeastern North American Grassland & Shrubland |
| Macrogroup | 2.B.2.Ne Southeastern Ruderal Grassland & Shrubland |
| Group | 2.B.2.Ne Southeastern Ruderal Grassland & Shrubland |
| Alliance | A3321 *Andropogon virginicus - Ambrosia artemisiifolia - Conyza canadensis* Eastern Ruderal Grassland Alliance |
| Association | 2.B.2.Ne *Paspalum notatum* Ruderal Grassland (CEGL004700) |

**Field Plots:** Association added from legacy oil and gas surveys

**Map Class:** BITH MC101

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 20 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain lower terrace

**Soil Texture**: Sand

**Environment**: These communities occur along banks of the Neches River. Bare soil and litter dominate the ground cover.

Local Vegetation Description
**Structure**: Herbaceous (70%-100%)

**Vegetation Floristics**: This community contains a variety of exotic or weedy graminoids such as *Paspalum notatum*, *Paspalum laeve*, *Paspalum urvillei*, *Digitaria ciliaris*, *Polygonum hydropiperoides*, *Echinochloa walteri*, *Eleusine indica*, and *Diodia virginiana*. A sparse shrub layer can occur when *Prunus umbellata* is common along the edges of the community.

**Dynamics:** Although originally planted, *Paspalum notatum* maintains itself spontaneously, though especially so with continued grazing or mowing, and this vegetation is considered "semi-natural."

Conservation Status Rank
**Global**: GNA

Global Environmental Description
This improved pasture association occurs on a wide variety of soils and sites in uplands of the Southeastern Coastal Plain.

Global Vegetation Description
These improved pastures, roadsides and lawns are dominated by *Paspalum notatum*, with varying degrees of native composition remaining. Various remnant native species occur to varying degrees and are sometimes codominant.

Example Photograph
Figure A1 below shows an example of CEGL004700 *Paspalum notatum* Ruderal Grassland.



**Figure A1.** *Paspalum notatum* Ruderal Grassland (CSU)

***NPSBITH005 Juncus effusus Ruderal Marsh***
USNVC Hierarchy: Park Special NPSBITH005

**Field Plots:** 7014, 0319_074

**Map Class:** BITH MC102

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 143 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands

**Soil Texture**: Muck

**Environment**: 2 plots were sampled within this type. This community usually occurs on flatlands. This community occurs within a ruderal marsh with ground cover dominated by water with cover reaching up to 60%. Litter typically codominates the ground cover with values reaching up to ~30%.

Local Vegetation Description
**Structure**: Herbaceous (~95%)

**Vegetation Floristics**: *Juncus effusus* dominates this community with cover reaching up to 95%. Other common species may include *Schoenoplectus tabernaemontani*, *Saccharum giganteum*, *Andropogon glomeratus*, and *Hydrocotyle umbellata*. Occasionally, there may be large patches of open water scattered throughout the community.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A2 below shows an example of Park Special NPSBITH005 *Juncus effusus* Ruderal Marsh.



**Figure A2.** *Juncus effusus* Ruderal Marsh (CSU)

***NPSBITH011 Schoenoplectus tabernaemontani Brackish Marsh***
USNVC Hierarchy*:* Park Special NPSBITH011

**Field Plots:** 6038, 6035, 6041, 6036, 6044a

**Map Class:** BITH MC103

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 5 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Marsh

**Soil Texture**: Muck

**Environment**: Several plots were sampled within this type. These marshes are typically brackish and inundated with 1 through 6 ft of water. Ground cover is almost completely dominated by water (~85%). Litter usually only forms a minor component with cover (<1%).

Local Vegetation Description
**Structure**: Herbaceous (80%-100%)

**Vegetation Floristics**: *Schoenoplectus tabernaemontani* typically forms dense stands within large *Zizaniopsis miliacea* marshes. Cover often reaches up to 95%. Occasionally, *Ludwigia leptochloa* may form dense patches within this marsh. *Zizaniopsis miliacea* may occur within this community, but does not have cover >10%.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A3 below shows an example of Park Special NPSBITH011 *Schoenoplectus tabernaemontani* Brackish Marsh.



**Figure A3.** *Schoenoplectus tabernaemontani* Brackish Marsh (CSU)

### *CEGL004150 Typha latifolia Southern Ruderal Marsh*

Table A2 below shows the USNVC Hierarchy for CEGL004150 *Typha latifolia* Southern Ruderal Marsh.

**Table A2.** USNVC hierarchy for CEGL004150 *Typha latifolia* Southern Ruderal Marsh

| Category | Description |
|---|---|
| Class | 2 Shrub & Herb Vegetation |
| Subclass | 2.C Shrub & Herb Wetland |
| Formation | 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland |
| Division | 2.C.4.Nd Eastern North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland |
| Macrogroup | 2.C.4.Nd Eastern North American Marsh, Wet Meadow & Shrubland |
| Group | 2.C.4.Nd Eastern North American Freshwater Marsh |
| Alliance | A1436 *Typha angustifolia* - *Typha latifolia* - *Schoenoplectus* spp. Deep Marsh Alliance |
| Association | 2.C.4.Nd *Typha latifolia* Southern Ruderal Marsh (CEGL004150) |

**Field Plots:** Association added from legacy oil and gas surveys

**Map Class:** BITH MC103

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 12 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Marsh

**Soil Texture**: Muck

**Environment**: This community occurs in small pockets within a larger marsh. This community is perennially submerged.

Local Vegetation Description
**Structure**: Herbaceous (60%-95%)

**Vegetation Floristics**: Semi-natural type common in artificial wetlands where the water table is above the soil surface for most of the growing season. *Typha latifolia* forms essentially monospecific stands. Along the margins, herbs such as *Carex* spp., *Juncus effusus*, *Schoenoplectus* spp., and *Scirpus cyperinus* are common.

**Dynamics**: N/A

Conservation Status Rank
**Global**: GNA

Global Environmental Description
This type is found especially in artificial wetlands, such as borrow pits or ponds. The water table is at or above the soil surface for at least part of the growing season.

Global Vegetation Description
Stands of this association consist of *Typha latifolia* as an essentially monospecific stand. *Carex* spp. and *Schoenoplectus* spp. (= *Scirpus* spp.) are often found in this community, especially on the margins. Other co-occurring species of this association are not fully understood. In the Interior Low Plateau of Tennessee, *Typha latifolia* is commonly found with *Scirpus cyperinus*. In addition, *Juncus effusus* and an occasional *Alnus serrulata* are also present.

Example Photograph
N/A

### *CEGL004921 Panicum virgatum – Panicum rigidulum var. elongatum – Polygonum hydropiperoides Wet Meadow*

Table A3 below shows the USNVC Hierarchy for CEGL004921 *Panicum virgatum – Panicum rigidulum* var. *elongatum – Polygonum hydropiperoides* Wet Meadow.

**Table A3.** USNVC hierarchy for CEGL004921 *Panicum virgatum – Panicum rigidulum* var. *elongatum – Polygonum hydropiperoides* Wet Meadow

| Category | Description |
|---|---|
| Class | 2 Shrub & Herb Vegetation |
| Subclass | 2.C Shrub & Herb Wetland |
| Formation | 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland |
| Division | 2.C.4.Ne Atlantic & Gulf Coastal Marsh, Wet Meadow & Shrubland |
| Macrogroup | 2.C.4.Ne Atlantic & Gulf Coastal Plain Wet Prairie & Marsh |
| Group | 2.C.4.Ne Atlantic & Gulf Coastal Plain River & Basin Freshwater Marsh |
| Alliance | A3405 *Panicum rigidulum - Polygonum hydropiperoides - Polygonum punctatum* Southeastern Sandbar Alliance |
| Association | 2.C.4.Ne *Panicum virgatum - Panicum rigidulum* var. *elongatum - Polygonum hydropiperoides* Wet Meadow (CEGL004921) |

**Field Plots:** 6023, 6025, 0319_178

**Map Class:** BITH MC104

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 43 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain active channel

**Soil Texture**: Sand, Loamy sand

**Environment:** 3 plots were sampled within this type. This community occurs along the banks of large rivers or creeks such as the Neches River and Village Creek. Ground cover is dominated by litter and bare soil.

Local Vegetation Description
**Structure**: Herbaceous (30%-80%)

**Vegetation Floristics**: This community typically occurs on riverscour sandbars of blackwater rivers. Dominant herbaceous species include *Panicum virgatum*, *Panicum rigidulum* var. *elongatum*, and *Polygonum hydropiperoides*. Additional herbaceous species include *Diodia teres*, *Eupatorium serotinum*, *Paspalum urvillei*, *Pluchea camphorata*, *Rubus trivialis*, and *Solidago canadensis*. Common vine species are *Campsis radicans*, *Mikania scandens*, and *Smilax rotundifolia*. Scattered trees can include *Salix nigra* and *Betula nigra*.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
This vegetation occurs on sandbars of blackwater rivers of the Gulf Coastal Plain of Mississippi and possibly other states.

Global Vegetation Description
Stands may be dominated by *Panicum virgatum*, *Panicum rigidulum* var. *elongatum*, and *Polygonum hydropiperoides*. In addition to these species, which were dominant in the examples seen, graminoids and forbs include *Eupatorium serotinum*, *Pluchea camphorata*, *Diodia teres*, *Solidago* sp. (cf. *Solidago canadensis*), *Aeschynomene* sp., *Rubus trivialis*, *Paspalum urvillei*, *Sida* sp., *Ipomoea* sp., *Hypericum galioides*, *Lycopus virginicus*, and *Mikania scandens*. A sparser and more open phase with lower *Panicum virgatum* cover contains *Verbena brasiliensis*, *Bulbostylis stenophylla*, *Croton capitatus*, *Houstonia* sp., *Agalinis fasciculata*, and *Dichanthelium* sp. Woody vines include *Smilax rotundifolia* and *Campsis radicans*. Scattered woody plants of low stature include *Salix nigra* and *Betula nigra*.

Example Photograph
Figure A4 below shows an example of CEGL004921 *Panicum virgatum – Panicum rigidulum* var. *elongatum – Polygonum hydropiperoides* Wet Meadow.



**Figure A4.** *Panicum virgatum – Panicum rigidulum* var. *elongatum – Polygonum hydropiperoides* Wet Meadow (CSU)

### *CEGL004705 Zizaniopsis miliacea Tidal Marsh*

Table A4 below shows the USNVC Hierarchy for CEGL004705 *Zizaniopsis miliacea* Tidal Marsh.

**Table A4.** USNVC hierarchy for CEGL004705 *Zizaniopsis miliacea* Tidal Marsh

| Category | Description |
|---|---|
| Class | 2 Shrub & Herb Vegetation |
| Subclass | 2.C Shrub & Herb Wetland |
| Formation | 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland |
| Division | 2.C.4.Ne Atlantic & Gulf Coastal Marsh, Wet Meadow & Shrubland |
| Macrogroup | 2.C.4.Ne Atlantic & Gulf Coastal Fresh-Oligohaline Tidal Marsh |
| Group | 2.C.4.Ne Atlantic & Gulf Coastal Fresh-Oligohaline Tidal Marsh |
| Alliance | A1485 *Zizania aquatica* - *Zizaniopsis miliacea* Tidal Freshwater Marsh Alliance |
| Association | 2.C.4.Ne *Zizaniopsis miliacea* Tidal Marsh (CEGL004705) |

**Field Plots:** 4014a, 4015, 4016, 6033

**Map Class:** BITH MC105

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 10 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Marsh

**Soil Texture**: Muck

**Environment**: This community occurs within large tidally influenced marshes near the southern end of the Neches River. It is perennially flooded and ground cover is dominated by water and basal area.

Local Vegetation Description
**Structure**: Herbaceous (70%-95%)

**Vegetation Floristics**: Tidal marsh where *Zizaniopsis miliacea* is the sole dominant herbaceous species. Associated herbaceous species can include *Alternanthera philoxeroides*, *Peltandra virginica*, *Pontederia cordata*, *Salvinia* spp., and *Zizania aquatica*.

**Dynamics**: N/A

Conservation Status Rank
**Global**: G3G5

Global Environmental Description
Wharton (1978) reports that marshes are dominated by *Zizaniopsis* where water levels are stabilized by daily tides or other phenomena.

Global Vegetation Description
This tidal marsh is dominated by *Zizaniopsis miliacea*. Other dominants that may occur include *Zizania aquatica*, *Pontederia cordata*, *Peltandra virginica*; other common plants are *Saccharum giganteum*, *Rhynchospora corniculata*, *Cicuta maculata*, and *Boltonia asteroides*. In Virginia, common associates include *Leersia oryzoides* and *Polygonum punctatum*.

Example Photograph
Figure A5 below shows an example of CEGL004705 *Zizaniopsis miliacea* Tidal Marsh.



**Figure A5.** *Zizaniopsis miliacea* Tidal Marsh (CSU)

Short Citation
Wharton 1978

***CEGL007895 Zizaniopsis miliacea – Panicum hemitomon Tidal Marsh***
Table A5 below shows the USNVC Hierarchy for CEGL007895 *Zizaniopsis miliacea – Panicum hemitomon* Tidal Marsh.

**Table A5.** USNVC hierarchy for CEGL007895 *Zizaniopsis miliacea – Panicum hemitomon* Tidal Marsh

| Category | Description |
|---|---|
| Class | 2 Shrub & Herb Vegetation |
| Subclass | 2.C Shrub & Herb Wetland |
| Formation | 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland |
| Division | 2.C.4.Ne Atlantic & Gulf Coastal Marsh, Wet Meadow & Shrubland |
| Macrogroup | 2.C.4.Ne Atlantic & Gulf Coastal Fresh-Oligohaline Tidal Marsh |
| Group | 2.C.4.Ne Atlantic & Gulf Coastal Fresh-Oligohaline Tidal Marsh |
| Alliance | A1485 *Zizania aquatica - Zizaniopsis miliacea* Tidal Freshwater Marsh Alliance |
| Association | 2.C.4.Ne *Zizaniopsis miliacea - Panicum hemitomon* Tidal Marsh (CEGL007895) |

**Field Plots:** 4018, 6030, 6046

**Map Class:** BITH MC105

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 5 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain, active channel

**Soil Texture**: Muck

**Environment**: 3 plots were sampled within this type. This community typically occurs within brackish marshes. Ground cover is dominated by water with cover reaching up to 70%. Litter may form a minor component of ground cover with values <20%.

Local Vegetation Description
**Structure**: Herbaceous (50%-90%)

**Vegetation Floristics**: This herbaceous community is dominated by *Zizaniopsis miliacea* with cover reaching ~90%. Other species tend to have low cover values typically <10%. Other common herbaceous species include *Sagittaria latifolia*, *Ludwigia leptocarpa*, *Schoenoplectus tabernaemontani*, *Alternanthera philoxeroides*, and *Salvinia minima*.

**Dynamics**: N/A

Conservation Status Rank
**Global**: G3G4

Global Environmental Description
In the Deltaic Plain of Louisiana, it is found mainly along the natural levee of Bayou Lafourche.

Global Vegetation Description
Stands of this association are dominated by *Zizaniopsis miliacea* with *Panicum hemitomon* as a frequent codominant. Other commonly occurring species include *Hydrocotyle* spp., *Ludwigia leptocarpa* and/or *Ludwigia peploides, Sagittaria lancifolia, Schoenoplectus californicus (= Scirpus californicus)* and/or *Schoenoplectus tabernaemontani (= Scirpus validus), Typha* spp., *Morella cerifera (= Myrica cerifera), Cephalanthus occidentalis, Cyperus* spp., and others.

Example Photograph
Figure A6 below shows an example of CEGL007895 *Zizaniopsis miliacea – Panicum hemitomon* Tidal Marsh.



**Figure A6.** *Zizaniopsis miliacea – Panicum hemitomon* Tidal Marsh (CSU)

***NPSBITH003 Sparganium androcladum – Sparganium americanum Marsh***
USNVC Hierarchy: Park Special NPSBITH003

**Field Plots:** 1089

**Map Class:** BITH MC106

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 104 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland flat

**Soil Texture**: Silty clay loam

**Environment**: 1 plot was sampled within this type. This community typically occurs within upland marshes with silty clay loams. This community is typically inundated with ~90% ground cover of water.

Local Vegetation Description
**Structure**: Herbaceous (100%)

**Vegetation Floristics**: *Sparganium androcladum* and/or *Sparganium americanum* are the most dominant species in the herbaceous stratum with ~80% cover. The herb layer can also include *Hygrophila lacustris*, *Scirpus cyperinus* (20% cover), and *Typha* spp. The canopy is sparse to absent with <5% cover and can include *Nyssa aquatica* and *Taxodium distichum*.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A7 below shows an example of Park Special NPSBITH003 *Sparganium androcladum – Sparganium americanum* Marsh.



**Figure A7.** *Sparganium androcladum – Sparganium americanum* Marsh (CSU)

***NPSBITH014 Xyris fimbriata Upland Marsh***
USNVC Hierarchy: Park Special NPSBITH014

**Field Plots:** 3001, 0319_067

**Map Class:** BITH MC106

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 135 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Marsh

**Soil Texture**: Muck

**Environment**: This community is found in isolated depressions. These marshes are perennially flooded and ground cover is dominated by standing water.

Local Vegetation Description
**Structure**: Herbaceous (50%-90%)

**Vegetation Floristics**: This herbaceous community consists of *Phanopyrum gymnocarpon*, *Sparganium americanum*, and *Xyris difformis*. The shrub layer is sparse with occasional occurrences of *Clethra alnifolia*.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A8 below shows an example of Park Special NPSBITH014 *Xyris fimbriata* Upland Marsh.



**Figure A8.** *Xyris fimbriata* Upland Marsh (CSU)

***CEGL003858 Alternanthera philoxeroides Ruderal Aquatic Vegetation***

Table A6 below shows the USNVC Hierarchy for CEGL003858 *Alternanthera philoxeroides* Ruderal Aquatic Vegetation.

**Table A6.** USNVC hierarchy for CEGL003858 *Alternanthera philoxeroides* Ruderal Aquatic Vegetation

| Category | Description |
|---|---|
| Class | 5 Aquatic Vegetation |
| Subclass | 5.B Freshwater Aquatic Vegetation |
| Formation | 5.B.2 Temperate & Boreal Freshwater Aquatic Vegetation |
| Division | 5.B.2.Na North American Freshwater Aquatic Vegetation |
| Macrogroup | 5.B.2.Na North American Temperate Ruderal Aquatic Vegetation |
| Group | 5.B.2.Na Eastern North American Ruderal Aquatic Vegetation |
| Alliance | A4219 *Eichhornia crassipes - Alternanthera philoxeroides* Ruderal Aquatic Vegetation Alliance |
| Association | 5.B.2.Na *Alternanthera philoxeroides* Ruderal Aquatic Vegetation (CEGL003858) |

**Field Plots:** 4017, 6031, 6037, 6039, 0319_214

**Map Class:** BITH MC107

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 0

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Marsh

**Soil Texture**: Muck

**Environment**: Several plots were sampled within this type. This community typically occurs in the brackish marshes; however, occasionally. Ground cover is dominated by water with cover >90%.

Local Vegetation Description
**Structure**: (Herbaceous 80%-100%)

**Vegetation Floristics**: These floating vegetation communities occur in deep water slow water habitats and along the edges of bayous. Vegetation is usually dominated by a combination of weedy invasive species such as *Alternanthera philoxeroides*, *Eichhornia crassipes*, and/or *Salvinia minima*. Cover often reaches up to 100%; however, in old bayous or backwaters where vegetation occurs along edges of the water cover may only reach up to ~30%. *Zizaniopsis miliacea* may occur along edge of this community with cover <10%.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A9 below shows an example of CEGL003858 *Alternanthera philoxeroides* Ruderal Aquatic Vegetation.



**Figure A9.** *Alternanthera philoxeroides* Ruderal Aquatic Vegetation (CSU)

***CEGL002386 Nuphar advena – Nymphaea odorata Aquatic Vegetation***

Table A7 below shows the USNVC Hierarchy for CEGL002386 *Nuphar advena – Nymphaea odorata* Aquatic Vegetation.

**Table A7.** USNVC hierarchy for CEGL002386 *Nuphar advena – Nymphaea odorata* Aquatic Vegetation

| Category | Description |
|---|---|
| Class | 5 Aquatic Vegetation |
| Subclass | 5.B Freshwater Aquatic Vegetation |
| Formation | 5.B.2 Temperate & Boreal Freshwater Aquatic Vegetation |
| Division | 5.B.2.Na North American Freshwater Aquatic Vegetation |
| Macrogroup | 5.B.2.Na Eastern North American Freshwater Aquatic Vegetation |
| Group | 5.B.2.Na Eastern North American Freshwater Aquatic Vegetation |
| Alliance | A4064 *Nymphaea odorata - Nuphar* spp. - *Brasenia schreberi* Aquatic Vegetation Alliance |
| Association | 5.B.2.Na *Nuphar advena - Nymphaea odorata* Aquatic Vegetation (CEGL002386) |

**Field Plots:** 3002, 3024

**Map Class:** BITH MC107

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 38 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland

**Soil Texture**: Muck

**Environment:** 2 plots were sampled within this type. This community occurs in ponds in upland environments. Ground cover is dominated by water with values reaching 90%.

Local Vegetation Description
**Structure**: Herbaceous (30%-60%)

**Vegetation Floristics**: Open water with an abundance of lily pads such as *Nuphar advena* and/or *Nymphaea odorata*. Shrubs grow on exposed raised ground and at the water's edge; common species are *Cyrilla racemiflora*, *Morella cerifera*, and *Triadica sebifera.*

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
This community occupies shallow-water depressions, oxbow ponds, sluggish streams, and backwater sloughs of river floodplains, ponds (natural and artificial), and small lakes. In pools and slow-flowing stretches of river, at Obed River (TN), *Nuphar advena* is rooted in sandy substrate (Schmalzer and DeSelm 1982).

Global Vegetation Description
This community is dominated by rooted, floating-leaved aquatic species, with both submergent and emergent aquatics also present. *Nuphar advena (= Nuphar lutea ssp. advena)* and *Nymphaea odorata* are dominants, either in combination together, or each singly. Other species present include *Brasenia schreberi*, various *Potamogeton* and *Stuckenia* spp., *Eleocharis robbinsii* and other *Eleocharis* spp., *Polygonum amphibium, Polygonum amphibium var. emersum (= Polygonum coccineum), Sparganium americanum, Lemna* spp., *Spirodela polyrrhiza, Typha latifolia*, and *Saururus cernuus* (Anderson 1982, G. Fleming pers. comm.). Submerged aquatic species more common in the southern part of the range include *Cabomba caroliniana, Ceratophyllum demersum*, and *Heteranthera dubia*. This broadly conceived type may include ponds, or zones of ponds, dominated by *Nymphaea odorata*, with or without *Nuphar advena*.

Example Photograph

Figure A10 below shows an example of CEGL002386 *Nuphar advena – Nymphaea odorata* Aquatic Vegetation.



**Figure A10.** *Nuphar advena – Nymphaea odorata* Aquatic Vegetation (CSU)

Short Citation

- Anderson 1982
- G. Fleming pers. comm.
- Schmalzer and DeSelm 1982

### *CEGL007930 Schizachyrium scoparium – Rudbeckia missouriensis – Grindelia lanceolata – (Liatris mucronata) Grassland*

Table A8 below shows the USNVC Hierarchy for CEGL007930 *Schizachyrium scoparium – Rudbeckia missouriensis – Grindelia lanceolata –* (*Liatris mucronata*) Grassland.

**Table A8.** USNVC hierarchy for CEGL007930 *Schizachyrium scoparium – Rudbeckia missouriensis – Grindelia lanceolata* – (*Liatris mucronata*) Grassland

| Category | Description |
|---|---|
| Class | 2 Shrub & Herb Vegetation |
| Subclass | 2.B Temperate & Boreal Grassland & Shrubland |
| Formation | 2.B.2 Temperate Grassland & Shrubland |
| Division | 2.B.2.Ne Southeastern North American Grassland & Shrubland |
| Macrogroup | 2.B.2.Ne Southeastern Coastal Plain Patch Prairie |
| Group | 2.B.2.Ne Southeastern Coastal Plain Patch Prairie |
| Alliance | A3318 *Schizachyrium scoparium - Sorghastrum nutans* Coastal Plain Prairie Alliance |
| Association | 2.B.2.Ne *Schizachyrium scoparium - Rudbeckia missouriensis - Grindelia lanceolata* - (*Liatris mucronata*) Grassland (CEGL007930) |

**Field Plots:** 4054

**Map Class:** BITH MC108

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 20 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain lower terrace

**Soil Texture**: Loam

**Environment:** 1 plot was sampled within this type. This community occurs in relict circular depressions that historically lack trees. Ground cover is dominated by litter with values reaching >90%.

Local Vegetation Description
**Structure**: Short shrub (10%) Herbaceous (40%)

**Vegetation Floristics**: Upland grassland occurring in isolated patches amongst pine/pine-hardwood forests. The herbaceous stratum can be diverse and variable. Common grasses include *Sorghastrum elliottii*, *Andropogon ternarius*, *Schizachyrium scoparium*, *Panicum virgatum*, *Andropogon virginicus*, *Andropogon glomeratus*, *Bouteloua hirsuta*. Additional possible forbs include *Euphorbia bicolor*, *Heliotropium tenellum*, *Solidago altissima*, *Symphyotrichum drummondii*, *Dalea compacta*,

*Rudbeckia hirta*, *Agalinis heterophylla*, *Carex cherokeensis*, *Liatris mucronata*, *Penstemon cobaea*, and *Allium stellatum*. Shrub layer is sparse with occasional occurrences of *Ilex vomitoria*.

**Dynamics**: All known examples are surrounded by a matrix of pine- and pine-hardwood-dominated forests. This community occurs in a matrix of infrequently burned calcareous forests. The historical fire frequency of this grassland is estimated to range from 5 to 20 years. Calcareous woody species such as *Juniperus virginiana*, *Fraxinus americana*, and *Gleditsia triacanthos* invade this community and change the physiognomy as a result of fire suppression.

Conservation Status Rank
**Global**: G1

Global Environmental Description
This herbaceous community occurs on the Dough Hills Member of the Fleming Formation on uplands over stiff, alkaline, calcareous clays with very high shrink-swell characteristics. Generally classified as Vertisols, these soils typically have pH values 7.5 to 8.0, are olive-gray to gray-black in color, and often contain limestone nodules or marine mollusk shells. The combination of periodic fire, high soil pH and extreme physical soil properties are thought to be important in maintaining this community. The hydrology ranges from dry to mesic (Smith and Craig 1990).

Global Vegetation Description
The grass component of these prairies is usually poorly developed and often weedy in nature, due to past soil disturbances and livestock grazing. However, species may include *Paspalum pubiflorum, Schizachyrium scoparium, Muhlenbergia capillaris, Sporobolus compositus, Panicum virgatum, Sorghastrum nutans, Andropogon gerardii, Bouteloua rigidiseta, Bouteloua hirsuta, Andropogon virginicus, Andropogon glomeratus*, and *Aristida oligantha*. Other species present include *Euphorbia bicolor, Heliotropium tenellum, Salvia azurea, Astragalus distortus, Rhynchosia minima, Asclepias viridiflora, Solidago altissima, Symphyotrichum oolentangiense (= Aster oolentangiensis), Symphyotrichum drummondii (= Aster drummondii)*, and *Manfreda virginica*. Some examples have scattered *Juniperus virginiana var. virginiana, Sideroxylon lanuginosum, Crataegus spathulata*, and *Crataegus crus-galli*. Dominant and characteristic species are locally variable but may include *Dalea compacta* var. *compacta, Rudbeckia missouriensis, Rudbeckia hirta, Acacia angustissima, Eustoma exaltatum ssp. russellianum (= Eustoma russellianum), Grindelia lanceolata, Agalinis heterophylla, Stenosiphon linifolius, Carex microdonta, Carex cherokeensis, Neptunia lutea, Indigofera miniata (= Indigofera miniata var. leptosepala), Onosmodium molle ssp. occidentale (= Onosmodium occidentale), Liatris mucronata*, and *Euphorbia bicolor*, all of which are rare or absent in the Pineywoods region as a whole, except in this community. Two especially unusual species (*Penstemon cobaea* and *Allium stellatum*) have only been documented at the "Lone Wolf" or "Windham Prairie" site in Polk County where this type was first described.

Example Photograph
Figure A11 below shows an example of CEGL007930 *Schizachyrium scoparium – Rudbeckia missouriensis – Grindelia lanceolata –* (*Liatris mucronata*) Grassland.



**Figure A11.** *Schizachyrium scoparium – Rudbeckia missouriensis – Grindelia lanceolata* – (*Liatris mucronata*) Grassland (CSU)

Short Citation
Smith and Craig 1990

## Mapped Shrubland Types

***NPSBITH004 Sesbania drummondii – (Morella cerifera) / Juncus effusus Ruderal Wet Shrubland***
USNVC Hierarchy: Park Special NPSBITH004

**Field Plots:** Field Reconnaissance

**Map Class:** BITH MC201

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 65 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Freshwater marsh

**Soil Texture**: Clay loam, Muck

**Environment**: These communities typically occur within wet ruderal marshes on flatlands caused by past oil and gas disturbance. These communities typically occur on poorly drained clay soils and muck. Ground cover is typically dominated by water with covers reaching up to 60%. Litter may reach up to 25% of the ground cover. Wood may be present with cover <5%.

Local Vegetation Description
**Structure**: Short shrub (20%-70%), Herbaceous (60%-80%)

**Vegetation Floristics**: This shrubland community often dominated by *Sesbania drummondii* and/or *Morella cerifera* with cover ranging from 20% to 70%. Other common shrubs may include *Triadica sebifera*, *Forestiera acuminata*, and *Cephalanthus occidentalis*. The herbaceous stratum is vigorous and strongly dominated by *Juncus effusus* with cover reaching up to 80%. Other common graminoids include *Schoenoplectus tabernaemontani*, *Andropogon glomeratus*, and *Saccharum giganteum*.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A12 below shows an example of Park Special NPSBITH004 *Sesbania drummondii* – (*Morella cerifera*) / *Juncus effusus* Ruderal Wet Shrubland.



**Figure A12.** *Sesbania drummondii* – (*Morella cerifera*) / *Juncus effusus* Ruderal Wet Shrubland (CSU)

***NPSBITH001 Quercus hemisphaerica Shrubland***
USNVC Hierarchy: Park Special NPSBITH001

**Field Plots:** 2064, 1063, 6004

**Map Class:** BITH MC202

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 37.5 ft range 26 ft to 49 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland, Floodplain upper terrace

**Soil Texture**: Sand, Loamy sand

**Environment:** 3 plots were sampled within this type. This community typically occurs on uplands with sandy soils. Litter is the most dominant ground cover with values ranging between 45% and 90%. Bare soil may form a major component of ground cover, but it has ground cover <50%.

Local Vegetation Description
**Structure**: Canopy (0%-10%), Tall shrub (40%-70%), Short shrub (0%-30%)

**Vegetation Floristics:** *Quercus hemisphaerica* is the most dominant shrub species with *Ilex vomitoria*, *Vaccinium arboreum*, and *Vaccinium stamineum* occurring within the community as well. Scattered trees can include *Pinus taeda* and *Quercus hemisphaerica*. Vines such as *Vitis rotundifolia*, *Gelsemium sempervirens*, and *Bignonia capreolata* are common. The herbaceous layer is sparse but can include a number of species such as and *Dichanthelium* spp. and *Euthamia leptocephala*.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A13 below shows an example of Park Special NPSBITH001 *Quercus hemisphaerica* Shrubland.



**Figure A13.** *Quercus hemisphaerica* Shrubland (CSU)

***CEGL002191 Cephalanthus occidentalis / Carex spp. – Lemna spp. Southern Shrub Swamp***

Table A9 below shows the USNVC Hierarchy for CEGL002191 *Cephalanthus occidentalis* / *Carex* spp. – *Lemna* spp. Southern Shrub Swamp.

**Table A9.** USNVC hierarchy for CEGL002191 *Cephalanthus occidentalis* / *Carex* spp. – *Lemna* spp. Southern Shrub Swamp

| Category | Description |
|---|---|
| Class | 2 Shrub & Herb Vegetation |
| Subclass | 2.C Shrub & Herb Wetland |
| Formation | 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland |
| Division | 2.C.4.Nd Eastern North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland |
| Macrogroup | 2.C.4.Nd Eastern North American Marsh, Wet Meadow & Shrubland |
| Group | 2.C.4.Nd Eastern North American Shrub Swamp |
| Alliance | A3670 *Cephalanthus occidentalis - Decodon verticillatus* Shrub Swamp Alliance |
| Association | 2.C.4.Nd *Cephalanthus occidentalis* / *Carex* spp. - *Lemna* spp. Southern Shrub Swamp (CEGL002191) |

**Field Plots:** 4036, 7001, 7006

**Map Class:** BITH MC203

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 6.5 ft range 5 ft to 8 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain active channel

**Soil Texture**: Muck

**Environment:** 3 plots were sampled within this type. This community occurs in back water swamps near the Neches River and Village Creek. Water dominates ground cover with values >90%.

Local Vegetation Description
**Structure**: Canopy (0%-10%), Tall shrub (0%-90%), Short shrub (0%-90%), Herbaceous (10%-80%)

**Vegetation Floristics**: Swamp shrubland occurs in shallow water depressions and backwater sloughs of stream and river floodplains. Inundation is semi-permanent to permanent depending on drought conditions. The canopy is sparse to absent with scattered *Taxodium distichum* and *Triadica sebifera*. Shrub layer abundance is nearly monospecific with *Cephalanthus occidentalis*. Associated shrubs may include *Salix* spp., and *Cornus amomum*. Herbaceous layer is sparse with common occurrences of *Carex stipata*, *Carex stricta*, *Carex lurida*, and *Carex intumescens*. Emergent and floating aquatics such as *Salvinia minima* and *Alternanthera philoxeroides* are common.

**Dynamics:** Periods of excessive, prolonged flooding are common in the rainy season (winter and spring). Seasonal flooding and heavy rains leading to inundation of stands to a depth of 1-2 m favor establishment of this type and contribute nutrients, sediments, and organic debris. Excessive inputs of any of these can greatly accelerate natural successional processes which are responsible for the conversion of wetlands to terrestrial habitats.

Conservation Status Rank
**Global**: N/A

Global Environmental Description
Stands occupy shallow water depressions, oxbow ponds, upland pond depressions, beaver ponds, and backwater sloughs of stream and river floodplains. Inundation is usually continuous throughout the year, but these sites can become dry in mid or late summer or during periods of prolonged drought. In floodplain situations, soils are deep (one meter or more) consisting of peat or muck over alluvial parent material (Nelson 1985, Lauver et al. 1999). Key environmental factors which favor the

establishment and maintenance of this community include nearly continuous inundation from 1-2 m in depth (Voigt and Mohlenbrock 1964). Soils can be mineral or organic but are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part (Mitsch and Gosselink 1993). Soil associations listed are those types in Illinois which could support this community. Soils are deep (100 cm [40 inches] or more) consisting of peat or muck over alluvial parent material (Nelson 1985). They include Lawson - Sawmill - Darwin, Haymond - Petrolia - Karnak, Martinsville - Sciotoville, Alford - Wellston, Hosmer - Zanesville - Berks, Grantsburg - Zanesville - Wellston, Houghton - Palms - Muskego| fine-fine/silty-coarse-silty (some evic-coprogenous), mixed montmorillonitic, mesic; Cumulic Hapludolls, Cumulic Haplaquolls, Typic Hapladalfs, Aquic Fragiudalfs, Ultic Hapludalfs, Typic Fragiudalfs, Typic Dystrochrepts, Terrice Medisaprists, Typic Medisaprists, Limnic Medisaprists; Alfisols, Mollisols, Inceptisols, Entisols (Fehrenbacher et al. 1982). The geologic substrate is Paleozoic rock deeply buried by alluvium. Vegetative diversity and density are highly variable in response to the depth and duration of flooding. This community is characterized by continuous (or nearly so) flooding to depths ranging from 1-2 m (Voigt and Mohlenbrock 1964). As water levels approach 2 m, large areas of open water may occur.

Global Vegetation Description

*Cephalanthus occidentalis* comprises nearly 90% of the shrub layer in waters 1-2 m deep (Voigt and Mohlenbrock 1964). Other shrubs commonly encountered include *Cornus amomum* to the south and *Cornus sericea (= Cornus stolonifera)* to the north and *Salix* spp. Sedges are the dominant herbaceous species present, including *Carex stipata, Carex stricta, Carex lurida*, and *Carex intumescens*, although *Hibiscus* spp. can also form dense stands in shallower water. *Lemna* spp. and *Leersia oryzoides* are also common plants in this natural community. *Populus heterophylla* and *Nyssa biflora* may also occur within their range (TNC 1995a). In the Columbia Bottomlands of Texas, common associates include *Salix nigra, Forestiera acuminata, Echinodorus berteroi (= Echinodorus rostrata), Sagittaria* sp., and floating aquatics such as *Pistia stratiotes, Limnobium spongia, Azolla caroliniana*, and *Spirodela polyrrhiza*. In the Upper East Gulf Coastal Plain, some associated herbs (e.g., at Shiloh National Military Park) include *Leersia oryzoides, Polygonum* spp., and *Saururus cernuus*.

Example Photograph

Figure A14 below shows an example of CEGL002191 *Cephalanthus occidentalis* / *Carex* spp. – *Lemna* spp. Southern Shrub Swamp.



**Figure A14.** *Cephalanthus occidentalis* / *Carex* spp. – *Lemna* spp. Southern Shrub Swamp (CSU)

Short Citation

- Fehrenbacher et al. 1982
- Lauver et al. 1999
- Mitsch and Gosselink 1993
- Nelson 1985
- TNC 1995a
- Voigt and Mohlenbrock 1964

### *CEGL003911 Forestiera acuminata – (Planera aquatica, Cephalanthus occidentalis) Floodplain Scrub*

Table A10 below shows the USNVC Hierarchy for CEGL003911 *Forestiera acuminata* – (*Planera aquatica*, *Cephalanthus occidentalis*) Floodplain Scrub.

**Table A10.** USNVC hierarchy for CEGL003911 *Forestiera acuminata* – (*Planera aquatica*, *Cephalanthus occidentalis*) Floodplain Scrub

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Bald-cypress - Tupelo Floodplain Forest |
| Alliance | A3594 *Taxodium distichum - Nyssa aquatica - Nyssa biflora* Floodplain Forest Alliance |
| Association | 1.B.3.Nb *Forestiera acuminata* - (*Planera aquatica*, *Cephalanthus occidentalis*) Floodplain Scrub (CEGL003911) |

**Field Plots:** 4014

**Map Class:** BITH MC203

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 15 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands

**Soil Texture**: Silty clay loam

**Environment:** 1 plot was sampled within this type. Ground cover is dynamic and is dominated by either water or litter depending on time of year.

Local Vegetation Description
**Structure**: Canopy (20%), Short shrub (60%)

**Vegetation Floristics**: Swamp shrubland with seasonal flooding for most of the growing season. Shrub layer dominants include *Forestiera acuminata*, *Cephalanthus occidentalis*, and *Planera aquatica*. Herbaceous layer is sparse/absent due to extended flooding events; *Saururus cernuus* may be present. Canopy is sparse and typically contains *Pinus taeda*.

**Dynamics**: N/A

Conservation Status Rank
**Global**: G3?

Global Environmental Description
No Data Available

Global Vegetation Description
This swamp shrubland is dominated by *Forestiera acuminata*, often with *Planera aquatica* and/or *Cephalanthus occidentalis*. There is very little to no herbaceous layer because standing water is present throughout much of the growing season. Some *Saururus cernuus* may be present.

Example Photograph
Figure A15 below shows an example of *Forestiera acuminata* – (*Planera aquatica*, *Cephalanthus occidentalis*) Floodplain Scrub.



**Figure A15.** *Forestiera acuminata* – (*Planera aquatica*, *Cephalanthus occidentalis*) Floodplain Scrub (CSU)

***NPSBITH010 Ilex vomitoria Shrubland***
USNVC Hierarchy: Park Special NPSBITH010

**Field Plots:** Field Reconnaissance

**Map Class:** BITH MC204

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 280 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland flat

**Soil Texture**: Sandy loam

**Environment**: Several plots were sampled within this type. This community may occur across a variety of topographic positions, but typically occurs in upland areas. Ground cover is dominated by litter with values ranging up to 90%.

Local Vegetation Description
**Structure**: Short shrub (70%-90%)

**Vegetation Floristics**: This community is almost completely dominated by *Ilex vomitoria* with cover reaching up to 90%. *Pinus taeda* seedlings may be prevalent throughout the community, but these seedlings do not rise taller than *Ilex vomitoria*.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A16 below shows an example of Park Special NPSBITH010 *Ilex vomitoria* Shrubland.



**Figure A16.** *Ilex vomitoria* Shrubland (CSU)

***NPSBITH022 Morella cerifera – Ilex vomitoria Wet Meadow Shrubland***
USNVC Hierarchy: Park Special NPSBITH022

**Field Plots:** 7019, 7020

**Map Class:** BITH MC205

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 78 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland

**Soil Texture**: Clay

**Environment**: 2 plots were sampled within this type. This community contained saturated soils composed of sandy clay to clay. Ground cover was dominated by litter with cover values reaching 60%. Bare soil is typically present with cover reaching up to 20%.

Local Vegetation Description
**Structure**: Shrub (20%), Herbaceous (50%)

**Vegetation Floristics**: This wet meadow shrubland is dominated by *Ilex vomitoria* and *Morella cerifera* with cover ~20%. Young *Pinus palustris* seedling have been planted around the community. The herbaceous stratum is abundant and dominated by graminoids. Common species include *Phalaris angusta*, *Andropogon glomeratus*, *Muhlenbergia expansa*, *Sporobolus clandestinus*, and *Helenium drummondii*.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A17 below shows an example of Park Special NPSBITH022 *Morella cerifera – Ilex vomitoria* Wet Meadow Shrubland.



**Figure A17.** *Morella cerifera – Ilex vomitoria* Wet Meadow Shrubland (CSU)

***NPSBITH023 Morella cerifera – Ilex coriacea – Baccharis halimifolia Wet Scrub Shrubland***
USNVC Hierarchy: Park Special NPSBITH023

**Field Plots:** 7021

**Map Class:** BITH MC206

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 83 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands

**Soil Texture**: Silty clay

**Environment**: 1 plot was sampled within this type. The community typically resides on saturated and temporarily flooded areas with soils composed of silty clay. Ground cover is dominated by litter

with cover reaching up to 70%. Wood is typically present and composes <5% of the ground cover. Bare soil is usually present and covers ~20% of the ground cover.

Local Vegetation Description
**Structure**: Tall shrub (70%), Short shrub (10%), Herbaceous (10%)

**Vegetation Floristics**: *Morella cerifera* forms a dense shrub layer with cover typically >60%. Other common shrubs include *Ilex coriacea* and *Baccharis halimifolia*. There are sparse trees scattered throughout the shrubland with cover <10% and include *Nyssa biflora* and *Magnolia virginiana*. The herbaceous stratum is often sparse with *Rubus argutus* as the most dominant species.

Dynamics: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A18 below shows an example of Park Special NPSBITH023 *Morella cerifera – Ilex coriacea – Baccharis halimifolia* Wet Scrub Shrubland.



**Figure A18.** *Morella cerifera – Ilex coriacea – Baccharis halimifolia* Wet Scrub Shrubland (CSU)

## Mapped Forest and Woodland Types

### *CST007179 Pinus taeda Forest Plantation*

Table A11 below shows the USNVC Hierarchy for CST007179 *Pinus taeda* Forest Plantation.

**Table A11.** USNVC hierarchy for CST007179 *Pinus taeda* Forest Plantation

| Category | Description |
|---|---|
| Cultural Class | CCL01 Agricultural & Developed Vegetation |
| Cultural Subclass | CSC01 Woody Agricultural Vegetation |
| Cultural Formation | CFO02 Forest Plantation & Agroforestry |
| Cultural Subformation | CSF05 Forest Plantation |
| Cultural Group | CGR007 Temperate & Boreal Plantation |
| Cultural Subgroup | CSG005 Eastern North American Temperate Forest Plantation |

**Table A11 (continued).** USNVC hierarchy for CST007179 *Pinus taeda* Forest Plantation

| Category | Description |
|---|---|
| Cultural Type | CTY012 Native Southern Pine Plantation |
| Cultural Subtype | CST007179 Loblolly Pine Plantation |

**Field Plots:** 7005, 2043, 2044

**Map Class:** BITH MC301

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 130 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands

**Soil Texture**: Silt loam

**Environment:** 3 plots were sampled within this type. This community occurs across a wide variety of environments. Ground cover is dominated by litter with values >90%.

Local Vegetation Description
**Structure**: Canopy (50%-80%), Tall shrub (0%-70%), Short shrub (0%-70%)

**Vegetation Floristics**: This community is dominated by rows of planted *Pinus taeda*. Often the canopy is dense and other species do not form major components of the canopy. Other common canopy species include *Quercus nigra* and *Liquidambar styraciflua*. *Ilex vomitoria* may dominate the shrub layer. Herbaceous layer is typically sparse.

**Dynamics**: This association is heavily managed for pulpwood to remove hardwood species that would otherwise become established in the understory. The closed canopy results in a poorly developed herbaceous layer, if it is present at all. Stands are typically maintained on a 20- to 25-year rotation.

Conservation Status Rank
**Global**: N/A

Global Environmental Description
Environmental setting varies widely by site. Stands often occur on level to gently sloping areas, on soils that range from dry to poorly drained.

Global Vegetation Description

This association represents young, monospecific planted stands of *Pinus taeda*. Due to the commercial value of this species, this type is widely distributed across much of the southeastern United States from the Interior Highlands to the Coastal Plain, including areas outside the natural range of the species. The core concept of stands attributable to this type are those which support dense, often perfect rows of planted *Pinus taeda* or otherwise dense, young stands which are established, managed, and/or maintained for the extraction of forest products (usually pulpwood). In most cases these stands support almost no other tree species in the overstory. Understory composition and density can vary widely depending upon location, management history, and stand age. Stands are typically established with mechanical planting, but may also be established through other means. This association rarely exceeds 20-40 years of age on most timberlands. Excluded from this association are plantation stands which have "broken up" with age or thinning to approximate a more natural structure. Dense planting in rows, if successful, tends to result in nearly complete canopy closure which persists until the stand has either been regenerated or transitions into a different association. Herbaceous ground cover of any kind tends to be sparse due to reduction during site preparation, the typically dense canopy cover, and to the fact that many young plantations are infrequently burned at best.

Example Photograph

Figure A19 below shows an example of CST007179 *Pinus taeda* Forest Plantation.



**Figure A19.** *Pinus taeda* Forest Plantation (CSU)

***CST007170 Pinus elliottii var. elliottii Forest Plantation***

Table A12 below shows the USNVC Hierarchy for CST007170 *Pinus elliottii* var. *elliottii* Forest Plantation.

**Table A12.** USNVC hierarchy for CST007170 *Pinus elliottii* var. *elliottii* Forest Plantation

| Category | Description |
|---|---|
| Cultural Class | CCL01 Agricultural & Developed Vegetation |
| Cultural Subclass | CSC01 Woody Agricultural Vegetation |
| Cultural Formation | CFO02 Forest Plantation & Agroforestry |
| Cultural Subformation | CSF05 Forest Plantation |
| Cultural Group | CGR007 Temperate & Boreal Plantation |
| Cultural Subgroup | CTY012 Native Southern Pine Plantation |
| Cultural Subtype | CST007170 Slash Pine Plantation |

**Field Plots:** 6028

**Map Class:** BITH MC301

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 19 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands

**Soil Texture**: Sand

**Environment:** This community occurs on well drained flatlands. Ground cover is dominated by litter with values up to 85%. Bare soil and wood are typically present and have <5% and <10% cover, respectively.

Local Vegetation Description
**Structure**: Canopy (50%-80%)

**Vegetation Floristics:** Plantation forest dominated by *Pinus elliottii* in straight plantation rows.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description

Stands are primarily in uplands, but occasional stands in wetland environments are included here as well.

Global Vegetation Description

This association includes planted stands (plantations) of *Pinus elliottii* var. *elliottii* (typically monospecific), within and outside of its natural range. These are cultivated forests and are not considered natural or semi-natural vegetation. They are maintained as plantations for the harvest of forest products (lumber, pulpwood). Stands are primarily in uplands, but occasional stands in wetland environments are included here as well. This concept is also supposed to include the rare case of "exotic" stands resulting from natural regeneration out of the natural range of *Pinus elliottii* var. *elliottii*, although these are probably better accommodated as examples of ~*Pinus elliottii* var. *elliottii* - (*Pinus palustris*) Forest Plantation (CST007171).

Example Photograph

Figure A20 below shows an example of CST007170 *Pinus elliottii* var. *elliottii* Forest Plantation.



**Figure A20.** *Pinus elliottii* var. *elliottii* Forest Plantation (CSU).

***NPSBITH017 Pinus taeda Regenerating Plantation Shrubland***
USNVC Hierarchy***:*** Park Special NPSBITH017

**Field Plots:** 3006, 4011, 6001, 2065

**Map Class:** BITH MC301

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 120 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands, Upland

**Soil Texture**: Sandy loam, Silt, Loamy Sand

**Environment**: 4 plots were sampled within this type. This community usually occurs on flat sandy uplands. Ground cover is typically dominated by litter with values reaching 80%. Bare soil occasionally forms a component with values reaching 30%.

Local Vegetation Description
**Structure**: Canopy (0%-40%), Sub-canopy (0%-20%), Short shrub (0%-70%)

**Vegetation Floristics**: Regenerating shrubland plantation of *Pinus taeda*. Shrub layer dominants include *Pinus taeda* and *Ilex vomitoria*.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A21 below shows an example of Park Special NPSBITH017 *Pinus taeda* Regenerating Plantation Shrubland.



**Figure A21.** *Pinus taeda* Regenerating Plantation Shrubland (CSU)

### *CEGL007142 Pinus taeda Riparian Forest*

Table A13 below shows the USNVC Hierarchy for CEGL007142 *Pinus taeda* Riparian Forest.

**Table A13.** USNVC hierarchy for CEGL007142 *Pinus taeda* Riparian Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Oak - Sweetgum Floodplain Forest |
| Alliance | A3628 *Quercus laurifolia - Quercus phellos - Pinus taeda* Coastal Plain Riparian Forest Alliance |
| Association | 1.B.3.Nb *Pinus taeda* Riparian Forest (CEGL007142) |

**Field Plots:** 2074, 1071, 1050, 1114, 1087, 0319_272, 0319_373, 6026, 7004

**Map Class:** BITH MC302

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 140.6 ft range 70 ft to 233 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland, Upland swales, Floodplain upper terrace

**Soil Texture**: Sandy loam, Loamy sand, Sandy clay loam

**Environment**: 9 plots were sampled within this type. These communities typically occur on floodplains. Ground cover is mainly dominated by litter with cover between 50% and 90%. Wood is also present in the ground cover with cover between 1% and 5%.

Local Vegetation Description
**Structure**: Canopy (30%-50%), Sub canopy (0%-60%), Tall shrub (10%-60%), Herbaceous (0%-20%), Vine (0%-10%)

**Vegetation Floristics**: These forests are clearly dominated by *Pinus taeda*. *Pinus taeda* typically covers at least 50% with few to no hardwoods. Other species that may occur in the subcanopy include *Ostrya virginiana*, *Carpinus caroliniana*, and *Quercus laurifolia*, but these species rarely

have cover >10%. Shrubs are sparse to moderately dense with cover ranging from 10% to 30% with common species including *Ilex vomitoria*, *Ligustrum sinense*, and *Ulmus alata*. The herbaceous stratum is sparse to nonexistent with cover usually <10%. Common species include *Carex* spp. and *Chasmanthium laxum*.

**Dynamics**: N/A

Conservation Status Rank
**Global**: G4?

Global Environmental Description
These stands occur on higher ridges in floodplains.

Global Vegetation Description
Stands are dominated by *Pinus taeda*. Associated species vary with geography and floodplain position, but include *Quercus lyrata*, *Quercus laurifolia*, *Quercus nigra*, *Quercus phellos*, *Quercus michauxii*, *Celtis laevigata*, *Fraxinus pennsylvanica*, *Liquidambar styraciflua*, and *Nyssa biflora*. In Oklahoma, associates include *Fraxinus pennsylvanica*, *Quercus falcata*, *Quercus shumardii*, *Ulmus americana*, *Carpinus caroliniana*, *Crataegus marshallii*, *Ilex opaca*, *Morus rubra*, *Nyssa biflora*, *Arundinaria gigantea*, *Berchemia scandens*, *Carex lupulina*, and *Chasmanthium sessiliflorum*.

Example Photograph
Figure A22 below shows an example of CEGL007142 *Pinus taeda* Riparian Forest.



**Figure A22.** *Pinus taeda* Riparian Forest (CSU)

***CEGL007069 Pinus taeda – (Pinus echinata) – Quercus (pagoda, phellos) Wet Woodland***

Table A14 below shows the USNVC Hierarchy for CEGL007069 *Pinus taeda* – (*Pinus echinata*) – *Quercus* (*pagoda*, *phellos*) Wet Woodland.

**Table A14.** USNVC hierarchy for CEGL007069 *Pinus taeda* – (*Pinus echinata*) – *Quercus* (*pagoda*, *phellos*) Wet Woodland

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Basin Swamp & Flatwoods |
| Group | 1.B.3.Nb Hardwood - Loblolly Pine Nonriverine Wet Flatwoods |
| Alliance | A4190 *Pinus taeda* - *Quercus laurifolia* - *Quercus phellos* West Gulf Coastal Plain Wet Flatwoods Forest Alliance |
| Association | 1.B.3.Nb *Pinus taeda* - (*Pinus echinata*) - *Quercus* (*pagoda*, *phellos*) Wet Woodland (CEGL007069) |

**Field Plots:** 0319_302, 0319_305, 0319_117, 7003

**Map Class:** BITH MC303

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 28 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands

**Soil Texture**: Silt loam

**Environment**: 4 plots were sampled within this type. This type typically occurs along flatlands. Litter dominates the ground cover with values >90%. Wood is typically present with cover around 5%.

Local Vegetation Description
**Structure**: Canopy (30%-60%), Herbaceous (0%-30%)

**Vegetation Floristics**: Hydroxeric non-riverine wet flatwood woodland or forest. Typically, these sites are above the floodplain. Fire maintained communities are represented as a woodland but due to fire suppression, succession from a woodland to forest is common. *Pinus taeda* dominates the canopy with a combination of *Pinus echinata*, *Quercus pagoda*, *Quercus phellos*, and *Quercus stellata*. Possible associates include *Quercus alba*, *Quercus marilandica*, *Quercus nigra*, and *Quercus similis*. Common shrub species are *Callicarpa americana*, *Hamamelis virginiana*, and *Vaccinium arboreum*. Herbaceous species are *Croton willdenowii*, *Dichanthelium aciculare*, *Dichanthelium scoparium*, and *Schizachyrium scoparium*. This community and the embedded saline barrens can be extremely diverse with over 400 species and includes about 25 species of conservation concern such as the federally-listed red-cockaded woodpecker (*Picoides borealis*), and *Geocarpon minimum*.

**Dynamics**: This is a pine-hardwood flatwoods which should have a woodland structure under a natural fire regime. Under current conditions with a lack of fire, it will present a forest physiognomy. Stands in a woodland condition are rare in the current landscape. The overstory composition of stands attributed to this type suggest a fire-return interval of lower frequency than that associated with longleaf pine but similar to that of shortleaf pine forests. Many of the historical stands of this type have been converted to plantations or have had fire removed, resulting in conversion or succession to other types. Published references to loblolly - shortleaf mixed forest of the Coastal Plain of Arkansas (Cain and Shelton 1994) and eastern Texas (Halls and Homesley 1966) are from successional, fire-suppressed stands.

Conservation Status Rank
**Global**: G2G3

Global Environmental Description
These woodlands or forests typically occur in non-riverine flatwoods environments. They occur on sites with a "hydroxeric" moisture regime, that is, significant intra-annual variation in site moisture - very wet in wet season (winter-spring) to very dry in the dry season (summer-fall). They are typically found on Pleistocene terraces that are primarily along the Ouachita and Red rivers and their tributaries, and are typically but not always found above the current floodplain. As a result of extreme seasonal dryness of the flatwoods sites, frequent fire is an important process in this community. In frequently burned sites, this type occurs as a woodland, but in most cases today has succeeded to forest with a lack of fire under current conditions. Plant and animal species that prefer open canopy conditions are typically high priorities for conservation.

Global Vegetation Description
Stands of this woodland or forest are dominated by *Pinus taeda* with some combination of *Pinus echinata, Quercus pagoda, Quercus phellos*, and/or *Quercus stellata*. Associated woody species include the trees *Quercus alba, Quercus marilandica*, and *Quercus similis*, with the shrubs *Callicarpa americana, Hamamelis virginiana*, and *Vaccinium arboreum*. Herbaceous species include *Croton willdenowii, Dichanthelium aciculare, Dichanthelium scoparium*, and *Schizachyrium scoparium*. Over 400 species have been recorded in this community (ANHC file data). Federally listed species include the red-cockaded woodpecker (*Picoides borealis*), and *Geocarpon minimum* occurs, sometimes abundantly, in saline barrens which are embedded within this community. Approximately 25 other species of conservation concern have been recorded in examples of this association or in the saline barrens embedded within it.

Example Photograph
Figure A23 below shows an example of CEGL007069 *Pinus taeda* – (*Pinus echinata*) – *Quercus* (*pagoda*, *phellos*) Wet Woodland.



**Figure A23.** *Pinus taeda* – (*Pinus echinata*) – *Quercus* (*pagoda*, *phellos*) Wet Woodland (CSU)

Short Citation

- Cain and Shelton 1994
- Halls and Homesley 1966

***CEGL008587 Quercus stellata – Pinus taeda Flatwoods Wet Forest***

Table A15 below shows the USNVC Hierarchy for CEGL008587 *Quercus stellata – Pinus taeda* Flatwoods Wet Forest.

**Table A15.** USNVC hierarchy for CEGL008587 *Quercus stellata – Pinus taeda* Flatwoods Wet Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Basin Swamp & Flatwoods |
| Group | 1.B.3.Nb Hardwood - Loblolly Pine Nonriverine Wet Flatwoods |

**Table A15 (continued).** USNVC hierarchy for CEGL008587 *Quercus stellata* – *Pinus taeda* Flatwoods Wet Forest

| Category | Description |
|---|---|
| Alliance | A3445 *Quercus stellata - Quercus falcata* Wet Flatwoods Forest Alliance |
| Association | 1.B.3.Nb *Quercus stellata - Pinus taeda* Flatwoods Wet Forest (CEGL008587) |

**Field Plots:** 6003

**Map Class:** BITH MC303

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 102 ft

**Aspect**: 210

**Slope**: 2

**Macro Topography**: Hillslope

**Soil Texture**: Clay loam

**Environment:** 1 plot was sampled within this type. Ground cover is dominated by litter with values reaching 90%.

Local Vegetation Description
**Structure**: Canopy (50%-90%), Tall shrub (0%-50%), Short shrub (0%-50%), Herbaceous (0%-10%)

**Vegetation Floristics**: Seasonally flooded flatwood forest found on depressions or shallow ponds. An impermeable hardpan may exist resulting in a shallow water table. The canopy nearly exclusively consists of *Pinus taeda* and *Quercus stellata* with >80% combined cover. No other tree species have been documented from this community. Understory is characteristically sparse. Understory trees and shrubs such as *Callicarpa americana*, *Ilex vomitoria*, and *Ulmus alata* may occur. The herbaceous stratum typically contains only *Carex glaucescens*, *Chasmanthium sessiliflorum*, and *Chasmanthium laxum*.

**Dynamics**: N/A

Conservation Status Rank
**Global**: G2G3

Global Environmental Description

Stands of this association occur in slight topographic depressions or shallow ponds on Pleistocene high terraces. Soil moisture fluctuates widely throughout the growing season depending largely upon rain events which are well distributed throughout the year. Surface soils in these depressions appear to be finer textured than adjacent areas which may slow drainage of these areas. In addition, soils may have a hardpan which impedes the downward migration of water into the subsoil, causing a shallowly perched water table. The hardpan may also impede movement of water up to the dry surface soil from deeper, more moist soil in the summer and restrict the potential rooting depth of vegetation within these depressions. These depressions have been documented on soils mapped as Keithville-Sawtown on the Angelina and Sabine national forests (NatureServe Ecology unpubl. data).

Global Vegetation Description

Stands are dominated by closed to somewhat open forests in which the canopy and subcanopy cover is composed almost exclusively of *Quercus stellata* and *Pinus taeda*. The aspect of the pond is open under the canopy especially when compared to surrounding upland forests which may be densely shrubby. These ponds have a very sparse shrub and herbaceous layer which is not floristically rich. Shrubs include *Ulmus alata, Ilex vomitoria*, and *Callicarpa americana*. The sparse understory contains *Chasmanthium sessiliflorum, Chasmanthium laxum, Carex glaucescens*, and relatively few additional species (NatureServe Ecology unpubl. data).

Example Photograph

Figure A24 below shows an example of CEGL008587 *Quercus stellata – Pinus taeda* Flatwoods Wet Forest.



**Figure A24.** *Quercus stellata – Pinus taeda* Flatwoods Wet Forest (CSU)

Short Citation

NatureServe Ecology unpubl. data

***CEGL007715 Quercus michauxii – Quercus (nigra, pagoda) – Liquidambar styraciflua – Pinus taeda Wet Forest***

Table A16 below shows the USNVC Hierarchy for CEGL007715 *Quercus michauxii – Quercus* (*nigra*, *pagoda*) *– Liquidambar styraciflua – Pinus taeda* Wet Forest.

**Table A16.** USNVC hierarchy for CEGL007715 *Quercus michauxii – Quercus* (*nigra*, *pagoda*) *– Liquidambar styraciflua – Pinus taeda* Wet Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Basin Swamp & Flatwoods |
| Group | 1.B.3.Nb Hardwood - Loblolly Pine Nonriverine Wet Flatwoods |

**Table A16 (continued).** USNVC hierarchy for CEGL007715 *Quercus michauxii* – *Quercus* (*nigra*, *pagoda*) – *Liquidambar styraciflua* – *Pinus taeda* Wet Forest

| Category | Description |
|---|---|
| Alliance | A4190 *Pinus taeda* - *Quercus laurifolia* - *Quercus phellos* West Gulf Coastal Plain Wet Flatwoods Forest Alliance |
| Association | 1.B.3.Nb *Quercus michauxii* - *Quercus* (*nigra*, *pagoda*) - *Liquidambar styraciflua* - *Pinus taeda* Wet Forest (CEGL007715) |

**Field Plots:** 7002, 0319_278, 0319_282, 0319_285, 2080

**Map Class:** BITH MC303

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 76 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands

**Soil Texture**: Silty clay

**Environment:** 5 plots were sampled within this type. This community occurs within mesic flatlands. Litter dominates the ground cover with values reaching 90%. Wood is typically present with values <5%.

Local Vegetation Description
**Structure**: Canopy (30%-60%), Sub-canopy (0%-30%), Tall shrub (10%-20%), Short shrub (0%-30%), Herbaceous (10%-30%)

**Vegetation Floristics:** This community typically occurs on mesic flats. The canopy dominant is *Quercus michauxii* with associated *Liquidambar styraciflua*, *Pinus taeda*, *Quercus laurifolia*, *Quercus nigra*, *Quercus pagoda*. Additional canopy associates in smaller amounts include *Acer rubrum*, *Carya glabra*, *Fagus grandifolia*, *Fraxinus americana*, *Liriodendron tulipifera*, *Magnolia grandiflora*, *Nyssa sylvatica*, *Prunus serotina*, and *Quercus phellos*. Common shrubs are *Ilex vomitoria*, *Halesia diptera*, *Hamamelis virginiana*, *Symplocos tinctoria*, and *Sabal minor*. Vines include *Berchemia scandens*, *Bignonia capreolata*, *Gelsemium sempervirens*, *Lonicera sempervirens*, *Parthenocissus quinquefolia*, *Smilax* spp., *Toxicodendron radicans*, and *Vitis rotundifolia*. Ferns can be diverse and abundant with *Osmunda regalis* var. *spectabilis*, *Polystichum acrostichoides*, *Thelypteris palustris*, and *Woodwardia areolata*. Herbs may include *Arundinaria*

*gigantea*, *Boehmeria cylindrica*, *Carex* spp., *Chasmanthium laxum*, and *Veratrum virginicum* (*Melanthium virginicum*).

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
This association is a hardwood - loblolly forest found in Louisiana's East Gulf Coastal Plain on flats of the Pleistocene Prairie Terrace that are overlain by loess.

Global Vegetation Description
This association is a hardwood - loblolly pine forest found in Louisiana's East Gulf Coastal Plain on flats of the Pleistocene Prairie Terrace that are overlain by loess. It is usually associated with the drier community ~*Quercus pagoda - Quercus michauxii - Magnolia grandiflora - (Tilia americana var. caroliniana) / Sabal minor* Forest (CEGL007712) in a complex of wetland and non-wetland forests occurring on interdigitated microtopographic highs and lows. The canopy is dominated by *Quercus michauxii* with *Quercus nigra, Quercus phellos, Quercus pagoda, Quercus laurifolia, Liquidambar styraciflua, Pinus taeda, Pinus glabra, Magnolia grandiflora, Acer rubrum, Carya glabra, Liriodendron tulipifera, Nyssa sylvatica, Prunus serotina*, and others. *Quercus alba, Fagus grandifolia, Gleditsia triacanthos*, and *Fraxinus americana* are present in small amounts. The subcanopy and shrub strata include canopy species in addition to *Magnolia virginiana, Diospyros virginiana, Ilex opaca var. opaca, Ilex vomitoria, Halesia diptera, Carpinus caroliniana, Hamamelis virginiana, Sebastiania fruticosa, Symplocos tinctoria, Arundinaria gigantea*, and *Vaccinium elliottii*, with *Sabal minor* as a prominent component. Vines include *Berchemia scandens, Parthenocissus quinquefolia, Toxicodendron radicans, Bignonia capreolata, Gelsemium sempervirens, Lonicera sempervirens, Smilax* spp., and *Vitis rotundifolia*. Ferns are diverse and abundant, including *Thelypteris palustris, Woodwardia areolata, Osmunda regalis var. spectabilis, Athyrium filix-femina, Polystichum acrostichoides*, and *Pleopeltis polypodioides ssp. michauxiana*. Other herbs may include *Arisaema dracontium, Arisaema triphyllum, Boehmeria cylindrica, Chasmanthium laxum, Carex* spp., and *Melanthium virginicum*, among others.

Example Photograph
Figure A25 below shows an example of CEGL007715 *Quercus michauxii – Quercus* (*nigra*, *pagoda*) *– Liquidambar styraciflua – Pinus taeda* Wet Forest.



**Figure A25.** *Quercus michauxii – Quercus* (*nigra*, *pagoda*) *– Liquidambar styraciflua – Pinus taeda* Wet Forest (CSU)

***NPSBITH009 Pinus taeda / Ilex coriacea – (Cyrilla racemiflora) Wet Flatwood Woodland***
USNVC Hierarchy*:* Park Special NPSBITH009

**Field Plots:** Field Reconnaissance

**Map Class:** BITH MC303

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 100 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatwoods

**Soil Texture**: Sandy clay loam

**Environment**: This community typically occurs within flatwoods. Soils tend to be sand loams. Ground cover is typically dominated by litter with cover reaching up to 70%. Wood is usually present with cover <5%.

Local Vegetation Description
**Structure**: Canopy (10%-60%), Short shrub (60%-80%)

**Vegetation Floristics**: The canopy is typically dominated by *Pinus taeda* with cover ranging from 10% to 60%. *Pinus palustris* and *Pinus elliottii* may be present in the canopy with cover usually <10%. The shrub layer is typically dense with cover ranging from 60%-80%. *Cyrilla racemiflora* and *Ilex coriacea* dominate the shrub layer. Occasionally, *Ilex vomitoria* will codominate with either *Cyrilla racemiflora* or *Ilex coriacea*. Herbaceous stratum is typically sparse to absent.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A26 below shows an example of Park Special NPSBITH009 *Pinus taeda* / *Ilex coriacea* – (*Cyrilla racemiflora*) Wet Flatwood Woodland.



**Figure A26.** *Pinus taeda* / *Ilex coriacea* – (*Cyrilla racemiflora*) Wet Flatwood Woodland (CSU).

***NPSBITH012 Pinus taeda – Magnolia grandiflora – (Fagus grandifolia, Quercus alba, Quercus falcata) Flatwoods Forest***
USNVC Hierarchy**:** Park Special NPSBITH012

**Field Plots:** 6002, 6006, 6009a, 7015, 8001, 0319_275, 0319_276, 0319_284, 0319_338, 0319_343, 0319_378, 2031

**Map Class:** BITH MC303

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 146.7 ft range 84 ft to 198 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands, Floodplain lower terrace

**Soil Texture**: Sandy loam, Sandy clay, Loamy sand

**Environment**: 11 plots were sampled within this type. These flatwoods occur on more well drained soils with texture typically ranging from sand to sandy clay. Litter dominates the ground cover with values ranging from 70% to 80%. Wood is often present with cover <10%. Occasionally bare soil may be present when hogs have disturbed the area.

Local Vegetation Description
**Structure**: Canopy (30%-70%), Short shrub (20%-40%), Herbaceous (1%-5%)

**Vegetation Floristics**: *Pinus taeda* dominates the canopy with cover ranging from ~30% to 50%. *Magnolia grandiflora* is often a major component and may codominate with *Pinus taeda*. *Magnolia grandiflora* may reach up to 30% cover. Other canopy associates are common and often include a combination of *Quercus alba*, *Quercus falcata*, *Quercus hemisphaerica*, *Fagus grandifolia*, and *Ilex opaca*. Shrubs may reach up to 40% cover and typically include a combination of *Ilex* spp. such as *Ilex vomitoria*, *Ilex opaca*, and *Ilex coriacea*. The herbaceous stratum is often sparse with cover <5%.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A27 below shows an example of Park Special NPSBITH012 *Pinus taeda* – (*Magnolia grandiflora*) – (*Fagus grandifolia*, *Quercus alba*, *Quercus falcata*) Flatwoods Forest.



**Figure A27.** *Pinus taeda* – (*Magnolia grandiflora*) – (*Fagus grandifolia*, *Quercus alba*, *Quercus falcata*) Flatwoods Forest (CSU)

***CEGL003530 (Magnolia virginiana) / Ilex coriacea – Morella caroliniensis Seepage Bog***

Table A17 below shows the USNVC Hierarchy for CEGL003530 (*Magnolia virginiana*) / *Ilex coriacea – Morella caroliniensis* Seepage Bog.

**Table A17.** USNVC hierarchy for CEGL003530 (*Magnolia virginiana*) / *Ilex coriacea – Morella caroliniensis* Seepage Bog

| Category | Description |
|---|---|
| Class | 2 Shrub & Herb Vegetation |
| Subclass | 2.C Shrub & Herb Wetland |
| Formation | 2.C.2 Temperate to Polar Bog & Fen |
| Division | 2.C.2.Nb Atlantic & Gulf Coastal Plain Pocosin |
| Macrogroup | 2.C.2.Nb Southeastern Coastal Bog & Fen |
| Group | 2.C.2.Nb Southeastern Coastal Pocosin & Shrub Bog |
| Alliance | A3442 *Ilex coriacea - Ilex glabra - Kalmia latifolia* Hillside Seepage Shrub Bog Alliance |
| Association | 2.C.2.Nb (*Magnolia virginiana*) / *Ilex coriacea - Morella caroliniensis* Seepage Bog (CEGL003530) |

**Field Plots:** 2003, 4009, 4004, 0319_002, 0319_093

**Map Class:** BITH MC304

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 170 ft

**Aspect**: 69

**Slope**: 10

**Macro Topography**: Hillslope

**Soil Texture**: Muck

**Environment**: 5 plots were sampled within this type. This community typically occurs on hillslopes. Ground cover is dominated by litter with cover ~70% and wood is the second highest ground cover with ~20%.

Local Vegetation Description
**Structure**: Canopy (~2.5%), Tall shrub (~90%), Short shrub (50%)

**Vegetation Floristics**: *Magnolia virginiana* is sparsely present in the canopy with cover ~2.5%. The plot was dominated by a dense shrub layer with cover values around 90%. Typical shrubs include *Ilex coriacea*, *Callicarpa americana*, and *Clethra alnifolia*. The herbaceous layer is generally sparse.

**Dynamics:** According to Grace and Smith (1995) the degree of development of this type is dynamically related to fire frequency. These wooded seeps can only develop in areas that do not burn with great frequency or in areas that have been fire-suppressed for at least a few years. Unburned hillside bogs may succeed into wooded seeps; correspondingly, wooded seeps may revert to hillside bogs when subjected to increased fire frequency.

Occurrences within a Pinus palustris matrix are fire-suppressed seepage slope communities. Historically, growing-season fires likely burned into this community from the surrounding *Pinus palustris* woodlands and flatwoods, and regulated the successional status of this community. Occurrences on seepage slopes in some *Pinus echinata - Pinus taeda* forests were likely always wooded due to the less frequent historical fire frequencies.

Conservation Status Rank
**Global**: G3?

Global Environmental Description
This community is known from the Western Gulf Coastal Plain of Louisiana and eastern Texas (Bridges and Orzell 1989a, Martin and Smith 1991, 1993, Grace and Smith 1995). It occurs on mid to lower slopes within or along narrow drains in the sandy hills of western Louisiana and eastern

Texas, and receives enough seepage to possess permanently to semi-permanently saturated conditions. The deep, poorly drained, strongly acidic, loamy fine sand soils have a high organic matter content and may be mapped as Osier loamy fine sand (Typic Psammaquent). The sandy soils overtop an impermeable layer, generally clay. This seepage community is known from the Sparta, Catahoula, Fleming (Blounts Creek Member), and Pleistocene High Terraces (Willis and Bentley in Texas; Williana, Citronelle, and Bentley in Louisiana) formations. Occurrences are never extensive, typically less than 0.4 hectare.

Global Vegetation Description

Stands are dense and generally dominated by tall shrubs, such as *Ilex coriacea*, *Morella cerifera* (= *Myrica cerifera*), *Morella caroliniensis* (= *Myrica heterophylla*), *Persea palustris*, *Alnus serrulata*, *Toxicodendron vernix*, *Vaccinium fuscatum*, *Viburnum nudum* var. *nudum*, *Photinia pyrifolia* (= *Aronia arbutifolia*), *Lyonia lucida*, and *Rhododendron oblongifolium*. Scattered trees, including *Magnolia virginiana*, *Nyssa biflora*, and *Acer rubrum* may be present. *Smilax laurifolia* is often an abundant, entangling vine. The herbaceous stratum is sparse to moderately dense, depending on the overstory cover. This stratum is dominated by pteridophytes. *Osmunda cinnamomea*, *Osmunda regalis* var. *spectabilis*, *Woodwardia areolata*, *Onoclea sensibilis*, and *Woodwardia virginica* are typical. Scattered forbs and graminoids typical of open herbaceous seeps, such as *Rudbeckia scabrifolia*, *Solidago patula* var. *strictula*, *Carex* spp., *Dichanthelium* spp., may occur in more open examples of this woodland. *Sphagnum* spp. are generally an abundant ground cover in this community.

Example Photograph

Figure A28 below shows an example of CEGL003530 (*Magnolia virginiana*) / *Ilex coriacea – Morella caroliniensis* Seepage Bog.



**Figure A28.** (*Magnolia virginiana*) / *Ilex coriacea – Morella caroliniensis* Seepage Bog (CSU)

Short Citation

- Bridges and Orzell 1989a,
- Grace and Smith 1995
- Martin and Smith 1991
- Martin and Smith 1993

***CEGL007474 Nyssa biflora – Magnolia virginiana – Quercus laurifolia / Cyrilla racemiflora – Rhododendron oblongifolium Swamp Forest***

Table A18 below shows the USNVC Hierarchy for CEGL007474 *Nyssa biflora – Magnolia virginiana – Quercus laurifolia* / *Cyrilla racemiflora – Rhododendron oblongifolium* Swamp Forest.

**Table A18.** USNVC hierarchy for CEGL007474 *Nyssa biflora – Magnolia virginiana – Quercus laurifolia* / *Cyrilla racemiflora – Rhododendron oblongifolium* Swamp Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |

**Table A18 (continued).** USNVC hierarchy for CEGL007474 Nyssa biflora – Magnolia virginiana – Quercus laurifolia / Cyrilla racemiflora – Rhododendron oblongifolium Swamp Forest

| Category | Description |
|---|---|
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Evergreen Hardwood - Conifer Swamp |
| Group | 1.B.3.Nb Coastal Plain Mixed Evergreen Swamp |
| Alliance | A0378 *Magnolia virginiana - Nyssa biflora - Quercus laurifolia* Swamp Forest Alliance |
| Association | 1.B.3.Nb *Nyssa biflora - Magnolia virginiana - Quercus laurifolia* / *Cyrilla racemiflora - Rhododendron oblongifolium* Swamp Forest (CEGL007474) |

**Field Plots:** 1022, 0319_025, 0319_026, 0319_070, 0319_092, 0319_095, 0319_120, 0319_374, 7016b

**Map Class:** BITH MC304

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 53 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain ridge and swale

**Soil Texture**: Muck

**Environment**: 9 plots were sampled within this type. The community occurs on floodplain ridge and swales. Ground cover is dominated by water with cover ~50%. Litter cover may reach up to 30%. When wood is present, its cover reaches 5%. Bare soil may reach up to 15%.

Local Vegetation Description
**Structure**: Canopy (30%), Sub canopy (10%), Tall shrub (40%)

**Vegetation Floristics**: A mixed evergreen/deciduous baygall forest with saturated soils for much of the year. Canopy dominants include *Magnolia virginiana*, *Nyssa biflora*, *Nyssa sylvatica*, and *Quercus laurifolia.* Other possible canopy associates are *Acer rubrum*, *Acer barbatum*, *Ilex opaca* var. *opaca*, *Magnolia grandiflora*, *Pinus taeda*, and *Taxodium distichum*. Shrub layer is dense with *Alnus serrulata*, *Cyrilla racemiflora*, *Ilex coriacea*, and *Clethra alnifolia*. Common vines are *Decumaria barbara* and *Smilax laurifolia*. Herb stratum is typically abundant with the ferns *Onoclea sensibilis*, *Osmunda cinnamomea*, *Osmunda regalis* var. *spectabilis*, *Woodwardia areolata*, and *Woodwardia virginica*; other possible herbs include *Carex* spp., *Chasmanthium laxum*, *Eleocharis*

*microcarpa*, *Eleocharis tortilis*, *Leersia virginica*, *Platanthera ciliaris*, *Platanthera clavellata*, *Platanthera cristata*, and *Saururus cernuus*. Common non-native invasive species are *Lonicera japonica* and *Ligustrum sinense*.

**Dynamics:** No evidence of fire was observed in the example sampled by Martin and Smith (1991). Due to its sheltered topographic position along stream headwaters and moist conditions, streamhead occurrences of this community likely burned very infrequently. Occurrences in flatwoods, however, may have burned more frequently, typically during droughts. In addition, examples occurring in a matrix of frequently burned *Pinus palustris* communities may be influenced by the pulse of post-fire nutrients occurring in runoff from uplands (Schafale and Weakley 1990). This forest does not appear to be a disturbance-dependent community, but specific successional trajectories are not currently known.

Conservation Status Rank
**Global**: G3?

Global Environmental Description
This seasonally flooded wetland forest occurs on deep, very acidic silt loams, fine sandy loam, and loamy fine sand soils with high organic content. Soils are typically mapped as Corrigan (Typic Albaqualf), Melhomes (Humaqueptic Psammaquent), and possibly Osier (Typic Psammaquent). This community is known from the following intermediate and high Pleistocene Terraces and Tertiary uplands: Catahoula (Oligocene), Sparta, Fleming (Miocene) and possibly the Vicksburg (Oligocene) formations. It occurs primarily on floodplain flats and along small blackwater streams of low velocity. Nixon et al. (1983a) measured stream depths of 0.3-0.6 m and widths of less than 1 m at the time of their study. The fluctuating periods of inundation result in a wider stream channel (i.e., section that floods more often than 2 years out of every 3) that is often saturated, although sections of it are generally not inundated. This community also occurs downstream in flatwoods associated with drainages (Groat 1990, Soil Conservation Service 1990, Martin and Smith 1991, Smith 1996a).

Global Vegetation Description
The canopy is typically strongly dominated by *Nyssa sylvatica* and/or *Nyssa biflora*, *Magnolia virginiana*, and *Quercus laurifolia*. The canopy may also contain other species, such as *Acer rubrum*, *Magnolia grandiflora*, *Ilex opaca* var. *opaca*, *Pinus taeda*, *Taxodium distichum*, and *Liquidambar styraciflua*, and sometimes *Quercus michauxii*. *Persea palustris*, *Persea borbonia*, *Acer rubrum*, *Ilex opaca* var. *opaca*, and other canopy species form the subcanopy. The diverse, relatively dense, and primarily evergreen tall-shrub stratum may be dominated by *Cyrilla racemiflora* and *Ilex coriacea* but often includes *Alnus serrulata*, *Photinia pyrifolia* (= *Aronia arbutifolia*), *Chionanthus virginicus*, *Itea virginica*, *Morella cerifera* (= *Myrica cerifera* var. *cerifera*), *Morella caroliniensis* (= *Myrica heterophylla*), *Persea palustris*, *Rhododendron canescens*, *Rhododendron oblongifolium*, *Styrax americanus*, *Viburnum nudum* var. *nudum*, *Viburnum dentatum*, and sometimes *Carpinus caroliniana*, *Sebastiania fruticosa*, and *Vaccinium virgatum*. Woody vines, especially *Smilax laurifolia* and *Decumaria barbara*, can be common. The herb stratum is typically dominated by the ferns *Woodwardia areolata*, *Osmunda regalis* var. *spectabilis*, *Osmunda cinnamomea*, *Woodwardia virginica*, and *Onoclea sensibilis*; other components include *Apteria aphylla*, *Athyrium filix-femina*

ssp. *asplenioides*, *Chasmanthium laxum*, *Carex leptalea*, *Carex atlantica*, *Carex debilis*, *Carex lonchocarpa* (= *Carex folliculata* var. *australis*), *Eleocharis tortilis*, *Platanthera clavellata*, *Platanthera ciliaris*, *Platanthera cristata*, *Leersia virginica*, *Lycopus rubellus*, *Triadenum walteri* (= *Hypericum walteri*), *Boehmeria cylindrica*, and *Saururus cernuus*. *Woodwardia areolata* and *Eleocharis microcarpa* are common and important enough to be used as nominals. *Mayaca aubletii*, *Burmannia biflora*, and *Apteria aphylla* are fairly rare in eastern Texas, all of which can occur in this association. *Bartonia texana* may also be present. The exotics *Lonicera japonica* and *Ligustrum sinense* frequently invade disturbed examples of this community. *Microstegium vimineum* may become a problem in the future as the range of this Asiatic exotic expands.

Example Photograph

Figure A29 below shows an example of CEGL007474 *Nyssa biflora – Magnolia virginiana – Quercus laurifolia* / *Cyrilla racemiflora – Rhododendron oblongifolium* Swamp Forest.



**Figure A29.** *Nyssa biflora – Magnolia virginiana – Quercus laurifolia* / *Cyrilla racemiflora – Rhododendron oblongifolium* Swamp Forest (CSU)

Short Citation

- Groat 1990
- Martin and Smith 1991

- Nixon et al. 1983a
- Schafale and Weakley 1990
- Smith 1996a

Soil Conservation Service 1990

***CEGL007904 Magnolia virginiana – Nyssa sylvatica – Acer rubrum / Morella caroliniensis / Woodwardia areolata Swamp Forest***

Table A19 below shows the USNVC Hierarchy for CEGL007904 *Magnolia virginiana – Nyssa sylvatica – Acer rubrum* / *Morella caroliniensis* / *Woodwardia areolata* Swamp Forest.

**Table A19.** USNVC hierarchy for CEGL007904 *Magnolia virginiana – Nyssa sylvatica – Acer rubrum* / *Morella caroliniensis* / *Woodwardia areolata* Swamp Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Evergreen Hardwood - Conifer Swamp |
| Group | 1.B.3.Nb Coastal Plain Mixed Evergreen Swamp |
| Alliance | A0378 *Magnolia virginiana - Nyssa biflora - Quercus laurifolia* Swamp Forest Alliance |
| Association | 1.B.3.Nb *Magnolia virginiana - Nyssa sylvatica - Acer rubrum* / *Morella caroliniensis* / *Woodwardia areolata* Swamp Forest (CEGL007904) |

**Field Plots:** 2069, 2048, 2035, 0319_380

**Map Class:** BITH MC304

Local Environmental Description

Plot/Sample Data Environmental Summary

**Elevation**: Mean 139 ft range 72 ft to 189 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain upper terrace, Upland

**Soil Texture**: Sandy clay loam, Sandy loam

**Environment**: 4 plots were sampled within this type. This community typically occurs on upper floodplains and flatwoods with sandy clay loams or sandy loams. Litter is the dominant ground cover with values ranging from 10% to 62%. Bare ground may range in values from 0% to 60%. Wood is typically present with values <5%.

Local Vegetation Description

**Structure**: Emergent (0%-10%), Canopy (20%-60%), Sub canopy (10%-40%), Tall shrub (10%-70%), Short shrub (0%-40%), Herbaceous (0%-40%), Vine (0%-10%)

**Vegetation Floristics**: This forest community is dominated by *Magnolia virginiana* and *Nyssa* spp. with covers of ~40% and ~50% respectively. Other species that may occur in the canopy include *Quercus nigra*, *Pinus elliottii*, and/or *Pinus taeda*. Shrubs tend to fairly dense with total shrub cover usually reaching up to 60%. Common shrubs include *Cyrilla racemiflora*, *Morella cerifera*, and *Ilex coriacea*. Herbaceous stratum is fairly sparse and typically composed of sparse sedges and seedlings of various species.

**Dynamics:** N/A

Conservation Status Rank

**Global**: G3?

Global Environmental Description

This forest occurs on saturated soils associated with springs and seepage flow at the headwaters and margins of topographically flat creek bottoms. The creek channels themselves tend to be highly meandering, often with multiple channels and extremely shallow banks. These communities are invariably embedded within adjacent sandy slopes and uplands. The deep, poorly drained, strongly acidic, loamy fine sand soils have a high organic matter content (Brooks et al. 1993). Van Kley (1999a) indicates that these habitats, mapped as the Betis series and Guyton complex on the Kisatchie Ranger District of Louisiana, are notably low in calcium and magnesium. Other examples of this type are mapped as Lovelady (Arenic Glossudalf), Rentzel (Arenic Plinthaquic Paleudult), and Osier (Typic Psammaquent). The sandy soils usually overtop an impermeable layer. These infertile soils have a high available water capacity with very slow ponded surface water runoff. This seepage community is known from sandy uplands throughout Louisiana and eastern Texas, including the Carrizo, Sparta, Willis (High Pleistocene Terraces), Bentley (Intermediate Terraces), Catahoula (Oligocene), Fleming (Miocene), Cockfield, Wilcox, and other formations. Surface soils are predominately sandy-textured and low in nutrients.

Global Vegetation Description

This association type primarily reflects the quantitative analysis of Brooks et al. (1993) in which the most important woody species were *Magnolia virginiana, Nyssa sylvatica, Acer rubrum, Liquidambar styraciflua*, and *Morella caroliniensis (= Myrica heterophylla)*. *Pinus taeda* is present in most examples. *Nyssa biflora* apparently occurs in Louisiana examples (L. Smith pers. comm.). *Ilex opaca* may be present but is more common in southern baygalls of the region (Brooks et al. 1993). Other important woody species in the shrub layer at a site in Nacogdoches County, Texas

(Nixon et al. 1980b), included *Sambucus canadensis, Alnus serrulata, Vaccinium fuscatum (= Vaccinium arkansanum)*, and *Itea virginica*. Woody species such as *Fagus grandifolia* may be present along the edges but are usually absent from the interior due to intolerance to flooding. According to Brooks et al. (1993), the canopy stratum is strongly dominated by *Magnolia virginiana*, followed by *Nyssa sylvatica, Acer rubrum*, and *Liquidambar styraciflua*. Data from two additional plots on the national forests in Texas document *Nyssa sylvatica* as the dominant overstory tree (Turner et al. unpubl. data). The shrub stratum is dense and supports a variety of evergreen shrubs, although *Morella caroliniensis* is usually dominant. Other typical woody species include *Alnus serrulata* and *Itea virginica*, as well as *Vitis rotundifolia* and *Smilax laurifolia*. Other woody species present may include *Persea palustris, Toxicodendron vernix, Vaccinium fuscatum, Viburnum nudum var. nudum, Photinia pyrifolia (= Aronia arbutifolia), Lyonia* spp., and *Rhododendron oblongifolium*. The herbaceous stratum is sparse to fairly dense, depending on the density of the overstory. This stratum is dominated by pteridophytes, such as *Osmunda cinnamomea, Osmunda regalis var. spectabilis, Woodwardia areolata, Onoclea sensibilis*, and *Woodwardia virginica*. *Carex leptalea, Isotria verticillata, Solidago patula*, and *Eleocharis tortilis* may be present in some examples. Scattered forbs and graminoids typical of open herbaceous seeps may occur in more open examples of this forest. *Sphagnum* spp. are generally an abundant ground cover in this community.

Example Photograph

Figure A30 below shows an example of CEGL007904 *Magnolia virginiana – Nyssa sylvatica – Acer rubrum* / *Morella caroliniensis* / *Woodwardia areolata* Swamp Forest.



**Figure A30.** *Magnolia virginiana – Nyssa sylvatica – Acer rubrum* / *Morella caroliniensis* / *Woodwardia areolata* Swamp Forest (CSU)

Short Citation

- Brooks et al. 1993
- Nixon et al. 1980b
- Turner et al. unpubl. data
- Van Kley 1999a

***NPSBITH018 Cyrilla racemiflora Seepage Bog Shrubland***
USNVC Hierarchy*:* Park Special NPSBITH018

**Field Plots:** 3011, 3015, 0319_051

**Map Class:** BITH MC304

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 85 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands, Upland

**Soil Texture**: Silt loam, Silt, Silt loam

**Environment**: 3 plots were sampled within this type. This community occurs in small, inundated depressions. Ground cover is dominated by litter with values up to 80%. Often water forms a major component with ground cover values reaching up to 40%.

Local Vegetation Description
**Structure**: Tall shrub (0-30%), Short shrub (10%-70%), Herbaceous (10%-30%)

**Vegetation Floristics**: This shrubland community is dominated by *Cyrilla racemiflora* and *Ilex coriacea* with cover reaching up to ~70%. Herbaceous stratum is often moderate with cover up to ~30%. Common species include *Magnolia virginiana*, *Xyris ambigua*, and *Andropogon* sp.. Occasionally, *Magnolia virginiana* and *Pinus taeda* may be sparsely present within the community or encroaching from the edges.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A31 below shows an example of Park Special NPSBITH018 *Cyrilla racemiflora* Seepage Bog Shrubland.



**Figure A31.** *Cyrilla racemiflora* Seepage Bog Shrubland (CSU)

***NPSBITH007 Acer rubrum Floodplain Forest***
USNVC Hierarchy*:* Park Special NPSBITH007

**Field Plots:** 6012

**Map Class:** BITH MC305

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 150 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain active channel

**Soil Texture**: Clay

**Environment**: 1 plot was sampled within this type. This community typically occurs on floodplains. Soil was typically sandy clay. Ground cover was dominated by litter with cover reaching up to ~75%. Bare soil and wood were usually present with cover <10% each.

Local Vegetation Description
**Structure**: Canopy (40%), Herbaceous (80%)

**Vegetation Floristics**: This floodplain forest typically occurs on floodplains of small streams. *Acer rubrum* is typically the sole canopy tree with cover reaching up to 40%. Shrubs are typically sparse with cover usually <5%. The herbaceous stratum is vigorous and dominated by graminoids with total cover reaching 80%. Common species include *Chasmanthium laxum*, *Carex* spp., *Arundinaria gigantea*, and *Juncus effusus*.

**Dynamics**:

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A32 below shows an example of Park Special NPSBITH007 *Acer rubrum* Floodplain Forest.



**Figure A32.** *Acer rubrum* Floodplain Forest (CSU)

### *CEGL007410 Salix nigra – (Platanus occidentalis, Populus deltoides) Southern Floodplain Forest*

Table A20 below shows the USNVC Hierarchy for CEGL007410 *Salix nigra* – (*Platanus occidentalis*, *Populus deltoides*) Southern Floodplain Forest.

**Table A20.** USNVC hierarchy for CEGL007410 *Salix nigra* – (*Platanus occidentalis*, *Populus deltoides*) Southern Floodplain Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Southern Ash - Elm - Willow Floodplain Forest |
| Alliance | A3421 *Populus deltoides - Salix nigra - Salix caroliniana* Coastal Plain Floodplain Forest Alliance |
| Association | 1.B.3.Nb *Salix nigra* - (*Platanus occidentalis*, *Populus deltoides*) Southern Floodplain Forest (CEGL007410) |

**Field Plots:** 2103, 2098, 1108

**Map Class:** BITH MC306

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 42.33 ft range 19 ft to 55 ft

**Aspect**: Mean 13.33 range 0 to 40

**Slope**: Mean 3.33 range 0 to 10

**Macro Topography**: Floodplain lower terrace

**Soil Texture**: Sand

**Environment**: 3 plots were sampled within this type. This community typically occurs on floodplains. Bare soil typically dominates the ground cover with values ranging between 75% and 95%. Litter may be present with values up to 20%.

Local Vegetation Description
**Structure**: Canopy (80%), Vine (0%-10%)

**Vegetation Floristics**: These communities typically occur on sandbars next to large rivers such as the Neches River. *Salix nigra* dominates the canopy with cover generally around 80%. Other species that may be present in the canopy and subcanopy include *Betula nigra* and *Platanus occidentalis*.

**Dynamics:** N/A

Conservation Status Rank
**Global**: G3G5

Global Environmental Description
This riverine willow community occurs on recently deposited ground in large river floodplains. This includes "sandbar forests dominated by *Salix nigra*, with *Platanus occidentalis* and *Populus deltoides*" in the Mississippi River Alluvial Plain (formerly included in CEGL007908). Heineke (1987) mentions "riverfront areas and frontlands of islands which are actively accreting" with *Salix nigra* and *Populus deltoides*. Landward stands may be pure *Salix nigra*. In addition, he mentions "older, higher sites with more coarse-grained sediments" which are dominated by the mixture of *Salix nigra* and *Populus deltoides*.

Global Vegetation Description
*Salix nigra* may be the sole dominant in stands of this type, with few other species present. This association also includes some examples with *Platanus occidentalis* and *Populus deltoides*. Heineke (1987) mentions "riverfront areas and frontlands of islands which are actively accreting" with *Salix nigra* and *Populus deltoides*. Landward stands may be pure *Salix nigra*. In addition, he mentions "older, higher sites with more coarse-grained sediments" which are dominated by the mixture of *Salix nigra* and *Populus deltoides*.

Example Photograph
Figure A33 below shows an example of CEGL007410 *Salix nigra* – (*Platanus occidentalis*, *Populus deltoides*) Southern Floodplain Forest.



**Figure A33.** *Salix nigra* – (*Platanus occidentalis*, *Populus deltoides*) Southern Floodplain Forest (CSU)

Short Citation
Heineke 1987

***CEGL004773 Salix nigra / (Cephalanthus occidentalis) Swamp Forest***

Table A21 below shows the USNVC Hierarchy for CEGL004773 *Salix nigra* / (*Cephalanthus occidentalis*) Swamp Forest.

**Table A21.** USNVC hierarchy for CEGL004773 *Salix nigra* / (*Cephalanthus occidentalis*) Swamp Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Southern Ash - Elm - Willow Floodplain Forest |
| Alliance | A1914 *Salix caroliniana* - *Salix nigra* Coastal Plain Swamp Forest Alliance |
| Association | 1.B.3.Nb *Salix nigra* / (*Cephalanthus occidentalis*) Swamp Forest (CEGL004773) |

**Field Plots:** 1100, 2088, 2102

**Map Class:** BITH MC306

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 26 ft range 23 ft to 31 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain lower terrace, Floodplain perennially flooded oxbows

**Soil Texture**: Silty clay, Clay loam

**Environment**: 3 plots were sampled within this type. These communities typically occur within the floodplain. Bare soil was typically the most dominant ground cover with values around 90%. One site was partially flooded with water covering ~45% of the ground cover and bare soil covering ~45%.

Local Vegetation Description
**Structure**: Canopy (40%-60%), Sub canopy (0%-10%), Tall shrub (0%-10%), Vine (10%-20%)

**Vegetation Floristics**: Canopy is dominated by a moderate layer of *Salix nigra* with cover ranging from 30% to 60%. Other mesic species may occur in the canopy, but these species occur at lower covers and do not codominate. Common species include *Triadica sebifera*, *Carya aquatica*, *Liquidambar styraciflua*, *Taxodium distichum*, *Betula nigra*, and *Planera aquatica*. Shrubs tend to be sparse with cover <10%. The herbaceous component was typically sparse with cover <10%. *Sauruus cernuus* was generally the most common herbaceous species.

**Dynamics**: N/A

Conservation Status Rank
**Global**: G4G5

Global Environmental Description
This early-successional forest occurs along the shores of lakes, ponds, and possibly in other topographic situations in the Gulf Coastal Plain and adjacent ecoregions.

Global Vegetation Description
The canopy is strongly dominated by *Salix nigra* but may also include *Liquidambar styraciflua, Acer rubrum, Fraxinus pennsylvanica*, and *Acer negundo* within their respective ranges. *Cephalanthus occidentalis* is often a strong dominant in the shrub layer and may be the only species present in that stratum. Other understory components may also include *Ampelopsis arborea, Baccharis neglecta*, and *Amorpha fruticosa*.

Example Photograph
Figure A34 below shows an example of CEGL004773 *Salix nigra* / (*Cephalanthus occidentalis*) Swamp Forest.



**Figure A34.** *Salix nigra* / (*Cephalanthus occidentalis*) Swamp Forest (CSU)

***NPSBITH002 Betula nigra Mixed Hardwood Riverine Forest***
USNVC Hierarchy: Park Special NPSBITH002

**Field Plots:** 6022

**Map Class:** BITH MC306

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 10 ft range 0 ft to 20 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain, active channel

**Soil Texture**: Silty clay loam

**Environment**: This community occurs next to the river on raised levees on the floodplain. Ground cover is typically codominated by bare soil and litter.

Local Vegetation Description
**Structure**: Canopy (50%-80%), Herbaceous (0%-10%)

**Vegetation Floristics**: This community is dominated by *Betula nigra*. Often there are a variety of mesic hardwoods in the canopy such as *Salix nigra*, *Triadica sebifera*, *Liquidambar styraciflua*, and *Acer rubrum*. The herbaceous stratum is often sparse and may include *Zizaniopsis miliacea* with cover typically ~10%. Vines are often vigorous and cover many of the trees. Common vines may include *Vitis riparia* and *Berchemia scandens*.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A35 below shows an example of Park Special NPSBITH002 *Betula nigra* Mixed Hardwood Riverine Forest.



**Figure A35.** *Betula nigra* Mixed Hardwood Riverine Forest (CSU)

### *CEGL007412 Triadica sebifera Ruderal Wet Forest*

Table A22 below shows the USNVC Hierarchy for CEGL007412 *Triadica sebifera* Ruderal Wet Forest.

**Table A22.** USNVC hierarchy for CEGL007412 *Triadica sebifera* Ruderal Wet Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southeastern North American Ruderal Flooded & Swamp Forest |
| Group | 1.B.3.Nb Southeastern Exotic Ruderal Flooded & Swamp Forest |
| Alliance | A3339 *Triadica sebifera - Melaleuca quinquenervia - Schinus terebinthifolius* Ruderal Flooded & Swamp Forest Alliance |
| Association | 1.B.3.Nb *Triadica sebifera* Ruderal Wet Forest (CEGL007412) |

**Field Plots:** 2053, 2086, 2092, 1101, 2079, 4053, 0319_212, 0319_260

**Map Class:** BITH MC307

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 72.83 ft range 18 ft to 190 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain lower terrace, Floodplain ridge and swale, Floodplain perennially flooded oxbows, Flatlands

**Soil Texture**: Silty clay loam, Silt loam, Clay loam

**Environment**: 8 plots were sampled within this type. This community generally occurs on low bottomlands. The majority of sites had ground cover dominated by bare soil with cover ranging from 73% to 94%. Litter formed a portion of the ground cover with values ranging from 10% to 60%. Wood usually occurred in the ground cover with cover ranging from 2% to 5%.

Local Vegetation Description
**Structure**: Canopy (40%-90%), Sub canopy (30%-60%), Tall shrub (0%-10%), Herbaceous (0%-20%), Vine (0%-20%)

**Vegetation Floristics**: This community is dominated by an abundance of *Triadica sebifera* with cover ranging from 30% to 60%. Other species typically occur in the canopy but have less cover than *Triadica*. These species include *Carya aquatica*, *Liquidambar styraciflua*, *Nyssa aquatica*, *Quercus lyrata*, *Taxodium distichum*, *Quercus phellos*, *Acer rubrum*, and *Ulmus americana*. There is typically a sparse shrub layer with cover <10%. Common species include *Acer floridanum*, *Carpinus caroliniana*, and *Forestiera acuminata*. The herbaceous species are sparse with cover <10% and common species include *Justicia lanceolata* and *Saururus cernuus*.

**Dynamics**: N/A

Conservation Status Rank
**Global**: GNA

Global Environmental Description
N/A

Global Vegetation Description
Stands are strongly dominated by the exotic tree *Triadica sebifera* (= *Sapium sebiferum*) (Euphorbiaceae). Other wetland trees may be present including *Acer rubrum* var.

*drummondii*, *Salix nigra*, and *Salix caroliniana*. Various wetland grasses, sedges, and forbs are present.

Example Photograph

Figure A36 below shows an example of CEGL007412 *Triadica sebifera* Ruderal Wet Forest.



**Figure A36.** *Triadica sebifera* Ruderal Wet Forest (CSU)

### *CEGL002427 Fraxinus pennsylvanica – Ulmus americana – Celtis laevigata / Ilex decidua Floodplain Forest*

Table A23 below shows the USNVC Hierarchy for CEGL002427 *Fraxinus pennsylvanica – Ulmus americana – Celtis laevigata* / *Ilex decidua* Floodplain Forest.

**Table A23.** USNVC hierarchy for CEGL002427 *Fraxinus pennsylvanica – Ulmus americana – Celtis laevigata* / *Ilex decidua* Floodplain Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |

**Table A23 (continued).** USNVC hierarchy for CEGL002427 *Fraxinus pennsylvanica – Ulmus americana – Celtis laevigata* / *Ilex decidua* Floodplain Forest

| Category | Description |
|---|---|
| Division | 1.B.3.Na Eastern North American-Great Plains Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Na Central Hardwood Floodplain Forest |
| Group | 1.B.3.Na Silver Maple - Sugarberry - Sweetgum Floodplain Forest |
| Alliance | A3700 *Fraxinus pennsylvanica - Platanus occidentalis - Acer saccharinum* Ozark-Ouachita Floodplain Forest Alliance |
| Association | 1.B.3.Na *Fraxinus pennsylvanica - Ulmus americana - Celtis laevigata* / *Ilex decidua* Floodplain Forest (CEGL002427) |

**Field Plots:** 3003

**Map Class:** BITH MC308

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 0 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain lower terrace

**Soil Texture**: Clay loam

**Environment**: 1 plot was sampled within this type. This community generally occurs within low floodplain terraces. Litter typically dominates the ground cover with values up to 80%. Wood occurs in low values usually <5%.

Local Vegetation Description
**Structure**: Canopy (10%-50%), Short Shrub (10%-20%), Herbaceous (50%-80%)

**Vegetation Floristics**: Broadleaf deciduous floodplain forest along large rivers. *Fraxinus pennsylvanica* is abundant on wet flats and sloughs while *Celtis laevigata* is most dominant on front sites. *Ulmus americana* has been mostly eliminated due to Dutch elm disease and logging. Tree associates include *Acer negundo*, *Carpinus caroliniana*, *Carya aquatica*, *Liquidambar styraciflua*, and *Quercus lyrata*. Shrubs typically include *Cornus drummondii*, *Crataegus* spp., and *Ilex decidua*. Herbaceous layer is diverse and dense with *Chasmanthium latifolium*, *Boehmeria cylindrica*, *Campsis radicans*, *Carex* spp., *Galium* spp., *Impatiens capensis*, *Laportea canadensis*, *Leersia* spp., and *Pilea pumila*. Vines such as *Parthenocissus quinquefolia* and *Toxicodendron radicans* typically grow.

**Dynamics**: Frequent or prolonged ponding due to excessive rainfall or beaver activity results in considerable variations in vegetative structure and composition, often causing high tree mortality. Flooding occurs during the winter and spring and often extends into the growing season. Although this community can be early-successional, occurring on river fronts and other recently disturbed areas, this is a generally long-lived type (Eyre 1980, Diamond 1993). This community is usually located in transitional areas between *Quercus michauxii* - *Quercus pagoda* floodplain forests and *Quercus lyrata* - *Quercus phellos* bottomland forests.

Conservation Status Rank
**Global**: G4G5

Global Environmental Description
This community occurs in floodplains of major rivers, generally alluvial or brownwater rivers, on low ridges, flats, and sloughs; terrace flats and sloughs in first bottoms; and occasionally on new lands or fronts (Eyre 1980). In terms of hydrology, this is a Zone IV community (Wharton et al. 1982). Short-term, shallow flooding occurs seasonally/periodically within this community. Soils are clay or silt loams that are seasonally inundated or saturated for 1 or 2 months during the growing season, with a 50-100% annual frequency (Eyre 1980, Smith and Craig 1990). Alluvial deposition and nutrient input occur, but less than in more frequently flooded forest types (Schafale and Weakley 1990).

Soils include dominantly level or nearly level soils that formed in water-laid clayey or loamy sediments on floodplains of the Mississippi and other rivers and large perennial streams in the Coastal Plain. They are Aquepts, Aqualfs, and Aquents. Haplaquepts, Ochraqualfs, Fluvaquents, Natraqualfs, and Hapludalfs are found in backswamp areas and older natural levees. Dystrochrepts, Udifluvents, and Fluvaquents occur in smaller areas. Hydraquents are in southern Louisiana. These soils have a udic or aquic moisture regime, thermic temperature regime, and montmorillonitic or mixed mineralogy. These soils formed in alluvium and are deep, medium-textured, and have adequate or excessive moisture available for vegetation during the growing season (McNab and Avers 1994). Bedrock is deeply buried Paleozoic sandstone or stratified Cenozoic marine deposits.

Global Vegetation Description
This community is a broadleaf deciduous floodplain forest which exhibits high canopy diversity and good herbaceous diversity (although lower herbaceous diversity than mesic floodplain forest). *Ulmus americana* was once the most prominent member of this forest, but Dutch elm disease (*Ceratostomella ulmi*) and logging have eliminated many of the largest mature *Ulmus* spp. from most of the species natural range (Collingwood and Brush 1984). *Fraxinus pennsylvanica* dominates on moist flats and shallow sloughs, while *Celtis laevigata* is most prevalent on new land or front sites. Other species commonly encountered include *Carya aquatica*, *Quercus lyrata*, *Liquidambar styraciflua*, and *Acer negundo*. The subcanopy is often dense and dominated by *Fraxinus pennsylvanica* which sprouts prolifically. *Fraxinus pennsylvanica*, however, is considered a pioneer species and does not maintain its canopy position under intense shading found in later successional stages (Voigt and Mohlenbrock 1964). Shrubs typical of this forest include *Cornus drummondii*, *Ilex decidua*, and *Crataegus* spp. The herbaceous layer is dense and diverse, dominated by *Galium* spp.,

*Viola* spp., *Carex* spp., *Leersia* spp., *Boehmeria cylindrica*, *Laportea canadensis*, *Pilea pumila*, *Impatiens capensis* (= *Impatiens biflora*), and *Impatiens pallida*. Vines most often encountered include *Toxicodendron radicans*, *Campsis radicans*, and *Parthenocissus quinquefolia* (TNC 1995a).

Species variability within and among occurrences of this community is great and directly related to the level of saturation of the substrate. Alluvial deposition varies and slight ridges may favor sugarberry, while depressions will favor green ash. Species variability and composition within this community are considerable as a result of a mosaic of moisture conditions controlled by seasonal flooding and local topography. In the northern part of the range (north-central Oklahoma, northern Arkansas, Missouri, Tennessee, Kentucky, southern Illinois, southeastern Indiana), this community coincides with the distribution of *Celtis occidentalis*. In this section *Celtis occidentalis* is often a dominant in the canopy-subcanopy. In Louisiana, Mississippi, Alabama, Arkansas, and southwestern Missouri, *Quercus texana* is a major associate in this type. *Celtis laevigata* is especially abundant on river front and disturbed sites. *Fraxinus pennsylvanica* is relatively more abundant on saturated flats or shallow sloughs. *Berchemia scandens* is common in this community northward through southeastern Virginia and Tennessee. Areas that have been cleared or logged in the past may have locally abundant disturbance species such as *Acer rubrum*, *Pinus taeda*, *Liquidambar styraciflua*, or *Platanus occidentalis*.

Example Photograph

Figure A37 below shows an example of CEGL002427 *Fraxinus pennsylvanica – Ulmus americana – Celtis laevigata* / *Ilex decidua* Floodplain Forest.



**Figure A37.** *Fraxinus pennsylvanica – Ulmus americana – Celtis laevigata* / *Ilex decidua* Floodplain Forest (CSU)

Short Citation

- Collingwood and Brush 1984
- Diamond 1993
- Eyre 1980
- McNab and Avers 1994
- Schafale and Weakley 1990
- Smith and Craig 1990
- Voigt and Mohlenbrock 1964
- Wharton et al. 1982

### *CEGL004753 Fraxinus caroliniana Swamp Forest*

Table A24 below shows the USNVC Hierarchy for CEGL004753 *Fraxinus caroliniana* Swamp Forest.

**Table A24.** USNVC hierarchy for CEGL004753 *Fraxinus caroliniana* Swamp Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Bald-cypress - Tupelo Floodplain Forest |
| Alliance | A0344 *Fraxinus caroliniana* Swamp Forest Alliance |
| Association | 1.B.3.Nb *Fraxinus caroliniana* Swamp Forest (CEGL004753) |

**Field Plots:** 1051, 4050, 4051

**Map Class:** BITH MC309

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 160 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain lower terrace, Freshwater marsh

**Soil Texture**: Silt, Muck

**Environment**: 3 plots were sampled within this type. This community occurred in a flooded swale. Ground cover was dominated by water with cover at 97%.

Local Vegetation Description
**Structure**: Canopy (60%-80%), Herbaceous (0%-10%)

**Vegetation Floristics**: The canopy was densely dominated by *Fraxinus caroliniana* with cover ~80%. Shrubs tend to be sparse with cover <10%. These communities typically occur within floodplains. Common shrubs included *Morella cerifera*, *Taxodium distichum*, and *Triadica sebifera*. The herbaceous stratum was extremely sparse, and its cover was <5%.

**Dynamics:** This small-patch community type occurs in a rather extensive high Pleistocene terrace "flatwoods" environment. This environment where the type was first described (Angelina National Forest, eastern Texas) is not fire-prone like other flatwoods landscapes, and the influence of fire is

probably insignificant. Standing water is present for long periods during average years inhibiting establishment of seedlings of most species.

Conservation Status Rank
**Global**: G2G3

Global Environmental Description
This small-patch community type occurs in a rather extensive high Pleistocene terrace "flatwoods" environments in eastern Texas (R. Evans pers. obs.) and similar topographic depressions in second bottoms in western Louisiana (L. Smith pers. comm.). Standing water is present for long periods during average years but not due to the influence of overbank flooding. It is believed that extremely fine-textured soils and/or subsurface hardpans impede drainage of precipitation from these sites.

Global Vegetation Description
This wetland depression of the West Gulf Coastal Plain is typified by a nearly monospecific, dense stand of *Fraxinus caroliniana*; most individuals have swollen bases. Relative to surrounding vegetation, this woody vegetation has much lower stature and smaller diameter, thus appearing almost shrub-like. This forest is found in topographic depressions on fairly broad Pleistocene terrace flatwoods. Species diversity is quite low. A rooted herbaceous layer may be absent to sparse, and floating aquatics may or may not be present.

Example Photograph
Figure A38 below shows an example of CEGL004753 *Fraxinus caroliniana* Swamp Forest.



**Figure A38.** *Fraxinus caroliniana* Swamp Forest (CSU)

Short Citation

- L. Smith pers. Comm.
- R. Evans pers. obs.

***NPSBITH013 Nyssa aquatica – (Taxodium distichum) / Zizaniopsis miliacea Marsh Woodland***
USNVC Hierarchy: Park Special NPSBITH013

**Field Plots:** 3020, 3021

**Map Class:** BITH MC310

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 10 ft range 0 ft to 20 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain active channel

**Soil Texture**: Muck

**Environment**: This community is found in the tidally influenced marshes along the lower Neches. These marsh woodlands are perennially flooded and ground cover is dominated by water.

Local Vegetation Description
**Structure**: Canopy (20%-60%), Herbaceous (60%-100%)

**Vegetation Floristics**: Inundated forest with canopy of *Nyssa aquatica* and *Taxodium distichum*. Subcanopy is composed of *Acer rubrum* and *Triadica sebifera*. A dense herbaceous layer composed nearly exclusively of *Zizaniopsis miliacea* and *Ludwigia leptocarpa* is common.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A39 below shows an example of Park Special NPSBITH013 *Nyssa aquatica* – (*Taxodium distichum*) / *Zizaniopsis miliacea* Marsh Woodland.



**Figure A39.** *Nyssa aquatica* – (*Taxodium distichum*) / *Zizaniopsis miliacea* Marsh Woodland (CSU)

### *CEGL007422 Taxodium distichum – Nyssa aquatica – Acer rubrum / Itea virginica Floodplain Forest*

Table A25 below shows the USNVC Hierarchy for CEGL007422 *Taxodium distichum – Nyssa aquatica – Acer rubrum* / *Itea virginica* Floodplain Forest.

**Table A25.** USNVC hierarchy for CEGL007422 *Taxodium distichum – Nyssa aquatica – Acer rubrum* / *Itea virginica* Floodplain Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Bald-cypress - Tupelo Floodplain Forest |
| Iliance | A3594 *Taxodium distichum - Nyssa aquatica - Nyssa biflora* Floodplain Forest Alliance |
| Association | 1.B.3.Nb *Taxodium distichum - Nyssa aquatica - Acer rubrum* / *Itea virginica* Floodplain Forest (CEGL007422) |

**Field Plots:** 1039, 2073, 1064, 2054, 1059, 1026, 1040, 2052, 1088

**Map Class:** BITH MC311

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 81.89 ft range 31 ft to 176 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands, Floodplain active channel, Floodplain lower terrace, Floodplain perennially flooded oxbows

**Soil Texture**: Muck, Sandy clay loam, Silt loam, Silty clay loam

**Environment**: 9 plots were sampled within this type. This community generally occurs on floodplains. Water may completely dominate the ground cover with values up to 95%. If water is not present, bare soil makes up most of the ground cover with values up to 95%. Wood is often present with cover <10%.

Local Vegetation Description
**Structure**: Canopy (40%-90%), Sub canopy (0%-40%), Tall shrub (0%-20%), Herbaceous (0%-70%)

**Vegetation Floristics**: The canopy is dominated by a combination of *Nyssa aquatica* and *Taxodium distichum* with cover of ~50% for each species. Other canopy species include *Quercus laurifolia* and *Liquidambar styraciflua*. Typical shrubs include *Cyrilla racemiflora* and *Triadica sebifera*.

**Dynamics:** Hydrologic fluctuation is the main disturbance in this community and the primary ecological factor affecting the species composition and structure. The water budget of alluvial cypress swamp systems includes surface flow, groundwater inflow, precipitation throughfall, flooding, evapotranspiration, interception loss, and surface and subsurface outflow into the river channel. Hydrologic inflows are predominantly runoff from surrounding uplands and overflow of the flooding river. Flooding generally accounts for less than 50% of the total annual water input. Seasonal pulses of floods bring in water and nutrient-rich sediments (Mitsch and Gosselink 1993). As this community matures, the relative abundance of *Acer rubrum* var. *drummondii* may decrease, with the canopy becoming increasingly dominated by *Taxodium distichum* and *Nyssa aquatica*.

Conservation Status Rank
**Global**: G4?

Global Environmental Description
This association includes seasonally flooded swamps. In the Mississippi River Alluvial Plain and Gulf Coastal Plain, this community primarily occurs in sloughs which flood for 3-4 months annually.

This community occurs primarily in sloughs which receive annual flooding for approximately 3 or 4 months. The acidic clay soils are very poorly drained and very slowly permeable; the Yorktown series (Typic Fluvaquent) is commonly associated with this community in Louisiana. Slopes are typically less than 1%, and the high-water table is within 15 cm of the soils surface throughout the year in most years (Soil Conservation Service 1990, L. Smith pers. comm. 1995). Stands assigned here from the Savannah River Plant (South Carolina) are in "floodplains which are flooded most of the year" (Jones et al. 1981b).

Global Vegetation Description

This swamp forest has a canopy dominated by *Taxodium distichum*, *Nyssa aquatica*, and *Acer rubrum* var. *drummondii*. Associated canopy species include *Styrax americanus*, *Fraxinus caroliniana*, *Liquidambar styraciflua*, *Quercus phellos*, *Fraxinus pennsylvanica*, *Ulmus rubra*, *Ulmus alata*, *Nyssa biflora*, and *Quercus laurifolia*. This is typically a closed-canopy community, with cover ranging approximately between 60-100%, but most often 80-90%. The sparse to patchy tall-shrub stratum (2-5 m in height) includes *Itea virginica*, *Cephalanthus occidentalis*, *Diospyros virginiana*, *Forestiera acuminata*, *Ilex decidua*, and *Carpinus caroliniana*. In the Kisatchie National Forest, Itea virginica has a frequency of 50% in occurrences. The short-shrub stratum (0.5-2 m in height; mean cover of 13%) is dominated by *Acer rubrum*, *Itea virginica*, *Taxodium distichum*, and *Nyssa aquatica*. Associates include *Styrax americanus*, *Ulmus alata*, *Cephalanthus occidentalis*, *Rubus argutus*, *Fraxinus pennsylvanica*, *Quercus* spp., *Diospyros virginiana*, *Quercus lyrata*, *Ilex decidua*, *Liquidambar styraciflua*, *Forestiera acuminata*, *Celtis laevigata*, *Fraxinus caroliniana*, *Carpinus caroliniana*, *Triadica sebifera* (= *Sapium sebiferum*) (exotic), *Rubus trivialis*, *Carya aquatica*, *Nyssa biflora*, *Crataegus viridis*, and *Quercus phellos*. The mixed graminoid-forb herbaceous layer (mean cover 33%) is dominated by *Triadenum tubulosum*, *Triadenum virginicum*, *Carex atlantica*, *Saururus cernuus*, and *Gratiola virginiana*. Associates include *Boehmeria cylindrica*, *Justicia ovata* var. *lanceolata*, *Polygonum punctatum*, *Proserpinaca palustris*, *Carex joorii*, *Peltandra virginica*, *Lycopus rubellus*, *Mikania scandens*, *Leersia virginica*, *Lysimachia radicans*, *Carex intumescens*, *Spiranthes cernua*, *Carex tribuloides*, *Hydrocotyle verticillata*, *Viola* spp., *Panicum rigidulum*, *Rhynchospora corniculata*, *Ludwigia glandulosa*, *Osmunda regalis*, *Symphyotrichum lateriflorum* (= *Aster lateriflorus*), *Carex flaccosperma*, *Commelina virginica*, *Leersia lenticularis*, *Bidens mitis*, *Carex lupulina*, *Carex louisianica*, *Penthorum sedoides*, *Pluchea camphorata*, and *Cyperus virens*. Minor associates (each with cover less than 1%) include *Acmella oppositifolia* var. *repens*, *Carex lonchocarpa*, *Onoclea sensibilis*, *Acalypha rhomboidea* (= *Acalypha virginica* var. *rhomboidea*), *Pilea pumila*, *Lobelia cardinalis*, *Sagittaria platyphylla*, *Dichanthelium dichotomum* var. *dichotomum*, *Carex bromoides*, *Mimulus alatus*, *Hydrolea uniflora*, *Juncus effusus*, *Micranthemum umbrosum*, *Mitchella repens*, *Elephantopus carolinianus*, *Helenium flexuosum*, *Poa autumnalis*, *Woodwardia areolata*, *Asclepias perennis*, *Juncus diffusissimus*, *Phanopyrum gymnocarpon*, *Cerastium glomeratum*, *Erechtites hieraciifolia*, *Erigeron philadelphicus*, *Ageratina altissima* var. *altissima*, *Hypericum mutilum*, *Dichanthelium commutatum*, *Sphenopholis obtusata*, and *Spirodela polyrrhiza*. *Sphagnum* spp. are not significant in this community. Within their ranges *Tillandsia usneoides* and *Pleopeltis polypodioides* ssp. *polypodioides* are present on canopy trees and woody shrubs (Martin and Smith 1991, Allen 1993c). *Triphora trianthophora* may occur in

Louisiana examples of this community, although this species is more typical of mesic slope forests (Allen 1995c).

Example Photograph

Figure A40 below shows an example of CEGL007422 *Taxodium distichum – Nyssa aquatica – Acer rubrum* / *Itea virginica* Floodplain Forest.



**Figure A40.** *Taxodium distichum – Nyssa aquatica – Acer rubrum* / *Itea virginica* Floodplain Forest (CSU)

Short Citation

- Allen 1993c
- Allen 1995c
- L. Smith pers. comm. 1995
- Jones et al. 1981b
- Martin and Smith 1991
- Mitsch and Gosselink 1993
- Soil Conservation Service 1990

***CEGL002419 Nyssa aquatica Swamp Forest***

Table A26 below shows the USNVC Hierarchy for CEGL002419 *Nyssa aquatica* Swamp Forest.

**Table A26.** USNVC hierarchy for CEGL002419 *Nyssa aquatica* Swamp Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Bald-cypress - Tupelo Floodplain Forest |
| Alliance | A0345 *Nyssa aquatica* Swamp Forest Alliance |
| Association | 1.B.3.Nb *Nyssa aquatica* Swamp Forest (CEGL002419) |

**Field Plots:** 1113, 1116, 1014, 1049, 2010

**Map Class:** BITH MC311

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 112.5 ft range 48 ft to 219 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain Ridge and Swale, Upland, Flatlands

**Soil Texture**: Loamy sand, Sandy clay loam, Muck

**Environment**: 5 plots were sampled within this type. Communities typically occurred on floodplains and flatlands. Ground cover is dominated by litter, wood, water, and bare soil. Depending on the site and seasonal flooding, occasional water was the dominant with cover values >90%. Areas that were not flooded were dominated by litter with cover ranging from 32% to 97%. Bare soil may also have cover reaching up to 60%.

Local Vegetation Description
**Structure**: Canopy (20%-70%), Sub canopy (0%-60%), Tall shrub (0%-30%), Short shrub (0%-30%), Herbaceous (0%-80%)

**Vegetation Floristics**: Often the canopy is exclusively dominated by *Nyssa aquatica* with cover values ranging from 20% to 70%. The subcanopy typically contains *Ilex opaca*, *Nyssa aquatica*, and/or *Acer rubrum* with cover ranging from 5% to 40%. Shrubs are typically present with common species including *Cyrilla racemiflora*, *Ilex opaca*, *Triadica sebifera*, and *Triadica sebifera*. Shrub

cover is usually <30%. Herbaceous cover is usually sparse; however, one site contained 80% cover of *Utricularia radiata*.

**Dynamics**: This is a climax wetland community. Flooding frequency is approximately 100% of years, and flooding duration is approximately 100% of the growing season. Seasonal (spring and fall) flood pulses contribute to channel scouring and deposition of organic matter (where slackwater and pooling of floodwaters occur). Flooding also provides water which persists during dry periods, although dewatering during summer months is not uncommon. Seasonal flooding and permanent water require special adaptations by vegetation to exist in this extremely dynamic ecosystem. Many plants have highly specialized methods to facilitate acquisition and transport of oxygen during periods of prolonged inundation. Neither bald-cypress nor water tupelo are able to germinate in water and require dry periods to produce seedlings. Seedlings are unable to survive complete submergence, and prolonged flooding with excessive water levels can kill even mature trees. Subcanopy and herbaceous components of this community are very dynamic, and densities fluctuate with availability of substrate.

*Nyssa aquatica* swamps occur most commonly in riparian zones subject to seasonal hydrologic pulses. Inundation is usually more than 6 months of the year and is greatest during spring and fall. Timing, duration, depth, and extent of flooding greatly affect community composition. Deeper, more permanent flooding conditions seem to select for bald-cypress. Prolonged drought can create conditions favorable for tupelo recruitment. In addition, *Nyssa aquatica* may replace *Taxodium distichum* on some sites because bald-cypress has minimal sprouting ability, erratic reproduction, and slower growth (Wharton et al. 1982). Prolonged flooding can increase senescence of seedlings and saplings, removing all but older mature timber. These open areas, while quickly colonized during subsequent dry years, are very dynamic until the hydrology stabilizes sufficiently long to select for a specific species.

Conservation Status Rank
**Global**: G4G5

Global Environmental Description
This is a climax wetland community. Flooding frequency is approximately 100% of years, and flooding duration is approximately 100% of the growing season. Seasonal (spring and fall) flood pulses contribute to channel scouring and deposition of organic matter (where slackwater and pooling of floodwaters occur). Flooding also provides water which persists during dry periods, although dewatering during summer months is not uncommon. Seasonal flooding and permanent water require special adaptations by vegetation to exist in this extremely dynamic ecosystem. Many plants have highly specialized methods to facilitate acquisition and transport of oxygen during periods of prolonged inundation. Neither bald-cypress nor water tupelo are able to germinate in water and require dry periods to produce seedlings. Seedlings are unable to survive complete submergence, and prolonged flooding with excessive water levels can kill even mature trees. Subcanopy and herbaceous components of this community are very dynamic, and densities fluctuate with availability of substrate.

*Nyssa aquatica* swamps occur most commonly in riparian zones subject to seasonal hydrologic pulses. Inundation is usually more than 6 months of the year and is greatest during spring and fall. Timing, duration, depth, and extent of flooding greatly affect community composition. Deeper, more permanent flooding conditions seem to select for bald-cypress. Prolonged drought can create conditions favorable for tupelo recruitment. In addition, *Nyssa aquatica* may replace *Taxodium distichum* on some sites because bald-cypress has minimal sprouting ability, erratic reproduction, and slower growth (Wharton et al. 1982). Prolonged flooding can increase senescence of seedlings and saplings, removing all but older mature timber. These open areas, while quickly colonized during subsequent dry years, are very dynamic until the hydrology stabilizes sufficiently long to select for a specific species.

Global Vegetation Description

The vegetation is dominated by dense, and occasionally pure, stands of *Nyssa aquatica* but often in association with *Taxodium distichum* (never very abundant in this type), *Liquidambar styraciflua*, *Planera aquatica*, *Nyssa biflora*, *Gleditsia aquatica*, *Fraxinus profunda*, and *Cephalanthus occidentalis*. The herbaceous layer is conspicuously sparse, and density is wholly dependent upon the extent and duration of flooding. Where water is permanent, herbaceous plants rely on substrates found on rotting logs, stumps, terraces, and buttresses of trees. Some herbs which may be present at low densities on these elevated places include *Phanopyrum gymnocarpon*, *Pluchea camphorata*, *Boehmeria cylindrica*, *Rudbeckia laciniata*, *Sagittaria latifolia*, *Onoclea sensibilis*, *Triadenum walteri*, *Carex joorii*, *Carex glaucescens*, *Asclepias perennis*, *Saururus cernuus*, *Justicia ovata*, *Leersia lenticularis*, and others. The exotic plant species *Eichhornia crassipes* may a problem. Subcanopy density and forest tree recruitment are poor due to fluctuating water levels (TNC 1995a).

At Shiloh National Military Park (western Tennessee) this occurs with vegetation open-canopied, due to beaver activity (both impounding and chewing of bark which has killed trees). The dominant canopy tree is *Nyssa aquatica*. *Salix nigra* is also present in the canopy. *Acer rubrum* is the only subcanopy tree. Shrubs are dense; *Acer rubrum*, *Alnus serrulata*, *Cornus foemina*, and *Itea virginica* are the most important, with *Nyssa aquatica*, *Cephalanthus occidentalis*, and *Salix nigra*. *Polygonum sagittatum*, *Leersia oryzoides*, *Microstegium vimineum*, *Impatiens capensis*, and *Polygonum punctatum* are the dominant herbaceous plants. Other herbs are *Scirpus cyperinus*, *Mikania scandens*, *Boehmeria cylindrica*, *Cicuta maculata*, *Apios americana*, *Triadenum walteri*, *Cinna arundinacea*, *Sagittaria latifolia* (= *Sagittaria longirostra*), *Erechtites hieraciifolia*, *Ludwigia decurrens*, *Peltandra virginica*, *Carex crinita*, *Commelina virginica*, *Bidens aristosa* (= *Bidens polylepis*), *Carex lupulina*, *Panicum dichotomiflorum*, *Bidens frondosa*, *Ceratophyllum demersum*, *Pilea pumila*, *Heteranthera reniformis*, *Saururus cernuus*, *Cuscuta gronovii*, *Gratiola virginiana*, *Ludwigia peploides* ssp. *glabrescens*, *Eclipta prostrata* (= *Eclipta alba*), *Galium tinctorium*, *Lobelia cardinalis*, and the exotic *Arthraxon hispidus*.

This community most commonly occurs in seasonally flooded riparian wetlands or lakes, where standing water is absent during parts of the year. Timing, duration, and depth of flooding are the major environmental factors governing vegetative composition within and among occurrences of forested swamps. Water tupelo is more commonly associated with riparian floodplain wetlands or

margins of lakes or ponds where standing water occurs for only a few months of each year (usually winter and spring). Bald-cypress is more commonly associated with permanent deep-water forested wetlands.

Example Photograph

Figure A41 below shows an example of CEGL002419 *Nyssa aquatica* Swamp Forest.



**Figure A41.** *Nyssa aquatica* Swamp Forest (CSU)

Short Citation

- TNC 1995a
- Wharton et al. 1982

### *CEGL002421 Taxodium distichum – (Nyssa aquatica) / Forestiera acuminata – Planera aquatica Floodplain Forest*

Table A27 below shows the USNVC Hierarchy for CEGL002421 *Taxodium distichum* – (*Nyssa aquatica*) / *Forestiera acuminata – Planera aquatica* Floodplain Forest.

**Table A27.** USNVC hierarchy for CEGL002421 *Taxodium distichum* – (*Nyssa aquatica*) / *Forestiera acuminata* – *Planera aquatica* Floodplain Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Bald-cypress - Tupelo Floodplain Forest |
| Alliance | A3594 *Taxodium distichum - Nyssa aquatica - Nyssa biflora* Floodplain Forest Alliance |
| Association | 1.B.3.Nb *Taxodium distichum* - (*Nyssa aquatica*) / *Forestiera acuminata - Planera aquatica* Floodplain Forest (CEGL002421) |

**Field Plots:** 1008, 2025, 2021, 0319_091, 0319_370

**Map Class:** BITH MC311

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 74.67 ft range 0 ft to 150 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands, Floodplain lower terrace

**Soil Texture**: Silty clay, Silty clay loam, Sandy clay loam

**Environment:** 3 plots were sampled within this type. This community generally occurs on floodplains. Soils are usually fine grained and range between sandy clay loam and silty clay loam. Bare soil usually dominates with values ranging from 75% to 90%. Pools of water may be present with cover <20%. Litter cover is usually sparse with cover <10%.

Local Vegetation Description
**Structure**: Canopy (60%-70%), Sub canopy (30%-40%), Tall shrub (0%-40%), Short shrub (0%-10%), Herbaceous (0%-20%)

**Vegetation Floristics:** Canopy is dominated by a large variety of species. Typically, *Taxodium distichum*, *Nyssa aquatica*, and *Quercus nigra* dominate the canopy with cover generally around 40%-60%. Other canopy species typically include *Carya aquatica*, *Cornus florida*, *Fagus*

*grandifolia*, *Liquidambar styraciflua*, and *Planera aquatica* with cover <20%. *Fraxinus caroliniana* is usually present in this community.

**Dynamics:** Flooding and drought effects are seasonal, of variable duration, and subject to local weather patterns. Inundation is continuous, fluctuating seasonally with high water occurring during spring and fall. Extensive beaver predation on water tupelo may severely impact community composition. Beavers may alter vegetative composition, hydrologic conditions, and sedimentation rates by removing trees and pooling water. Prolonged flooding increases senescence of mature trees, subcanopy and herbaceous vegetation which may create openings and encourage gap-phase regeneration during normal hydrologic periods. Drought encourages woody regeneration which is typically absent in bald-cypress - water tupelo swamp communities. Typical swamps consist of a few large, very old trees, numerous medium-aged trees, and few saplings or seedlings.

Conservation Status Rank
**Global**: G3G5

Global Environmental Description
Stands occur in semipermanently flooded back sloughs, abandoned tributaries, and floodplain depressions. They are often linear in shape and range in size from less than one acre to hundreds of acres. All examples are characterized by shallow standing water all or most of the year. Soils are poorly drained and tend to be organic. Bedrock of deeply buried Paleozoic rock, exhibits little or no effect on plant communities. Deep accumulation of duff and litter can occur where not scoured by floodwaters. This community can be found adjacent to all other floodplain forests. Hydroperiod determines bald-cypress regeneration and understory layer composition. Poor bald-cypress regeneration in individual stands suggests that hydrology has changed since stand establishment and that different hydrologic conditions may be required for future regeneration of bald-cypress and water tupelo. Soils are deep and nearly level on broad flats and narrow depressions or sloughs on the floodplains of the Mississippi and Ohio rivers. Soils are difficult to till with silty clay surface and subsurface layers, high shrink-swell capacity, and slow permeability, with ponding of water common. Inundated soils are anaerobic. Inundation is continuous, fluctuating seasonally with high water occurring during spring and fall.

Global Vegetation Description
This type tends to be dominated by *Taxodium distichum* and *Nyssa aquatica* with *Taxodium* often emergent in the overstory above shorter individuals of *Nyssa aquatica*. In some instances, *Carya aquatica* and (rarely) *Quercus lyrata* may also be present. Dominant trees exhibit tall, straight growth and swelled buttresses. The canopy can be closed but is more commonly partially open. Water depth is highly correlated with canopy dominance, with *Taxodium distichum* dominating deeper, more permanent water, small *Taxodium distichum* and mature *Nyssa aquatica* in shallower zones, and mixed bottomland species in expansive shallower zones (Faircloth 1971). The subcanopy is sparse, consisting primarily of *Forestiera acuminata, Cephalanthus occidentalis*, and *Planera aquatica*.

Shrubs and herbs tend to occur sporadically, most often growing on old stumps, tree buttresses, fallen logs, or along slough margins. Shrubs may include *Cephalanthus occidentalis* and *Itea virginica* with

a variety of other species, such as *Acer rubrum var. drummondii, Acer negundo, Cornus obliqua (= Cornus amomum ssp. obliqua), Fraxinus pennsylvanica, Ilex decidua*, and *Liquidambar styraciflua*, mostly occurring around the slough margins. Woody vines are uncommon but may include *Ampelopsis arborea* and *Berchemia scandens*. Common herbaceous species may include *Asclepias perennis, Bidens aristosa, Bignonia capreolata, Boehmeria cylindrica, Carex lupulina, Carex joorii, Commelina virginica, Cyperus* sp., *Erechtites hieraciifolia, Leersia oryzoides, Lemna minor, Onoclea sensibilis, Pilea pumila, Polygonum hydropiperoides, Saururus cernuus*, and *Triadenum tubulosum*. This community exhibits shifts in dominance largely governed by water fluctuations, windthrows, beaver predation, senescence and fire. Summer low-water periods exhibit increased herbaceous growth, woody regeneration, and high primary productivity. Fall and spring high water levels contribute to woody mortality and associated canopy openings.

Example Photograph

Figure A42 below shows an example of CEGL002421 *Taxodium distichum* – (*Nyssa aquatica*) / *Forestiera acuminata – Planera aquatica* Floodplain Forest.



**Figure A42.** *Taxodium distichum* – (*Nyssa aquatica*) / *Forestiera acuminata – Planera aquatica* Floodplain Forest (CSU)

Short Citation

Faircloth 1971

***CEGL007429 Nyssa aquatica – Nyssa biflora Swamp Forest***

Table A28 below shows the USNVC Hierarchy for CEGL007429 *Nyssa aquatica – Nyssa biflora* Swamp Forest.

**Table A28.** USNVC hierarchy for CEGL007429 *Nyssa aquatica – Nyssa biflora* Swamp Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Bald-cypress - Tupelo Floodplain Forest |
| Alliance | A0345 Nyssa aquatica Swamp Forest Alliance |
| Association | 1.B.3.Nb Nyssa aquatica - Nyssa biflora Swamp Forest (CEGL007429) |

**Field Plots:** 0319_114, 0319_115, 0319_274, 0319_296

**Map Class:** BITH MC311

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 260 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands, Floodplain active channel

**Soil Texture**: Silt

**Environment:** 4 sites were sampled within this type. This community is typically inundated for most of the year. Ground cover is dominated by water with values >90%.

Local Vegetation Description
**Structure**: Canopy (10%-50%), Sub-canopy (0%-20%), Short shrub (0%-40%), Herbaceous (0%-40%)

**Vegetation Floristics**: Community borders alluvial swamps and flats near uplands. Flooding persists throughout the growing season. *Nyssa aquatica* and *Nyssa biflora* are the most abundant species in the canopy. Associated tree species are *Carpinus caroliniana*, *Fraxinus pennsylvanica*, *Planera*

*aquatica*, *Salix nigra*, and *Taxodium distichum*. Common shrubs are *Cyrilla racemiflora* and *Leucothoe racemosa*. *Saururus cernuus* is a common herbaceous species. Vines such as *Ampelopsis arborea*, *Bignonia capreolata*, *Decumaria barbara*, and *Toxicodendron radicans* can occur. Herbaceous species such as *Sparganium americanum* and *Xyris* spp. are common.

**Dynamics**: Probability of annual flooding is 100%, and duration of flooding is approximately 100% of the growing season with soils nearly permanently saturated. Seedlings of the dominant tree species are not shade-tolerant and require unflooded soil for germination. Successional relationships of this community to others is not clear, although with organic matter accumulation and soil buildup, this community may succeed to a bottomland hardwood type.

Conservation Status Rank
**Global**: G4G5

Global Environmental Description
This forest association is found along shallow borders of alluvial swamps and flats near uplands. Hydrologic regime is the most important environmental determinant of the distribution of this community. It occurs in Zone II (Wharton et al. 1982), and therefore probability of annual flooding is 100% and duration of flooding is approximately 100% of the growing season with soils nearly permanently saturated. The community occurs along shallow borders of alluvial swamps and flats near the uplands (Eyre 1980) and probably is found in less wet areas than swamp forests dominated by *Taxodium distichum* and *Nyssa aquatica*.

Global Vegetation Description
Stands of this forest are dominated by *Nyssa aquatica* and *Nyssa biflora* in varying proportions. *Taxodium distichum* may occur in the canopy of this community, but is not a dominant (usually less than 25% cover). Other tree canopy/subcanopy species are *Fraxinus pennsylvanica, Salix nigra, Populus heterophylla*, and *Carpinus caroliniana*. Other shrub and herbaceous species are *Leucothoe racemosa, Cyrilla racemiflora, Planera aquatica*, and *Saururus cernuus*. *Decumaria barbara, Toxicodendron radicans, Ampelopsis arborea*, and *Bignonia capreolata* are commonly occurring vines, but have less than 10% cover.

Example Photograph
Figure A43 below shows an example of CEGL007429 *Nyssa aquatica – Nyssa biflora* Swamp Forest.



**Figure A43.** *Nyssa aquatica* – *Nyssa biflora* Swamp Forest (CSU)

Short Citation

- Eyre 1980
- Wharton et al. 1982

***CEGL002104 Taxodium distichum – Platanus occidentalis Edwards Plateau Floodplain Forest***

Table A29 below shows the USNVC Hierarchy for CEGL002104 *Taxodium distichum – Platanus occidentalis* Edwards Plateau Floodplain Forest.

**Table A29.** USNVC hierarchy for CEGL002104 *Taxodium distichum – Platanus occidentalis* Edwards Plateau Floodplain Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Great Plains Floodplain Forest & Woodland |

**Table A29 (continued).** USNVC hierarchy for CEGL002104 *Taxodium distichum – Platanus occidentalis* Edwards Plateau Floodplain Forest

| Category | Description |
|---|---|
| Group | 1.B.3.Nb Southeastern Great Plains Floodplain Forest |
| Alliance | A3681 *Taxodium distichum - Platanus occidentalis* Edwards Plateau Floodplain Forest Alliance |
| Association | 1.B.3.Nb *Taxodium distichum - Platanus occidentalis* Edwards Plateau Floodplain Forest (CEGL002104) |

**Field Plots:** 1094

**Map Class:** BITH MC311

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 58 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain ridge and swale

**Soil Texture**: Clay loam

**Environment:** This community is regularly flooded and usually has standing water. Ground cover is either dominated by bare soil or water depending on time of year. This community typically occurs in old swales or oxbows within the floodplain.

Local Vegetation Description
**Structure**: Canopy (40%), Subcanopy (50%), Vine (10%)

**Vegetation Floristics**: The canopy is dominated by a combination of *Taxodium distichum* and *Platanus occidentalis*. These species are usually codominant with cover reaching up to ~40%. The understory is typically dominated by *Acer negundo* and *Ulmus americana*. Herbaceous stratum is typically sparse to absent, and *Vitus rotundifolia* usually occurs climbing on the trees with cover reaching ~10%.

**Dynamics**: N/A

Conservation Status Rank
**Global**: G2

Global Environmental Description

This community occurs as narrow (10-m) strips along floodplains of perennial streams that run through steep-sided canyons. Deep, alluvial soils are usually saturated and periodically inundated during flood events.

Global Vegetation Description

This open forest is dominated by *Taxodium distichum* with *Platanus occidentalis* usually occurring as the second-most important species. Large individuals of *Taxodium distichum* are typical. There is no significant midstory, but *Salix nigra*, *Cephalanthus occidentalis*, *Celtis laevigata* var. *laevigata*, *Celtis laevigata* var. *reticulata*, *Amorpha fruticosa*, and *Sabal minor* may occur as tall shrubs or small trees. The ground layer is highly disturbed by flooding and may have areas of standing water.

Example Photograph

Figure A44 below shows an example of CEGL002104 *Taxodium distichum – Platanus occidentalis* Edwards Plateau Floodplain Forest.



**Figure A44.** *Taxodium distichum – Platanus occidentalis* Edwards Plateau Floodplain Forest (CSU)

***CEGL002420 Taxodium distichum / Lemna minor Floodplain Forest***

Table A30 below shows the USNVC Hierarchy for CEGL002420 *Taxodium distichum* / *Lemna minor* Floodplain Forest.

**Table A30.** USNVC hierarchy for CEGL002420 *Taxodium distichum* / *Lemna minor* Floodplain Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Bald-cypress - Tupelo Floodplain Forest |
| Alliance | A3594 *Taxodium distichum - Nyssa aquatica - Nyssa biflora* Floodplain Forest Alliance |
| Association | 1.B.3.Nb *Taxodium distichum* / *Lemna minor* Floodplain Forest (CEGL002420) |

**Field Plots:** 1033, 1066, 2040, 2110, 2061, 2107, 2094, 2101, 6034, 0319_182

**Map Class:** BITH MC312

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 39 ft range 0 ft to 94 ft

**Aspect**: Mean 5 range 0 to 40

**Slope**: Mean 0.88 range 0 to 7

**Macro Topography**: Flatlands, Floodplain Ridge and Swale, Floodplain Perennially Flooded Oxbows

**Soil Texture**: Silty clay loam, Loamy sand, Sandy clay loam, Clay, Silt

**Environment**: 10 plots were sampled within this type. This community generally occurs within perennially flooded oxbow sloughs with water dominating the ground cover. Water cover values are usually around 95%. Some plots were not flooded and had bare soil as the dominant ground cover with values around 90%.

Local Vegetation Description
**Structure**: Canopy (50%-80%), Sub canopy (0%-60%), Tall shrub (0%-30%), Herbaceous (0%-10%), Vine (0%-30%)

**Vegetation Floristics**: This community is often dominated by a moderate to dense canopy of *Taxodium distichum* with cover usually between 40% and 80%. Other canopy species may include *Nyssa aquatica*, *Liquidambar styraciflua*, and *Planera aquatica*. These species usually only compose a minor component of the canopy and do not codominate with *Taxodium distichum*. A subcanopy is

typically present with cover <30%; common species include *Acer floridanum*, *Carpinus caroliniana*, and *Planera aquatica*.

**Dynamics**: Prolonged flooding (most pronounced during late winter and early spring) can cause even mature trees to die. Drought encourages woody and herbaceous regeneration, and the herbaceous layer can become very dense when substrates are available during dry periods. Excessive sedimentation can increase the rate of fill common to all wetlands. Beaver predation, windthrows, senescence, and fire are ongoing seasonal and cyclic occurrences which can dramatically affect community composition. Canopy cover is variable, from at or near 100% to less than 60% in some examples. More open examples of this type tend to occur in deeper water. In the deepest water situations scattered trees grow over an open water surface covered by floating and submersed aquatic plants (Van Kley and Hine 1998). *Taxodium distichum* regeneration is absent in areas of permanent inundation, as seed germination does not occur in standing water. The subcanopy and herbaceous layers are dependent upon timing, duration, and depth of flooding. Woody regeneration is completely dependent on periods of drawdown, which may result in dense stands of even-aged trees. Very old, mature trees are generally scattered throughout bald-cypress swamps among dominant, medium-aged trees. Swamps containing large numbers of mature trees exhibit numerous canopy openings due to senescence and windthrows. Old-growth bald-cypress are usually hollow with many snags and dead limbs. Regeneration in bald-cypress swamps does occur on the periphery where fluctuating water levels often leave moist soil areas ideal for seed germination. Seed dispersal is accomplished by floating on the water surface.

Conservation Status Rank
**Global**: G4G5

Global Environmental Description
This community occurs on a variety of inundated topographic habitats, including oxbow ponds, natural lakes, drowned floodplains, backwater sloughs, along river edges, and in various isolated depressions within the floodplain. It is more commonly associated with brownwater than blackwater rivers. The community usually is linear in outline as it occurs in river floodplains and oxbows. Occurrences generally are surrounded by bottomland hardwood communities. Bedrock is deeply buried Paleozoic rock and has little or no effect on plant communities. Unconsolidated alluvial sediments need further characterization. Soil types on which it is found are very poorly drained. This includes impounded water (e.g., abandoned millponds, beaver ponds) and other habitats with relatively stable water levels. Hydrologic regime is the most important environmental determinant of the distribution of this community. Sites experience frequent flooding to near permanent ponding. Soils are always saturated. Floodwater may be 3 m or more deep and may be stagnant or flow up to 7 km/hour (Eyre 1980). *Taxodium distichum* is adapted to surviving under prolonged flooding, although exposed unflooded soils are necessary for seedling establishment. Saturated soils, with standing water all or most of the year, select for plants which exhibit special adaptations for existence in an environment with limited oxygen and nutrient availability. Seasonal flood pulses deposit sediment which can, when excessive, cause plant stress and speed wetland succession. Prolonged inundation does not allow for bald-cypress regeneration within the swamp and restricts new growth

to perimeter low-water zones. Bald-cypress also has minimal sprouting ability, erratic reproduction, and slow growth which makes it a poor competitor with Nyssa aquatica (Wharton et al. 1982).

In Illinois, bald-cypress swamps occur on nearly level, deep soils on broad flats and narrow depressions or sloughs in the floodplains of the Mississippi and Ohio rivers. Soils are difficult to till and have silty clay surface and subsurface layers, high shrink-swell capacity, low organic matter, and slow permeability with ponding of water common. Bald-cypress swamps exhibit reduced soil chemistry while substrates are saturated.

Global Vegetation Description

The vegetation is characterized by a monospecific canopy of straight, tall individuals of *Taxodium distichum* with a sparse to moderate subcanopy and depauperate shrub and herb layers. Trees are generally very tall and straight with their trunks forming swelled buttresses. Canopy cover is extremely variable, from densely closed forests to sparse canopies. *Taxodium distichum* regeneration is absent in areas of permanent inundation, as seed germination does not occur in standing water. The subcanopy and herbaceous layers are dependent upon timing, duration, and depth of flooding. *Cephalanthus occidentalis* and *Rosa palustris* are common shrubs in this community, while *Fraxinus caroliniana* (in its range) and *Acer rubrum* var. *drummondii* are common in the subcanopy. A common vine is *Brunnichia ovata*. Shallow water emergents, floating-leaved aquatics, such as *Azolla caroliniana*, *Brasenia schreberi*, *Cabomba caroliniana*, *Limnobium spongia*, *Spirodela punctata*, *Wolffia columbiana*, *Lemna minor*, *Nymphaea* spp., and submerged hydrophytes, such as *Ceratophyllum demersum*, are common in permanent water zones throughout the range of this type. In the southern part of the range (e.g., southern Alabama) *Lemna minor* is replaced by *Lemna valdiviana*. Other important aquatic species may include *Ludwigia palustris*, *Ludwigia peploides*, and *Hydrolea uniflora*. The most open-canopied examples, in deeper water, may support dense colonies of *Nuphar advena*, and often greater cover of *Nelumbo lutea*, *Cabomba caroliniana*, *Ceratophyllum demersum*, *Egeria densa*, and *Wolffia columbiana* (Van Kley and Hine 1998). Interestingly, cover of the epiphyte *Tillandsia usneoides* apparently peaks in more closed-canopied situations. Common herbaceous species from occurrences in southwestern Arkansas include *Bidens discoidea*, *Carex lupulina*, *Carex glaucescens*, *Echinodorus cordifolius*, *Heliotropium indicum*, *Leersia oryzoides*, *Limnobium spongia*, *Lycopus rubellus*, *Polygonum hydropiperoides*, *Proserpinaca palustris*, and *Saururus cernuus* (J. Campbell pers. comm. 1999, D. Zollner pers. comm. 1999, TNC 1995a). The exotic plant species *Eichhornia crassipes* may a problem.

Bald-cypress swamps are similar in species composition and physiognomy throughout their range. Water levels determine species composition, density, and regeneration. Sites exhibit pronounced variability in herbaceous growth, and many species are specially adapted to flooded conditions. Bald-cypress swamps exhibit shifts in vegetative dominance largely governed by water fluctuations, windthrows, beaver predation, senescence, and fire. Bald-cypress forest understory varies from sparse herbaceous growth to very dense and diverse herbaceous flora. Bald-cypress reaches its greatest size in areas of permanent inundation.

Example Photograph

Figure A45 below shows an example of CEGL002420 *Taxodium distichum* / *Lemna minor* Floodplain Forest.



**Figure A45.** *Taxodium distichum* / *Lemna minor* Floodplain Forest (CSU)

Short Citation

- D. Zollner pers. comm. 1999
- Eyre 1980
- J. Campbell pers. comm. 1999
- TNC 1995a
- Van Kley and Hine 1998
- Wharton et al. 1982

***CEGL007370 Quercus phellos – Liquidambar styraciflua / Ilex decidua – Carpinus caroliniana / Lysimachia radicans Floodplain Forest***

Table A31 below shows the USNVC Hierarchy for CEGL007370 *Quercus phellos – Liquidambar styraciflua* / *Ilex decidua – Carpinus caroliniana* / *Lysimachia radicans* Floodplain Forest.

**Table A31.** USNVC hierarchy for CEGL007370 *Quercus phellos – Liquidambar styraciflua* / *Ilex decidua – Carpinus caroliniana* / *Lysimachia radicans* Floodplain Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Oak - Sweetgum Floodplain Forest |
| Alliance | A3632 *Quercus phellos - Quercus nigra* Coastal Plain Floodplain Forest Alliance |
| Association | 1.B.3.Nb *Quercus phellos - Liquidambar styraciflua* / *Ilex decidua - Carpinus caroliniana* / *Lysimachia radicans* Floodplain Forest (CEGL007370) |

**Field Plots:** 1060, 2089, 2090, 2095, 1111, 0319_191

**Map Class:** BITH MC313

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 35.6 ft range 0 ft to 100 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain ridge and swale, Floodplain lower terrace

**Soil Texture**: Clay loam, Loamy sand, Silty clay loam

**Environment**: 6 plots were sampled within this type. This community generally occurs on ridge and swale regions on floodplains. Ground cover is typically dominated by litter with covers ranging from 15% to 85%. Bare soil usually forms the other major component of ground cover with values ranging from 10% to 80%. Wood is usually present with cover <5%.

Local Vegetation Description
**Structure**: Canopy (40%-80%), Sub canopy (0%-70%), Tall shrub (0%-60%), Herbaceous (0%-20%), Vine (0%-30%)

**Vegetation Floristics**: This wet forest is characterized by *Quercus phellos* with cover ranging from 10% to 30%. The canopy is often a mix of different hardwoods with variable cover such as *Quercus nigra*, *Acer rubrum*, *Liquidambar styraciflua*, and *Carpinus caroliniana* with cover ranging from

10% to 70%. Shrub cover usually has sparse to moderate cover with cover values between 10% and 60%. Common species include *Ilex opaca* and *Ilex coriacea*. The herbaceous stratum is often sparse with common species including *Oplismenus hirtellus*, *Oxalis stricta*, *Sanicula canadensis*, and *Justicia lanceolata*.

**Dynamics:** Hydrologic regime is the principle natural disturbance and the main ecological process shaping the composition, structure, and distribution of this community. This forest is typically inundated or saturated throughout the winter and early spring, and floods for 1 or 2 months during the growing season, with a 100-year average of at least 51 to 100 years (Smith 1988). Regeneration occurs chiefly in canopy gaps and is dependent on the hydrologic conditions at the time of germination and establishment (Smith 1988, Martin and Smith 1991).

This forest is generally a mature community, although some examples may be in a distributional flux in the sense that a major disturbance happened recently (approximately 40 to 60 years ago) and is indicated by a bimodal canopy stage distribution of larger *Liquidambar styraciflua* individuals and smaller-diameter specimens of *Quercus phellos*, *Quercus laurifolia*, and *Quercus lyrata*.

Conservation Status Rank
**Global**: G3?

Global Environmental Description
In Texas, this type has been documented along the Neches River floodplain on soils rich in both calcium and magnesium. In addition to low-lying flats in this large river bottom, this type apparently also occurs in abandoned stream channels, low positions on natural levees, and depressional areas in otherwise flat alluvial plains in Louisiana. Floodplains border clear-flowing streams typically with outcroppings of sandstone and siltstone bedrock such as those of the Catahoula and Fleming formations. Soils are somewhat poorly drained, very slowly permeable clays or silt loams formed in alluvium. This type has been documented from the Moreland Soil Series (Vertic Hapludalf) in Louisiana where the A horizon pH varies from slightly acidic to mildly alkaline. The seasonal high-water table is within 0.3 m of the soils surface from December through April in most years. Slopes range from 0-3%.

Global Vegetation Description
This broad-leaved bottomland forest is dominated by *Liquidambar styraciflua, Acer rubrum, Ulmus rubra, Quercus phellos, Quercus laurifolia*, and *Quercus lyrata*. Canopy cover ranges from approximately 60-100%, but is typically fairly open in the 70-80% range. Canopy associates include *Carya aquatica, Nyssa biflora, Celtis laevigata*, and *Fraxinus pennsylvanica*. The patchy tall-shrub stratum (2-5 m in height) is dominated by *Carpinus caroliniana* and *Ilex decidua*. *Crataegus viridis, Vaccinium elliottii, Vaccinium arboreum, Ilex opaca, Halesia diptera*, and *Rhododendron canescens* are also associated with this stratum. In addition to regenerating canopy and tall-shrub species, the patchy short-shrub stratum (0.5-2m tall) contains *Sebastiania fruticosa, Rubus trivialis, Rubus argutus, Morus rubra*, and *Hypericum hypericoides*. The sparse to patchy herbaceous layer is approximately 10-30% cover and is dominated by *Viola* spp., *Dichanthelium commutatum, Boehmeria cylindrica, Carex intumescens, Oxalis stricta,*

*Lysimachia radicans* (which is frequent in the ground layer), *Dichanthelium dichotomum var. dichotomum, Symphyotrichum lateriflorum (= Aster lateriflorus)*, and *Chasmanthium laxum*. Associates include *Impatiens capensis, Acalypha rhomboidea (= Acalypha virginica var. rhomboidea)*, and *Mikania scandens* (Martin and Smith 1991, Allen 1993b). Based on plots from eastern Texas, *Quercus phellos* is the single most important canopy species, ranging from strongly dominant to codominant with *Liquidambar styraciflua*. Other canopy and subcanopy trees include *Quercus michauxii, Quercus pagoda, Quercus nigra, Quercus lyrata, Ostrya virginiana, Ulmus americana*, and *Nyssa sylvatica*. The subcanopy is dominated by *Carpinus caroliniana*, followed closely by *Fraxinus caroliniana, Ilex decidua*, and individuals of species present in the canopy. The lower strata contain species typical of bottomland habitats in the region. Shrubs and woody vines include *Sebastiania fruticosa, Ampelopsis arborea, Berchemia scandens, Bignonia capreolata, Brunnichia ovata, Campsis radicans, Smilax bona-nox, Smilax rotundifolia*, and *Toxicodendron radicans*. Herbs may include *Chasmanthium laxum, Justicia ovata, Lysimachia lanceolata, Carex louisianica*, and *Carex tribuloides*. Some additional herbs found in a stand assigned here from the Angelina National Forest include *Chasmanthium latifolium, Justicia ovata, Ruellia* sp., *Symphyotrichum* sp., *Panicum anceps, Phanopyrum gymnocarpon, Dichanthelium* sp., *Lycopus virginicus, Carex frankii, Carex lupulina, Carex lurida, Elymus virginicus, Geum canadense, Gratiola* sp., *Oxalis* sp., *Yeatesia viridiflora, Matelea* sp., and *Trachelospermum difforme*. Exotic species seem to compete very successfully in floodplain environments, likely due to the frequent flooding disturbances and the pulse of nutrients input by alluvial deposition. *Ligustrum sinense, Lonicera japonica*, and *Microstegium vimineum* may invade this forest and exclude native species.

Example Photograph

Figure A46 below shows an example of CEGL007370 *Quercus phellos – Liquidambar styraciflua* / *Ilex decidua – Carpinus caroliniana* / *Lysimachia radicans* Floodplain Forest.



**Figure A46.** *Quercus phellos – Liquidambar styraciflua* / *Ilex decidua – Carpinus caroliniana* / *Lysimachia radicans* Floodplain Forest (CSU)

Short Citation

- Allen 1993b
- Martin and Smith 1991
- Smith 1988

***CEGL007397 Quercus lyrata – Carya aquatica Floodplain Forest***

Table A32 below shows the USNVC Hierarchy for CEGL007397 *Quercus lyrata – Carya aquatica* Floodplain Forest.

**Table A32.** USNVC hierarchy for CEGL007397 *Quercus lyrata – Carya aquatica* Floodplain Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |

**Table A32 (continued).** USNVC hierarchy for CEGL007397 *Quercus lyrata* – *Carya aquatica* Floodplain Forest

| Category | Description |
|---|---|
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Oak - Sweetgum Floodplain Forest |
| Alliance | A3629 *Quercus lyrata - Quercus phellos - Carya aquatica* Swamp Forest Alliance |
| Association | 1.B.3.Nb *Quercus lyrata - Carya aquatica* Floodplain Forest (CEGL007397) |

**Field Plots:** 1106, 1107, 1109, 1112, 2111, 1091, 1104, 2093, 2100, 8002

**Map Class:** BITH MC313

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 53 ft range 0 ft to 91 ft

**Aspect**: Mean 31.11 range 0 to 280

**Slope**: Mean 1 range 0 to 9

**Macro Topography**: Floodplain lower terrace, Floodplain ridge and swale, Floodplain upper terrace

**Soil Texture**: Clay loam, Loamy sand, Muck, Sandy clay loam, Silty clay, Silty clay loam

**Environment**: 10 plots were sampled within this type. This community usually occurs on floodplains and ridge and swale areas. Soil typically ranges from much to silty clay loam and clay loam. Bare soil typically dominates the ground cover with values ranging from 80% to 95%. Litter usually comprises a small portion of ground cover with values ~10%. Wood is usually present with cover values <5%.

Local Vegetation Description
**Structure**: Canopy (30%-70%), Sub canopy (0%-60%), Tall shrub (0%-60%), Herbaceous (0%-20%), Vine (0%-20%)

**Vegetation Floristics**: This forest community occurs on wet floodplains and is typically dominated by Carya aquatica with cover ~30%. *Quercus lyrata* may be a codominant with cover up to 30%. Other mesic species that occur in the canopy include *Liquidambar styraciflua*, *Celtis laevigata*, and *Triadica sebifera*. Shrub and herbaceous stratum are typically sparse with cover <10%. Vines tend to be abundant with cover ~10%-20%. Common species include *Brunnichia ovata*, *Vitis rotundifolia*, and *Campsis radicans*.

**Dynamics:** Subcanopy, shrub, herbaceous, and vine density and diversity are directly affected by the timing, duration, and depth of seasonal flooding. Herbaceous growth and diversity will be limited in areas of consistently longer hydroperiod (Wharton et al. 1982).

Conservation Status Rank
**Global**: G4G5

Global Environmental Description
Forests dominated by the nominal species may commonly occur in wet flats and on old levee ridge edges (Wharton et al. 1982). This is a community of Zone III (Wharton et al. 1982).

Global Vegetation Description
Stands are dominated by *Quercus lyrata* and *Carya aquatica*. Other canopy associates may include *Gleditsia aquatica*, *Liquidambar styraciflua*, *Acer rubrum* var. *drummondii*, *Taxodium distichum*, *Populus deltoides*, and *Diospyros virginiana*. Shrubs include *Planera aquatica*, *Cornus foemina* (= *Cornus stricta*), and *Cephalanthus occidentalis* (Wharton et al. 1982). Herbaceous growth and diversity will be limited in areas of consistently longer hydroperiod (Wharton et al. 1982). A stand assigned here from the Francis Marion National Forest, South Carolina, is dominated by *Liquidambar styraciflua* with *Quercus lyrata*, *Acer rubrum*, *Celtis laevigata*, *Quercus laurifolia*, *Carya cordiformis*, and *Ulmus americana* in the canopy. The subcanopy contains *Ilex decidua* in addition to canopy species. Shrubs include *Cornus foemina*, *Ilex decidua*, *Carpinus caroliniana*, and *Crataegus marshallii*. Prominent herbs include *Leersia lenticularis* and *Phanopyrum gymnocarpon*. Other herbs include *Boehmeria cylindrica*, *Dulichium arundinaceum*, *Carex grayi*, *Asclepias perennis*, and *Polygonum pensylvanicum*.

Example Photograph
Figure A47 below shows an example of CEGL007397 *Quercus lyrata – Carya aquatica* Floodplain Forest.



**Figure A47.** *Quercus lyrata – Carya aquatica* Floodplain Forest (CSU)

Short Citation
Wharton et al. 1982

***CEGL007804 Quercus laurifolia – Liquidambar styraciflua – Nyssa biflora – Acer rubrum / Sabal minor Floodplain Forest***

Table A33 below shows the USNVC Hierarchy for CEGL007804 *Quercus laurifolia – Liquidambar styraciflua – Nyssa biflora – Acer rubrum* / *Sabal minor* Floodplain Forest.

**Table A33.** USNVC hierarchy for CEGL007804 *Quercus laurifolia – Liquidambar styraciflua – Nyssa biflora – Acer rubrum* / *Sabal minor* Floodplain Forest+

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Oak - Sweetgum Floodplain Forest |

**Table A33 (continued).** USNVC hierarchy for CEGL007804 *Quercus laurifolia – Liquidambar styraciflua – Nyssa biflora – Acer rubrum* / *Sabal minor* Floodplain Forest+

| Category | Description |
|---|---|
| Alliance | A3627 *Quercus laurifolia - Liquidambar styraciflua - Nyssa biflora* Coastal Plain Floodplain Forest Alliance |
| Association | 1.B.3.Nb *Quercus laurifolia - Liquidambar styraciflua - Nyssa biflora - Acer rubrum* / *Sabal minor* Floodplain Forest (CEGL007804) |

**Field Plots:** 2029, 1098

**Map Class:** BITH MC313

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 72.5 ft range 54 ft to 91 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands, Upland

**Soil Texture**: Silty clay loam

**Environment**: 2 plots were sampled within this type. This community typically occurs on floodplains with silty clay loams. Bare soil is usually the most dominant ground cover with values ranging from 65% to 95%. Litter may reach cover values up to 30%, and wood is usually present with values <5%.

Local Vegetation Description
**Structure**: Canopy (30%-60%), Sub canopy (20%-30%), Tall shrub (0%-10%), Short shrub (20%-60%)

**Vegetation Floristics**: The canopy is comprised of a variety of mesic hardwoods including *Quercus laurifolia*, *Quercus nigra*, *Triadica sebifera*, *Acer floridanum*, and *Quercus nigra*. The shrubland is usually sparse with cover <30%. Common species include *Ilex opaca*, *Triadica sebifera*, and *Sabal minor*.

**Dynamics:** N/A

Conservation Status Rank
**Global**: G3?

Global Environmental Description

This forest occurs in active floodplains of small (intermittent) to intermediate streams and in relict stream sloughs in pine flatwoods landscapes of the West Gulf Coastal Plain of southwestern Louisiana (L. Smith pers. comm.) and related environments of eastern Texas. It is found upslope from (and with shorter hydroperiod than) ~*Nyssa biflora* - *Quercus laurifolia / Sphagnum* spp. Riparian Forest (CEGL007390).

Global Vegetation Description

Dominant canopy species are typically *Quercus laurifolia*, *Quercus phellos*, *Liquidambar styraciflua*, *Nyssa biflora*, *Fraxinus pennsylvanica*, and *Acer rubrum*. Other characteristic species can include *Pinus taeda*, *Quercus phellos*, and *Magnolia virginiana*. *Sabal minor* can be common in the shrub layer. Some additional taxa present in a stand from the Davy Crockett National Forest include *Campsis radicans*, *Smilax rotundifolia*, *Brunnichia ovata*, *Carex glaucescens*, *Carex* spp., *Leersia oryzoides*, *Juncus coriaceus*, and *Rhynchospora* sp. (NatureServe Ecology unpubl. data). A description attributed to Watson (1979) suggests that eastern Texas examples may be dominated by *Quercus laurifolia*, *Quercus nigra*, and *Quercus lyrata*. The shrub layer characteristically includes substantial *Sabal minor*.

Example Photograph

Figure A48 below shows an example of CEGL007804 *Quercus laurifolia – Liquidambar styraciflua – Nyssa biflora – Acer rubrum* / *Sabal minor* Floodplain Forest.



**Figure A48.** *Quercus laurifolia – Liquidambar styraciflua – Nyssa biflora – Acer rubrum* / *Sabal minor* Floodplain Forest (CSU)

Short Citation

- L. Smith pers. comm.
- NatureServe Ecology unpubl. data
- Watson 1979

### *CEGL007906 Quercus michauxii – Liquidambar styraciflua – Quercus texana – Quercus lyrata Floodplain Forest*

Table A34 below shows the USNVC Hierarchy for CEGL007906 *Quercus michauxii – Liquidambar styraciflua – Quercus texana – Quercus lyrata* Floodplain Forest.

**Table A34.** USNVC hierarchy for CEGL007906 *Quercus michauxii – Liquidambar styraciflua – Quercus texana – Quercus lyrata* Floodplain Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |

**Table A34 (continued).** USNVC hierarchy for CEGL007906 *Quercus michauxii* – *Liquidambar styraciflua* – *Quercus texana* – *Quercus lyrata* Floodplain Forest

| Category | Description |
|---|---|
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Oak - Sweetgum Floodplain Forest |
| Alliance | A3631 *Quercus michauxii - Quercus pagoda* Coastal Plain Floodplain Forest Alliance |
| Association | 1.B.3.Nb *Quercus michauxii - Liquidambar styraciflua - Quercus texana - Quercus lyrata* Floodplain Forest (CEGL007906) |

**Field Plots:** 2051, 1096, 0319_226, 0319_372, 0319_375

**Map Class:** BITH MC313

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 118 ft range 63 ft to 173 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands, Floodplain lower terrace

**Soil Texture**: Silty clay loam, Sandy clay loam

**Environment**: 5 plots were sampled within this type. This community typically occurs on floodplains with silty clay loams. Ground cover is typically dominated by litter with values ranging between 25% and 78%. Bare soil will usually compose 20% to 70% of the ground cover. Wood is typically present with values <5%.

Local Vegetation Description
**Structure**: Canopy (70%-80%), Sub canopy (0%-70%), Tall shrub (0%-40%), Short shrub (0%-50%)

**Vegetation Floristics**: The canopy is dominated by a variety of mesic oaks including *Quercus michauxii*, *Quercus laurifolia*, *Quercus marilandica*, and *Quercus nigra*. The majority of these species have cover ranging from 10% to 30% with no clear dominant species. The shrub layer tends to be sparse; however, occasionally, *Sabal minor* may dominate the understory with cover reaching up to 50%. Other common species include *Ilex vomitoria*, *Morella cerifera*, and *Carpinus caroliniana*. The herbaceous layer is sparse to absent.

**Dynamics:** N/A

Conservation Status Rank
**Global**: G3G4

Global Environmental Description
This community occurs along intermediate-sized streams in the West Gulf Coastal Plain. It is intermediate in hydrology, in that it lacks *Pinus taeda*, yet supports other species not typical of very wet bottomland hardwood forests.

Global Vegetation Description
The overstory is characterized by *Quercus michauxii*, *Liquidambar styraciflua*, *Quercus texana*, *Quercus lyrata*, *Quercus nigra*, *Ulmus americana*, *Carya aquatica*, *Carya glabra*, and (at least at times) *Carya ovata*. It is noteworthy that *Pinus taeda* is typically lacking. The midstory is typically greatly dominated by *Carpinus caroliniana* ssp. *caroliniana*, although some *Ulmus alata*, *Crataegus marshallii*, *Crataegus viridis* may be present. *Cephalanthus occidentalis* is a common shrub. Additionally, *Arundinaria gigantea* is common in patches. Common vines include *Bignonia capreolata*, *Toxicodendron radicans*, *Smilax rotundifolia*, *Ampelopsis arborea*, *Berchemia scandens*, and *Vitis rotundifolia*. Although the ground is well-shaded, there are patches of *Chasmanthium* spp., *Carex* spp., and *Saururus cernuus*. Other herbs may include *Boehmeria cylindrica*, *Polygonum virginianum*, *Elephantopus carolinianus*, and *Mitchella repens*.

Example Photograph
Figure A49 below shows an example of CEGL007906 *Quercus michauxii – Liquidambar styraciflua – Quercus texana – Quercus lyrata* Floodplain Forest.



**Figure A49.** *Quercus michauxii – Liquidambar styraciflua – Quercus texana – Quercus lyrata* Floodplain Forest (CSU)

***CEGL007953 Quercus nigra – Ulmus alata / Ostrya virginiana Floodplain Forest***

Table A35 below shows the USNVC Hierarchy for CEGL007953 *Quercus nigra – Ulmus alata* / *Ostrya virginiana* Floodplain Forest.

**Table A35.** USNVC hierarchy for CEGL007953 *Quercus nigra – Ulmus alata* / *Ostrya virginiana* Floodplain Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Oak - Sweetgum Floodplain Forest |
| Alliance | A3632 *Quercus phellos* - *Quercus nigra* Coastal Plain Floodplain Forest Alliance |
| Association | 1.B.3.Nb *Quercus nigra* - *Ulmus alata* / *Ostrya virginiana* Floodplain Forest (CEGL007953) |

**Field Plots:** 1069

**Map Class:** BITH MC313

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 5 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain ridge and swale

**Soil Texture**: Silty clay loam

**Environment**: 1 plot was sampled within this type. This community typically occurs on the ridge and swale area within the floodplain. Soils usually are clay with either a component of sand or silt. Litter is variable and ranges from 45% to 84%. Occasionally small rocks may form up 40% of the ground cover. Wood is typically present with cover <5%.

Local Vegetation Description
**Structure**: Canopy (40%), Sub canopy (40%-60%), Tall shrub (0%-10%), Short shrub (0%-10%), Herbaceous (0%-40%), Vine (0%-40%)

**Vegetation Floristics**: This community is dominated by a canopy of *Quercus nigra*, *Nyssa aquatica*, and *Ulmus alata* with a cover ranging from 30% to 60%. The subcanopy is usually dominated *by Carpinus caroliniana* and *Ilex opaca* with cover typically 40%. Shrubs are usually dense with cover ranging from 30% to 60%. Common species include *Ilex vomitoria*, *Crataegus marshallii*, and *Triadica sebifera*.

**Dynamics:** N/A

Conservation Status Rank
**Global**: GNR

Global Environmental Description
This is a stream terrace forest of the Upper West Gulf Coastal Plain of Texas.

Global Vegetation Description
Stands contain *Quercus nigra*, *Ulmus alata*, and *Ostrya virginiana*. In addition to these nominals, the following species are important: *Mitchella repens*, *Melica mutica*, *Dichanthelium commutatum*, *Chasmanthium sessiliflorum*, *Toxicodendron radicans*, *Forestiera ligustrina*, *Callicarpa americana*, *Smilax glauca*, *Vitis rotundifolia*, *Smilax smallii*, *Rubus arvensis* (= *Rubus saepescandens*), and *Sanicula canadensis*.

Example Photograph

Figure A50 below shows an example of CEGL007953 *Quercus nigra – Ulmus alata* / *Ostrya virginiana* Floodplain Forest.



**Figure A50.** *Quercus nigra – Ulmus alata* / *Ostrya virginiana* Floodplain Forest (CSU)

### *CEGL007954 Quercus nigra – Quercus phellos / Carya myristiciformis – Sabal minor / Carex cherokeensis Floodplain Forest*

Table A36 below shows the USNVC Hierarchy for CEGL007954 *Quercus nigra – Quercus phellos* / *Carya myristiciformis – Sabal minor* / *Carex cherokeensis* Floodplain Forest.

**Table A36.** USNVC hierarchy for CEGL007954 *Quercus nigra – Quercus phellos* / *Carya myristiciformis – Sabal minor* / *Carex cherokeensis* Floodplain Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |

**Table A36 (continued).** USNVC hierarchy for CEGL007954 *Quercus nigra – Quercus phellos* / *Carya myristiciformis – Sabal minor* / *Carex cherokeensis* Floodplain Forest

| Category | Description |
|---|---|
| Group | 1.B.3.Nb Oak - Sweetgum Floodplain Forest |
| Alliance | A3632 *Quercus phellos - Quercus nigra* Coastal Plain Floodplain Forest Alliance |
| Association | 1.B.3.Nb *Quercus nigra - Quercus phellos* / *Carya myristiciformis - Sabal minor* / *Carex cherokeensis* Floodplain Forest (CEGL007954) |

**Field Plots:** 1031

**Map Class:** GUIS MC101

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 65 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain lower terrace

**Soil Texture**: Silty clay loam

**Environment**: 1 plot was sampled within this type. This community typically occurs on floodplains on silty clay loams. Floods have scoured the ground leaving bare soil as the dominant ground cover with values up to 95%.

Local Vegetation Description
**Structure**: Canopy (80%), Short shrub (40%)

**Vegetation Floristics**: The canopy is a mix of mesic species such as *Carya aquatica*, *Quercus lyrata*, *Quercus nigra*, and *Taxodium distichum* with cover usually >20%. Shrub layer is usually dominated by *Sabal minor* with cover ~ 40%. Herbaceous stratum is sparse to absent.

**Dynamics:** N/A

Conservation Status Rank
**Global**: G2G3

Global Environmental Description
This forest association is restricted to circumneutral calcareous-influenced substrates, in part derived from the Fleming Formation.

Global Vegetation Description

The canopy of this forest association is dominated by *Quercus nigra* and *Quercus phellos*, and is distinguished from other bottomland forests by the presence of *Quercus similis, Carya myristiciformis*, and *Ulmus crassifolia*. Midstory shrubs include *Ilex longipes, Crataegus viridis, Crataegus marshallii, Crataegus spathulata, Ulmus alata, Forestiera ligustrina, Fraxinus americana*, and *Ilex decidua*. The low-shrub and herbaceous layer contains *Toxicodendron radicans, Dichanthelium commutatum, Carex caroliniana, Carex flaccosperma, Chasmanthium latifolium, Rubus argutus (= Rubus louisianus), Symphyotrichum lateriflorum (= Aster lateriflorus), Poa autumnalis, Symphyotrichum drummondii (= Aster drummondii), Trepocarpus aethusae, Campsis radicans, Ruellia caroliniensis, Carya ovata*, and many other species. The herbaceous layer dominants in plot samples in eastern Texas are *Carex cherokeensis* and *Poa autumnalis*. Other important herbaceous species are *Yeatesia viridiflora, Ruellia caroliniensis, Chasmanthium latifolium, Phanopyrum gymnocarpon, Dichanthelium commutatum, Elymus virginicus, Carex caroliniana*, and *Carex flaccosperma*.

Example Photograph

Figure A51 below shows an example of CEGL007954 *Quercus nigra – Quercus phellos* / *Carya myristiciformis – Sabal minor* / *Carex cherokeensis* Floodplain Forest.



**Figure A51.** *Quercus nigra – Quercus phellos* / *Carya myristiciformis – Sabal minor* / *Carex cherokeensis* Floodplain Forest (CSU)

### *CEGL007984 Quercus nigra – Liquidambar styraciflua / Ilex opaca – Vaccinium fuscatum / Carex debilis Floodplain Forest*

Table A37 below shows the USNVC Hierarchy for CEGL007984 *Quercus nigra – Liquidambar styraciflua* / *Ilex opaca – Vaccinium fuscatum* / *Carex debilis* Floodplain Forest.

**Table A37.** USNVC hierarchy for CEGL007984 *Quercus nigra – Liquidambar styraciflua* / *Ilex opaca – Vaccinium fuscatum* / *Carex debilis* Floodplain Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Oak - Sweetgum Floodplain Forest |
| Alliance | A3632 *Quercus phellos* - *Quercus nigra* Coastal Plain Floodplain Forest Alliance |
| Association | 1.B.3.Nb *Quercus nigra* - *Liquidambar styraciflua* / *Ilex opaca* - *Vaccinium fuscatum* / *Carex debilis* Floodplain Forest (CEGL007984) |

**Field Plots:** 2087, 2020, 1001, 2083, 1047, 1118, 1119, 2027

**Map Class:** BITH MC313

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 90 ft range 0 ft to 192 ft

**Aspect**: 0

**Slope**: Mean 4.75 range 0 to 38

**Macro Topography**: Upland, Upland prairie mounds, Floodplain lower terrace

**Soil Texture**: Clay loam, Muck, Sandy clay loam, Sandy loam, Silt loam, Silty clay loam

**Environment**: 8 plots were sampled within this type. This community typically occurs on floodplains with silty or sandy clay loams. Litter dominates the ground cover with values >70%. Bare soil can compose a major component of ground cover with values <30%. Wood is typically present with values <5%.

Local Vegetation Description

**Structure**: Canopy (20%-60%), Sub canopy (0%-70%), Tall shrub (0%-70%), Short shrub (0%-10%), Herbaceous (0%-10%), Vine (0%-10%)

**Vegetation Floristics**: The canopy is dominated by *Quercus marilandica*, *Quercus nigra*, *Liquidambar styraciflua*, *Ilex opaca*, and occasionally *Pinus taeda*. Subcanopy species often include *Acer rubrum* and *Ilex opaca* with cover generally ~40%. Shrubs tend to be moderately dense with cover often reaching up to 70%. Common species include *Ilex opaca*, *Ilex vomitoria*, *Persea borbonia*, and *Callicarpa americana*.

**Dynamics**: N/A

Conservation Status Rank

**Global**: G4?

Global Environmental Description

These forests occur on slightly elevated, relatively well-drained, acidic (?), sandy soils in floodplains and terraces. Some stands attributed here contain taxa regarded as not strongly acid-loving components. The inclusion of these plots may have somewhat broadened the overall concept.

Global Vegetation Description

*Quercus nigra* is the dominant tree in stands of this type, with *Liquidambar styraciflua* being a common to codominant component. The canopy is moderately tall (80+ feet) and generally closed, although constant tree-fall disturbance leads to a high component of *Liquidambar styraciflua* in the overstory. Other tree species include *Carya alba, Carya ovata, Nyssa sylvatica, Pinus taeda* (present only as stumps in some examples), *Quercus shumardii, Quercus alba*, and *Ulmus americana*. *Ilex opaca* is the dominant understory tree with *Acer rubrum var. rubrum, Carpinus caroliniana, Celtis laevigata, Cercis canadensis, Cornus florida, Crataegus marshallii, Diospyros virginiana, Fraxinus pennsylvanica, Morus rubra, Ostrya virginiana, Ulmus alata*, and *Ulmus rubra*. In addition, *Juglans nigra* will be present in some stands as a subcanopy or canopy component. The shrub layer is often sparse except in tree-fall gaps and includes *Asimina triloba, Callicarpa americana, Forestiera ligustrina, Frangula caroliniana, Vaccinium fuscatum*, and *Vaccinium virgatum* and *Sebastiania fruticosa* in more southerly examples. *Sabal minor* may be present within its range. Woody vines are an important component of this community and may be present in high cover values. Vine species include *Vitis rotundifolia, Ampelopsis arborea, Amphicarpaea bracteata, Berchemia scandens, Bignonia capreolata, Campsis radicans, Cocculus carolinus, Parthenocissus quinquefolia, Smilax bona-nox, Smilax glauca, Smilax rotundifolia, Trachelospermum difforme*, and *Toxicodendron radicans*. The herbaceous layer is moderately dense with *Symphyotrichum lanceolatum (= Aster lanceolatus), Carex complanata, Carex debilis, Carex glaucodea, Chasmanthium sessiliflorum, Galium obtusum ssp. obtusum, Sanicula canadensis, Trachelospermum difforme, Tridens strictus*, and occasional stands of *Arundinaria gigantea*. Some additional herbs and herbaceous vines may include *Ageratina altissima, Elephantopus carolinianus, Melothria pendula, Oplismenus hirtellus ssp. setarius (= Oplismenus setarius), Polygonum virginianum*, and *Verbesina virginica*. Little leaf litter is present.

Example Photograph

Figure A52 below shows an example of CEGL007984 *Quercus nigra – Liquidambar styraciflua* / *Ilex opaca – Vaccinium fuscatum* / *Carex debilis* Floodplain Forest.



**Figure A52.** *Quercus nigra – Liquidambar styraciflua* / *Ilex opaca – Vaccinium fuscatum* / *Carex debilis* Floodplain Forest (CSU)

***NPSBITH006 Liquidambar styraciflua Ruderal Forest***

USNVC Hierarchy: Park Special NPSBITH006

**Field Plots:** 2055

**Map Class:** BITH MC313

Local Environmental Description

Plot/Sample Data Environmental Summary

**Elevation**: 54 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland flat

**Soil Texture**: Clay loam

**Environment**: 1 plot was sampled within this type. This community occurs across a variety of topographies especially where there has been disturbance including flooding and logging. Ground cover is extremely variable depending on the previous disturbance. Litter occasionally dominates, but when flooding occurs bare soil will dominate the ground cover.

Local Vegetation Description
**Structure**: Canopy (30%), Sub-canopy (70%), Herbaceous (1%)

**Vegetation Floristics**: This ruderal community is dominated by dense *Liquidambar styraciflua*. A variety of other hardwoods may occur in the canopy, but their cover is typically <10%.

**Dynamics**:

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A53 below shows an example of Park Special NPSBITH006 *Liquidambar styraciflua* Ruderal Forest.



**Figure A53.** Liquidambar styraciflua Ruderal Forest (CSU)

### *CEGL007335 Platanus occidentalis – Liquidambar styraciflua – (Ulmus americana) / (Crataegus viridis) Floodplain Forest*

Table A38 below shows the USNVC Hierarchy for CEGL007335 *Platanus occidentalis – Liquidambar styraciflua –* (*Ulmus americana*) / (*Crataegus viridis*) Floodplain Forest.

**Table A38.** USNVC hierarchy for CEGL007335 *Platanus occidentalis – Liquidambar styraciflua –* (*Ulmus americana*) / (*Crataegus viridis*) Floodplain Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Oak - Sweetgum Floodplain Forest |
| Alliance | A3625 *Liquidambar styraciflua - Fraxinus pennsylvanica - Acer rubrum* Flooded & Swamp Forest Alliance |
| Association | 1.B.3.Nb *Platanus occidentalis - Liquidambar styraciflua -* (*Ulmus americana*) / (*Crataegus viridis*) Floodplain Forest (CEGL007335) |

**Field Plots:** 2113, 2106, 2108, 2109, 1090, 2018, 2099, 2114

**Map Class:** BITH MC313

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 75.38 ft range 56 ft to 114 ft

**Aspect**: Mean 79.38 range 0 to 320

**Slope**: Mean 3.25 range 0 to 10

**Macro Topography**: Floodplain point bar, Floodplain ridge and swale, Floodplain upper terrace, Upland, Upland slope terrace, Upland swales

**Soil Texture**: Clay, Clay loam, Loamy sand, Sandy clay loam, Sandy loam, Silt loam

**Environment**: 8 plots were sampled within this type. This community generally occurs on a mesic soils of loamy sand to clay loam, and is found on ridge and swale areas within the floodplain. Litter forms the main component of the ground cover with values between 30% and 95%. Bare soil may form a large component of the ground cover with values up to 65%. Wood is usually present with cover typically <5%.

Local Vegetation Description
**Structure**: Canopy (0%-40%), Sub canopy (0%-70%), Tall shrub (20%-90%), Short shrub (0%-20%), Vine (10%-30%)

**Vegetation Floristics**: The canopy is often a mix of hardwoods with *Platanus occidentalis* often as the most dominant species. *Platanus occidentalis* cover often ranges from 10% to 30%. Other common canopy species include *Triadica sebifera*, *Liquidambar styraciflua*, *Pinus taeda*, *Carpinus caroliniana*, and *Celtis laevigata*. These other species typically have <20%. Shrub canopy can be very dense. On several areas near the river, *Ilex coriacea* obtained cover of ~70%. Other areas have very sparse herbaceous cover.

**Dynamics:** The composition and structure of this community is dependent on the hydrologic regime of the river. Levees on the outside of channel bends may be undercut and eroded away, while those on the inside may be gradually abandoned by the river as new point bar deposition occurs. Point bars stabilized by early successional vegetation serve as new sites on which this forest can establish. This forest often succeeds from *Salix nigra* and *Populus deltoides* - *Salix nigra* early successional communities. The state of this community is variable, ranging from mid-seral to mature examples.

Conservation Status Rank
**Global**: G3G4

Global Environmental Description

This forest occurs on stabilized natural levees, point bars and first bottoms of small- to large-sized alluvial streams and rivers in the Gulf Coastal Plain from Texas as far eastward as Alabama and Georgia. Soils are seasonally/temporarily flooded. In much of its range this community is inundated or saturated typically for 1 or 2 months during the growing season with a frequency ranging from 51 to 100 years out of every 100. The inundation persists almost continuously during the winter and early spring (Wharton et al. 1982, Smith 1988c).

Global Vegetation Description

The canopy of stands of this association is dominated by *Platanus occidentalis* and *Liquidambar styraciflua*. The canopy cover ranges from 60-100%. Other canopy associates may include *Carya illinoinensis, Nyssa biflora, Celtis laevigata, Populus deltoides, Quercus nigra, Salix nigra, Fraxinus pennsylvanica, Betula nigra, Acer negundo*, and *Carya aquatica*. *Ulmus americana* may also be present in some examples and may have been an historically common component of this type. However, *Ulmus americana* is currently less abundant due to a vascular fungus (Dutch elm disease) that has severely reduced populations of this species (Harlow et al. 1991). Shrubs are sparse to moderately dense in this community with covers ranging from 10-40%. Floodplain communities in general are particularly prone to exotics, likely due to frequent flooding disturbances of the ground cover and the deposition of high-nutrient alluvial material. *Lonicera japonica, Microstegium vimineum*, and *Ligustrum sinense* may come to dominate large areas of this forest to the exclusion of native species. More floristic data are available (NatureServe Ecology unpubl. data), but more comprehensive data are needed.

Example Photograph

Figure A54 below shows an example of CEGL007335 *Platanus occidentalis – Liquidambar styraciflua –* (*Ulmus americana*) / (*Crataegus viridis*) Floodplain Forest.



**Figure A54.** *Platanus occidentalis – Liquidambar styraciflua –* (*Ulmus americana*) / (*Crataegus viridis*) Floodplain Forest (CSU)

Short Citation

- Harlow et al. 1991
- NatureServe Ecology unpubl. data
- Smith 1988c
- Wharton et al. 1982

***CEGL007961 Quercus laurifolia – Quercus phellos / Viburnum dentatum – (Sebastiana fruticosa) / Carex glaucescens Upper West Gulf Wet Flatwoods Forest***

Table A39 below shows the USNVC Hierarchy for CEGL007961 *Quercus laurifolia – Quercus phellos* / *Viburnum dentatum –* (*Sebastiana fruticosa*) / *Carex glaucescens* Upper West Gulf Wet Flatwoods Forest.

**Table A39.** USNVC hierarchy for CEGL007961 *Quercus laurifolia* – *Quercus phellos* / *Viburnum dentatum* – (*Sebastiana fruticosa*) / *Carex glaucescens* Upper West Gulf Wet Flatwoods Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Basin Swamp & Flatwoods |
| Group | 1.B.3.Nb Hardwood - Loblolly Pine Nonriverine Wet Flatwoods |
| Alliance | A4190 *Pinus taeda* - *Quercus laurifolia* - *Quercus phellos* West Gulf Coastal Plain Wet Flatwoods Forest Alliance |
| Association | 1.B.3.Nb *Quercus laurifolia* - *Quercus phellos* / *Viburnum dentatum* - (*Sebastiania fruticosa*) / *Carex glaucescens* Upper West Gulf Wet Flatwoods Forest (CEGL007961) |

**Field Plots:** 2026, 2030, 2016, 2067, 2070, 2072, 2057, 0319_273, 0319_280, 0319_379

**Map Class:** BITH MC314

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 97.43 ft range 36 ft to 172 ft

**Aspect**: Mean 32 range 0 to 224

**Slope**: Mean 0.43 range 0 to 3

**Macro Topography**: Flatlands, Floodplain lower terrace, Floodplain upper terrace, Upland, Upland Swales

**Soil Texture**: Loamy sand, Sandy clay loam, Silty clay, Silty clay loam

**Environment**: 10 plots were sampled within this type. This community usually occurs on floodplains. This community typically occurs on upland areas with loamy sands. Litter typically dominates with cover >60%. Wood is usually present with cover <5%. Occasionally bare soil forms a strong component of the ground cover with values <40%.

Local Vegetation Description
**Structure**: Canopy (10%-60%), Sub canopy (0%-50%), Tall shrub (20%-90%), Short shrub (0%-40%), Herbaceous (0%-10%), Vine (0%-10%)

**Vegetation Floristics**: Canopy is dominated by mesic oaks such as *Quercus alba*, *Quercus laurifolia*, *Quercus nigra*, *Quercus michauxii*, and *Carya tomentosa*. Shrub layer is dense and

dominated by *Ilex opaca*, *Liquidambar styraciflua*, *Sabal minor*, and *Ilex vomitoria*. Herbaceous stratum is sparse to absent.

**Dynamics**: N/A

Conservation Status Rank
**Global**: G2G3

Global Environmental Description
This forest occurs in seasonally wet flatwood depressions that occur on broad flats not subject to overbank flooding. Small-scale mounds and depressions are common throughout most occurrences. Even the lowest topographic areas dry out during the summer months. Large areas of this type occur in southeast Texas, in part on Kirbyville soils and in part on the Keithville Sawtown complex which developed over Pleistocene terraces that were reworked by wind into mounds and intermounds, and a large expanse of this type may be present along the Louisiana/Arkansas state line. In this area, flatwoods may have historically occurred in much broader expanses than were typical of other portions of the region.

Global Vegetation Description
As currently described, this association encompasses vegetation occurring in swales with varying hydroperiods and/or possibly varying soil nutrients. Areas with apparently slightly longer hydroperiods are characterized by *Quercus laurifolia* in the canopy often occurring with *Quercus phellos*. Understory components may include *Fraxinus pennsylvanica, Nyssa biflora, Sebastiania fruticosa, Sabal minor, Cephalanthus occidentalis*, and *Cornus foemina*. Areas with apparently slightly shorter hydroperiods or differing soil nutrients are characterized by a mixture hydric to mesic oaks and other hardwoods in the canopy including *Quercus phellos* which is often dominant, *Quercus pagoda, Quercus michauxii, Quercus nigra, Nyssa biflora*, and *Fraxinus pennsylvanica*. Subcanopy components include *Crataegus marshallii, Carpinus caroliniana, Ulmus alata, Ilex opaca, Liquidambar styraciflua, Acer rubrum, Arundinaria gigantea*, and *Ulmus americana*. Characteristic vines include *Campsis radicans, Smilax rotundifolia, Smilax bona-nox, Ampelopsis arborea, Brunnichia ovata, Vitis rotundifolia*, and *Berchemia scandens*. Ground cover is usually sparse to patchy but may reach 50% cover. Characteristic ground cover components include *Carex glaucescens* and *Chasmanthium laxum* which are often dominants, *Carex intumescens, Carex debilis, Polygonum punctatum, Lycopus rubellus, Juncus repens, Eleocharis microcarpa, Saururus cernuus, Amsonia* sp., *Trachelospermum difforme*, and *Rhynchospora corniculata*.

Example Photograph
Figure A55 below shows an example of CEGL007961 *Quercus laurifolia – Quercus phellos* / *Viburnum dentatum* – (*Sebastiana fruticosa*) / *Carex glaucescens* Upper West Gulf Wet Flatwoods Forest.



**Figure A55.** *Quercus laurifolia – Quercus phellos* / *Viburnum dentatum* – (*Sebastiana fruticosa*) / *Carex glaucescens* Upper West Gulf Wet Flatwoods Forest (CSU)

### *CEGL007845 Quercus alba – Quercus (michauxii, nigra) / Ilex opaca / Chasmanthium laxum Forest*

Table A40 below shows the USNVC Hierarchy for CEGL007845 *Quercus alba – Quercus* (*michauxii*, *nigra*) / *Ilex opaca* / *Chasmanthium laxum* Forest.

**Table A40.** USNVC hierarchy for CEGL007845 *Quercus alba – Quercus* (*michauxii*, *nigra*) / *Ilex opaca* / *Chasmanthium laxum* Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.1 Warm Temperate Forest & Woodland |
| Division | 1.B.1.Na Southeastern North American Forest & Woodland |
| Macrogroup | 1.B.1.Na Southern Mesic Mixed Broadleaf Forest |
| Group | 1.B.1.Na Southern Mesic Beech - Oak - Mixed Deciduous Forest |
| Alliance | A2059 *Fagus grandifolia - Quercus alba - Quercus nigra* Coastal Plain Forest Alliance |
| Association | 1.B.1.Na *Quercus alba - Quercus* (*michauxii*, *nigra*) / *Ilex opaca* / *Chasmanthium laxum* Forest (CEGL007845) |

**Field Plots:** 1034, 2068, 6009c, 7012, 0319_271

**Map Class:** BITH MC314

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 129 ft range 98 ft to 160 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland

**Soil Texture**: Sandy loam, Sandy clay loam

**Environment**: 5 plots were sampled within this type. This community usually occurs on flatlands with sandy loams. Litter is typically the most dominant ground cover with values ranging from 45% to 80%. Bare soil is the second most dominant ground cover ranging from 10% to 50%. Wood is typically present with cover <5%.

Local Vegetation Description
**Structure**: Canopy (40%-60%), Sub canopy (30%-50%), Tall shrub (20%-30%), Short shrub (0%-10%), Herbaceous (0%-10%)

**Vegetation Floristics**: Canopy typically is composed of a variety of oaks including *Quercus alba*, *Quercus falcata*, and *Quercus nigra*. Each of these oaks typically has ~20% cover. Understory typically contains *Ilex opaca*, *Liquidambar styraciflua*, and *Magnolia grandiflora*. Shrub stratum is composed of *Ilex vomitoria* and *Callicarpa americana* with cover typically ~30%.

**Dynamics:** N/A

Conservation Status Rank
**Global**: G3G4

Global Environmental Description
This forest occurs on slight upland rises in a very flat, wet landscape, in the Outer Coastal Plain of southeastern South Carolina and possibly eastern Georgia.

Global Vegetation Description
The canopy of this association is characterized by the presence of *Quercus alba*, *Quercus nigra*, and *Quercus falcata*. Other canopy trees include *Quercus pagoda*, *Pinus taeda*, *Pinus glabra*, *Carya glabra*, *Carya alba*, *Fagus grandifolia*, and *Liquidambar styraciflua*. The subcanopy may include *Fagus grandifolia*, *Carpinus caroliniana* ssp. *caroliniana*, *Cornus florida*, *Persea palustris*, *Magnolia grandiflora*, and (rarely) *Ostrya virginiana*. The shrub stratum includes *Symplocos tinctoria*, *Ilex vomitoria*, *Vaccinium tenellum*, and *Leucothoe axillaris*. The herb stratum is sparse and

includes *Chasmanthium laxum*, *Chasmanthium sessiliflorum*, *Hexastylis arifolia* var. *arifolia*, *Mitchella repens*, *Smilax pumila*, and *Pteridium aquilinum* var. *pseudocaudatum*.

Example Photograph

Figure A56 below shows an example of CEGL007845 *Quercus alba – Quercus* (*michauxii*, *nigra*) / *Ilex opaca* / *Chasmanthium laxum* Forest.



**Figure A56.** *Quercus alba – Quercus* (*michauxii*, *nigra*) / *Ilex opaca* / *Chasmanthium laxum* Forest (CSU)

### *CEGL008576 Quercus phellos / Chasmanthium laxum Wet Forest*

Table A41 below shows the USNVC Hierarchy for CEGL008576 *Quercus phellos* / *Chasmanthium laxum* Wet Forest.

**Table A41.** USNVC hierarchy for CEGL008576 *Quercus phellos* / *Chasmanthium laxum* Wet Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |

**Table A41 (continued).** USNVC hierarchy for CEGL008576 *Quercus phellos* / *Chasmanthium laxum* Wet Forest

| Category | Description |
|---|---|
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Basin Swamp & Flatwoods |
| Group | 1.B.3.Nb Hardwood - Loblolly Pine Nonriverine Wet Flatwoods |
| Alliance | A4190 *Pinus taeda - Quercus laurifolia - Quercus phellos* West Gulf Coastal Plain Wet Flatwoods Forest Alliance |
| Association | 1.B.3.Nb *Quercus phellos* / *Chasmanthium laxum* Wet Forest (CEGL008576) |

**Field Plots:** Field Reconnaissance

**Map Class:** BITH MC314

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 264 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland

**Soil Texture**: Sandy loam

**Environment:** This community occurs in upland depressions. Litter dominates ground cover with a minimal amount of wood <5%.

Local Vegetation Description
**Structure**: Canopy (40%-60%), Herbaceous (20%-40%)

**Vegetation Floristics**: Forest situated between streams on slight topographic depressions with in upland communities. Species diversity is low in this community. Water will pond as a result of what is likely to be an underlying impermeable clay fragipan. The canopy has low diversity with a nearly monospecific canopy of *Quercus phellos* (>60% cover). The subcanopy, shrub, and herb layer is extremely sparse. *Ilex decidua* is the dominant shrub species. Common vines such as *Berchemia scandens*, *Bignonia capreolata*, *Smilax bona-nox*, *Smilax rotundifolia*, *Smilax smallii*, and *Toxicodendron radicans* comprise the majority of diversity. The only documented herbaceous species is *Chasmanthium laxum*. *Sphagnum* spp. may be present in some areas.

**Dynamics**: N/A

Conservation Status Rank
**Global**: G3?

Global Environmental Description
This forest occurs in slight topographic depressions on broad, nearly level uplands. These areas are not subject to overbank flooding but do pond water after local rainfall events. Many of these sites are very small "inclusions" which are too small to be mapped separately on soils maps. It is hypothesized that soils may have a fragipan layer which impedes drainage of precipitation downward through the soil profile. This type includes both "shallow upland depressions" and "flatwoods" which are related ecologically and similar in floristic composition.

Global Vegetation Description
*Quercus phellos* may comprise 60% or more of the overstory canopy in most examples. Shrubs are uncommon in this association but may include an occasional *Ilex decidua*. Woody vines, namely *Berchemia scandens, Bignonia capreolata, Smilax bona-nox, Smilax rotundifolia, Toxicodendron radicans*, and *Smilax smallii*, comprise a significant percentage of the species present. The herbaceous layer is quite sparse. The dominant species is *Chasmanthium laxum*, and almost no other species are frequently encountered. *Sphagnum* sp. may be present in small patches.

Example Photograph
Figure A57 below shows an example of CEGL008576 *Quercus phellos* / *Chasmanthium laxum* Wet Forest.



**Figure A57.** *Quercus phellos* / *Chasmanthium laxum* Wet Forest (CSU)

### *CEGL004638 Quercus nigra Ruderal Forest*

Table A42 below shows the USNVC Hierarchy for CEGL004638 *Quercus nigra* Ruderal Forest.

**Table A42.** USNVC hierarchy for CEGL004638 *Quercus nigra* Ruderal Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.1 Warm Temperate Forest & Woodland |
| Division | 1.B.1.Na Southeastern North American Forest & Woodland |
| Macrogroup | 1.B.1.Na Southeastern North American Ruderal Forest |
| Group | 1.B.1.Na Southeastern Native Ruderal Forest |
| Alliance | A3232 *Liquidambar styraciflua - Celtis laevigata - Quercus nigra* Ruderal Forest Alliance |
| Association | 1.B.1.Na *Quercus nigra* Ruderal Forest (CEGL004638) |

**Field Plots:** 1015, 1105, 2063, 2023, 2001, 1058, 1092, 2024, 6008, 0319_301, 0319_303

**Map Class:** BITH MC314

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 95.38 ft range 6 ft to 213 ft

**Aspect**: Mean 11.88 range 0 to 95

**Slope**: Mean 0.25 range 0 to 2

**Macro Topography**: Floodplain upper terrace, Upland, Upland slope terrace, Upland swales

**Soil Texture**: Loamy sand, Sandy clay loam, Sandy loam, Silt loam

**Environment**: 11 plots were sampled within this type. Litter dominates the ground cover with cover values generally range from 80% to 95%. This community typically occurs on flatwoods or floodplain upper terraces. Bare soil typically composes ~15% of the ground cover with wood forming the remaining ground cover.

Local Vegetation Description
**Structure**: Canopy (20%-80%), Sub canopy (0%-60%), Tall shrub (10%-50%), Short shrub (0%-20%), Herbaceous (0%-40%), Vine (0%-10%)

**Vegetation Floristics**: The canopy is typically dominated by *Quercus nigra* with cover ranging from 10% to 80%. Other hardwoods generally occur in the canopy and may codominate. Common species may include *Carya glabra*, *Liquidambar styraciflua*, *Triadica sebifera*, *Quercus marilandica*, and *Quercus texana*. A sub canopy is typically present with cover <50%. Common species include *Ilex opaca*, *Nyssa aquatica*, *Nyssa sylvatica*, *Ostrya virginiana*, and *Quercus nigra*. When present shrub cover is <50% with common species including *Carpinus caroliniana*, *Ilex coriacea*, and *Ilex vomitoria*. Herbaceous stratum is generally sparse with cover <10%. Herbaceous species are variable with *Chasmanthium sessiliflorum* as the most common herbaceous species.

**Dynamics:** This community occurs as a successional community following either degradation of pinelands or recovery from agricultural disturbance of old fields in sandy soils, as well as other forms of soil disturbance in the southern coastal plains and adjacent Piedmont. In the Piedmont area of South Carolina, this is reported to occur on areas formerly codominated by *Quercus oglethorpensis*. In these areas, the *Quercus oglethorpensis* still survives, making this modified community of more conservation value in those areas. This manifestation may be an altered version of a natural association, and not strictly "ruderal."

Conservation Status Rank
**Global**: GNA

Global Environmental Description

This community is a result of disturbance and/or fire suppression of upland pinelands of the southeastern Coastal Plain and adjacent Piedmont. South of the range of southern yellow pines, this community is found on highly disturbed upland sites, spoil banks, artificial levees, and other anthropogenic landforms in a marsh and swamp landscape context. It occurs on mesic or dry-mesic sites, especially on loamy or other fine-textured soils. In the Piedmont transition of South Carolina, it may have grown out of areas that were heavily farmed or cut over in the past and did not grow up into *Pinus taeda* forests.

Global Vegetation Description

The canopy of this association is dominated by *Quercus nigra*. Other oaks may be intermixed, especially *Quercus phellos*, as well as *Quercus falcata*, *Quercus hemisphaerica*, *Liquidambar styraciflua*, remnant *Pinus palustris*, weedy *Pinus elliottii* var. *elliottii*, *Carya* spp., or *Pinus taeda*. In the Upper Gulf Coastal Plain of Georgia, some examples may contain *Fagus grandifolia*, *Liriodendron tulipifera*, *Carya alba*, and *Cornus florida* in the subcanopy.

Example Photograph

Figure A58 below shows an example of CEGL004638 *Quercus nigra* Ruderal Forest.



**Figure A58.** *Quercus nigra* Ruderal Forest (CSU)

***CEGL007980 Quercus alba – Carya alba / Symplocos tinctoria / Mitchella repens Forest***
Table A43 below shows the USNVC Hierarchy for CEGL007980 *Quercus alba – Carya alba* / *Symplocos tinctoria* / *Mitchella repens* Forest.

**Table A43.** USNVC hierarchy for CEGL007980 *Quercus alba – Carya alba* / *Symplocos tinctoria* / *Mitchella repens* Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.1 Warm Temperate Forest & Woodland |
| Division | 1.B.1.Na Southeastern North American Forest & Woodland |
| Macrogroup | 1.B.1.Na Southern Mesic Mixed Broadleaf Forest |
| Group | 1.B.1.Na Southern Mesic Beech - Oak - Mixed Deciduous Forest |
| Alliance | A3234 *Quercus alba - Carya alba* Mesic Coastal Plain Forest Alliance |
| Association | 1.B.1.Na *Quercus alba - Carya alba* / *Symplocos tinctoria* / *Mitchella repens* Forest (CEGL007980) |

**Field Plots:** Field Reconnaissance

**Map Class:** BITH MC314

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 37.5 ft range 15 ft to 60 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands, Floodplain lower terrace

**Soil Texture**: Clay loam

**Environment:** This community typically occurs within ridge and swale regions. Ground cover is dominated by litter with values reaching 80%. Bare soil typically forms 10% to 20% of the ground cover. Wood is often present with values ranging from 5% to 15%.

Local Vegetation Description
**Structure**: Canopy (30%-60%), Short shrub (10%-50%)

**Vegetation Floristics:** *Quercus alba* dominates the canopy with cover ranging from 30%-60%. Other common canopy species include *Carya alba*, *Quercus nigra*, *Quercus michauxii*, and *Quercus falcata*. Occasionally, *Fagus grandifolia* and *Magnolia grandiflora* occur in the canopy with abundance. Shrub canopy contains *Symplocos tinctoria*, *Cornus florida*, *Ostrya virginiana*, *Quercus hemisphaerica*, and *Carpinus caroliniana*.

**Dynamics**: This plant community is rarely flooded and drains quickly. The extent to which *Pinus taeda* was present historically is unknown. It is present in many existing examples, and many mounds have *Pinus taeda* stumps, suggesting that this tree was present in presettlement forests. However, some mounds which support almost monospecific stands of *Pinus taeda* are believed to be relatively natural. These mound forests would be subject to late summer and fall wildfires but probably not to winter, spring, or early summer fires due to mesic and wet conditions in surrounding floodplain forests. The herbaceous layer can be sparse due to low light levels and litter build-up. It is not exactly clear where these pine-dominated mounds should be accommodated in the classification given that floristically these areas will overlap with types already defined from upland settings.

Conservation Status Rank
**Global**: G3?

Global Environmental Description
This forest community occupies elevated areas in mound - swale microtopographic environments. In Arkansas, these areas are called mima mounds. Throughout the region, mounds are generally small-scale features, locally ranging from 0.25-1.0 acre in size. However, they may be quite numerous in a given area separated only by narrow, often sinuous, swales. In some cases, mounds may be elevated to 10 feet above the nearby floodplain. They appear to be sufficiently elevated to contribute to only rare flooding. Soils of the mounds are relatively well-drained, acidic, and low in fertility, and are somewhat coarser-textured than the adjacent swales. Large areas of this type occur in southeast Texas, in part on Kirbyville soils, and a large expanse of this type may be present along the Louisiana/Arkansas Stateline. In this area, flatwoods may have historically occurred in much broader expanses than were typical of other portions of the region.

Global Vegetation Description
The canopy is tall (100+ feet) and semi-closed under old-growth conditions. Younger stands typically exhibit a more closed-canopy condition. Dominant trees include *Quercus alba* and *Nyssa sylvatica*. *Acer rubrum* var. *rubrum*, *Carya alba*, *Quercus nigra*, and *Quercus michauxii* may also be present. *Quercus falcata* (= var. *falcata*) is found in somewhat drier examples. Scattered *Pinus taeda* are often present, the density of which is dependent upon past disturbance. *Fagus grandifolia* is also occasionally present within its range, although this community extends further west than does *Fagus grandifolia*. It may be especially common in some areas of southern Arkansas (D. Zollner pers. obs.) *Magnolia grandiflora* may be present in examples in eastern Texas, but is not found in southern Arkansas. The subcanopy usually includes *Symplocos tinctoria*, *Fraxinus* spp., *Ilex opaca*, and *Cornus florida*, and rarely with *Sassafras albidum*. Midstory stems and the understory are fairly sparse and may include *Vaccinium virgatum*, *Acer rubrum*, *Morella cerifera* (= *Myrica cerifera*), *Ostrya virginiana*, *Carpinus caroliniana*, *Hamamelis virginiana*, *Asimina triloba*,

*Viburnum dentatum*, and regenerating stems of species previously mentioned. *Callicarpa americana* (disturbed mounds) and *Vaccinium arboreum* also occur occasionally. *Parthenocissus quinquefolia* is the usual woody vine occasionally with *Smilax bona-nox* and *Vitis rotundifolia*. The flora of these mounds may appear to be a depauperate version of other mesic forests in the region. Dominant herbaceous species include *Chasmanthium sessiliflorum* with *Arisaema triphyllum*, *Arundinaria gigantea*, *Asclepias perennis*, *Carex glaucodea*, *Eupatorium altissimum*, *Eupatorium semiserratum*, *Podophyllum peltatum*, *Polystichum acrostichoides*, *Sisyrinchium angustifolium*, *Viola* x *palmata*, and *Viola sororia*. The herbaceous layer can be sparse due to low light levels and litter build-up. *Mitchella repens* is the common ground cover.

Example Photograph

Figure A59 below shows an example of CEGL007980 *Quercus alba – Carya alba* / *Symplocos tinctoria* / *Mitchella repens* Forest.



**Figure A59.** *Quercus alba – Carya alba* / *Symplocos tinctoria* / *Mitchella repens* Forest (CSU)

Short Citation

D. Zollner pers. obs.

***CEGL007910 Pinus taeda – Quercus phellos – Quercus nigra Riparian Forest***

Table A44 below shows the USNVC Hierarchy for CEGL007910 *Pinus taeda – Quercus phellos – Quercus nigra* Riparian Forest.

**Table A44.** USNVC hierarchy for CEGL007910 *Pinus taeda* – *Quercus phellos* – *Quercus nirgra* Riparian Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Oak - Sweetgum Floodplain Forest |
| Alliance | A3628 *Quercus laurifolia - Quercus phellos - Pinus taeda* Coastal Plain Riparian Forest Alliance |
| Association | 1.B.3.Nb *Pinus taeda - Quercus phellos - Quercus nigra* Riparian Forest (CEGL007910) |

**Field Plots:** 1002, 2097, 2104, 2081, 1035, 2032, 2045, 1072, 1117, 2039, 1004, 2082

**Map Class:** BITH MC315

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 95 ft range 15 ft to 283 ft

**Aspect**: Mean 40.42 range 0 to 320

**Slope**: Mean 0.75 range 0 to 4

**Macro Topography**: Flatlands, Floodplain ridge and swale, Upland, Upland swales

**Soil Texture**: Clay loam, Loamy sand, Sand, Sandy clay loam, Sandy loam, Silt loam, Silty clay loam

**Environment**: 12 plots were sampled within this type. This community typically occurs on floodplain upper terraces with loamy sands. Ground cover is dominated by litter with cover >70%. Bare soil is typically sparse with cover <10%. Wood is usually present and has cover <5%.

Local Vegetation Description
**Structure**: Canopy (20%-80%), Sub canopy (0%-70%), Tall shrub (0%-60%), Short shrub (0%-30%), Dwarf shrub (0%-10%), Herbaceous (0%-10%), Vine (0%-20%)

**Vegetation Floristics**: Canopy is dominated by *Pinus taeda* with cover ranging from 30% and 60%. *Quercus nigra* also dominates the canopy to a lesser extent than the pines. Cover usually ranges from 30% to 50%. Other canopy species usually have cover <20% and include *Magnolia virginiana*, *Quercus michauxii*, and *Acer rubrum*. Shrubs tend to form a moderately dense stratum with cover

ranging from 30% to 60%. Common species include *Cyrilla racemiflora*, *Ilex vomitoria*, *Ilex opaca*, and *Acer rubrum*. The herbaceous stratum is sparse to absent with cover <5%.

**Dynamics:** N/A

Conservation Status Rank
**Global**: G4

Global Environmental Description
N/A

Global Vegetation Description
Stands of this association are dominated by some combination of *Pinus taeda, Quercus phellos*, and *Quercus nigra*. Louisiana occurrences have *Quercus laurifolia*.

Example Photograph
Figure A60 below shows an example of CEGL007910 *Pinus taeda – Quercus phellos – Quercus nigra* Riparian Forest.



**Figure A60.** *Pinus taeda – Quercus phellos – Quercus nigra* Riparian Forest (CSU)

### *CEGL004911 Pinus taeda – Liquidambar styraciflua – Quercus (nigra, phellos) / Crataegus marshallii Floodplain Forest*

Table A45 below shows the USNVC Hierarchy for CEGL004911 *Pinus taeda – Liquidambar styraciflua – Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest.

**Table A45.** USNVC hierarchy for CEGL004911 *Pinus taeda – Liquidambar styraciflua – Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Oak - Sweetgum Floodplain Forest |
| Alliance | A3627 *Quercus laurifolia - Liquidambar styraciflua - Nyssa biflora* Coastal Plain Floodplain Forest Alliance |
| Association | 1.B.3.Nb *Pinus taeda - Liquidambar styraciflua - Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest (CEGL004911) |

**Field Plots:** 2071, 1041, 1052, 2062, 2075, 2112, 1057, 1061, 2115, 1081, 1044, 1053, 1075, 2058, 2041, 2105

**Map Class:** BITH MC315

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 104.25 ft range 0 ft to 219 ft

**Aspect**: Mean 57.25 range 0 to 320

**Slope**: Mean 2.375 range 0 to 24

**Macro Topography**: Flatlands, Floodplain lower terrace, Floodplain ridge and swale, Floodplain upper terrace, Hillslope, Upland

**Soil Texture**: Clay loam, Loamy sand, Muck, Sandy clay loam, Sandy loam, Silt loam

**Environment**: 16 plots were sampled within this type. These communities are found across a variety of landforms but are mainly located on floodplains. Ground cover is dominated by litter with cover values ranging from 57% to 96%. Bare soil ranged from 1% to 40%. Wood was the other component of ground cover with values ranging from 1% to 15%.

Local Vegetation Description

**Structure**: Canopy (20%-80%), Sub canopy (0%-70%), Tall shrub (0%-70%), Short shrub (0%-40%), Herbaceous (0%-40%), Non-vascular (0%-10%), Vine (0%-20%)

**Vegetation Floristics:** Canopy is moderate to dense with cover ranging from 20% to 80%. Dominant canopy species are typically *Pinus taeda* and *Quercus nigra* with ~40% cover each. There is usually a dense and variable mix of hardwoods in the subcanopy with common species including *Nyssa aquatica*, *Quercus velutina*, *Cornus florida*, *Liquidambar styraciflua*, *Acer rubrum*, and *Ilex coriacea*. Shrubs tend to sparse to dense with cover ranging from 10% to 70%. Common shrubs include *Carpinus caroliniana*, *Fraxinus caroliniana*, *Ilex vomitoria*, *Acer rubrum*, *Vaccinium arboreum*, *Callicarpa americana*, and *Sabal minor*. *Crataegus marshallii* is usually present in small abundances with cover generally ~10%. Herbaceous stratum tends to be sparse with cover <10%. Common species include *Chasmanthium sessiliflorum*, *Dichanthelium dichotomum*, and *Mitchella repens*.

**Dynamics**: N/A

Conservation Status Rank

**Global**: G3

Global Environmental Description

This type is found along small stream channels on acidic soils. These areas may be narrow or somewhat broader depending upon individual stream and floodplain characteristics. Short-duration flooding may occur during limited periods of the year. Soils at a Texas plot location were predominately silty and low in nutrients (Turner et al. unpubl. data).

Global Vegetation Description

In addition to *Pinus taeda*, *Liquidambar styraciflua*, *Quercus nigra*, and *Quercus phellos*, other important species found in plots attributed to this type from Texas include *Quercus falcata*, *Quercus pagoda*, *Quercus stellata*, *Fraxinus americana*, *Nyssa sylvatica*, *Ulmus alata*, *Nyssa biflora*, *Acer rubrum*, *Carpinus caroliniana*, and *Quercus shumardii*. The shrub layer may include *Forestiera ligustrina*, *Fraxinus americana*, *Callicarpa americana*, *Crataegus marshallii*, *Ilex opaca*, *Ilex vomitoria*, *Sebastiania fruticosa*, *Chionanthus virginicus*, *Viburnum rufidulum*, *Celtis tenuifolia*, and *Arundinaria gigantea*. Important herbaceous species in some examples may include *Carex abscondita*, *Carex albicans* var. *australis* (= *Carex physorhyncha*), *Carex blanda*, *Carex lupulina*, *Carex striatula*, *Chasmanthium sessiliflorum*, *Dichanthelium boscii*, *Dichanthelium commutatum*, *Elephantopus carolinianus*, *Mitchella repens*, and the vines *Parthenocissus quinquefolia* and *Smilax rotundifolia*.

Example Photograph

Figure A61 below shows an example of CEGL004911 *Pinus taeda – Liquidambar styraciflua – Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest.



**Figure A61.** *Pinus taeda – Liquidambar styraciflua – Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest (CSU)

Short Citation
Turner et al. unpubl. data

***CEGL007899 Quercus pagoda – Liquidambar styraciflua – Pinus taeda Floodplain Forest***
Table A46 below shows the USNVC Hierarchy for CEGL007899 *Quercus pagoda – Liquidambar styraciflua – Pinus taeda* Floodplain Forest.

**Table A46.** USNVC hierarchy for CEGL007899 *Quercus pagoda – Liquidambar styraciflua – Pinus taeda* Floodplain Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Oak - Sweetgum Floodplain Forest |

**Table A46 (continued).** USNVC hierarchy for CEGL007899 *Quercus pagoda – Liquidambar styraciflua – Pinus taeda* Floodplain Forest

| Category | Description |
|---|---|
| Alliance | A3631 *Quercus michauxii - Quercus pagoda* Coastal Plain Floodplain Forest Alliance |
| Association | 1.B.3.Nb *Quercus pagoda - Liquidambar styraciflua - Pinus taeda* Floodplain Forest (CEGL007899) |

**Field Plots:** Field Reconnaissance

**Map Class:** BITH MC315

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 11 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain flat terrace

**Soil Texture**: Clay loam

**Environment:** This community occurs on low floodplains. Ground cover is dominated by litter with values reaching 60%. Wood comprises about 30% of the ground cover, and bare soil typically forms up to 30% of the ground cover.

Local Vegetation Description
**Structure**: Canopy (40%-80%), Subcanopy (10%-30%), Short shrub (10%-50%), Vines (0%-10%), Herbaceous (0%-10%)

**Vegetation Floristics**: Floodplain forest along streams and rivers that experiences seasonal flooding. Canopy dominants are *Quercus pagoda*, *Liquidambar styraciflua*, *Pinus taeda*, *Quercus michauxii*, and *Quercus laurifolia*. Associated species are *Carya glabra*, *Fraxinus* spp., *Quercus alba*, *Quercus similis*, *Nyssa sylvatica*, *Ulmus alata*, and *Ulmus americana*. Understory with *Acer leucoderme*, *Carpinus caroliniana*, *Crataegus marshallii*, *Ostrya virginiana*, *Symplocos tinctoria*, and *Ulmus alata*. Vines such as *Parthenocissus quinquefolia*, *Toxicodendron radicans*, and *Smilax rotundifolia* are present. Shrubs include *Sambucus canadensis*, *Sebastiania fruticosa*, and *Ilex vomitoria*. Herb layer is sparse with occasional *Carex* spp., *Chasmanthium* spp., *Michella repens*, *Osmunda cinnamomea*, and *Onoclea sensibilis.*

**Dynamics**: N/A

Conservation Status Rank
**Global**: G3?

Global Environmental Description
This temporarily flooded floodplain forest was originally developed to cover intermediate-sized streams in the West Gulf Coastal Plain of Louisiana and Texas. It is also being generally applied to some larger river systems such as the Neches River in Texas. Soils are silt loams. This association has a longer hydroperiod than *~Fagus grandifolia - Pinus taeda - (Liquidambar styraciflua, Magnolia grandiflora, Quercus alba)* Small Stream Forest (CEGL007320).

Global Vegetation Description
The canopy dominants of stands of this type include *Quercus pagoda*, *Liquidambar styraciflua*, *Pinus taeda*, *Quercus michauxii*, and *Quercus laurifolia*. Other characteristic tree species include *Carya glabra*, *Carya illinoinensis*, *Quercus similis*, *Ulmus alata*, *Ulmus americana*, *Fraxinus* sp., *Quercus alba*, *Nyssa sylvatica*, and occasional *Taxodium distichum*. Understory trees include *Carpinus caroliniana*, *Crataegus marshallii*, *Ilex opaca*, *Symplocos tinctoria*, *Ostrya virginiana*, *Prunus serotina*, *Ulmus alata*, and (rarely) *Acer leucoderme*. Woody vines include *Berchemia scandens*, *Bignonia capreolata*, *Parthenocissus quinquefolia*, *Toxicodendron radicans*, *Smilax rotundifolia*, and *Vitis rotundifolia*. Shrubs may include *Arundinaria gigantea*, *Sambucus canadensis*, *Sebastiania fruticosa*, and *Ilex vomitoria*. The herb stratum is sparse but can include *Carex* spp., *Osmunda cinnamomea*, *Onoclea sensibilis*, and others. Additional herbs in a stand assigned to this type from the Sabine National Forest (Texas) include *Chasmanthium laxum*, *Botrychium dissectum* (= var. *obliquum*), *Mitchella repens*, *Polygonum virginianum*, *Carex* sp., *Elephantopus carolinianus*, *Oplismenus hirtellus* ssp. *setarius*, *Yeatesia viridiflora*, *Desmodium glutinosum*, *Dichanthelium commutatum*, *Dioscorea villosa*, *Hypericum hypericoides*, and *Sanicula canadensis*.

Example Photograph
Figure A62 below shows an example of CEGL007899 *Quercus pagoda – Liquidambar styraciflua – Pinus taeda* Floodplain Forest.



**Figure A62.** *Quercus pagoda – Liquidambar styraciflua – Pinus taeda* Floodplain Forest (CSU)

### *CEGL007901 Quercus michauxii – Quercus nigra – Pinus taeda / Carpinus caroliniana Floodplain Forest*

Table A47 below shows the USNVC Hierarchy for CEGL007901 *Quercus michauxii – Quercus nigra – Pinus taeda* / *Carpinus caroliniana* Floodplain Forest.

**Table A47.** USNVC hierarchy for CEGL007901 *Quercus michauxii – Quercus nigra – Pinus taeda* / *Carpinus caroliniana* Floodplain Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Oak - Sweetgum Floodplain Forest |
| Alliance | A3631 *Quercus michauxii - Quercus pagoda* Coastal Plain Floodplain Forest Alliance |
| Association | 1.B.3.Nb *Quercus michauxii - Quercus nigra - Pinus taeda* / *Carpinus caroliniana* Floodplain Forest (CEGL007901) |

**Field Plots:** 1086, 1011, 1012, 1082, 2046, 1025, 1007, 1056, 1065, 2042, 2050, 2066, 1103, 1110, 1115, 1067, 1074, 1073, 2060, 2038, 2022, 2049, 1013

**Map Class:** BITH MC315

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 87.78 ft range 0 ft to 202 ft

**Aspect**: Mean 51.83 range 0 to 350

**Slope**: Mean 1.57 range 0 to 10

**Macro Topography**: Floodplain ridge and swale, Floodplain upper terrace, Hillslope, Upland, Upland swales

**Soil Texture**: Loam, Loamy sand, Sandy clay loam, Sandy loam, Silt loam, Silty clay loam

**Environment**: 23 plots were sampled within this type. This community typically occurs on floodplains with sandy clay loam, silt loam, or loamy sand soils. Ground cover typically is primarily composed of litter (40-90% cover) followed by bare soil (30-80% cover). Wood is present with <15% cover.

Local Vegetation Description
**Structure**: Emergent (0%-10%), Canopy (10%-80%), Sub canopy (0%-90%), Tall shrub (0%-80%), Short shrub (0%-20%), Herbaceous (0%-30%), Vine (0%-20%)

**Vegetation Floristics**: Canopy dominants include *Quercus nigra* (20-50%), *Quercus michauxii* (20-40%), *Pinus taeda* (20-60%), *Magnolia grandiflora* (20-40%), and *Carpinus caroliniana* (30-60% cover). Shrub dominants include *Ilex vomitoria* (10-40%), *Ilex opaca* (10-40%) with associated *Ilex coriacea*, *Rubus argutus*, and *Persea borbonia*. Common vines are *Vitis rotundifolia* (10% cover) *Smilax rotundifolia*, *Mitchella repens*, *Parthenocissus quinquefolia*, and *Toxicodendron radicans*. Herbs such as *Arundinaria gigantea* (<25%), *Carex* sp. (<10%), and *Chasmanthium sessiliflorum* (<10%).

**Dynamics:** N/A

Conservation Status Rank
**Global**: G3?

Global Environmental Description
This association was once prevalent along intermediate streams throughout much of west-central Louisiana within the range of *Magnolia grandiflora*. Both this association and ~*Quercus pagoda - Liquidambar styraciflua - Pinus taeda* Floodplain Forest (CEGL007899) represent the intermediate ('wettest') stream forests that arise along the lower reaches of drainages in the floodplains of small to

intermediate streams on acidic silty to sandy substrates, in the West Gulf Coastal Plain of central Louisiana.

Global Vegetation Description

Typical canopy species include *Quercus michauxii*, *Quercus nigra*, *Pinus taeda*, *Magnolia grandiflora*, *Quercus pagoda*, *Magnolia virginiana*, *Acer rubrum*, and *Quercus laurifolia*. *Taxodium distichum* and *Nyssa aquatica* are present in depressional inclusions in the floodplain. The midstory is dominated by *Carpinus caroliniana*. *Toxicodendron radicans* is a common woody vine. Herb layer species include numerous *Carex* spp., *Cardamine bulbosa*, *Rudbeckia laciniata* var. *laciniata*, *Phanopyrum gymnocarpon* (= *Panicum gymnocarpon*), and *Solidago patula* var. *strictula* (= *Solidago salicina*). This type occurs in the floodplains of small to intermediate streams on acidic silty to sandy substrates, in central Louisiana.

Example Photograph

Figure A63 below shows an example of CEGL007901 *Quercus michauxii – Quercus nigra – Pinus taeda* / *Carpinus caroliniana* Floodplain Forest.



**Figure A63.** *Quercus laurifolia* – (*Quercus nigra*, *Nyssa biflora*) / *Diospyros virginiana* Wet Forest (CSU)

***CEGL008574 Fagus grandifolia – Quercus (laurifolia, nigra) – Pinus taeda Forest***

Table A48 below shows the USNVC Hierarchy for CEGL008574 *Fagus grandifolia – Quercus* (*laurifolia*, *nigra*) – *Pinus taeda* Forest.

**Table A48.** USNVC hierarchy for CEGL008574 *Fagus grandifolia* – *Quercus* (*laurifolia*, *nigra*) – *Pinus taeda* Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.1 Warm Temperate Forest & Woodland |
| Division | 1.B.1.Na Southeastern North American Forest & Woodland |
| Macrogroup | 1.B.1.Na Southern Mesic Mixed Broadleaf Forest |
| Group | 1.B.1.Na Southern Mesic Beech - Magnolia - Oak Forest |
| Alliance | A0369 *Fagus grandifolia* - *Magnolia grandiflora* Forest Alliance |
| Association | 1.B.1.Na *Fagus grandifolia* - *Quercus* (*laurifolia*, *nigra*) - *Pinus taeda* Forest (CEGL008574) |

**Field Plots:** Association added from legacy oil and gas surveys

**Map Class:** BITH MC315

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 180 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands, Floodplain lower terrace

**Soil Texture**: Clay loam

**Environment**: This community occurs along flatlands and floodplains. Litter dominates the ground cover with values reaching up to 70%. Bare soil typically occurs with values reaching up to 40%. Wood occurs scattered throughout the plot with values <5%.

Local Vegetation Description
**Structure**: Canopy (30%-60%), Short shrub (0%-30%), Herbaceous (0%-50%)

**Vegetation Floristics**: Temporarily flooded forests along floodplains of creeks and rivers. *Fagus grandifolia* is the sole canopy dominant. Associates include *Quercus laurifolia*, *Quercus nigra*, and *Pinus taeda* (<30% cover). Herbaceous stratum may have an abundance of *Chasmanthium laxum*

**Dynamics**: N/A

Conservation Status Rank
**Global**: G3?

Global Environmental Description
This association represents temporarily flooded forests in the West Gulf Coastal Plain of Texas and possibly Louisiana which are dominated by *Fagus grandifolia*. One stand was observed on the Angelina National Forest in a broad, flat area in the floodplain of Big Creek, adjacent to the Upland Island Wilderness Area. This association is presumed to also be present in that Wilderness Area, along Big Creek and Oil Well Creek.

Global Vegetation Description
The canopy of stands of this association are dominated by *Fagus grandifolia*. Other species noted in a stand from the Angelina National Forest (Texas) include *Quercus nigra, Quercus laurifolia*, and *Pinus taeda*. The herbaceous layer may be dominated by *Chasmanthium laxum* (NatureServe Ecology unpubl. data).

Example Photograph
Figure A64 below shows an example of CEGL008574 *Fagus grandifolia – Quercus* (*laurifolia*, *nigra*) *– Pinus taeda* Forest.



**Figure A64.** *Fagus grandifolia – Quercus* (*laurifolia*, *nigra*) *– Pinus taeda* Forest (CSU)

***CEGL007955 Pinus taeda – (Quercus spp.) / Ostrya virginiana – Sabal minor Forest***

Table A49 below shows the USNVC Hierarchy for CEGL007955 *Pinus taeda* – (*Quercus* spp.) / *Ostrya virginiana – Sabal minor* Forest.

**Table A49.** USNVC hierarchy for CEGL007955 *Pinus taeda* – (*Quercus* spp.) / *Ostrya virginiana – Sabal minor* Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.2 Cool Temperate Forest & Woodland |
| Division | 1.B.2.Na Eastern North American Forest & Woodland |
| Macrogroup | 1.B.2.Na Southern & South-Central Oak - Pine Forest & Woodland |
| Group | 1.B.2.Na Western Gulf Coastal Plain Pine - Oak Forest & Woodland |
| Alliance | A3130 *Pinus taeda* - *Quercus alba* / *Viburnum* spp. Forest Alliance |
| Association | 1.B.2.Na *Pinus taeda* - (*Quercus* spp.) / *Ostrya virginiana* - *Sabal minor* Forest (CEGL007955) |

**Field Plots:** 1003, 2076, 1085, 1084, 1042, 2028, 2056

**Map Class:** BITH MC315

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 65.43 ft range 24 ft to 147 ft

**Aspect**: Mean 13.57 range 0 to 95

**Slope**: Mean 1.43 range 0 to 10

**Macro Topography**: Upland, Upland swales, Floodplain ridge and swale

**Soil Texture**: Clay loam, Loamy sand, Sandy loam, Silt loam, Silty clay loam

**Environment**: 7 plots were sampled within this type. This community typically occurs on floodplain ridge and swales with sandy to clay loams. Litter formed the dominant ground cover with cover usually >80%. In some areas, water and bare soil may each reach cover up to 50%. Wood is usually present with cover <5%.

Local Vegetation Description
**Structure**: Emergent (0%-10%), Canopy (10%-70%), Sub canopy (0%-70%), Tall shrub (0%-40%), Short shrub (0%-70%), Herbaceous (0%-10%), Vine (0%-10%)

**Vegetation Floristics**: The canopy is dominated by pines with cover ranging from 10% and 40%. Other canopy species include a mix of mesic oaks *Quercus nigra*, *Quercus lyrata*, and *Quercus velutina*. Subcanopy species include *Fraxinus caroliniana*, *Liquidambar styraciflua*, *Ostrya virginiana*, and *Carpinus caroliniana* with cover ranging from 30% to 70%. The shrub stratum is typically dominated by *Sabal minor* with cover ~50%. Other common shrubs include *Acer rubrum*, *Morella cerifera*, *Ilex vomitoria*, and *Ilex opaca*. Herbaceous stratum is typically sparse to absent.

**Dynamics:** N/A

Conservation Status Rank
**Global**: G2G3

Global Environmental Description
This association has been documented from the Fleming Formation in eastern Texas on soils mapped as the Gowker series. Contrary to the hypothesis suggested by floristic indicator species, namely that the soils would be clayey and/or rich in nutrients and/or high in pH, soil samples revealed a pH of 5.6, with an upper surface texture dominated by sand, and relatively low levels of both calcium (99 ppm) and magnesium (22 ppm) (Turner et al. unpubl. data). This type is found at the base of a gradual sloping upland along lower slopes and flats near riparian areas. The lowermost portions of this community grade into small stream floodplains which could receive some temporary flooding (NatureServe Ecology unpubl. data). Small seepage areas are present along this ecotone.

Global Vegetation Description
The overstory is dominated by *Pinus taeda*. Portions of this community which receive temporary flooding from the stream may have some hardwoods in the overstory as well. Typical species are *Quercus nigra, Ostrya virginiana*, and *Liquidambar styraciflua*. The upland edges of this community, further away from the creek bank, may lack additional overstory trees. Additional overstory and subcanopy species include *Quercus shumardii, Quercus texana (= Quercus nuttallii), Quercus similis, Ulmus alata, Ulmus americana, Morus rubra, Ilex opaca, Celtis laevigata*, and *Fraxinus americana*. *Ostrya virginiana* and *Fraxinus americana* are the most important midstory species. The midstory and shrub layer may also include *Forestiera ligustrina, Ilex decidua, Callicarpa americana, Crataegus spathulata*, and *Ulmus rubra*. *Parthenocissus quinquefolia* is abundant in the understory, with the next most numerically important species being *Carex albicans var. australis (= Carex physorhyncha), Carex cherokeensis, Carex abscondita*, and *Toxicodendron radicans*. Patches of *Thelypteris kunthii* may be abundant at the base of the slope.

Example Photograph
Figure A65 below shows an example of CEGL007955 *Pinus taeda* – (*Quercus* spp.) / *Ostrya virginiana – Sabal minor* Forest.



**Figure A65.** *Pinus taeda* – (*Quercus* spp.) / *Ostrya virginiana* – *Sabal minor* Forest (CSU)

Short Citation

- NatureServe Ecology unpubl. data
- Turner et al. unpubl. data

### *CEGL003619 Pinus taeda – Quercus hemisphaerica / Osmanthus americanus / Ilex glabra Woodland*

Table A50 below shows the USNVC Hierarchy for CEGL003619 *Pinus taeda – Quercus hemisphaerica* / *Osmanthus americanus* / *Ilex glabra* Woodland.

**Table A50.** USNVC hierarchy for CEGL003619 *Pinus taeda – Quercus hemisphaerica* / *Osmanthus americanus* / *Ilex glabra* Woodland

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.1 Warm Temperate Forest & Woodland |
| Division | 1.B.1.Na Southeastern North American Forest & Woodland |
| Macrogroup | 1.B.1.Na Southeastern Coastal Plain Evergreen Oak - Mixed Hardwood Forest |

**Table A50 (continued).** USNVC hierarchy for CEGL003619 *Pinus taeda – Quercus hemisphaerica* / *Osmanthus americanus* / *Ilex glabra* Woodland

| Category | Description |
|---|---|
| Group | 1.B.1.Na Southern Evergreen Oak Forest |
| Alliance | A0053 *Quercus hemisphaerica - Quercus nigra* Forest Alliance |
| Association | 1.B.1.Na *Pinus taeda - Quercus hemisphaerica* / *Osmanthus americanus* / *Ilex glabra* Woodland (CEGL003619) |

**Field Plots:** 0319_069, 0319_071

**Map Class:** BITH MC315

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 230 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland

**Soil Texture**: Sandy Loam

**Environment**: This community occurs on sandy uplands. Ground cover is typically dominated by litter with some spots of bare soil.

Local Vegetation Description
**Structure**: Canopy (30%-50%), Short shrub (10%-50%)

**Vegetation Floristics**: Canopy is dominated by *Pinus taeda* and *Quercus hemisphaerica*. *Pinus taeda* and *Quercus hemisphaerica* dominates the canopy. The subcanopy is typically dominated by *Quercus nigra* and *Quercus hemisphaerica*. The shrub stratum is usually composed of *Ilex opaca*, *Ilex vomitoria*, *Symplocos tinctoria*, *Vaccinium arboreum*, and *Cyrilla racemiflora*.

**Dynamics:** Fire is limited due to landscape position with natural firebreaks.

Conservation Status Rank
**Global**: G2

Global Environmental Description
This community consists of pine-oak woodlands on sandy swamp islands isolated from fire, or on levees and creek banks where fire is limited.

Global Vegetation Description

The open to closed canopy is dominated by *Pinus taeda* and *Quercus hemisphaerica*. The subcanopy includes *Osmanthus americanus* var. *americanus*, *Persea palustris*, *Ilex opaca* var. *opaca*, *Quercus nigra*, and *Quercus hemisphaerica*. The shrub layer is characteristically open and dominated by *Ilex glabra*; other species may include *Vitis rotundifolia* and *Lyonia lucida*. In Florida, *Serenoa repens* is important. On Apalachicola National Forest, the plots were dominated by an open canopy of *Pinus taeda* with small amounts of subcanopy *Magnolia grandiflora*, *Quercus nigra*, *Quercus hemisphaerica*, *Liquidambar styraciflua*, *Ilex opaca*, *Symplocos tinctoria*, *Nyssa biflora*, and *Acer rubrum*. Openings in the canopy are dominated by *Serenoa repens* (low shrub) with *Vaccinium arboreum*, *Vaccinium stamineum*, *Symplocos tinctoria*, *Cyrilla racemiflora*, *Ilex opaca*, *Lyonia ferruginea*, *Osmanthus americanus*, *Ilex glabra*, *Ilex vomitoria*, *Hamamelis virginiana*, *Magnolia grandiflora*, *Quercus hemisphaerica*, *Quercus virginiana*, *Gaylussacia frondosa*, and *Sebastiania fruticosa*. Herbaceous species present included *Pteridium aquilinum*, *Smilax pumila*, *Mitchella repens*, *Aureolaria flava*, and *Rhynchospora megalocarpa*. Vines included *Vitis rotundifolia*, *Smilax smallii*, *Smilax auriculata*, and *Gelsemium sempervirens*. The epiphytes were *Pleopeltis polypodioides* ssp. *michauxiana* and *Tillandsia usneoides*.

Example Photograph

N/A

***CEGL007320 Fagus grandifolia – Pinus taeda – (Liquidambar styraciflua, Magnolia grandiflora, Quercus alba) Small Stream Forest***

Table A51 below shows the USNVC Hierarchy for CEGL007320 *Fagus grandifolia – Pinus taeda –* (*Liquidambar styraciflua*, *Magnolia grandiflora*, *Quercus alba*) Small Stream Forest.

**Table A51.** USNVC hierarchy for CEGL007320 *Fagus grandifolia – Pinus taeda –* (*Liquidambar styraciflua*, *Magnolia grandiflora*, *Quercus alba*) Small Stream Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.1 Warm Temperate Forest & Woodland |
| Division | 1.B.1.Na Southeastern North American Forest & Woodland |
| Macrogroup | 1.B.1.Na Southern Mesic Mixed Broadleaf Forest |
| Group | 1.B.1.Na Southern Mesic Beech - Magnolia - Oak Forest |
| Alliance | A0369 *Fagus grandifolia - Magnolia grandiflora* Forest Alliance |
| Association | 1.B.1.Na *Fagus grandifolia - Pinus taeda* - (*Liquidambar styraciflua*, *Magnolia grandiflora*, *Quercus alba*) Small Stream Forest (CEGL007320) |

**Field Plots:** 1006, 1018, 1021, 2047, 1020, 1062, 6010, 0319_094

**Map Class:** BITH MC316

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 130.5 ft range 48 ft to 206 ft

**Aspect**: Mean 58 range 0 to 328

**Slope**: Mean 6.17 range 0 to 30

**Macro Topography**: Floodplain lower terrace, Upland, Hillslope

**Soil Texture**: Loamy sand, Sandy clay loam

**Environment**: 8 plots were sampled within this type. This community occurred on loamy sand. This community typically occurs on hillslopes and flatlands. Ground cover is dominated by litter with values ranging from 35% to 95%. When present, bare soil may make up as much as 60% of the ground cover. Wood is typically present with cover <10%.

Local Vegetation Description
**Structure**: Canopy (20%-70%), Sub canopy (0%-70%), Tall shrub (0%-30%), Short shrub (0%-10%)

**Vegetation Floristics**: This forest community is dominated by *Fagus grandifolia* and *Pinus taeda*. *Fagus grandifolia* typically dominates with cover ranging from 30% to 60% with *Pinus taeda* often codominating with cover <30%. *Magnolia grandifolia*, *Quercus nigra*, and *Liquidambar styraciflua* typically occur in the canopy with cover <20%. Shrubs tends to be relatively sparse with cover <20%. Common species include *Cyrilla racemiflora* and *Ilex vomitoria*. The herbaceous stratum tends to be sparse to absent.

**Dynamics:** Most of this forest tends to be uneven aged with the majority of regeneration occurring in canopy gaps. This is a disturbance-sensitive community, with the primary disturbance vectors being occasional to rare windthrows, diseases and pathogens. Due to the isolated topographic position, nearly permanently wet soils, lack of available fuels and fire-sensitivity of canopy species, fires are believed to play a very minor role in this community's dynamics. Fire scars, however, are occasionally found on *Fagus grandifolia* implying that limited fires may occur in very dry years and may have a role in creating canopy gaps (Smith 1991). Unless perturbed by a major disturbance, this community will likely persist for an undetermined length of time.

Conservation Status Rank
**Global**: G3

Global Environmental Description
This forest occurs on knolls in and bordering small to intermediate streams in the Western Gulf Coastal Plain. The restriction to drier knolls is especially pronounced on intermediate-sized streams.

Although this community experiences annual flooding generally 5 to 10 days a year, the flooding is never of long duration (usually not more than 2 days at a time). Soils are extremely variable in both texture and pH, but are often acidic sandy floodplain and natural levee soils mapped as Guyton (Martin and Smith 1991, L. Smith pers. comm. 1995).

This forest is found within the average annual floodplain of small streams in central and western Louisiana and eastern Texas. Examples have been documented on sandy soils, with low pH (4.7-5.3), and very low nutrients on the national forests in eastern Texas, one of which occurs on the Sparta Formation along the northern boundary of Angelina National Forest (Turner et al. unpubl. data). This type may also occur on acidic sandy loams and silt loams on other Pleistocene and Tertiary formations in the region. Hydrologically, it is characterized by short-duration flood events, on the order of 1-3 days per event, occurring a few times in an average year. This type has been documented on the Dallardsville soil series in east Texas.

Global Vegetation Description

Stands of this forest typically have canopies dominated by a combination of *Fagus grandifolia*, *Pinus taeda*, *Liquidambar styraciflua*, *Quercus alba*, and *Quercus nigra*. Other canopy species often present include *Magnolia grandiflora*, *Quercus laurifolia*, *Quercus michauxii*, *Quercus pagoda*, *Nyssa sylvatica*, *Nyssa biflora*, *Magnolia virginiana*, *Fraxinus americana*, *Ulmus alata*, *Acer rubrum*, *Carya alba*, *Carya glabra*, and *Quercus falcata*. Common midstory and understory species include *Carpinus caroliniana*, *Ilex opaca*, *Vaccinium elliottii*, *Viburnum dentatum*, *Halesia diptera*, *Hamamelis virginiana*, *Ostrya virginiana*, *Rhododendron canescens*, *Symplocos tinctoria*, *Sebastiania fruticosa*, *Asimina triloba*, *Sambucus canadensis*, *Itea virginica*, and others. *Arundinaria gigantea* is typically very common in patches. Vines are usually conspicuous and may include *Vitis rotundifolia*, *Smilax* spp., *Berchemia scandens*, *Campsis radicans*, *Parthenocissus quinquefolia*, *Toxicodendron radicans*, and *Bignonia capreolata*. Herbaceous species often include *Athyrium filix-femina*, *Polystichum acrostichoides*, *Chasmanthium latifolium*, *Chasmanthium sessiliflorum*, *Arisaema triphyllum*, *Lobelia cardinalis*, *Polygonum* spp., and others. Rare species that may occur in this community include *Triphora trianthophora*, *Cypripedium kentuckiense*, *Prenanthes barbata*, *Solidago auriculata*, and *Amsonia ludoviciana*.

Example Photograph

Figure A66 below shows an example of CEGL007320 *Fagus grandifolia – Pinus taeda –* (*Liquidambar styraciflua*, *Magnolia grandiflora*, *Quercus alba*) Small Stream Forest.



**Figure A66.** *Fagus grandifolia – Pinus taeda* – (*Liquidambar styraciflua*, *Magnolia grandiflora*, *Quercus alba*) Small Stream Forest (CSU)

Short Citation

- L. Smith pers. comm. 1995
- Martin and Smith 1991,
- Smith 1991

***CEGL007903 Magnolia grandiflora – Fagus grandifolia – Quercus alba – Pinus taeda Forest***

Table A52 below shows the USNVC Hierarchy for CEGL007903 *Magnolia grandiflora – Fagus grandifolia – Quercus alba – Pinus taeda* Forest.

**Table A52.** USNVC hierarchy for CEGL007903 *Magnolia grandiflora – Fagus grandifolia – Quercus alba – Pinus taeda* Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.1 Warm Temperate Forest & Woodland |
| Division | 1.B.1.Na Southeastern North American Forest & Woodland |

**Table A52 (continued).** USNVC hierarchy for CEGL007903 *Magnolia grandiflora – Fagus grandifolia – Quercus alba – Pinus taeda* Forest

| Category | Description |
|---|---|
| Macrogroup | 1.B.1.Na Southern Mesic Mixed Broadleaf Forest |
| Group | 1.B.1.Na Southern Mesic Beech - Magnolia - Oak Forest |
| Alliance | A0369 *Fagus grandifolia - Magnolia grandiflora* Forest Alliance |
| Association | 1.B.1.Na *Magnolia grandiflora - Fagus grandifolia - Quercus alba - Pinus taeda* Forest (CEGL007903) |

**Field Plots:** 1010, 1078, 1037, 1055, 2033, 2005, 2006, 2036, 1032, 2007, 1016, 2004, 1005, 2002, 1023, 2008, 2034, 2037, 1019, 1045, 2091, 0319_049, 0319_377, 0319_376, 0319_118

**Map Class:** BITH MC316

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 137.19 ft range 0 ft to 228 ft

**Aspect**: Mean 25.62 range 0 to 274

**Slope**: Mean 0.86 range 0 to 10

**Macro Topography**: Floodplain upper terrace, Hillslope, Upland, Upland swales

**Soil Texture**: Loam, Loamy sand, Sandy clay loam, Sandy loam, Silty clay

**Environment**: 25 plots were sampled within this type. The community typically occurs on upland flatlands loamy sand, and sandy loam. Ground cover dominants are litter (85-95%), bare soil (<25%), and wood (<10%).

Local Vegetation Description
**Structure**: Canopy (10%-70%), Sub canopy (0%-70%), Tall shrub (10%-70%), Short shrub (0%-10%), Dwarf shrub (0%-10%), Herbaceous (0%-30%), Vine (0%-70%)

**Vegetation Floristics**: *Magnolia grandiflora* (20-40%) is the most consistent dominant canopy species. Canopy dominants include *Quercus nigra* (20-60%), *Pinus taeda* (10-40%), *Quercus alba* (<20%), *Ilex opaca* (<20%), *Acer rubrum* (10-30%), *Ostrya virginiana* (20-70%), and *Fagus grandifolia* (<30%). Tree associates include *Quercus marilandica*, *Liquidambar styraciflua*, and *Carpinus caroliniana*. The shrub layer's most dominant species is *Ilex vomitoria* (20-60%) with *Ilex coriacea* (10-30%), *Morella cerifera* (10-20%), *Callicarpa americana*, and *Symplocos tinctoria*. Common vines are *Vitis rotundifolia* (<20%), *Berchemia scandens*, *Parthenocissus quinquefolia*, *Smilax pumila*, and *Smilax smallii*. The herbaceous layer is sparse but can include *Chasmanthium sessiliflorum* with <10% cover.

**Dynamics:** N/A

Conservation Status Rank
**Global**: G3G4

Global Environmental Description
N/A

Global Vegetation Description
Stands of this forest typically have canopies dominated by a combination of *Magnolia grandiflora*, *Fagus grandifolia*, *Pinus taeda*, *Quercus alba*, *Liquidambar styraciflua*, *Nyssa sylvatica*, and *Quercus nigra*. Other canopy species often present include *Quercus laurifolia*, *Quercus michauxii*, *Quercus pagoda*, *Nyssa biflora*, *Magnolia virginiana*, *Liriodendron tulipifera*, *Ulmus alata*, *Acer rubrum*, *Prunus serotina*, *Carya alba*, *Carya glabra*, and *Quercus falcata*. Common midstory and understory species include *Carpinus caroliniana*, *Ilex opaca*, *Viburnum dentatum*, *Halesia diptera*, *Hamamelis virginiana*, *Cornus florida*, *Rhododendron canescens*, *Symplocos tinctoria*, *Vaccinium elliottii*, *Sambucus canadensis*, *Itea virginica*, and others. *Arundinaria gigantea* is typically very common in patches. Vines are usually conspicuous and may include *Vitis rotundifolia*, *Smilax* spp., *Berchemia scandens*, *Campsis radicans*, *Parthenocissus quinquefolia*, *Toxicodendron radicans*, and *Bignonia capreolata*. Herbaceous species often include *Athyrium filix-femina*, *Polystichum acrostichoides*, *Chasmanthium latifolium*, *Chasmanthium sessiliflorum*, *Arisaema triphyllum*, *Lobelia cardinalis*, *Polygonum* spp., and others.

Example Photograph
Figure A67 below shows an example of CEGL007903 *Magnolia grandiflora – Fagus grandifolia – Quercus alba – Pinus taeda* Forest.



**Figure A67.** *Magnolia grandiflora – Fagus grandifolia – Quercus alba – Pinus taeda* Forest (CSU)

### *CEGL007525 Pinus taeda – Quercus alba – (Fagus grandifolia) / Smilax pumila – Mitchella repens Forest*

Table A53 below shows the USNVC Hierarchy for CEGL007525 *Pinus taeda – Quercus alba –* (*Fagus grandifolia*) / *Smilax pumila – Mitchella repens* Forest.

**Table A53.** USNVC hierarchy for CEGL007525 *Pinus taeda – Quercus alba –* (*Fagus grandifolia*) / *Smilax pumila – Mitchella repens* Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.1 Warm Temperate Forest & Woodland |
| Division | 1.B.1.Na Southeastern North American Forest & Woodland |
| Macrogroup | 1.B.1.Na Southern Mesic Mixed Broadleaf Forest |
| Group | 1.B.1.Na Southern Mesic Beech - Oak - Mixed Deciduous Forest |
| Alliance | A2059 *Fagus grandifolia - Quercus alba - Quercus nigra* Coastal Plain Forest Alliance |
| Association | 1.B.1.Na *Pinus taeda - Quercus alba -* (*Fagus grandifolia*) / *Smilax pumila - Mitchella repens* Forest (CEGL007525) |

**Field Plots:** 1054, 1077, 1080, 1036, 2017, 2019, 0319_027, 0319_371

**Map Class:** BITH MC316

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 130.67 ft range 11 ft to 250 ft

**Aspect**: Mean 142.83 range 0 to 349

**Slope**: Mean 2 range 0 to 6

**Macro Topography**: Flatlands, Upland, Upland swales

**Soil Texture**: Loamy sand, Sandy clay loam, Sandy loam, Silty clay loam

**Environment**: 8 plots were sampled within this type. The community typically occurs on flatlands with sandy loam soils. Litter comprises the dominant ground cover with values ranging from 85% to 95%. Bare soil is typically present with cover values <10%. Wood is also usually present with values <5%.

Local Vegetation Description
**Structure**: Canopy (20%-80%), Sub canopy (40%-70%), Tall shrub (10%-60%), Short shrub (0%-20%), Herbaceous (0%-60%), Vine (0%-10%)

**Vegetation Floristics**: *Pinus taeda* and *Quercus alba* dominate the canopy with cover of ~50% and ~30% respectively. The canopy is also composed of a variety of oaks including *Quercus marilandica*, *Quercus nigra*, and *Quercus laurifolia*. Additional canopy species may be *Ostrya virginiana*, *Liquidambar styraciflua*, and *Magnolia grandifolia*. The shrub stratum is usually moderately dense with cover ranging from 30% to 50% and common species include *Ilex vomitoria*, *Quercus laurifolia*, *Quercus nigra*, and *Triadica sebifera*. Herbaceous stratum is typically sparse.

**Dynamics:** This is a topographically isolated community that rarely burns. It typically contains a few to an abundant number of fire-sensitive species such as Fagus grandifolia, Magnolia grandiflora, and Ilex opaca. Insect and pathogen outbreaks are likely more important disturbance vectors in this community (Martin and Smith 1991, 1993). The influence and historical importance of fire on this type are poorly understood. Stands are found in areas where fire-return intervals were likely longer than in adjacent pyrogenic communities, with fire only entering from those adjacent areas (Martin and Smith 1993). Landers (1989) proposed that Pinus taeda habitats did not burn at all. In many areas where this vegetation is found in eastern Texas, there is no adjacent pyrogenic vegetation, suggesting that these areas may not have burned regularly, if at all, although attempts are made to use prescribed fire in these areas at least once every 10 years (R. Evans pers. obs.).

Conservation Status Rank
**Global**: G3G4

Global Environmental Description

This type occurs in a variety of ecological settings in the region, including middle and lower slopes between uplands and stream bottoms and at the heads of drainages along small, intermittent streams on acidic sandy loams, silt loams and silty clays, and mesic situations in flatwoods environments. Hydrology ranges from mesic-wet to dry-mesic. Soils are acidic and include silt loams, sandy loams, and silty clays. This forest occurs on mesic flats and middle and lower slopes between uplands and stream bottoms, often on Caddo and Glenmora silt loams. It is also known from along small streams on Caddo-Guyton silt loams. Caddo soils are poorly drained, slowly permeable fine-silty, siliceous, thermic Typic Glossaqualfs occurring on broad flats in the terrace uplands, with slopes less than 1%. Glenmora soils are moderately well-drained, slowly permeably fine-silty, siliceous, thermic Glossaquic Paleudalf with slopes ranging from 1-3%, occurring on broad ridgetops and gentle side slopes in terrace uplands. Guyton soils are poorly drained, slowly permeable soils formed in loamy alluvium. They are fine-silty, siliceous, thermic Typic Glossaqualfs with slopes less than 1% occurring in broad flats and depressions, and along streams. Caddo, Glenmora, and Guyton soils are typically found near each other (Kilpatrick et al. 1986, Martin and Smith 1991, 1993).

Global Vegetation Description

This mixed forest is dominated by both *Pinus taeda* and mixed hardwoods. Associated hardwoods may include *Quercus alba*, *Quercus nigra*, *Quercus laurifolia*, *Quercus phellos*, *Nyssa sylvatica*, *Liquidambar styraciflua*, *Fagus grandifolia*, *Magnolia grandiflora* (diminishes greatly north of central Louisiana), *Quercus michauxii*, *Quercus pagoda*, *Acer rubrum*, *Carya alba*, *Carya cordiformis*, and less commonly *Quercus falcata*, *Quercus stellata*, and *Carya texana*. The subcanopy may include canopy species and *Ilex opaca* var. *opaca*, *Ostrya virginiana*, *Carpinus caroliniana*, *Prunus mexicana*, and *Cornus florida*. The short-shrub stratum may include canopy and subcanopy species, plus *Callicarpa americana*, *Symplocos tinctoria*, *Morella cerifera* (= *Myrica cerifera*), *Vaccinium elliottii*, *Viburnum dentatum*, and *Viburnum acerifolium*. Herbaceous species may include *Polystichum acrostichoides*, *Athyrium filix-femina* ssp. *asplenioides*, *Phegopteris hexagonoptera*, *Spigelia marilandica*, *Mitchella repens*, *Podophyllum peltatum*, *Phlox divaricata*, *Tipularia discolor*, *Arisaema triphyllum*, *Chasmanthium laxum*, and *Melica mutica* (NatureServe Ecology unpubl. data, Turner et al. unpubl. data). The exotics *Lonicera japonica*, *Ligustrum sinense*, and *Microstegium vimineum* may occur in this community.

Example Photograph

Figure A68 below shows an example of CEGL007525 *Pinus taeda – Quercus alba –* (*Fagus grandifolia*) / *Smilax pumila – Mitchella repens* Forest.



**Figure A68.** *Pinus taeda – Quercus alba –* (*Fagus grandifolia*) / *Smilax pumila – Mitchella repens* Forest (CSU)

Short Citation

- Kilpatrick et al. 1986
- Landers 1989
- Martin and Smith 1991
- Martin and Smith 1993
- NatureServe Ecology unpubl. data
- R. Evans pers. obs.
- Turner et al. unpubl. data

***CEGL004713 Pinus echinata – Pinus taeda – Quercus (alba, falcata, stellata) Forest***

Table A54 below shows the USNVC Hierarchy for CEGL004713 *Pinus echinata – Pinus taeda – Quercus* (*alba*, *falcata*, *stellata*) Forest.

**Table A54.** USNVC hierarchy for CEGL004713 *Pinus echinata – Pinus taeda – Quercus* (*alba*, *falcata*, *stellata*) Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.2 Cool Temperate Forest & Woodland |
| Division | 1.B.2.Na Eastern North American Forest & Woodland |
| Macrogroup | 1.B.2.Na Southern & South-Central Oak - Pine Forest & Woodland |
| Group | 1.B.2.Na Western Gulf Coastal Plain Pine - Oak Forest & Woodland |
| Alliance | A3129 *Pinus echinata - Pinus taeda - Quercus stellata* Forest Alliance |
| Association | 1.B.2.Na *Pinus echinata - Pinus taeda - Quercus* (*alba*, *falcata*, *stellata*) Forest (CEGL004713) |

**Field Plots:** 8003, 8009

**Map Class:** BITH MC316

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 311.5 ft range 270 ft to 353 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland

**Soil Texture**: Sand, Sandy clay loam

**Environment**: 2 plots were sampled within this type. Ground cover is typically dominated by litter with cover values >90%. There is occasional wood as well with values <5%.

Local Vegetation Description
**Structure**:

**Vegetation Floristics**: Forest usually occurs on slopes. Codominant canopy species are *Pinus echinata* and *Pinus taeda.* At least two of the following oaks are dominant: *Quercus alba*, *Quercus falcata*, and *Quercus stellata.* Associated canopy species include *Carya alba*, *Carya texana*, and *Liquidambar styraciflua*. Shrub layer can contain *Callicarpa americana, Ilex decidua, Ilex vomitoria*, *Rhus aromatica*, *Sabal minor*, *Vaccinium* arboreum, and *Viburnum dentatum*. Common herbaceous species are *Chasmanthium sessiliflorum*, *Dichanthelium boscii*, *Elephantopus tomentosus*, *Euphorbia corollata*, *Michella repens*, and *Pteridium aquilinum*.

**Dynamics:** Apparently natural upland mixed stands with this composition were historically uncommon, but did occur in the West Gulf Coastal Plain region (R. Evans pers. comm., T. Foti pers. comm.). The overstory composition of stands attributed to this type suggest a fire-return interval of lower frequency than that associated with either longleaf or shortleaf pine forests. Many of the historical stands of this type have been converted to plantations or have been heavily fire-suppressed, resulting in succession to other types. Published references to loblolly - shortleaf mixed forest of the Coastal Plain of Arkansas (Cain and Shelton 1994) and eastern Texas (Halls and Homesley 1966) are from successional, fire-suppressed stands. In some cases, it may be hard to distinguish semi-natural mixed stands which have resulted from encroachment of loblolly pine into formerly pure shortleaf pine stands from naturally mixed stands.

Conservation Status Rank
**Global**: G3?

Global Environmental Description
These forests tend to occur on slopes, and generally occupy sites of intermediate moisture status, being somewhat drier than typical *Pinus taeda* communities, and somewhat more mesic than typical *Pinus echinata* or *Pinus palustris* communities. They may occur both within and beyond (landward and north of) the range of *Pinus palustris*.

Global Vegetation Description
Stands in eastern Texas are codominated by *Pinus echinata* and *Pinus taeda* with some combination of the nominal oaks *Quercus alba, Quercus falcata*, and *Quercus stellata*. Associated woody species may include *Carya alba, Carya texana* (within its range), with the shrubs *Callicarpa americana, Vaccinium* spp., and *Viburnum dentatum* (NatureServe Ecology unpubl. data, Turner et al. unpubl. data). An example from the Sam Houston National Forest (Mays Creek, SAMH.9; NatureServe Ecology unpubl. data) has an open canopy dominated by *Pinus echinata, Quercus alba*, and *Quercus falcata*, a subcanopy dominated by *Carya texana, Liquidambar styraciflua*, and *Sassafras albidum*, with *Callicarpa americana, Ilex vomitoria*, and *Rhus aromatica* as shrubs, and *Chasmanthium sessiliflorum, Dichanthelium boscii*, and *Mitchella repens* dominating the ground layer. In addition, the trees *Fraxinus americana, Nyssa sylvatica, Pinus taeda, Prunus serotina, Quercus stellata*, and *Quercus velutina* are present, along with the shrubs *Crataegus spathulata, Forestiera ligustrina, Frangula caroliniana, Ilex decidua, Sabal minor, Vaccinium arboreum*, and *Viburnum rufidulum*. Some additional herbs and ferns include *Botrychium dissectum, Cnidoscolus texanus, Elephantopus tomentosus, Euphorbia corollata*, and *Pteridium aquilinum*.

Example Photograph
N/A

Short Citation

- Cain and Shelton 1994)
- Halls and Homesley 1966
- NatureServe Ecology unpubl. data

- R. Evans pers. obs.
- T. Foti pers. comm.
- Turner et al. unpubl. data

***CEGL008581 Quercus alba – Quercus nigra / Ostrya virginiana / Sabal minor Forest***

Table A55 below shows the USNVC Hierarchy for CEGL008581 *Quercus alba – Quercus nigra* / *Ostrya virginiana* / *Sabal minor* Forest.

**Table A55.** USNVC hierarchy for CEGL008581 *Quercus alba – Quercus nigra* / *Ostrya virginiana* / *Sabal minor* Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.1 Warm Temperate Forest & Woodland |
| Division | 1.B.1.Na Southeastern North American Forest & Woodland |
| Macrogroup | 1.B.1.Na Southern Mesic Mixed Broadleaf Forest |
| Group | 1.B.1.Na Southern Mesic Beech - Magnolia - Oak Forest |
| Alliance | A3115 *Quercus alba - Quercus nigra - Sabal minor* Forest Alliance |
| Association | 1.B.1.Na *Quercus alba - Quercus nigra* / *Ostrya virginiana* / *Sabal minor* Forest (CEGL008581) |

**Field Plots:** 1043, 1030, 1097, 1038, 1083, 2077

**Map Class:** BITH MC317

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 72.67 ft range 18 ft to 135 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands, Floodplain ridge and swale, Upland, Upland swales

**Soil Texture**: Clay loam, Sandy clay loam, Silty clay, Silty clay loam

**Environment**: 6 plots were sampled within this type. This community typically occurs on flatlands and floodplains with silty to sandy clay loams. Litter usually dominates the ground cover with values generally >70%. Bare soil often forms a major component with cover <40%. Wood is sparse and has cover <3%.

Local Vegetation Description

**Structure**: Canopy (40%-60%), Sub canopy (0%-90%), Tall shrub (0%-30%), Short shrub (30%-90%), Herbaceous (0%-20%), Vine (0%-10%)

**Vegetation Floristics**: Canopy dominants include *Quercus alba*, *Quercus michauxii* (20-40% cover), *Quercus phellos* (30% cover), *Quercus nigra*, *Carya glabra*, *Carya tomentosa*, *Nyssa sylvatica*, *Ostrya virginiana*, and *Carpinus caroliniana*. Shrub layer dominants include *Sabal minor* (30-75% cover) and *Ilex vomitoria* (10-30% cover). The herbaceous layer is generally sparse and can commonly include *Chasmanthium laxum* and *Vitis rotundifolia*.

**Dynamics**: N/A

Conservation Status Rank

**Global**: G2G3

Global Environmental Description

This community occurs on the Fleming Formation of eastern Texas, on subcalcareous substrates (NatureServe Ecology unpubl. data). It is found on gentle mesic slopes adjacent to riparian areas along the southwestern periphery of the Upper West Gulf Coastal Plain, near the terminus of many typically southeastern species. Although the type is not temporarily flooded, the flora may be influenced by proximity to the creekside.

Global Vegetation Description

The canopy is dominated by *Quercus alba*, *Liquidambar styraciflua*, and *Quercus nigra* with lesser amounts of *Tilia americana* var. *caroliniana* (= *Tilia caroliniana*) and *Pinus taeda* present. The subcanopy is dominated by *Ostrya virginiana*, *Ilex opaca*, *Platanus occidentalis*, and *Morus rubra*. *Sabal minor*, *Forestiera ligustrina*, and *Arundinaria gigantea* are the dominant shrub species. The understory includes *Polystichum acrostichoides*, *Chasmanthium sessiliflorum*, *Cocculus carolinus*, *Bignonia capreolata*, *Berchemia scandens*, *Sanicula canadensis*, *Passiflora lutea*, *Elephantopus tomentosus*, *Dichanthelium boscii*, *Oplismenus hirtellus* ssp. *setarius* (= *Oplismenus setarius*), *Smallanthus uvedalius*, and *Thelypteris kunthii*.

Example Photograph

Figure A69 below shows an example of CEGL008581 *Quercus alba – Quercus nigra* / *Ostrya virginiana* / *Sabal minor* Forest.



**Figure A69.** *Quercus alba – Quercus nigra* / *Ostrya virginiana* / *Sabal minor* Forest (CSU)

### *CEGL007872 Fagus grandifolia – Magnolia grandiflora – Quercus alba / Carpinus caroliniana – Ostrya caroliniana Forest*

Table A56 below shows the USNVC Hierarchy for CEGL007872 *Fagus grandifolia – Magnolia grandiflora – Quercus alba* / *Carpinus caroliniana – Ostrya caroliniana* Forest.

**Table A56.** USNVC hierarchy for CEGL007872 *Fagus grandifolia – Magnolia grandiflora – Quercus alba* / *Carpinus caroliniana – Ostrya caroliniana* Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.1 Warm Temperate Forest & Woodland |
| Division | 1.B.1.Na Southeastern North American Forest & Woodland |
| Macrogroup | 1.B.1.Na Southern Mesic Mixed Broadleaf Forest |
| Group | 1.B.1.Na Southern Mesic Beech - Magnolia - Oak Forest |
| Alliance | A0369 *Fagus grandifolia - Magnolia grandiflora* Forest Alliance |
| Association | 1.B.1.Na *Fagus grandifolia - Magnolia grandiflora - Quercus alba* / *Carpinus caroliniana - Ostrya virginiana* Forest (CEGL007872) |

**Field Plots:** 7016a

**Map Class:** BITH MC317

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 145 ft

**Aspect**: Mean 180 range 90 to 270

**Slope**: Mean 2.5 range 1 to 5

**Macro Topography**: Hillslope

**Soil Texture**: Loamy sand

**Environment**: One plot was sampled within this type. This community typically occurs along low slopes near drainages. Ground cover is dominated by litter with values reaching 90%. Wood occasionally occurs here with values around 5%.

Local Vegetation Description
**Structure**: Canopy (10%-60%), Short shrub (0%-20%), Herbaceous (10%-30%)

**Vegetation Floristics**: *Fagus grandifolia* (20-50% cover) is the canopy dominant with minor components of *Liquidambar styraciflua*, *Magnolia grandiflora*, *Pinus taeda* (<10% cover), *Quercus alba*, and *Quercus nigra*. Understory trees include an abundance of *Carpinus caroliniana* ssp. *caroliniana* and *Ostrya virginiana* with associated *Cornus florida*, *Ilex opaca* var. *opaca*, and *Nyssa sylvatica*. A sparse shrub layer is present with common occurrences of *Callicarpa americana*, *Hamamelis virginiana*, *Ilex vomitoria*, *Rhamnus caroliniana* (*Frangula caroliniana*), *Styrax americanus*, and *Vaccinium elliottii*. *Vitis rotundifolia* is an abundant vine. Herbaceous layer is sparse.

**Dynamics:** *Magnolia grandiflora* may not be regenerating successfully in the best-known example of this type in eastern Texas (Nixon et al. 1980). Many natural canopy gaps are present at this site. Due to the status of this site as a Research Natural Area, permanent vegetation plots were established, and additional data on successional trends may be available.

Conservation Status Rank
**Global**: G2

Global Environmental Description
This community occurs on the Wilcox and Beaumont formations in eastern Texas on moist slopes and non-flooding flats. The classic example of this association, documented by Nixon et al. (1980a), occurred on loam to sandy loam soils that averaged about 54% sand, 32% silt, and 14% clay, with pH ranging from 4.4-4.6, and very low nutrient levels.

Global Vegetation Description

The closed upper canopy consists of *Fagus grandifolia* with occasional representatives of *Magnolia grandiflora, Liquidambar styraciflua, Quercus nigra*, and *Quercus alba*. *Pinus taeda* is usually present to some degree. Other woody species may include *Acer rubrum, Aesculus pavia, Amelanchier arborea, Aralia spinosa, Arundinaria gigantea, Berchemia scandens, Bignonia capreolata, Carya glabra, Crataegus marshallii, Fraxinus americana, Gelsemium sempervirens, Halesia diptera, Magnolia virginiana, Morus rubra, Parthenocissus quinquefolia, Prunus caroliniana, Quercus falcata, Quercus laurifolia, Quercus michauxii, Quercus pagoda, Quercus phellos, Smilax laurifolia, Styrax grandifolius, Ulmus alata, Sideroxylon lanuginosum, Symplocos tinctoria, Vaccinium arboreum, Viburnum dentatum, Ilex ambigua*, and *Sassafras albidum*. In more easterly examples, *Magnolia macrophylla* and *Hydrangea quercifolia* can be present and common. Midstory trees are prevalent, with *Carpinus caroliniana ssp. caroliniana* and *Ostrya virginiana* being most important, although *Ilex opaca var. opaca, Cornus florida*, and *Nyssa sylvatica* are also common A sparse herbaceous stratum typical of mesic, acid, hardwood forests of the region may include *Arisaema triphyllum, Aristolochia serpentaria, Athyrium filix-femina ssp. asplenioides, Botrychium virginianum, Carex* spp., *Chasmanthium sessiliflorum, Desmodium nudiflorum, Elephantopus carolinianus, Epifagus virginiana, Galium circaezans, Mitchella repens, Oxalis* sp., *Phegopteris hexagonoptera, Podophyllum peltatum, Polystichum acrostichoides, Trillium ludovicianum*, and *Viola* sp.

Example Photograph

Figure A70 below shows an example of CEGL007872 *Fagus grandifolia – Magnolia grandiflora – Quercus alba* / *Carpinus caroliniana – Ostrya caroliniana* Forest.



**Figure A70.** *Fagus grandifolia – Magnolia grandiflora – Quercus alba* / *Carpinus caroliniana – Ostrya caroliniana* Forest (CSU)

Short Citation
Nixon et al. 1980

### *CEGL008415 Quercus falcata – Quercus stellata – (Pinus taeda) West Gulf Coastal Plain Forest*

Table A57 below shows the USNVC Hierarchy for CEGL008415 *Quercus falcata – Quercus stellata* – (*Pinus taeda*) West Gulf Coastal Plain Forest.

**Table A57.** USNVC hierarchy for CEGL008415 *Quercus falcata – Quercus stellata* – (*Pinus taeda*) West Gulf Coastal Plain Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.2 Cool Temperate Forest & Woodland |
| Division | 1.B.2.Na Eastern North American Forest & Woodland |
| Macrogroup | 1.B.2.Na Southern & South-Central Oak - Pine Forest & Woodland |

**Table A57 (continued).** USNVC hierarchy for CEGL008415 *Quercus falcata* – *Quercus stellata* – (*Pinus taeda*) West Gulf Coastal Plain Forest

| Category | Description |
|---|---|
| Group | 1.B.2.Na South-Central Interior Oak Forest & Woodland |
| Alliance | A3288 *Quercus alba* - *Quercus falcata* - *Quercus stellata* Ozark-Ouachita Forest Alliance |
| Association | 1.B.2.Na *Quercus falcata* - *Quercus stellata* - (*Pinus taeda*) West Gulf Coastal Plain Forest (CEGL008415) |

**Field Plots:** 7011

**Map Class:** BITH MC317

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 263 ft

**Aspect**: 220

**Slope**: 7

**Macro Topography**: Mid slope

**Soil Texture**: Sandy clay

**Environment**: 1 plot was sampled within this type. This community occurs on low south facing slopes. Ground cover is dominated by litter with values reaching 90%. Wood is typically present within the ground cover with values <5%.

Local Vegetation Description
**Structure**: Canopy (60%), Sub canopy (10%), Short shrub (40%), Herbaceous (10%)

**Vegetation Floristics**: *Quercus falcata* dominates the canopy. *Liquidambar styraciflua*, *Quercus stellata*, and *Pinus taeda* are often present in the canopy. The shrub layer is often moderate and includes *Ilex vomitoria*, *Cornus florida*, and *Fagus grandifolia*.

**Dynamics**: The landscape in which these sites are found are predominately riparian, suggesting that natural fire frequency may have been quite low.

Conservation Status Rank
**Global**: G3?

Global Environmental Description
This type occurs on the Yegua Formation in eastern Texas on mid to lower slopes and high Pleistocene terraces which do not receive overbank flooding under normal conditions. Soils at

documented plot locations were mapped as 84, 88m (Moswell Series?), 85e (Eastwood?), and 52. They tested fairly low in surface pH (5.0-5.9) with sandy loam to loamy surface textures (Turner et al. unpubl. data). Stands documented in eastern Texas vary somewhat in moisture status, from dry-mesic to mesic.

Global Vegetation Description

All stands are characterized by *Quercus falcata* as the single most important species. Other woody species documented in drier vegetation plots in eastern Texas include *Acer rubrum, Pinus echinata, Ilex vomitoria, Callicarpa americana, Viburnum rufidulum, Chionanthus virginicus, Liquidambar styraciflua, Forestiera ligustrina, Vaccinium arboreum, Carya cordiformis, Quercus velutina, Cornus florida*, and *Quercus alba*. The understory, as is typical of densely shaded dry to dry-mesic forests of the region, is relatively low in species diversity and dominated by *Chasmanthium sessiliflorum, Parthenocissus quinquefolia*, and *Gelsemium sempervirens*. Slightly more mesic plots also have *Ilex opaca, Carpinus caroliniana, Ostrya virginiana, Quercus nigra, Quercus phellos, Quercus laurifolia*, and *Ulmus* spp.

Example Photograph

Figure A71 below shows an example of CEGL008415 *Quercus falcata – Quercus stellata –* (*Pinus taeda*) West Gulf Coastal Plain Forest.



**Figure A71.** *Quercus falcata – Quercus stellata –* (*Pinus taeda*) West Gulf Coastal Plain Forest (CSU)

Short Citation
Turner et al. unpubl. Data.

***CEGL007959 Quercus alba – Quercus hemisphaerica / Prunus caroliniana – Persea borbonia – Viburnum acerifolium Forest***

Table A58 below shows the USNVC Hierarchy for CEGL007959 *Quercus alba – Quercus hemisphaerica* / *Prunus caroliniana – Persea borbonia – Viburnum acerifolium* Forest.

**Table A58.** USNVC hierarchy for CEGL007959 *Quercus alba – Quercus hemisphaerica* / *Prunus caroliniana – Persea borbonia – Viburnum acerifolium* Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.1 Warm Temperate Forest & Woodland |
| Division | 1.B.1.Na Southeastern North American Forest & Woodland |
| Macrogroup | 1.B.1.Na Southern Mesic Mixed Broadleaf Forest |
| Group | 1.B.1.Na Southern Mesic Beech - Magnolia - Oak Forest |
| Alliance | A3115 *Quercus alba* - *Quercus nigra* - *Sabal minor* Forest Alliance |
| Association | 1.B.1.Na *Quercus alba* - *Quercus hemisphaerica* / *Prunus caroliniana* - *Persea borbonia* - *Viburnum acerifolium* Forest (CEGL007959) |

**Field Plots:** Field Reconnaissance

**Map Class:** BITH MC317

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 220 ft range 200 ft to 240 ft

**Aspect**: Mean 215 range 170 to 260

**Slope**: Mean 4 range 2 to 6

**Macro Topography**: Hillslope

**Soil Texture**: Sandy loam

**Environment:** This community occurs on mesic west to south facing slopes. Ground cover is dominated by litter with cover values reaching 90%. Wood often is present with cover values reaching 10%.

Local Vegetation Description

**Structure**: Canopy (20%-60%), Sub-canopy (0%-30%), Tall shrub (0%-20%), Short shrub (20%-40%), Herbaceous (0%-20%)

**Vegetation Floristics**: Forest occurs on mesic gradual slopes that grade into a riparian zone. The dominant canopy species are *Quercus alba* and *Quercus hemisphaerica*. Associated tree species can include *Acer rubrum*, *Cornus florida*, *Fraxinus americana*, *Ilex opaca*, *Pinus echinata*, *Pinus taeda*, *Quercus falcata*, and *Quercus stellata*. Dominant shrubs are *Persea borbonia* and *Viburnum acerifolium*; found with *Callicarpa americana*, *Chionanthus virginicus*, *Ilex vomitoria*, *Prunus caroliniana*, *Vaccinium virgatum*, and *Viburnum dentatum*. A diverse herbaceous stratum may contain 70 unique species with the most common being *Chasmanthium sessiliflorum*, *Dichanthelium boscii*, *Dichanthelium commutatum*, *Smilax pumila*, *Smilax tamnoides*, *Viburnum acerifolium*, and *Vitis rotundifolia.*

**Dynamics**: This type occurs in locally mesic settings where the role of fire is believed to have been of minor importance, and many of the key species are intolerant of repeated, frequent fires.

Conservation Status Rank

**Global**: G2

Global Environmental Description

This forest occurs on broad, gradual, mesic slopes grading into riparian areas along the southwestern periphery of the West Gulf Coastal Plain. Plot locations on Sam Houston National Forest were reportedly mapped as Pinetucky, Boykin, and Doucette soil series. Actual soil analysis from these locations documents pH ranging from 5.4-6.3 at 5 sample sites, 2 sites were considerably lower (4.8 and 5.0), and one site was extremely high (8.1). All sites were more than 68% sand in the upper surface and relatively low in nutrients, except for the high pH outlier site, which was dominated by fine-textured particles in the upper surface sample and tested very high in calcium (plot SHNF H9103B).

Global Vegetation Description

*Pinus echinata* and *Pinus taeda* are sometimes present. Other important overstory tree species include *Quercus falcata*, *Quercus stellata*, *Ilex opaca*, *Prunus serotina*, *Cornus florida*, *Liquidambar styraciflua*, *Acer rubrum*, and *Fraxinus americana*. *Persea borbonia* and *Viburnum acerifolium* are strong shrub dominants with *Ilex vomitoria*, *Vaccinium virgatum*, *Chionanthus virginicus*, *Prunus caroliniana*, *Callicarpa americana*, and *Viburnum dentatum* also frequently encountered, along with *Ostrya virginiana* and *Symplocos tinctoria*. About 60-70 species have been documented in the understory. The most dominant ground cover species are *Smilax pumila*, *Dichanthelium boscii*, *Dichanthelium commutatum*, *Smilax tamnoides* (= *Smilax hispida*), *Viburnum acerifolium*, *Vitis rotundifolia*, *Chasmanthium sessiliflorum*, and *Mitchella repens*.

Example Photograph

Figure A72 below shows an example of CEGL007959 *Quercus alba – Quercus hemisphaerica* / *Prunus caroliniana – Persea borbonia – Viburnum acerifolium* Forest.



**Figure A72.** *Quercus alba – Quercus hemisphaerica* / *Prunus caroliniana – Persea borbonia – Viburnum acerifolium* Forest (CSU)

### *CEGL007208 Fagus grandifolia – Quercus alba / Ilex opaca var. opaca / Athyrium filix – femina spp. asplenioides Forest*

Table A59 below shows the USNVC Hierarchy for CEGL007208 *Fagus grandifolia – Quercus alba* / *Ilex opaca* var. *opaca* / *Athyrium filix – femina* spp. *asplenioides* Forest.

**Table A59.** USNVC hierarchy for CEGL007208 *Fagus grandifolia – Quercus alba* / *Ilex opaca* var. *opaca* / *Athyrium filix – femina* spp. *asplenioides* Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.1 Warm Temperate Forest & Woodland |
| Division | 1.B.1.Na Southeastern North American Forest & Woodland |
| Macrogroup | 1.B.1.Na Southern Mesic Mixed Broadleaf Forest |
| Group | 1.B.1.Na Southern Mesic Beech - Oak - Mixed Deciduous Forest |
| Alliance | A2059 *Fagus grandifolia - Quercus alba - Quercus nigra* Coastal Plain Forest Alliance |
| Association | 1.B.1.Na *Fagus grandifolia - Quercus alba* / *Ilex opaca* var. *opaca* / *Athyrium filix-femina* ssp. *asplenioides* Forest (CEGL007208) |

**Field Plots:** Field Reconnaissance

**Map Class:** BITH MC317

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 48 ft

**Aspect**: 328

**Slope**: 30

**Macro Topography**: Hillslope

**Soil Texture**: Loamy sand

**Environment**: This community occurs on steep hillslopes. Ground cover is dominated by litter with cover reaching up to ~95%. Wood is typically present with cover <5%.

Local Vegetation Description
**Structure**: Canopy (~70%), Subcanopy (~30%)

**Vegetation Floristics**: The canopy is dominated by tall mature *Fagus grandifolia* with cover reaching 40%. Other common canopy species include *Quercus alba*, *Ilex opaca*, *Quercus nigra*, and *Magnolia virginiana*. Shrubs are sparse and common species include *Ilex vomitoria*, *Carya tomentosa*, *Morella cerifera*, and *Hamamelis virginiana*. Herbaceous stratum is sparse with total cover <5%.

**Dynamics**: This forest is not a pyrogenic community and experiences very infrequent fires due to its position on generally steep slopes and the lack of available fuel generated by the relatively inflammable deciduous leaf litter. Mesic examples on lower slopes probably burn even less frequently than dry/mesic sites on mid to upper slopes. This association occurs on portions of the landscape where periodic fires were rare to nonexistent, especially mesic steep slopes, and mid to lower slopes along rivers and small streams throughout much of the West Gulf Coastal Plain. The main disturbance vectors in this broad-leaved deciduous forest are windthrow and the active erosion that occurs on the steep slopes. As downstream channelization and gully formation cause streams to erode headward, banks are undercut and erosion is catalyzed on the slopes. This active erosion may contribute to the sparse herbaceous layer. Windstorms, diseases and insects are other disturbances in this uneven-aged forest. Regeneration occurs primarily in canopy gaps (Martin and Smith 1991).

Conservation Status Rank
**Global**: G3

Global Environmental Description
This forest occurs on acidic soils, typically loamy sands or silt loams including Susquehanna silt loam and Betis and Briley loamy fine sands. Associated geology includes the Sparta, Cockfield,

Jackson, Vicksburg, Catahoula, and Fleming formations and Pleistocene High Terraces. Hydrology ranges from dry-mesic to mesic; this community is not subject to flooding. This broad-leaved forest is associated with hilly terrain. The slopes from which this community is known are generally steep, and grade down to riparian forests along streams. It is most common on middle and lower slopes (Martin and Smith 1991).

Global Vegetation Description

Stands are dominated by a combination of *Fagus grandifolia* and *Quercus alba* (NatureServe Ecology unpubl. data, Turner et al. unpubl. data). Some stands may have slightly more *Quercus alba* than *Fagus grandifolia* and vice versa (R. Evans pers. obs.). *Pinus taeda* may occur in the canopy but not as a dominant. Although *Fagus grandifolia* and *Quercus alba* may be the only canopy species in some occurrences, canopy species in other occurrences may include *Quercus michauxii, Quercus pagoda, Quercus velutina, Quercus nigra, Quercus stellata, Carya alba, Nyssa sylvatica, Liquidambar styraciflua*, and *Acer rubrum*. *Liriodendron tulipifera* may be present in Arkansas and Louisiana examples, but is not a natural component of this type in Texas or Oklahoma. *Magnolia grandiflora* may also be present in examples of this type in Louisiana and Texas, but is absent in Arkansas and Oklahoma. *Phoradendron leucarpum, Tillandsia usneoides*, and *Pleopeltis polypodioides (= Polypodium polypodioides)* are common epiphytes on the canopy trees. The scattered to patchy tall-shrub stratum includes regenerating canopy species and *Ilex opaca var. opaca, Carpinus caroliniana, Ostrya virginiana, Cornus florida, Styrax grandifolius*, and *Crataegus marshallii*. The patchy short-shrub stratum includes *Vaccinium virgatum (= Vaccinium amoenum), Vaccinium arboreum, Vaccinium elliottii, Ilex opaca var. opaca, Chionanthus virginicus, Crataegus marshallii, Frangula caroliniana (= Rhamnus caroliniana), Amelanchier arborea, Callicarpa americana, Ilex ambigua, Viburnum acerifolium, Viburnum dentatum*, and *Viburnum rufidulum*. The sparse herbaceous layer includes *Polystichum acrostichoides, Trillium* spp., *Prenanthes altissima, Spigelia marilandica, Galium circaezans, Desmodium nudiflorum, Uvularia perfoliata, Polygonatum biflorum, Arisaema triphyllum, Viola walteri, Mitchella repens, Tipularia discolor, Lilium michauxii, Smilax herbacea*, and *Podophyllum peltatum*. *Magnolia acuminata* may be present in a few examples of this type, along the eastern and northern periphery of the region associated with especially moist lower slopes. Rare species that may occur in this community include *Prenanthes barbata, Cypripedium kentuckiense*, and *Triphora trianthophora*.

Example Photograph

Figure A73 below shows an example of CEGL007208 *Fagus grandifolia – Quercus alba* / *Ilex opaca* var. *opaca* / *Athyrium filix – femina* spp. *asplenioides* Forest.



**Figure A73.** *Fagus grandifolia – Quercus alba* / *Ilex opaca* var. *opaca* / *Athyrium filix – femina* spp. *asplenioides* Forest (CSU)

Short Citation

- Martin and Smith 1991
- NatureServe Ecology unpubl. data
- R. Evans pers. obs.
- Turner et al. unpubl. data

***NPSBITH024 Quercus michauxii – Quercus nigra – Magnolia grandiflora Mesic Forest***
USNVC Hierarchy: Park Special NPSBITH024

**Field Plots:** 7016

**Map Class:** BITH MC317

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 145 ft

**Aspect**: 22

**Slope**: 10

**Macro Topography**: Hillslope

**Soil Texture**: Loamy sand

**Environment**: 1 plot was sampled within this type. These communities typically occur on loamy sands near above riparian or flatwood environments. Ground cover is dominated by litter with cover up to 90%. Wood is typically present in small amounts with cover <3%.

Local Vegetation Description
**Structure**: Canopy (60%), Subcanopy (20%), Tall shrub (10%), Herbaceous (30%)

**Vegetation Floristics**: *Quercus michauxii* dominates the canopy with *Fagus grandifolia*, *Magnolia grandiflora*, and *Quercus nigra* are often canopy associates and occasionally codominate. The shrub layer is often dominated by *Ostrya virginiana*, *Carpinus caroliniana*, and *Ilex vomitoria*. *Arundinaria gigantea* and *Parthenocissus quinquefolia* often dominates the herbaceous stratum with cover ~30%.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A74 below shows an example of Park Special NPSBITH024 *Quercus michauxii – Quercus nigra – Magnolia grandiflora* Mesic Forest.



**Figure A74.** *Quercus michauxii – Quercus nigra – Magnolia grandiflora* Mesic Forest (CSU)

### *CEGL008413 Quercus alba – Carya alba / Chasmanthium sessiliflorum West Gulf Coastal Plain*

Table A60 below shows the USNVC Hierarchy for CEGL008413 *Quercus alba – Carya alba* / *Chasmanthium sessiliflorum* West Gulf Coastal Plain.

**Table A60.** USNVC hierarchy for CEGL008413 *Quercus alba – Carya alba* / *Chasmanthium sessiliflorum* West Gulf Coastal Plain

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.1 Warm Temperate Forest & Woodland |
| Division | 1.B.1.Na Southeastern North American Forest & Woodland |
| Macrogroup | 1.B.1.Na Southern Mesic Mixed Broadleaf Forest |
| Group | 1.B.1.Na Southern Mesic Beech - Oak - Mixed Deciduous Forest |
| Alliance | A3234 *Quercus alba - Carya alba* Mesic Coastal Plain Forest Alliance |
| Association | 1.B.1.Na *Quercus alba - Carya alba* / *Chasmanthium sessiliflorum* West Gulf Coastal Plain Forest (CEGL008413) |

**Field Plots:** 1027, 1009, 1046, 1017, 1076, 1079, 2059

**Map Class:** BITH MC318

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 173.86 ft range 13 ft to 258 ft

**Aspect**: Mean 76.29 range 0 to 252

**Slope**: Mean 3.86 range 0 to 20

**Macro Topography**: Hillslope seepage area, Upland, Upland swales

**Soil Texture**: Loamy sand, Sandy loam

**Environment**: 7 plots were sampled within this type. This community typically occurs on uplands with loamy sands. Litter dominates the ground cover with values >70%. Wood may be plentiful as ground cover with values ranging from 3% to 15%. Bare soil is typically sparse with cover usually <10%.

Local Vegetation Description
**Structure**: Canopy (20%-60%), Sub canopy (0%-40%), Tall shrub (10%-90%), Short shrub (0%-10%), Herbaceous (0%-20%), Vine (0%-10%)

**Vegetation Floristics**: Quercus alba is the most abundant species in the canopy with cover usually ranging from 30% and 60%. Other common canopy codominants include Carya tomentosa, Ilex opaca, Magnolia grandiflora, Quercus laurifolia, and Fagus grandifolia. Shrub layer most abundant species is Ilex vomitoria (40-80% cover). Herbaceous layer is sparse typically with Chasmanthium sessiliflorum and Vitis rotundifolia.

**Dynamics**: N/A

Conservation Status Rank
**Global**: G3G4

Global Environmental Description
This forest has been recognized from a single site in eastern Texas, where it is found on a very gradual lower slope which grades into a broad expanse of hardwood "flatwoods" near Patroon Bayou in the Sabine National Forest.

Global Vegetation Description
This type has been only recently recognized in the region and remains poorly documented. At a single plot location in eastern Texas (near Patroon Bayou in the Sabine National Forest), *Quercus alba* is strongly dominant in the overstory, along with lesser amounts of *Carya alba, Quercus pagoda*, and *Liquidambar styraciflua*. The subcanopy consists of *Nyssa sylvatica, Ilex opaca*,

and *Tilia americana var. caroliniana*. A short-shrub layer is dominated by *Carpinus caroliniana*, with some *Ostrya virginiana, Acer rubrum, Chionanthus virginicus, Aralia spinosa, Viburnum dentatum*, and *Ilex vomitoria* present. More data on stands of this type throughout the region are needed.

Example Photograph

Figure A75 below shows an example of CEGL008413 *Quercus alba – Carya alba* / *Chasmanthium sessiliflorum* West Gulf Coastal Plain.



**Figure A75.** *Quercus alba – Carya alba* / *Chasmanthium sessiliflorum* West Gulf Coastal Plain (CSU)

### *CEGL008414 Quercus alba – Quercus falcata – Quercus stellata – Nyssa sylvatica / Carex cherokeensis Forest*

Table A61 below shows the USNVC Hierarchy for CEGL008414 *Quercus alba – Quercus falcata – Quercus stellata – Nyssa sylvatica* / *Carex cherokeensis* Forest.

**Table A61.** USNVC hierarchy for CEGL008414 *Quercus alba – Quercus falcata – Quercus stellata – Nyssa sylvatica* / *Carex cherokeensis* Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.2 Cool Temperate Forest & Woodland |
| Division | 1.B.2.Na Eastern North American Forest & Woodland |
| Macrogroup | 1.B.2.Na Southern & South-Central Oak - Pine Forest & Woodland |
| Group | 1.B.2.Na South-Central Interior Oak Forest & Woodland |
| Alliance | A3290 *Quercus stellata - Quercus marilandica - Quercus alba* Ozark-Ouachita Woodland Alliance |
| Association | 1.B.2.Na *Quercus alba - Quercus falcata - Quercus stellata - Nyssa sylvatica* / *Carex cherokeensis* Forest (CEGL008414) |

**Field Plots:** 0319_119, 0319_122

**Map Class:** BITH MC318

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: mean 260 ft range 200 ft to 320 ft

**Aspect**: mean 165 range 130 to 200

**Slope**: mean 7 range 4 to 14

**Macro Topography**: Upper slope

**Soil Texture**: Loamy sand

**Environment**: Two plots were sampled within this type. This community occurs on dry southeast facing slopes. Ground cover is dominated by litter with covers reaching up to 95%. Wood is typically present with low abundance of <5%.

Local Vegetation Description
**Structure**: Canopy (40%-70%), Short shrub (30%-50%)

**Vegetation Floristics**: The canopy is dominated by *Quercus alba* and *Quercus falcata*. Other common canopy species include *Nyssa sylvatica*, *Quercus pagoda*, and *Pinus taeda*. Shrubs typically have moderate cover and common species include *Ilex vomitoria*, *Ostrya virginiana*, and *Liquidambar styraciflua*.

**Dynamics**: N/A

Conservation Status Rank
**Global**: G3G4

Global Environmental Description
This dry-mesic mixed oak (or oak - pine) upland forest or woodland community of the Upper West Gulf Coastal Plain generally occurs on nearly level terrain usually in higher topographic positions on the landscape. The soils are moderately deep with high moisture-holding capacities. Soils are nearly level, fine sandy loams of the Okitibbeha Series. Okitibbeha soils have acidic surface layers over calcareous marls with a high shrink-swell character and could be described as xero-hydric. Small ravines or eroded areas that cut through the Okitibbeha soils create habitat for calciphiles such as *Carya myristiciformis* and *Quercus muehlenbergii*.

Global Vegetation Description
Dominant matrix tree species in this association include *Quercus alba, Quercus falcata*, and *Nyssa sylvatica*. *Pinus* spp. density appears to depend on disturbance frequency and can be missing or dominant. Large *Pinus echinata* appear almost relictual, and with non-fire disturbance patterns, *Pinus taeda* replaces it. Other tree species include *Carya myristiciformis, Carya texana, Carya alba (= Carya tomentosa), Quercus marilandica*, and *Quercus muehlenbergii*. Other sapling, shrub and woody vines include *Asimina triloba, Berchemia scandens, Callicarpa americana, Campsis radicans, Ostrya virginiana, Parthenocissus quinquefolia, Rubus flagellaris, Smilax bona-nox, Smilax rotundifolia*, and *Toxicodendron radicans*. Dominant herbaceous species include *Chasmanthium sessiliflorum* with *Andropogon virginicus, Asclepias variegata, Botrychium virginianum, Carex cherokeensis, Camassia scilloides, Coreopsis lanceolata, Elephantopus carolinianus, Phlox pilosa, Polystichum acrostichoides, Ruellia strepens, Schizachyrium scoparium, Scleria oligantha, Solidago odora, Solidago petiolaris, Vernonia baldwinii*, and *Viola x palmata*.

Example Photograph
Figure A76 below shows an example of CEGL008414 *Quercus alba – Quercus falcata – Quercus stellata – Nyssa sylvatica* / *Carex cherokeensis* Forest.



**Figure A76.** *Quercus alba – Quercus falcata – Quercus stellata – Nyssa sylvatica* / *Carex cherokeensis* Forest (CSU)

### *CEGL007751 Quercus hemisphaerica – Quercus (falcata, nigra) / Vaccinium arboreum / Cnidoscolus stimulosus Forest*

Table A62 below shows the USNVC Hierarchy for CEGL007751 *Quercus hemisphaerica – Quercus* (*falcata*, *nigra*) / *Vaccinium arboreum* / *Cnidoscolus stimulosus* Forest.

**Table A62.** USNVC hierarchy for CEGL007751 *Quercus hemisphaerica – Quercus* (*falcata*, *nigra*) / *Vaccinium arboreum* / *Cnidoscolus stimulosus* Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.1 Warm Temperate Forest & Woodland |
| Division | 1.B.1.Na Southeastern North American Forest & Woodland |
| Macrogroup | 1.B.1.Na Southeastern Coastal Plain Evergreen Oak - Mixed Hardwood Forest |
| Group | 1.B.1.Na Southern Evergreen Oak Forest |
| Alliance | A0053 *Quercus hemisphaerica* - *Quercus nigra* Forest Alliance |
| Association | 1.B.1.Na *Quercus hemisphaerica* - *Quercus* (*falcata*, *nigra*) / *Vaccinium arboreum* / *Cnidoscolus stimulosus* Forest (CEGL007751) |

**Field Plots:** 3007, 7013

**Map Class:** BITH MC318

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 107 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain lower terrace, Upland

**Soil Texture**: Sandy loam, Clay

**Environment**: 2 plots were sampled within this type. This community occurs along a variety of topographies. Ground cover is dominated by litter with cover >85%. Woody is usually present with cover ~5%.

Local Vegetation Description
**Structure**: Canopy (20%-40%), Short shrub (50%-90%), Herbaceous (0%-20%)

**Vegetation Floristics**: Sandy upland forest occurring on sites sheltered from fire. Canopy dominants include *Quercus hemisphaerica*, *Quercus falcata*, and *Quercus nigra*. Associated tree species can include *Carya tomentosa* (*Carya alba*), *Cornus florida*, *Ilex opaca*, *Liriodendron tulipifera*, *Liquidambar styraciflua*, *Magnolia grandiflora*, *Pinus taeda* (<30% cover), and *Quercus nigra*. Shrub layer is dense (>70% cover) with *Quercus hemisphaerica* and *Ilex vomitoria*; common species are *Callicarpa americana*, *Hypericum hypericoides*, *Vaccinium arboreum*, and *Vaccinium* spp. Common vines are *Gelsemium sempervirens* and *Vitis rotundifolia*. Herbs are sparse and may include *Cnidoscolus stimulosus* and *Desmodium* spp.

**Dynamics:** Some examples in heavily eroded or impacted landscapes may be virtually monospecific and have few other canopy species other than Quercus hemisphaerica.

Conservation Status Rank
**Global**: G4

Global Environmental Description
This vegetation type is found on fire-sheltered sandy uplands.

Global Vegetation Description
The canopy is dominated by various combinations of *Quercus hemisphaerica, Quercus falcata*, and *Quercus nigra*. Other canopy and subcanopy trees may include *Carya pallida, Carya alba, Liriodendron tulipifera*, and *Liquidambar styraciflua*. Within its range, *Quercus virginiana* may be present. The subcanopy may include *Cornus florida, Magnolia grandiflora, Quercus nigra*, and *Ilex*

*opaca*. Shrubs and vines include *Vaccinium arboreum, Vaccinium* sp., *Callicarpa americana, Hypericum hypericoides, Gelsemium sempervirens*, and *Vitis rotundifolia*. Herbs, which are few and sparse, include *Cnidoscolus stimulosus, Indigofera caroliniana, Euphorbia floridana* (within its range), *Aristolochia serpentaria*, and *Desmodium* sp.

Example Photograph

Figure A77 below shows an example of CEGL007751 *Quercus hemisphaerica – Quercus* (*falcata*, *nigra*) / *Vaccinium arboreum* / *Cnidoscolus stimulosus* Forest.



**Figure A77.** *Quercus hemisphaerica – Quercus* (*falcata*, *nigra*) / *Vaccinium arboreum* / *Cnidoscolus stimulosus* Forest (CSU)

***CEGL002112 Pinus taeda – Quercus stellata / Crataegus spp. Woodland***

Table A63 below shows the USNVC Hierarchy for CEGL002112 *Pinus taeda – Quercus stellata* / *Crataegus* spp. Woodland.

**Table A63.** USNVC hierarchy for CEGL002112 *Pinus taeda* – *Quercus stellata* / *Crataegus* spp. Woodland

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.2 Cool Temperate Forest & Woodland |
| Division | 1.B.2.Na Eastern North American Forest & Woodland |
| Macrogroup | 1.B.2.Na Southern & South-Central Oak - Pine Forest & Woodland |
| Group | 1.B.2.Na Western Gulf Coastal Plain Pine - Oak Forest & Woodland |
| Alliance | A3129 *Pinus echinata* - *Pinus taeda* - *Quercus stellata* Forest Alliance |
| Association | 1.B.2.Na *Pinus taeda* - *Quercus stellata* / *Crataegus* spp. Woodland (CEGL002112) |

**Field Plots:** 1024, 1028, 1093, 1095, 0319_019

**Map Class:** BITH MC319

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 91.3 ft range 0 ft to 168 ft

**Aspect**: Mean 22.5 range 0 to 90

**Slope**: Mean 2.5 range 0 to 10

**Macro Topography**: Upland Flat, Hillslope

**Soil Texture**: Loamy sand, Silt loam, Clay loam

**Environment**: 5 plots were sampled within this type. Ground cover is dominated by litter, wood, and bare soil. Litter has the greatest cover with cover values ranging from 85% to 95%. Wood is usually present with cover ~5%. When present, bare soil can reach up to 10%. This community occurred on uplands with occasional small hills.

Local Vegetation Description
**Structure**: Canopy (30%-50%), Sub-canopy (0%-60%), Tall shrub (20%-40%), Herbaceous (0%-20%), Vine (0%-40%)

**Vegetation Floristics**: The canopy is typically dominated by *Pinus elliottii* and *Quercus stellata*. Their cover values are typically <50%. There is usually a mix of hardwoods in the understory including *Quercus marilandica*, *Quercus nigra*, *Ostrya virginiana*, *Acer rubrum*, and *Carya glabra*.

*Ilex vomitoria*, *Nyssa sylvatica*, and *Ulmus alata* usually occur in tall shrub layer with combined cover usually <50%. Various sparse species occur in the herbaceous layer with cover less than 1%.

**Dynamics:** It has been suggested that in the absence of fire the pine component may decline, although this seems unlikely since *Pinus taeda* is poorly adapted to fire, especially frequent fire. The specific historical role of fire in this vegetation type is likely to remain speculative, but most known examples in eastern Texas occur in proximity to *Pinus palustris* vegetation which likely burned very frequently. Late growing-season fires would have the most ecological effect in these communities, when understories have dried out completely. Fires originating in longleaf stands almost certainly burned through these areas with several predictable outcomes. First, it is expected that *Pinus taeda* regeneration would have been hindered, possibly favoring either *Pinus echinata* and/or *Quercus stellata* and *Quercus marilandica*. In addition, it is expected that frequent fires would have fostered species-rich understories, some evidence of which can be seen in stands today. Southern Pine Beetle activity almost certainly reduced the amount of *Pinus taeda* present on the historical landscape, but heavy interspersion of upland hardwoods may have reduced their local impact (Clarke et al. 2000). It has also been suggested that many occurrences of this community are not natural, and that they occur in areas which formerly supported woodlands with *Pinus palustris* or *Pinus echinata*, instead of with *Pinus taeda*. This may be accurate in eastern Texas where similar vegetation dominated by *Pinus echinata* has been defined (see CEGL007499, CEGL007800). However, it is important to note that when comparing the two types, the *Pinus echinata* type is more likely to occur in higher topographic positions and/or on broader upland landforms more conducive to the spread of fires, while this type tends to occur on lower topographic positions and more fire-sheltered landscapes.

Conservation Status Rank
**Global**: G2G3

Global Environmental Description
This community is best known from the Cook Mountain and Yegua formations in eastern Texas where most documented examples are found on vertic Alfisols including the Moswell and Herty series. These soils have shallow, loamy surface textures above a substantial clay subsurface with shrink-swell properties. Surface pH is acidic (5.1-5.5), and level of calcium and magnesium are quite high. The availability of these important nutrients for plant growth is unknown. Harcombe et al. (1993) point out that vegetation growing on clayey soils may exhibit physiological stress much like that of deep sands. Other stands, with overlapping floristic composition are found in areas mapped as Keithville-Sawtown soils (NatureServe Ecology unpubl. data). These areas are high Pleistocene terraces (Soil Conservation Service 1988) or "flatwoods" environments. Within this mound-and-swale environment, this vegetation occurs on possibly the driest portion of the local soil gradient. Documented examples of this vegetation occur on Keithville-Sawtown soils overlaying the Cook Mountain Formation on the Angelina National Forest and the Wilcox Formation on the Sabine National Forest (Anonymous n.d.).

Global Vegetation Description

*Pinus taeda* and *Quercus stellata* dominate the canopy. Associated canopy and subcanopy species include *Quercus falcata*, *Fraxinus americana*, *Carya alba*, *Cornus florida*, *Prunus serotina*, *Quercus nigra*, *Nyssa sylvatica*, *Acer rubrum*, and *Sassafras albidum*. *Pinus echinata* may be present but is not dominant. Shrub layer species include *Callicarpa americana*, *Crataegus marshallii*, *Crataegus brachyacantha*, *Crataegus spathulata*, *Viburnum rufidulum*, and *Vaccinium arboreum* The understory may be dominated by *Scleria oligantha*, *Toxicodendron radicans*, *Gelsemium sempervirens*, *Vitis rotundifolia*, and *Parthenocissus quinquefolia* when stands are dense due to infrequent burning. (NatureServe Ecology unpubl. data, Turner et al. unpubl. data). With increased burning and open-stand conditions species such as *Schizachyrium scoparium*, *Helianthus hirsutus*, *Helenium flexuosum*, *Vernonia texana*, *Lespedeza hirta*, *Baptisia nuttalliana*, *Stylosanthes biflora*, *Crotalaria sagittalis*, and *Pycnanthemum albescens* become more abundant (R. Evans pers. obs.).

Example Photograph

Figure A78 below shows an example of CEGL002112 *Pinus taeda – Quercus stellata* / *Crataegus* spp. Woodland.



**Figure A78.** *Pinus taeda – Quercus stellate* / *Crataegus* spp. Woodland (CSU)

Short Citation

- Clarke et al. 2000
- Harcombe et al. (1993)

- NatureServe Ecology unpubl. data
- Soil Conservation Service 1988
- Turner et al. unpubl. Data
- R. Evans pers. obs

***CEGL007800 Pinus echinata – Quercus stellata – Quercus falcata – Carya texana Woodland***

Table A64 below shows the USNVC Hierarchy for CEGL007800 *Pinus echinata – Quercus stellata – Quercus falcata – Carya texana* Woodland.

**Table A64.** USNVC hierarchy for CEGL007800 *Pinus echinata – Quercus stellata – Quercus falcata – Carya texana* Woodland

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.2 Cool Temperate Forest & Woodland |
| Division | 1.B.2.Na Eastern North American Forest & Woodland |
| Macrogroup | 1.B.2.Na Southern & South-Central Oak - Pine Forest & Woodland |
| Group | 1.B.2.Na Western Gulf Coastal Plain Pine - Oak Forest & Woodland |
| Alliance | A3129 *Pinus echinata - Pinus taeda - Quercus stellata* Forest Alliance |
| Association | 1.B.2.Na *Pinus echinata - Quercus stellata - Quercus falcata - Carya texana* Woodland (CEGL007800) |

**Field Plots:** 7010

**Map Class:** BITH MC319

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 312 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland

**Soil Texture**: Loamy sand

**Environment**: 1 plot was sampled within this community. These communities occur in sandy uplands. Ground cover is dominated by litter with cover ~85%. Wood is typically present with cover <5%.

Local Vegetation Description
**Structure**: Canopy (50%), Short shrub (50%), Herbaceous (40%)

**Vegetation Floristics**: Upland woodland maintained by fire occurring on soils of dry loam to clay. Canopy dominants are *Pinus echinata* and *Quercus stellata*. Associates include *Carya alba*, *Carya texana*, and *Quercus falcata*. Herbaceous layer is diverse with frequent fire events; *Chasmanthium sessiliflorum* is a particularly abundant species. Upwards of 100 species have been documented from fire managed sites on Angelina National Forest.

**Dynamics**: It is believed that historically frequent fires may have been an important factor maintaining the open, woodland structure of this type. The extent to which the understory would have been graminoid-dominated under such conditions is unknown, but it is believed that most examples would have supported a fairly rich herbaceous layer. Indeed, some frequently prescribe-burned examples in eastern Texas support over 100 species amidst a dense ground cover of *Chasmanthium sessiliflorum* (R. Evans pers. comm.), while less frequently burned sites tend toward a less well-developed and more scattered herbaceous layer. Species-rich examples of this type have also been documented by plot data and analysis work done by Susan Carr (Louisiana State University) in northwestern Louisiana. Examples which occur on more extreme soils (vertic and Vertisols) may persist in open, woodland structure (in the absence of frequent fire) for longer periods than less extreme sites. At least one open-structured example which seems to have persisted in this way is still inhabited by Red-cockaded Woodpeckers (near Huntsville, Texas, Fish Hatchery, R. Evans pers. obs.). This is the now very rare (largely historic) woodland phase related to *~Pinus echinata - Pinus taeda - Quercus stellata - Carya texana* / *Vaccinium arboreum* Woodland (CEGL007499).

In some areas in which this association occurs, the ignition source of most natural fires may have been isolated natural prairie pockets which occur at varying distances from this type. Most often, at least conceptually, the prairies are ringed by an oak woodland type [see *~Quercus stellata* / *Forestiera ligustrina - Symphoricarpos orbiculatus* / *Carex cherokeensis - Schizachyrium scoparium* Woodland (CEGL007777)], which then grades into this pine-dominated type. The relative extent of each type (prairie versus oak woodland versus shortleaf woodland) has certainly been altered by fire suppression. For example, this pine woodland has likely encroached onto sites historically dominated by the oak woodlands, and to some extent the prairie. Some evidence (Evans and Nesom pers. comm.) suggests that chance pine establishment on these sites, fostered by reduced fire frequency, may alter surface soil pH. As individual pines alter local surface soil chemistry, other species more typical of acid pine forests establish as well.

Conservation Status Rank
**Global**: G1

Global Environmental Description

In eastern Texas, this community type is best documented from a very narrow geographic area on the Cook Mountain and adjacent portions of the Yegua geological formation in San Augustine County, on the Angelina National Forest. In this area, the community occurs most typically on acidic, loamy to clayey vertic Alfisols (including the Eastwood and Moswell soil series). These sites tend to have higher than normal levels of calcium and magnesium (Turner et al. unpubl. data). As the type ranges further northward (where it is less well understood), it may occur on sandier loams, especially in Louisiana.

Global Vegetation Description

This *Pinus echinata* - *Quercus stellata* woodland occurs on dry, acidic, loamy to clayey uplands in the West Gulf Coastal Plain of Louisiana and Texas. The canopy is dominated by *Pinus echinata* and *Quercus stellata*. Other important overstory trees include *Quercus falcata, Carya texana*, and *Carya alba*. The understory tends to be quite open and herb-dominated, and may be quite species-rich. Most of the former examples of this woodland have been fire-suppressed resulting in more closed forests, in which *Pinus taeda* has become an important overstory tree.

Example Photograph

Figure A79 below shows an example of CEGL007800 *Pinus echinata – Quercus stellata – Quercus falcata – Carya texana* Woodland.



**Figure A79.** *Pinus echinata – Quercus stellata – Quercus falcata – Carya texana* Woodland (CSU)

Short Citation

- Evans and Nesom pers. comm.
- R. Evans pers. Obs
- Turner et al. unpubl. data

### *CEGL006011 Pinus taeda / Liquidambar styraciflua – Acer rubrum / Vaccinium stamineum Ruderal Forest*

Table A65 below shows the USNVC Hierarchy for CEGL006011 *Pinus taeda* / *Liquidambar styraciflua – Acer rubrum* / *Vaccinium stamineum* Ruderal Forest.

**Table A65.** USNVC hierarchy for CEGL006011 *Pinus taeda* / *Liquidambar styraciflua – Acer rubrum* / *Vaccinium stamineum* Ruderal Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.1 Warm Temperate Forest & Woodland |
| Division | 1.B.1.Na Southeastern North American Forest & Woodland |
| Macrogroup | 1.B.1.Na Southeastern North American Ruderal Forest |
| Group | 1.B.1.Na Southeastern Native Ruderal Forest |
| Alliance | A3231 *Pinus taeda - Liriodendron tulipifera - Liquidambar styraciflua* Ruderal Forest Alliance |
| Association | 1.B.1.Na *Pinus taeda* / *Liquidambar styraciflua - Acer rubrum* var. *rubrum* / *Vaccinium stamineum* Ruderal Forest (CEGL006011) |

**Field Plots:** 2085, 2078, 0319_017

**Map Class:** BITH MC320

Local Environmental Description

Plot/Sample Data Environmental Summary

**Elevation**: Mean 91 ft range 58 ft to 124 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland

**Soil Texture**: Sandy loam, Silt loam

**Environment:** 3 plots were sampled within this type. These communities are found in upland environments. Litter dominates the ground cover with cover between 79% and 94%. Wood is usually present as well with cove <5%.

Local Vegetation Description
**Structure**: Canopy (20%-50%), Sub canopy (30%-50%), Tall shrub (10%-40%), Short shrub (0%-10%), Vine (0%-10%)

**Vegetation Floristics**: This community tends to have a sparse overstory of *Pinus taeda* with cover ~10%-30%. There is often a mix of hardwoods composing a moderate canopy with cover ~50%. Common species include *Carya tomentosa*, *Quercus pagoda*, *Quercus velutina*, *Acer rubrum*, and *Nyssa aquatica*. The understory is usually present with common species including *Ilex opaca*, *Liquidambar styraciflua*, and *Magnolia virginiana*. There is a sparse to moderate shrub layer typically present with cover ranging from 10% to 40%. Common shrubs include *Ilex vomitoria*, *Vaccinium arboreum*, *Ilex opaca*, *Morella cerifera*, and *Sabal minor*. Herbaceous typically is sparse with only a few individuals present. The most common herbaceous species include *Chasmanthium sessiliflorum* and *Dichanthelium sphaerocarpon*.

**Dynamics:** This forest follows agricultural cropping or silvicultural site preparation on a variety of sites, and presumably is more likely on moderately dissected topography where fire is a rare occurrence. This community usually is not present on steep slopes and does not occur on wet soils. It occurs on well- to moderately well-drained soils, usually Ultisols, on sites that formerly were under hardwood cover or subjected to agriculture.

Conservation Status Rank
**Global**: GNA

Global Environmental Description
This forest follows agricultural cropping or silvicultural site preparation on a variety of sites, and presumably is more likely on moderately dissected topography where fire is a rare occurrence. This community usually is not present on steep slopes and does not occur on wet soils. It occurs on well- to moderately well-drained soils, usually Ultisols, on sites that formerly were under hardwood cover or subjected to agriculture.

Global Vegetation Description
The tree canopy of *Pinus taeda* is at least 60% but may be considerably denser, up to and including closed canopies. Tree subcanopy density varies with stand disturbance history but generally is <50%. Shrub and herb layer coverages do not exceed 25% and decrease with increasing age of the stand. Other species of pine, especially *Pinus echinata* and *Pinus virginiana* may be sparingly present in the canopy. Other species that may be present in the subcanopy in addition to *Liquidambar styraciflua* and *Acer rubrum var. rubrum* include *Quercus coccinea, Quercus velutina, Quercus alba, Quercus falcata, Nyssa sylvatica, Carya glabra, Carya alba, Diospyros virginiana, Prunus serotina, Cornus florida, Liriodendron tulipifera*, and *Sassafras albidum* (NatureServe Ecology unpubl. data). Other species in addition to *Vaccinium stamineum* that may be present in the shrub stratum

include *Juniperus virginiana, Vaccinium arboreum, Rhus copallinum, Gaylussacia baccata, Callicarpa americana*, and probably others. The herbaceous layer usually forms <5% cover and contains such species as *Gelsemium sempervirens, Chimaphila maculata, Polystichum acrostichoides*, and *Potentilla canadensis*. An example from Oconee National Forest has a thinned canopy and grassy herbaceous layer. The exotic *Lonicera japonica*may be common within occurrences of this community.

Example Photograph

Figure A80 below shows an example of CEGL006011 *Pinus taeda* / *Liquidambar styraciflua – Acer rubrum* / *Vaccinium stamineum* Ruderal Forest.



**Figure A80.** *Pinus taeda* / *Liquidambar styraciflua – Acer rubrum* / *Vaccinium stamineum* Ruderal Forest (CSU)

Short Citation

NatureServe Ecology unpubl. data

***CEGL006327 Pinus echinata Ruderal Forest***

Table A66 below shows the USNVC Hierarchy for CEGL006327 *Pinus echinata* Ruderal Forest.

**Table A66.** USNVC hierarchy for CEGL006327 *Pinus echinata* Ruderal Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.2 Cool Temperate Forest & Woodland |
| Division | 1.B.2.Na Eastern North American Forest & Woodland |
| Macrogroup | 1.B.2.Na Eastern North American Ruderal Forest |
| Group | 1.B.2.Na Eastern North American Native Ruderal Forest |
| Alliance | A3227 *Juniperus virginiana - Pinus virginiana - Pinus echinata* Ruderal Forest Alliance |
| Association | 1.B.2.Na *Pinus echinata* Ruderal Forest (CEGL006327) |

**Field Plots:** Association added from legacy oil and gas surveys

**Map Class:** BITH MC320

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 75 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland

**Soil Texture**: Loam

**Environment**: This type is found in old plantations. It mainly occurs in upland area and the ground cover is strongly dominated by litte with values >90%.

Local Vegetation Description
**Structure**: Canopy (50%-80%), Short shrub (10%-40%), Herbaceous (0%-20%)

**Vegetation Floristics**: Early successional forest found on disturbed sites typically occurring on former agricultural land, unmanaged clear-cuts, and highly eroded soils. *Pinus echinata* is the most abundant canopy species occasionally occurring with *Pinus taeda*. Associated early successional hardwoods are *Acer rubrum*, *Liquidambar styraciflua*, and *Liriodendron tulipifera*. Shrub and herb layer typically consist of invasive exotics or ruderal species.

**Dynamics:** Composition of this community depends more on past disturbance history and adjacent forest composition than on the micro-environment of the site. The community can be found on a

variety of upland exposures but is most well-developed in areas that were heavily farmed and then abandoned. Over time, the canopy composition shifts as Pinus echinata succumbs to disease, blowdown, or pine beetle damage and other later successional species begin to take advantage of the gaps left by dead and dying pines. At this point, the community can begin to shift to one of a number of community types that are considered "later successional" than this type and possess a canopy that is dominated by hardwoods rather than pines.

Conservation Status Rank
**Global**: GNA

Global Environmental Description
This broadly defined type may develop under a variety of circumstances associated with severe natural and/or anthropogenic disturbance. It is most frequently associated with abandoned agricultural land, unmanaged clearcuts, and burned or eroded areas. These are considered ruderal forests as they typically result from anthropogenic disturbances which fundamentally alter the vegetation structure, floristic composition, and often the physical and chemical structure of the soil.

Global Vegetation Description
*Pinus echinata* is clearly the single most dominant tree. In addition, other "old-field" *Pinus* species (e.g., *Pinus taeda, Pinus virginiana*) and/or other early-successional deciduous trees (e.g., *Acer rubrum, Liquidambar styraciflua, Liriodendron tulipifera*) may also be present. Forests of 50+ years may begin to become codominated by mid-successional species such as *Quercus* spp. and *Carya* spp. in some instances. Associated woody and herbaceous species vary with geography but are typically ruderal or exotic species.

Example Photograph
N/A

### *CEGL007947 Pinus echinata – (Pinus taeda) – Quercus falcata / Dichanthelium sphaerocarpon Forest*

Table A67 below shows the USNVC Hierarchy for CEGL007947 *Pinus echinata* – (*Pinus taeda*) – *Quercus falcata* / *Dichanthelium sphaerocarpon* Forest.

**Table A67.** USNVC hierarchy for CEGL007947 *Pinus echinata* – (*Pinus taeda*) – *Quercus falcata* / *Dichanthelium sphaerocarpon* Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.2 Cool Temperate Forest & Woodland |
| Division | 1.B.2.Na Eastern North American Forest & Woodland |
| Macrogroup | 1.B.2.Na Southern & South-Central Oak - Pine Forest & Woodland |

**Table A67 (continued).** USNVC hierarchy for CEGL007947 *Pinus echinata* – (*Pinus taeda*) – *Quercus falcata* / *Dichanthelium sphaerocarpon* Forest

| Category | Description |
|---|---|
| Group | 1.B.2.Na Western Gulf Coastal Plain Pine - Oak Forest & Woodland |
| Alliance | A3129 *Pinus echinata - Pinus taeda - Quercus stellata* Forest Alliance |
| Association | 1.B.2.Na *Pinus echinata* - (*Pinus taeda*) - *Quercus falcata* / *Dichanthelium sphaerocarpon* Forest (CEGL007947) |

**Field Plots:** Association added from legacy oil and gas surveys

**Map Class:** BITH MC320

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 31 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands

**Soil Texture**: Sandy loam

**Environment**: This community occurs on wet flatlands. Litter dominates the ground cover with values reaching up to 90%. Wood is typically present with values <5%. This community occasionally floods with water cover reaching up to 50%.

Local Vegetation Description
**Structure**: Canopy (40%-80%), Short shrubs (10%-40%), Herbaceous (0%-50%)

**Vegetation Floristics**: *Pinus echinata* typically dominates the canopy. Other common canopy associates include *Quercus falcata*, *Quercus alba*, *Quercus marilandica*, *Nyssa sylvatica*, and *Acer rubrum*. The shrub layer is often ranging from moderate to dense. Common shrubs include *Ilex vomitoria* and *Quercus hemisphaerica*. The herbaceous layer is often sparse.

**Dynamics:** In most examples *Pinus echinata* is believed to have been the historical dominant, although *Pinus taeda* may have been important in some areas and is frequently important in existing examples. It is believed that past land-use practices and alteration of fire regimes may have allowed the relative percentage of *Pinus taeda* to increase in many of these examples.

Conservation Status Rank
**Global**: G2G3

Global Environmental Description

These communities occur most commonly on upper and middle slopes on sandy or loamy soils with acidic surface pH, and moderate nutrient levels. Many, if not most, known examples occur along the western and southwestern periphery of the pine-dominated portions of the Coastal Plain, primarily outside the native range of both *Pinus palustris* and *Quercus alba*. This type has been documented from the Willis, Yegua, and Sparta geological formations. Soils mapped at plot locations referred to this type include Annona and Huntsburg.

Global Vegetation Description

In most known stands referable to this type, *Pinus echinata* may have been the only pine species present, assuming historical fire regimes were as frequent as is often postulated. Given long periods of fire suppression, and only infrequent winter burning, the relative abundance and importance of *Pinus taeda* has likely increased in many stands and is now frequently important in existing examples. Both *Pinus palustris* and *Quercus alba* are typically absent or rare in these stands. In addition to the nominal species, other overstory and subcanopy species may also include *Liquidambar styraciflua, Quercus velutina, Quercus nigra, Quercus stellata, Quercus margarettiae, Quercus marilandica, Fraxinus americana, Cornus florida, Acer rubrum*, and *Ulmus alata*. The shrub layer may include *Chionanthus virginicus, Vaccinium arboreum, Forestiera ligustrina, Ilex vomitoria, Callicarpa americana, Morella cerifera (= Myrica cerifera), Rhus copallinum*, and *Frangula caroliniana*. Understory species include *Parthenocissus quinquefolia, Smilax glauca, Carex albicans var. australis (= Carex physorhyncha), Chasmanthium sessiliflorum, Vitis rotundifolia, Passiflora lutea, Piptochaetium avenaceum, Dichanthelium commutatum, Dichanthelium laxiflorum, Smilax tamnoides (= Smilax hispida), Solidago ulmifolia, Rubus argutus, Elephantopus tomentosus, Sanicula canadensis, Gelsemium sempervirens, Pteridium aquilinum*, and other species (Turner et al. unpubl. data).

Example Photograph

Figure A81 below shows an example of CEGL007947 *Pinus echinata* – (*Pinus taeda*) – *Quercus falcata* / *Dichanthelium sphaerocarpon* Forest.



**Figure A81.** *Pinus echinata* – (*Pinus taeda*) – *Quercus falcata* / *Dichanthelium sphaerocarpon* Forest (CSU)

Short Citation
Turner et al. unpubl. data

***CEGL007528 Pinus taeda – (Pinus echinata) – Quercus falcata – Carya texana / Vaccinium arboreum Forest***

Table A68 below shows the USNVC Hierarchy for CEGL007528 *Pinus taeda* – (*Pinus echinata*) – *Quercus falcata – Carya texana* / *Vaccinium arboreum* Forest.

**Table A68.** USNVC hierarchy for CEGL007528 *Pinus taeda* – (*Pinus echinata*) – *Quercus falcata – Carya texana* / *Vaccinium arboreum* Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.2 Cool Temperate Forest & Woodland |
| Division | 1.B.2.Na Eastern North American Forest & Woodland |
| Macrogroup | 1.B.2.Na Southern & South-Central Oak - Pine Forest & Woodland |

**Table A68 (continued).** USNVC hierarchy for CEGL007528 *Pinus taeda* – (*Pinus echinata*) – *Quercus falcata* – *Carya texana* / *Vaccinium arboreum* Forest

| Category | Description |
|---|---|
| Group | 1.B.2.Na Western Gulf Coastal Plain Pine - Oak Forest & Woodland |
| Alliance | A3129 *Pinus echinata* - *Pinus taeda* - *Quercus stellata* Forest Alliance |
| Association | 1.B.2.Na *Pinus taeda* - (*Pinus echinata*) - *Quercus falcata* - *Carya texana* / *Vaccinium arboreum* Forest (CEGL007528) |

**Field Plots:** 7007, 0319_121

**Map Class:** BITH MC320

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 203 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland

**Soil Texture**: Loam

**Environment**: 2 plots were sampled within this community. This community typically occurs in uplands with loamy soils. Ground cover is dominated by a thick layer of litter with cover ~90%. Wood is usually present with cover ~5%.

Local Vegetation Description
**Structure**: Canopy (70%), Tall shrub (60%), Herbaceous (10%)

**Vegetation Floristics**: Dry-mesic to dry forest on mid to lower slopes isolated from frequent fire. Strictly mesic species and dry upland species are uncommon in this community. Canopy dominants are *Pinus taeda*, *Quercus falcata*, and *Liquidambar styraciflua*. Associates include *Carya texana*, *Carya tomentosa* (*Carya alba), Nyssa sylvatica*, *Pinus echinata*, *Quercus alba*, *Quercus marilandica*, *Quercus nigra*, and *Quercus stellata*. The subcanopy contains *Cornus florida* and regenerating *Pinus taeda*. The shrub layer is short and patchy with *Callicarpa americana*, *Chionanthus virginicus*, *Forestiera ligustrina*, *Ilex vomitoria*, *Rhus aromatica*, *Sassafras albidum*, *Vaccinium arboreum*, and *Vaccinium stamineum*. Vines such as *Gelsemium sempervirens*, *Parthenocissus quinquefolia*, *Smilax glauca*, *Smilax rotundifolia*, *Smilax tamnoides*, *Toxicodendron radicans*, *Vitis aestivalis*, and *Vitis rotundifolia* can occur. A sparse herbaceous layer consists of *Carex albicans* var. *australis*, *Chasmanthium sessiliflorum*, *Dichanthelium commutatum*, *Dichanthelium laxiflorum*, *Melica mutica*, *Scutellaria elliptica*, and *Scleria triglomerata*.

**Dynamics:** This community is protected from the frequent fires of the typically adjacent *Pinus palustris* communities, but does experience enough smoldering surface fires in drought years to exclude fire-sensitive species such as *Fagus grandifolia*, *Magnolia grandiflora*, and *Ilex opaca*. Insect and pathogen outbreaks are other disturbance vectors in this community (Martin and Smith 1991, 1993).

This community is a natural unmanaged type or follows seedtree or shelterwood regeneration. *Pinus taeda* is a rather short-lived species (80-130 years), so in the absence of disturbance this community may be seral to a *Quercus*-dominated forest. However, the actual length of this disturbance-free period may be unrealistically long, as *Pinus taeda* is a fast colonizer and natural mortality in the canopy may be frequent enough to allow this species to persist via regeneration in canopy gaps.

Conservation Status Rank
**Global**: G4

Global Environmental Description
Plot locations ascribed to this type in eastern Texas are found on the Yegua and Willis geological formations, mapped as Huntsburg and Gunter soils. These locations have predominately sandy surface textures with surface pH ranges from 5.4-5.9 (Turner et al. unpubl. data). This forest is known from the West Gulf Coastal Plain of Louisiana and Texas, and likely ranges into the Coastal Plain of Arkansas.

Hydrology ranges from dry-mesic to dry. Soils are acidic and include silt loams, sandy loams, and silty clays. This forest occurs on upper slopes and ridges, particularly on low Pleistocene terraces, often on Cadeville very fine sandy loam and Glenmora silt loam. Cadeville soils are moderately well-drained, very slowly permeable fine, mixed thermic Albaquic Hapludalfs occurring on side slopes and ridgetops in terrace uplands; slopes range from 2-12%. Glenmora soils are moderately well-drained, slowly permeable fine-silty, siliceous, thermic Glossaquic Paleudalf with slopes ranging from 1-3%, occurring on broad ridgetops and gentle side slopes in terrace uplands. Cadeville and Glenmora soils are typically found near each other (Kilpatrick et al. 1986, Martin and Smith 1991, 1993).

Global Vegetation Description
The overstory of stands of this type may contain *Pinus echinata*. *Liquidambar styraciflua* and *Quercus falcata* are constant components. Other associated hardwoods include *Quercus stellata*, *Quercus nigra*, *Quercus marilandica*, *Carya alba*, and *Carya texana*. *Quercus alba* and *Quercus velutina* are uncommon in Texas examples. The subcanopy is sometimes dominated by *Cornus florida*, although regenerating *Pinus taeda* may be locally dominant as well. The patchy short-shrub stratum includes canopy and subcanopy species, plus *Vaccinium arboreum*, *Chionanthus virginicus*, *Sassafras albidum*, *Callicarpa americana*, *Vaccinium stamineum*, and *Rhus aromatica*. The herbaceous layer is typically sparse. Species include *Chasmanthium sessiliflorum*, *Scleria triglomerata*, *Melica mutica*, and *Scutellaria elliptica*. *Quercus alba* is rare. The midstory includes *Callicarpa americana*, *Ulmus alata*, *Ilex vomitoria*, *Forestiera ligustrina*, *Chionanthus virginicus*, *Cornus florida*, *Sassafras albidum*, and *Nyssa sylvatica*. The most frequent

understory may include *Parthenocissus quinquefolia*, *Smilax glauca*, *Dichanthelium commutatum*, *Chasmanthium sessiliflorum*, *Toxicodendron radicans*, *Smilax tamnoides* (= *Smilax hispida*), *Galium uniflorum*, *Viburnum dentatum*, *Elephantopus tomentosus*, *Phryma leptostachya*, *Vitis rotundifolia*, *Sanicula canadensis*, *Morus rubra*, *Vitis aestivalis*, *Dichanthelium laxiflorum*, *Carex albicans* var. *australis* (= *Carex physorhyncha*), *Gelsemium sempervirens*, and *Smilax rotundifolia*. The exotics *Lonicera japonica*, *Ligustrum sinense*, and *Microstegium vimineum* may occur in this community.

Example Photograph

Figure A82 below shows an example of CEGL007528 *Pinus taeda* – (*Pinus echinata*) – *Quercus falcata – Carya texana* / *Vaccinium arboreum* Forest.



**Figure A82.** *Pinus taeda* – (*Pinus echinata*) – *Quercus falcata – Carya texana* / *Vaccinium arboreum* Forest (CSU)

Short Citation

- Kilpatrick et al. 1986
- Martin and Smith 1991
- Martin and Smith 1993
- Turner et al. unpubl. data

***CEGL007115 Pinus taeda – Pinus echinata / Chasmanthium sessiliflorum Ruderal Forest***

Table A69 below shows the USNVC Hierarchy for CEGL007115 *Pinus taeda – Pinus echinata* / *Chasmanthium sessiliflorum* Ruderal Forest.

**Table A69.** USNVC hierarchy for CEGL007115 *Pinus taeda – Pinus echinata* / *Chasmanthium sessiliflorum* Ruderal Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.1 Warm Temperate Forest & Woodland |
| Division | 1.B.1.Na Southeastern North American Forest & Woodland |
| Macrogroup | 1.B.1.Na Southeastern North American Ruderal Forest |
| Group | 1.B.1.Na Southeastern Native Ruderal Forest |
| Alliance | A3231 *Pinus taeda - Liriodendron tulipifera - Liquidambar styraciflua* Ruderal Forest Alliance |
| Association | 1.B.1.Na *Pinus taeda - Pinus echinata* / *Chasmanthium sessiliflorum* Ruderal Forest (CEGL007115) |

**Field Plots:** 7009

**Map Class:** BITH MC320

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 229 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland

**Soil Texture**: Loamy sand

**Environment**: 1 plot was sampled within this community. These communities occur within sandy uplands. Ground cover is dominated by a dense layer of litter with cover ~90%. Wood may be sparsely present with cover <3%.

Local Vegetation Description
**Structure**: Canopy (50%), Short shrub (20%), Herbaceous (70%)

**Vegetation Floristics**: Forest of dry to xeric uplands but can occasionally exist on mesic sites. Soils vary but tend to include clay loams, sandy loams, and deep sands. Codominant canopy species are *Pinus echinata* and *Pinus taeda*. Shrub layer ranges from sparse to dense depending on fire frequency with *Chionanthus virginicus*, *Cornus florida*, *Ilex vomitoria*, *Morella cerifera*, *Rhus copallinum*, *Vaccinium arboreum*, and *Vaccinium stamineum*. Herbaceous layer varies depending on shrub cover. In open conditions an abundance of *Chasmanthium sessiliflorum* can occur with *Croton capitatus*, *Galactia regularis*, *Dichanthelium* spp., *Dichondra caroliniensis*, *Liatris elegans*, and *Rhynchosia latifolia*. Invasive exotics may include *Ligustrum sinense*, *Lonicera japonica*, and *Microstegium vimineum.*

**Dynamics**: The origin of mixed *Pinus taeda* and *Pinus echinata* vegetation is not known. This association was originally conceived as a semi-natural type, created through management. In most of the region, *Pinus taeda* was not historically present on uplands (Martin and Smith 1993, Evans 1997), suggesting that such a type may represent an anthropogenic artifact. However, mature examples of this vegetation are extant and can be reliably shown to have not been planted. There is also some evidence documenting such stands on the historical landscape in limited areas (Evans unpubl. data). It is possible that early land clearing removed original forest cover, allowing *Pinus taeda* to become important. In this scenario, these sites would likely have supported mixed *Pinus echinata* / *Quercus* spp. woodlands. Within the range of *Pinus palustris* this type is not known to have occurred naturally. layer may be abundant and somewhat diverse, and on-site *Pinus echinata* is codominant with off-site *Pinus taeda*. Shrubs may vary in composition and density with management regimes and moisture conditions. In denser stands (including unburned/unthinned younger stands) the herbaceous layer is sparse, but older plantations (greater than 40 years) are often thinned more frequently and can have abundant ground cover. Under natural conditions these sites would likely support mixed *Pinus echinata* / *Pinus taeda* - *Quercus* spp. woodlands or *Pinus palustris* woodlands, depending on the site conditions.

Conservation Status Rank
**Global**: GNA

Global Environmental Description
This community is typically dry to xeric, but occasionally may occur on more mesic sites. This community occurs on a range of soil types, including clay loams, sandy loams underlain by clay, and deeper sands. Soil series include Betis, Briley, Ruston and Smithdale. Under natural conditions these sites would likely support mixed *Pinus echinata / Pinus taeda - Quercus* spp. woodlands or *Pinus palustris* woodlands, depending on the site conditions. This community is most common on the outer to middle West Gulf Coastal Plain.

Global Vegetation Description
This community is a typically dry to xeric, but occasionally mesic mature *Pinus taeda* plantation or seed tree/shelterwood-regenerated type of the West Gulf Coastal Plain with ingrowing *Pinus echinata*. Canopy cover ranges from 60-100%. Shrubs (2-5 m tall) vary in composition and density with management regimes and moisture conditions, but are typically patchy to dense. Dominant shrub species include *Vaccinium arboreum, Ilex vomitoria, Chionanthus virginicus, Cornus florida,*

*Vaccinium stamineum, Rhus copallinum*, and *Morella cerifera (= Myrica cerifera)*. In denser stands (including unburned/unthinned younger stands) the canopy cover may be too great for a well-developed herbaceous layer dominated by graminoids, but older plantations (over 40 years) are often thinned more frequently and can have abundant ground cover. *Chasmanthium sessiliflorum* is a typical ground layer dominant or codominant. Other species encountered in an open, herbaceous-dominated plot in eastern Texas included *Croton capitatus, Galactia regularis, Dichondra carolinensis, Dichanthelium* sp., *Rhynchosia latifolia, Liatris elegans*, and a fairly large list of other taxa (NatureServe Ecology unpubl. data). The exotics *Lonicera japonica, Ligustrum sinense*, and *Microstegium vimineum* may occur in this community.

Example Photograph

Figure A83 below shows an example of CEGL007115 *Pinus taeda – Pinus echinata* / *Chasmanthium sessiliflorum* Ruderal Forest.



**Figure A83.** *Pinus taeda – Pinus echinata* / *Chasmanthium sessiliflorum* Ruderal Forest (CSU)

Short Citation

- Evans unpubl. data
- Evans 1997
- Martin and Smith 1993
- NatureServe Ecology unpubl. data

### *CEGL007162 Pinus palustris / Morella cerifera – Morella caroliniensis – Ilex coriacea Ruderal Wet Woodland*

Table A70 below shows the USNVC Hierarchy for CEGL007162 *Pinus palustris* / *Morella cerifera – Morella caroliniensis – Ilex coriacea* Ruderal Wet Woodland.

**Table A70.** USNVC hierarchy for CEGL007162 *Pinus palustris* / *Morella cerifera – Morella caroliniensis – Ilex coriacea* Ruderal Wet Woodland

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southeastern North American Ruderal Flooded & Swamp Forest |
| Group | 1.B.3.Nb Southeastern Native Ruderal Flooded & Swamp Forest |
| Alliance | A3345 *Pinus taeda - Liquidambar styraciflua* Ruderal Flooded & Swamp Forest Alliance |
| Association | 1.B.3.Nb *Pinus palustris* / *Morella cerifera - Morella caroliniensis - Ilex coriacea* Ruderal Wet Woodland (CEGL007162) |

**Field Plots:** 2014, 2015, 1070, 2012, 2009, 2013, 2011, 0319_012, 0319_014, 0319_016, 0319_068, 0319_298, 0319_299, 0319_300, 0319_304, 6044b, 6050

**Map Class:** BITH MC321

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 130.14 ft range 31 ft to 164 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland, Upland swales

**Soil Texture**: Loamy sand, Sandy clay, Sandy clay loam, Sandy loam, Silt loam

**Environment**: 17 plots were sampled within this type. This community generally occurs on upland areas with soil ranging from loamy sand to sandy clay loam. Ground cover is dominated by litter with cover ranging from 15% to 90%. Bare soil is usually the second most dominant class with cover ranging from 1% to 50%. Wood is often present with cover values usually <5%.

Local Vegetation Description

**Structure**: Canopy (0%-60%), Sub canopy (0%-50%), Tall shrub (0%-40%), Short shrub (0%-80%), Dwarf shrub (0%-20%), Herbaceous (10%-90%)

**Vegetation Floristics**: The canopy of these forest communities are dominated by *Pinus palustris* and *Pinus taeda*. *Pinus palustris* typically dominates with cover ranging from 10% to 70% with *Pinus taeda* typically as a codominant with cover <20%. Hardwoods are typically sparse in the canopy and subcanopy with cover <20%. Common species include *Nyssa sylvatica*, *Liquidambar styraciflua*, and *Quercus nigra*. The shrub stratum tends to be sparse to moderate with cover <40%. Typical shrubs include *Ilex vomitoria*, *Morella cerifera*, *Crataegus spathulata*, *Cyrilla racemiflora*, and *Callicarpa americana*.

**Dynamics**: This is a fire-suppressed community, which no longer experiences the historic 1- to 3-year fire-return interval. The total canopy cover is variable; it can range from 90% or more in dense unthinned planted stands to 25% in recently thinned stands. Residual natural stands usually have canopy closures of between 60-80%. This community occurs in central to central-western Louisiana, and is topographically isolated from the larger belt of *Pinus palustris* flatwoods that occurs in southwestern Louisiana and central eastern Texas.

Plantation stands are managed silviculturally. Residual occurrences are fire-suppressed, leading to the increase in shrub and canopy cover. Frequent surface fires historically occurred in these relict stands even during relatively high moisture conditions, and likely had return times of 1 to 3 years. The chief natural fire season in Louisiana is believed to be late March through June (Martin and Smith 1991, 1993). Growing-season fires in the Gulf Coastal Plain have very different ecological effects than dormant-season fires on forb and graminoid flowering and shrub mortality.
The time since the last fire event greatly affects the shrub cover, the herbaceous layer and the regeneration of *Pinus palustris*. Shrub covers greatly increase with fire suppression, and both the diversity and the cover of the herbaceous layer are dramatically decreased. The natural regeneration of *Pinus palustris* in this fire-suppressed forest has been curtailed or halted by the lack of exposed soil for germination and safe sites for regeneration.

With the initiation of frequent prescribed burns, it has been observed that this forest community can be restored at least partially to open woodland with an extremely rich herbaceous layer that historically comprised one of the dominant plant communities in this region (R. Stewart pers. comm.). With the continuation of fire suppression, the *Pinus palustris* canopy will approach an even-aged structure. Eventually the canopy may become mixed as *Liquidambar styraciflua*, *Nyssa sylvatica*, *Acer rubrum*, and *Pinus taeda* enter this stratum.

Conservation Status Rank

**Global**: GNA

Global Environmental Description

Residual stands of this community are known from intermediate and high Pleistocene terraces. Soils are poorly drained to very poorly drained, acidic, fine sandy loams or silt loams (Martin and Smith

1991, 1993). Denser stands are drier than open stands due to the higher rate of water loss through vegetative use and evapotranspiration. Although saturated soils persist from December through June, the top few inches of soil are dry by August and remain so until November (R. Stewart pers. comm.). This community is known from the Vernon, southern Catahoula, southern Evangeline, and southern Kisatchie ranger districts of the Kisatchie National Forest.

Global Vegetation Description

The canopy is strongly dominated by *Pinus palustris*, which generally accounts for over 75% of the total cover. Other canopy species may include *Liquidambar styraciflua, Nyssa sylvatica, Acer rubrum, Pinus taeda*, and possibly *Pinus elliottii var. elliottii* from nearby plantations. *Magnolia virginiana* has also been included as a component (Turner et al. 1999). Shrubs and shrubby vines are frequently dense, and include *Morella cerifera (= Myrica cerifera), Morella caroliniensis (= Myrica heterophylla), Persea palustris, Smilax bona-nox, Smilax laurifolia, Smilax pumila, Smilax rotundifolia*, and *Rubus* spp. Where the shrubs and canopy are very dense, the ground cover is suppressed and has a cover of approximately 5%; in thinned plantations, the more open canopies allow a low-diversity ground cover of 30% or less. The lower strata in this situation are dominated by the short shrubs *Hypericum fasciculatum* and *Hypericum hypericoides ssp. hypericoides*, as well as *Hypericum mutilum*, with some *Viola* spp. and occasional *Carex* spp. and *Scleria* spp. Although currently not above-ground constituents of this community, many heliophytic taxa such as *Xyris, Rhexia, Ctenium*, and *Rhynchospora* still persist in a seed/root bank and readily come back with the onset of prescribed burning (R. Stewart pers. comm.). The exotics *Lonicera japonica, Ligustrum sinense*, and *Microstegium vimineum* may invade this community.

Example Photograph

Figure A84 below shows an example of CEGL007162 *Pinus palustris* / *Morella cerifera – Morella caroliniensis – Ilex coriacea* Ruderal Wet Woodland.



**Figure A84.** *Pinus palustris* / *Morella cerifera* – *Morella caroliniensis* – *Ilex coriacea* Ruderal Wet Woodland (CSU)

Short Citation

- Martin and Smith 1991
- Martin and Smith 1993
- R. Stewart pers. Comm
- Turner et al. 1999

### *CEGL008571 Pinus palustris – Pinus (echinata, taeda) – Quercus falcata – Carya texana Woodland*

Table A71 below shows the USNVC Hierarchy for CEGL008571 *Pinus palustris – Pinus* (*echinata*, *taeda*) – *Quercus falcata – Carya texana* Woodland.

**Table A71.** USNVC hierarchy for CEGL008571 *Pinus palustris – Pinus* (*echinata*, *taeda*) – *Quercus falcata – Carya texana* Woodland

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |

**Table A71 (continued).** USNVC hierarchy for CEGL008571 *Pinus palustris* – *Pinus* (*echinata*, *taeda*) – *Quercus falcata* – *Carya texana* Woodland

| Category | Description |
|---|---|
| Formation | 1.B.1 Warm Temperate Forest & Woodland |
| Division | 1.B.1.Na Southeastern North American Forest & Woodland |
| Macrogroup | 1.B.1.Na Longleaf Pine Woodland |
| Group | 1.B.1.Na Xeric Longleaf Pine Woodland |
| Alliance | A3122 *Pinus palustris* / *Quercus incana* Woodland Alliance |
| Association | 1.B.1.Na *Pinus palustris* - *Pinus* (*echinata*, *taeda*) - *Quercus falcata* - *Carya texana* Woodland (CEGL008571) |

**Field Plots:** 3016, 3025a, 4001, 6027a, 0319_018, 0319_052, 0319_053, 0319_103, 0319_336, 0319_337

**Map Class:** BITH MC321

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 53 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland, Upland flat, Flatlands

**Soil Texture**: Loam, Sandy loam, Sand

**Environment**: 10 plots were sampled within this type. This community typically occurs on flat uplands. Litter dominates the ground cover with values reaching 90%. Wood composed between 5% and 10% of the ground cover.

Local Vegetation Description
**Structure**: Canopy (40%-70%), Short shrub (30%-60%)

**Vegetation Floristics**: Sandy upland woodland of xeric sites such as ridgetops where fire is naturally infrequent. Canopy dominants include *Pinus taeda* (>30% cover), *Pinus palustris* (10-30% cover), *Pinus echinata*, *Carya texana*, *Quercus falcata*, and *Quercus incana* (20-40% cover). Associated tree species include *Aesculus pavia*, *Cornus florida*, *Liquidambar styraciflua*, *Prunus mexicana*, *Quercus marilandica*, *Quercus stellata*, and *Sideroxylon lanuginosum* ssp. *lanuginosum*. Common shrubs are *Callicarpa americana*, *Ceanothus americanus*, *Rhus aromatica*, *Rhus copallinum*, *Rubus argutus*, *Sassafras albidum*, *Vaccinium arboreum*, and *Viburnum rufidulum*. Vines include *Berchemia*

*scandens*, *Smilax rotundifolia*, *Toxicodendron radicans*, *Vitis mustangensis*, and *Vitis rotundifolia*. Scattered herbaceous species such as *Andropogon ternarius*, *Baptisia nuttalliana*, *Desmodium canescens*, *Desmodium paniculatum*, *Erythrina herbacea*, *Galactia volubilis*, *Gymnopogon ambiguus*, *Lespedeza hirta*, *Schizachyrium scoparium*, *Scleria oligantha*, *Solidago odora*, and *Stillingia sylvatica* are common.

**Dynamics**: The natural fire regime of this type is lower than that of other *Pinus palustris* communities because of topographic isolation. These sites are sand-capped hills adjoining steep mesic slopes and creek bottoms, areas that are not conducive to the spread of fire, requiring lightning ignitions to take place inside these relatively small patches.

Conservation Status Rank
**Global**: G2G3

Global Environmental Description
This type occurs on well-drained, acidic, sandy, Arenic soils.

Global Vegetation Description
The overstory of this community supports a natural mixture of *Pinus palustris, Pinus echinata*, and *Pinus taeda*. A well-developed, diverse layer of hardwoods is also present in the subcanopy and midstory. The most typical hardwood species are *Quercus falcata* and *Carya texana*. The short-shrub stratum is patchy to dense and may include a number of species. Woody species documented in eastern Texas plots assigned to this type include *Cornus florida, Quercus stellata, Quercus marilandica, Prunus mexicana, Sassafras albidum, Vaccinium arboreum, Sideroxylon lanuginosum ssp. lanuginosum, Aesculus pavia, Liquidambar styraciflua, Callicarpa americana, Ceanothus americanus, Viburnum rufidulum, Rhus copallinum, Stillingia sylvatica*, and *Rubus argutus*. Vining species include *Berchemia scandens, Vitis rotundifolia, Vitis mustangensis, Smilax rotundifolia*, and *Toxicodendron radicans*. The scattered herbaceous layer contains *Schizachyrium scoparium, Scleria oligantha, Baptisia nuttalliana, Solidago odora, Galactia volubilis, Lespedeza hirta, Rhus aromatica, Desmodium canescens, Aristolochia serpentaria, Rhynchosia reniformis, Galactia regularis, Erythrina herbacea, Berlandiera pumila, Desmodium paniculatum, Gymnopogon ambiguus*, and other species (Turner et al. unpubl. data).

Example Photograph
Figure A85 below shows an example of CEGL008571 *Pinus palustris – Pinus* (*echinata*, *taeda*) – *Quercus falcata – Carya texana* Woodland.



**Figure A85.** *Pinus palustris – Pinus* (*echinata*, *taeda*) – *Quercus falcata – Carya texana* Woodland (CSU)

Short Citation
Turner et al. unpubl. data

***CEGL003609 Pinus palustris – Pinus (echinata, taeda) / (Liquidambar styraciflua) / Schizachyrium scoparium Ruderal Woodland***

Table A72 below shows the USNVC Hierarchy for CEGL003609 *Pinus palustris – Pinus* (*echinata*, *taeda*) / (*Liquidambar styraciflua*) / *Schizachyrium scoparium* Ruderal Woodland.

**Table A72.** USNVC hierarchy for CEGL003609 *Pinus palustris – Pinus* (*echinata*, *taeda*) / (*Liquidambar styraciflua*) / *Schizachyrium scoparium* Ruderal Woodland

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.1 Warm Temperate Forest & Woodland |
| Division | 1.B.1.Na Southeastern North American Forest & Woodland |
| Macrogroup | 1.B.1.Na Longleaf Pine Woodland |
| Group | 1.B.1.Na Dry-Mesic Loamy Longleaf Pine Woodland |

**Table A72 (continued).** USNVC hierarchy for CEGL003609 *Pinus palustris* – *Pinus* (*echinata*, *taeda*) / (*Liquidambar styraciflua*) / *Schizachyrium scoparium* Ruderal Woodland

| Category | Description |
|---|---|
| Alliance | A3124 *Pinus palustris* / *Schizachyrium scoparium* West Gulf Coastal Plain Woodland Alliance |
| Association | 1.B.1.Na *Pinus palustris* - *Pinus* (*echinata*, *taeda*) / (*Liquidambar styraciflua*) / *Schizachyrium scoparium* Ruderal Woodland (CEGL003609) |

**Field Plots:** 2084, 0319_102, 0319_298

**Map Class:** BITH MC321

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: mean 79.5 ft range 78 ft to 79 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland flatland

**Soil Texture**: Sandy clay loam

**Environment**: 3 plots was sampled within this type. This community was found on flatlands. Ground cover was split evenly with litter and bare soil.

Local Vegetation Description
**Structure**: Canopy (20%), Tall shrub (20%), Herbaceous (80%)

**Vegetation Floristics**: Species diversity is quite diverse within this community. The canopy is dominated by *Pinus taeda*, *Pinus echinata*, and *Pinus taeda* with cover values ~20%. Shrub cover reaches ~20% with common species including *Ilex coriacea*, *Ilex opaca*, *Ilex vomitoria*, *Morella cerifera*, *Liquidambar styraciflua*, *Magnolia virginiana*, and *Persea borbonia*. Herbaceous cover is abundant with cover ~80%. *Schizachyrium scoparium* dominates the herbaceous layer with cover ~30%.

**Dynamics:** This type can result from partial thinning or regeneration cutting of formerly pure longleaf stands and/or from infrequent burning of plantations and naturally regenerated stands.

Conservation Status Rank
**Global**: GNA

Global Environmental Description

As broadly defined, this type extends across a moisture gradient from mesic flats to xeric ridgetops. Soil textures can be extremely variable from fine-textured silty soils to sandy loam soils overlying clay, and coarse-textured sands. Some specific soils series from examples in Louisiana include Smithdale, Ruston, Betis, and Briley. Some examples may be naturally occurring, unmanaged types still suffering from fire suppression, in which the areas are naturally sheltered from frequent fire.

Global Vegetation Description

*Pinus taeda* is generally a codominant on more mesic sites and flats, while *Pinus taeda* and/or *Pinus echinata* may codominate on drier sites. *Pinus echinata* tends to be the only codominant pine on xeric sites. The vegetation tends to have a patchy understory due to fire suppression. Depending on the moisture regime, understory species may include *Liquidambar styraciflua, Quercus alba, Quercus stellata, Quercus falcata*, and *Quercus hemisphaerica*. Part of the canopy (but typically not more than 25%) may be composed of these or other hardwood species. Shrubs that may be present, depending on fire history and moisture, include *Cornus florida, Callicarpa americana, Ostrya virginiana, Ilex vomitoria*, and *Vaccinium arboreum*. Herbaceous cover is sparse to fairly dense and is typically dominated by *Schizachyrium scoparium*. The ground cover is greatly decreased in stands with a high canopy cover. The exotic *Lonicera japonica* may invade this community, especially where it is not frequently burned.

Example Photograph

Figure A86 below shows an example of CEGL003609 *Pinus palustris – Pinus* (*echinata*, *taeda*) / (*Liquidambar styraciflua*) / *Schizachyrium scoparium* Ruderal Woodland.



**Figure A86.** *Pinus palustris – Pinus* (*echinata*, *taeda*) / (*Liquidambar styraciflua*) / *Schizachyrium scoparium* Ruderal Woodland (CSU)

***NPSBITH016 Pinus spp. (taeda, echinata, palustris) Regenerating Woodland and Shrubland***
USNVC Hierarchy*:* Park Special NPSBITH016

**Field Plots:** 3017, 7008, 0319_090

**Map Class:** BITH MC322

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 229 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland

**Soil Texture**: Sandy loam

**Environment**: 3 plots were sampled within this type. These communities typically occur on uplands with sandy soils. Ground cover is dominated by litter with values reaching ~90%. Wood may be sparsely present scattered about the community.

Local Vegetation Description
**Structure**: Canopy (0%-40%), Tall shrub (0%-50%), Herbaceous (0%-20%)

**Vegetation Floristics**: These areas typically result from regenerating *Pinus* spp. These communities are typically formed from management to restore *Pinus palustris* communities. The canopy dominant is *Pinus palustris*, *Pinus echinata*, and/or *Pinus taeda* (30-40% cover). Shrub layer dominants include *Pinus* spp. at ~4m tall (30% cover), *Quercus incana* (30% cover), *Liquidambar styraciflua* (20% cover), *Ilex vomitoria*, *Quercus hemisphaerica*, and *Quercus falcata*. Herbaceous layer is vigorous with graminoids such as *Andropogon gerardii* (50% cover), *Andropogon ternarius*, and *Andropogon virginicus*.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A87 below shows an example of Park Special NPSBITH016 *Pinus* spp. (*taeda*, *echinata*, *palustris*) Regenerating Woodland and Shrubland.



**Figure A87.** *Pinus* spp. (*taeda*, *echinata*, *palustris*) Regenerating Woodland and Shrubland (CSU)

### *CEGL007157 Pinus elliottii – (Pinus palustris) / Morella cerifera – Ilex coriacea Ruderal Wet Woodland*

Table A73 The table below shows the USNVC Hierarchy for CEGL007157 *Pinus elliottii* – (*Pinus palustris*) / *Morella cerifera – Ilex coriacea* Ruderal Wet Woodland.

**Table A73.** USNVC hierarchy for CEGL007157 *Pinus elliottii* – (*Pinus palustris*) / *Morella cerifera – Ilex coriacea* Ruderal Wet Woodland

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southeastern North American Ruderal Flooded & Swamp Forest |
| Group | 1.B.3.Nb Southeastern Native Ruderal Flooded & Swamp Forest |
| Alliance | A3345 *Pinus taeda - Liquidambar styraciflua* Ruderal Flooded & Swamp Forest Alliance |
| Association | 1.B.3.Nb *Pinus elliottii* var. *elliottii* - (*Pinus palustris*) / *Morella cerifera - Ilex coriacea* Ruderal Wet Woodland (CEGL007157) |

**Field Plots:** Association added from legacy oil and gas surveys

**Map Class:** BITH MC323

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 10 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands

**Soil Texture**: Sandy clay loam

**Environment**: This community occurs on moist flatlands near the floodplain. Ground cover may be strongly dominated by pine litter under a closed canopy, but bare soil and herbaceous litter will occur within canopy openings.

Local Vegetation Description
**Structure**: Canopy (60%-90%), Short shrub (10%-60%), Herbaceous (5%-40%)

**Vegetation Floristics**: Degraded fire suppressed *Pinus palustris* woodland on soils of fine sandy loams or silt loams. Codominant canopy species *Pinus elliottii* and *Pinus palustris* have 75% combined cover. *Liquidambar styraciflua* (<25% cover) is a common associate. Shrub density ranges from sparse to dense with *Callicarpa americana*, *Ilex coriacea*, *Morella caroliniensis*, *Morella cerifera*, *Vaccinium elliottii*, and *Viburnum nudum* var. *nudum*. Herbaceous layer is dense under open conditions with *Carex* spp., *Ctenium aromaticum*, *Muhlenbergia expansa*, and *Schizachyrium scoparium*. Exotic aggressively invasive species such as *Ligustrum sinense*, *Lonicera japonica*, and *Microstegium vimineum* are especially common.

**Dynamics:** This forest is primarily disturbed through silvicultural management techniques such as burning and thinning. This forest is initially planted as a seedling/sapling phase and progresses relatively quickly (9-12 years) to a forest physiognomy. This forest is likely cut before it succeeds to another community.

Conservation Status Rank
**Global**: GNA

Global Environmental Description
Soils on which this type occurs range from poorly drained to very poorly drained, fine sandy loams or silt loams. The variable hydrology includes forests with soils saturated in winter, early spring, and periodically throughout the growing season. Examples can be highly variable, ranging from heavily silviculturally managed vegetation consisting of planted or seed tree/shelterwood-regenerated *Pinus elliottii var. elliottii* to unmanaged, "naturalized" stands resulting from fire suppression.

Global Vegetation Description

This evergreen forest consists of planted or seed tree/shelterwood-regenerated *Pinus elliottii var. elliottii* and *Pinus palustris* comprising over 75% of the canopy. The total canopy cover ranges from 60-100%. *Liquidambar styraciflua* may be in the understory or subcanopy but comprises less than 25% of the canopy. Shrubs range from very patchy in frequently burned sites to dense in examples that have not burned for several (over 5) years and include *Morella caroliniensis (= Myrica heterophylla), Morella cerifera (= Myrica cerifera), Ilex coriacea, Viburnum nudum var. nudum, Vaccinium elliottii*, and *Callicarpa americana*. Little herbaceous cover occurs under denser canopies, while more open examples may include a fairly dense ground cover of *Schizachyrium scoparium, Muhlenbergia expansa, Ctenium aromaticum*, and *Carex* spp. The exotics *Lonicera japonica, Ligustrum sinense*, and *Microstegium vimineum* may invade this community.

Example Photograph

Figure A88 below shows an example of CEGL007157 *Pinus elliottii* – (*Pinus palustris*) / *Morella cerifera – Ilex coriacea* Ruderal Wet Woodland.



**Figure A88.** *Pinus elliottii* – (*Pinus palustris*) / *Morella cerifera – Ilex coriacea* Ruderal Wet Woodland (CSU)

***CEGL007065 Taxodium distichum / Morella cerifera / Thelypteris palustris Tidal Woodland***

Table A74 below shows the USNVC Hierarchy for CEGL007065 *Taxodium distichum* / *Morella cerifera* / *Thelypteris palustris* Tidal Woodland.

**Table A74.** USNVC hierarchy for CEGL007065 *Taxodium distichum* / *Morella cerifera* / *Thelypteris palustris* Tidal Woodland

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Floodplain Forest |
| Group | 1.B.3.Nb Bald-cypress - Tupelo Floodplain Forest |
| Alliance | A3595 *Taxodium distichum - Nyssa biflora* Tidal Swamp Forest Alliance |
| Association | 1.B.3.Nb *Taxodium distichum* / *Morella cerifera* / *Thelypteris palustris* Tidal Woodland (CEGL007065) |

**Field Plots:** 6042, 6043

**Map Class:** BITH MC324

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 5

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Marsh

**Soil Texture**: Muck

**Environment:** 2 plots were sampled within this type. Water dominates ground cover with cover >95%.

Local Vegetation Description
**Structure**: Canopy (10%-30%), Short shrub (10%-30%), Herbaceous (30%-60%)

**Vegetation Floristics**: Woodland community with 10-25% canopy cover. Palustrine semipermanently flooded woodland occurs adjacent to estuarine and riverine habitats. Canopy dominants include *Taxodium distichum* (20% cover), *Acer rubrum*, and *Nyssa aquatica*. Shrubs such as *Morella cerifera* (10-20% cover), *Baccharis halimifolia*, *Cephalanthus occidentalis*, and *Ilex cassine* are common. Characteristic herbaceous species are *Zizaniopsis miliacea* (30-60% cover), *Eleocharis spp*., *Pontederia cordata*, *Sagittaria lancifolia*, *Sagittaria latifolia*, and *Typha*

*domingensis*. *Tillandsia usneoides* is a common epiphyte. Non-native noxious species such as *Alternanthera philoxeroides*, *Eichhornia crassipes*, *Salvinia minima*, *Salvinia molesta*, and *Triadica sebifera* commonly invade.

**Dynamics**: N/A

Conservation Status Rank
**Global**: GNR

Global Environmental Description
This wooded marsh vegetation is located adjacent to estuarine and riverine tidal waters, but the occurrences where it was documented are mostly mapped as palustrine semipermanently flooded and not identified as tidal (NPS 2005). Though tidal influence has not been documented, it might be present, especially from wind tides. In some occurrences this sparsely wooded marsh community is separated from open water by expansive herb and herb-shrub marshes. All locations are impacted by levees and ditches that are presumably disrupting the flow of water. Some examples of this community may occur as a floating mat of vegetation (flotant).

Global Vegetation Description
This community is characterized by a scattered, short-statured overstory of *Taxodium distichum, Acer rubrum, Nyssa aquatica*, and *Morella cerifera* in combination with a variety of fresh to oligohaline marsh species. Other shrubs may include *Ilex cassine, Baccharis halimifolia*, and *Cephalanthus occidentalis*. Characteristic marsh species include *Pontederia cordata, Polygonum hydropiperoides, Sagittaria lancifolia, Sagittaria latifolia, Eleocharis cellulosa, Thelypteris palustris, Typha domingensis, Panicum hemitomon*, and *Eleocharis* spp. The marsh is often mixed with no clear dominant. Other marsh species commonly encountered include *Boehmeria cylindrica, Eleocharis vivipara, Hydrocotyle* spp., *Kosteletzkya virginica, Phyla lanceolata, Rhynchospora corniculata, Sacciolepis striata, Saururus cernuus, Solidago sempervirens*, and the floating aquatic *Lemna obscura*. Common non-native species include *Triadica sebifera, Alternanthera philoxeroides, Eichhornia crassipes, Salvinia minima*, and *Salvinia molesta*. The epiphyte *Tillandsia usneoides* is common in this community.

Example Photograph
Figure A89 below shows an example of CEGL007065 *Taxodium distichum* / *Morella cerifera* / *Thelypteris palustris* Tidal Woodland.



**Figure A89.** *Taxodium distichum* / *Morella cerifera* / *Thelypteris palustris* Tidal Woodland (CSU)

Short Citation
NPS 2005

***NPSBITH015 Ilex coriacea – Prunus caroliniana Dense Evergreen Forest and Shrubland***
USNVC Hierarchy*:* Park Special NPSBITH015

**Field Plots:** 6020, 7022, 0319_079, 0319_176

**Map Class:** BITH MC325

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 40.5 ft range 4 ft to 77 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland Flat, Floodplain active channel, Flatlands

**Soil Texture**: Loam, Silt loam, Sandy loam

**Environment**: 4 plots were sampled within this type. This community occurs across a variety of topographies, but it is mainly found in more mesic areas. Ground cover is dominated by litter with values reaching 90%.

Local Vegetation Description
**Structure**: Canopy (0%-30%), Shrubs (50%-100%), Herbaceous (0%-20%)

**Vegetation Floristics**: This community typically occurs on small rises above within or adjacent to the floodplain. This tall shrubland community is on the verge of becoming a forest with shrubs often reaching ~5m in height. Shrub stratum dominant is *Ilex coriacea* and/or *Prunus caroliniana* (50-80% cover). Canopy species can include *Acer floridanum* (20% cover), *Nyssa biflora* (10% cover), *Liquidambar styraciflua*, *Pinus taeda* (<10% cover), and *Juniperus virginiana*. Herbaceous species such as *Callicarpa americana* and *Mitchella repens* are common.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A90 below shows an example of Park Special NPSBITH015 *Ilex coriacea – Prunus caroliniana* Dense Evergreen Forest and Shrubland.



**Figure A90.** *Ilex coriacea – Prunus caroliniana* Dense Evergreen Forest and Shrubland (CSU)

### *CEGL007871 Quercus laurifolia – (Quercus nigra, Nyssa biflora) / Diospyros virginiana Wet Forest*

Table A75 below shows the USNVC Hierarchy for CEGL007871 *Quercus laurifolia* – (*Quercus nigra*, *Nyssa biflora*) / *Diospyros virginiana* Wet Forest.

**Table A75.** USNVC hierarchy for CEGL007871 *Quercus laurifolia* – (*Quercus nigra*, *Nyssa biflora*) / *Diospyros virginiana* Wet Forest

| Category | Description |
|---|---|
| Class | 1 Forest & Woodland |
| Subclass | 1.B Temperate & Boreal Forest & Woodland |
| Formation | 1.B.3 Temperate Flooded & Swamp Forest |
| Division | 1.B.3.Nb Southeastern North American Flooded & Swamp Forest |
| Macrogroup | 1.B.3.Nb Southern Coastal Plain Basin Swamp & Flatwoods |
| Group | 1.B.3.Nb Hardwood - Loblolly Pine Nonriverine Wet Flatwoods |
| Alliance | A4190 *Pinus taeda* - *Quercus laurifolia* - *Quercus phellos* West Gulf Coastal Plain Wet Flatwoods Forest Alliance |
| Association | 1.B.3.Nb *Quercus laurifolia* - (*Quercus nigra*, *Nyssa biflora*) / *Diospyros virginiana* Wet Forest (CEGL007871) |

**Field Plots:** Field Reconnaissance

**Map Class:** BITH MC326

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: Mean 36 ft range 25 ft to 70 ft, 25, 30, 30, 70

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Upland flat, Floodplain flat terrace, Flatlands

**Soil Texture**: Sandy clay loam, silty loam

**Environment**: This community occurs on mesic flatlands near floodplains and occasionally within uplands. Litter typically dominated the ground cover with values reaching to 90%. This community occasionally floods, so water may occur with values up to 40%.

Local Vegetation Description
**Structure**: Canopy (60%-80%), Short shrub (20%-40%)

**Vegetation Floristics**: Swamp wet forest occurring on isolated circular depressions within pine flatwoods. *Quercus laurifolia* is the most abundant canopy species with associated *Acer rubrum*, *Crataegus* spp., *Diospyros virginiana*, *Ilex opaca*, *Nyssa biflora*, *Pinus taeda*, and *Quercus nigra*. *Cyrilla racemiflora* is common in the shrub layer. Herbaceous layer is sparse due to consistent flooding; *Carex* spp. (5-10% cover) can occur. Sphagnum spp. is a common bryophyte.

**Dynamics:** N/A

Conservation Status Rank
**Global**: G3?

Global Environmental Description
This community occurs on the Intermediate Pleistocene Terraces (Bentley and Montgomery) in a pine flatwoods landscape. This West Gulf Coastal Plain community occurs as isolated circular depressions of less than an acre to several acres in size, locally called "baygols" (Bridges 1988).

Global Vegetation Description
The closed canopy is typically dominated by *Quercus laurifolia*, with lesser amounts of *Quercus nigra* and *Nyssa biflora*. The typical understory contains *Diospyros virginiana* and *Crataegus* spp. The herb stratum is poorly developed.

Example Photograph

Figure A91 below shows an example of CEGL007871 *Quercus laurifolia* – (*Quercus nigra*, *Nyssa biflora*) / *Diospyros virginiana* Wet Forest.



**Figure A91.** *Quercus laurifolia* – (*Quercus nigra*, *Nyssa biflora*) / *Diospyros virginiana* Wet Forest (CSU)

Short Citation

Bridges 1988

***NPSBITH008 Acer rubrum – (Triadica sebifera) / Morella cerifera Swamp Woodland***

USNVC Hierarchy*:* Park Special NPSBITH008

**Field Plots:** 1029, 6013, 6014, BITH0319_257

**Map Class:** BITH MC327

Local Environmental Description

Plot/Sample Data Environmental Summary

**Elevation**: 88 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain active channel

**Soil Texture**: Sandy clay, Silty clay, Muck

**Environment**: 4 plots were sampled within this type. This community typically occurs within the floodplain in small depressions. Soil is typically poorly drained and range from sandy clay to clay. The community is typically flooded, but the amount of water may vary drastically during the year. Ground cover is usually codominated evenly between water and litter.

Local Vegetation Description
**Structure**: Canopy (30%-70%), Short shrub (10%-40%), Herbaceous (50%-90%)

**Vegetation Floristics**: These flooded communities are typically dominated by *Acer rubrum* and *Liquidambar styraciflua* with cover ranging from 30%-70%. *Triadica sebifera* may begin to invade this community; however, cover should not reach >70%. The shrub stratum reaches moderate cover ranging from 10% to 40%. *Morella cerifera* tends to be the most dominant shrub within this community. Herbaceous stratum is vigorous with cover ranging from 50% to 90%. Common species include *Juncus effusus*, *Saccharum giganteum*, *Hydrocotyle bonariensis*, and *Polygonum hydropiperoides*.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A92 below shows an example of Park Special NPSBITH008 *Acer rubrum* – (*Triadica sebifera*) / *Morella cerifera* Swamp Woodland.



**Figure A92.** *Acer rubrum* – (*Triadica sebifera*) / *Morella cerifera* Swamp Woodland (CSU)

***NPSBITH025 Nyssa biflora – Acer rubrum – (Triadica sebifera) / Morella cerifera / Saccharum giganteum Swamp Woodland***
USNVC Hierarchy***:*** Park Special NPSBITH025

**Field Plots:** 6011, 7018, 0319_073

**Map Class:** BITH MC328

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 102 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands

**Soil Texture**: Muck

**Environment**: 3 plots were sampled within this community. These communities were found in wet depressions that are often flooded. Litter dominates the ground cover with values up to 60%. Water often forms up to 25% of the ground cover.

Local Vegetation Description
**Structure**: Canopy (40%), Tall shrub (10%), Herbaceous (70%)

**Vegetation Floristics**: *Nyssa biflora* and *Acer rubrum* codominate the canopy with cover <50%. *Triadica sebifera* may occur in the canopy as well. The shrub stratum is sparse to moderate with *Cephalanthus occidentalis* and *Morella cerifera*. Herbaceous stratum is dense with *Saccharum giganteum* and *Juncus effusus* with cover >60%.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A93 below shows an example of Park Special NPSBITH025 Nyssa biflora – (Triadica sebifera) / Morella cerifera / Saccharum giganteum Swamp Woodland.



**Figure A93.** *Nyssa biflora* – (*Triadica sebifera*) / *Morella cerifera* / *Saccharum giganteum* Swamp Woodland (CSU)

***NPSBITH026 Pinus taeda – Nyssa biflora – Magnolia virginiana / Andropogon glomeratus Wet Woodland***

USNVC Hierarchy**:** Park Special NPSBITH026

**Field Plots:** Field Reconnaissance

**Map Class:** BITH MC329

Local Environmental Description

Plot/Sample Data Environmental Summary

**Elevation**: 83 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands

**Soil Texture**: Muck

**Environment**: These communities were found in small, saturated depressions that temporarily flood. Ground cover is dominated by litter with cover exceeding 70%. Water may be present with cover values <30%.

Local Vegetation Description
**Structure**: Canopy (50%), Short shrub (10%), Herbaceous (40%)

**Vegetation Floristics**: This woodland community is codominated by *Pinus taeda* and *Nyssa biflora* with cover typically <50%. *Magnolia virginiana* is often present as well. Dense shrubs surround this circular community and are composed of *Morella cerifera* and *Persea palustris*. Young *Liquidambar styraciflua* may be found scattered throughout the community. The herbaceous stratum is vigorous and dominated by a variety of mesic grasses and sedges including *Saccharum giganteum*, *Andropogon glomeratus, Carex glaucescens*, and *Anthaenantia rufa*.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A94 below shows an example of Park Special NPSBITH026 *Pinus taeda – Nyssa biflora – Magnolia virginiana* / *Andropogon glomeratus* Wet Woodland.



**Figure A94.** *Pinus taeda – Nyssa biflora – Magnolia virginiana* / *Andropogon glomeratus* Wet Woodland (CSU)

***NPSBITH027 Pinus taeda – Nyssa biflora – Quercus laurifolia Circular Depression Flooded Flatwood Forest***

USNVC Hierarchy**:** Park Special NPSBITH027

**Field Plots:** 8004, 8005, 8006, 8007, 8008, 8012, 8013

**Map Class:** BITH MC330

Local Environmental Description

Plot/Sample Data Environmental Summary

**Elevation**: Mean 278.67 ft range 224 ft to 353 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Flatlands, Upland

**Soil Texture**: Sandy clay loam, Silty clay loam

**Environment**: 7 sites were sampled within this community. These communities typically occur within flooded circular depressions. Generally, the soil contains some amount of clay and loam. Ground cover is dominated by litter with cover ranging from 20%-95% cover. Wood is often present with cover <5%. Often these communities are inundated and may have cover up to 70%.

Local Vegetation Description
**Structure**: Canopy (70%-90%), Short shrub (0%-30%), Herbaceous (0%-30%)

**Vegetation Floristics**: This community occurs in small circular depressions within sandy uplands. *Pinus taeda*, *Quercus laurifolia*, and *Quercus phellos* typically dominate the canopy with cover ~80%. The subcanopy often contains *Nyssa sylvatica*, *Nyssa biflora*, and/or *Liquidambar styraciflua*. Occasionally, *Quercus stellata* and/or *Quercus alba* may occur around the edges of these communities. If present, the herbaceous stratum is usually composed of *Chasmanthium laxum* and/or *Carex* spp.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A95 below shows an example of Park Special NPSBITH027 *Pinus taeda – Nyssa biflora – Quercus laurifolia* Circular Depression Flooded Flatwood Forest.



**Figure A95.** *Pinus taeda – Nyssa biflora – Quercus laurifolia* Circular Depression Flooded Flatwood Forest (CSU)

## Mapped Sparse Types

***NPSBITH019 Riverine Sand Flats – Bars Sparse Vegetation***
USNVC Hierarchy**:** Park Special NPSBITH019

**Field Plots:** Field Reconnaissance

**Map Class:** BITH MC401

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 10 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain active channel

**Soil Texture**: Sand

**Environment:** This community occurs along the banks of large rivers and creeks such as eh Neches River and Village Creek. The ground cover is dominated by bare soil with values reaching >95%.

Local Vegetation Description
**Structure**: Herbaceous (0%-10%)

**Vegetation Floristics**: This sparse community is found on riverine sand bars. Herbaceous vegetation is often sparse and variable depending on time of year.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A96 below shows an example of Park Special NPSBITH019 Riverine Sand Flats – Bars Sparse Vegetation.



**Figure A96.** Riverine Sand Flats – Bars Sparse Vegetation (CSU)

***NPSBITH020 Bare Alluvial Depositional Bar***
USNVC Hierarchy**:** Park Special NPSBITH020

**Field Plots:** Field Reconnaissance

**Map Class:** BITH MC401

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 10 ft

**Aspect**: 0

**Slope**: 0

**Macro Topography**: Floodplain active channel

**Soil Texture**: Silt loam, Silt, Sandy loam

**Environment**: This community occurs along the Neches River. Ground cover is dominated by bare soil with values reaching >95%.

Local Vegetation Description
**Structure**: (Herbaceous 0%-10%)

**Vegetation Floristics**: This sparse community is found alluvial bars along the rivers and streams. The herbaceous stratum is sparse and variable depending on the time of year.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A97 below shows an example of Park Special NPSBITH020 Bare Alluvial Depositional Bar.



**Figure A97.** Bare Alluvial Depositional Bar (CSU)

***NPSBITH021 Sparse Cliff Vegetation***
USNVC Hierarchy**:** Park Special NPSBITH021

**Field Plots:** 6027b

**Map Class:** BITH MC402

Local Environmental Description
Plot/Sample Data Environmental Summary

**Elevation**: 278 ft

**Aspect**: Mean 45 range 20 to 70

**Slope**: Mean 30 range 20 to 40

**Macro Topography**: Cliff

**Soil Texture**: Sand

**Environment:** This community occurs along the northern reaches of the Neches River. Ground cover is dominated by bare soil with values reaching 80%.

Local Vegetation Description
**Structure**: Herbaceous (0%-10%)

**Vegetation Floristics**: Cliff lacking vegetation.

**Dynamics**: N/A

Conservation Status Rank
**Global**: N/A

Global Environmental Description
N/A

Global Vegetation Description
N/A

Example Photograph
Figure A98 below shows an example of Park Special NPSBITH021 Sparse Cliff Vegetation.



**Figure A98.** Sparse Cliff Vegetation (CSU)

# Appendix B: Field Key to Community Associations/Types

## Introduction

The vegetation classification and key of Big Thicket National Preserve (BITH) has been developed as part of the Vegetation Classification and Mapping project being conducted at these parks. The project is managed by the Gulf Coast Inventory and Monitoring Network under the guidance of the National Park Service's National Vegetation Inventory Program. The field key is one of the products produced as part of the classification phase of the project. It has been developed by using the compiled field data, which was analyzed to identify the vegetation types that occur within BITH. The vegetation types identified during analysis have been classified according to the National Vegetation Classification (NVC) hierarchy (USNVC 2016).

This key has been written to assist users in identifying the major physiognomic units and the vegetation alliances within BITH. The key also lists each alliance's respective vegetation associations that were sampled within the park. The alliances and associations are based on one or more dominant and/or diagnostic species and on environmental settings. The key is used to distinguish formal mapping units and to conduct the accuracy assessment of the vegetation maps for the park. This key can also be used to identify various vegetation communities for other projects within the park. The key is based on classification of new data collected by the Colorado Natural Heritage Program vegetation mapping field crew in 2016 and additional surveys conducted by the Center for Environmental Management of Military Lands in 2017.

The key may not denote all vegetation types that occur within the park, nor explain the full range of variation of vegetation types as they appear on the ground. Species interact in a continuum based on a complex set of habitat preferences, and they can intermix in wide or narrow zones within the landscape. While this key attempts to reflect this complexity, unusual or site specific assemblages of plants may exist in the landscape and may not be easily keyed.

The following paragraphs define the conventions for how those terms and concepts are used in the key. Be sure to consider these usage conventions as you work through the keys. If you are having trouble reaching a satisfactory conclusion, your interpretation of a term or concept may be different and leading you down the wrong path. If you feel you are not getting a satisfactory outcome, critically evaluate the specific terms used in each couplet and consider your interpretation of them and how that may be impacting your results. Remember, by design, vegetation classification is an attempt to place lines around things that are not bounded by hard lines. As such, one must often accept "the preponderance of the evidence" in lieu of a "perfect fit".

Before using this key, several terms and concepts need to be clearly defined:

Shrubs tend to be multi-stemmed plants less than 5 meters tall. Trees are generally single-stemmed and are greater than 5 meters tall. Some canopy trees such as *Quercus laurifolia* may straddle the line between tree and shrub; these plants can occupy both layers, and the decision between shrub and sub canopy should be based on average height of the species in the area.

Forest canopies typically have greater than 60% cover; woodland canopies have cover values between 60% and 25%. However, cover values tend to be variable and are not necessarily hard cutoffs. Forests may have cover ~55% if you happen to catch a gap in the canopy, and woodlands may have cover values of ~15% if the trees are exceptionally sparse. When deciding on whether or not an area is a forest or woodland, consider the surrounding area and whether or not the cover the plot and where you are is representative of the entire area.

Species abbreviations use the USDA PLANTS Database syntax in which each Latin binomial and trinomial is assigned a unique symbol. For a binomial, the symbol consists of the uppercase first two letters of the genus, plus the uppercase first two letters of the specific epithet. For example, the symbol for *Fagus grandifolia* is FAGR, and the symbol for *Iva imbricata* is IVIM. Different plants with the same 4 letter symbol are differentiated by adding a number as a tie-breaking suffix. For example, the symbol for *Pinus palustris* is not PIPA, but PIPA2. Likewise, *Callicarpa americana* is not CAAM, but CAAM2. The symbol for a trinomial consists of the first two letters of the genus, plus the first two letters of the specific epithet, plus the first letter of the sub-specific or varietal epithet. For example, the symbol for *Elymus elymoides* ssp. *elymoides* is ELELE. Tie-breaking numbers are used here for differentiating duplicative letter combinations.

USNVC community types have a 10-digit CEGL code (CEGL000658). Communities present at GUIS without an appropriate USNVC type are labeled as “Park Specials” and are recognized under a 10-digit code beginning with “NPSBITH” followed by a sequential number (NPSBITH001).

The syntax of the USNVC names use the symbols “/”, “-”, and “( )” to indicate the structure and composition of the community. The “/” symbol separating two species names indicates the species are in different strata. The species listed on the left of the “/” is in the stratum above the stratum containing the species on the right of the “/”. The “-” symbol separating two species names indicates the species separated by the dash are essentially codominant within the same stratum. Species names within parentheses [e.g. “( )”] indicates that species may or may not be present in the community.

Determining the correct vegetation associations and map units require an awareness of the scale at which those are being defined. The scale, or minimum mapping unit (MMU), used in this project is 0.5 hectares (ha).

The floristic structure of these associations is broken down into 5 strata: Emergent, Canopy, Sub canopy, Shrub, and Herbaceous.

**Emergent:** Emergent stratum is characterized by tall trees that are distinctly above a canopy. The most common tree to occur in this stratum is *Pinus palustris*. For there to be an emergent stratum, there must first be a canopy stratum.

**Canopy:** A canopy is the main layer of trees formed by mature crowns. A canopy must be present in order for either an Emergent or Sub Canopy layer to be present.

**Sub Canopy:** The sub canopy is a distinct layer of trees occurring beneath the canopy. There must be a canopy for there to be a sub canopy. Common sub canopy trees include *Magnolia virginiana* and *Acer rubrum*.

**Shrub:** The shrub layer is often underneath the canopy/sub canopy, but it may occur without either. The shrub canopy is composed of shrubs between 0.5 m and 5 m in height. Common shrubs include *Morella cerifera, Ilex vomitoria,* and *Ceratiola ericoides*.

**Herbaceous:** The herbaceous layer is composed of graminoids, forbs, ferns, and seedlings. At BITH, graminoids and forbs are the most common plants in the herbaceous layer.

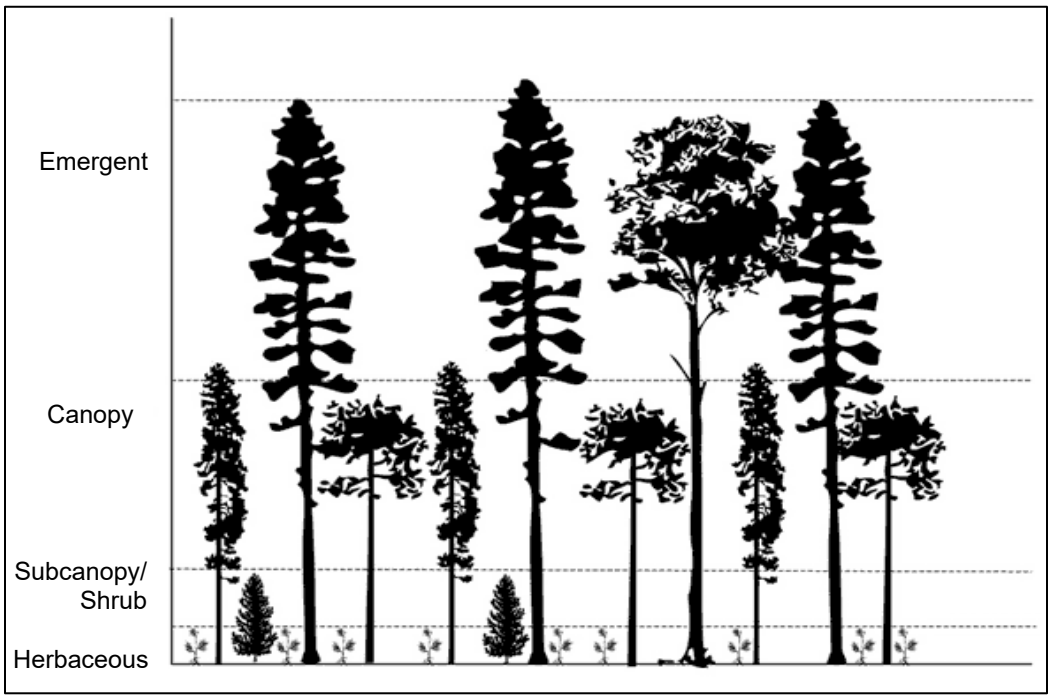



**Figure B-1.** The floristic structure of the associations used. Adapted from Warren and Lemmen (2014).

The area of the map includes everything within the park's administrative boundary. That means there are map classes for all the vegetated areas, the non-vegetated areas such as open water and sand bars, as well as areas of land-use such as agricultural fields, roads, and developed vegetation such as maintained lawns. Each of these types is described in the following key and defined in the map class descriptions document. Below is a list of physiognomic classes:

**Forest**: Trees with their crowns overlapping (generally forming 60-100% cover).

**Woodland**: Open stands of trees with crowns not usually touching (generally forming 25-60% cover). Canopy tree cover may be <25% when it exceeds shrub, dwarf-shrub, herb, and nonvascular cover.

**Shrubland**: Shrubs generally >0.5 m tall with individuals or clumps overlapping to not touching (generally forming >25% cover, trees generally <25% cover). Shrub cover may be <25% when it exceeds tree, dwarf-shrub, herb, and nonvascular cover. Vegetation dominated by woody vines is generally treated in this class.

**Dwarf Shrubland**: Low-growing shrubs usually <0.5 m tall. Individuals or clumps overlapping to not touching (generally forming >25% cover, trees and tall shrubs generally <25% cover). Dwarf-shrub cover may be <5% when it exceeds tree, shrub, herb, and nonvascular cover.

**Herbaceous**: Herbs (graminoids, forbs, and ferns) dominant (generally forming >25% cover; trees, shrubs, and dwarf-shrubs generally with <25% cover). Herb cover may be <25% when it exceeds tree, shrub, dwarf-shrub, and nonvascular cover.

**Nonvascular**: Nonvascular cover (bryophytes, biotic crusts, non-crustose lichens, and algae) dominant (generally forming >25% cover). Nonvascular cover may be <25% when it exceeds tree, shrub, dwarf-shrub, and herb cover.

**Sparse vegetation:** Abiotic substrate features dominant. Vegetation is scattered to nearly absent and generally restricted to areas of concentrated resources (total vegetation ranges from 0-10% cover).

### *Land Use Classes*

Adapted from USGS (2011) and Anderson et al. (2001).

The following land use classes are areas that are not included in the list of natural and semi-natural vegetation types. They are any area where the human use of the land dominates and dictates the vegetation present, if any. These areas tend to be heavily developed such agricultural croplands and pastures, and urban/commercial development such as roads, parking lots, houses, parks, etc. Additionally, open water is one of the land use classes.

### *Key to Land Use Classes*

1a Areas used for the production of grasses, legumes, or grass-legume mixtures planted for livestock grazing and/or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20% of total vegetation ..... ..... **LC001 Pasture/Hay Ground Agricultural Vegetation**

1b Areas have not been developed for vegetation production .....(2a)

2a Area has been developed in some way; usually there are roads, campgrounds, or mowed areas .....(3a)

2b Area has low amounts of vegetation and does not look developed .....(4a)

3a Areas with a mixture of some constructed materials, but mostly vegetation in the form of turf grass. Impervious surfaces typically account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses,

campgrounds, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes ..... **LC003 Developed, Open Space**

3b All other developed areas. These areas typically include 20% to 100% impervious surfaces. These areas most commonly include urban/commercial development, roads, parking lots, etc. Areas such as the mowed margins of roadways are classified as developed, despite the presence of natural or semi-natural vegetation ..... ..... **LC004 Developed, Low- High Intensity**

4a Developed areas with typically 20% to 100% impervious surfaces. These areas most commonly include urban/commercial development, roads, parking lots, etc. Areas such as the mowed margins of roadways are classified as developed, despite the presence of natural or semi-natural vegetation..... **LC004 Developed, Low- High Intensity**

4b Not as above. Barren ground or open water .....(5a)

5a Areas of bare ground, strip mines, gravel pits, borrow pits, road cut banks and other areas that accumulate bare earthen material. Generally, vegetation accounts for <20% of total cover .....**LC002 Non-vegetated/Barren Land, Borrow Pit, Cut Bank**

5b Areas of open water, generally with <25% cover of vegetation or exposed soil. These are usually areas of deep water such as inundated bays, lakes, or streams within a salt marsh. If natural vegetation is present such as Nymphaea odorata, Spartina alterniflora, Spartina patens, Juncus roemerianus, Cladium mariscus, Typha domingensis, or Nyssa spp. with cover >25%, the community should be run through the appropriate Forest/Woodland or Herbaceous key ..... **LC005 Water**

### *Key to Plant Associations*

The following physiognomic classes separate the vegetation into groupings based on the growth habit and structure of the vegetation. The associations within each of these groupings are based on species and communities with similar diagnostic characteristics. However, because the definition and interpretation of those characteristics is highly variable, it is important to keep an open mind and remain flexible in how one interprets the terms and concepts used in the key. For example, if you are in an area that contains a patchy and variable cover of short shrubs set into a matrix of mixed grass, you may be inclined to call it a shrub association and work through the key from that perspective. Depending on the cover values, you may decide that it is a grassland with a low cover of shrubs and attempt to key the types through the grasslands section. Either approach may be correct. We have tried to build flexibility into the key that will allow one to reach the same conclusion regardless of the starting point. However, if you start to key an area from one key Division but are failing to reach what feels like a suitable conclusion try to start from an alternative Division.

### *Physiognomic Classes*

Deciduous and/or coniferous tree species, or a combination of the two, form an open too dense canopy with cover generally >25% .....**Division A – Tree associations**

Shrubs form the dominant stratum with cover typically >10%. If present, trees will generally have <10% cover. An herbaceous stratum is usually present and may have great abundance ..... .....**Division B – Shrub associations**

Herbaceous plants dominate the site. Any woody species such as shrubs and trees typically have <10% cover. Total vegetation cover is typically >10%. ..... ..... **Division C – Herbaceous associations**

Total vegetation cover on the site is <10% and the surface of the substrate is easily visible. Typically, located in dynamic settings where disturbance occurs regularly (e.g. sandbars) or where substrates are not favorable for plant growth (e.g. solid rock) ..... **Division D – Sparse associations**

### *Division A – Tree Associations*

**Tree associations** include types considered forests as well as woodlands. Woodlands have an overstory tree canopy containing approximately 20-60% cover. For the most part, woodlands have an open canopy that allows a clear view of the sky throughout most of the area, although the crowns of trees in a woodland may occasionally touch or overlap.

**Forests** have an overstory tree canopy containing approximately 60-100% cover. The crowns of trees in a forest are almost always touching and often overlap; for the most part they form a closed canopy that precludes a clear view of the sky in most areas.

While most forest and woodland types will have trees of different species occupying different stratum, it is the uppermost stratum with at least 10% cover that is diagnostic of the community type. Likewise, different aged individuals of the same species may be present in each stratum in the community. However, it is always the dominant species of the uppermost stratum that is diagnostic of the overall community type, while dominant species in any sub strata are diagnostic of the specific association within the overall type.

**Trees and shrubs** are classified by species. However, when using this key, height is usually considered more important when placing a species in a canopy or shrub. Woody species will fall into one of the shrub strata if it is <5m tall, and if a species is >5m tall, it will be included into a tree canopy stratum. Some sub-canopy trees such as Juniperus virginiana may straddle the line between tree and shrub; these plants can occupy both layers, and the decision between shrub and sub canopy will need to be finessed to get to the correct association.

**Uplands:** These will be areas of highest relief within BITH. Most of these areas will have well drained sandy soils and will never be at the bottom of any slopes.

**Slopes:** The majority of southeast Texas is relatively flat, so identifying a slope may be difficult. Slope forests in the context of this project are defined as an area having a 3% overall average slope. There will be a shapefile provided for you containing slopes. Areas that contain warmer colors such as dark yellows, reds, and oranges are considered to have >3% slopes. However, some caution should be exercised because small streams, depressions, and edges of rivers will have similar signatures, but

they are not considered slopes due to their small size. These features are easily distinguished in the field by the presence of water and the sinuous nature in the imagery.

**Flatwoods:** These communities are relatively flat areas on poorly drained soils often composed of sandy, silty loams, or clay. Flatwoods typically receive most of their moisture through precipitation and/or high water tables; these factors combine causing moist soils and occasional wet depressions through this landform. Flatwoods generally occur above floodplains or rivers and streams and generally, under an upland community; however, due to the flat nature of southeast Texas the upland community may be further away and not readily evident. Small raised areas called pimple mounds are often seen scattered throughout this landform and is often a defining characteristic.

**Floodplains:** These communities occur within the 100-year floodplain of streams and rivers throughout BITH. Floodplains can typically be distinguished by evidence of flooding such as a thin layer of litter often with bare ground exposed, piles of litter, and possible high water marks on trees (unlikely unless there was recent flooding). Through bare earth imagery, floodplains can be distinguished as the lowest topographic relief next to rivers and streams with channels running through the area.

***Key to the Section Key***

2a Upland forest or woodland community; a combination of *Pinus echinata*, *Pinus palustris*, *Pinus taeda*, *Quercus alba*, *Quercus falcata*, *Quercus hemisphaerica*, or *Quercus stellata* are canopy dominants..... **Key A: Upland Forest and Woodland**

2b Dry to mesic slopes, flatwoods, floodplains, swamp, marsh, or bog community; wetland/riparian habitat..... 3a

3a Flatwood or slope forest with ≥3% average slope; pimple mounds are typically indicative of flatwoods; flooding does not result from rivers/streams; lack signs of scouring, and high water marks should be <6”; a combination of *Fagus grandifolia*, *Magnolia grandiflora*, *Pinus palustris*, *Pinus taeda*, *Quercus alba*, *Quercus falcata*, *Quercus hemisphaerica*, *Quercus laurifolia*, *Quercus michauxii*, *Quercus nigra*, *Quercus phellos,* or *Quercus stellata* are canopy dominants ..... **Key B: Mesic Flatwoods and Slope Forests**

3b Floodplain, swamp, marsh, or bog community; seasonal inundation is common..... 4a

4a Floodplain community; seasonal inundation causes evidence of flooding such as scour marks, piles of litter, and a thin layer of litter; a combination of *Acer rubrum*, *Carya aquatica*, *Fraxinus pennsylvanica*, *Liquidambar styraciflua*, *Pinus palustris*, *Pinus taeda*, *Platanus occidentalis*, *Quercus laurifolia*, *Quercus lyrata*, *Quercus michauxii*, *Quercus nigra*, *Quercus pagoda*, or *Quercus phellos* are canopy dominants.. **Key C: Floodplain Forest and Woodland**

4b Swamp, marsh, floodplain or bog community; permanent flooding or saturated soils are typical; a combination of *Acer rubrum*, *Betula nigra*, *Fraxinus* caroliniana, *Liquidambar styraciflua*, *Magnolia virginiana*, *Nyssa* spp., *Salix* spp., *Taxodium distichum*, or *Triadica sebifera* are canopy dominants.....**Key D: Swamp / Floodplain Forest and Woodland**

***Key A: Upland Forest and Woodland***

1a *Pinus* spp. are uncommon/absent canopy species with (0-) avg. 10 (-30) % cover; a combination of *Quercus alba*, *Quercus falcata*, *Quercus hemisphaerica*, and/or *Quercus stellata* are dominant canopy species .....**Section 1: *Quercus* spp. Upland Forest**

1b *Pinus* spp. are common canopy species with avg. 30-75 (-90)% cover ..... 2a

2a A combination of *Quercus alba*, *Quercus falcata*, and/or *Quercus stellata* are dominant canopy species.....**Section 2: *Pinus echinata – Pinus taeda – Quercus stellata* Forest**

2b *Quercus alba*, *Quercus falcata*, and *Quercus stellata* are uncommon/absent canopy species .....**Section 3: *Pinus* spp. Upland Woodland and Forest**

Section 1: Quercus spp. Upland Forest

1a *Quercus hemisphaerica* is abundant in the canopy/shrub stratum ..... Sandy upland forest occurring on sites sheltered from fire. Canopy dominants include *Quercus hemisphaerica*, *Quercus falcata*, and *Quercus nigra*. Associated tree species can include *Carya tomentosa* (*Carya alba*), *Cornus florida*, *Ilex opaca*, *Liriodendron tulipifera*, *Liquidambar styraciflua*, *Magnolia grandiflora*, *Pinus taeda* (<30% cover), *Quercus alba*, and *Quercus nigra*. Shrub layer is dense (>70% cover) with *Quercus hemisphaerica* and *Ilex vomitoria*; common species are *Callicarpa americana*, *Hypericum hypericoides*, *Vaccinium arboreum*, and *Vaccinium* spp. Common vines are *Gelsemium sempervirens* and *Vitis rotundifolia*. Herbs are sparse and may include *Cnidoscolus stimulosus* and *Desmodium* spp..... **CEGL007751: *Quercus hemisphaerica* - *Quercus* (*falcata*, *nigra*) / *Vaccinium arboreum* / *Cnidoscolus stimulosus* Forest [MC318]**

1b *Quercus hemisphaerica* is uncommon/absent in the canopy/shrub stratum..... 2a

2a *Quercus falcata* (>30% cover) forms a major component of the canopy; *Quercus alba* typically forms a minor component of the canopy (<10**%)** Riparian forest where *Quercus falcata* (>30% cover) is the sole canopy dominant with minor components of *Quercus stellata* and *Pinus taeda* (<10% cover). Associated tree species include *Acer rubrum*, *Carya cordiformis*, *Cornus florida*, *Liquidambar styraciflua*, *Pinus echinata*, *Quercus alba*, and *Quercus velutina*. Shrub species include *Callicarpa americana*, *Chionanthus virginicus*, *Forestiera ligustrina*, *Ilex vomitoria*, *Vaccinium arboreum*, and *Viburnum rufidulum*. Herbaceous diversity is low with an abundance of *Chasmanthium sessiliflorum*, *Gelsemium sempervirens*, and *Parthenocissus quinquefolia* ..... . **CEGL008415: *Quercus falcata* - *Quercus stellata* - (*Pinus taeda*) West Gulf Coastal Plain Forest [MC317]**

3a *Quercus alba* forms a major component of the canopy (>10% cover) ..... 4a

4a *Quercus alba* (30-60%) cover dominates the canopy
Acidic dry-mesic forest typically of gradual lower slopes. *Quercus alba* (30-60% cover) is by far the most abundant canopy species. Associated species include *Acer rubrum*, *Carya tomentosa* (*Carya alba*), *Ilex opaca*, *Liquidambar styraciflua*, *Nyssa sylvatica, Quercus*

*pagoda, Quercus falcata,* and *Tilia americana* var. *caroliniana*. *Pinus taeda* and *Pinus echinata* may occasionally grow in this community with <10% combined cover. Common subcanopy species include *Aralia spinosa*, *Carpinus caroliniana*, *Chionanthus virginicus*, and *Ostrya virginiana*. Shrub layer is dense primarily with *Ilex vomitoria* (40-80% cover) and *Prunus caroliniana*. Herb and vine layer is sparse and occasionally includes *Chasmanthium sessiliflorum* and *Vitis rotundifolia* ..... **CEGL008413: *Quercus alba - Carya alba* / *Chasmanthium sessiliflorum* West Gulf Coastal Plain Forest [MC318]**

4b *Quercus falcata* typically codominates with *Quercus alba*
The canopy is dominated by *Quercus alba* and *Quercus falcata*. Other common canopy species include *Nyssa sylvatica*, *Quercus pagoda*, and *Pinus taeda*. Shrubs typically have moderate cover and common species include *Ilex vomitoria*, *Ostrya virginiana*, and *Liquidambar styraciflua* ..... **CEGL008414: *Quercus alba – Quercus falcata – Quercus stellata – Nyssa sylvatica* / *Carex cherokeensis* Forest [MC318]**

Section 2: Pinus echinata – Pinus taeda – Quercus stellata Forest

5a Woodland community with <60% canopy cover ..... 6a

5b Forest community with >60% canopy cover..... 7a

6a *Pinus taeda* (30-40% cover) and *Quercus stellata* (10-20% cover) are the canopy dominants; *Quercus hemisphaerica* may codominate in some stands; *Pinus echinata* is uncommon/absent Upland woodland to dense forest depending on fire frequency. Canopy dominants are *Pinus taeda* (30-40% cover) and *Quercus stellata* (10-20% cover). Associate species include *Acer rubrum*, *Carya glabra*, *Carya tomentosa* (*Carya alba*), *Fraxinus americana*, *Nyssa sylvatica*, *Ostrya virginiana*, *Pinus elliottii*, *Prunus serotina*, *Quercus falcata*, *Quercus marilandica*, and *Quercus nigra*. Common shrubs are *Callicarpa americana*, *Crataegus brachyacantha*, *Crataegus marshallii, Crataegus spathulata*, *Ilex vomitoria*, *Vaccinium arboreum*, and *Viburnum rufidulum*. Common vines are *Gelsemium sempervirens*, *Parthenocissus quinquefolia*, *Toxicodendron radicans*, and *Vitis rotundifolia*. Herb layer varies from sparse to moderate depending on fire with *Baptisia nuttalliana*, *Crotalaria sagittalis*, *Helianthus hirsutus*, *Helenium flexuosum*, *Lespedeza hirta*, *Pycnanthemum albescens*, *Schizachyrium scoparium*, *Scleria oligantha*, *Stylosanthes biflora*, and *Vernonia texana* ..... . **CEGL002112: *Pinus taeda - Quercus stellata* / *Crataegus* spp. Woodland [MC319]**

6b *Pinus echinata* and *Quercus stellata* are the sole canopy dominants; *Pinus taeda* is uncommon/absent…Upland woodland maintained by fire occurring on soils of dry loam to clay. Canopy dominants are *Pinus echinata* and *Quercus stellata*. Associates include *Carya alba*, *Carya texana*, and *Quercus falcata*. Minor amounts of *Pinus taeda* may occur throughout these communities. Herbaceous layer is diverse with frequent fire events; *Chasmanthium sessiliflorum* is a particularly abundant species. Upwards of 100 species have been documented from fire managed sites on Angelina National Forest..... . **CEGL007800:**

***Pinus echinata - Quercus stellata - Quercus falcata - Carya texana* Woodland [MC319]**

7a *Pinus taeda* is a canopy dominant; *Pinus echinata* is an uncommon canopy associate…Dry-mesic to dry forest commonly occurring on upland ridgetops. Strictly mesic species and dry upland species are uncommon in this community. Canopy dominants are *Pinus taeda*, *Quercus falcata*, and *Liquidambar styraciflua*. Associates include *Carya texana*, *Carya tomentosa* (*Carya alba), Nyssa sylvatica*, *Pinus echinata*, *Magnolia grandiflora, Quercus alba*, *Quercus marilandica*, *Quercus nigra*, and *Quercus stellata*. The subcanopy contains *Cornus florida* and regenerating *Pinus taeda*. The shrub layer is short and patchy with *Callicarpa americana*, *Chionanthus virginicus*, *Forestiera ligustrina*, *Ilex vomitoria*, *Rhus aromatica*, *Sassafras albidum*, *Vaccinium arboreum*, and *Vaccinium stamineum*. Vines such as *Gelsemium sempervirens*, *Parthenocissus quinquefolia*, *Smilax glauca*, *Smilax rotundifolia*, *Smilax tamnoides*, *Toxicodendron radicans*, *Vitis aestivalis*, and *Vitis rotundifolia* can occur. A sparse herbaceous layer consists of *Carex albicans* var. *australis*, *Chasmanthium sessiliflorum*, *Dichanthelium commutatum*, *Dichanthelium laxiflorum*, *Melica mutica*, *Scutellaria elliptica*, and *Scleria triglomerata*..... . **CEGL007528: *Pinus taeda* - (*Pinus echinata*) - *Quercus falcata - Carya texana* / *Vaccinium arboreum* Forest [MC320]**

7b ....*Pinus echinata* dominates or codominates in the canopy..... 8a

8a *Pinus echinata* and *Pinus taeda* are codominant canopy species…Forest usually occurs on slopes. Codominant canopy species are *Pinus echinata* and *Pinus taeda.* At least two of the following oaks are dominant: *Quercus alba*, *Quercus falcata*, and *Quercus stellata.* Associated canopy species include *Carya alba*, *Carya texana*, and *Liquidambar styraciflua*. Shrub layer can contain *Callicarpa americana, Ilex decidua, Ilex vomitoria*, *Rhus aromatica*, *Sabal minor*, *Vaccinium* arboreum, and *Viburnum dentatum*. Common herbaceous species are *Chasmanthium sessiliflorum*, *Dichanthelium boscii*, *Elephantopus tomentosus*, *Euphorbia corollata*, *Michella repens*, and *Pteridium aquilinum*..... . **CEGL004713: *Pinus echinata - Pinus taeda - Quercus* (*alba*, *falcata*, *stellata*) Forest (Legacy) [MC316]**

8b *Pinus echinata* is the dominant canopy species; *Pinus taeda* often forms a minor component *Pinus echinata* typically dominates the canopy. Other common canopy associates include *Quercus falcata*, *Quercus alba*, *Quercus marilandica*, *Nyssa sylvatica*, and *Acer rubrum*. The shrub layer is often ranging from moderate to dense. Common shrubs include *Ilex vomitoria* and *Quercus hemisphaerica*. The herbaceous layer is often sparse ..... .. **CEGL007947: *Pinus echinata – (Pinus taeda) – Quercus falcata / Dichanthelium sphaerocarpon* Forest [MC320]**

Section 3: Pinus spp. Upland Woodland and Forest

1a Community has distinct rows of planted *Pinus* spp. or contains young regenerating *Pinus* spp …These lines may be clearer on aerial imagery rather than in the field..... 2a

1b Community lacks distinct rows of planted *Pinus* spp. or does not contain young regenerating

*Pinus* spp. ..... 5a

2a Mature *Pinus taeda* dominates the canopy..... 3a

2b Young *Pinus* spp. dominate community ..... 4a

3a Pinus taeda dominates the community …Plantation forest where *Pinus taeda* (60-70% cover) is the most abundant canopy species. Canopy associates include *Acer rubrum, Liquidambar styraciflua,* and *Nyssa sylvatica*. Shrub layer lacks diversity with *Ilex vomitoria* (30% cover) as the sole species. Occasional flooding can allow for the growth of mesic herbaceous species such as *Cladium mariscoides*, *Eleocharis microcarpa*, *Rhynchospora inexpansa*, and *Utriculata radiata*..... **CST007179: *Pinus taeda* Forest Plantation [MC301]**

3b Pinus elliottii dominates the canopy …Plantation forest dominated by Pinus elliottii in straight plantation rows.....**CST007170: Pinus elliottii var. elliottii Forest Plantation [MC301]**

4a A combination of young *Pinus* spp. dominate the canopy …These areas typically result from regenerating *Pinus* spp.. These communities are typically formed from management to restore *Pinus palustris* communities or from past logging disturbance. The canopy dominant is *Pinus palustris*, *Pinus echinata*, and/or *Pinus taeda* (30-40%). Shrub layer dominants include *Pinus* spp. at ~4m tall (30% cover), *Quercus incana* (30% cover), *Liquidambar styraciflua* (20% cover), *Triadica sebifera*, *Ilex vomitoria*, *Quercus hemisphaerica*, *Cyrilla racemiflora, Morella cerifera*, and *Quercus falcata*. Herbaceous layer is vigorous with graminoids such as *Andropogon gerardii* (50% cover), *Andropogon ternarius*, and *Andropogon virginicus*. Some stands may contain an abundance of *Rubus argutus* and *Vitis rotundifolia*..... . **NPSBITH016: *Pinus* spp. (*taeda, echinata, palustris*) Regenerating Woodland and Shrubland [MC322]**

4b A shrub layer is present and dominated by *Pinus taeda* (>70% cover) …Regenerating shrubland plantation of *Pinus taeda*. Shrub layer dominants include *Pinus taeda* (>70% cover) and *Ilex vomitoria* (20% cover)..... . **NPSBITH017: *Pinus taeda* Regenerating Plantation Shrubland [MC301]**

5a *Pinus palustris* is a common canopy component with (10-) avg. 30-75% cover..... 6a

5b *Pinus palustris* is an uncommon or absent canopy species with avg. 0-10 (-20)% cover..... 9a

6a *Morella cerifera* (10-40% cover) is common in the shrub layer; *Quercus falcata* and *Quercus stellata* are uncommon/absent canopy associates..... 7a

6b *Morella cerifera* is uncommon/absent in the shrub layer (<10%); *Quercus falcata* and *Quercus stellata* are common canopy associates..... 8a

7a *Pinus elliottii* dominates the canopy with cover typically >50%; *Pinus palustris* may codominate in some stands; *Persea palustris*, *Rubus* spp., and *Hypericum* spp. are uncommon shrub species …Degraded fire suppressed *Pinus palustris* woodland on soils of fine sandy

loams or silt loams. Codominant canopy species *Pinus elliottii* and *Pinus palustris* have 75% combined cover. *Liquidambar styraciflua* (<25% cover) is a common associate. Shrub density ranges from sparse to dense with *Callicarpa americana*, *Ilex coriacea*, *Morella caroliniensis*, *Morella cerifera*, *Vaccinium elliottii*, and *Viburnum nudum* var. *nudum*. Herbaceous layer is dense under open conditions with *Carex* spp., *Ctenium aromaticum*, *Muhlenbergia expansa*, and *Schizachyrium scoparium*. Exotic aggressively invasive species such as *Ligustrum sinense*, *Lonicera japonica*, and *Microstegium vimineum* are especially common ..... **CEGL007157: *Pinus elliottii* - (*Pinus palustris*) / *Morella cerifera - Ilex coriacea* Ruderal Wet Woodland [MC323]**

7b *Pinus elliottii* is an uncommon canopy associate (cover <20%); *Pinus palustris* (20-70% cover) is the canopy dominant; *Persea palustris*, *Rubus* spp., and *Hypericum* spp. are common shrub species …Fire suppressed flatwoods that no longer burn every 1-3 years on soils of fine sandy loam or silt loam. Canopy cover (25-90%) depends on fire frequency. Canopy dominants are *Pinus palustris* (20-70% cover) and *Pinus taeda* (<20% cover). Associated species include *Acer rubrum*, *Crataegus spathulata*, *Liquidambar styraciflua*, *Nyssa sylvatica*, *Pinus elliottii* var. *elliottii*, and *Quercus nigra*. Shrub layer cover is moderate to dense with *Morella cerifera* (10-40% cover), *Morella caroliniensis*, *Ilex coriacea*, *Ilex vomitoria*, *Cyrilla racemiflora, Persea palustris*, and *Rubus* spp. Common dwarf shrubs are *Hypericum fasciculatum*, *Hypericum hypericoides*, and *Hypericum mutilum*. Prevalent vines are *Smilax bona-nox*, *Smilax laurifolia*, *Smilax pumila*, and *Smilax rotundifolia*. Herbs such as *Carex* spp., *Scleria* spp., and *Viola* spp. can occur. Exotic and aggressively invasive species such as *Ligustrum sinense*, *Lonicera japonica*, and *Microstegium vimineum* are especially common ..... . **CEGL007162: *Pinus palustris* / *Morella cerifera - Morella caroliniensis - Ilex coriacea* Ruderal Wet Woodland [MC321]**

8a *Quercus incana* and/or *Quercus marilandica* (20-40% cover) are common canopy species; *Schizachyrium scoparium* is an uncommon herbaceous species; *Quercus alba* and *Quercus hemisphaerica* are absent tree associatesSandy upland woodland of xeric sites such as ridgetops where fire is naturally infrequent. Canopy dominants include *Pinus taeda* (>30% cover), *Pinus palustris* (10-30% cover), *Pinus echinata*, *Carya texana*, *Quercus falcata*, and *Quercus incana* (20-40% cover). Associated tree species include *Aesculus pavia*, *Cornus florida*, *Liquidambar styraciflua*, *Prunus mexicana*, *Quercus marilandica*, *Quercus stellata*, and *Sideroxylon lanuginosum* ssp. *lanuginosum*. Common shrubs are *Callicarpa americana*, *Ceanothus americanus*, *Rhus aromatica*, *Rhus copallinum*, *Rubus argutus*, *Sassafras albidum*, *Vaccinium arboreum*, and *Viburnum rufidulum*. Vines include *Berchemia scandens*, *Smilax rotundifolia*, *Toxicodendron radicans*, *Vitis mustangensis*, and *Vitis rotundifolia*. Scattered herbaceous species such as *Andropogon ternarius*, *Baptisia nuttalliana*, *Desmodium canescens*, *Desmodium paniculatum*, *Erythrina herbacea*, *Galactia volubilis*, *Gymnopogon ambiguus*, *Lespedeza hirta*, *Schizachyrium scoparium*, *Scleria oligantha*, *Solidago odora*, and *Stillingia sylvatica* are common ..... . **CEGL008571: *Pinus palustris - Pinus* (*echinata, taeda*) *- Quercus falcata - Carya texana* Woodland [MC321]**

8b *Quercus incana* and *Quercus marilandica* are absent tree associates; *Schizachyrium scoparium* (<30% cover) is the dominant herbaceous species; *Quercus alba* and *Quercus hemisphaerica* are common tree associates …Woodland of dry-mesic flats to xeric ridgetops with soils of sandy loams, fine silty, to coarse textured sands. Frequency of prescribed burns has a large effect on vegetation variability. Canopy dominants are Pinus palustris, *Pinus echinata*, and *Pinus taeda* (20-75% cover). *Pinus palustris* may be young and only a few meters tall. Associate canopy species (<25% cover) can include *Liquidambar styraciflua*, *Quercus alba*, *Quercus falcata*, *Quercus hemisphaerica*, and *Quercus stellata*. Shrub species are *Callicarpa americana*, *Cornus florida*, *Ilex vomitoria*, *Ostrya virginiana*, and *Vaccinium arboreum*. Herbaceous cover varies from sparse to dense with *Schizachyrium scoparium* (<30% cover), *Aletris aurea*, *Liatris elegans*, *Liatris punctata*, *Hypericum galioides*, *Rhynchospora inexpansa*, and *Xyris difformis*. Lack of fire management may result in an abundance of the exotic invasive *Lonicera japonica*..... . **CEGL003609: *Pinus palustris - Pinus* (*echinata, taeda*) / (*Liquidambar styraciflua*) / *Schizachyrium scoparium* Ruderal Woodland [MC321]**

9a *Pinus taeda* (30-70% cover) is a major component of the canopy; *Liquidambar styraciflua* and *Acer rubrum* var. *rubrum* are common associatesForest occurring on well to moderately drained soils; formerly a hardwood forest or agricultural field. *Pinus taeda* (30-70% cover) is the sole canopy dominant. Associated canopy species include *Acer rubrum* var. *rubrum*, *Liquidambar* styraciflua, *Carya glabra*, *Ilex opaca*, *Liriodendron tulipifera*, *Magnolia virginiana*, *Nyssa sylvatica*, *Pinus echinata*, *Prunus serotina*, *Quercus alba*, *Quercus coccinea*, *Quercus falcata*, *Quercus nigra*, and *Quercus velutina*. The most abundant shrubs are *Vaccinium stamineum* and *Ilex vomitoria*; associates include *Callicarpa americana*, *Juniperus virginiana*, *Morella cerifera*, *Rhus copallinum*, and *Sabal minor*. Herbaceous layer is sparse (<5% cover) with *Chasmanthium sessiliflorum*, *Dichanthelium sphaerocarpon*, *Polystichum acrostichoides*, and *Potentilla canadensis*. *Lonicera japonica* may be a common exotic..... **CEGL006011: *Pinus taeda* / *Liquidambar styraciflua - Acer rubrum* / *Vaccinium stamineum* Ruderal Forest [MC320]**

9b *Pinus taeda* is not the sole canopy dominant ..... 10a

10a Community occurs within a flooded circular depression; Pinus taeda often codominates with Nyssa biflora and/or Nyssa sylvatica …This community occurs in small circular depressions within sandy uplands. *Pinus taeda*, *Quercus laurifolia*, and *Quercus phellos* typically dominate the canopy with cover ~80%. The subcanopy often contains *Nyssa sylvatica*, *Nyssa biflora*, and/or *Liquidambar styraciflua*. Occasionally, *Quercus stellata* and/or *Quercus alba* may occur around the edges of these communities. If present, the herbaceous stratum is usually composed of *Chasmanthium laxum* and/or *Carex* spp. ..... .. **NPSBITH027 *Pinus taeda – Nyssa biflora – Quercus laurifolia* Circular Depression Flooded Flatwood Forest**

10b Community does not occur within a flooded circular depression ..... 11a

11a *Pinus echinata* (>30% cover) is the sole canopy dominant …Early successional forest found on disturbed sites typically occurring on former agricultural land, unmanaged clear-cuts, and highly eroded soils. *Pinus echinata* is the most abundant canopy species occasionally occurring with *Pinus taeda*. Associated early successional hardwoods are *Acer rubrum*, *Liquidambar styraciflua*, and *Liriodendron tulipifera*. Shrub and herb layer typically consist of invasive exotics or ruderal species.....**CEGL006327: *Pinus echinata* Ruderal Forest [MC320]**

11b *Pinus echinata* and *Pinus taeda* are codominant canopy species …Forest of dry to xeric uplands but can occasionally exist on mesic sites. Soils vary but tend to include clay loams, sandy loams, and deep sands. Codominant canopy species are *Pinus echinata* and *Pinus taeda*. Shrub layer ranges from sparse to dense depending on fire frequency with *Chionanthus virginicus*, *Cornus florida*, *Ilex vomitoria*, *Morella cerifera*, *Rhus copallinum*, *Vaccinium arboreum*, and *Vaccinium stamineum*. Herbaceous layer varies depending on shrub cover. In open conditions an abundance of *Chasmanthium sessiliflorum* can occur with *Croton capitatus*, *Galactia regularis*, *Dichanthelium* spp., *Dichondra caroliniensis*, *Liatris elegans*, and *Rhynchosia latifolia*. Invasive exotics may include *Ligustrum sinense*, *Lonicera japonica*, and *Microstegium vimineum* ..... . **CEGL007115: *Pinus taeda - Pinus echinata* / *Chasmanthium sessiliflorum* Ruderal Forest [MC320]**

***Key B: Mesic Flatwoods and Slope Forest***

1a Slope forest with a ≥3% average slope; a combination of *Fagus grandifolia*, *Magnolia grandiflora, Pinus taeda*, *Quercus alba*, *Quercus falcata*, *Quercus hemisphaerica*, or *Quercus nigra* are the most abundant canopy species ..... ..... **Section 4: *Fagus grandifolia – Magnolia grandiflora – Quercus* spp. Slope Forest**

1b Flatwood forest; pimple mounds are indicative of flatwoods; a combination of *Liquidambar styraciflua*, *Pinus palustris*, *Pinus taeda*, or *Quercus* spp. are the most abundant canopy species ..... 2a

2a *Pinus* spp. are common/abundant with (10-) avg. 20-50 (-75) % cover; a combination of *Pinus elliottii*, *Pinus palustris*, *Pinus taeda*, *Quercus alba*, *Magnolia grandiflora*, *Fagus grandifolia, Quercus falcata*, *Quercus michauxii*, *Quercus pagoda*, or *Quercus stellata* are the most abundant canopy species ..... ..... **Section 5: *Pinus* spp. – *Quercus* spp. Flatwoods Forest**

2b *Pinus* spp. are uncommon/absent with <10% cover; a combination of *Quercus alba*, *Quercus falcata*, *Quercus laurifolia*, *Quercus nigra*, or *Quercus phellos* are the most abundant canopy species..... **Section 6: *Quercus spp.* Flatwoods Forest**

<u>Section 4: Fagus grandifolia – Magnolia grandiflora – Quercus spp. Slope Forest</u>

1a *Pinus taeda* is a common canopy species with (10-) avg. 20-40 (-50)% cover ..... 2a

1b *Pinus taeda* is an uncommon canopy species with <30% cover ..... 7a

2a *Pinus palustris* is present in the canopy (>30% cover) …Sandy upland woodland of xeric sites such as ridgetops where fire is naturally infrequent. Canopy dominants include *Pinus taeda* (>30% cover), *Pinus palustris* (10-30% cover), *Pinus echinata*, *Carya texana*, *Quercus falcata*, and *Quercus incana* (20-40% cover). Associated tree species include *Aesculus pavia*, *Cornus florida*, *Liquidambar styraciflua*, *Prunus mexicana*, *Quercus marilandica*, *Quercus stellata*, and *Sideroxylon lanuginosum* ssp. *lanuginosum*. Common shrubs are *Callicarpa americana*, *Ceanothus americanus*, *Rhus aromatica*, *Rhus copallinum*, *Rubus argutus*, *Sassafras albidum*, *Vaccinium arboreum*, and *Viburnum rufidulum*. Vines include *Berchemia scandens*, *Smilax rotundifolia*, *Toxicodendron radicans*, *Vitis mustangensis*, and *Vitis rotundifolia*. Scattered herbaceous species such as *Andropogon ternarius*, *Baptisia nuttalliana*, *Desmodium canescens*, *Desmodium paniculatum*, *Erythrina herbacea*, *Galactia volubilis*, *Gymnopogon ambiguus*, *Lespedeza hirta*, *Schizachyrium scoparium*, *Scleria oligantha*, *Solidago odora*, and *Stillingia sylvatica* are common ..... . **CEGL008571: *Pinus palustris – Pinus* (*echinata*, *taeda*) *– Quercus falcata – Carya texana* Woodland [MC321]**

2b Canopy does not include *Pinus palustris* ..... 3a

3a *Magnolia grandiflora* (20-40% cover) is an abundant canopy species …Forest occurring within the annual floodplain of small streams. Soils are usually loams and silt loams. Canopy is a mix of *Magnolia grandiflora* (20-40% cover)*, Quercus nigra* (20-60% cover) *Fagus grandifolia* (<30% cover), *Liquidambar* styraciflua, *Nyssa sylvatica*, *Pinus taeda* (10-40% cover), and *Quercus alba*. Associates can include *Acer rubrum*, *Carya tomentosa*, *Liriodendron tulipifera*, *Magnolia virginiana*, *Nyssa biflora*, *Prunus serotina*, *Quercus laurifolia*, *Quercus michauxii*, and *Ulmus alata*. Subcanopy species such as *Ostrya virginiana* (20-70% cover), *Carpinus caroliniana*, *Cornus florida*, *Halesia diptera*, *Ilex opaca*, and *Symplocos tinctoria* are common. Shrubs include *Ilex vomitoria* (20-60% cover)*, Ilex coriacea* (10-30% cover), *Morella cerifera, Callicarpa americana, Hamamelis virginiana, Rhododendron canescens, Symplocos tinctoria, Viburnum dentatum*, and *Vaccinium elliottii*. Vines such as *Berchemia scandens*, *Bignonia capreolata*, *Campsis radicans*, *Parthenocissus quinquefolia*, *Smilax* spp., *Toxicodendron radicans*, and *Vitis rotundifolia* are common. Herbs are patchy and can include *Arundinaria gigantea*, *Athyrium filix-femina*, *Chasmanthium latifolium*, *Chasmanthium sessiliflorum,* and *Polystichum acrostichoides* ..... . **CEGL007903: *Magnolia grandiflora - Fagus grandifolia - Quercus alba - Pinus taeda* Forest [MC316]**

3b *Magnolia grandiflora* (<20% cover) is an uncommon canopy species..... 4a

4a *Fagus grandifolia* is an abundant canopy species with (10-) avg. 30-60% cover..... 5a

4b *Fagus grandifolia* is an uncommon canopy associate with <10% cover ..... 6a

5a *Liquidambar styraciflua*, *Magnolia grandiflora*, and *Quercus alba* are common canopy associates …Mesic forest occurring next to a small stream. Dominant canopy species include *Fagus grandifolia* (30-60% cover), and *Pinus taeda* (20-50% cover); commonly with

*Liquidambar styraciflua*, *Quercus alba*, and *Quercus nigra*. Possible canopy associates include *Fraxinus americana*, *Magnolia grandiflora*, *Nyssa biflora*, *Nyssa sylvatica*, *Quercus laurifolia*, *Quercus michauxii*, *Quercus pagoda*, and *Ulmus alata.* Subcanopy trees include *Asimina triloba*, *Carpinus caroliniana*, *Ilex opaca*, *Itea virginica*, and *Ostrya virginiana*. Common shrubs are *Cyrilla racemiflora*, *Ilex vomitoria*, *Hamamelis virginiana*, *Rhododendron canescens*, *Symplocos tinctoria*, *Vaccinium elliottii*, and *Viburnum dentatum*. Common vines are *Berchemia scandens*, *Bignonia capreolata*, *Campsis radicans*, *Parthenocissus quinquefolia*, *Toxicodendron radicans*, and *Vitis rotundifolia*. Herbaceous species such as *Mitchella repens* and *Smilax pumila* are abundant; *Athyrium filix-femina*, *Chasmanthium latifolium*, *Chasmanthium sessiliflorum*, and *Polystichum acrostichoides* typically occur. Rare species can include *Amsonia ludoviciana*, *Cypripedium kentuckiense*, *Prenenthes barbata*, *Solidago auriculata*, and *Triphora trianthophora*..... . **CEGL007320: *Fagus grandifolia - Pinus taeda - (Liquidambar styraciflua, Magnolia grandiflora, Quercus alba)* Small Stream Forest [MC316]**

5b *Liquidambar styraciflua*, *Magnolia grandiflora*, and *Quercus alba* are rare canopy associates …Temporarily flooded forests along floodplains of creeks and rivers. *Fagus grandifolia* is the sole canopy dominant. Associates include *Quercus laurifolia*, *Quercus nigra*, and *Pinus taeda* (<30% cover). Herbaceous stratum may have an abundance of *Chasmanthium laxum*..... **CEGL008574: *Fagus grandifolia - Quercus* (*laurifolia, nigra*) - *Pinus taeda* Forest [MC315]**

6a *Pinus taeda* (20-50% cover) and *Quercus alba* (20-40% cover) are codominant canopy species …Occurring on slopes between uplands and stream bottoms, and along small streams. Soils consist of silt loam and silty clay. *Pinus taeda* (20-50% cover) and *Quercus alba* (20-40% cover) are codominant in the canopy. Associate species may include *Carya tomentosa*, *Fagus grandifolia*, *Liquidambar styraciflua*, *Magnolia grandiflora, Nyssa sylvatica, Pinus echinata, Pinus palustris, Pinus elliottii, Quercus laurifolia, Quercus marilandica*, *Quercus falcata*, *Quercus michauxii*, *Quercus nigra*, and *Quercus phellos*. Subcanopy can consist of *Carpinus caroliniana*, *Cornus florida*, *Ilex opaca* var. *opaca*, and *Ostrya virginiana*. Shrubs are usually moderately dense (30-50% cover) with *Callicarpa americana*, *Ilex vomitoria*, *Symplocos tinctoria*, *Vaccinium elliottii*, *Viburnum acerifolium,* and *Viburnum dentatum*. Exotic invasive species are *Ligustrum sinense*, *Lonicera japonica*, *Microstegium vimineum*, and *Triadica sebifera*. Herbaceous stratum is typically sparse..... **CEGL007525: *Pinus taeda - Quercus alba - (Fagus grandifolia) / Smilax pumila - Mitchella repens* Forest [MC316]**

6b *Pinus taeda* and *Pinus echinata* are codominant canopy species …Forest usually occurs on slopes. Codominant canopy species are *Pinus echinata* and *Pinus taeda.* At least two of the following oaks are dominant: *Quercus alba*, *Quercus falcata*, and *Quercus stellata.* Associated canopy species include *Carya alba*, *Carya texana*, and *Liquidambar styraciflua*. Shrub layer can contain *Callicarpa americana, Ilex decidua, Ilex vomitoria*, *Rhus aromatica*, *Sabal minor*, *Vaccinium* arboreum, and *Viburnum dentatum*. Common herbaceous species are

*Chasmanthium sessiliflorum*, *Dichanthelium boscii*, *Elephantopus tomentosus*, *Euphorbia corollata*, *Michella repens*, and *Pteridium aquilinum*..... . **CEGL004713: *Pinus echinata - Pinus taeda - Quercus* (*alba*, *falcata*, *stellata*) Forest (Legacy) [MC316]**

7a *Fagus grandifolia* (>20% cover) is a dominant canopy species ..... 8a

7b *Fagus grandifolia* (<20% cover) is a common/uncommon canopy associate; *Quercus alba, Quercus falcata*, *Quercus hemisphaerica*, *Quercus michauxii*, and *Quercus nigra* are the most abundant canopy species ..... 10a

8a *Fagus grandifolia* is the sole canopy dominant; *Magnolia grandiflora*, *Liquidambar styraciflua*, and *Quercus alba* are rare canopy associates …Temporarily flooded forests along floodplains of creeks and rivers. *Fagus grandifolia* is the sole canopy dominant. Associates include *Quercus laurifolia*, *Quercus nigra*, and *Pinus taeda* (<30% cover). Herbaceous stratum may have an abundance of *Chasmanthium laxum*..... . **CEGL008574: *Fagus grandifolia - Quercus* (*laurifolia*, *nigra*) - *Pinus taeda* Forest [MC315]**

8b *Fagus grandifolia* is not the sole canopy dominant; *Magnolia grandiflora*, *Liquidambar styraciflua*, and/or *Quercus alba* typically codominate in the canopy..... 9a

9a *Ostrya virginiana* and/or *Carpinus caroliniana* are common components of the subcanopy …*Fagus grandifolia* (20-50% cover) is the canopy dominant with minor components of *Liquidambar styraciflua*, *Magnolia grandiflora*, *Pinus taeda* (<10% cover), *Quercus alba*, *Quercus falcata,* and *Quercus nigra*. Understory trees include an abundance of *Carpinus caroliniana* ssp. *caroliniana* and *Ostrya virginiana* with associated *Cornus florida*, *Ilex opaca* var. *opaca*, and *Nyssa sylvatica*. A sparse shrub layer is present with common occurrences of *Callicarpa americana*, *Hamamelis virginiana*, *Ilex vomitoria*, *Rhamnus caroliniana* (*Frangula caroliniana*), *Styrax americanus*, and *Vaccinium elliottii*. *Vitis rotundifolia* is an abundant vine. Herbaceous layer is sparse..... . **CEGL007872: *Fagus grandifolia - Magnolia grandiflora - Quercus alba* / *Carpinus caroliniana - Ostrya virginiana* Forest [MC317]**

9b *Ostrya virginiana* and/or *Carpinus caroliniana* are not common components of the subcanopy; shrub stratum tends to be patchy… The canopy is dominated by tall mature *Fagus grandifolia* with cover reaching 40%. Other common canopy species include *Quercus alba*, *Ilex opaca*, *Quercus nigra*, and *Magnolia virginiana*. Shrubs are sparse and common species include *Ilex vomitoria*, *Carya tomentosa*, *Morella cerifera*, and *Hamamelis virginiana*. Herbaceous stratum is sparse with total cover <5%..... ...**CEGL007208 *Fagus grandifolia – Quercus alba* / *Ilex opaca* var. *opaca* / *Athyrium Filix – femina* spp. *asplenioides* Forest**

10a *Quercus hemisphaerica* is abundant in the canopy..... 11a

10b *Quercus hemisphaerica* (<10% cover) is uncommon/absent in the canopy ..... 12a

11a *Quercus alba* codominates with *Quercus hemisphaerica*; Forest occurs on mesic gradual slopes …The dominant canopy species are *Quercus alba* and *Quercus hemisphaerica*. Associate tree species can include *Acer rubrum*, *Cornus florida*, *Fraxinus americana*, *Ilex opaca*, *Pinus echinata*, *Pinus taeda*, *Quercus falcata*, and *Quercus stellata*. Dominant shrubs are *Persea borbonia* and *Viburnum acerifolium*; found with *Callicarpa americana*, *Chionanthus virginicus*, *Ilex vomitoria*, *Prunus caroliniana*, *Vaccinium virgatum*, and *Viburnum dentatum*. A diverse herbaceous stratum may contain 70 unique species with the most common being *Chasmanthium sessiliflorum*, *Dichanthelium boscii*, *Dichanthelium commutatum*, *Smilax pumila*, *Smilax tamnoides*, *Viburnum acerifolium*, and *Vitis rotundifolia* ..... . **CEGL007959: *Quercus alba – Quercus hemisphaerica* / *Prunus caroliniana – Persea borbonia – Viburnum acerifolium* Forest [MC317]**

11b *Quercus alba* is an uncommon/absent in the canopy; Forest occurs within sandy uplands …Sandy upland forest occurring on sites sheltered from fire. Canopy dominants include *Quercus hemisphaerica*, *Quercus falcata*, and *Quercus nigra*. Associated tree species can include *Carya tomentosa* (*Carya alba*), *Cornus florida*, *Ilex opaca*, *Liriodendron tulipifera*, *Liquidambar styraciflua*, *Magnolia grandiflora*, *Pinus taeda* (<30% cover), *Quercus alba*, and *Quercus nigra*. Shrub layer is dense (>70% cover) with *Quercus hemisphaerica* and *Ilex vomitoria*; common species are *Callicarpa americana*, *Hypericum hypericoides*, *Vaccinium arboreum*, and *Vaccinium* spp. Common vines are *Gelsemium sempervirens* and *Vitis rotundifolia*. Herbs are sparse and may include *Cnidoscolus stimulosus* and *Desmodium* spp. **CEGL007751: *Quercus hemisphaerica – Quercus* (*falcata*, *nigra*) / *Vaccinium arboreum* / *Cnidoscolus stimulosus* Forest [MC318]**

12a *Quercus michauxii* forms a dominant species (>20%) within the canopy ..... 13a

12b *Quercus michauxii* forms a minor or uncommon species (<20%) within the canopy..... 14a

13a *Sabal minor* (30-75% cover) is dominant in the shrub layer; *Quercus michauxii* (20-40% cover) is an abundant canopy species …Forest occurs on mesic slopes adjacent to riparian habitat. Dominant canopy species include *Quercus alba*, *Quercus michauxii* (20-40% cover), *Quercus nigra* (20% cover), and *Quercus phellos* (30% cover). Associated canopy species include *Carpinus caroliniana*, *Carya glabra*, *Carya tomentosa* (*Carya alba*), *Ilex opaca*, *Morus rubra*, *Nyssa sylvatica*, *Ostrya virginiana*, *Platanus occidentalis*, *Pinus taeda*, and *Tilia americana* var. *caroliniana*. Common shrubs are *Sabal minor* (30-75% cover), *Ilex vomitoria* (10-30% cover), and *Forestiera ligustrina*. *Vitis rotundifolia* is a common vine. Herbaceous layer is sparse but can include *Arundinaria gigantea*, *Berchemia scandens*, *Bignonia capreolata*, *Chasmanthium laxum, Chasmanthium sessiliflorum*, *Cocculus carolinus*, *Dichanthelium boscii*, *Elephantopus tomentosus*, *Polystichum acrostichoides*, *Sanicula canadensis*, *Smallanthus uvedalius*, and *Thelypteris kunthii* ..... . **CEGL008581: *Quercus alba - Quercus nigra* / *Ostrya virginiana* / *Sabal minor* Forest [MC317]**

13b *Sabal minor* is uncommon/absent in the shrub layer …Quercus michauxii dominates the canopy with *Fagus grandifolia*, *Magnolia grandiflora*, and *Quercus nigra* are often canopy associates and occasionally codominate. The shrub layer is often dominated by *Ostrya*

*virginiana*, *Carpinus caroliniana*, and *Ilex vomitoria*. *Arundinaria gigantea* and *Parthenocissus quinquefolia* often dominates the herbaceous stratum with cover ~30%. .... **NPSBITH024: *Quercus michauxii – Quercus nigra – Magnolia grandiflora* Mesic Forest [MC317]**

14a *Quercus falcata* is an uncommon canopy species with <10% cover …Acidic dry-mesic forest typically of gradual lower slopes. *Quercus alba* (30-60% cover) is by far the most abundant canopy species. Associated species include *Acer rubrum*, *Carya tomentosa* (*Carya alba*), *Ilex opaca*, *Liquidambar styraciflua*, *Nyssa sylvatica, Quercus pagoda, Quercus falcata,* and *Tilia americana* var. *caroliniana*. *Pinus taeda* and *Pinus echinata* may occasionally grow in this community with <10% combined cover. Common subcanopy species include *Aralia spinosa*, *Carpinus caroliniana*, *Chionanthus virginicus*, and *Ostrya virginiana*. Shrub layer is dense primarily with *Ilex vomitoria* (40-80% cover) and *Prunus caroliniana*. Herb and vine layer is sparse and occasionally includes *Chasmanthium sessiliflorum* and *Vitis rotundifolia* ..... **Plain Forest [MC318]**

*14b* *Quercus falcata* is a common canopy species with (10-) avg. 20-40% cover..... 15a

15a *Quercus falcata* (>30% cover) is the most abundant canopy species; Quercus alba may occasionally codominate ...*Quercus falcata* (>30% cover) is the most abundant canopy species with minor components of *Quercus stellata* and *Pinus taeda* (<10% cover). Associated tree species include *Acer rubrum*, *Carya cordiformis*, *Cornus florida*, *Liquidambar styraciflua*, *Pinus echinata*, *Quercus alba*, and *Quercus velutina*. Shrub species include *Callicarpa americana*, *Chionanthus virginicus*, *Forestiera ligustrina*, *Ilex vomitoria*, *Vaccinium arboreum*, and *Viburnum rufidulum*. Herbaceous diversity is low with an abundance of *Chasmanthium sessiliflorum*, *Gelsemium sempervirens*, and *Parthenocissus quinquefolia*..... **CEGL008415: *Quercus falcata* - *Quercus stellata* - (*Pinus taeda*) West Gulf Coastal Plain Forest [MC317]**

15b *Quercus alba* is a canopy dominant with cover >20%..... 16a

16a Canopy contains mesic oaks such as *Quercus nigra* and *Quercus michauxii* ...This forest occurs on flat slight topographic upland rises within flatwoods environments. Abundant canopy species are *Quercus alba* (20% cover), *Quercus nigra* (20% cover), and *Quercus falcata* (20% cover). Associated species are *Carpinus caroliniana*, *Carya tomentosa*, *Cornus florida*, *Fagus grandifolia*, *Ilex opaca*, *Liquidambar styraciflua*, *Magnolia grandiflora*, *Quercus michauxii*, *Quercus pagoda*, *Pinus taeda*, and *Platanus occidentalis*. Shrub layer contains *Callicarpa americana*, *Ilex vomitoria*, *Persea palustris*, and *Symplocos tinctoria*. A sparse herb layer includes *Chasmanthium laxum*, *Chasmanthium sessiliflorum*, *Hexastylis arifolia* var. *arifolia*, *Mitchella repens*, *Pteridium aquilinum* var. *pseudocaudatum*, and *Smilax pumila*..... **CEGL007845: *Quercus alba* - *Quercus* (*michauxii*, *nigra*) / *Ilex opaca* / *Chasmanthium laxum* Forest [MC314]**

16b Canopy lacks *Quercus nigra* and *Quercus michauxii*; more upland species are present such as

*Carya texana* and *Quercus marilandica* …The canopy is dominated by *Quercus alba* and *Quercus falcata*. Other common canopy species include *Nyssa sylvatica*, *Quercus pagoda*, and *Pinus taeda*. Shrubs typically have moderate cover and common species include *Ilex vomitoria*, *Ostrya virginiana*, and *Liquidambar styraciflua*..... **CEGL008414 *Quercus alba – Quercus falcata – Quercus stellata – Nyssa sylvatica* / *Carex cherokeensis* Forest [MC318]**

Section 5: Pinus spp. – Quercus spp. Flatwoods Forest

1a *Pinus palustris* is a dominant canopy species with (10-) avg. 30-75% cover ..... 2a

1b *Pinus palustris* is a rare/absent canopy species with avg. 0-10 (-30)% cover..... 5a

2a *Morella cerifera* is uncommon/absent in the shrub layer; *Quercus falcata* and *Quercus stellata* are common canopy associatesWoodland of dry-mesic flats to xeric ridgetops with soils of sandy loams, fine silty, to coarse textured sands. Frequency of prescribed burns has a large effect on vegetation variability. Canopy dominants are Pinus palustris, *Pinus echinata*, and *Pinus taeda* (20-75% cover). *Pinus palustris* may be young and only a few meters tall. Associate canopy species (<25% cover) can include *Liquidambar styraciflua*, *Quercus alba*, *Quercus falcata*, *Quercus hemisphaerica*, and *Quercus stellata*. Shrub species are *Callicarpa americana*, *Cornus florida*, *Ilex vomitoria*, *Ostrya virginiana*, and *Vaccinium arboreum*. Herbaceous cover varies from sparse to dense with *Schizachyrium scoparium* (<30% cover), *Aletris aurea*, *Liatris elegans*, *Liatris punctata*, *Hypericum galioides*, *Rhynchospora inexpansa*, and *Xyris difformis*. Lack of fire management may result in an abundance of the exotic invasive *Lonicera japonica*..... . **CEGL003609: *Pinus palustris - Pinus* (*echinata, taeda*) / (*Liquidambar styraciflua*) / *Schizachyrium scoparium* Ruderal Woodland [MC321]**

3a *Morella cerifera* (10-40% cover) is common in the shrub layer; *Quercus falcata* and *Quercus stellata* are uncommon/absent canopy associates..... 4a

4a *Pinus elliottii* and *Pinus palustris* are codominant canopy species with 75% combined cover; *Persea palustris*, *Rubus* spp., and *Hypericum* spp. are uncommon shrub species …Degraded fire suppressed *Pinus palustris* woodland on soils of fine sandy loams or silt loams. Codominant canopy species *Pinus elliottii* and *Pinus palustris* have 75% combined cover. *Liquidambar styraciflua* (<25% cover) is a common associate. Shrub density ranges from sparse to dense with *Callicarpa americana*, *Ilex coriacea*, *Morella caroliniensis*, *Morella cerifera*, *Vaccinium elliottii*, and *Viburnum nudum* var. *nudum*. Herbaceous layer is dense under open conditions with *Carex* spp., *Ctenium aromaticum*, *Muhlenbergia expansa*, and *Schizachyrium scoparium*. Exotic aggressively invasive species such as *Ligustrum sinense*, *Lonicera japonica*, and *Microstegium vimineum* are especially common ..... . **CEGL007157: *Pinus elliottii* - (*Pinus palustris*) / *Morella cerifera* - *Ilex coriacea* Ruderal Wet Woodland [MC323]**

4b *Pinus elliottii* is an uncommon canopy associate; *Pinus palustris* (20-70% cover) is the canopy

dominant; *Persea palustris*, *Rubus* spp., and *Hypericum* spp. are common shrub species …Fire suppressed flatwoods that no longer burn every 1-3 years on soils of fine sandy loam or silt loam. Canopy cover (25-90%) depends on fire frequency. Canopy dominants are *Pinus palustris* (20-70% cover) and *Pinus taeda* (<20% cover). Associated species include *Acer rubrum*, *Crataegus spathulata*, *Liquidambar styraciflua*, *Nyssa sylvatica*, *Pinus elliottii* var. *elliottii*, and *Quercus nigra*. Shrub layer cover is moderate to dense with *Morella cerifera* (10-40% cover), *Morella caroliniensis*, *Ilex coriacea*, *Ilex vomitoria*, *Cyrilla racemiflora, Persea palustris*, and *Rubus* spp. Common dwarf shrubs are *Hypericum fasciculatum*, *Hypericum hypericoides*, and *Hypericum mutilum*. Prevalent vines are *Smilax bona-nox*, *Smilax laurifolia*, *Smilax pumila*, and *Smilax rotundifolia*. Herbs such as *Carex* spp., *Scleria* spp., and *Viola* spp. can occur. Exotic and aggressively invasive species such as *Ligustrum sinense*, *Lonicera japonica*, and *Microstegium vimineum* are especially common..... .. **CEGL007162: *Pinus palustris* / *Morella cerifera - Morella caroliniensis - Ilex coriacea* Ruderal Wet Woodland [MC321]**

5a Pinus taeda codominates with Nyssa biflora and/or Nyssa sylvatica ..... 6a

5b Pinus taeda does not codominate with Nyssa spp. ..... 7a

6a Canopy forms a woodland with a dense herbaceous layer …This woodland community is codominated by *Pinus taeda* and *Nyssa biflora* with cover typically <50%. *Magnolia virginiana* is often present as well. Dense shrubs surround this circular community and are composed of *Morella cerifera* and *Persea palustris*. Young *Liquidambar styraciflua* may be found scattered throughout the community. The herbaceous stratum is vigorous and dominated by a variety of mesic grasses and sedges including *Saccharum giganteum*, *Andropogon glomeratus*, *Carex glaucescens*, and *Anthaenantia rufa* ..... . **NPSBITH026: *Pinus taeda – Nyssa biflora – Magnolia virginiana* / *Andropogon glomeratus* Wet Woodland**

6b Canopy forms a forest; herbaceous stratum <30% cover …This community occurs in small circular depressions within sandy uplands. *Pinus taeda*, *Quercus laurifolia*, and *Quercus phellos* typically dominate the canopy with cover ~80%. The subcanopy often contains *Nyssa sylvatica*, *Nyssa biflora*, and/or *Liquidambar styraciflua*. Occasionally, *Quercus stellata* and/or *Quercus alba* may occur around the edges of these communities. If present, the herbaceous stratum is usually composed of *Chasmanthium laxum* and/or *Carex* spp..... **NPSBITH027: *Pinus taeda – Nyssa biflora – Quercus laurifolia* Circular Depression Flooded Flatwood Forest**

7a A combination of young *Pinus* spp. dominate the canopy …These areas typically result from regenerating *Pinus* spp.. These communities are typically formed from management to restore *Pinus palustris* communities or from past logging disturbance. The canopy dominant is *Pinus palustris*, *Pinus echinata*, and/or *Pinus taeda* (30-40%). Shrub layer dominants include *Pinus* spp. at ~4m tall (30% cover), *Quercus incana* (30% cover), *Liquidambar styraciflua* (20% cover), *Triadica sebifera*, *Ilex vomitoria*, *Quercus hemisphaerica*, *Cyrilla racemiflora*, *Morella*

*cerifera*, and *Quercus falcata*. Herbaceous layer is vigorous with graminoids such as *Andropogon gerardii* (50% cover), *Andropogon ternarius*, and *Andropogon virginicus*. Some stands may contain an abundance of *Rubus argutus* and *Vitis rotundifolia*..... . **NPSBITH016: *Pinus* spp. (*taeda*, *echinata*, *palustris*) Regenerating Woodland and Shrubland [MC322]**

7b Canopy does not contain a mix of young pines..... 8a

8a *Cyrilla racemiflora* and *Ilex coriacea* are abundant shrub species with 60-80% combined cover; *Pinus taeda* (10-60% cover) is the sole canopy dominant …Seasonally/permanently flooded flatwood woodland. *Pinus taeda* (10-60% cover) is the most abundant canopy species. Canopy associates with <10% combined cover can include *Pinus elliottii* and *Pinus palustris*. The shrub layer is dense (60-80% cover) with *Cyrilla racemiflora*, *Ilex coriacea*, and *Persea borbonia*. *Ilex vomitoria* can occasionally occur in abundance. Herbaceous stratum is sparse to absent. *Sphagnum* spp. is a common bryophyte where flooding persists..... . **NPSBITH009: *Pinus taeda* / *Ilex coriacea* - (*Cyrilla racemiflora*) Wet Flatwood Woodland [MC303]**

8b *Cyrilla racemiflora* is an uncommon/absent shrub species; *Pinus taeda* is not the sole canopy dominant..... 9a

9a Canopy contains a combination of *Pinus* taeda, Magnolia *grandiflora* (>20% cover), *Quercus alba*, and/or *Fagus grandifolia* ...This community typically occurs on slight rises within flatwoods. *Pinus taeda* (30-50% cover) and Magnolia grandiflora (<30% cover) are the most abundant canopy species. Canopy associates can include a combination of *Fagus grandifolia*, *Ilex opaca*, *Quercus alba*, *Quercus falcata*, and *Quercus hemisphaerica*. Common shrubs (<40% cover) are *Ilex coriacea*, *Ilex opaca*, and *Ilex vomitoria*. Herbaceous stratum is often sparse with <5% cover ..... . **NPSBITH012: *Pinus taeda - Magnolia grandiflora* - (*Fagus grandifolia*, *Quercus alba*, *Quercus falcata*) Flatwoods Forest [MC303]**

9b *Magnolia grandiflora* (<20% cover) is an uncommon/absent canopy species ..... 10a

10a *Pinus taeda* and/or *Quercus stellata* are major canopy components..... 11a

10b *Pinus taeda* and *Quercus stellata* are not major canopy species; canopy dominants include *Quercus michauxii*, *Quercus nigra*, *Quercus pagoda*, *Quercus phellos*, *Quercus falcata*, and *Quercus stellata* ..... 12a

11a *Pinus taeda* and *Quercus stellata* are the sole canopy dominants with >80 combined cover … Seasonally flooded flatwood forest found on depressions or shallow ponds. The canopy nearly exclusively consists of *Pinus taeda* and *Quercus stellata* with >80% combined cover. No other tree species have been documented from this community. Understory is characteristically sparse. Understory trees and shrubs such as *Callicarpa americana*, *Ilex vomitoria*, and *Ulmus alata* may occur. The herbaceous stratum typically contains only *Carex glaucescens*, *Chasmanthium sessiliflorum*, and *Chasmanthium laxum*..... . **CEGL008587: *Quercus stellata - Pinus taeda* Flatwoods Wet Forest [MC303]**

11b *Pinus taeda* dominates the community; *Quercus stellata* does not form a major component of the canopy … Plantation forest where *Pinus taeda* (60-70% cover) is the most abundant canopy species. Canopy associates include *Acer rubrum, Liquidambar styraciflua,* and *Nyssa sylvatica*. Shrub layer lacks diversity with *Ilex vomitoria* (30% cover) as the sole species. Occasional flooding can allow for the growth of mesic herbaceous species such as *Cladium mariscoides*, *Eleocharis microcarpa*, *Rhynchospora inexpansa*, and *Utriculata radiata* ..... .....**CST007179: *Pinus taeda* Forest Plantation [MC301]**

12a *Quercus michauxii* is a major component of the canopy … This community typically occurs on mesic flats. The canopy dominant is *Quercus michauxii* with associated *Liquidambar styraciflua, Pinus taeda, Quercus laurifolia*, *Quercus nigra, Quercus pagoda*. Additional canopy associates in smaller amounts include *Acer rubrum, Carya glabra, Fagus grandifolia, Fraxinus americana*, *Liriodendron tulipifera, Magnolia grandiflora, Nyssa sylvatica, Prunus serotina*, and *Quercus phellos*. Common shrubs are *Ilex vomitoria*, *Halesia diptera*, *Hamamelis virginiana*, *Symplocos tinctoria*, and *Sabal minor*. Vines include *Berchemia scandens*, *Bignonia capreolata*, *Gelsemium sempervirens*, *Lonicera sempervirens*, *Parthenocissus quinquefolia*, *Smilax* spp., *Toxicodendron radicans*, and *Vitis rotundifolia*. Ferns can be diverse and abundant with *Osmunda regalis* var. *spectabilis*, *Polystichum acrostichoides*, *Thelypteris palustris*, and *Woodwardia areolata*. Herbs may include *Arundinaria gigantea*, *Boehmeria cylindrica*, *Carex* spp., *Chasmanthium laxum*, and *Veratrum virginicum* (*Melanthium virginicum*) ..... ...**CEGL007715 *Quercus michauxii* - *Quercus* (*nigra, pagoda*) - *Liquidambar styraciflua* - *Pinus taeda* Wet Forest [MC303]**

12b *Quercus michauxii* is an uncommon canopy species; *Pinus taeda* is the most abundant canopy species in combination with *Quercus pagoda*, *Quercus nigra, Quercus phellos*, and/or *Quercus stellata* ... Hydroxeric non-riverine wet flatwood woodland or forest. Typically, these sites are above the floodplain. Fire maintained communities are represented as a woodland but due to fire suppression, succession from a woodland to forest is common. *Pinus taeda* dominates the canopy with a combination of *Pinus echinata*, *Magnolia grandiflora, Quercus pagoda*, *Quercus phellos*, and *Quercus stellata*. Possible associates include *Quercus alba*, *Quercus falcata, Quercus marilandica*, *Quercus nigra*, and *Quercus similis*. Common shrub species are *Callicarpa americana*, *Hamamelis virginiana*, and *Vaccinium arboreum*. Herbaceous species are *Croton willdenowii*, *Dichanthelium aciculare*, *Dichanthelium scoparium*, and *Schizachyrium scoparium*..... . **CEGL007069: *Pinus taeda* (*Pinus echinata*) - *Quercus* (*pagoda, phellos*) Wet Woodland [MC303]**

Section 6: Quercus spp. Nonriverine Flatwood Forest

1a Topography varies slightly between mounds and depressions resulting in varying vegetation... ..... 2a

1b Topography is flat and does not vary slightly between mounds and depressions..... 3a

2a Communities typically occur on slight ridges or mounds within a ridge and swale region; Canopy include *Quercus alba* and the shrub layer often contains *Cornus florida*, *Ostrya virginiana*, *Carpinus caroliniana*, and *Vaccinium arboretum* ... This community typically occurs within ridge and swale regions. *Quercus alba* dominates the canopy with cover ranging from 30%-60%. Other common canopy species include *Carya alba*, *Quercus nigra*, *Quercus michauxii*, and *Quercus falcata*. Occasionally, *Fagus grandifolia* and *Magnolia grandiflora* occur in the canopy with abundance. Shrub canopy contains *Symplocos tinctoria*, *Cornus florida*, *Ostrya virginiana*, *Quercus hemisphaerica*, and *Carpinus caroliniana*…**CEGL007980 *Quercus alba – Carya alba* / *Symplocos tinctoria* / *Mitchella repens* Forest [MC314]**

2b Communities typically occur within swales; canopy lacks *Quercus alba* ... Hardwood flatwoods forest occurring on seasonally wet flats. This association takes into account the vegetation occurring in the swales not the mounds. Swales may exhibit floodplain characteristics such as debris piles and thin litter layers. Flooding may occur from upland precipitation. Vegetation is highly variable. *Quercus laurifolia* (20-40% cover) is the most dominant species which typically occurs with *Carya tomentosa*, *Quercus michauxii*, *Quercus phellos*, *Fraxinus pennsylvanica*, *Cornus foemina*, and *Nyssa biflora*. Shrubs such as *Cephalanthus occidentalis*, *Ditrysinia fruticosa*, *Hamamelis virginiana*, *Ilex vomitoria*, *Sabal minor,* and *Vaccinium arboreum* are common. Common vines are *Lonicera japonica*, and *Vitis rotundifolia*. Herbaceous stratum is sparse to absent with common occurrences of *Chasmanthium sessiliflorum* and *Carex intumescens* ..... .. **CEGL007961: *Quercus laurifolia - Quercus phellos* / *Viburnum dentatum* - (*Sebastiania fruticosa*) / *Carex glaucescens* Upper West Gulf Wet Flatwoods Forest [MC314]**

3a *Triadica sebifera* and/or *Acer rubrum* dominate the canopy ..... **go to section 9**

3b Community is dominated by a variety of *Quercus* spp. ..... 4a

4a Forest community occurs on wet flats..... 5a

4b Forest community occurs on a floodplain of a small stream or river..... 11a

5a Wet forest occurs on isolated circular depressions; *Quercus laurifolia* is the most abundant canopy species … Swamp wet forest occurring on isolated circular depressions with in pine flatwoods. *Quercus laurifolia* is the most abundant canopy species with associated *Acer rubrum*, *Crataegus* spp., *Diospyros virginiana*, *Ilex opaca*, *Nyssa biflora*, *Pinus taeda*, and *Quercus nigra*. *Cyrilla racemiflora* is common in the shrub layer. Herbaceous layer is sparse due to consistent flooding; *Carex* spp. (5-10% cover) can occur. Sphagnum spp. is a common bryophyte..... . **CEGL007871:**

***Quercus laurifolia* - (*Quercus nigra*, *Nyssa biflora*) / *Diospyros virginiana* Wet Forest [MC314]**

5b Wet forest does not occur on isolated circular depressions; *Quercus laurifolia* is an uncommon/absent canopy associate ..... 6a

6a *Quercus hemisphaerica* is abundant in the canopy/shrub stratum … Sandy upland forest occurring on sites sheltered from fire. Canopy dominants include *Quercus hemisphaerica*, *Quercus falcata*, and *Quercus nigra*. Associated tree species can include *Carya tomentosa* (*Carya alba*), *Cornus florida*, *Ilex opaca*, *Liriodendron tulipifera*, *Liquidambar styraciflua*, *Magnolia grandiflora*, *Pinus taeda* (<30% cover), *Quercus alba*, and *Quercus nigra*. Shrub layer is dense (>70% cover) with *Quercus hemisphaerica* and *Ilex vomitoria*; common species are *Callicarpa americana*, *Hypericum hypericoides*, *Vaccinium arboreum*, and *Vaccinium* spp. Common vines are *Gelsemium sempervirens* and *Vitis rotundifolia*. Herbs are sparse and may include *Cnidoscolus stimulosus* and *Desmodium* spp. ..... . **CEGL007751: *Quercus hemisphaerica – Quercus* (*falcata*, *nigra*) / *Vaccinium arboreum* / *Cnidoscolus stimulosus* Forest [MC318]**

6b *Quercus hemisphaerica* is not abundant in the canopy/shrub stratum ..... 7a

7a *Quercus phellos* is an abundant canopy species ..... 8a

7b *Quercus phellos* is an uncommon/absent canopy species ..... 9a

8a *Quercus phellos* (>60% cover) is nearly monospecific in the canopy; *Sabal minor* is uncommon/absent in the shrub layer … Forest situated between streams on slight topographic depressions within upland communities. Species diversity is low in this community. Water will pond as a result of what is likely to be an underlying impermeable clay fragipan. The canopy has low diversity with a nearly monospecific canopy of *Quercus phellos* (>60% cover). The subcanopy, shrub, and herb layer is extremely sparse. *Ilex decidua* is the dominant shrub species. Common vines such as *Berchemia scandens*, *Bignonia capreolata*, *Smilax bona-nox*, *Smilax rotundifolia*, *Smilax smallii*, and *Toxicodendron radicans* comprise the majority of diversity. The only documented herbaceous species is *Chasmanthium laxum*. *Sphagnum* spp. may be present in some areas ..... . **CEGL008576: *Quercus phellos* / *Chasmanthium laxum* Wet Forest [MC314]**

8b *Quercus phellos* and *Quercus nigra* are the most dominant canopy species; *Quercus phellos* is not monospecific; *Sabal minor* (40% cover) is a dominant shrub species … A riparian forest where *Quercus nigra* (40% cover) and *Quercus phellos* are the most dominant canopy species. Distinguished from other floodplain forests by *Carya myristiciformis*, *Quercus similis*, and *Ulmus crassifolia*. Additional associates include *Carya aquatica*, *Crataegus marshallii*, *Quercus lyrata*, and *Taxodium distichum*. *Sabal minor* (40% cover) is the most abundant shrub with associated Crataegus viridis, *Forestiera ligustrina*, *Ilex decidua*, *Ilex longipes*, and *Ulmus alata*. Abundant herbs are *Carex cherokeensis* and *Poa autumnalis*; associates include *Carex caroliniana*, *Carex flaccosperma*, *Chasmanthium latifolium*, *Dichanthelium commutatum*,

*Elymus virginicus*, *Justicia lanceolata*, *Phanopyrum gymnocarpon*, and *Sauruus cernuus…* **CEGL007954: *Quercus nigra - Quercus phellos* / *Carya myristiciformis - Sabal minor* / *Carex cherokeensis* Floodplain Forest [MC313]**

9a *Quercus nigra* is the most abundant canopy dominant; canopy associates have <10% cover … This community is the result of upland pine fire suppression or soil disturbance. Occurring on mesic to dry sites with loamy, fine textured soils. *Quercus nigra* (40-80% cover) is the most abundant canopy species. Associates include *Carpinus caroliniana*, *Carya glabra*, *Ilex opaca*, *Liquidambar styraciflua*, *Nyssa aquatica*, *Nyssa sylvatica*, *Ostrya virginiana*, *Pinus elliottii*, *Pinus taeda,* remnant *Pinus palustris, Quercus falcata*, *Quercus hemisphaerica*, *Quercus marilandica*, *Quercus phellos*, and *Triadica sebifera.* Shrub layer typically has <50% cover with *Ilex coriacea*, and *Ilex vomitoria*. Herb layer is sparse with occasional occurrences of *Chasmanthium sessiliflorum*. ..... **CEGL004638: *Quercus nigra* Ruderal Forest [MC313]**

9b *Quercus nigra* is not the sole canopy dominant; *Quercus alba*, *Quercus falcata*, and *Quercus nigra* are abundant in the canopy ..... 10a

10a Canopy include *Carya alba* and the shrub layer often contains *Cornus florida*, *Ostrya virginiana*, *Carpinus caroliniana*, and *Vaccinium arboretum …* This community typically occurs within ridge and swale regions. *Quercus alba* dominates the canopy with cover ranging from 30%-60%. Other common canopy species include *Carya alba*, *Quercus nigra*, *Quercus michauxii*, and *Quercus falcata*. Occasionally, *Fagus grandifolia* and *Magnolia grandiflora* occur in the canopy as well. Shrub canopy contains *Symplocos tinctoria*, *Cornus florida*, *Ostrya virginiana*, and *Carpinus caroliniana* ..... …**CEGL007980 *Quercus alba – Carya alba* / *Symplocos tinctoria* / *Mitchella repens* Forest [MC314]**

10b Canopy does not include *Carya alba*; *Quercus alba, Quercus falcata,* and *Quercus nigra* dominate the canopy … This forest occurs on flat slight topographic upland rises. Abundant canopy species are *Quercus alba* (20% cover), *Quercus nigra* (20% cover), and *Quercus falcata* (20% cover). Associated species are *Carpinus caroliniana*, *Carya tomentosa*, *Cornus florida*, *Fagus grandifolia*, *Ilex opaca*, *Liquidambar styraciflua*, *Magnolia grandiflora*, *Quercus michauxii*, *Quercus pagoda*, *Pinus taeda*, and *Platanus occidentalis*. Shrub layer contains *Callicarpa americana*, *Ilex vomitoria*, *Persea palustris*, and *Symplocos tinctoria*. A sparse herb layer includes *Chasmanthium laxum*, *Chasmanthium sessiliflorum*, *Hexastylis arifolia* var. *arifolia*, *Mitchella repens*, *Pteridium aquilinum* var. *pseudocaudatum*, and *Smilax pumila*..... . **CEGL007845: *Quercus alba - Quercus* (*michauxii*, *nigra*) / *Ilex opaca* / *Chasmanthium laxum* Forest [MC314]**

11a *Quercus nigra* is the sole canopy dominant; canopy associates have <10% cover … This community is the result of upland pine fire suppression or soil disturbance. Occurring on mesic to dry sites with loamy, fine textured soils. *Quercus nigra* (40-80% cover) is the most abundant canopy species. Associates include *Carpinus caroliniana*, *Carya glabra*, *Ilex opaca*, *Liquidambar styraciflua*, *Nyssa aquatica*, *Nyssa sylvatica*, *Ostrya virginiana*, *Pinus elliottii*,

*Pinus taeda,* remnant *Pinus palustris, Quercus falcata*, *Quercus hemisphaerica*, *Quercus marilandica*, *Quercus phellos*, and *Triadica sebifera.* Shrub layer typically has <50% cover with *Ilex coriacea*, and *Ilex vomitoria*. Herb layer is sparse with occasional occurrences of *Chasmanthium sessiliflorum*. ..... **CEGL004638: *Quercus nigra* Ruderal Forest [MC313]**

11b *Quercus nigra* is an uncommon/absent canopy associate ..... 12a

12a *Quercus falcata* (>30% cover) is the most abundant canopy species … Riparian forest where *Quercus falcata* (>30% cover) is the sole canopy dominant with minor components of *Quercus stellata* and *Pinus taeda* (<10% cover). Associated tree species include *Acer rubrum*, *Carya cordiformis*, *Cornus florida*, *Liquidambar styraciflua*, *Pinus echinata*, *Quercus alba*, and *Quercus velutina*. Shrub species include *Callicarpa americana*, *Chionanthus virginicus*, *Forestiera ligustrina*, *Ilex vomitoria*, *Vaccinium arboreum*, and *Viburnum rufidulum*. Herbaceous diversity is low with an abundance of *Chasmanthium sessiliflorum*, *Gelsemium sempervirens*, and *Parthenocissus quinquefolia* ..... . **CEGL008415: *Quercus falcata - Quercus stellata* - (*Pinus taeda*) West Gulf Coastal Plain Forest [MC317]**

12b *Quercus falcata* is an uncommon canopy associate ..... 13a

13a *Sabal minor* can be common in the shrub layer with 20-60% cover; *Quercus laurifolia* is a common canopy associate … Floodplains of small to intermediate streams and relict stream sloughs in pine flatwoods. Dominant canopy species include *Acer floridanum*, *Acer rubrum*, *Liquidambar styraciflua*, *Nyssa biflora*, and *Quercus laurifolia*. Associates are *Fraxinus pennsylvanica*, *Magnolia virginiana*, *Pinus taeda*, *Quercus phellos*, *Quercus nigra*, and *Triadica sebifera*. *Sabal minor* can be common in the shrub layer with 20-60% cover. Herbaceous layer is sparse, occasionally with *Chasmanthium sessiliflorum* and *Juncus texanus* **CEGL007804: *Quercus laurifolia - Liquidambar styraciflua - Nyssa biflora - Acer rubrum* / *Sabal minor* Floodplain [MC313]**

13b *Sabal minor* is absent in the shrub layer; *Quercus phellos* (10-30% cover) is common in the canopy … Bottomland forest where flooding occurs for 1-2 months out of the growing season. Canopy dominants are *Quercus phellos* (10-30% cover) and *Liquidambar styraciflua*. Associates include *Acer rubrum*, *Carpinus caroliniana*, *Carya aquatica*, *Celtis laevigata*, *Fraxinus pennsylvanica*, *Nyssa sylvatica*, *Ostrya virginiana*, *Quercus lyrata*, *Quercus michauxii*, *Quercus nigra*, *Quercus pagoda*, and *Ulmus americana*. Dominant shrub species are *Carpinus caroliniana*, *Fraxinus caroliniana*, *Ilex coriacea*, and *Ilex decidua*. Vines may include *Ampelopsis arborea*, *Bignonia capreolata*, *Brunnichia ovata*, and *Campsis radicans.* Herbaceous layer includes *Carex louisianica*, *Carex tribuloides*, *Chasmanthium laxum*, *Lysimachia lanceolata*, *Justicia lanceolata, Justicia ovata, Oplismenus hirtellus, Oxalis stricta,* and *Sanicula canadensis*..... . **CEGL007370: *Quercus phellos - Liquidambar styraciflua* / *Ilex decidua - Carpinus caroliniana* / *Lysimachia radicans* Floodplain Forest [MC313]**

***Key C: Floodplain Forest and Woodland***

1a *Pinus taeda* is typically absent in the canopy but can occur with 5-15% cover; a combination of *Acer rubrum*, *Carya aquatica*, *Fraxinus pennsylvanica*, *Liquidambar styraciflua*, *Platanus* occidentalis, *Quercus laurifolia*, *Quercus lyrata*, *Quercus nigra*, *Quercus phellos*, or *Quercus* spp. are dominant canopy species ..... **Section 7: *Quercus* spp. - *Fraxinus pennsylvanica* - *Acer rubrum* Floodplain Forest**

1b *Pinus taeda*, *Pinus elliottii,* and/or *Pinus palustris* is an abundant canopy species with (10-) avg. 30-70% cover; a combination of *Fagus grandifolia*, *Liquidambar styraciflua*, *Quercus michauxii*, *Quercus nigra*, or *Quercus pagoda* are dominant canopy species ..... **Section 8: *Pinus* spp. - *Quercus* spp. Forest and Woodland**

Section 7: Quercus spp. - Fraxinus Pennsylvanica - Acer rubrum Floodplain Forest

1a *Quercus* spp. (<15% cover) are uncommon/absent canopy species..... 2a

1b *Quercus* spp. (>15% cover) are abundant canopy species ..... 6a

2a *Acer rubrum* and/or *Triadica sebifera* dominate the canopy ..... 3a

2b *Acer rubrum* is uncommon/absent in the canopy ..... 5a

3a *Acer rubrum* dominates the canopy … Floodplain forest occurring on floodplains of small streams with soils of sandy clay. The sole canopy dominant is *Acer rubrum* (<40% cover). Shrub layer is typically sparse with <5% cover. Herbaceous stratum is vigorous (60-80% cover) with an abundance of graminoids such as *Arundinaria gigantea*, *Carex* spp., *Chasmanthium laxum*, and *Juncus effusus* ..... . **NPSBITH007: *Acer rubrum* Floodplain Forest [MC305]**

3b . *Triadica sebifera* is the sole canopy dominant … Wetland forest that is highly variable. By far the most dominant canopy species is the noxious non-native *Triadica sebifera* (40-80% cover). Associated canopy species have <10% combined cover; possible tree species are *Acer rubrum* var. *drummondii*, *Quercus nigra*, *Salix caroliniana*, and *Salix nigra*. Herbaceous layer includes various wetland grasses, sedges, and forbs; *Carex glaucescens* (20% cover) can be particularly common… ..... **CEGL007412: *Triadica sebifera* Ruderal Wet Forest [MC307]**

4a *Fraxinus pennsylvanica* and *Celtis laevigata* are the most abundant canopy species… Broadleaf deciduous floodplain forest along large rivers. *Fraxinus pennsylvanica* (40% cover) is abundant on wet flats and sloughs while *Celtis laevigata* is most dominant on front sites. *Ulmus americana* has been mostly eliminated due to Dutch elm disease and logging. Tree associates include *Acer negundo*, *Carpinus caroliniana*, *Carya aquatica*, *Liquidambar styraciflua*, and *Quercus lyrata*. Shrubs typically include *Cornus drummondii*, *Crataegus* spp., and *Ilex decidua*. Herbaceous layer is diverse and dense with *Chasmanthium latifolium* (70% cover), *Boehmeria cylindrica*, *Campsis radicans*, *Carex* spp., *Galium* spp., *Impatiens capensis*, *Laportea canadensis*, *Leersia* spp., and *Pilea pumila*. Vines such as *Parthenocissus*

*quinquefolia* and *Toxicodendron radicans* typically grow..... . **CEGL002427: *Fraxinus pennsylvanica – Ulmus Americana – Celtis laevigata* / *Ilex decidua* Floodplain Forest [MC308]**

4b *Fraxinus pennsylvanica* and *Celtis laevigata* are uncommon/absent canopy species..... 5a

5a *Liquidambar styraciflua* (50-80% cover) is the sole canopy dominant; *Platanus occidentalis* is absent … Recent disturbance is characteristic of this community. The sole canopy dominant is *Liquidambar styraciflua* with 50-80% cover. Scattered associated canopy species include *Ilex opaca*, *Nyssa sylvatica*, *Platanus occidentalis*, and/or *Quercus* spp. in the subcanopy. The shrub stratum (<80% cover) is dense with *Carpinus caroliniana*, *Forestiera acuminata*, *Ilex decidua*, *Ilex opaca*, *Ilex vomitoria*, and *Planera aquatica*. Invasive non-native *Triadica sebifera* is common with <50% cover. Herbaceous layer is sparse with <10% cover..... .....**NPSBITH006: *Liquidambar styraciflua* Ruderal Forest [MC313]**

5b *Liquidambar styraciflua* and *Platanus occidentalis* (10-30% cover) are common in the canopy along with a variety of associates … Floodplain forest on stabilized natural levees, point bars, first bottoms of large streams and rivers. This forest usually succeeds from *Salix nigra* and *Populus deltoids*. *Liquidambar styraciflua* (20-40% cover) and *Platanus occidentalis* (10-30% cover) are common canopy species. Depending on flooding disturbance numerous associates can be found including *Acer negundo*, *Betula nigra*, *Carya aquatica*, *Carya illinoinensis*, *Celtis laevigata*, *Fraxinus pennsylvanica*, *Nyssa biflora*, *Pinus taeda*, *Populus deltoides*, *Quercus nigra*, *Salix nigra*, and *Ulmus americana*. Subcanopy and shrub layer cover can range from 40-70% with *Aesculus pavia* var. *pavia*, *Carpinus caroliniana*, *Crataegus viridis*, *Ilex* coriacea, *Ilex decidua*, and *Lindera benzoin*. Herbaceous layer is sparse with *Arundinaria gigantea*, *Boehmeria cylindrica*, *Chasmanthium latifolium*, *Elymus hystrix*, and *Viola* spp. Exotic invasive species such as *Ligustrum sinense*, *Lonicera japonica*, *Microstegium vimineum*, and *Triadica sebifera* can dominate large areas of the forest..... . **CEGL007335: *Platanus occidentalis – Liquidambar styraciflua* – (*Ulmus americana*) / (*Crataegus viridis*) Floodplain Forest [MC305]**

6a *Quercus nigra* (>20% cover) is the most abundant canopy species..... 7a

6b *Quercus nigra* (<20% cover) is an uncommon canopy species ..... 10a

7a *Quercus nigra* is the sole canopy dominant; canopy associates with <10% cover … This community is the result of upland pine fire suppression or soil disturbance. Occurring on mesic to dry sites with loamy, fine textured soils. *Quercus nigra* (40-80% cover) is the most abundant canopy species. Associates include *Carpinus caroliniana*, *Carya glabra*, *Ilex opaca*, *Liquidambar styraciflua*, *Nyssa aquatica*, *Nyssa sylvatica*, *Ostrya virginiana*, *Pinus elliottii*, *Pinus taeda,* remnant *Pinus palustris, Quercus falcata*, *Quercus hemisphaerica*, *Quercus marilandica*, *Quercus phellos*, and *Triadica sebifera.* Shrub layer typically has <50% cover with *Ilex coriacea*, and *Ilex vomitoria*. Herb layer is sparse with occasional occurrences of *Chasmanthium sessiliflorum*. ..... **CEGL004638: *Quercus nigra* Ruderal Forest [MC313]**

7b *Quercus nigra* is not the sole canopy dominant; canopy associates with >10% cover ..... 8a

8a *Sabal minor* (40% cover) is a dominant shrub species; *Quercus phellos* is an abundant canopy species … A riparian forest where *Quercus nigra* (40% cover) and *Quercus phellos* are the most dominant canopy species. Distinguished from other floodplain forests by *Carya myristiciformis*, *Quercus similis*, and *Ulmus crassifolia*. Additional associates include *Carya aquatica*, *Crataegus marshallii*, *Quercus lyrata*, and *Taxodium distichum*. *Sabal minor* (40% cover) is the most abundant shrub with associated Crataegus viridis, *Forestiera ligustrina*, *Ilex decidua*, *Ilex longipes*, and *Ulmus alata*. Abundant herbs are *Carex cherokeensis* and *Poa autumnalis*; associates include *Carex caroliniana*, *Carex flaccosperma*, *Chasmanthium latifolium*, *Dichanthelium commutatum*, *Elymus virginicus*, *Justicia lanceolata*, *Phanopyrum gymnocarpon*, and *Sauruus cernuus*..... . **CEGL007954: *Quercus nigra - Quercus phellos* / *Carya myristiciformis - Sabal minor* / *Carex cherokeensis* Floodplain Forest [MC313]**

8b Sabal minor is uncommon (<10%) or absent; Carpinus caroliniana and/or Ostrya virginiana are often common in the subcanopy..... 9a

9a *Ulmus alata* and/or *Nyssa aquatica* codominate along with *Quercus nigra* ... This community is dominated by a canopy of *Quercus nigra*, *Nyssa aquatica*, and *Ulmus alata* with a cover ranging from 30% to 60%. The subcanopy is usually dominated by *Carpinus caroliniana* and *Ilex opaca* with cover typically 40%. Shrubs are usually dense with cover ranging from 30% to 60%. Common species include *Ilex vomitoria*, *Crataegus marshallii*, and *Triadica sebifera* **CEGL007953 *Quercus nigra – Ulmus alata* / *Ostrya virginiana* Floodplain Forest [MC313]**

9b *Liquidambar styraciflua* and *Ilex opaca* are dominant in the canopy; *Sabal minor* (<10% cover) is an uncommon shrub species; *Quercus phellos* is uncommon/absent in the canopy … Floodplain forest along stream/river terraces. A high water table leads to many downed trees. Canopy dominants are *Ilex opaca* (20-50% cover), *Liquidambar styraciflua* (10-40% cover), and *Quercus nigra* (20-40% cover). Canopy associates include *Acer rubrum var. rubrum*, *Celtis laevigata*, *Carpinus caroliniana* (<40% cover), *Carya ovata*, *Crataegus marshallii* (10-30% cover), *Diospyros virginiana*, *Fraxinus pennsylvanica*, *Nyssa aquatica* (30% cover), *Nyssa sylvatica*, *Pinus taeda* (<10% cover), *Quercus shumardii*, *Quercus michauxii, Quercus laurifolia*, *Quercus alba*, and *Ulmus americana*. Shrub layer varies from sparse to dense with *Ilex vomitoria* (<60% cover), *Vaccinium fuscatum*, *Vaccinium virgatum*, *Cyrilla racemiflora*, *Sebastiania fruticosa*, and possibly *Sabal minor*. Vines can include *Ampelopsis arborea*, *Amphicarpaea bracteata*, *Berchemia scandens*, *Bignonia capreolata*, *Campsis radicans*, *Parthenocissus quinquefolia*, *Smilax bona-nox*, *Smilax rotundifolia*, *Trachelospermum difforme*, *Toxicodendron radicans*, and *Vitis rotundifolia*. A dense herbaceous layer grows with *Carex complanata*, *Carex debilis*, *Carex glaucodea*, *Carex intumescens*, *Chasmanthium latifolium*, *Chasmanthium sessiliflorum*, *Dichanthelium dichotomum*, *Galium obtusum ssp. obtusum*, *Justicia lanceolata*, *Rhynchospora macrostachya*, *Sanicula canadensis*, *Symphyotrichum lanceolatum*, and *Tridens strictus*..... . **CEGL007984:**

***Quercus nigra - Liquidambar styraciflua* / *Ilex opaca - Vaccinium fuscatum* / *Carex debilis* Floodplain Forest [MC313]**

10a *Quercus lyrata* or *Quercus laurifolia* are canopy dominants ..... 11a

10b *Quercus lyrata* and *Quercus laurifolia* are uncommon canopy species..... 12a

11a *Carya aquatica* and *Quercus lyrata* are abundant canopy species; *Quercus laurifolia* is an uncommon canopy associate; *Sabal minor* is uncommon/absent in the shrub layer … Bottomland forest that is largely impacted by seasonal flooding. Dominant canopy species are *Quercus lyrata* (10-30% cover) and *Carya aquatica* (30% cover). Associate canopy species are *Acer rubrum var. drummondii, Celtis laevigata*, *Diospyros virginiana*, *Gleditsia aquatica*, *Liquidambar styraciflua, Populus deltoides*, *Taxodium distichum*, and *Triadica sebifera*. Common shrubs (<10% cover) are *Cephalanthus occidentalis*, *Cornus foemina*, and *Planera aquatica*. Vines (10-20% cover) include *Brunnichia ovata*, *Campsis radicans*, and *Vitis rotundifolia*. Herbs (<10% cover) include *Boehmeria cylindrica*, *Carex grayi*, *Leersia lenticularis*, *Phanopyrum gymnocarpon*, and *Polygonum pensylvanicum*..... **CEGL007397: *Quercus lyrata - Carya aquatica* Floodplain Forest [MC313]**

11b *Quercus laurifolia* is a common canopy associate; *Sabal minor* can be common in the shrub layer with 20-60% cover; *Carya aquatica* and *Quercus lyrata* are uncommon/absent in the canopy … Floodplains of small to intermediate streams and relict stream sloughs in pine flatwoods. Dominant canopy species include *Acer floridanum*, *Acer rubrum*, *Liquidambar styraciflua*, *Nyssa biflora*, and *Quercus laurifolia*. Associates are *Fraxinus pennsylvanica*, *Magnolia virginiana*, *Pinus taeda*, *Quercus phellos*, *Quercus nigra*, and *Triadica sebifera*. *Sabal minor* can be common in the shrub layer with 20-60% cover. Herbaceous layer is sparse, occasionally with *Chasmanthium sessiliflorum* and *Juncus texanus* ..... . **CEGL007804: *Quercus laurifolia - Liquidambar styraciflua - Nyssa biflora - Acer rubrum* / *Sabal minor* Floodplain [MC313]**

12a *Quercus phellos* (10-30% cover) is common in the canopy … Bottomland forest where flooding occurs for 1-2 months out of the growing season. Canopy dominants are *Quercus phellos* (10-30% cover) and *Liquidambar styraciflua*. Associates include *Acer rubrum*, *Carpinus caroliniana*, *Carya aquatica*, *Celtis laevigata*, *Fraxinus pennsylvanica*, *Nyssa sylvatica*, *Nyssa biflora, Ostrya virginiana*, *Quercus lyrata*, *Quercus michauxii*, *Quercus nigra*, *Quercus pagoda*, and *Ulmus americana*. Dominant shrub species are *Carpinus caroliniana*, *Fraxinus caroliniana*, *Ilex coriacea*, and *Ilex decidua*. Vines may include *Ampelopsis arborea*, *Bignonia capreolata*, *Brunnichia ovata*, and *Campsis radicans.* Herbaceous layer includes *Carex louisianica*, *Carex tribuloides*, *Chasmanthium laxum*, *Lysimachia lanceolata*, *Justicia lanceolata, Justicia ovata, Oplismenus hirtellus, Oxalis stricta,* and *Sanicula canadensis*..... **CEGL007370: *Quercus phellos - Liquidambar styraciflua* / *Ilex decidua - Carpinus caroliniana* / *Lysimachia radicans* Floodplain Forest [MC313]**

12b *Quercus phellos* is an uncommon/absent canopy associate … Wet bottomland hardwood

forests along medium sized streams. Canopy species include *Liquidambar styraciflua*, *Quercus michauxii*, *Quercus laurifolia*, *Quercus lyrata*, *Quercus pagoda, Quercus texana*, *Quercus nigra*, *Nyssa aquatica*, *Ulmus alata*, *Ulmus americana*, *Carya aquatica*, *Carya glabra*, *Carpinus caroliniana*, *Crataegus marshallii*, and *Crataegus viridis*. Shrub layer tends to be sparse but can include *Cephalanthus occidentalis*, *Ilex vomitoria*, *Morella cerifera*, and occasionally *Sabal minor*. Common vines are *Ampelopsis arborea*, *Berchemia scandens*, *Bignonia capreolata*, *Campsis radicans*, *Smilax rotundifolia*, *Toxicodendron radicans*, and *Vitis rotundifolia*. Possible herbs include *Arundinaria gigantea*, *Boehmeria cylindrica*, *Carex* spp., *Chasmanthium* spp., *Elephantopus carolinianus*, *Justicia lanceolata*, *Mitchella repens*, *Polygonum virginianum*, and *Saururus cernuus* ..... . **CEGL007906: *Quercus michauxii - Liquidambar styraciflua - Quercus texana - Quercus lyrata* Floodplain Forest [MC313]**

Section 8: Pinus spp. – Quercus spp. Forest and Woodland

1a *Pinus taeda* (50-70% cover) is the sole canopy dominant; oaks are typically absent in the canopy/subcanopy; canopy is typically closed ..... 2a

1b *Pinus taeda* is not the sole canopy dominant ..... 3a

2a Community has distinct rows of planted *Pinus taeda …* Plantation forest where *Pinus taeda* (60-70% cover) is the most abundant canopy species. Canopy associates may include species from other adjacent communities. Common canopy associates may include *Acer rubrum*, *Liquidambar styraciflua*, and *Nyssa sylvatica*. Shrub layer lacks diversity with *Ilex vomitoria* (30% cover) as the sole species. Occasional flooding can allow for the growth of mesic herbaceous species such as *Cladium mariscoides*, *Eleocharis microcarpa*, *Rhynchospora inexpansa*, and *Utricularia radiata*..... **CST007179: *Pinus taeda* Forest Plantation [MC301]**

2b Community lacks distinct rows of planted *Pinus taeda* … Riparian forest where *Pinus taeda* is the sole canopy dominant. Cover of *Pinus taeda* exceeds 70%. Associates include *Pinus echinata*, *Pinus elliottii*, and *Pinus palustris* (<10% cover). Hardwoods are uncommon (<10% cover) but can include *Carpinus caroliniana*, *Celtis laevigata*, *Fraxinus pennsylvanica*, *Liquidambar styraciflua*, *Nyssa biflora*, *Ostrya virginiana*, *Quercus laurifolia*, *Quercus lyrata*, *Quercus michauxii*, *Quercus nigra*, and *Quercus phellos*. Shrubs (10-30% cover) include *Ilex vomitoria*, *Hamamelis virginiana*, *Ligustrum sinense*, *Persea borbonia*, and *Ulmus alata*. Vines include *Bignonia capreolata*, *Gelsemium sempervirens*, *Parthenocissus quinquefolia*, and *Vitis rotundifolia*. Herbaceous layer (<10% cover) is sparse to absent with *Carex* spp. and *Chasmanthium laxum*. Ground cover is mostly pine needle litter with 50-90% cover .....**CEGL007142: *Pinus taeda* Riparian Forest [MC302]**

3a *Pinus elliottii* and/or *Pinus palustris* dominate in the canopy … Degraded fire suppressed *Pinus palustris* woodland on soils of fine sandy loams or silt loams. Codominant canopy species *Pinus elliottii* and *Pinus palustris* have 75% combined cover. *Liquidambar styraciflua* (<25% cover) is a common associate. Shrub density ranges from sparse to dense with *Callicarpa americana*, *Ilex coriacea*, *Morella caroliniensis*, *Morella cerifera*, *Vaccinium elliottii*, and

*Viburnum nudum* var. *nudum.* Herbaceous layer is dense under open conditions with *Carex* spp., *Ctenium aromaticum*, *Muhlenbergia expansa*, and *Schizachyrium scoparium*. Exotic aggressively invasive species such as *Ligustrum sinense*, *Lonicera japonica*, and *Microstegium vimineum* are especially common..... . **CEGL007157: *Pinus elliottii* - (*Pinus palustris*) / *Morella cerifera – Ilex coriacea* Ruderal Wet Woodland [MC323]**

3b *Pinus elliottii* and/or *Pinus palustris* are uncommon or absent in the canopy ..... 4a

4a *Sabal minor* (40-50% cover) is dominant in the shrub layer … Forests on flats near riparian habitats, and occasionally found at the base of gradual sloping upland communities. *Pinus taeda* (10-40% cover) is the most abundant canopy species. Common associates are *Acer rubrum*, *Fraxinus americana*, *Liquidambar styraciflua*, *Ostrya virginiana*, *Quercus lyrata*, *Quercus nigra*, and *Quercus velutina*. Associates include *Celtis laevigata*, *Ilex opaca*, *Morus rubra*, *Quercus shumardii*, *Ulmus alata*, and *Ulmus americana*. Shrub layer characteristically contains an abundance of *Sabal minor* (40-50% cover) with *Callicarpa americana*, *Crataegus spathulata*, *Forestiera ligustrina*, *Ilex decidua*, *Ilex vomitoria*, and *Morella cerifera*. Abundant vines are *Parthenocissus quinquefolia* and *Toxicodendron radicans*. Herbaceous stratum remains sparse with patches of *Carex abscondita*, *Carex albicans var. australis,* and *Carex cherokeensis* ..... . **CEGL007955: *Pinus taeda* - (*Quercus* spp.) / *Ostrya virginiana - Sabal minor* Forest [MC315]**

4b *Sabal minor* (<20% cover) is uncommon/absent in the shrub layer..... 5a

5a *Quercus michauxii* and/or *Quercus pagoda* are canopy dominants ..... 6a

5b *Quercus michauxii* and/or *Quercus pagoda* are uncommon/absent canopy associates ..... 7a

6a *Quercus michauxii* is a major component of the canopy; *Magnolia grandiflora* (20-40% cover) is a common canopy species … Found along wet floodplains of streams with silty to sandy soils. Canopy dominants include *Quercus michauxii* (20-40% cover), *Quercus nigra* (20-50% cover), *Pinus taeda* (20-60% cover), *Acer rubrum*, *Carpinus caroliniana* (30-60% cover), *Ilex opaca*, *Magnolia grandiflora* (20-40% cover), *Magnolia virginiana*, *Quercus laurifolia*, and *Quercus pagoda*. Depressional inclusions are common with *Taxodium distichum* and *Nyssa aquatica*. Common shrub species are *Ilex vomitoria* (10-40% cover), *Ilex coriacea*, *Persea borbonia*, and *Rubus argutus*. Common vines are *Mitchella repens*, *Parthenocissus quinquefolia*, *Smilax rotundifolia*, *Toxicodendron radicans*, and *Vitis rotundifolia*. Herbaceous layer is abundant with Arundinaria gigantea (<25% cover), *Carex* spp., *Chasmanthium sessiliflorum*, *Phanopyrum gymnocarpon*, *Rudbeckia laciniata* var. *laciniata*, and *Solidago patula* var. *strictula* ..... . **CEGL007901: *Quercus michauxii - Quercus nigra - Pinus taeda* / *Carpinus caroliniana* Floodplain Forest [MC315]**

6b *Quercus pagoda* is a major component of the canopy; *Magnolia grandiflora* is uncommon/absent in the canopy … Floodplain forest along streams and rivers that experiences

seasonal flooding. Canopy dominants are *Quercus pagoda*, *Liquidambar styraciflua*, *Pinus taeda*, *Quercus michauxii*, and *Quercus laurifolia*. Associated species are *Carya glabra*, *Fraxinus* spp., *Quercus alba*, *Quercus similis*, *Nyssa sylvatica*, *Ulmus alata*, and *Ulmus americana*. Understory with *Acer leucoderme*, *Carpinus caroliniana*, *Crataegus marshallii*, *Ostrya virginiana*, *Symplocos tinctoria*, and *Ulmus alata*. Vines such as *Parthenocissus quinquefolia*, *Toxicodendron radicans*, and *Smilax rotundifolia* are present. Shrubs include *Sambucus canadensis*, *Sebastiania fruticosa*, and *Ilex vomitoria*. Herb layer is sparse with occasional *Carex* spp., *Chasmanthium* spp., *Michella repens*, *Osmunda cinnamomea*, and *Onoclea sensibilis*..... . **CEGL007899: *Quercus pagoda - Liquidambar styraciflua - Pinus taeda* Floodplain Forest [MC315]**

7a *Fagus grandifolia* is a major component of the canopy … Temporarily flooded forests along floodplains of creeks and rivers. *Fagus grandifolia* is the sole canopy dominant. Associates include *Quercus laurifolia*, *Quercus nigra*, and *Pinus taeda* (<30% cover). Herbaceous stratum may have an abundance of *Chasmanthium laxum*..... . **CEGL008574: *Fagus grandifolia - Quercus* (*laurifolia*, *nigra*) - *Pinus taeda* Forest [MC315]**

7b *Fagus grandifolia* is uncommon/absent in the canopy..... 8a

8a Canopy is dominated by *Pinus taeda* and *Quercus hemisphaerica* … *Pinus taeda* and *Quercus hemisphaerica* dominates the canopy. The subcanopy is typically dominated by *Quercus nigra* and *Quercus hemisphaerica*. The shrub stratum is usually composed of *Ilex opaca*, *Ilex vomitoria*, *Symplocos tinctoria*, *Vaccinium arboreum*, and *Cyrilla racemiflora*…**CEGL003619 *Pinus taeda – Quercus hemisphaerica* / *Osmanthus americanus* / *Ilex glabra* Woodland [MC315]**

8b ....*Quercus hemisphaerica* is uncommon to absent in the canopy; *Quercus phellos* typically occurs in the canopy ..... 9a

9a *Liquidambar styraciflua* (30-40% cover) is abundant in the canopy; small stream floodplain forest … Small stream floodplain forest with silty and acidic soils. Abundant canopy species include *Pinus taeda* (30-50% cover), *Liquidambar styraciflua* (30-40% cover), and *Quercus nigra* (20% cover). Canopy associates are *Acer rubrum*, *Carpinus caroliniana*, *Cornus florida*, *Fraxinus americana, Ilex opaca*, *Nyssa aquatica*, *Nyssa sylvatica*, *Quercus laurifolia*, *Quercus phellos*, and *Ulmus alata*. Ruderal communities may have a sparse canopy forming a woodland. Shrub species such as *Callicarpa americana*, *Chionanthus virginicus*, *Crataegus marshallii* (10% cover), *Fraxinus caroliniana*, *Forestiera ligustrina*, *Ilex vomitoria*, *Sebastiania fruticosa*, and *Viburnum rufidulum*. Common vines are *Parthenocissus quinquefolia* and *Smilax rotundifolia*. Herbaceous strata (<10% cover) can include *Carex abscondita*, *Carex albicans* var. *australis*, *Carex blanda*, *Carex lupulina*, *Carex striatula*, *Chasmanthium sessiliflorum*, *Dichanthelium boscii*, *Dichanthelium commutatum*, *Dichanthelium dichotomum*, *Elephantopus carolinianus*, and *Mitchella repens*..... **CEGL004911: *Pinus taeda - Liquidambar styraciflua - Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest [MC315]**

9b *Liquidambar styraciflua* is an uncommon/absent canopy associate; large river floodplains of the Trinity and Neches River … Riparian forest found on large river floodplains of the Trinity and Neches River. Canopy dominants are *Pinus taeda* (30-60%) and *Quercus nigra* (30-50%). Associated species (<20% cover) include *Acer rubrum*, *Carpinus caroliniana*, *Ilex opaca*, *Magnolia virginiana*, *Nyssa aquatica*, *Nyssa sylvatica*, *Quercus laurifolia Quercus michauxii*, and *Quercus phellos*. Shrub layer ranges from sparse to moderately dense (20-60% cover) with *Cyrilla racemiflora*, *Ilex coriacea*, *Ilex vomitoria* (40% cover), *Morella cerifera*, and *Persea borbonia*. Vines include *Berchemia scandens*, *Smilax walteri*, and *Vitis rotundifolia*. The herbaceous stratum is sparse to absent (<5% cover) with *Chasmanthium sessiliflorum*, *Cladium mariscoides*, *Dichanthelium ovale*, *Justicia lanceolata*, and *Rhynchospora inexpansa* ..... **CEGL007910: *Pinus taeda - Quercus phellos - Quercus nigra* Riparian Forest [MC315]**

***Key D: Swamp and Floodplain Forest / Woodland***

1a *Acer rubrum, Betula nigra*, *Liquidambar styraciflua*, *Salix* spp., or *Triadica sebifera* are canopy dominants **Section 9: *Betula nigra - Salix nigra - Triadica sebifera* Floodplain Forest**

1b *Fraxinus caroliniana*, *Magnolia virginiana*, *Nyssa* spp., or *Taxodium distichum* are canopy dominants ..... 2a

2a *Fraxinus caroliniana*, Nyssa spp., or Taxodium distichum are canopy dominants .... **Section 10: *Taxodium distichum - Nyssa* spp. - *Fraxinus caroliniana* Floodplain Forest**

2b *Magnolia virginiana* and/or *Nyssa* spp. are canopy dominants; communities are locally known as baygalls; *Sphagnum* moss is typically present; Shrubs such as *Ilex coriacea* and *Cyrilla racemiflora* to have cover >30% ...**Section 11: *Magnolia virginiana* Evergreen Bog / Baygall**

<u>Section 9: Salix nigra - Triadica sebifera - Betula nigra Floodplain Forest</u>

1a *Triadica sebifera*, *Acer rubrum*, or *Liquidambar styraciflua* are canopy dominants; *Betula nigra* and *Salix nigra* are uncommon/absent canopy species..... 2a

1b *Betula nigra* and/or *Salix nigra* are canopy dominants; *Triadica sebifera* (<20% cover), *Acer rubrum*, or *Liquidambar styraciflua* are uncommon/absent canopy species..... 3a

2a *Triadica sebifera* (40-80% cover) is the most abundant canopy species … Wetland forest that is highly variable. By far the most dominant canopy species is the noxious non-native *Triadica sebifera* (40-80% cover). Associated canopy species have <10% combined cover; possible tree species are *Acer rubrum* var. *drummondii*, *Liquidambar styraciflua*, *Quercus nigra*, *Salix caroliniana*, and *Salix nigra*. Herbaceous layer includes various wetland grasses, sedges, and forbs; *Carex glaucescens* (20% cover) can be particularly common ..... **CEGL007412: *Triadica sebifera* Ruderal Wet Forest [MC307]**

2b *Triadica sebifera* (<70% cover) is not the sole canopy dominant; *Acer rubrum* and *Liquidambar styraciflua* have 30-70% combined cover … Swamp woodland with seasonal to permanent flooding. Saturated soils range from sandy clay to clay. Canopy dominants have 30-70% combined cover and include *Acer rubrum* and *Liquidambar styraciflua*. Invasion of the

noxious non-native *Triadica sebifera* (<70% cover) is common. Shrub stratum has 10-40% overall cover with *Morella cerifera* as the most abundant species. Herbaceous layer is vigorous and has 50-90% overall cover; common species are *Hydrocotyle bonariensis*, *Juncus effusus*, *Polygonum hydropiperoides*, and *Saccharum giganteum* ..... **NPSBITH008: *Acer rubrum* - (*Triadica sebifera*) / *Morella cerifera* Swamp Woodland [MC327]**

3a *Betula nigra* (30-60% cover) is the most abundant canopy species … Riverine forest that experiences seasonal flooding is commonly found on the lower Neches River with silty clay loam soils. Canopy is highly variable and diverse with *Betula nigra* (30-60% cover) as the most abundant canopy species. Common canopy associates include *Liquidambar styraciflua*, *Acer rubrum*, *Salix nigra*, *Platanus occidentalis*, and *Triadica sebifera* (<20% cover). Young *Pinus* spp. may present within this community. Herbaceous stratum is typically sparse (<20% cover) but common species are *Carex* spp., *Panicum virgatum*, *Panicum rigidulum*, and *Zizaniopsis miliacea* ..... . **NPSBITH002: *Betula nigra* Mixed Hardwood Riverine Forest [MC306]**

3b *Salix nigra* (30-80% cover) is the most abundant canopy species; *Betula nigra* is uncommon/absent in the canopy ..... 4a

4a *Salix nigra* (80% cover) is the sole canopy dominant....Riparian floodplain on sandbars of large rivers such as the Neches River where regeneration relies on flooding regimes being maintained. Canopy characterized by the sole dominant canopy species *Salix nigra* (80% cover). Possible canopy associates include *Betula nigra*, *Platanus occidentalis*, and *Populus deltoids*. Common vines include *Brunnichia ovata*, *Nekemias arborea*, and *Vitis rotundifolia* .... **CEGL007410: *Salix nigra* – (*Platanus occidentalis*, *Populus deltoids*) Southern Floodplain Forest [MC306]**

*4b* *Salix nigra* (30-60% cover) is the most abundant canopy species … Early successional swamp forest typically occurring along the shores of lakes and ponds. *Salix nigra* (30-60% cover) is the most abundant canopy species. Common associates include *Acer negundo*, *Acer rubrum*, *Carya aquatica*, *Fraxinus pennsylvanica*, *Liquidambar styraciflua*, *Planera aquatica*, *Taxodium distichum,* and *Triadica sebifera*. Shrub layer tends to be sparse with *Cephalanthus occidentalis* and occasionally *Amorpha fruticosa*. Common vines are *Ampelopsis arborea*, *Brunnichia ovata*, *Campsis radicans*, and *Nekemias arborea*. *Saururus cernuus* is the most common herbaceous species..... . **CEGL004773: *Salix nigra* / (*Cephalanthus occidentalis*) Swamp Forest [MC306]**

<u>Section 10: Taxodium distichum – Nyssa spp. Floodplain Forest</u>

1a *Zizaniopsis miliacea* is a dominant herbaceous grass; woodland with 10-40% tree cover ..... 2a

1b *Zizaniopsis miliacea* is an uncommon/absent herbaceous grass; forest with >40% tree cover.. 3a

2a *Morella cerifera* (10-20% cover) is common in the shrub layer … Woodland community with 10-25% canopy cover. Palustrine semipermanently flooded woodland occurs adjacent to estuarine and riverine habitats. Canopy dominants include *Taxodium distichum* (20% cover),

*Acer rubrum*, and *Nyssa aquatica*. Shrubs such as *Morella cerifera* (10-20% cover), *Baccharis halimifolia*, *Forestiera acuminata*, *Cephalanthus occidentalis*, and *Ilex cassine* are common. Characteristic herbaceous species are *Zizaniopsis miliacea* (30-60% cover), *Eleocharis spp*., *Pontederia cordata*, *Sagittaria lancifolia*, *Sagittaria latifolia*, and *Typha domingensis*. *Tillandsia usneoides* is a common epiphyte. Non-native noxious species such as *Alternanthera philoxeroides*, *Eichhornia crassipes*, *Salvinia minima*, *Salvinia molesta*, and *Triadica sebifera* commonly invade ..... ...**CEGL007065 *Taxodium distichum* / *Morella cerifera* / *Thelypteris palustris* Tidal Woodland [MC324]**

2b *Morella cerifera* is uncommon/absent in the shrub layer … Inundated forest with canopy of *Nyssa aquatica* (20% cover) and *Taxodium* distichum (30-50% cover). Subcanopy is composed of *Acer rubrum* and *Triadica sebifera.* A dense herbaceous layer composed nearly exclusively of *Zizaniopsis miliacea* (>70% cover) and *Ludwigia leptocarpa* (10% cover) is common ..... **NPSBITH013 *Nyssa aquatic* – (*Taxodium distichum*) / *Zizaniopsis miliacea* Marsh Woodland [MC310]**

3a *Taxodium distichum* (<25% cover) is uncommon in the canopy ..... 4a

3b *Taxodium distichum* (>25% cover) is abundant in the canopy..... 7a

4a *Fraxinus caroliniana* (30-80% cover) forms nearly monospecific dense stands Swamp found on topographic depressions of flatwoods where standing water persists for long periods. *Fraxinus caroliniana* with 30-80% cover forms dense nearly monospecific stands. *Fraxinus caroliniana* has shrub like characters with a lower stature, multi-stemmed, and small diameter. Species diversity is low. Shrub and tree saplings are sparse with <10% cover and can include *Morella cerifera*, *Taxodium distichum*, *Cyrilla racemiflora*, and *Triadica sebifera*. Herbaceous stratum can range from 15-70% cover; common species are *Phanopyrum gymnocarpon* (40% cover), *Polygonum hydropiperoides* (20% cover), and *Rhynchospora corniculata*..... **CEGL004753: *Fraxinus caroliniana* Swamp Forest [MC309]**

4b *Fraxinus caroliniana* is uncommon/absent in the subcanopy ..... 5a

5a *Nyssa biflora* and *Acer rubrum* dominate the canopy … *Nyssa biflora* and *Acer rubrum* codominate the canopy with cover <50%. *Triadica sebifera* may occur in the canopy as well. The shrub stratum is sparse to moderate with *Cephalanthus occidentalis* and *Morella cerifera*. Herbaceous stratum is dense with *Saccharum giganteum* and *Juncus effusus* with cover >60%.. **NPSBITH025: *Nyssa biflora – Acer rubrum* – (*Triadica sebifera*) / *Morella cerifera* / *Saccharum giganteum* Swamp Woodland [MC328]**

5b *Nyssa aquatica* dominates the canopy; community typically contains standing water..... 6a

6a *Nyssa aquatica* can occur in pure stands; *Gleditsia aquatica* and *Liquidambar styraciflua* are associated canopy species; *Cephalanthus occidentalis* is a common shrub; *Carpinus caroliniana*, *Fraxinus pennsylvanica*, *Populus heterophylla*, and *Salix nigra* are uncommon/absent canopy species … Semipermanently flooded swamp forest along riparian

zones with permanently saturated soils. Typically inundated for >6 months a year; occurs on low, wet flats and sloughs, swales and back swamps. *Nyssa aquatica* (20-70%) is the most dominant canopy species and can occur in dense pure stands. Canopy associates such as *Acer rubrum*, *Gleditsia aquatica*, *Ilex opaca*, *Liquidambar styraciflua*, *Nyssa* aquatica, *Nyssa biflora*, *Planera aquatica*, and *Taxodium distichum* can occur. Shrub layer (<30% cover) with *Cephalanthus occidentalis*, and *Cyrilla racemiflora.* Herbaceous layer is typically sparse, occasionally *Utricularia radiata* is dominant ..... ...**CEGL002419 *Nyssa aquatica* Swamp Forest [MC311]**

6b *Nyssa aquatica* occurs in association with other species; *Gleditsia aquatica* and *Liquidambar styraciflua* are uncommon/absent canopy species; *Cephalanthus occidentalis* is absent; *Nyssa biflora, Acer rubrum*, *Carpinus caroliniana*, *Fraxinus pennsylvanica*, *Populus heterophylla*, *Salix nigra*, and *Quercus* spp. are common canopy species ... Community borders alluvial swamps and flats near uplands. Flooding persists throughout the growing season. *Nyssa aquatica* and *Nyssa biflora* are the most abundant species in the canopy. Associated tree species are *Carpinus caroliniana*, *Fraxinus pennsylvanica*, *Planera aquatica*, *Salix nigra*, and *Taxodium distichum* (<25% cover). Common shrubs are *Cyrilla racemiflora* and *Leucothoe racemosa*. *Saururus cernuus* is a common herbaceous species. Vines (<10% cover) such as *Ampelopsis arborea*, *Bignonia capreolata*, *Decumaria barbara*, and *Toxicodendron radicans* can occur. Herbaceous species such as *Sparganium americanum* and *Xyris* spp. are common ..... **CEGL007429 *Nyssa aquatica – Nyssa biflora* Swamp Forest [MC311]**

7a *Taxodium distichum* (40-80% cover) is the sole dominant canopy species; *Nyssa* spp. is absent in the canopy … Forest occurs along banks of rivers typically in deep standing water. Seasonal flooding takes place in spring and winter. *Taxodium distichum* is the sole dominant canopy species. Associated canopy species have a <5% combined cover; *Acer rubrum* var. *drummondii*, *Liquidambar styraciflua*, and *Nyssa aquatica.* A sparse subcanopy with <30% cover; *Acer floridanum*, *Carpinus* caroliniana, *Fraxinus caroliniana*, and *Planera aquatica*. Shrub and herb layer is depauperate. *Cephalanthus occidentalis* may occur in the shrub layer. Shallow emergents and floating aquatics like *Azolla microphylla*, *Hydrocotyle ranunculoides*, *Lemna minor*, *Nuphar advena*, and *Nymphaea spp.* are common. *Brunnichia ovata* is a common vine. Submerged hydrophytes such as *Ceratophyllum demersum*, *Egeria densa*, and *Potamogeton nodosus* grow in areas with permanent water zones ..... ...**CEGL002420 *Taxodium distichum* / *Lemna minor* Floodplain Forest [MC312]**

7b Other species occur within the canopy along with *Taxodium distichum* ..... 8a

8a *Taxodium distichum* and *Platanus occidentalis* codominate the canopy … The canopy is dominated by a combination of *Taxodium distichum* and *Platanus occidentalis*. These species are usually codominant with cover reaching up to ~40%. The understory is typically dominated by *Acer negundo* and *Ulmus americana*. Herbaceous stratum is typically sparse to absent, and *Vitus rotundifolia* usually occurs climbing on the trees with cover reaching ~10% **CEGL002104: *Taxodium distichum – Platanus occidentalis* Edwards Plateau Floodplain Forest [MC311]**

8b *Taxodium distichum* codominates with *Nyssa aquatica* and/or *Nyssa biflora*..... 9a

9a *Acer rubrum* is a codominant canopy species; *Planera aquatica* is absent in the subcanopy; flooding occurs seasonally and is not permanent … Seasonally flooded swamps with a closed canopy of (60-) 80-90 (-100) % cover. Canopy dominates include *Taxodium distichum* (~50% cover), *Nyssa aquatica* (~50% cover), *Acer floridanum*, *Acer rubrum*, and *Ulmus americana*. Associated canopy species are *Fraxinus caroliniana*, *Fraxinus pennsylvanica, Liquidambar styraciflua*, *Nyssa biflora*, *Quercus laurifolia*, *Quercus lyrata*, *Quercus phellos*, *Ulmus alata*, and *Ulmus rubra*. A sparse to patchy shrub layer may include *Clethra alnifolia, Cyrilla racemiflora, Ilex vomitoria*, and *Itea virginica*. Herbaceous species such as *Carex leptalea*, *Saururus cernuus*, *Triadenum walteri*, *Woodwardia areolata*, and possibly *Boehmeria cylindrica*, *Sagittaria latifolia*, and *Smilax* spp ..... . **CEGL007422: *Taxodium distichum – Nyssa aquatica – Acer rubrum* / *Itea virginica* Floodplain Forest [MC311]**

9b *Planera aquatica* (<20% cover) is common in the subcanopy; *Acer rubrum* is an uncommon canopy species; permanent flooding persists throughout the growing season … Floodplain forest is linear in shape on back sloughs, abandoned tributaries, and floodplain depressions. Shallow standing water occurs all or most of the year. The most abundant canopy species are *Taxodium distichum* (30% cover) and *Nyssa aquatica* (30-40% cover). Associate canopy species include *Carya aquatica* (20% cover), *Carpinus caroliniana* (40% cover), and occasionally *Quercus lyrata*. A sparse subcanopy can persist with *Planera aquatica* (<20% cover). Shrub layer primarily consists of *Cephalanthus occidentalis, Forestiera acuminata*, and *Itea virginica*. Herbaceous layer is sparse and restricted to rotting logs, buttresses of trees, and small mounds that typically remain dry. Possible herbaceous species include *Carex intumescens*, *Commelina virginica*, *Polygonum punctatum*, and *Saururus cernuus*..... **CEGL002421: *Taxodium distichum* – (*Nyssa aquatica*) / *Forestiera acuminata – Planera aquatica* Floodplain Forest [MC311]**

Section 11: Magnolia virginiana Evergreen Bog / Baygall

1a *Ilex coriacea* (>50% cover) is the dominant shrub species; *Magnolia virginiana* is uncommon with <10% cover; *Cyrilla racemiflora* is absent in the shrub layer dominant shrub species; *Magnolia virginiana* (<10% cover) is uncommon … Evergreen shrub thicket that can grade into a woodland with scattered emergent small tress. Trees which may occur are *Acer rubrum*, *Magnolia virginiana*, and *Nyssa biflora*. The tall shrub stratum is dense with *Ilex coriacea* (70-90% cover), *Alnus serrulata*, *Aronia arbutifolia* (*Photinia pyrifolia*) *Callicarpa americana*, *Clethra alnifolia*, *Lyonia lucida*, *Morella caroliniensis*, *Morella cerifera*, *Persea palustris, Rhododendron oblongifolium*, *Toxicodendron vernix, Vaccinium fuscatum,* and *Viburnum nudum var. nudum*. *Smilax laurifolia* is abundant as a vine. Herbaceous stratum is sparse to dense with an abundance of pteridophytes such as *Onoclea sensibilis*, *Osmunda cinnamomea*, *Osmunda regalis* var. *spectabilis*, *Woodwardia areolata*, and *Woodwardia virginica*. *Sphagnum* spp. grows readily as a ground cover in areas of saturated soils ..... **CEGL003530: (*Magnolia virginiana*) / *Ilex coriacea - Morella caroliniensis* Seepage Bog [MC304]**

1b *Ilex coriacea* (<50% cover) is an uncommon shrub species; *Magnolia virginiana* is common in the canopy and/or *Nyssa biflora* with (10-) 20-40% cover; *Cyrilla racemiflora* is common/abundant in the shrub layer ..... 2a

2a *Morella cerifera* (30-40% cover) is dominant in the shrub layer … A seepage baygall forest community. Found at headwaters and margins of flat creek bottoms with saturated, nutrient poor, and sandy soil. Canopy dominants are *Magnolia virginiana* (30-40% cover), *Nyssa aquatica* (30-60% cover), *Nyssa sylvatica*, *Acer rubrum*, and *Liquidambar styraciflua*; associates are *Pinus taeda* (<10% cover), *Nyssa biflora*, and *Ilex opaca*. A thick shrub stratum composed primarily of *Morella cerifera* (30-40% cover), *Morella caroliniensis*, *Cyrilla racemiflora* (30-60% cover), with associated *Alnus serrulata, Ilex coriacea*, *Itea virginica*, *Sambucus canadensis*, and *Vaccinium fuscatum*. Vines such as *Toxicodendron radicans* and *Vitis rotundifolia* are common. Herbaceous stratum can be sparse to dense and contains an abundance of pteridophytes such as *Onoclea sensibilis*, *Osmunda cinnamomea*, *Osmunda regalis* var. *spectabilis*, *Woodwardia areolata*, and *Woodwardia virginica*. Other herbs such as *Carex leptalea* (10% cover), *Eleocharis tortilis*, *Isotria verticillata*, *Saururus cernuus*, *Solidago patula*, and *Triadenum walteri* may also be present. *Sphagnum* spp. grows readily as a ground cover..... . **CEGL007904: *Magnolia virginiana - Nyssa sylvatica - Acer rubrum* / *Morella caroliniensis* / *Woodwardia areolate* Swamp Forest [MC304]**

2b *Morella cerifera* is uncommon/absent in the shrub layer … A mixed evergreen/deciduous baygall forest with saturated soils for much of the year. Canopy dominants include *Magnolia virginiana*, *Nyssa biflora*, *Nyssa sylvatica*, and *Quercus laurifolia.* Other possible canopy associates are *Acer rubrum*, *Acer barbatum*, *Ilex opaca* var. *opaca*, *Magnolia grandiflora*, *Pinus taeda*, and *Taxodium distichum*. Shrub layer is dense with *Alnus serrulata*, *Cyrilla racemiflora*, *Ilex coriacea*, and *Clethra alnifolia*. Common woody vines are *Decumaria barbara* and *Smilax laurifolia*. Herb stratum is typically abundant with the ferns *Onoclea sensibilis*, *Osmunda cinnamomea*, *Osmunda regalis* var. *spectabilis*, *Woodwardia areolata*, and *Woodwardia virginica*; other possible herbs include *Carex* spp., *Chasmanthium laxum*, *Eleocharis microcarpa*, *Eleocharis tortilis*, *Leersia virginica*, *Platanthera ciliaris*, *Platanthera clavellata*, *Platanthera cristata*, and *Saururus cernuus*. Common non-native invasive species are *Lonicera japonica* and *Ligustrum sinense*..... . **CEGL007474: *Nyssa biflora - Magnolia virginiana - Quercus laurifolia* / *Cyrilla racemiflora - Rhododendron oblongifolium* Swamp Forest [MC304]**

### *Division B – Shrub Associations*

Shrublands are generally characterized as areas where trees have <10% cover and shrubs have >10% cover. Shrublands may occur as dense thickets in valleys or a sparse shrub stratum occurring in a grassland. The minimum mapping unit for communities is ½ hectare; however due to the patchy nature of shrublands, several clusters of shrubs can equal a minimum mapping unit as long as each patch of shrubs are <30m from each other. Shrubs are typically multi-stemmed plants <5m in height.

Species that are always considered shrubs are Morella cerifera, Baccharis halimifolia, Ilex coriacea, and Ilex vomitoria. Some species may be considered a tree or shrub such as Ilex opaca or Pinus taeda. Generally, height is used to determine whether or not these species are shrubs (<5m) or trees (>5m).

1a Mesic slopes to upland community; lacks standing water..... 2a

1b Wetland community; persistent standing water..... 7a

2a Morella cerifera dominates the community…..... 3a

2b Morella cerifera forms only a minor component of the community ..... 4a

3a Area contains an abundance of graminoids such as *Phalaris angusta*, *Andropogon glomeratus*, and/or *Muhlenbergia expansa* … This wet meadow shrubland is dominated by *Ilex vomitoria* and *Morella cerifera* with cover ~20%. Young *Pinus palustris* seedling have been planted around the community. The herbaceous stratum is abundant and dominated by graminoids. Common species include *Phalaris angusta*, *Andropogon glomeratus*, *Muhlenbergia expansa*, *Sporobolus clandestinus*, and *Helenium drummondii* ..... . **NPSBITH022: Morella cerifera – Ilex vomitoria Wet Meadow Shrubland [MC205]**

3b Area lacks a dense herbaceous stratum; shrubs form a dense shrub stratum … Morella cerifera forms a dense shrub layer with cover typically >60%. Other common shrubs include Ilex coriacea and Baccharis halimifolia. There are sparse trees scattered throughout the shrubland with cover <10% and include Nyssa biflora and Magnolia virginiana. The herbaceous stratum is often sparse with Rubus argutus as the most dominant species..... . **NPSBITH023: Morella cerifera – Ilex coriacea – Baccharis halimifolia Wet Scrub Shrubland [MC206]**

4a Community is characterized by young regenerating *Pinus* taeda … Regenerating shrubland plantation of *Pinus taeda*. Shrub layer dominants include *Pinus taeda* (>70% cover) and *Ilex vomitoria* (20% cover)..... . **NPSBITH017: *Pinus* taeda Regenerating Plantation Shrubland [MC301]**

4b Community lacks distinct rows of planted *Pinus taeda* ..... 5a

5a *Quercus hemisphaerica* (30-50% cover) is the dominant shrub species … Upland with sandy soils. *Quercus hemisphaerica* (30-50% cover) is the most abundant shrub species with *Ilex vomitoria* (30% cover), *Vaccinium arboreum* (30% cover), and *Vaccinium stamineum*. Scattered trees can include *Pinus taeda* (10% cover) and *Quercus hemisphaerica* (10% cover). Vines such as *Bignonia capreolata*, *Gelsemium sempervirens*, and *Vitis rotundifolia* are common. The herbaceous layer is sparse but can include a number of species such as *Dichanthelium* spp. and *Euthamia leptocephala*..... .. **NPSBITH001 *Quercus hemisphaerica* Shrubland [MC202]**

5b *Quercus hemisphaerica* is an uncommon/absent shrub species..... 6a

6a *Ilex vomitoria* (75-90% cover) is nearly monospecific in the shrub layer … Shrubland occurring across a variety of topographic positions. Shrub layer is nearly monospecific with an abundance of *Ilex vomitoria* (75-90% cover). Other common shrubs include *Callicarpa americana*, and *Quercus* spp.. *Pinus taeda* seedlings (<2m in height) can be prevalent in the shrub layer. Herbaceous layer is absent due to the abundance of *Ilex vomitoria*..... ..... **NPSBITH010: *Ilex vomitoria* Shrubland [MC204]**

6b *Ilex coriacea* (50-80% cover) is the dominant shrub speciesThis community typically occurs on small rises above within or adjacent to the floodplain. This tall shrubland community is on the verge of becoming a forest with shrubs often reaching ~5m in height. Shrub stratum dominant is *Ilex coriacea* (50-80% cover). Canopy species can include *Acer floridanum* (20% cover), *Nyssa biflora* (10% cover), *Liquidambar styraciflua*, *Pinus taeda* (<10% cover), and *Juniperus virginiana*. Herbaceous species such as *Callicarpa americana* and *Mitchella repens* are common..... . **NPSBITH015: *Ilex coriacea – Prunus caroliniana* Dense Evergreen Forest and Shrubland [MC325]**

7a *Sesbania drummondii* is the most abundant shrub species … This shrubland community often dominated by Sesbania drummondii and/or Morella cerifera with cover ranging from 20% to 70%. Other common shrubs may include Triadica sebifera, Forestiera acuminata, and Cephalanthus occidentalis. The herbaceous stratum is vigorous and strongly dominated by Juncus effusus with cover reaching up to 80%. Other common graminoids include Schoenoplectus tabernaemontani, Andropogon glomeratus, and Saccharum giganteum. ..... **NPSBITH004 *Sesbania drummondii* – (*Morella cerifera*) / *Juncus effusus* Ruderal Wet Shrubland [MC201]**

7b *Sesbania drummondii* is uncommon/absent in the shrub layer ..... 8a

8a *Fraxinus caroliniana* (30-80% cover) forms nearly monospecific dense standsSwamp found on topographic depressions of flatwoods where standing water persists for long periods. *Fraxinus caroliniana* with 30-80% cover forms dense nearly monospecific stands. *Fraxinus caroliniana* has shrub like characters with a lower stature, multi-stemmed, and small diameter. Species diversity is low. Shrub and tree saplings are sparse with <10% cover and can include *Morella cerifera*, *Taxodium distichum*, *Cyrilla racemiflora*, and *Triadica sebifera*. Herbaceous stratum can range from 15-70% cover; common species are *Phanopyrum gymnocarpon* (40% cover), *Polygonum hydropiperoides* (20% cover), and *Rhynchospora corniculata*..... . **CEGL004753: *Fraxinus caroliniana* Swamp Forest [MC309]**

8b *Fraxinus caroliniana* is uncommon/absent from the shrub layer..... 9a

9a *Ilex coriacea* (70-90% cover) or *Cyrilla racemiflora* (50-70% cover) are the most abundant shrub species; *Magnolia virginiana* (<15% cover) is typically present ..... 10a

9b *Forestiera acuminata* or *Cephalanthus occidentalis* are the most abundant shrub species*; Ilex coriacea* and *Cyrilla racemiflora* are uncommon/absent from the shrub layer; *Magnolia virginiana* is absent in the canopy ..... 11a

10a *Cyrilla racemiflora* is uncommon/absent in the shrub layer; *Ilex coriacea* (>50% cover) is the dominant shrub species; *Magnolia virginiana* (<10% cover) is uncommon … Evergreen shrub thicket that can grade into a woodland with scattered emergent small tress. Trees which may occur are *Acer rubrum*, *Magnolia virginiana*, and *Nyssa biflora*. The tall shrub stratum is dense with *Ilex coriacea* (70-90% cover), *Alnus serrulata*, *Aronia arbutifolia* (*Photinia pyrifolia*) *Callicarpa americana*, *Clethra alnifolia*, *Lyonia lucida*, *Morella caroliniensis*, *Morella cerifera*, *Persea palustris, Rhododendron oblongifolium*, *Toxicodendron vernix, Vaccinium fuscatum,* and *Viburnum nudum var. nudum*. *Smilax laurifolia* is abundant as a vine. Herbaceous stratum is sparse to dense with an abundance of pteridophytes such as *Onoclea sensibilis*, *Osmunda cinnamomea*, *Osmunda regalis* var. *spectabilis*, *Woodwardia areolata*, and *Woodwardia virginica*. *Sphagnum* spp. grows readily as a ground cover in areas of saturated soils ..... . **CEGL003530: (*Magnolia virginiana*) / *Ilex coriacea – Morella caroliniensis* Seepage Bog [MC304]**

10b *Cyrilla racemiflora* (50-70% cover) is the dominant shrub species Shrubland dominants include *Cyrilla racemiflora* (50-70% cover), *Ilex coriacea* (10% cover), and *Persea palustris*. Herbaceous layer may contain *Andropogon* spp. (10% cover), *Carex debilis* (10% cover), *Dichanthelium* spp., and *Xyris ambigua* (10% cover). Canopy is sparse and can occur along the community edge with *Magnolia virginiana* (10% cover) and *Pinus taeda*..... **NPSBITH018: *Cyrilla racemiflora* Seepage Bog Shrubland [MC304]**

11a *Forestiera acuminata* (30-60% cover) is the most abundant shrub species … Swamp shrubland with seasonal flooding for most of the growing season. Shrub layer dominants include *Forestiera acuminata* (30-60% cover), *Cephalanthus occidentalis* (10% cover), and *Planera aquatica*. Herbaceous layer is sparse/absent due to extended flooding events; *Saururus cernuus* may be present. Canopy is sparse to scattered typically with *Pinus taeda* (<20% cover). ..... **CEGL003911: *Forestiera acuminata* - (*Planera aquatica*, *Cephalanthus occidentalis*) Floodplain Scrub [MC203]**

11b *Cephalanthus occidentalis* (60-90% cover) is the most abundant shrub species … Swamp shrubland occurs in shallow water depressions and backwater sloughs of stream and river floodplains. Inundation is semi-permanent to permanent depending on drought conditions. The canopy is sparse to absent with scattered *Taxodium distichum* (<10% cover) and *Triadica sebifera* (<10% cover). Shrub layer abundance is nearly monospecific with *Cephalanthus occidentalis* (60-90% cover). Associated shrubs may include *Salix* spp., and *Cornus amomum*. Herbaceous layer is sparse with common occurrences of *Carex stipata*, *Carex stricta*, *Carex lurida*, and *Carex intumescens*. Emergent and floating aquatics such as *Salvinia minima* (60% cover) and *Alternanthera philoxeroides* (20% cover) are common ..... **CEGL002191: *Cephalanthus occidentalis* / *Carex* spp. - *Lemna* spp. Southern Shrub Swamp [MC203]**

### *Division C – Herbaceous Associations*

Herbaceous associations are dominated by forbs and grasses or grass-like species. They may contain shrubs, and occasional trees at low cover levels. Typically, shrub or tree species present in a grassland will be widely scattered and have low cover values of less than 10 - 15%.

Herbaceous communities within the area of the Park may be either riparian and wetland types, or upland types that occur away from areas of wet soils. Many of the herbaceous types exhibit a large amount of overlap in their species composition and can be difficult to classify in the field. This is particularly true of the wetland and riverine types that tend to form a mosaic of two to four species that range from complete monocultures to equally co-dominant across short distances the size of the MMU or smaller. Issues of scale and pattern become very important considerations in discerning the most appropriate type to select.

1a Floodplain terraces to uplands; does not occur in wetlands ..... 2a

1b Wetland community; standing water is typically at or above the soil surface ..... 4a

2a Ruderal community with an abundance of exotic or weedy species such as *Digitaria ciliaris*, *Echinochloa walteri*, *Polygonum hydropiperoides*, and *Paspalum notatum …* This community contains a variety of exotic or weedy species such as *Digitaria ciliaris*, *Paspalum notatum*, *Paspalum laeve*, *Paspalum urvillei*, *Polygonum hydropiperoides*, *Echinochloa walteri*, *Eleusine indica*, and *Diodia virginiana*. A sparse shrub layer can occur where *Prunus umbellata* is common.....**CEGL004700 *Paspalum notatum* Ruderal Grassland [MC101]**

2b Native grassland with a diverse range of native species such as *Schizachyrium scoparium*, *Sorghastrum elliottii*, *Andropogon ternarius*, and *Panicum virgatum* ..... 3a

3a Upland grassland; *Sorghastrum elliottii* (20% cover), *Andropogon ternarius*, and *Schizachyrium scoparium* are common herbaceous species … Upland grassland occurring in isolated patches amongst pine/pine-hardwood forests. The herbaceous stratum can be diverse and variable. Common grasses include *Sorghastrum elliottii* (20% cover), *Andropogon ternarius*, *Schizachyrium scoparium*, *Panicum virgatum*, *Andropogon virginicus*, *Andropogon glomeratus*, *Bouteloua hirsuta*. Additional possible forbs are *Euphorbia bicolor*, *Heliotropium tenellum*, *Solidago altissima*, *Symphyotrichum drummondii*, *Dalea compacta*, *Rudbeckia hirta*, *Agalinis heterophylla*, *Carex cherokeensis*, *Liatris mucronata*, *Penstemon cobaea*, and *Allium stellatum*. Shrub layer is sparse with occasional occurrences of *Ilex vomitoria* (10% cover)..... **CEGL007930: *Schizachyrium scoparium - Rudbeckia missouriensis - Grindelia lanceolata - (Liatris mucronata)* Grassland [MC108]**

3b Riverscour sandbar*; Panicum virgatum* is a dominant herbaceous species … Riverscour sandbars of blackwater rivers. Dominant herbaceous species include *Panicum virgatum*, *Panicum rigidulum* var. *elongatum*, and *Polygonum hydropiperoides*. Additional herbaceous species include *Diodia teres Eupatorium serotinum*, *Paspalum urvillei*, *Pluchea camphorata*, *Rubus trivialis*, and *Solidago canadensis*. Common vine species are *Campsis radicans*, *Mikania scandens*, and *Smilax rotundifolia*. Scattered trees can include *Salix nigra* and *Betula nigra* ..... ...**CEGL004921 *Panicum virgatum-Panicum rigidulum-Polygonum hydropiperoides* Wet Meadow [MC104]**

4a Vegetation is typically >1m tall..... 5a

4b Vegetation is typically <1m tall..... 8a

5a *Typha latifolia* forms essentially monospecific stands … Semi-natural type common in artificial wetlands where the water table is above the soil surface for most of the growing season. *Typha latifolia* forms essentially monospecific stands. Along the margins herbs such as *Carex* spp., *Juncus effusus*, *Schoenoplectus* spp., and *Scirpus cyperinus* are common..... ..... **CEGL004150 *Typha latifolia* Southern Ruderal Marsh [MC103]**

5b *Zizaniopsis miliacea* and/or *Schoenoplectus tabernaemontani* are the most abundant herbaceous species; *Typha latifolia* is absent from the herbaceous layer..... 6a

6a *Zizaniopsis miliacea* is the sole dominant herbaceous species … Tidal marsh where *Zizaniopsis miliacea* is the sole dominant herbaceous species. Associated herbaceous species can include *Alternanthera philoxeroides*, *Peltandra virginica*, *Pontederia cordata*, *Salvinia* spp., and *Zizania aquatica* ..... **CEGL004705 *Zizaniopsis miliacea* Tidal Marsh [MC105]**

6b *Zizaniopsis miliacea*, *Panicum hemitomon*, and/or *Schoenoplectus tabernaemontani* are the dominant herbaceous species..... 7a

7a *Schoenoplectus tabernaemontani* (75-90% cover) is the most abundant herbaceous species … Brackish marsh permanently flooded with .5-1m of water. *Schoenoplectus tabernaemontani* (75-90% cover) typically forms dense stands within a larger *Zizaniopsis miliacea* marsh. Occasionally, *Ludwigia leptochloa* forms dense patches with *Zizaniopsis miliacea* (<10% cover)..... **NPSBITH011: *Schoenoplectus tabernaemontani* Brackish Marsh [MC103]**

7b *Zizaniopsis miliacea* and *Panicum hemitomon* are codominant … Tidal marsh herbaceous community where *Zizaniopsis miliacea* and *Panicum hemitomon* are codominant. Common associated herbs are *Cyperus* spp., *Ludwigia leptocarpa*, and dense patches of *Schoenoplectus tabernaemontani*. Shrub layer can be patchy with thick stands of *Morella cerifera*..... ..... **CEGL007895 *Zizaniopsis miliacea – Panicum hemitomon* Tidal Marsh [MC105]**

8a Emergent and floating aquatics such as *Alternanthera philoxeroides*, *Nuphar advena*, and/or *Nymphaea odorata* are the dominant herbaceous species ..... 9a

8b *Panicum virgatum*, *Polygonum hydropiperoides*, *Juncus effusus*, *Sparganium androcladum*, and/or *Xyris fimbriata* marsh are the dominant herbaceous species..... 10a

9a *Alternanthera philoxeroides* is the most abundant herbaceous species … These floating vegetation communities occur in deep water slow water habitats and along the edges of bayous. Vegetation is usually dominated by a combination of weedy invasive species such as Alternanthera philoxeroides, Eichhornia crassipes, and/or Salvinia minima. Cover often reaches up to 100%; however, in old bayous or backwaters where vegetation occurs along edges of the water cover may only reach up to ~30%. Zizaniopsis miliacea may occur along edge of this community with cover <10%..... ...**CEGL003858 *Alternanthera philoxeroides* Ruderal Aquatic Vegetation [MC107]**

9b *Nuphar advena* and *Nymphaea odorata* are the most abundant herbaceous species … Open water with an abundance of lily pads such as *Nuphar advena* and/or *Nymphaea odorata*. Shrubs grow on exposed raised ground and at the water's edge; common species are *Cyrilla racemiflora*, *Morella cerifera*, and *Triadica sebifera* ..... ...**CEGL002386 *Nuphar advena-Nymphaea odorata* Aquatic Vegetation [MC107]**

10a *Juncus effusus* is the most dominant herbaceous species … Freshwater flooded marsh that can occur in natural or artificial ponds, wet ditches, and disturbed wet fields. The community is characterized by the dominance of *Juncus effusus* and tends to have low species diversity. Associated herbaceous species (<10% cover) include *Andropogon glomeratus*, *Apios americana*, *Cyperus* spp., *Galium aparine*, *Typha latifolia*, *Scirpus cyperinus*, and *Triadenum walteri*.....**NPSBITH005: *Juncus effusus* Marsh [MC102]**

10b *Panicum virgatum*, *Sparganium androcladum*, or *Xyris fimbriata* are the most dominant herbaceous species..... 11a

11a *Panicum virgatum* is a dominant herbaceous species … Riverscour sandbars of blackwater rivers. Dominant herbaceous species include *Panicum virgatum*, *Panicum rigidulum* var. *elongatum*, and *Polygonum hydropiperoides*. Additional herbaceous species include *Diodia teres*, *Eupatorium serotinum*, *Paspalum urvillei*, *Pluchea camphorata*, *Rubus trivialis*, and *Solidago canadensis*. Common vine species are *Campsis radicans*, *Mikania scandens*, and *Smilax rotundifolia*. Scattered trees can include *Betula nigra* and *Salix nigra*..... **CEGL004921: *Panicum virgatum-Panicum rigidulum-Polygonum hydropiperoides* Wet Meadow [MC104]**

11b *Panicum virgatum* is uncommon/absent in the herbaceous layer..... 12a

12a *Sparganium androcladum* (80% cover) is the most dominant herbaceous species … *Sparganium androcladum* and/or *Sparganium americanum* (80% cover) is the most dominant herbaceous species. The herb layer can also include *Hygrophila lacustris*, *Scirpus cyperinus* (20% cover), and *Typha* spp. The canopy (<5% cover) is sparse to absent and can include *Nyssa aquatica* and *Taxodium distichum* ..... **NPSBITH003: *Sparganium androcladum* – Sparganium americanum Marsh [MC106]**

12b *Phanopyrum gymnocarpon* (40% cover) is the most dominant herbaceous species … This herbaceous community consists of *Phanopyrum gymnocarpon* (40% cover), Sparganium americanum (30% cover), and *Xyris difformis* (20% cover). The shrub layer is sparse with occasional occurrences of *Clethra alnifolia* (<10% cover)..... .**NPSBITH014: *Xyris fimbriata* Upland Marsh [MC106]**

### *Division D – Sparse Associations*

Sparse associations generally have <10% vegetated cover and tend to occur on rock outcrops, beaches, or sandbars.

1a Cliff lacking vegetation ..... **NPSBITH021: Sparse Cliff Vegetation [MC402]**

1b Alluvial depositional sand bar, mud flat, and/or cobble bar..... 2a

2a Alluvial sand bar … This sparse community is found on riverine sand bars. Herbaceous vegetation is often sparse and variable depending on time of year..... ..... **NPSBITH019: Riverine Sand Flats – Bars Sparse Vegetation [MC401]**

2b Alluvial mud flat and/or cobble bar …This sparse community is found alluvial bars along the rivers and streams. The herbaceous stratum is sparse and variable depending on the time of year .....N**PSBITH020: Alluvial Park Special: Bare Alluvial Depositional Bar [MC401}**

# Appendix C: List of Plant Species Documented During Plot Sampling at Big Thicket National Preserve

**Table C1.** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Acalypha virginica* | ACVI |
| *Acer barbatum* | ACBA2 |
| *Acer floridanum* | ACFL |
| *Acer negundo* | ACNE2 |
| *Acer rubrum* | ACRU |
| *Acer rubrum* var. *drummondii* | ACRUD |
| *Acer rubrum* var. *rubrum* | ACRUR |
| *Aletris aurea* | ALAU |
| *Alnus serrulata* | ALSE2 |
| *Alophia drummondii* | ALDR2 |
| *Alternanthera philoxeroides* | ALPH |
| *Ambrosia artemisiifolia* | AMAR2 |
| *Ambrosia psilostachya* | AMPS |
| *Amorpha fruticosa* | AMFR |
| *Andropogon capillipes* | ANCA4 |
| *Andropogon gerardii* | ANGE |
| *Andropogon glomeratus* | ANGL2 |
| *Andropogon* sp. | ANDRO2 |
| *Andropogon ternarius* | ANTE2 |
| *Andropogon ternarius* var. *ternarius* | ANTET |
| *Andropogon virginicus* | ANVI2 |
| *Andropogon virginicus* var. *virginicus* | ANVIV |
| *Anthaenantia rufa* | ANRU |
| *Apteria aphylla* | APAP |
| *Aralia spinosa* | ARSP2 |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Ardisia crenata* | ARCR80 |
| *Arisaema triphyllum* | ARTR |
| *Aristida desmantha* | ARDE3 |
| *Aristida oligantha* | AROL |
| *Aristida palustris* | ARPA26 |
| *Aristolochia serpentaria* | ARSE3 |
| *Arnoglossum ovatum* | AROV |
| *Arnoglossum plantagineum* | ARPL4 |
| *Arundinaria gigantea* | ARGI |
| *Arundinaria gigantea s*sp. *gigantea* | ARGIG |
| *Arundo donax* | ARDO4 |
| *Asclepias perennis* | ASPE |
| *Asclepias* sp. | ASCLE |
| *Asimina parviflora* | ASPA18 |
| *Asimina triloba* | ASTR |
| *Asplenium platyneuron* | ASPL |
| *Athyrium filix-femina* | ATFI |
| *Athyrium filix-femina s*sp. *asplenioides* | ATFIA2 |
| *Atrichum angustatum* | ATAN3 |
| *Baccharis halimifolia* | BAHA |
| *Bacopa caroliniana* | BACA |
| *Bacopa monnieri* | BAMO |
| *Bacopa* sp. | BACOP |
| *Baptisia nuttalliana* | BANU2 |
| *Baptisia alba* | BAAL |
| *Berchemia scandens* | BESC |
| *Betula nigra* | BENI |
| *Bignonia capreolata* | BICA |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Boehmeria cylindrica* | BOCY |
| *Boltonia diffusa* var. *diffusa* | BODID |
| *Botrychium biternatum* | BOBI |
| *Botrychium* sp. | BOTRY |
| *Brunnichia ovata* | BROV4 |
| *Bulbostylis ciliatifolia* var. *ciliatifolia* | BUCIC2 |
| *Bulbostylis juncoides* | BUJU |
| *Callicarpa americana* | CAAM2 |
| *Campsis radicans* | CARA2 |
| *Carex abscondita* | CAAB5 |
| *Carex cherokeensis* | CACH3 |
| *Carex digitalis* | CADI5 |
| *Carex festucacea* | CAFE3 |
| *Carex glaucescens* | CAGL5 |
| *Carex intumescens* | CAIN12 |
| *Carex joorii* | CAJO2 |
| *Carex leptalea* | CALE10 |
| *Carex louisianica* | CALO6 |
| *Carex lupulina* | CALU4 |
| *Carex* sp. | CAREX |
| *Carex tenax* | CATE12 |
| *Carpinus caroliniana* | CACA18 |
| *Carpinus caroliniana* ssp. *caroliniana* | CACAC2 |
| *Carya aquatica* | CAAQ2 |
| *Carya cordiformis* | CACO15 |
| *Carya glabra* | CAGL8 |
| *Carya illinoinensis* | CAIL |
| *Carya ovata* | CAOV2 |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Carya* sp. | CARYA |
| *Carya texana* | CATE9 |
| *Carya tomentosa* | CATO6 |
| *Castanea dentata* | CADE12 |
| *Castanea pumila* | CAPU9 |
| *Catalpa ovata* | CAOV5 |
| *Cayaponia quinqueloba* | CAQU3 |
| *Celtis laevigata* | CELA |
| *Celtis* sp. | CELTI |
| *Celtis tenuifolia* | CETE |
| *Centella erecta* | CEER2 |
| *Centella asiatica* | CEAS |
| *Centrosema virginianum* | CEVI2 |
| *Cephalanthus occidentalis* | CEOC2 |
| *Cercis canadensis* | CECA4 |
| *Chamaecrista fasciculata* | CHFA2 |
| *Chasmanthium latifolium* | CHLA5 |
| *Chasmanthium laxum* | CHLA6 |
| *Chasmanthium sessiliflorum* | CHSE2 |
| *Chasmanthium* sp. | CHASM |
| *Chionanthus virginicus* | CHVI3 |
| *Chrysopsis mariana* | CHMA14 |
| *Cladium mariscoides* | CLMA |
| *Claytonia virginica* | CLVI3 |
| *Clematis terniflora* | CLTE4 |
| *Clethra alnifolia* | CLAL3 |
| *Cnidoscolus texanus* | CNTE |
| *Cocculus carolinus* | COCA |
| *Coelorachis cylindrica* | COCY |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Commelina erecta* | COER |
| *Commelina* sp. | COMME |
| *Commelina virginica* | COVI3 |
| *Conoclinium coelestinum* | COCO13 |
| *Cornus drummondii* | CODR |
| *Cornus florida* | COFL2 |
| *Cornus foemina* | COFO |
| *Cornus* sp. | CORNU |
| *Crataegus brachyacantha* | CRBR |
| *Crataegus crus-galli* | CRCR2 |
| *Crataegus marshallii* | CRMA5 |
| *Crataegus opaca* | CROP |
| *Crataegus* sp. | CRATA |
| *Crataegus spathulata* | CRSP |
| *Crataegus viridis* | CRVI2 |
| *Croton argyranthemus* | CRAR2 |
| *Croton capitatus* | CRCA6 |
| *Croton* sp. | CROTO |
| *Cuscuta* sp. | CUSCU |
| *Cynodon dactylon* | CYDA |
| *Cyperaceae* sp. | CYPERA |
| *Cyperus acuminatus* | CYAC2 |
| *Cyperus echinatus* | CYEC2 |
| *Cyperus erythrorhizos* | CYER2 |
| *Cyperus grayoides* | CYGR11 |
| *Cyperus haspan* | CYHA |
| *Cyperus odoratus* | CYOD |
| *Cyperus pseudovegetus* | CYPS |
| *Cyperus* sp. | CYPER |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Cyperus strigosus* | CYST |
| *Cyperus virens* | CYVI2 |
| *Cyrilla racemiflora* | CYRA |
| *Dalea villosa* | DAVI |
| *Delphinium carolinianum* | DECA3 |
| *Desmodium glabellum* | DEGL4 |
| *Desmodium glutinosum* | DEGL5 |
| *Desmodium laevigatum* | DELA2 |
| *Desmodium nudiflorum* | DENU4 |
| *Desmodium obtusum* | DEOB5 |
| *Desmodium paniculatum* | DEPA6 |
| *Desmodium* sp. | DESMO |
| *Desmodium villosum* | DEVI |
| *Desmodium viridiflorum* | DEVI14 |
| *Dichanthelium acuminatum* | DIAC2 |
| *Dichanthelium clandestinum* | DICL |
| *Dichanthelium commutatum* | DICO2 |
| *Dichanthelium dichotomum* | DIDI6 |
| *Dichanthelium dichotomum* var. *dichotomum* | DIDID |
| *Dichanthelium latifolium* | DILA8 |
| *Dichanthelium laxiflorum* | DILA9 |
| *Dichanthelium malacophyllum* | DIMA |
| *Dichanthelium ovale* | DIOV |
| *Dichanthelium scoparium* | DISC3 |
| *Dichanthelium* sp. | DICHA2 |
| *Dichanthelium sphaerocarpon* | DISP2 |
| *Dichanthelium strigosum* var. *strigosum* | DISTS |
| *Digitaria ciliaris* | DICI |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Digitaria cognata* | DICO6 |
| *Digitaria* sp. | DIGIT2 |
| *Diodia virginiana* | DIVI3 |
| *Dioscorea villosa* | DIVI4 |
| *Diospyros virginiana* | DIVI5 |
| *Ditrichum pallidum* | DIPA22 |
| *Ditrysinia fruticosa* | DIFR6 |
| *Dryopteris ludoviciana* | DRLU |
| *Duchesnea indica* | DUIN2 |
| *Echinochloa colona* | ECCO2 |
| *Echinochloa walteri* | ECWA |
| *Echinodorus cordifolius* | ECCO3 |
| *Eichhornia crassipes* | EICR |
| *Eleocharis flavescens* | ELFL |
| *Eleocharis geniculata* | ELGE |
| *Eleocharis microcarpa* | ELMI2 |
| *Eleocharis quadrangulata* | ELQU |
| *Eleocharis* sp. | ELEOC |
| *Eleocharis tortilis* | ELTO |
| *Eleocharis tuberculosa* | ELTU |
| *Elephantopus carolinianus* | ELCA3 |
| *Elephantopus* sp. | ELEPH |
| *Elephantopus tomentosus* | ELTO2 |
| *Eleusine indica* | ELIN3 |
| *Elymus virginicus* | ELVI3 |
| *Elymus virginicus* var. *virginicus* | ELVIV |
| *Eragrostis japonica* | ERJA4 |
| *Erechtites hieraciifolia* var. *hieraciifolia* | ERHI12 |
| *Erigeron philadelphicus* | ERPH |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Erigeron tenuis* | ERTE7 |
| *Eriocaulon* sp. | ERIOC |
| *Eryngium yuccifolium* | ERYU |
| *Erythrina herbacea* | ERHE4 |
| *Eubotrys racemosus* | EURA14 |
| *Eupatorium capillifolium* | EUCA5 |
| *Eupatorium glaucescens* | EUGL7 |
| *Eupatorium leucolepis* | EULE |
| *Eupatorium rotundifolium* | EURO4 |
| *Eupatorium serotinum* | EUSE2 |
| *Eupatorium* sp. | EUPAT |
| *Euphorbia cordifolia* | EUCO9 |
| *Euthamia gymnospermoides* | EUGY |
| *Euthamia leptocephala* | EULE4 |
| *Fagus grandifolia* | FAGR |
| *Fimbristylis autumnalis* | FIAU2 |
| *Fimbristylis vahlii* | FIVA |
| *Fissidens* sp. | FISSI |
| *Forestiera acuminata* | FOAC |
| *Forestiera ligustrina* | FOLI |
| *Frangula caroliniana* | FRCA13 |
| *Fraxinus americana* | FRAM2 |
| *Fraxinus caroliniana* | FRCA3 |
| *Fraxinus pennsylvanica* | FRPE |
| *Fraxinus* sp. | FRAXI |
| *Fuirena breviseta* | FUBR |
| *Fuirena bushii* | FUBU |
| *Galactia volubilis* | GAVO |
| *Galium* sp. | GALIU |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Galium uniflorum* | GAUN2 |
| *Gelsemium sempervirens* | GESE |
| *Gleditsia aquatica* | GLAQ |
| *Gleditsia* sp. | GLEDI |
| *Gleditsia triacanthos* | GLTR |
| *Halesia diptera* | HADI3 |
| *Hamamelis virginiana* | HAVI4 |
| *Helenium amarum* var. *amarum* | HEAMA |
| *Helenium drummondii* | HEDR2 |
| *Helenium flexuosum* | HEFL |
| *Helianthus angustifolius* | HEAN2 |
| *Helianthus mollis* | HEMO2 |
| *Helianthus pauciflorus* | HEPA19 |
| *Helianthus* sp. | HELIA |
| *Hibiscus laevis* | HILA2 |
| *Hibiscus lasiocarpos* | HILA6 |
| *Hibiscus* sp. | HIBIS2 |
| *Houstonia pusilla* | HOPU3 |
| *Hydrocotyle bonariensis* | HYBO |
| *Hydrocotyle* sp. | HYDRO |
| *Hydrocotyle verticillata* | HYVE2 |
| *Hydrolea ovata* | HYOV |
| *Hygrophila lacustris* | HYLA |
| *Hygrophila* sp. | HYGRO |
| *Hymenocallis liriosme* | HYLI |
| *Hymenocallis occidentalis* | HYOC2 |
| *Hypericum crux-andreae* | HYCR3 |
| *Hypericum drummondii* | HYDR |
| *Hypericum galioides* | HYGA |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Hypericum gentianoides* | HYGE |
| *Hypericum hypericoides* | HYHY |
| *Hypericum mutilum* | HYMU |
| *Hypericum* sp. | HYPER |
| *Hypoxis curtissii* | HYCU5 |
| *Hypoxis* sp. | HYPOX |
| *Hyptis alata* | HYAL |
| *Ilex coriacea* | ILCO |
| *Ilex decidua* | ILDE |
| *Ilex opaca* | ILOP |
| *Ilex opaca* var. *opaca* | ILOPO |
| *Ilex* sp. | ILEX |
| *Ilex vomitoria* | ILVO |
| *Ipomoea lacunosa* | IPLA |
| *Ipomoea sagittata* | IPSA |
| *Ipomoea* sp. | IPOMO |
| *Isopterygium tenerum* | ISTE3 |
| *Itea virginica* | ITVI |
| *Janesoniella autumnalis* | JAAU |
| *Juglans nigra* | JUNI |
| *Juncus diffusissimus* | JUDI2 |
| *Juncus effusus* | JUEF |
| *Juncus effusus* var. *solutus* | JUEFS |
| *Juncus interior* | JUIN2 |
| *Juncus repens* | JURE2 |
| *Juncus tenuis* | JUTE |
| *Juncus texanus* | JUTE3 |
| *Juncus validus* | JUVA2 |
| *Juniperus virginiana* | JUVI |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Juniperus virginiana* var. *virginiana* | JUVIV |
| *Justicia lanceolata* | JULA3 |
| *Justicia ovata* var. *lanceolata* | JUOVL |
| *Justicia* sp. | JUSTI |
| *Kyllinga pumila* | KYPU |
| *Lachnocaulon anceps* | LAAN |
| *Landoltia punctata* | LAPU12 |
| *Lemna minor* | LEMI3 |
| *Leptochloa panicea* | LEPA6 |
| *Lespedeza procumbens* | LEPR |
| *Lespedeza* sp. | LESPE |
| *Leucobryum albidum* | LEAL |
| *Leucobyrum glaucum* | LEGL19 |
| *Liatris elegans* | LIEL |
| *Liatris elegans* var. *elegans* | LIELE |
| *Liatris punctata* | LIPU |
| *Liatris pycnostachya* | LIPY |
| *Liatris* sp. | LIATR |
| *Liatris squarrosa* | LISQ |
| *Ligustrum sinense* | LISI |
| *Liquidambar styraciflua* | LIST2 |
| *Lonicera japonica* | LOJA |
| *Ludwigia leptocarpa* | LULE4 |
| *Ludwigia linearis* | LULI |
| *Ludwigia palustris* | LUPA |
| *Ludwigia peploides* | LUPE5 |
| *Ludwigia pilosa* | LUPI |
| *Ludwigia* sp. | LUDWI |
| *Lycopodium* sp. | LYCOP2 |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Lycopus rubellus* | LYRU |
| *Lycopus* sp. | LYCOP4 |
| *Lycopus virginicus* | LYVI4 |
| *Lygodium japonicum* | LYJA |
| *Lyonia ligustrina* var. *foliosiflora* | LYLI |
| *Lysimachia radicans* | LYRA |
| *Magnolia grandiflora* | MAGR4 |
| *Magnolia virginiana* | MAVI2 |
| *Marshallia graminifolia* var. *cynanthera* | MAGRC2 |
| *Matelea gonocarpos* | MAGO |
| *Mikania scandens* | MISC |
| *Mimosa latidens* | MILA15 |
| *Mimosa* sp. | MIMOS |
| *Mimosa strigillosa* | MIST2 |
| *Mitchella repens* | MIRE |
| *Mitreola petiolata* | MIPE3 |
| *Mollugo verticillata* | MOVE |
| *Morella caroliniensis* | MOCA7 |
| *Morella cerifera* | MOCE2 |
| *Morus rubra* | MORU2 |
| *Morus* sp. | MORUS |
| *Muhlenbergia expansa* | MUEX |
| *Nasturtium officinale* | NAOF |
| *Nekemias arborea* | NEAR5 |
| *Nuphar advena* | NUAD2 |
| *Nuphar lutea* | NULUA |
| *Nymphaea odorata* | NYOD |
| *Nymphaea* sp. | NYMP |
| *Nymphoides aquatica* | NYAQ |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Nyssa aquatica* | NYAQ2 |
| *Nyssa biflora* | NYBI |
| *Nyssa* sp. | NYSSA |
| *Nyssa sylvatica* | NYSY |
| *Onoclea sensibilis* | ONSE |
| *Oplismenus hirtellus* | OPHI |
| *Oplismenus hirtellus s*sp. *setarius* | OPHIS |
| *Opuntia humifusa* | OPHU |
| *Opuntia stricta* var. *dillenii* | OPSTD |
| *Osmanthus americanus* | OSAM |
| *Osmunda cinnamomea* | OSCI |
| *Osmunda regalis* | OSRE |
| *Osmunda regalis* var. *spectabilis* | OSRES |
| *Ostrya virginiana* | OSVI |
| *Oxalis* sp. | OXALI |
| *Oxalis stricta* | OXST |
| *Oxydendron arboreum* | OXAR |
| *Pallavicinia lyellii* | PALY3 |
| *Panicum anceps* | PAAN |
| *Panicum hemitomon* | PAHE2 |
| *Panicum repens* | PARE3 |
| *Panicum rigidulum* | PARI4 |
| *Panicum* sp. | PANIC |
| *Panicum virgatum* | PAVI2 |
| *Parthenocissus quinquefolia* | PAQU2 |
| *Paspalum bifidum* | PABI3 |
| *Paspalum denticulatum* | PADE24 |
| *Paspalum floridanum* | PAFL4 |
| *Paspalum notatum* | PANO2 |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Paspalum praecox* | PAPR4 |
| *Paspalum urvillei* | PAUR2 |
| *Passiflora incarnata* | PAIN6 |
| *Passiflora lutea* | PALU2 |
| *Paulownia tomentosa* | PATO2 |
| *Penthorum sedoides* | PESE6 |
| *Persea borbonia* | PEBO |
| *Persea palustris* | PEPA37 |
| *Persicaria hydropiperoides* | POHY2 |
| *Persicaria longiseta* | PELO10 |
| *Persicaria punctata* | PEPU18 |
| *Persicaria setacea* | PESE15 |
| *Phalaris angusta* | PHAN2 |
| *Phanopyrum gymnocarpon* | PHGY2 |
| *Physalis angulata* | PHAN5 |
| *Pilea pumila* | PIPU2 |
| *Pinus echinata* | PIEC2 |
| *Pinus elliottii* | PIEL |
| *Pinus palustris* | PIPA2 |
| *Pinus taeda* | PITA |
| *Pityopsis graminifolia* | PIGR4 |
| *Planera aquatica* | PLAQ |
| *Platanthera cristata* | PLCR |
| *Platanus occidentalis* | PLOC |
| *Pleopeltis polypodiodes* | PLPO2 |
| *Pleopeltis polypodioides* ssp. *michauxiana* | PLPOM |
| *Pluchea camphorata* | PLCA7 |
| *Pluchea foetida* | PLFO |
| *Pluchea foetida* var. *foetida* | PLFOF |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Pluchea* sp. | PLUCH |
| *Podophyllum peltatum* | POPE |
| *Polygala incarnata* | POIN4 |
| *Polygala mariana* | POMA8 |
| *Polygala ramosa* | PORA2 |
| *Polygala* sp. | POLYG |
| *Polygonum glabrum* | POGL10 |
| *Polygonum punctatum* | POPU5 |
| *Polygonum punctatum* | POPUP4 |
| *Polygonum* sp. | POLYG4 |
| *Polygonum virginianum* | POVI2 |
| *Polypodium virginianum* | POVI7 |
| *Polystichum acrostichoides* | POAC4 |
| *Poncirus trifoliata* | POTR4 |
| *Pontederia cordata* | POCO14 |
| *Proserpinaca intermedia* | PRIN2 |
| *Proserpinaca pectinata* | PRPE |
| *Prunus caroliniana* | PRCA |
| *Prunus serotina* | PRSE2 |
| *Prunus umbellata* | PRUM |
| *Pseudognaphalium obtusifolium* ssp. *obtusifolium* | PSOBO |
| *Ptelea trifoliata* | PTTR |
| *Pteridium aquilinum* | PTAQ |
| *Ptilimnium capillaceum* | PTCA |
| *Pueraria montana* var. *lobata* | PUMOL |
| *Pycnanthemum albescens* | PYAL |
| *Quercus alba* | QUAL |
| *Quercus falcata* | QUFA |
| *Quercus hemisphaerica* | QUHE2 |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Quercus incana* | QUIN |
| *Quercus laurifolia* | QULA3 |
| *Quercus lyrata* | QULY |
| *Quercus margarettiae* | QUMA13 |
| *Quercus marilandica* | QUMA3 |
| *Quercus michauxii* | QUMI |
| *Quercus nigra* | QUNI |
| *Quercus pagoda* | QUPA5 |
| *Quercus phellos* | QUPH |
| *Quercus shumardii* | QUSH |
| *Quercus* sp. | QUERC |
| *Quercus stellata* | QUST |
| *Quercus texana* | QUTE |
| *Quercus velutina* | QUVE |
| *Rhexia lutea* | RHLU |
| *Rhexia mariana* | RHMA |
| *Rhexia mariana* var. *mariana* | RHMAM2 |
| *Rhexia* sp. | RHEXI |
| *Rhexia virginica* | RHVI |
| *Rhodochiton atrosanguineus* | RHAT |
| *Rhododendron canescens* | RHCA7 |
| *Rhododendron oblongifolium* | RHOB |
| *Rhododendron* sp. | RHODO |
| *Rhus copallinum* | RHCO |
| *Rhynchosia reniformis* | RHRE |
| *Rhynchospora chalarocephala* | RHCH2 |
| *Rhynchospora colorata* | RHCO7 |
| *Rhynchospora corniculata* | RHCO2 |
| *Rhynchospora elliottii* | RHEL |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Rhynchospora fascicularis* | RHFA |
| *Rhynchospora globularis* | RHGL2 |
| *Rhynchospora glomerata* | RHGL3 |
| *Rhynchospora inexpansa* | RHIN4 |
| *Rhynchospora macrostachya* | RHMA6 |
| *Rhynchospora microcarpa* | RHMI17 |
| *Rhynchospora rariflora* | RHRA2 |
| *Rhynchospora scirpoides* | RHSC5 |
| *Rhynchospora* sp. | RHYNC3 |
| *Rubus apogaeus* | RUAP |
| *Rubus argutus* | RUAR2 |
| *Rubus* sp. | RUBUS |
| *Rubus trivialis* | RUTR |
| *Rudbeckia hirta* | RUHI2 |
| *Rudbeckia texana* | RUTE4 |
| *Ruellia caroliniensis* | RUCA4 |
| *Ruellia humilis* | RUHU |
| *Sabal minor* | SAMI8 |
| *Sabatia gentianoides* | SAGE |
| *Saccharum giganteum* | SAGI |
| *Saccharum* sp. | SACCH |
| *Sagittaria latifolia* | SALA2 |
| *Sagittaria papillosa* | SAPA2 |
| *Sagittaria platyphylla* | SAPL |
| *Sagittaria* sp. | SAGIT |
| *Salix nigra* | SANI |
| *Salix* sp. | SALIX |
| *Salvia lyrata* | SALY2 |
| *Salvinia minima* | SAMI7 |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Salvinia molesta* | SAMO5 |
| *Sanicula canadensis* | SACA15 |
| *Sanicula* sp. | SANIC |
| *Sarracenia alata* | SAAL4 |
| *Sassafras albidum* | SAAL5 |
| *Saururus cernuus* | SACE |
| *Schizachyrium scoparium* | SCSC |
| *Schizachyrium scoparium* var. *scoparium* | SCSCS |
| *Schizachyrium tenerum* | SCTE5 |
| *Schoenoplectus* sp. | SCHOE6 |
| *Schoenoplectus tabernaemontani* | SCTA2 |
| *Scirpus cyperinus* | SCCY |
| *Scirpus divaricatus* | SCDI2 |
| *Scleria flaccida* | SCFL3 |
| *Scleria georgiana* | SCGE |
| *Scleria oligantha* | SCOL2 |
| *Scleria* sp. | SCLER2 |
| *Scleria triglomerata* | SCTR |
| *Scoparia dulcis* | SCDU |
| *Scutellaria cardiophylla* | SCCA4 |
| *Selaginella apoda* | SEAP |
| *Sesbania drummondii* | SEDR |
| *Sesbania herbacea* | SEHE8 |
| *Sesbania* sp. | SESBA |
| *Sesbania vesicaria* | SEVE |
| *Setaria parviflora* | SEPA10 |
| *Setaria* sp. | SETAR |
| *Sida rhombifolia* | SIRH |
| *Silphium laciniatum* | SILA3 |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Smilax bona-nox* | SMBO2 |
| *Smilax glauca* | SMGL |
| *Smilax laurifolia* | SMLA |
| *Smilax pumila* | SMPU |
| *Smilax rotundifolia* | SMRO |
| *Smilax smallii* | SMSM |
| *Smilax* sp. | SMILA2 |
| *Smilax tamnoides* | SMTA2 |
| *Smilax walteri* | SMWA |
| *Solanum carolinense* | SOCA3 |
| *Solanum elaeagnifolium* | SOEL |
| *Solanum pseudocapsicum* | SOPS |
| *Solidago altissima* | SOAL6 |
| *Solidago odora* | SOOD |
| *Solidago odora* var. *odora* | SOODO |
| *Sorghastrum elliottii* | SOEL3 |
| *Sparganium americanum* | SPAM |
| *Sparganium androcladum* | SPAN |
| *Sphagnum cuspidatum* | SPCU4 |
| *Sphagnum palustre* | SPPA70 |
| *Sphagnum* sp. | SPHAG2 |
| *Sporobolus clandestinus* | SPCL |
| *Sporobolus compositus* | SPCO16 |
| *Sporobolus* sp. | SPORO |
| *Steerecleus serrulatus* | STSE9 |
| *Stellaria media s*sp. *media* | STMEM |
| *Strophostyles helvula* | STHE9 |
| *Stylosanthes biflora* | STBI2 |
| *Symphyotrichum* sp. | SYMPH4 |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Symplocos tinctoria* | SYTI |
| *Taraxacum officinale* | TAOF |
| *Taxiphyllum taxirameum* | TATA |
| *Taxodium distichum* | TADI2 |
| *Tephrosia virginiana* | TEVI |
| *Thelypteris kunthii* | THKU |
| *Thelypteris palustris* | THPA |
| *Thelypteris* sp. | THELY2 |
| *Thuidium delicatulum* | THDE10 |
| *Tilia americana* | TIAM |
| *Tillandsia usneoides* | TIUS |
| *Toxicodendron pubescens* | TOPU2 |
| *Toxicodendron radicans* | TORA2 |
| *Trachelospermum difforme* | TRDI |
| *Tradescantia ohiensis* | TROH |
| *Triadenum walteri* | TRWA |
| *Triadica sebifera* | TRSE6 |
| *Typha latifolia* | TYLA |
| *Typha* sp. | TYPHA |
| *Ulmus alata* | ULAL |
| *Ulmus americana* | ULAM |
| *Ulmus rubra* | ULRU |
| *Ulmus* sp. | ULMUS |
| *Urochloa platyphylla* | URPL2 |
| *Utricularia gibba* | UTGI |
| *Utricularia radiata* | UTRA |
| *Vaccinium arboreum* | VAAR |
| *Vaccinium corymbosum* | VACO |
| *Vaccinium elliottii* | VAEL |

**Table C1 (continued).** List of plant species documented during plot sampling.

| Plant Taxon Name | USDA Plants Taxon Code |
|---|---|
| *Vaccinium* sp. | VACCI |
| *Vaccinium stamineum* | VAST |
| *Vernonia gigantea* | VEGI |
| *Vernonia gigantea* ssp. *gigantea* | VEGIG |
| *Viburnum dentatum* | VIDE |
| *Viburnum dentatum* var. *dentatum* | VIDED4 |
| *Viburnum nudum* | VINU |
| *Viburnum rufidulum* | VIRU |
| *Viola affinis* | VIAF2 |
| *Viola* sp. | VIOLA |
| *Vitis acerifolia* | VIAC2 |
| *Vitis aestivalis* | VIAE |
| *Vitis mustangensis* | VIMU2 |
| *Vitis rotundifolia* | VIRO3 |
| *Wahlenbergia marginata* | WAMA |
| *Woodwardia areolata* | WOAR |
| *Woodwardia virginica* | WOVI |
| *Xanthium strumarium* | XAST |
| *Xyris ambigua* | XYAM |
| *Xyris difformis* | XYDI |
| *Xyris difformis* var. *difformis* | XYDID |
| *Xyris fimbriata* | XYFI |
| *Xyris laxifolia* var. *iridifolia* | XYLAI |
| *Xyris* sp. | XYRIS |
| *Xyris stricta* | XYST |
| *Yucca louisianensis* | YULO |
| *Yucca* sp. | YUCCA |
| *Zanthoxylum clava-herculis* | ZACL |
| *Zizaniopsis miliacea* | ZIMI |

# Appendix D: List of Plots and Classified Vegetation

**Table D1.** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_0319_002 | CEGL003530 | (*Magnolia virginiana*) / *Ilex coriacea - Morella caroliniensis* Seepage Bog |
| BITH_VC_0319_012 | CEGL007162 | *Pinus palustris* / *Morella cerifera - Morella caroliniensis - Ilex coriacea* Ruderal Wet Woodland |
| BITH_VC_0319_014 | CEGL007162 | *Pinus palustris* / *Morella cerifera - Morella caroliniensis - Ilex coriacea* Ruderal Wet Woodland |
| BITH_VC_0319_016 | CEGL007162 | *Pinus palustris* / *Morella cerifera - Morella caroliniensis - Ilex coriacea* Ruderal Wet Woodland |
| BITH_VC_0319_017 | CEGL006011 | *Pinus taeda* / *Liquidambar styraciflua - Acer rubrum* / *Vaccinium stamineum* Ruderal Forest |
| BITH_VC_0319_018 | CEGL008571 | *Pinus palustris - Pinus* (*echinata*, *taeda*) - *Quercus falcata - Carya texana* Woodland |
| BITH_VC_0319_019 | CEGL002112 | *Pinus taeda - Quercus stellata* / *Crataegus* spp. Woodland |
| BITH_VC_0319_025 | CEGL007474 | *Nyssa biflora - Magnolia virginiana - Quercus laurifolia* / *Cyrilla racemiflora - Rhododendron oblongifolium* Swamp Forest |
| BITH_VC_0319_026 | CEGL007474 | *Nyssa biflora - Magnolia virginiana - Quercus laurifolia* / *Cyrilla racemiflora - Rhododendron oblongifolium* Swamp Forest |
| BITH_VC_0319_027 | CEGL007525 | *Pinus taeda - Quercus alba* - (*Fagus grandifolia*) / *Smilax pumila - Mitchella repens* Forest |
| BITH_VC_0319_049 | CEGL007903 | *Magnolia grandiflora - Fagus grandifolia - Quercus alba - Pinus taeda* Forest |
| BITH_VC_0319_051 | NPSBITH018 | *Cyrilla racemiflora* Seepage Bog Shrubland |
| BITH_VC_0319_052 | CEGL008571 | *Pinus palustris - Pinus* (*echinata*, *taeda*) - *Quercus falcata - Carya texana* Woodland |
| BITH_VC_0319_053 | CEGL008571 | *Pinus palustris - Pinus* (*echinata*, *taeda*) - *Quercus falcata - Carya texana* Woodland |
| BITH_VC_0319_067 | NPSBITH014 | *Xyris fimbriata* Upland Marsh |
| BITH_VC_0319_068 | CEGL007162 | *Pinus palustris* / *Morella cerifera - Morella caroliniensis - Ilex coriacea* Ruderal Wet Woodland |
| BITH_VC_0319_069 | CEGL003619 | *Pinus taeda - Quercus hemisphaerica* / *Osmanthus americanus* / *Ilex glabra* Woodland |
| BITH_VC_0319_070 | CEGL007474 | *Nyssa biflora - Magnolia virginiana - Quercus laurifolia* / *Cyrilla racemiflora - Rhododendron oblongifolium* Swamp Forest |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_0319_071 | CEGL003619 | *Pinus taeda* - *Quercus hemisphaerica* / *Osmanthus americanus* / *Ilex glabra* Woodland |
| BITH_VC_0319_073 | NPSBITH025 | *Nyssa biflora* - *Acer rubrum* - (*Triadica sebifera*) / *Morella cerifera* / *Saccharum giganteum* Swamp Woodland |
| BITH_VC_0319_074 | NPSBITH005 | *Juncus effusus* Ruderal Marsh |
| BITH_VC_0319_079 | NPSBITH015 | *Ilex coriacea* - *Prunus caroliniana* Dense Evergreen Forest and Shrubland |
| BITH_VC_0319_090 | NPSBITH016 | *Pinus* spp. (*taeda*, *echinata*, *elliottii*, *palustris*) Regenerating Woodland and Shrubland |
| BITH_VC_0319_091 | CEGL002421 | *Taxodium distichum* - (*Nyssa aquatica*) / *Forestiera acuminata* - *Planera aquatica* Floodplain Forest |
| BITH_VC_0319_092 | CEGL007474 | *Nyssa biflora* - *Magnolia virginiana* - *Quercus laurifolia* / *Cyrilla racemiflora* - *Rhododendron oblongifolium* Swamp Forest |
| BITH_VC_0319_093 | CEGL003530 | (*Magnolia virginiana*) / *Ilex coriacea* - *Morella caroliniensis* Seepage Bog |
| BITH_VC_0319_094 | CEGL007320 | *Fagus grandifolia* - *Pinus taeda* - (*Liquidambar styraciflua*, *Magnolia grandiflora*, *Quercus alba*) Small Stream Forest |
| BITH_VC_0319_095 | CEGL007474 | *Nyssa biflora* - *Magnolia virginiana* - *Quercus laurifolia* / *Cyrilla racemiflora* - *Rhododendron oblongifolium* Swamp Forest |
| BITH_VC_0319_102 | CEGL003609 | *Pinus palustris* - *Pinus* (*echinata*, *taeda*) / (*Liquidambar styraciflua*) / *Schizachyrium scoparium* Ruderal Woodland |
| BITH_VC_0319_103 | CEGL008571 | *Pinus palustris* - *Pinus* (*echinata*, *taeda*) - *Quercus falcata* - *Carya texana* Woodland |
| BITH_VC_0319_114 | CEGL007429 | *Nyssa aquatica* - *Nyssa biflora* Swamp Forest |
| BITH_VC_0319_115 | CEGL007429 | *Nyssa aquatica* - *Nyssa biflora* Swamp Forest |
| BITH_VC_0319_117 | CEGL007069 | *Pinus taeda* - (*Pinus echinata*) - *Quercus* (*pagoda*, *phellos*) Wet Woodland |
| BITH_VC_0319_118 | CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| BITH_VC_0319_119 | CEGL008414 | *Quercus alba* - *Quercus falcata* - *Quercus stellata* - *Nyssa sylvatica* / *Carex cherokeensis* Forest |
| BITH_VC_0319_120 | CEGL007474 | *Nyssa biflora* - *Magnolia virginiana* - *Quercus laurifolia* / *Cyrilla racemiflora* - *Rhododendron oblongifolium* Swamp Forest |
| BITH_VC_0319_121 | CEGL007528 | *Pinus taeda* - (*Pinus echinata*) - *Quercus falcata* - *Carya texana* / *Vaccinium arboreum* Forest |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_0319_122 | CEGL008414 | *Quercus alba* - *Quercus falcata* - *Quercus stellata* - *Nyssa sylvatica* / *Carex cherokeensis* Forest |
| BITH_VC_0319_176 | NPSBITH015 | *Ilex coriacea* - *Prunus caroliniana* Dense Evergreen Forest and Shrubland |
| BITH_VC_0319_178 | CEGL004921 | *Panicum virgatum* - *Panicum rigidulum* var. *elongatum* - *Polygonum* hydropiperoides Wet Meadow |
| BITH_VC_0319_182 | CEGL002420 | *Taxodium distichum* / *Lemna minor* Floodplain Forest |
| BITH_VC_0319_191 | CEGL007370 | *Quercus phellos* - *Liquidambar styraciflua* / *Ilex decidua* - *Carpinus caroliniana* / *Lysimachia radicans* Floodplain Forest |
| BITH_VC_0319_212 | CEGL007412 | *Triadica sebifera* Ruderal Wet Forest |
| BITH_VC_0319_214 | CEGL003858 | *Alternanthera philoxeroides* Ruderal Aquatic Vegetation |
| BITH_VC_0319_226 | CEGL007906 | *Quercus michauxii* - *Liquidambar styraciflua* - *Quercus texana* - *Quercus lyrata* Floodplain Forest |
| BITH_VC_0319_257 | NPSBITH008 | *Acer rubrum* - (*Triadica sebifera*) / *Morella cerifera* Swamp Woodland |
| BITH_VC_0319_260 | CEGL007412 | *Triadica sebifera* Ruderal Wet Forest |
| BITH_VC_0319_271 | CEGL007845 | *Quercus alba* - *Quercus* (*michauxii*, *nigra*) / *Ilex opaca* / *Chasmanthium laxum* Forest |
| BITH_VC_0319_272 | CEGL007142 | *Pinus taeda* Riparian Forest |
| BITH_VC_0319_273 | CEGL007961 | *Quercus laurifolia* - *Quercus phellos* / *Viburnum dentatum* - (*Sebastiana fruticosa*) / *Carex fruticosa* Upper West Gulf Wet Flatwoods Forest |
| BITH_VC_0319_274 | CEGL007429 | *Nyssa aquatica* - *Nyssa biflora* Swamp Forest |
| BITH_VC_0319_275 | NPSBITH012 | *Pinus taeda* - *Magnolia grandiflora* - (*Fagus grandifolia*, *Quercus alba*, *Quercus falcata*) Flatwoods Forest |
| BITH_VC_0319_276 | NPSBITH012 | *Pinus taeda* - *Magnolia grandiflora* - (*Fagus grandifolia*, *Quercus alba*, *Quercus falcata*) Flatwoods Forest |
| BITH_VC_0319_278 | CEGL007715 | *Quercus michauxii* - *Quercus* (*nigra*, *pagoda*) - *Liquidambar styraciflua* - *Pinus taeda* Wet Forest |
| BITH_VC_0319_280 | CEGL007961 | *Quercus laurifolia* - *Quercus phellos* / *Viburnum dentatum* - (*Sebastiana fruticosa*) / *Carex fruticosa* Upper West Gulf Wet Flatwoods Forest |
| BITH_VC_0319_282 | CEGL007715 | *Quercus michauxii* - *Quercus* (*nigra*, *pagoda*) - *Liquidambar styraciflua* - *Pinus taeda* Wet Forest |
| BITH_VC_0319_284 | NPSBITH012 | *Pinus taeda* - *Magnolia grandiflora* - (*Fagus grandifolia*, *Quercus alba*, *Quercus falcata*) Flatwoods Forest |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_0319_285 | CEGL007715 | *Quercus michauxii* - *Quercus* (*nigra*, *pagoda*) - *Liquidambar styraciflua* - *Pinus taeda* Wet Forest |
| BITH_VC_0319_296 | CEGL007429 | *Nyssa aquatica* - *Nyssa biflora* Swamp Forest |
| BITH_VC_0319_297 | CEGL003609 | *Pinus palustris* - *Pinus* (*echinata*, *taeda*) / (*Liquidambar styraciflua*) / *Schizachyrium scoparium* Ruderal Woodland |
| BITH_VC_0319_298 | CEGL007162 | *Pinus palustris* / *Morella cerifera* - *Morella caroliniensis* - *Ilex coriacea* Ruderal Wet Woodland |
| BITH_VC_0319_299 | CEGL007162 | *Pinus palustris* / *Morella cerifera* - *Morella caroliniensis* - *Ilex coriacea* Ruderal Wet Woodland |
| BITH_VC_0319_300 | CEGL007162 | *Pinus palustris* / *Morella cerifera* - *Morella caroliniensis* - *Ilex coriacea* Ruderal Wet Woodland |
| BITH_VC_0319_301 | CEGL004638 | *Quercus nigra* Ruderal Forest |
| BITH_VC_0319_302 | CEGL007069 | *Pinus taeda* - (*Pinus echinata*) - *Quercus* (*pagoda*, *phellos*) Wet Woodland |
| BITH_VC_0319_303 | CEGL004638 | *Quercus nigra* Ruderal Forest |
| BITH_VC_0319_304 | CEGL007162 | *Pinus palustris* / *Morella cerifera* - *Morella caroliniensis* - *Ilex coriacea* Ruderal Wet Woodland |
| BITH_VC_0319_305 | CEGL007069 | *Pinus taeda* - (*Pinus echinata*) - *Quercus* (*pagoda*, *phellos*) Wet Woodland |
| BITH_VC_0319_336 | CEGL008571 | *Pinus palustris* - *Pinus* (*echinata*, *taeda*) - *Quercus falcata* - *Carya texana* Woodland |
| BITH_VC_0319_337 | CEGL008571 | *Pinus palustris* - *Pinus* (*echinata*, *taeda*) - *Quercus falcata* - *Carya texana* Woodland |
| BITH_VC_0319_338 | NPSBITH012 | *Pinus taeda* - *Magnolia grandiflora* - (*Fagus grandifolia*, *Quercus alba*, *Quercus falcata*) Flatwoods Forest |
| BITH_VC_0319_343 | NPSBITH012 | *Pinus taeda* - *Magnolia grandiflora* - (*Fagus grandifolia*, *Quercus alba*, *Quercus falcata*) Flatwoods Forest |
| BITH_VC_0319_370 | CEGL002421 | *Taxodium distichum* - (*Nyssa aquatica*) / *Forestiera acuminata* - *Planera aquatica* Floodplain Forest |
| BITH_VC_0319_371 | CEGL007525 | *Pinus taeda* - *Quercus alba* - (*Fagus grandifolia*) / *Smilax pumila* - *Mitchella repens* Forest |
| BITH_VC_0319_372 | CEGL007906 | *Quercus michauxii* - *Liquidambar styraciflua* - *Quercus texana* - *Quercus lyrata* Floodplain Forest |
| BITH_VC_0319_373 | CEGL007142 | *Pinus taeda* Riparian Forest |
| BITH_VC_0319_374 | CEGL007474 | *Nyssa biflora* - *Magnolia virginiana* - *Quercus laurifolia* / *Cyrilla racemiflora* - *Rhododendron oblongifolium* Swamp Forest |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_0319_375 | CEGL007906 | *Quercus michauxii* - *Liquidambar styraciflua* - *Quercus texana* - *Quercus lyrata* Floodplain Forest |
| BITH_VC_0319_376 | CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| BITH_VC_0319_377 | CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| BITH_VC_0319_378 | NPSBITH012 | *Pinus taeda* - *Magnolia grandiflora* - (*Fagus grandifolia*, *Quercus alba*, *Quercus falcata*) Flatwoods Forest |
| BITH_VC_0319_379 | CEGL007961 | *Quercus laurifolia* - *Quercus phellos* / *Viburnum dentatum* - (*Sebastiana fruticosa*) / *Carex fruticosa* Upper West Gulf Wet Flatwoods Forest |
| BITH_VC_0319_380 | CEGL007904 | *Magnolia virginiana* - *Nyssa sylvatica* - *Acer rubrum* / *Morella caroliniensis* / *Woodwardia areolata* Swamp Forest |
| BITH_VC_1001 | CEGL007984 | *Quercus nigra* - *Liquidambar styraciflua* / *Ilex opaca* - *Vaccinium fuscatum* / *Carex debilis* Floodplain Forest |
| BITH_VC_1002 | CEGL007910 | *Pinus taeda* - *Quercus phellos* - *Quercus nigra* Riparian Forest |
| BITH_VC_1003 | CEGL007955 | *Pinus taeda* - (*Quercus* spp.) / *Ostrya virginiana* - *Sabal minor* Forest |
| BITH_VC_1004 | CEGL007910 | *Pinus taeda* - *Quercus phellos* - *Quercus nigra* Riparian Forest |
| BITH_VC_1005 | CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| BITH_VC_1006 | CEGL007320 | *Fagus grandifolia* - *Pinus taeda* - (*Liquidambar styraciflua*, *Magnolia grandiflora*, *Quercus alba*) Small Stream Forest |
| BITH_VC_1007 | CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_1008 | CEGL002421 | *Taxodium distichum* - (*Nyssa aquatica*) / *Forestiera acuminata* - *Planera aquatica* Floodplain Forest |
| BITH_VC_1009 | CEGL008413 | *Quercus alba* - *Carya alba* / *Chasmanthium sessiliflorum* West Gulf Coastal Plain Forest |
| BITH_VC_1010 | CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| BITH_VC_1011 | CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_1012 | CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_1013 | CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_1014 | CEGL002419 | *Nyssa aquatica* Swamp Forest |
| BITH_VC_1015 | CEGL004638 | *Quercus nigra* Ruderal Forest |
| BITH_VC_1016 | CEGL007903 | *Magnolia grandiflora - Fagus grandifolia - Quercus alba - Pinus taeda* Forest |
| BITH_VC_1017 | CEGL008413 | *Quercus alba - Carya alba* / *Chasmanthium sessiliflorum* West Gulf Coastal Plain Forest |
| BITH_VC_1018 | CEGL007320 | *Fagus grandifolia - Pinus taeda* - (*Liquidambar styraciflua*, *Magnolia grandiflora*, *Quercus alba*) Small Stream Forest |
| BITH_VC_1019 | CEGL007903 | *Magnolia grandiflora - Fagus grandifolia - Quercus alba - Pinus taeda* Forest |
| BITH_VC_1020 | CEGL007320 | *Fagus grandifolia - Pinus taeda* - (*Liquidambar styraciflua*, *Magnolia grandiflora*, *Quercus alba*) Small Stream Forest |
| BITH_VC_1021 | CEGL007320 | *Fagus grandifolia - Pinus taeda* - (*Liquidambar styraciflua*, *Magnolia grandiflora*, *Quercus alba*) Small Stream Forest |
| BITH_VC_1022 | CEGL007474 | *Nyssa biflora - Magnolia virginiana - Quercus laurifolia* / *Cyrilla racemiflora - Rhododendron oblongifolium* Swamp Forest |
| BITH_VC_1023 | CEGL007903 | *Magnolia grandiflora - Fagus grandifolia - Quercus alba - Pinus taeda* Forest |
| BITH_VC_1024 | CEGL002112 | *Pinus taeda - Quercus stellata* / *Crataegus* spp. Woodland |
| BITH_VC_1025 | CEGL007901 | *Quercus michauxii - Quercus nigra - Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_1026 | CEGL007422 | *Taxodium distichum - Nyssa aquatica - Acer rubrum* / *Itea virginica* Floodplain Forest |
| BITH_VC_1027 | CEGL008413 | *Quercus alba - Carya alba* / *Chasmanthium sessiliflorum* West Gulf Coastal Plain Forest |
| BITH_VC_1028 | CEGL002112 | *Pinus taeda - Quercus stellata* / *Crataegus* spp. Woodland |
| BITH_VC_1029 | NPSBITH008 | *Acer rubrum* - (*Triadica sebifera*) / *Morella cerifera* Swamp Woodland |
| BITH_VC_1030 | CEGL008581 | *Quercus alba - Quercus nigra* / *Ostrya virginiana* / *Sabal minor* Forest |
| BITH_VC_1031 | CEGL007954 | *Quercus nigra - Quercus phellos* / *Carya myristiciformis - Sabal minor* / *Carex cherokeensis* Floodplain Forest |
| BITH_VC_1032 | CEGL007903 | *Magnolia grandiflora - Fagus grandifolia - Quercus alba - Pinus taeda* Forest |
| BITH_VC_1033 | CEGL002420 | *Taxodium distichum* / *Lemna minor* Floodplain Forest |
| BITH_VC_1034 | CEGL007845 | *Quercus alba - Quercus* (*michauxii*, *nigra*) / *Ilex opaca* / *Chasmanthium laxum* Forest |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_1035 | CEGL007910 | *Pinus taeda* - *Quercus phellos* - *Quercus nigra* Riparian Forest |
| BITH_VC_1036 | CEGL007525 | *Pinus taeda* - *Quercus alba* - (*Fagus grandifolia*) / *Smilax pumila* - *Mitchella repens* Forest |
| BITH_VC_1037 | CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| BITH_VC_1038 | CEGL008581 | *Quercus alba* - *Quercus nigra* / *Ostrya virginiana* / *Sabal minor* Forest |
| BITH_VC_1039 | CEGL007422 | *Taxodium distichum* - *Nyssa aquatica* - *Acer rubrum* / *Itea virginica* Floodplain Forest |
| BITH_VC_1040 | CEGL007422 | *Taxodium distichum* - *Nyssa aquatica* - *Acer rubrum* / *Itea virginica* Floodplain Forest |
| BITH_VC_1041 | CEGL004911 | *Pinus taeda* - *Liquidambar styraciflua* - *Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest |
| BITH_VC_1042 | CEGL007955 | *Pinus taeda* - (*Quercus* spp.) / *Ostrya virginiana* - *Sabal minor* Forest |
| BITH_VC_1043 | CEGL008581 | *Quercus alba* - *Quercus nigra* / *Ostrya virginiana* / *Sabal minor* Forest |
| BITH_VC_1044 | CEGL004911 | *Pinus taeda* - *Liquidambar styraciflua* - *Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest |
| BITH_VC_1045 | CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| BITH_VC_1046 | CEGL008413 | *Quercus alba* - *Carya alba* / *Chasmanthium sessiliflorum* West Gulf Coastal Plain Forest |
| BITH_VC_1047 | CEGL007984 | *Quercus nigra* - *Liquidambar styraciflua* / *Ilex opaca* - *Vaccinium fuscatum* / *Carex debilis* Floodplain Forest |
| BITH_VC_1048 | CEGL002419 | *Nyssa aquatica* Swamp Forest |
| BITH_VC_1049 | CEGL002419 | *Nyssa aquatica* Swamp Forest |
| BITH_VC_1050 | CEGL007142 | *Pinus taeda* Riparian Forest |
| BITH_VC_1051 | CEGL004753 | *Fraxinus caroliniana* Swamp Forest |
| BITH_VC_1052 | CEGL004911 | *Pinus taeda* - *Liquidambar styraciflua* - *Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest |
| BITH_VC_1053 | CEGL004911 | *Pinus taeda* - *Liquidambar styraciflua* - *Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest |
| BITH_VC_1054 | CEGL007525 | *Pinus taeda* - *Quercus alba* - (*Fagus grandifolia*) / *Smilax pumila* - *Mitchella repens* Forest |
| BITH_VC_1055 | CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_1056 | CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_1057 | CEGL004911 | *Pinus taeda* - *Liquidambar styraciflua* - *Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest |
| BITH_VC_1058 | CEGL004638 | *Quercus nigra* Ruderal Forest |
| BITH_VC_1059 | CEGL007422 | *Taxodium distichum* - *Nyssa aquatica* - *Acer rubrum* / *Itea virginica* Floodplain Forest |
| BITH_VC_1060 | CEGL007370 | *Quercus phellos* - *Liquidambar styraciflua* / *Ilex decidua* - *Carpinus caroliniana* / *Lysimachia radicans* Floodplain Forest |
| BITH_VC_1061 | CEGL004911 | *Pinus taeda* - *Liquidambar styraciflua* - *Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest |
| BITH_VC_1062 | CEGL007320 | *Fagus grandifolia* - *Pinus taeda* - (*Liquidambar styraciflua*, *Magnolia grandiflora*, *Quercus alba*) Small Stream Forest |
| BITH_VC_1063 | NPSBITH001 | *Quercus hemisphaerica* Shrubland |
| BITH_VC_1064 | CEGL007422 | *Taxodium distichum* - *Nyssa aquatica* - *Acer rubrum* / *Itea virginica* Floodplain Forest |
| BITH_VC_1065 | CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_1066 | CEGL002420 | *Taxodium distichum* / *Lemna minor* Floodplain Forest |
| BITH_VC_1067 | CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_1068 | – | – |
| BITH_VC_1069 | CEGL007953 | *Quercus nigra* - *Ulmus* alata / *Ostrya virginiana* Floodplain Forest |
| BITH_VC_1070 | CEGL007162 | *Pinus palustris* / *Morella cerifera* - *Morella caroliniensis* - *Ilex coriacea* Ruderal Wet Woodland |
| BITH_VC_1071 | CEGL007142 | *Pinus taeda* Riparian Forest |
| BITH_VC_1072 | CEGL007910 | *Pinus taeda* - *Quercus phellos* - *Quercus nigra* Riparian Forest |
| BITH_VC_1073 | CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_1074 | CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_1075 | CEGL004911 | *Pinus taeda* - *Liquidambar styraciflua* - *Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest |
| BITH_VC_1076 | CEGL008413 | *Quercus alba* - *Carya alba* / *Chasmanthium sessiliflorum* West Gulf Coastal Plain Forest |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_1077 | CEGL007525 | *Pinus taeda* - *Quercus alba* - (*Fagus grandifolia*) / *Smilax pumila* - *Mitchella repens* Forest |
| BITH_VC_1078 | CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| BITH_VC_1079 | CEGL008413 | *Quercus alba* - *Carya alba* / *Chasmanthium sessiliflorum* West Gulf Coastal Plain Forest |
| BITH_VC_1080 | CEGL007525 | *Pinus taeda* - *Quercus alba* - (*Fagus grandifolia*) / *Smilax pumila* - *Mitchella repens* Forest |
| BITH_VC_1081 | CEGL004911 | *Pinus taeda* - *Liquidambar styraciflua* - *Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest |
| BITH_VC_1082 | CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_1083 | CEGL008581 | *Quercus alba* - *Quercus nigra* / *Ostrya virginiana* / *Sabal minor* Forest |
| BITH_VC_1084 | CEGL007955 | *Pinus taeda* - (*Quercus* spp.) / *Ostrya virginiana* - *Sabal minor* Forest |
| BITH_VC_1085 | CEGL007955 | *Pinus taeda* - (*Quercus* spp.) / *Ostrya virginiana* - *Sabal minor* Forest |
| BITH_VC_1086 | CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_1087 | CEGL007142 | *Pinus taeda* Riparian Forest |
| BITH_VC_1088 | CEGL007422 | *Taxodium distichum* - *Nyssa aquatica* - *Acer rubrum* / *Itea virginica* Floodplain Forest |
| BITH_VC_1089 | NPSBITH003 | Sparganium androcladum - Sparganium americanum Marsh |
| BITH_VC_1090 | CEGL007335 | *Platanus occidentalis* - *Liquidambar styraciflua* - (*Ulmus americana*) / (*Crataegus viridis*) Floodplain Forest |
| BITH_VC_1091 | CEGL007397 | *Quercus lyrata* - *Carya aquatica* Floodplain Forest |
| BITH_VC_1092 | CEGL004638 | *Quercus nigra* Ruderal Forest |
| BITH_VC_1093 | CEGL002112 | *Pinus taeda* - *Quercus stellata* / *Crataegus* spp. Woodland |
| BITH_VC_1094 | CEGL002104 | *Taxodium distichum* - *Platanus occidentalis* Edwards Plateau Floodplain Forest |
| BITH_VC_1095 | CEGL002112 | *Pinus taeda* - *Quercus stellata* / *Crataegus* spp. Woodland |
| BITH_VC_1096 | CEGL007906 | *Quercus michauxii* - *Liquidambar styraciflua* - *Quercus texana* - *Quercus lyrata* Floodplain Forest |
| BITH_VC_1097 | CEGL008581 | *Quercus alba* - *Quercus nigra* / *Ostrya virginiana* / *Sabal minor* Forest |
| BITH_VC_1098 | CEGL007804 | *Quercus laurifolia* - *Liquidambar styraciflua* - *Nyssa biflora* - *Acer rubrum* / *Sabal minor* Floodplain Forest |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_1099 | CEGL007037 | *Triadica sebifera* Ruderal Forest |
| BITH_VC_1100 | CEGL004773 | *Salix nigra* / (*Cephalanthus occidentalis*) Swamp Forest |
| BITH_VC_1101 | CEGL007037 | *Triadica sebifera* Ruderal Forest |
| BITH_VC_1102 | CEGL007397 | *Quercus lyrata - Carya aquatica* Floodplain Forest |
| BITH_VC_1103 | CEGL007901 | *Quercus michauxii - Quercus nigra - Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_1104 | CEGL007397 | *Quercus lyrata - Carya aquatica* Floodplain Forest |
| BITH_VC_1105 | CEGL004638 | *Quercus nigra* Ruderal Forest |
| BITH_VC_1106 | CEGL007397 | *Quercus lyrata - Carya aquatica* Floodplain Forest |
| BITH_VC_1107 | CEGL007397 | *Quercus lyrata - Carya aquatica* Floodplain Forest |
| BITH_VC_1108 | CEGL007410 | *Salix nigra* - (*Platanus occidentalis*, *Populus deltoides*) Southern Floodplain Forest |
| BITH_VC_1109 | CEGL007397 | *Quercus lyrata - Carya aquatica* Floodplain Forest |
| BITH_VC_1110 | CEGL007901 | *Quercus michauxii - Quercus nigra - Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_1111 | CEGL007370 | *Quercus phellos - Liquidambar styraciflua* / *Ilex decidua - Carpinus caroliniana* / *Lysimachia radicans* Floodplain Forest |
| BITH_VC_1112 | CEGL007397 | *Quercus lyrata - Carya aquatica* Floodplain Forest |
| BITH_VC_1113 | CEGL002419 | *Nyssa aquatica* Swamp Forest |
| BITH_VC_1114 | CEGL007142 | *Pinus taeda* Riparian Forest |
| BITH_VC_1115 | CEGL007901 | *Quercus michauxii - Quercus nigra - Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_1116 | CEGL002419 | *Nyssa aquatica* Swamp Forest |
| BITH_VC_1117 | CEGL007910 | *Pinus taeda - Quercus phellos - Quercus nigra* Riparian Forest |
| BITH_VC_1118 | CEGL007984 | *Quercus nigra - Liquidambar styraciflua* / *Ilex opaca - Vaccinium fuscatum* / *Carex debilis* Floodplain Forest |
| BITH_VC_1119 | CEGL007984 | *Quercus nigra - Liquidambar styraciflua* / *Ilex opaca - Vaccinium fuscatum* / *Carex debilis* Floodplain Forest |
| BITH_VC_2001 | CEGL004638 | *Quercus nigra* Ruderal Forest |
| BITH_VC_2002 | CEGL007903 | *Magnolia grandiflora - Fagus grandifolia - Quercus alba - Pinus taeda* Forest |
| BITH_VC_2003 | CEGL003530 | (*Magnolia virginiana*) / *Ilex coriacea - Morella caroliniensis* Seepage Bog |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_2004 | CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| BITH_VC_2005 | CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| BITH_VC_2006 | CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| BITH_VC_2007 | CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| BITH_VC_2008 | CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| BITH_VC_2009 | CEGL007162 | *Pinus palustris* / *Morella cerifera* - *Morella caroliniensis* - *Ilex coriacea* Ruderal Wet Woodland |
| BITH_VC_2010 | CEGL002419 | *Nyssa aquatica* Swamp Forest |
| BITH_VC_2011 | CEGL007162 | *Pinus palustris* / *Morella cerifera* - *Morella caroliniensis* - *Ilex coriacea* Ruderal Wet Woodland |
| BITH_VC_2012 | CEGL007162 | *Pinus palustris* / *Morella cerifera* - *Morella caroliniensis* - *Ilex coriacea* Ruderal Wet Woodland |
| BITH_VC_2013 | CEGL007162 | *Pinus palustris* / *Morella cerifera* - *Morella caroliniensis* - *Ilex coriacea* Ruderal Wet Woodland |
| BITH_VC_2014 | CEGL007162 | *Pinus palustris* / *Morella cerifera* - *Morella caroliniensis* - *Ilex coriacea* Ruderal Wet Woodland |
| BITH_VC_2015 | CEGL007162 | *Pinus palustris* / *Morella cerifera* - *Morella caroliniensis* - *Ilex coriacea* Ruderal Wet Woodland |
| BITH_VC_2016 | CEGL007961 | *Quercus laurifolia* - *Quercus phellos* / *Viburnum dentatum* - (*Sebastiana fruticosa*) / *Carex fruticosa* Upper West Gulf Wet Flatwoods Forest |
| BITH_VC_2017 | CEGL007525 | *Pinus taeda* - *Quercus alba* - (*Fagus grandifolia*) / *Smilax pumila* - *Mitchella repens* Forest |
| BITH_VC_2018 | CEGL007335 | *Platanus occidentalis* - *Liquidambar styraciflua* - (*Ulmus americana*) / (*Crataegus viridis*) Floodplain Forest |
| BITH_VC_2019 | CEGL007525 | *Pinus taeda* - *Quercus alba* - (*Fagus grandifolia*) / *Smilax pumila* - *Mitchella repens* Forest |
| BITH_VC_2020 | CEGL007984 | *Quercus nigra* - *Liquidambar styraciflua* / *Ilex opaca* - *Vaccinium fuscatum* / *Carex debilis* Floodplain Forest |
| BITH_VC_2021 | CEGL002421 | *Taxodium distichum* - (*Nyssa aquatica*) / *Forestiera acuminata* - *Planera aquatica* Floodplain Forest |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_2022 | CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_2023 | CEGL004638 | *Quercus nigra* Ruderal Forest |
| BITH_VC_2024 | CEGL004638 | *Quercus nigra* Ruderal Forest |
| BITH_VC_2025 | CEGL002421 | *Taxodium distichum* - (*Nyssa aquatica*) / *Forestiera acuminata* - *Planera aquatica* Floodplain Forest |
| BITH_VC_2026 | CEGL007961 | *Quercus laurifolia* - *Quercus phellos* / *Viburnum dentatum* - (*Sebastiana fruticosa*) / *Carex fruticosa* Upper West Gulf Wet Flatwoods Forest |
| BITH_VC_2027 | CEGL007984 | *Quercus nigra* - *Liquidambar styraciflua* / *Ilex opaca* - *Vaccinium fuscatum* / *Carex debilis* Floodplain Forest |
| BITH_VC_2028 | CEGL007955 | *Pinus taeda* - (*Quercus* spp.) / *Ostrya virginiana* - *Sabal minor* Forest |
| BITH_VC_2029 | CEGL007804 | *Quercus laurifolia* - *Liquidambar styraciflua* - *Nyssa biflora* - *Acer rubrum* / *Sabal minor* Floodplain Forest |
| BITH_VC_2030 | CEGL007961 | *Quercus laurifolia* - *Quercus phellos* / *Viburnum dentatum* - (*Sebastiana fruticosa*) / *Carex fruticosa* Upper West Gulf Wet Flatwoods Forest |
| BITH_VC_2031 | NPSBITH012 | *Pinus taeda* - *Magnolia grandiflora* - (*Fagus grandifolia*, *Quercus alba*, *Quercus falcata*) Flatwoods Forest |
| BITH_VC_2032 | CEGL007910 | *Pinus taeda* - *Quercus phellos* - *Quercus nigra* Riparian Forest |
| BITH_VC_2033 | CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| BITH_VC_2034 | CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| BITH_VC_2035 | CEGL007904 | *Magnolia virginiana* - *Nyssa sylvatica* - *Acer rubrum* / *Morella caroliniensis* / *Woodwardia areolata* Swamp Forest |
| BITH_VC_2036 | CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| BITH_VC_2037 | CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| BITH_VC_2038 | CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_2039 | CEGL007910 | *Pinus taeda* - *Quercus phellos* - *Quercus nigra* Riparian Forest |
| BITH_VC_2040 | CEGL002420 | *Taxodium distichum* / *Lemna minor* Floodplain Forest |
| BITH_VC_2041 | CEGL004911 | *Pinus taeda* - *Liquidambar styraciflua* - *Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_2042 | CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_2043 | CST007179 | *Pinus taeda* Forest Plantation |
| BITH_VC_2044 | CST007179 | *Pinus taeda* Forest Plantation |
| BITH_VC_2045 | CEGL007910 | *Pinus taeda* - *Quercus phellos* - *Quercus nigra* Riparian Forest |
| BITH_VC_2046 | CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_2047 | CEGL007320 | *Fagus grandifolia* - *Pinus taeda* - (*Liquidambar styraciflua*, *Magnolia grandiflora*, *Quercus alba*) Small Stream Forest |
| BITH_VC_2048 | CEGL007904 | *Magnolia virginiana* - *Nyssa sylvatica* - *Acer rubrum* / *Morella caroliniensis* / *Woodwardia areolata* Swamp Forest |
| BITH_VC_2049 | CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_2050 | CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_2051 | CEGL007906 | *Quercus michauxii* - *Liquidambar styraciflua* - *Quercus texana* - *Quercus lyrata* Floodplain Forest |
| BITH_VC_2052 | CEGL007422 | *Taxodium distichum* - *Nyssa aquatica* - *Acer rubrum* / *Itea virginica* Floodplain Forest |
| BITH_VC_2053 | CEGL007037 | *Triadica sebifera* Ruderal Forest |
| BITH_VC_2054 | CEGL007422 | *Taxodium distichum* - *Nyssa aquatica* - *Acer rubrum* / *Itea virginica* Floodplain Forest |
| BITH_VC_2055 | NPSBITH006 | *Liquidambar styraciflua* Ruderal Forest |
| BITH_VC_2056 | CEGL007955 | *Pinus taeda* - (*Quercus* spp.) / *Ostrya virginiana* - *Sabal minor* Forest |
| BITH_VC_2057 | CEGL007961 | *Quercus laurifolia* - *Quercus phellos* / *Viburnum dentatum* - (*Sebastiana fruticosa*) / *Carex fruticosa* Upper West Gulf Wet Flatwoods Forest |
| BITH_VC_2058 | CEGL004911 | *Pinus taeda* - *Liquidambar styraciflua* - *Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest |
| BITH_VC_2059 | CEGL008413 | *Quercus alba* - *Carya alba* / *Chasmanthium sessiliflorum* West Gulf Coastal Plain Forest |
| BITH_VC_2060 | CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_2061 | CEGL002420 | *Taxodium distichum* / *Lemna minor* Floodplain Forest |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_2062 | CEGL004911 | *Pinus taeda* - *Liquidambar styraciflua* - *Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest |
| BITH_VC_2063 | CEGL004638 | *Quercus nigra* Ruderal Forest |
| BITH_VC_2064 | NPSBITH001 | *Quercus hemisphaerica* Shrubland |
| BITH_VC_2065 | NPSBITH017 | *Pinus taeda* Regenerating Plantation Shrubland |
| BITH_VC_2066 | CEGL007901 | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest |
| BITH_VC_2067 | CEGL007961 | *Quercus laurifolia* - *Quercus phellos* / *Viburnum dentatum* - (*Sebastiana fruticosa*) / *Carex fruticosa* Upper West Gulf Wet Flatwoods Forest |
| BITH_VC_2068 | CEGL007845 | *Quercus alba* - *Quercus* (*michauxii*, *nigra*) / *Ilex opaca* / *Chasmanthium laxum* Forest |
| BITH_VC_2069 | CEGL007904 | *Magnolia virginiana* - *Nyssa sylvatica* - *Acer rubrum* / *Morella caroliniensis* / *Woodwardia areolata* Swamp Forest |
| BITH_VC_2070 | CEGL007961 | *Quercus laurifolia* - *Quercus phellos* / *Viburnum dentatum* - (*Sebastiana fruticosa*) / *Carex fruticosa* Upper West Gulf Wet Flatwoods Forest |
| BITH_VC_2071 | CEGL004911 | *Pinus taeda* - *Liquidambar styraciflua* - *Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest |
| BITH_VC_2072 | CEGL007961 | *Quercus laurifolia* - *Quercus phellos* / *Viburnum dentatum* - (*Sebastiana fruticosa*) / *Carex fruticosa* Upper West Gulf Wet Flatwoods Forest |
| BITH_VC_2073 | CEGL007422 | *Taxodium distichum* - *Nyssa aquatica* - *Acer rubrum* / *Itea virginica* Floodplain Forest |
| BITH_VC_2074 | CEGL007142 | *Pinus taeda* Riparian Forest |
| BITH_VC_2075 | CEGL004911 | *Pinus taeda* - *Liquidambar styraciflua* - *Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest |
| BITH_VC_2076 | CEGL007955 | *Pinus taeda* - (*Quercus* spp.) / *Ostrya virginiana* - *Sabal minor* Forest |
| BITH_VC_2077 | CEGL008581 | *Quercus alba* - *Quercus nigra* / *Ostrya virginiana* / *Sabal minor* Forest |
| BITH_VC_2078 | CEGL006011 | *Pinus taeda* / *Liquidambar styraciflua* - *Acer rubrum* / *Vaccinium stamineum* Ruderal Forest |
| BITH_VC_2079 | CEGL007037 | *Triadica sebifera* Ruderal Forest |
| BITH_VC_2080 | CEGL007715 | *Quercus michauxii* - *Quercus* (*nigra*, *pagoda*) - *Liquidambar styraciflua* - *Pinus taeda* Wet Forest |
| BITH_VC_2081 | CEGL007910 | *Pinus taeda* - *Quercus phellos* - *Quercus nigra* Riparian Forest |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_2082 | CEGL007910 | *Pinus taeda* - *Quercus phellos* - *Quercus nigra* Riparian Forest |
| BITH_VC_2083 | CEGL007984 | *Quercus nigra* - *Liquidambar styraciflua* / *Ilex opaca* - *Vaccinium fuscatum* / *Carex debilis* Floodplain Forest |
| BITH_VC_2084 | CEGL003609 | *Pinus palustris* - *Pinus* (*echinata*, *taeda*) / (*Liquidambar styraciflua*) / *Schizachyrium scoparium* Ruderal Woodland |
| BITH_VC_2085 | CEGL006011 | *Pinus taeda* / *Liquidambar styraciflua* - *Acer rubrum* / *Vaccinium stamineum* Ruderal Forest |
| BITH_VC_2086 | CEGL007037 | *Triadica sebifera* Ruderal Forest |
| BITH_VC_2087 | CEGL007984 | *Quercus nigra* - *Liquidambar styraciflua* / *Ilex opaca* - *Vaccinium fuscatum* / *Carex debilis* Floodplain Forest |
| BITH_VC_2088 | CEGL004773 | *Salix nigra* / (*Cephalanthus occidentalis*) Swamp Forest |
| BITH_VC_2089 | CEGL007370 | *Quercus phellos* - *Liquidambar styraciflua* / *Ilex decidua* - *Carpinus caroliniana* / *Lysimachia radicans* Floodplain Forest |
| BITH_VC_2090 | CEGL007370 | *Quercus phellos* - *Liquidambar styraciflua* / *Ilex decidua* - *Carpinus caroliniana* / *Lysimachia radicans* Floodplain Forest |
| BITH_VC_2091 | CEGL007903 | *Magnolia grandiflora* - *Fagus grandifolia* - *Quercus alba* - *Pinus taeda* Forest |
| BITH_VC_2092 | CEGL007037 | *Triadica sebifera* Ruderal Forest |
| BITH_VC_2093 | CEGL007397 | *Quercus lyrata* - *Carya aquatica* Floodplain Forest |
| BITH_VC_2094 | CEGL002420 | *Taxodium distichum* / *Lemna minor* Floodplain Forest |
| BITH_VC_2095 | CEGL007370 | *Quercus phellos* - *Liquidambar styraciflua* / *Ilex decidua* - *Carpinus caroliniana* / *Lysimachia radicans* Floodplain Forest |
| BITH_VC_2096 | – | – |
| BITH_VC_2097 | CEGL007910 | *Pinus taeda* - *Quercus phellos* - *Quercus nigra* Riparian Forest |
| BITH_VC_2098 | CEGL007410 | *Salix nigra* - (*Platanus occidentalis*, *Populus deltoides*) Southern Floodplain Forest |
| BITH_VC_2099 | CEGL007335 | *Platanus occidentalis* - *Liquidambar styraciflua* - (*Ulmus americana*) / (*Crataegus viridis*) Floodplain Forest |
| BITH_VC_2100 | CEGL007397 | *Quercus lyrata* - *Carya aquatica* Floodplain Forest |
| BITH_VC_2101 | CEGL002420 | *Taxodium distichum* / *Lemna minor* Floodplain Forest |
| BITH_VC_2102 | CEGL004773 | *Salix nigra* / (*Cephalanthus occidentalis*) Swamp Forest |
| BITH_VC_2103 | CEGL007410 | *Salix nigra* - (*Platanus occidentalis*, *Populus deltoides*) Southern Floodplain Forest |
| BITH_VC_2104 | CEGL007910 | *Pinus taeda* - *Quercus phellos* - *Quercus nigra* Riparian Forest |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_2105 | CEGL004911 | *Pinus taeda* - *Liquidambar styraciflua* - *Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest |
| BITH_VC_2106 | CEGL007335 | *Platanus occidentalis* - *Liquidambar styraciflua* - (*Ulmus americana*) / (*Crataegus viridis*) Floodplain Forest |
| BITH_VC_2107 | CEGL002420 | *Taxodium distichum* / *Lemna minor* Floodplain Forest |
| BITH_VC_2108 | CEGL007335 | *Platanus occidentalis* - *Liquidambar styraciflua* - (*Ulmus americana*) / (*Crataegus viridis*) Floodplain Forest |
| BITH_VC_2109 | CEGL007335 | *Platanus occidentalis* - *Liquidambar styraciflua* - (*Ulmus americana*) / (*Crataegus viridis*) Floodplain Forest |
| BITH_VC_2110 | CEGL002420 | *Taxodium distichum* / *Lemna minor* Floodplain Forest |
| BITH_VC_2111 | CEGL007397 | *Quercus lyrata* - *Carya aquatica* Floodplain Forest |
| BITH_VC_2112 | CEGL004911 | *Pinus taeda* - *Liquidambar styraciflua* - *Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest |
| BITH_VC_2113 | CEGL007335 | *Platanus occidentalis* - *Liquidambar styraciflua* - (*Ulmus americana*) / (*Crataegus viridis*) Floodplain Forest |
| BITH_VC_2114 | CEGL007335 | *Platanus occidentalis* - *Liquidambar styraciflua* - (*Ulmus americana*) / (*Crataegus viridis*) Floodplain Forest |
| BITH_VC_2115 | CEGL004911 | *Pinus taeda* - *Liquidambar styraciflua* - *Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest |
| BITH_VC_3001 | NPSBITH014 | *Xyris fimbriata* Upland Marsh |
| BITH_VC_3002 | CEGL002386 | *Nuphar advena* - *Nymphaea odorata* Aquatic Vegetation |
| BITH_VC_3003 | CEGL002427 | *Fraxinus pennsylvanica* - *Ulmus americana* - *Celtis laevigata* / *Ilex decidua* Floodplain Forest |
| BITH_VC_3006 | NPSBITH017 | *Pinus taeda* Regenerating Plantation Shrubland |
| BITH_VC_3007 | CEGL007751 | *Quercus hemisphaerica* - *Quercus* (*falcata*, *nigra*) / *Vaccinium arboreum* / *Cnidoscolus stimulosus* Forest |
| BITH_VC_3011 | NPSBITH018 | *Cyrilla racemiflora* Seepage Bog Shrubland |
| BITH_VC_3015 | NSPBITH018 | *Cyrilla racemiflora* Seepage Bog Shrubland |
| BITH_VC_3016 | CEGL008571 | *Pinus palustris* - *Pinus* (*echinata*, *taeda*) - *Quercus falcata* - *Carya texana* Woodland |
| BITH_VC_3017 | NPSBITH016 | *Pinus* spp. (*taeda*, *echinata*, *elliottii*, *palustris*) Regenerating Woodland and Shrubland |
| BITH_VC_3020 | NPSBITH013 | *Nyssa aquatica* - (*Taxodium distichum*) / *Zizaniopsis miliacea* Marsh Woodland |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_3021 | NPSBITH013 | *Nyssa aquatica* - (*Taxodium distichum*) / *Zizaniopsis miliacea* Marsh Woodland |
| BITH_VC_3024 | CEGL002386 | *Nuphar advena* - *Nymphaea odorata* Aquatic Vegetation |
| BITH_VC_3025a | CEGL008571 | *Pinus palustris* - *Pinus* (*echinata*, *taeda*) - *Quercus falcata* - *Carya texana* Woodland |
| BITH_VC_4001 | CEGL008571 | *Pinus palustris* - *Pinus* (*echinata*, *taeda*) - *Quercus falcata* - *Carya texana* Woodland |
| BITH_VC_4004 | CEGL003530 | (*Magnolia virginiana*) / *Ilex coriacea* - *Morella caroliniensis* Seepage Bog |
| BITH_VC_4009 | CEGL003530 | (*Magnolia virginiana*) / *Ilex coriacea* - *Morella caroliniensis* Seepage Bog |
| BITH_VC_4011 | NPSBITH017 | *Pinus taeda* Regenerating Plantation Shrubland |
| BITH_VC_4012 | CEGL007142 | *Pinus taeda* Riparian Forest |
| BITH_VC_4014 | CEGL003911 | *Forestiera acuminata* - (*Planera aquatica*, *Cephalanthus occidentalis*) Floodplain Scrub |
| BITH_VC_4014a | CEGL004705 | *Zizaniopsis miliacea* Tidal Marsh |
| BITH_VC_4015 | CEGL004705 | *Zizaniopsis miliacea* Tidal Marsh |
| BITH_VC_4016 | CEGL004705 | *Zizaniopsis miliacea* Tidal Marsh |
| BITH_VC_4017 | CEGL003858 | *Alternanthera philoxeroides* Ruderal Aquatic Vegetation |
| BITH_VC_4018 | CEGL007895 | *Zizaniopsis miliacea* - *Panicum hemitomon* Tidal Marsh |
| BITH_VC_4036 | CEGL002191 | *Cephalanthus occidentalis* / *Carex* spp. - *Lemna* spp. Southern Shrub Swamp |
| BITH_VC_4050 | CEGL004753 | *Fraxinus caroliniana* Swamp Forest |
| BITH_VC_4051 | CEGL004753 | *Fraxinus caroliniana* Swamp Forest |
| BITH_VC_4053 | CEGL007412 | *Triadica sebifera* Ruderal Wet Forest |
| BITH_VC_4054 | CEGL007930 | *Schizachyrium scoparium* - *Rudbeckia missouriensis* - *Grindelia lanceolata* - (*Liatris mucronata*) Grassland |
| BITH_VC_6001 | NPSBITH017 | *Pinus taeda* Regenerating Plantation Shrubland |
| BITH_VC_6002 | NPSBITH012 | *Pinus taeda* - *Magnolia grandiflora* - (*Fagus grandifolia*, *Quercus alba*, *Quercus falcata*) Flatwoods Forest |
| BITH_VC_6003 | CEGL008587 | *Quercus stellata* - *Pinus taeda* Flatwoods Wet Forest |
| BITH_VC_6004 | NPSBITH001 | *Quercus hemisphaerica* Shrubland |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_6006 | NPSBITH012 | *Pinus taeda* - *Magnolia grandiflora* - (*Fagus grandifolia*, *Quercus alba*, *Quercus falcata*) Flatwoods Forest |
| BITH_VC_6008 | CEGL004638 | *Quercus nigra* Ruderal Forest |
| BITH_VC_6009a | NPSBITH012 | *Pinus taeda* - *Magnolia grandiflora* - (*Fagus grandifolia*, *Quercus alba*, *Quercus falcata*) Flatwoods Forest |
| BITH_VC_6009b | – | – |
| BITH_VC_6009c | CEGL007845 | *Quercus alba* - *Quercus* (*michauxii*, *nigra*) / *Ilex opaca* / *Chasmanthium laxum* Forest |
| BITH_VC_6010 | CEGL007320 | *Fagus grandifolia* - *Pinus taeda* - (*Liquidambar styraciflua*, *Magnolia grandiflora*, *Quercus alba*) Small Stream Forest |
| BITH_VC_6011 | NPSBITH025 | *Nyssa biflora* - *Acer rubrum* - (*Triadica sebifera*) / *Morella cerifera* / *Saccharum giganteum* Swamp Woodland |
| BITH_VC_6012 | NPSBITH007 | *Acer rubrum* Floodplain Forest |
| BITH_VC_6013 | NPSBITH008 | *Acer rubrum* - (*Triadica sebifera*) / *Morella cerifera* Swamp Woodland |
| BITH_VC_6014 | NPSBITH008 | *Acer rubrum* - (*Triadica sebifera*) / *Morella cerifera* Swamp Woodland |
| BITH_VC_6020 | NPSBITH015 | *Ilex coriacea* - *Prunus caroliniana* Dense Evergreen Forest and Shrubland |
| BITH_VC_6022 | NPSBITH002 | *Betula nigra* Mixed Hardwood Riverine Forest |
| BITH_VC_6023 | CEGL004921 | *Panicum virgatum* - *Panicum rigidulum* var. *elongatum* - *Polygonum* hydropiperoides Wet Meadow |
| BITH_VC_6025 | CEGL004921 | *Panicum virgatum* - *Panicum rigidulum* var. *elongatum* - *Polygonum* hydropiperoides Wet Meadow |
| BITH_VC_6026 | CEGL007142 | *Pinus taeda* Riparian Forest |
| BITH_VC_6027a | CEGL008571 | *Pinus palustris* - *Pinus* (*echinata*, *taeda*) - *Quercus falcata* - *Carya texana* Woodland |
| BITH_VC_6027b | NPSBITH021 | Sparse Cliff Vegetation |
| BITH_VC_6028 | CST007170 | *Pinus elliottii* var. *elliottii* Forest Plantation |
| BITH_VC_6030 | CEGL007895 | *Zizaniopsis miliacea* - *Panicum hemitomon* Tidal Marsh |
| BITH_VC_6031 | CEGL003858 | *Alternanthera philoxeroides* Ruderal Aquatic Vegetation |
| BITH_VC_6033 | CEGL004705 | *Zizaniopsis miliacea* Tidal Marsh |
| BITH_VC_6034 | CEGL002420 | *Taxodium distichum* / *Lemna minor* Floodplain Forest |
| BITH_VC_6035 | NPSBITH011 | *Schoenoplectus tabernaemontani* Brackish Marsh |
| BITH_VC_6036 | NPSBITH011 | *Schoenoplectus tabernaemontani* Brackish Marsh |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_6037 | CEGL003858 | *Alternanthera philoxeroides* Ruderal Aquatic Vegetation |
| BITH_VC_6038 | NPSBITH011 | *Schoenoplectus tabernaemontani* Brackish Marsh |
| BITH_VC_6039 | CEGL003858 | *Alternanthera philoxeroides* Ruderal Aquatic Vegetation |
| BITH_VC_6041 | NPSBITH011 | *Schoenoplectus tabernaemontani* Brackish Marsh |
| BITH_VC_6042 | CEGL007065 | *Taxodium distichum* / *Morella cerifera* / *Thelypteris palustris* Tidal Woodland |
| BITH_VC_6043 | CEGL007065 | *Taxodium distichum* / *Morella cerifera* / *Thelypteris palustris* Tidal Woodland |
| BITH_VC_6044a | NPSBITH011 | *Schoenoplectus tabernaemontani* Brackish Marsh |
| BITH_VC_6044b | CEGL007162 | *Pinus palustris* / *Morella cerifera - Morella caroliniensis - Ilex coriacea* Ruderal Wet Woodland |
| BITH_VC_6046 | CEGL007895 | *Zizaniopsis miliacea - Panicum hemitomon* Tidal Marsh |
| BITH_VC_6050_HS | CEGL007162 | *Pinus palustris* / *Morella cerifera - Morella caroliniensis - Ilex coriacea* Ruderal Wet Woodland |
| BITH_VC_6051_HS | – | – |
| BITH_VC_6052_ HS | – | – |
| BITH_VC_7001 | CEGL002191 | *Cephalanthus occidentalis* / *Carex* spp. - *Lemna* spp. Southern Shrub Swamp |
| BITH_VC_7002 | CEGL007715 | *Quercus michauxii* - *Quercus* (*nigra*, *pagoda*) - *Liquidambar styraciflua* - *Pinus taeda* Wet Forest |
| BITH_VC_7003 | CEGL007069 | *Pinus taeda* - (*Pinus echinata*) - *Quercus* (*pagoda*, *phellos*) Wet Woodland |
| BITH_VC_7004 | CEGL007142 | *Pinus taeda* Riparian Forest |
| BITH_VC_7005 | CST007179 | *Pinus taeda* Forest Plantation |
| BITH_VC_7006 | CEGL002191 | *Cephalanthus occidentalis* / *Carex* spp. - *Lemna* spp. Southern Shrub Swamp |
| BITH_VC_7007 | CEGL007528 | *Pinus taeda* - (*Pinus echinata*) - *Quercus falcata* - *Carya texana* / *Vaccinium arboreum* Forest |
| BITH_VC_7008 | NPSBITH016 | *Pinus* spp. (*taeda*, *echinata*, *elliottii*, *palustris*) Regenerating Woodland and Shrubland |
| BITH_VC_7009 | CEGL007115 | *Pinus taeda* - *Pinus echinata* / *Chasmanthium sessiliflorum* Ruderal Forest |
| BITH_VC_7010 | CEGL007800 | *Pinus echinata* - *Quercus stellata* - *Quercus falcata* - *Carya texana* Woodland |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_7011 | CEGL008415 | *Quercus falcata* - *Quercus stellata* - (*Pinus taeda*) West Gulf Coastal Plain Forest |
| BITH_VC_7012 | CEGL007845 | *Quercus alba* - *Quercus* (*michauxii*, *nigra*) / *Ilex opaca* / *Chasmanthium laxum* Forest |
| BITH_VC_7013 | CEGL007751 | *Quercus hemisphaerica* - *Quercus* (*falcata*, *nigra*) / *Vaccinium arboreum* / *Cnidoscolus stimulosus* Forest |
| BITH_VC_7014 | NPSBITH005 | *Juncus effusus* Ruderal Marsh |
| BITH_VC_7015 | NPSBITH012 | *Pinus taeda* - *Magnolia grandiflora* - (*Fagus grandifolia*, *Quercus alba*, *Quercus falcata*) Flatwoods Forest |
| BITH_VC_7016a | CEGL007872 | *Fagus grandifolia* - *Magnolia grandiflora* - *Quercus alba* / *Carpinus caroliniana* - *Ostrya virginiana* Forest |
| BITH_VC_7016b | CEGL007474 | *Nyssa biflora* - *Magnolia virginiana* - *Quercus laurifolia* / *Cyrilla racemiflora* - *Rhododendron oblongifolium* Swamp Forest |
| BITH_VC_7018 | NPSBITH025 | *Nyssa biflora* - *Acer rubrum* - (*Triadica sebifera*) / *Morella cerifera* / *Saccharum giganteum* Swamp Woodland |
| BITH_VC_7019 | NPSBITH022 | *Morella cerifera* - *Ilex* vomitoria Wet Meadow Shrubland |
| BITH_VC_7020 | NPSBITH022 | *Morella cerifera* - *Ilex* vomitoria Wet Meadow Shrubland |
| BITH_VC_7021 | NPSBITH023 | *Morella cerifera* - *Ilex coriacea* - Baccharis halimifolia Wet Scrub Shrubland |
| BITH_VC_7022 | NPSBITH015 | *Ilex coriacea* - *Prunus caroliniana* Dense Evergreen Forest and Shrubland |
| BITH_VC_8001 | NPSBITH012 | *Pinus taeda* - *Magnolia grandiflora* - (*Fagus grandifolia*, *Quercus alba*, *Quercus falcata*) Flatwoods Forest |
| BITH_VC_8002 | CEGL007397 | *Quercus lyrata* - *Carya aquatica* Floodplain Forest |
| BITH_VC_8003 | CEGL004713 | *Pinus echinata* - *Pinus taeda* - *Quercus* (*alba*, *falcata*, *stellata*) Forest |
| BITH_VC_8004 | NPSBITH027 | *Pinus taeda* - *Nyssa biflora* - *Quercus laurifolia* Circular Depression Flooded Flatwood Forest |
| BITH_VC_8005 | NPSBITH027 | *Pinus taeda* - *Nyssa biflora* - *Quercus laurifolia* Circular Depression Flooded Flatwood Forest |
| BITH_VC_8006 | NPSBITH027 | *Pinus taeda* - *Nyssa biflora* - *Quercus laurifolia* Circular Depression Flooded Flatwood Forest |
| BITH_VC_8007 | NPSBITH027 | *Pinus taeda* - *Nyssa biflora* - *Quercus laurifolia* Circular Depression Flooded Flatwood Forest |
| BITH_VC_8008 | NPSBITH027 | *Pinus taeda* - *Nyssa biflora* - *Quercus laurifolia* Circular Depression Flooded Flatwood Forest |

**Table D1 (continued).** List of plots and classified vegetation.

| Plot Code | Classified code | Scientific name |
|---|---|---|
| BITH_VC_8009 | CEGL004713 | *Pinus echinata* - *Pinus taeda* - *Quercus* (*alba*, *falcata*, *stellata*) Forest |
| BITH_VC_8010 | – | – |
| BITH_VC_8011 | – | – |
| BITH_VC_8012 | NPSBITH027 | *Pinus taeda* - *Nyssa biflora* - *Quercus laurifolia* Circular Depression Flooded Flatwood Forest |
| BITH_VC_8013 | NPSBITH027 | *Pinus taeda* - *Nyssa biflora* - *Quercus laurifolia* Circular Depression Flooded Flatwood Forest |
| BITH_VC_8014 | – | – |

# Appendix E: Preliminary Vegetation Classification

**Table E1.** Preliminary vegetation classification.

| Formation Subclass | NVC Alliance | NVC Association | Element Code |
|---|---|---|---|
| 1.B Temperate & Boreal Forest & Woodland | *Acer saccharinum - Populus deltoides* Floodplain Forest Alliance | *Salix nigra* Central Floodplain Forest | CEGL002103 |
| | *Albizia julibrissin - Broussonetia papyrifera - Triadica sebifera* Ruderal Forest | *Triadica sebifera* Ruderal Forest | CEGL007037 |
| | *Betula nigra - Platanus occidentalis* Appalachian-Piedmont Floodplain Forest | *Betula nigra - Platanus occidentalis* / *Alnus serrulata* / *Boehmeria cylindrica* Floodplain Forest | CEGL007312 |
| | *Crataegus aestivalis - Crataegus opaca - Crataegus rufula* Swamp Forest | (*Quercus laurifolia*) / *Crataegus opaca - Crataegus viridis* Swamp Forest | CEGL007386 |
| | *Fagus grandifolia - Magnolia grandiflora* Forest | *Fagus grandifolia - Pinus taeda* - (*Liquidambar styraciflua*, *Magnolia grandiflora*, *Quercus alba*) Small Stream Forest | CEGL007320 |
| | *Fagus grandifolia - Magnolia grandiflora* Forest | *Fagus grandifolia - Magnolia grandiflora - Quercus alba* / *Carpinus caroliniana - Ostrya virginiana* Forest | CEGL007872 |
| | *Fagus grandifolia - Magnolia grandiflora* Forest | *Magnolia grandiflora - Fagus grandifolia - Quercus alba - Pinus taeda* Forest | CEGL007903 |
| | *Fagus grandifolia - Magnolia grandiflora* Forest | *Fagus grandifolia - Magnolia virginiana* - (*Pinus palustris*) / *Chasmanthium sessiliflorum* Sandhill Streamhead Forest | CEGL007976 |
| | *Fagus grandifolia - Magnolia grandiflora* Forest | *Fagus grandifolia - Quercus* (*laurifolia*, *nigra*) - *Pinus taeda* Forest | CEGL008574 |
| | *Fagus grandifolia - Magnolia grandiflora* Forest | *Magnolia grandiflora* / *Prunus caroliniana - Carpinus caroliniana* / *Arundinaria gigantea* Forest | CEGL008577 |
| | *Fagus grandifolia - Magnolia grandiflora* Forest | *Fagus grandifolia - Quercus* (*laurifolia*, *nigra*) - *Pinus taeda* Forest | CEGL008574 |
| | *Fagus grandifolia - Quercus alba - Quercus nigra* Coastal Plain Forest | *Fagus grandifolia - Quercus alba* / *Ilex opaca* var. *opaca* / *Athyrium filix - femina* ssp. *asplenioides* Forest | CEGL007208 |

**Table E1 (continued).** Preliminary vegetation classification.

| Formation Subclass | NVC Alliance | NVC Association | Element Code |
|---|---|---|---|
| 1.B Temperate & Boreal Forest & Woodland (continued) | *Fagus grandifolia* - *Quercus alba* - *Quercus nigra* Coastal Plain Forest | *Pinus taeda* - *Quercus alba* - (*Fagus grandifolia*) / *Smilax pumila* - *Mitchella repens* Forest | CEGL007525 |
| | *Fraxinus caroliniana* Swamp Forest | *Fraxinus caroliniana* Swamp Forest | CEGL004753 |
| | *Fraxinus pennsylvanica* - *Platanus occidentalis* - *Acer saccharinum* Ozark-Ouachita Floodplain Forest | *Fraxinus pennsylvanica* - *Ulmus americana* - *Celtis laevigata* / *Ilex decidua* Floodplain Forest | CEGL002427 |
| | *Liquidambar styraciflua* - *Fraxinus pennsylvanica* - *Acer rubrum* Flooded & Swamp Forest | *Platanus occidentalis* - *Liquidambar styraciflua* - (*Ulmus americana*) / (*Crataegus viridis*) Floodplain Forest | CEGL007335 |
| | *Magnolia virginiana* - *Nyssa biflora* - *Quercus laurifolia* Swamp Forest | *Nyssa biflora* - *Magnolia virginiana* - *Quercus laurifolia* / *Cyrilla racemiflora* - *Rhododendron oblongifolium* Swamp Forest | CEGL007474 |
| | *Magnolia virginiana* - *Nyssa biflora* - *Quercus laurifolia* Swamp Forest | *Magnolia virginiana* - *Nyssa sylvatica* - *Acer rubrum* / *Morella caroliniensis* / *Woodwardia areolata* Swamp Forest | CEGL007904 |
| | *Nyssa aquatica* Swamp Forest | *Nyssa aquatica* Swamp Forest | CEGL002419 |
| | *Nyssa aquatica* Swamp Forest | *Nyssa aquatica* - *Nyssa biflora* Swamp Forest | CEGL007429 |
| | *Pinus echinata* - *Pinus taeda* - *Quercus stellata* Forest | *Pinus taeda* - *Quercus stellata* / *Crataegus* spp. Woodland | CEGL002112 |
| | *Pinus echinata* - *Pinus taeda* - *Quercus stellata* Forest | *Pinus echinata* - *Pinus taeda* - *Quercus* (*alba*, *falcata*, *stellata*) Forest | CEGL004713 |
| | *Pinus echinata* - *Pinus taeda* - *Quercus stellata* Forest | *Pinus echinata* - *Pinus taeda* - *Quercus stellata* - *Carya texana* / *Vaccinium arboreum* Woodland | CEGL007499 |
| | *Pinus echinata* - *Pinus taeda* - *Quercus stellata* Forest | *Pinus taeda* - (*Pinus echinata*) - *Quercus falcata* - *Carya texana* / *Vaccinium arboreum* Forest | CEGL007528 |
| | *Pinus echinata* - *Pinus taeda* - *Quercus stellata* Forest | *Pinus echinata* - *Quercus stellata* - *Quercus falcata* - *Carya texana* Woodland | CEGL007800 |
| | *Pinus echinata* - *Pinus taeda* - *Quercus stellata* Forest | *Pinus echinata* - (*Pinus taeda*) - *Quercus falcata* / *Dichanthelium sphaerocarpon* Forest | CEGL007947 |

**Table E1 (continued).** Preliminary vegetation classification.

| Formation Subclass | NVC Alliance | NVC Association | Element Code |
|---|---|---|---|
| 1.B Temperate & Boreal Forest & Woodland (continued) | *Pinus palustris* West Gulf Coastal Plain Wet Open Woodland Alliance | *Pinus palustris* / *Sporobolus silveanus* - *Muhlenbergia capillaris* - *Chaetopappa asteroides* Woodland | CEGL003654 |
| | *Pinus palustris* West Gulf Coastal Plain Wet Open Woodland Alliance | *Pinus palustris* / *Eryngium integrifolium* - *Rhynchospora* spp. - (*Ctenium aromaticum*) Woodland | CEGL003646 |
| | *Pinus palustris* / *Quercus incana* Woodland | (*Pinus palustris*) - *Quercus stellata* - *Quercus incana* / *Tetragonotheca ludoviciana* Woodland | CEGL008566 |
| | *Pinus palustris* / *Quercus incana* Woodland | *Pinus palustris* - *Pinus* (*echinata*, *taeda*) - *Quercus falcata* - *Carya texana* Woodland | CEGL008571 |
| | *Pinus palustris* / *Quercus incana* Woodland | *Pinus palustris* - *Pinus echinata* - *Quercus* (*incana*, *margarettiae*) / *Schizachyrium scoparium* Woodland | CEGL007513 |
| | *Pinus palustris* / *Quercus marilandica* / *Schizachyrium scoparium* West Gulf Coastal Plain Woodland | *Pinus palustris* / *Quercus marilandica* / *Ilex vomitoria* / *Schizachyrium scoparium* Woodland | CEGL003579 |
| | *Pinus palustris* / *Schizachyrium scoparium* West Gulf Coastal Plain Woodland | *Pinus palustris* / *Quercus* (*falcata*, *stellata*) - *Carya texana* / *Schizachyrium scoparium* Woodland | CEGL003576 |
| | *Pinus palustris* / *Schizachyrium scoparium* West Gulf Coastal Plain Woodland | *Pinus palustris* / *Schizachyrium scoparium* - *Rudbeckia grandiflora* var. *alismifolia* Woodland | CEGL003572 |
| | *Pinus palustris* / *Schizachyrium scoparium* West Gulf Coastal Plain Woodland | *Pinus palustris* / *Schizachyrium scoparium* - *Liatris pycnostachya* Woodland | CEGL003571 |
| | *Pinus taeda* - *Liriodendron tulipifera* - *Liquidambar styraciflua* Ruderal Forest | *Pinus taeda* - *Pinus echinata* / *Chasmanthium sessiliflorum* Ruderal Forest | CEGL007115 |
| | *Pinus taeda* - *Liriodendron tulipifera* - *Liquidambar styraciflua* Ruderal Forest | *Pinus taeda* / *Liquidambar styraciflua* - *Acer rubrum* var. *rubrum* / *Vaccinium stamineum* Ruderal Forest | CEGL006011 |
| | *Pinus taeda* - *Liriodendron tulipifera* - *Liquidambar styraciflua* Ruderal Forest | *Pinus taeda* - *Liquidambar styraciflua* Ruderal Forest | CEGL008462 |
| | *Pinus taeda* - *Liriodendron tulipifera* - *Liquidambar styraciflua* Ruderal Forest | *Pinus elliottii* var. *elliottii* - (*Pinus palustris*) / *Morella cerifera* - *Ilex coriacea* Ruderal Wet Woodland | CEGL007157 |
| | *Pinus taeda* - *Quercus alba* / *Viburnum* spp. Forest | *Pinus echinata* - *Quercus alba* / *Viburnum* (*dentatum*, *acerifolium*) Forest | CEGL003855 |

**Table E1 (continued).** Preliminary vegetation classification.

| Formation Subclass | NVC Alliance | NVC Association | Element Code |
|---|---|---|---|
| 1.B Temperate & Boreal Forest & Woodland (continued) | *Pinus taeda* - *Quercus alba* / *Viburnum* spp. Forest | *Pinus taeda* - (*Quercus* spp.) / *Ostrya virginiana* - *Sabal minor* Forest | CEGL007955 |
| | *Pinus taeda* - *Quercus alba* / *Viburnum* spp. Forest | *Pinus* (*echinata*, *taeda*) / *Symplocos tinctoria* - *Morella cerifera* - *Vaccinium elliottii* Forest | CEGL008410 |
| | *Pinus taeda* - *Quercus alba* / *Viburnum* spp. Forest | *Pinus taeda* - (*Pinus echinata*) / *Quercus michauxii* / *Thaspium barbinode* Forest | CEGL008582 |
| | *Pinus taeda* - *Quercus laurifolia* - *Quercus phellos* West Gulf Coastal Plain Wet Flatwoods Forest | *Quercus phellos* - *Quercus similis* / *Crataegus marshallii* - *Crataegus spathulata* / *Chasmanthium laxum* Wet Forest | CEGL007363 |
| | *Pinus taeda* - *Quercus laurifolia* - *Quercus phellos* West Gulf Coastal Plain Wet Flatwoods Forest | *Quercus phellos* / *Chasmanthium laxum* - *Carex* (*flaccosperma*, *intumescens*) - *Hymenocallis liriosme* Wet Flatwoods Forest | CEGL007371 |
| | *Pinus taeda* - *Quercus laurifolia* - *Quercus phellos* West Gulf Coastal Plain Wet Flatwoods Forest | *Quercus laurifolia* - *Quercus phellos* / *Viburnum dentatum* - (*Sebastiania fruticosa*) / *Carex glaucescens* Upper West Gulf Wet Flatwoods Forest | CEGL007961 |
| | *Pinus taeda* - *Quercus laurifolia* - *Quercus phellos* West Gulf Coastal Plain Wet Flatwoods Forest | *Quercus phellos* / *Chasmanthium laxum* Wet Forest | CEGL008576 |
| | *Pinus taeda* - *Quercus laurifolia* - *Quercus phellos* West Gulf Coastal Plain Wet Flatwoods Forest | *Quercus phellos* - *Quercus similis* - *Ulmus crassifolia* Wet Forest | CEGL007921 |
| | *Pinus taeda* - *Quercus laurifolia* - *Quercus phellos* West Gulf Coastal Plain Wet Flatwoods Forest | *Quercus laurifolia* - (*Quercus nigra*, *Nyssa biflora*) / *Diospyros virginiana* Wet Forest | CEGL007871 |
| | *Populus deltoides* - *Salix nigra* - *Salix caroliniana* Coastal Plain Floodplain Forest | *Populus deltoides* - *Salix nigra* / *Ilex vomitoria* Floodplain Forest | CEGL004613 |
| | *Populus deltoides* - *Salix nigra* - *Salix caroliniana* Coastal Plain Floodplain Forest | *Populus deltoides* - *Salix nigra* / *Mikania scandens* Floodplain Forest | CEGL007346 |
| | *Quercus alba* - *Carya alba* Mesic Coastal Plain Forest | *Quercus alba* - *Carya alba* / *Symplocos tinctoria* / *Mitchella repens* Forest | CEGL007980 |
| | *Quercus alba* - *Carya alba* Mesic Coastal Plain Forest | *Quercus alba* - *Carya alba* / *Chasmanthium sessiliflorum* West Gulf Coastal Plain Forest | CEGL008413 |

**Table E1 (continued).** Preliminary vegetation classification.

| Formation Subclass | NVC Alliance | NVC Association | Element Code |
|---|---|---|---|
| 1.B Temperate & Boreal Forest & Woodland (continued) | *Quercus alba* - *Quercus falcata* - *Quercus stellata* Ozark - Ouachita Forest | *Quercus falcata* - *Quercus stellata* - (*Pinus taeda*) West Gulf Coastal Plain Forest | CEGL008415 |
| | *Quercus alba* - *Quercus nigra* - *Sabal minor* Forest | *Quercus alba* - *Quercus hemisphaerica* / *Prunus caroliniana* - *Persea borbonia* - *Viburnum acerifolium* Forest | CEGL007959 |
| | *Quercus alba* - *Quercus nigra* - *Sabal minor* Forest | *Quercus alba* - *Quercus nigra* / *Ostrya virginiana* / *Sabal minor* Forest | CEGL008581 |
| | *Quercus incana* - *Quercus arkansana* - *Pinus echinata* Woodland | *Pinus echinata* - *Quercus* (*incana*, *stellata*, *margarettiae*) / *Cnidoscolus texanus* Woodland | CEGL007507 |
| | *Quercus incana* - *Quercus arkansana* - *Pinus echinata* Woodland | *Pinus echinata* - *Quercus* (*margarettiae*, *stellata*, *falcata*) - *Carya texana* Woodland | CEGL007946 |
| | *Quercus laurifolia* - *Liquidambar styraciflua* - *Nyssa biflora* Coastal Plain Floodplain Forest | *Pinus taeda* - *Liquidambar styraciflua* - *Quercus* (*nigra*, *phellos*) / *Crataegus marshallii* Floodplain Forest | CEGL004911 |
| | *Quercus laurifolia* - *Liquidambar styraciflua* - *Nyssa biflora* Coastal Plain Floodplain Forest | *Quercus laurifolia* - *Liquidambar styraciflua* - *Nyssa biflora* - *Acer rubrum* / *Sabal minor* Floodplain Forest | CEGL007804 |
| | *Quercus laurifolia* - *Liquidambar styraciflua* - *Nyssa biflora* Coastal Plain Floodplain Forest | *Betula nigra* - *Liquidambar styraciflua* - *Platanus occidentalis* - *Quercus nigra* Floodplain Forest | CEGL007898 |
| | *Quercus laurifolia* - *Quercus phellos* - *Pinus taeda* Coastal Plain Riparian Forest | *Quercus laurifolia* - *Quercus* (*lyrata*, *phellos*) - *Nyssa biflora* West Gulf Riparian Forest | CEGL003854 |
| | *Quercus laurifolia* - *Quercus phellos* - *Pinus taeda* Coastal Plain Riparian Forest | *Pinus taeda* Riparian Forest | CEGL007142 |
| | *Quercus laurifolia* - *Quercus phellos* - *Pinus taeda* Coastal Plain Riparian Forest | *Nyssa biflora* - *Quercus laurifolia* / *Sphagnum* spp. Riparian Forest | CEGL007390 |
| | *Quercus lyrata* - *Quercus phellos* - *Carya aquatica* Swamp Forest | *Quercus lyrata* - *Liquidambar styraciflua* / *Forestiera acuminata* Floodplain Forest | CEGL002424 |
| | *Quercus lyrata* - *Quercus phellos* - *Carya aquatica* Swamp Forest | *Quercus texana* - *Quercus lyrata* Floodplain Forest | CEGL007407 |
| | *Quercus lyrata* - *Quercus phellos* - *Carya aquatica* Swamp Forest | *Quercus lyrata* - *Carya aquatica* Floodplain Forest | CEGL007397 |

**Table E1 (continued).** Preliminary vegetation classification.

| Formation Subclass | NVC Alliance | NVC Association | Element Code |
|---|---|---|---|
| 1.B Temperate & Boreal Forest & Woodland (continued) | *Quercus michauxii* - *Quercus pagoda* Coastal Plain Floodplain Forest | *Quercus pagoda* - *Liquidambar styraciflua* - *Pinus taeda* Floodplain Forest | CEGL007899 |
| | *Quercus michauxii* - *Quercus pagoda* Coastal Plain Floodplain Forest | *Quercus michauxii* - *Quercus nigra* - *Pinus taeda* / *Carpinus caroliniana* Floodplain Forest | CEGL007901 |
| | *Quercus michauxii* - *Quercus pagoda* Coastal Plain Floodplain Forest | *Quercus pagoda* / *Ulmus crassifolia* - *Celtis laevigata* / *Carex cherokeensis* Floodplain Forest | CEGL007952 |
| | *Quercus phellos* - *Quercus nigra* Coastal Plain Floodplain Forest | *Quercus phellos* - *Liquidambar styraciflua* / *Ilex decidua* - *Carpinus caroliniana* / *Lysimachia radicans* Floodplain Forest | CEGL007370 |
| | *Quercus phellos* - *Quercus nigra* Coastal Plain Floodplain Forest | *Quercus phellos* - *Quercus nigra* / *Sabal minor* - *Sebastiania fruticosa* Floodplain Forest | CEGL007869 |
| | *Quercus phellos* - *Quercus nigra* Coastal Plain Floodplain Forest | *Quercus nigra* - *Quercus phellos* / *Carya myristiciformis* - *Sabal minor* / *Carex cherokeensis* Floodplain Forest | CEGL007954 |
| | *Quercus phellos* - *Quercus nigra* Coastal Plain Floodplain Forest | *Quercus nigra* - *Liquidambar styraciflua* / *Ilex opaca* - *Vaccinium fuscatum* / *Carex debilis* Floodplain Forest | CEGL007984 |
| | *Quercus shumardii* - *Quercus pagoda* - *Fraxinus americana* Coastal Plain Forest | *Fraxinus americana* - *Celtis laevigata* - *Nyssa sylvatica* - *Quercus shumardii* - *Ulmus americana* Forest | CEGL007897 |
| | *Quercus stellata* - *Quercus falcata* Wet Flatwoods Forest | *Quercus stellata* - *Pinus taeda* Flatwoods Wet Forest | CEGL008587 |
| | *Quercus stellata* - *Quercus marilandica* - *Quercus alba* Ozark-Ouachita Woodland Alliance | *Quercus alba* - *Quercus falcata* - *Quercus stellata* - *Nyssa sylvatica* / *Carex cherokeensis* Forest | CEGL008414 |
| | *Quercus virginiana* - *Celtis laevigata* Chenier Forest | *Quercus virginiana* - *Magnolia grandiflora* - *Quercus pagoda* - *Celtis laevigata* / *Sabal minor* Forest | CEGL007467 |
| | *Taxodium distichum* - *Nyssa aquatica* - *Nyssa biflora* Floodplain Forest | *Taxodium distichum* / *Lemna minor* Floodplain Forest | CEGL002420 |
| | *Taxodium distichum* - *Nyssa aquatica* - *Nyssa biflora* Floodplain Forest | *Taxodium distichum* - (*Nyssa aquatica*) / *Forestiera acuminata* - *Planera aquatica* Floodplain Forest | CEGL002421 |
| | *Taxodium distichum* - *Nyssa aquatica* - *Nyssa biflora* Floodplain Forest | *Planera aquatica* Floodplain Forest | CEGL007394 |

**Table E1 (continued).** Preliminary vegetation classification.

| Formation Subclass | NVC Alliance | NVC Association | Element Code |
|---|---|---|---|
| 1.B Temperate & Boreal Forest & Woodland (continued) | *Taxodium distichum - Nyssa aquatica - Nyssa biflora* Floodplain Forest | *Taxodium distichum - Nyssa aquatica - Acer rubrum / Itea virginica* Floodplain Forest | CEGL007422 |
| | *Taxodium distichum - Nyssa aquatica - Nyssa biflora* Floodplain Forest | *Taxodium distichum - Nyssa aquatica / Fraxinus caroliniana* Floodplain Forest | CEGL007431 |
| | *Triadica sebifera - Melaleuca quinquenervia - Schinus terebinthifolius* Ruderal Flooded & Swamp Forest | *Triadica sebifera* Ruderal Wet Forest | CEGL007412 |
| | *Ulmus americana - Ulmus crassifolia - Celtis laevigata* West Gulf Coastal Plain Floodplain Forest | *Ulmus crassifolia - Celtis laevigata* - (*Ulmus rubra*) / *Carex digitalis - Geum canadense* Floodplain Forest | CEGL007950 |
| 2.B Temperate & Boreal Grassland & Shrubland | *Andropogon virginicus - Ambrosia artemisiifolia - Conyza canadensis* Eastern Ruderal Grassland | *Paspalum notatum* Ruderal Grassland | CEGL004700 |
| | *Panicum virgatum - Tripsacum dactyloides* Grassland | *Panicum virgatum - Tripsacum dactyloides* - (*Panicum hemitomon*) Grassland | CEGL007937 |
| | *Schizachyrium scoparium - Liatris elegans* var. *carizzana* Sandy Grassland | *Schizachyrium scoparium - Triplasis purpurea - Eriogonum multiflorum - Liatris elegans* var. *carizzana* Grassland | CEGL008483 |
| | *Schizachyrium scoparium - Paspalum plicatulum - Schizachyrium tenerum* Grassland | *Schizachyrium scoparium - Paspalum plicatulum - Sorghastrum nutans - Dichanthelium oligosanthes - Symphyotrichum pratense* Alfisol Grassland | CEGL002208 |
| | *Schizachyrium scoparium - Paspalum plicatulum - Schizachyrium tenerum* Grassland | *Schizachyrium scoparium - Sorghastrum nutans - Paspalum plicatulum - Carex microdonta - Neptunia lutea* Vertisol Grassland | CEGL004519 |
| | *Spartina spartinae - Schizachyrium scoparium - Liatris bracteata* Saline Coastal Prairie | *Muhlenbergia capillaris* Grassland | CEGL004607 |
| 2.C Shrub & Herb Wetland | *Aristida palustris - Panicum virgatum - Eriocaulon* spp. Pondshore Marsh | *Aristida palustris - Panicum virgatum - Eriocaulon decangulare* var. *decangulare - Rhynchospora elliottii* Marsh | CEGL004576 |
| | *Aristida palustris - Panicum virgatum - Eriocaulon* spp. Pondshore Marsh | *Aristida palustris - Panicum virgatum - Eriocaulon compressum - Eleocharis equisetoides* Marsh | CEGL004577 |
| | *Aristida palustris - Panicum virgatum - Eriocaulon* spp. Pondshore Marsh | *Nyssa biflora / Panicum hemitomon - Woodwardia virginica* Wet Scrub | CEGL004586 |

**Table E1 (continued).** Preliminary vegetation classification.

| Formation Subclass | NVC Alliance | NVC Association | Element Code |
|---|---|---|---|
| 2.C Shrub & Herb Wetland (continued) | *Arundinaria gigantea* Shrub Swamp | *Arundinaria gigantea* ssp. *gigantea* Shrub Swamp | CEGL003836 |
| | *Cephalanthus occidentalis* - *Decodon verticillatus* Shrub Swamp | *Cephalanthus occidentalis* / *Carex* spp. - *Lemna* spp. Southern Shrub Swamp | CEGL002191 |
| | *Ilex coriacea* - *Ilex glabra* - *Kalmia latifolia* Hillside Seepage Shrub Bog | (*Magnolia virginiana*) / *Ilex coriacea* - *Morella caroliniensis* Seepage Bog | CEGL003530 |
| | *Juncus effusus* - *Andropogon glomeratus* var. *pumilus* - *Saccharum giganteum* Ruderal Marsh | *Andropogon glomeratus* var. *pumilus* Ruderal Marsh | CEGL004099 |
| | *Panicum hemitomon* Floating Marsh | *Panicum hemitomon* Marsh | CEGL004665 |
| | *Panicum hemitomon* Pondshore Marsh | *Panicum hemitomon* - *Eriocaulon compressum* - *Rhynchospora corniculata* Marsh | CEGL004578 |
| | *Panicum hemitomon* Pondshore Marsh | *Panicum hemitomon* - *Ludwigia sphaerocarpa* Marsh | CEGL008478 |
| | *Panicum rigidulum* - *Polygonum hydropiperoides* - *Polygonum punctatum* Southeastern Sandbar Alliance | *Panicum virgatum* - *Panicum rigidulum* var. *elongatum* - *Polygonum hydropiperoides* Wet Meadow | CEGL004921 |
| | *Rhynchospora careyana* - *Rhynchospora inundata* Pondshore Marsh Alliance | *Sparganium americanum* - *Saccharum giganteum* | CEGL004769 |
| | *Typha angustifolia* - *Typha latifolia* - *Schoenoplectus* spp. Deep Marsh | *Typha latifolia* Southern Ruderal Marsh | CEGL004150 |
| | *Zizaniopsis miliacea* - *Zizania aquatica* - *Pontederia cordata* Southeastern Floodplain Marsh Alliance | *Sparganium americanum* - (*Sparganium erectum* ssp. *Stoloniferum*) - *Epilobium leptophyllum* Seep | CEGL004510 |
| | *Zizaniopsis aquatica* - *Zizaniopsis miliacea* Tidal Freshwater Marsh Alliance | *Zizaniopsis miliacea* Tidal Marsh | CEGL004705 |
| 5.B Freshwater Aquatic Vegetation | *Nymphaea odorata* - *Nuphar* spp. - *Brasenia schreberi* Aquatic Vegetation | *Nuphar advena* - *Nymphaea odorata* Aquatic Vegetation | CEGL002386 |
| | *Nymphaea odorata* - *Nuphar* spp. - *Brasenia schreberi* Aquatic Vegetation | *Nelumbo lutea* Aquatic Vegetation | CEGL004323 |
| | *Nymphaea odorata* - *Nuphar* spp. - *Brasenia schreberi* Aquatic Vegetation | *Nymphoides aquatica* - *Nymphaea odorata* - *Gratiola brevifolia* Aquatic Vegetation | CEGL004601 |
| 6.B Temperate & Boreal Open Rock Vegetation | Coastal Plain-Piedmont Cliff | *Pallavicinia lyellii* - *Sphagnum* sp. Cliff Nonvascular Vegetation | CEGL004779 |

# Appendix F: Accuracy Assessment Contingency Tables

Tables F1 and F2 show the initial and revised accuracy assessment contingency tables.

**Table F1.** Initial/raw accuracy assessment contingency table. Row values are mapped classes and column values are classes assigned in the field.

| Map Class Codes | MC101 | MC102 | MC103 | MC104 | MC105 | MC106 | MC107 | MC108 | MC201 | MC202 | MC203 | MC204 | MC205 | MC206 | MC301 | MC302 | MC303 | MC304 | MC305 | MC306 | MC307 | MC308 | MC309 | MC310 | MC311 | MC312 | MC313 | MC314 | MC315 | MC316 | MC317 | MC318 | MC319 | MC320 | MC321 | MC322 | MC323 | MC324 | MC325 | MC326 | MC327 | MC328 | MC329 | MC330 | MC401 | MC402 | Row Total ($n_{i+}$) |
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| MC101 | 4* | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 6 |
| MC102 | – | 2* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 |
| MC103 | – | – | 2* | – | 3 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 6 |
| MC104 | – | – | – | 2* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 |
| MC105 | – | – | – | – | 29* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | 31 |
| MC106 | – | – | – | – | – | 1* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | 2 |
| MC107 | – | – | – | – | 2 | – | 9* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 3 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 14 |
| MC108 | – | – | – | – | – | – | – | 1* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 |
| MC201 | – | 1 | – | – | – | – | – | – | 4* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 5 |
| MC202 | – | – | – | – | – | – | – | – | – | 1* | – | 1 | – | – | – | 1 | 3 | 1 | – | – | – | – | – | – | – | – | – | 1 | 1 | – | – | 8 | – | 1 | 1 | – | – | – | 1 | – | – | – | – | – | – | – | – | 20 |
| MC203 | – | 1 | – | – | – | – | – | – | – | – | 2* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | 1 | – | – | – | – | – | – | 1 | – | – | – | – | – | 6 |
| MC204 | – | – | – | – | – | – | – | – | – | – | – | 2* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 |
| MC205 | – | – | – | – | – | – | – | – | – | – | – | – | 1* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 |
| MC206 | – | – | – | – | – | – | – | – | – | – | – | – | – | 1* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 |
| MC301 | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | 27* | – | 2 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | 31 |
| MC302 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 4 | 14* | 3 | – | – | – | – | – | – | – | – | – | – | – | 8 | – | – | – | – | 1 | 1 | – | – | – | – | – | – | – | – | – | – | – | 31 |
| MC303 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 18* | – | – | – | – | – | – | – | – | – | – | 1 | 6 | 1 | 1 | 1 | – | 3 | 1 | – | – | – | – | – | – | – | – | – | – | – | 32 |
| MC304 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 25* | – | – | – | – | – | – | – | – | 1 | 1 | 1 | – | – | – | – | – | – | – | – | – | – | 2 | – | – | 1 | 1 | – | 32 |
| MC305 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 |
| MC306 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 23* | – | – | – | – | – | – | 7 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 30 |
| MC307 | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | 1 | 1 | – | 1 | 19* | – | 2 | 1 | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 | 1 | – | – | – | – | 30 |
| MC308 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 4* | – | – | – | – | – | 2 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 6 |
| MC309 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | 6* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | 8 |
| MC310 | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 22* | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 24 |
| MC311 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 25* | 1 | 2 | – | – | – | – | – | – | – | – | – | – | – | 2 | – | – | – | – | – | – | 30 |
| MC312 | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 | 7* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 10 |
| MC313 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 28* | 1 | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | 30 |
| MC314 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 5 | – | – | – | – | – | – | – | – | 2 | 19* | 1 | – | – | 3 | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 32 |
| MC315 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 3 | – | – | – | – | – | – | – | – | – | 1 | 1 | 22* | 2 | – | – | – | 1 | – | – | – | – | – | – | – | – | – | 1 | – | – | 31 |
| MC316 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | 1 | 3 | 23* | – | 2 | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | 31 |
| MC317 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 4 | – | – | – | – | – | – | – | – | – | 7 | – | 1 | 15* | 3 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 31 |
| MC318 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 3 | – | – | 2 | 25* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 31 |
| MC319 | – | – | – | – | – | – | – | – | – | – | – | 2 | – | – | 2 | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 | – | 2 | 5* | 4 | 4 | 10 | – | – | 1 | – | – | – | – | – | – | – | – | 32 |
| MC320 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 3 | – | 2 | – | 1 | – | 20* | 4 | – | – | – | – | – | – | – | 1 | – | – | – | – | 31 |
| MC321 | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | 3 | – | – | – | – | – | – | – | – | – | – | – | 1 | 1 | – | – | 1 | – | 22* | 2 | – | – | – | – | – | – | – | – | – | – | 31 |
| MC322 | – | – | – | – | – | – | – | – | – | – | – | 4 | 1 | – | 3 | – | – | – | – | – | – | – | – | – | – | – | 2 | 3 | 1 | – | – | 1 | 1 | – | – | 15* | – | – | – | – | – | – | – | – | – | – | 31 |
| MC323 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1* | – | – | – | – | – | – | – | – | – | – | 1 |
| MC324 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | 4 | – | – | – | – | – | – | – | – | – | – | – | – | 3* | – | – | – | – | – | – | – | – | – | 8 |
| MC325 | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 3 | 6 | 1 | 1 | – | 7 | – | – | – | – | – | 11* | – | – | – | – | – | – | – | – | 30 |
| MC326 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 2 | – | – | – | – | – | – | – | – | – | – | 8* | – | – | – | 1 | – | – | – | 12 |
| MC327 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 3* | – | – | – | – | – | 3 |
| MC328 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1* | – | – | – | – | 1 |
| MC329 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1* | – | – | – | 1 |
| MC330 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 2 | – | – | – | – | – | – | – | – | – | 13* | – | – | 17 |
| MC401 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 33* | – | 33 |
| MC402 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2* | 2 |
| Column Total ($n_{+i}$) | 4 | 4 | 2 | 3 | 36 | 1 | 10 | 1 | 4 | 1 | 2 | 11 | 3 | 1 | 37 | 15 | 36 | 36 | 2 | 26 | 20 | 4 | 8 | 29 | 28 | 11 | 52 | 49 | 45 | 33 | 18 | 53 | 9 | 31 | 36 | 28 | 1 | 5 | 13 | 12 | 7 | 2 | 4 | 16 | 33 | 2 | 784 |

* The map code for this cell is identical on that row (expected map code) and the for that column (map code assigned in the field) combintation (also with a gray background).

**Table F2.** Revised accuracy assessment contingency table. Row values are mapped classes and column values are classes assigned in the field.

| Map Class Codes | MC101 | MC102 | MC103 | MC104 | MC105 | MC106 | MC107 | MC108 | MC201 | MC202 | MC203 | MC204 | MC205 | MC206 | MC301 | MC302 | MC303 | MC304 | MC305 | MC306 | MC307 | MC308 | MC309 | MC310 | MC311 | MC312 | MC313 | MC314 | MC315 | MC316 | MC317 | MC318 | MC319 | MC320 | MC321 | MC322 | MC323 | MC324 | MC325 | MC326 | MC327 | MC328 | MC329 | MC330 | MC401 | MC402 | Row Total ($n_{i+}$) |
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| MC101 | 4* | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 6 |
| MC102 | – | 2* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 |
| MC103 | – | – | 2* | – | 3 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 6 |
| MC104 | – | – | – | 2* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 |
| MC105 | – | – | – | – | 29* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | 31 |
| MC106 | – | – | – | – | – | 1* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | 2 |
| MC107 | – | – | – | – | 2 | – | 9* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 3 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 14 |
| MC108 | – | – | – | – | – | – | – | 1* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 |
| MC201 | – | 1 | – | – | – | – | – | – | 4* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 5 |
| MC202 | – | – | – | – | – | – | – | – | – | 1* | – | 1 | – | – | – | 1 | 3 | 1 | – | – | – | – | – | – | – | – | – | 1 | 1 | – | – | 8 | – | 1 | 1 | – | – | – | 1 | – | – | – | – | – | – | – | – | 20 |
| MC203 | – | 1 | – | – | – | – | – | – | – | – | 2* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | 6 |
| MC204 | – | – | – | – | – | – | – | – | – | – | – | 2* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 |
| MC205 | – | – | – | – | – | – | – | – | – | – | – | – | 1* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 |
| MC206 | – | – | – | – | – | – | – | – | – | – | – | – | – | 1* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 |
| MC301 | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | 27* | – | 2 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | 31 |
| MC302 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 4 | 14* | 3 | – | – | – | – | – | – | – | – | – | – | – | 8 | – | – | – | – | 1 | 1 | – | – | – | – | – | – | – | – | – | – | – | 31 |
| MC303 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 18* | – | – | – | – | – | – | – | – | – | – | 1 | 6 | 1 | 1 | 1 | – | 3 | 1 | – | – | – | – | – | – | – | – | – | – | – | – | 32 |
| MC304 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 25* | – | – | – | – | – | – | – | – | 1 | 1 | 1 | – | – | – | – | – | – | – | – | – | 2 | – | – | 1 | 1 | – | – | 32 |
| MC305 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 |
| MC306 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 23* | – | – | – | – | – | – | 7 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 30 |
| MC307 | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | 1 | 1 | – | 1 | 19* | – | 2 | 1 | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | – | 2 | 1 | – | – | – | – | 30 |
| MC308 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 4* | – | – | – | – | 2 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 6 |
| MC309 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | 6* | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | 8 |
| MC310 | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 22* | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 24 |
| MC311 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 25* | 1 | 2 | – | – | – | – | – | – | – | – | – | – | – | 2 | – | – | – | – | – | – | 30 |
| MC312 | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 | 7* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 10 |
| MC313 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 28* | 1 | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | 30 |
| MC314 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 | 19* | 1 | – | – | 3 | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | 32 |
| MC315 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 3 | – | – | – | – | – | – | – | – | – | 1 | 1 | 22* | 2 | – | – | – | – | 1 | – | – | – | – | – | – | – | – | 1 | – | – | 31 |
| MC316 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | 1 | 3 | 23* | – | 2 | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | 31 |
| MC317 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 4 | – | – | – | – | – | – | – | – | – | 7 | – | 1 | 15* | 3 | – | – | – | – | – | – | – | – | – | – | – | – | – | 31 |
| MC318 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 3 | – | – | 2 | 25* | – | – | – | – | – | – | – | – | – | – | – | – | – | 31 |
| MC319 | – | – | – | – | – | – | – | – | – | – | – | 2 | – | – | 2 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2 | – | 2 | 5* | 4 | 4 | 10 | – | – | 1 | – | – | – | – | – | – | – | 32 |
| MC320 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 3 | – | 2 | – | 1 | – | 20* | 4 | – | – | – | – | – | – | 1 | – | – | – | – | 31 |
| MC321 | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | 3 | – | – | – | – | – | – | – | – | – | – | – | 1 | 1 | – | – | 1 | – | 22* | 2 | – | – | – | – | – | – | – | – | – | – | 31 |
| MC322 | – | – | – | – | – | – | – | – | – | – | – | 4 | 1 | – | 3 | – | – | – | – | – | – | – | – | – | – | – | 2 | 3 | 1 | – | – | 1 | 1 | – | – | 15* | – | – | – | – | – | – | – | – | – | – | 31 |
| MC323 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1* | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 |
| MC324 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | 4 | – | – | – | – | – | – | – | – | – | – | – | 3* | – | – | – | – | – | – | – | – | – | – | 8 |
| MC325 | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 3 | 6 | 1 | 1 | – | 7 | – | – | – | – | – | 11* | – | – | – | – | – | – | – | 30 |
| MC326 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 2 | – | – | – | – | – | – | – | – | – | – | 8* | – | – | 1 | – | – | – | 12 |
| MC327 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 3* | – | – | – | – | – | 3 |
| MC328 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1* | – | – | – | – | 1 |
| MC329 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1* | – | – | – | 1 |
| MC330 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 1 | 2 | – | – | – | – | – | – | – | – | – | 13* | – | – | – | 17 |
| MC401 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 33* | – | – | 33 |
| MC402 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | 2* | – | 2 |
| Column Total ($N_{+j}$) | 4 | 4 | 2 | 3 | 36 | 1 | 10 | 1 | 4 | 1 | 2 | 11 | 3 | 1 | 37 | 15 | 36 | 36 | 2 | 26 | 20 | 4 | 8 | 29 | 28 | 11 | 52 | 49 | 45 | 33 | 18 | 53 | 9 | 31 | 36 | 28 | 1 | 5 | 13 | 12 | 7 | 2 | 4 | 16 | 33 | 2 | 784 |

* The map code for this cell is identical on that row (expected map code) and the for that column (map code assigned in the field) combintation (also with a gray background).

# Appendix G: Photo Signature Interpretation Guide

### *Paspalum notatum* Ruderal Herbaceous Grassland

**Map Class Code:** MC101

**Color:** Tan, Brown, Red, Pink

**Texture:** Smooth

**Crown Size:** n/a

**Crown Shape:** n/a

**Density:** low

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G1).



**Figure G1.** Photo signature example of the MC101 *Paspalum notatum* Ruderal Herbaceous Grassland map class.

### *Juncus effusus* Marsh

**Map Class Code:** MC102

**Color:** Brown, Pink, Rust, Red, Gray

**Texture:** smooth to coarse

**Crown Size:** Small

**Crown Shape:** round

**Density:** Low

**Notes:**

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G2).

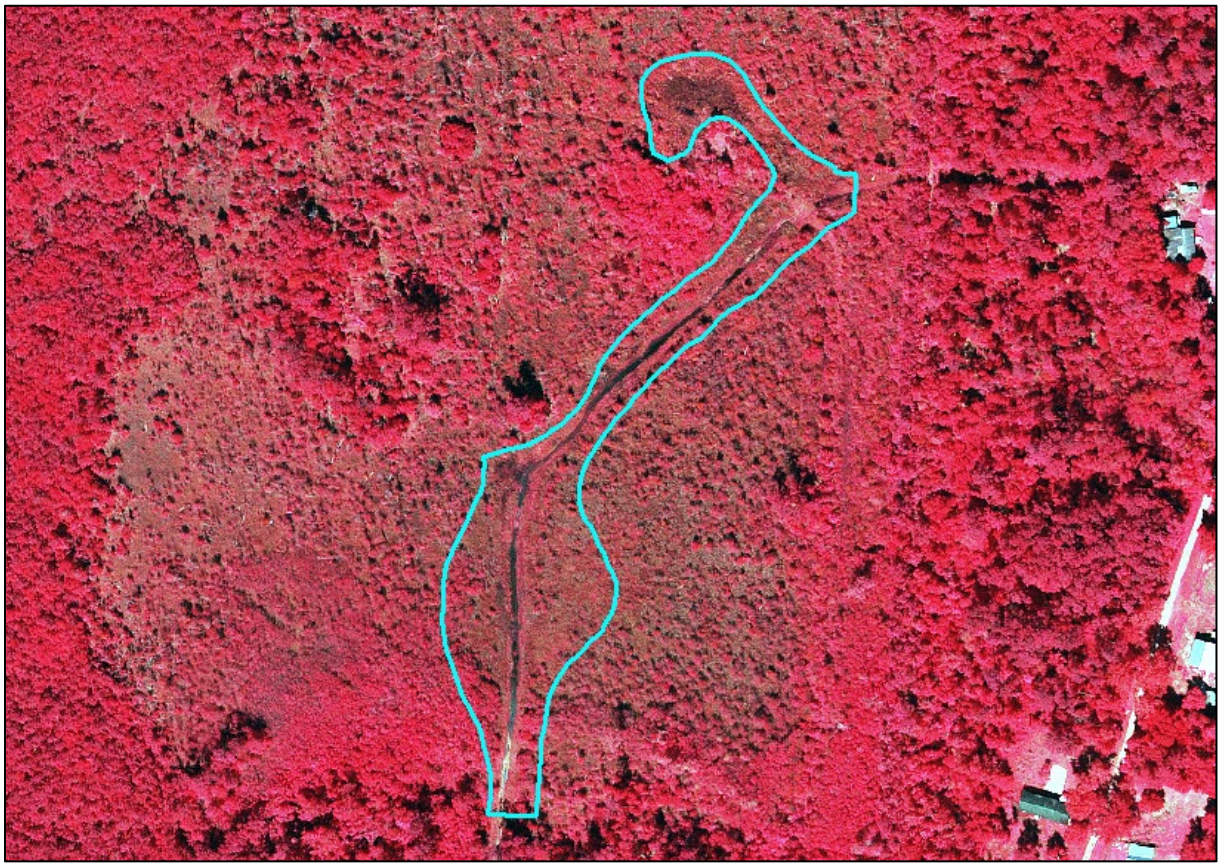


**Figure G2.** Photo signature example of the MC102 *Juncus effusus* Marsh map class.

**Schoenoplectus tabernaemontani – (Typha latifolia) Brackish Marsh**
**Map Class Code:** MC103

**Color:** Brown, Red, White, Gray, Pink

**Texture:** Smooth

**Crown Size:** n/a

**Crown Shape:** n/a

**Density:** Low

**Notes:** Very dynamic community.

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G3).



**Figure G3.** Photo signature example of the MC103 *Schoenoplectus tabernaemontani* – (*Typha latifolia*) Brackish Marsh map class.

### *Panicum virgatum - Panicum rigidulum* var. *elongatum - Polygonum hydropiperoides* Wet Meadow

**Map Class Code:** MC104

**Color:** Tan, Pink, Red, Brown

**Texture:** Smooth to Coarse

**Crown Size:** n/a

**Crown Shape:** n/a

**Density:** Low

**Notes:** Typically occurs on sandbars, very dynamic community. Sand can occasionally over-saturate the photo signature.

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G4).



**Figure G4.** Photo signature example of the MC104 *Panicum virgatum - Panicum rigidulum* var. *elongatum - Polygonum hydropiperoides* Wet Meadow map class.

### *Zizaniopsis miliacea* Tidal Marsh
**Map Class Code:** MC105

**Color:** Tan, brown, gray, pink, white

**Texture:** Smooth

**Crown Size:** Small

**Crown Shape:** Round

**Density:** Low

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G5).



**Figure G5.** Photo signature example of the MC105 *Zizaniopsis miliacea* Tidal Marsh map class.

### Upland Seepage Marsh
**Map Class Code:** MC106

**Color:** Brown, Red, Tan, Pink

**Texture:** smooth to coarse

**Crown Size:** small

**Crown Shape:** round

**Density:** low

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G6).



**Figure G6.** Photo signature example of the MC106 *Upland Seepage* Marsh map class.

### Floating Aquatic Vegetation

**Map Class Code:** MC107

**Color:** Pink, black, white, gray, red

**Texture:** smooth to coarse

**Crown Size:** n/a

**Crown Shape:** n/a

**Density:** low

**Notes:**

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G7).

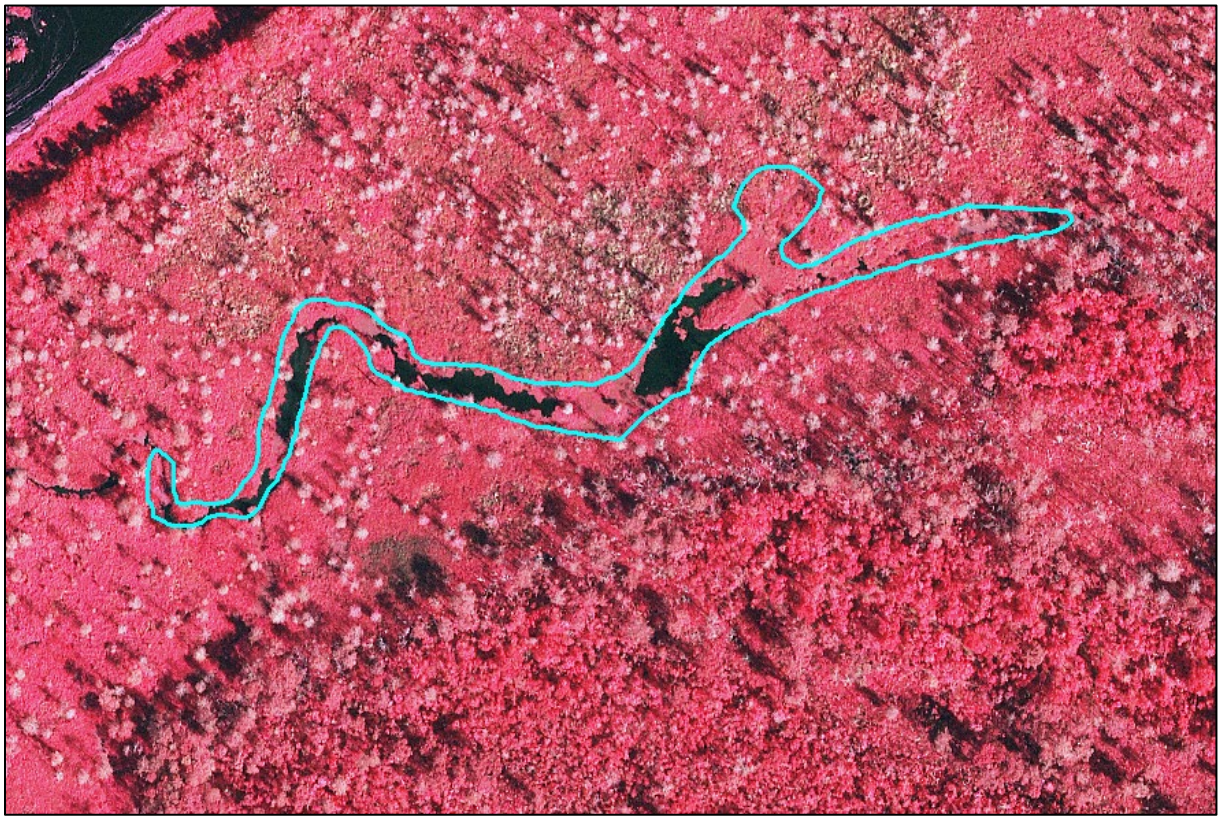


**Figure G7.** Photo signature example of the MC107 Floating Aquatic Vegetation map class.

### ***Schizachyrium scoparium - Rudbeckia missouriensis - Grindelia lanceolata*** **- (*Liatris mucronata*) Relict Grassland**

**Map Class Code:** MC108

**Color:** Tan, Brown, Pink, Red

**Texture:** Smooth

**Crown Size:** n/a

**Crown Shape:** n/a

**Density:** low

**Notes:** Example shown is edge of map, whole clearing is included in the map class.

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G8).



**Figure G8.** Photo signature example of the MC108 *Schizachyrium scoparium* - *Rudbeckia missouriensis* - *Grindelia lanceolata* - (*Liatris mucronata*) Relict Grassland map class.

### *Sesbania drummondii* – (*Morella cerifera*) / *Juncus effusus* Ruderal Wet Shrubland

**Map Class Code:** MC201

**Color:** Tan, brown, pink, red, green, gray

**Texture:** Coarse

**Crown Size:** n/a

**Crown Shape:** n/a

**Density:** low

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G9).

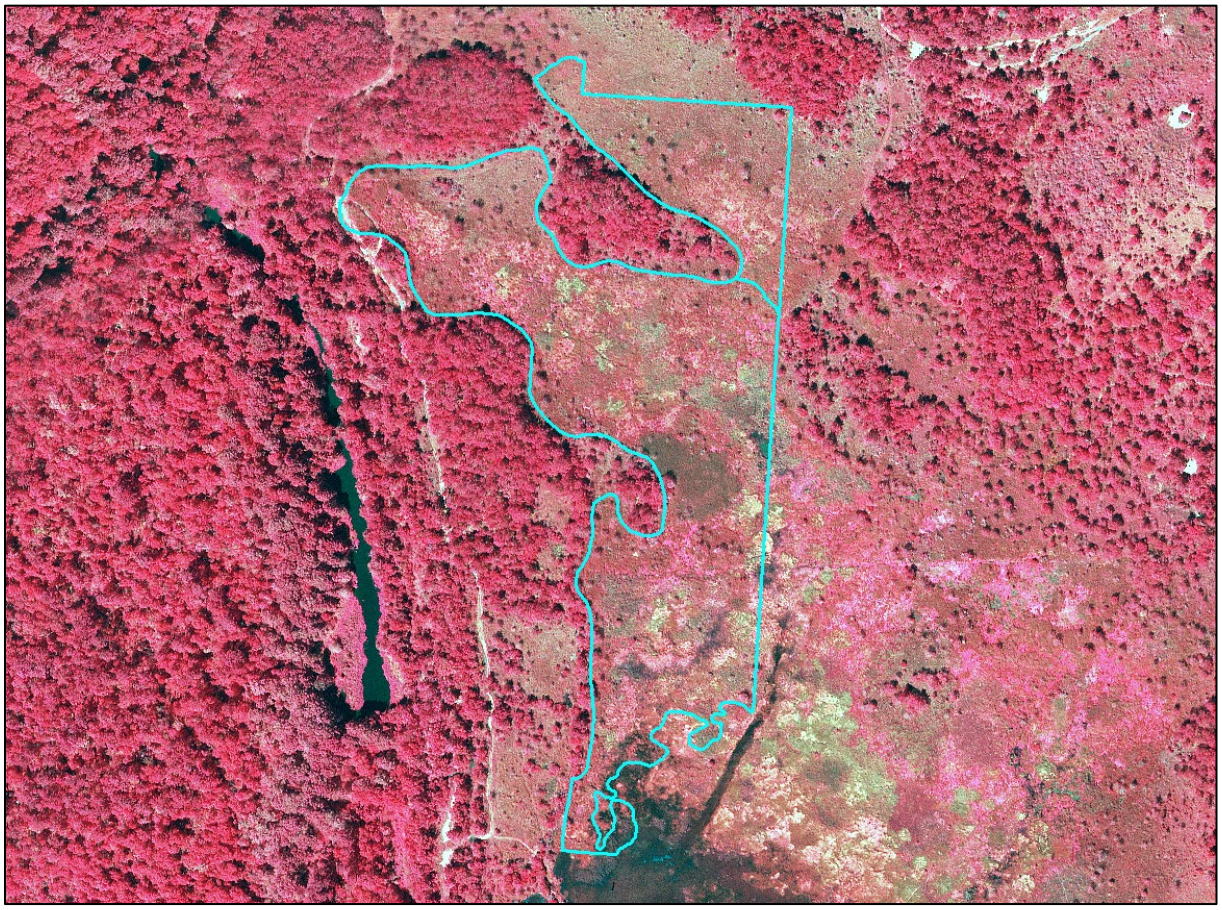


**Figure G9.** Photo signature example of the MC201 *Sesbania drummondii* – (*Morella cerifera*) / *Juncus effusus* Ruderal Wet Shrubland map class.

### *Quercus hemisphaerica* Shrubland

**Map Class Code:** MC202

**Color:** Pink, red, gray

**Texture:** Smooth to coarse

**Crown Size:** small

**Crown Shape:** irregular

**Density:** high

**Notes:**

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G10).

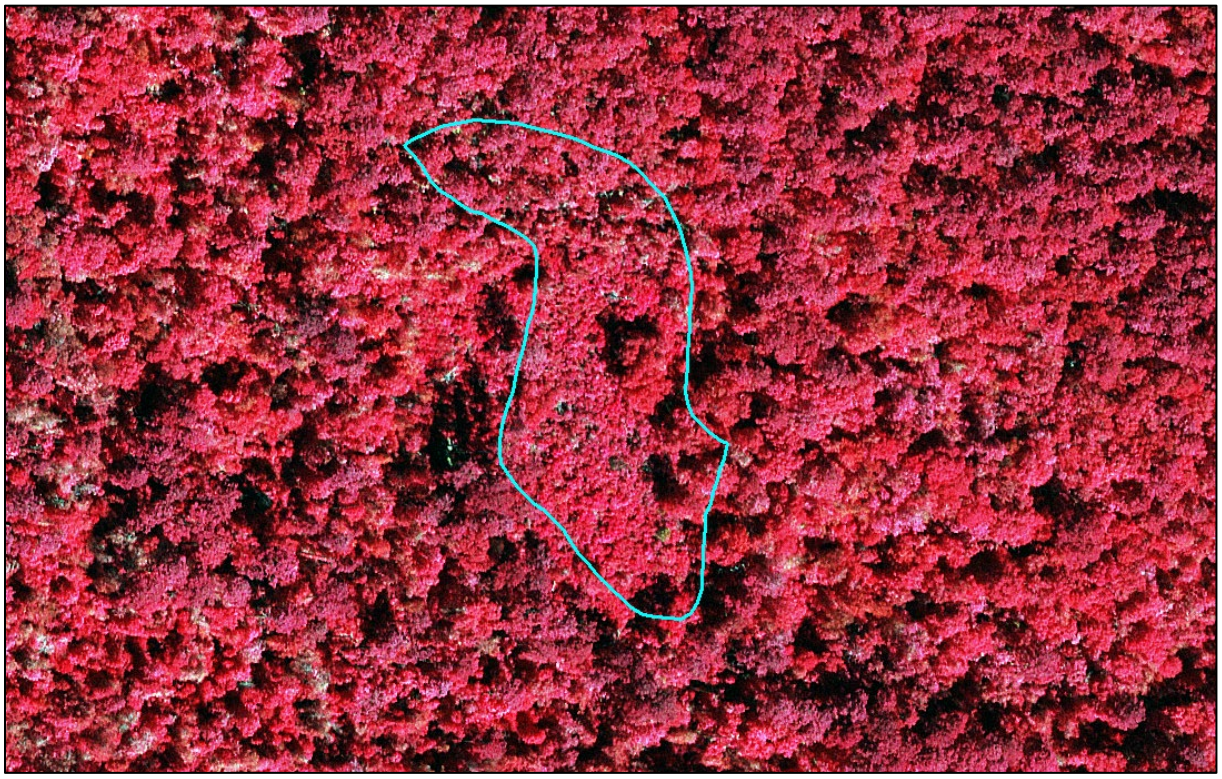


**Figure G10.** Photo signature example of the MC202 *Quercus hemisphaerica* Shrubland map class.

### *Cephalanthus occidentalis* / *Forestiera acuminata* Southern Shrub Swamp

**Map Class Code:** MC203

**Color:** Pink, red, gray, brown, tan

**Texture:** Smooth to coarse

**Crown Size:** small to medium

**Crown Shape:** round

**Density:** low

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G11).

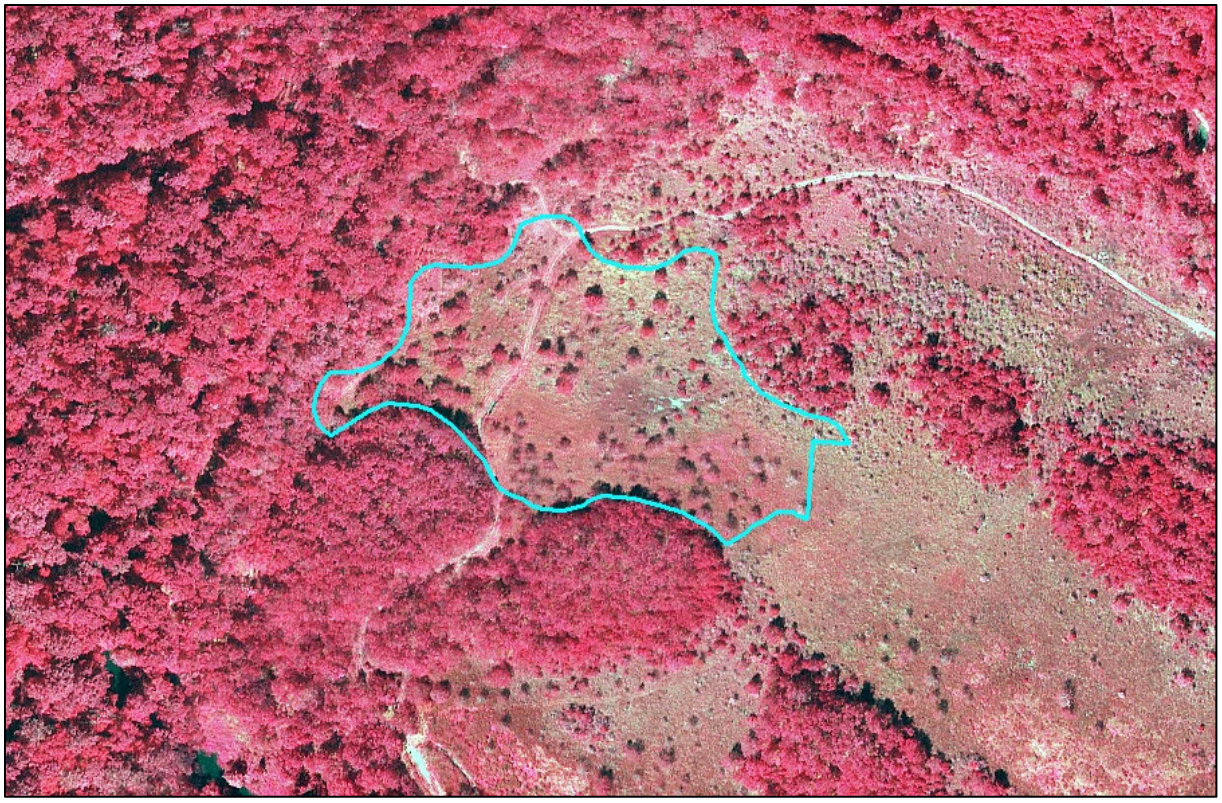


**Figure G11**. Photo signature example of the MC203 *Cephalanthus occidentalis / Forestiera acuminata* Southern Shrub Swamp map class.

### *Ilex vomitoria* Shrubland

**Map Class Code:** MC204

**Color:** Pink, gray, red

**Texture:** coarse

**Crown Size:** small

**Crown Shape:** irregular

**Density:** high

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G12).



**Figure G12.** Photo signature example of the MC204 *Ilex vomitoria* Shrubland map class.

### *Morella cerifera - Ilex vomitoria* Wet Meadow Shrubland
**Map Class Code:** MC205

**Color:** Brown, red, pink, gray

**Texture:** coarse

**Crown Size:** small

**Crown Shape:** irregular

**Density:** medium

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data. (Figure G13)

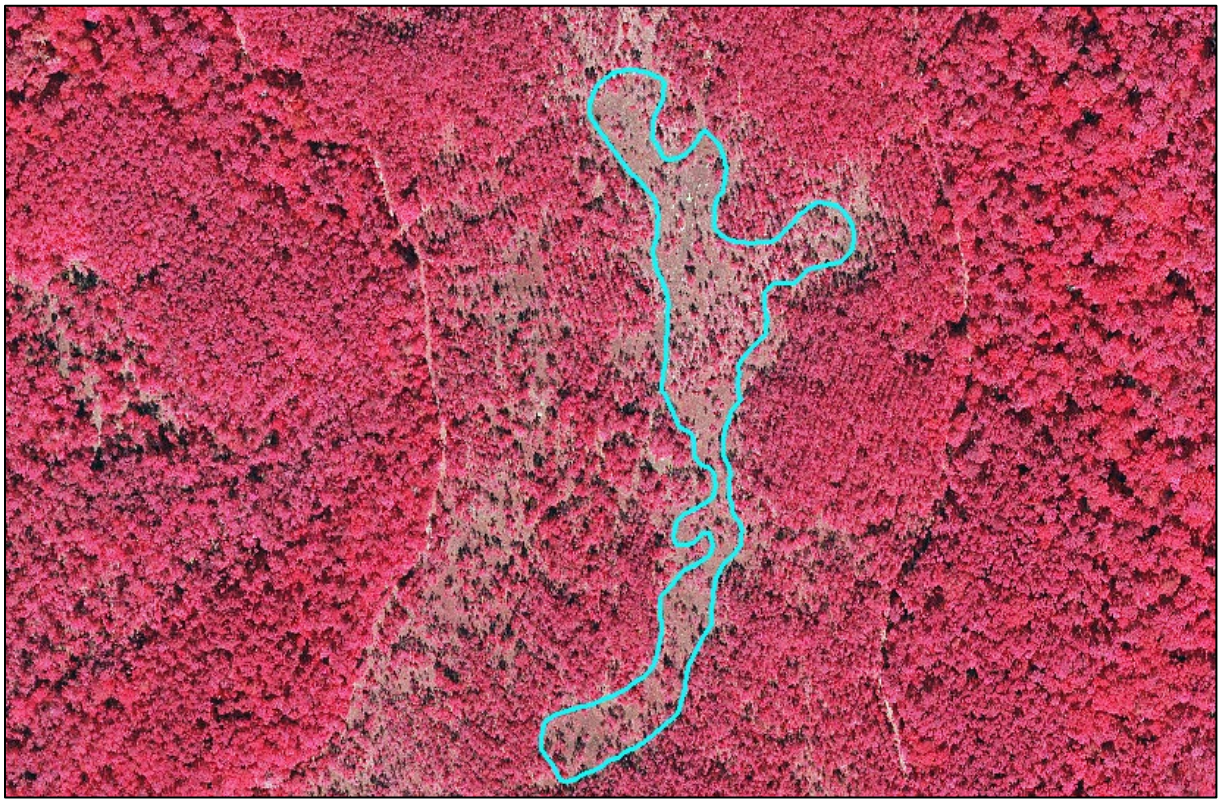


**Figure G13.** Photo signature example of the MC205 *Morella cerifera - Ilex vomitoria* Wet Meadow Shrubland map class.

### *Morella cerifera – Ilex coriacea – Baccharis halimifolia* Wet Scrub Shrubland
**Map Class Code:** MC206

**Color:** green, gray, light green, tan

**Texture:** coarse

**Crown Size:** small

**Crown Shape:** irregular

**Density:** low

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G14).

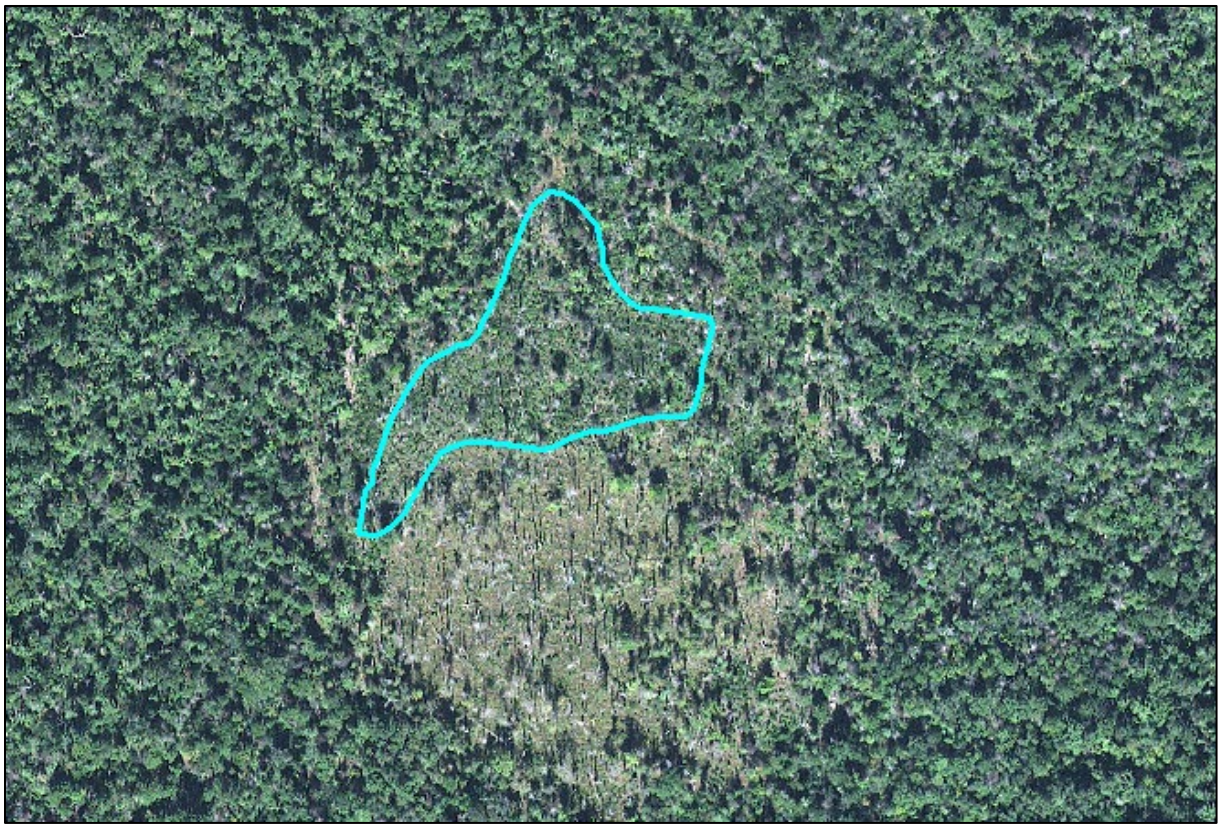


**Figure G14.** Photo signature example of the MC206 *Morella cerifera – Ilex coriacea – Baccharis halimifolia* Wet Scrub Shrubland map class.

### Pine Forest Plantation

**Map Class Code:** MC301

**Color:** Red, pink, brown, rust

**Texture:** smooth to coarse

**Crown Size:** medium

**Crown Shape:** irregular to round

**Density:** low to high

**Notes:** Rows typically evident in the imagery.

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G15).

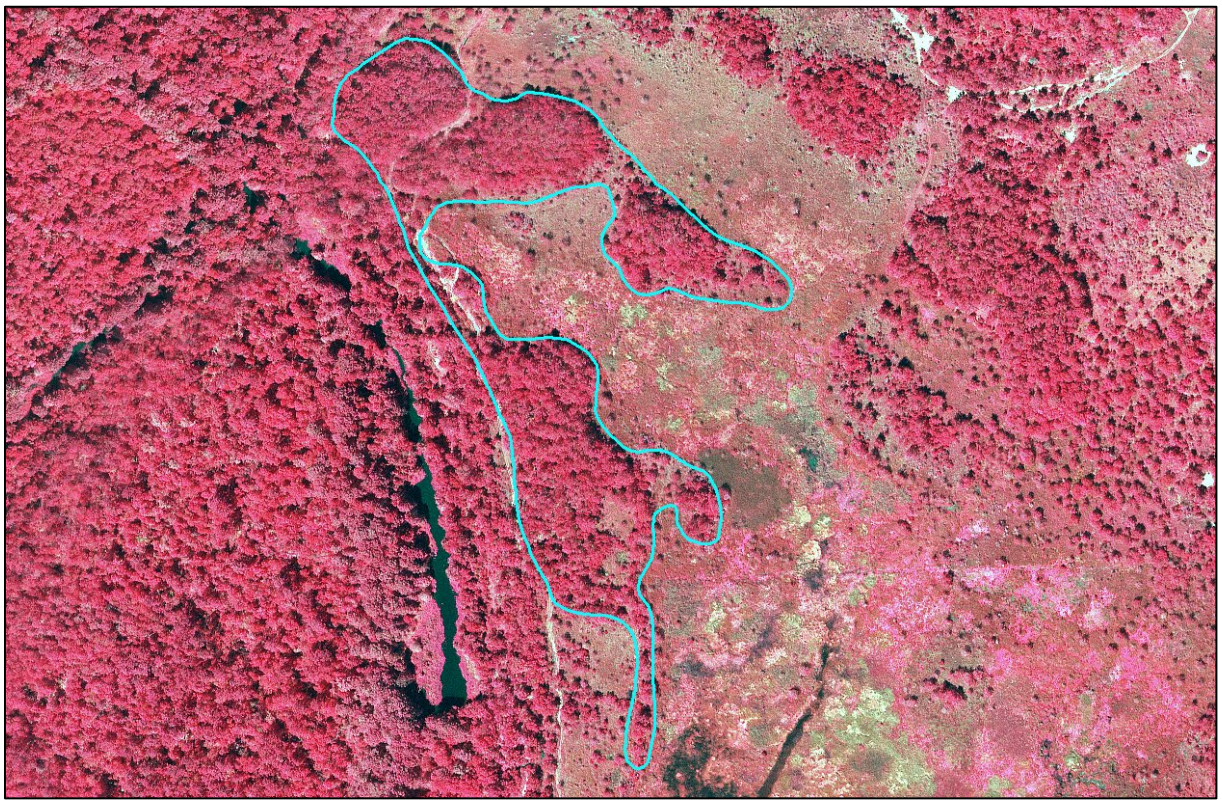


**Figure G15.** Photo signature example of the MC301 Pine Forest Plantation map class.

### *Pinus taeda* Riparian Forest

**Map Class Code:** MC302

**Color:** Red, pink, white

**Texture:** Coarse

**Crown Size:** medium

**Crown Shape:** irregular

**Density:** high

**Notes:** greater than 60% pine cover

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G16).

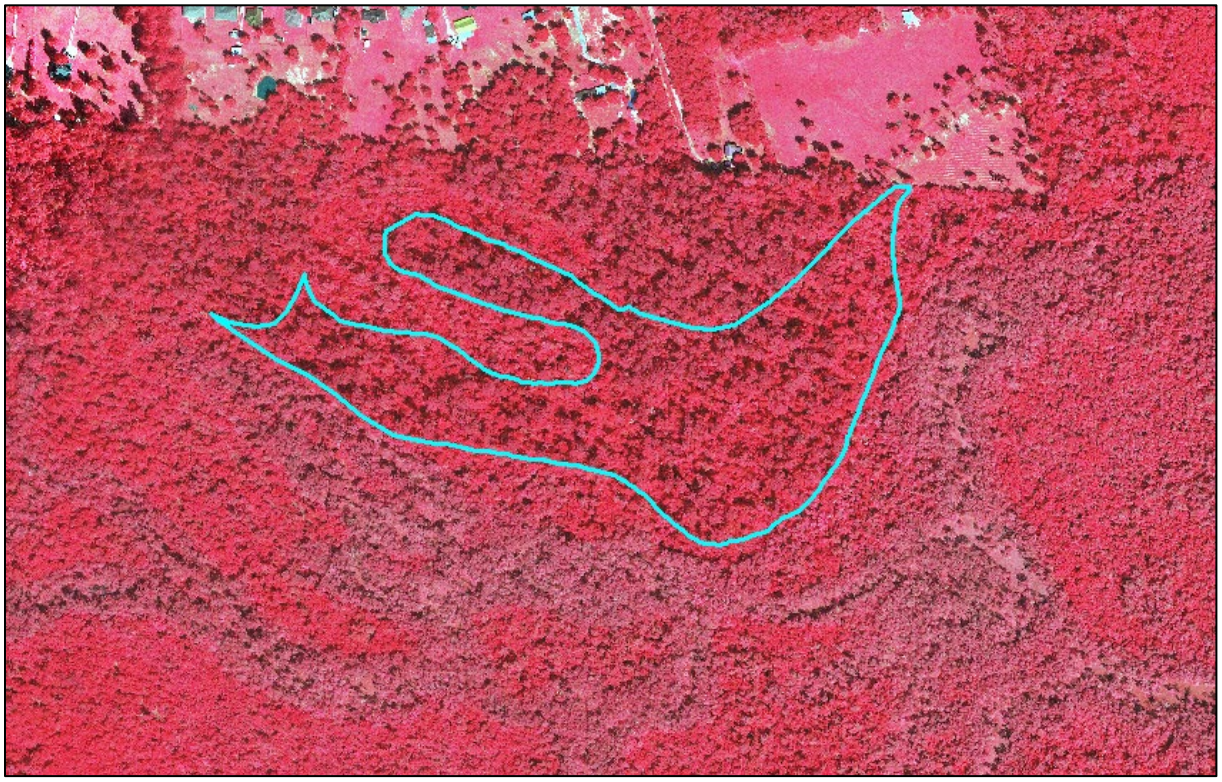


**Figure G16.** Photo signature example of the MC302 *Pinus taeda* Riparian Forest map class.

### *Pinus taeda* – (*Pinus echinata*) Nonriverine Flatwoods Forest

**Map Class Code:** MC303

**Color:** Pink, red, gray, white

**Texture:** coarse

**Crown Size:** small

**Crown Shape:** irregular

**Density:** high

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G17).

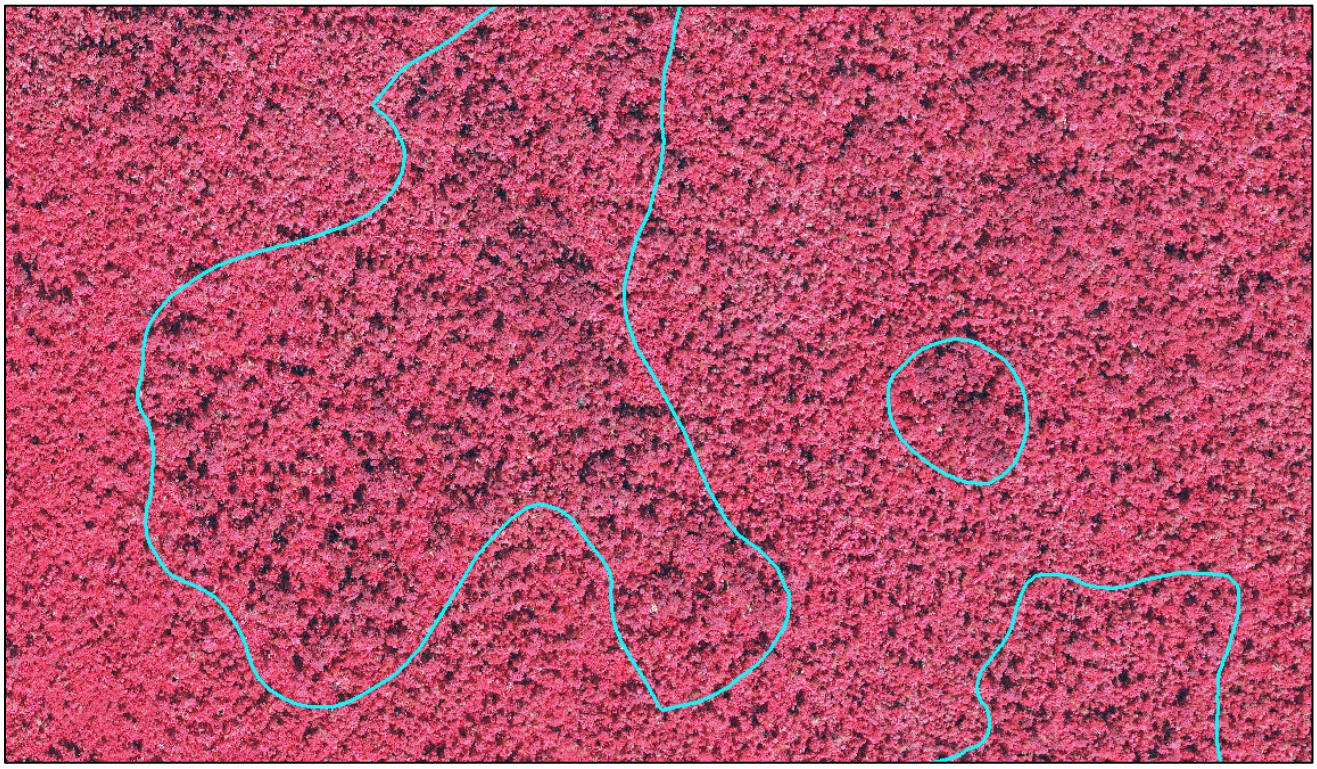


**Figure G17.** Photo signature example of the MC303 *Pinus taeda – (Pinus echinata)* Nonriverine Flatwoods Forest map class.

### Baygall Seepage Bog

**Map Class Code:** MC304

**Color:** Red, pink, gray, reddish brown

**Texture:** coarse

**Crown Size:** small

**Crown Shape:** irregular

**Density:** high

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G18).

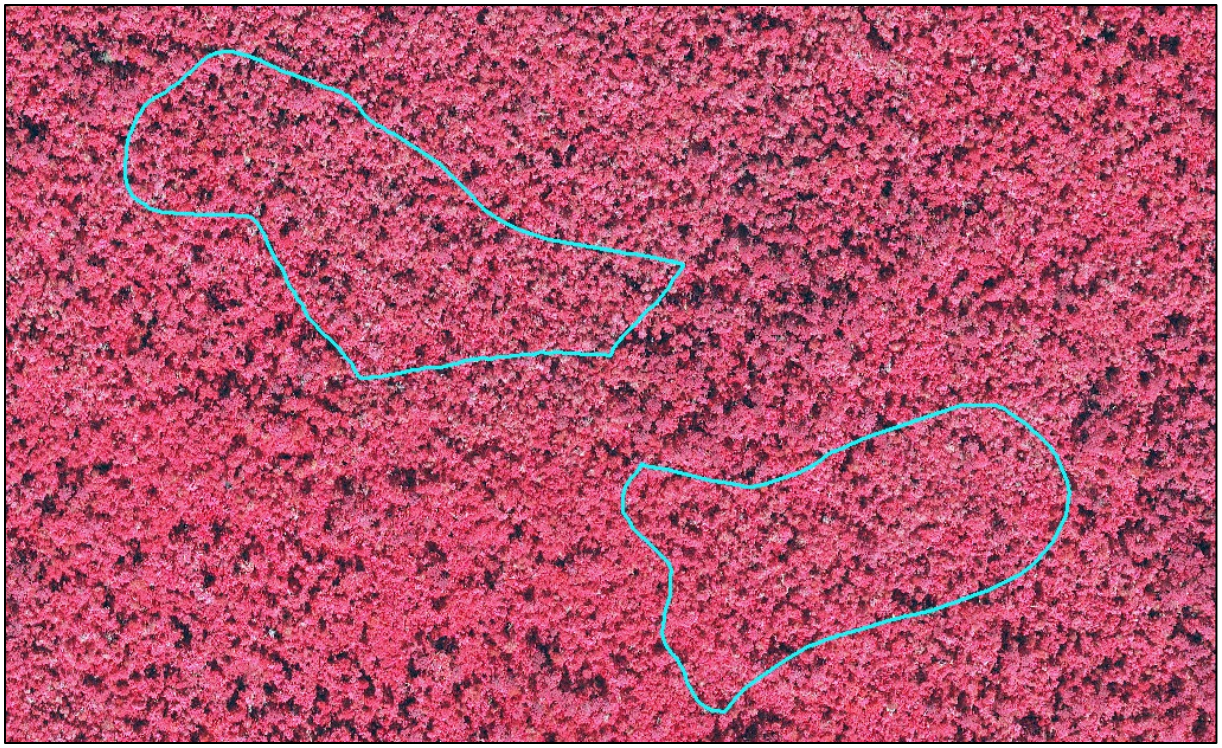


**Figure G18.** Photo signature example of the MC304 Baygall Seepage Bog map class.

### *Acer rubrum* Floodplain Forest

**Map Class Code:** MC305

**Color:** Green, light green, gray

**Texture:** coarse

**Crown Size:** medium

**Crown Shape:** irregular

**Density:** medium to high

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G19).

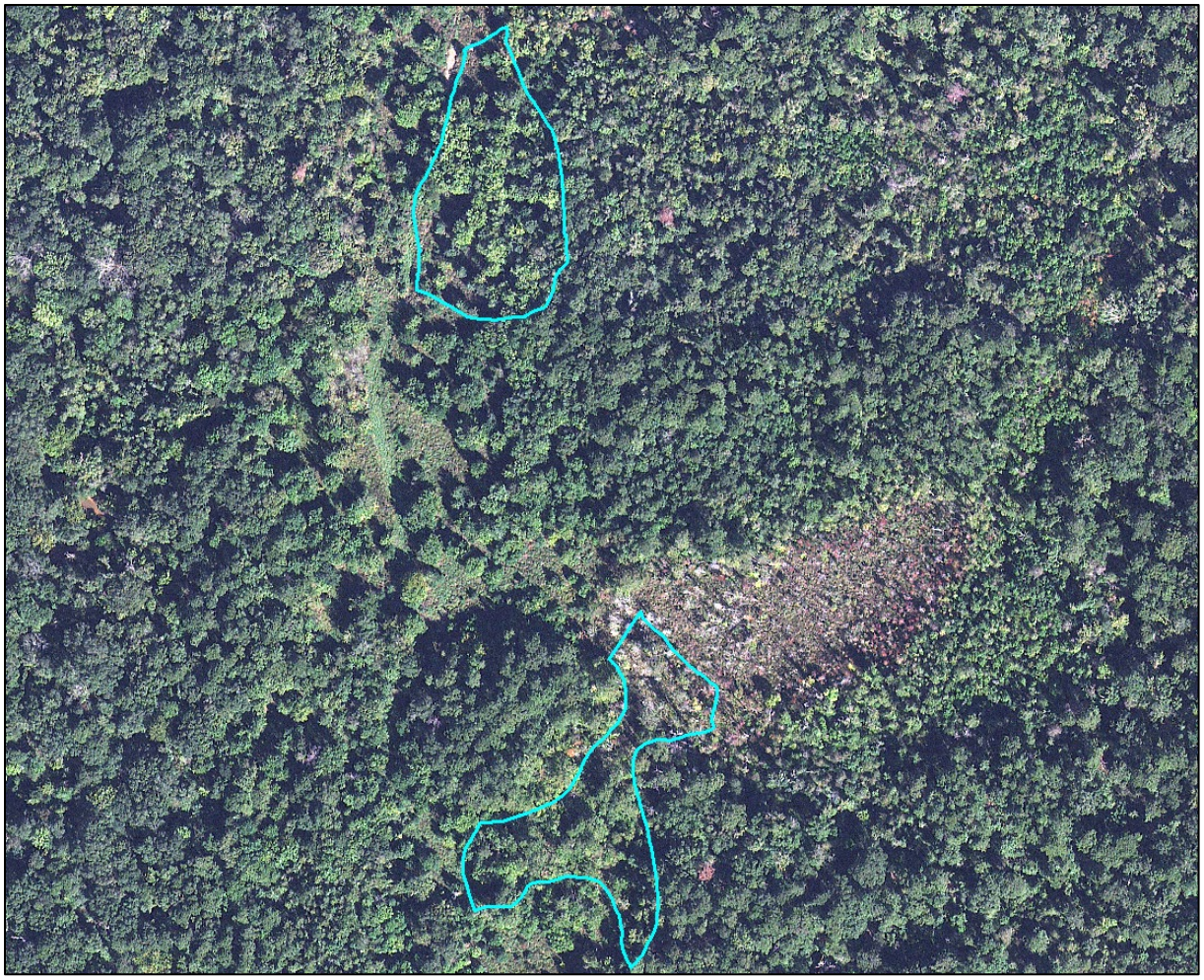


**Figure G19.** Photo signature example of the MC305 *Acer rubrum* Floodplain Forest map class.

### Riverfront Successional Floodplain Forest

**Map Class Code:** MC306

**Color:** light green, green, gray, brown

**Texture:** coarse

**Crown Size:** small to medium

**Crown Shape:** irregular

**Density:** medium to high

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G20).



**Figure G20.** Photo signature example of the MC306 Riverfront Successional Floodplain Forest map class.

### *Triadica sebifera* Ruderal Forest and Woodland

**Map Class Code:** MC307

**Color:** Pink, brown, red, gray

**Texture:** smooth to coarse

**Crown Size:** small

**Crown Shape:** irregular

**Density:** high

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G21).



**Figure G21.** Photo signature example of the MC307 *Triadica sebifera* Ruderal Forest and Woodland map class.

### *Fraxinus pennsylvanica - Ulmus americana - Celtis laevigata* / *Ilex decidua* Floodplain Forest

**Map Class Code:** MC308

**Color:** Red, pink, white, gray, tan

**Texture:** Coarse

**Crown Size:** medium

**Crown Shape:** round to irregular

**Density:** medium to high

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G22).

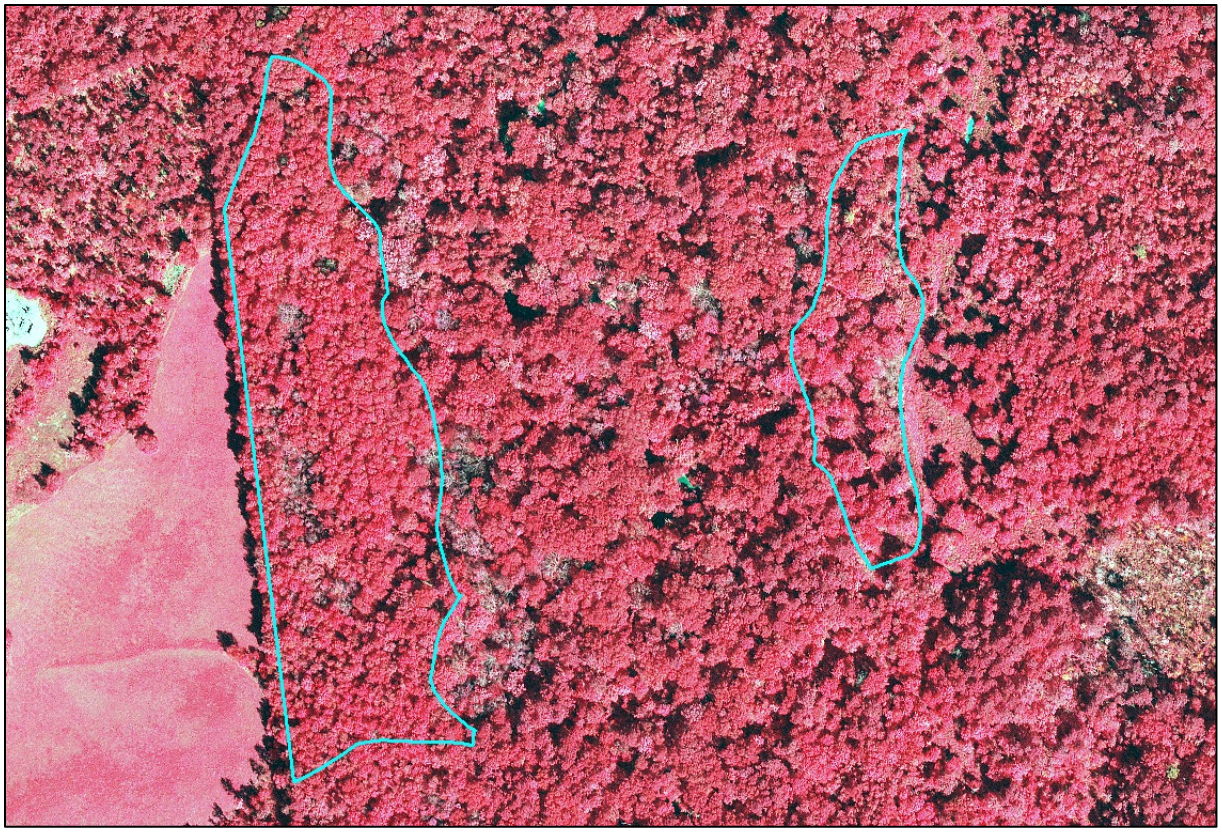


**Figure G22.** Photo signature example of the MC308 Fraxinus pennsylvanica - Ulmus americana - Celtis laevigata / Ilex decidua Floodplain Forest map class.

### *Fraxinus caroliniana* Swamp Forest
**Map Class Code:** MC309

**Color:** Pink, white, gray, red

**Texture:** coarse

**Crown Size:** small to medium

**Crown Shape:** irregular

**Density:** high

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G23).



**Figure G23.** Photo signature example of the MC309 *Fraxinus caroliniana* Swamp Forest map class.

### *Nyssa aquatica* - (*Taxodium distichum*) / *Zizaniopsis miliacea* Marsh Woodland
**Map Class Code:** MC310

**Color:** Gray, tan, green, light green

**Texture:** coarse

**Crown Size:** small to medium

**Crown Shape:** irregular

**Density:** medium to high

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G24).



**Figure G24.** Photo signature example of the MC310 *Nyssa aquatica* - (*Taxodium distichum*) / *Zizaniopsis miliacea* Marsh Woodland map class.

### Taxodium distichum - Nyssa aquatica Floodplain Forest

**Map Class Code:** MC311

**Color:** Pink, red, brown, gray, white

**Texture:** coarse

**Crown Size:** medium

**Crown Shape:** irregular

**Density:** medium to high

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G25).

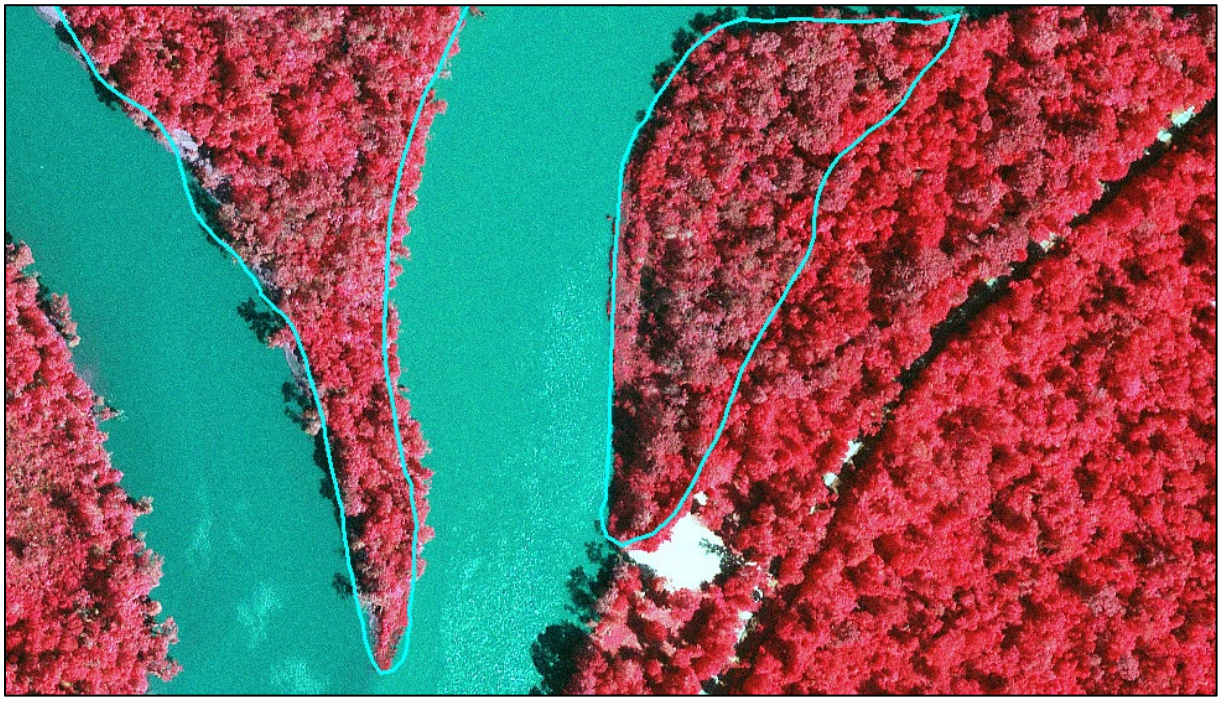


**Figure G25.** Photo signature example of the MC311 *Taxodium distichum - Nyssa aquatica* Floodplain Forest map class.

### *Taxodium distichum* / *Lemna minor* Inundated Swamp Floodplain Forest

**Map Class Code:** MC312

**Color:** Black, pink, red, yellow, brown

**Texture:** coarse

**Crown Size:** small

**Crown Shape:** round

**Density:** low

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G26).

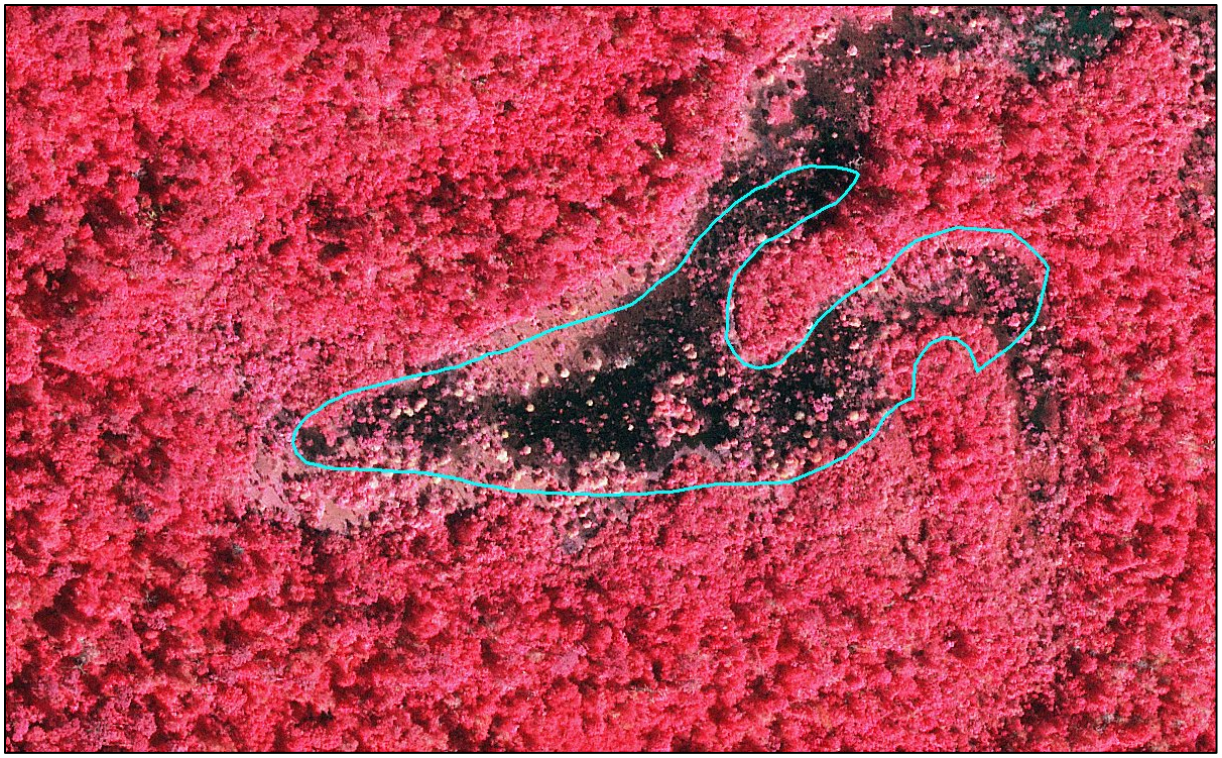


**Figure G26.** Photo signature example of the MC312 *Taxodium distichum* / *Lemna minor* Inundated Swamp Floodplain Forest map class.

### *Quercus* spp. Mixed Hardwood Floodplain Forest

**Map Class Code:** MC313

**Color:** Pink, red, gray

**Texture:** Coarse

**Crown Size:** small

**Crown Shape:** irregular

**Density:** high

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G27).



**Figure G27.** Photo signature example of the MC313 *Quercus* spp. Mixed Hardwood Floodplain Forest map class.

### *Quercus* spp. Wet Mixed Hardwood Flatwoods Forest

**Map Class Code:** MC314

**Color:** Pink, red, gray

**Texture:** Coarse

**Crown Size:** Medium

**Crown Shape:** irregular

**Density:** Medium

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G28).

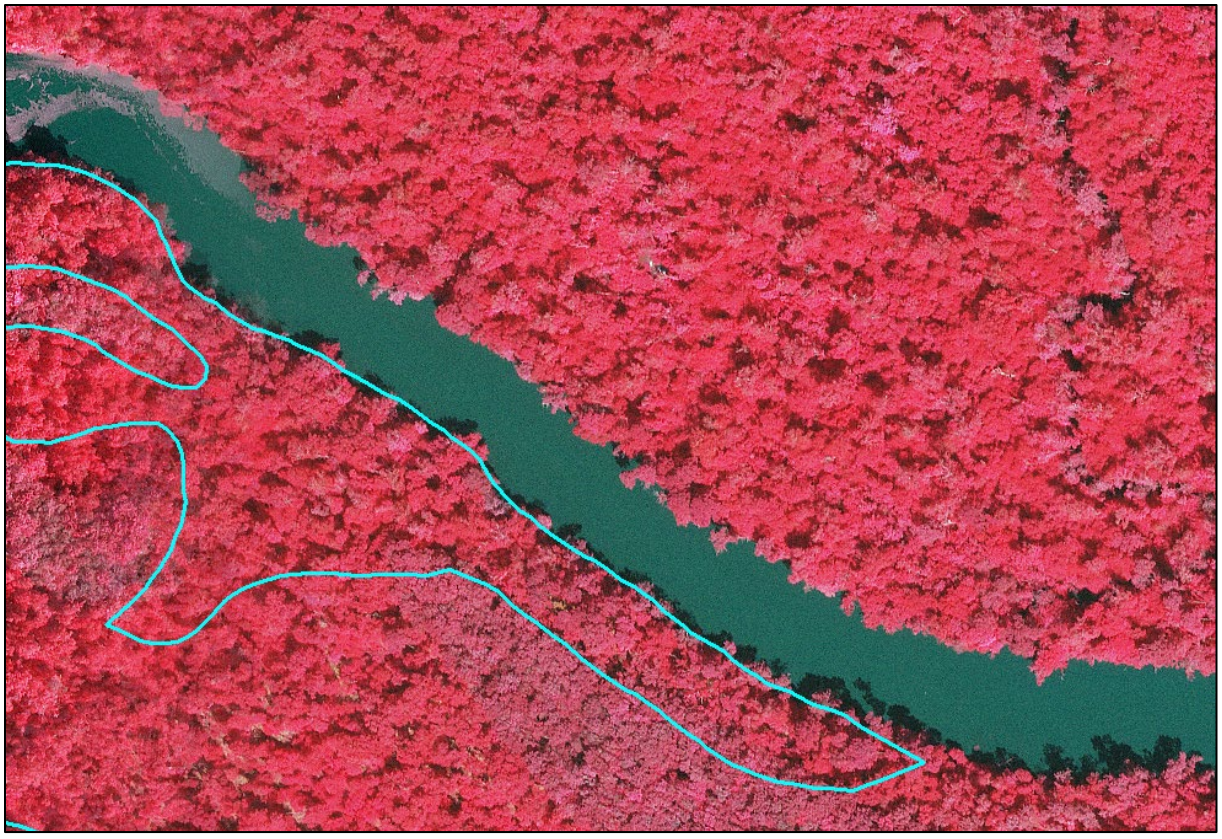


**Figure G28.** Photo signature example of the MC314 *Quercus* spp. Wet Mixed Hardwood Flatwoods Forest map class.

### Mixed Hardwoods - *Pinus taeda* Floodplain Forest

**Map Class Code:** MC315

**Color:** Red, pink, gray

**Texture:** Coarse

**Crown Size:** Medium

**Crown Shape:** Irregular

**Density:** high

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G29).



**Figure G29.** Photo signature example of the MC315 Mixed Hardwoods - *Pinus taeda* Floodplain Forest map class.

### *Pinus taeda* - Mixed Hardwoods Slope and Small Stream Forest
**Map Class Code:** MC316

**Color:** Red, pink, gray

**Texture:** coarse

**Crown Size:** medium to large

**Crown Shape:** irregular

**Density:** medium to high

**Notes:** LiDAR data used to confirm slope.

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G30).

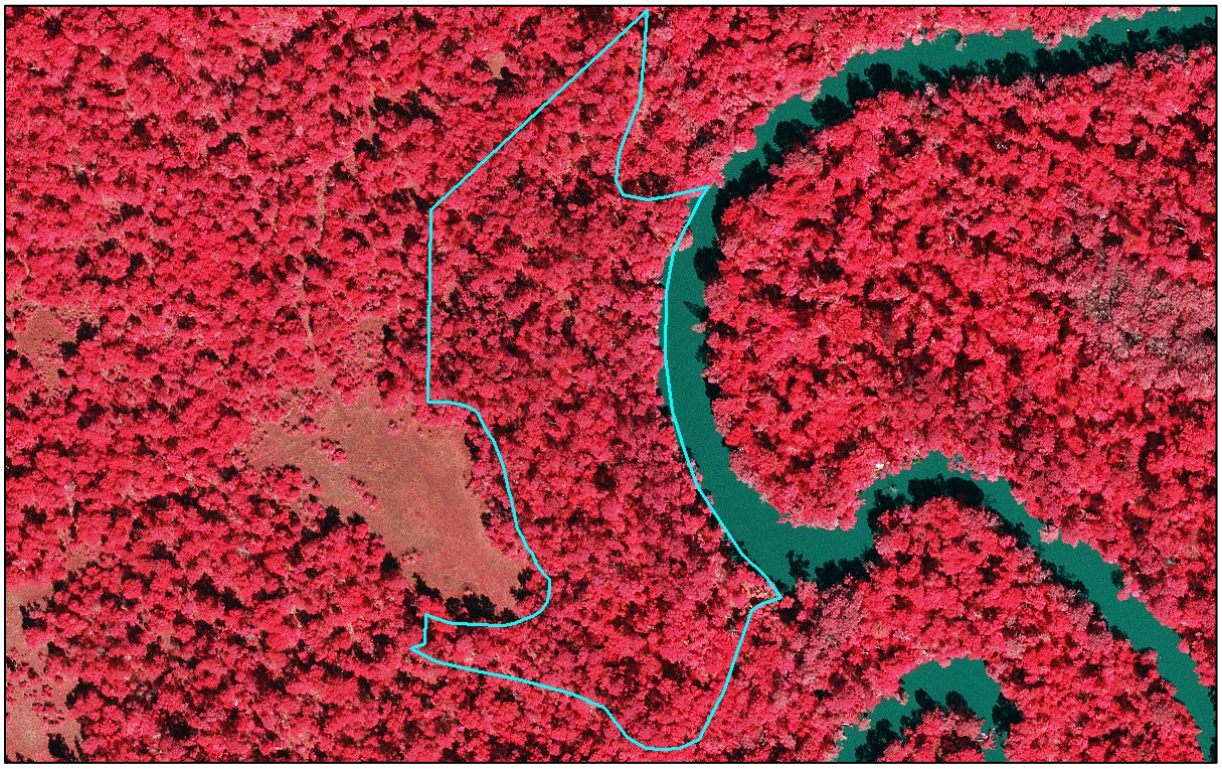


**Figure G30.** Photo signature example of the MC316 *Pinus taeda* - Mixed Hardwoods Slope and Small Stream Forest map class.

### Mixed Hardwood Mesic Slope Forest
**Map Class Code:** MC317

**Color:** Red, pink, white

**Texture:** Coarse

**Crown Size:** Medium

**Crown Shape:** irregular to round

**Density:** High

**Notes:** LiDAR data used to confirm slope.

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G31).

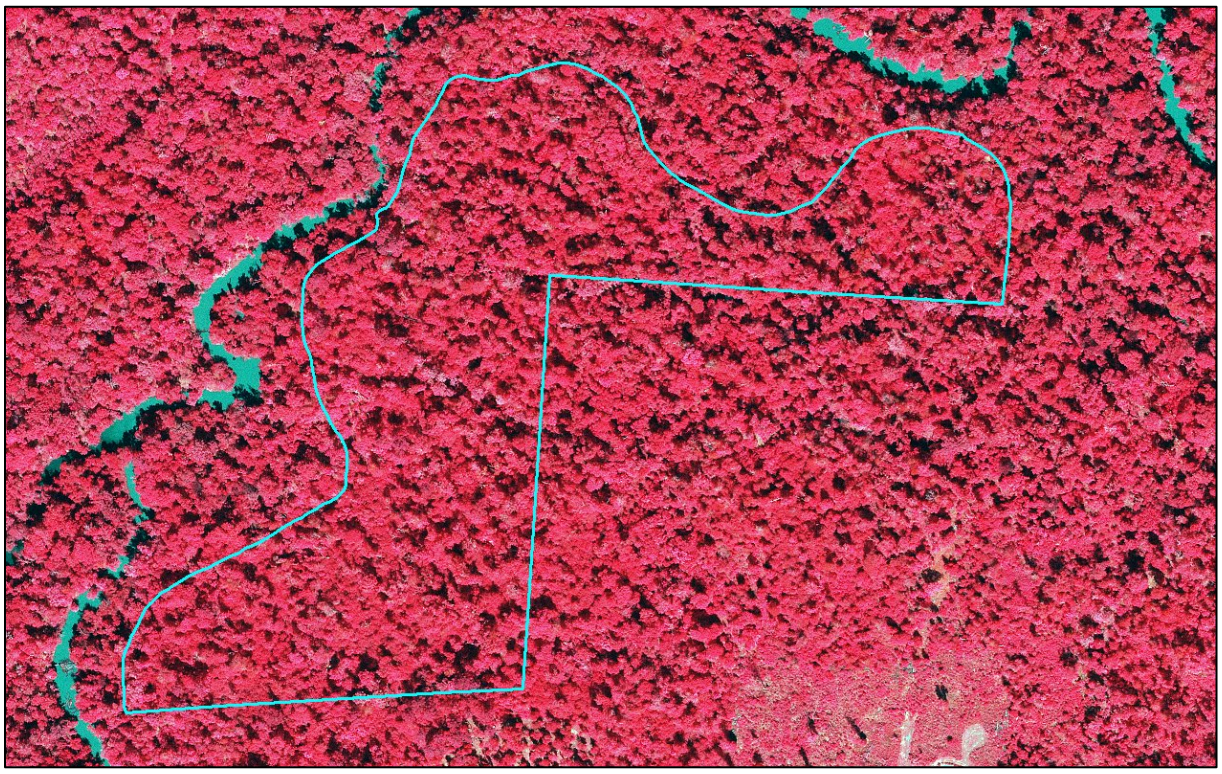


**Figure G31.** Photo signature example of the MC317 Mixed Hardwood Mesic Slope Forest map class.

### Mixed Hardwood Dry Upland and Slope Forest

**Map Class Code:** MC318

**Color:** Red, pink, tan, white

**Texture:** Coarse

**Crown Size:** Small to medium

**Crown Shape:** irregular

**Density:** Medium to high

**Notes:** LiDAR data used to confirm slope.

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G33).

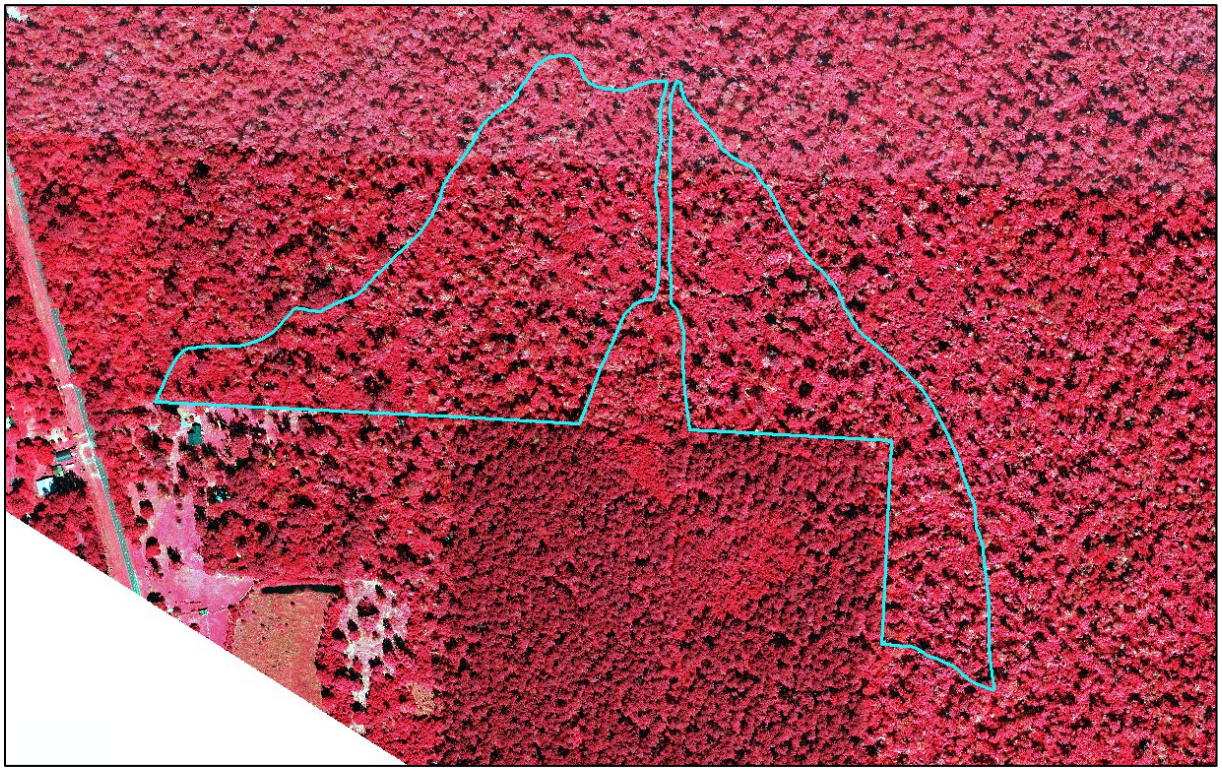


**Figure G33.** Photo signature example of the MC318 Mixed Hardwood Dry Upland and Slope Forest map class.

### *Pinus* (*taeda*, *echinata*) Upland Woodland

**Map Class Code:** MC319

**Color:** Pink, red, white, tan, gray

**Texture:** coarse

**Crown Size:** Variable

**Crown Shape:** irregular to round

**Density:** medium

**Notes:** LiDAR data used to confirm woodland.

**Imagery Used**: 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G34).

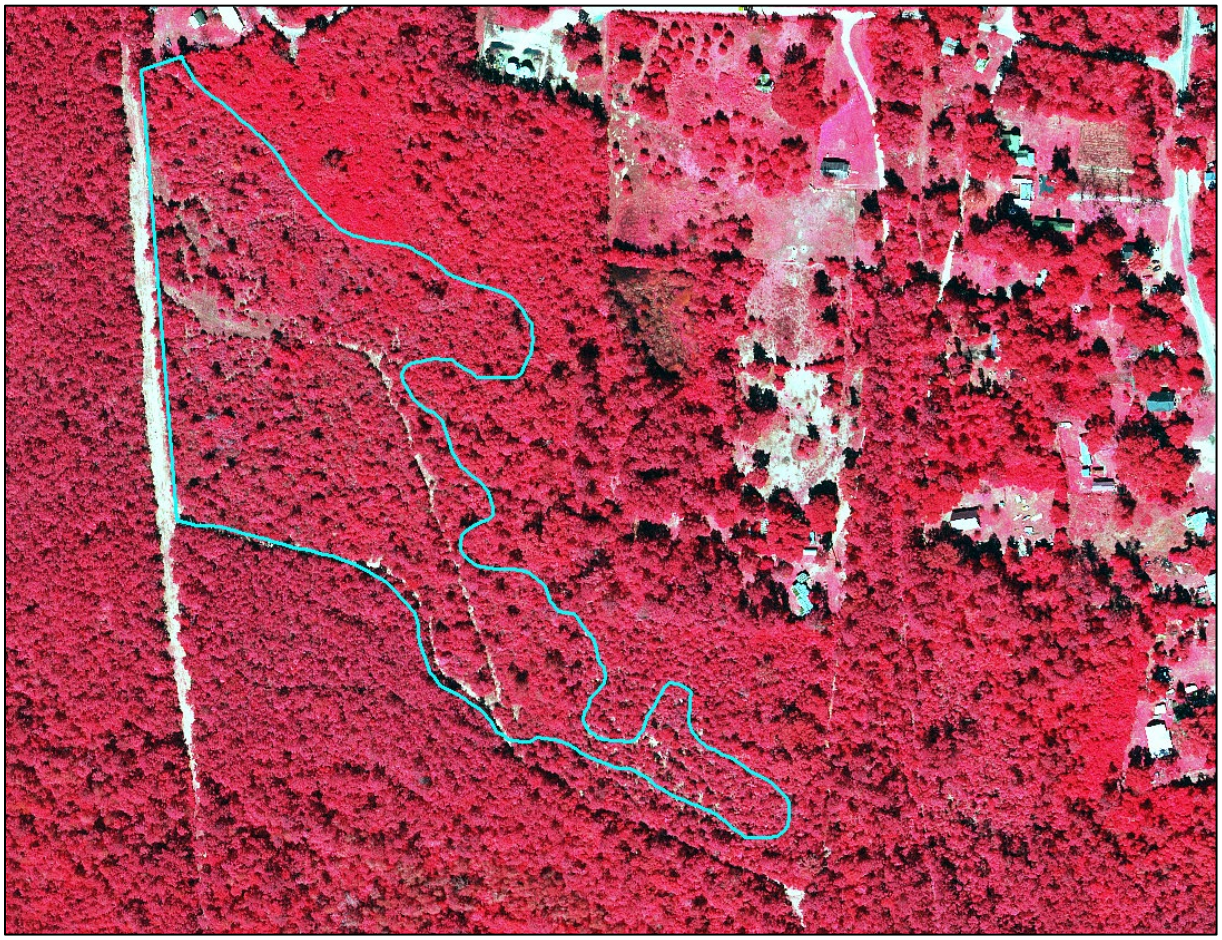


**Figure G34.** Photo signature example of the MC319 *Pinus* (*taeda*, *echinata*) Upland Woodland map class.

### *Pinus* (*taeda*, *echinata*) Upland Forest

**Map Class Code:** MC320

**Color:** Red, pink, brown, white

**Texture:** smooth to coarse

**Crown Size:** Small

**Crown Shape:** irregular

**Density:** high

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G35).



**Figure G35.** Photo signature example of the MC320 *Pinus* (*taeda*, *echinata*) Upland Forest map class.

### *Pinus palustris* - (*Pinus echinata*, *taeda*, *elliottii*) Forest and Woodland

**Map Class Code:** MC321

**Color:** Pink, red, gray, white

**Texture:** Coarse

**Crown Size:** Small to medium

**Crown Shape:** irregular

**Density:** medium

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G36).

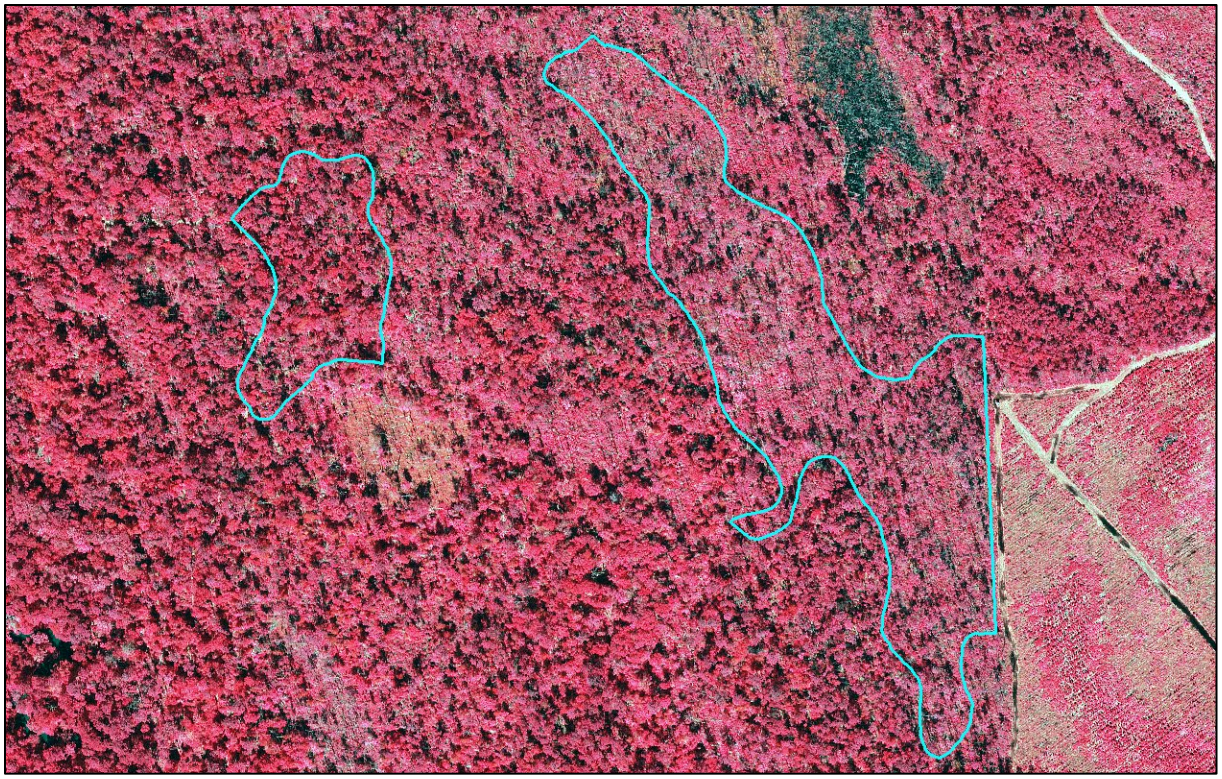


**Figure G36**. Photo signature example of the MC321 *Pinus palustris* - (*Pinus echinata, taeda, elliottii*) Forest and Woodland map class.

### *Pinus* spp. (*taeda, echinata, palustris*) Regenerating Woodland and Shrubland

**Map Class Code:** MC322

**Color:** White, red, pink, tan

**Texture:** Coarse

**Crown Size:** small

**Crown Shape:** irregular

**Density:** variable

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G37).

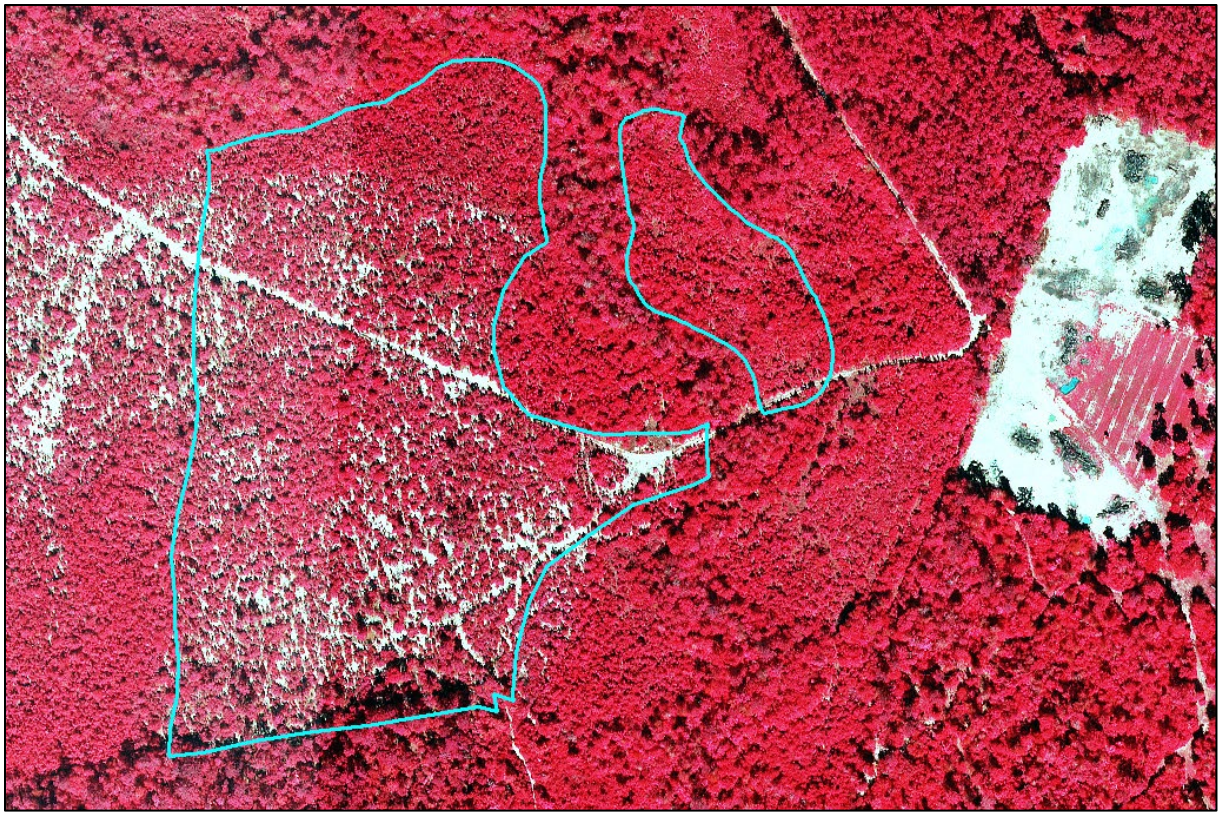


**Figure G37.** Photo signature example of the MC322 *Pinus* spp. (*taeda*, *echinata*, *palustris*) Regenerating Woodland and Shrubland map class.

### *Pinus elliottii* var. *elliottii* Ruderal Woodland and Forest

**Map Class Code:** MC323

**Color:** Red, pink, tan

**Texture:** Coarse

**Crown Size:** Medium

**Crown Shape:** Irregular

**Density:** High

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G38).



**Figure G38.** Photo signature example of the MC323 *Pinus elliottii* var. *elliottii* Ruderal Woodland and Forest map class.

### *Taxodium distichum* / *Morella cerifera* / *Thelypteris palustris* Tidal Woodland

**Map Class Code:** MC324

**Color:** Pink, red, gray, brown, tan

**Texture:** Coarse

**Crown Size:** small

**Crown Shape:** round

**Density:** low to medium

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G39).



**Figure G39.** Photo signature example of the MC324 *Taxodium distichum / Morella cerifera / Thelypteris palustris* Tidal Woodland map class.

### *Ilex coriacea – Prunus caroliniana* Dense Evergreen Forest and Shrubland

**Map Class Code:** MC325

**Color:** Pink, tan, red

**Texture:** Coarse

**Crown Size:** small

**Crown Shape:** irregular

**Density:** High

**Notes:** Extremely vibrant in CIR.

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G40).



**Figure G40.** Photo signature example of the MC325 *Ilex coriacea – Prunus caroliniana* Dense Evergreen Forest and Shrubland map class.

### *Nyssa biflora - Acer rubrum* - (*Triadica sebifera*) / *Morella cerifera* / *Saccharum giganteum* Swamp Woodland

**Map Class Code:** MC328

**Color:** Rust. Red, pink

**Texture:** Coarse

**Crown Size:** Small

**Crown Shape:** Round

**Density:** Low to medium

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G41).



**Figure G41.** Photo signature example of the MC328 Nyssa biflora - Acer rubrum - (Triadica sebifera) / Morella cerifera / Saccharum giganteum Swamp Woodland map class.

### *Quercus laurifolia - Nyssa biflora* Circular Depression Flooded Flatwood Forest

**Map Class Code:** MC326

**Color:** Dark green, green, gray

**Texture:** Coarse

**Crown Size:** Medium

**Crown Shape:** irregular

**Density:** High

**Notes:** Circular depression confirmed with LiDAR Bare Earth DEM.

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G42).

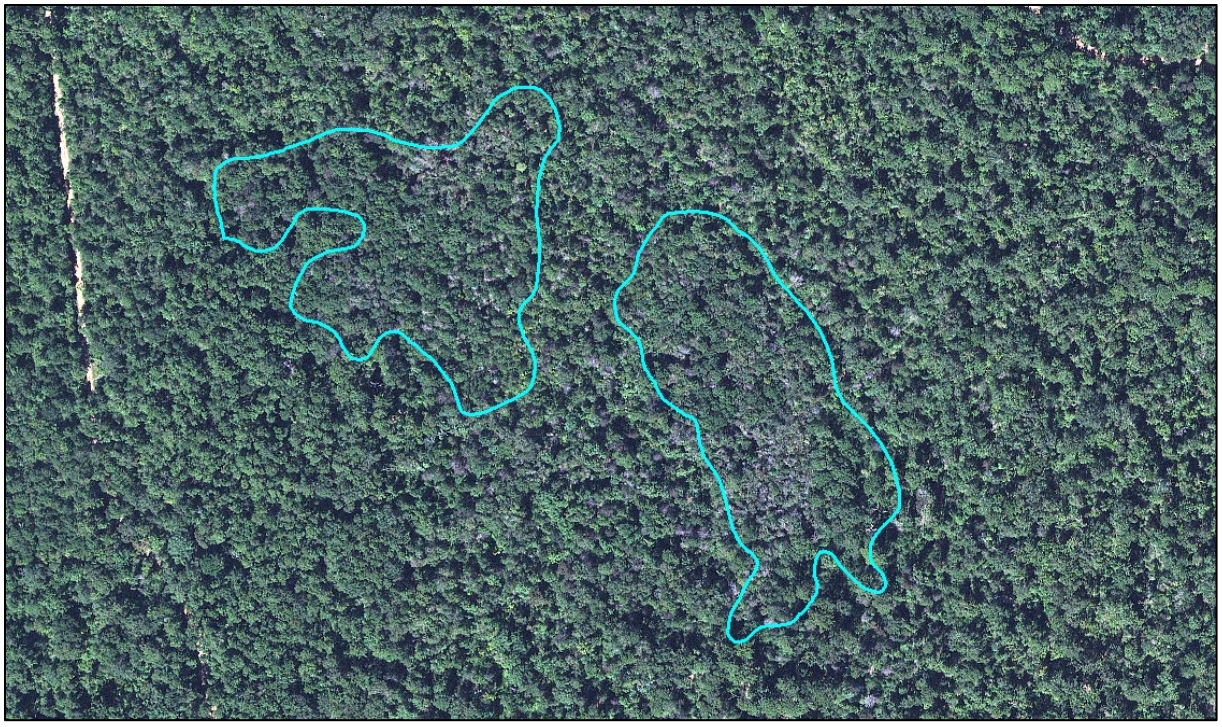


**Figure G42.** Photo signature example of the MC326 *Quercus laurifolia - Nyssa biflora* Circular Depression Flooded Flatwood Forest map class.

### *Acer rubrum* - (*Triadica sebifera*) / *Morella cerifera* Swamp Woodland

**Map Class Code:** MC327

**Color:** Rust, black, pink, red

**Texture:** coarse

**Crown Size:** small

**Crown Shape:** irregular

**Density:** low

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G43).



**Figure G43.** Photo signature example of the MC327 *Acer rubrum* - (*Triadica sebifera*) / *Morella cerifera* Swamp Woodland map class.

### *Pinus taeda – Nyssa biflora – Magnolia virginiana* / *Andropogon glomeratus* Wet Woodland

**Map Class Code:** MC329

**Color:** Red, pink, rust, gray

**Texture:** Coarse

**Crown Size:** small

**Crown Shape:** irregular

**Density:** low

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G44).

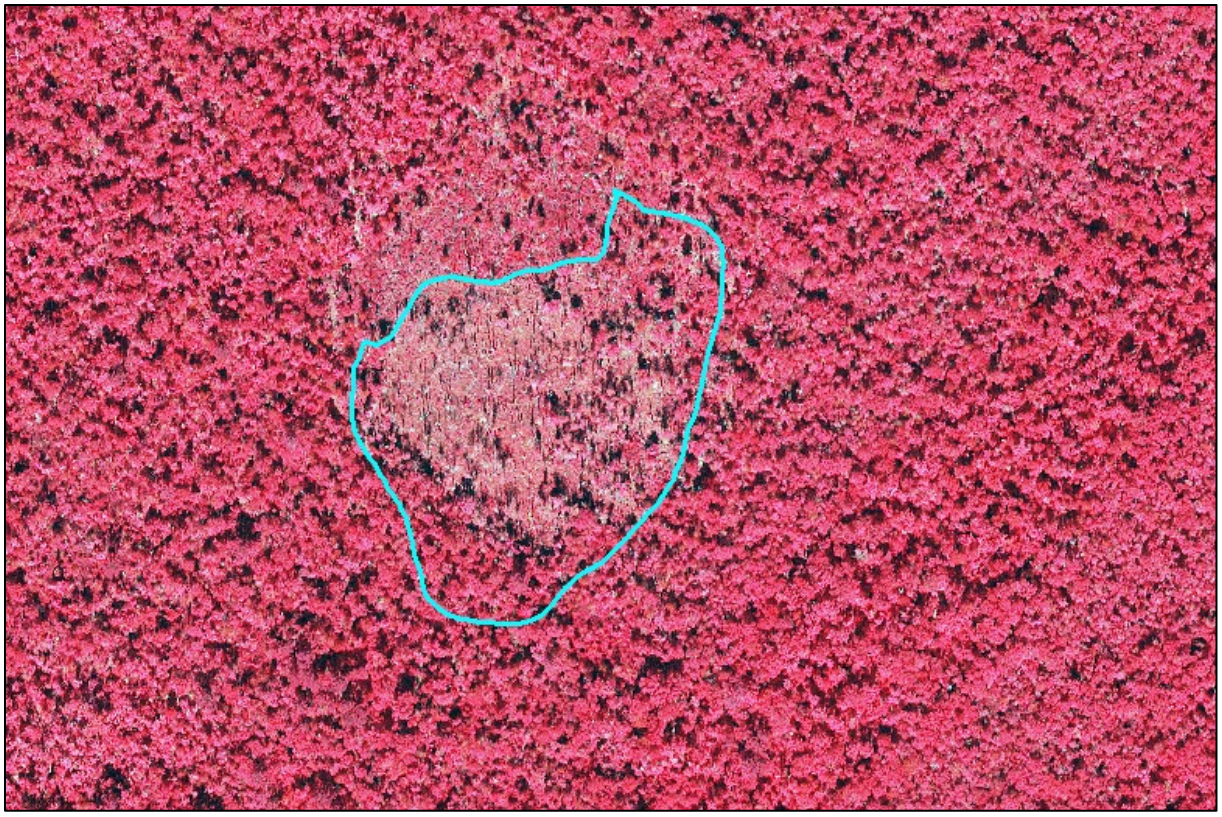


**Figure G44.** Photo signature example of the MC329 *Pinus taeda – Nyssa biflora – Magnolia virginiana / Andropogon glomeratus* Wet Woodland map class.

### *Pinus taeda – Nyssa biflora – Quercus laurifolia* Circular Depression Flooded Flatwood Forest

**Map Class Code:** MC330

**Color:** Red, Purple, Pink, Gray

**Texture:** Coarse

**Crown Size:** Medium

**Crown Shape:** Round to irregular

**Density:** High

**Notes:** Circular depression confirmed with LiDAR Bare Earth DEM.

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G45).



**Figure G45.** Photo signature example of the MC330 *Pinus taeda – Nyssa biflora – Quercus laurifolia* Circular Depression Flooded Flatwood Forest map class.

### Riverine Sparse Bar Vegetation

**Map Class Code:** MC401

**Color:** Pink, Tan, Gray

**Texture:** Smooth

**Crown Size:** n/a

**Crown Shape:** n/a

**Density:** low

**Notes:** Variable community depending on river levels.

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G46).

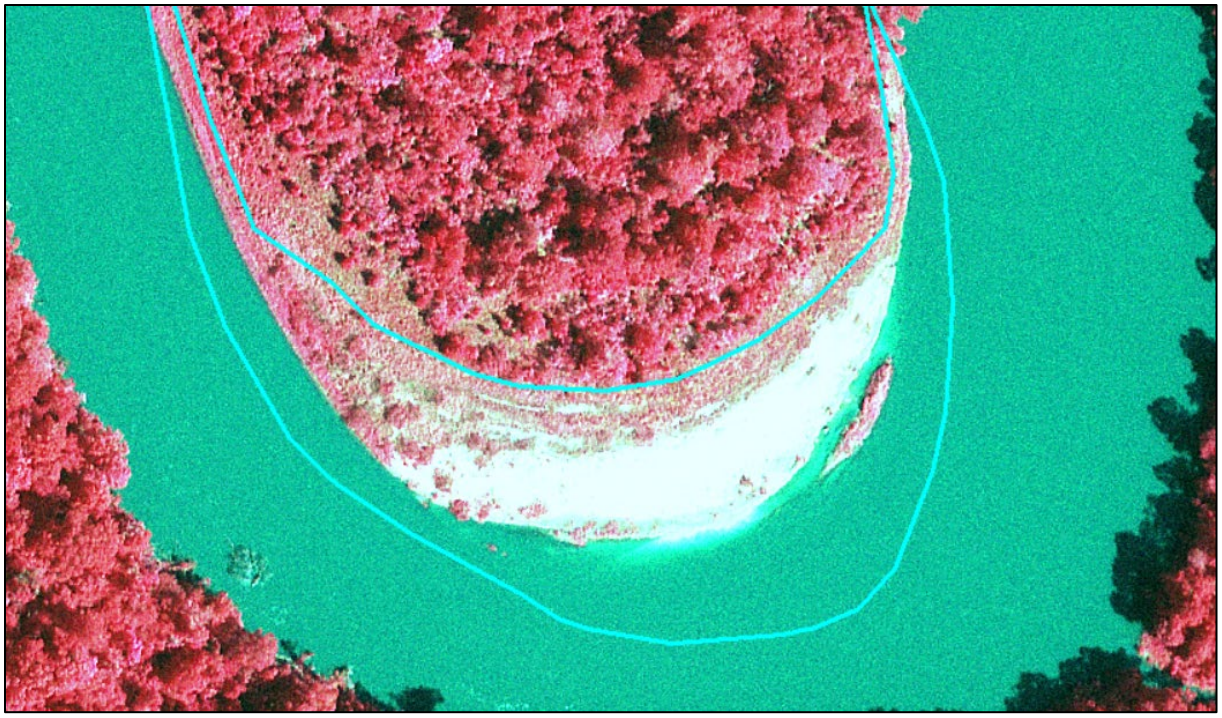


**Figure G46.** Photo signature example of the MC401 Riverine Sparse Bar Vegetation map class.

### Sparse Cliff Vegetation

**Map Class Code:** MC402

**Color:** Black/shadow, red, pink, gray

**Texture:** Coarse

**Crown Size:** irregular

**Crown Shape:** irregular

**Density:** Medium

**Notes:** --

**Imagery Used:** 2014 HxIP imagery 30 cm 4-band (RGB and CIR), TNRIS 2015 50 cm leaf-off 4-band imagery, FSA 100 cm (2016) and 60 cm (2018) NAIP imagery, 2017 Neches River Basin LiDAR data (Figure G47).



**Figure G47.** Photo signature example of the MC402 Sparse Cliff Vegetation map class.

The Department of the Interior protects and manages the nation’s natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 175/192398, January 2024




**Natural Resource Stewardship and Science**
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