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Located on the Cape Canaveral Air Force Station (CCAFS) on the eastern coast of Florida (see Figure 1 below), Quarterman, or 8BR223, is a prehistoric and historic archaeological site that is currently threatened by rising sea levels. As a result, the Cultural Resource Management Program was created by the 45th Space Wing to salvage and preserve whatever possible of this site and others like it before they are lost to the Atlantic and the Banana River. Under the CRM program, the Cape Canaveral Archaeological Mitigation Project (CCAMP) was founded by director Thomas Penders as a partnership between the 45th Space Wing and the University of Central Florida, tasked with preserving the history and contextual information discerned from the area. Already on Season III of its efforts to survey, excavate, and analyze parts of the Cape, Quarterman is the next site to be investigated. With the creation of basic, natural and archaeological feature maps, the spatial representation of 8BR223 can be preserved long after the site itself is flooded.

Figure 1. Map showing the location of Cape Canaveral and 8BR223 in Florida (Gaba 2008).

Quarterman Site Background

The Quarterman Site was named after one of the first pioneering families to settle on Cape Canaveral in the mid-nineteenth century, making it an important location in local history.

George M. Quarterman moved to the Cape in the 1860s and received 60 acres of land through a homestead claim to the US government in 1882 [redacted] 2019; Levy 1984). He married Anna D. Burnham in 1879 and spent his life maintaining orange groves with his brother Orlando A. Quarterman and operating the Cape Canaveral lighthouse, which his son Oscar Floyd Quarterman took over upon his retirement ([redacted] 2019). The Quarterman family continued to own the land until 1950 when the property was bought by the United States Air Force (Penders 2014). Up until then, the land now designated 8BR223 was used as the family graveyard where at least five known members and two dogs are buried. The site currently includes the Quarterman South Cemetery and the Quarterman North Cemetery, known as 8BR2356 and 8BR2355, respectively. Together, these cemeteries and the site as a whole are located on the western side of Cape Canaveral along the Banana River. In regard to the Air Force station, they are north of Fuel Storage Area 2 and south of the CCAFS Industrial Area (Penders 2014).

Furthermore, numerous test unit excavations have been conducted at Quarterman Site over the years as components of larger surveys of the Florida Power & Light transmission line corridor and of high-probability historic properties. Resource Analysts, Inc. (RAI) first recorded the site in 1982. During surface collections and shovel probing of the transmission corridor, the agency found evidence of aboriginal activity, dating to the Malabar I and II periods in addition to a significant historical component, which included "domestic and outbuilding ruins, a stucco or cement wall casing, a stove pavement, and extensive trash dumps south of where the Quarterman house once stood" (Levy 1984; Voorhies 1993: 3). Later, in 1992 and 1993, 8BR223 was revisited by New South Associates (NSA) who conducted surface inspections on exposed ground in the transmission corridor and the two cemeteries while also digging equally spaced shovel test pits inside of transects. The findings heavily concurred with RAI's evaluation: "The prehistoric component was large, retains integrity in its deeper midden deposits, and was occupied over an extended period of time" (Voorhies 1993: 3). Although, almost ten years later, there was a significant decrease in the number of discoverable historical elements due to either the Air Force station's negligence or deliberate bull-dozing. Today, all that remains visible are the two cemeteries.

Moreover, Quarterman's potential eligibility for inclusion in the National Register of Historic Places (NRHP) was evaluated by both RAI and NSA, and each time, the agencies recommended additional site testing to determine eligibility, but only if 8BR223 was going to be adversely affected by future activities. Neither actually did recommend Quarterman for the NRHP, and the evaluations only considered the eligibility of the historical component at the site due to its association with the settlement and economic history of Cape Canaveral, and for the information that it could provide on early orange groves in the Cape (Levy 1984; Voorhies 1993). Ironically enough, when the site was possibly going to be adversely impacted by the rebuilding of the FP&L power corridor, it was only then in 1994 that a Janus Research survey found that the site *did not* meet the minimum criteria for listing in the NRHP as a result of the severe disturbances caused by the initial construction of the corridor, which had taken place before RAI's investigation. Additionally, the project did receive clearance to continue because the historical, cemetery portion of the site was outside of the corridor; thus, the reconstruction could be undertaken without causing additional damage (Bellomo 1996).

The most recent surface and subsurface testing was conducted in 2013 by Thomas Penders. The goal of the survey was to establish an accurate boundary for the eastern portion of the site (see Figure 2) and to document the north and south cemeteries utilizing ground penetrating radar (GPR). In addition, Florida State University conducted tests using pollen cores and optically-stimulated luminescence (Penders 2014). This work is ongoing and continues even in the current season.

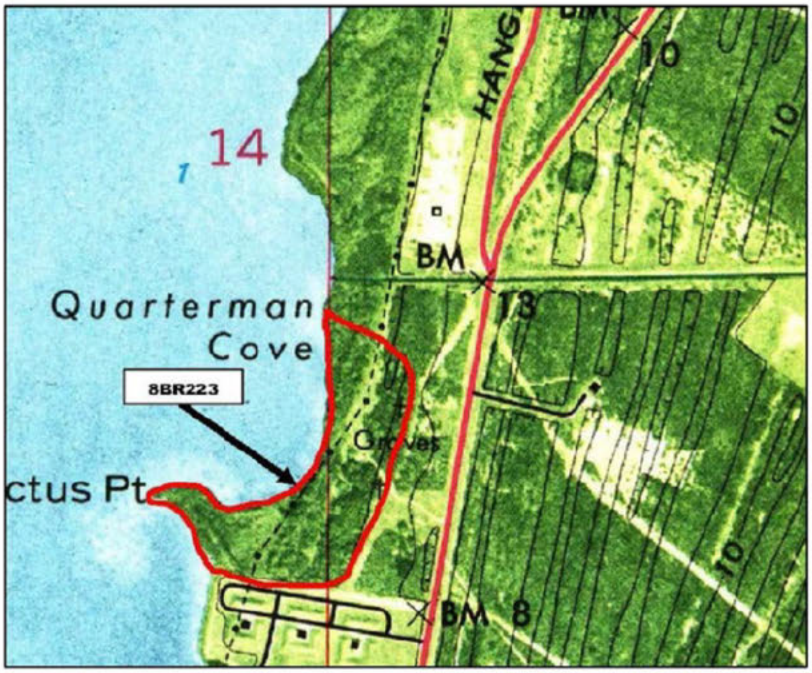

Figure 2. Map showing the location of 8BR223 and the correct boundaries (Penders 2014).

Research Design

With fieldwork at 8BR223 beginning in earnest this season, one of the primary goals of the Cape Canaveral Archaeological Mitigation Project was to establish a basic site map denoting natural and cultural features. Areas recorded include but are not limited to the North and South Quarterman cemeteries, the modern security building foundation, the vegetation line, and the road running through the site. The finished products are thus preliminary maps that can aid future research at Quarterman and can be updated and added to as site boundaries are finalized and more features are uncovered. In addition, this project was necessary because there are no US Geological Survey maps that include all of the site's features. Satellite images are also not sufficient due to the expansive vegetation obstructing the site from above.

Due to the sensitive nature of the mapping equipment, the Phase I archaeology conducted during the season, whose components include transects, shovel test pits (spaced 25 meters apart on transects), and presumed archaeological features, could only be documented in a parallel project utilizing a Trimble GPS as they were located farther into the vegetation. Additional projects that took place at Quarterman utilized GPR, shovel probing, metal detecting, and historical research that was conducted on the individuals buried within the cemeteries ([redacted] 2019; Ruby 2019; [redacted] 2019).

Methodology

To create a digital map of the Quarterman Site, two complex pieces of equipment were used: the Topcon GTS-230 Total Station and the TDS Recon Data Collector. The process by which this was achieved equated to giving the terrain a preliminary walking survey and then progressively mapping the site several portions at a time. Additionally, because this equipment is among the most accurate and up-to-date pieces of mapping technology, much of this section is dedicated to explaining the mechanical steps taken to conduct the project.

The Topcon Total Station is an extremely precise instrument that can collect coordinate and elevation data up to within a fraction of an inch. Combined, this data represents individual points in space which are stored in large files on the TDS Data Collector. This secondary device is a multi-purpose mobile tool that, through an application called Survey Pro, is responsible for remotely setting up and controlling all Topcon tasks through a Bluetooth connection. These tasks include orienting the total station in space, creating an arbitrary (x, y, z) coordinate plane for the points, and finally, creating the points themselves.

To collect individual point data, the total station fires a laser beam at a glass prism that is attached to a red and white stadia rod held some distance away. Using the mathematical equation for the speed of light, it then calculates distance. Elevation is also automatically established by the angle of the beam, which computes the difference in height between the Topcon's occupy point and the point being shot to. Each point taken is then assigned a number and given a descriptor, helping to create the map later on by designating which points belong to which landscape or cultural feature. Furthermore, the total station's position from which the points are shot is known as a datum, and depending on the terrain and amount of vegetation at a site, the project may need to establish more datums as the Topcon can only capture what is in its line of sight. For example, while mapping Quarterman, only a segment of the site could be captured from the original datum. Thus, to move the total station and record more of the site, the farthest visible point would be shot to and given a descriptor, Datum(n+1). The equipment would then be disassembled and moved to the new datum. Quarterman was mapped with five of these points.

Consequently, this process of capturing data means that each point's position on the coordinate plane is relative to the Topcon datum point that it was taken from, and each established datum is taken relative to the previous and the original datum. This is important to note because the total station does not come equipped with GPS capabilities, meaning that the 10,000x10,000 m coordinate plane is useless until the Trimble GPS is used to locate Datum1 geographically. Only then can the map be situated in real space on Earth's surface. For example, the GPS point of Quarterman's original datum was 28º28'27.185" N, -80º35'22.949" E.

In mapping the Quarterman site, methodology consisted of four main steps: (1) putting up the total station, (2) setting up the data collector and mapping application, (3) shooting foresight points, and (4) switching occupy/datum points. Due to issues with the instruments and the surveyors somewhat limited knowledge of the equipment, certain steps outlined in the Survey Pro manual were forgotten or had to be substituted with an unconventional procedure.

1. Assembling the total station. After walking the length of the site to judge how many datums were needed and what features would be included, Datum1 was placed at the sharp turn in the vegetation line by the South Cemetery (see Figure 3 below). Once a stake was placed in the ground, the flat-top tripod was positioned directly over the datum. This step was crucial to maintaining the precision and accuracy of the total station's measurements; thus, the stake needed to be visible through the mounting screw at the center of the tripod. This process was aided by the use of a plumbob and the laser plummet feature on the total station. In addition, a spirit level was used to make sure the instrument was perfectly horizontal with the ground. From there, the Topcon GTS-230 was screwed into the tripod and turned on. Internal readers and horizontal and vertical controls were used to make fine balance adjustments.

2. Setting up the data collector and Survey Pro. Once the total station was assembled, the TDS Data Collector was activated. Normally, the total station would ask automatically to set up a Bluetooth connection with the data collector, but if not, it was connected later through the Survey Pro job settings. Once the connection was established, the Survey Pro application was initiated, and a new or existing file was opened. During the first day of data collection when the job file was created, initial preferences were decided on such as preferred azimuth type (North), unit for distance (meters), unit for angles (degrees), and whether the program should adjust for the curvature of the earth (yes). After this, the data collector suggested default coordinates for the first occupy point, which created the arbitrary coordinate grid (TDS 2007). There was a feature allowing the input of a GPS point to situate the grid on earth before shooting, but this option was forgone because the Trimble GPS was not available during job setup.

After setting job preferences, the Backsight Setup option in the Survey menu was selected and three pieces of information were entered: the current Occupy Point, the height of the stadia rod (HR) which was always extended to 2 m, and the height of the instrument off the ground (HI) which was measured during every setup (TDS 2007). The Fixed Backsight box was checked as well. Next the total station was aimed either toward True North if Backsight Direction was toggled (only used at the original datum) or toward the previous datum if Backsight Point was toggled (used when setting up at any other datum). Then the Backsight Circle value was checked to ensure a reading of zero degrees. If it was correct, Solve was selected to open the Backsight Solved screen. If oriented north, BS Circle on this screen read zero degrees or was changed to read this value. If the total station was directed at its previous occupy/datum point, the BS Direction displayed the azimuth between the current occupy point and the previous datum. If it was correct, the BS Circle was edited to match the BS Direction. Once these steps were completed, Send Circle was selected, thus, causing the horizontal angle (HR) on the total station screen to change to the value entered in BS Circle (TDS 2007).

3. Taking foresight points. From there, both devices were ready to begin shooting points. This process took the least amount of time despite being the actual data collection stage. The total station was aimed toward the prism being held, level, some distance away, and Side Shot was selected. After being prompted to create a descriptor, the red enter arrow was pressed. The total station would beep, capture the point, and then automatically advanced the foresight point to the next number. This process continued until the entire visible area was mapped.

4. Switching occupy/datum points. The Survey Pro Manual suggests using the Traverse function next to Side Shot in order to begin the process of changing the Topcon’s occupy point. This routine expects that the total station will eventually be occupying the foresight point its shooting and backsighting to its current occupy point; therefore, it automatically updates the points and the Topcon's position on the Recon accordingly. However, due to the age of the data collector, it frequently froze and disrupted the Bluetooth connection, which would have interfered with the Traverse process had it been utilized, forcing the survey team to start over from scratch each time. Thus, Side Shot was used to move the instrument, meaning the foresight and backsight point information had to be updated manually each time.

Once mapping was completed, the data had to be exported from the TDS data collector into a map-making software. This entailed saving the job in Survey Pro as a Comma Separated Values (.CVS) file and the exporting it to a PC to be edited into a finished product. According to the Recon's manual, the process of exporting the file can easily be accomplished by downloading the program Microsoft ActiveSync 4.1 (TDS 2006). However, this program was made obsolete by the release of the Windows Mobile Device Center (WMDC) computer application approximately 10 years ago. Furthermore, the WMDC does not operate on PCs that run on software later than Windows Vista. Thus, in order to transfer the data, a significant amount of time was spent jailbreaking the software and using administrative passwords to bypass several firewalls. It did not connect, as one would imagine, like a regular external hard drive.

The mapping program of choice is typically Esri's ArcGIS system; however, due to time constraints and limited access to the program, the map shown below was created using Adobe Illustrator. The .CSV file with the data points was imported into the program using JavaScript code. This ensured that the points retained their relative positions to one another on the arbitrary coordinate plan. Then, using the point descriptors, feature shapes were created with line and coloring tools; thus, producing the map to be discussed in the following section.

Results and Discussion

This project resulted in several digitally-rendered maps, depicting both natural and cultural features at the Quarterman Site. While difficult to see its contents at full scale, the main representation of 8BR223 comprises both Quarterman North and Quarterman South Cemetery, which are surrounded by black, metal fencing at either ends of the map (see Figure 3).

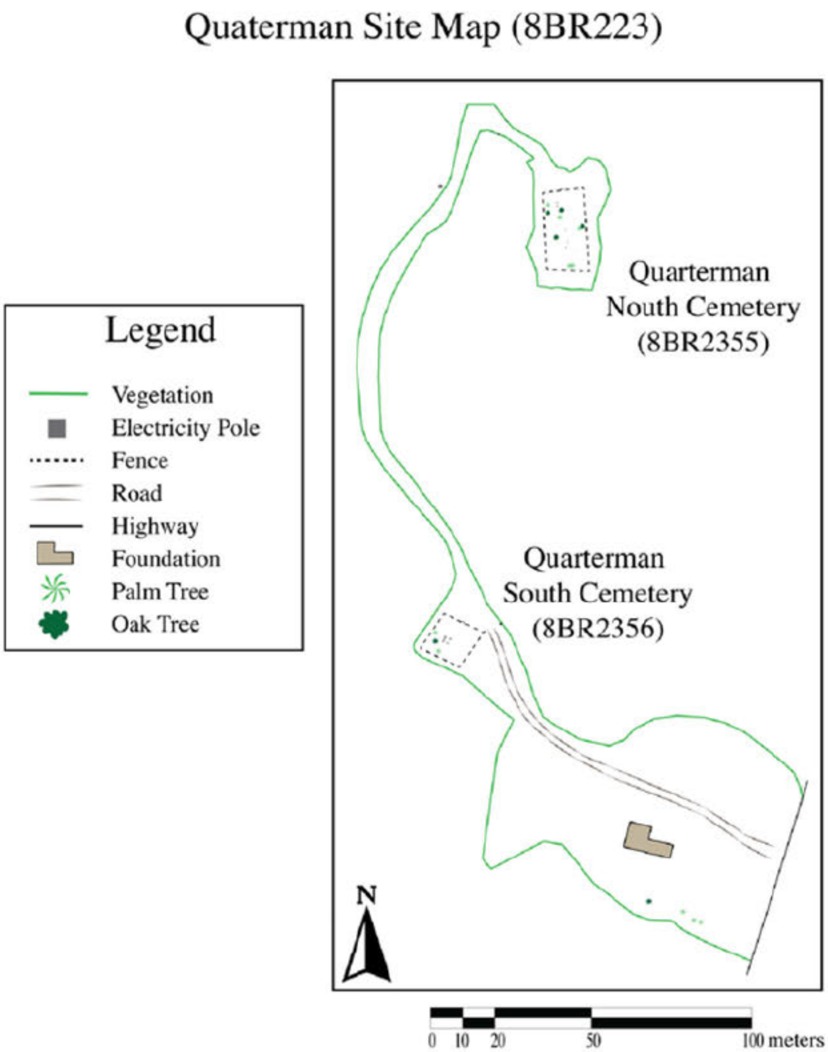

Figure 3. Map of 8BR223.

In terms of natural features, the vegetation barrier is outlined in green and landmark trees are depicted as palms or oaks. Visible down to the bottom of the map is the dirt road leading into the site and the edge of the highway that runs through CCAFS, Cape Road. South of the site road is the remaining foundation of the early CCAFS security building, which was torn down when the department was moved closer to the Industrial Area. Near the top of the map, a small gray square represents the only directly accessible FP&L transmission pole at the site. The corridor maintains a 10 meter-wide gap in the vegetation as it runs north and southwest for several more miles; thus, is responsible for the road that allows access to the northern portion of the site. Not labeled on the diagram are the five datums used to map Quarterman; however, locating the aforementioned GPS coordinate leads to the sharp corner in the vegetation line down by the Quarterman South Cemetery; again, this is Datum 1.

Within in the Quarterman South Cemetery (see Figure 4), there are three graves, but only the end two burials have footstones. These belong to Mary Ann Quarterman (1817-1878),

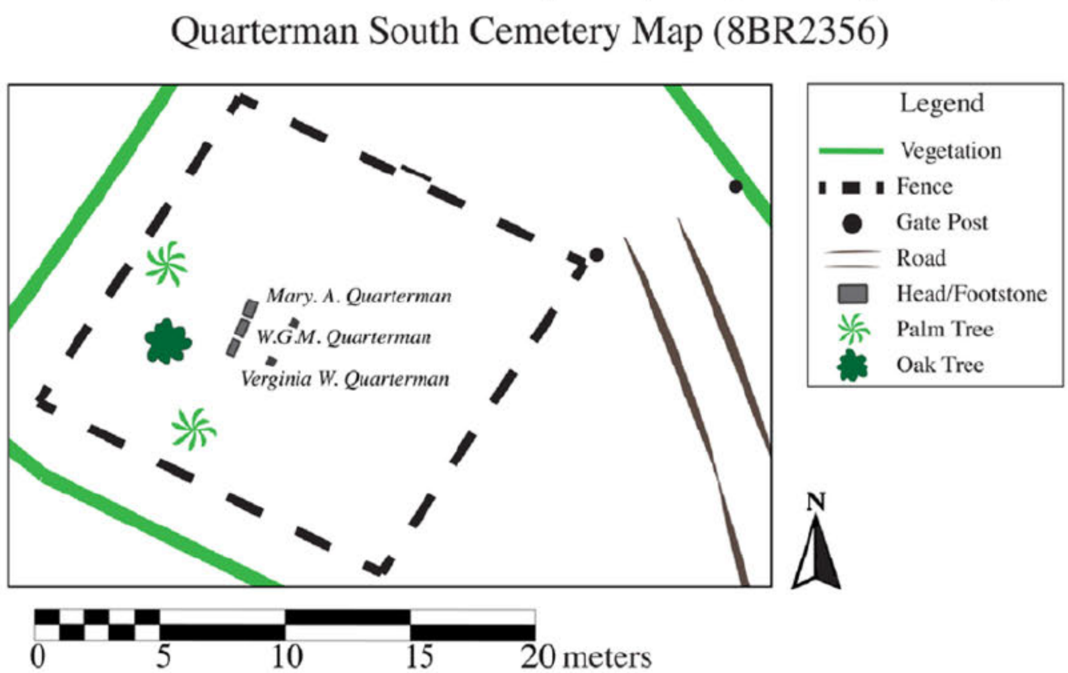

Figure 4. Map of 8BR2356.

William George Myddleton Quarterman (1816-1869), and Verginia W. Quarterman (1888-1888), respectively. Mary A. Quarterman, previously Mary A. Grant, was the wife of W.G.M. Quarterman. The couple married in 1839 in Glynn County Georgia and was reported to have had eight children, though two are thought to have been born out of wedlock ([redacted] 2019). Both George M. and Orlando A. Quarterman are their sons, and they moved to Cape Canaveral some years before W.G.M.'s death. The infant Verginia's relationship to the other Quartermans is unknown, but she was potentially a granddaughter to Mary and W.G.M. ([redacted] 2019).

In the Quarterman North Cemetery (see Figure 5), there are four graves. The two identified burials are marked by both the remains of their original brick headstones and new wooden crosses donated by the CCAFS. They belong to Anna Dummet Quarterman (1859-1945) and George Myddleton Quarterman (1853-1923). Anna's maiden name was Burnham; however, in 1879, she married George M. Quarterman, and seven years prior, her sister

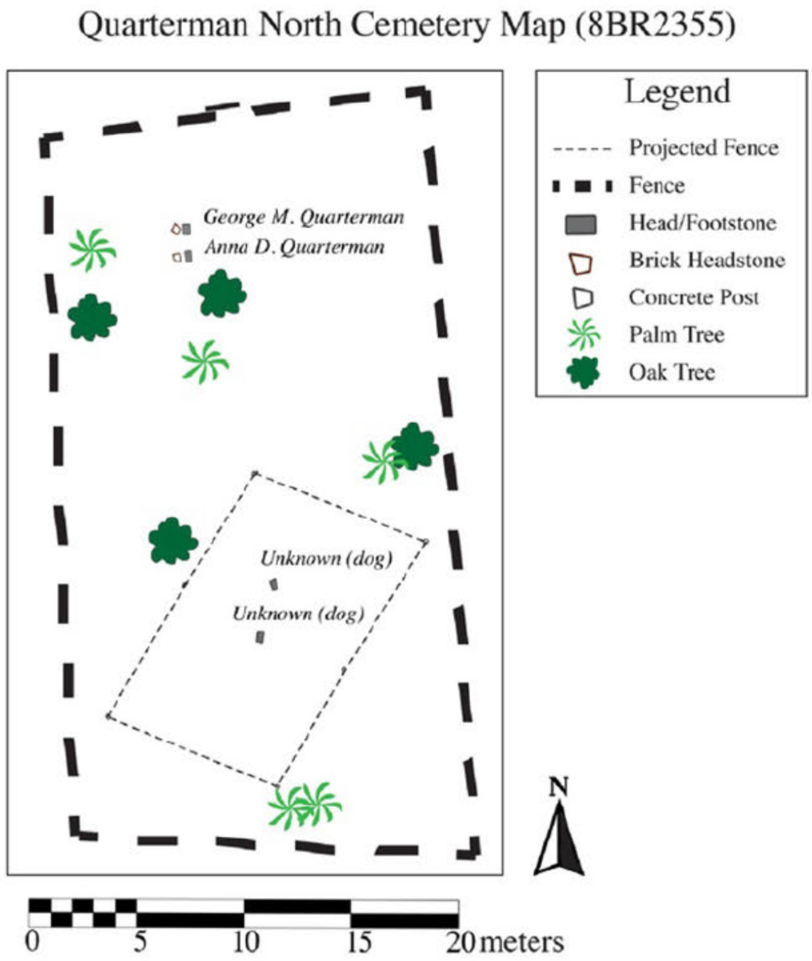

Figure 5. Map of 8BR2355.

Jerusha Catherine married George's brother, Orlando A. Quarterman. Both sisters were the daughters of Captain Mills Olcott Burnham, the original lighthouse keeper of Cape Canaveral ([redacted] 2019). George M. Quarterman obtained this title after the Captain's death; thus, the cross marking his grave is denoted with an image of a lighthouse. Anna and George Quarterman also had three children: Annice Quarterman, George M. Quarterman Jr., and Oscar Floyd Quarterman. Oscar replaced his father as lighthouse keeper upon the latter's retirement ([redacted] 2019).

On the far side of the cemetery there are two unknown graves. However, during an interview with Florence Quarterman (maiden name Wilson and wife of Oscar F. Quarterman) on March 29th, 1971, the widow described the locations and burials of her and her husband's families in addition to those of several others. Her description included the two unknown graves in the northern cemetery: "Mrs. Deem's dogs died. They took a role of wire, put it around the plot and buried the two dogs. Those are the 'unidentified' graves. The other two graves are across the way…Mrs. Deem put the dogs to sleep when she left" (Schell 2004). Thus, the two unknown graves in 8BR2355 belong to two dogs owned by someone that lived on Cape Canaveral who was not a part of the Quarterman, Wilson, or Burnham families.

Finally, there six unidentified concrete posts in the Quarterman North Cemetery. Their existence is confusing, given that there are no other death records associated with the site; however, each post has several holes drilled through it, and together, they create a perimeter around the two canine graves. Based on historical methods of fencing and Florence Quarterman's interview where she mentions the wire that was put up around the plot, it follows that the concrete posts were meant for fencing. The projected fence layout is depicted in Figure 5.

Pros and Cons of Total Station Mapping

Working with a total station and advanced equipment like it has its advantages and disadvantages. The principal barrier to creating the digitally-rendered maps laid in the amount of time that was needed simply to learn the scientific principles that drove the devices as well as the operational steps that ultimately lead to the finished products. This is why the above methodology section is so detailed. The learning curve was so great that it was almost overwhelming to undertake this project. Even with the help of experienced professionals, steps were forgotten and device manuals were lost.

Furthermore, even if all researchers had already been familiar with the total station, fieldwork was still hampered by a number of external factors. During the season, viable field days at Quarterman were limited by weather, the surveying schedule, conflicting advisor schedules that prevented access to equipment, the NASA launch schedule, and the CCAFS critical period schedule. In truth, the whole season was one large scheduling error. In addition, even if it was a feasible workday, the total station and (our) data collector are finicky instruments. An accurate piece of equipment needs steady hands and a good eye for balance in order to be able to operate. If someone was lacking in one of those categories, it took upwards of 15 minutes to complete setup. One reliving fact is that the process progressed more quickly the more times it had to done, and it had to be done quite frequently.

The more frustrating part of the project was ultimately reserved for the TDS Recon Data Collector. Problems began in the field upon the discovery that it was more than 16 years old, which meant that it froze every half hour on the dot, so the batteries had to be taken out quite a few times to reboot it. After mapping was completed, it was learned that the software suggested by the data collector's manufacturer was no longer operational. Furthermore, the newer software that was suggested by internet technology forums did not work on any PC that had a version of Windows past the Vista update. The steps that had to be taken as a result of this are outlined in the project's methods. It seems that what surveyors receive in accuracy and speed from cutting-edge technology is always matched by issues such as instrument fickleness and limited field days.

Conclusion

Despite the setbacks encountered by this venture during the season, the Cape Canaveral Archaeological Mitigation Project now has access to preliminary but accurate maps of the Quarterman Site, which denote significant natural and cultural features. Thus, when the site receives Phase II excavation in the proceeding seasons, the project can make use of the digital representation of 8BR223 and its subsequent inserts of the north and south cemeteries. These maps will serve as the groundwork for future analyses and can be updated as more features are discovered, potentially like that of the Quarterman homestead foundation. Perhaps then, the site will finally be eligible for inclusion in the National Register of Historic Places; although, one hopes this occurs before the site is inundated by the Atlantic.

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