1-2023

Geophysical Survey of Morrill Cemetery, Town of Stockton, Portage County, WI BPT-0021

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LAWRENCE UNIVERSITY
ARCHAEOLOGICAL REPORTS
NUMBER FOURTEEN

ARCHAEOLOGICAL SURVEY
LAWRENCE UNIVERSITY

JANUARY 2023

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January, 2023

Final Report

Wisconsin PLP#22-1547

Abstract:

On November 1, 2022 Lawrence University conducted a geophysical survey on the eastern side of Morrill Cemetery (BPT-0021) in the Town of Stockton, Portage County, Wisconsin. High-resolution magnetic data were collected over a 30 meter by 60 meter grid to determine if unmarked interments were present in the cemetery. The survey identified a number of magnetic anomalies that appear to be consistent with the presence of unmarked interments. It is recommended that any ground disturbance in the cemetery proceed under the expectation that interments might be disturbed.

Contents

Introduction and Context

The research reported here was undertaken by the request of the Town of Stockton, Portage County, Wisconsin. The Township owns and manages Morrill Cemetery, located in the northwest quarter of the southwest quarter of the southwest quarter of Township 23, Range 9 East, Section 30 (Figures 1 & 2). The cemetery is typical of a township cemetery, covering an area of roughly 60 meters East-West by 160 meters North-South, and containing roughly 153 marked interments dating from 1832 to 2009 (Figure 3). The Town of Stockton requested a geophysical survey of the cemetery because there is a large area in the center of the cemetery that has very few marked interments, even though, being an older part of the cemetery, there should be many. In addition, there are numerous broken headstones removed from their locations, so it is clear some interments no longer are properly marked.

Methods

Geomagnetic survey was conducted over two 30 meter by 30 meter grids covering the area where possible unmarked internments were thought to be located (Figure 4). Geomagnetic data were collected using a Geoscan FM256 differential gradiometer (Geoscan Research 2009). This instrument consists of two magnetometers arranged one atop the other with a 0.5 meter separation. Each magnetometer measures the earth's magnetic field and the difference between the two readings, which is equivalent to the vertical gradient of the earth's magnetic field, is recorded. The instrument is sensitive enough to measure tiny variations in the earth's magnetic field, variations that might be caused by subtle soil changes or the presence of buried materials (Aspinall, Gaffney, and Schmidt 2009). For this application sensitivity of the FM256 was set at 1.0 nanotesla, or about 1/25,000th of the earth's total magnetic field. Data were collected at 0.25 meter intervals along 0.5 meter spaced parallel North-South lines and using a zig-zag method.

The raw magnetic data were downloaded from the FM256 into the Geoplot 4.0 software package (Geoscan Research 2016). Analyses were complicated because of a mistake made during data collection. At in about the middle of collecting the southern grid the direction in which data were being collected was mistakenly reversed. Before any analysis could be done those data points needed to be flipped back into the correct orientation, which was accomplished by cutting and pasting the data into a new dataset after the values in the cut portion were put in the correct orientation. Once this was done analysis conducted on the data involved (in the following order) (1) "clipping" to remove high and low data points more than one standard deviation from the mean; (2) "zero mean traverse" and "zero mean grid" to balance the data values across the separate grids; (3) "destaggering" to bring individual transects into proper alignment; (4) "low pass filtering" based on a given data point's two surrounding measurements to enhance weak magnetic features; and (5) "interpolation" conducted once in the X direction to make each pixel represent 25 square centimeters. The image resulting from this processing is presented in Figure 5. Magnetic highs appear as darker grays; magnetic lows as lighter grays.

Results of Investigations

The basic assumption underlying the interpretation of geomagnetic data is that the survey area has a uniform magnetic character. Deviations from that uniform pattern suggest the presence of buried objects or features with a different magnetic signature. The focus of interpretation is these magnetic anomalies. Interpreting anomalies is as much an art as it is a science. The analyst uses mathematical manipulation of the data and alters the color and contrast of the related geomagnetic map to isolate features with specific magnetic characteristics or that seem to form patterns of interest. In the case of unmarked interments, the analyst looks for anomalies that are oblong in shape, roughly 3 meters by 2 meters in size, and oriented East-West, as these are the shape and orientation of most cemetery interments in the United States (Strangstad 2013). Such anomalies are also expected to be arranged in linear patterns or some other regular pattern reflecting planned placement within the cemetery's organizational blueprint.

In addition to shape and orientation, previous research suggests that interments with a wooden coffin or casket (a coffin is angled toward the head and feet, while a casket is square) have a magnetic signature of between 5 and 15 nanotesla, compared to the surrounding soil (e.g. Peregrine 2016). This magnetic signature is due to the presence of metal objects used to construct the coffin or casket and metal objects on the interred individual. The decay of organic material can also impart a small magnetic moment to soils. Interments in metal caskets, which became ubiquitous in the early 20th century (Haberstein and Lamers 2014), have much higher magnetic signatures, sometimes higher than the maximum reading of the FM 256 gradiometer (2400 nanotesla). This makes metal caskets easy to locate, but their strong magnetic field also masks all other magnetic signatures in an area roughly 3 to 5 square meters around the metal casket.

Figure 6 indicates with green dots those anomalies that appear consistent with interments. Note that some of the dots mark known interments, which provides some confirmation that the identified anomalies are consistent with other interments in Morrill Cemetery. That these anomalies are consistent with known interments does not mean such interments are actually present, as there are other disturbances that might cause similar anomalies. For example, Figure 7 shows an aerial image of Morrill Cemetery taken in 1938. Note the large trees scattered across the survey area. Some of the anomalies marked in Figure 6 may be the decayed stumps of these or other plantings that once grew in the cemetery.

There is a very large linear anomaly running East-West through the center of the survey area, roughly along the Southern side of the extant access lane though the cemetery. This linear anomaly is almost certainly caused by a buried metal pipe of some kind. Farms in the area around Morrill Cemetery use irrigation extensively because of the sandy soils which do not retain water, so irrigation systems, and associated pipes, are common in the area. Figure 8 shows the location of inactive wells in the area. It is likely that the pipe running through the cemetery is connected to the well in the field immediately West of the cemetery.

Recommendations

1. The Town of Stockton should, in consultation with the State Historical Society of Wisconsin, act to preserve intact the entire area within the boundaries of Morrill Cemetery.

2. The Town of Stockton should, in consultation with the State Historical Society of Wisconsin, undertake Phase II investigations in advance of any construction, landscaping, or other ground disturbance within the boundaries of Morrill Cemetery.

3. The Town of Stockton should, in consultation with the State Historical Society of Wisconsin, have additional non-invasive surveys conducted within the boundaries of Morrill Cemetery in order to more precisely identify and locate potential unmarked interments.

References

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Figures

Figure 1: General location of Morrill Cemetery (BPT-0021) within the State of Wisconsin.

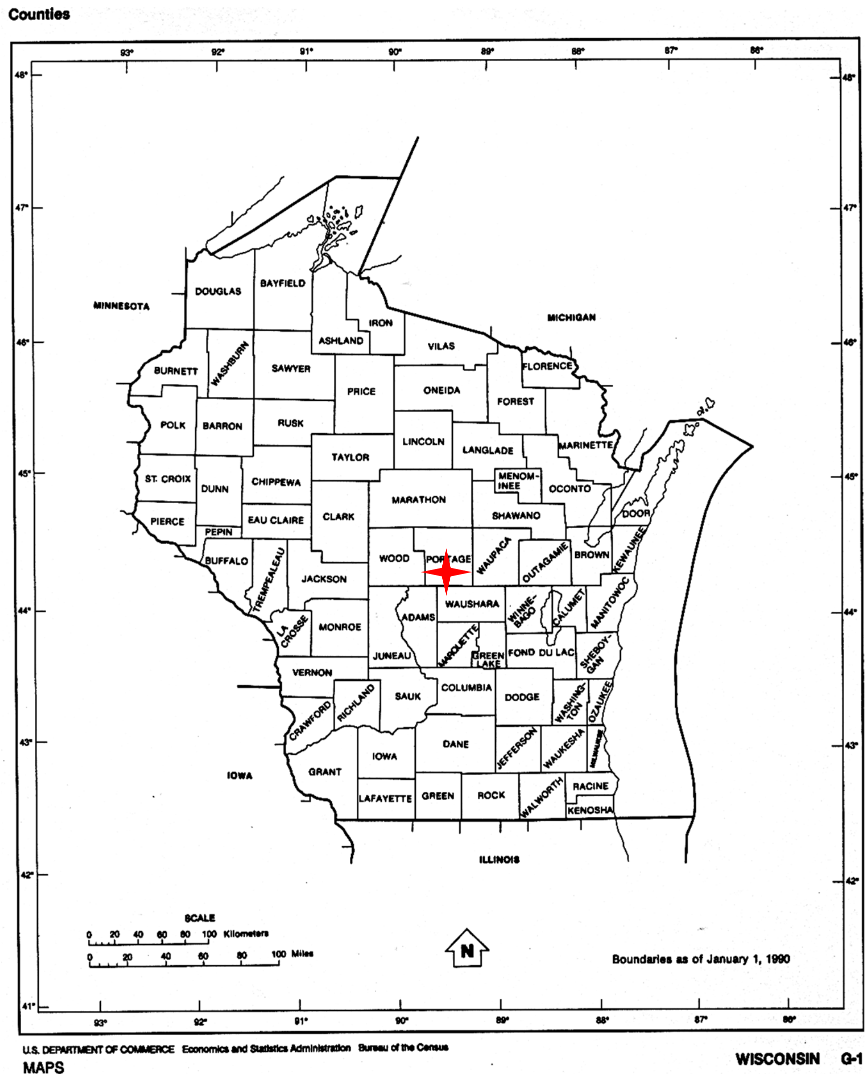

Figure 2: USGS 7.5 minute quad image showing the location of BPT-0021, Morrill Cemetery.

Figure 3: Aerial image of Morrill Cemetery, showing lot lines.

Figure 4: Aerial image showing the geomagnetic survey area (outlined in yellow).

Figure 5: Geomagnetic data superimposed on an aerial image of Morrill Cemetery.

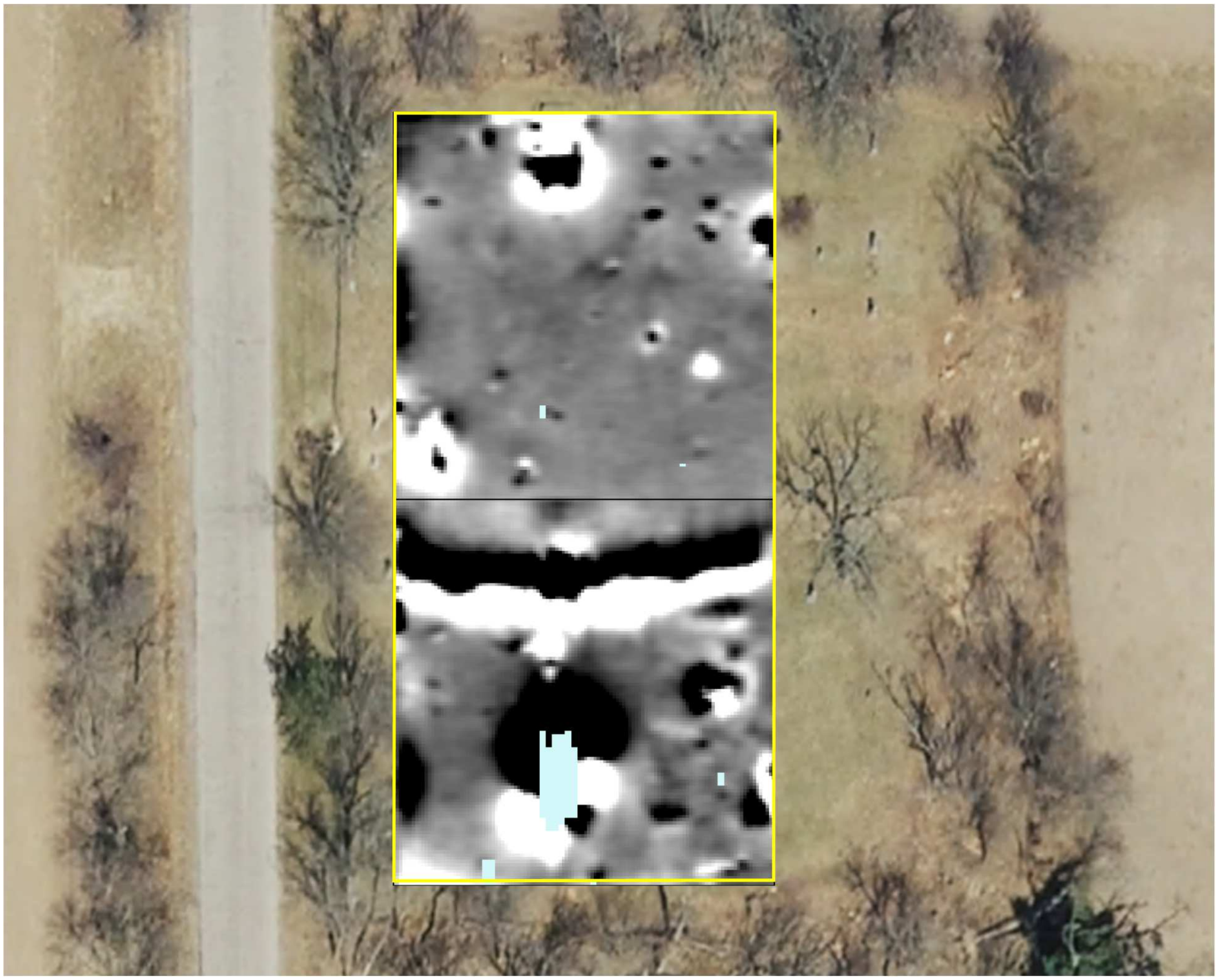

Figure 6: Geomagnetic anomalies that appear consistent with possible interments (identified with green dots).

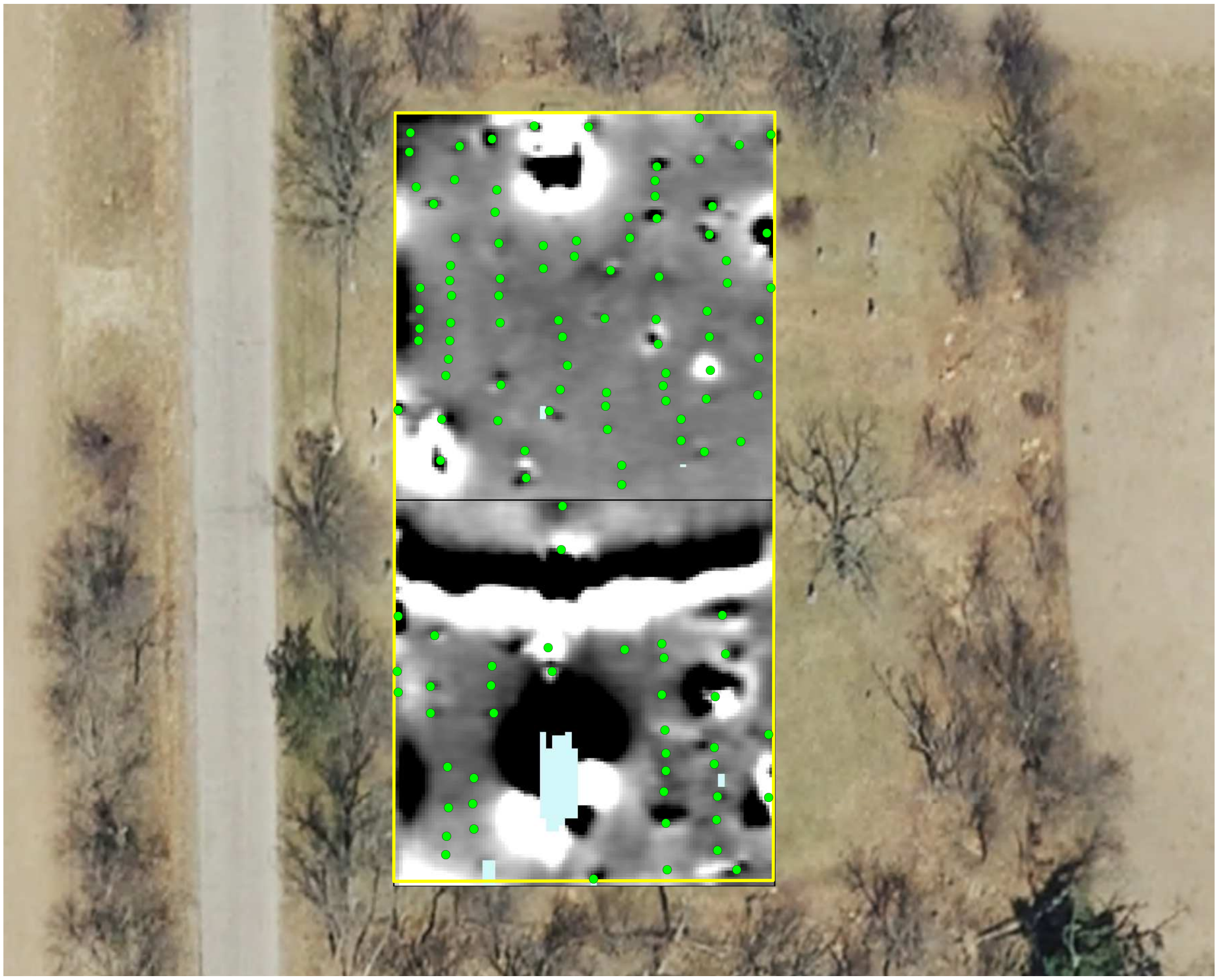

Figure 7: A 1938 aerial photograph of Morrill Cemetery showing trees that are no longer present.

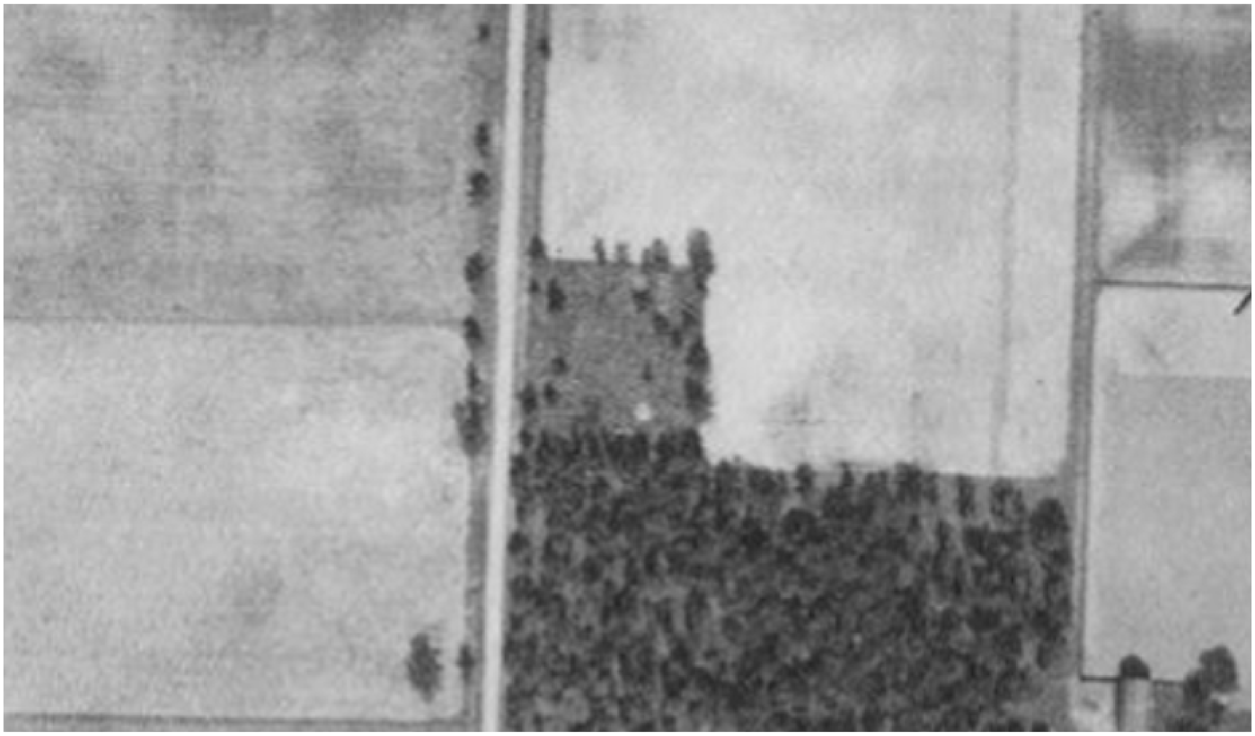

Figure 8: The location of inactive wells (blue dots) in the area around Morrill Cemetery. The cemetery itself is in the center of the image.

Figure 9: Geomagnetic anomalies superimposed on an aerial image of Morrill Cemetery. The purple dashed lines mark areas where the geomagnetic field of subsurface deposits made it difficult to identify more subtle anomalies.