Summary of Gradiometer survey of the 'Applegarth' field North of the Castle Site and Resistivity Survey of Town Council Land on the Riverside in Tadcaster

A geophysical survey was carried out on a section of the field north of the motte and bailey scheduled monument in Tadcaster. The field contains a number of apparently man-made features consisting of mounds and areas of possible quarrying. (This field is referred to as 'Applegarth' in the 1611 estate map and we will use this name when referring to this field in the absence of a better designation).

The survey was carried out using a gradiometer (a type of magnetometer) on the area shaded blue on the map. A gradiometer measures differences in the magnetic gradient of the ground it passes over.

The method is particularly suited for detecting ditches and pits where the ditch or pit fills have different magnetic properties to the surrounding area.

Figure 1 shows the location of the surveys in relation to the town of Tadcaster.

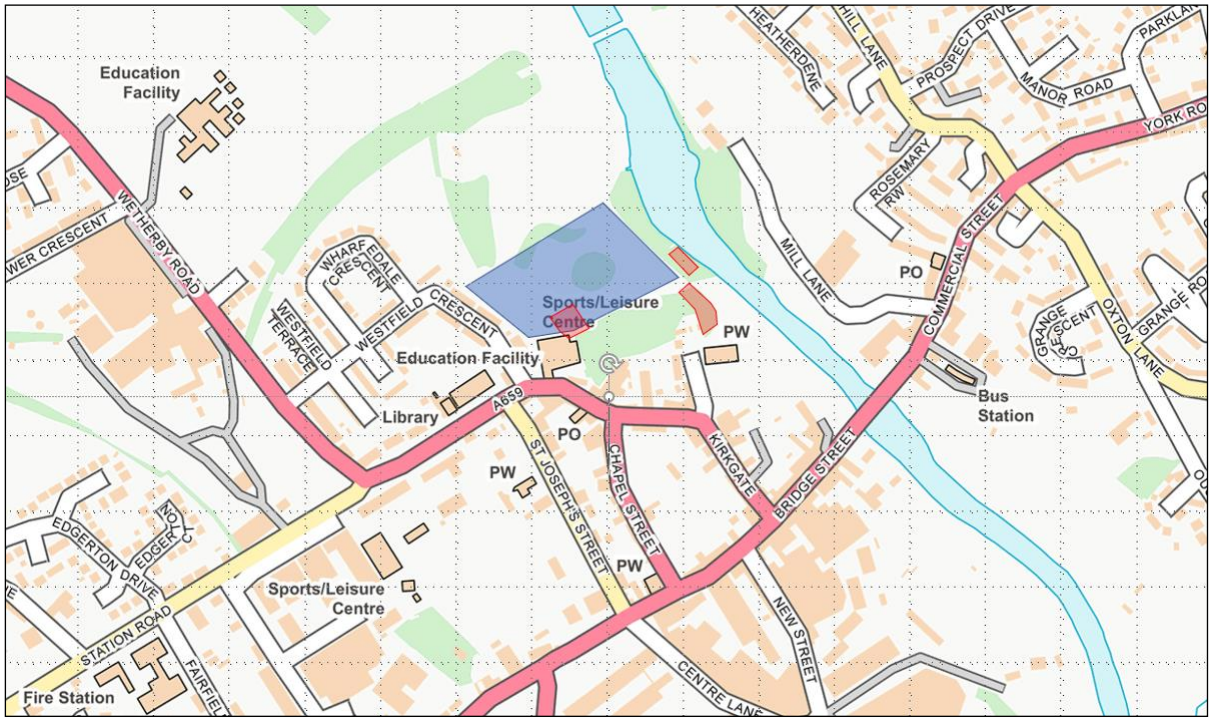

Figure 1: Position of gradiometer survey field (blue) in relation to Tadcaster. © Ordnance Survey, 2016.

Further geophysical surveys were carried out using a technique known as 'resistivity' in the three areas shaded red on the map. The first survey was carried out along the riverside taking in the area which was the subject of an archaeological dig in 2015, between the castle and the riverside path. A second area slightly north of the castle between the riverside path and the river embankment was also surveyed and a third survey in 'Applegarth' field adjacent to the swimming pool was carried out to overlap with the gradiometer survey.

Resistivity surveys measure the electrical resistance in the ground between a fixed point and a set of probes which are passed over the area being surveyed. This technique is particularly useful for detecting walls, masonry, rubble etc where these produce a high resistance. It can also detect ditches which may have a lower resistance than the natural subsoil into which they were dug.

As a general rule of thumb archaeologists will use a gradiometer for ditches and a resistance meter for structural features, however, both techniques can find both types of features if the conditions are favourable. As the gradiometer uses GPS to accurately measure its position, its use close to trees which can obscure the satellite signals can make this method impractical.

Historic England Scheduled Monument consent was obtained for the relevant areas of the surveys. Mr. Fielden of the Grimston Estate and the Town Council have very graciously allowed us to carry out these surveys on their land. Tadcaster Historical Society are very grateful for the expert supervision and involvement of James Lyall, geophysicist.

Background

The 2015 dig established that the motte is on the site of the Roman settlement of Calcaria. This was the site of a bridge carrying the Roman road from London to York over the Wharfe.

In Saxon times, a new river crossing was chosen at the site of the present bridge. The Saxon town centre moved south. Sometime in the Saxon or Viking period, a ditch and rampart was built around the town. This ran from the river just north of the motte, under the site of the swimming pool, along St. Joseph's Street and Centre Lane, re-joining the river near the football ground.

After the Norman invasion a motte and bailey was built which used this ditch as its northern boundary. The dig showed that the motte was probably surrounded by a ditch.

The mounds in Applegarth are not natural, but it is not known when these appeared. They could date from any time between pre-Roman times and the 17th Century. They could be burial barrows or spoil from gravel works. They remain one of Tadcaster's mysteries.

At some time in the 16th or 17th Century, part of the motte was removed, probably for river defence and to provide a path across the ditch. The site was subsequently used for the first Grammar School in 1557 and later for cottages that were demolished in the 20th Century.

The purpose of the surveys was multifold.

The site of the dig was surveyed as the dig had provided us with a lot of information about what was below and this was an opportunity to check the results of a resistivity survey against what we know of the underlying material. This site was not suitable for gradiometer survey because of the trees and the known quantities of iron material from the cottage demolition.

The riverbank survey was over the likely position of the ditch. It was hoped that the extent of the ditch may be visible in spite of the great depth of material deposited for flood alleviation.

The gradiometer survey of the field was conducted in the hope that a clue to the origin of the mounds could be found. The gradiometer would reveal any ditches surrounding them that have subsequently been filled in.

The resistivity survey in the field was to span the ditch. The presence of the iron fence precluded a successful gradiometer survey in the vicinity of the ditch.

Other Surveys:

In an attempt to understand the mounds in the field, a survey by drone was undertaken (Nov. 2018). The drone was used to photograph the area in considerable detail enabling the heights of all points in the field to be calculated.

The Environment Agency has carried out a series of Lidar ('LIght Detection And Ranging') surveys, again providing very accurate height information.

Both high resolution drone photography (figure 2) and LiDAR imagery (figure 3) of the site do not show any significant features which might indicate archaeological activity. However, as the site is close to known areas of archaeological interest, it was considered worthy of a more detailed study using gradiometry and resistivity which might show evidence of human activity.

We hope to be able to carry out a ground penetrating radar survey of the area covered by the first resistivity survey adjacent to the castle motte when the necessary equipment becomes available. This technique will give us the best chance of penetrating to a sufficient depth to detect possible Roman and early medieval levels.

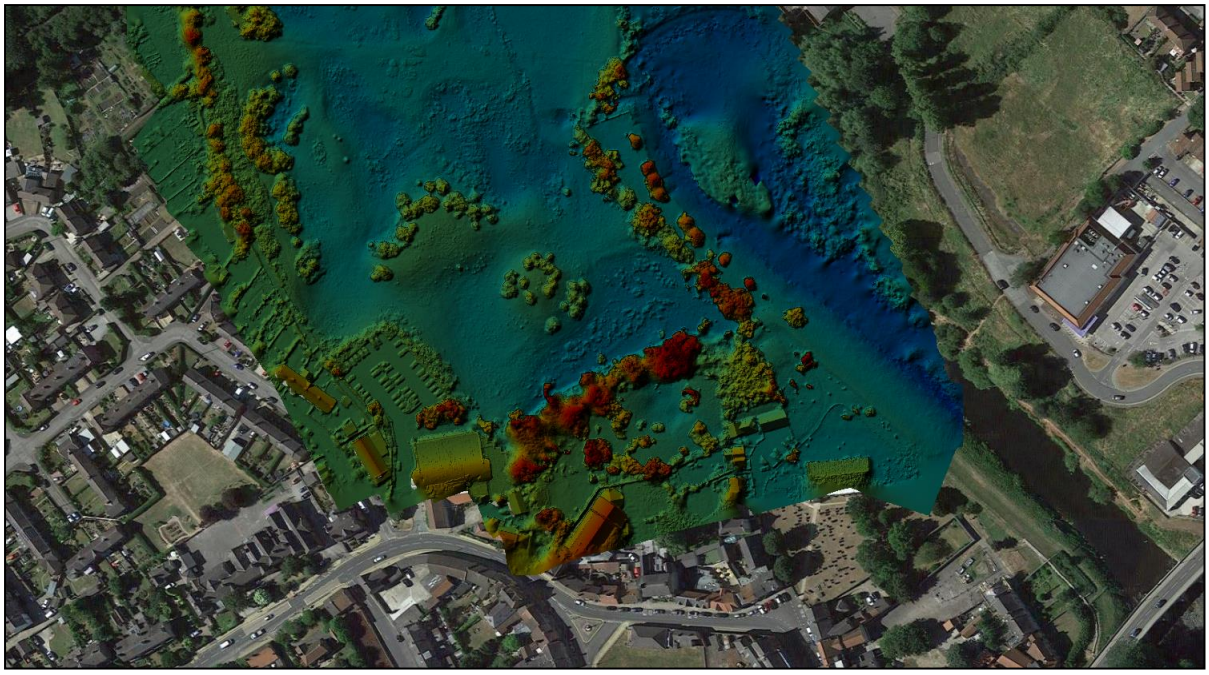

Figure 2. High resolution aerial photography (© Tony Hunt, 2018) superimposed on Google Maps satellite imagery of Tadcaster (© Google, 2018).

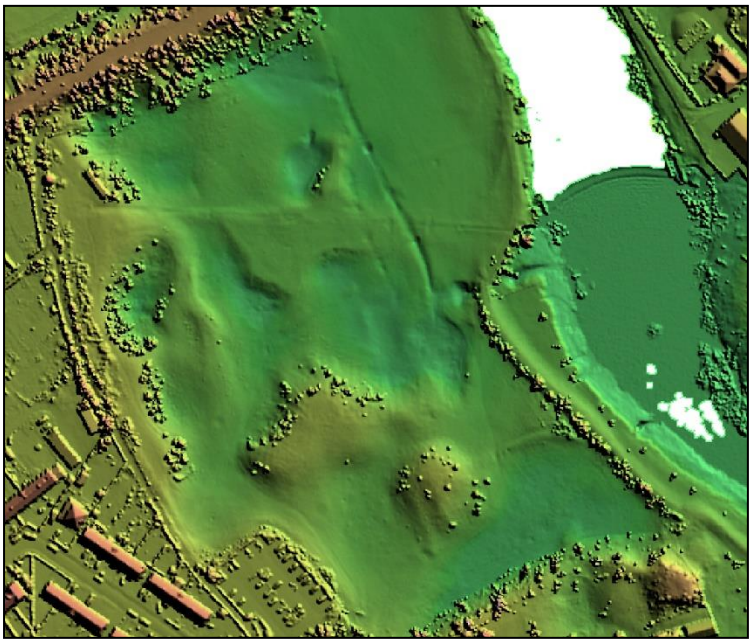

Figure 3. LiDAR image of site, Environment Agency DSM 50cm data. (Sun NE 30º Elevation).

Results

Figure 4 shows the data obtained by the survey and figure 5 shows the same data with our interpretation of what the gradiometer survey may show.

An immediately obvious feature is the black/white band running from the swimming pool area towards the river. This is almost certainly an iron pipe (or the remains of an iron pipe). This is not believed to be of modern origin, but may have come from the garage that used to be on the site of the swimming pool.

Other black and white dots probably are iron items that are buried on the site. These may be quite small but are found by the very sensitive equipment used.

There are a number of “holes” in the plot which are due to bushes which block access for the equipment.

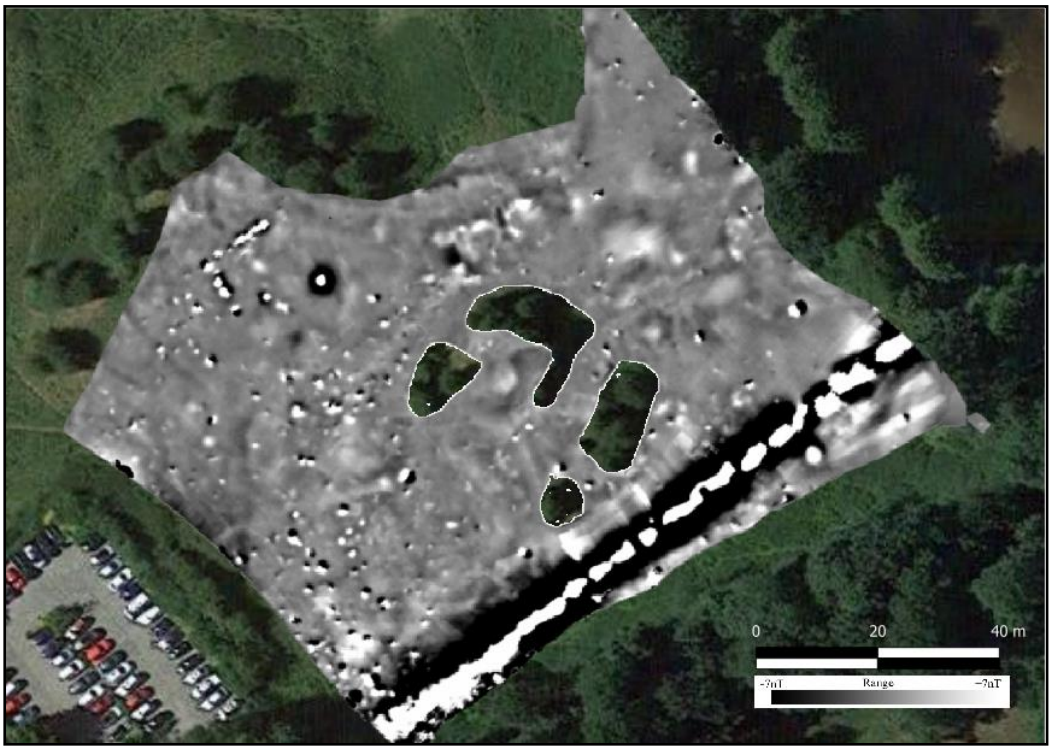

Figure 4. Gradiometer survey of site at 50cm resolution. (Map data © Google, 2018).

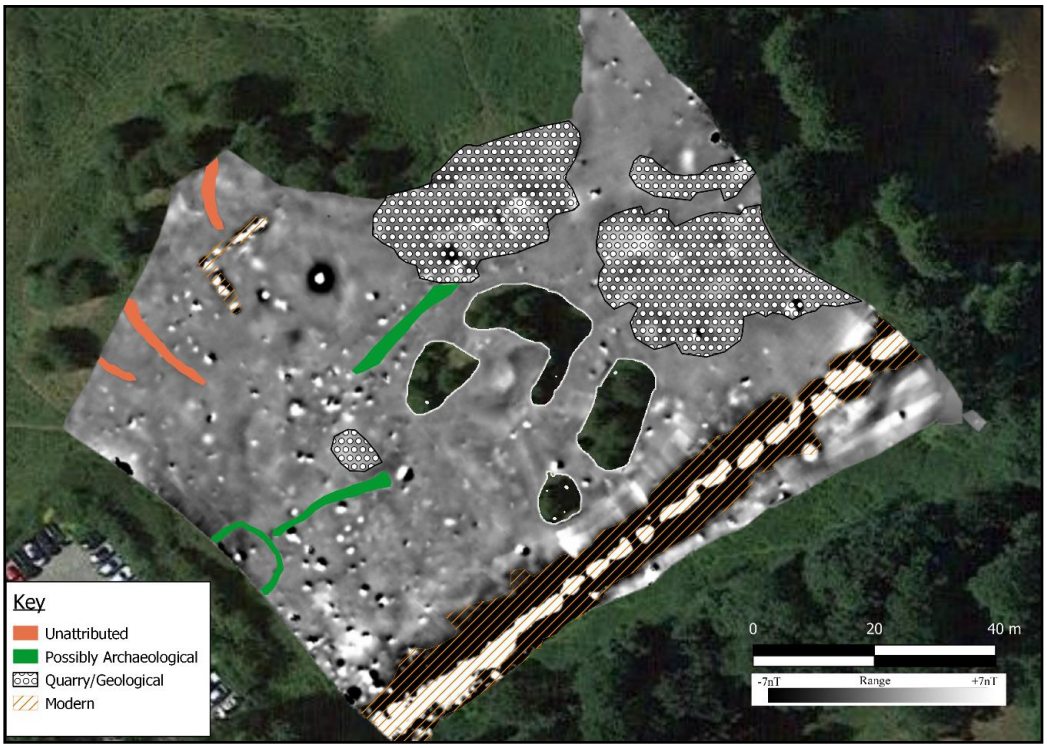

Figure 5. Possible Interpretation of gradiometer results. (Map data © Google, 2018).

Figure 6 shows the results obtained by the three resistivity surveys.

Figure 6. Results of resistivity surveys at the three locations. (Map data © Google, 2018).

Interpretation

Gradiometer survey: The most striking feature detected by the gradiometer survey is the very strong linear signal along the south east side of the surveyed area. This is highly likely to be a pipeline made of ferrous material. We were not aware of the presence of this pipe – it is likely to be pre mid-20th Century as modern pipelines are more usually laid using plastic. It has been suggested that it may relate to the garage that once stood on the site of the swimming pool. Unfortunately, the pipeline obscures what we hoped to be the moat/ditch of the castle bailey and renders it impossible to locate by this method.

There are several features which may be archaeological (fig. 5 in green) of which the most likely is the semi-circular feature on the south west side of the survey area. This might indicate domestic or agricultural activity and is on slightly raised ground which may have avoided flooding. The linear 'green' features may represent ditches although they do not seem to delineate any area and cannot be viewed as archaeological with much confidence.

The strong magnetic ‘L’ shaped feature in the north west section is likely to be a modern feature with high ferrous content, possibly buried agricultural/domestic debris.

The three bands of negative magnetic response in the north west section (fig. 5 in orange) cannot be confidently identified as archaeological and are most likely geological, they may indicate different stages of deposition of the mound which they flank.

The other features which cover a significant portion of the surveyed area are interpreted as quarrying or geological features which show disturbed magnetic responses but are unlikely to be archaeological due to their undefined nature.

Resistivity surveys: None of the three resistivity surveys show clearly defined archaeological features. In the area adjacent to the castle motte there are areas of high resistivity which can be attributed to demolition rubble from the cottages which were known to stand on the site into the 20th Century.

The riverside survey shows two areas of high resistivity but these do not extend to any great extent and certainly do not appear to be structural. They most likely represent buried items or possibly tree roots which have affected the resistance properties in that area.

The resistivity survey in the ‘Applegarth’ field again shows several areas of high resistance, none of which can be attributed to structural features although a wider survey of the area would provide more information. Most striking is the absence of any indication of the pipeline in this area. It appears that, although having strong magnetic properties, it did not affect the resistivity of the soil to any detectable extent. This may indicate that it is buried too deeply for the equipment to detect.

Conclusions

The gradiometer results do not show significant evidence of archaeological land use of a domestic or agricultural nature. However, the absence of such evidence does help in forming a view as to the origins of the mounds. There is evidence of quarrying or geological disturbance - possibly glacial deposition. There are several features which might yield useful information if subjected to excavation, particularly the semi-circular feature on the south west edge of the survey area.

Similarly, the resistivity survey was not able to show any features other than the rubble known to occupy the area adjacent to the castle. The other two areas surveyed did not show any features which could confidently be identified as being archaeological.

The gradiometer and resistivity surveys were carried out while we await the availability of ground penetrating radar equipment which can penetrate the ground to a much greater depth and is certainly the technique most likely to provide evidence of archaeological features adjacent to the castle and along the riverside.

It is probable that the land along the riverside has been substantially built up over the centuries for the purposes of flood defence. The ancient ground level is more likely to be represented by the lower ground in Applegarth field which is substantially lower than the riverside embankment especially in the area adjacent to the castle site.

Using the two techniques of magnetometry and resistivity, we cannot see any strong candidates for further investigation (other than the semi-circular feature in the Applegarth). We hope that the proposed ground penetrating radar survey along the riverside and in the churchyard may provide the best chance of detecting archaeology in this key area of ancient Tadcaster.

Richard Gibson/John Firth/James Lyall