INVENTORY AND CLASSIFICATION OF WETLANDS AT KINGS MOUNTAIN NATIONAL MILITARY PARK BLACKSBURG, SOUTH CAROLINA



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INVENTORY AND CLASSIFICATION OF WETLANDS AT KINGS MOUNTAIN NATIONAL MILITARY PARK, BLACKSBURG, SOUTH CAROLINA

A Report Submitted to the National Park Service

by

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EXECUTIVE SUMMARY

During the spring and summer of 2003, an inventory was conducted to collect baseline information on wetlands at Kings Mountain National Military Park (KMNMP). The inventory was conducted by walking transects of varying widths until the entire park had been systematically searched.

National Wetland Inventory (NWI) maps did not indicate wetlands were present at KMNMP, and no other published data were available that indicated wetlands occurred inside KMNMP boundaries. Methods to identify areas as wetlands followed the definition and procedures outlined in the 1987 U. S. Army Corps of Engineers, Wetland Delineation Manual. When a wetland was found, data were collected regarding wetland hydrology, hydric soils, dominant wetland plant species, location, wetland type, and estimated size. The functions and potential values of the wetland also were recorded. Functions included surface water storage, ground water discharge to streams, carbon/nutrient export, provision of wildlife habitat, and support of wetland plants. Values included cultural importance, research and scientific value, and economic value. Additionally, observations regarding the presence of exotic plant species and alterations or degradations of the wetland and the potential for restoration of degraded wetlands also were recorded.

Upon completion of the inventory, seventy-four wetlands had been located and characterized. These wetlands totaled approximately 4.25 acres, with the average wetland size being approximately 0.06 acres. Based on the Cowardin system, forty-six wetlands were classified as palustrine, forested, and deciduous (PFO1) with varying hydrologic regimes. Forty-two wetlands were considered temporarily flooded (PFO1A) and four was considered seasonally flooded (PFO1C). Twenty-six wetlands were considered palustrine scrub-shrub (PSS). Of

these, 22 were considered to be temporarily flooded and dominated by deciduous vegetation (PSS1A), while one was considered to be seasonally flooded (PSS1C). The remaining three PSS wetlands were temporarily flooded and dominated by evergreen vegetation (PSS3A). One wetland was considered a palustrine emergent system that was temporarily flooded (PEM1A). The remaining wetland was considered a riverine system that is intermittently flooded within a streambed dominated by rubble (R4SB2). Based on the Hydrogeomorphic (HGM) classification system, seventy-one of the sites were slope wetlands and three were riverine.

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INTRODUCTION AND BACKGROUND

Wetlands are defined as "Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." (U. S. Army Corps of Engineers 1987). Wetlands are characterized by the presence of "hydric" soils and are dominated by "hydrophytes" that have adaptations that enable them to persist where "upland" plants cannot. A prolonged hydrologic regime (i.e., one in which the site is flooded, ponded, or saturated for approximately two or more consecutive weeks during the growing season) is the primary factor that controls the establishment and maintenance of wetland characteristics.

This water-logging is responsible for the fundamental difference between wetland and non-wetland areas. Specifically, the upper portion of the soil profile in wetlands becomes anoxic because microorganisms consume the available oxygen that is not replenished because of the slow rate of diffusion from the atmosphere into and through a saturated medium. This anoxic environment supports unique microbial populations that have the ability to use elements other than oxygen as terminal electron acceptors in their metabolic processes. These anaerobic microbes are responsible for mediating the biochemical reactions in wetlands (e.g., denitrification) that typically do not take place in environments in which oxygen is present. From a practical perspective, these reactions also result in changes in soil color (from brown to gray) because of the conversion of oxidized ferric iron to reduced ferrous iron. The presence of this distinctive color can be used in combination with an examination of the plant community and indicators of hydrology to identify wetlands and delineate the extent of their boundaries. Examination of these three factors (hydrology, soils, and vegetation) has become accepted as the basis for the process of wetland delineation as outlined in the Wetland Delineation Manual (WDM) (U. S. Army Corps of Engineers 1987).

Wetlands include a variety of landforms including marshes, swamps, bogs, fens, vernal pools, pocosins, potholes, playas, wet meadows and others that are described in varying detail in Mitch and Gosselink (2000). These diverse types occur in different landscape positions and may have quite different hydrologic regimes. For example, wetlands commonly are found in lower landscape positions such as lake fringes and river bottoms, but also may occur on hillsides or even on topographic highs such as watershed divides. Similarly, wetlands vary from those in which surface flooding or ponding occurs regularly to those in which surface water is seldom present. Examples of those in the former category include inland and coastal marshes, and river bottom swamps that are commonly referred to as bottomland hardwoods. These types account for the majority of wetlands in the Southeast. In the latter category are wetlands such as wet meadows and seeps or "springs" where groundwater discharges to the surface. Groundwater discharge wetlands have highly variable hydroperiods with some containing water throughout the year while others are wet only following periods of significant rainfall.

WETLAND CLASSIFICATION SYSTEMS/FUNCTIONS

Due to the many inherent differences in wetlands, several classification systems have been developed over the years to place wetlands into meaningful groups for inventory, management, and other purposes. Two of the most useful are the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979) and *A Hydrogeomorphic Classification for Wetlands* (HGM) (Brinson 1993). The former, normally referred to as the Cowardin system, was developed as the basis for the National Wetland Inventory (NWI) conducted by the U. S. Fish and Wildlife Service. It assigns wetlands to 1 of 5 *systems* and then to a varying number of *subsystems* and *classes* based on hydrologic regime, water chemistry, plant community, and other characteristics. The notation or codes for these various attributes are recorded on the NWI maps so users have information not only regarding the presence of

wetlands, but also the characteristics of those wetlands. The Cowardin system has proved very useful for the NWI but sometimes does not take into account even major differences in landscape position, the source of hydrology for the wetland, or its hydrodynamics; all factors that influence the functions wetlands perform. Thus, its use in classifying wetlands into groups that function similarly is limited. As a result, the HGM classification system was developed based on those three factors (landscape setting, source of hydrology, and hydrodynamics). In the HGM classification system, wetlands are assigned to 1 of 7 *classes*: riverine, depressional, slope, tidal fringe, lacustrine fringe, mineral soil flats, and organic soils flats. Further subdivisions into *subclasses* are based on hydrology source and hydrodynamics. A desirable feature of the HGM classification system is that inferences regarding function can be made from the classification system alone. For example, wetlands in the depression class usually will store surface water whereas those in the slope class typically will not. Export of carbon and nutrients typically will occur in riverine wetlands, but typically will not occur in either of the flats classes. Thus, simply by assigning a wetland to the appropriate HGM class or subclass, much is known about the wetland's role in the landscape.

In addition to those functions mentioned above, wetlands also may cycle nutrients, trap sediments and pollutants, and in some cases, recharge groundwater and provide base flow to streams and rivers. Almost all wetlands provide habitat for a wide variety of flora and fauna and are critical in maintaining local and regional biodiversity. Sather and Smith (1984), Marble (1990), Mitsch and Gosselink (2000) and various HGM documents and guidebooks (e.g., Smith et al. 1995, Ainslie et al. 1999, Smith and Klimas 2002, Wilder and Roberts 2003) all provide excellent summaries of functions that wetlands perform and the values derived from them. During the past decade, consideration of wetland functions has become a routine part of the wetland regulatory process, and it is now common for functions to serve as the basis for decision making regarding issuance of permits and development of mitigation alternatives.

The HGM approach also has been used as the basis for the development of assessment "models" that identify functions performed by a specific wetland class and subclass and can be used to determine the degree to which those functions are performed. The output usually is on a 0 - 1.0 scale in which a score of 1.0 indicates the wetland performs the function to the highest degree, while a score of 0 indicates that the function is not performed at all. Such rigorous assessments may be needed to calculate potential impacts due to a proposed project or to assist in the development of mitigation alternatives. Less detailed assessments where potential wetland function is ranked as high, medium, or low often are appropriate for inventory and baseline determination projects. The HGM approach has been recognized as one of the most useful tools for assessing wetland function by the major federal agencies with regulatory authority or oversight over wetlands; these include the U. S. Fish and Wildlife Service (FWS), U. S. Environmental Protection Agency (EPA), U. S. Army Corps of Engineers (COE), and the U. S. Natural Resources Conservation Service (NRCS)

RATIONALE FOR STUDY

In spite of the many functions that wetlands perform and the often significant value derived from those functions, approximately 53% of the wetlands originally present in the lower 48 states have been lost since European settlement as a direct result of human activities (Dahl 1990) and in many states, those losses are continuing (Hefner et al. 1994). Dahl (2000) reported that from 1986 to 1997, the wetland types in which the greatest losses occurred were freshwater, forested wetlands and freshwater marshes. Estimated losses in each category were 1.2 million acres.

While wetland loss continues today, our understanding of their importance has changed considerably since the mid-1800s through the 1900s when landowners were encouraged to drain, ditch, and fill wetlands (Mitsch and Gosselink 2000). State and Federal regulations have since

been instituted to reduce wetland loss, and many entities at all levels of government have adopted programs to aid in wetland conservation and stewardship. The U. S. National Park Service, (NPS) which manages millions of acres in the United States, has begun an initiative to determine the extent and quality of natural resources (including wetlands) under its jurisdiction, including those at KMNMP.

With a general goal of improving the stewardship of wetlands at KMNMP, it was determined that information needed included the location and types of wetlands present and a rapid assessment of wetland functions performed by them. Such knowledge is necessary to facilitate the evaluation of future potential impacts on wetlands. Further, if unavoidable impacts do occur, this information would be useful in the determination of appropriate compensation as required by the U. S. Army Corps of Engineers under Section 404 of the Clean Water Act (CWA), State requirements under Section 401 of the CWA, and requirements by the NPS for compliance with Directors Order #77-1.

OBJECTIVES

The primary objectives of this inventory and assessment included: (1) identify and delineate all wetlands subject to jurisdiction under Sections 404 and 401 of the CWA, and all wetlands subject to National Park Service procedures for implementing Director's order #77-1, (2) produce a database that includes the location and description of all wetlands present including their Cowardin and HGM classifications, and (3) assess the biotic and abiotic functions and values of these wetlands.

METHODS

Prior to conducting the field investigation at KMNMP, data that might provide information regarding wetlands there were examined. The principal data source were the NWI

maps upon which KMNMP occurs. In spite of their usefulness in inventory studies, NWI maps have limitations. For example, the NWI is more accurate in open landscapes in which wetland "signatures" such as open water can be seen and identified from remotely sensed imagery. Wetlands in which saturation as opposed to ponding or flooding is the primary source of hydrology often were not detected by the NWI. Wetland size also is a factor that determines the likelihood of wetlands being identified by the NWI surveys. There is no absolute minimum size necessary to be included in either database, but commonly, wetlands smaller than one acre will be missed.

Following this "office" investigation, the entire area within the Park boundaries (Figure 1) was searched systematically on foot to identify areas that potentially might meet the criteria for being considered a wetland according to the WDM (U. S. Army Corps of Engineers 1987). Detailed topographic maps that included the network of roads and trails within the Park along with a Global Positioning System (GPS) receiver were used as navigation aids in the field. The primary indicators of potential wetlands were the presence of surface water, an obvious change in vegetation cover, and the presence of plant species known to occur primarily in wetlands (e.g., sedges (*Carex* spp.), royal fern (*Osmunda regalis*), giant cane (*Arundinaria gigantea*), and alder (*Alnus serrulata*), etc

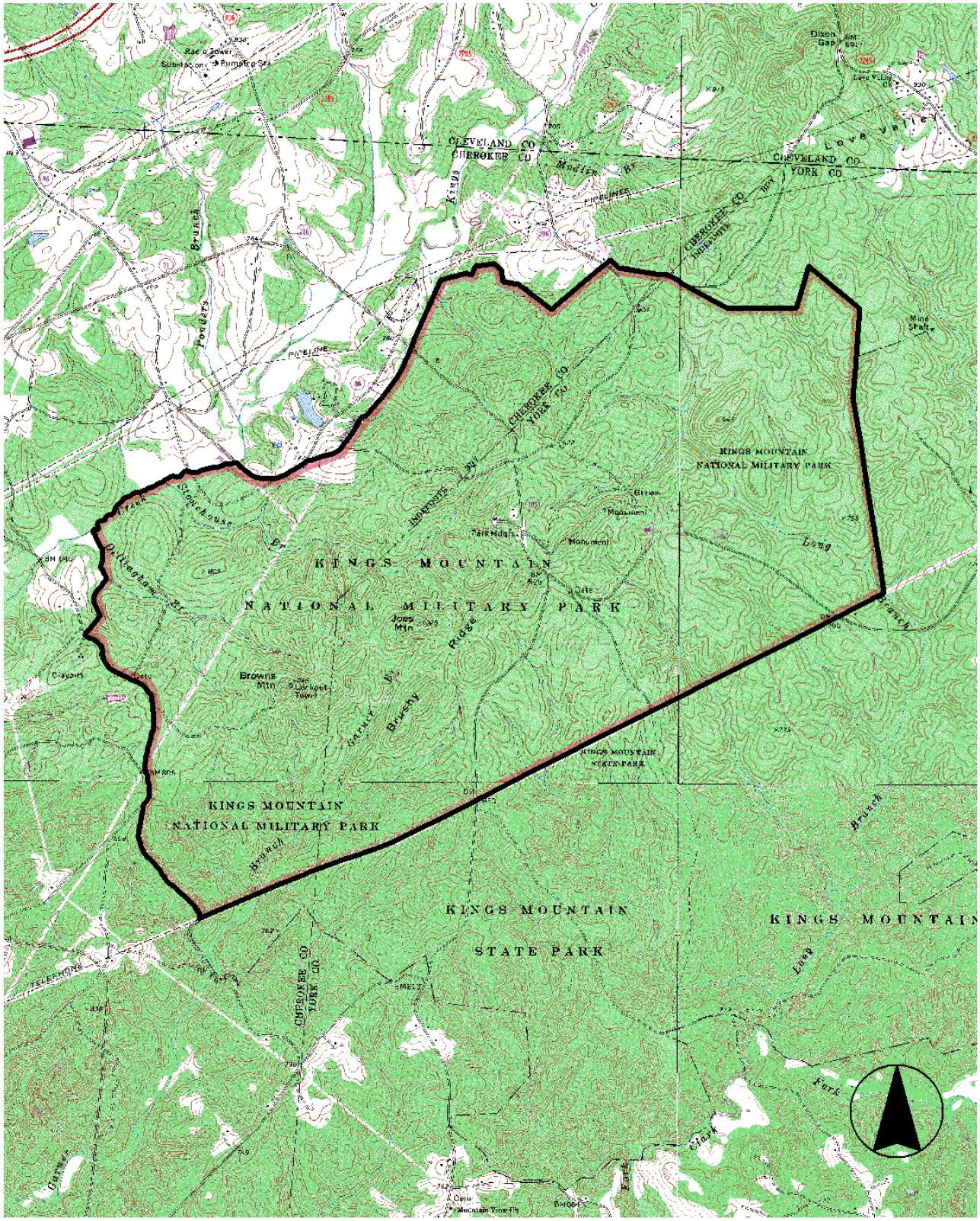


Figure 1. Location of Kings Mountain National Military Park

Once such areas were identified, procedures prescribed by the WDM (U. S. Army Corps of Engineers 1987) were employed to: 1) determine if the area was a wetland, and if so, 2) delineate the boundary of the wetland. This latter procedure involves documenting the dominant plant species and carefully examining potential indicators of soils and hydrology. The dominant plant species in all strata (i.e., tree, shrub, ground, and woody vine) were identified to species if possible using Radford et al. (1968) and Godfrey and Wooten (1979) and their indicator status (obligate, facultative wetland, etc.) was determined from Reed (1988) (Table 1). If more than 50% of the dominant species were facultative, facultative wetland, or obligate, then the site was considered dominated by hydrophytic vegetation. Soils were exposed either by digging a series of pits with a sharpshooter shovel, or pulling soil samples with a soil probe to a depth of approximately 18 inches. Color of the soil matrix (the primary color) and of the mottles (splotches of color within the matrix, if present) was described using standard Munsell color notation. Indicators of "hydric" soil listed in the WDM (U. S. Army Corps of Engineers 1987) were noted. The primary one used in this study was the presence of low matrix chromas (i.e., those < 2). This indicator develops as a result of prolonged reduction; thus it can be inferred that the site is flooded, ponded, or saturated for long periods during the growing

Table 1. Wetland indicator definitions (Reed 1988) used to determine the indicator status of plant species recorded in wetlands at Kings Mountain National Military Park.

Category	Abbreviation	Definition
Obligate Wetland	OBL	Occur almost always (estimated probability >99%) in wetlands under natural conditions
Facultative Wetland	FACW	Usually occur in wetlands (estimated probability 67-99%), but occasionally found in non-wetlands
Facultative	FAC	Equally likely to occur in wetlands or non-wetlands (estimated probability 33-66%)
Facultative Upland	FACU	Usually occur in non-wetlands (estimated probability 67-99%), but occasionally found in wetlands
Upland	UPL	Occur almost always (estimated probability >99%) in non-wetlands under natural conditions

season.

A determination of whether the site had a hydroperiod prolonged enough to be considered "wetland hydrology" was made based on field indicators described in the WDM (U. S. Army Corps of Engineers 1987). The primary indicators used in this study were the presence of standing water (i.e., inundation), soil saturation within 12 inches of the surface, and moss/lichen lines on trees. Oxidized rhizospheres that indicate prolonged saturation were found at some sites. Additional information regarding each of the indicators/parameters can be found in the WDM (U. S. Army Corps of Engineers 1987).

Once an area was determined to be a wetland, its boundaries were delineated based on the presence or absence of each of the three parameters (soils, hydrology, and vegetation). A flag or other marker was placed in the ground at the point where one or more of the parameters ceased to be present, thus denoting the edge of the wetland. Wetland size was estimated by approximating a geometric figure (square, rectangle, circle, etc.) and using a rangefinder to determine distances needed for the appropriate calculations.

Universal Transverse Mercator (UTM) coordinates for each wetland were determined using a handheld GPS receiver. Coordinates were stored in the receiver and recorded on field data sheets. After each field sampling period, the UTM coordinates were transferred to a Geographic Information System (GIS) and graphically represented using ArcView© software. By continuously updating the GIS database (and maps), areas of the Park that still needed to be searched could be identified.

Each wetland was assigned to the most detailed Cowardin and HGM classification possible. The Cowardin classification uses an alphanumeric code to denote characteristics of the wetland. The first character is an upper case letter that represents the *system*. All the wetlands at KMNMP fall within the palustrine and riverine systems that are denoted by the letter P and R respectively on NWI maps. The palustrine system includes most interior freshwater wetlands

not associated with large open water bodies. Next is a set of two upper case letters that represent the *class*. For the wetlands at KMNMP, the potential classes included: EM - emergent wetland (dominated by non-woody vegetation), SS - scrub/shrub (dominated by woody vegetation < 20 feet tall), and FO - forested (dominated by woody vegetation > 20 feet tall). The next character is a number representing the *subclass*. These modifiers provide more detail regarding the plant community and they vary with the class. In forested and scrub/shrub wetlands, the most common modifiers at KMNMP was "1" - broad leaved deciduous (those plants that lose their leaves in winter). In emergent wetlands, the two potential modifiers included "1" - persistent (species that remain standing until the next growing season) and "2" - non-persistent (species that do not remain standing until the next growing season). The next character is an upper case letter that represents the water regime (i.e., the hydroperiod). Examples of potential modifiers at KMNMP included: A - temporarily flooded (typically floods for < 2 weeks during the growing season), B - saturated (substrate saturated for most of growing season, but rarely floods), and C - seasonally flooded (typically floods for two or more weeks during the growing season). As an example, a wetland assigned a code of PSS1A is a freshwater wetland not associated with a lake or open water body that is dominated by deciduous, scrub/shrub vegetation and is inundated for less than two weeks during the growing season. A complete explanation of these notations can be found in Cowardin et al. (1979).

In the HGM system, the classes occurring at KMNMP were riverine, and slope. Further designations are not as structured as in Cowardin and vary among classes. Examples of factors that potentially could be used to assign wetlands to the more-detailed subclass level include: stream gradient (high or low) for riverine wetlands, landscape form (open or closed contours) for depressions, and primary source of hydrology (ground or surface water) for depressions. Species of vegetation usually is not considered formally when considering wetland class and subclass within the HGM system.

The initial list of potential functions/values (biotic, hydrologic, research/scientific, cultural, and economic) was reviewed to determine their applicability to the wetland types most likely to occur at KMNMP. Further, a review of HGM guidebooks, the scientific literature, and previous inventory and assessment work completed in the region was conducted to identify the physical, chemical, and biological characteristics of the wetlands responsible for the performance of the function(s). Based on this preliminary work, eight specific functions/values believed to be the most relevant at KMNMP were selected for evaluation. These included: surface water storage, groundwater discharge to streams, carbon/nutrient export, provide wildlife habitat, support wetland plants, cultural value, research/scientific value, and economic value. These functions/values along with a section in which ratings could be recorded were included on the field data form.

The functions/values of each wetland identified at KMNMP were evaluated by visually examining the characteristics of wetlands likely to be related directly to one or more functions/values. The following references provided background regarding these characteristics and recommendations on how they can be estimated: Mueller-Dombois and Ellenberg (1974) and Hays et al. (1981) for plant and habitat-related parameters; Brady and Weil (1999) for soil and soil-related parameters; and Ponce (1989) for hydrologic parameters. Examples of characteristics presumed to be related to the capacity of the wetlands to perform one or more functions include: species composition of the vegetation in the overstory, mid-story, and understory layers, diameter at breast height (DBH) of the overstory and mid-story trees, density of saplings and shrubs, size and density of logs and snags, percent cover of ground-level vegetation, and percent cover of litter. Non-vegetation characteristics included hydrology source (i.e., flooding, ponding, or saturation), timing and duration of inundation or saturation, depth to the seasonal high water table, landscape position (i.e., floodplain, seepage area at base of slope, proximity to stream or river, etc.), and soil characteristics (i.e., color, depth to redoximorphic

features, texture, presence or confining layers, etc.). Nominal ratings of high, medium, or low were used for three functions; high and low only for two functions; and yes or no for the three "values." The following sections provide a description of each function/value and an overview of the characteristics and conditions used to derive the ratings. More detail regarding the logic used to assign ratings to various wetland functions can be found in Ainslie et al. (1999), Smith and Klimas (2002), and Wilder and Roberts (2003). Wetland size is an obvious factor related to all functions or values. In many instances larger wetlands provide increased function and value over that produced by smaller wetlands. Size however is not considered directly in the HGM process. If desired, users can incorporate size into the comparison when two or more wetlands are being assessed.

Surface Water Storage

This function addresses the capacity of a wetland to store water during periods of rainfall and runoff**.** It is performed by wetlands in both the depression and riverine HGM classes, particularly those depressions directly adjacent to streams or rivers. Many benefits related to flood attenuation and the reduction of flood damage occur as a result of wetlands performing this function. For example, storage of water in wetlands can reduce the velocity of the floodwave and as a result, decrease peak discharge downstream. Similarly, this reduction in velocity can have a dramatic effect in reducing damage from erosive forces.

Wetlands at KMNMP were assigned a rating of either high or low for this function based solely on wetland type. Depressions occur in both upland and floodplain locations and vary greatly in size. Regardless of their location or size, depressions store water so they were assigned a rating of high for this function. Riverine wetlands (i.e., those on floodplains) adjacent to mid-and low-gradient streams or rivers also store water, so those in this landscape position also scored high. Other types of wetlands do not store surface water and were assigned a rating of low or not applicable (N/A) for this function.

Groundwater Discharge to Streams

This function addresses the capacity of a wetland to retain and convey subsurface water to an adjacent stream or river and is performed most commonly by wetlands in the riverine and slope HGM classes. Subsurface water stored in or moving through the wetland will be released more slowly than would surface flow. This slow release is important in maintaining water levels in the channel during periods of low rainfall, that in turn is important in developing and maintaining habitat structure and biotic diversity in stream or river systems.

Wetlands at KMNMP were assigned a rating of high or low for this function based on HGM classification and landscape position. Only wetlands in which groundwater discharge occurred adjacent to a stream or river have the opportunity to facilitate the slow release of water to maintain baseflow, so those that met this condition received a score of high. Conversely, depressions with a "perched" water table and all wetlands not adjacent to a stream or river were assigned a score of low or not applicable (N/A) for this function.

Carbon/Nutrient Export

This function addresses the capacity of a wetland to export dissolved and particulate organic carbon and other nutrients present in the wetland to down-gradient systems. Mechanisms include leaching and flushing of litter. It is performed most commonly, by wetlands in the riverine and slope HGM classes. Many benefits accrue from the performance of this function. Material exported to downstream systems is vital to supporting aquatic food webs and numerous biogeochemical processes. Dissolved organic carbon is a significant source of energy for the microorganisms that form the base of many food webs, while particulate carbon is used to support invertebrate shredders.

Wetlands at KMNMP were assigned a rating of high, medium, or low for this function based on landscape position and condition of the plant community. First, only wetlands adjacent to a conveyance, stream or river have the opportunity to export significant amounts of carbon, so

this condition had to be met before a score could be assigned. Wetlands that were not adjacent to a conveyance, stream or river were assigned a score of low for this function. Second, only wetlands with a well-developed plant community have the potential to produce substantial amounts of organic carbon and other nutrients. Assuming wetlands at KMNMP were forested historically, only wetlands in which all vegetation strata (understory, midstory, and overstory) were present received a high score for this function. Wetlands with two strata received a score of medium, while those with only one stratum received a score of low. These conditions were determined onsite, but can be approximated by the Cowardin classification. In most cases, palustrine forested (PFO) wetlands are comprised of three strata, palustrine scrub/shrub (PSS) wetlands of two strata, and palustrine emergent (PEM) wetlands of only one strata.

Provide Wildlife Habitat

This function addresses the capacity of a wetland to provide habitat for wildlife either periodically or year around. This function is somewhat unique in that wetlands in all HGM classes support various species of wildlife. The focus of this assessment was on amphibians, a group of organisms that is dependent on wetlands for completing their life cycle in that they generally must lay their eggs in water or saturated soils. Amphibians have experienced worldwide population declines that make them ideal for serving as the emphasis of this function.

Wetlands were assigned a rating of high, medium, or low for this function based on their hydrologic regime. Only wetlands with prolonged hydroperiods and containing areas of standing water for extended periods (usually two or more weeks during reproductive periods) have the potential to provide breeding habitat for amphibians; so only these wetlands could receive a high score for this function. Such wetlands often are referred to as vernal pools and typically belong to the HGM depression class; although, wetlands in other classes also may contain depressions within their boundaries. Wetlands in which only short-term ponding occurs

were assigned a score of medium. These mostly could be characterized as micro-depressions. Wetlands in which only soil saturation occurred were assigned a score of low for this function.

Support Wetland Plants

This function addresses the capacity of a wetland to support a plant community comprised primarily of species and age classes strongly associated with wetland ecosystems having little disturbance. In this study, the emphasis was placed on species found only or primarily in wetlands (i.e., the obligate and facultative wetland groups described by Reed (1988)). In addition to the inherent value of the plants themselves, the plant community in most instances is one of the major factors upon which the animal community depends. Further, the plant community is the ultimate source of primary production and as such essentially drives many of the other functions performed by wetlands such as on-site cycling of nutrient and production of material for export to other systems.

Wetlands were assigned a score for this function based on the uniqueness of the plant community present. Wetlands that were dominated by unique species, particularly those in the obligate category or those wetlands containing a rare, threatened, or endangered plant species were assigned a score of high. Wetlands that were dominated by species in the facultative wetland category were assigned a score of medium. Wetlands dominated by species in the facultative category were assigned a score of low. Sites in which exotic species were dominants were assigned a lower score than would have been received had no exotics been present.

Cultural Values

Cultural values include a broad array of concepts ranging from aesthetics to archeological significance. The values differ somewhat from those derived from the above functions, but are extremely important at a facility such as KMNMP where consideration for the experiences of the visiting public are a high priority.

Wetlands at KMNMP were assigned either a "yes" or "no" (i.e., either having or not having value) for this category. Factors that were considered were uniqueness, size (the larger the better), evidence of use by humans living in the area, and proximity to trails and roads (an important consideration for environmental education), etc. It could be argued that all wetlands have cultural significance in the form of aesthetics and potential for environmental education; but, unless a wetland "stood out" for one or more of the above reasons, it was given a rating of "no." As an example, wetlands of below average size, that had no apparent evidence of past human activity, and were not readily accessible by the public, were not considered to have cultural significance. Reasons for rating wetlands as having cultural significance were noted on the field forms. Nothing was noted for wetlands judged to lack cultural significance.

Research/Scientific Value

Research/scientific values include a broad array of concepts ranging from supporting unique species to serving as "reference" sites to promote a better understanding of ecosystems function and how they may be degraded. As with cultural considerations, these values differ somewhat from those derived from the above ecological functions.

Wetlands at KMNMP were assigned either a "yes" or "no" (i.e., either having or not having value) for this category. Factors that were considered included uniqueness, size, degree of disturbance, and presence of species of high interest. It could be argued that all wetlands have research/scientific value; but, unless a wetland "stood out" for one or more of the above reasons, it was given a rating of "no." Reasons for rating wetlands as having research/scientific value were noted on the field forms. Nothing was noted for wetlands judged to have no research/scientific potential.

Economic Values

Economic values may be derived from resources produced by or within a wetland or may be due to some function that the wetland performs. Examples of the former include timber or

fisheries production. Examples of the latter include the value of a wetland for reducing flooding downstream due to it storing water. Some wetlands are unique or otherwise of sufficient interest to serve as an attraction for park visitors.

Wetlands at KMNMP were assigned either a "yes" or "no" (i.e., either having or not having value) for this category. The two factors that were considered were the ability of the wetland to serve as a significant attraction to Park visitors (i.e., increase tourism) and the value of the wetland for reducing flood damage. Because hunting and commercial timber harvest is not allowed at this park, values associated with timber and commercial exploitation of wildlife and other natural resources were not considered. Reasons for rating wetlands as having economic value were noted on the field forms. Nothing was noted for wetlands judged to have no economic value.

RESULTS

The preliminary investigations using the NWI database yielded little information regarding wetlands at the park. Although wetlands and hydric soils were shown in the vicinity of KMNMP, none were identified within the Park's boundaries. Additionally, soil surveys did not indicate the presence of any hydric soils within the Park's boundaries. Thus, based solely on these sources, it seemed likely that KMNMP contained few if any wetlands.

The field investigation revealed however, that numerous wetlands did occur at KMNMP, and that the shortcomings of the soil survey and NWI information mentioned previously simply had not permitted them to be identified. Seventy-four wetlands totaling 4.25 acres were located within the Park boundaries (Figure 2). The average wetland size was approximately 0.06 acres with the largest being approximately 0.34 acres and the smallest approximately 0.004 acres. Most supported both woody and herbaceous vegetation. Common species included red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), American hornbeam (*Carpinus*

caroliniana), spicebush (*Lindera benzoin*), blueberry (*Vaccinium* spp.), azalea (*Rhododendron* spp.), and various sedges, and ferns.

Wetlands were found throughout the Park and occurred in a variety of landscape positions (e.g., from floodplains of streams to discharge points on steep slopes). Most were associated with stream drainages. The primary type of hydrology, even in those adjacent to streams, was

groundwater discharge; overbank flooding did not appear to be the primary source of hydrology for any wetland at KMNMP.

Within the Cowardin system, forty-six wetlands were classified as palustrine, forested, and deciduous (PFO1) with varying hydrologic regimes. Forty-two wetlands were considered temporarily flooded (PFO1A) and four was considered seasonally flooded (PFO1C). Twenty-six wetlands were considered palustrine scrub-shrub (PSS). Of these, 22 were considered to be temporarily flooded and dominated by deciduous vegetation (PSS1A), while one was considered to be seasonally flooded (PSS1C). The remaining three PSS wetlands were temporarily flooded and dominated by evergreen vegetation (PSS3A). One wetland was considered a palustrine emergent system that was temporarily flooded (PEM1A). The remaining wetland was considered a riverine system that is intermittently flooded within a streambed dominated by rubble (R4SB2).

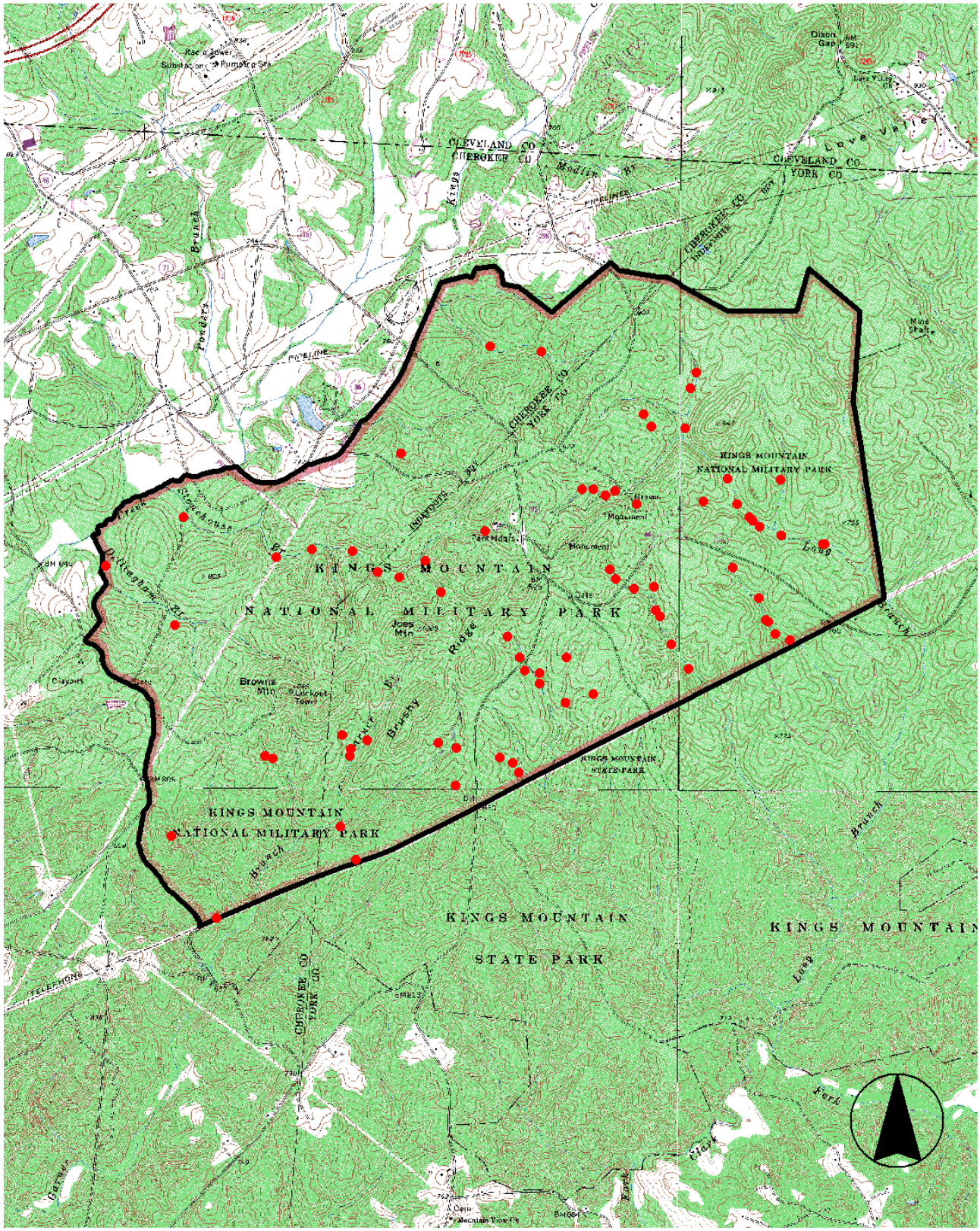


Figure 2. Wetland Locations at Kings Mountain National Military Park

Based on the HGM classification, seventy-one were classified as slope wetlands and three were classified as riverine wetlands.

The primary functions performed by wetlands at KMNMP were to maintain base flow and export carbon and nutrients to streams and rivers. These processes are critical for maintaining water levels and food webs necessary to support vertebrate and invertebrate organisms associated with such systems. Several wetlands ponded water long enough to be utilized by amphibians for breeding (e.g., W004, W046, and W071); adult amphibians or their egg masses were observed at these wetlands during field sampling. No threatened or endangered animals or plants were found, but several wetlands did support populations of obligate plant species that are seldom found in other habitats (e.g., W031 and W045).

In landscapes where surface water is not plentiful, small wetlands and headwater streams are the only habitats suitable for many such species. Some wetlands at KMNMP had the potential to store surface water; but overall, the attenuation of floods was not considered a major function. None of the wetlands had the capability to store enough water to reduce downstream flooding; and at KMNMP (as in most landscapes), it is the cumulative storage that is significant. Several wetlands were at sites of historical occupation/use and have cultural significance (e.g., W010). Several of the wetlands have potential as research areas and as reference sites. The original forest community at KMNMP has been altered and as such, none of the sites are "pristine." The hydrology and soils of most however, have not been altered substantially; thus, they are examples of wetlands in generally good condition. They should be valuable as standards of comparison in model development projects (e.g., HGM guidebooks) and examples for the restoration of more severely degraded wetlands, especially those on private lands. Several wetlands were near trails (e.g., W046, W072, and W073) and have substantial potential for environmental education.

RECOMMENDATIONS FOR FUTURE RESEARCH

Small, isolated wetlands have received little attention by researchers and managers, thus, wetlands at KMNMP should be investigated further. We observed that wetlands holding water into the growing season were commonly used as breeding habitat, but because of the nature of our survey, there was not time to document use by other vertebrate groups. Because wetlands at KMNMP exist as unique patches within a mostly upland landscape, their value as water sources for other groups of wildlife should be investigated, especially during prolonged dry periods. This could be accomplished by live-trapping, track counts, or use of remotely operated cameras.

It is possible that some wetlands at KMNMP contain rare plants or animals. This inventory will facilitate searches by botanists, herpetologists, and other researchers. If rare species are found, it would be useful to determine the role these wetlands play in maintaining their populations. Further, genetic makeup of these populations would be of interest to scientists as part of recent endeavors to understand metapopulation dynamics.

Fire historically had a significant influence on community composition of eastern forests including KMNMP, and decades of fire suppression doubtless resulted in changes to the forest communities. The return to a more frequent fire regime in recent years provides a unique opportunity for investigators to examine the role of fire and its influence on small wetland ecosystems at the park.

CONCLUSIONS

This study revealed that KMNMP contained numerous wetlands that had not been indicated by either the county soil surveys or the NWI. Most were small and were hydrologically driven by groundwater discharge. Flooding seldom occurs in these wetlands, but the soil may remain saturated for extended periods. Many supported plants found primarily in wetland habitats, and several supported breeding populations of amphibians. A common critical

function performed by many of the wetlands was to maintain stable stream levels by storing and slowing releasing water. Many also exported material such as particulate and dissolved organic carbon to downstream systems. Some had cultural significance and the potential to be used in an environmental education program. Most could serve as reference sites for scientific studies given that they have not been as severely impacted as most wetlands on private lands.

ACKNOWLEDGEMENTS

We wish to thank Dan Twyman for his assistance in the field, and Jerald Moore for developing the GIS portion of this project. Chris Revels, Shepard McAninch, and Rodney Martinez (KMNMP) provided us with valuable field and administrative assistance and made arrangements for access to all portions of the Park. We also wish to thank Teresa Liebfreid of the Cumberland Piedmont Network and Center for the Management, Utilization, and Protection of Water Resources at Tennessee Technological University for providing support and helping to administer the project.

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APPENDIX A

Wetland Photographs and Selected Data



Site ID – 1

Area (ac) – 0.310

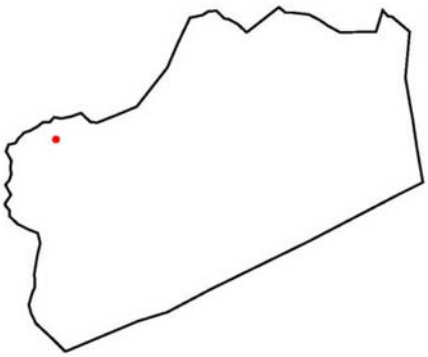
UTM – E 462356

N 3888698

Cowardin Class – PFO1C

HGM Class - Slope

Dominant Species – ***Acer rubrum, Carpinus caroliniana, Liriodendron tulipifera, Platanus occidentalis, Impatiens capensis***





Site ID – 2

Area (ac) – 0.05

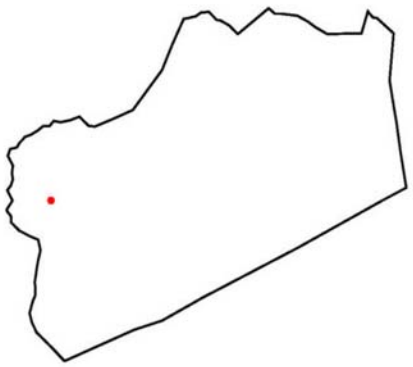
UTM – E 462291

N 3887943

Cowardin Class – PFO1C

HGM Class - Slope

Dominant Species – ***Leucothoe axillaris, Osmunda regalis,Carex sp.***





Site ID – 3

Area (ac) – 0.02

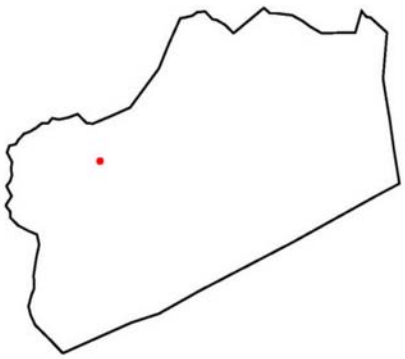
UTM – E 463013

N 3888420

Cowardin Class – PSS1C

HGM Class - Slope

Dominant Species – ***Acer rubrum, Liquidambar styraciflua, Cornus sp.***





Site ID – 4

Area (ac) – 0.04

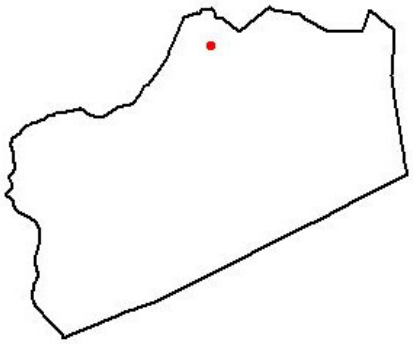
UTM – E 464522

N 3890102

Cowardin Class – PFO1A

HGM Class - Slope

Dominant Species – *Liquidambar styraciflua, Kalmia latifolia*





Site ID – 5

Area (ac) – 0.26

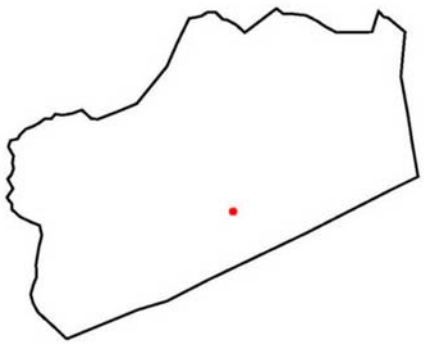
UTM – E 464764

N 3887626

Cowardin Class – PFO1A

HGM Class - Slope

Dominant Species – ***Acer rubrum, Liquidambar styraciflua, Liriodendron tulipifera, Cornus florida, Lycopodium sp.***





Site ID – 6

Area (ac) – 0.06

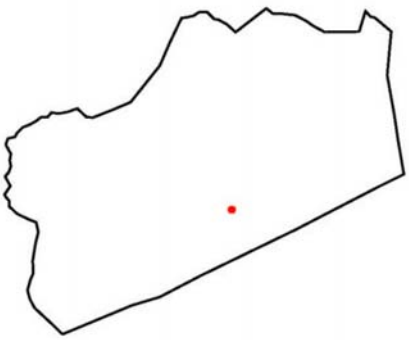
UTM – E 464870

N 3887606

Cowardin Class – PSS1A

HGM Class - Slope

Dominant Species – ***Liquidambar styraciflua, Acer rubrum, Smilax sp.***





Site ID – 7

Area (ac) – 0.004

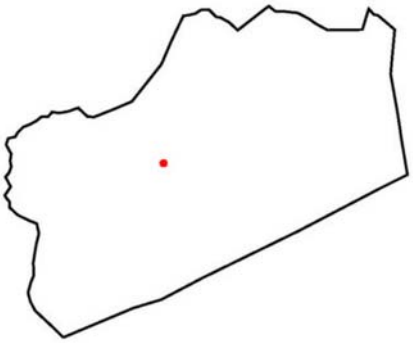
UTM – E 463885

N 3888275

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Liquidambar styraciflua, Acer rubrum, Vaccinium sp., Osmunda cinnamomea***





Site ID – 8

Area (ac) – 0.08

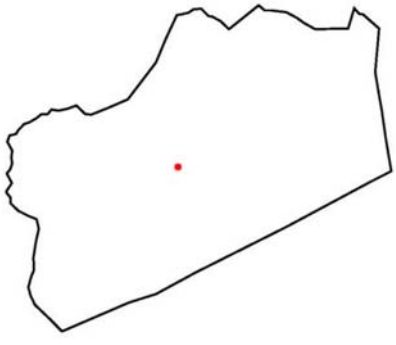
UTM – E 464179

N 3888174

Cowardin Class – PSS1A

HGM Class - Slope

Dominant Species – ***Vaccinium sp., Osmunda regalis, Thelypteris noveboracencis***





Site ID – 9

Area (ac) – 0.04

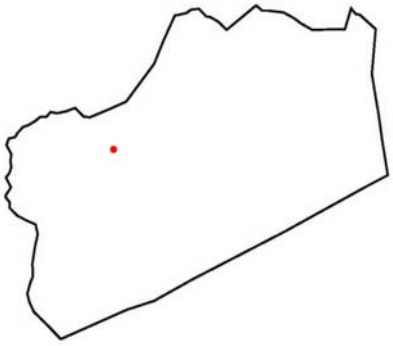
UTM – E 463260

N 3888475

Cowardin Class – PSS1A

HGM Class - Slope

Dominant Species – ***Osmunda regalis, Rhododendron periclymenoides, Acer rubrum***





Site ID – 10

Area (ac) – 0.06

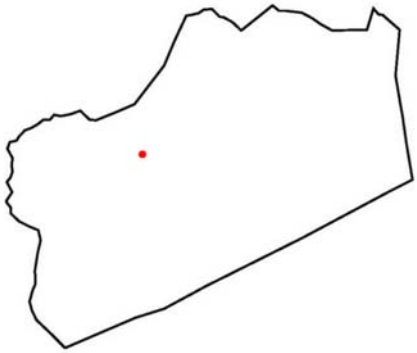
UTM – E 463554

N 3888460

Cowardin Class – PSS1A

HGM Class - Slope

Dominant Species – ***Cornus amomum, Kalmia latifolia, Xanthorhiza simplicissima, Eleocharis tenuis***





Site ID – 11

Area (ac) – 0.002

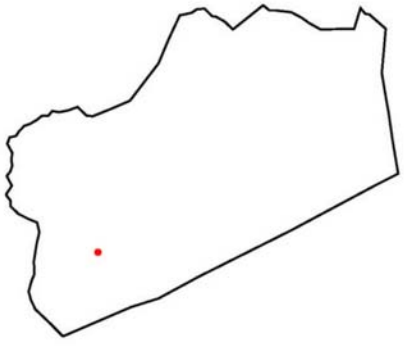
UTM – E 462986

N 3887007

Cowardin Class – PFO1A

HGM Class - Slope

Dominant Species – ***Vaccinium sp.,***
Osmunda cinnamomea, Acer rubrum





Site ID – 12

Area (ac) – 0.30

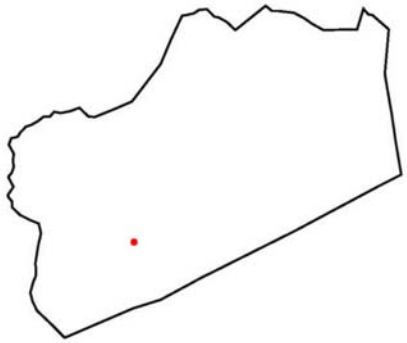
UTM – E 463475

N 3887169

Cowardin Class – PSS1A

HGM Class - Slope

Dominant Species – ***Alnus serrulata, Lindera benzoin, Vitis sp., Liquidambar styraciflua, Impatiens capensis***





Site ID – 13

Area (ac) – 0.03

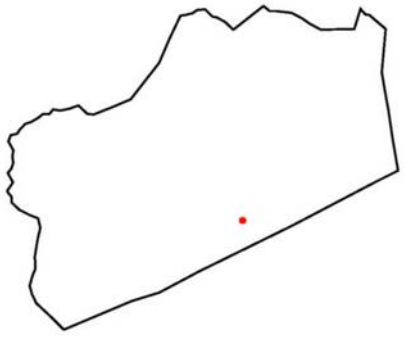
UTM – E 465058

N 3887400

Cowardin Class – PSS1A

HGM Class - Slope

Dominant Species – ***Vaccinium sp., Fraxinus pennsylvanica, Nyssa sylvatica***





Site ID – 14

Area (ac) – 0.006

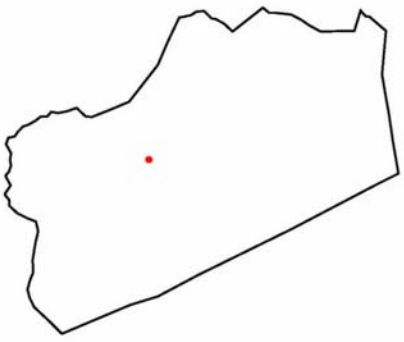
UTM – E 463728

N 3888311

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Liquidambar styraciflua, Toxicodendron radicans, Acer rubrum***





Site ID – 15

Area (ac) – 0.01

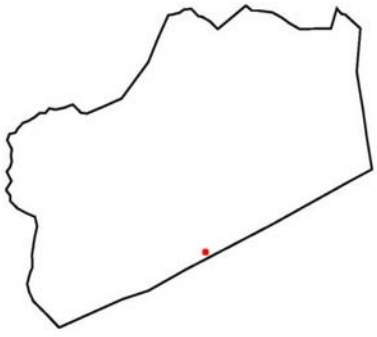
UTM – E 464722

N 3886905

Cowardin Class – PSS1A

HGM Class – Slope

Dominant Species – *Arundinaria gigantea, Acer rubrum*





Site ID – 16

Area (ac) – 0.04

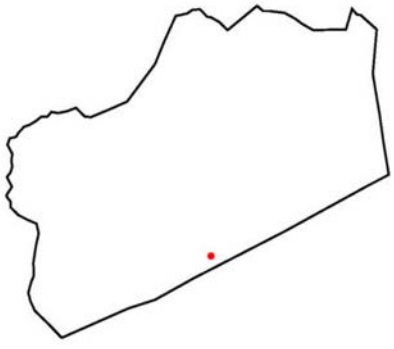
UTM – E 464679

N 3886972

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Acer rubrum, Liriodendron tulipifera, Carex sp., Eleocharis tenuis***





Site ID – 17

Area (ac) – 0.01

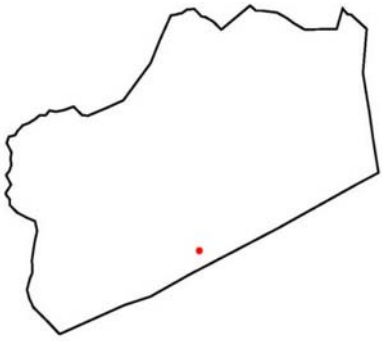
UTM – E 464591

N 3887009

Cowardin Class – PSS1A

HGM Class – Slope

Dominant Species – *Eleocharis tenuis*, *Acer rubrum*





Site ID – 18

Area (ac) – 0.07

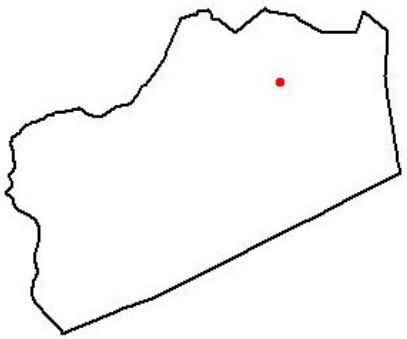
UTM – E 465606

N 3889620

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – *Chasmanthium laxum*, *Acer rubrum*, *Liquidambar styraciflua*





Site ID – 19

Area (ac) – 0.17

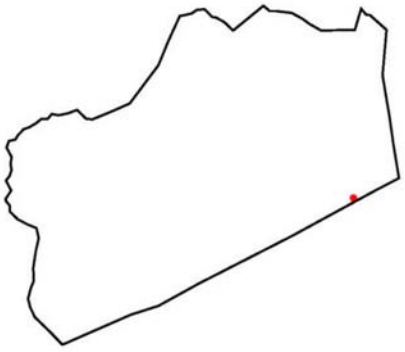
UTM – E 466644

N 3887842

Cowardin Class – PSS1A

HGM Class – Slope

Dominant Species – *Osmunda cinnamomea, Arundinaria gigantea, Acer rubrum, Ostrya virginiana*





Site ID – 20

Area (ac) – 0.06

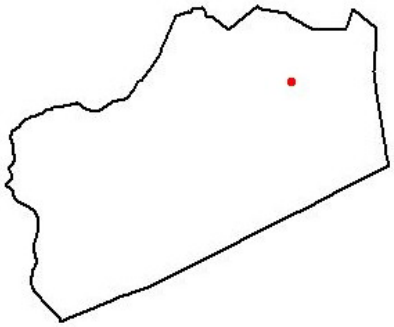
UTM – E 465904

N 3889524

Cowardin Class – PSS3A

HGM Class – Slope

Dominant Species – ***Rhododendron periclymenoides, Leucothoe axillaris*****,** ***Arundinaria gigantea***





Site ID – 21

Area (ac) – 0.04

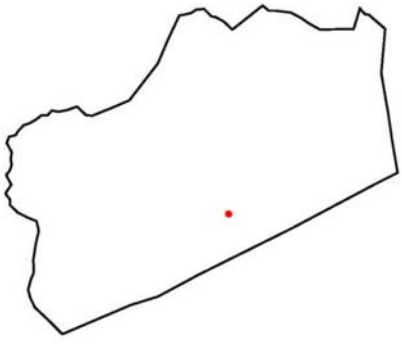
UTM – E 464869

N 3887533

Cowardin Class – PSS1A

HGM Class – Slope

Dominant Species – *Carpinus caroliniana, Acer rubrum, Liquidambar styraciflua, Eleocharis tenuis*





Site ID – 22

Area (ac) – 0.02

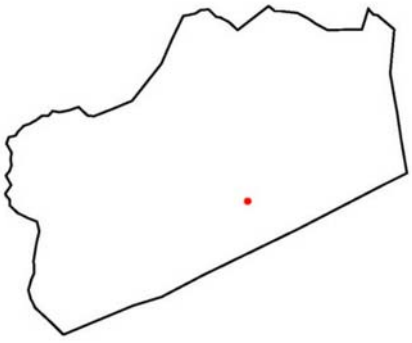
UTM – E 465064

N 3887719

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Acer rubrum, Nyssa sylvatica, Vitis sp.***





Site ID – 23

Area (ac) – 0.02

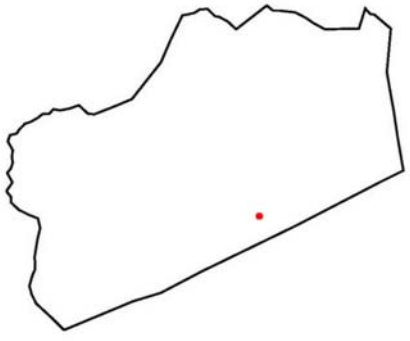
UTM – E 465253

N 3887459

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Liriodendron tulipifera, Acer rubrum, Eleocharis tenuis***





Site ID – 24

Area (ac) – 0.02

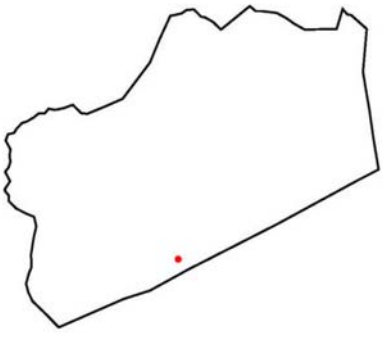
UTM – E 464280

N 3886815

Cowardin Class – PSS1A

HGM Class – Slope

Dominant Species – ***Liquidambar styraciflua, Carex sp., Rhododendron periclymenoides***





Site ID – 25

Area (ac) – 0.10

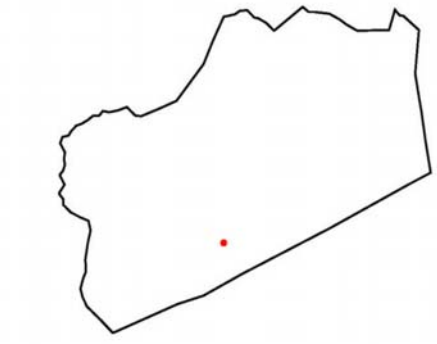
UTM – E 464161

N 3887115

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Ulmus americana, Liquidambar styraciflua, Carex sp.,***





Site ID – 26

Area (ac) – 0.04

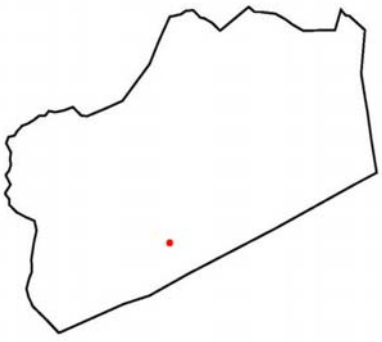
UTM – E 463575

N 3886293

Cowardin Class – PSS1A

HGM Class – Slope

Dominant Species – ***Acer rubrum, Vaccinium sp., Eleocharis tenuis***





Site ID – 27

Area (ac) – 0.002

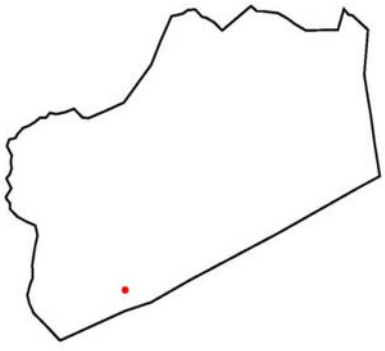
UTM – E 463463

N 3886530

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – *Leucothoe axillaris, Acer rubrum, Liquidambar styraciflua*





Site ID – 28

Area (ac) – 0.009

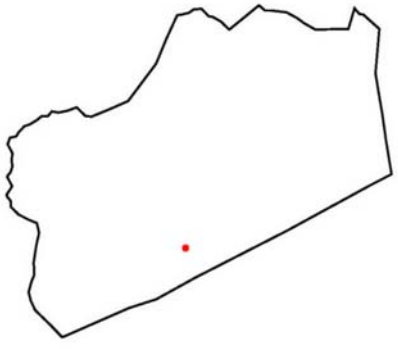
UTM – E 464286

N 3887077

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Liquidambar styraciflua, Carex sp., Acer rubrum***





Site ID – 29

Area (ac) – 0.03

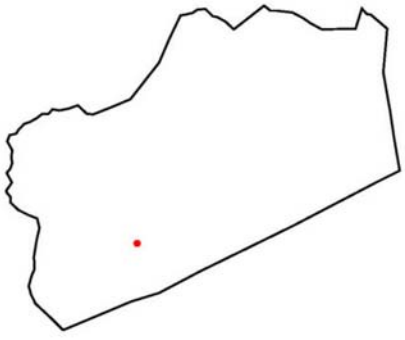
UTM – E 463541

N 3887071

Cowardin Class – PSS3A

HGM Class – Slope

Dominant Species – *Leucothoe axillaris, Acer rubrum, Osmunda cinnamomea*





Site ID – 30

Area (ac) – 0.03

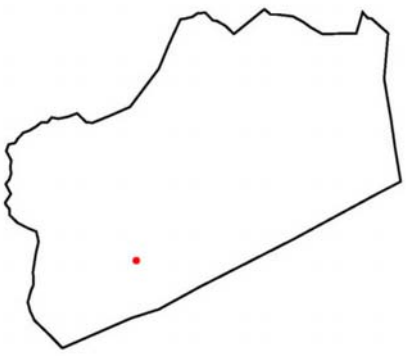
UTM – E 463535

N 3887027

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Acer rubrum, Alnus serrulata, Liquidambar styraciflua, Eleocharis tenuis***





Site ID – 31

Area (ac) – 0.07

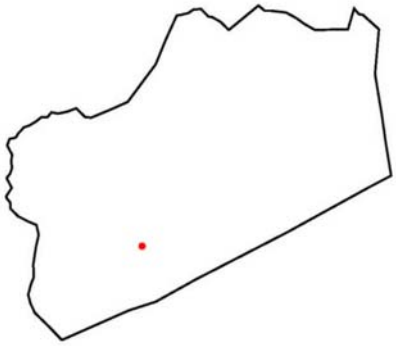
UTM – E 463656

N 3887134

Cowardin Class – PSS1A

HGM Class – Slope

Dominant Species – ***Liquidambar styraciflua, Acer rubrum, Eleocharis tenuis***





Site ID – 32

Area (ac) – 0.03

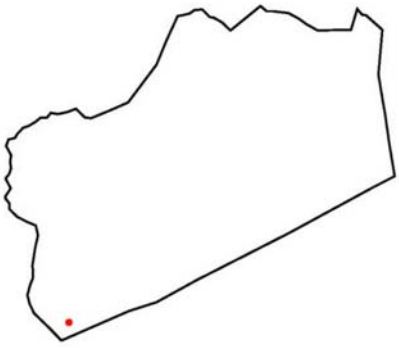
UTM – E 462590

N 3886083

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – Acer rubrum,
Alnus serrulata, Arundinaria gigantea,
Smilax sp.





Site ID – 33

Area (ac) – 0.03

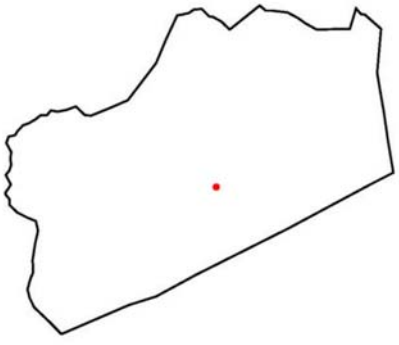
UTM – E 464728

N 3887914

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Acer rubrum, Liriodendron tulipifera, Arundinaria gigantea***





Site ID – 34

Area (ac) – 0.02

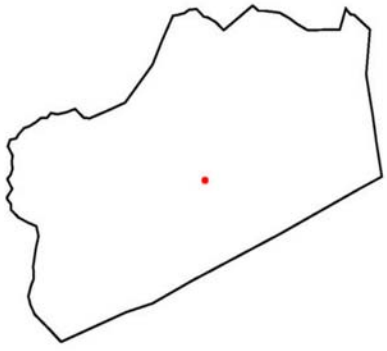
UTM – E 464644

N 3888063

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Acer rubrum, Liriodendron tulipifera, Arundinaria gigantea***





Site ID – 35

Area (ac) – 0.004

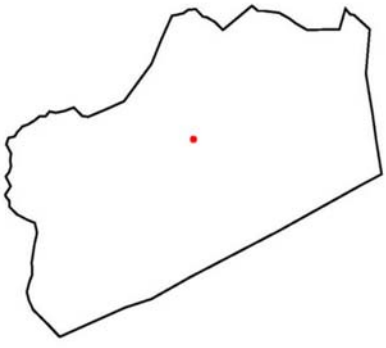
UTM – E 464483

N 3888604

Cowardin Class – PSS1A

HGM Class – Slope

Dominant Species – ***Osmunda regalis, Acer rubrum, Nyssa sylvatica, Liquidambar styraciflua***





Site ID – 36

Area (ac) – 0.01

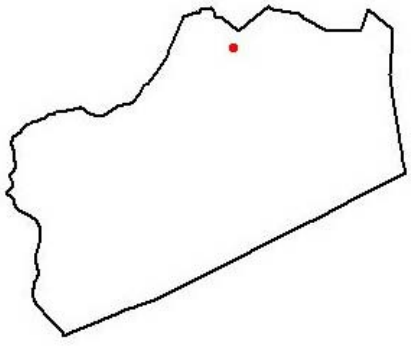
UTM – E 464882

N 3890064

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Osmunda regalis, Osmunda cinnamomea, Rhododendron periclymenoides, Ilex opaca***





Site ID – 37

Area (ac) – 0.005

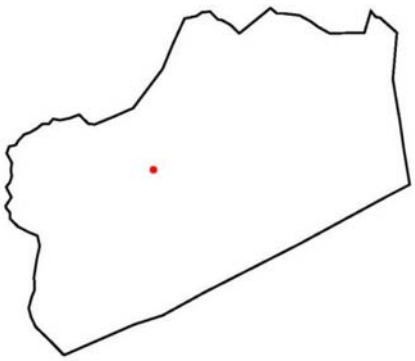
UTM – E 463728

N 3888311

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Fraxinus pennsylvanica, Ilex opaca, Osmunda regalis, Leucothoe axillaris***





Site ID – 38

Area (ac) – 0.02

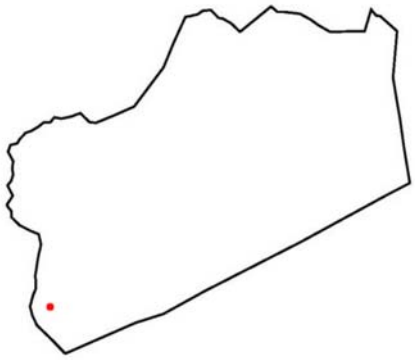
UTM – E 462271

N 3886458

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Liriodendron tulipifera, Leucothoe axillaris, Liquidambar styraciflua, Acer rubrum***





Site ID – 39

Area (ac) – 0.06

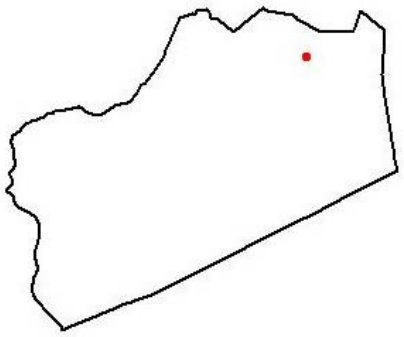
UTM – E 465984

N 3889918

Cowardin Class – PFO1C

HGM Class – Slope

Dominant Species – *Dichanthelium clandestinum, Acer rubrum, Rhododendron periclymenoides*





Site ID – 40

Area (ac) – 0.001

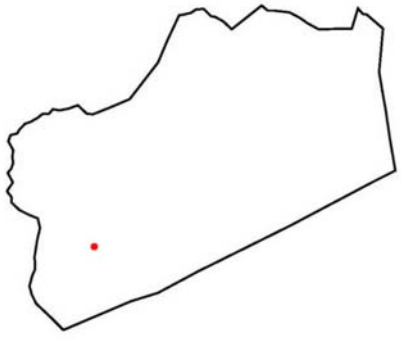
UTM – E 462930

N 3887024

Cowardin Class – PSS1A

HGM Class – Slope

Dominant Species – ***Acer rubrum, Woodwardia areolata, Quercus alba***





Site ID – 41

Area (ac) – 0.09

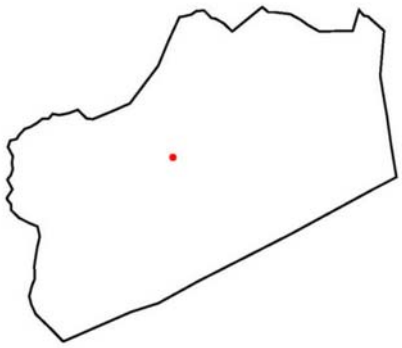
UTM – E 464068

N 3888390

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Acer rubrum, Liquidambar styraciflua, Xanthorhiza simplicissima, Eleocharis tenuis, Carex sp.***





Site ID – 42

Area (ac) – 0.01

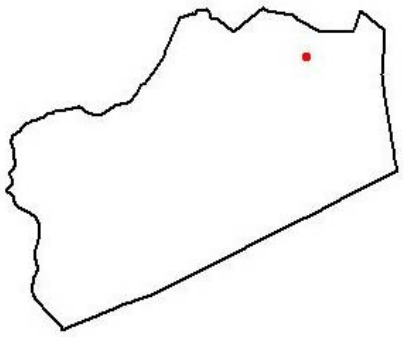
UTM – E 465984

N 3889918

Cowardin Class – PFO1C

HGM Class – Slope

Dominant Species – *Osmunda cinnamomea, Arundinaria gigantea, Acer rubrum*





Site ID – 43

Area (ac) – 0.02

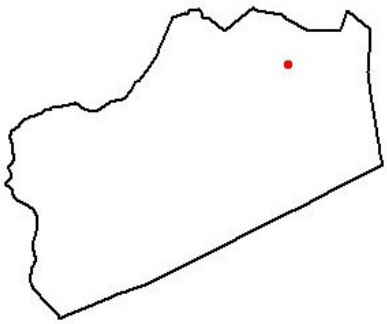
UTM – E 465942

N 3889808

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Arundinaria gigantea, Osmunda cinnamomea, Kalmia latifolia, Liquidambar styraciflua***





Site ID – 44

Area (ac) – 0.10

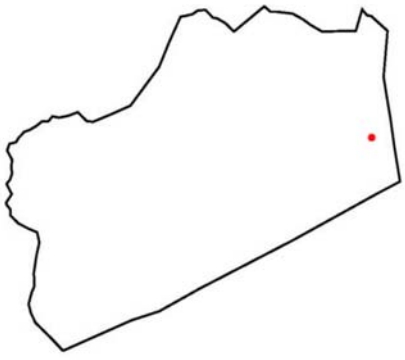
UTM – E 466892

N 3888708

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Liriodendron tulipifera, Toxicodendron radicans, Acer rubrum***





Site ID – 45

Area (ac) – 0.03

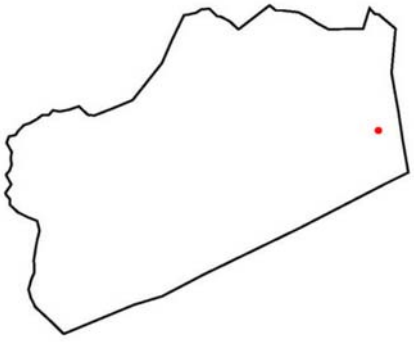
UTM – E 466878

N 3888709

Cowardin Class – R4SB2

HGM Class – Riverine

Dominant Species – ***Lobelia cardinalis, Penthorum sedoides, Xanthorhiza simplicissima***





Site ID – 46

Area (ac) – 0.33

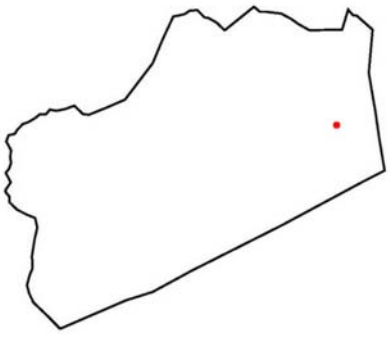
UTM – E 466584

N 3888769

Cowardin Class – PFO1A

HGM Class – Riverine

Dominant Species – ***Acer rubrum, Kalmia latifolia, Eleocharis tenuis*****,** ***Arundinaria gigantea***





Site ID – 47

Area (ac) – 0.03

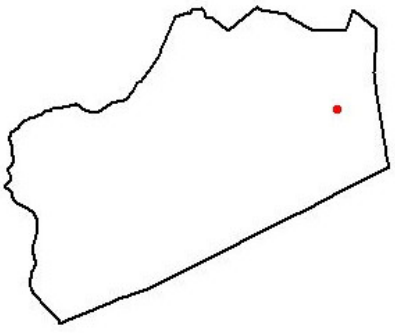
UTM – E 466575

N 3889162

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Liquidambar styraciflua, Kalmia latifolia, Campsis radicans***





Site ID – 48

Area (ac) – 0.02

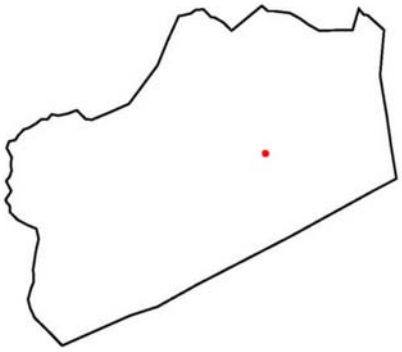
UTM – E 465411

N 3888462

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Acer rubrum, Vaccinium sp., Carex sp., Ostrya virginiana***





Site ID – 49

Area (ac) – 0.01

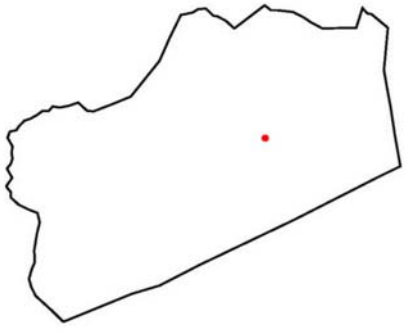
UTM – E 465366

N 3888530

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Alnus serrulata, Vaccinium sp., Kalmia latifolia, Liriodendron tulipifera***





Site ID – 50

Area (ac) – 0.006

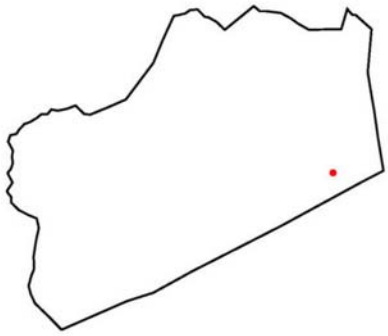
UTM – E 466543

N 3888082

Cowardin Class – PSS1A

HGM Class – Slope

Dominant Species – ***Ilex opaca, Carpinus caroliniana, Acer rubrum***





Site ID – 51

Area (ac) – 0.01

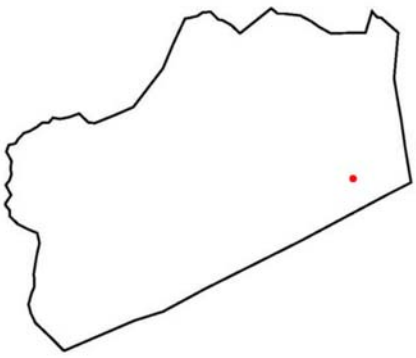
UTM – E 466492

N 3888166

Cowardin Class – PSS3A

HGM Class – Slope

Dominant Species – ***Ilex opaca, Leucothoe axillaris, Arundinaria gigantea, Eleocharis tenuis***





Site ID – 52

Area (ac) – 0.004

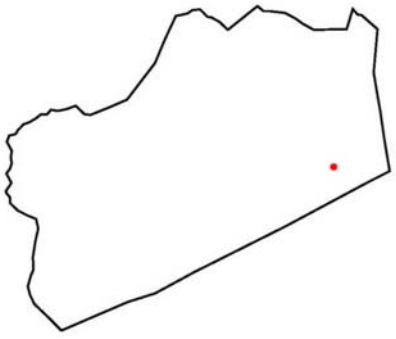
UTM – E 466476

N 3888178

Cowardin Class – PSS1A

HGM Class – Slope

Dominant Species – ***Arundinaria gigantea, Acer rubrum, Xanthorhiza simplicissima, Smilax sp.***





Site ID – 53

Area (ac) – 0.03

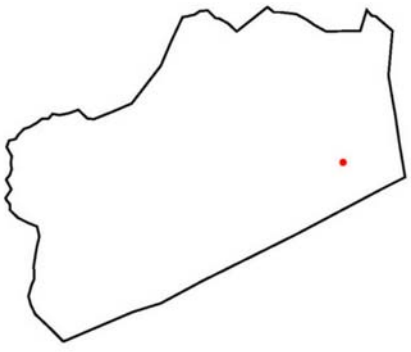
UTM – E 466423

N 3888324

Cowardin Class – PSS1A

HGM Class – Slope

Dominant Species – ***Ilex opaca, Acer rubrum, Arundinaria gigantea, Smilax sp.***





Site ID – 54

Area (ac) – 0.02

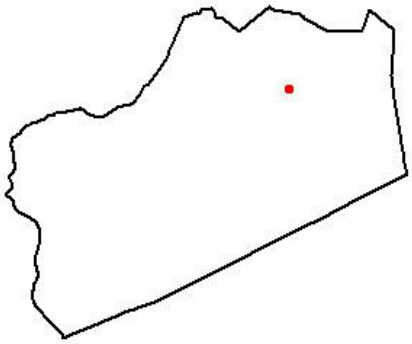
UTM – E 465665

N 3889535

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Osmunda cinnamomea, Acer rubrum, Vitis sp.***





Site ID – 55

Area (ac) – 0.007

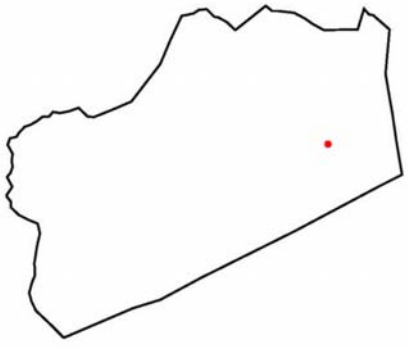
UTM – E 466243

N 3888540

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Acer rubrum, Smilax sp., Vitis sp., Eleocharis tenuis***





Site ID – 56

Area (ac) – 0.05

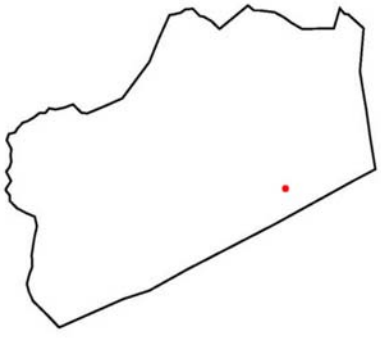
UTM – E 465929

N 3887838

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Liriodendron tulipifera, Lindera benzoin, Acer rubrum***





Site ID – 57

Area (ac) – 0.02

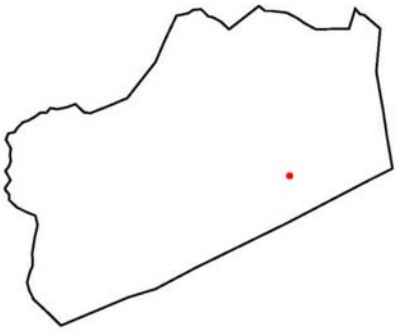
UTM – E 465804

N 3888010

Cowardin Class – PSS1A

HGM Class – Slope

Dominant Species – *Osmunda cinnamomea, Carex sp., Eleocharis tenuis* , *Ilex opaca*





Site ID – 58

Area (ac) – 0.02

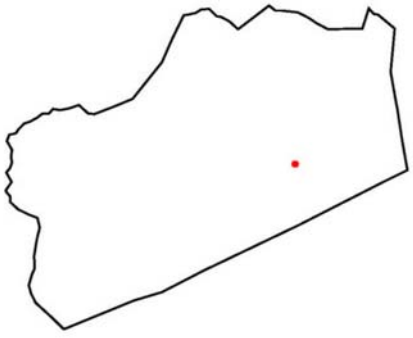
UTM – E 465724

N 3888206

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Carpinus caroliniana, Acer rubrum***





Site ID – 59

Area (ac) – 0.08

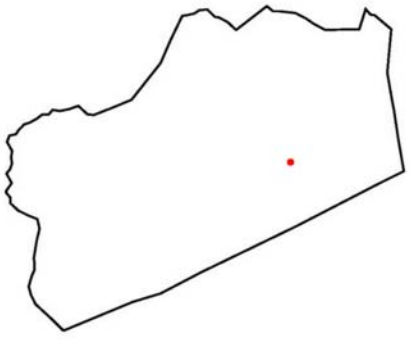
UTM – E 465693

N 3888246

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Vaccinium sp., Lindera benzoin, Liquidambar styraciflua***





Site ID – 60

Area (ac) – 0.02

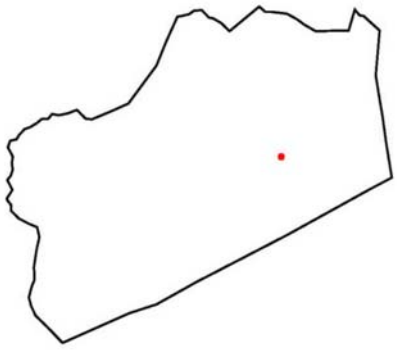
UTM – E 465680

N 3888407

Cowardin Class – PSS1A

HGM Class – Slope

Dominant Species – ***Lindera benzoin, Eleocharis tenuis, Carex sp.***





Site ID – 61

Area (ac) – 0.01

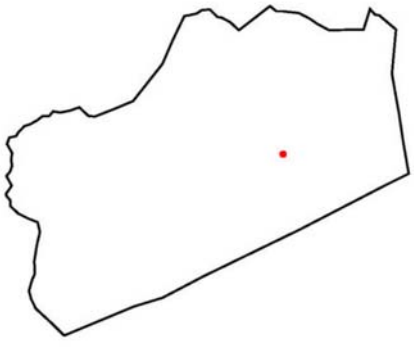
UTM – E 465540

N 3888392

Cowardin Class – PSS1A

HGM Class – Slope

Dominant Species – ***Vaccinium sp., Rhododendron periclymenoides, Polystichum acrostichoides, Arundinaria gigantea, Acer rubrum***





Site ID – 62

Area (ac) – 0.01

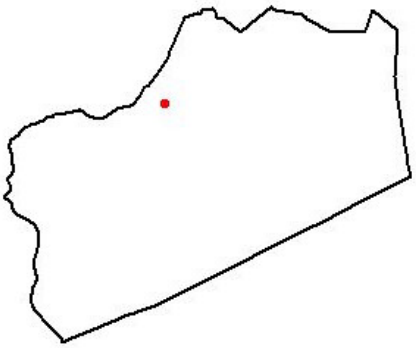
UTM – E 463896

N 3889344

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Kalmia latifolia, Liquidambar styraciflua, Chasmanthium laxum, Thelypteris noveboracensis***





Site ID – 63

Area (ac) – 0.03

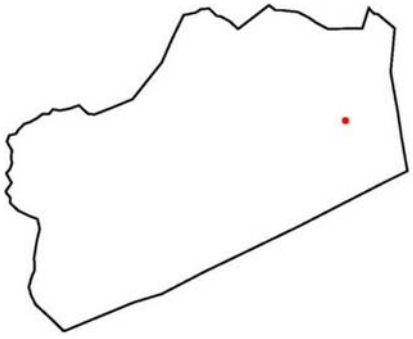
UTM – E 466429

N 3888831

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Leucothoe axillaris, Lindera benzoin, Smilax sp., Acer rubrum***





Site ID – 64

Area (ac) – 0.03

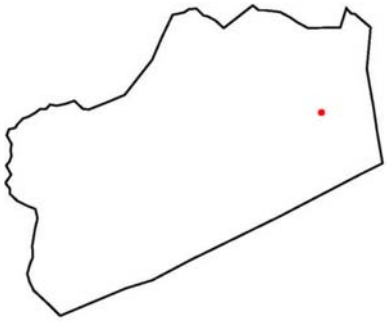
UTM – E 466384

N 3888874

Cowardin Class – PSS1A

HGM Class – Slope

Dominant Species – ***Lindera benzoin, Leucothoe axillaris, Smilax sp.***





Site ID – 65

Area (ac) – 0.07

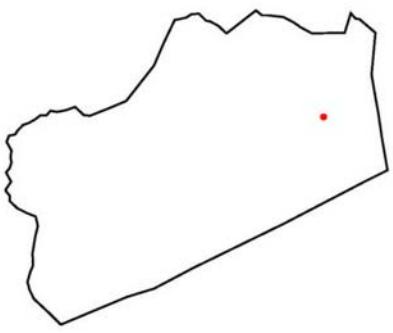
UTM – E 466355

N 3888899

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Eleocharis tenuis*****,** ***Lindera benzoin, Kalmia latifolia, Acer rubrum***





Site ID – 66

Area (ac) – 0.03

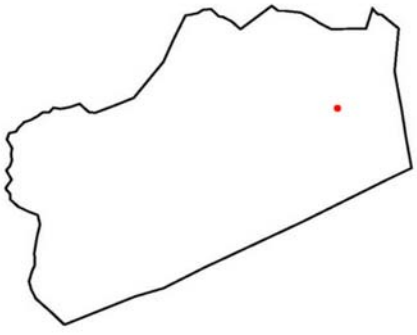
UTM – E 466270

N 3888990

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Acer rubrum, Polystichum acrostichoides, Arundinaria gigantea***





Site ID – 67

Area (ac) – 0.04

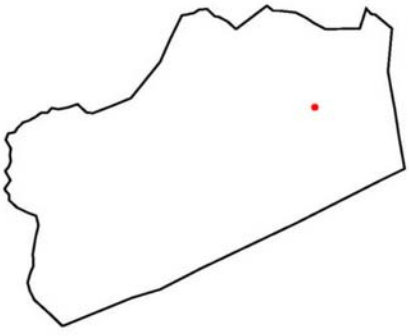
UTM – E 466033

N 3889006

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Acer rubrum, Carex sp., Arundinaria gigantea***





Site ID – 68

Area (ac) – 0.06

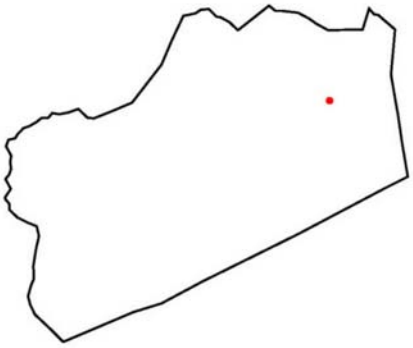
UTM – E 466203

N 3889166

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Liriodendron tulipifera, Leucothoe axillaris, Acer rubrum***





Site ID – 71

Area (ac) – 0.16

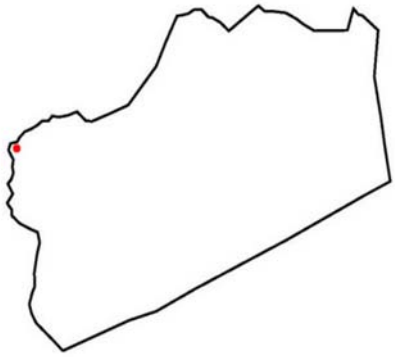
UTM – E 461804

N 3888555

Cowardin Class – PFO1A

HGM Class - Riverine

Dominant Species – ***Liriodendron tulipifera, Lindera benzoin, Toxicodendron radicans, Smilax sp.***





Site ID – 72

Area (ac) – 0.34

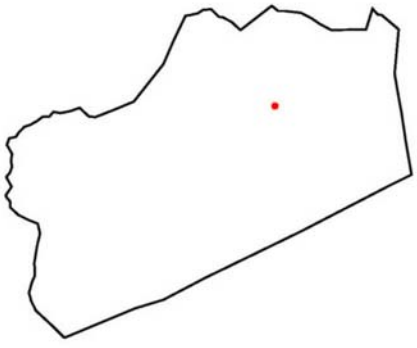
UTM – E 465403

N 3889080

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Acer rubrum, Chasmanthium latifolium, Toxicodendron radicans, Alnus serrulata, Liriodendron tulipifera, Leucothoe axillaris***





Site ID – 73

Area (ac) – 0.27

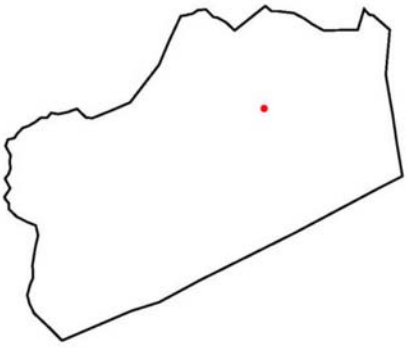
UTM – E 465341

N 3889053

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Ilex opaca, Acer rubrum, Liquidambar styraciflua, Lindera benzoin***





Site ID – 74

Area (ac) – 0.06

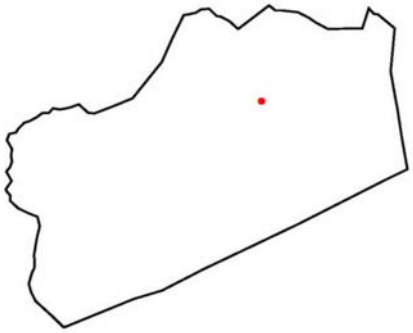
UTM – E 465253

N 3889094

Cowardin Class – PFO1A

HGM Class – Slope

Dominant Species – ***Liquidambar styraciflua, Rhododendron periclymenoides, Vaccinium sp., Kalmia latifolia***





Site ID – 75

Area (ac) – 0.02

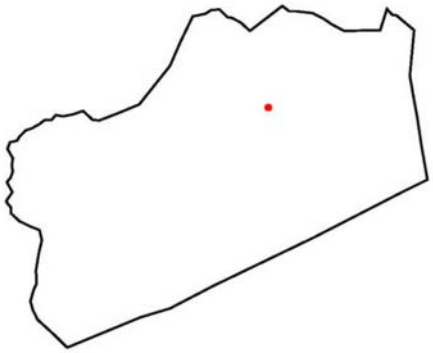
UTM – E 465560

N 3888990

Cowardin Class – PFO1A

HGM Class - Slope

Dominant Species – ***Acer rubrum, Osmunda cinnamomea, Polystichum acrostichoides, Arundinaria gigantea***





Site ID – 76

Area (ac) – 0.03

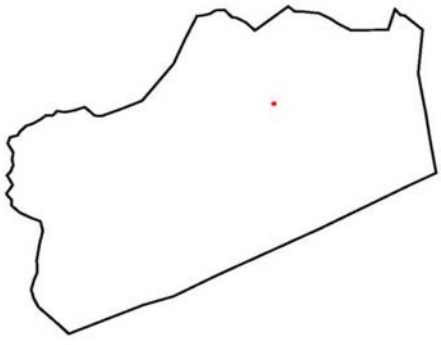
UTM – E 465171

N 3889096

Cowardin Class – PEM1A

HGM Class – Slope

Dominant Species – ***Acer rubrum, Osmunda cinnamomea, Liquidambar styraciflua***



APPENDIX B

Database Table

SITE ID	UTM EAST	UTM NORTH	ACREAGE	HGM CLASS	COWARDIN CLASS	SURFACE WATER STORAGE	GROUNDWATER DISCHARGE (to streams)	CARBON NUTRIENT EXPORT	PROVIDE WILDLIFE HABITAT	SUPPORT WETLAND PLANTS	CULTURAL VALUES	RESEARCH / SCIENTIFIC	ECONOMIC VALUES	EXOTICS PRESENT
KM1	462356	3888698	0.310	Slope	PFO1C	High	High	High	High	Medium	Yes-Herpetological Studies	Yes-Larger than average size, Herpetological Research	No	Yes - Multiflora rose, Japanese honeysuckle
KM2	462291	3887943	0.050	Slope	PFO1C	Low	High	Medium	Medium	Medium	Yes-Herpetological Studies	No	No	Yes - Japan grass
KM3	463013	3888420	0.020	Slope	PSS1C	Low	High	Medium	Low	Medium	No	No	No	No
KM4	464522	3890102	0.040	Slope	PFO1A	Low	Medium	Medium	Medium	Low	No	No	No	No
KM5	464764	3887626	0.260	Slope	PFO1A	Low	High	High	High	Medium	No	Yes-Larger than average size	No	Yes - Japanese honeysuckle
KM6	464870	3887606	0.060	Slope	PSS1A	Low	Low	Low	Medium	Medium	No	No	No	No
KM7	463885	3888275	0.004	Slope	PFO1A	Low	Low	Low	Medium	Medium	No	No	No	No
KM8	464179	3888174	0.080	Slope	PSS1A	Low	High	Medium	Low	Medium	No	No	No	No
KM9	463260	3888475	0.040	Slope	PSS1A	Low	High	Medium	Medium	Medium	No	No	No	Yes - Japanese honeysuckle
KM10	463554	3888460	0.060	Slope	PSS1A	Low	High	Medium	High	Medium	Yes-Evidence of past human activity	No	No	No
KM11	462986	3887007	0.002	Slope	PFO1A	Low	High	Medium	Low	Medium	No	No	No	No
KM12	463475	3887169	0.300	Slope	PSS1A	Low	Low	Low	Low	Medium	Yes-Evidence of past human activity	Yes-Larger than average size	No	No
KM13	465058	3887400	0.030	Slope	PSS1A	Low	High	Medium	Low	Medium	No	No	No	Yes - Japan Grass
KM14	463728	3888311	0.006	Slope	PFO1A	Low	Low	Low	Low	Medium	No	No	No	No
KM15	464722	3886905	0.010	Slope	PSS1A	Low	High	Medium	Low	Medium	No	No	No	No
KM16	464679	3886972	0.040	Slope	PFO1A	Low	Low	Low	Medium	Medium	No	No	No	No
KM17	464591	3887009	0.010	Slope	PSS1A	Low	Low	Low	Low	Medium	No	No	No	No
KM18	465606	3889620	0.070	Slope	PFO1A	Low	High	Medium	Medium	Low	No	No	No	No
KM19	466644	3887842	0.170	Slope	PSS1A	Low	High	Medium	High	Medium	No	Yes-Larger than average size	No	Yes - Multifora rose, Japanese honeysuckle
KM20	465904	3889524	0.060	Slope	PSS3A	Low	High	High	High	Medium	No	No	No	No
KM21	464869	3887533	0.040	Slope	PSS1A	Low	High	Medium	Low	Medium	No	No	No	Yes - Japan grass
KM22	465064	3887719	0.020	Slope	PFO1A	Low	High	High	Low	Medium	No	No	No	No
KM23	465253	3887459	0.020	Slope	PFO1A	Low	Low	Low	Low	Medium	No	No	No	No
KM24	464280	3886815	0.020	Slope	PSS1A	Low	High	Medium	Low	Medium	No	No	No	No
KM25	464161	3887115	0.100	Slope	PFO1A	Low	High	High	Medium	Medium	No	Yes-Larger than average size	No	No
KM26	463575	3886293	0.040	Slope	PSS1A	Low	High	Medium	Low	Medium	No	No	No	No
KM27	463463	3886530	0.002	Slope	PFO1A	Low	Low	Low	Low	Medium	No	No	No	No
KM28	464286	3887077	0.009	Slope	PFO1A	Low	High	High	Low	Medium	No	No	No	No
KM29	463541	3887071	0.030	Slope	PSS3A	Low	Low	Low	Low	Medium	No	No	No	No
KM30	463535	3887027	0.030	Slope	PFO1A	Low	High	High	Low	Medium	No	No	No	No
KM31	463656	3887134	0.070	Slope	PSS1A	Low	High	Medium	Low	Medium	No	Yes-Larger than average size	No	No
KM32	462590	3886083	0.030	Slope	PFO1A	Low	High	Medium	Medium	Medium	No	No	No	No
KM33	464728	3887914	0.030	Slope	PFO1A	Low	High	Medium	Low	Medium	No	No	No	No
KM34	464644	3888063	0.020	Slope	PFO1A	Low	High	High	Low	Medium	No	No	No	No

SITE ID	UTM EAST	UTM NORTH	ACREAGE	HGM CLASS	COWARDIN CLASS	SURFACE WATER STORAGE	GROUNDWATER DISCHARGE (to streams)	CARBON NUTRIENT EXPORT	PROVIDE WILDLIFE HABITAT	SUPPORT WETLAND PLANTS	CULTURAL VALUES	RESEARCH / SCIENTIFIC	ECONOMIC VALUES	EXOTICS PRESENT
KM35	464483	3888604	0.004	Slope	PSS1A	Low	High	Medium	Low	Medium	No	No	No	No
KM36	464882	3890064	0.010	Slope	PFO1A	Low	Low	High	High	Medium	No	No	No	No
KM37	463728	3888311	0.005	Slope	PFO1A	Low	High	Medium	Low	Medium	No	No	No	No
KM38	462271	3886458	0.020	Slope	PFO1A	Low	Low	Low	Medium	Medium	No	No	No	No
KM39	465984	3889918	0.060	Slope	PFO1C	Low	High	High	High	Medium	No	No	No	No
KM40	462930	3887024	0.001	Slope	PSS1A	Low	High	Medium	Low	Medium	No	No	No	No
KM41	464068	3888390	0.090	Slope	PFO1A	Low	High	High	Low	Medium	No	Yes-Larger than average size	No	Yes - Japan grass
KM42	465984	3889918	0.010	Slope	PFO1C	Low	High	High	High	Medium	No	No	No	No
KM43	465942	3889808	0.020	Slope	PFO1A	Low	High	High	Low	Medium	No	No	No	No
KM44	466892	3888708	0.100	Slope	PFO1A	Low	Low	Medium	Medium	Medium	No	Yes-Larger than average size	No	Yes - Japanese honeysuckle
KM45	466878	3888709	0.030	Riverine	R4SB2	Low	Low	Low	Medium	Medium	No	No	No	No
KM46	466584	3888769	0.330	Riverine	PFO1A	High	High	High	High	Medium	Yes-Adjacent to trail	Yes-Larger than average size	No	Yes - Japanese honeysuckle
KM47	466575	3889162	0.030	Slope	PFO1A	Low	High	High	Low	Low	No	No	No	No
KM48	465411	3888462	0.020	Slope	PFO1A	Low	High	Medium	Low	Medium	No	No	No	No
KM49	465366	3888530	0.010	Slope	PFO1A	Low	High	High	Low	Medium	No	No	No	Yes - Multiflora rose
KM50	466543	3888082	0.006	Slope	PSS1A	Low	High	Medium	Low	Medium	No	No	No	No
KM51	466492	3888166	0.010	Slope	PSS3A	Low	High	Medium	Low	Medium	No	No	No	No
KM52	466476	3888178	0.004	Slope	PSS1A	Low	High	Medium	Low	Medium	No	No	No	No
KM53	466423	3888324	0.030	Slope	PSS1A	Low	High	Medium	Low	Medium	No	No	No	No
KM54	465665	3889535	0.020	Slope	PFO1A	Low	High	High	Low	Low	No	No	No	No
KM55	466243	3888540	0.007	Slope	PFO1A	Low	High	Medium	Low	Medium	No	No	No	Yes - Privet
KM56	465929	3887838	0.050	Slope	PFO1A	Low	Low	Low	Low	Medium	No	No	No	No
KM57	465804	3888010	0.020	Slope	PSS1A	Low	High	Medium	Low	Medium	No	No	No	No
KM58	465724	3888206	0.020	Slope	PFO1A	Low	Low	Low	Low	Medium	No	No	No	No
KM59	465693	3888246	0.080	Slope	PFO1A	Low	Low	Low	Low	Medium	No	Yes-Larger than average size	No	No
KM60	465680	3888407	0.020	Slope	PSS1A	Low	High	Medium	Low	Medium	No	No	No	No
KM61	465540	3888392	0.010	Slope	PSS1A	Low	High	Medium	Low	Medium	No	No	No	No
KM62	463896	3889344	0.010	Slope	PFO1A	Low	High	High	High	Low	Yes-Evidence of past human activity	No	No	No
KM63	466429	3888831	0.030	Slope	PFO1A	Low	Low	Low	Low	Medium	No	No	No	No
KM64	466384	3888874	0.030	Slope	PSS1A	Low	High	Medium	Low	Medium	No	No	No	No
KM65	466355	3888899	0.070	Slope	PFO1A	Low	High	High	Low	Medium	No	Yes-Larger than average size	No	No
KM66	466270	3888990	0.030	Slope	PFO1A	Low	High	Medium	Low	Medium	No	No	No	No
KM67	466033	3889006	0.040	Slope	PFO1A	Low	Low	Low	Low	Medium	No	No	No	No
KM68	466203	3889166	0.060	Slope	PFO1A	Low	High	High	Low	Medium	No	No	No	No
KM71	461804	3888555	0.160	Riverine	PFO1A	High	High	High	High	Medium	No	Yes-Larger than average size	Yes-Cumulative flood attenuation	Yes - Privet, Japan grass, Japanese honeysuckle
KM72	465403	3889080	0.340	Slope	PFO1A	Low	High	High	Low	Medium	Yes-Adjacent to trail	Yes-Larger than average size	No	No
KM73	465341	3889053	0.270	Slope	PFO1A	Low	High	High	Low	Medium	Yes-Adjacent to trail	Yes-Larger than average size	No	Yes - Multiflora rose, Bicolor lespedeza
KM74	465253	3889094	0.060	Slope	PFO1A	Low	High	High	Low	Medium	Yes-Adjacent to trail	No	No	No
KM75	465560	3888990	0.020	Slope	PFO1A	Low	Low	Low	Low	Medium	Yes-Adjacent to trail	No	No	Yes - Japan grass
KM76	465171	3889096	0.030	Slope	PEM1A	Low	High	High	Low	Medium	Yes-Adjacent to trail	No	No	No

APPENDIX C

List of Plant Species and Indicator Status

Scientific Name	Common Name	Indicator Status
Acer rubrum	Red Maple	FAC
Alnus serrulata	Brook-Side Alder	FACW+
Arisaema triphyllum	Jack-in-the-Pulpit	FACW-
Arundinaria gigantea	Giant Cane	FACW
Asimina triloba	Pawpaw	FAC
Boehmeria cylindrica	Smallspike False Nettle	FACW
Campsis radicans	Trumpet Creeper	FAC
Carex sp.	Sedge	Unknown
Carpinus caroliniana	American Hornbeam	FAC
Chasmanthium latifolium	Indian Sea-Oats	FAC-
Chasmanthium laxum	Slender Woodoats	FACW-
Cornus amomum	Silky Dogwood	FACW
Dichanthelium clandestinum	Deer-Tongue Panic Grass	FACW
Eleocharis obtusa	Blunt spikerush	OBL
Erythronium sp.	Trout Lily	Unknown
Fagus grandifolia	American Beech	FACU
Fraxinus pennsylvanica	Green Ash	FACW
Hexastylis sp.	Heartleaf	Unknown
Ilex opaca	American Holly	FAC-
Impatiens capensis	Spotted Touch-Me-Not	FACW
Kalmia latifolia	Mountain Laurel	FAC
Leucothoe axillaris	Coastal Dog Hobble	FACW
Lindera benzoin	Northern Spicebush	FACW
Liquadambar styraciflua	Sweet Gum	FAC
Liriodendron tulipifera	Tulip Poplar	FAC
Lobelia cardinalis	Cardinal Flower	FACW+
Lonicera japonica	Japanese Honeysuckle	FAC-
Microstegium vimineum	Japan Grass	Unknown
Mitchella repens	Partridge Berry	FACU+
Nyssa sylvatica	Black Gum	FAC
Osmunda cinnamomea	Cinnamon Fern	FACW
Osmunda regalis	Royal Fern	OBL
Penthorum sedoides	Ditch Stonecrop	OBL
Platanus occidentalis	Sycamore	FAC
Polygonatum biflorum	Small Solomon's Seal	FAC-
Polygonum pensylvanicum	Smartweed	FACW
Polystichum acrostichoides	Christmas Fern	FAC
Quercus alba	White Oak	FACU
Rhododendron periclymenoides	Pink Azalia	FAC
Rumex crispus	Dock	FAC
Smilax rotundifolia	Greenbrier	FAC
Sphagnum sp.	Sphagnum	Unknown
Thelypteris noveboracencis	New York Fern	FAC
Toxicodendron radicans	Poison Ivy	FAC
Ulmus americana	American Elm	FACW
Vaccinium sp.	Unknown	Unknown
Verbena noveboracensis	New York Ironweed	FAC+
Viola sp.	Violet	Unknown
Vitis. sp.	Grape	FAC
Woodwardia areolata	Netted Chain Fern	OBL
Xanthohriza simplicissima	Yellowroot	FACW-

APPENDIX D

Data Forms