Lympsham Archaeological Group (LAGS)

Riverside, Eastertown Lympsham - Geoff Janes

Caesium Gradiometer Survey – 15th August 2011

Introduction

This site was introduced to the LAGS team when extension to the pond in the field named Garston at Riverside revealed buried walls and Roman potsherds (Mainly Congresbury Greyware, some potsherds of black burnished ware, and possible Samian ware – all manufactures in the second to early fifth centuries).

Resistivity survey over the locations where walls had been detected seemed to show little more than the location of grypes in the field, and one ridge identified as possibly a ploughing baulk. It was suspected that the resistivity method of geophysical survey could not 'see' far enough into the ground, as the limit of resistivity is a depth of 0.8 to 1.2 m.

It was decided to see if the University of Bristol's Caesium Gradiometer G-858 Magmapper would be able to detect archaeology (or at least ground disturbance) to a greater depth, as the extreme sensitivity of this technique is capable of reading to depths claimed by the manufacturer to be in excess of 5m.

Location

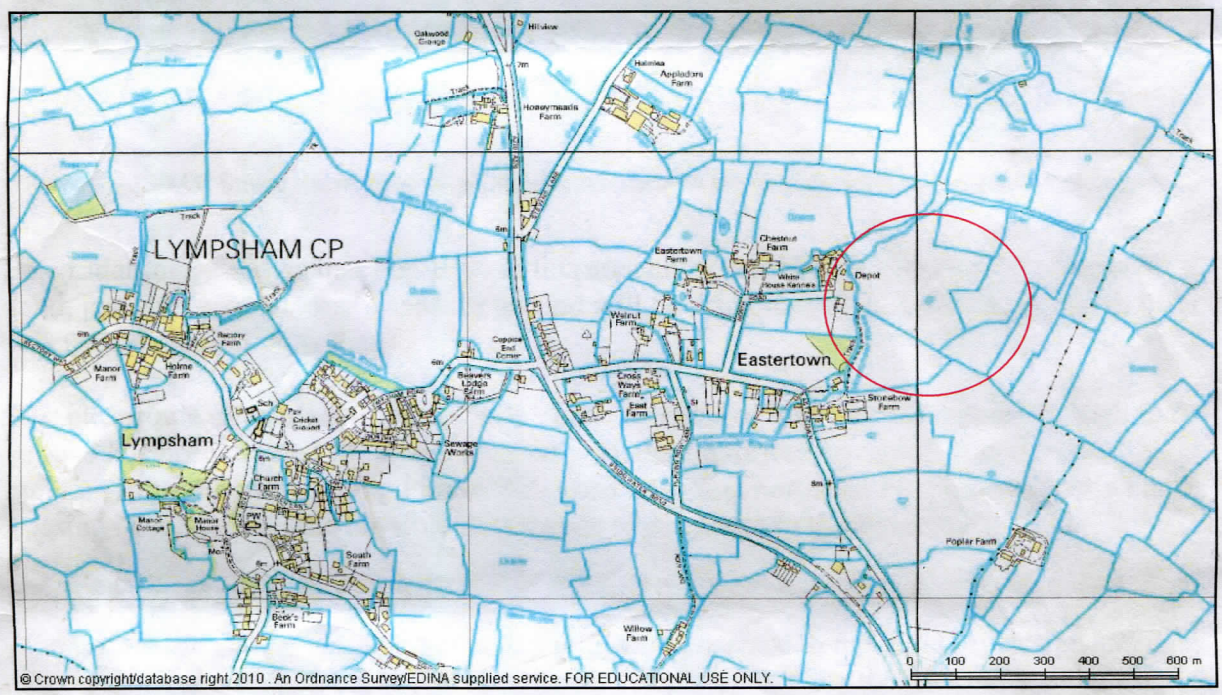

Figure 1 – Location Map

The field outlined in red, is alongside a major rhyne that is suspected to be former watercourse draining the area east of Brent Knoll to the river Parrett, probably navigable in the past for much of its length. For example, there was a windmill on this watercourse in Eastertown in Medieval and post-Medieval times.

Lidar

A detailed topographic survey using LiDAR, purchased from the Environment Agency shows a probable palaeo-channel, probably a navigable watercourse on a branch of the River Axe into this area.

Figure 2 – LiDAR image showing in detail small variations in the ground level in the area of riverside.

The Lidar image shows that buildings in this area cluster on the marginally higher areas of land, just above the moors, where the ground will be drier, and as 'islands' in the marsh offer a better foundation.

The clear route of a palaeo-channel, still visible as areas of lower ground level although the ground has been drained for a very long time, suggest a former navigable watercourse running from the south (along Purvin Row) and swinging northeast Past Mary Roper's Farm, passing Riverside and the possible Roman site to discharge to the River Axe.

Caesium Magnetometry

The Geomatrix G-858 MagMapper uses a graphical interface to make survey design and data acquisition quick and efficient. Various modes of operation allow the user to custom design a survey grid for their particular needs. The specification for the instrument is attached as Appendix 2.

The system is dependent upon 'optically pumping' atoms of alkali vapour. It is known that if a magnetic field is applied to a vapour then the valence electrons in the atoms are raised to a higher quantum state. The separation of the energy levels is dependent on the total intensity of the surrounding magnetic field. This influences the absorption of light from a source of the same material as the vapour. In this system Caesium is the alkali of choice as it has only a

single isotope and requires little energy to vaporise the element. Absorption occurs in the material as the exited electrons precess about the magnetic field in a specified frequency. In the case of Caesium this is about 175kHz. In practice an external field is applied to raise the electrons to this precession state and the intensity of the absorbed light is modulated at the frequency of the precession (Gaffney and Gator 2004, 42).

In simplicity, the equipment reads a series of lines of magnetic response to sensitivity of the order of 0.1 nanotessla. If surveyed in correctly, the MagMapper software provided with the equipment permits these lines to be joined to form a 2D map, the operator being able to specify the location of every reading taken. In the absence of a dedicated GPS total station, the optimum method of operation is to use the equipment in the 'Simple Survey' mode.

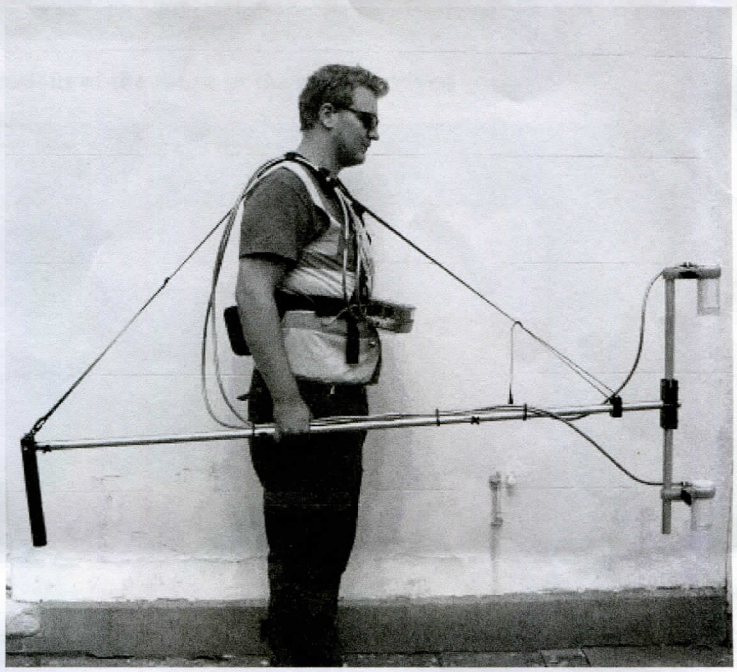

Figure 3– Andy Bell models the equipment set up to operate as a Caesium Gradiometer.

Results

The results from the survey can be displayed on a not-to-scale image within the Magmapper software, and the results can be displayed as colour rendered images. It is important to note –

- Green is the colour of the natural background of the earth's magnetic field
- Blue shows areas where the magnetic field is less than the average
- Red shows the areas where the magnetic field is more than the average.

In general terms, either blue or red indicates areas where the ground has been disturbed, by activities such as fires, digging of ditches, some types of buried building materials, or buried magnetic metals (such as tractor parts etc.).

It must be understood that gradiometer geophysics merely indicates locations where the ground has been disturbed, or where there have been fires. It is probable, but not certain, that these are due to the agency of man. Excavation is needed to be absolutely certain, and to obtain dating material.

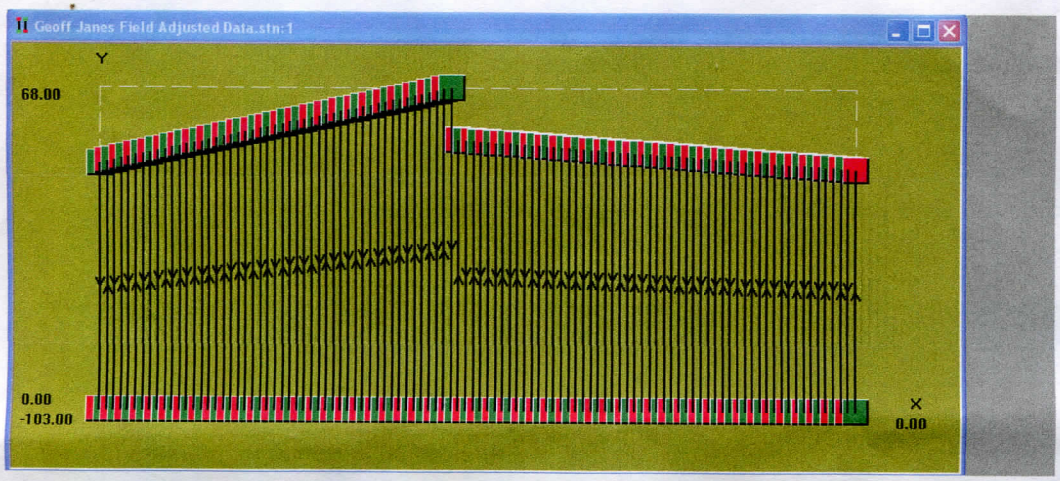

Figure 4 – Plan plot of survey lines with dimensions of the shape of the area surveyed

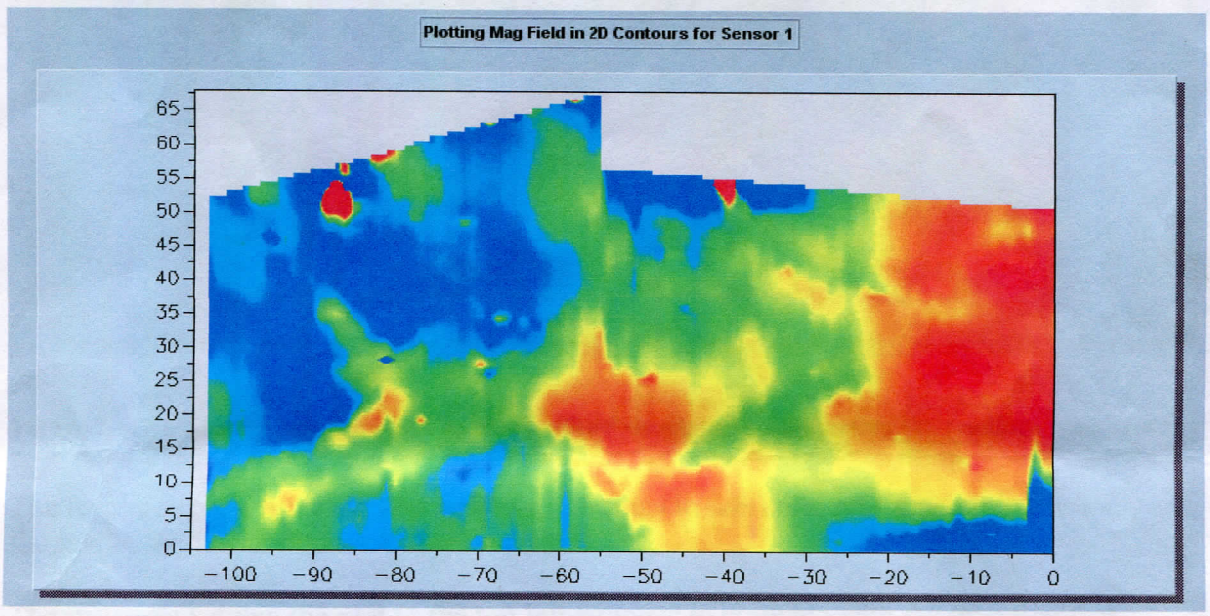

Figure 5 – MagMap Plot of results as Magnetometer from Sensor 1

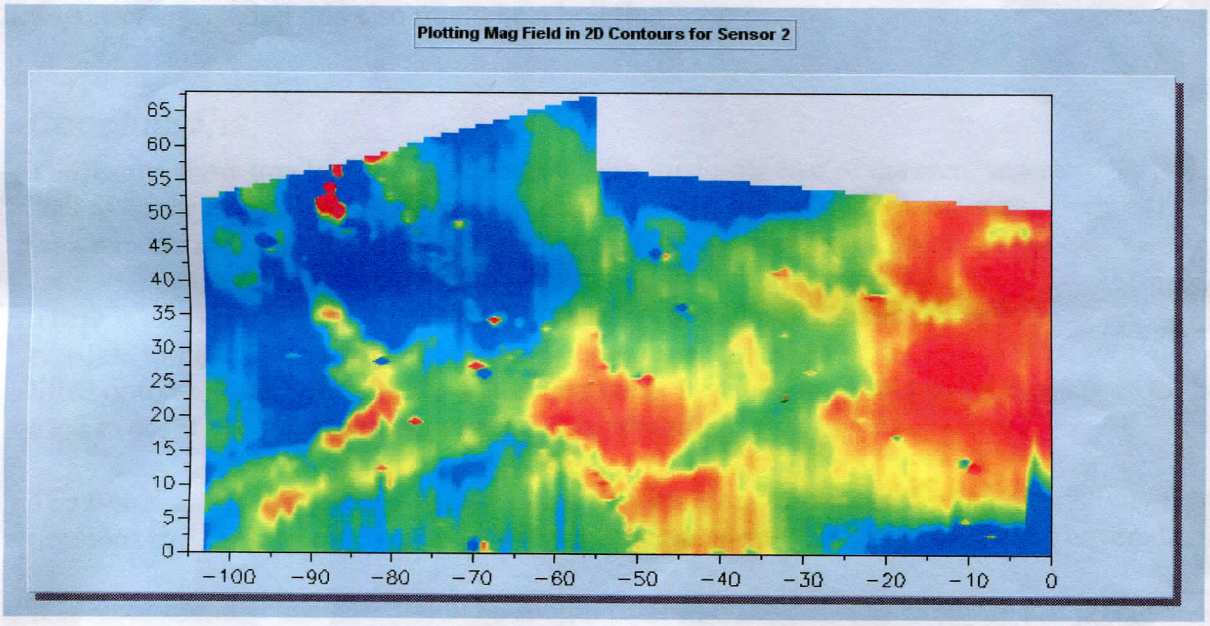

Figure 6 – MagMap Plot of results as Magnetometer from Sensor 2

The sensitivity of the method can be increased by looking at the difference between the two sensors, where the sensor farthest from the ground will be less affected by any buried features than the sensor nearest the ground.

This gives a pattern of readings that shows underground activity, but now the colours have less significance than the shapes and forms of the image.

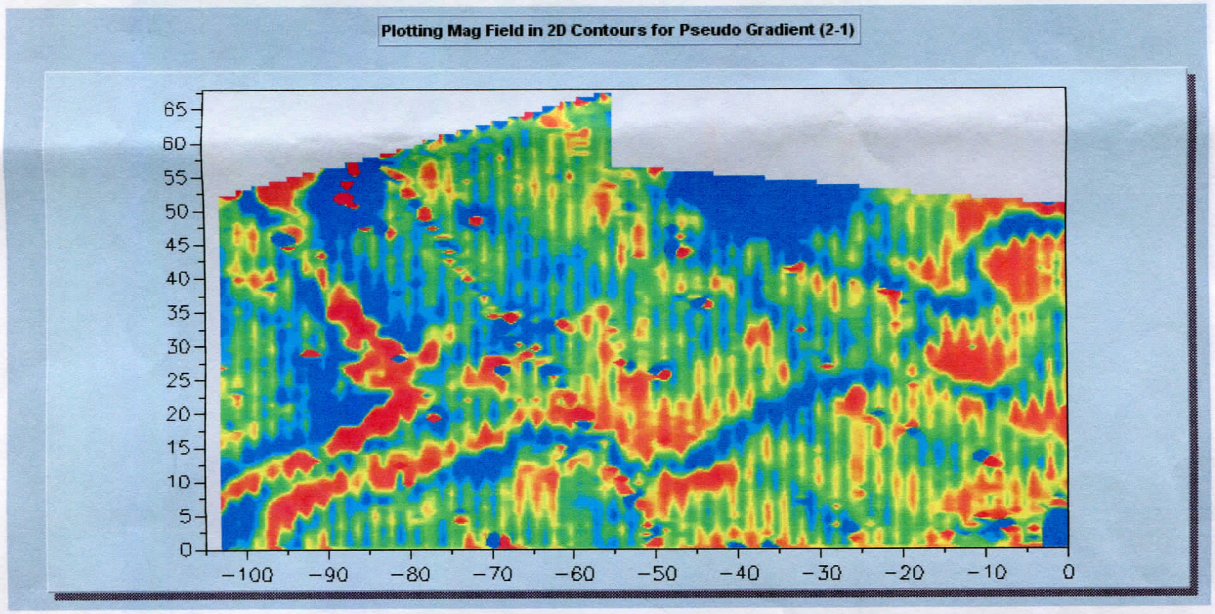

Figure 7 – Gradiometer survey, the 'Pseudo-gradient' developed by deducting the readings from sensor 1 from those of sensor 2.

The results suggest there are two possible buildings in this area, plus a possible trackway flanked by walls and ditches.

The trackway leaving the plot to the top left happens to coincide with the wall that was visible where it extended into the pond when it was being excavated. The central disturbed area has yielded Roman potsherds, while the right area also returned higher resistivity responses suggesting this also might be a building.

Conclusions

The results show tow large areas of intense activity, to the east of the area, and centrally, as well as linear features suspected to be a trackway bounded by ditches and walls – one of which to the northeast of the plot meets the pond where a wall was found during excavation.

There is one very high response near the edge of the pond, in an area where it has been possible to pick Roman potsherds from the surface of the pond. This may well be something lifted onto the bank when the pond was extended. It is recommended that a metal detector be used to see if this high response target can be identified.

The two areas of significant response coincide with areas of increased ground resistivity from previous surveys, and may well be areas where some former activities have been covered up.

It is recommended that permission be sought from the landowner to excavate test pits over this area to find out what might be here, and obtain dating materials.

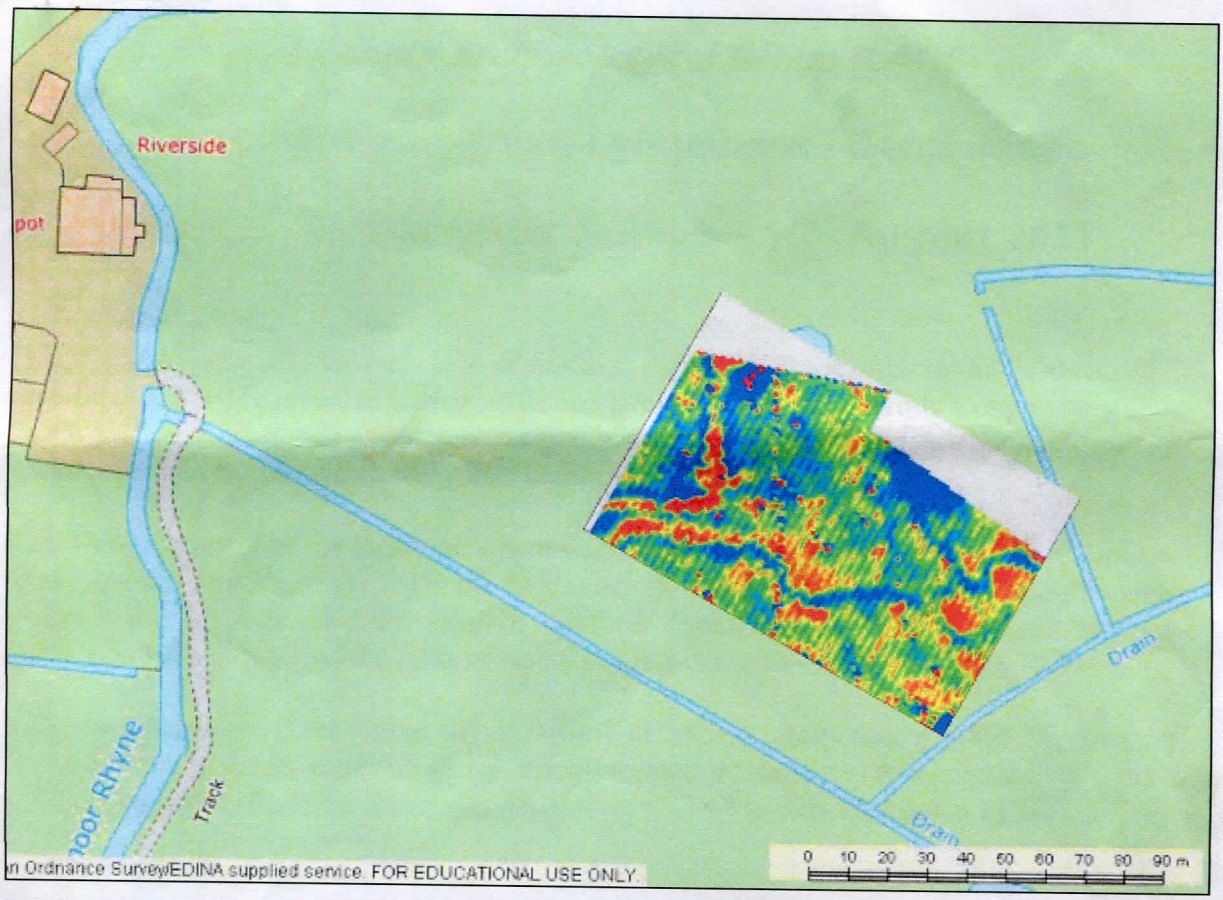

Figure 8 – Approximate overlay of results on the Ordnance Survey map of the Riverside site.

Subject to the results, this are might warrant more intense research to determine the type and extent of use of this area, and if there is any evidence of maritime activiy.

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August 2011