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Remote Sensing: Lidar, GPS, and GIS Examination of Cattle Mound Archaeological Sites in Congaree National Park

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REMOTE SENSING: LIDAR, GPS, AND GIS EXAMINATION OF CATTLE MOUND ARCHAEOLOGICAL SITES IN CONGAREE NATIONAL PARK

Prepared for: The National Park Service’s Southeast Archeological Center (SEAC), Dr. Margo Schwadron

Lori Collins, Ph.D., Travis Doering, Ph.D. - Principal Investigators with Jorge Gonzalez - Lead 3D Specialist
Contributions by: Garrett Speed, Richard McKenzie, and Noelia Garcia, University of South Florida Libraries Digital Heritage and Humanities Collections

Summary: This project spatially recorded and documented selected cattle mound site locations in the Congaree National Park by means of aerial LiDAR for a remote sensing examination and used Global Positioning Systems (GPS) for ground verification. A Geographic Information System (GIS) approach, along with targeted examination of the spatial aspects (e.g., position, extent, metrology, and relationships), and cartographic mapping of these historic cultural resources was performed to capture and document the contextual terrain and site details. Results from the LiDAR prospection and ground verification were also considered with historic maps, aerial imagery, and other information, to examine landscape and terrain features. The focus of this project was on the historic features known as: Cooner’s Cattle Mound (COSW-4), Cattle Mound #6 (COSW-25), Buyck’s Cattle Ring (COSW-24), Spigener Mound (COSW-29), and Cook’s Lake Cattle Mound (COSW-21), with overview mapping and remote sensing efforts also including related landscape and environmental features within the park.
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Project Description

This project is part of a cooperative agreement (CESU# P13AC00443) between the University of South Florida, (Drs. Lori Collins and Travis Doering), and the National Park Service (Southeast Archeological Center-SEAC, ATR: Dr. Margo Schwadron). The scope of the project is to map and provide remote sensing using aerial LiDAR and imaging techniques, along with GPS and GIS assessment of the resources, to assist in the better understanding of spatial extents, configurations, morphologies, and cultural affiliations for select Cattle Mound site locations in Congaree National Park, South Carolina (Figure 1).

Prevailing theory and historical evidence suggest that in the nineteenth century, settlers to the Congaree area utilized slave labor to build earthen dikes and cattle mounds as constructed attempts at controlling flooding and to create land more appropriate for agriculture. Cattle mound location and position, along with their shape, size, and scale and association with other land modifications, can be critically assessed through use of LiDAR in combination with GPS verification. Using this Geographic Information Science (GIScience) approach, information can be examined to assist in the better understanding of these sites and their intended use. Due to the remote and hard-to-access locations of these sites, as well as the nature of the field conditions (soils, brush, cover, wetness of ground aspects, transport logistics), it was decided that LiDAR and 3D examination of the features in combination with ground truth verification and examination of any open stratigraphic or subsurface areas, offered the most cost effective and best science approach to examine cultural and/or temporal affiliations. Spatial details and points of reference were obtained in this survey that would allow later targeted geophysical examination, with only magnetometer or resistivity providing feasible means (sled or cart-based GPR was determined to not be feasible, and soil conditions are likely not conducive). Shallow surface examination in these types of soils would likely not yield additional information, and logistics of transporting this type of equipment is not feasible given the locale of most of these locations.

Results from this project include a developed Geographic Information System (GIS) geodatabase and webGIS landscape viewing tool, that contain processed LiDAR information in combination with land use historical data, cultural site location data, and environmental variables of note. Aerial LiDAR, classified specifically for ground feature examination, provide a new means of assessing, prospecting, and locating sites and resources in this area. Examination of profiles, shape, dimensions, and associated features are performed, and 3D modeling of select resources are provided as part of our survey results. Using LiDAR and GPS tools of analysis, factors such as erosion, conditional assessments and land change can also be examined.

Landscape Background

A chain of great swamps had originally extended from the Chesapeake Bay to east Texas, but in late 1800s and early 1900s, most were decimated by urban and commercial expansion (The Trust for Public Land 2005). The significance of what was originally called Congaree Swamp National Monument is due to the fact that it represents the nation’s largest intact expanse of old-growth bottomland hardwood forest, a remnant of the great swamps. Several of the trees growing in the park’s floodplain forest are the tallest of their species in the Eastern United States and, together, the forest comprises one of the highest temperate deciduous woodland canopies remaining in the world (Olson et al. 2001). Today, Congaree, named for the Native American tribe that occupied the land at the time of European arrival, is an extensive forest of flats and meandering sloughs that cut through the landscape. Interestingly, Congaree does not
Congaree National Park - LiDAR Survey Cattle Mounds – USF Collins and Doering

Cattle Mound Survey Project Area Map
Congaree National Park
Hopkins, SC

contain standing water throughout most of the year and, therefore, is not technically a swamp, but is instead a floodplain forest that is inundated by flood water several times each year.

The biodiversity and natural resources within the Congaree National Park are remarkable. Nevertheless, there are also significant cultural and historic resources that have contributed to the shaping of the landscape, and demonstrates the interconnectedness of nature and culture (Almlie 2011). The history of human exploitation and conservation of the land make it a valuable example for the study of flora and fauna as well as anthropology and history. For millennia, prehistoric peoples had hunted, gathered food, and camped at places like nearby Sampson’s Island. When Spaniard Hernando de Soto explored the region 1540, the land was occupied by Congaree’s indigenous peoples who had inhabited the area since around AD 700. The earliest Europeans entered the Congaree River basin in the early 1700s, to conduct trade with the Indian tribes of the area. By the mid-1700s, colonial settlers had begun to move into the area. They opened small plots for cultivation, and introduced domestic animals (e.g., cattle, horses, sheep, and hogs) primarily on the south banks of the Congaree River. The arrival of Europeans led to the rapid demise of the native population in the 18th century, primarily as a result of smallpox (Almlie 2011). As settlement grew in the 18th century, transportation routes were required to move materials, goods, and resources across the floodplain. Prior to the construction of bridges in the 20th century, the travel networks were connected by ferry services that plied the river.
The swamplands to the north of the river, however, remained relatively uninhabited and unused. This situation began to change around 1800, however, when area farmers began to use portions of the land for agriculture (e.g., corn and cotton), logging, and the raising of livestock. Compared to other similar areas in the region, the impacts from farming, grazing, and logging in Congaree National Park were significantly less intensive and extensive. Nevertheless, to a knowledgeable observer, the results remain unmistakable (Kinzer 2017).

It was shortly after the conclusion of the Civil War that widespread logging became the principle commercial operation in the swamplands of what would become the Congaree National Park (Janiskee 2008). The major player in the region was Chicagoan, Francis Beidler, owner of the Santee River Cypress Lumber Company, who began harvesting timber in the late 1890’s, but due to the generally inaccessible terrain, their work had halted in the first decade of the 20th century. Ironically, it was Beider who initially set in motion the process that would eventually result in the protection of the nation’s largest intact expanse of old-growth bottomland hardwood forest at Congaree. He had purchased extensive tracts of old-growth timber at Congaree with the intention of harvesting the timber. The heat and humidity, recurrent flooding, intensive labor requirements, exposure to debilitating diseases, and lack of overland roads made logging difficult and expensive, however. The logging operations were forced to use water transport, therefore, they took place close to the river and along the irregular watercourses called sloughs or guts.

Beider found the commercial logging venture at Congaree to be extremely difficult and unprofitable. He shut down his operation there in 1915, with more than 10,000 acres at the center of his Congaree tract left almost completely untouched. By the 1960s, all the large tracts of river bottom hardwood forest in the Southeast United States had been eliminated, except for the Beidler Tract on the Congaree floodplain (Karlin 2015). Although logging operations had ended, renewed and aggressive attempts to again begin harvesting the area’s timber started in the late 1950s. It was at this time that a grassroots campaign began efforts to protect the old growth forest. Harry Hampton, who is considered the founding father of South Carolina’s conservation movement, waged a 20-year crusade to preserve the Congaree River’s old growth forest. In the 1970s, a group of concerned citizens who saw the loss and degradation of other forests, formed the Congaree Swamp National Preserve Association, which followed through on Hampton’s policies and vision. They judged that the virgin forest of the Congaree Swamp needed to be preserved, and felt that the only way to make sure that this would happen was if it were brought under federal protection.

In 1976, Congress established the Congaree Swamp National Monument. UNESCO designated the national monument an International Biosphere Reserve in 1983, and in 1988, it was proclaimed a Wilderness Area. In 2003, Congress re-designated the monument as a national park, and the expansion of the Congaree National Park land now covers an area of 26,546 acres in Hopkins, South Carolina.

Historic Agricultural Activities and Logging in Congaree

“Southern floodplain forests have experienced extensive habitat loss, fragmentation and degradation due to hydrologic alteration, clearing for agriculture, commercial harvesting” (Kupfer et al. 2010:1). Modifications to the environment of the Congaree floodplain included the burning of canebrakes, the clearing of fields, and harvesting trees. The most substantial impact was created by the logging activities that intermittently occurred between the mid-1700s and the 1970s. Little is known about the earliest
logging and agricultural practices for the region, with the initial account not being made until 1872, by Fred Seeley (1872), a manager for Francis Beidler’s Santee River Cypress Lumber Company.

Around 1915, due to the extremely difficult conditions, the company abandoned its logging operation in the Congaree. Nevertheless, various methods of logging practices ensued over the next one hundred years. Using information from ethno-historic sources and Congaree National Park resource managers, Meitzen (2011:79) identified eight discrete land use classifications that “sufficiently captured the variations in the type of logging method and intensity of disturbance.” Ranked according to clearing types (from least to greatest) she developed eight classification categories that were then assigned to locations within the park, with a map created to display these associations (Figure 2).

Congaree Cattle Mounts or Mounds

“The cattle mounts…are all considered significant, especially on a level of local and state importance. These sites are associated with specific aspects of South Carolina history, and they are relevant to cultural patterns during the historic period. They are also unique to central South Carolina: they represent a previously unrecognized form of environmental adaptation; they provide a documentation of historical events; and they have a potential to educate the public about past lifeways, while they enrich and enhance the cultural heritage of South Carolina” (James Michie 1980:xii).

The bottomlands provided isolated areas where, “[f]rom April to October, hogs and cattle were allowed to roam freely in the woods and wetlands along the Congaree River (Lockhart 2006b:19). In these areas the animals had ample food that grew naturally in the vast forests. During these Late Spring to Early Autumn months, the river basin became the drainage channel for the Lower Saluda and Lower Broad watersheds (Figure 3). Because of the inundation of the lowlands (Figure 4), it was necessary to build mounds to elevate the cattle and livestock above the rising water level. The solution were cattle mounts, large earthen mound structures where the livestock could continue to graze safely during the periodic flooding.

Figure 2. Map showing logging history classification categories developed by Meitzen (2011:79, Figure 3.6). These categories were derived from ethno-historic resources.
Figure 3. Map showing the Congaree River Drainage Basin created by the Saluda and Broad Rivers. (Image after the South Carolina Department of Natural Resources, [http://www.dnr.sc.gov/water/waterplan/surfacewater.html](http://www.dnr.sc.gov/water/waterplan/surfacewater.html)).

Figure 4. Flood inundation mapping reveals that water approaching a meter or more in height happens annually within areas where cattle mounts are located (Map Credit: Meitzen 2011:45).
The cattle mounts that are found within the Congaree River Valley were located in the lower portion of Richland County, north of the river, in an area where natural elevated ridges did not occur (Michie 1980:131). These mounds are associated with the agricultural activities of 19th and early 20th century farmers, and some share similar characteristics (e.g., topographical location, materials and method of construction, form, and size). The construction of the mounds involved the manual movement of massive quantities of earth, usually in intolerable conditions. Landowners used slaves to do the work (Lockhart 2006c). Today, the mounts are impacted by vegetation, erosion, and wildlife intrusion.

The cattle mounts are considered significant cultural resources as specified by the criteria for National Register sites. Michie (1980) summarized the following points of significance:

- They are associated with specific aspects of state and local history, and they provide information relevant to cultural patterns during the Historic period.
- They are a phenomenon, confined in South Carolina to the lower Congaree River Valley, and they represent a previously unrecognized form of environmental adaptation within swampy bottomlands.
- They represent a portion, or a fragment, of local and state history formerly unrecorded in public literature and apparently unknown to historians. By this fact, the occurrence of the cattle mounts provides a grasp of historical events and processes in the absence of any written documentation.
- Furthermore, these earthen structures represent a cultural resource with a potential to educate the public about past lifeways and thereby bring about an awareness and realization of historic events that occurred more than a century ago. Additionally, these large and impressive structures enrich and enhance the heritage of South Carolina, and by these virtues, they have considerable public significance.

**Cattle Mounts Identified in Congaree National Park**

There are a total of seven cattle mount locations that have been identified within Congaree National Park. These locations include: Cook’s Lake Cattle Mount (COSW-21, 38RD229, HS-02); Brady’s Cattle Mount (COSW-9, 38RD196); Big Lake Cattle Mount (COSW-3, 38RD195, HS-09); Dead River Cattle Mount (Old Dead River Cattle Mound) (COSW-2, 38RD193, HS-06); Cooner’s Cattle Mount (COSW-4, 38RD194, HS-04) 1830s; Cattle Mound 6 (Georgia-Pacific Cattle Mount, Mitchell Mound)(COSW-25, 38RD1236, HS-05); and Buyck’s Cattle Ring (COSW-24, 38RD-1235)(Figure 5). Accounts of these features have been made in a number of NPS Southeast Archeological Center reports, which were used as reference and background materials for this current survey. These references include: Michie 1978–1979 (SEAC Acc. 346, COSW Acc. 17); Wild 1990 (SEAC Acc. 882, COSW Acc. 19); Cornelison and Meyer 1996 (SEAC Acc. 1280, COSW Acc. 21); Meyer 1998 (SEAC Acc. 148, COSW Acc. 20) Hardy 2003 (SEAC Acc. 1817, COSW Acc. 24); Hardy and Prentice 2008 (SEAC 1817).

The most notable archeological reporting to include the cattle mounts were the Michie (1980), Hardy (2003), and Hardy and Prentice (2008) reports. James Michie worked in Congaree in 1978 and 1979, and used historical documents and field observation in his overview and discussion of the cattle mounts. His work included observations in the field with naturalist, John Emmett Cely, whose long years of field research at Congaree helped to produce a natural history of the area and detailed mapping of resources (Cely, 1976, Gaddy 2012). SEAC Archeologist, Meredith Hardy conducted ground verification and archeological survey in the park, and wrote reports in 2005 and 2008, providing a detailed overview of
Figure 5. Map of cattle mounts and other cultural resources within Congaree National Park (image after Lockhart, 2006 #11409:17).
previous work and strategies for inquiry involving cultural resources in the park. Her work includes a cultural history and literature review, as well as recommendations for future work. Importantly, Hardy’s report is critical of previous survey work by Michie, which did not include much in the way of excavation at cattle mound site locales and relied more heavily on historic documents and field observations. Michie’s work with cultural resources in Congaree was largely used to make the case for National Register of Historic Places nomination, officially recognized following Jill Hanson’s NRHP nomination forms filed in 1995, listing the sites under a multiple property nomination as historic structures, significant at the state level under the context “Agricultural Settlement in the Congaree Swamp: 1740–1900” (Hanson 1996).

Matthew Lockhart’s article concerning wilderness management designations and issues (Lockhart 2006), looks critically at how a wilderness concept impacts the cattle mounts of Congaree, and also provides historical overview building on Michie’s discussions, including work that was done in conjunction with Cely to field truth and include information about many of the historic landscape features at Congaree. Lockhart uses the case study of the cattle mounts of Congaree to argue that when we manage under wilderness designation for a landscape, we can lose the human stories, focusing on wilderness education over historical land use and interpretation (Lockhart 2006:11).

LiDAR and GPS Field Verification Survey

On March 20 and 21, 2017, Collins and Doering working in collaboration with Congaree National Park managers, scientists, and staff, undertook a GPS verification survey utilizing aerial LiDAR mapping strategies to accurate locate and field document five cattle mounts that were prioritized for understanding in the park management summary document. Cooner’s Cattle Mount, Buyck’s Ring, Cattle Mound #6, Spigener Mound, and Cook’s Cattle Mound were selected for survey and GIS analyses.

Cooner’s Cattle Mound (aka: Cooner’s Cattle Mount, Kooner’s Mount) COSW-4, 38RD194, HS-04

This site was reported by Michie (1980:144-146) and Hardy and Prentice (2008:123). The feature may be better described as a raised platform rather than a mound. Both the Michie and Hardy and Prentice reports comment on the rectangular shape and size, but neither describe the parallel matching rectangular apron or lip on the northwest, southwest, and northeast sides of the platform, noted from our field visit and documentation on 3/21/17. The site is accessed from a nearly 2.1 mile walk into the site across the iron bridge, floodplains, and following in part the Kingsnake trail. The presence of standing water may have concealed this portion of the feature at the time of previous survey visits. The apron lip surrounding the three sides of the structure appears to be the natural surface elevation upon which the earthen platform was constructed (Figures 6 and 7). Immediately adjacent to the NE, NW, and SW apron lip areas are borrow trenches that provided the fill for the raised earthen platform.

Supporting the assessment that the apron lip represents the natural surface elevation is the fact that the southeast side of the platform is the same elevation as the apron, an elevation that extends approximately 40 to 50 meters to the southeast. There is no borrow trench on this side. Also, the land beyond the outer edges of the borrow trenches that are adjacent to the three apron sides of the structure are only slightly lower than the elevation of the aprons. These observations suggest that the platform was constructed on a naturally elevated portion of land relative to the broader surrounding terrain.

The orderly arrangement of the base apron indicates that the borrow trenches were dug in such a way as to intentionally preserve a four to five foot portion of the naturally elevated land along three sides of the
Figure 6. Field digital sketch maps made during the USF 2017 site survey at Cooner’s Cattle Mound, showing plan view and SW profile depictions.
Figure 7. Classified LiDAR data as a digital elevation model (DEM), with view of Cooner’s Cattle Mound, including a profile taken at the center of the mound. Note the apron basal area, rectangular shape, and scarp borrow areas that are evenly dug on three sides.
platform. The fourth (southeast) side is a continuation of the existing level of the elevated terrain and is corresponds to the level of the base apron. There is no evidence of any depression along SE side of the structure. Constructing the mound in this manner would minimize the labor required and, at the same time, provide a greater elevation above the flood level. As Michie (1980a) commented the “symmetry [of the mound] suggests a well-executed construction.” Indeed, the straight edges, horizontal planes, and angled side slopes remain clearly defined even today, and visible in the aerial LiDAR data.

The size of Cooner’s Cattle Mound has been given variously as 160 x 52 x 5 ft. high by Charles (1979); 96 x 52 x 5 ft. high by Michie (1980); and 95 x 49 x 6.6 ft. high by Hardy (2008). Our recent survey using Trimble Geo7x with Zephyr Antenna and centimeter package Terrasync software with post-processing, combined with an assessment utilizing aerial LiDAR data, indicates that the upper measurements of the mound are 113.5 x 67.8 ft. (with diagonal measurement of 113.9 ft.). The elevation value for the mound derived from LiDAR is shown to be 1.6 meters from base of mound to top or 5.2 feet high. There is a borrow trench on three sides with corresponding apron base on these sides, as well as another defined linear scarp feature to the south of the mound that has the appearance of being mechanically excavated with sharp-line edges (Figure 8). Examination of the georeferenced Cely (1976) map shows annotation indicating a “c. 1840” date, and when overlain on the LiDAR show the position of the site in relation to logging activity areas including a logging trail that runs in proximity to the site and several pine stands and cut areas of note (Figure 9). The positioning and location of the COSW-4 Cooner’s Mound site has been updated using the LiDAR and GPS current survey information, showing a variance slightly from that previously recorded, with the polygonal location data on file oriented incorrectly and the size slightly different (Figure 10).

Michie excavated a 3 x 5 ft. test unit to a depth of 6 ft. near the center of the northeast quadrant on the top of the platform. Our survey relocated the remnants of this excavation unit, showing an area of subsidence at the location of Michie’s excavation. Michie determined the site to be of historic construction due in part to the finding of no cultural material, and to the method of construction that included scarping materials and building up of fill areas as well as a shaping and leveling of the platform surface, with noted differences in construction methods known for indigenous mound building techniques (Michie 1980:104 and 105). Cely (1976), reached the same conclusion and dated the mound to c. 1840 based on historical references. During the USF field visit to the site, several large trees at the east corner of the structure had been blown over or snapped at the lower trunk and fallen in a northeasterly direction. Our field examination of all tree fall locales as well as exposed stratigraphic surfaces found no indication of any cultural materials present at the site.

Buyck’s Cattle Ring (aka Buyck’s Ring) 38RD1235, COSW-24

“The most unique and remote of the cattle mounts of Congaree National Park is Buyck’s Cattle Ring” (Lockhart 2006a:20). Cely and Lockhart visited the site after Lockhart inquired about the location, having found notations about a “circular levee” in the park’s administrative files. Cely knew of the site and after confirming the location, it was added to his map, described as a “round dike” northeast of Buyck’s Island. Hardy (2008) indicates that the property had been owned prior to c. 1794, when Buyck took possession, and states the ring measured 112 ft. in diameter, 2.5 to 4 ft. in height, and measured five feet across. Dimensions from the Michie (1980) report were given as four to five feet high with a circumference of 440 feet.
Figure 8. LiDAR model of Cooner’s Cattle Mound, with dimension information indicated and dug borrow trenches.

Figure 9. Cely georeferenced map overlain on aerial LiDAR data to examine the position of Cooner’s Mound in relation to other logging and historical agricultural activities in this slough confluence area. Cely indicates a c. 1840 date for the site, and shows food plots and logging roads in close proximity.
Figure 10. LiDAR DEM showing position, orientation and updated boundary for the COSW-4 site, Cooner’s Cattle Mound in relation to previous positioning and size estimation. Examination of the larger landscape area also affords an understanding of connections with historic agriculture activities and water drainage and flow aspects.
Lockhart (2001; 2006a:20-22) has done the most extensive investigation and historical review for the site, and indicates that the structure is an “earthen levee constructed by slave labor in the early-to-mid nineteenth century...[and] like other mounts, served as refuge from floodwaters for free-ranging livestock.” Lockhart (2006:22) goes on to say that Augustine Buyck, or one of his descendants, “in the early to mid-nineteenth century, used slave labor to construct Buyck’s Cattle Ring...[and] that the “ring remained in use as a refuge for free-ranging livestock during floods until the early twentieth century.” At the time of Lockhart’s 2001 visit to the site, accompanied by Cely, the circular walls of the structure were noted as having not been breached. During our USF visit in 2017, this was found not to be the case, with a slight break noted in the processed aerial LiDAR data and then confirmed on the ground. The break was found along the northern perimeter wall, where slumping and erosion were noted (Figure 1).

The site was accessed via boat from the river, where we were able to walk in and collect data during the survey (on 3/20/17) indicates that the ring interior diameter is 97.9 feet with a width ranging from 11 to 18 ft. across the top of the dike along locales measured, with the berm elevation approximately 2.2 to 2.9 feet above surrounding land surface to the interior and exterior of the ring. Sides of the ring are sloping at approximately 45 degrees. Measurement from the outer edge to the outer edge diameter was found to be 132.3 ft. across at the centroid point, and the circumference of the outer edge measured ~396.5 ft around.

The LiDAR derived DEM data in conjunction with the GPS survey is used to update the previous location and dimensions of the site (Figures 12 and 13). The Cely map shows to be accurate as to the extent and location for the dike. Taken in the broader landscape context, the site is also shown on the Cely map to be in close proximity to a historic ditch which runs out to the river bed nearby (Figure 15). Site construction methods, shape and connectivity of the site to floodplain features, differ from other cattle mount locations. Ethnographic/historic and descendant interview information discussed in Mitchie (1980) and Lockhart (2006), and shown by Cely (1976), point to the unique structure being used as part of a free-range grazing operation and cultural adaptation to floodplain agriculture, built by slave labor in the early-to-mid 19th century. These previous sources along with our LiDAR and field verification, are suggestive that that structure was built as a retaining dike, possibly used to create a confined disposal or holding area in the central portion by creating a circular earth embankment.

These types of dewatering and confinement or diking techniques have been historically documented as a type of construction seen in lowland areas, such as in Congaree Swamp, and were used for the purpose of retaining solid particles (or possibly creating an area of ponding/impoundment) within the central area. Barrier structures if used for disposal holding, allow the release of clean effluent back to natural waters, such as through the rimmed exterior and connecting ditch that is observed in both the LiDAR and Cely (1976) map as going back to the river and out to wetland swamp/slough features. Ditching, draining, confining, and modifying sheet flow have been long-noted practices related to wetland modification and farming or timber practices (Pavelis 1987). Further, the Dutch culture (Augustine Buyck was of Dutch origin, immigrating to Charleston before becoming a planter—see Lockhart 2006:22), is often noted for their water management and control techniques (Fleisher 2005). Soil sampling and testing, especially in the central portion of the structure looking for presence of gardening signatures or potentially metals, petroleum, coal or other materials, offer a prudent means for understanding past agricultural and land use activities that might be associated with this feature.
Figure 11. The aerial LiDAR showing COSW-24, Buyck’s Ring site location (above) with a noted break to the northeast on the dike berm area. The central portion of the ring serves as a confining area, with water able to pass around the berm and out the ditch cut to the river nearby. You can clearly note the scarped circular borrow area around the dike where earth was removed to create the feature (below). The central portion as well appears lowered slightly, with soil from the center used for the interior wall construction. To view the model in 3D, see: https://skfb.ly/69KRG.
Figure 12. Sectional data collected and processed using GPS field verification in conjunction with aerial LiDAR derived DEM.
Figure 13. Updated boundary location information for the COSW-24 site, shown in relation to previous survey location and documented shape and dimensions. The current survey utilizes aerial LiDAR in conjunction with centimeter grade GPS.
Aquaculture designations on the Cely (1976) map are noted along the northwest boundary, just outside of Congaree. Buyck’s ring must be considered as part of a broader range of possibilities, with subsistence and agricultural practices ranging beyond grazing and hoof stock. Examination of historic aerials from 1959 that have been georeferenced for the park, show two field areas – one cleared for grazing at that time, located in close proximity to the ring (Figure 15). Historic fence remnants were encountered along the walk in to the site, as were ditches that provided drainage from the interior to the old river bed location (see also: Figure 14).

Soil testing along with stratigraphy examination by the cleaning of exposed profiles at the site, could offer a clearer picture of activities, and further understand this unique earthwork feature that was not likely used as a mount, but rather for some other type of agroindustry or subsistence strategy.
Figure 15. Georeferenced 1959 aerial (above) showing the location of Buyck’s Ring to agricultural fields and pastures. Classified aerial LiDAR (below) has been optimized to reveal drainage features of note that also connect to the cleared field and old river channel from the circular dike area.
Cattle Mound No. 6 (aka Georgia-Pacific Mound; Mitchell’s Mound) COSW-25, 38RD 1236, HS-05
Cattle Mound No. 6, lies adjacent to a sizable paleo oxbow channel that is clearly visible in the aerial LiDAR imagery (Figure 16). The present survey visited the site on 3/20/17, accessing the site via boat from the river and walking in to the location. The mound is approximately 1200 feet north and slightly east of the Congaree River. A diagonal cut through the northwest portion of the mound has been attributed to a logging road by Hardy and Prentice (2008:140), and can clearly be seen in the processed LiDAR data (Figure 17). Other road cut locations in proximity were field verified in our survey and show as historic logging roads on the Cely (1976) map (Figure 18). The site is listed on the 1995 NRHP multiple-property nomination form as Historic Structure 5 (HS-05), where it was described as oval in shape, 8 to 10 feet in height, approximately 400 feet in circumference, with 45 degree angle sloping sides, and a flat top surface. Our analyses from our survey visit on 3/20/17, show that the site is clearly rectangular and flat-topped, rather than oval shaped, with a logging road cut on the northern end that reveals the stratigraphy of the earthen structure in places (Figure 19). Several tree falls near the mound (see: Figure 16 inset), were also investigated for any indication of cultural materials or defined strata.

Consistency in materials used to create the mound were observed at all of these locales, with no cultural materials discovered. Measurements for the site as derived from LiDAR and GPS ground verification are 134.5 feet in length (inclusive of the cut portion to the north) and 78 feet in width. The elevation in the center compared to surrounding ground surface is approximately 6.5 feet above surrounding surface (Figure 20). Boundary adjustments for the site, using the GPS and LiDAR data, show the shape and extent to vary, with previous positioning location capturing a portion of the site locale (Figure 21).

Figure 16. COSW-25 site is rectangular in shape and is shown in the LiDAR derived DEM as being in proximity to an oxbow channel off the Congaree River. Inset image arrows point to area with tree fall and road cut.
Figure 17. COSW-25 location and sectional profile information. Note the disconnected cut area impacted by a logging road that cut through the mount on the northwest portion of the site.
Figure 18. The Cely (1976) map shown georeferenced with aerial LiDAR denotes the COSW-25 location as Mitchell’s Cattle Mound, with a logging road shown going to the site and with elbow shaped oxbow and ponded water features and the Congaree River in close proximity. Cely denotes this site and one near here as being “cut over, mostly in the 1980s).
Figure 19. GPS data collection at area with tree fall and subsidence along northeast edge of the earthen structure.

Figure 20. Profile of southwest face of Cattle Mound #6.
Figure 21. Site update showing new boundary, dimensions and shape of COSW-25. The rectangular earthen structure has a logging road on the northern end of the site that bisects the mound and ends at the location.
Spigener Mound -COSW-29, 38RD195
A small, low, oval-shaped mound in Congaree National Park that measures roughly 44 x 28 feet and rises about 0.6 meters (1.9 feet) above the surrounding ground surface, the current survey visit on 3/20/2017, accessed the site via boat, walking in from the river. We utilized centimeter grade GPS and aerial LiDAR in examining the location (Figures 22 and 23). Designated as a Cattle Mound site on the John Cely map from 1976, Cely’s positioning is slightly in error from that confirmed with GPS in our visit, and the Hardy GPS data also shows a larger site extent in the GPS, despite similar measurement size reporting consistency with the present survey. Noted features include a slightly scarped linear area on the east end of the mound, and close proximity to a gut area. Erosion and slumping were recorded along mound edges, as was hog damage at the base of the mound. No cultural materials were evident along exposed surfaces or areas were hog rutting and erosion were recorded.

Spigener Mound is located approximately 350 feet from the river edge and within a 1/2 mile of another cattle mound (Old Dead River Cattle Mound) and extensive dike system (Old Dead River Dike), known to be part of the Spigner (sic) old agriculture area (Figure 24). This historically shaped landscape area is noted on the Cely map as dating to the c. Antebellum Period (before the Civil War and after the War of 1812). Discussed in Michie (1980:108), the Spigner (sic) tract according to Cely’s investigations, relates to a tract of approximately 370 acres where cotton and corn were likely grown, and water was diverted and managed using extensive dikes. Hardy and Prentice (2008) discuss the site, with Hardy locating Spigener Mound in 2005 during a field visit. She described the site as oval and measuring 46’ x 26’ x 1.6’ above surface level.

It should be noted that an evaluation of the LiDAR data shows the shape of the site to be rectangular and similar to several other of the sites ground verified. The previous survey visit, discussed in the Hardy (2005) report and as noted in the NPS GPS data layer, show a slightly different location, size and shape for this site (Figure 25).

Cook’s Cattle Mound – COSW-21, 38RD229, HS-02
James Mitchie from the South Carolina Institute of Archaeology and Anthropology (SCIAA), conducted survey work at Congaree Swamp National Monument in 1978-79 (Mitchie 1980). According to Hardy (2005), Mitchie utilized information from NPS park ranger Guy Taylor to describe the site in state file records. Taylor had found the location in 1979 after having discussions with naturalist Harry Hampton, who mentioned it to be in proximity to extensive dike systems near Cook’s Lake (Hardy 2005:87). These extant dikes are noted on the processed LiDAR data (Figure 26), and are also described in the Cely (1976) map, and Hardy noted that according to Mitchie the dikes were related to rice plantation activities. The National Register of Historic Places (NRHP) forms for the site note it as being oval in shape, 3 feet high, and 165 feet in circumference with 45 degree sloped sides and a flat top.

Hardy visited the site in 2002 and provided an update including a GPS position and extent measurements. She describes the site as being 67.9 feet long and 44 ft. wide. The elevation from ground surface was said to be 3.4 feet. Condition notes indicated a possible tree fall near the center of the mound with a hole noted, however she does not mention examining strata in this area, nor the presence of any cultural materials. She calls for archeological testing to be conducted at the site.
Figure 22. Profile map from LiDAR of the Spigener Mound site location.
Figure 23. LiDAR and 3D modeling of the Spigener Mound site, showing location near gut and scarped area on the east end of the mound, and prepared platform appearance.
Figure 24. The Cely (1976) map shows a circular cattle mound location in the area of the mapped location of Spigener (shown on the map as “29” in the southeast portion of the map). Cely shows this area as rich with antebellum era modifications, such as the Old Dead River Cattle Mound (to the west) and the large and still extant Old Dead River Dike system. Timber harvesting and hoof stock activities are also shown as well as ditching, trails, and other testaments to water diversion and settlement in the vicinity.
Figure 25. Spigener Mound is rectangular in shape as noted with aerial LiDAR (above). The location of the site and shape differ slightly from that noted by Hardy in her 2005 visit (below yellow).
Figure 26. The Cook’s Lake Cattle Mound site (COSW21 seen above in upper center), is located in an area near extensive timber trails, dike systems, and guts off the river and Cook’s Lake area. Cely shows references to cows and hogs in this area, as well as noted agricultural modifications. Cely’s georeferenced map shows some error on the Hammond Gut and cattle mound locations, which he shows to the south of the actual locales.
The Cook’s Lake site was visited in the current survey on 3/21/17, with aerial LiDAR ground truth verification performed using centimeter grade GPS. Examination of the LiDAR processed for the site prior to conducting field assessment suggested that Hardy’s location was likely in error, with no elevated feature near the previously plotted location. The site general vicinity was approached via the River Trail near Cook’s Creek, with the vehicle parked approximately ½ mile from where we walked in to the site. We used the position created by Harvey to navigate and crossed over the area delineated to note that no site occurs where this location was marked. We continued along adjacent to Hammond’s Gut where the Cely map indicated there was a cattle mound, encountering an elevated area noted in the LiDAR data some 600 feet to the northeast of the previously noted location (Figure 27).

Using GPS, we documented several large tree falls at the mound, including one on the northeast edge of the mound that had tipped to reveal the stratigraphy of the side of the mound (Figure 28). The dirt in this area is homogeneous with no presence of layering and with no cultural materials present. Measurements derived from the LiDAR and GPS recorded information, provide some concurrence with minor differences noted from previous surveys, but indicating this indeed is the location of the site that Hardy visited based on similarities in metrology.

Measurements were taken and shown to be 69.5 feet in length, 34.2 feet wide, and with a circumference of 160 feet. The height above ground surface was found to range from 2.3 feet in profile to 3.2 feet at highest point measured (Figures 29 and 30). Consideration for the 3D configuration of the site show the presence of linear scarp areas likely used for borrow (Figure 31). The site is situated in proximity to a number of timber and agro-industry sites and land modifications.
Figure 28. Tree uprooting at the Cook’s Lake Cattle Mound site, likely occurring after Hurricane Matthew in October 2016, have exposed mound areas allowing for examination of construction. No cultural materials were noted in any of the tree fall locations.
Figure 29. Using aerial LiDAR (above) and GPS field verification along with measurements at the site, the mound is shown to be similar in shape and dimensions to that noted previously by both Michie and later, Hardy. Condition updates included the mapping of right angle clearing and possible adjacent borrow cut areas (below image is optimized to show elevated soil areas adjacent to cuts and borrow areas). Hammond’s Gut is noted in close proximity to the site. This feature is shown on the Cely (1976) map, but the position is slightly in error when georeferenced.
Figure 30. Profile map through the center point of Cook’s Cattle Mound show the slight elevation change across the mound, which appears to be flat-topped but actually shows a slightly elevated center portion.
Figure 31. Three-dimensional modeling from the aerial LiDAR data, shown from different positions and perspectives, reveal a 90 degree linear feature running adjacent to the site, with a smaller scarped out borrow area. It appears the trail or logging road that is adjacent to Hammond’s Gut has spoil associated with its construction that shows as a linear elevation in this area, as well.
GIS Methods and Data Derivatives Provided
This project began with preliminary GIS data mining for available cartographic and spatial data resources, as well as compiling all background literature. Working with NPS SEAC personnel, the authors obtained relevant reports, previous investigation information, and aggregated all available GIS and remote sensing (RS) information, such as current and historic aerials and aerial LiDAR data available for the project area vicinity. A digital elevation model (DEM) was rendered to 30 cm from 2010 South Carolina Department of Natural Resources Calhoun County Aerial LiDAR survey. Data was obtained through the National Oceanic and Atmospheric Administration’s (NOAA) Digital Coast website in the projection of Continental US Albers Equal Area Conic, and the LiDAR point cloud was classified. The DHHC reclassified the ground and water points, and then rendered the DEM. The DEM was then projected into South Carolina State Plane meters.

Classifying the LiDAR data enables you to organize into specific data classes while still maintaining the overall information, allowing for a better understanding of bare earth values or examining different elevation aspects in the data. Display options were chosen to reveal maximum deviation in features and elevation. Previous historic information from the Cely (1976) map was georeferenced to show the relationship between the features of note and defined landscape areas. A complete geodatabase inclusive of all data collected and processed for this project is provided as a deliverable supplement to this report.

Additionally, we have prepared an online GIS tool, which will allow land managers to have access to a prepared elevation model for the entirety of the Congaree National Park. Due to the sensitivity of cultural locations, the GPS information for cattle mounds are not included with the online versioning, which can be found at the static URL link of: http://arcg.is/LnHa0. This online viewer contains georeferenced historic aerial imagery from 1959 and 1970 for portions of the park were data were available, and also a fully processed DEM for the entirety of the park, with three different visualizations of color along with a multi-directional hillshade (Figure 32). The online webGIS allows for viewing with transparency and other visual layering tools and provides easy access for managers without the need for specialized software or other applications. Additionally, provided as a separate data tool is a .CSV file containing the coordinate location updates for the sites visited in this survey. These can be added to the webGIS simply by clicking on the add tool feature and dragging and dropping the file. Similarly, managers can zip shapefiles and drag and drop into the webGIS to provide a customized experience while maintaining data security local to the machine they are working on. Full datasets are available to the ArcGIS user through the project geodatabase.

Aerial LiDAR data were also exported into a format to visualize in 3D modeling software. 3D models were creating using a vertical exaggeration of surface to better visualize elevation of the site locations (Figure 33). These models were rendered for viewing online, and can be used to create 3D print models, visualize and share in 3D, Virtual Reality mode or through an Augmented Reality projection (available on mobile app device only). The digital collection for these 3D models (Figure 34), can be found at the static URL: https://skfb.ly/6BqnF.
Figure 32. WebGIS viewing tool allows for easy visualization of the landscape and elevation data. Widget tools seen in the upper left of the screen allow for secure import of data residing on the user desktop. http://arcg.is/LnHa0
Figure 33. 3D models for each of the five locations examined in this survey were created from aerial LiDAR to allow for a variety of visualization and interpretive development strategies.
Figure 34. Development of sharable 3D renders from aerial LiDAR were produced for the sites visited as part of this survey, with models created to allow for 3D printing and other online and virtual visualization opportunities. See: https://skfb.ly/6Bqnf.
Discussion
Recommendations for future work include the further use of the aerial LiDAR to target features for ground truth verification and survey. Our review of remotely sensed LiDAR data, optimally classified to reveal bare earth features and viewed using dynamic range adjustment to enhance raster based values in the display, led to the discovery of a previously unrecorded cattle mound location. This site, when reviewed in relation to the Cely (1976) map that was georeferenced, shows that a cattle mound location was noted here, but has not been recorded (Figure 35). The rectangular mound has a similar appearance to Cooner’s and Cattle Mound #6 sites, measuring 63.5 ft. long and 33.7 ft. wide. The flat-topped mound stands 2.2 ft. above surrounding elevation and has an approximate 15 ft. wide borrow area surrounding it, with the appearance of a prepared foundation similar to the Cooner’s Cattle Mound site (Figure 36).

Suggestions for further research using the data sets compiled include ground truth verification with precision GPS of this newly documented site, as well as visiting, verifying, and mapping other agroindustry type sites and features, such as dikes, ditch cuts, trails, and additional earthworks. Many of these sites that were previously recorded show inaccurate boundaries, shapes, and extents when assessed in relation to the LiDAR (Figure 37). The prehistoric Starling’s Mound site can also be examined for condition and erosion pathologies using these tools provided. The site is shown adjacent to the river bend in 1959 aerial imagery that has been georeferenced, and compared to modern aerials and LiDAR, the erosion and loss of this site can be better assessed and documented (Figure 38).

Documenting and understanding these landscape usages and modifications is especially important as we reassess the definition of wilderness designations to include a broader perspective for cultural resource sites. Wilderness landscapes are often managed based largely on natural histories, pointing to concerns for wilderness designations for cultural resources (Lockhart 2006). At Congaree National Park, the human story is inextricably tied to the landscape, and can be brought to light in ways that still are complimentary to wilderness management. Utilization of GIS and 3D renders of the landscape, showing change, succession, subsistence, and use, can become part of the interpretive story. The LiDAR and 3D data in fact, provide a way to see the broad scale of the landscape and to understand how features are related to the occupational and use history of the site.

At Congaree, using LiDAR, imagery and 3D topographical considerations in relation to historic references, can assist with the broader understanding of wilderness to include human activity. In this way, wilderness encompasses the more holistic story of the land, and strengthens interpretation and representation as a result. Because the cattle mounds and other historic sites are part of a broader picture of subsistence and use, it is difficult to understand them without consideration at a wider scale. These sites are not expressed as isolated locations, but are associated with other historic signatures on the land, subtly expressed in the form of fence lines, trails, ditches, cuts, clearings, and wetland drainage features. These sites were part of historic land use strategies, with the land today “rewilding” or returning to wilderness, showing the integration of nature and culture (Cronan 2003, Feldman 2004).

Agriculture and subsistence practices that occur at landscape scales are often ephemerally expressed and difficult to detect, especially true when the land has been reclaimed as wilderness and left to return to natural functions. Elevation data offer the best way to examine these types of system changes in heavily
Figure 35. Coordinate (UTM centroid location) for the unrecorded cattle mound location (above), which appears in the Cely (1976) map (below), but has not been field verified by archeologists. The site is to the west of Buyck’s Ring location.
Figure 36. Close up of optimized LiDAR with enhanced display of raster values to bring out the shape and extent of the structure and related borrow features and linear spoil area.
Figure 37. Mapped location data for the Old Dead River Dike (left) with the corrected extent, shape, and association as noted in aerial LiDAR enhanced raster viewing data (right). Image below, with dynamic range adjustment, highlights the dike system extent as well as the Dead River Cattle Mound (COSW-2) location (left arrow) and nearby Spigener Mound (COSW-29 (right arrow)).
Figure 38. Starling’s Mound vicinity (above) as seen in the 1959 aerial, and below with 1959 aerial set to transparency and modern image compared. Area in yellow dotted line is now submerged. Examination of the historic imagery shows there has also been erosion and change to channel configuration along this bend of the Congaree.
canopied and forested systems such as Congaree. As new, higher resolution LiDAR data are collected, this will improve our capacity to see, link, and understand these connected systems and features.

Although the LiDAR for Congaree is from 2010 and is of the highest resolution, we are nonetheless able to process and visualize in a way that allows for general topographical and landscape understanding. The LiDAR was rendered to 30 cm and was reclassified into ground and water points, and then rendered as a Digital Elevation Model (DEM). The DEM was then projected into South Carolina State Plane meters, and was enhanced using dynamic range adjustment image visualization tools. From these data, wetland modifications can still be seen in the form of ditches, dikes, and rim drainage features. Elevated mounds, shown to be related to cattle and agricultural activities can also be readily found, including sites not yet recorded (several dike systems and a cattle mound). Many of these sites are in need of further investigation and clarification as to location. An example of this is Brady’s Cattle Mount (COSW-9, 38RD196, HS-08) - described by Michie (1980) and in Hardy and Prentice (2008) as being 7 feet in height. This site is plotted inaccurately in the NPS SER GIS database, but with its large size and height, is easily seen in the processed LiDAR data, and these data can be used to correct this position (Figure 39). This cattle mound is significant in that there is direct historical information from descendants that constructed this site in c. 1900, demonstrating similar techniques and use applications for cattle and hog refuge provision during flood seasons. Further investigation at this site with GPS survey may prove important for comparison studies.

Cattle mounds and agroindustry sites in Congaree point to a time in the historic record when Congaree served as a mosaic of wilderness interspersed with human activities. When viewed at a broad scale, it is evident that historic occupation and agricultural and timber practices are imbued on the landscape even today. Many of these practices, such as cattle mounds, can be found to have similar correlates in modern agricultural practices and farming records, and can still be seen today in cattle production locations that are prone to flooding (Figure 40). These human stories can easily be lost to the record as Congaree continues to be going through the process of “rewilding” (see: Cronan 2003, Feldman 2004, and Lockhart 2006). The interpretive framework can include these often ephemeral stories in ways that consider use and adaptive strategies across broader scales. LiDAR and GIScience approaches can allow for this type of visualization and interpretive understanding, and can also assist with management, preservation, and research at these sites into the future.
Figure 39. Brady’s Cattle Mound, not visited as part of the USF survey, is clearly noted in the LiDAR (above) and shown in close proximity to the location noted by Cely (1976) (below). The NPS SER GIS data show, as recorded following the Hardy 2003 site visit, shows the 7 foot tall mound to be in a flat elevation area, some 760 feet to the east of the actual location. LiDAR and accurate spatial data in this way can be used to greatly improve management, understanding, and landscape relationship interpretation.
Figure 40. Still images from the WFLA-News Channel 8 drone coverage showing cattle escaping flooding in 2017 in the Myakka River/Sarasota, Florida area (see also: https://www.youtube.com/watch?v=YSVdInveYTU).
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The Trust for Public Land  
APPENDIX A – Description of the Geodatabase Metadata
Congaree National Park Geodatabase- Produced by the University of South Florida Libraries, Digital Heritage and Humanities Collections (DHHC) – Principal Investigators: Drs. Lori Collins and Travis Doering with Southeast Archeological Center and Agency Technical Representative (ATR), Dr. Margo Schwadron

This geodatabase contains the following:

1. Feature classes (sets of points, lines, and polygons)
2. Imagery and rasters
3. Continuous surfaces that can be represented using features (such as contours), rasters (digital elevation models [DEM]), or triangulated irregular networks (TINs) using terrain datasets
4. Attribute tables for descriptive data

For the Congaree project, we produced or brought together the follow:

- **DHHC_Features2Points** – this is a centroid point derived from our GPS GNSS Survey of sites visited.
- **GNSS_Points** – these are GPS positions with associated attribute information collected during our field survey.
- **Potential_Site** – this is the unrecorded cattle mound location, discovered using LiDAR and in relation to the Cely (1976) map. This site requires field verification.
- **GNSS_Lines** – these are linear features recorded during our GPS survey, and include trails, boundaries of note, roads and river trip documentation.
- **Mound_Profiles** – these are positions selected to take profile measurements that are provided in the report and in the complete map document package.
- **NPS_CONG_Boardwalk** – data provided by the park to show boardwalk location
- **NPS_CONG_trails** – data provided by the park to show trail locations
- **CONG_Boundary** – data provided by the park to delineate the park boundary
- **DHHC_Sites** – polygonal data to show size, extent, and position of each site recorded with GPS and as noted from LiDAR interpretation.
- **SSURGO_Soils** – soil types and attributes clipped to the CONG Boundary.
- **Aerial Mosaic from 1959** – DHHC created a georeferenced mosaic raster image set from available data for the CONG area. The aerials were color balanced to each other in an ArcGIS Mosaic dataset.
- **Historic black and white aerial imagery from November 27, 1970** was georeferenced in ArcMap to South Carolina State Plane.
- **Historic black and white aerial imagery from November 22, 1959** georeferenced in ArcMap to South Carolina State Plane.
- **Georeferenced scan of the artistic park map by John Cely (1976)**. We utilized an oversized scanner and used georeferencing techniques to define location using map coordinates and assigned the coordinate system of the data frame. We aligned the map using control points collected during our GNSS survey on locations represented in the map, connecting known raster dataset positions to known positions in map coordinates.
- **NAIP 2015 Imagery** - National Agriculture Inventory Program 4 band imagery from the South Carolina 2015 aerial survey extracted to Congaree National Park.
• **NPS CONG DEM 30 CM** - A digital elevation model (DEM) was rendered to 30 cm from 2010 South Carolina Department of Natural Resources Calhoun County Aerial LiDAR survey. Data was obtained through the National Oceanic and Atmospheric Administration’s (NOAA) Digital Coast website in the projection Continental US Albers Equal Area Conic, and the LiDAR point cloud was classified. The DHHC reclassified the ground and water points, and then rendered the DEM, the DEM was then projected into South Carolina State Plane meters.

• **NPS CONG HSh 30 CM** - A hillshade model simulated from digital elevation model (DEM) rendered to 30 cm from 2010 South Carolina Department of Natural Resources Calhoun County Aerial LiDAR survey. Data was obtained through the National Oceanic and Atmospheric Administration’s (NOAA) Digital Coast website in the projection Continental US Albers Equal Area Conic, and the LiDAR point cloud was classified. The DHHC reclassified the ground and water points, and then rendered the DEM, then the hillshade model was simulated, the hillshade was then projected into South Carolina State Plane meters.

• **USDA Raster Imagery** - Historic black and white aerial imagery from January 24, 1981 georeferenced in ArcMap to South Carolina State Plane.
APPENDIX B - Updates to Previously Recorded Locations
COSW 9 - Brady's Cattle Mound
Site Location Update

New Location UTM Coordinates
516003.7E
3738775.3N

54 | P a g e
COSW 21 - Cook's Lake Cattle Mound
Site Location Update

New Location UTM Coordinates
513478.9E
3741615.6N

148 ft
0 75 150 300 Feet
80 0 40 80 Meters

N
DHHC
USF LIBRARIES
COSW 24 - Buyck's Ring
Site Location Update

New Location UTM Coordinates
518847.5E
3737345.2N