



# A GROUND PENETRATING RADAR SURVEY OF BELLE GROVE CEMETARY

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## Introduction



Figure 1 shows the Belle Grove Plantation House (where the museum is currently located) right center, and the slave cemetery (on the left, inside the red oval). (Image courtesy of Google Earth)

According to family records, the Hite family owned 276 enslaved persons at Belle Grove Plantation between the years of 1783 to 1851. The names of the original 15 enslaved persons have been retained: Jerry, Milley, Sally, Elza with her five children, Diana, Demas, Joanna, Pendar, Webster, and Truelove along with her four children, Henry, Katey, Peggy, and Priscilla. The records are not complete, and the lives of the enslaved were often transitory; as a result it is not known how many of these people were buried at Belle Grove. Extensive research is currently in progress to uncover as much of the history of the individuals and families that were enslaved here.

The location of our ground penetrating radar survey was thought to be a likely place in which these individuals were buried, a conclusion supported by both oral history and the presence of a number of stones, that while unmarked, are consistent with the marker stones that might have been used.

Our survey identified the location of fourteen distinct burials, at least eight of which are definitive. Based on the relative location of these burials with some of the stones, and the presence of a number of similar stones for which burials were not detected, it is likely that due to burial conditions or other factors, there are more burials here than we were able to detect. However, we were able to confirm that this site is a graveyard.



Figure 2 shows a view of the Belle Grove Cemetery site from the entrance (Photo courtesy of Kristen Laise)

## Site Ground Penetrating Radar (GPR) Survey

The cemetery is within a fenced in area measuring 93 ft north to south and 52 ft east to west. We collected a total of 92 lines of GPR data, 34 of which are shown in the figure to the right. The lines were collected with a spacing of 18 inches between each line. This spacing ensured that a burial perpendicular to the lines would show up on three consecutive lines.

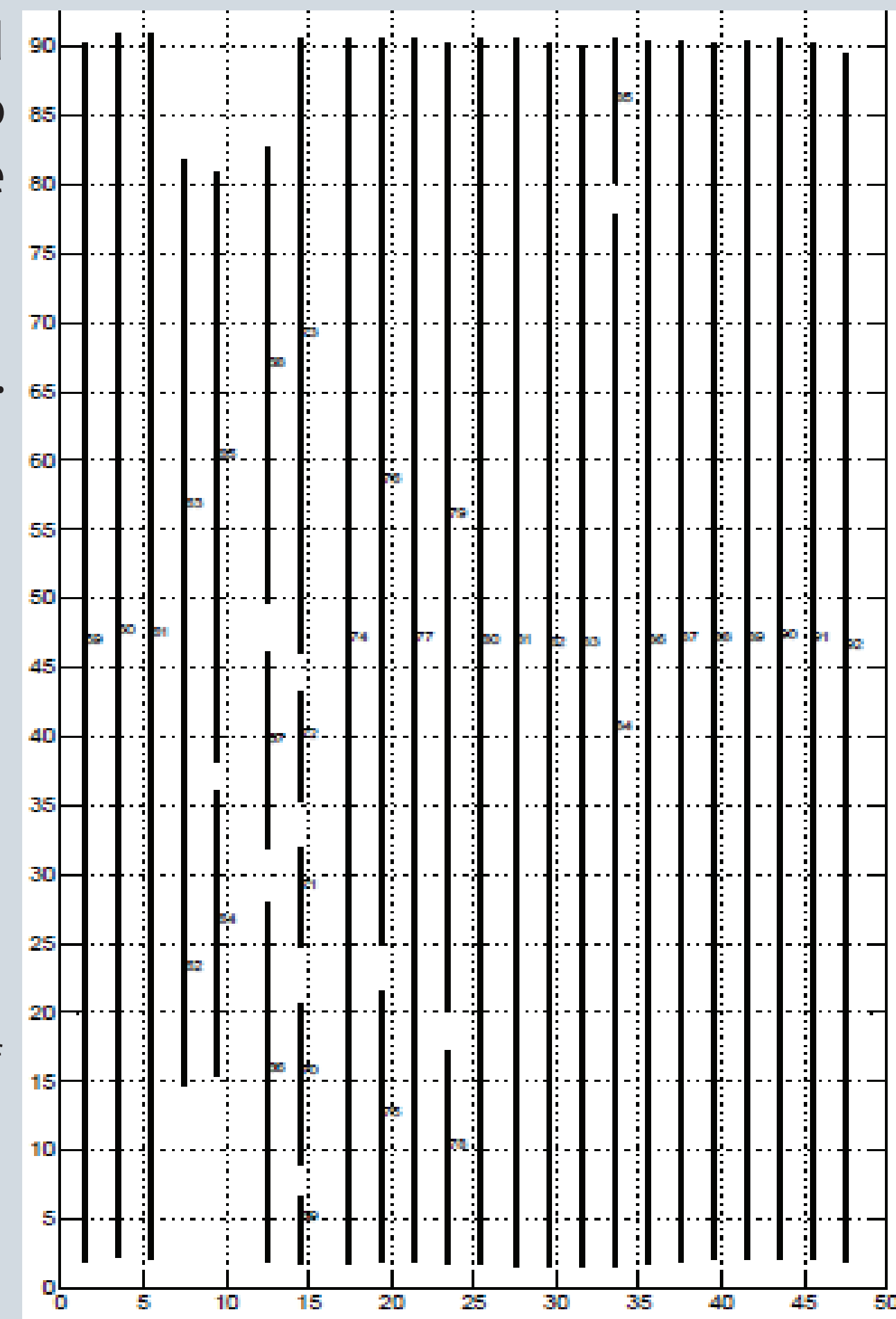


Figure 3 shows the locations of each of the 34 GPR lines collected at the Belle Grove Cemetery.

## How GPR Works

A ground penetrating radar transmitter emits a high frequency (400 MHz for our survey) electromagnetic wave which propagates downward into the ground. When this wave encounters an object in the subsurface that has contrasting electromagnetic properties, part of the wave energy is reflected upward where it can be detected by the GPR receiver. The time between transmission and reception is correlated with the depth of the object. The magnitude of the difference in the electromagnetic properties between the object and the surrounding subsurface determine the fraction of the energy that is reflected.

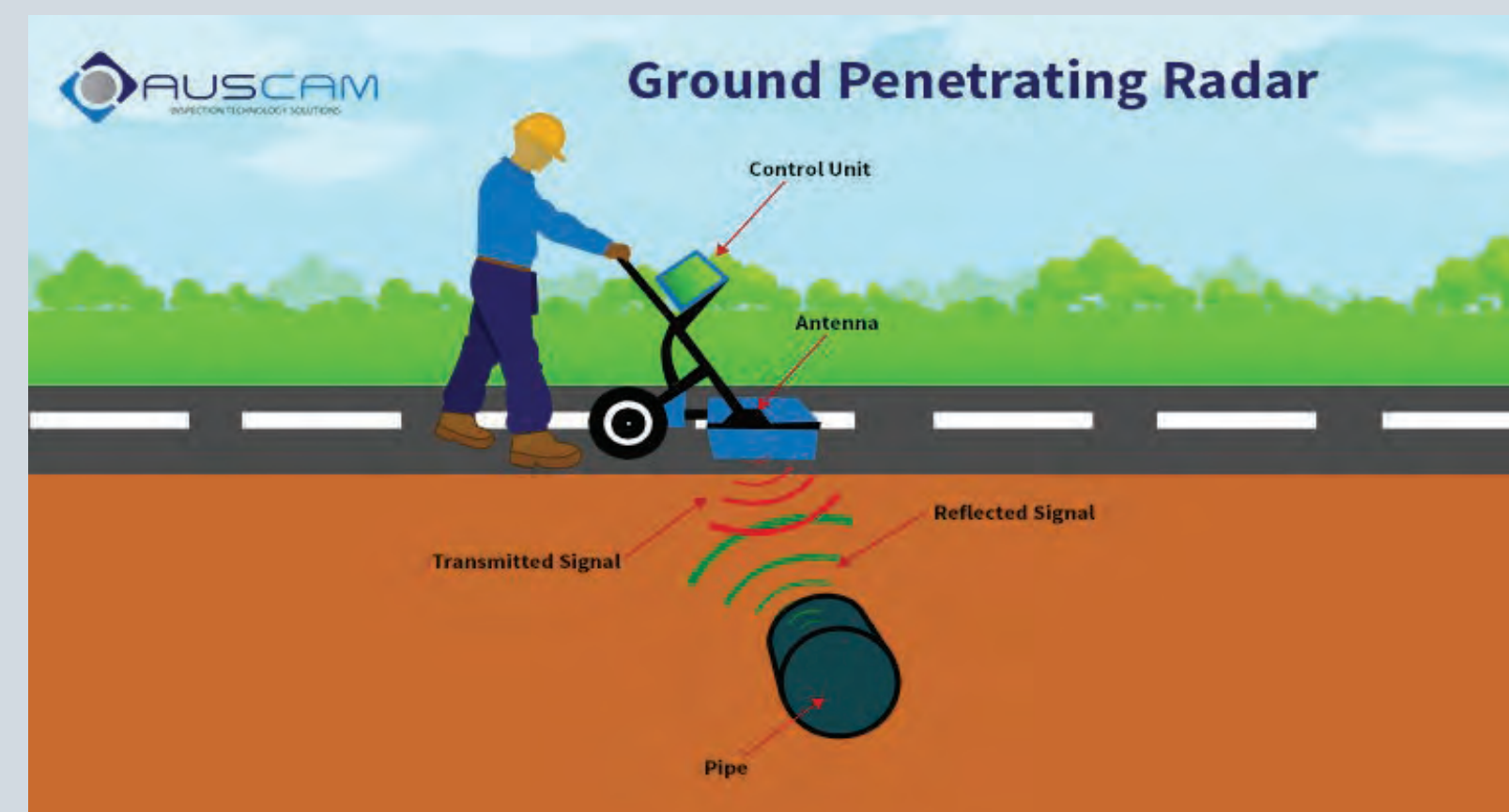


Figure 4: Depiction of the operation of a ground penetrating radar unit. The transmitted wave is shown in red and the reflective wave in green.

## Results

Figure 6 shows a cross-section for one of the GPR lines in this survey. We have highlighted two hyperbolae depicting reflected waves that are representative of common features detected during this survey. The top of each hyperbola shows depth to the target and the angle of the peak of the hyperbola gives information about the size of the target. Additionally, the contrast

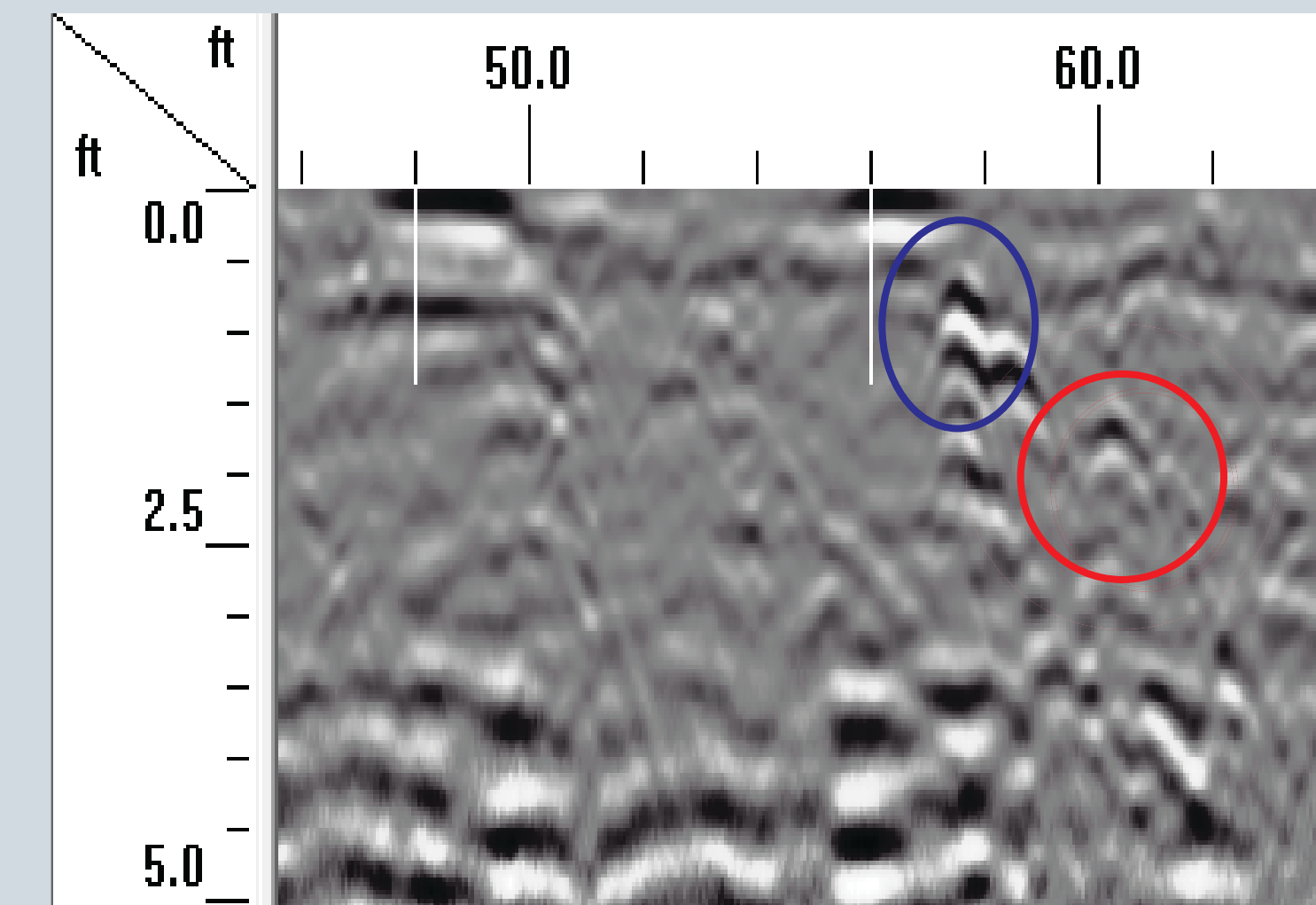


Figure 5: Selected cross-section from one of the GPR lines for the Belle Grove Cemetery

between the lighter and darker features near the top of each hyperbola contains information regarding the electromagnetic properties of the target. For example, the feature circled in blue is shallow, small angled and contrasts sharply, consistent with the signal we would expect to get from a shallow buried rock. The feature circled in red is deeper, wider angled and with less contrast, consistent with a wooden coffin. Determining the confidence level for a specific burial site required consideration of several factors. First, the depth to the top of the burials in Belle Grove tended to be approximately two feet or a bit less. We also hoped to find clean signals across three consecutive lines indicating a target at least five feet in length. The feature outlined in red above is one that has corresponding signals in each of the next two lines. Finally, we took into consideration other features such as the presence of marker stones or whether the interpretation would put the burial into an already established row. In this case, the feature outlined in blue could be a buried marker stone. While GPR is a standard geophysical method used for burial detection, a combination of factors, including the age of the grave, soils, the method of burial (e.g. coffin or shroud), and the size of the body, may make some burials more difficult to detect than others.

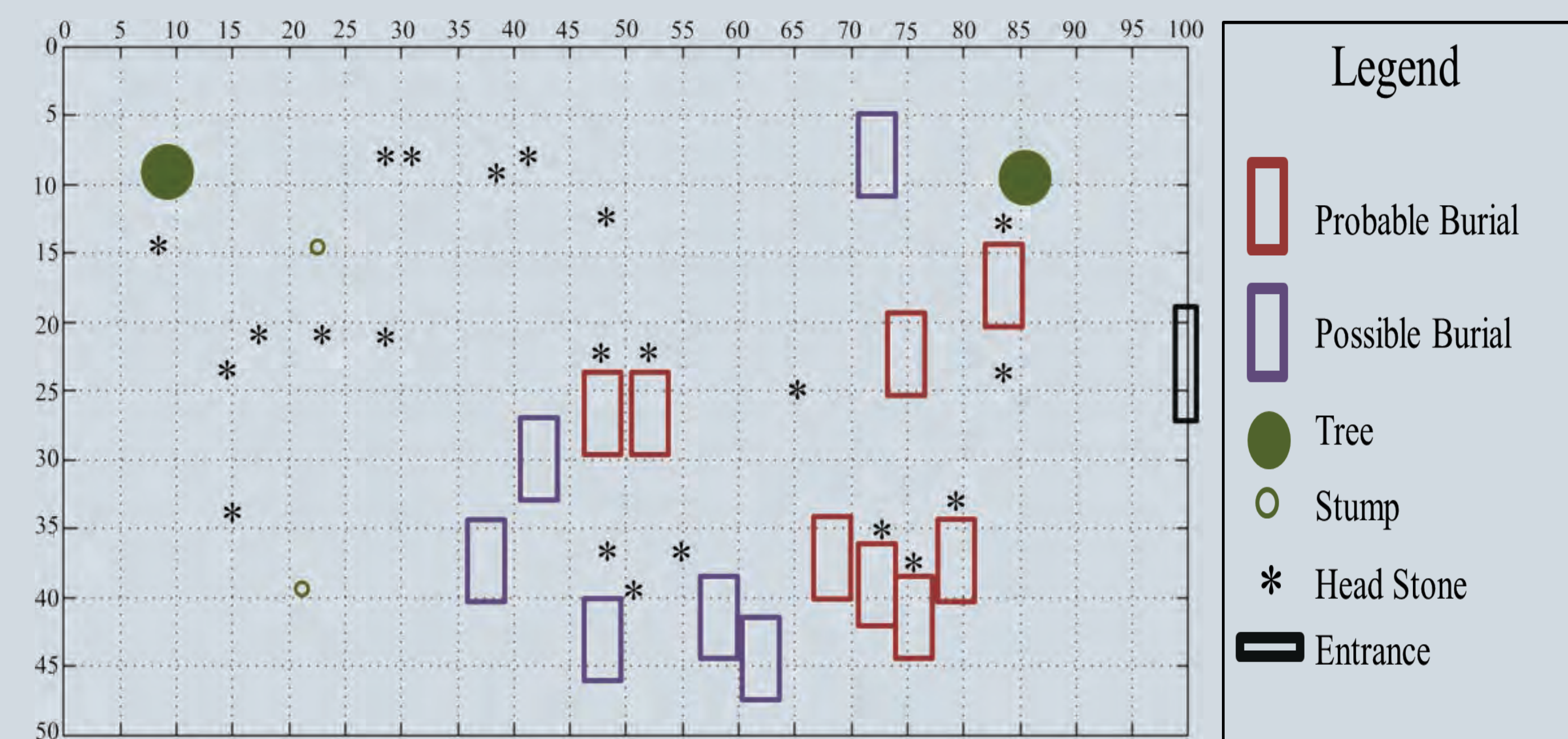


Figure 6: Interpretation of distribution of marked and unmarked burials in the Belle Grove Cemetery. The color of the boxes represents the level of confidence for each specific burial. Marker stones and other relevant surface features such as trees and stumps are also depicted (see legend).

References:

Ground Penetrating Radar: Theory and Applications. Edited by Harry M. Jol, Elsevier, 2009.  
A Guide to Bowman's Family Cemetery at Bowman's Fort (Harmony Hall), Jacob Blosser.

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