

# United States Department of Agriculture Natural Resources Conservation Service Ecological Site Description

## Section I: Ecological Site Characteristics

### Ecological Site Identification and Concept

**Site name:** Wet Acidic Sandy Flatwoods

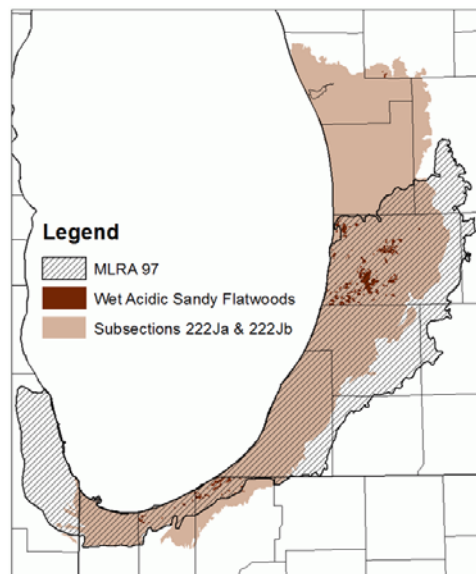
*Acer rubrum* - *Quercus palustris* / *Vaccinium corymbosum* / *Osmundastrum cinnamomeum*

(red maple - pin oak / highbush blueberry)

**Site type:** Forestland

**Site ID:** F097XA007MI

**Major land resource area (MLRA):** 097-Southwestern Michigan Fruit and Truck Belt



This map identifies the Wet Acidic Sandy Flatwoods

Major land resource area 97 wraps around the southern end of Lake Michigan covering portions of Michigan, Illinois, and Indiana corresponding to a major lake-moderated fruit-growing region. The subunit of the MLRA corresponding to the extent of this ecological site description, however, is Forest Service subsections 222Ja and 222Jb. As such, it excludes most of the Illinois portion of the MLRA because the lake plain is less sandy and less lake-moderated there. Instead, the subunit includes a significant portion of MLRA 98, following sandy lake plains and fruit-growing moraines northward into Muskegon County, Michigan. The western boundary is Lake Michigan and the eastern boundary is roughly the extent of lake-ameliorated climate. The northern boundary is defined by a major floristic boundary where vegetation switches from one of predominantly central hardwoods species to one of mainly northern woodland species. The southern boundary is defined by a predominantly prairie flora. The triple juxtaposition of central hardwood, prairie, and northern woodland species in the southern portion of the region make this among the more plant species rich areas of the country.

Soil map units where Wet Acidic Sandy Flatwoods is a major component cover about 14,834 acres (6003 ha) or about 0.7 percent of this area, but mostly in subsection 222Ja.

### Ecological Site Concept

The central concept of the Wet Acidic Sandy Flatwoods is deep sands (>70 percent sands >100 cm deep) with low base saturation (pHs <5.5 or Spodosols) and seasonal ponding (poorly drained and very poorly drained). Such sites support vegetation composed of mostly wetland species of which tolerate low nutrient conditions. Late successional forest dominates the area, but small areas of open marsh and prairie do occur. Characteristic species include red maple, pin oak, and black gum in forested sites with ferns, heaths, and peat moss in the understory. Open sites tend to have various grasses, sedges, and rushes and buttonbush.

Sites with loamier surface textures, shallower depths to clay, higher base saturation, or that are dryer belong to other ecological sites. Some ponded and water map units which have such long hydro periods that surface water is absent only for periods during drought years are a different site concept.

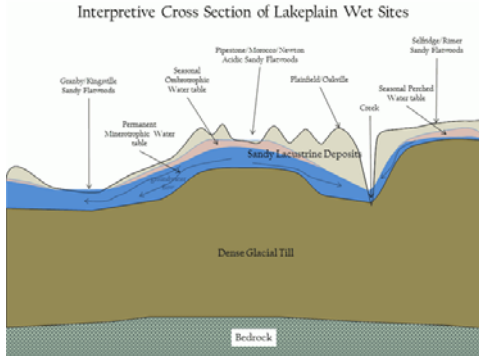
### Physiographic Features

The surface of this area is covered mainly with glacial till and lacustrine deposits. The lake plain consists of sands deposited by high-energy shoreline processes, which reworked glacial outwash deltas of post-glacial Lake Chicago. Some areas have relict shoreline features of alternating dune and swale topography wherein this ecological site is found in the margin of wet swales. Some higher areas (>200 m elevation; 656 feet) are underlain with a dense glacial till aquatard, usually deeper than 2 meters (80 inches), which is responsible for perched water tables. The wetlands in these sites tend to be acidic Newton soils. The site becomes more minerotrophic due to the influence of the calcareous till where the depths to till is within 50-100 cm (20-40 inches) converging with Rimer and Selfridge soils.

This site also occurs on the margins of broad flat plains with a high regional water table due to low elevations relative to lake level (which is at 176 m; 577 feet) and undrained by rivers or creeks. In these lower areas, groundwater has a larger catchment area and is consequently more minerotrophic, resulting in richer adjacent wetland ecological sites in Granby or Kingsville soils.

Bedrock has no influence on local topography or soils in this area. Bedrock is buried beneath 10-200 m (33-656 feet) of surface deposits and consists primarily of limestone

and dolomite in Indiana, and sandstone and shale in Michigan.



Physiographic Image.—Cross Section

- Landform: (1) Lake plain  
(2) Interdune

	<u>Minimum</u>	<u>Maximum</u>
Elevation (feet):	591	755
Slope (percent):	0	3
Water table depth (inches):	0	10
<b>Flooding</b>		
Frequency:	None	None
<b>Ponding</b>		
Depth (inches):	0	20
Frequency:	Occasional	Frequent
Duration:	Brief	Long
Runoff class:	Negligible	Negligible
Aspect:	No Influence on this site	

### Climatic Features

The southeastern Lake Michigan lake plain and adjacent lake influenced moraines have a humid warm continental climate with cold winters and warm summers. Average annual precipitation is 841 to 1045 mm (33-41 inches). Average July temperatures are 20.7 to 23.4°C (69-74°F). Average January temperatures are -5.3 to -2.6°C (23-27°F). About 55 to 61 percent of the precipitation is distributed during the warmer half of the year with a significant portion of the precipitation occurring as heavy downpours during thunderstorms. Thunderstorm activity is enhanced inland by lake breeze fronts, while it is diminished near the lakeshore by the stabilizing effect of the cooler lake waters. Occasionally, thunderstorm microbursts cause localized high winds which open single tree gaps in forest canopies, or more rarely, tornados and derechos (severe straight-line winds) open larger gaps. Fall storms bring more frequent strong winds, but with impacts moderated by the lack of leaves (wind resistance) in the canopy. During July, average precipitation lags potential evapotranspiration, resulting in droughty conditions in the upper soil horizons of upland sites. During dry years, this droughty period is extended into August and September, resulting in dry fuels and potential for wildfire over oak and pine dominated areas. Winter precipitation is enhanced by lake effect snows, with 1.0 to 2.4 m (40 to 95 inches) falling annually. Peak snowfall occurs at intermediate distances from the lake where topography enhances uplift. The combination of heavier winter snowfall, lake-delayed spring warm up, and frequent wetlands all contribute to relatively lower fire frequencies relative to inland locations with similarly droughty soils. The area falls within USDA hardiness zones 6a and 6b and has delayed spring warm up until after the last killing frosts, allowing for a wide range of fruit crops to be grown. Precipitation and temperatures come from 1981 to 2010 averages, whereas frost and freeze data come from 1971 to 2000 averages. The 1981 to 2010 period was somewhat wetter and warmer than the 1971 to 2000 period. The warming trend was most pronounced during winter months.

	<u>Averaged</u>
Frost-free period (days):	189
Freeze-free period (days):	162
Mean annual precipitation (inches):	36.94

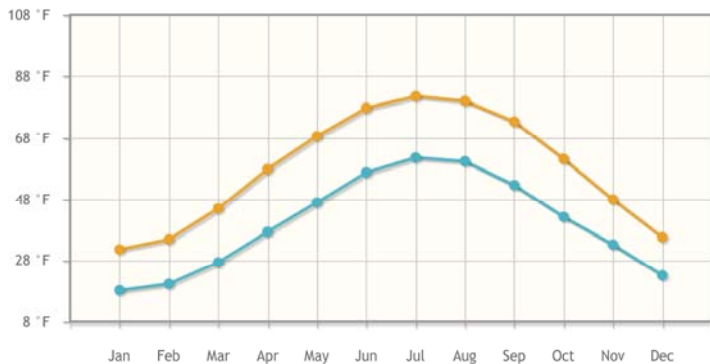
Monthly Precipitation (Inches):

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>
High	3.23	2.29	2.66	3.67	4.31	4.34	4.36	4.31	4.19	3.75	3.67	3.17
Low	2.00	1.65	1.82	2.91	3.18	2.55	2.37	2.90	3.33	3.11	3.11	2.13



Monthly Temperature (°F):

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	31.9	35.2	45.4	58.3	69.0	78.2	82.0	80.5	73.8	61.6	48.4	35.9
Low	18.4	20.5	27.6	37.7	47.4	57.2	62.0	60.8	53.1	42.6	33.5	23.3



- Climate stations: (1) USC00124008, HOBART 2 WNW. Period of record 1981-2010  
 (2) USC00124244 INDIANA DUNES NATL LKS Period of Record 1981-2010  
 (3) USC00128999 VALPARAISO WTR WKS Period of Record 1981-2010  
 (4) USC00200128 ALLEGAN 5NE Period of Record 1981-2010  
 (5) USC00200864 BLOOMINGDALE Period of Record 1981-2010  
 (6) USC00202445 EAU CLAIRE 4 NE Period of Record 1981-2010  
 (7) USC00203290 GRAND HAVEN FIRE DEPT Period of Record 1981-2010  
 (8) USC00203858 HOLLAND WTP Period of Record 1981-2010  
 (9) USC00207690 SOUTH HAVEN Period of Record 1981-2010  
 (10) USW00004839 HOLLAND TULIP CITY AP Period of Record 1981-2010  
 (11) USW00014840 MUSKEGON CO AP Period of Record 1981-2010  
 (12) USW00094871 BENTON HARBOR AP Period of Record 1981-2010

### Influencing Water Features

In the hydrogeomorphic classification, this site is a mineral flats (flat lake plain), or an upland depression (interdunal). Layers restricting the drainage of local rainwater such as clay loam (till) textures are usually below a depth of 2 m (180 inches), but can occasionally be found within as close as 1 m (40 inches) where the lacustrine sands are the thinnest. Sites are located above sources of more minerotrophic groundwater, and are thus only influenced by local precipitation, which maintains very low pHs.

#### Wetland Description (Cowardin System)

System	Subsystem	Class
Palustrine	N/A	Forested Wetland

### Representative Soil Features

Soils generally classify as poorly drained and very poorly drained Typic Psammaquents (Dair series) and Typic Humaquepts (Newton series). Soils are generally 80 to 100 percent sand to a depth greater than 200 cm (80 inch). Fluctuating water table from local precipitation and a lack of clay in the sandy parent material maintains low pH and low base saturation. An O horizon is often present and is 10 to 17 cm (4 to 7 inches) thick. The A horizon is generally black and 18 to 30 cm (7 to 12 inches) thick and is usually mucky sand. Where thick enough, the A horizon is part of an umbric epipedon (in Humaquepts). Where substantial hard, root-restricting ortstein is developed in the B horizon (Bhsm) and the soils classify as Typic Duraquods (Jebavy series). Other Spodosols (Endoaquods) can occur but are too infrequent to form a series.

The seasonally high water table limits stand composition to wetland species. As a site becomes more forested, the water table may drop somewhat from increased water utilization by trees and tip-up mounds may form from wind thrown trees, factors both of which may increase the number of non-wetland species that can occur.

The low base saturation of the soil limits the site to species adapted to acidic, low nutrient conditions. Sites with calcareous clay-loam till within depths of 100 to 200 cm (40 to 80 inches) may also behave in ways similar to this site in as much as the rooting zone lacks nutrients to support high base obligates. The low pH occur in the upper horizons and can extend throughout the profile, but sometimes the lowest wettest sites have more moderate pHs with depth associated with a more long term widely flowing ground water. The productivity is likely higher at the upper end of the pH scale (greater than 5), and thus the wettest sites may have higher grass cover and may converge with the higher base concepts such as Wet Sandy Flatwoods.



Soils Profile Image.—Example of the Newton soil series

#### Parent materials

Kind: Glaciolacustrine deposits, Eolian deposits

Surface texture: (1) Sand

(2) Fine sand

(3) Mucky Sand

Subsurface texture group: Sandy

	<u>Minimum</u>	<u>Maximum</u>
Surface fragments <=3" (% cover):	0	0
Surface fragments >3" (% cover):	0	0
Subsurface fragments <=3" (% volume):		10
Subsurface fragments >3" (% volume):		0
Drainage class: Poorly drained to very poorly drained		
Permeability class: Rapid		

	<u>Minimum</u>	<u>Maximum</u>
Depth (inches):	80	80
Available water capacity (inches):	4.50	6.50
Calcium carbonate equivalent (percent):	0	0
Soil reaction (1:1 water):	3.5	5.5

## Plant Communities

### Ecological Dynamics of the Site

The reference state is characterized by a relatively low fire frequency (fire return interval >100 years) and a trend towards shade tolerant and hydrophytic vegetation. Prior to European-American settlement of the area, about 88 percent of this ecological site was forested, of which more than half was conifer (hemlock) swamp. Only 2 percent was in a wet sand prairie phase, and about 10 percent was in a buttonbush swamp or coastal plain marsh phase.

Variation in fire return intervals, which combined with hydrology ultimately account for the frequency of open community phases, are themselves affected by fire return intervals of adjacent uplands. Fire return intervals of adjacent uplands ranged from greater than 1,000 years for a northern hardwoods-hemlock dominated system to crown fires about every 290 years with understory fires every 70 years for a pine-oak dominated system (U.S. Department of the Interior, Geological Survey, 2008). Even in its wettest expressions of hydrology, fire is thought to be an important factor in preventing (or reversing) the buildup of peat and long-term conversion to bog (Kost and Penskar, 2000).

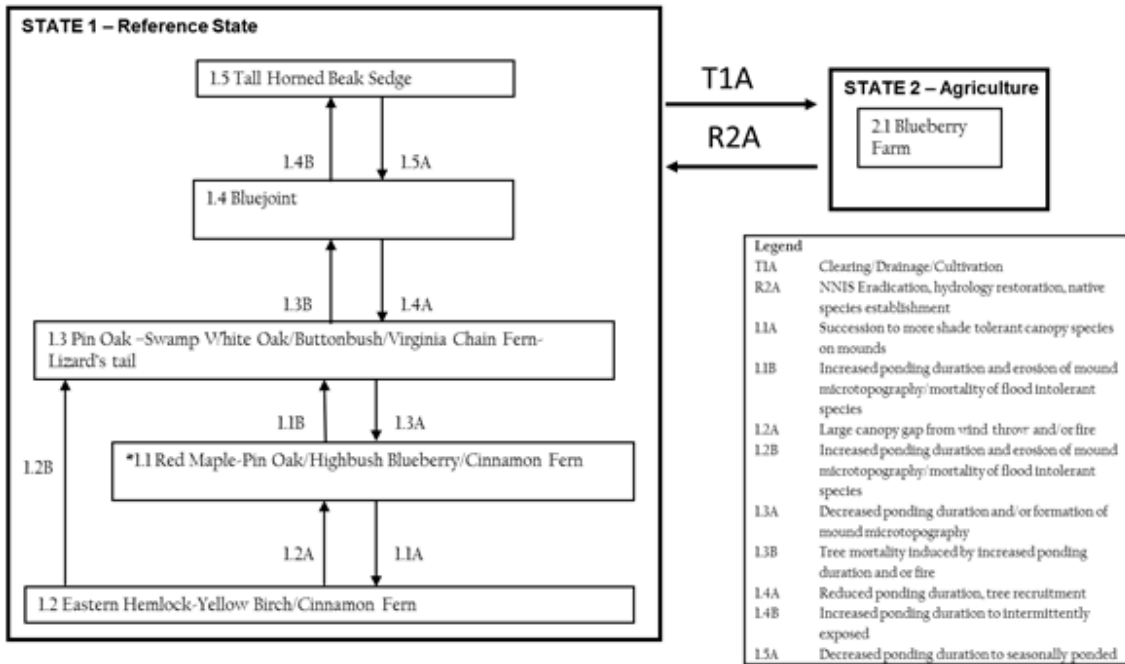
Presently, 17 percent of the ecological site is forested, more or less consistent with a phase within the reference condition (U.S. Department of the Interior, Geological Survey, 2011). About 49 percent is of the ecological site is intensively managed as agriculture, urban development, or other managed vegetation more or less addressed in state 2. Another 35 percent is in open condition, which may either be a post agricultural phase of state 2 or something resembling natural vegetation in the more open phases within the reference state.

The highest (deepest water table) portions of the Wet Acidic Sandy Flatwoods ecological site typically have pit and mound topography, which results in a complex mosaic of seasonally ponded and unponded ground surfaces within 1 to 10 meters distance. Many of the hummock or mound sites are not submerged for long enough to be considered poorly drained and can support non-hydrophytic vegetation. At the scale of a typical vegetation plot (100 to 400 m<sup>2</sup>), the difference between the Wet Acidic Sandy Flatwoods site concept and the adjacent Acidic Sandy site concept is which portion of the microtopography constitutes the majority of the area. Where microtopography does not exist, there is more hydrophytic vegetation.



**State-and-Transition Diagram**

**Wet Acidic Sandy Flatwoods, F097XA007MI**



**State 1: Reference State**

Prior to European-American settlement of the area, about 49 percent of the vegetation was dominated by very shade tolerant species such as hemlock (*Tsuga canadensis*) (phase 1.2) and about 28 percent was dominated by red maple (*Acer rubrum*) and other swamp hardwoods (phase 1.1) (Albert, et al., 1995). Hemlock does not occur naturally in northern Indiana (Kartesz, 2013; Swink & Wilhelm, 1994), so there phase 1.2 would have included only yellow birch (*Betula alleghaniensis*). Because forests are still recovering from past logging, most forests today are intermediate in succession as phase 1.1. Canopy dominants range from red maple to pin oak with varying amounts of black gum (*Nyssa sylvatica*) and swamp white oak (*Quercus bicolor*). Although usually not abundant in this region, black gum is a reliable indicator of acidic sites like these. Pin oak (*Quercus palustris*) is found throughout the range of this site concept, but is less prevalent to absent in stands north of Ottawa County. Acid tolerant ferns (e.g. cinnamon fern, *Osmundastrum cinnamomeum*; Virginia chain fern, *Woodwardia virginica*) are found in the understory. Most of the frequent understory shrubs (e.g. blueberries, swamp dewberry – *Rubus hispidus*) and forbs (e.g. partridge berry, *Mitchella repens*; Canada mayflower, *Maianthemum canadense*) are found almost exclusively on hummocks, whereas the low wet ponded portions are nearly bare of vegetation depending on shade levels. Peat moss (*Sphagnum* spp.) is common in zones that remain saturated for long periods, but which are only shallowly ponded. Otherwise, buttonbush (*Cephalanthus occidentalis*) and lizard’s tail (*Saururus cernuus*) are frequent constituents where ponding has precluded other species. Sites that are ponded for longer durations may lack canopy altogether and give way to wet-mesic prairie or coastal plain marsh.

Because wet acidic sands are relative outliers in a region otherwise dominated by calcareous tills, many species occur here that are disjuncts from their main ranges in unglaciated areas to the south (e.g. *Rhynchospora macrostachya*). Several species are disjuncts from the Gulf and Atlantic Coastal Plains where they are found in similarly acidic sandy sites (Reznicek, 1994; Sorrie & Weakley, 2001).

**Community Phase 1.1: Red maple-Pin Oak/Highbush Blueberry/Cinnamon Fern**



Pin oak with chain fern and peat moss.





Ponding in spring with pollen on the surface. Pin oak on the outer portion of the pond with buttonbush in the center.

Ponding

Red maple

Black gum



Pin oak



Pin oak trunk with moss zonation



Blue racer (*Coluber constrictor foxii*)

This phase consists of a mix of lowland hardwoods typical of wet conditions that are of lesser shade tolerance: pin oak (intolerant), swamp white oak (intermediate), red maple (tolerant). The persistence of pin oak and swamp white oak depends on their greater tolerance to flooding relative to the more shade-tolerant red maple and black gum.

**Community Phase Pathway 1.1A**

Continued shade in the overstory inhibits the ability of oak to recruit. The accumulation of down woody debris provides elevated seedbeds (nurse logs) for light seeded, flood intolerant trees such as hemlock and yellow birch, further reducing the advantage of flood tolerance over shade tolerance. Intense shade of hemlock results in reduced red maple coverage.

**Community Phase Pathway 1.1B**

Increased ponding duration, erosion of mound microtopography, and reduced nurse log frequency, results in the mortality of less flood intolerant species such as red maple and black gum. This increases the light available for pin oak and swamp white oak. Larger windthrow gaps allow for buttonbush establishment.

**Structure and Cover**

Soil Surface Cover

<u>Cover type</u>	<u>Minimum</u>	<u>Maximum</u>
Basal cover, grasses/grasslikes	0%	3%
Basal cover, forbs	1%	2%
Basal cover, shrubs/vines	0.5%	2%
Basal cover, trees	0.5%	1%
Nonvascular plants	0.1%	1%
Biological crust	0%	0%
Litter	75%	90%
Surface fragments >0.25" and <=3"	0%	0%
Surface Fragments >3"	0%	0%
Bedrock	0%	0%
Water	0%	0%
Bare ground	0%	0%

<u>Downed woody material</u>	<u>Minimum</u>	<u>Maximum</u>	<u>Predominant decomposition class*</u>
Downed wood, fine-small (<0.40" diameter; 1-hour fuels)	3%	5%	N
Downed wood, fine-medium (0.40-0.99" diameter; 10-hour fuels)	3%	5%	N
Downed wood, fine-large (1.00-2.99" diameter; 100-hour fuels)	0%	1%	N
Downed wood, coarse-small (3.00-8.99" diameter; 1000-hour fuels)	0%	5%	N

Downed wood, coarse-large (>9.00" diameter; 10000-hour fuels)	0%	5%	I
Tree snags** (hard***)	0%	0.05%	N
Tree snags** (soft***)	0%	0.1%	N

Tree snags\*\* per acre

Hard snags***	0	65
Soft snags***	0	28

\* Decomposition classes: N=No or little integration with the soil surface. I=Partial to nearly full integration with the soil surface.

\*\* >4" diameter at 4.5' above ground and >6' height. If diameter or height is smaller, use applicable downed wood type. For pinyon and juniper, use 1.0' above ground.

\*\*\* Hard=Tree is dead with most or all of bark intact. Soft=Most of bark has sloughed off.

Structure of Canopy Cover

Height above ground	Grasses/grasslikes		Forbs		Shrubs/vines		Trees	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
<=0.5 foot	0%	2%	2%	3%	0%	1%	0%	1%
>0.5 to <1 foot	0%	1%	1%	10%	0%	1%	0%	1%
>1 to <=2 feet	0%	1%	1%	10%	1%	3%	1%	5%
>2 to <4.5 feet	--	--	--	--	1%	2%	1%	5%
>4.5 to <=13 feet	--	--	--	--	1%	2%	10%	60%
>13 to <40 feet	--	--	--	--	0%	1%	40%	70%
>40 to >=80 feet	--	--	--	--	0%	1%	100%	100%
>80 to <120 feet	--	--	--	--	--	--	10%	45%
>=120 feet	--	--	--	--	--	--	--	--

**Forest Overstory**

Red maple and pin oak are the most dominant trees, with frequent black gum and occasional swamp white oak.

**Forest Overstory Characterization Summary (tree, tree fern and vine species >13 feet in height)**

Forest canopy:	<u>Low canopy cover %</u> 60	<u>RV canopy cover %</u> 98	<u>High canopy cover %</u> 100
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**Overstory plant type: Tree**

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top	Tree diameter low	Tree diameter high	Basal area low	Basal area high
tuliptree										
<i>Liriodendron tulipifera</i>	LITU	N	0.0	5.0		88.6		32.9	0.0	10.0
swamp white oak										
<i>Quercus bicolor</i>	QUBI	N	0.0	60.0	32.8	82.0	13.0	23.9	0.0	60.0
swamp white oak										
<i>Quercus bicolor</i>	QUBI	N	0.0	60.0	32.8	82.0				
northern red oak										
<i>Quercus rubra</i>	QURU	N	0.0	25.0	32.8	82.0	6.8	18.6	0.0	40.0
red maple										
<i>Acer rubrum var. rubrum</i>	ACRUR	N	0.0	100.0	32.8	78.7	5.3	25.7	0.0	150.0
pin oak										
<i>Quercus palustris</i>	QUPA2	N	0.0	70.0	41.0	73.8	7.2	16.9	0.0	90.0
blackgum										
<i>Nyssa sylvatica</i>	NYSY	N	0.0	25.0	32.8	65.6	8.5	17.4	0.0	20.0
sassafras										
<i>Sassafras albidum</i>	SAAL5	N	0.0	10.0	32.8	65.6	8.5	10.9	0.0	20.0
American elm										
<i>Ulmus americana</i>	ULAM	N	0.0	10.0	32.8	65.6			0.0	10.0
American beech										
<i>Fagus grandifolia</i>	FAGR	N	10.0	45.0	16.4	49.2			0.0	10.0
pin oak										
<i>Quercus palustris</i>	QUPA2	N	0.0	5.0	16.4	49.2				
northern red oak										
<i>Quercus rubra</i>	QURU	N	0.0	2.0	16.4	49.2				
sassafras										
<i>Sassafras albidum</i>	SAAL5	N	0.0	2.0	16.4	49.2				
American elm										
<i>Ulmus americana</i>	ULAM	N	0.0	25.0	16.4	49.2				
red maple										
<i>Acer rubrum var. rubrum</i>	ACRUR	N	0.0	25.0	16.4	43.7				
blackgum										
<i>Nyssa sylvatica</i>	NYSY		0.0	5.0	16.4	38.3				
American hornbeam										
<i>Carpinus caroliniana</i>	CACA18	N	0.0	5.0	16.4	32.8				
American witchhazel										
<i>Hamamelis virginiana</i>	HAVI4	N	0.0	2.0	16.4	32.8				
	BEAL2	N	0.0	5.0					0.0	10.0

yellow birch <i>Betula alleghaniensis</i>							
paper birch <i>Betula papyrifera</i>	<a href="#">BEPA</a>	N	0.0	0.1			
green ash <i>Fraxinus pennsylvanica</i>	<a href="#">FRPE</a>	N	0.0	40.0		0.0	70.0
black cherry <i>Prunus serotina</i>	<a href="#">PRSE2</a>	N	0.0	5.0		0.0	10.0
white oak <i>Quercus alba</i>	<a href="#">QUAL</a>	N	0.0	5.0		0.0	10.0
black oak <i>Quercus velutina</i>	<a href="#">QUVE</a>	N	0.0	5.0		0.0	10.0

**Forest Understory**

Highbush blueberry and cinnamon fern are among the more frequent components of the moderately sparse understory. Blueberries and most of the other species are usually found on hummocks. Peat moss may occur at the base of hummocks near the high water line. Virginia chain fern usually occurs in the seasonally ponded areas.

**Forest Understory Canopy Cover Summary (all species <13 feet in height)**

**Understory plant type: Grass/grass-like (Graminoids)**

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
greater bladder sedge <i>Carex intumescens</i>	<a href="#">CAIN12</a>	N	0.0	0.1	0.3	1.6
drooping sedge <i>Carex prasina</i>	<a href="#">CAPR12</a>	N	0.0	0.1	0.3	1.6
sedge <i>Carex</i>	<a href="#">CAREX</a>	N	0.0	15.0	0.0	0.3
mannagrass <i>Glyceria</i>	<a href="#">GLYCE</a>	N	0.0	0.5	0.0	0.3
weak stellate sedge <i>Carex seorsa</i>	<a href="#">CASE6</a>	N	0.0	0.2	0.0	0.1

**Understory plant type: Forb/Herb**

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
beggarticks <i>Bidens</i>	<a href="#">BIDEN</a>	N	0.0	0.1	0.3	1.6
smallspike false nettle <i>Boehmeria cylindrica</i>	<a href="#">BOCY</a>	N	0.0	5.0	0.0	1.6
spotted water hemlock <i>Cicuta maculata</i>	<a href="#">CIMA2</a>	N	0.0	2.0	0.3	1.6
jewelweed <i>Impatiens capensis</i>	<a href="#">IMCA</a>	N	0.0	2.0	0.0	1.6
American water horehound <i>Lycopus americanus</i>	<a href="#">LYAM</a>	N	0.0	0.2	0.0	1.6
Indian cucumber <i>Medeola virginiana</i>	<a href="#">MEVI</a>	N	0.0	1.0	0.0	1.6
hairy Solomon's seal <i>Polygonatum pubescens</i>	<a href="#">POPU4</a>	N	0.0	0.1	0.3	1.6
lizard's tail <i>Saururus cernuus</i>	<a href="#">SACE</a>	N	0.0	45.0	0.3	1.6
blue skullcap <i>Scutellaria lateriflora</i>	<a href="#">SCLA2</a>	N	0.0	1.0	0.0	1.6
threeleaf goldthread <i>Coptis trifolia</i>	<a href="#">COTR2</a>	N	0.0	0.2	0.0	0.3
pinemap <i>Hypopitys monotropa(syn)</i>	<a href="#">HYMO3</a>	N	0.0	0.1	0.0	0.3
Canada mayflower <i>Maianthemum canadense</i>	<a href="#">MACA4</a>	N	0.0	2.0	0.0	0.3
partridgeberry <i>Mitchella repens</i>	<a href="#">MIRE</a>	N	0.0	0.5	0.0	0.3
starflower <i>Trientalis borealis</i>	<a href="#">TRBO2</a>	N	0.0	0.1	0.0	0.3
water plantain <i>Alisma</i>	<a href="#">ALISM</a>	N	0.0	0.1	0.0	
Virginia iris <i>Iris virginica</i>	<a href="#">IRVI</a>	N	0.0	0.1	0.3	
duckweed <i>Lemna</i>	<a href="#">LEMNA</a>	N	0.0	0.1	0.0	
waterhorehound <i>Lycopus</i>	<a href="#">LYCOP4</a>	N	0.0	2.0	0.0	
marsh skullcap <i>Scutellaria galericulata</i>	<a href="#">SCGA</a>	N	0.0	0.1	0.0	
hemlock waterparsnip <i>Sium suave</i>	<a href="#">SISU2</a>	N	0.0	0.1	0.0	



**Understory plant type:** Fern/fern ally

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
spinulose woodfern <i>Dryopteris carthusiana</i>	<a href="#">DRCA11</a>	N	0.0	1.0	0.0	1.6
cinnamon fern <i>Osmundastrum cinnamomeum(syn)</i>	<a href="#">OSCI2</a>	N	0.2	25.0	0.3	1.6
royal fern <i>Osmunda spectabilis(syn)</i>	<a href="#">OSSP3</a>	N	0.0	35.0	0.3	1.6
New York fern <i>Parathelypteris noveboracensis(syn)</i>	<a href="#">PANO</a>	N	0.0	0.1	0.3	1.6
western brackenfern <i>Pteridium aquilinum var. latiusculum</i>	<a href="#">PTAQL</a>	N	0.0	0.2	0.3	1.6
Virginia chainfern <i>Woodwardia virginica</i>	<a href="#">WOVI</a>	N	0.0	2.0	0.3	1.6
rare clubmoss <i>Dendrolycopodium obscurum(syn)</i>	<a href="#">DEOB4</a>	N	0.0	2.0	0.0	0.3
sensitive fern <i>Onoclea sensibilis</i>	<a href="#">ONSE</a>	N	0.0	0.1	0.0	

**Understory plant type:** Shrub/Subshrub

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
glossy buckthorn <i>Frangula alnus</i>	<a href="#">FRAL4</a>	I	0.0	0.5	6.6	16.4
common winterberry <i>Ilex verticillata</i>	<a href="#">ILVE</a>	N	0.0	5.0	1.6	6.6
common buttonbush <i>Cephalanthus occidentalis</i>	<a href="#">CEOC2</a>	N	0.0	45.0	1.6	3.3
northern spicebush <i>Lindera benzoin</i>	<a href="#">LIBE3</a>	N	0.0	2.0	1.6	3.3
highbush blueberry <i>Vaccinium corymbosum</i>	<a href="#">VACO</a>	N	0.1	25.0	1.6	3.3
common buttonbush <i>Cephalanthus occidentalis</i>	<a href="#">CEOC2</a>	N	0.0	1.0	0.3	1.6
gray dogwood <i>Cornus racemosa</i>	<a href="#">CORA6</a>	N	0.0	0.1	0.3	1.6
swamp loosestrife <i>Decodon verticillatus</i>	<a href="#">DEVE</a>	N	0.0	0.1	0.3	1.6
common winterberry <i>Ilex verticillata</i>	<a href="#">ILVE</a>	N	0.0	1.0	0.0	1.6
northern spicebush <i>Lindera benzoin</i>	<a href="#">LIBE3</a>	N	0.0	1.0	0.0	1.6
swamp rose <i>Rosa palustris</i>	<a href="#">ROPA</a>	N	0.0	0.1	0.3	1.6
lowbush blueberry <i>Vaccinium angustifolium</i>	<a href="#">VAAN</a>	N	0.0	2.0	0.3	1.6
highbush blueberry <i>Vaccinium corymbosum</i>	<a href="#">VACO</a>	N	0.0	0.1	0.0	1.6
eastern teaberry <i>Gaultheria procumbens</i>	<a href="#">GAPR2</a>	N	0.0	2.0	0.0	0.3
bristly dewberry <i>Rubus hispidus</i>	<a href="#">RUHI</a>	N	0.1	1.0	0.0	0.3
purple chokeberry <i>Aronia prunifolia(syn)</i>	<a href="#">ARPR2</a>	N	0.0	0.5	1.6	
southern arrowwood <i>Viburnum recognitum</i>	<a href="#">VIRE7</a>	N	0.0	2.0	0.0	
southern arrowwood <i>Viburnum recognitum</i>	<a href="#">VIRE7</a>	N	0.0	2.0	1.6	

**Understory plant type:** Tree

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
red maple <i>Acer rubrum var. rubrum</i>	<a href="#">ACRUR</a>	N	0.0	5.0	6.6	16.4
common serviceberry <i>Amelanchier arborea</i>	<a href="#">AMAR3</a>	N	0.0	0.1	6.6	16.4
yellow birch <i>Betula alleghaniensis</i>	<a href="#">BEAL2</a>	N	0.0	5.0	6.6	16.4
American hornbeam <i>Carpinus caroliniana</i>	<a href="#">CACA18</a>	N	0.0	10.0	6.6	16.4
American beech <i>Fagus grandifolia</i>	<a href="#">FAGR</a>	N	15.0	60.0	1.6	16.4
American witchhazel <i>Hamamelis virginiana</i>	<a href="#">HAVI4</a>	N	0.0	2.0	1.6	16.4
blackgum <i>Nyssa sylvatica</i>	<a href="#">NYSY</a>	N	0.0	2.0	6.6	16.4
	<a href="#">ULAM</a>	N	0.0	10.0	1.6	16.4

American elm							
<i>Ulmus americana</i>							
red maple							
<i>Acer rubrum</i> var. <i>rubrum</i>	<a href="#">ACRUR</a>	N	0.0	0.2	0.0	1.6	
common serviceberry							
<i>Amelanchier arborea</i>	<a href="#">AMAR3</a>	N	0.0	0.2	0.0	1.6	
American beech							
<i>Fagus grandifolia</i>	<a href="#">FAGR</a>	N	0.0	2.0	0.3	1.6	
green ash							
<i>Fraxinus pennsylvanica</i>	<a href="#">FRPE</a>	N	0.0	0.3	0.3	1.6	
blackgum							
<i>Nyssa sylvatica</i>	<a href="#">NYSY</a>	N	0.0	0.2	0.0	1.6	
black cherry							
<i>Prunus serotina</i>	<a href="#">PRSE2</a>	N	0.0	1.0	0.0	1.6	
white oak							
<i>Quercus alba</i>	<a href="#">QUAL</a>	N	0.0	0.2	0.3	1.6	
northern red oak							
<i>Quercus rubra</i>	<a href="#">QURU</a>	N	0.0	0.5	0.3	1.6	
sassafras							
<i>Sassafras albidum</i>	<a href="#">SAAL5</a>	N	0.0	0.2	0.3	1.6	
eastern white pine							
<i>Pinus strobus</i>	<a href="#">PIST</a>	N	0.0	0.1	0.0	0.3	
pin oak							
<i>Quercus palustris</i>	<a href="#">QUPA2</a>	N	0.0	0.1	0.0	0.3	
eastern hemlock							
<i>Tsuga canadensis</i>	<a href="#">TSCA</a>	N	0.0	0.1	0.0	0.3	
yellow birch							
<i>Betula alleghaniensis</i>	<a href="#">BEAL2</a>	N	0.0	0.1	0.0		
green ash							
<i>Fraxinus pennsylvanica</i>	<a href="#">FRPE</a>	N	0.0	2.0	1.6		
tuliptree							
<i>Liriodendron tulipifera</i>	<a href="#">LITU</a>	N	0.0	0.1	0.0		
white oak							
<i>Quercus alba</i>	<a href="#">QUAL</a>	N	0.0	2.0	1.6		
swamp white oak							
<i>Quercus bicolor</i>	<a href="#">QUBI</a>	N	0.0	0.1	0.0		
black oak							
<i>Quercus velutina</i>	<a href="#">QUVE</a>	N	0.0	1.0	1.6		
sassafras							
<i>Sassafras albidum</i>	<a href="#">SAAL5</a>	N	0.0	2.0	1.6		

**Understory plant type: Vine/Liana**

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
Virginia creeper						
<i>Parthenocissus quinquefolia</i>	<a href="#">PAQU2</a>	N	0.0	0.1	1.6	16.4
roundleaf greenbrier						
<i>Smilax rotundifolia</i>	<a href="#">SMRO</a>	N	0.0	5.0	6.6	16.4
roundleaf greenbrier						
<i>Smilax rotundifolia</i>	<a href="#">SMRO</a>	N	0.0	10.0	0.3	1.6
Virginia creeper						
<i>Parthenocissus quinquefolia</i>	<a href="#">PAQU2</a>	N	0.0	0.1	0.0	0.3

**Understory plant type: Nonvascular**

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
Moss						
<i>2MOSS</i>	<a href="#">2MOSS</a>	N	0.0	0.5	0.0	0.3
climacium moss						
<i>Climacium</i>	<a href="#">CLIMA2</a>	N	0.0	0.1	0.0	0.3
sphagnum						
<i>Sphagnum</i>	<a href="#">SPHAG2</a>	N	0.0	15.0	0.0	0.3
<i>Riccia fluitans</i>	<a href="#">RIFL4</a>	N	0.0	0.1	0.0	

**Community Phase 1.2: Eastern Hemlock-Yellow Birch/Cinnamon Fern**



Hemlock with peat moss understory.



Hemlock

In general, conifers in these swampy sites consisted of eastern hemlock, which is very shade tolerant (Barnes and Wagner, 2004). Thus, the conifer domination of these sites is an indicator of a tendency for late successional phases. Yellow birch shares with hemlock the tendency to establish seedlings on nurse logs (Marx and Walters, 2008), which may give it an edge in late successional habitats despite intermediate shade tolerance.

**Community Phase Pathway 1.2A**

Large canopy gaps from windthrow or fire could allow more shade-intolerant species such as pin oak or red maple to establish.

**Community Phase Pathway 1.2B**

Increased ponding duration, erosion of mound microtopography, and reduced nurse log frequency results in the mortality of less flood intolerant species such as red maple and black gum. This increases the light available for pin oak and swamp white oak. Larger windthrow gaps allow for buttonbush establishment.

**Forest Overstory**

Eastern hemlock (*Tsuga canadensis*) and occasional yellow birch (*Betula alleghaniensis*) characterize the overstory.

**Forest Overstory Characterization Summary (tree, tree fern and vine species >13 feet in height)**

Forest canopy:	<u>Low canopy cover %</u>	<u>RV canopy cover %</u>	<u>High canopy cover %</u>
	80	95	100

**Overstory plant type:** Tree

<u>Name</u>	<u>Symbol</u>	<u>Nativity</u>	<u>Cover low %</u>	<u>Cover high %</u>	<u>Canopy height bottom</u>	<u>Canopy height top</u>	<u>Tree diameter low</u>	<u>Tree diameter high</u>	<u>Basal area low</u>	<u>Basal area high</u>
yellow birch <i>Betula alleghaniensis</i>	<a href="#">BEAL2</a>	N								
eastern hemlock <i>Tsuga canadensis</i>	<a href="#">TSCA</a>	N								

**Forest Understory**

Cinnamon fern (*Osmundastrum cinnamomeum*) and peat moss (*Sphagnum* spp.) are typical understory plants.

**Forest Understory Canopy Cover Summary (all species <13 feet in height)**

**Understory plant type:** Fern/fern ally

<u>Name</u>	<u>Symbol</u>	<u>Nativity</u>	<u>Cover low %</u>	<u>Cover high %</u>	<u>Canopy height bottom</u>	<u>Canopy height top</u>
cinnamon fern <i>Osmundastrum cinnamomeum</i> (syn)	<a href="#">OSCI2</a>	N				

**Understory plant type:** Nonvascular

<u>Name</u>	<u>Symbol</u>	<u>Nativity</u>
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<u>Cover</u>	<u>Cover</u>	<u>Canopy</u>	<u>Canopy</u>
<u>low %</u>	<u>high %</u>	<u>height</u>	<u>height</u>
		<u>bottom</u>	<u>top</u>

sphagnum  
*Sphagnum*      [SPHAG2](#) N

**Community Phase 1.3: Pin Oak –Swamp White Oak/Buttonbush/Virginia Chain Fern-Lizard’s tail**



Pin oak at edge of longer duration ponding phase.



Lizards Tail (*Saururus cernuus*)



Leatherleaf (*Chamaedaphne calyculata*)



Swamp white oak



Virginia chain fern



Pin oak swamp with high water line on their trunks. Buttonbush



This phase represents a wetter, less hummocky condition, often at the edge of an open pond. Trees such as pin oak and swamp white oak that are more tolerant of ponding prevail over red maple and black gum.

**Community Phase Pathway 1.3A**

Decreased ponding duration due to dryer climate or increased water use by forest vegetation, combined with the accumulation of pit and mound microtopography from wind throws of larger trees, results in the recruitment of less flood-tolerant and more shade-tolerant red maple and black gum.

**Community Phase Pathway 1.3B**

Tree mortality induced by increased ponding duration or crown fire results in increased light availability for a rich understory of forbs and graminoids.

**Forest Overstory**

Pin oak and swamp white oak are the most frequent and characteristic members of the canopy. Green ash (*Fraxinus pensylvanica*) may be present, presumably, where nutrient levels are higher.



**Forest Overstory Characterization Summary (tree, tree fern and vine species >13 feet in height)**

Forest canopy:	<u>Low canopy cover %</u> 60	<u>RV canopy cover %</u> 95	<u>High canopy cover %</u> 100
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**Overstory plant type: Tree**

Name	Symbol	Nativity	<u>Cover low %</u>	<u>Cover high %</u>	<u>Canopy height bottom</u>	<u>Canopy height top</u>	<u>Tree diameter low</u>	<u>Tree diameter high</u>	<u>Basal area low</u>	<u>Basal area high</u>
swamp white oak <i>Quercus bicolor</i>	<a href="#">QUBI</a>	N								
pin oak <i>Quercus palustris</i>	<a href="#">QUPA2</a>	N								

**Forest Understory**

Buttonbush and lizards tail may occur in the understory, particularly where the canopy is more open. Keeping with the hypothesis that some sites are burned out peat bogs, leatherleaf (*Chamaedaphne calyculata*) has been observed at the forest-pond boundary.

**Forest Understory Canopy Cover Summary (all species <13 feet in height)**

**Understory plant type: Forb/Herb**

Name	Symbol	Nativity	<u>Cover low %</u>	<u>Cover high %</u>	<u>Canopy height bottom</u>	<u>Canopy height top</u>
lizard's tail <i>Saururus cernuus</i>	<a href="#">SACE</a>	N				

**Understory plant type: Fern/fern ally**

Name	Symbol	Nativity	<u>Cover low %</u>	<u>Cover high %</u>	<u>Canopy height bottom</u>	<u>Canopy height top</u>
Virginia chainfern <i>Woodwardia virginica</i>	<a href="#">WOVI</a>	N				

**Understory plant type: Shrub/Subshrub**

Name	Symbol	Nativity	<u>Cover low %</u>	<u>Cover high %</u>	<u>Canopy height bottom</u>	<u>Canopy height top</u>
common buttonbush <i>Cephalanthus occidentalis</i>	<a href="#">CEOC2</a>	N				

**Community Phase 1.4: Bluejoint**



Bluejoint, wet-mesic sand prairie



Steeplebush



Eleocharis melanocarpa spikes with achenes (1 mm, 0.2 mm scale)



Eleocharis tricostata spikes with achenes (1 mm, 0.2 mm scale)



Sisyrrinchium atlanticum



Virginia meadow-beauty (*Rhexia virginica*)



Maryland meadowbeauty (*Rhexia mariana*)



Slender goldentop (*Euthamia caroliniana*)



*Rhynchospora capitellata*



Hyssop hedge-nettle (*Stachys hyssopifolia*)

This phase represents an open canopy condition where grasses prevail. Unless maintained with fire or prolonged ponding, this phase will be colonized by swamp hardwoods.

**Community Phase Pathway 1.4A**

Reduced ponding duration due to dryer climate or reduced fire frequency permits colonization by flood-tolerant tree species. Increasing shade results in the reduction of the understory vegetation and replacement by more shade-tolerant taxa.

**Community Phase Pathway 1.4B**

Increased ponding duration from seasonally ponded to intermittently exposed allows for the establishment of aquatic plants and reduces the number emergent species. Some of the rarest annuals are maintained in the seed bank, only emerging during extreme dry years when the pond bottom is exposed.

**Forest Understory**

Bluejoint (*Calamagrostis canadensis*) is a typical common grass species in this community phase; however, a diversity of other grasses, sedges, rushes, and forbs differentiate it from other wet prairie site concepts. A large proportion of the total flora are Atlantic-Gulf Coastal Plain disjuncts. Species list, in part, was taken from Kost and Penskar (2000). While there is overlap in taxa among community phases, zonation is visibly apparent.

**Understory plant type:** Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
densetuft hairsedge <i>Bulbostylis capillaris</i>	<a href="#">BUCA2</a>	N				
bluejoint <i>Calamagrostis canadensis</i>	<a href="#">CACA4</a>	N				
broom sedge <i>Carex scoparia</i>	<a href="#">CASC11</a>	N				
smooth sawgrass <i>Cladium mariscoides</i>	<a href="#">CLMA</a>	N				
slender flatsedge <i>Cyperus bipartitus</i>	<a href="#">CYBI6</a>	N				
rough panicgrass <i>Dichanthelium leucothrix</i>	<a href="#">DILE4</a>	N				
blackfruit spikerush <i>Eleocharis melanocarpa</i>	<a href="#">ELME</a>	N				
smallfruit spikerush <i>Eleocharis microcarpa</i>	<a href="#">ELMI2</a>	N				
three-angle spikerush <i>Eleocharis tricostata</i>	<a href="#">ELTR5</a>	N				
	<a href="#">JUBR</a>	N				

whiteroot rush		
<i>Juncus brachycarpus</i>		
brownfruit rush		
<i>Juncus pelocarpus</i>	<a href="#">JUPE</a>	N
needlepod rush		
<i>Juncus scirpoides</i>	<a href="#">JUSC</a>	N
Vasey's rush		
<i>Juncus vaseyi</i>	<a href="#">JUVA</a>	N
smallflower halfchaff sedge		
<i>Lipocarpa micrantha</i>	<a href="#">LIMI12</a>	N
redtop panicgrass		
<i>Panicum longifolium(syn)</i>	<a href="#">PALO</a>	N
warty panicgrass		
<i>Panicum verrucosum</i>	<a href="#">PAVE2</a>	N
switchgrass		
<i>Panicum virgatum</i>	<a href="#">PAVI2</a>	N
brownish beaksedge		
<i>Rhynchospora capitellata</i>	<a href="#">RHCA12</a>	N
Hall's bulrush		
<i>Schoenoplectiella hallii</i>	<a href="#">SCHA10</a>	N
fewflower nutrush		
<i>Scleria pauciflora</i>	<a href="#">SCPA5</a>	N
weakstalk bulrush		
<i>Schoenoplectiella purshiana</i>	<a href="#">SCPU14</a>	N
whip nutrush		
<i>Scleria triglomerata</i>	<a href="#">SCTR</a>	N
prairie dropseed		
<i>Sporobolus heterolepis</i>	<a href="#">SPHE</a>	N
purple sandgrass		
<i>Triplasis purpurea</i>	<a href="#">TRPU4</a>	N

**Understory plant type:** Forb/Herb

<u>Name</u>	<u>Symbol</u>	<u>Nativity</u>	<u>Cover low %</u>	<u>Cover high %</u>	<u>Canopy height bottom</u>	<u>Canopy height top</u>
twining screwstem						
<i>Bartonia paniculata</i>	<a href="#">BAPA2</a>	N				
slender goldentop						
<i>Euthamia caroliniana</i>	<a href="#">EUCA26</a>	N				
roundfruit hedgehyssop						
<i>Gratiola virginiana</i>	<a href="#">GRVI</a>	N				
lesser Canadian St. Johnswort						
<i>Hypericum canadense</i>	<a href="#">HYCA7</a>	N				
orangegrass						
<i>Hypericum gentianoides</i>	<a href="#">HYGE</a>	N				
Virginia marsh St. Johnswort						
<i>Hypericum virginicum(syn)</i>	<a href="#">HYVI4</a>	N				
Leggett's pinweed						
<i>Lechea pulchella</i>	<a href="#">LEPU4</a>	N				
seedbox						
<i>Ludwigia alternifolia</i>	<a href="#">LUAL2</a>	N				
American water horehound						
<i>Lycopus americanus</i>	<a href="#">LYAM</a>	N				
yellow fringed orchid						
<i>Platanthera ciliaris</i>	<a href="#">PLCI2</a>	N				
drumheads						
<i>Polygala cruciata</i>	<a href="#">POCR</a>	N				
rabbit-tobacco						
<i>Pseudognaphalium obtusifolium ssp. obtusifolium</i>	<a href="#">PSOBO</a>	N				
whorled mountainmint						
<i>Pycnanthemum verticillatum</i>	<a href="#">PYVE</a>	N				
Maryland meadowbeauty						
<i>Rhexia mariana</i>	<a href="#">RHMA</a>	N				
handsome Harry						
<i>Rhexia virginica</i>	<a href="#">RHVI</a>	N				
rosepink						
<i>Sabatia angularis</i>	<a href="#">SAAN</a>	N				
eastern blue-eyed grass						
<i>Sisyrinchium atlanticum</i>	<a href="#">SIAT</a>	N				
little lady's tresses						
<i>Spiranthes tuberosa</i>	<a href="#">SPTU</a>	N				
hyssopleaf hedgenettle						
<i>Stachys hyssopifolia</i>	<a href="#">STHY3</a>	N				
rice button aster						
<i>Symphotrichum dumosum var. dumosum</i>	<a href="#">SYDUD2</a>	N				
bog white violet						
<i>Viola lanceolata</i>	<a href="#">VILA4</a>	N				
slender yelloweyed grass						
<i>Xyris torta</i>	<a href="#">XYTO</a>	N				

**Understory plant type:** Fern/fern ally

<u>Name</u>	<u>Symbol</u>	<u>Nativity</u>	<u>Cover low %</u>	<u>Cover high %</u>	<u>Canopy height bottom</u>	<u>Canopy height top</u>
inundated clubmoss <i>Lycopodiella inundata</i>	<a href="#">LYIN2</a>	N				
Marguerite's clubmoss <i>Lycopodiella margueritiae</i>	<a href="#">LYMA7</a>	N				
northern bog clubmoss <i>Lycopodiella subappressa</i>	<a href="#">LYSU2</a>	N				

**Understory plant type:** Shrub/Subshrub

<u>Name</u>	<u>Symbol</u>	<u>Nativity</u>	<u>Cover low %</u>	<u>Cover high %</u>	<u>Canopy height bottom</u>	<u>Canopy height top</u>
purple chokeberry <i>Aronia prunifolia</i> (syn)	<a href="#">ARPR2</a>	N				
common buttonbush <i>Cephalanthus occidentalis</i>	<a href="#">CEOC2</a>	N				
leatherleaf <i>Chamaedaphne calyculata</i>	<a href="#">CHCA2</a>	N				
swamp loosestrife <i>Decodon verticillatus</i>	<a href="#">DEVE</a>	N				
bristly dewberry <i>Rubus hispidus</i>	<a href="#">RUHI</a>	N				
white meadowsweet <i>Spiraea alba</i>	<a href="#">SPAL2</a>	N				
steeplebush <i>Spiraea tomentosa</i>	<a href="#">SPTO2</a>	N				
highbush blueberry <i>Vaccinium corymbosum</i>	<a href="#">VACO</a>	N				

**Understory plant type:** Nonvascular

<u>Name</u>	<u>Symbol</u>	<u>Nativity</u>	<u>Cover low %</u>	<u>Cover high %</u>	<u>Canopy height bottom</u>	<u>Canopy height top</u>
sphagnum <i>Sphagnum subsecundum</i>	<a href="#">SPSU9</a>	N				

**Community Phase 1.5: Tall Horned Beak Sedge**



Tall Horned Beak Sedge (*Rhynchospora macrostachya*)



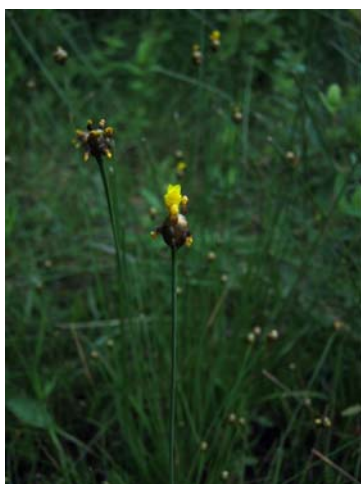


Cowles Bog at Indiana Dunes National Lakeshore

Dead pin oak

Buttonbush in long duration seasonally ponded zone (dry period)

Rhynchospora scirpoides

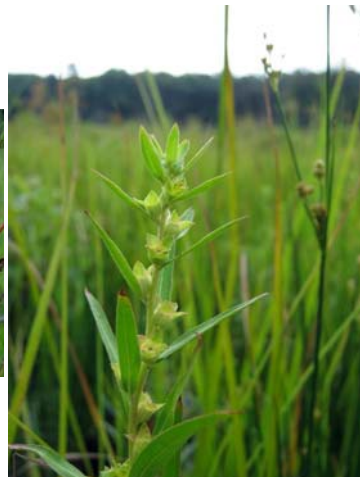
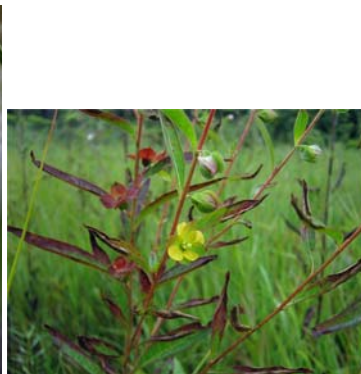
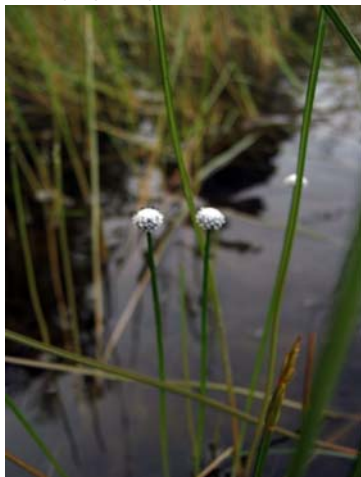


Yellow-eyed grass (*Xyris torta*)

Pickerel-weed (*Pontederia cordata*)

Sundew (*Drosera intermedia*)

Rhynchospora fusca



Pipewort (*Eriocaulon aquaticum*)

Seedbox (*Ludwigia alternifolia*)

*Ludwigia sphaerocarpa*

Mermaidweed (*Proserpinaca palustris*)

This community phase is ponded for most of the year, and sometimes only exposed during drought years.

**Community Phase Pathway 1.5A**

Decreased ponding duration due to drying climate allows a wider array of emergent herbaceous taxa to colonize, but reduces the abundance of aquatic taxa.

**Forest Understory**

There is a mix of aquatic and emergent herbaceous taxa, with a dominance of graminoids. A large portion of the flora is Gulf-Atlantic Coastal Plain disjuncts (e.g. *Rhynchospora macrostachya*, having a large gap in its distribution separating it from its main range in the Southeast). Some taxa are rare annuals, which only emerge when the pond bottom is exposed and may go unnoticed for decades before rediscovery (e.g. *Rhynchospora nitens*). While there is overlap in taxa among community phases, zonation is visibly apparent.

**Understory plant type:** Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
jointed spikesedge						
<i>Eleocharis equisetoides</i>	<a href="#">ELEQ</a>	N				
	<a href="#">ELRO</a>	N				

Robbins' spikerush		
<i>Eleocharis robbinsii</i>		
sevenangle pipewort		
<i>Eriocaulon aquaticum</i>	<a href="#">ERAQ2</a>	N
slender fimbry		
<i>Fimbristylis autumnalis</i>	<a href="#">FIAU2</a>	N
dwarf umbrella-sedge		
<i>Fuirena pumila</i>	<a href="#">FUPU</a>	N
brown beaksedge		
<i>Rhynchospora fusca</i>	<a href="#">RHFU</a>	N
tall horned beaksedge		
<i>Rhynchospora macrostachya</i>	<a href="#">RHMA6</a>	N
shortbeak beaksedge		
<i>Rhynchospora nitens</i>	<a href="#">RHNI</a>	N
longbeak beaksedge		
<i>Rhynchospora scirpoides</i>	<a href="#">RHSC5</a>	N
netted nutrush		
<i>Scleria reticularis</i>	<a href="#">SCRE</a>	N
swaying bulrush		
<i>Schoenoplectus subterminalis</i>	<a href="#">SCSU10</a>	N
slender yelloweyed grass		
<i>Xyris torta</i>	<a href="#">XYTO</a>	N

**Understory plant type:** Forb/Herb

<u>Name</u>	<u>Symbol</u>	<u>Nativity</u>	<u>Cover low %</u>	<u>Cover high %</u>	<u>Canopy height bottom</u>	<u>Canopy height top</u>
watershield						
<i>Brasenia schreberi</i>	<a href="#">BRSC</a>	N				
spoonleaf sundew						
<i>Drosera intermedia</i>	<a href="#">DRIN3</a>	N				
mudbabies						
<i>Helanthium tenellum(syn)</i>	<a href="#">HETE</a>	N				
seedbox						
<i>Ludwigia alternifolia</i>	<a href="#">LUAL2</a>	N				
marsh seedbox						
<i>Ludwigia palustris</i>	<a href="#">LUPA</a>	N				
globefruit primrose-willow						
<i>Ludwigia sphaerocarpa</i>	<a href="#">LUSP</a>	N				
yellow pond-lily						
<i>Nuphar advena(syn)</i>	<a href="#">NUAD2</a>	N				
American white waterlily						
<i>Nymphaea odorata ssp. odorata</i>	<a href="#">NYODO</a>	N				
snailseed pondweed						
<i>Potamogeton bicupulatus</i>	<a href="#">POBI9</a>	N				
pickerelweed						
<i>Pontederia cordata</i>	<a href="#">POCO14</a>	N				
variableleaf pondweed						
<i>Potamogeton gramineus</i>	<a href="#">POGR8</a>	N				
Illinois pondweed						
<i>Potamogeton illinoensis</i>	<a href="#">POIL</a>	N				
marsh mermaidweed						
<i>Proserpinaca palustris</i>	<a href="#">PRPA3</a>	N				
combleaf mermaidweed						
<i>Proserpinaca pectinata</i>	<a href="#">PRPE</a>	N				
lowland rotala						
<i>Rotala ramosior</i>	<a href="#">RORA</a>	N				
European bur-reed						
<i>Sparganium emersum</i>	<a href="#">SPEM2</a>	N				
swollen bladderwort						
<i>Utricularia inflata</i>	<a href="#">UTIN</a>	N				
zigzag bladderwort						
<i>Utricularia subulata</i>	<a href="#">UTSU</a>	N				

**Understory plant type:** Fern/fern ally

<u>Name</u>	<u>Symbol</u>	<u>Nativity</u>	<u>Cover low %</u>	<u>Cover high %</u>	<u>Canopy height bottom</u>	<u>Canopy height top</u>
spiny-spore quillwort						
<i>Isoetes echinospora(syn)</i>	<a href="#">ISEC</a>	N				

**Transition T1A**

Clearing/Drainage/Cultivation

**State 2: Agriculture**

The Agriculture State accommodates the 49 percent of the sites that are actively managed, or are recovering from agriculture. This is a heterogeneous assemblage addressed here collectively. Included within the 49 percent is 31 percent of the area considered agriculture and 17 percent that is developed at low to high intensities (e.g. cities) (U.S. Department of the Interior, Geological Survey, 2011).

### Community Phase 2.1: Blueberry Farm



Blueberry Farm

Blueberries are among the most important crops in this ecological site. This and adjacent riparian sandy sites support some of the nation's largest supply of blueberries. Although commonly in the form of cultivars, this is one of the few essentially native crops, being that all are derived from *Vaccinium corymbosum*. Large operations require chemical control for introduced insect pests (affecting fruit quality), but these pests do not otherwise threaten the viability of wild populations (Demchak and Rudisill, 2006).

Despite the natural occurrence of native blueberries on these low nutrient sites, for optimal production, blueberry farmers increase the levels of available nitrogen and calcium in the form of salts, which maintain the optimal low pH, levels (4.5 to 5.1). Nitrogen is supplied as ammonium sulfate, and calcium is supplied with calcium sulfate (gypsum). When necessary, pH is adjusted upward with lime (calcium carbonate) and downward with sulfur (Hayden, 2001). Sites are often mulched to help maintain low pH.

Recommended water tables for blueberry production are 36 to 56 cm (14 to 24 inches), which requires drainage ditches for poorly drained sites (Hayden, 2001). Deeper seasonal water tables allows for larger rooting volumes, which helps maintain stronger plants for production. With or without drainage ditches, the natural variability in water table and low available water holding capacity of the sandy textures requires that the blueberry crop be irrigated.

Other practices represented by this community phase are ornamental nurseries, hayfields, and pastures. Although not elaborated here, these agricultural practices involve the establishment of different species, alternative patterns of drainage and irrigation, and different nutrient management regimes. In general, they may require higher applications of lime to raise the soil pH as compared to blueberry cultivation.

#### Forest Understory

Production blueberry fields typically have ample herbaceous ground covers. The composition of the ground vegetation differs in important ways from the reference condition due to frequent disturbance, the heavy inputs of nitrogen fertilizers, and most importantly the artificially lowered water tables. As a result, cosmopolitan weed species such as yellow nutsedge can proliferate. Other weeds such as the non-native sheep sorrel are characteristic of disturbed sites such as these that are acidic.

#### Understory plant type: Grass/grass-like (Graminoids)

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
yellow nutsedge <i>Cyperus esculentus</i>	<a href="#">CYES</a>	N				
crabgrass <i>Digitaria</i>	<a href="#">DIGIT2</a>	I				
fall panicgrass <i>Panicum dichotomiflorum</i>	<a href="#">PADI</a>	N				
bristlegrass <i>Setaria</i>	<a href="#">SETAR</a>	I				

#### Understory plant type: Forb/Herb

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
Canadian horseweed <i>Erigeron canadensis(syn)</i>	<a href="#">ERCA20</a>	U				
alfalfa <i>Medicago sativa</i>	<a href="#">MESA</a>	I				
common sheep sorrel <i>Rumex acetosella</i>	<a href="#">RUAC3</a>	I				
white clover <i>Trifolium repens</i>	<a href="#">TRRE3</a>	I				

#### Understory plant type: Shrub/Subshrub

Name	Symbol	Nativity	Cover low %	Cover high %	Canopy height bottom	Canopy height top
highbush blueberry <i>Vaccinium corymbosum</i>	<a href="#">VACO</a>	N				

#### Restoration Pathway R2A

Restoration of poorly drained conditions by blocking drainage ditches is critical to restoring reference state hydrology. Control non-native invasive species, and reestablish native plant species characteristic of the forested reference state. If applicable, cease nutrient enrichment (to allow excess calcium and nitrogen to be slowly flushed from the system or incorporated into biomass). If the site had been limed heavily, application of sulfur should be considered depending on restoration objectives.



## Section II: Ecological Site Interpretations

### Forest Site Productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
red maple	<a href="#">ACRU</a>	67	67	22	22		094	50TA	Lloyd, William J. 1971b. Site index tables for red maple. USDA, Soil Conservation Service. Regional Technical Service Center Technical Note WOOD-UD-10. (An adaptation from: Foster, Ralph W. 1959. Relation between site indexes of eastern white pine and red maple. Forest Science, Volume 5, No. 3.)
pin oak	<a href="#">QUPA2</a>	82	82	76	76		860	50Ta	Broadfoot, W.M. 1963. Guide for evaluating water oak sites. USDA, Forest Service. Southern Forest Experiment Station Research Paper SO-1.

### Animal Community

The following wildlife species discussion emphasizes species of economic (game or fur trapping) or conservation concern, which have suitable habitat within one or more community, phases within the site concept or that are ecologically significant to the structure of community phases. The major references used to determine habitat suitability are NatureServe (2013), Michigan Natural Features Inventory (2013), Indianapolis Department of Transportation (2004), Harding (1997), Chartier, et al. (2011), Brewer, et al. (1991), Ehrlich, et al. (1988), and National Park Service (2013). Vertebrate nomenclature is consistent with NatureServe (2013).

#### Mammals

##### Large Herbivores

The largest herbivore in the region is white-tailed deer (*Odocoileus virginianus*), a browser that occupies a wide range of cover phases in all but the most inundated habitats. Agricultural conversion and forest fragmentation, both of which are favorable to deer forage, and the extirpation of most natural predators has resulted in excess populations of deer across the entire area. Excess deer browse limits the continued recruitment of hemlock into the overstory and severely reduces the diversity of forbs in the understory (Rooney, 2001).

##### Large Predators

Formerly, gray wolf (*Canis lupus*), American black bear (*Ursus americanus*), and cougar (*Puma concolor*), were among the top predators occupying all community phases. By the late 1800s, these species were extirpated from the area through excess hunting and habitat conversion. Bobcat (*Lynx rufus*) and fisher (*Pekania pennanti*) ranked among the medium-sized predators until they too were extirpated by the late 1800s. However, bear and bobcats may yet occur at the northern end of this ecological site concept, in Muskegon and Newaygo Counties, Michigan, adjacent to where they can still be hunted legally.

At present, the only native carnivore capable of preying on deer is the coyote (*Canis latrans*), which occupies all community phases. Medium-sized mammalian predators include gray fox (*Urocyon cinereoargenteus*) and red fox (*Vulpes vulpes*), both of which occupy a wide range of community phases, but on balance, gray fox prefers more forested phases than red fox.

##### Small Mammals

Small predators that occur across the span of community phases include striped skunk (*Mephitis mephitis*) and long-tailed weasel (*Mustela frenata*). Both forested and open phases of this ecological site provide suitable habitats for eastern cottontail (*Sylvilagus floridanus*) and various deer mice and voles (*Cricetidae*) and shrews (*Soricidae*).

Among the various bat species which may pass through or occupy community phases of this ecological site, the Indiana myotis (*Myotis sodalis*) and tricolored bat (or eastern pipistrelle, *Perimyotis subflavus*) are of conservation concern. These species roost in summer in cavities and under bark, thus requiring community phases with at least mature trees. They also favor forest edges adjacent to savanna or water bodies. Indiana myotis hibernates off-site in Kentucky and Indiana caves, whereas tricolored bat may be only of local concern to this ecological site concept, since it is seldom more than 48 km (30 miles) from local hibernacula such as a cave in Berrien County, Michigan (the only cave in the area) (Michigan Natural Features Inventory, 2013).

#### Birds

American woodcock (*Scolopax minor*) has a potential to occur in this poorly drained site concept in mostly early successional community phases that include openings and dense shrubs, except perhaps the long duration ponded phase.

Passenger pigeon (*Ectopistes migratorius*) and blue jay (*Cyanocitta cristata*) are historically important components of the avifauna responsible for the long distance dispersal of nut trees (beech and oaks) that occur in forested phases of this ecological site concept (Webb, 1986; Johnson and Webb III, 1989). The passenger pigeon is now extinct.

Woodpeckers such as pileated woodpecker (*Dryocopus pileatus*) and red-bellied woodpecker (*Melanerpes carolinus*) are important creators of tree and snag cavities, in which they and many other animal taxa depend for nesting. As such, their frequency would be expected to increase with stand age and associated tree mortality. Typically encountered song bird species in the forested phases include: eastern wood-pewee (*Contopus virens*), acadian flycatcher (*Empidonax virens*), yellow-throated vireo (*Vireo flavifrons*), red-eyed vireo (*Vireo olivaceus*), black-capped chickadee (*Parus atricapillus*), tufted titmouse (*Baeolophus bicolor*), veery (*Catharus fuscescens*), wood thrush (*Hylocichla mustelina*), American robin (*Turdus migratorius*), ovenbird (*Seiurus aurocapilla*), black-and-white warbler (*Mniotilta varia*), hooded warbler (*Setophaga citrina*), American redstart (*Setophaga ruticilla*), cerulean warbler (*Setophaga cerulea*), yellow warbler (*Setophaga petechia*), scarlet tanager (*Piranga olivacea*), rose-breasted grosbeak (*Pheucticus ludovicianus*) (ebird, 2013).

Large tracts of late successional forested phases are favorable to northern goshawk (*Accipiter gentilis*), red-shouldered hawk (*Buteo lineatus*), cerulean warbler (*Setophaga cerulea*), prothonotary warbler (*Protonotaria citrea*), and hooded warbler (*Setophaga citrina*) forage and nesting sites. In particular, goshawk and red-shouldered hawk require snags or larger trees for nesting. Prothonotary warbler requires tree or snag cavities for nesting. Management for small forest interior songbirds species such as cerulean and hooded warblers, must consider their vulnerability to brown-headed cowbird (*Molothrus ater*), a brood parasite that becomes more common near forest edges. Tall emergent canopy white pine, particularly near water, is favorable to bald eagle (*Haliaeetus leucocephalus*) nesting.

In the open wet "coastal plain marsh" phases there is potential for Wilson's snipe (*Gallinago delicata*) and sora (*Porzana carolina*) to occur. The birds with the greatest conservation concern in these sites are: American bittern (*Botaurus lentiginosus*), black tern (*Chlidonias niger*), northern harrier (*Circus cyaneus*), marsh wren (*Cistothorus palustris*), trumpeter swan (*Cygnus buccinator*), common moorhen (*Gallinula chloropus*), least bittern (*Ixobrychus exilis*), black-crowned night-heron (*Nycticorax nycticorax*), Wilson's phalarope (*Phalaropus tricolor*), and king rail (*Rallus elegans*).

#### Reptiles

Common snakes such as ribbon and garter (*Thamnophis* spp.) prey upon soft invertebrates and amphibians among all cover types (community phases) on land and occasionally in the water. Blue racer (*Coluber constrictor foxii*) and midland ratsnake (*Pantherophis spiloides*, of the "black ratsnake" species complex) are the largest snakes, preying upon small mammals and birds. The snakes with the greatest conservation concern are the midland ratsnake and the eastern massasauga (*Sistrurus*



catenatus catenatus). Ratsnakes are arboreal and terrestrial and would likely occupy forested areas in the dryer portions of the landscape, particularly where there is a suitable amount of down woody debris. Massaugas, the region's only significantly venomous species, occupies a mixture of cover types, but frequently associate with open upland phases during cooler periods. Massaugas also require the high water tables that characterize this site concept for their subterranean hibernacula, in order to avoid freezing over the winter.

The turtles with the greatest conservation concern in the open wet "coastal plain marsh" phases are: spotted turtle (*Clemmys guttata*) and Blanding's turtle (*Emydoidea blandingii*). Among these, the Blandings's turtle may venture into uplands whether open or forested. In addition to their preferred forage habitats, most turtles also prefer bare terrestrial microsites in sand (or other suitably friable soils) in order to bury a clutch of eggs.

#### Amphibians

The seasonally ponded areas associated with this ecological site provide potentially important fish-free pools for the development of amphibian larvae. Amphibians most frequently encountered in wooded community phases are wood frogs (*Lithobates sylvaticus*) and gray treefrogs (*Hyla versicolor* and *H. chrysoscelis*). This ecological site is a potentially significant larval recruitment site for marbled salamander (*Ambystoma opacum*). The adult marbled salamanders, normally stays hidden below ground in a range of forest types where they forage for invertebrates. However, unlike other related "mole" salamanders, these species reproduce in the fall rather than the spring. They lay their eggs in forest depressions that become inundated by fall rains (Harding, 1997). The eggs or larvae overwinter in the pools, where they later have a size advantage to prey upon the larvae of spring-breeding amphibian larvae. However, their fall breeding habit leaves them vulnerable, as shallow pools tend to freeze solid over winter in ecological sites occurring northward or inland away from the moderating influence of Lake Michigan.

Wet, open "coastal plain marsh" phase of this ecological site may provide suitable habitat for the Blanchard's cricket frog (*Acris blanchardi*).

#### Invertebrates

There is much uncertainty regarding invertebrates of conservation interest, so only species that show particular dependence on this or similar ecological sites are mentioned. Regal fern borer (*Papaipema speciosissima*) is a moth that specializes on royal and cinnamon ferns (*Osmundaceae*), which are frequent in forested phases of this ecological site. Pine katydid (*Scudderia fasciata*) specializes in hemlock and pine, which can be common in forested phases of this ecological site. In open wet "coastal plain marsh" and "wet sand prairie" phases there is potential for green desert grasshopper (*Orphulella pelidna*).

#### Non-native invasive species

Hemlock woolly adelgid (*Adelges tsugae*) is currently devastating hemlock in the Southern Appalachians (Hessl and Pederson, 2013). Should this serious pest spread northwestward, it would potentially alter the reference state by permanently eliminating hemlock as an important canopy component.

The scale insect, *Cryptococcus fagisuga*, is a vector of two different fungi responsible for beech bark disease, is a serious threat to the continued existence of beech, and has begun to spread into sites relatively close to this ecological site (O'Brien, et al., 2001).

#### Domesticated Livestock

This ecological site is not a significant host for domesticated livestock. Understory forage opportunities are likely sparse and low in nutrients without addition of fertilizers or non-native invasive nitrogen-fixers like clovers.

## Hydrology Functions

Generally speaking, predominantly broadleaf-forested states function to accelerate potential evapotranspiration and maintain a lower water table than under herbaceous vegetated or conifer dominated phases. Therefore, on the wettest sites, there may be a delay in reforestation if ponding duration increases beyond the physiological limits of the dominant tree species.

## Recreational Uses

Recreational opportunities are mainly hunting, hiking, botanizing, and bird watching. Ponding creates issues with camping. Abundant mosquitoes may compromise user experience during the warmer seasons.

## Wood Products

#### Red Maple (*Acer rubrum*)

Red maple is managed through a variety of silvicultural systems, including clearcutting, and regenerates by stump sprouting, but sometimes suppressed with herbicide and fire where oak is more desired.

Wood is used for furniture and cabinetry. It is a moderate-density firewood (dry specific gravity: 0.54).

#### Pin Oak (*Quercus palustris*)

Pin oak is managed by group selection and shelterwood harvest.

Wood is grouped with other related red oaks, and is used in flooring, furniture, cabinetry, but presence of persistent branches often result in knots that make this species undesirable for wood products. It is a high-density firewood (dry specific gravity: 0.63).

#### Swamp White Oak (*Quercus bicolor*)

Swamp white oak is managed by shelterwood harvest.

Wood is grouped with other related white oaks, is used in furniture, and is uniquely suitable (above all other woods) for its use in wine barrels. It is a high-density firewood (dry specific gravity: 0.72).

#### Black Gum (*Nyssa sylvatica*)

Although not frequently managed, black gum can be clearcut or selectively harvested. It can stump sprout, but is usually present in new stand as advance regeneration.

Wood is used in flooring, tool handles, pallets and crates, but rarely of merchantable size. It is a moderate-density firewood (dry specific gravity: 0.50).

Sources include Miles and Smith (2009) and Burns and Honkala (1990), and Andy Henriksen's expert knowledge.

## Other Products

Wild blueberries may be sought in most forested cover phases.

## Supporting Information

### Associated Sites

Site name	Site ID	Site narrative
Acidic Sandy Flatwoods	<a href="#">F097XA006MI</a>	Occurs on adjacent (drier) somewhat poorly drained sites.
Sand Pond	<a href="#">R097XA013MI</a>	Occurs as lower, wetter sites with longer duration ponding and no forested phases.

**Similar Sites**

<u>Site name</u>	<u>Site ID</u>	<u>Site narrative</u>
Wet Acidic Interdune	F098XB003IN	Equivalent site in Kankakee region, with a more pronounced continental climate and higher fire frequency. Flora shares some coastal plain disjunct components, but lacks hemlock and yellow birch phases.
Wet Acidic Sandy Flatwoods	F096XY002MI	Occurs north of floristic tension zone (Ecoregion section 212) outside the range of pin oak. Retains black gum as rare associate in Manistee Lake Plain ecoregion (212Ha). Coastal plain disjuncts restricted to Newaygo Outwash Plains ecoregion (212Hb) and Manistee Lake Plain ecoregion (212Ha).

**State Correlation**

This site has been correlated with the following states: IN MI

**Inventory Data References**

The type locations were 20 by 20 m plots, in which ocular estimates of cover by species by stratum were conducted.

The low intensity plots consisted of ocular estimates within roughly 10 m viewshed and for only three standard strata of delimited by 0.5 and 5 meters.

The site index plot consisted of a 3-4 trees measured per plot. No ECS-5 plots were used.

**Inventory Data References by Plot (Range-417, Wood-4, Wood-5)**

<u>Data source</u>	<u>Number</u>	<u>Year</u>	<u>State code</u>	<u>County code</u>	<u>State</u>	<u>County</u>
ECS-5	1	2014	26	05	Michigan	

**Other Inventory Data References**

<u>Data source</u>	<u>Number of records</u>	<u>Sample period</u>	<u>State</u>	<u>County</u>
Low Intensity Plots	5	2013	Indiana	LaPorte
Low Intensity Plots	6	2013	Michigan	Allegan
Low Intensity Plots	1	2013	Michigan	Newaygo

**Type Locality**

State:	IN
County:	LaPorte
Datum:	WGS84
Latitude degrees:	41
Latitude minutes:	43
Latitude seconds:	40
Latitude decimal:	14
Longitude degrees:	86
Longitude minutes:	48
Longitude seconds:	39
Longitude decimal:	6
Universal Transverse Mercator (UTM) system:	WGS84
State:	MI
County:	Allegan
Datum:	WGS84
Latitude degrees:	42
Latitude minutes:	31
Latitude seconds:	44
Latitude decimal:	46
Longitude degrees:	86
Longitude minutes:	2
Longitude seconds:	59
Longitude decimal:	46
Universal Transverse Mercator (UTM) system:	WGS84
State:	MI
County:	Newaygo
Datum:	WGS84
Latitude degrees:	43
Latitude minutes:	18
Latitude seconds:	16
Latitude decimal:	32
Longitude degrees:	85
Longitude minutes:	55
Longitude seconds:	44
Longitude decimal:	22
Universal Transverse Mercator (UTM) system:	WGS84

**Hierarchical Classification Relationships**

This ecological site concept has community phases equivalent to:  
 1 or more NatureServe systems  
 4 or more National Vegetation Classification (NVC) associations  
 4 Michigan Natural Features Inventory (MNFI) communities  
 3 Indiana Division of Nature Preserves communities

This ecological site concept has equivalent classifications in the following alternative ecological land type classifications

1 United State Forest Service ecological land type phase (ELTP)

0 Kotar habitat types

These are elaborated under "Other References".

## Other References

In the NatureServe Systems classification (NatureServe, 2011), this site concept would be grouped either with the hardwood dominated "North-Central Interior Wet Flatwoods" system or the mixed conifer-hardwood "North-Central Appalachian Acidic Swamp." Although "Laurentian-Acadian Alkaline Conifer-Hardwood Swamp" is more regionally appropriate for Michigan, the term "alkaline" and the presence of black gum make "North-Central Appalachian Acidic Swamp" a better fit. The open bluejoint phase is analogous (in the sense of being called "prairie") to the "Great Lakes Wet-Mesic Lakeplain Prairie" system but fits conceptually within the range of variation of the "Northern Atlantic Coastal Plain Pond" system. The wetter tall horned beak sedge phase is consistent with the "Northern Atlantic Coastal Plain Pond" system.

The NatureServe/National Vegetation Classification System (NatureServe, 2011) classifies the wetter hardwood dominated phases as "Quercus palustris - Quercus bicolor - Acer rubrum Flatwoods Forest." A related concept, "Quercus palustris - Quercus bicolor - Nyssa sylvatica - Acer rubrum Sand Flatwoods Forest" association (as applied just to the south in Kankakee Sands) may also be applicable. The late successional phase is floristically most consistent with "Tsuga canadensis - Betula alleghaniensis / Ilex verticillata / Sphagnum spp. Forest" (as described to the east in the northern Appalachian states), although the concept "Tsuga canadensis - Betula alleghaniensis Saturated Forest" (as described for less diverse stands in northern Michigan and Wisconsin) may also fit. The open bluejoint phase is analogous to the "Andropogon gerardii - Calamagrostis canadensis Sand Herbaceous Vegetation" association in the sense of it being "wet sand prairie," however; it lacks big bluestem and prairie cordgrass. Perhaps more appropriate to its relative zonation to a coastal plain marsh/pondshore is the "Calamagrostis canadensis - Dichanthelium meridionale - (Mixed Shrub) Herbaceous Vegetation" association, otherwise known as "Bluejoint Pondshore Margin" (albeit this association had not been attributed to Michigan or Indiana in NatureServe database). The wetter tall horned beak sedge phase is consistent with the "Rhynchospora capitellata - Rhexia virginica - Rhynchospora scirpoides - Schoenoplectus hallii Herbaceous Vegetation" association, but also overlaps "Rhexia virginica - Panicum verrucosum Herbaceous Vegetation."

According to the Indiana natural community types (Namestnik and Board, 2010; Jacquart, et al., 2002), the site concept is equivalent to "Boreal Flatwoods" (which emphasizes a minor amount of paper birch responsible for the "boreal" modifier in the name; other taxa are not distinctly northern, except relative to their ranges in Indiana). The site concept is also related to the "Sand Flatwoods" further south in the Kankakee region. The open bluejoint phase overlaps the Indiana concept of "Wet Sand Prairie." The wettest tall horned beak sedge phase overlaps the Indiana concept of "Muck and Sand Flats."

The Michigan Natural Features Inventory (MNFI, 2011) groups hardwood dominated wetlands with a broadly defined "Southern Hardwood Swamp" whereas anything that includes some hemlock classifies as "Hardwood-Conifer Swamp." The "Wet-Mesic Sand Prairie" concept overlaps with the bluejoint phase. (Michigan does not have "wet sand prairie," but some element occurrences occur on poorly drained sites, suggesting that they do not adhere to the Indiana the definition always equating wet-mesic with a somewhat poorly drained drainage class). The sand prairie concepts of Michigan and Indiana do not make a distinction between high and low pH status. The "Coastal Plain Marsh" overlaps the tall horned beak sedge phase.

This site concept is roughly equivalent to Huron-Manistee National Forest ELTP 72 (Cleland, et al., 1994).

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#### Original Site Description Approval

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