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Savannah River Archaeological Research

Historic Data or Just Old Maps?: The Digital Mills' Atlas Project at the SRARP

By J. Christopher Gillam

Introduction

Recent research at the Savannah River Archaeological Research Program (SRARP) demonstrates the prospects of Geographic Information Systems (GIS) technology for improving historic map accuracy. This was accomplished by digitizing portions of the Barnwell District map from the 1825 Mills' Atlas of South Carolina to form a geographic database, converting it to the modern UTM coordinate system, rubber-sheeting the data to modern landscape features, and measuring the distance from the map location of four known sites to GPS-verified site locations for a determination of map accuracy. It is illustrated that the Barnwell District map has very poor horizontal accuracy, but improvements of nearly 45 percent are possible through manipulation of the mapped data.

Background

The Mills' Atlas has national significance, representing the earliest statewide mapping project in the United States. The atlas contains 28 provincial maps and was published by the famous engineer and architect, Robert Mills, in 1825. Nineteen different surveyors conducted the original surveys between 1816 and 1824. Originally contracted for the production of John Wilson's 1822 State Map of South Carolina, the provincial maps were refined and re-drafted by Mills at a consistent scale of 1:125,000 for the atlas.

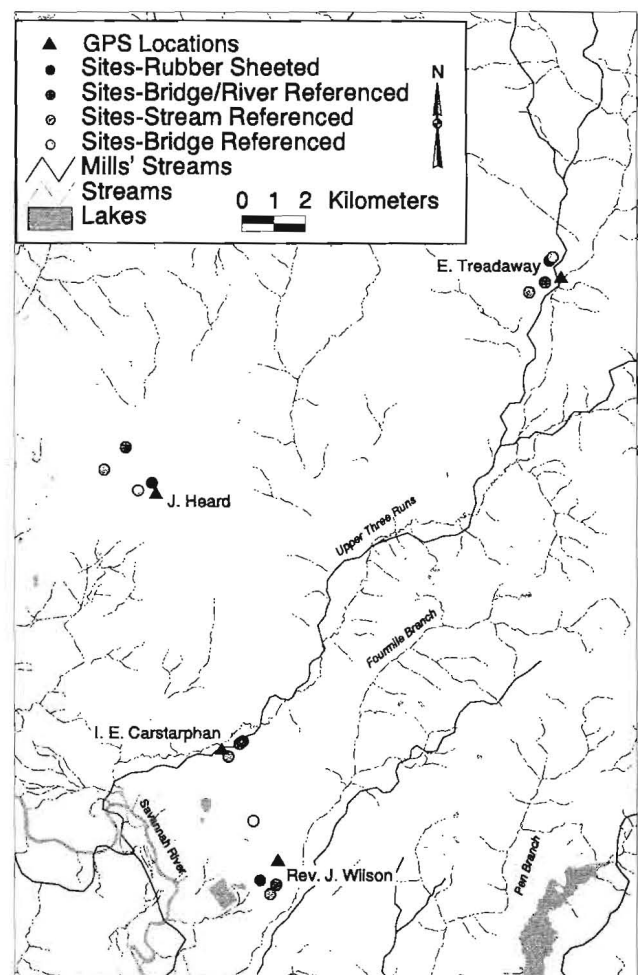
Thomas Anderson conducted the survey for the Barnwell District map in 1818. Like the other provincial maps, it contains a wealth of information about the cultural and environmental landscape of the era. In all, there are 80 cultural features depicted in the vicinity of the modern Savannah River Site (SRS) boundary. These features consist of 13 mills, 51 homesites, five churches, one warehouse, two ferries, three landings, and five bridges.

Documents of the cultural resources in this area suggested that at least four of Mills' sites had been

previously identified by archaeological survey. These consist of four homesites belonging to Ernest Treadaway, John Heard, I. E. Carstarphan, and the Reverend Jackson Wilson, consecutively. These sites were recorded during the normal compliance activities of the SRARP and were ground-truthed using a high-accuracy Global Positioning System (GPS) for this project.

Methods

The methods of this research included tasks of data development and analysis common to most GIS systems.



Distribution map illustrating rectified and rubber-sheeted site locations relative to their GPS-verified locations. (SCIAA drawing)

The map data were input into the GIS with a large digitizer, but a large-format scanner could be used instead. These processes are similar, the former representing a map-to-map rectification and the latter representing an image-to-map rectification. The coordinates were then updated in the map layer's associated database file and the layer subsequently projected to the UTM coordinate system. Once rectified to UTM meters, the historic features were rubber-sheeted to match modern landscape features. Then, the distances from the digitized locations to the GPS-verified locations of the four sites were calculated. Finally, summary statistics were generated from the distance measures, and a map was designed for cartographic output.

The data were rectified to the UTM coordinate system using control points derived from natural and cultural features discernable in the historic map and modern USGS 7.5' topographic quadrangles. The UTM coordinates of all control points were derived from the GIS data layers developed from the original USGS 7.5' topographic quads. To facilitate comparison and to refine the results, three separate sets of control points were used to produce three separate representations of the Mills' Atlas data in the GIS. The first used only natural landscape features (n=14), specifically major stream confluences and a large Carolina Bay. The second set of control points were based upon stable cultural features (n=7), bridges over the major tributaries of the Savannah River. The third set, a hybrid of the first two, used the bridges and the major stream confluences with the Savannah River (n=13). These mapped data are statistically compared to the final rubber-sheeted data in the following table.

Results

The great amount of variation in point location accuracy for the rectified data layers is evident in the output map. Even the best results indicate that the Barnwell District map has very poor horizontal accuracy (see table). However, rubber-sheeting the data to modern map features improves the accuracy by nearly 45 percent over the best of the other rectification processes (average distance of 627 m, compared to 905 m for the Bridge/River referenced data). With an average distance error of over 600 m, the data do not come close to meeting today's map accuracy standards. To illustrate this point further, the USGS standard for a 1:125,000 scale map requires that not more than 10 percent of points tested be in error of more than 64 m of their actual on-the-ground location. The error exhibited by the Mills' Atlas data is nearly 10-fold greater than that of the modern standard.

Despite its poor accuracy, rubber-sheeting enables the data to be normalized relative to modern landscape features. This improves the absolute horizontal accuracy of the data and permits the delineation of archaeological survey areas by narrowing down likely areas of site occurrence. The automated determination of site location is possible to within approximately 600 m.

Likewise, visual interpretation of historic map data is aided by incorporating modern landscape features. The potential for site destruction, protection, and discovery are just a few examples of visual analyses enabled by the automation of the data in a GIS environment. Hardcopy maps can also be produced and given to relatively inexperienced field crews, requiring minimal interpretation skills to comprehend modern and historic landscape relationships.

Distance and summary statistic measures (m) from the rectified to the GPS-verified locations.

	Bridge Ref.	Stream Ref.	Bridge/River Ref.	Rubber Sheet
Heard Site	566	1,774	1,710	329
Carstarphan Site	2,476	327	568	703
Wilson Site	3,793	1,109	794	855
Treadaway Site	662	1,138	546	620
Mean	1,874	1,087	905	627