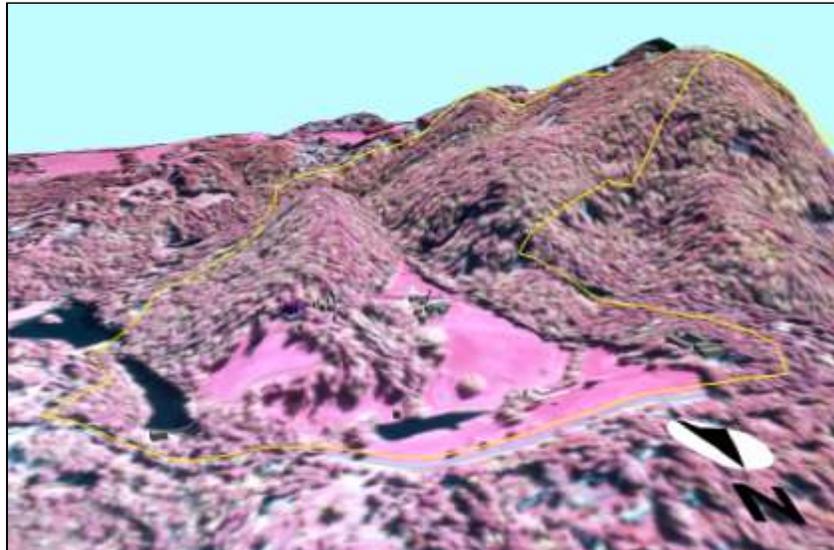




Digital Vegetation Maps for the NPS Cumberland-Piedmont I&M Network

Final Report November 1, 2010

Natural Resource Technical Report NPS/CUPN/NRTR—2010/406



ON THE COVER

Perspective view of Carl Sandburg Home created from a USGS
DEM and color orthophoto produced by the Center for Remote Sensing and
Mapping Science, UGA.

Produced by: John Dolesal

Digital Vegetation Maps for the NPS Cumberland-Piedmont I&M Network

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November 2010

U.S. Department of the Interior
National Park Service
Natural Resource Program Center
Fort Collins, Colorado

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Summary

This report describes the vegetation mapping procedures employed by the Center for Remote Sensing and Mapping Science (CRMS), Department of Geography, University of Georgia. This report describes the procedures and results of the vegetation mapping activities undertaken by the CRMS under Cooperative Agreements No. H5028 01 0651, entitled, "Digital Vegetation Databases and Maps for National Park Service Units in the Appalachian Highlands and Cumberland/Piedmont Networks" and No. H 5000-03-5040, Task No. J2-113-05-5004, entitled "Vegetation Databases, Orthoimages and Buffer-Area Land Cover in Four National Park Units of the Cumberland/Piedmont Network." The fourteen parks included in this report range in size from 50 to 20392 hectares (122 to 50390 acres) and include Abraham Lincoln NHS, Carl Sandburg Home NHS, Cowpens NB, Cumberland Gap NHP, Fort Donelson NB, Guilford Courthouse NMP, Little River Canyon NPRES, Ninety Six NHS, Stones River NB, Chickamauga and Chattanooga NMP, Kings Mountain NMP, Mammoth Cave NP, Russell Cave NM, and Shiloh NMP.

Using the National Vegetation Classification System (NVCS) developed by NatureServe, with additional classes and modifiers, overstory vegetation communities for each park were interpreted from stereo color infrared aerial photographs using manual interpretation methods. Using a minimum mapping unit of 0.5 hectares (MMU = 0.5 ha), polygons representing areas of relatively uniform vegetation were delineated and annotated on clear plastic overlays registered to the aerial photographs. Polygons were labeled according to the dominant vegetation community. Where the polygons were not uniform, second and third vegetation classes were added. Further, a number of modifier codes were employed to indicate important aspects of the polygon that could be interpreted from the photograph (for example, burn condition).

The polygons on the plastic overlays were then corrected using photogrammetric procedures and converted to vector format for use in creating a geographic information system (GIS) database for each park. In addition, high resolution color orthophotographs were created from the original aerial photographs for use in the GIS. Upon completion of the GIS database (including vegetation, orthophotos and updated roads and hydrology layers), both hardcopy and softcopy maps were produced for delivery.

Metadata for each database includes a description of the vegetation classification system used for each park, summary statistics and documentation of the sources, procedures and spatial accuracies of the data. At the time of this writing, an accuracy assessment of the vegetation mapping has not been performed for most of these parks. Thus, those procedures and results are not included in this report.

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Digital Vegetation Maps for the CUPN Network

Introduction:

As part of the USGS/BRD-NPS Vegetation Mapping Program, the Center for Remote Sensing and Mapping Science (CRMS), Department of Geography, University of Georgia, was requested to provide detailed vegetation maps of a number of national park units in the Cumberland Piedmont Inventory and Monitoring Network (CUPN) of the National Park Service. This report describes the procedures and results of the vegetation mapping activities undertaken by the CRMS under Cooperative Agreements No. H5028 01 0651, entitled, "Digital Vegetation Databases and Maps for National Park Service Units in the Appalachian Highlands and Cumberland/Piedmont Networks" and No. H 5000-03-5040, Task No. J2-113-05-5004, entitled "Vegetation Databases, Orthoimages and Buffer-Area Land Cover in Four National Park Units of the Cumberland/Piedmont Network."

The fourteen parks included in this report range in size from 50 to 20392 hectares (122 to 51341 acres) and include Abraham Lincoln NHS, Carl Sandburg Home NHS, Cowpens NB, Cumberland Gap NHP, Fort Donelson NB, Guilford Courthouse NMP, Little River Canyon NPRES, Ninety Six NHS, Stones River NB, Chickamauga and Chattanooga NMP, Kings Mountain NMP, Mammoth Cave NP, Russell Cave NM, and Shiloh NMP. Using the National Vegetation Classification System (NVCS) developed by NatureServe, with additional classes and modifiers, overstory vegetation communities for each park were interpreted from large-scale stereo color infrared aerial photographs using manual interpretation methods. Using a minimum mapping unit of 0.5 hectares (MMU = 0.5 ha), polygons representing areas of relatively uniform vegetation were delineated and annotated on clear plastic overlays registered to the aerial photographs. Polygons were labeled with CEGL codes according to the dominant vegetation community. Where the polygons were not uniform, second and third vegetation classes were added. Further, a number of modifier codes were employed to indicate important aspects of the polygon that could be interpreted from the photograph (for example, burn condition).

The polygons on the plastic overlays were then corrected using photogrammetric procedures and converted to vector format for use in creating a geographic information system (GIS) database for each park. In addition, high resolution color orthophotographs were created from the original aerial photographs for use in the GIS. Upon completion of the GIS database (including vegetation, orthophotos and updated roads and hydrology layers), both hardcopy and softcopy maps were produced for delivery.

Metadata for each database includes a description of the vegetation classification system used for each park, summary statistics and documentation of the sources, procedures and spatial accuracies of the data. At the time of this writing, an accuracy assessment of the vegetation mapping has not been performed for most of these parks. Thus, those procedures and results are not included in this report.

The Center for Remote Sensing and Mapping Science (CRMS), Department of Geography at The University of Georgia, (www.crms.uga.edu) has been involved in vegetation mapping and database development in national parks of the southeastern U.S. for the past 10 years (Welch et al. 1995, 1999, 2002a, 2002b; Welch and Remillard 1996). As a remote sensing and mapping facility, the CRMS is unique in its combination of expertise in

Digital Vegetation Maps for the CUPN Network

both technical and biological aspects of vegetation mapping projects. Scientists at the CRMS specialize in image processing, photogrammetry, GIS, air photo interpretation and field surveying, as well as botany, biology and ecology. This allows a close link between the two major components of a vegetation mapping/database project: 1) photogrammetric rectification and GIS database construction; and 2) vegetation interpretation, classification and field verification.

In addition to in-house cross training of technical and biological skills, the CRMS has developed a strong working relationship with NatureServe, a non-profit conservation organization that developed the U.S. National Vegetation Classification System (NVCS) and is a primary partner in the USGS-NPS Vegetation Mapping Program (www.natureserve.org). Collaboration between the CRMS and the NatureServe-Durham, North Carolina Office has resulted in the development of a detailed classification system for southeastern park lands that maximizes the information on vegetation communities that can be gleaned from large-scale color infrared aerial photographs, while remaining compatible with the U.S. National Vegetation Classification System (Anderson et al. 1998, Jackson et al. 2002).

Objectives

The objectives of this report are to:

1. describe the mapping procedures employed to map the vegetation communities of the parks in the NPS Cumberland Piedmont I&M Network (CUPN) ;
2. demonstrate how digital photogrammetry, photointerpretation, GIS and Global Positioning Systems (GPS)-assisted field techniques were refined, adapted and integrated to permit the construction of geocoded vegetation databases from large-scale aerial photographs;
3. discuss the NVCS in general and its adaptation for use in the Cumberland Piedmont parks; and
4. provide classification systems, summary statistics and vegetation maps for each park.

Digital data in the form of ArcGIS geodatabases, shapefiles, orthophotos and metadata are provided on the accompanying DVDs. Most of the techniques described below were first developed and refined during the mapping of Great Smoky Mountains National Park, which is considered to be one of the most difficult terrain areas to map in the United States (Jordan, 2002; Welch et al., 2004).

Study Area

The Cumberland-Piedmont Network (CUPN) encompasses 14 national parks with diverse cultural and natural resources distributed across seven states and six different physiographic regions in the southeastern United States. This report summarizes the

vegetation mapping work for those parks which include historic sites, battlefields, military parks and recreation areas in North Carolina, South Carolina, Alabama, Tennessee and Kentucky. The following parks are included in this report: Abraham Lincoln NHS (ABLI), Carl Sandburg Home NHS (CARL), Cowpens NB (COWP), Cumberland Gap NHP (CUGA), Fort Donelson NB (FODO), Guilford Courthouse NMP (GUCO), Little River Canyon NPRES (LIRI), Ninety Six NHS (NISI), Stones River NB (STRI), Chickamauga and Chattanooga NMP (CHCH), Kings Mountain NMP (KIMO), Mammoth Cave NP (MACA), Russell Cave NM (RUCA), and Shiloh NMP (SHIL) (Figure 1).

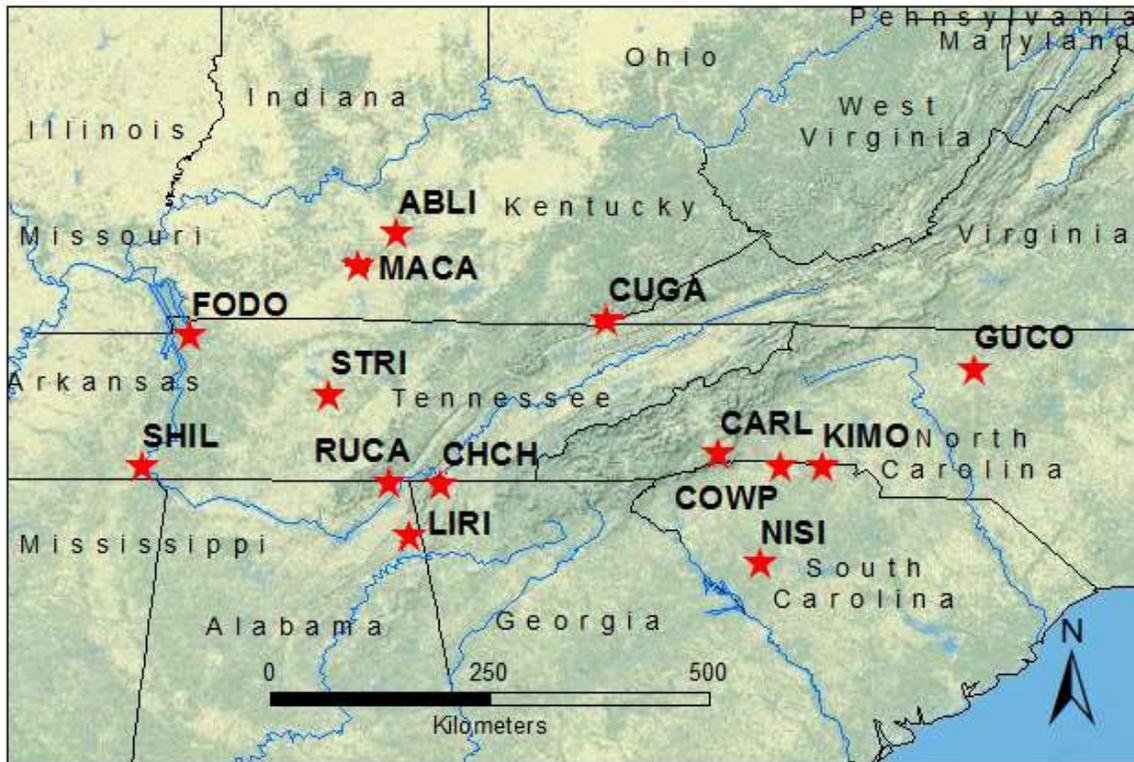


Figure 1: Location map for the Cumberland Piedmont (CUPN) I&M parks.

Requirements

The primary requirement for the project was to produce a vegetation database and associated maps in vector format that contained polygons for overstory plant communities plotted to within approximately ± 5 to 10 m of their true ground locations. Overstory vegetation was mapped using color infrared aerial photographs of 1:12,000 and 1:16,000 scale in film transparency format recorded with a standard photogrammetric mapping camera ($f = 15$ cm) in late October and early-November by the U. S. Forest Service and Air Photographics (Martinsville, WV). The fall photos were acquired when the leaves were still on the trees (leaf-on) and displayed a color diversity that allowed the vegetation communities/species to be identified (Table 1, Figure 2). Relief displacements were a major consideration in the mountainous areas and required photogrammetric correction methods in order to ensure geometric accuracy (Jordan, 2004). Using ground control obtained from USGS Digital Orthophoto Quarter-Quads (DOQQ) and the National

Digital Vegetation Maps for the CUPN Network

Elevation Dataset (NED), polygons were plotted to within approximately ± 5 m of their true ground locations, thus meeting National Map Accuracy Standards for 1:15,000 scale maps.

Table 1: CUPN Parks, photo acquisition dates and scales and park sizes.

PARK	Park Name	Photo date(s)	photo scale	Area (ac)
CHCH	Chickamauga and Chattanooga NMP; Lookout Mountain; Moccasin Bend and Reservations	10/30/2001	1:12,000	5,534; 3,353; 70
KIMO	Kings Mountain NMP	10/24/2000	1:12,000	3,955
MACA	Mammoth Cave NP	11/08/2001	1:16,000	51,341
RUCA	Russell Cave NM	10/25/2001	1:12,000	317
SHIL	Shiloh NMP	10/25/2001	1:12,000	3,960
CARL	Carl Sandburg Home NHS	10/24/00; 11/2/02	1:12,000	260
GUCO	Guilford Courthouse NMP	10/20/2000	1:12,000	203
CUGA	Cumberland Gap NHP	11/2/2002	1:16,000	20061
LIRI	Little River Canyon NPRES	10/31/2001	1:12,000	13698
NISI	Ninety Six NHS	10/24/2000	1:12,000	948
STRI	Stones River NB	10/25/2001	1:12,000	654
ABLI	Abraham Lincoln NHS (Boyhood Home)	11/2/2002	1:12,000	264
ABLI	Abraham Lincoln NHS (Birthplace)	11/2/2002	1:12,000	122
COWP	Cowpens NB	11/2/2002	1:12,000	839
FODO	Fort Donelson NB	11/2/2002	1:12,000	518

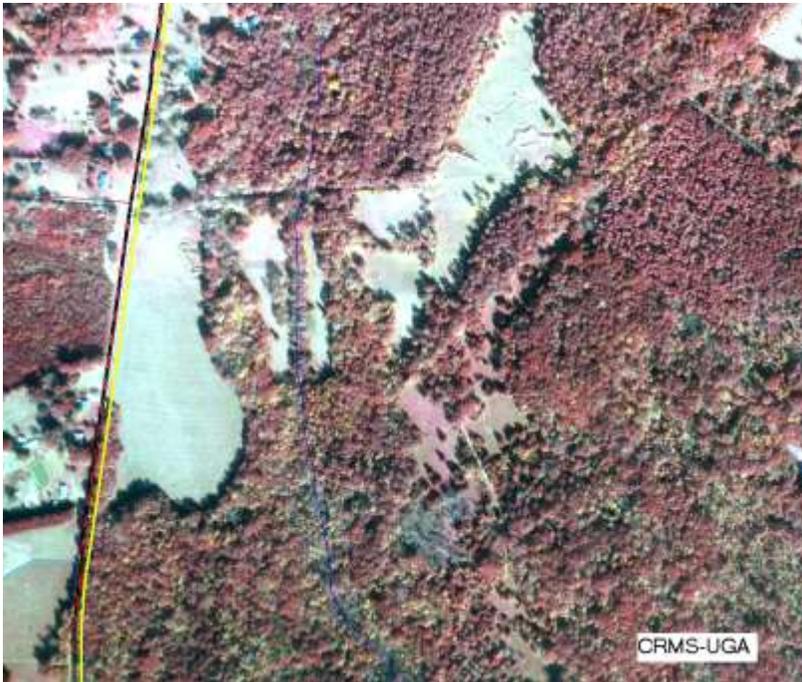


Figure 2: A portion of a color infrared aerial photograph of the Ninety Six NHS recorded in October 2002 and used for photo interpretation of vegetation detail.

Digital Vegetation Maps for the CUPN Network

In general, the mapping tasks are divided into four major categories of operations:

1. Collection and integration of collateral datasets;
2. Photogrammetry, which includes the initial scanning and orthorectifying of the CIR photographs and subsequent rectification of the interpreted overlays;
3. Photointerpretation and ground truthing, which includes delineation and attribution of polygons representing vegetation classes on aerial photographs; and
4. Geographic information systems (GIS), which includes converting the photointerpretation to vectors, editing and attributing the vegetation polygons and creating the final GIS database and hardcopy maps.

Final products include the following:

1. Overstory vegetation maps in digital format attributed according to the National Vegetation Classification System (NVCS);
2. Generalized vegetation classes for a buffer area extending 400 m outside of the park boundary;
3. Digital orthophotos created from the CIR aerial photographs;
4. Updated roads and hydrology line work within park boundaries;
5. Hard and softcopy maps of the final databases; and
6. Metadata for the vegetation maps.

As most national parks are located in natural areas with typically dense forest cover, steep slopes, absence of ground control and high relief, the construction of a vegetation database accurate in both the spatial and thematic context necessitated a combination of softcopy photogrammetry, manual photo interpretation and GIS procedures organized in parallel as shown in Figure 3. These are discussed below.

Collateral Datasets

A base GIS dataset was compiled for each park that consisted of a combination of publicly available data layers (<http://seamless.usgs.gov>) and those provided by the park resource managers. Basic layers included existing roads and trails, hydrology, boundaries, digital raster graphics (DRGs), digital orthophoto quarter quads (DOQQs), digital elevation models (DEMs), and any available additional ancillary data layers, such as geology, soils, and historical vegetation maps. All data layers were cast on the Universal Transverse Mercator (UTM) coordinate system, North American Datum of 1983 (NAD83), in the UTM majority zone for the park location (Table 2).

Digital Vegetation Maps for the CUPN Network

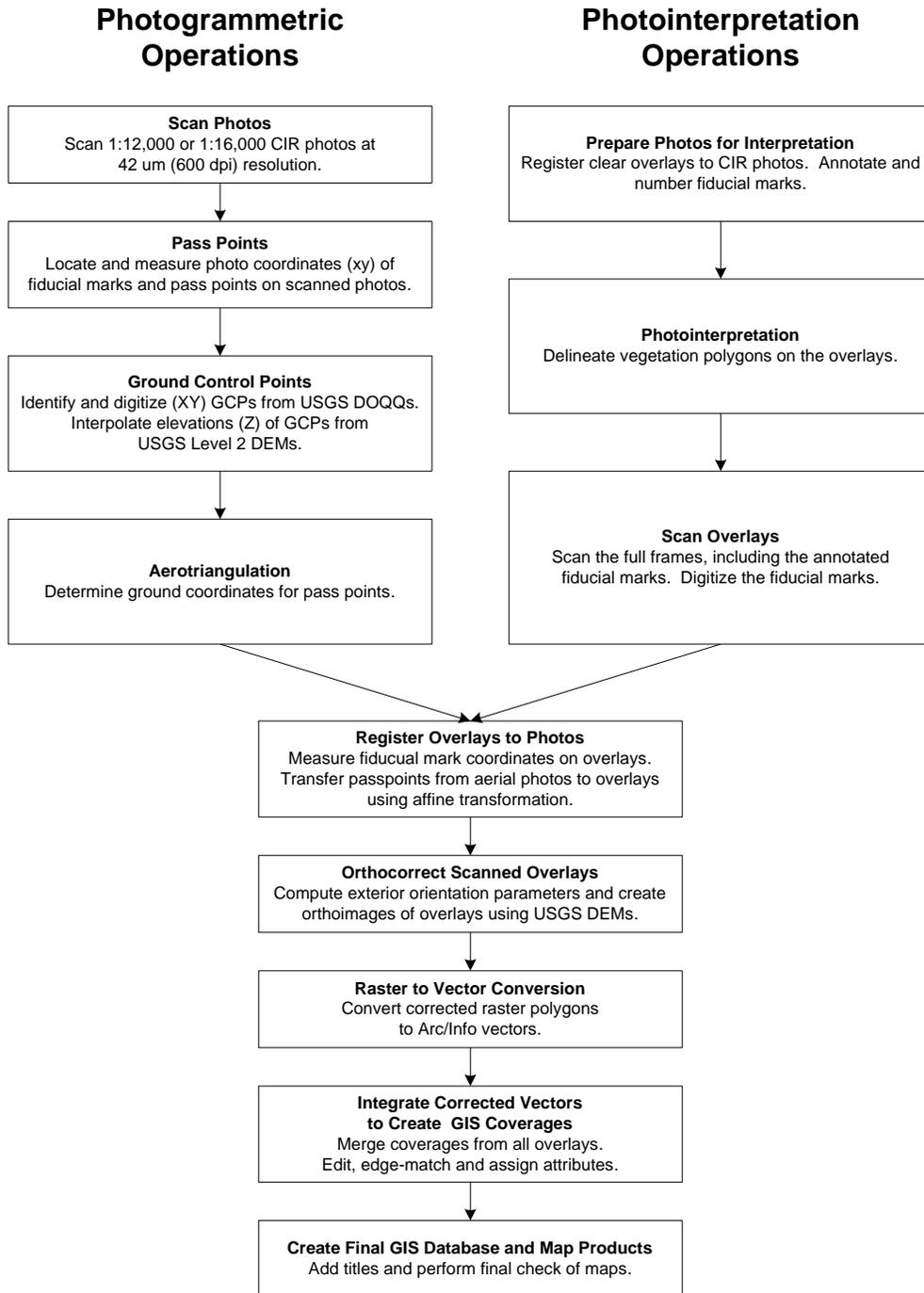


Figure 3: Diagram showing photogrammetric, photo interpretation and GIS operations used to map the vegetation of GRSM.

Digital Vegetation Maps for the CUPN Network

Table 2: Specifications of data sources available for map/database development of the Cumberland-Piedmont Network parks vegetation databases.

Data Source	Format and Type of Data	Flying Height (FH) and/or Scale	Resolution	Comments
Color infrared (CIR) Air Photos October/ November 2002	23 x 23 cm Analog film transparencies	FH = 1800 m 1:12,000 FH = 2400 m 1:16,000	~ 0.4 m 0.67 m	Fall leaf-on conditions are ideal for mapping overstory forest communities.
USGS Digital Raster Graphics Topographic Maps	Digital scanned topo maps	1:24,000	2.33 m	Last updated 1970's. A good base map but missing some more recent cultural features.
USGS DOQQs Pan (1993) and CIR (1999)	Digital Orthophotos	FH = 6000 m 1:40,000	1 m	USGS DOQQs have a planimetric accuracy of approximately ± 3 m RMS. Winter photographs.
USGS Level 2 DEMs	Digital Elevation Models	1:24,000	30 m post spacing	USGS Level 2 DEMs have a vertical accuracy of approximately $\pm 3-5$ m RMS.
USGS DLG Census TIGER Line Files National Hydrology Dataset (NHD)	Digital vector data (shape files) roads, trails, hydrology, boundaries	1:24,000	N/A	We used the best vector datasets available. Usually provided by the parks or retrieved from the USGS Seamless database.

Photogrammetric Operations

The main objective of the photogrammetric procedure was to create a set of color infrared orthophotos from the same aerial photographs that were being used for the vegetation mapping. To accomplish this, we first had to densify the sparse ground control in the Park by means of aerotriangulation, a photogrammetric operation whereby a relatively small number of ground control points (GCPs) are used to mathematically compute the ground coordinates of a much larger number of identified pass points (Jordan, 2002). In this way, an adequate control network is generated for the orthophoto rectification process. These control points were also used to rectify the interpretation overlays.

Scanning

The CIR aerial photographs in transparency format were scanned at 600 dpi (42 μ m) using an Epson Expression 10000XL flatbed scanner. This scanner is capable of scanning materials up to 11x17" in size at optical resolutions up to 1200 dpi and is equipped with a backlight attachment for scanning transparent materials. The 600 dpi scanning resolution was selected to balance the resolution requirements for the orthophotos with data storage and processing considerations. The photographs were laid on the scanning surface and, to reduce distortions, a heavy piece of clear glass was placed on top to ensure flatness of the film during scanning. Each photo was then scanned using Adobe Photoshop and saved as a 24-bit color TIFF file. During scanning, care was taken to scan the full frame of the photograph, including the corner fiducial marks and marginal data. File names for the scanned photographs were assigned according to the flight line and frame number. For example, photo 13 from flight line 2 was named 2-13.tif. Photos from each park were stored in separate folders on the CRMS Data server. All photos from each flight line were scanned. For original photos of 1:12,000 and 1:16,000 scales, the resulting pixel sizes were approximately 0.5 m and 0.67 m, respectively. After the photos were scanned, the original film transparencies were turned over to the photointerpreters while the photogrammetric operations continued using the digital data.

Ground Control and Pass Point Measurement

These digital photos were then displayed on the computer monitor and with the aid of the *R-WEL, Inc.* Desktop Mapping System (DMS) software package, the image (x,y) coordinates of pass points and GCPs were measured in the softcopy (computer, heads-up digitizing) environment. This was a painstaking and time-consuming task. Pass points per photo were selected and measured on adjacent photographs. In some parks, there were enough cultural features so that features such as driveways, road intersections, parking lots, or sidewalks could be used as pass points. In other cases, it was necessary to use hay bales, bare spots in a field, creeks, rocks or trees as pass points (Figure 4).

Digital Vegetation Maps for the CUPN Network

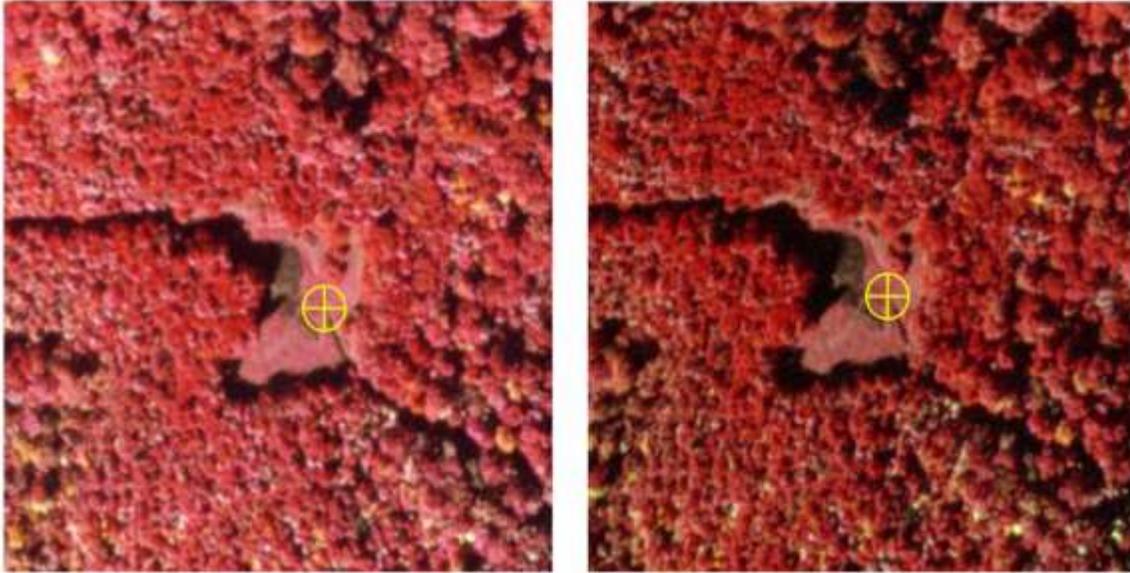


Figure 4: Well-defined natural and manmade features were used as pass points in overlapping images (yellow cross in circle symbols in the photos above). At least nine pass points per photo were identified with six being in the stereo overlap area between adjacent photos.

Ground control points were, for the most part, well-defined man-made and natural features (e.g., road intersections, parking lots, rock outcrops and forks in stream channels) identified on both the scanned color infrared transparencies and USGS Digital Orthophoto Quarter Quads (DOQQs) produced from 1:40,000-scale panchromatic or color infrared (CIR) aerial photographs recorded in 1993 or 1998. The Universal Transverse Mercator (UTM) grid coordinates (X,Y tied to the North American Datum of 1983 or NAD 83) of these GCPs were measured directly from the DOQQs (accurate to within ± 3 m). Elevations for the GCPs were derived using CRMS custom software to interpolate the Z-coordinates to within ± 3 to ± 5 m from USGS Level 2 Digital Elevation Models (DEMs) with 30-m post spacing (Figure 5). Thus, in this project, no ground survey work was required (or performed) to obtain the GCPs needed as a framework for the aerotriangulation process.

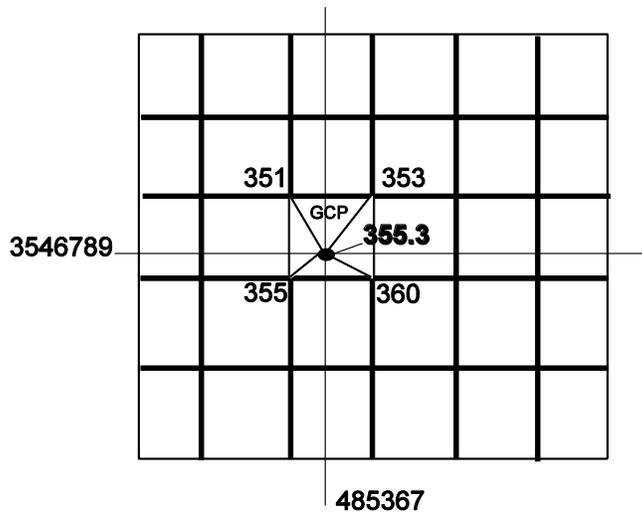


Figure 5: The elevations of ground control points (GCPs) were determined from the 30-m digital elevation model (DEM) using a bilinear interpolation algorithm.

Aerotriangulation

Analytical aerotriangulation was undertaken on a flight line by flight line basis and then all of the flightlines for a park were merged for the final run. The Aerosys software package, in conjunction with the DMS software, was employed for the aerotriangulation process. Output from the aerotriangulation was a set of X, Y and Z coordinates in the UTM coordinate system for the nine or more pass points identified by CRMS personnel on each photo. Typical root-mean-square error (RMSE) values for these coordinates averaged ± 5 m for the XY vectors and ± 6 m for elevations (Z).

Nine pass points per are measured and transferred to adjacent photos in the flight line. In addition, a number of ground control points are measured on the DOQQ and each photo (Figure 6). In the aerotriangulation process, the individual photos are joined numerically, related to the ground coordinate system using the GCPs and then the ground coordinates of the pass points are calculated. This dense network of GCPs can then be used to orient and orthorectify the CIR aerial photographs and to generate orthophotomosaics (Figure 7). After the orthophotomosaic is generated, the seamlines between adjacent photos are examined for misalignment. Terrain features that are well aligned between individual photographs indicate a good overall solution. The orthophotos and mosaics, in turn, are employed as a base reference layer in the editing and attributing operations required to build the vector database.

A critical use of the aerotriangulated GCPs is in the rectification of the vector overlays generated as part of the photointerpretation procedure described below. A well-aligned orthophoto mosaic provides the geometry and foundation necessary for the rectified vegetation linework of individual photographs to be edgematched correctly during the editing process.

Digital Vegetation Maps for the CUPN Network

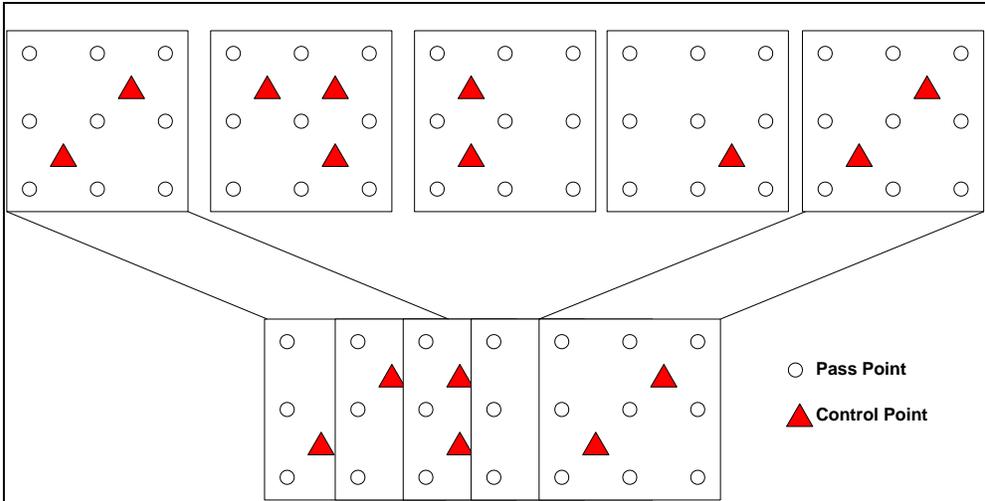


Figure 6: Nine pass points per photo and additional GCPs are measured and transferred to adjacent photos in the flight line.



Figure 7: A mosaic of orthorectified 1:12,000-scale photographs of Font Donelson was created for quality assurance and checking and to provide an image backdrop for the GIS database.

Photointerpretation and Ground Truthing Operations

The steps of the photointerpretation process listed in Figure 3 proceeded in parallel with the photogrammetric operations. Overstory vegetation was interpreted from the 1:12,000 to 1:16,000 scale leaf-on color infrared aerial photographs in 9 x 9 inch film transparency format.

Although it might appear desirable to scan the color infrared transparencies at high resolution and undertake the vegetation classification as an on-screen interpretation and digitizing procedure, this has proved to be exceedingly time consuming, cumbersome and expensive compared to more traditional approaches (Welch et al. 1995 and 1999; Rutchey and Vilchek 1999). More importantly, photointerpreters must view the vegetation and the terrain in stereo and in color within the context of a relatively large area of the landscape in order to identify the vegetation communities. This is most easily done using a stereoscope to view the analog air photos so that the vegetation patterns can be assessed in relation to the terrain. Recognizing the need to augment manual procedures with automated techniques, the steps described below integrate conventional photointerpretation procedures with digital processing technology in an attempt to streamline the database and map compilation process.

At the beginning of each individual park's mapping project, the photointerpreters, in conjunction with NatureServe and NPS plant specialists and resource managers, conducted field investigations to collect data on the vegetation communities and correlate signatures evident on the aerial photographs with ground observations. Photointerpreters learned about management concerns and impacts to the vegetation communities and their distributions such as damage by exotic insects, fire, wind, excessive park use, etc. Information on land use history before and after the creation of the park and invasive plant species also was critical to understanding past, present and future vegetation conditions.

The vegetation in some parks, especially the small battlefields, is highly managed to maintain the landscape and landuse/land cover of the time period for which the park was designated. All of these factors must be taken into consideration during the photointerpretation process to ensure a meaningful vegetation classification system is used for each park and to accurately identify and portray the vegetation communities. Depending on the size of the park, an initial reconnaissance field visit would be conducted for 2 to 5 days and include visits to representative habitats, rare and important communities and managed, disturbed or invaded areas, as well as revisits to plots previously surveyed by NatureServe. Additional field visits were conducted during the interpretation process to verify initial interpretations, identify communities with unusual signatures and answer any questions. A final field visit was usually conducted after the interpretation was complete and the vegetation database/maps were produced as a quality control check before the more rigorous accuracy assessments by NPS and NatureServe.

Field sampling consisted of field data collection at numerous points along and off trails within the parks that were representative of both typical vegetation communities and unique or highly damaged areas (Figure 8). . Methods and information collected resembled NatureServe's "Quick Plot" surveys For an area approximately 15 to 20 m

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around each point, the percent cover of dominant overstory and understory species was recorded, along with any additional overstory/understory species identified and characteristics of the herb layer such as rich, sparse, dominant species, etc. Site conditions were noted by recording relative slope, aspect and canopy openness. Notes on presence of exotics, evidence of past or present human influence (e.g., agriculture, grazing, logging, mowing, exotic vegetation removal, old homesites), damage by insects, wild hogs, blow down or fire also were recorded. Each point was geolocated by marking a waypoint with a Global Positioning System (GPS) handheld receiver such as a Garmin V or Garmin Geko. These units are Wide Area Augmentation System (WAAS)-enabled and typical horizontal positional accuracies were +/- 3 to 5 m. The Estimated Positional Error (EPE) was noted for each field waypoint collected, especially when error approached or exceeded +/- 10 m. The elevation of each field waypoint also was recorded, albeit vertical accuracy is generally more than two times lower than horizontal accuracy. As a back-up to the use of GPS for geolocation, field crews also carried paper field maps with the UTM grid coordinates, elevations, roads and rivers superimposed on an image background, usually a USGS DOQQ (Figure 9). The maps were useful in planning the field route, marking notes and augmenting the GPS digital display.

At each field point, the primary association type was determined based on NatureServe definitions of associations in the National Vegetation Classification System (NVCS) used in the USGS/NPS National Vegetation Mapping Program (i.e., NVCS Community Element Global (CEGL) code numbers) (Anderson et al. 1998, Grossman et al. 1998 and 1994). Since CRMS interpreters were usually accompanied by NatureServe botanists to assist with species identification and coordinate classification, interpretation and accuracy assessment efforts, CRMS and NatureServe personnel would discuss and agree on the association designation before moving on. If the field point was located in a mixed area indicative of an ecotone or an area of successional recovery, both the dominant and secondary (and sometimes tertiary) associations also were determined. If there was no good match to an NVCS CEGL, careful notes were taken to allow later assignment of the appropriate CEGL or CRMS-created class (e.g., a managed, damaged, human influence or successional class).

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Figure 8: Conducting a field survey of the vegetation at Ninety Six NHS prior to beginning detailed photo interpretation. During this field survey, the vegetation communities are explored to correlate the community with its appearance on the aerial photograph.

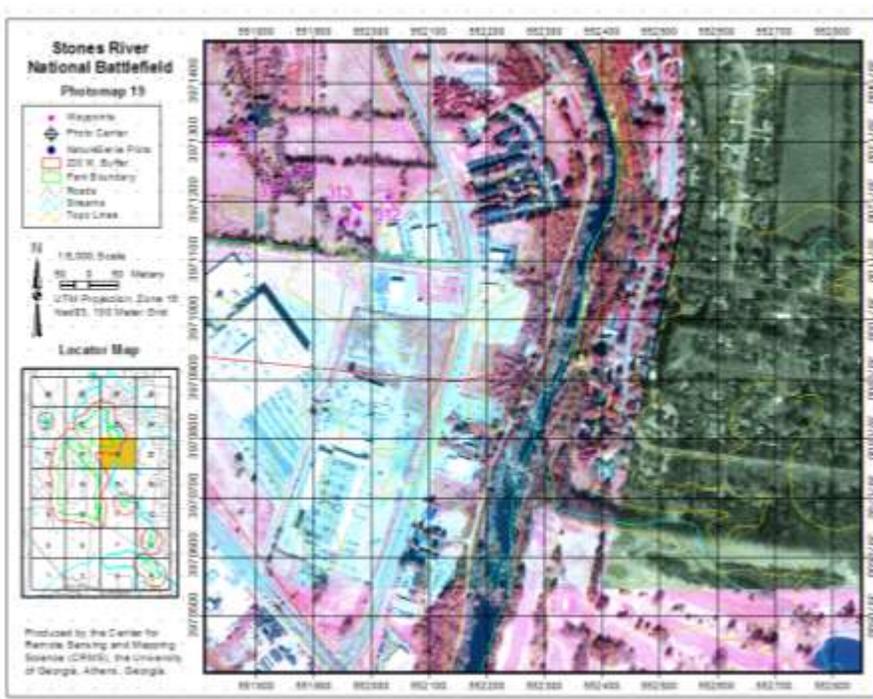


Figure 9: Field map for Stones River National Battlefield used for field data collection with UTM grid, USGS DOQQ image, topographic contours, roads and rivers.

NatureServe had completed their field plot surveys and developed a classification field key for a particular park before CRMS-NatureServe field work was conducted, then the key would be jointly used, informally tested and modified. Although this process tended to

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require considerable time that was outside of the scope of CRMS mapping tasks, its importance was recognized after NatureServe conducted some of the first accuracy assessments of CRMS vegetation databases. It is imperative that NVCS classes in the NatureServe field key match the classes used by CRMS for interpretation, definitions of the classes are not modified after the interpretation is completed and CRMS and NatureServe botanists agree on the classes the keys “key-out” to.

During a full field day, the UTM coordinates and field data were typically collected at approximately 25 to 35 locations. Digital camera images were taken at most field points to document the vegetation and site conditions. In some parks, ground photos were tied to geographic locations with the aid of a Garmin III Plus hand-held GPS receiver and a Kodak Digital Field Imaging System (FIS) 265 digital camera system. The hand-held Kodak digital camera was connected to the Garmin GPS that “stamped” the location, date and time on each image (Figure 10). These images were input to ArcView to provide a pictorial record of field observations.



Figure 10: Ground digital image of overstory and understory vegetation recorded with a Kodak FIS 265 digital camera interfaced to a Garmin III Plus GPS.

A compilation of all field information was used by CRMS photointerpreters to connect the NVCS association-level classes identified in the field with photo signatures for vegetation patches identified on the color infrared aerial photographs. The locations of CRMS field points were transferred from the GPS units to ArcMap and superimposed on orthorectified images of each park. Information from the field points on overstory, understory and herbaceous strata, environmental site conditions and any notes on human influence or disturbance were used to delineate areas of homogeneous vegetation communities into areas (i.e., vegetation polygons) and label (i.e., attribute) polygons with the appropriate NVCS association class (i.e., CEG).

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The term, association, is defined by Grossman et al. (1998) as a “plant community type of definite floristic composition, uniform habitat conditions and uniform physiognomy”. Vegetation classification studies by NatureServe were conducted prior to CRMS photointerpretation in most parks to create a list of typical NVCS associations and provide a comprehensive description of species found in one to several strata of vegetation: tree canopy, sub-canopy, tall shrub, short shrub, herbaceous, non-vascular, vine/liana and epiphyte. The combination of vegetation in all of these strata present determines the community type and NVCS association CEGL. Additional information on global and local site conditions also are included in NatureServe park classification descriptions. This information was extremely helpful to CRMS interpreters and photointerpretation proceeded most smoothly when classification studies by NatureServe were completed prior to photointerpretation. Close cooperation between CRMS and NatureServe personnel in conducting field work and throughout the photointerpretation process was essential because in some cases CRMS interpreters found vegetation signatures on the aerial photographs that did not fit in the existing NVCS associations listed for a particular park. Since NatureServe plots are regularly dispersed throughout the parks and the intensity of field work that is required for each plot may limit the number of plots that can practically be surveyed, there were times when additional existing NVCS classes and even new vegetation classes to the NVCS classification system were identified by the photointerpreters. Careful consideration was given to these perceived “new” classes and in some cases additional NatureServe plots were established to document the vegetation in the field. It was more common that NatureServe definitions of NVCS associations would be modified to reflect the particular dominance or mix of species in particular parks.

It should also be noted that the term “overstory vegetation” refers to vegetation communities that are named and referenced by vegetation in their tallest stratum, plus abundant and/or indicator species in lower strata. Photointerpreters can see the tallest strata on color infrared photos, and may or may not be able to see through this layer to shorter sub-canopy or understory layers. Sometimes a community can be determined solely by seeing its location (e.g., along a ridge or on the south slope) and seeing the uppermost stratum. In other cases, a lower stratum (or strata) must be seen because this stratum determines the community type. If supplemental air photos that were taken in leaf-off conditions were available at no cost for a park, such as USGS Digital Ortho Quarter Quads acquired in the winter months, then these photos were used to identify the type and density of the understory strata. This information, combined with species and abundances identified from field work, was used to separate NVCS classes with similar overstory components but difference sub-canopy understory or herbaceous components. If it was not possible to determine the association-level class due to similar overstory characteristics and lack of information on sub-canopy vegetation, then a more general class, perhaps at the alliance level, was assigned to the polygon.

The NVCS association-level classes listed as CEGL numbers and class names are fully described in separate documents produced by NatureServe and provided to the NPS on a park by park basis. Each of the parks in the Cumberland Piedmont Network that were mapped by CRMS include NVCS CEGLs with additional classes (Figure 11). The vegetation classification systems used for each park are provided in the Appendix of this report. Modifiers to the NVCS classes, for example, can indicate variations of a particular

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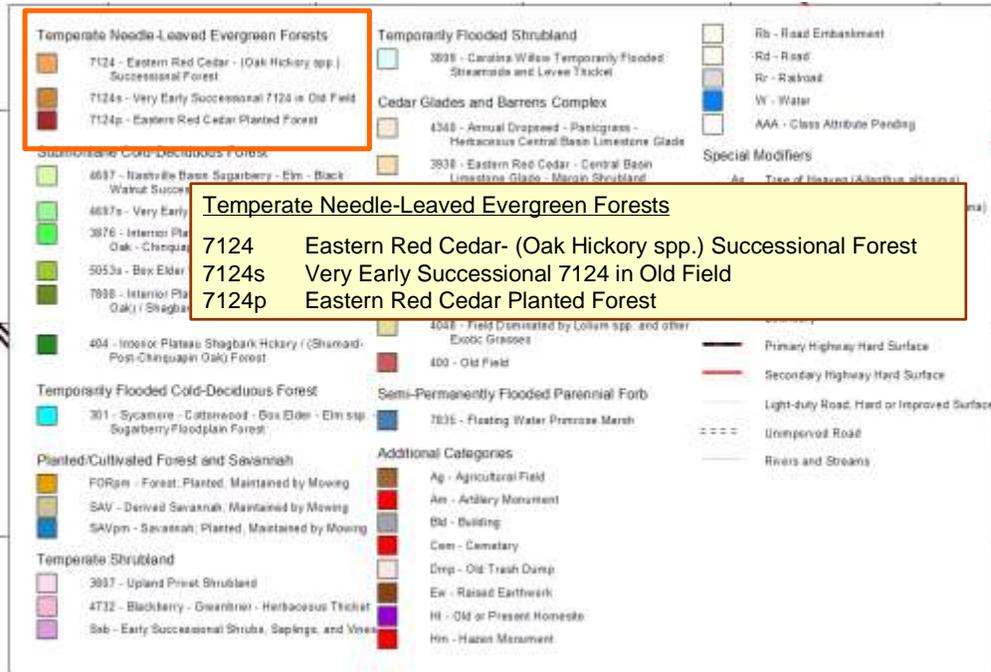


Figure 12: The CRMS Vegetation Classification System for Stones River National Battlefield includes modifications to the National Vegetation Classification System (NVCS) that indicate early successional (7124s) and managed (7124p) versions of CEGL associations (7124).

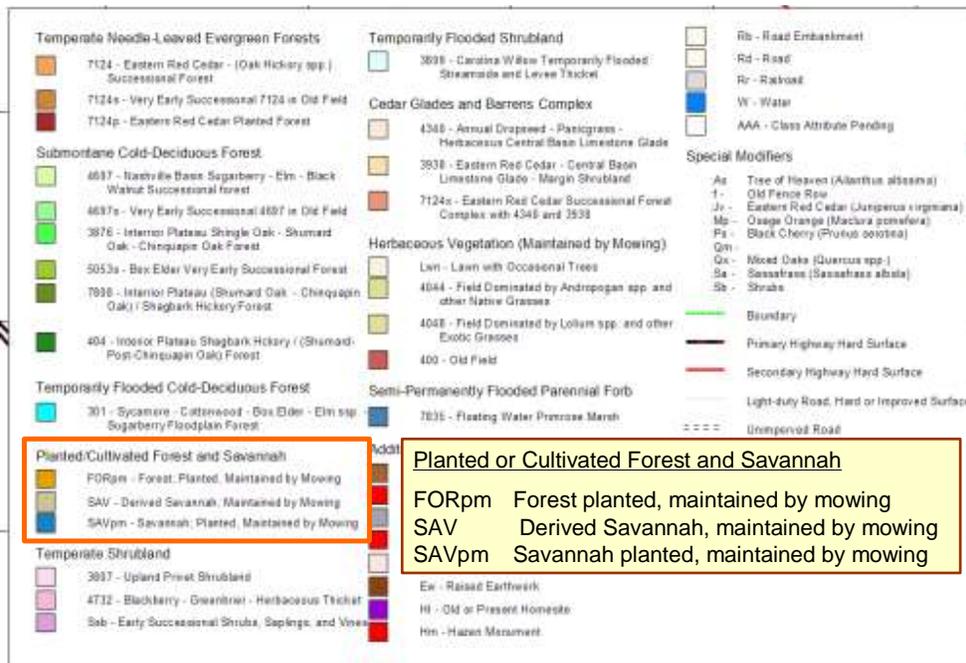


Figure 13: The CRMS Vegetation Classification System for Stones River National Battlefield includes additional land cover classes that indicate management practices such as planted savannah maintained by mowing (SAVpm) or land uses such as old or present home sites (HI).

The NVCS is best suited to large parks that are relatively undisturbed and have remained so for long enough for vegetation communities to develop in accordance with the environmental and climatic conditions of the site. Areas that are regularly or extensively disturbed by logging, fire, wind damage, exotic insects, exotic vegetation and human activities are not easily classified with the NVCS. For this reason the CRMS as augmented the NVCS classes developed for each park by NatureServe to include additional disturbed, managed, successional and modified classes, along with numerical and alpha modifiers to provide detailed information to users of the vegetation databases and maps.

Once the overstory community classification systems were established for each park, the photointerpretation proceeded by taping transparent plastic overlays to the film transparencies, and transferring the photo numbers and fiducial marks to the overlays by means of a Rapidograph technical pen. The film transparencies, with plastic overlays, were then placed on a high intensity light table and the polygons corresponding to the vegetation classes outlined on the overlay using the Rapidograph pen while viewing the photographs through a stereoscope. This is a simple, fast, inexpensive and flexible method of creating a vegetation overlay that can be scanned to create a raster file.

In order to accommodate the complex vegetation patterns often found in National Park units and generally maintain a minimum mapping unit of 0.5 ha, a three-tiered scheme was developed for attributing vegetation polygons, similar to that developed for an earlier project in the Everglades of south Florida (Madden et al. 1999). The three-tiered scheme allowed photointerpreters to annotate each polygon in the database with a primary or dominant vegetation class accounting for more than 50 percent of the vegetation in the polygon. Where appropriate, secondary and tertiary vegetation classes are added to describe mixed-plant communities within the polygon. Secondary and tertiary classes were especially useful for describing ecotones, and for polygons with a patchwork of communities below the minimum mapping unit size.

GIS Operations

Creating the Map Database

Following recommendations by Welch and Jordan (1996), the interpreted overlays were scanned using the Epson 10000xl scanner at a resolution of 127 μm (200 dpi) using Adobe Photoshop. All annotated point, line, polygon and attribute information on the overlay was thus converted to raster format and saved as a black-and-white, 8-bit TIFF file (Figure 14). The parameters derived from the differential rectification of the scanned 1:12,000-scale photos (described above) were then applied to the scanned overlay files via registration with the transferred fiducial marks and the scanned overlays were orthorectified in the same manner as the original aerial photographs. Figure 15 illustrates the magnitude of polygon displacement in a mountainous area, as well as distortion in polygon shape and size, due to variable relief displacements across the photograph. The image on the left (15a) represents an uncorrected overlay with a superimposed 1-cm grid. After differential rectification to correct for relief displacement (15b), the grid appears to be distorted but, in fact, the lines on the overlay are in their correct planimetric locations as a result of the rectification process. Figure 16 shows the entire overlay after correction.

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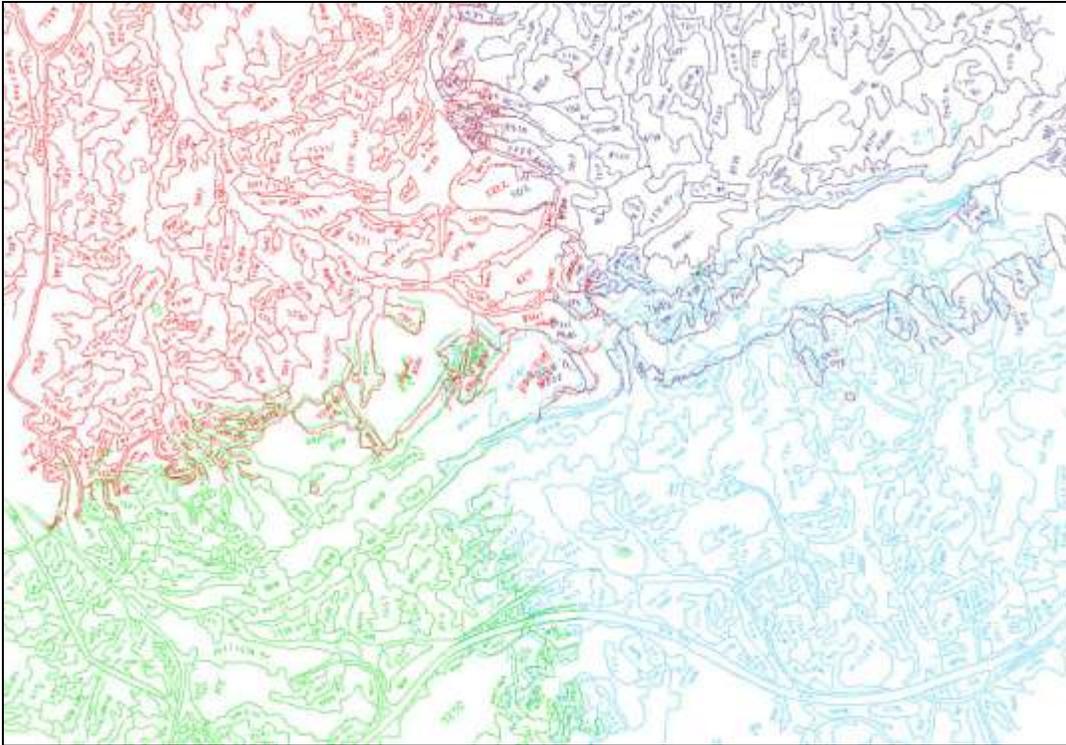


Figure 17: Individual (unedited) vector files from four adjacent photos.

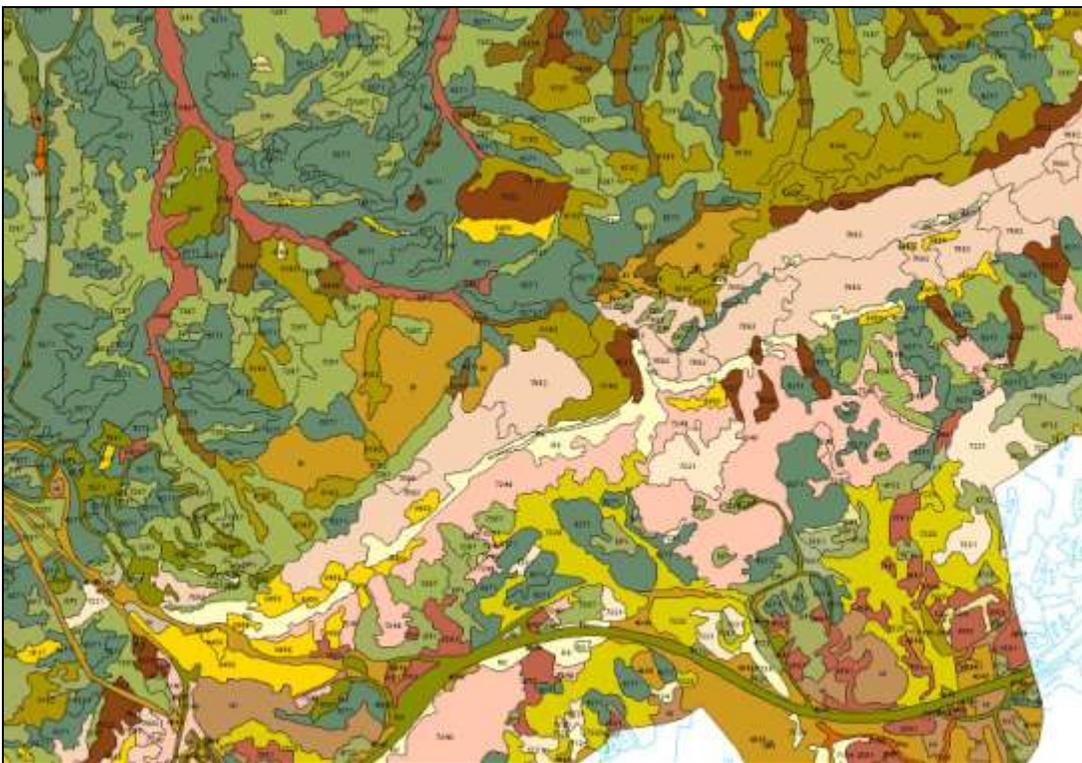


Figure 18: Section of the vegetation database that has been edited, edge matched and attributed.

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Experience in the Great Smoky Mountains National Park has shown that a typical coverage for the area corresponding to a USGS 1:24,000-scale map can contain over 4,500 polygons that must be attributed with a dominant vegetation class, and possibly secondary and tertiary vegetation classes. Depending upon the complexity of the map, more than 700 man-hours can be required to produce a single quad-sized vegetation map from the 1:12,000-scale photos, including quality control checks of labels/line work within and between adjacent maps. Although limited funds available for the project precluded a thorough check of thematic classification accuracy, maps were taken into the field as they were completed to assess the general agreement between map information and observations on the ground. A more thorough accuracy assessment of the vegetation will be performed by NatureServe as a separate project and has already been completed for several of the parks included in this report.

Final products included seamless park-wide GIS databases in ArcGIS geodatabase and ArcView shapefile formats of detailed overstory vegetation communities, along with vegetation statistics, hardcopy maps and orthophoto images plotted at large scale corresponding to the park area (Table 3). More generalized vegetation/land use/land cover classes are provided for a 400-m buffer surrounding the park boundaries. Each map sheet contains a color-coded legend and brief description of all vegetation classes found in the individual park. Applications of the park map/database products include: 1) vegetation assessment for general resource management tasks; 2) utilization of the overstory vegetation structure for classifying fuels and the associated risk of forest fire; 3) habitat assessment; and 4) provision of baseline data for future studies of vegetation or habitat change.

The vegetation databases provide a basis for park-wide resource management decisions. Basic information that is required by all managers includes a spatial inventory of existing vegetation communities and summary statistics indicating the total area covered by each community. These data can be quickly tallied in a GIS environment once the database has been developed. Comprehensive lists of all overstory and buffer vegetation classes as well as special modifiers are provided in this document and also within the database and metadata for each park. A summary of the respective areas of each dominant vegetation class within each park is also provided.

Detailed information at the association-level is often needed to address management problems that target individual species. For example, the overstory vegetation database can be queried to locate pure stands of high elevation table mountain pine (*Pinus pungens*) requiring controlled burning to eliminate hardwood invasion. Polygons containing Eastern hemlock (*Tsuga canadensis*) also can be selected to identify areas susceptible to die-off and damage caused by the non-native hemlock woolly adelgid.

Other management questions may require a broader-perspective. Given the complexity of vegetation diversity in the CUPN parks, it is difficult for managers to assess general trends in vegetation patterns when posed with management questions on a Park-wide level.

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Table 3: Summary of vegetation mapping for CUPN parks.

PARK	Park Name	Photo date(s)	Area (ac)	Area (ha)	Completion Date	Veg Classes	Polygons	Avg Polygon Size (ha)	Map Scale
CARL	Carl Sandburg Home NHS	10/24/00; 11/2/02	260	105	May, 2003	25	189	0.67	1:4,000
GUCO	Guilford Courthouse NMP	10/20/2000	203	82	Jan, 2005	19	143	0.53	1:3,000
CUGA	Cumberland Gap NHP	11/2/2002	20061	8122	March, 2006	37	2269	2.6	1:14,000
LIRI	Little River Canyon NPRES	10/31/2001	13698	5546	May, 2006	48	1802	2.35	1:13,000
NISI	Ninety Six NHS	10/24/2000	948	384	May, 2002	26	240	0.97	1:6,000
STRI	Stones River NB	10/25/2001	654	265	Nov, 2004	43	308	0.82	1:6,000
ABLI-BBH	Abraham Lincoln NHS (Boyhood Home)	11/2/2002	264	107	Dec, 2004	19	196	0.79	1:5,000
ABLI-BP	Abraham Lincoln NHS (Birthplace)	11/2/2002	122	50	Dec, 2004	18	106	0.57	1:5,000
COWP	Cowpens NB	11/2/2002	839	340	Dec, 2004	24	414	0.61	1:7,500
FODO	Fort Donelson NB	11/2/2002	518	210	Aug, 2005	30	284	0.53	1:6,000
CHCH	Chickamauga and Chattanooga NMP	10/30/2001	7956	3220	Oct, 2008	51	777	2.82	1:10,000
KIMO	Kings Mountain NMP	10/24/2000	3945	1597	Oct, 2008	20	382	4.18	1:9,000
MACA	Mammoth Cave NP	11/8/2002	50,390	20,392	Aug, 2009	35	7,907	2.58	1:26,000
RUCA	Russell Cave NM	10/25/2001	307	124	Nov, 2007	8	21	5.91	1:5,000
SHIL	Shiloh NMP	10/25/2001	3,245	1,1313	Dec, 2009	35	556	2.36	1:9,000

Quality Assurance/Quality Assessment

The final step before creating the actual map layouts was to perform quality assurance/quality assessment (QA/QC) inspections of the data. In this process, both the orthophotos and vegetation maps were checked to make sure that they fit the underlying DOQQs properly. In ArcMap, the DOQQ, orthophoto and vegetation layers were loaded and displayed in register with one another. The 'Effects' toolbar provides a *swipe* feature which allows one layer to be rolled back to see the underlying layers. By rolling the topmost layer back and forth, any misregistration between layers can be detected by visual inspection. This procedure was applied to both the orthophotos and the vegetation layer. Data mismatches of this sort resulted primarily from errors in aerotriangulation and ground control, orthophoto generation and edge matching operations. It was also possible that the photo interpreter did not delineate or attribute the feature correctly. When such a misregistration is found, the cause is determined and the data were corrected.

Final Map Creation

Large scale final map products were created within ArcMap and designed to show both the orthophoto coverage and the vegetation maps. For the vegetation maps, colors were assigned and the polygons labeled with the dominant vegetation and modifier and, where present, the second vegetation and modifier. For the orthophoto maps, the photos were simply plotted at the same scale and area coverage as the vegetation maps. Additional planimetric map data included roads, trails, hydrology, boundaries and a UTM coordinate grid. Legends are designed to provide full definitions of the vegetation and buffer classes and modifiers, as well as information about the park, map projection, data sources and authorship (Figure 19). All maps are projected to the Universal Transverse Mercator Coordinate System, North American Datum of 1984, in the local zone for the specific park.

Large-format (3x4 ft) hardcopy maps were provided to the Parks as data were delivered while softcopy versions in Adobe Acrobat (PDF) format are provided on the accompanying DVDs. Final databases compiled and organized into ArcGIS Geodatabases and ArcView shapefiles, along with metadata complying with NPS and FGDC Standard version FGDC-STD-001-1998. These files are also included on the accompanying DVDs.



Figure 19: Final map product for Guilford Courthouse National Military Park (GUCO).

Summary and Conclusion

Vegetation in fourteen parks within the NPS Cumberland-Piedmont Network (CUPN) was mapped by the Center for Remote Sensing and Mapping Science (CRMS), Department of Geography, University of Georgia. These parks ranged in size from 122 to 13698 acres and include Abraham Lincoln NHS, Carl Sandburg Home NHS, Cowpens NB, Fort Donelson NB, Guilford Courthouse NMP, Little River Canyon NPRES, Ninety Six NHS, and Stones River NB. Vegetation mapping of the parks was accomplished using a set of procedures and methods originally developed by the CRMS for the Great Smoky Mountains National Park Vegetation Mapping Project. In this process, color infrared aerial photographs of either 1:12,000 or 1:16,000 scale were acquired in the fall of 2002 and 2003, timed to coincide with the peak color change of the trees. The mapping included three primary areas of activity: photogrammetry, photointerpretation and field survey, and GIS database development and map creation.

Photogrammetric operations involved scanning the aerial photographs, the extension of ground control using analytical aerotriangulation and softcopy photogrammetric techniques, production of digital orthophotographs from the color infrared aerial photographs, and ortho-correction of the interpreted overlays in preparation for GIS database compilation. Photointerpretation was performed using manual methods on mylar overlays while viewing the aerial photographs in stereo on a light table. Although time-consuming, this method is superior to automated methods because it permits a much wider range of vegetation classes to be detected and delineated while drawing on the botanical and site specific knowledge of the photo interpreter, in addition to collateral datasets such as NatureServe plot data, field survey notes from site visits, and maps showing topography and geology. Using a minimum mapping unit of 0.5 ha, polygons delineating areas of a single vegetation community were drawn on the mylar overlays and assigned a numeric CEGL code corresponding to the appropriate National Vegetation Classification System (NVCS) class. Where a NVCS CEGL code did not fit the interpretation, an alpha code or modifier (e.g., HI = Human Influence) was employed as a descriptor. Where a polygon

Upon completion of the photointerpretation, the overlays are scanned and orthorectified using the photogrammetric parameters determined previously and transferred fiducial marks as registration points. The lines drawn on the rectified overlays representing vegetation polygons are converted from raster to vector format using Feature Analyst Extension for ArcGIS and then edited, edge matched and, finally, assigned attributes to create the preliminary vegetation GIS database. After final checking by the photo interpreters, the database is finalized and hardcopy and softcopy map products created for delivery to NPS.

For the fourteen parks described in this report, a total of 171 unique vegetation classes were found over a total area 15,210 ha (37,569 acres). The average size of vegetation polygons is 1.2 ha (~3 acres). The NVCS system was found to work best in areas where the vegetation had been relatively undisturbed but did not truly account for the successional or managed vegetation classes found in many of the parks in this project. For this reason, it was important for the photointerpreters and the NatureServe field

botanists to work together to develop keys and to refine the classes to best fit the situation on the ground. This cooperation not only creates a better set of vegetation classes but it also prevents serious errors from occurring in subsequent operations such as accuracy assessment surveys.

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Appendix A : Abraham Lincoln Birthplace National Historic Site and Abraham Lincoln Birthplace National Historic Site (Boyhood Home - Knob Creek Farm)

Vegetation Classification System

Rounded-Crown Temperate Needle-Leaved Evergreen Forests

2591 Virginia Pine Early Successional Forest

Conical-Crown Temperate Needle-Leaved Evergreen Forests

7124 Eastern Red Cedar – Oak species
Successional Forest

7124s Eastern Red Cedar – Oak species
Very Early Successional Saplings

Submontane Cold-Deciduous Forest

2411 Beech – Sugar Maple – Tuliptree Unglaciated Forest

7220 Successional Tuliptree/Redbud Forest, Circumneutral Type

2067 White Oak – Northern Red Oak – Hickory species/Dogwood Dry – Mesic Acid Forest

5018 Southern Red Oak – (Mixed Oak) Dry Mesic Forest

2070 White Oak –Northern Red Oak –Chinquapin Oak/Redbud Dry –Mesic Alkaline Forest (At Abraham Lincoln Knob Creek Farm, Sugar Maple and Shagbark and other hickories in the canopy)

2070:Qa White Oak dominated (>75%) steep slope, dry variation of 2070

4693 Sugarberry (Northern Hackberry) –Black Walnut – Elm Successional Forest

4741 Nashville Basin Sugar Maple – Shagbark Hickory – Black Walnut/Coralberry Mesic Forest

3876 Nashville Basin Shingle Oak – Shumard Oak – Chinquagin Oak Forest

Temporary Flooded Cold-Deciduous Forest

7707 Southern Interior Highland small stream Sycamore – (Sweet Gum – Silver Maple – Box Elder)/Ironwood Floodplain Forest

Herbaceous Vegetation

4044 Grasslands dominated by Andropogon spp. and other native grasses and forbs

4048 Cultivated meadow dominated by Fescue (*Lolium* spp.) and other exotic and native grasses and forbs

Central Interior Highlands Glade and Barrens

5131 Eastern Red Cedar – Chinquapin Oak/Little Bluestem – Eastern Agave Limestone Glade

Other Categories

PIs White Pine (*Pinus strobus*)

Ag Native Giant Cane (*Arudinaria gigantea*)

Bld Building
 HI Human Influence (e.g. Old or Present Homesite)
 Lwn Lawn
 OFs 4048 with very early successional Virginia pine, Eastern red cedar, *Andropogon* spp., asters, goldenrod, small oaks, moss and lichens
 Rd Road
 R-O-W Right-of-Way
 Snk Sinkhole
 W Water

Special Modifiers

:Ag Native Giant Cane (*Arudinaria gigantea*)
 :As Sugar Maple (*Acer saccharum*)
 :Cc Redbud (*Cercis Canadensis*)
 :Cx Shangbark hickory and mixed *Carya* spp.
 :Dd Damaged or Dead, most damage resulted
 :Fa White Ash (*Fraxinus americana*)
 :Jv Eastern Red Cedar (*Juniper virginiana*)
 :Lt Tuliptree (*Liriodendron tulipifera*)
 :PIv Virginia Pine (*Pinus virginiana*)
 :PIs White Pine (*Pinus strobus*), planted
 :Po Sycamore (*Plantanus occidentalis*)
 :Ps Black Cherry (*Prunus serotina*)
 :Qa White Oak (*Quercus alba*)
 :Qr Red Oak (*Quercus rubra*)
 :s Very early Successional
 :Sa Sassafras (*Sassafras albidum*)
 :Sb Successional tree saplings and shrubs
 :Snk Sinkhole
 :t Scattered trees and/or saplings in lawn or field

Additional Generalized Buffer Classes

Ag Agriculture
 Cem Cemetery
 Cf Coniferous Forest
 Df Deciduous Forest
 I Industry
 Mf Mixed Forest
 NoAgF Non Agriculture Field
 OF Off Field Successional
 Rd Road
 Res Residential
 W Water

ABLI Vegetation Statistics

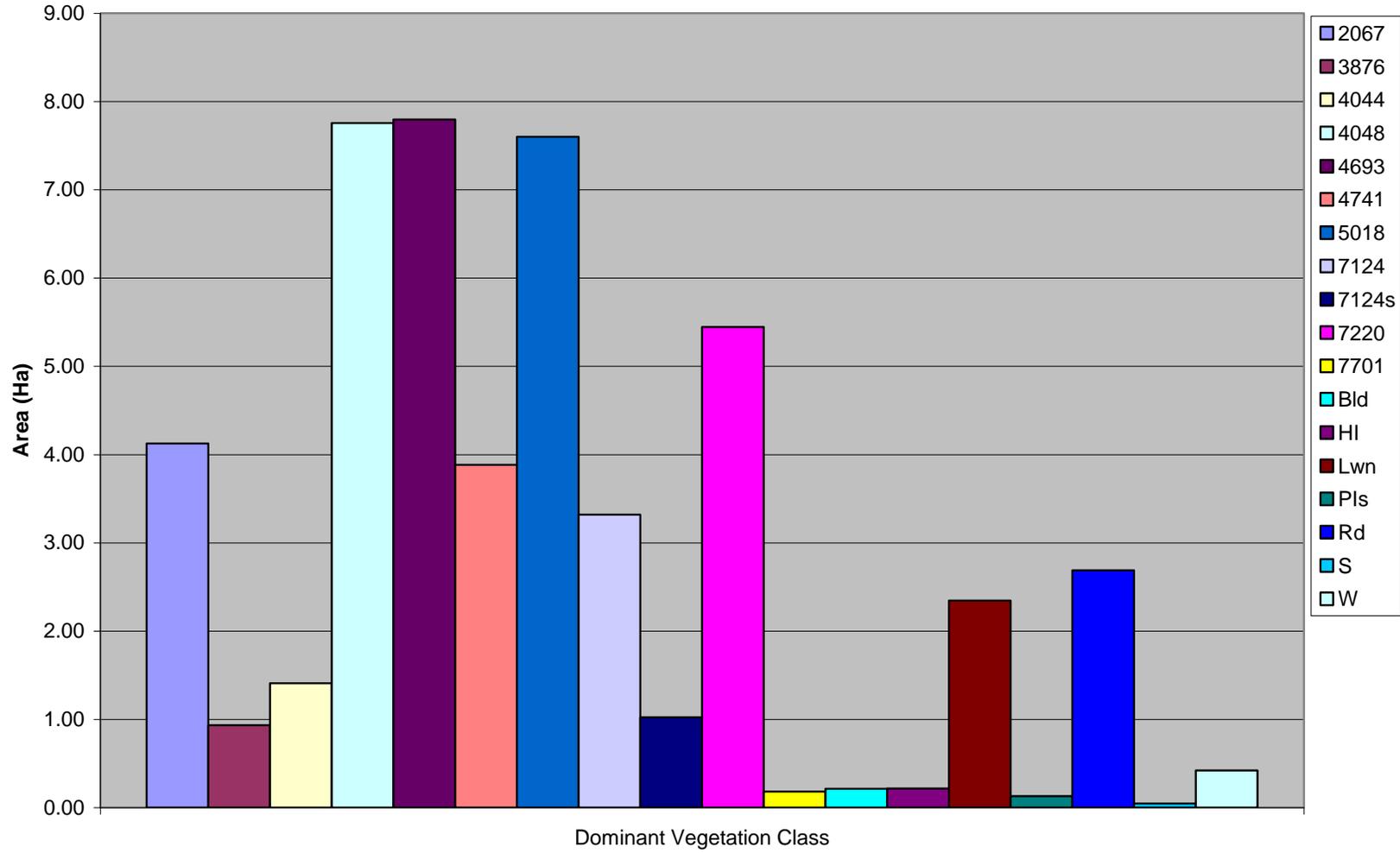
Table A1: Dominant vegetation statistics for Abraham Lincoln Birthplace National Historic Site

DomVeg	Count	Average Area	Area (sq. m)	Area (ha)	Area (Ac)
2067	5	8248.24	41241.20	4.12	10.19
3876	1	9334.53	9334.53	0.93	2.31
4044	3	4697.17	14091.52	1.41	3.48
4048	16	4847.00	77552.00	7.76	19.16
4693	14	5568.22	77955.06	7.80	19.25
4741	6	6472.19	38833.16	3.88	9.59
5018	18	4221.45	75986.14	7.60	18.77
7124	6	5532.14	33192.83	3.32	8.20
7124s	1	10230.86	10230.86	1.02	2.53
7220	16	3402.75	54443.92	5.44	13.45
7701	3	603.72	1811.17	0.18	0.45
Bld	5	424.12	2120.58	0.21	0.52
HI	1	2148.17	2148.17	0.21	0.53
Lwn	4	5863.51	23454.02	2.35	5.79
Pls	1	1290.75	1290.75	0.13	0.32
Rd	1	26878.91	26878.91	2.69	6.64
S	3	152.63	457.88	0.05	0.11
W	2	2097.36	4194.72	0.42	1.04
Total	106			49.52	122.32

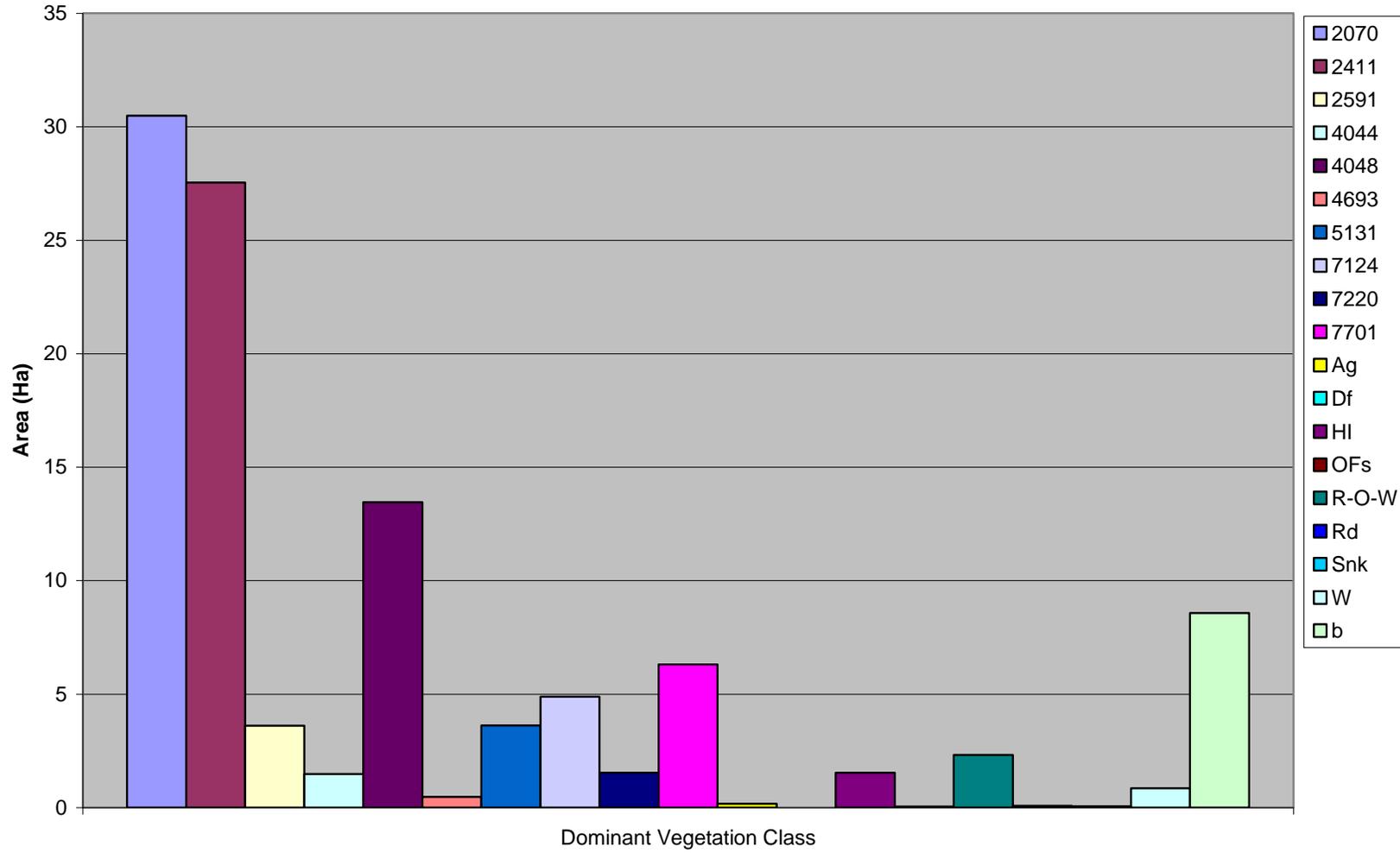
Table A2: Dominant vegetation statistics for Abraham Lincoln Birthplace National Historic Site (Boyhood Home - Knob Creek Farm)

DomVeg	Count	Average Area	Area (sq. m)	Area (ha)	Area (acres)
2070	33	9239.27	304896.07	30.49	75.31
2411	3	91791.83	275375.50	27.54	68.02
2591	10	3605.70	36056.99	3.61	8.91
4044	1	14738.14	14738.14	1.47	3.64
4048	30	4483.81	134514.42	13.45	33.23
4693	4	1177.32	4709.29	0.47	1.16
5131	7	5173.18	36212.27	3.62	8.94
7124	13	3754.47	48808.11	4.88	12.06
7220	7	2190.75	15335.27	1.53	3.79
7701	24	2628.17	63076.05	6.31	15.58
Ag	4	430.67	1722.69	0.17	0.43
Df	1	42.49	42.49	0.00	0.01
HI	7	2192.44	15347.06	1.53	3.79
OFs	1	470.25	470.25	0.05	0.12
R-O-W	8	2898.91	23191.24	2.32	5.73
Rd	1	809.15	809.15	0.08	0.20
Snk	1	556.31	556.31	0.06	0.14
W	13	657.63	8549.19	0.85	2.11
b	28	3059.01	85652.30	8.57	21.16
Total	196			107.01	264.31

ABLI Birthplace Vegetation Distribution



ABLI Boyhood Home Vegetation Distribution



ABLI Birthplace Map Products

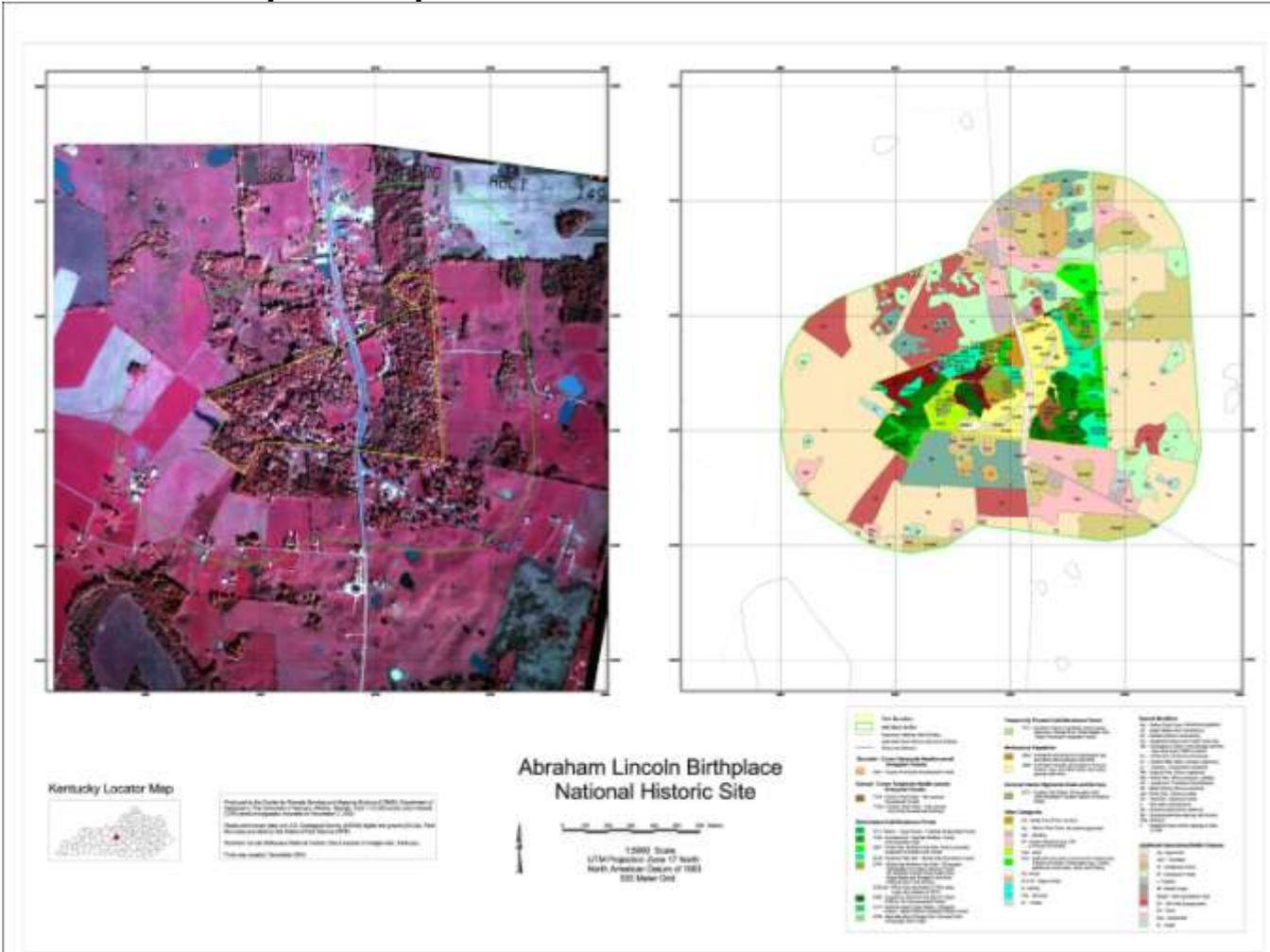


Figure A1: Color infrared and vegetation map of Abraham Lincoln Birthplace National Historic Site

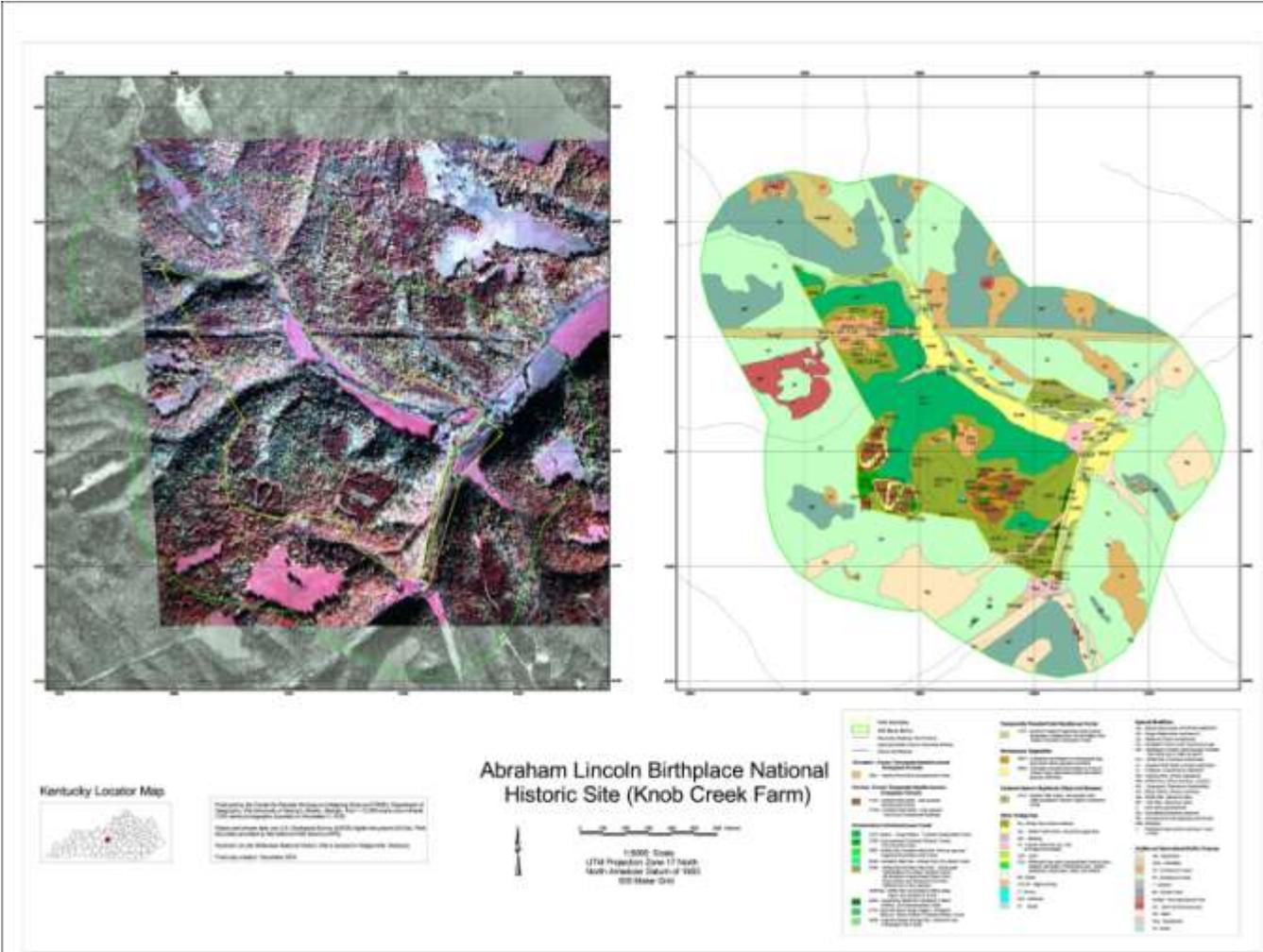


Figure A2: Color infrared (with DOQQ) photo and vegetation map of Abraham Lincoln Birthplace National Historic Site (Boyhood Home - Knob Creek Farm)

Table A3: Photo centers for Abraham Lincoln Birthplace.

ABLI (UTM 16) Meters		
Photo ID	X	Y
1493R	620087.25	4163800.25
1495R	611724.75	4155025.25
1496R	611849.75	4154500.25
1497R	611787.25	4154212.75

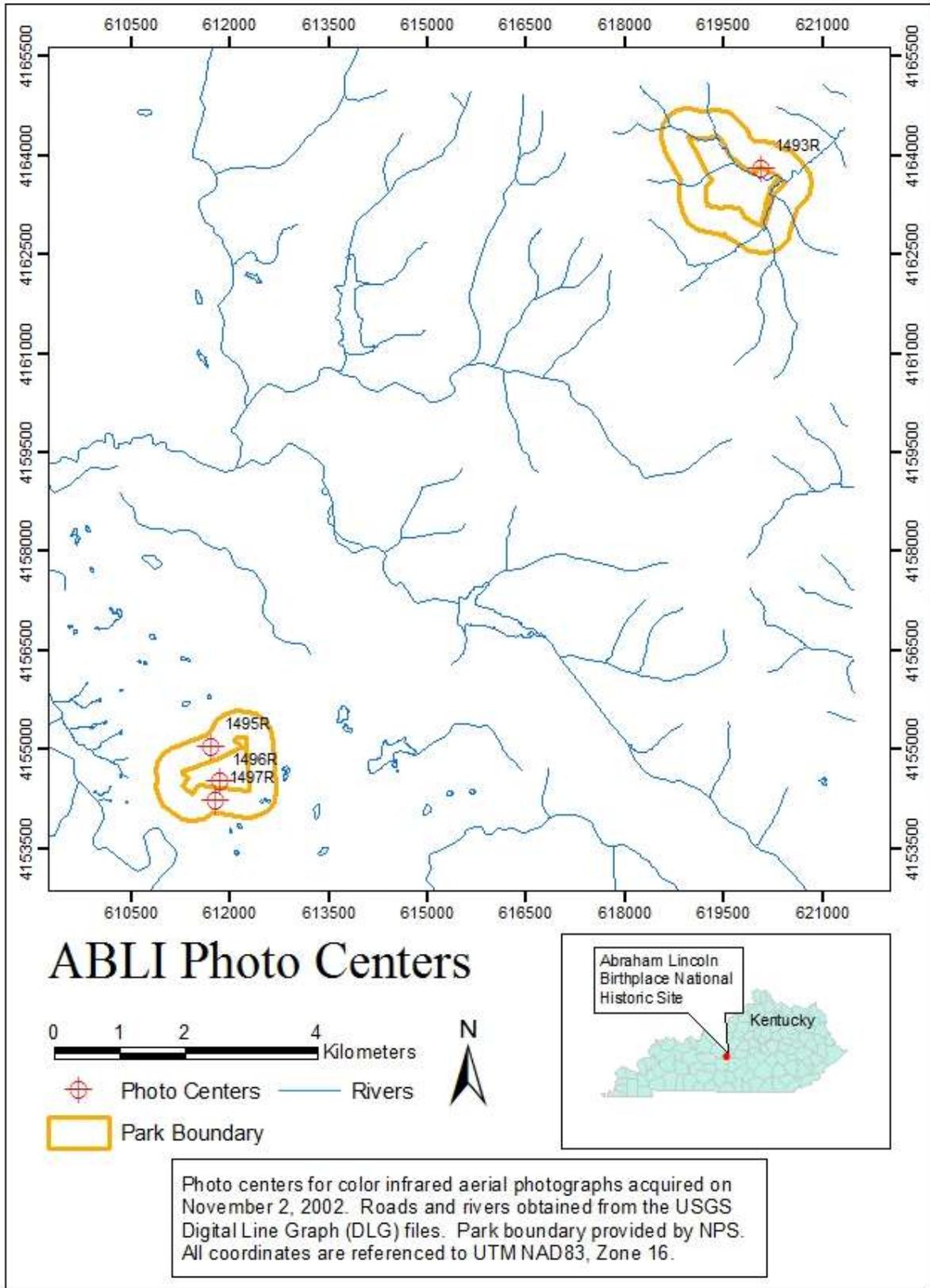


Figure A3: Photo centers map for Abraham Lincoln Birthplace.

Appendix B: Carl Sandburg Home National Historic Site

Vegetation Classification System

Temperate Needle-Leaved Evergreen Woodland

7097 Blue Ridge Table Mountain Pine – Pitch Pine Woodland (Typic Type)

Mixed Needle-Leaved Evergreen Cold-Deciduous Forest

7519 Appalachian White Pine – Xeric Oak Forest

8427 Appalachian Shortleaf Pine – Mesic Oak Forest

7543 Southern Appalachian Acid Cove Forest (Typic Type)

Sub-Montane Cold-Deciduous Forest

7267 Appalachian Montane Oak Hickory Forest (Chestnut Oak Type)

6271 Chestnut Oak Forest (Xeric Ridge Type)

6286 Chestnut Oak Forest (Mesic Slope Health Type)

7230 Appalachian Montane Oak – Hickory Forest (Typic Acidic Type)

6192 Appalachian Montane Oak – Hickory Forest (Red Oak Type)

7221 Tuliptree – Hardwood Successional Forest

Temperate Needle-Leaved Evergreen Forest

7944 Eastern White Pine Successional Forest

4048 Cultivated meadow – *Lolium (arudinaceum, pretense)* Herbaceous Vegetation

4112 Seasonally Flooded Herbaceous Vegetation (*Juncus effuses*)

Granitic Dome Complex

7690 Appalachian Low-Elevation Granitic Dome

7690x Appalachian Low-Elevation Granitic Dome Complex with White Pine and Shrubs

Open Water and Rooted Vegetation (Low Vegetation Cover)

2386 Water Lily Aquatic Wetland

W Pond, Man-Made

Additional Categories

Sb Shrub

Dd Dead

C Culturally Modified Vegetation

E Exotic Species

O Old Orchard

Home Carl Sandburg Home

Bld Building

Rd Roadway

Special Modifiers

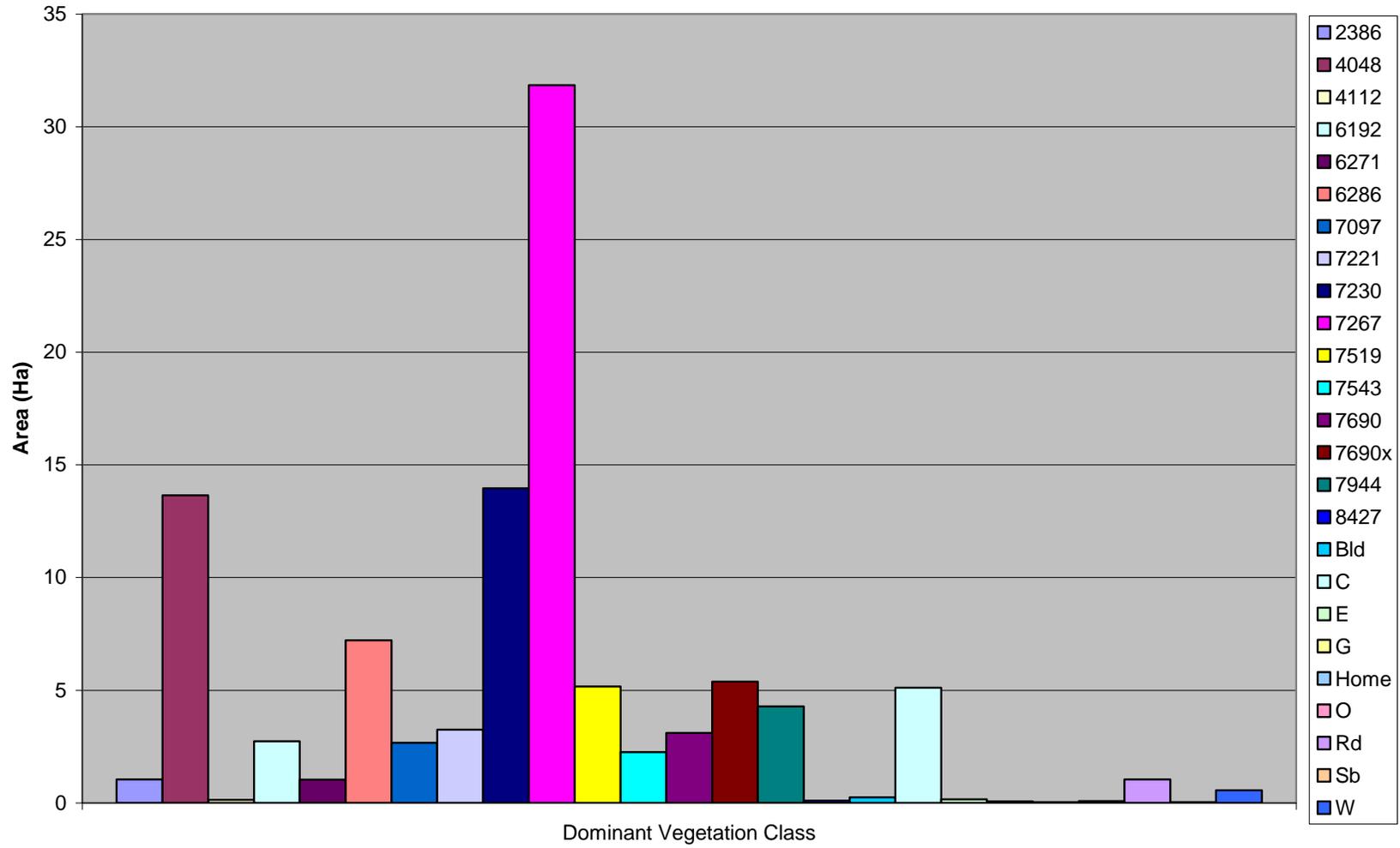
Ar	Red Maple (<i>Acer rubrum</i>)
B	Bamboo (<i>Phyllostachys spp.</i>)
Jn	Black Walnut (<i>Junglans nigra</i>)
Jv	Red Cedar (<i>Juniper virginiana</i>)
Lj	Japanese Honeysuckle (<i>Lonicera japonica</i>)
Ls	Chinese Privet (<i>Ligustrum sinense</i>)
Lt	Tuliptree (<i>Liriodendron tulipifera</i>)
PIe	Shortleaf Pine (<i>Pinus echinata</i>)
PIr	Pitch Pine (<i>Pinus rigida</i>)
PIs	White Pine (<i>Pinus strobus</i>)
Po	American Sycamore (<i>Plantanus occidentalis</i>)
Q	Mixed Oak (<i>Quercus spp.</i>)
Qa	White Oak (<i>Quercus alba</i>)
Qc	Scarlet Oak (<i>Quercus coccinea</i>)
Qp	Chestnut Oak (<i>Quercus prinus</i>)
Rm	Multiflora Rose (<i>Rosa multiflora</i>)
Tc	Eastern Hemlock (<i>Tsuga canadensis</i>)
Up	Siberian Elm (<i>Ulnus pumila</i>)

CARL Vegetation Statistics

Table B1: Dominant vegetation statistics for Carl Sandburg Home National Historic Site

DomVeg	Count	Average Area	Area (sq. m)	Area (ha)	Area (acres)
2386	1	10425.89	10425.89	1.04	2.58
4048	6	22752.48	136514.89	13.65	33.72
4112	1	1360.59	1360.59	0.14	0.34
6192	2	13674.93	27349.85	2.73	6.76
6271	3	3421.81	10265.43	1.03	2.54
6286	7	10306.34	72144.41	7.21	17.82
7097	5	5321.91	26609.53	2.66	6.57
7221	7	4644.38	32510.68	3.25	8.03
7230	10	13956.88	139568.79	13.96	34.47
7267	11	28950.14	318451.55	31.85	78.66
7519	4	12926.13	51704.52	5.17	12.77
7543	1	22534.25	22534.25	2.25	5.57
7690	30	1035.29	31058.65	3.11	7.67
7690x	16	3364.06	53825.01	5.38	13.29
7944	10	4279.21	42792.09	4.28	10.57
8427	1	1029.58	1029.58	0.10	0.25
Bld	19	131.52	2498.79	0.25	0.62
C	40	1276.91	51076.22	5.11	12.62
E	3	538.07	1614.20	0.16	0.40
G	2	342.04	684.07	0.07	0.17
Home	1	363.61	363.61	0.04	0.09
O	1	828.06	828.06	0.08	0.20
Rd	3	3486.46	10459.37	1.05	2.58
Sb	1	280.93	280.93	0.03	0.07
W	4	1412.81	5651.24	0.57	1.40
Total	189			105.16	259.75

CARL Vegetation Distribution



CARL Map Product

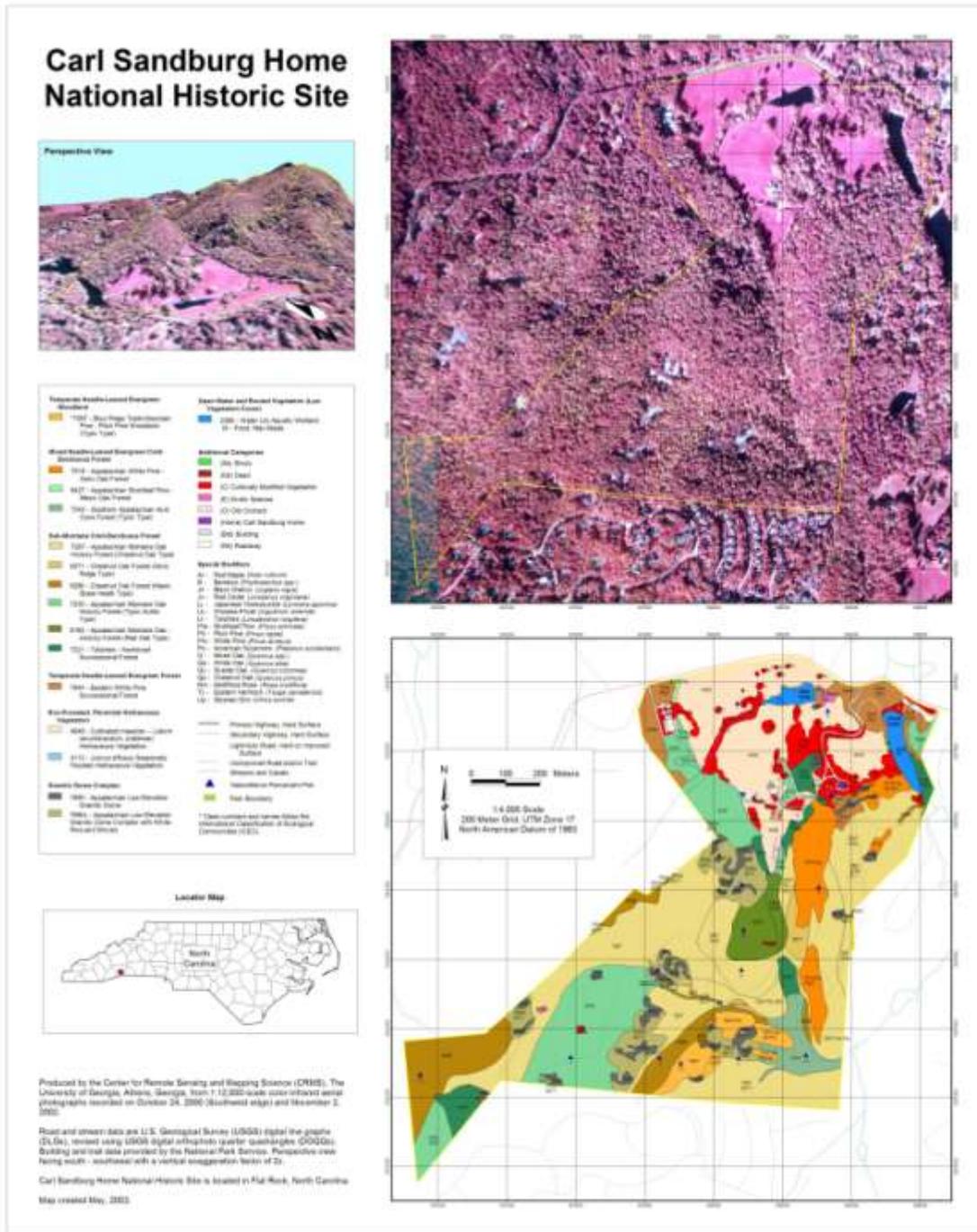


Figure B1: Color infrared photo and vegetation map of Carl Sandburg Home National Historic Site.

Table B2: Photo centers for Carl Sandburg Home.

CARL (UTM 17) Meters		
Photo ID	X	Y
1645R	368219.8	368219.8

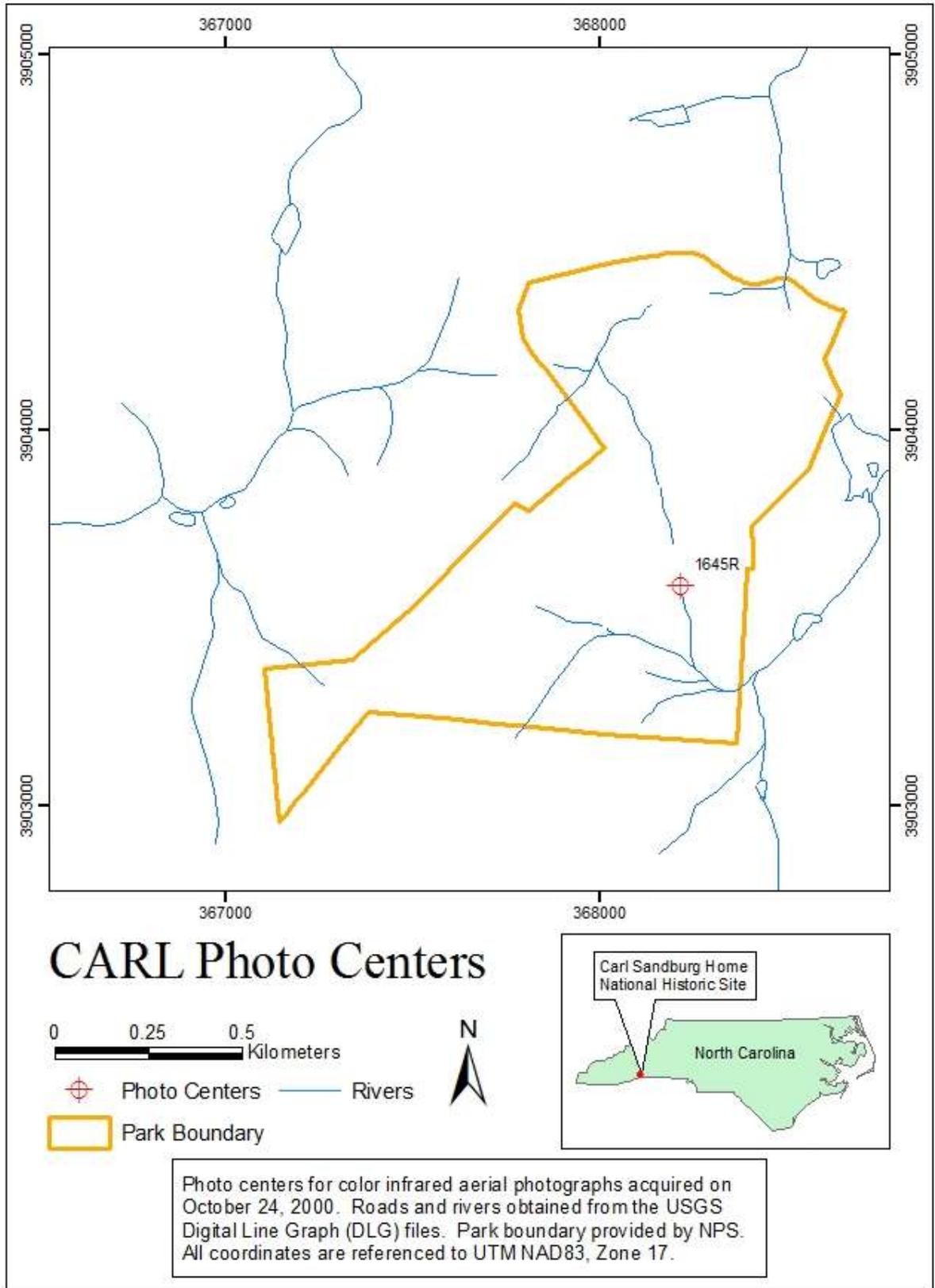


Figure B2: Photo centers map for Carl Sandburg Home.

Appendix C: Cowpens National Battlefield

Vegetation Classification System

Rounded-Crown Temperate Needle-Leaved Evergreen Forests

- 6327 Shortleaf Pine Early Successional Forest
6011 Loblolly Pine – (Sweet Gum, Red Maple)/Deerberry Forest
PIs White Pine (*Pinus strobus*), planted
PIv Virginia Pine (*Pinus virginiana*), planted

Submontane Cold-Deciduous Forest

- 7221 Tuliptree – Mixed Hardwood Successional Forest
6227 Southern Piedmont White Oak – (Tuliptree – Sweet Gum – Mockernut Hickory)/Deerberry Forest
7216 Sweet Gum Successional Forest (at Cowpens, with Persimmon, Black Cherry, Southern Red Oak, White Oak)
7244 Interior White Oak – Southern Red Oak – (Post Oak – Scarlet Oak – Mockernut Hickory/Heartleaf Forest)
4638 Water Oak – Willow Oak Successional Forest

Temporary Flooded Cold-Deciduous Forest

- 7330 Sweet Gum Successional Floodplain Forest
4418 Tuliptree – Sweet Gum/ Spicebush/ Jack-in-the-Pulpit Small Stream Forest
Bn River Birch (*Betula nigra*)/ Herbaceous Wetland

Savannahs and Woodlands

- SAVd Derived Savannah, Woodland; maintained by mowing (no new recruitment); formerly maintained by fires
SAVm Savannah, Successional in old field, maintained by mowing
3722 Piedmont Granitic White Oak – Black Oak – Post Oak/Little Bluestem Woodland

Temperate Broad-Leaved Evergreen Shrubland

- 8560 Golden Bamboo Shrubland (Exotic)

Temperate Cold-Deciduous Shrubland

- 4732 Blackberry – Dewberry – (Greenbriar species)/ Tree Saplings/ Herbaceous
8568 Wisteria Vine Shrubland (Exotic)

Herbaceous Vegetation

- 4044 Broomsedge – Native Grasses and Forbs, Successional
4048 Fescue – Exotic and Native Grasses and Forbs, Successional
OF Old Field formerly cleared for agriculture; “weedy” herbaceous species
Wt Herbaceous Wetland

Other Categories

Cem	Cemetery
HI	Human Influence (e.g. Old or Present Homesite)
Rd	Road / Parking Lot
W	Water
Bld	Building

Special Modifiers

:Dd	Dead vegetation
:d	Disturbed, cut over (recent)
:t	Scattered trees in old field, grassland
:m	Maintained by mowed, no new recruitment
:p	Planted, even-age stand
:s	Very early successional
:r	Regeneration, even-age saplings
:SSb	Successional tree saplings and shrubs
:Ag	Native Giant Cane (<i>Arundinaria gigantea</i>)
:Ar	Red Maple (<i>Acer rubrum</i>)
:Ci	Pecan (<i>Carya illinoensis</i>)
:Dv	Persimmon (<i>Diospyros virginia</i>)
:Jn	Black Walnut (<i>Juglans nigra</i>)
:Jv	Red Cedar (<i>Juniper virginiana</i>)
:Lt	Tuliptree (<i>Liriodendron tulipifera</i>)
:Ple	Shortleaf Pine (<i>Pinus echinata</i>)
:Piv	Virginia Pine (<i>Pinus virginiana</i>)
:Ps	Black Cherry (<i>Prunus serotina</i>)
:Qm	Blackjack Oak (<i>Quercus marylandica</i>)
:Qn	Water Oak (<i>Quercus nigra</i>)
:Qp	Willow Oak (<i>Quercus phellos</i>)
:Qa	White Oak (<i>Quercus alba</i>)
:Qf	Southern Red Oak (<i>Quercus falcata</i>)
:Qx	Mixed Oak Species, may be planted (<i>Quercus</i> spp.)
:Sn	Black Willow (<i>Salix nigra</i>)

Additional Generalized Buffer Classes

Ag	Agriculture
Cem	Cemetery
CF	Coniferous Forest
DF	Deciduous Forest
Lwn	Lawn
MF	Mixed Forest
Rd/P	Road/Parking Lot
Res	Residential
W	Water
SS/OF	Shrub – Sapling / Old Field Successional
SS/OF/d	Shrub – Sapling / Old Field Successional Disturbed

COWP Vegetation Statistics

Table C1: Dominant vegetation statistics for Cowpens National Battlefield

Dominant Vegetation	Count	Average Area	Area (sq. m)	Area (ha)	Area (acres)
4044	9	11059.87	99538.79	9.95	
4048	62	8080.20	500972.12	50.10	
4418	18	20579.09	370423.56	37.04	
4638	1	2341.48	2341.48	0.23	
4732	13	4728.27	61467.48	6.15	
6011	30	8528.67	255859.98	25.59	
6227	2	1552.88	3105.75	0.31	
6327	74	6608.71	489044.68	48.90	
7216	48	9644.96	462958.05	46.30	
7221	19	5467.70	103886.32	10.39	
7244	54	8775.70	473887.85	47.39	
7330	3	5958.44	17875.31	1.79	
8560	3	3421.28	10263.84	1.03	
Bld	9	665.95	5993.51	0.60	
Bn	1	3300.75	3300.75	0.33	
CEM	2	187.01	374.03	0.04	
HI	17	2456.35	41757.88	4.18	
OF	24	11660.20	279844.88	27.98	
Pls	4	1016.27	4065.09	0.41	
Plv	1	2782.67	2782.67	0.28	
Rd	7	19271.08	134897.53	13.49	
SAVd	11	6371.50	70086.47	7.01	
W	1	1594.39	1594.39	0.16	
Wt	1	582.50	582.50	0.06	
Total	414			339.69	839.04

COWP Vegetation Distribution

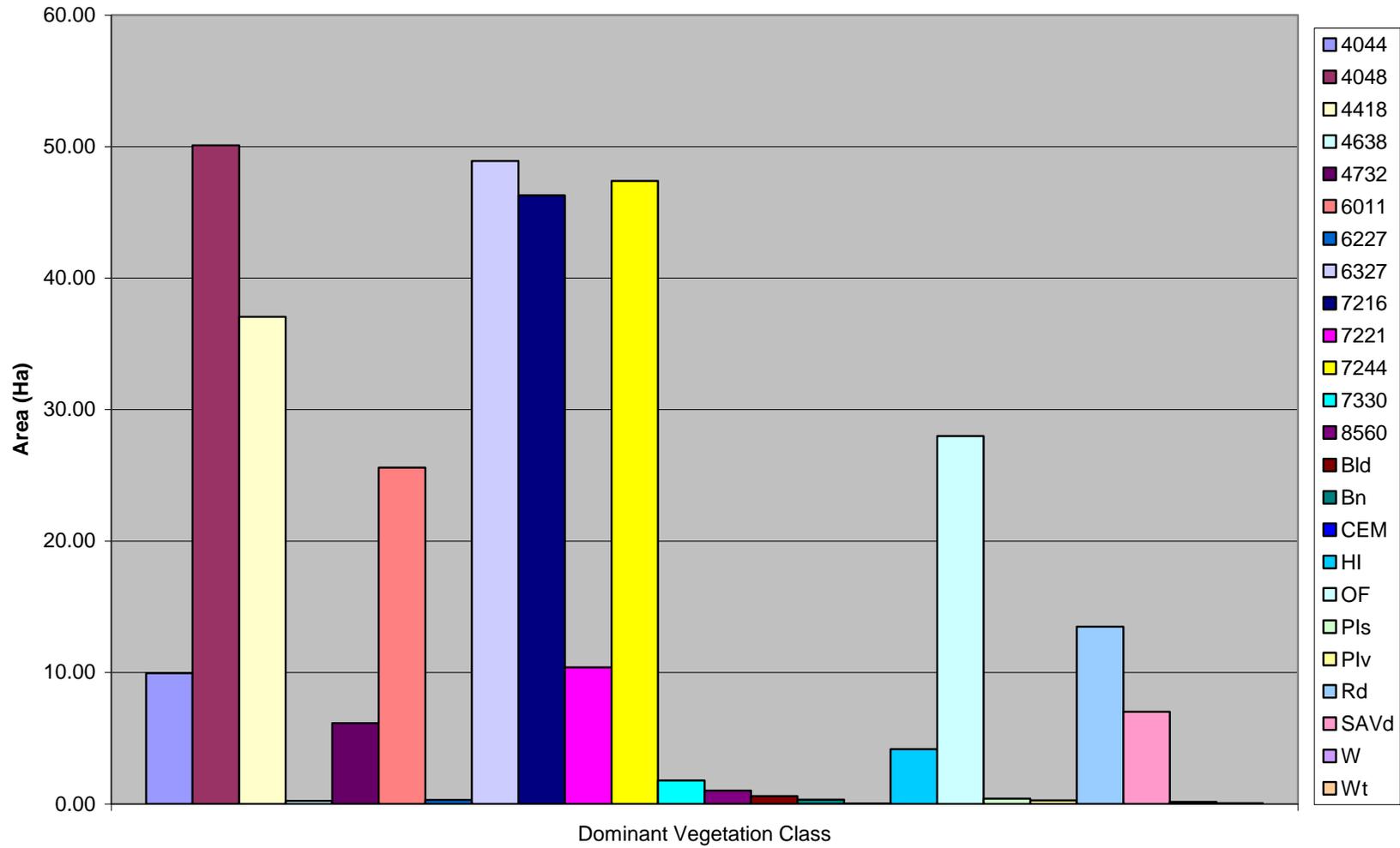


Table C2: Photo centers for Cowpens National Battlefield.

COWP (UTM 17) Meters		
Photo ID	UTM_X	UTM_Y
1648	425852.38	3886479.04
1649	425857.13	3887314.37
1650	425857.13	3888002.57
1651	425842.89	3888705.00
1652	425842.89	3889454.90
1656	427390.15	3885719.65
1657	427428.12	3886725.84
1658	427437.61	3887603.89
1659	427413.88	3888496.17
1660	427485.07	3889307.77

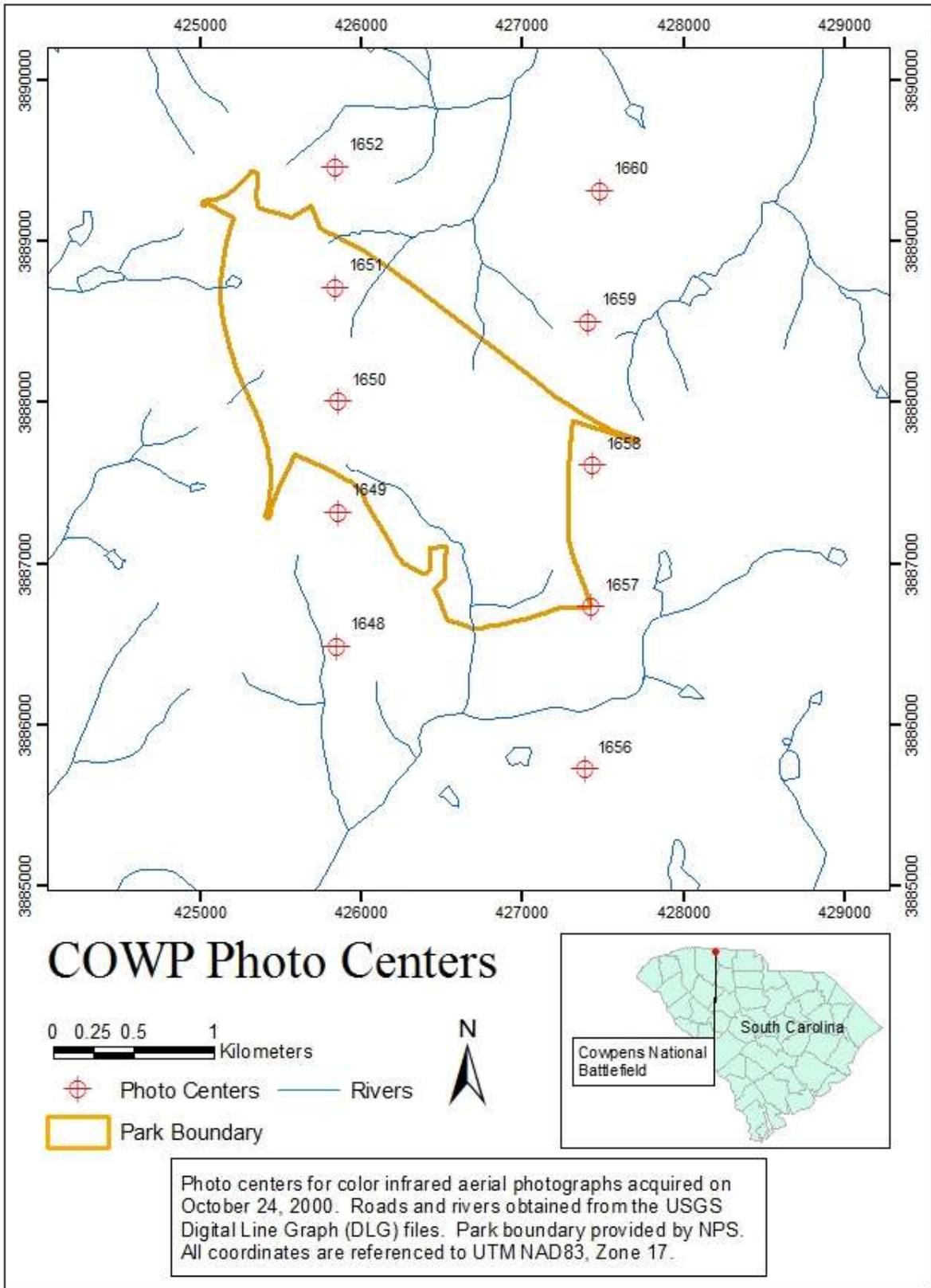


Figure C2: Photo centers map for Cowpens National Battlefield.

Appendix D: Cumberland Gap National Historical Park

Vegetation Classification System

Needle-Leaf Evergreen Forest

- 2591 Virginia Pine Successional Forest
- 7124 Eastern Red Cedar (Oak Species) Forest

Submontane Cold - Deciduous Forest

- 8558 Southern Appalachian Acidic Mixed Hardwood Forest
- 7881 Central Interior Beech – White Oak Forest
- 5222 Northern Mixed Mesophytic Forest
- 7220 Successional Tuliptree Forest (Circumneutral Type)
- 7221 Interior Mid to Late-Successional Tuliptree – Hardwood Upland Forest (Acidic Type)
- 7240 Ridge and Valley Dry-Mesic White Oak Forest
- 7692 Appalachian Mixed Oak-Hickory Forest (Rich Type)
- 6192 Appalachian Montane Oak-Hickory Forest (Red Oak Type)
- 4793 Ridge and Valley Limestone Oak-Hickory Forest
- 6271 Chestnut Oak Forest (Xeric Ridge Type)
- 7267 Appalachian Montane Oak-Hickory Forest (Chestnut Oak Type)
- 4096 Southern Blue Ridge Successional Sassafras Forest
- 6286 Chestnut Oak Forest (Mesic Slope Health Type)

Temporarily Flooded – Cold Deciduous Forest

- 7340 Sycamore – Sweetgum Piedmont Swamp Forest

Mixed Evergreen – Deciduous Forest

- 8407 Cumberland/Appalachian Hemlock – hardwood Forest Cove
- 7136 Southern Appalachian Eastern Hemlock Forest (Typic Type)

Needle-Leaf Evergreen Woodland

- 7097 Blue Ridge Table Mountain Pine – Pitch Pine Woodland (Typic Type)
- 3617 Hi Lewis Pitch Pine Barrens

Cold – Deciduous Woodland

- 8458 Dry Calcareous Forest/Woodland

Shrublands

- 3814 Southern Appalachian Mountain Laurel Bald
- 3882 Kudzu Vine – Shrubland
- 4732 Blackberry – Greenbriar Successional Shrubland Thicket

- 3890 Summer Grape Vine – Shrubland
- 8470 Cumberland Sandstone Glade Heath Shrubland

Herbaceous

4048 Cultivated Meadow

Wetlands and Bogs

7771 Cumberland Stream Side Bog

8433 Southern Blue Ridge Beaver Pond Marsh

7565 Swamp Forest – Bog Complex (Typic Type)

Additional Categories

RD Road

HI Human Influence

W Water

RK Rock Outcrops

DdPI Dead Pine

PDR Post-Disturbance Recovery

CCL Clear Cut Logging

SEL Selective Logging

Species/Modifiers

Ar Red Maple (*Acer rubrum*)

Bl Sweet Birch (*Betula lenta*)

Rm Great Rhododendron (*Rhododendron maxima*)

Cspp Hickory species (*Carya* species)

Lt Tulip Poplar (*Liriodendron tulipifera*)

Qc Scarlet Oak (*Quercus coccinea*)

Qr Red Oak (*Quercus rubra*)

Qv Black Oak (*Quercus velutina*)

Sa Sassafras (*Sassafras albidium*)

Tc Eastern Hemlock (*Tsuga canadensis*)

CUGA Vegetation Statistics

Table D1: Dominant vegetation statistics for Cumberland Gap National Historical Park

DomVeg	Count	Average Area	Area (sq. m)	Area (ha)	Area (acres)
2591	43	13205.86	567852.18	56.79	140.26
3617	31	19702.34	610772.46	61.08	150.86
3814	35	9214.27	322499.35	32.25	79.66
3890	1	4166.00	4166.00	0.42	1.03
4048	48	16189.73	777107.24	77.71	191.95
4096	23	11488.94	264245.54	26.42	65.27
4732	25	8196.61	204915.16	20.49	50.61
4793	4	14074.92	56299.67	5.63	13.91
5222	100	29347.84	2934783.82	293.48	724.89
6192	140	51488.41	7208378.07	720.84	1780.47
6271	441	29741.51	13116007.57	1311.60	3239.65
6286	73	27055.63	1975060.98	197.51	487.84
7097	105	18439.28	1936124.42	193.61	478.22
7124	3	1198.83	3596.50	0.36	0.89
7136	38	43732.75	1661844.43	166.18	410.48
7220	53	27073.62	1434901.62	143.49	354.42
7221	11	25093.24	276025.68	27.60	68.18
7240	120	55887.18	6706461.13	670.65	1656.50
7267	339	45663.36	15479880.26	1547.99	3823.53
7340	24	17737.18	425692.38	42.57	105.15
7565	10	20703.45	207034.47	20.70	51.14
7692	82	155004.05	12710332.31	1271.03	3139.45
7771	4	8385.65	33542.60	3.35	8.29
7881	15	26226.06	393390.89	39.34	97.17
8407	85	24978.59	2123180.48	212.32	524.43
8458	56	30264.14	1694792.04	169.48	418.61
8470	13	13994.02	181922.27	18.19	44.93
8558	3	22518.64	67555.93	6.76	16.69
Ar	15	45099.72	676495.82	67.65	167.09
BI	41	51586.96	2115065.23	211.51	522.42
DDPI	102	30265.85	3087116.26	308.71	762.52
HI	49	4522.30	221592.68	22.16	54.73
PDR	3	7846.28	23538.84	2.35	5.81
RD	24	28115.74	674777.83	67.48	166.67
RK	99	10150.19	1004869.01	100.49	248.20
Rm	1	9945.59	9945.59	0.99	2.46
SEL	10	2714.28	27142.84	2.71	6.70
Total	2269			8121.89	20061.07

CUGA Vegetation Distribution

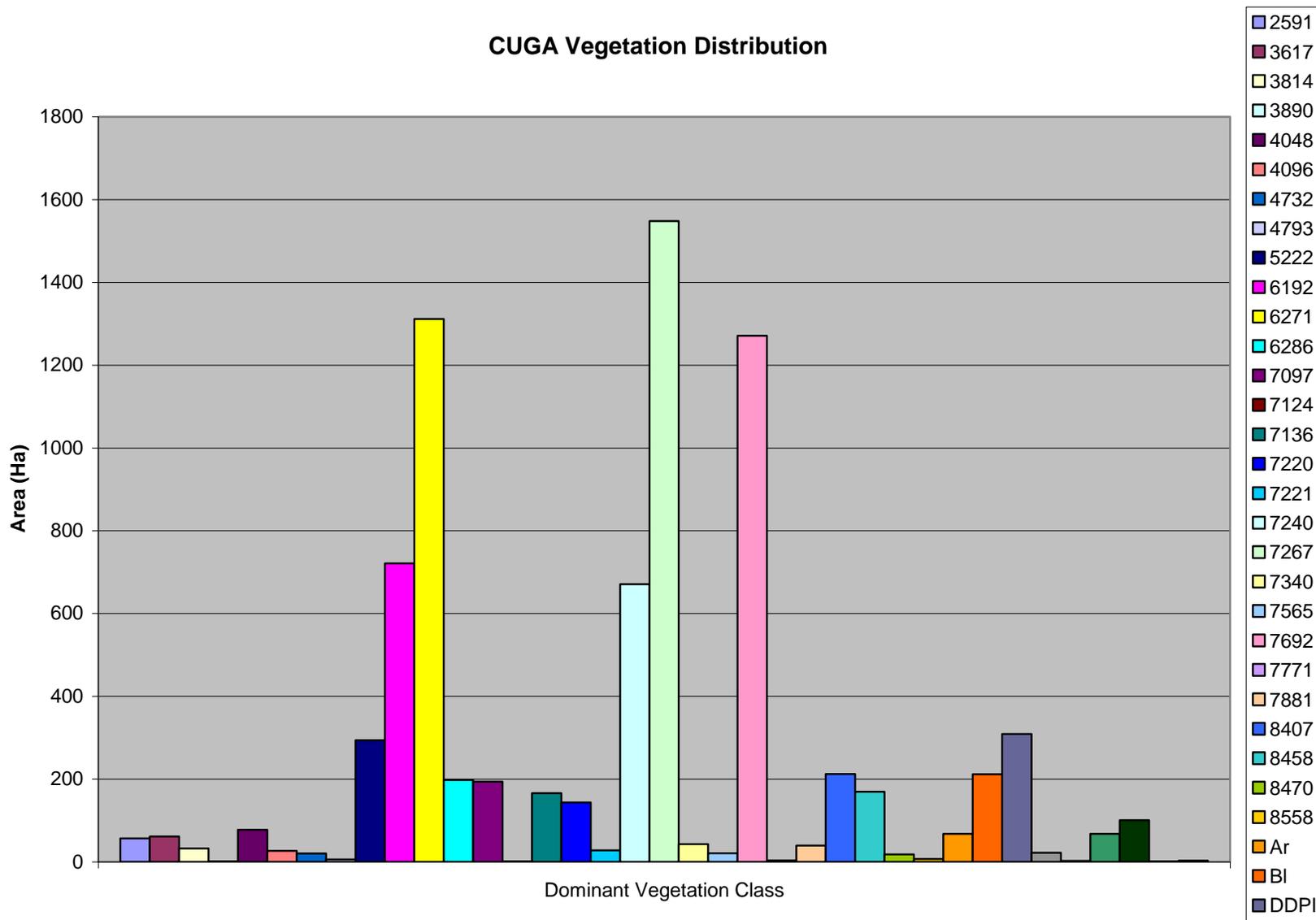


Table D2: Photo centers for Cumberland Gap.

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1_06R	261712.13	4051087.88
1_07R	263212.13	4051437.88
1_08R	264724.63	4051987.88
2_01R	255793.63	4052044.38
2_02R	257224.63	4052444.38
2_03R	258643.63	4052894.38
2_04R	260168.63	4053281.88
2_05R	261549.63	4053644.38
2_06R	262956.13	4054025.38
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2_10R	268606.13	4055662.88
2_11R	270124.63	4055994.38
2_12R	271556.13	4056444.38
2_13R	272999.63	4056956.88
2_14R	274624.63	4057325.38
2_15R	276081.13	4057737.88
2_16R	277543.63	4058225.38
2_17R	278887.13	4058600.38
2_18R	280093.63	4058906.88
2_19R	281343.63	4059206.88
2_20R	282599.63	4059600.38
2_21R	283849.63	4059950.38
2_22R	285149.63	4060350.38
2_23R	286418.63	4060750.38
2_09R	267118.63	4055219.38
3_10R	268231.13	4058119.38
3_11R	269537.13	4058556.88
3_12R	270812.13	4058937.88
3_13R	272037.13	4059256.88
3_14R	273374.63	4059575.38
3_15R	274618.63	4060006.88

3_16R	275937.13	4060275.38
3_17R	277168.63	4060744.38
3_18R	278449.63	4061094.38
3_19R	279743.63	4061362.88
3_01R	255381.13	4054431.88
3_20R	280981.13	4061731.88
3_21R	282281.13	4062181.88
3_22R	283568.63	4062525.38
3_23R	284993.63	4062906.88
3_24R	286293.63	4063312.88
3_02R	256931.13	4054900.38
3_02R	258431.13	4055387.88
3_04R	259931.13	4055762.88
3_05R	261387.13	4056212.88
3_06R	262737.13	4056662.88
3_07R	264187.13	4056912.88
3_08R	265487.13	4057412.88
3_09R	266837.13	4057762.88
4_10R	269537.13	4061194.38
4_11R	270887.13	4061550.38
4_12R	272149.63	4061925.38
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4_14R	274531.13	4062681.88
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4_18R	279774.63	4064125.38
4_19R	281012.13	4064425.38
4_01R	256487.13	4057487.88
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4_09R	268212.13	4060887.88
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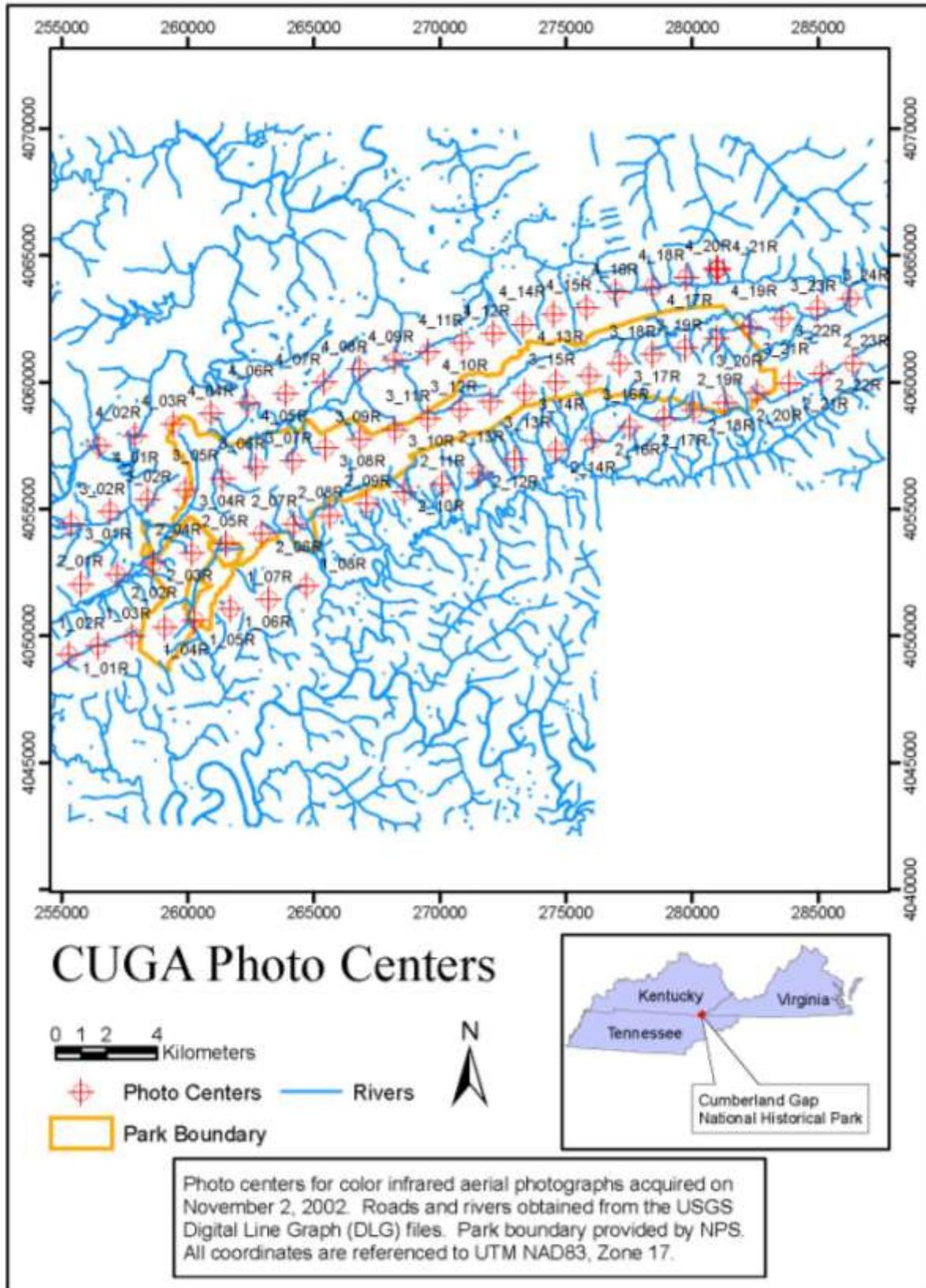


Figure D3: Photo centers map for Cumberland Gap.

Appendix E: Fort Donelson National Battlefield

Vegetation Classification System

Temperate Coniferous Evergreen Forests

- 7105 Loblolly Pine – Tuliptree/Sugar Maple, Mid to Late Successional Alkaline Forest
- 7124 Eastern Red Cedar – (Oak species) Forest

Submontane Central Interior Cold-Deciduous Forest

- 7881 Central Interior American Beech – White Oak/Dogwood Mesic Forest
- 7217 Sweetgum – (White Oak, Southern Red Oak) Mid and Late Successional Upland Forest
- 7220 Tuliptree/Redbud Successional (Circumneutral Type) Mesic Forest
- 7220:Cl:Jn Sugarberry – Black Walnut – (Successional Forest at Fort Donelson)
- 2070 White Oak – (Northern Red Oak – Chinquapin Oak – Shagbark Hickory – Mixed Hickory) / Redbud Dry – Mesic Alkaline Forest
- 3871 Cherryback Oak – (Southern Red Oak) / Eastern Hop-Hornbeam Dry – Mesic Alkaline Forest (At Fort Donelson, Southern Red Oak may co-dominate)

Temporary Flooded Cold-Deciduous Forest

- 7330 Sweetgum – (Tuliptree) Floodplain Forest
- 2103 Black Willow Riparian Forest
- 7334 Sycamore – Silver Maple – (Black Walnut – Slippery Elm) Calcareous Large River Floodplain Forest

Herbaceous Vegetation

- 4044 Grasslands, dominated by *Andropogon* spp. and other native grasses and forbs
- 4048 Cultivated Meadow dominated by fescue (*Lolium* spp.) and other exotic and native grasses and forbs

Sparse Vegetation – Seasonally/Temporarily Flooded Mud Flat

- 4049 Tennessee Valley Impoundment Mud Flat

Other Categories

- Ag Agriculture
- As Sugar Maple (*Acer saccharum*)
- Bld Building
- Cem Cemetery
- EW Earthworks
- F Fenced Row, with trees
- HI Human Influence
- Huts Civil War Soldiers' Huts
- LWB Lower Water Battery, earthworks with cannons
- Lwn Lawn
- MON Confederate Monument

- OF Old Field, formerly for agriculture; “weedy” herbaceous species with seedling/saplings
- PIs Eastern White Pine (*Pinus strobus*)
- Ra Roadway, abandoned
- Rb Road Bank
- Rd Road
- SAVm Derived Savannah, maintained by mowing
- Sb Successional Tree Saplings and Shrubs

Special Modifiers

- :Dd Dead vegetation
- :d Disturbed, cut over (recent)
- :m Mowed
- :p Planted
- :s Very early successional
- :t Scattered Trees, in lawn or field
- :Asi Silver Maple (*Acer saccharinum*)
- :As Sugar Maple (*Acer saccharum*)
- :At Paw-Paw (*Asimina triloba*)
- :Cl Sugarberry (*Celtis laevigata*)
- :Cx Shagbark Hickory (*Carya ovata*) and mixed *Carya* spp.
- :E Exotic, Privet (*Ligustrum sinense*)
- :Fg American Beech (*Fagus grandifolia*)
- :Jn Black Walnut (*Juglans nigra*)
- :Jv Eastern Red Cedar (*Juniper virginiana*)
- :Lt Tuliptree (*Liriodendron tulipifera*)
- :Mp Osage Orange (*Maclura pomifera*)
- :PIs Eastern White Pine (*Pinus strobus*)
- :PIt Loblolly Pine (*Pinus taeda*)
- :Qa White Oak (*Quercus alba*)
- :Qf Southern Red Oak (*Quercus falcata*)
- :Po Sycamore (*Plantanus occidentalis*)

Additional Generalized Buffer Classes

- Ag Agriculture
- Cem Cemetery
- C/I Commercial/Industry
- DF Deciduous Forest
- HR Horseriding Ring
- Lwn Lawn
- M Mud Flat
- MF Mixed Forest
- Rd/P Road/Parking Lot
- Res Residential
- SS/OF/d Shrub – Sapling / Old Field, successional disturbed
- W Water

FODO Vegetation Statistics

Table E1: Dominant vegetation statistics for Fort Donelson National Battlefield

DomVeg	Count	Average Area	Area (sq. m)	Area (ha)	Area (acres)
2070	37	15778.18	583792.71	58.38	144.20
2103	2	2140.49	4280.99	0.43	1.06
3871	26	11738.96	305213.06	30.52	75.39
4044	19	8857.14	168285.65	16.83	41.57
4048	19	2588.09	49173.65	4.92	12.15
4049	11	604.64	6651.04	0.67	1.64
7105	8	9336.71	74693.70	7.47	18.45
7124	18	1918.75	34537.43	3.45	8.53
7217	9	6242.66	56183.97	5.62	13.88
7220	41	10483.52	429824.20	42.98	106.17
7334	16	4820.89	77134.25	7.71	19.05
7881	1	7518.11	7518.11	0.75	1.86
Ag	1	25685.17	25685.17	2.57	6.34
As	1	848.72	848.72	0.08	0.21
Bld	4	187.57	750.27	0.08	0.19
CEM	2	11052.91	22105.82	2.21	5.46
EW	7	1100.60	7704.18	0.77	1.90
HI	7	1314.65	9202.54	0.92	2.27
Huts	1	109.88	109.88	0.01	0.03
LWB	1	1412.82	1412.82	0.14	0.35
Lwn	17	2794.36	47504.18	4.75	11.73
MON	1	13.25	13.25	0.00	0.00
Pls	3	1691.07	5073.22	0.51	1.25
Ra	3	2688.47	8065.41	0.81	1.99
Rb	2	7148.09	14296.19	1.43	3.53
Rd	7	10301.35	72109.47	7.21	17.81
SAVm	10	6738.40	67383.98	6.74	16.64
Sb	2	579.86	1159.72	0.12	0.29
W	6	2436.99	14621.92	1.46	3.61
F	2	1049.41	2098.83	0.21	0.52
Total	284			209.74	518.07

FODO Vegetation Distribution

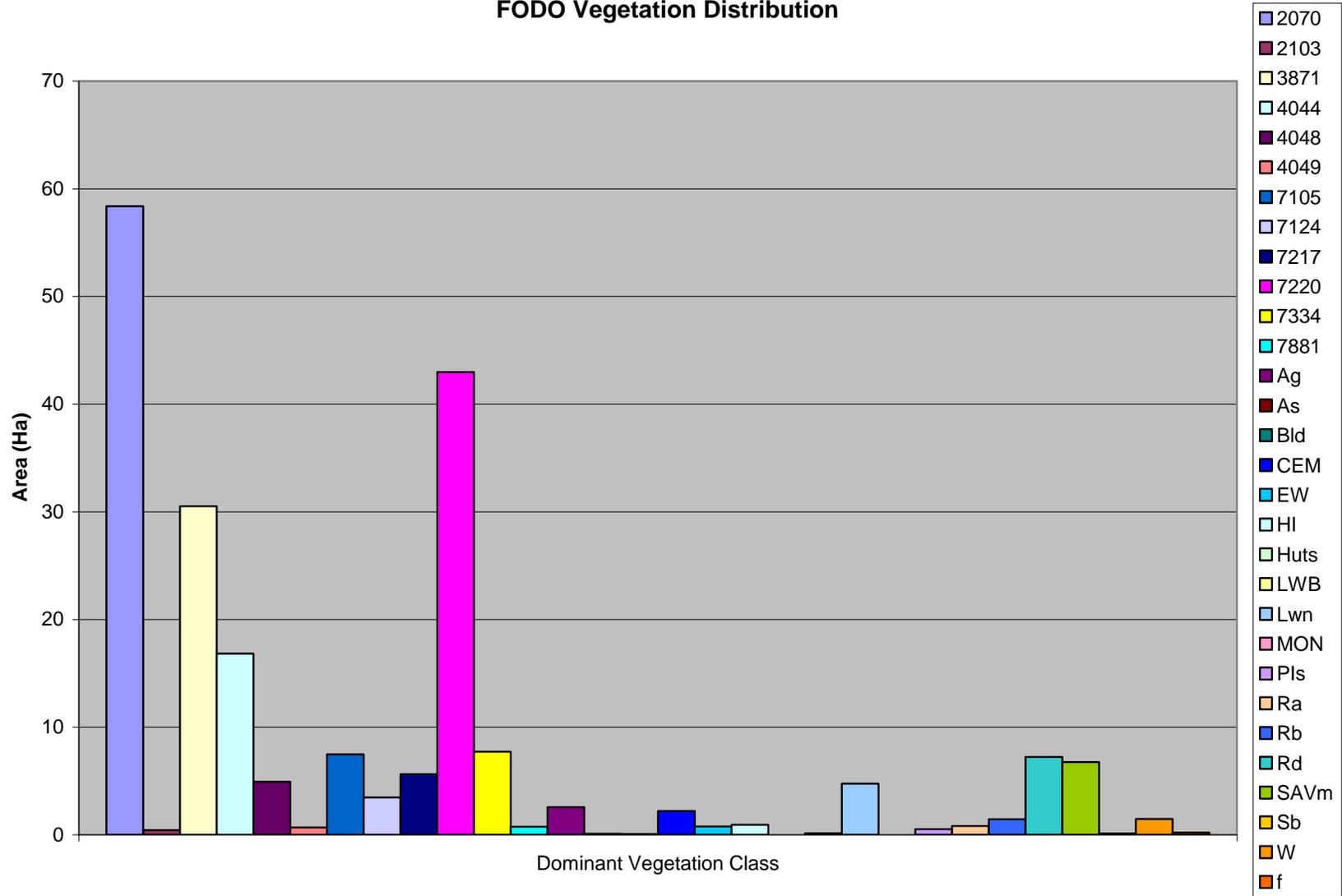


Table E2: Photo centers for Fort Donelson.

FODO (UTM 16) Meters		
Photo ID	X	Y
1498	425145.81	4039086.70
1499	424152.61	4039063.06
1500	423036.45	4039129.27
1501	421995.96	4039067.79
1503	425893.07	4037242.20
1504	424814.74	4037308.41
1505	423883.03	4037317.87
1506	422762.14	4037322.60
1507	421768.95	4037360.44

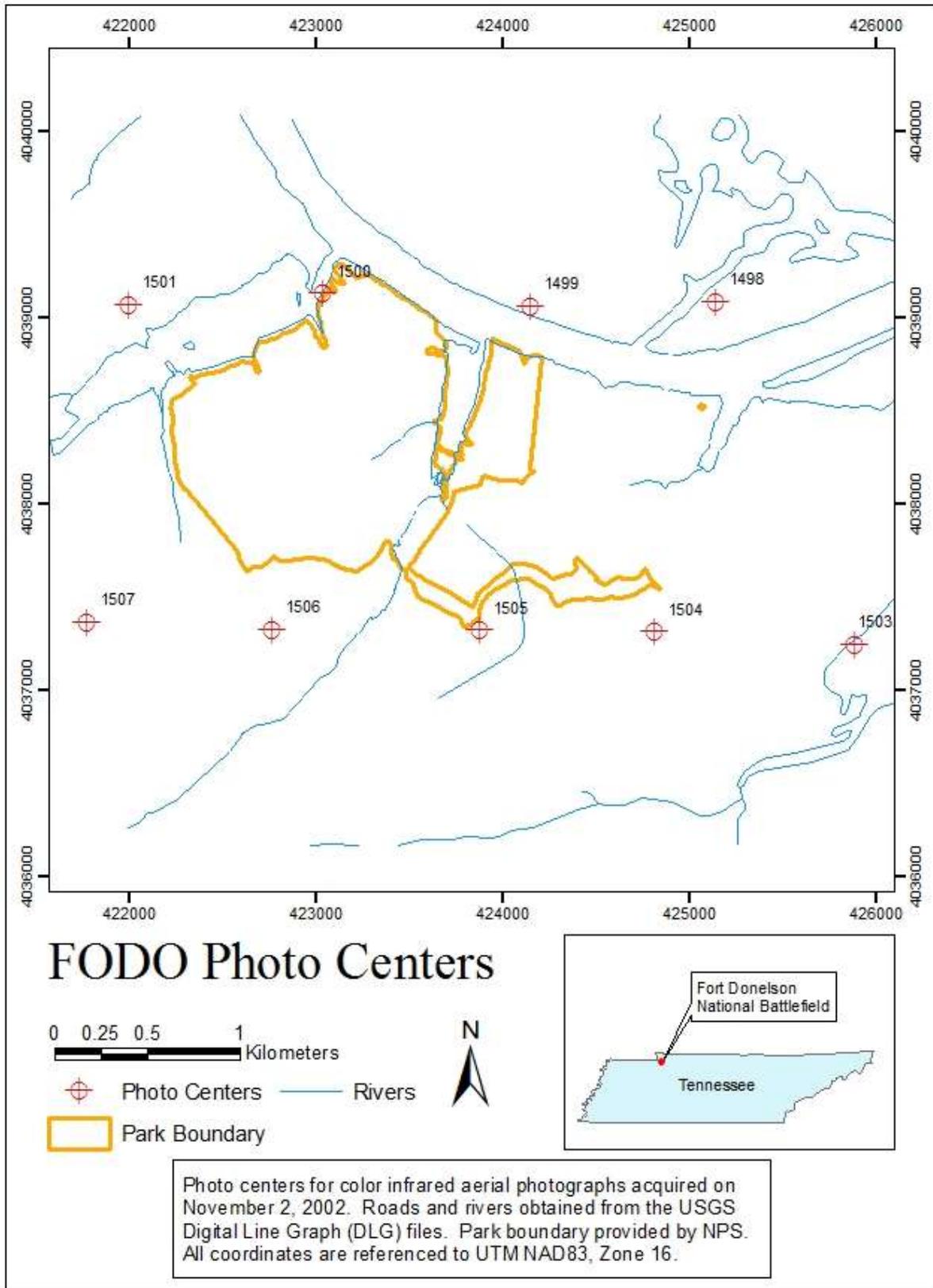


Figure E2: Photo centers map for Fort Donelson.

Appendix F: Guilford Courthouse National Military Park

Vegetation Classification System

Needle-Leaf Evergreen Forest

- 8462 Loblolly Pine/Sweetgum Successional
- 855 Virginia Pine Successional
- 875 Mixed Shorleaf and Virginia Pine Successional
- 876 White Pine

Submontane Cold-Deciduous Forest

- 8475 White Oak (Red Oak, Scarlet Oak, Hickory)/ Vaccinium pallidum Piedmont Dry Mesic
- 8465 American Beech – Northern Red Oak/Flowering Dogwood/Christmas Fern – Virginia Acidic Piedmont Mesic
- 7244 Southern Red Oak – White Oak – Mockernut Hickory/Sourwood/Deerberry Dry Mesic
- 4638 Water Oak – Willow Oak Successional
- 7221 Tuliptree – Red Maple – Oak Successional
- 820 Sweetgum Successional
- 801 Black Walnut Successional, formerly cultivated
- 802 Pecan Orchard, formerly cultivated

Temporary Flooded Cold-Deciduous Forest

- 7730 Sycamore – Green Ash – Sugarberry – Florida Maple/Spicebush
- 8487 Swamp Chestnut Oak, Shumard Oak, Cherrybark Oak, Oglethorpe Oak – Sweetgum
- 4740 Sugarberry, Green Ash – Box Elder
- 4418 Piedmont Small-stream Sweetgum/Northern Spicebush Bottomland
- 800 Black Walnut, Sugarberry, Elm, Grape Vine
- 440 Tuliptree (Sycamore) Bottomland

Herbaceous Vegetation

- 4048 Fescue Cultivated Meadow
- M Cultivated Meadow

Shrubland

- Sb Successional Shrubland, formerly cleared field

Exotic Species

- 8568 Wisteria Vine Shrubland
- 898 Exotic Species Dominated

Water

- W Water
- 202 Mud Bar
- W-201 Pond with Emergent and Floating Vegetation

Human Influence and Culturally Modified

- C Culturally Modified Vegetation
- Bld Building
- Rd Road
- F Old Fort, Earth Mounds
- Well Old Fort Well
- Tr Trail
- HI Old Homesite
- AAA Unknown

Special Modifiers

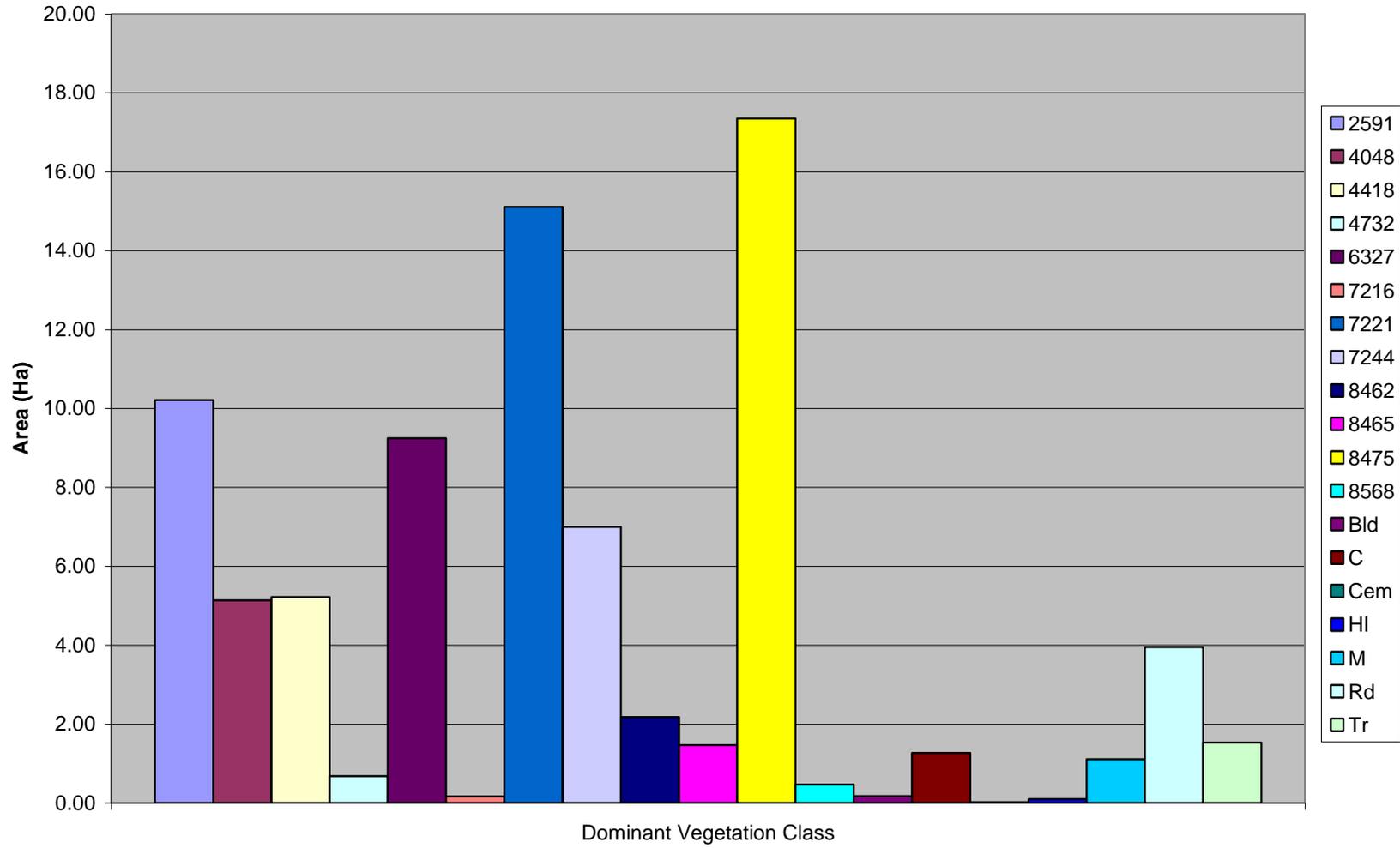
- 20 Scattered Shrubs and Trees in Meadow
- 89 Former Field; Large crown trees widely spaced
- As Sugar Maple (*Acer saccharum*)
- B Bamboo (Exotic)
- Br Broomsedge
- Ci Pecans
- CM Cemetery
- Co Sugarbeey (*Celtis occidentalis*), culturally modified
- Dd Dead, damage by insects
- G Graminoid
- Jv Red Cedar (*Juniper virginiana*)
- P Even Age and/of Planted
- PIs White Pine (*Pinus strobus*)
- Pr Privet (Exotic)
- Qa White Oak (*Quercus alba*)
- Qr Red Oak (*Quercus rubra*)
- V Grape Vines

GUCO Vegetation Statistics

Table F1: Dominant vegetation statistics for Guilford Courthouse National Military Park

DomVeg	Count	Average Area	Area (sq. m)	Area (ha)	Area (acres)
2591	16	6382.34	102117.45	10.21	25.22
4048	12	4277.13	51325.55	5.13	12.68
4418	7	7449.75	52148.23	5.21	12.88
4732	3	2254.23	6762.69	0.68	1.67
6327	11	8401.74	92419.12	9.24	22.83
7216	1	1662.26	1662.26	0.17	0.41
7221	29	5209.02	151061.45	15.11	37.31
7244	5	13993.47	69967.34	7.00	17.28
8462	4	5440.43	21761.73	2.18	5.38
8465	3	4897.33	14691.99	1.47	3.63
8475	19	9130.63	173481.88	17.35	42.85
8568	1	4652.66	4652.66	0.47	1.15
Bld	6	286.56	1719.38	0.17	0.42
C	6	2116.26	12697.55	1.27	3.14
Cem	1	182.75	182.75	0.02	0.05
HI	2	475.82	951.64	0.10	0.24
M	6	1846.01	11076.07	1.11	2.74
Rd	2	19743.14	39486.27	3.95	9.75
Tr	9	1703.24	15329.13	1.53	3.79
Total	143			82.350	203.40

GUCO Vegetation Distribution



GUCO Map Product



Figure F1: Color infrared photo and vegetation map for Guilford Courthouse National Military Park

Table F2: Photo centers for Guilford Courthouse.

GUCO (UTM 17) Meters		
Photo ID	X	Y
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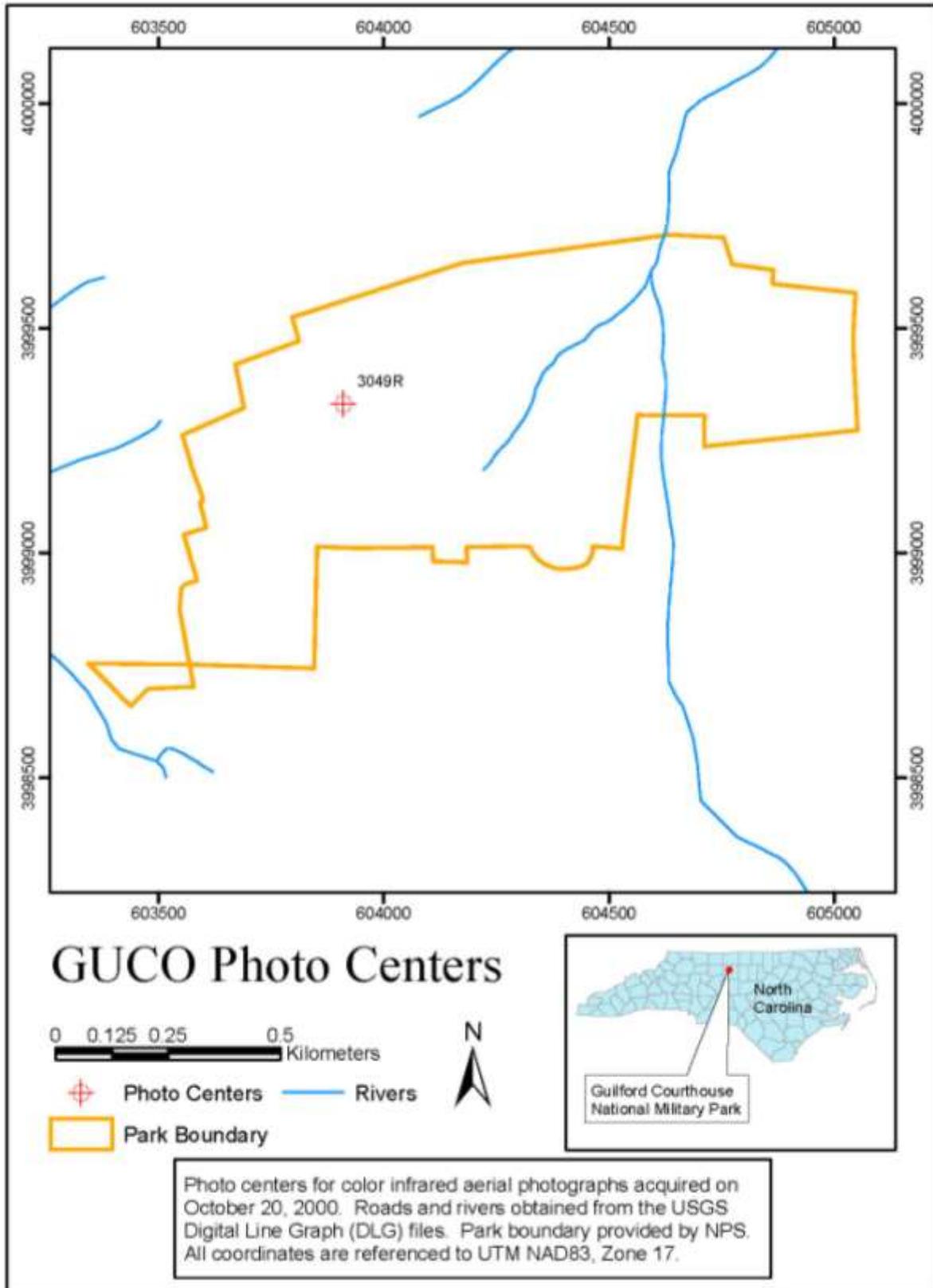


Figure F2: Photo centers map for Guilford Courthouse.

Appendix G: Little River Canyon National Preserve

Vegetation Classification System

Needle-Leaved Temperate Evergreen Forest

- 6327 Shortleaf Pine Early-Successional Forest
- 8462 Loblolly Pine – Sweetgum Mid to Late-Successional Forest
- 6011 Loblolly Pine Early to Mid-Successional Forest
- 7119 Virginia Pine – Shortleaf Pine – Chestnut Oak Forest
- 2591 Virginia Pine Successional Forest

Submontane Deciduous Forest

- 7192 Silktree (*Albizia julibrissin*) Successional Forest
- 4539 American Beech – White Oak – (Chestnut Oak)/Mountain Laurel – Catawba Rhododendron Bluff
- 4539:Qp/K Chestnut Oak/Mountain Laurel Bluff in northern Alabama
- 8428 White Oak – (Tuliptree – Sweetgum)/Chalk Maple/ Sweet-shrub Small Stream Forest
- 8488 Northern Red Oak – Basswood – Carolina Shagbark Hickory/Southern Sugar Maple – Chalk Maple/Oakleaf Hydrangea Forest
- 8430 White Oak-(Chestnut Oak)/ Oakleaf Hydrangea – Mapleleaf Viburnum Forest
- 8430:Qa 8430 dominated by White Oak, at Little River Canyon
- 8430:Qp 8430 dominated by Chestnut Oak, at Little River Canyon
- 8430:Cx 8430 dominated by Hickory (Pignut and/or Mockernut), at Little River Canyon
- 8430:Qp/K 8430 dominated by Chestnut Oak with Mountain Laurel understory, associated with rocky cliffs at Little River Canyon
- 7244 White Oak – (Southern Red Oak – Mixed Oak) – Pignut Hickory Forest
- 8431 Chestnut Oak – (Scarlet Oak)/Sand Hickory/*Vaccinium arboreum* –*Vaccinium pallidum* Forest and Woodland

Temporarily Flooded Deciduous Forest

- 4098 White Oak – (Scarlet Oak – Post Oak – Black Oak)/Mountain Laurel Temporarily Flooded High-Energy River Terrace Forest
- 7330 Sweetgum – (Tuliptree) Floodplain Forest

Seasonally Flooded Forest

- 7388 Red Maple – Sweetgum/Sedge spp./Sphagnum spp. Upland Depression Pond

Saturated Deciduous Forest

- 7443 Red Maple – Blackgum Forested Acid Steep, co-dominated by White Oak in Little River Canyon

Mixed Evergreen-Deciduous Forest

- 8427 Shortleaf Pine – Mesic Oak (White Oak – Southern Red Oak – Post Oak – Black Oak) Forest
7493 Shortleaf Pine – Dry Oak (Chestnut Oak – Southern Red Oak) Forest
7500 Shortleaf Pine – Xeric Oak (Post Oak – Chestnut Oak – Southern Red Oak) Forest

Temporarily Flooded Mixed Evergreen-Deciduous Forest

- 7546 Loblolly Pine – Tuliptree/Spicebush Bottomland Forest

Needle-Leaved Evergreen Woodland

- 3618 Loblolly Pine – (Shortleaf Pine)/ Little Bluestem Woodland

Temperate Cold-Deciduous Shrubland

- 8568 Wisteria Vine Shrubland (Exotic)

Temporarily Flooded Deciduous Shrubland

- 3895 Smooth Alder – Yellowroot Rocky Bar and Shore
8495 Bushy St. John’s Wort- Smooth Alder Riverscour Cobblebar

Saturated Mixed Evergreen-Deciduous Bog

- 3914 Smooth Alder – Smooth Azalea/Green Pitcherplant Seepage Bog

Medium-Tall Sod Temperate Grasslands

- 4044 Successional Broomsedge in former fields or pastures, with other pioneer or “weedy” perennial grasses and herbaceous species
4048 Cultivated meadow dominated by Fescue (*Lolium* spp.) and other exotic and native grasses and forbs

Low Temperate Perennial Forb

- 4622 Nuttalls’ Rayless goldenrod – Woodland Tickseed – Liatrus Alabama Cumberland Sandstone Glade
4622x Alabama Cumberland Sandstone Glade and Barrens Complex, with Virginia Pine and shrubs

Other Categories

- Ag Agriculture
BP Beaver Pond
CC Clear Cut
Dd Dead
HI Human Influence
Hdw Hardwoods, Sweetgum and other hardwoods remaining after pine canopy is dead
PI Pines
PIt Loblolly Pine (*Pinus taeda*)
PIv Virginia Pine (*Pinus virginiana*)
PIx Mixed Pines

Qx Mixed Oaks
 RK Rock
 ROW Right-of-Way
 RR Railroad
 Rd Road
 Sb Shrub, Woody Shrubland
 W Water
 WFP Wildlife Food Plot

Modifiers

:bb Blackberry Thicket
 :Cx Hickories (*Carya* spp.)
 :Dd Dead
 :Hdw Hardwoods, Sweetgum and other hardwoods remaining after pine canopy is dead
 :K Mountain Laurel (*Kalmia latifolia*)
 :Lt Tuliptree (*Liriodendron tulipifera*)
 :PI Pines
 :PIe Shortleaf Pine (*Pinus echinata*)
 :PIt Loblolly Pine (*Pinus taeda*)
 :PIv Virginia Pine (*Pinus virginiana*)
 :PIx Mixed Pines
 :Qa White Oak (*Quercus alba*)
 :Qp Chestnut Oak (*Quercus prinus*)
 :Qp/K Chestnut Oak with Mountain Laurel understory (*Quercus prinus/Kalmia latifolia*)
 :Qx Mixed Oaks
 :Qxr Mixed Oak, and other hardwoods regenerating, with a dense subcanopy in a thin pine forest
 :r Regeneration – small trees, very young stand
 :Rh Rhododendron spp.
 :sb Shrub, woody shrublands
 :SV Sparse Vegetation
 :t Thinned Forest
 :tt Very thinned forest, scattered tall trees

Buffer Classes

Ag Agriculture
 C/I Commercial/Industry
 Cc Clear Cut
 CF Coniferous Forest
 Lwn Lawn
 MF Mixed Forest
 Rd Road
 Res Residential
 RO Rock Outcrop
 RR Railroad
 SS/OF Shrub/Sapling/Old Field Successional

SS/OF/d
W

Shrub/Sapling/Old Field Successional disturbed
Water

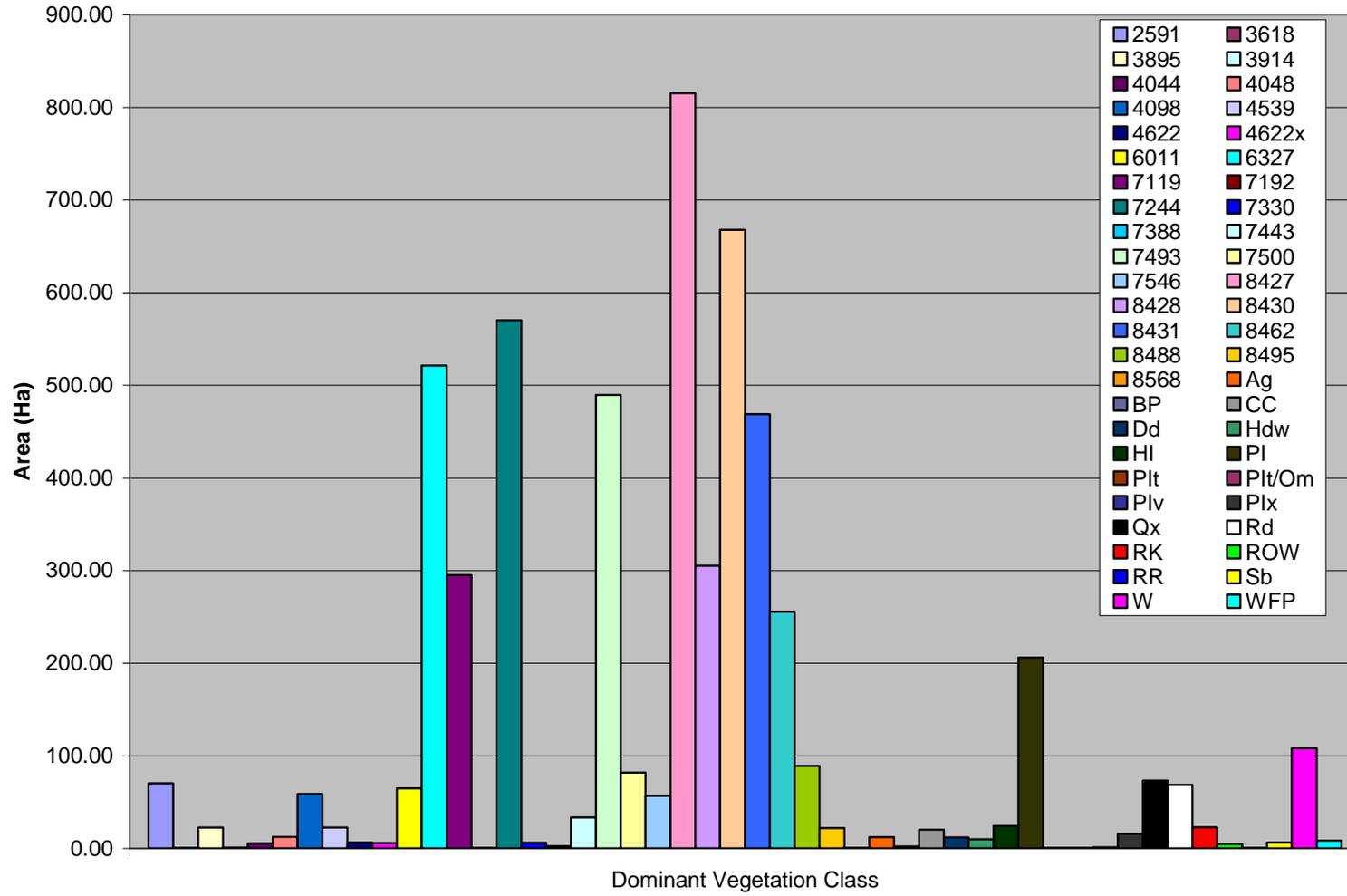
LIRI Vegetation Statistics

Table G1: Dominant vegetation statistics for the Little River Canyon National Preserve backcounty and canyon regions.

DomVeg	Count	Average Area	Area (sq. m)	Area (ha)	Area (acres)
2591	42	16753.43	703644.05	70.36	173.80
3618	1	3317.61	3317.61	0.33	0.82
3895	33	6847.66	225972.90	22.60	55.82
3914	3	2498.88	7496.65	0.75	1.85
4044	13	4301.88	55924.43	5.59	13.81
4048	6	20754.32	124525.92	12.45	30.76
4098	28	20978.73	587404.56	58.74	145.09
4539	10	22336.34	223363.44	22.34	55.17
4622	21	3071.33	64497.98	6.45	15.93
4622x	11	5282.02	58102.17	5.81	14.35
6011	45	14388.27	647472.23	64.75	159.93
6327	145	35946.10	5212183.98	521.22	1287.41
7119	138	21367.64	2948734.47	294.87	728.34
7192	1	4671.43	4671.43	0.47	1.15
7244	162	35201.99	5702721.69	570.27	1408.57
7330	6	10111.96	60671.77	6.07	14.99
7388	4	5521.05	22084.22	2.21	5.45
7443	19	17589.61	334202.63	33.42	82.55
7493	56	87400.09	4894405.23	489.44	1208.92
7500	13	62961.09	818494.14	81.85	202.17
7546	43	13171.08	566356.35	56.64	139.89
8427	155	52600.20	8153030.95	815.30	2013.80
8428	119	25642.97	3051513.20	305.15	753.72
8430	163	40976.17	6679116.01	667.91	1649.74
8431	67	69954.05	4686921.11	468.69	1157.67
8462	60	42603.07	2556184.22	255.62	631.38
8488	21	42345.08	889246.72	88.92	219.64
8495	34	6400.25	217608.40	21.76	53.75
8568	1	3294.62	3294.62	0.33	0.81
Ag	8	15104.06	120832.46	12.08	29.85
BP	2	9529.58	19059.16	1.91	4.71
CC	3	67609.28	202827.84	20.28	50.10
Dd	13	9032.04	117416.58	11.74	29.00
Hdw	7	14118.12	98826.83	9.88	24.41
HI	36	6743.78	242775.98	24.28	59.97
PI	126	16342.93	2059209.49	205.92	508.62
Plt	1	4096.71	4096.71	0.41	1.01
Plt/Om	1	2242.38	2242.38	0.22	0.55
Plv	2	5863.70	11727.40	1.17	2.90
Plx	6	25714.41	154286.43	15.43	38.11
Qx	24	30538.08	732913.86	73.29	181.03

DomVeg	Count	Average Area	Area (sq. m)	Area (ha)	Area (acres)
Rd	39	17613.02	686907.97	68.69	169.67
RK	63	3613.67	227661.45	22.77	56.23
ROW	6	7564.38	45386.26	4.54	11.21
RR	1	3612.98	3612.98	0.36	0.89
Sb	12	5173.47	62081.61	6.21	15.33
W	6	180272.09	1081632.56	108.16	267.16
WFP	26	3176.77	82596.01	8.26	20.40
Total	1802			5545.93	13698.44

LIRI Vegetation Distribution



LRIC Map Products

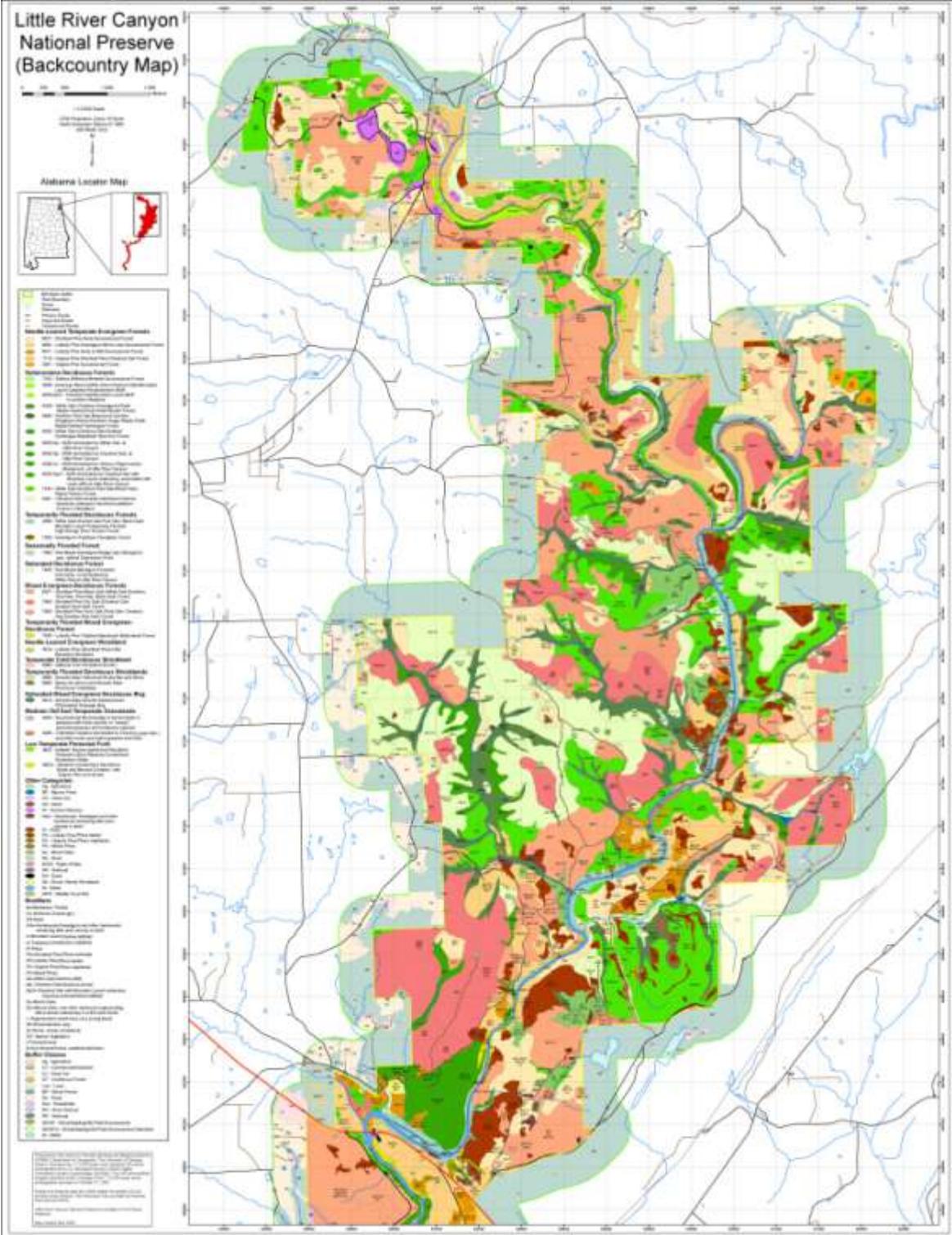


Figure G1: Vegetation map for the backcountry region of Little River Canyon National Preserve

CUPN Parks

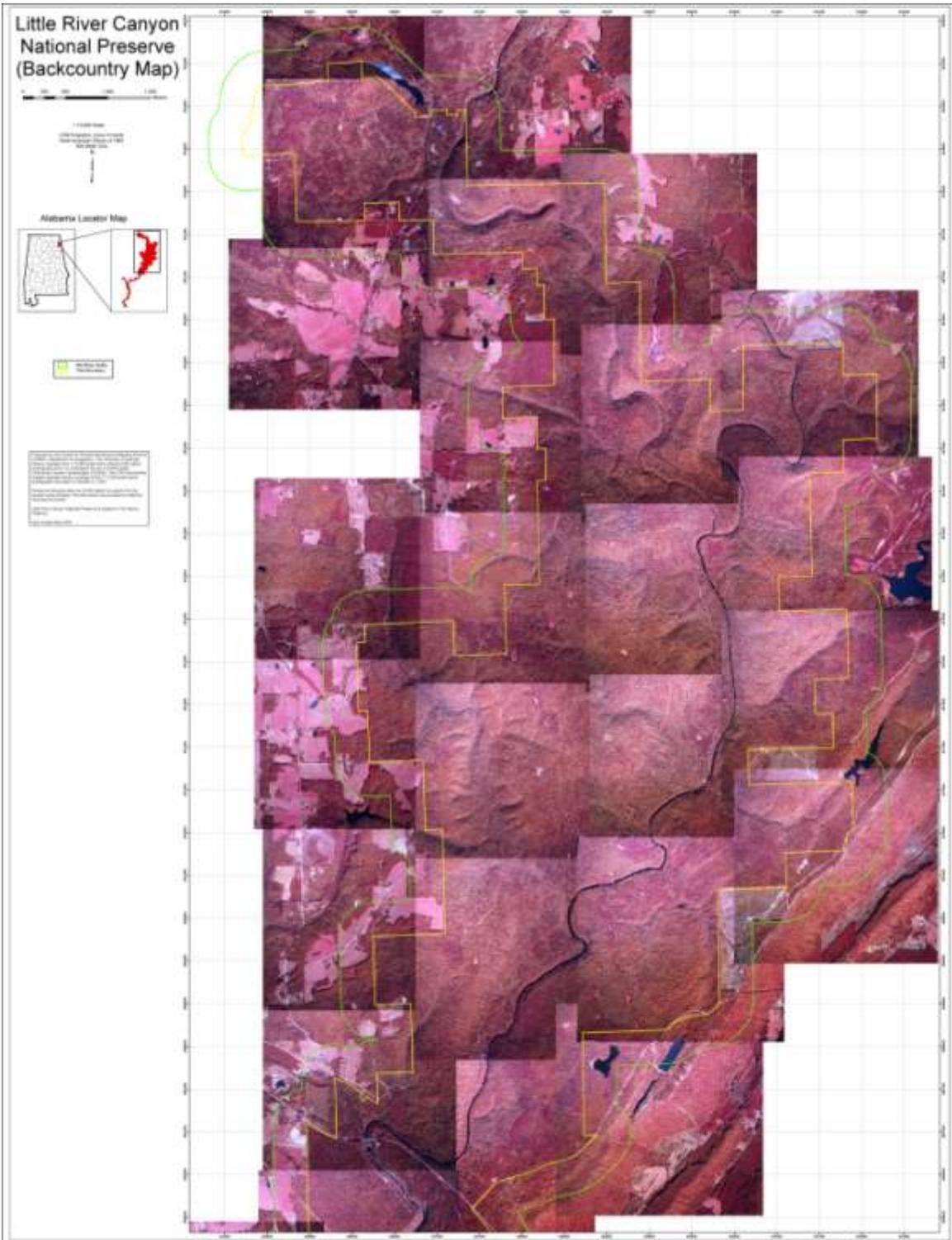


Figure G2: Color infrared photo map for the backcountry region of Little River Canyon National Preserve

CUPN Parks

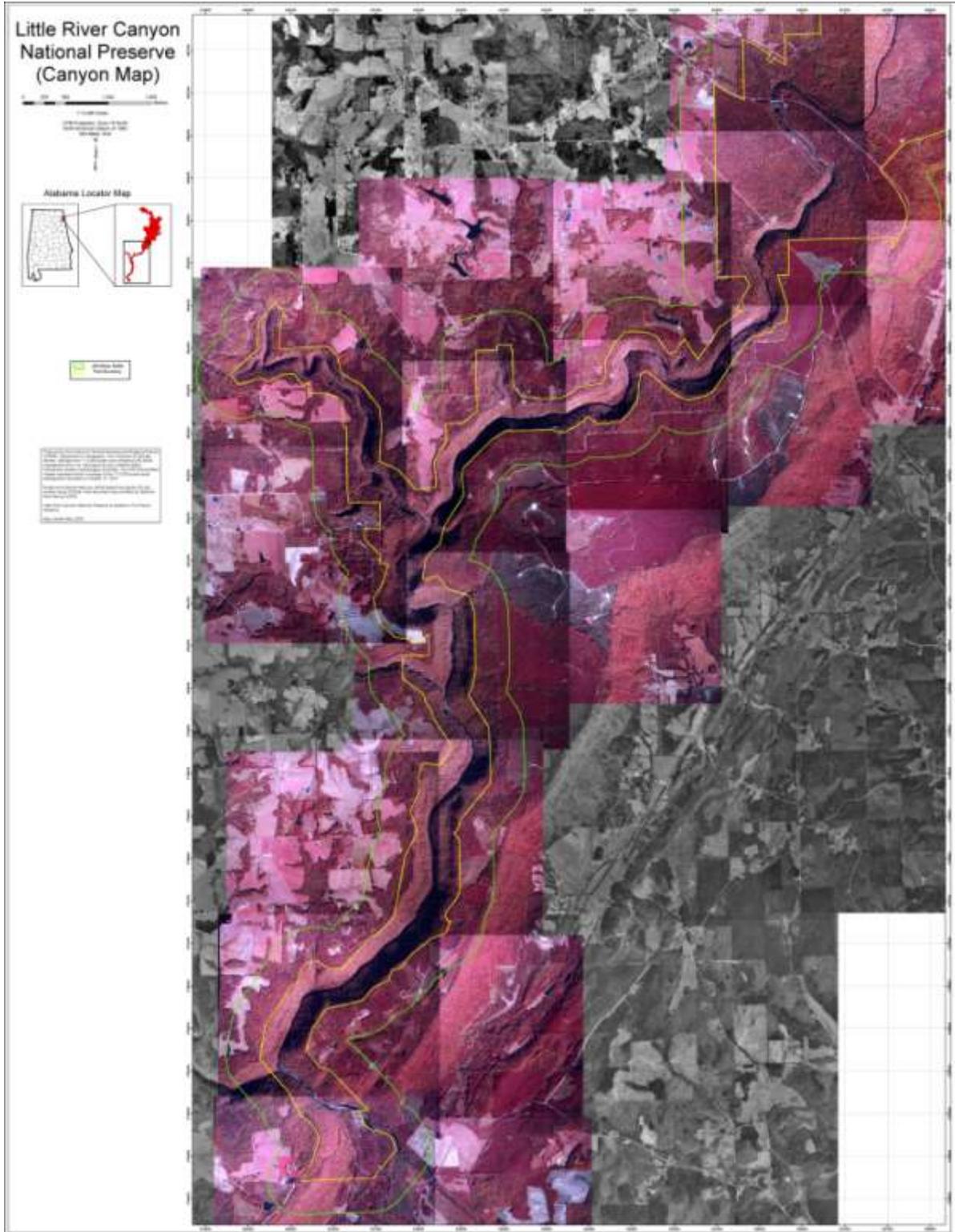


Figure G4: Color infrared (with DOQQs) photo map for the canyon region of Little River Canyon National Preserve.

CUPN Parks

Table G2: Photo centers for Little River Canyon.

LIRI (UTM 16) Meters		
Photo ID	X	Y
8664R	620899.60	3793900.40
8666R	620949.60	3796030.40
8668R	620993.60	3798090.40
8670R	620679.60	3801690.40
8672R	620629.60	3803770.40
8675R	622689.60	3793670.40
8677R	622689.60	3795860.40
8679R	622279.60	3798180.40
8681R	622509.60	3800440.40
8683R	622489.60	3802710.40
8685R	622439.60	3804760.40
8687R	624349.60	3800960.40
8689R	624389.60	3802960.40
8691R	624409.60	3804830.40
8694R	626129.60	3803320.40
8696R	626079.60	3805390.40
8698R	626089.60	3807450.40
8700R	626069.60	3809560.40
8702R	626029.60	3811620.40
8704R	625969.60	3813590.40
8707R	625729.60	3816450.40
8709R	626069.60	3818420.40
8711R	626069.60	3820360.40
8723R	627799.60	3804300.40

8725R	627679.60	3806680.40
8727R	627929.60	3809020.40
8729R	627949.60	3811110.40
8731R	627959.60	3813170.40
8733R	628019.60	3815170.40
8735R	628159.60	3817220.40
8737R	628069.60	3819250.40
8741R	629619.60	3807260.40
8743R	629869.60	3809250.40
8745R	629959.60	3811230.40
8747R	629989.60	3813250.40
8749R	629919.60	3815290.40
8751R	629609.60	3817270.40
8752R	629569.60	3818320.40
8756R	631699.60	3810110.40
8758R	631629.60	3811980.40
8760R	631689.60	3813800.40
8762R	631509.60	3815730.40

CUPN Parks

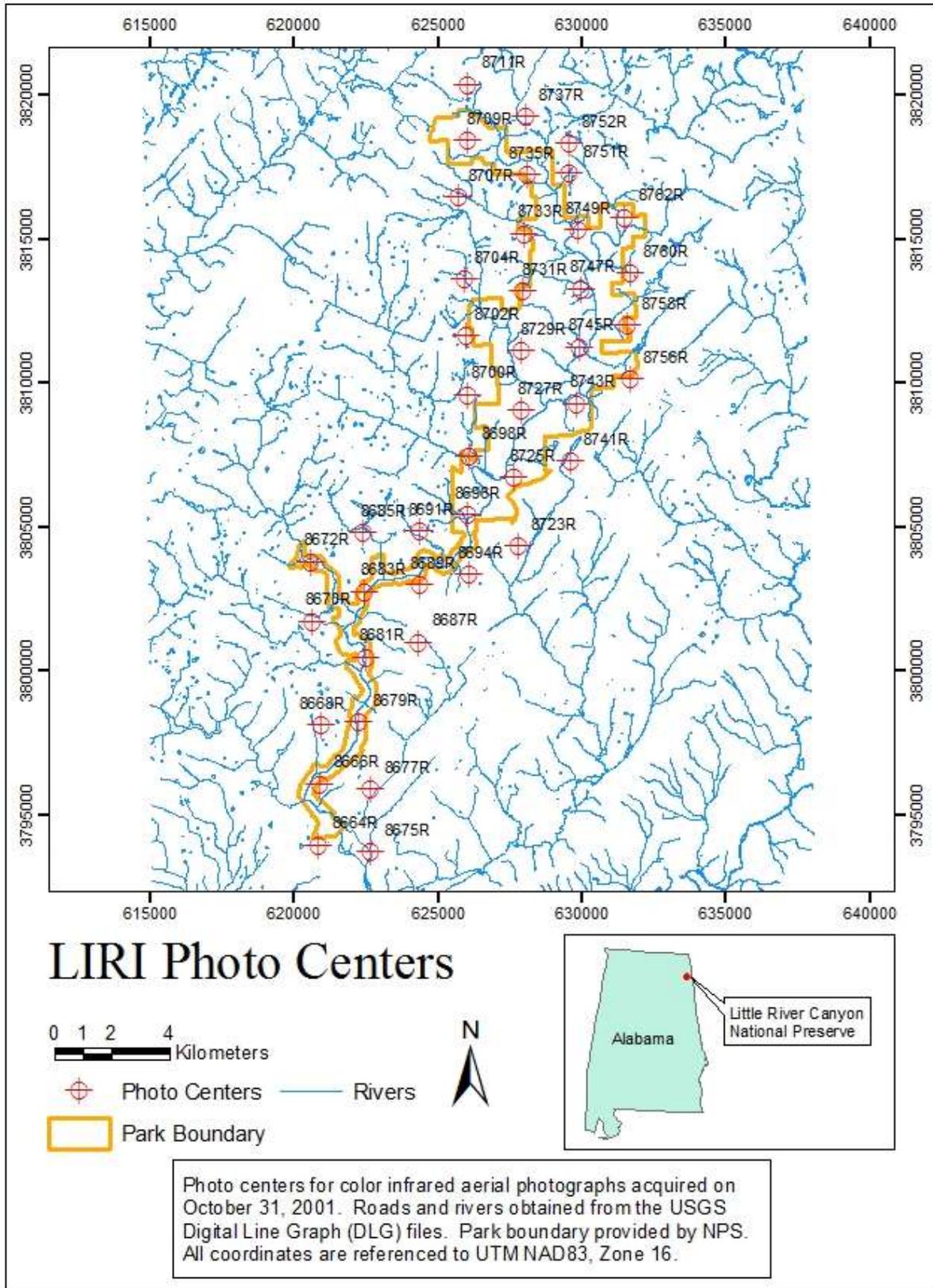


Figure G5: Photo centers map for Little River Canyon

Appendix H: Ninety Six National Historic Site

Vegetation Classification System

Needle-Leaf Evergreen Forest

- 8462 Loblolly Pine/Sweetgum Successional
- 855 Virginia Pine Successional
- 875 Mixed Shorleaf and Virginia Pine Successional
- 876 White Pine

Submontane Cold-Deciduous Forest

- 8475 White Oak (Red Oak, Scarlet Oak, Hickory)/ Vaccinium pallidum Piedmont Dry Mesic
- 8465 American Beech – Northern Red Oak/Flowering Dogwood/Christmas Fern – Virginia Acidic Piedmont Mesic
- 7244 Southern Red Oak – White Oak – Mockernut Hickory/Sourwood/Deerberry Dry Mesic
- 4638 Water Oak – Willow Oak Successional
- 7221 Tuliptree – Red Maple – Oak Successional
- 820 Sweetgum Successional
- 801 Black Walnut Successional, formerly cultivated
- 802 Pecan Orchard, formerly cultivated

Temporary Flooded Cold-Deciduous Forest

- 7730 Sycamore – Green Ash – Sugarberry – Florida Maple/Spicebush
- 8487 Swamp Chestnut Oak, Shumard Oak, Cherrybark Oak, Oglethorpe Oak – Sweetgum
- 4740 Sugarberry, Green Ash – Box Elder
- 4418 Piedmont Small-stream Sweetgum/Northern Spicebush Bottomland
- 800 Black Walnut, Sugarberry, Elm, Grape Vine
- 440 Tuliptree (Sycamore) Bottomland

Herbaceous Vegetation

- 4048 Fescue Cultivated Meadow
- M Cultivated Meadow

Shrubland

- Sb Successional Shrubland, formerly cleared field

Exotic Species

- 8568 Wisteria Vine Shrubland
- 898 Exotic Species Dominated

Water

- W Water

CUPN Parks

202 Mud Bar
W-201 Pond with Emergent and Floating Vegetation

Human Influence and Culturally Modified

C Culturally Modified Vegetation
Bld Building
Rd Road
F Old Fort, Earth Mounds
Well Old Fort Well
Tr Trail
HI Old Homesite
AAA Unknown

Special Modifiers

20 Scattered Shrubs and Trees in Meadow
89 Former Field; Large crown trees widely spaced
As Sugar Maple (*Acer saccharum*)
B Bamboo (Exotic)
Br Broomsedge
Ci Pecans
CM Cemetary
Co Sugarbeey (*Celtis occidentalis*), culturally modified
Dd Dead, damage by insects
G Graminoid
Jv Red Cedar (*Juniper virginiana*)
P Even Age and/of Planted
PIs White Pine (*Pinus strobus*)
Pr Privet (Exotic)
Qa White Oak (*Quercus alba*)
Qr Red Oak (*Quercus rubra*)
V Grape Vines

CUPN Parks

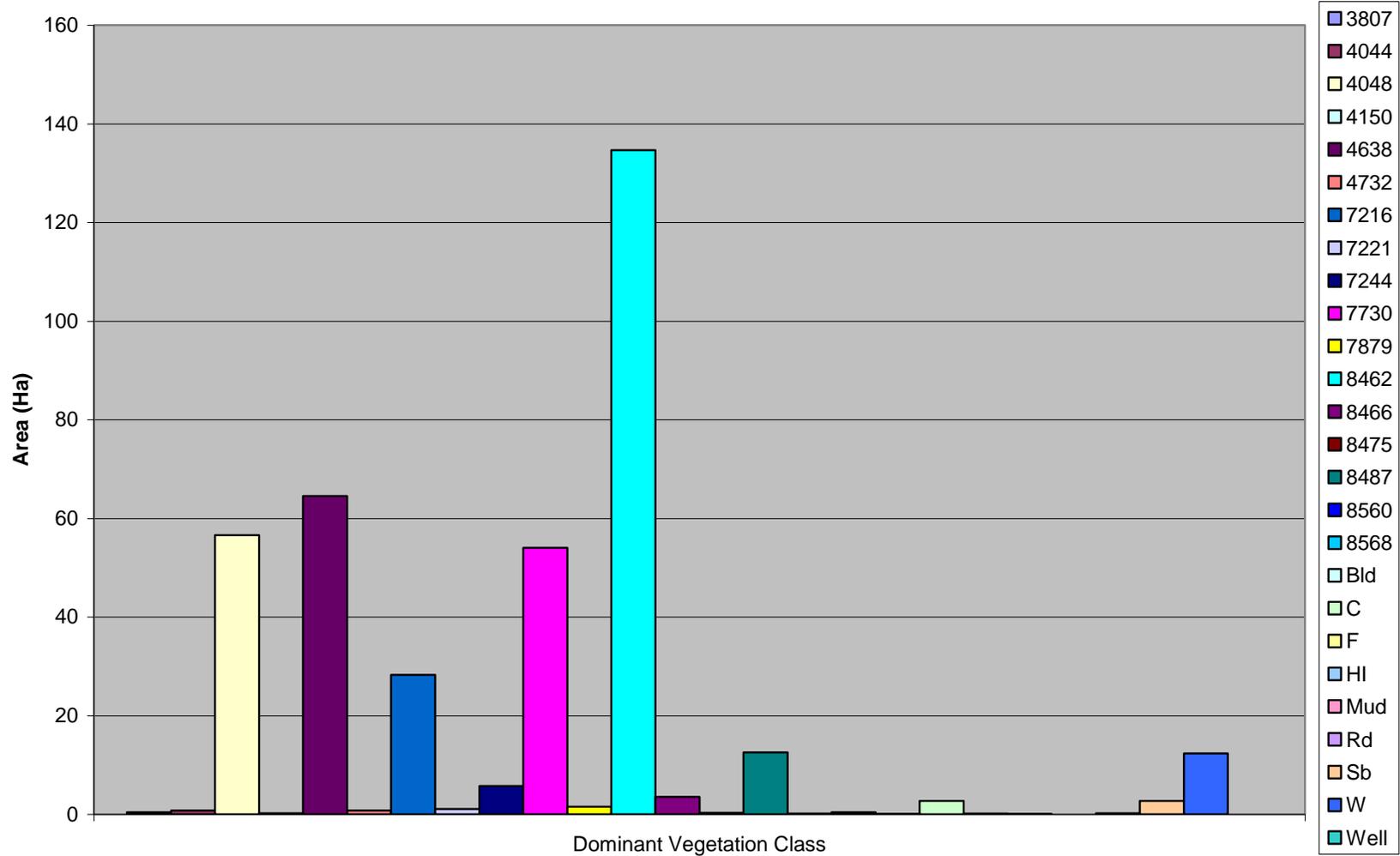
NISI Vegetation Statistics

Table H1: Dominant vegetation statistics for Ninety Six National Historic Site

DomVeg	Count	Average Area	Area (sq. m)	Area (ha)	Area (acres)
3807	3	1305.86	3917.58	0.39	0.97
4044	1	7441.82	7441.82	0.74	1.84
4048	24	23580.38	565929.05	56.59	139.78
4150	1	2262.25	2262.25	0.23	0.56
4638	44	14665.42	645278.58	64.53	159.38
4732	5	1573.69	7868.45	0.79	1.94
7216	43	6574.30	282694.86	28.27	69.83
7221	1	10683.11	10683.11	1.07	2.64
7244	12	4781.56	57378.70	5.74	14.17
7730	17	31786.89	540377.21	54.04	133.47
7879	4	3805.62	15222.46	1.52	3.76
8462	43	31314.78	1346535.53	134.65	332.59
8466	5	7109.87	35549.34	3.55	8.78
8475	2	1609.04	3218.08	0.32	0.79
8487	5	25119.49	125597.46	12.56	31.02
8560	1	1779.41	1779.41	0.18	0.44
8568	2	2073.57	4147.13	0.41	1.02
Bld	4	235.35	941.41	0.09	0.23
C	9	3013.48	27121.28	2.71	6.70
F	3	590.74	1772.21	0.18	0.44
HI	1	546.89	546.89	0.05	0.14
Mud	1	248.52	248.52	0.02	0.06
Rd	2	1098.88	2197.75	0.22	0.54
Sb	4	6838.80	27355.21	2.74	6.76
W	2	61833.93	123667.86	12.37	30.55
Well	1	16.18	16.18	0.00	0.00
Total	240			383.97	948.42

CUPN Parks

NISI Vegetation Distribution



CUPN Parks

NISI Map Products

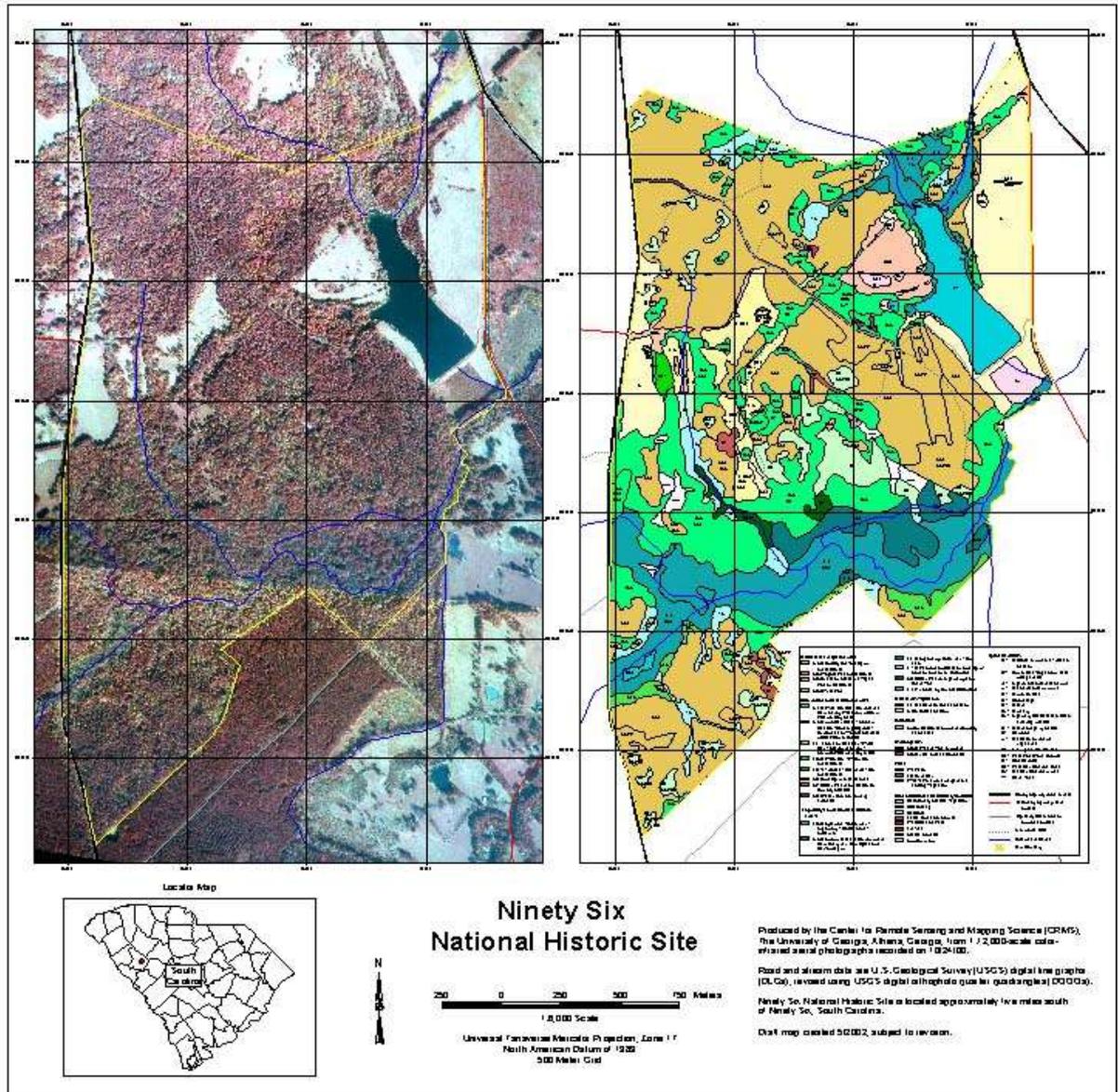


Figure H1: Color infrared map and vegetation map of Ninety Six National Historic Site.

CUPN Parks

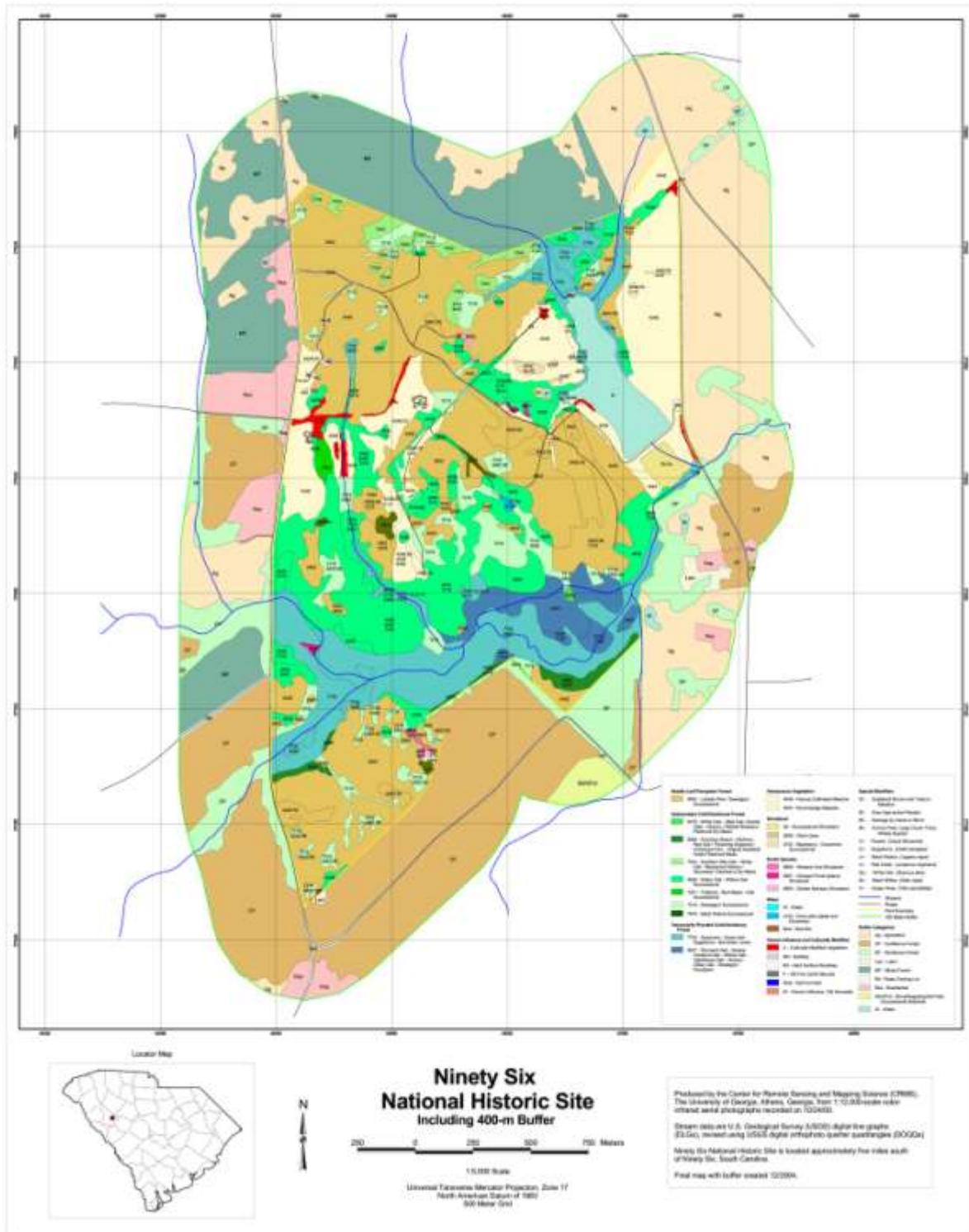


Figure H2: Vegetation map, including 400 meter buffer, of Ninety Six National Historic Site.

CUPN Parks

Table H2: Photo centers for Ninety Six National Historic Site.

NISI (UTM 17) Meters		
Photo ID	X	Y
3061	406491.17	3778985.83
3062	406416.13	3777901.26
3063	406536.46	3780128.33

CUPN Parks

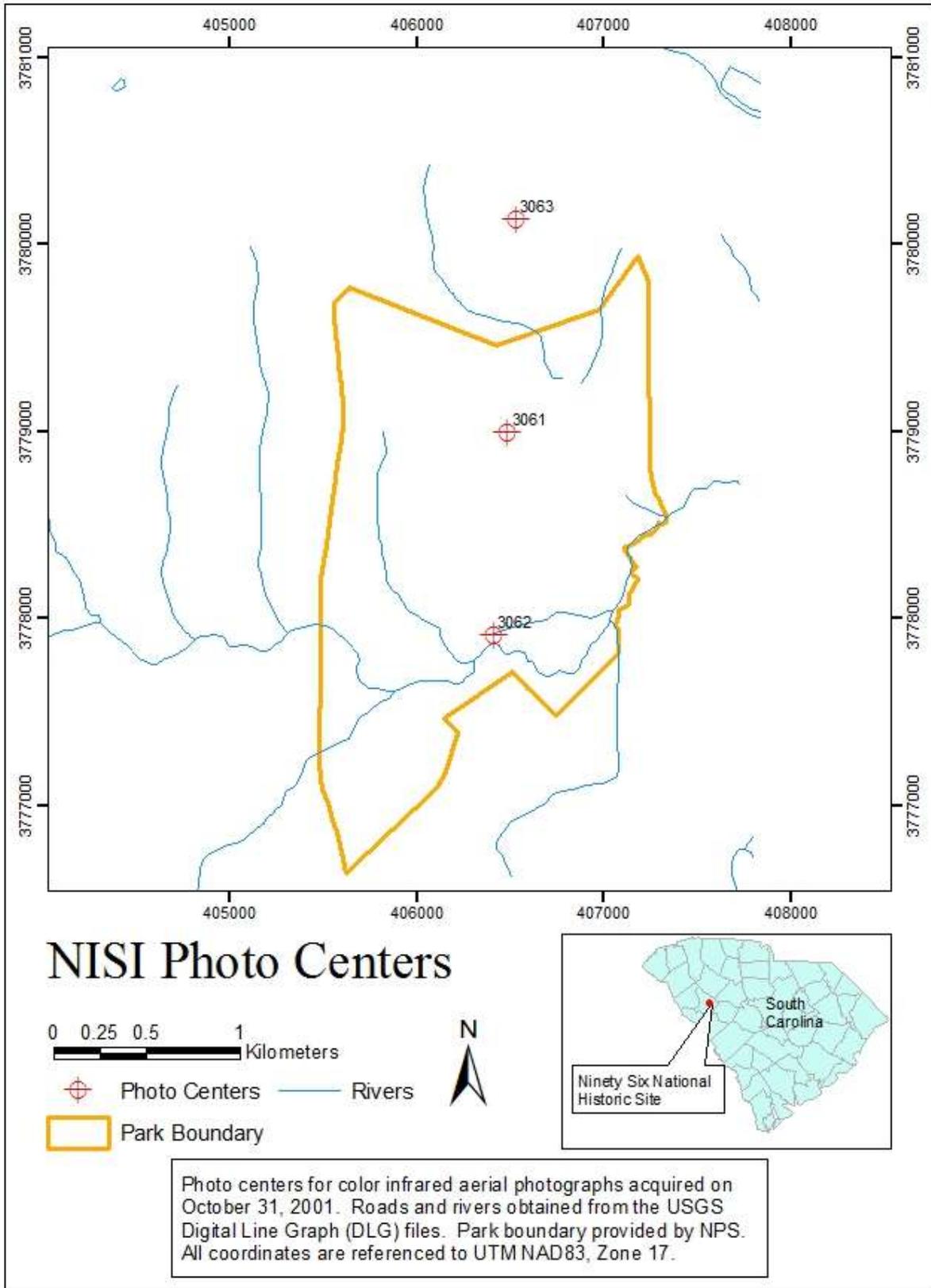


Figure H3: Photo centers map for Ninety Six National Historic Site.

Appendix I: Stones River National Battlefield

Vegetation Classification System

Temperate Needle-Leaved Evergreen Forests

- 7124 Eastern Red Cedar – (Old Hickory species) Successional Forest
- 7124p Eastern Red Cedar Planted Forest
- 7124s Very Early Successional 7124 in Old Field

Submontane Cold-Deciduous Forest

- 4697 Nashville Basin Sugarberry, Northern Hackberry – Elm species – Black Walnut Successional Forest
- 4697s Very Early Successional 4697 in Old Field
- 3876 Nashville Basin Shingle Oak – Shumard Oak – Chinquapin Oak Forest
- 7699 Southern Interior Low Plateau Chinquapin Oak – (Shumard Oak – Post Oak) / Redbud / Rusty Blackhaw Forest (At Stones River may be 50% Post Oak – 50% Shagbark and Carolina Shagbark Hickories)
- 7808 Nashville Basin Shumard Oak – Chinquapin Oak – Shagbark, Carolina Shagbark Hickory

Temporarily Flooded Cold-Deciduous Forest

- 4690 Southern Interior Box Elder – (Sycamore – Cottonwood – Silver Maple – Green Ash) Riparian Forest
- 2427 Green Ash – American Elm – Sugarberry/Possum-haw Southern Floodplain Forest
- 2103 Black Willow Riparian Forest

Planted/Cultivated Forest and Savannah

- FORpm Forest; Planted; maintained by mowing
- SAVd Derived Savannah; mowed; (7808, 4697, and 7124 species) formally maintained by mowing
- SAVpm Savannah; Planted, maintained by mowing

Temperate Shrubland

- 3807 Upland Chinese Privet Shrubland
- 4732 Blackberry Greenbriar – Herbaceous Thicket
- SSb Early Successional Shrubs, Saplings and Vines

Temporarily Flooded Shrubland

- 3899 Carolina Willow Temporarily Flooded Streamside Thicket and Levee Thicket
- 3837 Chinese Privet Temporarily Flooded

Cedar Glades and Barrens Complex

- 4340 Nashville Basin Limestone Glade, Annual Herbaceous; Barrens Dropseed – Poverty Dropseed – Panicgrass (4346 may also be present)

CUPN Parks

- 4346 Nashville Basin Limestone Glade Ephemeral Pool: Sedum – Limestone
Flameflower – Gladecress – Nostoc
- 3938 Nashville Basin Limestone Glade Margin Shrubland: Eastern Red Cedar /
Fragrant Sumac – Glade Privet – Golden St. John’s Wort
- 7124x Eastern Red Cedar Successional Forest – Glade Complex (7124 with 4340, 4346,
and 3938)

Herbaceous Vegetation (Maintained by Mowing)

- Lwn Lawn with occasional trees
- 4044 Field dominated by native grasses and forbs
- 4048 Field dominated by *Lolium* spp. and other exotic and native grasses and forbs
- Hay Hayfield with *Lolium* spp., *Sericia lespedeza*
- OF Old Field formerly cleared for agriculture. “Weedy” herbaceous species, woody
shrubs and vines, tree saplings and occasional limestone outcrops.
- OFwt Old Field, seasonally wet; with sedges and small seasonal ponds
- Wt Seasonal Wetland, sedges and *Juncus* spp.
- NRU Native Plant Restoration Site (Upland)
- NRB Native Plant Restoration Site (Bottomland)
- 5131 Big Bluestem Grassland with sparse trees (Eastern Red Cedar, Chinquapin Oak)

Semi-Permanently Flooded Perennial Forb

- 7835 Floating Water Primrose Marsh

Temporarily Flooded Perennial Forb

- 4286 Water-Willow Rocky Bar and Shore

Additional Categories

- Ag Agriculture Field (Soybeans, Cotton, Corn)
- AM Artillery Monument
- Bld Building
- Cem Cemetery
- Dmp Old Trash Dump
- EW Raised Earthwork
- GP Gravel Pit
- HI Human Influence (e.g. Old or Present Homesite)
- HM Hazen Monument
- Rb Road Embankment
- Rd Road, Parking Lot
- RR Railroad
- W Water

CUPN Parks

Special Modifiers

- :Aa Tree of Heaven (*Ailanthus altissima*)
- :Cx Shagbark Hickory (*Carya ovata*) and Carolina Shagbark Hickory (*C. caroliniana-septentrionalis*)
- :Fa White Ash (*Fraxinus americana*)
- :Jv Eastern Red Cedar (*Juniper virginiana*)
- :Mp Osage Orange (*Maclura pomifera*)
- :Ps Black Cherry (*Prunus serotina*)
- :Qi Shingle Oak (*Quercus imbricaria*)
- :Qm Chinquapin Oak (*Quercus muehlenbergii*)
- :Qs Post Oak (*Quercus stellata*)
- :Qx Mixed Oaks
- :Sa Sassafras (*Sassafras albidum*)
- :Sb Shrubs, saplings
- :f Old Fence Row
- :fh Old Fence Rows and Hog Lots South of Artillery Monument
- :m Mowed

Buffer Categories

- Ag Agriculture Field
- AF Athletic Field
- C/I Commercial/Industrial
- CF Coniferous Forest
- DF Deciduous Forest
- GF Golf Course
- Lwn Lawn
- MF Mixed Forest
- Rd Road, Parking Lot
- Res Residential
- RK/sv Rock with Sparse Vegetation
- SS/OF Shrub/Sapling/Old Field Successional
- SS/OF/d Shrub/Sapling/Old Field Successional Disturbed
- W Water

CUPN Parks

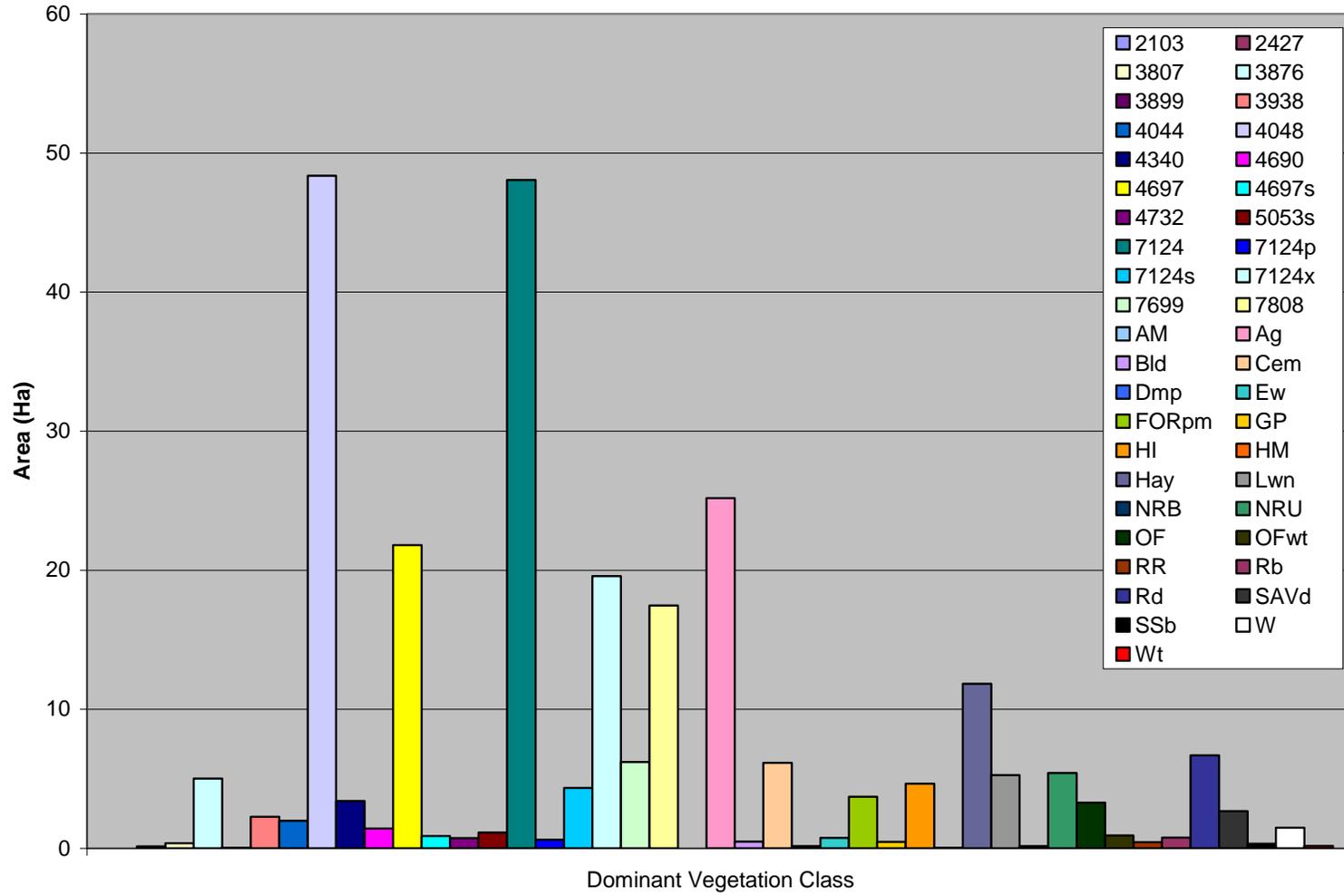
STRI Vegetation Statistics

Table 11: Dominant vegetation statistics for Stones River National Battlefield

DomVeg	Count	Average Area	Area (sq. m)	Area (ha)	Area (acres)
2103	1	2.60	2.60	0.00	0.00
2427	1	1428.96	1428.96	0.14	0.35
3807	3	1216.71	3650.13	0.37	0.90
3876	12	4173.11	50077.27	5.01	12.37
3899	1	432.73	432.73	0.04	0.11
3938	1	22608.79	22608.79	2.26	5.58
4044	7	2834.08	19838.53	1.98	4.90
4048	28	17273.06	483645.71	48.36	119.46
4340	24	1415.92	33982.10	3.40	8.39
4690	7	2031.98	14223.86	1.42	3.51
4697	44	4954.83	218012.68	21.80	53.85
4697s	3	2914.15	8742.44	0.87	2.16
4732	1	7292.30	7292.30	0.73	1.80
5053s	3	3790.88	11372.63	1.14	2.81
7124	32	15019.56	480626.01	48.06	118.71
7124p	2	3086.47	6172.95	0.62	1.52
7124s	6	7239.53	43437.17	4.34	10.73
7124x	4	48925.28	195701.12	19.57	48.34
7699	5	12417.70	62088.48	6.21	15.34
7808	22	7932.19	174508.22	17.45	43.10
AM	1	39.03	39.03	0.00	0.01
Ag	10	25170.01	251700.10	25.17	62.17
Bld	20	237.36	4747.19	0.47	1.17
Cem	3	20485.42	61456.26	6.15	15.18
Dmp	1	1558.48	1558.48	0.16	0.38
Ew	5	1512.47	7562.32	0.76	1.87
FORpm	2	18505.38	37010.76	3.70	9.14
GP	1	4699.10	4699.10	0.47	1.16
HI	9	5171.96	46547.65	4.65	11.50
HM	1	391.43	391.43	0.04	0.10
Hay	3	39409.41	118228.23	11.82	29.20
Lwn	7	7511.08	52577.58	5.26	12.99
NRB	2	783.70	1567.39	0.16	0.39
NRU	5	10839.32	54196.59	5.42	13.39
OF	8	4114.21	32913.64	3.29	8.13
OFwt	1	9263.54	9263.54	0.93	2.29
RR	1	4420.81	4420.81	0.44	1.09
Rb	1	7768.71	7768.71	0.78	1.92
Rd	9	7425.70	66831.31	6.68	16.51
SAVd	4	6674.59	26698.36	2.67	6.59
SSb	1	3201.13	3201.13	0.32	0.79
W	5	2944.43	14722.13	1.47	3.64
Wt	1	1753.65	1753.65	0.18	0.43
Total	308			264.77	653.98

CUPN Parks

STRI Vegetation Distribution



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Figure I2: Color infrared (with DOQQs) photo map of Stones River National Battlefield.

CUPN Parks - Appendices

Table I2: Photo centers for Stones River.

STRI (UTM 16) Meters		
Photo ID	X	Y
8588R	551287.25	3971175.25
8589BR	551549.75	3969900.25

CUPN Parks - Appendices

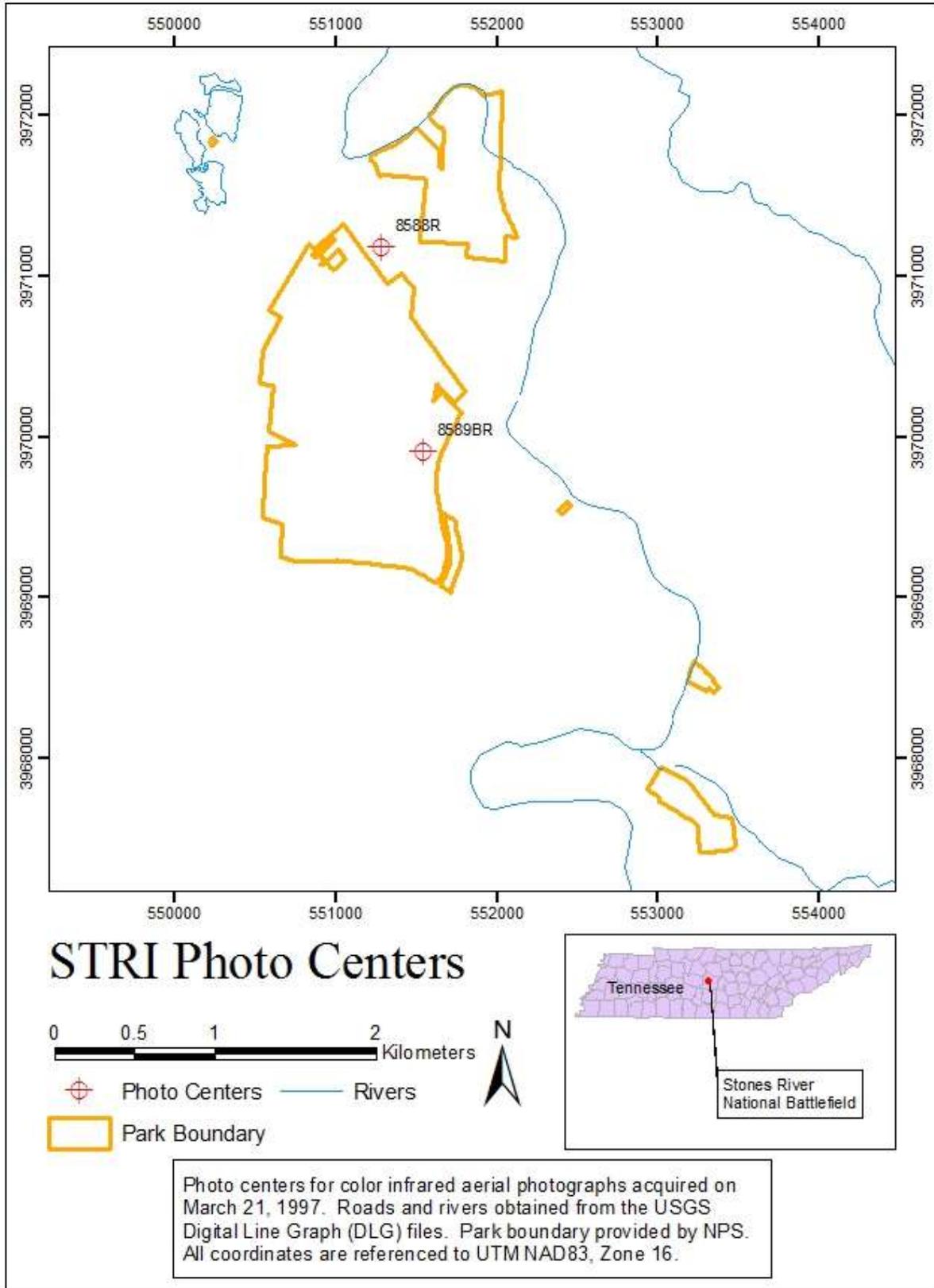


Figure 13: Photo centers map for Stones River.

Appendix J: Chickamauga and Chattanooga National Military Park, Lookout Mountain Battlefield, and Moccasin Bend

Vegetation Classification System

Coniferous Upland Forest

- 7124 Red Cedar Successional Forest
- 4730 Virginia Pine Plantation

Coniferous/Mixed Hardwood Upland Forest

- 8462 Mid- to Late- Successional Loblolly Pine – Sweetgum Forest
- 7105 Interior Mid- to Late- Successional Loblolly Forest

Coniferous/Oak Upland Forest

- 4731 Highland Rim Semi-Natural Red Cedar – Oak Forest
- 7493 Southern Blue Ridge Escarpment Shortleaf Pine – Oak Forest

Dry-Mesic Oak Upland Forest

- 8430 Cumberland Plateau Dry-Mesic White Oak Forest
- 7233 Rich Low Elevation Appalachian Oak Forest
- 7709 Highland Rim White Oak – Tuliptree Mesic Lower Slope Forest
- 7247 Southern Interior Southern Red Oak – Scarlet Oak Forest
- 8443 White Oak – Post Oak Subcalcareous Forest
- 7699 Interior Low Plateau Chinquapin Oak – Mixed Forest
- 7808 Interior Plateau Chinquapin – Shumard Oak Forest
- 7700 Interior Low Plateau Chestnut Oak – Mixed Forest
- 7231 Dry-Mesic Southern Appalachian White Oak – Hickory Forest

Xeric Oak Upland Forest

- 8431 Xeric Ridgetop Chestnut Oak Forest

Oak/Mixed Hardwood Upland Forest

- 6017 Appalachian Sugar Maple – Chinquapin Oak Limestone Forest
- 7881 Central Interior Beech – White Oak Forest

Successional Mixed Hardwood Upland Forest

- 7220 Successional Tuliptree Forest (Circumneutral Type)
- 7217 Interior Mid- to Late- Successional Sweetgum – Oak Forest

Alluvial and Wetland Forests

- 8441 Cumberland Plateau Oak Pond
- 5033 Box-Elder Floodplain Forest
- 7334 Sycamore – Silver Maple Calcareous Floodplain Forest
- 8429 Rich Levee Mixed Hardwood Bottomland Forest
- 8487 Southern Interior Oak Bottomland Forest

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- 2103 Black Willow Riparian Forest
- 7330 Successional Sweetgum Floodplain Forest
- 4418 Piedmont Small Stream Sweetgum Forest

Calcareous Glades

- 5131 Central Limestone Glade

Shrubland

- 3837 Chinese Privet Temporarily Flooded Shrubland
- 3938 Central Basin Limestone Glade Margin Shrubland

Grassland

- 4048 Cultivated Meadow

Aqueous Impoundments

- 4290 Smartweed – Cutgrass Beaver Pond

Rock Outcrops

- 4392 Cumberland Plateau Sandstone Cliff (Dry Type)

Other

- Pi Pine
- Sb Shrub
- SV Sparse Vegetation
- SU Successional
- G Graminoid
- L Mowed Lawn
- RES Residential
- B Building
- CI Commercial/Industrial
- HQ Headquarters
- M Maintenance Facility
- RD Road
- RR Railroad
- RK Rock
- W Water
- Sh Shadow

Modifiers

- :Asa Silver Maple
- :Jv Red Cedar
- :L Tulip Poplar
- :Ls Sweetgum
- :Pi Pine
- :Pv Virginia Pine
- :Qa White Oak
- :Qn River oak

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:Qph Willow Oak
:Qsh Shumard Oak

Additional Modifiers

:1 Damage, cause unknown
:3 Insect Damage
:BK Beaver Kill
:Mn Monument
:OF Old Field Succession
:SV Sparse Vegetation

Buffer Classes

DF Deciduous Forest
MF Mixed Forest
Pi Pine
Sb Shrub
SV Sparse Vegetation
SU Successional
Ev Emergent Vegetation
G Graminoid
P Pasture
GC Golf Course
L Mowed Lawn
RES Residential
B Building
CI Commercial/Industrial
RD Road
RR Railroad
RK Rock
W Water
Sh Shadow

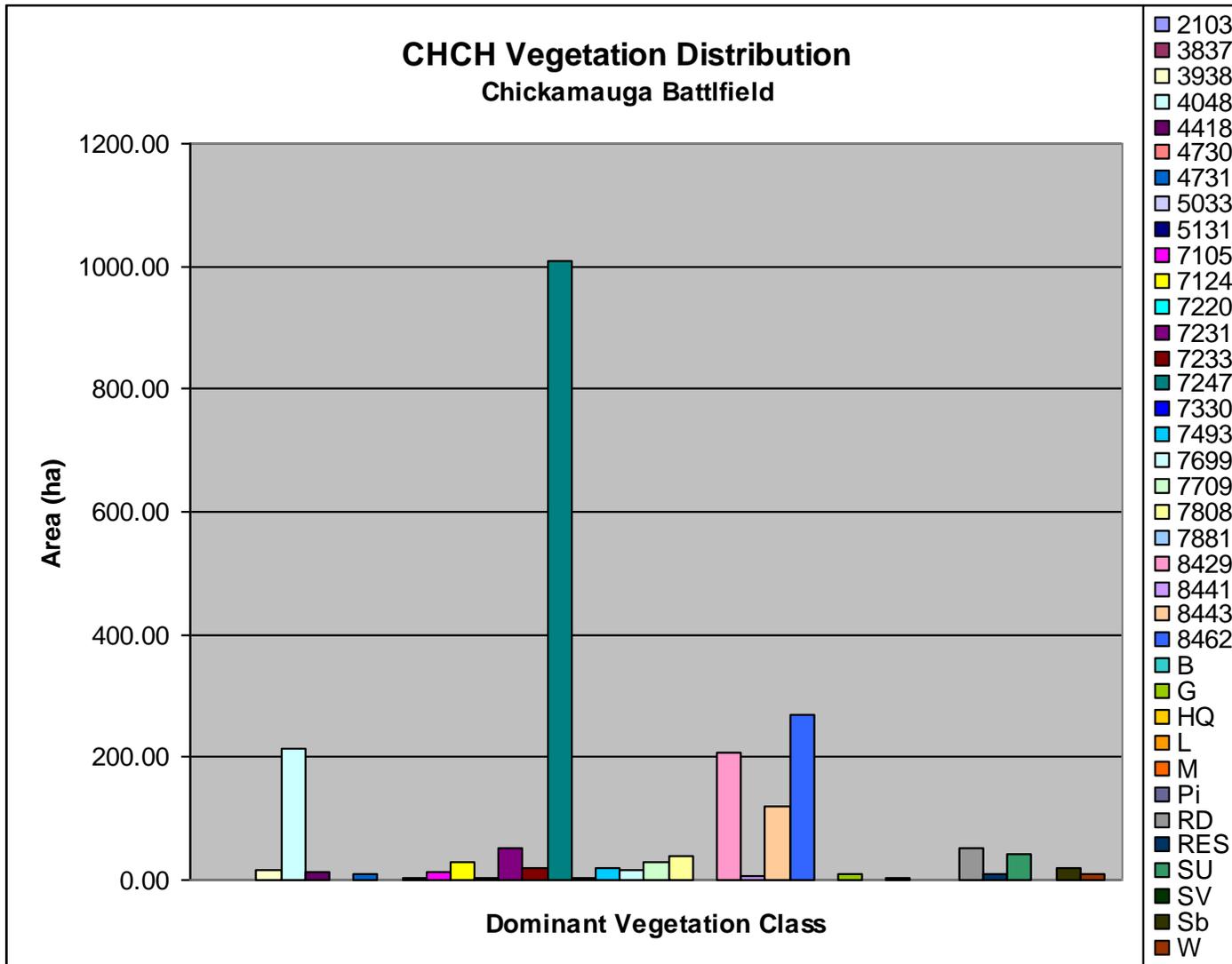
CUPN Parks - Appendices

CHCH Vegetation Statistics

Table J1: Dominant vegetation statistics for Chickamauga Battlefield.

DomVeg	Count	Area (sq. m)	Area (ha)	Area (ac)
2103	1	8291.98	0.83	2.05
3837	1	4273.75	0.43	1.06
3938	21	158686.90	15.87	39.21
4048	34	2156168.78	215.62	532.80
4418	11	133811.10	13.38	33.07
4730	2	9020.55	0.90	2.23
4731	6	100419.14	10.04	24.81
5033	1	12203.63	1.22	3.02
5131	28	47783.91	4.78	11.81
7105	4	130443.96	13.04	32.23
7124	34	303048.32	30.30	74.88
7220	2	28187.50	2.82	6.97
7231	13	523752.99	52.38	129.42
7233	7	188790.03	18.88	46.65
7247	121	10074745.83	1007.47	2489.51
7330	1	17599.34	1.76	4.35
7493	11	201070.06	20.11	49.69
7699	7	167835.93	16.78	41.47
7709	8	289872.99	28.99	71.63
7808	12	376171.76	37.62	92.95
7881	1	5455.93	0.55	1.35
8429	88	2061588.70	206.16	509.43
8441	6	52656.57	5.27	13.01
8443	33	1193105.20	119.31	294.82
8462	107	2687588.89	268.76	664.12
B	1	2041.99	0.20	0.50
G	21	81531.78	8.15	20.15
HQ	1	14345.28	1.43	3.54
L	12	22451.52	2.25	5.55
M	1	9071.96	0.91	2.24
Pi	1	246.24	0.02	0.06
RD	3	532364.27	53.24	131.55
RES	32	89647.16	8.96	22.15
SU	42	428230.16	42.82	105.82
SV	4	14000.63	1.40	3.46
Sb	18	181176.07	18.12	44.77
W	9	88147.84	8.81	21.78
Total:	705	22395828.61	2239.58	5534.11

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Table J2: Buffer vegetation statistics for Chickamauga Battlefield.

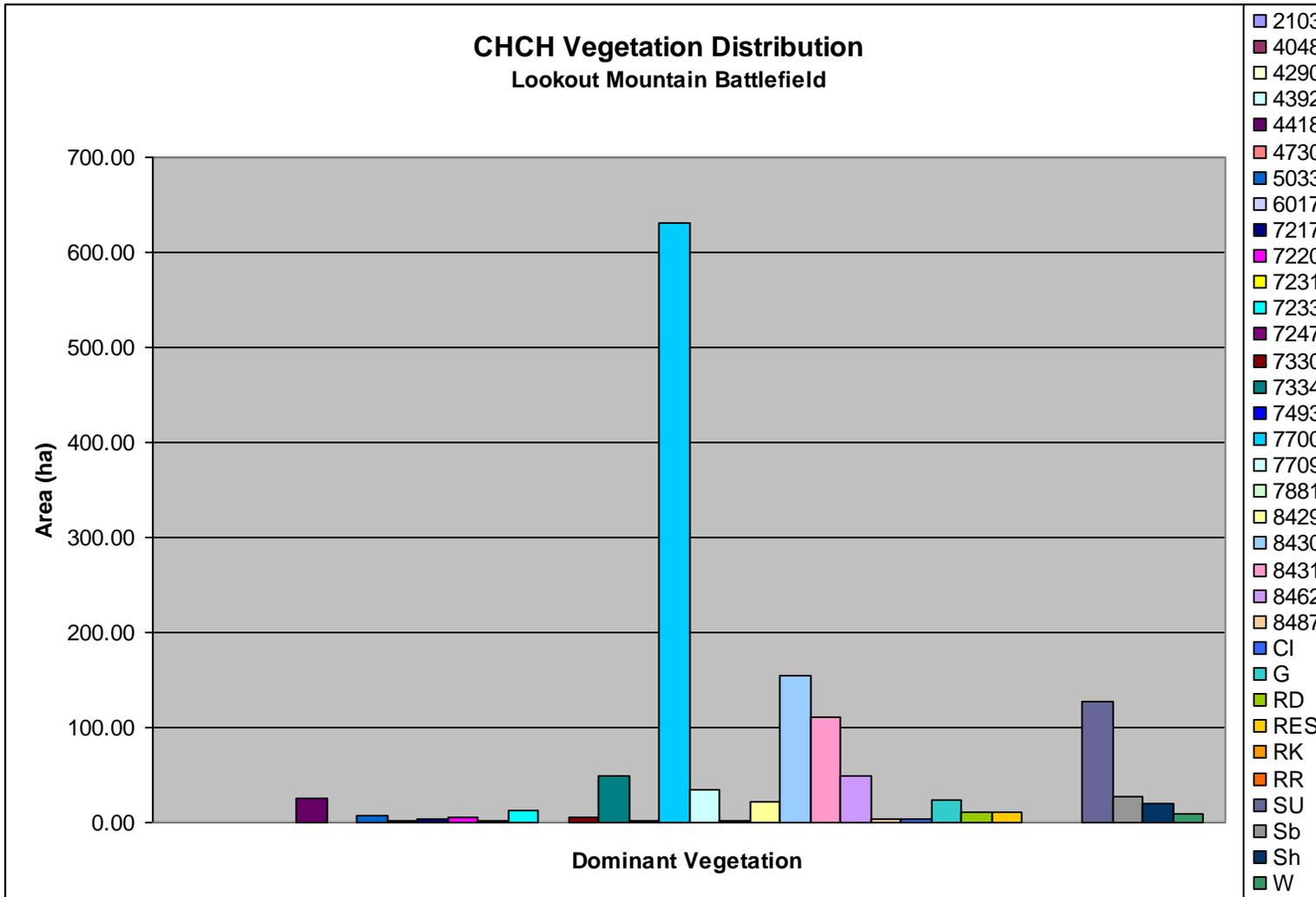
BufferVeg	Count	Area (sq. m)	Area (ha)	Area (ac)
CI	3	190923.54	19.09	47.18
DF	61	1196488.96	119.65	295.66
G	84	2602581.31	260.26	643.11
MF	45	1525290.14	152.53	376.91
Pi	7	70834.55	7.08	17.50
RD	11	134528.21	13.45	33.24
RES	67	3148682.11	314.87	778.05
SU	6	2293.75	0.23	0.57
SV	5	16621.97	1.66	4.11
Sb	29	320698.16	32.07	79.25
W	38	108405.67	10.84	26.79
Total:	356	9317348.36	931.73	2302.36

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Table J3: Dominant vegetation statistics for Lookout Mountain.

DomVeg	Count	Area (sq. m)	Area (ha)	Area (ac)
2103	4	7930.57	0.79	1.96
4048	1	402.44	0.04	0.10
4290	1	1977.60	0.20	0.49
4392	1	3778.69	0.38	0.93
4418	3	252843.57	25.28	62.48
4730	1	3037.97	0.30	0.75
5033	4	66730.96	6.67	16.49
6017	2	18651.30	1.87	4.61
7217	2	43220.07	4.32	10.68
7220	6	57043.19	5.70	14.10
7231	1	9320.47	0.93	2.30
7233	8	126528.45	12.65	31.27
7247	2	3450.17	0.35	0.85
7330	3	54074.24	5.41	13.36
7334	23	498387.96	49.84	123.15
7493	2	13829.65	1.38	3.42
7700	44	6310518.22	631.05	1559.36
7709	11	349936.31	34.99	86.47
7881	2	15016.42	1.50	3.71
8429	14	220594.09	22.06	54.51
8430	38	1545344.27	154.53	381.86
8431	22	1112623.37	111.26	274.93
8462	19	498607.52	49.86	123.21
8487	1	29612.52	2.96	7.32
CI	10	41177.43	4.12	10.18
G	30	238772.89	23.88	59.00
RD	18	101646.49	10.16	25.12
RES	41	108530.46	10.85	26.82
RK	7	6738.16	0.67	1.67
RR	1	4451.36	0.45	1.10
SU	79	1268432.68	126.84	313.44
Sb	63	267607.08	26.76	66.13
Sh	6	202564.37	20.26	50.05
W	25	84171.34	8.42	20.80
Total:	495	13567552.27	1356.76	3352.60

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Table J4: Buffer vegetation statistics for Lookout Mountain Battlefield.

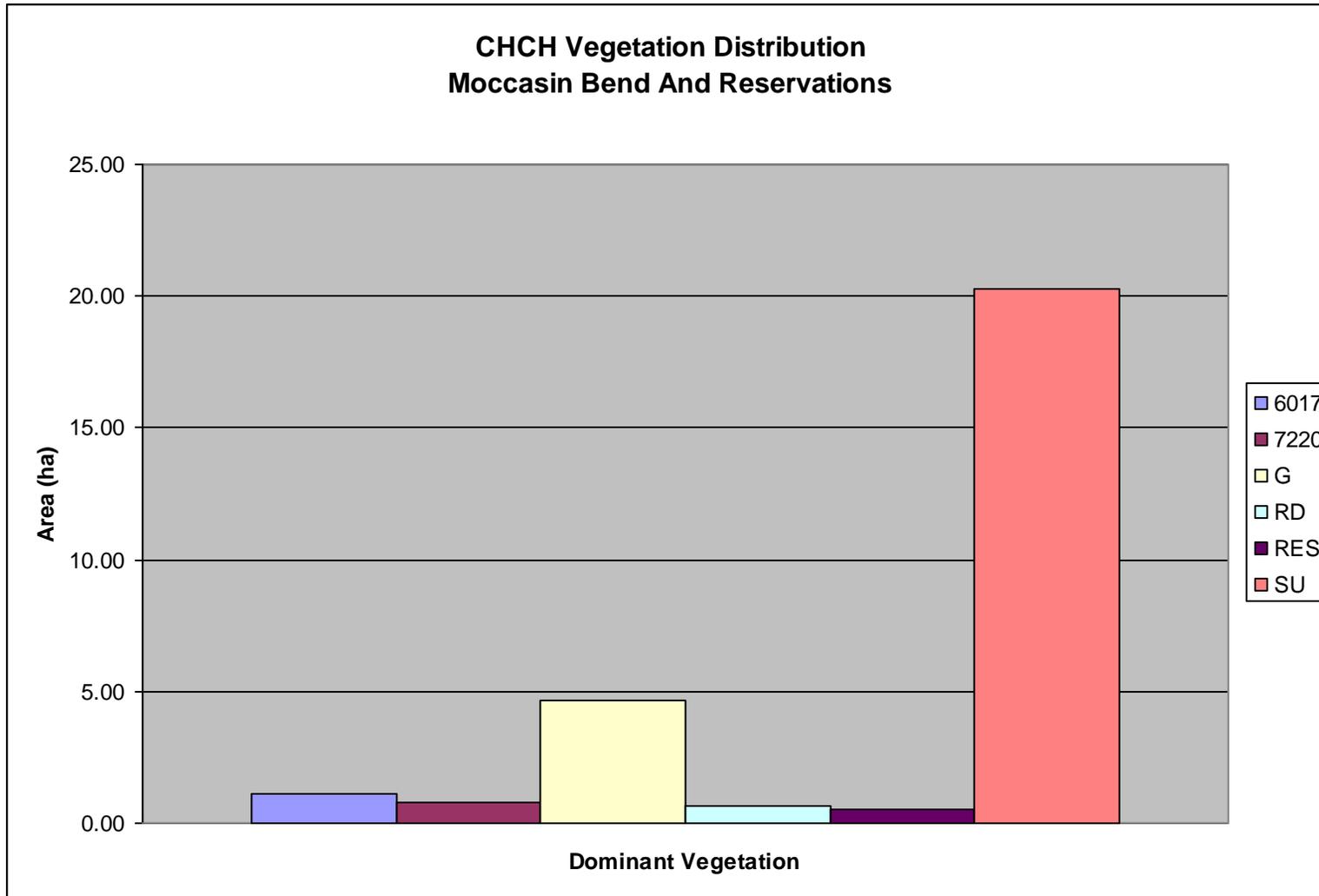
BufferVeg	Count	Area (sq. m)	Area (ha)	Area (ac)
B	2	4805.00	0.48	1.19
CI	26	2195896.33	219.59	542.62
DF	167	6858765.09	685.88	1694.83
Ev	3	43639.57	4.36	10.78
G	62	1239084.27	123.91	306.18
GC	1	478570.09	47.86	118.26
L	1	125.09	0.01	0.03
MF	68	1296613.91	129.66	320.40
P	1	10306.59	1.03	2.55
Pi	3	24411.56	2.44	6.03
RD	34	482393.02	48.24	119.20
RES	41	4582379.14	458.24	1132.33
RK	10	27027.60	2.70	6.68
RR	4	109689.02	10.97	27.10
SU	49	378789.95	37.88	93.60
SV	4	20203.06	2.02	4.99
Sb	84	737881.40	73.79	182.33
Sh	2	4632.78	0.46	1.14
W	20	3186513.16	318.65	787.40
Total:	582	21681726.63	2168.17	5357.65

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Table J5: Dominant vegetation statistics for Moccasin Bend and Reservations.

DomVeg	Count	Area (sq. m)	Area (ha)	Area (ac)
6017	1	11282.71	1.13	2.79
7220	1	8157.18	0.82	2.02
G	6	46632.62	4.66	11.52
RD	1	6685.13	0.67	1.65
RES	1	5013.77	0.50	1.24
SU	9	202948.34	20.29	50.15
Total:	19	280719.75	28.07	69.37

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Table J6: Buffer vegetation statistics for Moccasin Bend and Reservations.

BufferVeg	Count	Area (sq. m)	Area (ha)	Area (ac)
CI	20	584038.40	58.40	144.32
DF	30	1972360.77	197.24	487.38
G	9	77712.32	7.77	19.20
MF	3	207342.29	20.73	51.24
P	1	3332.63	0.33	0.82
RD	7	156212.78	15.62	38.60
RES	32	3068269.74	306.83	758.18
SU	1	11499.79	1.15	2.84
Sb	10	116546.70	11.65	28.80
Total:	113	6197315.44	619.73	1531.38

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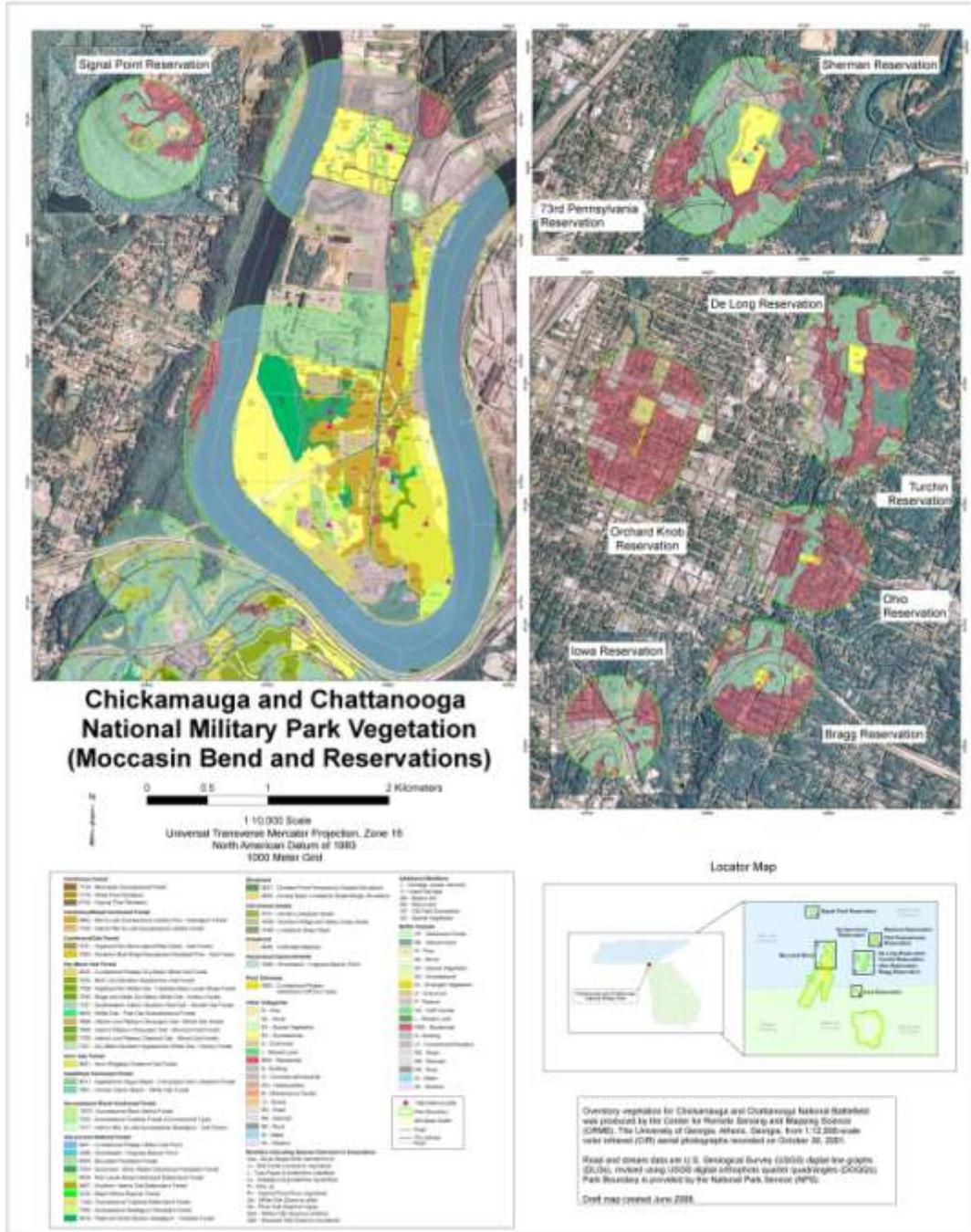


Figure J3: Mosaic color infrared photo and vegetation overlay for Moccasin Bend and Reservations.

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Photo Centers

Table J7: Photo centers for Chickamauga and Chattanooga National Military Park, Lookout Mountain Battlefield, and Moccasin Bend.

CHCH (UTM 16) meters		
Photo ID	X	Y
8601R	651136.17	3879046.83
8602R	650820.17	3877763.33
8603R	651054.67	3876745.33
8604R	650999.75	3875937.75
8605R	651153.67	3874996.33
8606R	651149.75	3874000.25
8607R	651070.67	3873178.83
8608R	651053.67	3872246.33
8609R	650999.75	3871250.25
8610R	651003.67	3870346.33
8611R	650899.75	3869350.25
8612R	648649.75	3877450.25
8613R	649049.75	3876237.75
8614R	649049.75	3875000.25
8615R	648874.75	3873725.25
8616R	648739.70	3872560.30
8617R	648629.70	3871255.30
8618R	648504.70	3869995.30
8619R	649449.75	3879100.25
8620R	649387.25	3877762.75
8621R	649349.75	3876550.25
8622R	649349.75	3875200.25
8623R	649249.75	3874050.25
8624R	649187.25	3873112.75
8635R	649019.70	3872235.30
8626R	649049.75	3871300.25
8627R	649199.75	3870450.25
8628R	647749.75	3868900.25
8629R	647599.75	3869450.25
8630R	647729.70	3870135.30
8631R	647662.25	3871012.75
8632R	647649.75	3871950.25
8633R	647487.25	3872862.75
8635R	658124.75	3868925.25
8636R	657549.75	3867975.25
8637R	657449.75	3867100.25
8638R	657387.25	3866062.75
8639R	657349.75	3865000.25
8640R	657087.25	3864087.75

Photo ID	X	Y
8641R	657274.75	3863025.25
8642R	657374.75	3862012.75
8643R	659999.75	3869087.75
8644R	659549.75	3867987.75
8645R	659399.75	3866987.75
8646R	659187.25	3865962.75
8647R	659049.75	3864975.25
8648R	659074.75	3864912.75
8649R	659249.75	3862900.25
8650R	659237.25	3861875.25
8652R	660899.75	3870250.25
8653R	660849.75	3869262.75
8654R	660574.75	3868337.75
8655R	660799.75	3867312.75
8656R	660874.75	3866387.75
8657R	660687.25	3865450.25
8658R	660812.25	3864487.75
8659R	661062.25	3863525.25
8660R	661174.75	3862625.25
8661R	661324.75	3861675.25
8662R	661424.75	3860750.25

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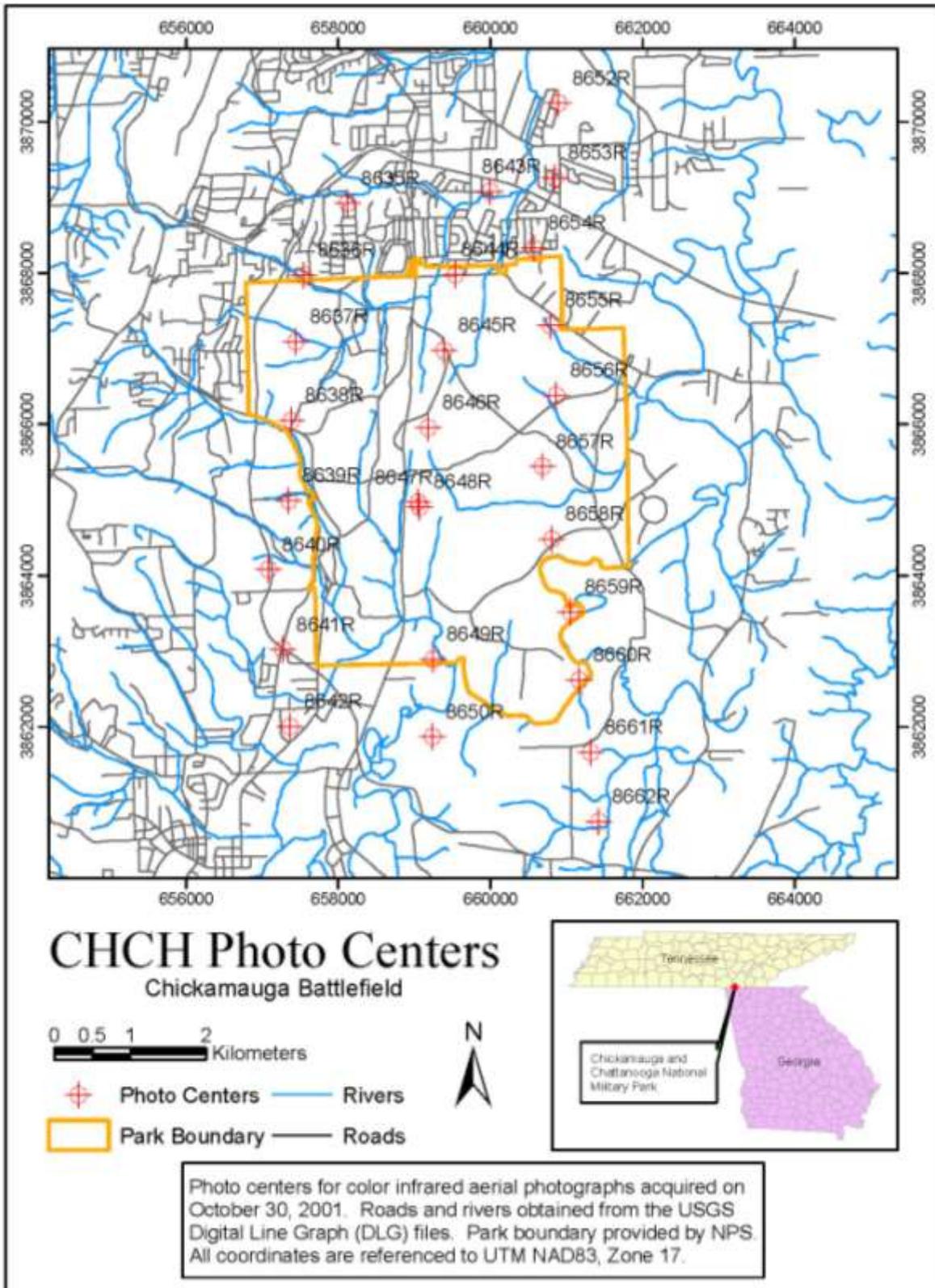


Figure J4: Photo centers map for Chickamauga Battlefield.

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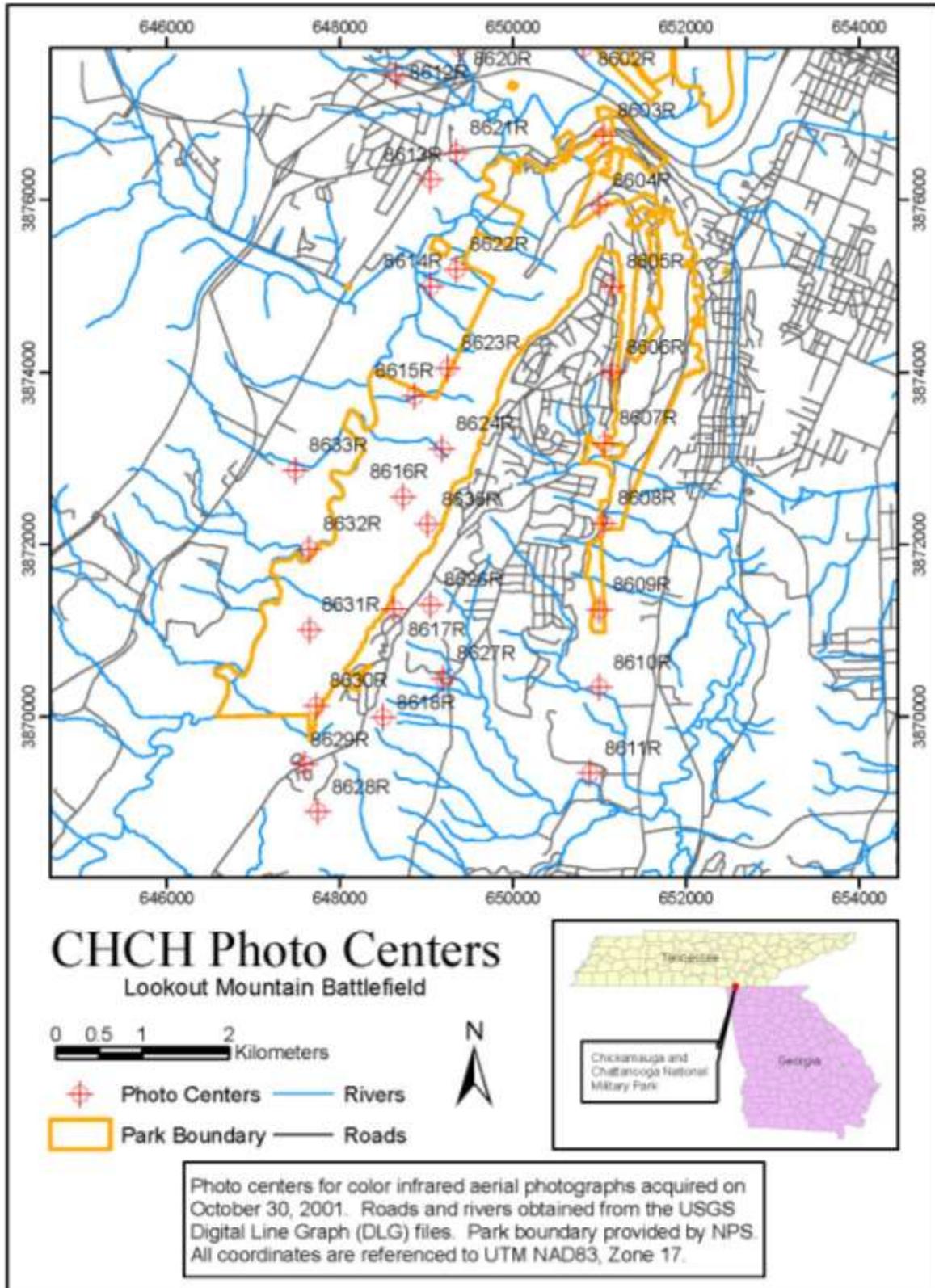


Figure J5: Photo centers map for Lookout Mountain Battlefield.

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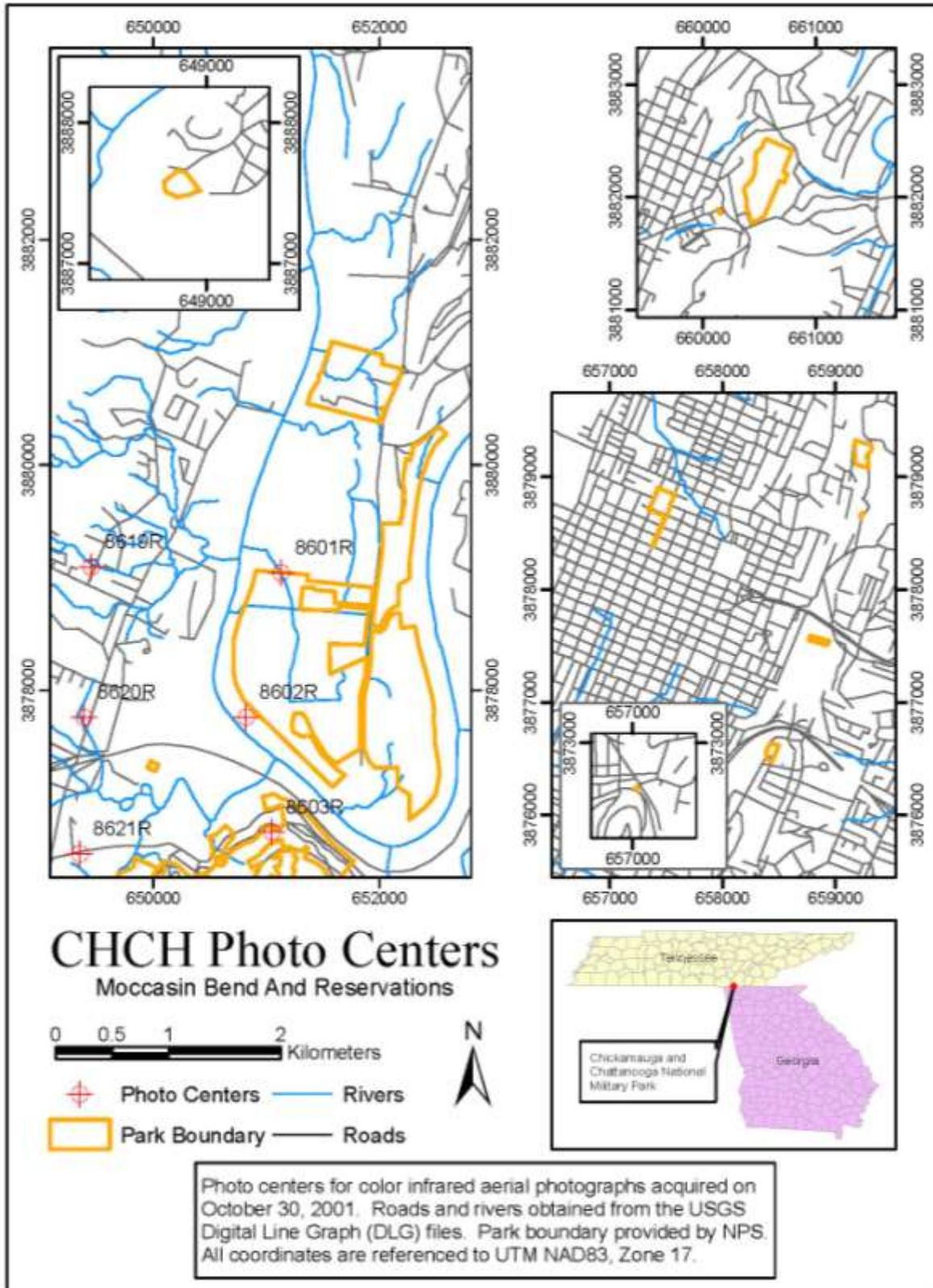


Figure J6: Photo centers Map for Moccasin Bend and Reservations.

Appendix K: Kings Mountain National Military Park

Vegetation Classification System

Alluvial and Wetland Forests

- 7330 Successional Sweetgum Floodplain Forest
- 7340 Sycamore – Sweetgum Floodplain Forest
- 4418 Piedmont Small Stream Sweetgum – Tuliptree Forest
- 4426 Piedmont Low-Elevation Headwater Seepage Swamp

Bluff

- 4415 Piedmont Chestnut Oak – Heath Bluff

Coniferous/Oak Forest

- 7493 Southern Blue Ridge Escarpment Shortleaf Pine – Oak Forest
- 8427 Appalachian Shortleaf Pine – Mesic Oak Forest

Dry-Mesic Oak Forest

- 7244 Southern Red Oak – White Oak Mixed Oak Forest
- 8475 Piedmont Dry-Mesic Oak – Hickory Forest

Herbaceous

- 4044 Successional Broom-sedge Vegetation
- 4048 Cultivated Meadow

Mesic Oak Forest

- 3949 Piedmont Mesic Basic Oak – Hickory Forest

Shrubland

- 4732 Blackberry – Greenbrier Successional Shrubland Thicket

Successional Forest

- 2591 Virginia Pine Successional Forest
- 7124 Red-cedar Successional Forest
- 7221 Interior Mid- to Late- Successional Tuliptree – Hardwood Upland Forest (Acid Type)
- 6327 Shortleaf Pine Early-Successional Forest

Woodland

- 3708 Piedmont Rock Chestnut Oak – Blackjack Oak Woodland
- 3765 Appalachian Shortleaf Pine – Post Oak Woodland

Xeric Oak Forest

- 8431 Xeric Ridgetop Chestnut Oak Forest

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Other

HI Human Influence
LWN Lawn
PK Parking Lot
RD Road
RES Residential
Soil Soil

Buffer Classes

AG Agriculture
CF Coniferous Forest
DF Deciduous Forest
G Graminoid
HI Human Influence
MF Mixed Forest
RD Road
RES Residential
SSb Early Successional shrubs, saplings, and vines
Soil Bare Soil
W Water

Class Modifiers

:Lt Tuliptree (*Liriodendron tulipifera*)
:Ddpi Dead Pine
:D Dead
:BRN Burn Area
:Ar *Acer rubrum*

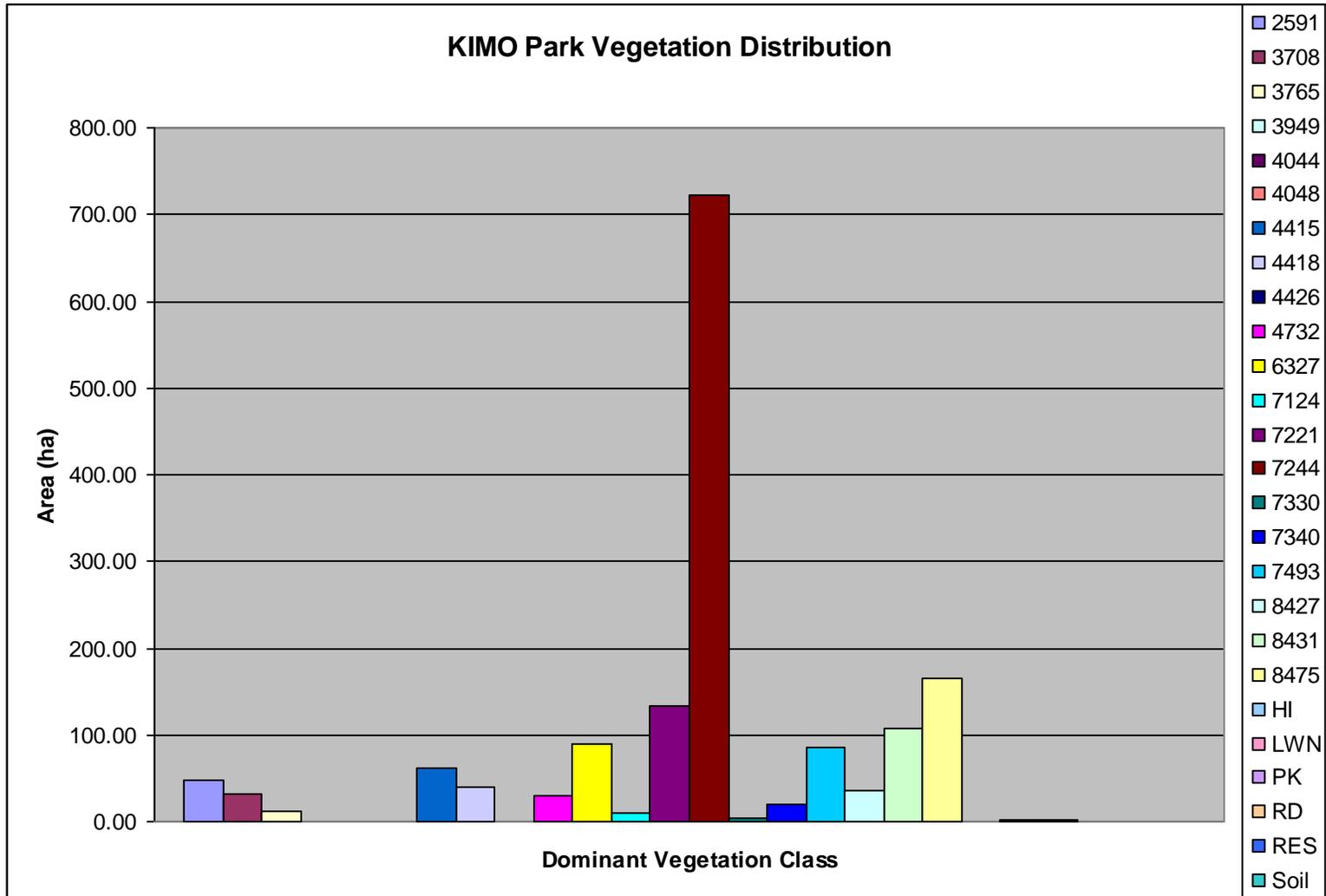
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KIMO Vegetation Statistics

Table K1: Dominant vegetation statistics for Kings Mountain National Military Park.

DomVeg	Count	Area (sq. m)	Area (ha)	Area (ac)
2591	18	474256.61	47.43	117.19
3708	17	321253.01	32.13	79.38
3765	5	113922.67	11.39	28.15
3949	1	3453.47	0.35	0.85
4044	2	4734.72	0.47	1.17
4048	2	6131.34	0.61	1.52
4415	31	608849.53	60.88	150.45
4418	9	391030.87	39.10	96.63
4426	2	6146.29	0.61	1.52
4732	8	305992.52	30.60	75.61
6327	33	891684.10	89.17	220.34
7124	5	107041.87	10.70	26.45
7221	44	1327407.77	132.74	328.01
7244	70	7215302.60	721.53	1782.93
7330	1	35485.54	3.55	8.77
7340	4	203633.10	20.36	50.32
7493	37	862031.98	86.20	213.01
8427	16	366391.97	36.64	90.54
8431	29	1078413.93	107.84	266.48
8475	48	1642037.14	164.20	405.75
HI	6	7776.41	0.78	1.92
LWN	7	11661.24	1.17	2.88
PK	3	10763.29	1.08	2.66
RD	2	5294.59	0.53	1.31
RES	5	6455.61	0.65	1.60
Soil	1	22.40	0.00	0.01
Total:	406	16007174.57	1600.72	3955.44

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Table K2: Buffer vegetation statistics for Kings Mountain National Military Park.

BufferVeg	Count	Area (sq. m)	Area (ha)	Area (ac)
AG	1	3681.91	0.37	0.91
CF	47	853926.80	85.39	211.01
DF	65	4589724.24	458.97	1134.14
G	26	865267.47	86.53	213.81
HI	5	18636.45	1.86	4.61
MF	26	330583.88	33.06	81.69
RD	1	12463.93	1.25	3.08
RES	57	276623.55	27.66	68.35
SSb	27	523265.19	52.33	129.30
Soil	2	76854.28	7.69	18.99
W	5	24652.99	2.47	6.09
Total:	262	7575680.70	757.57	1871.98

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Photo Centers

Table K3: Photo centers for Kings Mountain National Military Park.

KIMO (utm 17)		
Photo ID	X	Y
3079R	462674.75	3889850.25
3080R	462524.75	3889037.75
3081R	462349.75	3888150.25
3082R	462574.75	3887225.25
3083R	462574.75	3886325.25
3084R	462324.75	3885475.25
3085R	464624.75	3890625.25
3086R	464674.75	3889575.25
3087R	465224.75	3888425.25
3088R	464674.75	3887525.25
3089R	464474.75	3891825.25
3090R	464124.75	3890825.25
3091R	463974.75	3889625.25
3092R	463974.75	3888625.25
3093R	464424.75	3887625.25
3094R	464174.75	3886675.25
3095R	464324.75	3885575.25
3096R	466674.75	3891675.25
3097R	466674.75	3890725.25
3098R	466574.75	3889825.25
3099R	466524.75	3889025.25
3100R	466674.75	3888025.25
3101R	466674.75	3887075.25
3103R	466587.25	3892000.25
3104R	465887.25	3891087.75
3105R	465574.75	3890025.25
3106R	465574.75	3888975.25
3107R	466224.75	3887987.75
3108R	466324.75	3886925.25

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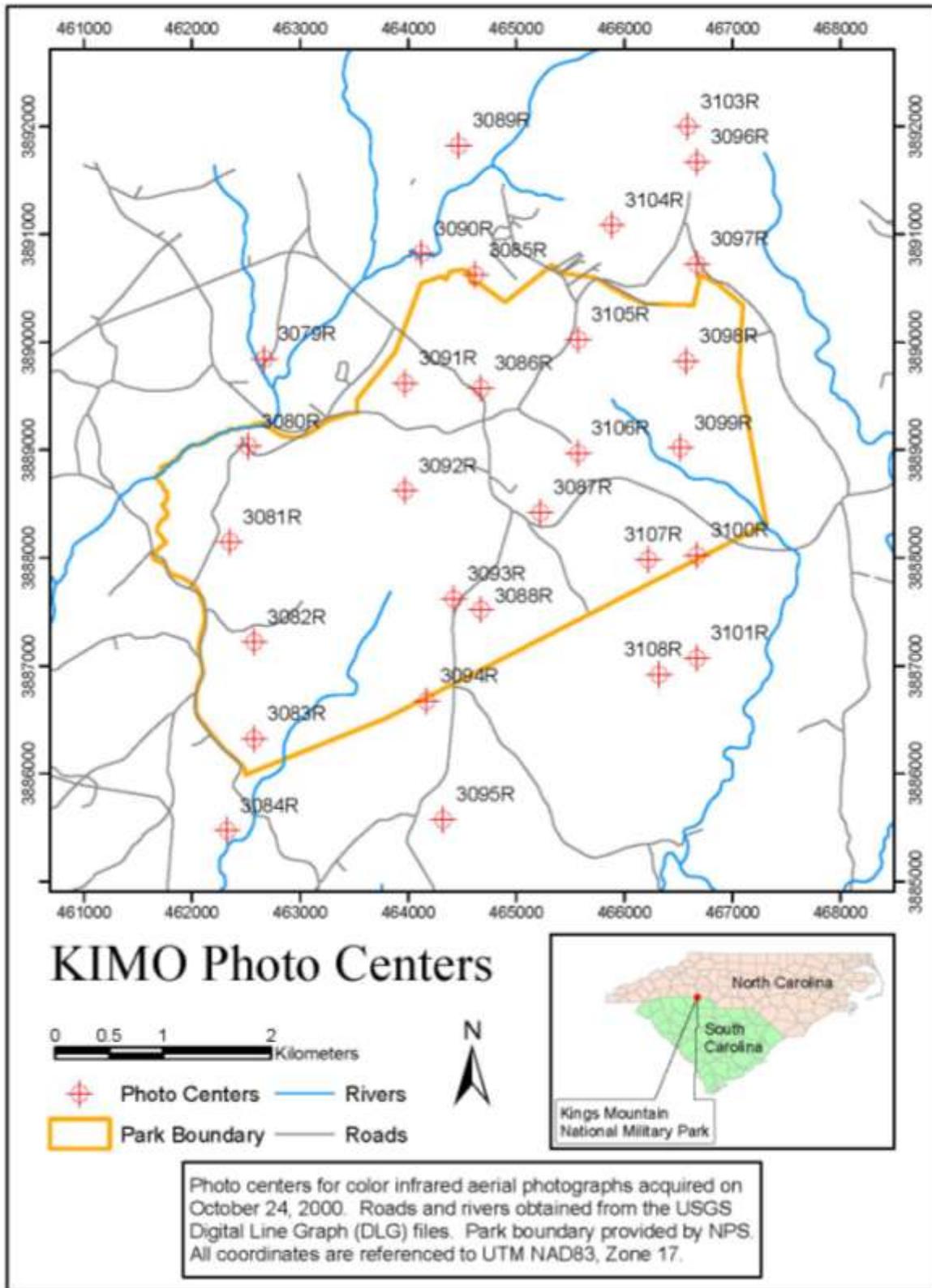


Figure K2: Photo centers map for Kings Mountain National Military Park.

Appendix L: Mammoth Cave National Park

Vegetation Classification System

Lowland or Submontane Cold-Deciduous Forest

- 2070 White Oak – Mixed Oak Dry-Mesic Alkaline Forest
- 2411 Beech – Maple Unglaciaded Forest
- 3876 Nashville Basin Shingle Oak – Shumard Oak – Chinquapin Oak Forest
- 4412 Southern Red Oak Flatwoods Forest
- 4741 Interior Low Plateau Mesic Sugar Maple – Hickory Forest
- 5018 Southern Red Oak – Mixed Oak Forest
- 5022 Interior Low Plateau Chestnut Oak Forest
- 7698 Rich Appalachian Red Oak – Sugar Maple Forest
- 7700 Interior Low Plateau Chestnut Oak – Mixed Oak Forest
- 7795 Interior Dry-Mesic White Oak – Hickory Forest
- 7881 Central Interior Beech – White Oak Forest
- 8442 Shumard Oak – Chinquapin Oak Mesic Limestone Forest

Pine Forest

- 6327 Early-Successional Shortleaf Pine Forest
- 7119 Appalachian Low-Elevation Mixed Pine/Hillside Blueberry Forest

Hemlock Hardwood Forest

- 5043 East Central Hemlock Hardwood Forest

Successional Forest

- 7124 Eastern Red-cedar Successional Forest
- 7121 Virginia Pine – Red-redar Successional Forest
- 2591 Virginia Pine Successional Forest
- 7220 Successional Tuliptree Forest (Circumneutral Type)
- 7221 Successional Tuliptree Forest (Acidic Type)
- 4133 Southeastern Successional Black Cherry Forest
- 7879 Successional Black Walnut Forest

Temporarily Flooded Forest

- 2432 Pin Oak Mixed Hardwood Depression Forest
- 7330 Successional Sweetgum Floodplain Forest
- 7334 Sycamore – Silver Maple Calcareous Floodplain Forest
- 8429 Rich Levee Mixed Hardwood Bottomland Forest

Woodland

- 4267 Chinquapin Oak Unglaciaded Bluff Woodland
- 4686 Western Highland Rim Post Oak Barrens

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Wetland

- 2413 Sinkhole Pond Marsh
- 4150 Southern Cattail March
- 4286 Water-Willow Rock Bar and Shore
- 4742 Buttonbush Sinkhole Pond Swamp

Herbaceous

- 4044 Successional Broomsedge Vegetation
- 4048 Cultivated Meadow

Shrubland

- 4708 Highland Rim Limestone Cliff/Talus Seep
- 4732 Blackberry – Greenbrier Successional Shrubland Thicket

Additional Categories

- AG Agriculture
- Bld Building
- COM Commercial
- HI Human Influence
- Lwn Lawn
- PK Parking Lot
- Pwer Power Line Easement
- RD Road
- RES Residential
- RK Rock
- Soil Soil
- W Water

Additional Modifiers

- CCL Clear Cut Logging
- Ddpi Dead Pine
- GH High Graded Logging
- REG Regeneration
- Succ Early Successional

Species Modifiers

- Ar Red Maple
- As Sugar Maple
- Asa Silver Maple
- Csp Hickory spp.
- Fg American Beech
- Jv Eastern Red Cedar
- Lt Tuliptree
- Pv Virginia Pine
- Qa White Oak
- Qv Black Oak

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MACA Vegetation Statistics

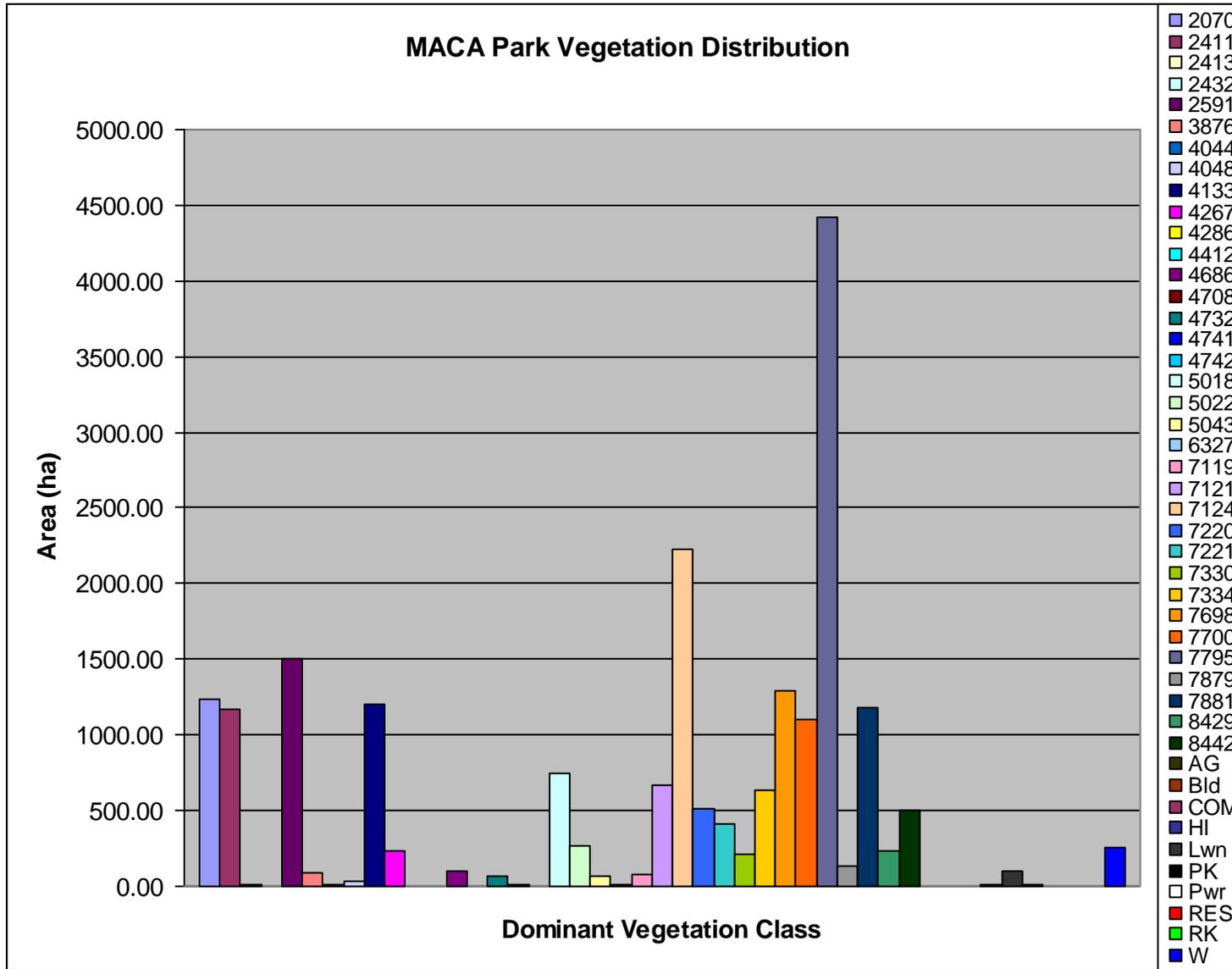
Table L1: Dominant vegetation statistics for Mammoth Cave National Park.

DomVeg	Count	Area (sq. m)	Area (ha)	Area (ac)
2070	364	12405814.07	1240.58	3065.53
2411	472	11724898.11	1172.49	2897.27
2413	12	72577.10	7.26	17.93
2432	7	41042.14	4.10	10.14
2591	695	15053359.47	1505.34	3719.75
3876	62	891972.69	89.20	220.41
4044	24	66324.24	6.63	16.39
4048	45	339792.28	33.98	83.96
4133	902	12066737.91	1206.67	2981.74
4267	160	2344816.95	234.48	579.41
4286	8	39702.98	3.97	9.81
4412	1	35021.27	3.50	8.65
4686	60	984786.51	98.48	243.35
4708	5	18232.36	1.82	4.51
4732	67	713031.55	71.30	176.19
4741	6	104505.53	10.45	25.82
4742	9	53725.86	5.37	13.28
5018	128	7441007.68	744.10	1838.71
5022	93	2620751.10	262.08	647.60
5043	73	654922.28	65.49	161.83
6327	17	163680.47	16.37	40.45
7119	88	828474.67	82.85	204.72
7121	442	6699120.85	669.91	1655.38
7124	836	22229256.77	2222.93	5492.95
7220	232	5129841.65	512.98	1267.61
7221	259	4072022.85	407.20	1006.21
7330	34	2136684.94	213.67	527.98
7334	73	6398226.81	639.82	1581.03
7698	441	12869038.73	1286.90	3180.00
7700	251	11028881.90	1102.89	2725.29
7795	857	44167490.63	4416.75	10913.98
7879	297	1389994.60	139.00	343.47
7881	364	11785197.78	1178.52	2912.17
8429	314	2379964.25	238.00	588.10
8442	209	4969079.60	496.91	1227.88
AG	6	6471.25	0.65	1.60
Bld	4	7303.79	0.73	1.80
COM	4	2429.92	0.24	0.60
HI	11	117912.45	11.79	29.14
Lwn	45	1030981.21	103.10	254.76
PK	3	63419.85	6.34	15.67
Pwr	1	4424.90	0.44	1.09
RES	19	30108.85	3.01	7.44

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DomVeg	Count	Area (sq. m)	Area (ha)	Area (ac)
RK	2	3675.24	0.37	0.91
W	23	2585209.66	258.52	638.82
Total:	8025	207,771,915.71	20,777.19	51,341.35

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Table L2: Buffer vegetation statistics for Mammoth Cave National Park.

BufferVeg	Count	Area (sq. m)	Area (ha)	Area (ac)
2070	63	1392758.36	139.28	344.16
2411	104	1999386.57	199.94	494.06
2413	10	23257.33	2.33	5.75
2591	246	3922713.63	392.27	969.32
3876	3	25144.18	2.51	6.21
4044	128	3126880.44	312.69	772.67
4048	194	12068267.05	1206.83	2982.12
4133	246	2243616.32	224.36	554.41
4150	1	2683.55	0.27	0.66
4267	4	52826.45	5.28	13.05
4412	1	138.43	0.01	0.03
4686	22	474344.82	47.43	117.21
4708	4	12979.84	1.30	3.21
4732	238	3009991.22	301.00	743.78
4742	1	344.52	0.03	0.09
5018	77	2864387.12	286.44	707.80
5022	31	380134.66	38.01	93.93
5043	26	188284.14	18.83	46.53
6327	23	176437.34	17.64	43.60
7119	54	495104.14	49.51	122.34
7121	82	619257.66	61.93	153.02
7124	245	2759067.33	275.91	681.78
7220	106	2538050.76	253.81	627.16
7221	161	2303640.71	230.36	569.24
7330	5	43918.61	4.39	10.85
7334	19	359535.68	35.95	88.84
7698	52	767337.82	76.73	189.61
7700	112	3119416.54	311.94	770.82
7795	239	4447994.81	444.80	1099.12
7879	46	176320.74	17.63	43.57
7881	77	1205381.98	120.54	297.86
8429	58	335982.85	33.60	83.02
8442	16	270698.26	27.07	66.89
AG	83	925572.08	92.56	228.71
Bld	8	5797.00	0.58	1.43
COM	7	102850.74	10.29	25.41
HI	15	209729.37	20.97	51.83
Lwn	74	917922.65	91.79	226.82
RD	1	62160.57	6.22	15.36
RES	278	1908673.15	190.87	471.64
RK	5	88832.01	8.88	21.95
Soil	5	42883.50	4.29	10.60
W	156	587780.99	58.78	145.24
Total:	3326	56258485.90	5625.85	13901.72

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Photo Centers

Table L3: Photo centers for Mammoth Cave National Park.

MACA (utm 16)		
Photo ID	X	Y
1-01	580268.94	4107543.61
1-02	581704.28	4107546.10
1-03	583134.90	4107540.41
1-04	584574.66	4107539.56
1-05	586018.66	4107535.14
1-06	587438.82	4107533.57
2-01	571826.99	4110056.32
2-02	573272.49	4110054.63
2-03	574721.11	4110055.11
2-04	576173.87	4110053.48
2-05	577627.10	4110058.98
2-06	579059.37	4110063.57
2-07	580498.32	4110067.89
2-08	581918.43	4110070.36
2-09	583336.73	4110071.97
2-10	584749.16	4110078.56
2-11	586185.82	4110080.59
2-12	587597.87	4110086.45
3-01	571201.93	4112537.59
3-02	572626.14	4112543.40
3-03	574055.70	4112542.47
3-04	575514.23	4112545.38
3-05	576965.57	4112572.33
3-06	578414.47	4112566.49
3-07	579844.85	4112574.61
3-08	581289.12	4112580.91
3-09	582723.69	4112589.57
3-10	584147.31	4112591.05
3-11	585564.42	4112600.37
3-12	586985.07	4112612.81
3-13	588395.46	4112613.84
4-01	567666.82	4115108.03
4-02	569102.98	4115110.80
4-03	570545.35	4115126.30
4-04	571989.22	4115133.76
4-05	573434.11	4115145.96
4-06	574880.07	4115155.10
4-07	576331.67	4115164.74
4-08	577760.85	4115169.48
4-09	579212.57	4115180.10
4-10	580641.81	4115188.41

Photo ID	X	Y
4-11	582095.32	4115189.45
4-12	583532.37	4115197.71
4-13	584953.80	4115213.33
4-14	586369.13	4115223.72
4-15	587799.33	4115236.75
4-16	589247.76	4115240.63
5-01	562308.41	4117768.24
5-02	563769.95	4117764.94
5-03	565235.53	4117759.44
5-04	566683.33	4117753.90
5-05	568146.00	4117759.11
5-06	569590.03	4117757.70
5-07	571021.03	4117762.37
5-08	572467.33	4117753.99
5-09	573899.66	4117745.63
5-10	575350.82	4117739.97
5-11	576776.93	4117738.93
5-12	578218.94	4117746.72
5-13	579654.49	4117740.58
5-14	581096.51	4117737.57
5-15	582540.64	4117738.21
5-16	583977.88	4117733.19
5-17	585407.94	4117732.57
5-18	586844.99	4117730.84
5-19	588287.37	4117733.69
5-20	589725.59	4117733.79
6-01	562346.28	4120285.67
6-02	563793.57	4120282.96
6-03	565243.72	4120283.90
6-04	566713.91	4120287.00
6-05	568180.61	4120290.42
6-06	569597.23	4120295.07
6-07	571037.62	4120297.91
6-08	572477.61	4120297.48
6-09	573921.11	4120300.55
6-10	575363.56	4120302.36
6-11	576798.76	4120302.96
6-12	578232.58	4120305.45
6-13	579666.50	4120308.62
6-14	581122.07	4120310.02
6-15	582554.82	4120315.53
6-16	583990.46	4120318.35

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Photo ID	X	Y
6-17	585423.95	4120320.83
6-18	586856.11	4120320.42
6-19	588290.00	4120323.86
6-20	589723.19	4120326.28
7-01	563068.05	4122790.50
7-02	564519.29	4122803.43
7-03	565974.64	4122806.43
7-04	567409.53	4122805.70
7-05	568849.07	4122811.41
7-06	570279.01	4122812.42
7-07	571725.43	4122817.69
7-08	573148.09	4122813.20
7-09	574585.47	4122818.40
7-10	576013.62	4122819.00
7-11	577445.41	4122820.01
7-12	578884.83	4122825.54
7-13	580302.21	4122825.06
7-14	581722.10	4122831.33
7-15	583169.36	4122834.87
7-16	584592.76	4122832.16
7-17	586041.83	4122832.91
7-18	587481.98	4122835.43
7-19	588903.20	4122838.64
8-01	563379.95	4125414.51
8-02	564831.29	4125414.65
8-03	566284.63	4125409.57
8-04	567732.60	4125409.24
8-05	569154.13	4125405.99
8-06	570608.26	4125395.25
8-07	572039.77	4125403.37
9-01	580627.40	4125397.30
9-02	582085.99	4125406.54
9-03	583505.26	4125415.54
9-04	584945.11	4125419.80
9-05	586379.02	4125421.24
9-06	587809.91	4125429.04
9-07	589240.86	4125436.27

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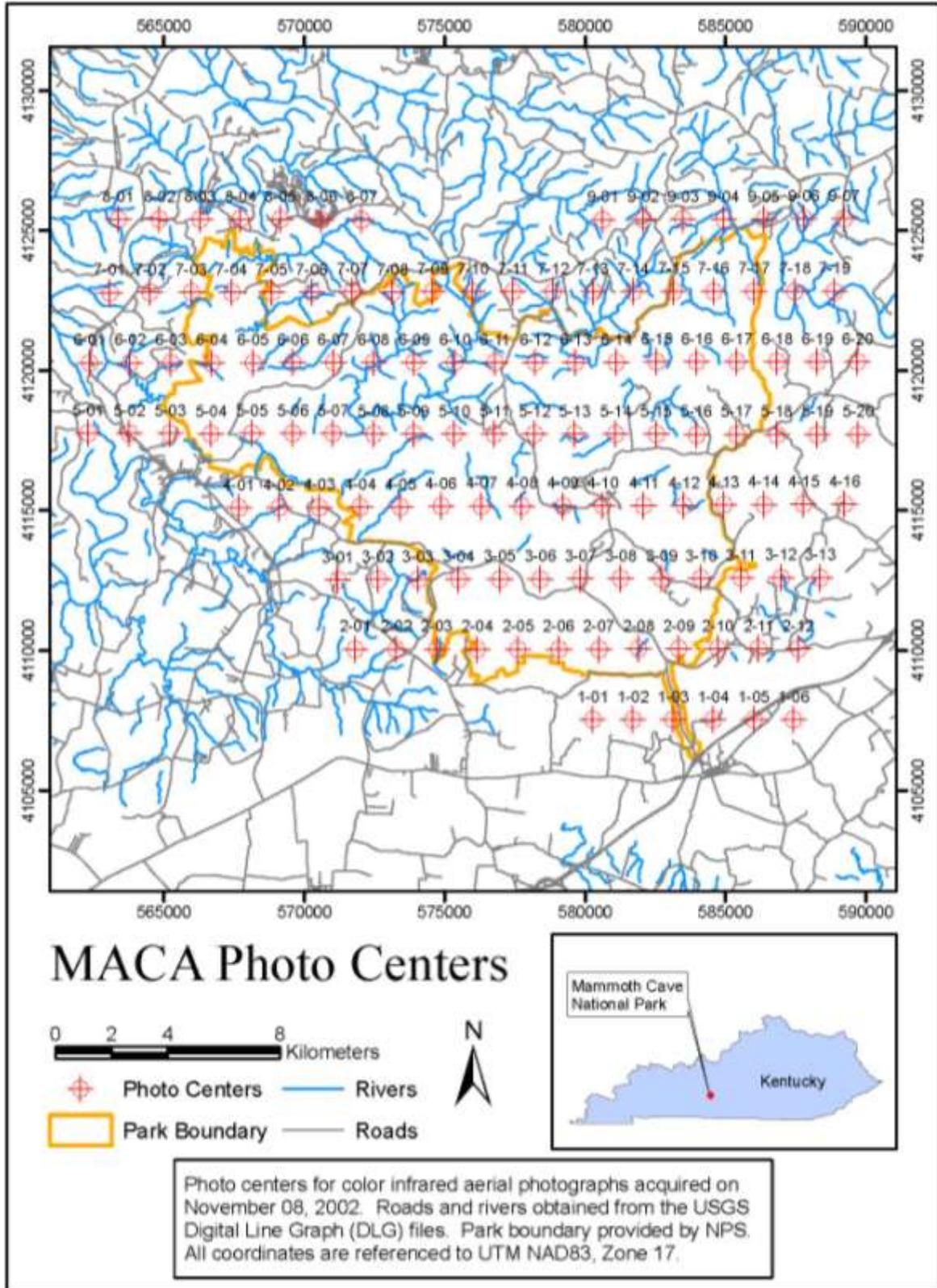


Figure L2: Photo centers map for Mammoth Cave National Park.

Appendix M: Russell Cave National Monument

Vegetation Classification System

Lowland or Submontane Cold-Deciduous Forest

- 7124 Red-cedar Successional Forest (*Juniperus virginiana* var. *virginiana* / *Quercus (muehlendegii, shumardii)* – *Cercis canadensis* – *Frangula caroliniana* – *Acer barbatum*) Forest
- 2070 White Oak - Mixed Oak Dry-Mesic Alkaline Forest (*Quercus alba* – *Quercus rubra* – *Quercus muehlenbergii* / *Cercis Canadensis*) Forest
- 7233 Rich Low-Elevation Appalachian Oak Forest *Quercus alba-Quercus rubra-Acer saccharum, Fagus gandifolia/Aesculus flava* Forest
- 8442 Shumard Oak-Chinquapin Oak Mesic Limestone Forest *Quercus shumardii* – *Quercus muehlenbergii* – *Acer (barbatum, leucoderme, saccharum)* / *Ostrya virginiana* Forest
- 8431 Xeric Ridgetop Chestnut Oak Forest *Quercus prinus* – (*Quercus coccinea* / *Carya pallida* / *Vaccinium arboretum* – *Vaccinium pallidum*) Forest
- 7268 Chestnut Oak-Shagbark Hickory-Sugar Maple Forest (*Quercus prinus* – *Carya ovata* – *Quercus rubra* / *Acer saccharum*) Forest
- 8429 Rich Levee Hardwood Bottomland Forest (*Platanus occidentalis* - *Celtis laevigata* - *Liriodendron tulipifera* / *Lindera benzoin* - *Arundinaria gigantea* / *Amphicarpaea bracteata*) Forest
- Ls/Lt Sweetgum Successional Forest (*Liquidambar styraciflua* / *Liriodendron tulipifera*)
- Pt Loblolly Pine (*Pinus taeda*)
- RD Road
- RES Residential

Herbaceous Vegetation

- 4048 Cultivated Meadow *Lolium (arundinaceum, pretense)* Herbaceous Vegetation

Modifiers

- :Succ Succession Vegetation
- :Co Shagbark hickory ([Carya ovata](#))
- :Fa White Ash (*Fraxinus americana*)

Buffer Classes

- CF Coniferous Forest
- DF Deciduous Forest
- MF Mixed Forest
- G Grassland, Field Meadow, Forbs, Pasture
- Res Residential
- Rd Road

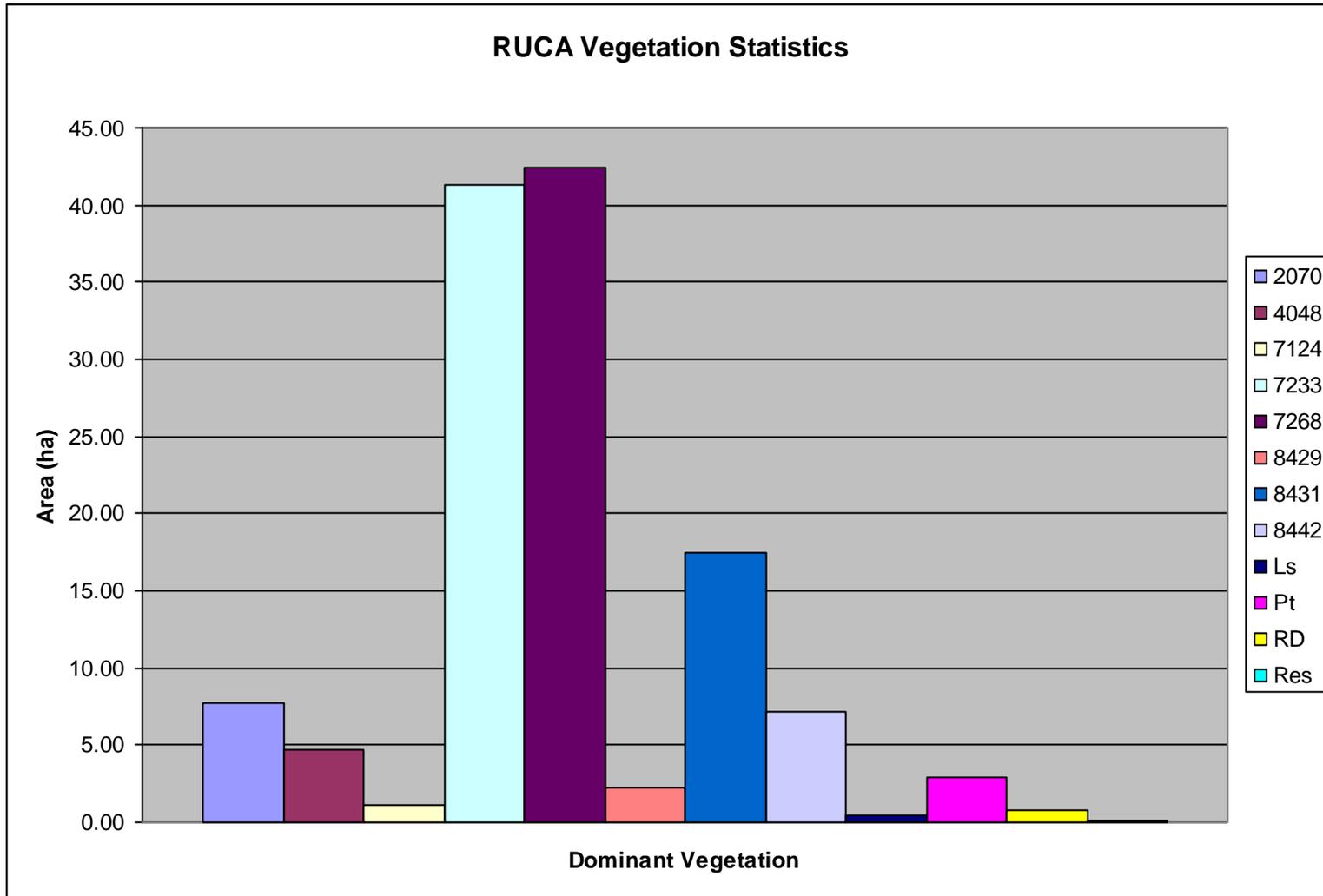
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RUCA Vegetation Statistics

Table M1: Dominant vegetation statistics for Russell Cave National Monument.

DomVeg	Count	Area (sq. m)	Area (ha)	Area (ac)
2070	3	77293.28	7.73	19.10
4048	6	46721.18	4.67	11.55
7124	2	11643.07	1.16	2.88
7233	4	412887.46	41.29	102.03
7268	1	423799.36	42.38	104.72
8429	1	22739.05	2.27	5.62
8431	2	174441.41	17.44	43.11
8442	2	71271.60	7.13	17.61
Ls	1	3935.47	0.39	0.97
Pt	1	29492.85	2.95	7.29
RD	1	7301.49	0.73	1.80
Res	2	1262.49	0.13	0.31
Total:	26	1282788.71	128.28	316.98

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Table M2: Buffer vegetation statistics for Russell Cave National Monument.

BufferVeg	Count	Area (sq. m)	Area (ha)	Area (ac)
CF	3	64315.98	6.43	15.89
DF	8	517842.29	51.78	127.96
G	3	709184.61	70.92	175.24
MF	6	1394219.85	139.42	344.52
RD	1	10903.79	1.09	2.69
Res	4	110797.73	11.08	27.38
Total:	25	2807264.24	280.73	693.69

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Photo Centers

Table M3: Photo centers for Russell Cave National Monument.

RUCA (utm16)		
Photo ID	X	Y
8539	608968.14	3869007.77
8538	609134.08	3867970.95
8540	608877.07	3869877.76
8541	608657.37	3870798.00
8542	608392.08	3871651.92
8543	608205.54	3872547.29
8533	608881.22	3871709.95
8534	608682.24	3870644.63
8536	608562.03	3868779.27
8537	608516.43	3867830.01
8535	608586.90	3869649.77

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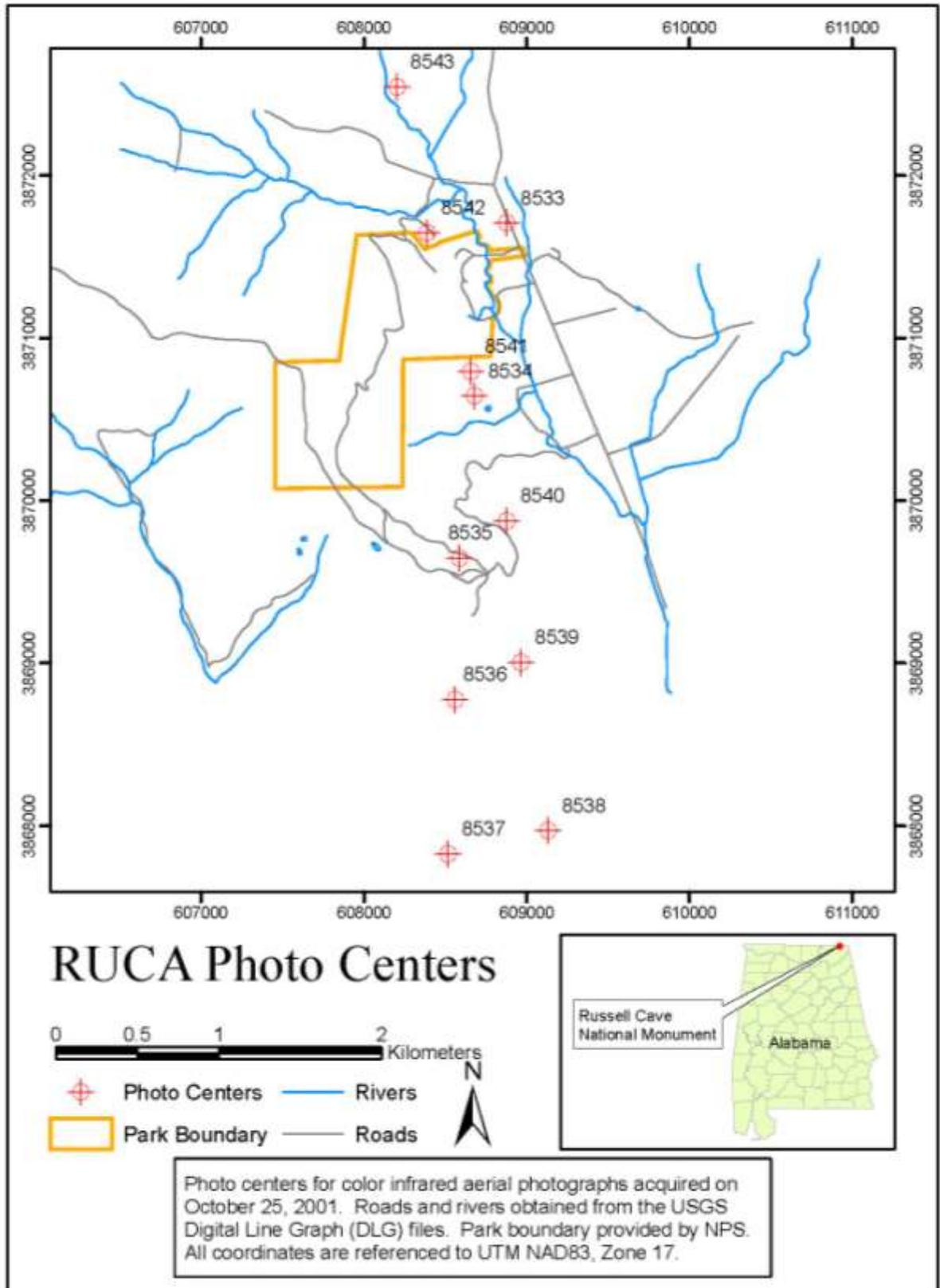


Figure M2: Photo centers map for Russell Cave National Monument.

Appendix N: Shiloh National Military Park

Vegetation Classification System

Needle-Leaved Evergreen Forest

- 6011 Early- to Mid-Successional Loblolly Pine Forest
- 6327 Early-Successional Shortleaf Pine Forest
- 7124 Successional Eastern Red-cedar Forest
- 8462 Mid- to Late-Successional Loblolly Pine – Sweetgum Forest

Lowland or Submontane Cold-deciduous Forest

- 2067 White Oak – Red Oak Dry-Mesic Acidic Forest
- 2070 White Oak – Mixed oak Dry-Mesic Alkaline Forest
- 3871 Central Interior Upland Cherrybark Oak Forest
- 3903 Upper East Gulf Coast Plain Chinquapin Oak – Hickory Forest
- 4412 Southern Red Oak Flatwoods Forest
- 7201 Southern Mesic beech – Tuliptree Slope Forest
- 7216 Successional Sweetgum Forest
- 7217 Interior Mid- to Late-Successional Sweetgum – Oak Forest
- 7221 Successional Tuliptree – Oak Forest (Acidic Type)
- 7244 Interior Southern Red Oak – White Oak – Pignut Hickory Forest
- 7246 Dry Acidic Eastern Coastal Plain Southern Red Oak – Post Oak – Pignut Hickory Forest
- 7795 Interior Dry-Mesic White oak – Hickory Forest
- 7881 Central Interior Beech – White Oak Forest

Mixed Needle-Leaved Evergreen – Cold-deciduous Forest

- 4052 East Gulf Coastal Plain Shortleaf Pine – Southern Red Oak – Mixed Oak Forest

Temporarily or Seasonally Flooded Cold-deciduous Forest

- 2099 Swamp Chestnut Oak – Sweetgum Mesic Floodplain Forest
- 2427 Southern Green Ash – Elm – Sugarberry Forest
- 4745 East Gulf Coast Plain Beech Floodplain Forest
- 7312 River Birch Levee Forest
- 7330 Successional Sweetgum – (Tuliptree) Floodplain Forest
- 7334 Sycamore – Silver Maple Calcareous Floodplain Forest
- 7335 Gulf Coast Plain Sycamore – Sweetgum Floodplain Forest
- 7353 Sweetgum – Cherrybark Oak Floodplain Forest
- 8441 Cumberland Plateau Willow Oak Pond
- A.291 (Swamp Chestnut Oak – Cherrybark Oak – Shumard Oak) – Sweetgum Alliance

Semipermanently Flooded or Saturated Cold-deciduous Forest

- 2419 Water Tupelo Swamp Forest
- 4425 Interior Red Maple – Balckgum Forested Acidic Seep

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Woodland

- 4686 Western Highland Rim Post Oak Barrens
- 4756 Western Highland Rim Blackjack Oak Barrens

Shrubland

- 2191 Southern Buttonbush Pond shrubland
- 3807 Upland Chinese Privet Shrubland

Herbaceous Vegetation

- Temperate Grassland
- 4044 Successional Broomsedge
- 4048 Cultivated Meadow

Additional Categories

- Ag Agricultural Field
- BG Bare Ground, Mud
- Cem Cemetery
- F Field, Historical
- G Graminoid/Forb Vegetation
- HI Human Influence, Old Homesite
- Hdw Hardwoods
- Pi Pine
- RD Road
- RK Rock
- ROW Utility Right-of-Way
- Sb Shrubs, Saplings, Vines, Blackberries
- W Water

Buffer Classes

- Ag Agricultural Field
- BG Bare Ground, Mud
- Cem Cemetery
- CF Coniferous Forest
- DF Deciduous Forest
- G Graminoid/Forb Vegetation
- HI Human Influence, Old Homesite, Buildings
- MF Mixed Forest
- Res Residential
- RD Road
- Sb Shrubs, Saplings, Vines, Blackberries
- W Water
- Wt Wetland

Modifiers

- Dd Dead
- Hwd Hardwoods

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m	Mowed
ot	Overtopped, by Later Successional Forest
p	Planted
r	Regenerating, Very Early Successional
Sb	Shrubs, Saplings, Vines, Blackberries

Species Modifiers

Ar	Red Maple
As(a)	Sugar Maple
Bn	River Birch
Cl	Sugarberry
Co	Shagbark Hickory
Cx	Hickory
Fa	American Ash
Jv	Eastern Red Cedar
Ls	Sweetgum
Lt	Tuliptree
Ns	Black Gum
Pi	Pine
Ple	Shortleaf Pine
Plt	Loblolly Pine
Ps	Black Cherry
Qa	White Oak
Qf	Southern Red Oak
Qp	Cherrybark oak
Qpr	Chestnut Oak
Qr	Northern Red Oak
Qs	Post Oak
Qx	Mixed Oak Species
Rm	Multiflora Rose
Sn	Black Willow
Vr	Muscadine Grape

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SHIL Vegetation Statistics

Table N1: Dominant vegetation statistics for Shiloh National Military Park.

DomVeg	Count	Area (sq. m)	Area (ha)	Area (ac)
2067	1	25326.00	2.53	6.26
2070	16	240075.16	24.01	59.32
2099	6	27193.29	2.72	6.72
2191	2	11330.93	1.13	2.80
2419	2	69041.89	6.90	17.06
2427	29	254550.83	25.46	62.90
3807	1	3856.50	0.39	0.95
3871	22	382558.69	38.26	94.53
3903	4	6854.12	0.69	1.69
4044	18	225487.18	22.55	55.72
4048	3	14500.99	1.45	3.58
4052	8	126243.42	12.62	31.20
4412	3	274470.65	27.45	67.82
4425	2	4205.14	0.42	1.04
4686	4	12588.57	1.26	3.11
4745	2	12557.59	1.26	3.10
4756	4	5325.43	0.53	1.32
6011	15	142467.33	14.25	35.20
6327	25	310107.09	31.01	76.63
7124	13	118156.74	11.82	29.20
7201	18	276749.81	27.67	68.39
7216	48	442890.48	44.29	109.44
7217	23	461932.18	46.19	114.15
7221	17	187063.79	18.71	46.22
7244	108	4795855.25	479.59	1185.08
7246	87	3101221.20	310.12	766.33
7312	2	3562.96	0.36	0.88
7330	31	851651.59	85.17	210.45
7334	3	22064.95	2.21	5.45
7335	4	128967.63	12.90	31.87
7353	7	313604.24	31.36	77.49
7795	4	10004.44	1.00	2.47
7881	21	235571.33	23.56	58.21
8441	1	6377.40	0.64	1.58
8462	2	29517.19	2.95	7.29
A.291	6	31319.45	3.13	7.74
Ag	43	480564.32	48.06	118.75
BG	14	23527.41	2.35	5.81
Cem	3	20364.26	2.04	5.03
F	41	1075876.80	107.59	265.85
G	49	478478.42	47.85	118.23

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DomVeg	Count	Area (sq. m)	Area (ha)	Area (ac)
HI	23	106309.75	10.63	26.27
Hdw	4	32386.53	3.24	8.00
PI	4	33098.02	3.31	8.18
RK	1	782.89	0.08	0.19
ROW	2	5514.71	0.55	1.36
Rd	24	442907.38	44.29	109.44
Sb	26	64449.42	6.44	15.93
W	51	94621.88	9.46	23.38
Total:	847	16024133.22	1602.41	3959.63

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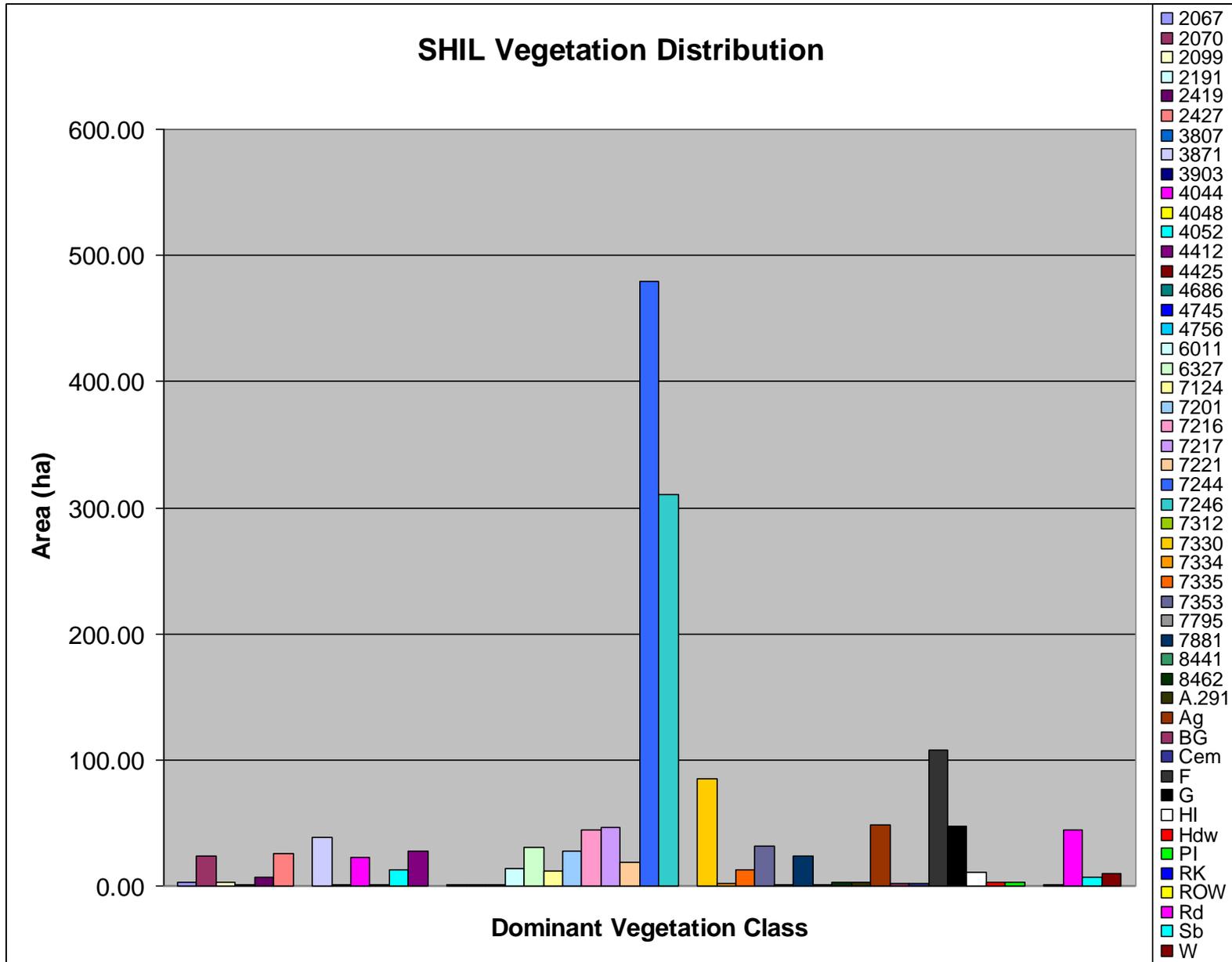


Table N2: Buffer vegetation statistics for Shiloh National Military Park.

BufferVeg	Count	Area (sq. m)	Area (ha)	Area (ac)
Ag	31	3014391.04	301.44	744.87
BG	8	78549.92	8.08	19.97
CF	21	263758.54	26.38	65.18
Cem	1	6984.72	0.70	1.73
DF	84	2606349.53	260.60	643.95
G	56	1187740.41	118.77	293.50
HI	10	112444.07	11.24	27.79
MF	18	450880.67	45.09	111.41
Rd	15	385148.03	38.51	95.17
Res	46	328822.75	32.88	81.25
Sb	14	111291.18	11.13	27.50
W	33	1076687.26	107.72	266.17
Wt	1	4181.06	0.42	1.03
Total:	338	9627229.18	962.96	2379.51

CUPN Parks - Appendices

Photo Centers

Table N3: Photo centers for Shiloh National Military Park

SHIL (utm 16)		
Photo ID	X	Y
8544	379836.05	3890843.96
8547	379952.33	3887694.57
8548	380015.67	3886799.19
8546	379875.90	3888793.60
8545	379843.64	3889766.62
8549	378677.10	3893535.04
8550	378585.71	3892400.75
8551	378660.97	3891325.59
8552	378945.89	3890282.69
8553	378972.77	3889304.30
8554	378929.76	3888209.79
8555	378902.88	3887193.77
8559	378644.84	3889612.87
8561	378725.48	3887547.50
8560	378650.22	3888547.39
8557	378510.45	3891677.17
8558	378569.58	3890612.76
8562	378671.72	3886625.02
8556	378263.16	3892673.84
8565	376408.52	3891587.93
8564	376661.18	3892528.69
8566	376508.51	3890783.71
8567	376535.39	3889778.44
8568	376567.65	3888730.17
8569	376583.77	3887988.31
8570	376599.90	3886902.41
8571	376610.65	3885863.81
8572	376664.41	3885019.81
8574	375672.04	3892499.66
8573	375710.75	3893680.18
8575	375623.66	3891648.14
8576	375497.87	3890603.09
8577	375526.90	3889499.98
8578	375381.75	3888571.05
8579	375265.63	3887555.02
8580	375226.93	3886645.44
8581	375236.60	3885426.22

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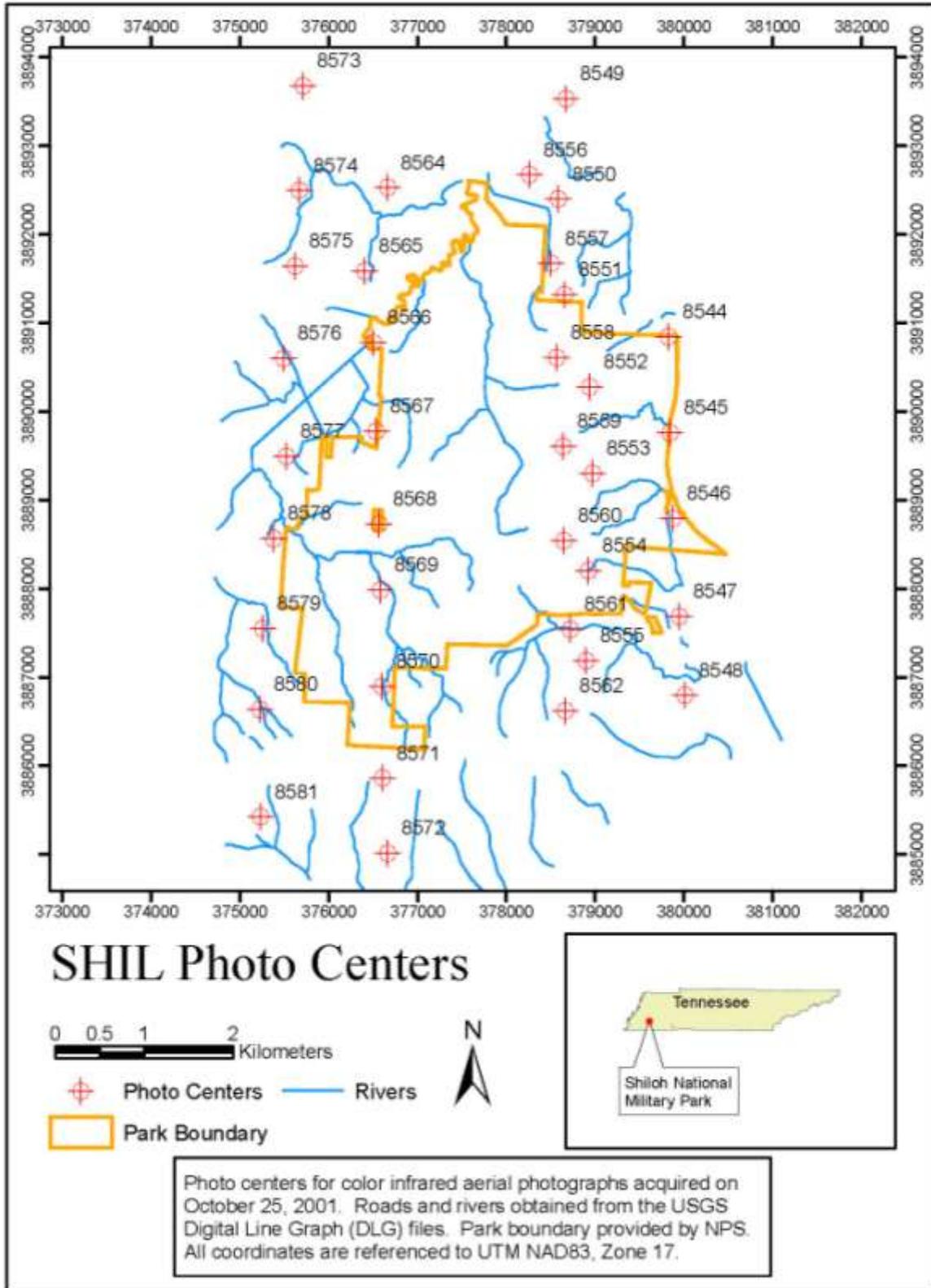


Figure N2: Photo centers map for Shiloh National Military Park.

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NPS 910/106100, November, 2010

National Park Service
U.S. Department of the Interior



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