

A Gradiometer Survey of Donnington Recreation Ground, Iffley, Oxford

For The East Oxford Archaeology and History Project



Olaf Bayer April 2014

1. **Summary Of Results.**

The East Oxford Archaeology and History Project conducted 1.8 hectares of gradiometer survey and smaller areas of detailed gradiometer and earth resistance survey on Donnington Recreation Ground, Iffley in 2012 and 2013. The survey was the most successful of all of the geophysical surveys carried out as part of the ARCHEOX project. Examination of archaeological records as well as cartographic and other geospatial data sets correctly identified the survey area as being both relatively undisturbed and as having a high archaeological potential. The survey identified a possible Neolithic pit circle (feature A), which was later tested by [excavation](#). A large number of other probable and possible archaeological features were also identified in the survey results, several of which may also be prehistoric in date. Two linear features are thought to be removed post-medieval field boundaries.

2. **Introduction.**

2.1 Background.

The survey was carried out as one of a number of geophysical surveys undertaken by the East Oxford Archaeology and History Project or ARCHEOX. ARCHEOX is a community archaeology project hosted by Oxford University's Department for Continuing Education, and funded by the Heritage Lottery Fund and Oxford University's John Fell Fund. The site was chosen as it was considered to be of high archaeological potential due to its proximity to known archaeological finds of prehistoric, Roman and Saxon date. It also represents one of the largest undisturbed areas of gravel terrace within the Archeox study area.

2.2 Survey Aims

The survey was carried out with 2 principle aims:

- To locate and map subsurface archaeological features in one of the largest green spaces in East Oxford
- To train project volunteers in gradiometer survey techniques

2.3 Survey area location and description

Owned by Oxford City Council, Donnington Recreation Ground is an area of level, mown grass, partially covered by a football pitch and approximately 2.6ha in extent. It is bounded to the north by the Boundary Brook, to the east by Cavell Road, to the south by disused playing fields belonging to the former St Augustine's secondary school, and to the west by Meadow Lane. Topographically it is situated at between 56 and 57.5m OD on the southern side of the floor of the shallow valley of the Boundary Brook, close to its confluence with the river Thames (see figures 1 and 2). It lies immediately to the south of the present day line of the brook. Solid geology comprises late Jurassic mudstones of the West Walton Formation, overlain locally by Quaternary sands and gravels from the first terrace of the river Thames/Boundary Brook (Northmoor Member).

2.4 Survey area history and archaeological potential

No previous archaeological research has been carried out on Donnington Recreation Ground prior to the geophysical surveys undertaken by the ARCHEOX Project in 2012/13. The survey area is at the northern end of Iffley parish approximately 500m from the historic core of the village. Whilst there is no archaeological evidence from the recreation ground itself, evidence of activity from

most periods between the middle Palaeolithic and the Post-Medieval period has been found within a 500m radius of the site. This includes:

- *Palaeolithic*
A significant assemblage of Mid-Palaeolithic lithic artefacts was recovered in the late 19th/early 20th century from a gravel quarry thought to be approximately 250m to the north of the recreation ground close to the junction of Donnington Bridge Road and Arnold Road (Oxford City Council 2011a, 8-9; Nicholas and Hicks 2013, 289-92).
- *Mesolithic, Neolithic and Early Bronze Age*
A large assemblage of Mesolithic, Neolithic and Early Bronze Age lithic artefacts was recovered in the late 19th/early 20th century from what were then open fields, approximately 500m to the north of the recreation ground, close to Fairacres Convent (Oxford City Council 2011a, 12-13; Oxford City Council 2011b, 21; Nicholas and Hicks 2013, 292; Case 1952, 11; Holgate 1988, 210-11 & 247-53).
- *Bronze Age*
A Late Bronze Age urn, possibly a Collared Urn, was found near Donnington Bridge Road, Iffley in the early 20th century (Oxford City Council 2011b, 20).
- *Iron Age and Roman*
There is little evidence of Iron Age activity in the immediate area of the site (Oxford City Council 2011c). A single Roman pottery find is indicated close to the eastern end of Donnington Bridge, approximately 250m northwest of the site (Oxford City Council 2011d, 55). The postulated line of a potential east/west running Roman road is plotted immediately to the south of the site (Oxford City Council 2011d, 27&51).
- *Saxon/Viking*
There is little evidence of Saxon/Viking activity in the immediate area of the site, the only exception being an early Saxon brooch from Iffley Turn 3-400m to the east and south-east (Oxford City Council 2011e, 31).
- *Norman/Medieval*
There is little evidence of Norman, Medieval or Post Medieval activity in the immediate area of the site (Oxford City Council 2011f, 2011g, 2011h).
- *Post-Medieval-Modern*
Historic mapping of the area suggests that the footprint of Donnington Recreation Ground has remained relatively unaltered between the 1830s and the present day (see figure 4). The only alterations being the removal of two north/south boundaries in the late 1930s/early 1940s which had previously divided the area into three smaller fields. The chequered appearance of the area on a 1945 aerial photograph suggests that the area may have been used as allotments during WW2 (see figure 5).

2.5 Site selection

The survey area was selected as it was thought to have a high potential for surviving archaeological features. This was determined partly through background research (see section 2.4 above) and partly through an examination of geological and topographic data (see figures 2 and 3). Archaeological research on the gravel terraces associated with the Thames and its tributaries have produced a wealth of sites and finds of all periods (for example, Morgi *et al.* 2011, Lambrick *et al.* 2009, Booth *et al.* 2007). The recreation ground represents one of the largest undeveloped and undisturbed areas of river terrace within the ARCHEOX project area. As can be seen in figures 2 and 3 the open area to the west of the survey area between Meadow Lane and the Thames has been substantially altered by rubbish dumping in the early 20th century. An initial inspection of the site, later confirmed by LiDAR data (see figure 3), showed that the level of the abandoned playing fields immediately to the south of the survey area had also been substantially altered.

3. Methodology

3.1 Date of fieldwork

Fieldwork was carried out in two blocks. The first in June 2012 consisted of 1.83ha of 'real time' gradiometer survey. The second in June 2013 consisted of 0.04ha of 'static point' gradiometer survey and 0.09 of earth resistance survey.

3.2 Grid Location

The location of the survey is shown in figure 6. The survey was based on a series of 30x30m grids. Survey grids were established in the field using a Leica Smart Rover RTK GPS to within +/- 0.01m of the Ordnance Survey National Grid. The coordinates for the survey grid pegs are given in appendix 1. Figure 6 also shows the relative location of each of the survey techniques set out in section 3.3 below.

3.3 Methodological sequence and rationale

1. 'Real time' gradiometer survey was the first methodology to be used and was applied to all of the current survey area. It is the standard geophysical survey data collection technique used by the project and by almost all other commercial and research surveys. This is principally a prospection technique which allows the rapid collection of reasonable quality survey data over large areas. The methodology uses the gradiometer's integral sample trigger to take readings at regular time intervals along a survey traverse. A combination of adjusting the frequency of the sample trigger's readings and the surveyor altering their pace ensures that data is collected at regularly spaced intervals along each walked survey traverse. The disadvantage of this technique is that even experienced surveyors will fail to consistently match their walking pace to the speed of the sample trigger. This results in a slight spatial displacement of survey data. This spatial error is normally processed out of the survey data using the 'destagger' or 'stretch' feature of the processing software. Whilst this has the effect of producing visually pleasing survey results it also slightly degrades their quality and resolution.
2. 'Static point' gradiometer data was the second methodology to be applied

and was used to add further detail to a single group of magnetic anomalies identified by *'real time'* collection. This technique bypasses the gradiometer's automated sample trigger. Instead of collecting streams of data in walked traverses, the surveyor stops at measured intervals along the survey traverse, and whilst stationary, manually triggers each reading. This removes the need for the spatial processing of survey data and produces much more detailed survey images. However, this methodology is very time consuming and as a result is only practical for elucidating previously identified survey targets.

3. *'Earth resistance'* survey was the final technique to be applied in the survey area. It was used in the same area as *'static point'* gradiometer survey to further characterise anomalies first identified by the *'real time'* gradiometer survey. Rather than measuring variations in the earth's magnetic field, earth resistance survey instead measures variations in soil moisture content caused by sub-surface features. Earth resistance survey is a much slower technique than *'real time'* gradiometry. In this instance it was used as a complementary technique to further refine the morphology of anomalies detected by the *'real time'* and *'static point'* surveys.

3.4 Survey Configuration

Date of survey	June 2012
Grid size	30x30m
Area of survey	1.83ha
Traverse direction	North/south
Traverse separation	1m
Reading interval	0.25m
Instrument type	Fluxgate gradiometer
Instrument model	Bartington Instruments Grad 601 (2)
Sensor element separation	1m
Number of sensors	2
Sensor separation	1m
Sample range	1nT
Processing software	TerraSurveyor Version 3.0.23.0
Processes	<ol style="list-style-type: none"> 1. DeStripe Median Traverse: Grids: All Threshold: 2 SDs 2. DeStripe Median Traverse: Grids: All Threshold: 2 SDs (vertical) 3. De Stagger: Grids: All Mode: Both By: -2 intervals 4. Interpolate: X Doubled. 5. Clip at 1.00 SD 6. Clip at 1.00 SD 7. Clip at 2.00 SD

Table 1. Real time gradiometer survey configuration

Date of survey	07/06/2013
Grid size	20x20m
Area of survey	0.04ha
Traverse direction	N/S
Traverse separation	1m
Reading interval	0.25m
Instrument type	Fluxgate gradiometer
Instrument model	Bartington Instruments Grad 601 (2)
Sensor element separation	1m
Number of sensors	2
Sensor separation	1m
Sample range	1nT
Processing software	TerraSurveyor Version 3.0.23.0
Processes	<ol style="list-style-type: none"> 1. DeStripe Median Traverse: Grids: All Threshold: 2 SDs 2. Clip at 1.00 SD 3. Clip from -3.00 to 3.00 nT

Table 2. Static point gradiometer survey configuration

Date of survey	07/06/2013
Grid size	30x30m
Area of survey	0.09ha
Traverse direction	N/S
Traverse separation	1m
Reading interval	0.25
Instrument type	Earth Resistance Meter
Instrument model	Geoscan RM15
Sensor element separation	N/A
Number of sensors	2
Sensor separation	1m
Sample range	ohm
Processing software	TerraSurveyor Version 3.0.23.0
Processes	<ol style="list-style-type: none"> 1. Interpolate: X Doubled. 2. Interpolate: Y Doubled. 3. Clip at 1.00 SD 4. Clip from 25.00 to 28.00 Ohm

Table 3. Earth resistance survey configuration

3.5 Data collection and volunteers

One of the main reasons for undertaking the survey was to train a group of volunteers in geophysical survey techniques. As a result survey data was collected by a number of individuals, both project staff and volunteers, with a wide range of experience in geophysical survey. To ensure high standards of data collection the collection speed of the gradiometer was varied to suit the pace of each individual, and data was collected along beaded traverse lines. The instrument was re-zeroed between users, and all data was collected under the close supervision of project staff. Each new operator was scanned prior to using the gradiometer to maintain a consistently high level of magnetic hygiene. The location, traverse configuration and name of operator were recorded in the field for each grid surveyed. When necessary grids affected by poor data collection or poor magnetic hygiene were

recollected.

3.6 Processing and presentation of results.

Survey data was downloaded to a laptop computer, roughly processed and checked for operator error on site. Data was then backed up to a networked desktop computer at the end of each day. Data was downloaded, assembled and processed using TerraSurveyor Version 3.0.23.0. Full processing of the data was undertaken on completion of the survey using the clip, despike, destagger and interpolate processes in TerraSurveyor. Once processed data was exported to ArcGIS 10.2 as a georeferenced ASCII file and combined with other datasets for presentation

3.7 Interpretation

Unprocessed data is shown in figure 7 (greyscale image) and in figure 8 (stacked trace). Processed data is shown in figure 9 (greyscale image). Once processed magnetic anomalies were digitised and assigned to one of the following nine interpretative categories (see figures 10-12).

1. **Archaeology:** Magnetic anomalies considered to be definitely archaeological in origin on either morphological grounds or correlation with features shown on historic mapping. Shown in dark blue in figures 10-12.
2. **Probable archaeology:** Magnetic anomalies considered on morphological grounds to be probably archaeological in origin (less certain than 'archaeology' but with a higher degree of certainty than 'possible archaeology'). Shown in mid blue in figures 10-12.
3. **Possible archaeology:** Magnetic anomalies considered on morphological grounds to be possibly archaeological in origin (less certain than 'probable archaeology'). Shown in light blue in figures 10-12.
4. **Archaeological trend:** linear trend in the survey data thought to be archaeological in origin. Shown as dark blue lines in figures 10-12.
5. **Geological trend:** diffuse arcing magnetic trends towards the western end of the survey area considered to be natural banding within the terrace deposits. Shown as dark blue hatching in figures 10-12.
6. **Land drain:** A series of parallel straight negative magnetic anomalies running approximately east/west across the survey area and thought to be caused by recent land drains. Shown as pale green lines in figures 10-12.
7. **Ferrous item:** extremely strong magnetic anomalies, either discrete (caused by a single ferrous item) or linear (caused by ferrous services - e.g. pipes/cables - and fencing). Shown in orange in figures 10-12.
8. **Magnetic disturbance:** areas of magnetic disturbance surrounding extremely magnetic anomalies. Shown in yellow in figures 10-12.
9. **Made ground:** An irregular area of strong magnetic anomalies in the central and south-east of the survey area thought caused by material introduced to consolidate the southern end of the football pitch. Shown as an area of light green hatching in figure 10-12.

Anomalies of particular interest have been assigned identifying letters and are discussed at greater length in section 4 below and illustrated on figure 11.

4. Results

4.1 Ferrous anomalies, magnetic disturbance and made ground

The detection of subtle magnetic anomalies caused by sub-surface archaeological features is made difficult across much of the survey area by magnetic interference from ferrous items including services, fencing and smaller objects, as well as areas of made ground masked by introduced material. However, Donnington Recreation Ground is unusual amongst other ARCHEOX gradiometer surveys in that significant areas are relatively unaffected by such 'back ground' noise. Although still covered by a scatter of smaller highly magnetic anomalies, parts of the south-western, central and north-eastern areas of the survey offer windows of relative clarity into the pre-twentieth century landscape.

4.2 Archaeological features

A small number of archaeological features were confidently identified in the survey area (see figure 11):

- A. Feature A is a sub-circular anomaly towards the western end of the survey area (see figures 9, 10 and 11). This penannular anomaly measures approximately 10m in diameter and encloses an area slightly over 5.5m in diameter. The feature consists of a ring of six sub-circular positive magnetic anomalies, each approximately 2 to 2.5m in diameter, with an apparent gap in its south eastern side. This feature was the focus for targeted areas of static point gradiometer and earth resistance survey (see figures 13, 14 and 15). Static point gradiometry added greater clarity to the morphology of these anomalies. Each of these six magnetic anomalies correlate with areas of higher resistance shown in the earth resistance survey plot (see figure 14). On the basis of the morphology of this feature shown in the combined survey results it is suggested that it is a pit circle of potential Neolithic date. Although smaller in size, it is morphologically similar to site IV excavated by Atkinson (1951) at Dorchester on Thames. Part of feature A was excavated in October 2013. The results of this excavation including a comparison between excavated finds/features, and geophysical survey anomalies is included in the [excavation report](#).
- B. Feature B is a linear anomaly running approximately north/south and measuring 60m long by 2m wide in the eastern area of the survey. Although not shown on historic mapping (see figure 4) this feature runs parallel with the historic field system and is thought to represent a removed post-medieval field boundary.

4.3 Probable archaeological features

A series of probable archaeological features labelled C-I are shown in figure 11.

- C. Linear anomaly C measures approximately 11m long by 3m wide in the central area of the survey. It has a strong positive magnetic signature but

does not contain any ferrous material. It is paralleled by a weaker possible archaeological feature of similar morphology 6m to the east. Anomaly C is very different in character to other features identified during the survey. It is suggested as being probably archaeological in origin but of unknown date. However, its location on the western edge of an area of apparent made ground means that it could be 20th century in origin and its interpretation as probable archaeology should be treated with a degree of caution.

D-G. Features D to G are small clusters of anomalies similar in morphology, extent and magnetic strength to feature A. They are suggested as probable archaeological features possibly of prehistoric date.

H. Feature H is a narrow curvilinear anomaly which stands out against the prevailing trend of features in this area. No date is suggested for this anomaly.

I. Feature I is a sub-circular anomaly approximately 3m in diameter. This is suggested as a probable pit.

4.4 Possible archaeological features

A series of magnetic anomalies considered to be possible pit and ditch features are shown in pale blue in figure 11.

4.5 Archaeological trends

Two trends in the survey data J and K are picked out in figure 11.

J. Trend J is likely to represent the traces of the western most of two removed field boundaries shown as extant features on historical mapping between the 1830s and 1930s (see figures 4 and 12), and faintly visible on a 1945 aerial photograph (see figure 5). If this interpretation is correct this feature appears to be approximately 12m to the east of its location as shown on historic mapping and not as previously thought cutting across feature A. Several discrete anomalies along this trend suggest that this boundary may have been fenced rather than hedged.

K. Trend K towards the eastern side of the survey is wide (3-4m) and diffuse in nature. It appears to predate the parallel pattern of land drains and is suggested too to be mid-20th century or earlier in origin. It does not mirror the orientation or location of any field boundaries shown on historic mapping.

Despite the comparative lack of highly magnetic background noise when compared to other surveys, the Donnington site is far from 'magnetically clean'. Localised areas of highly magnetic readings, combined with the magnetically variable nature of the underlying terrace deposits, and possibly numerous weakly magnetic archaeological features, presents considerable problems when attempting to interpret the survey data. Therefore the 'probable' and to a lesser extent the 'possible' classes of archaeological anomaly outlined below are likely to be an under representation of archaeological features within the survey area.

5. **Discussion.**

The Donnington Recreation Ground survey has been the most successful of all of the geophysical surveys carried out as part of the ARCHEOX project. Examination of archaeological records as well as cartographic and other geospatial data sets

correctly identified the survey area as being both relatively undisturbed and as having a high archaeological potential. Three different survey techniques were utilised as part of this survey. An initial 'real time' gradiometer survey was carried out across the entire study area. Subsequently a targeted area of 'static point' gradiometry and earth resistance survey were used to clarify the morphology of a specific group of features. The survey identified a possible Neolithic pit circle (feature A), which was later tested by [excavation](#). A large number of other probable and possible archaeological features are also identified in the survey results. Several of these features (D-G), although less clearly defined, are similar in size and shape to feature A, suggesting that prehistoric and later activity may be more widely distributed across the survey area. Two linear features (B and J) are thought to be removed post-medieval field boundaries.

Unlike many other of the ARCHEOX gradiometer surveys Donnington Recreation Ground contains significant areas which are relatively unaffected by magnetic background noise caused by ferrous features and structures. As a result it has been possible to identify a large number of potential archaeological features with varying degrees of certainty. However, the survey area is not 'magnetically clean' and as such the survey results are far from conclusive. Should further archaeological investigation or other intrusive works be undertaken in the survey area it is recommended to reanalyse targeted areas of the current survey data to reveal and define unidentified features. In a suburban area with such high levels of background magnetic noise it is suggested that targeted earth resistance survey might be useful to further elucidate some of the anomalies that are currently identified by magnetic data alone.

References

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8. Acknowledgements

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Appendix 1. Survey grid peg coordinates

Point ID	East	North
D1	452710	204220
D2	452710	204250
D3	452710	204280
D4	452740	204310
D5	452740	204280
D6	452740	204250
D7	452740	204220
D8	452740	204190
D9	452770	204220
D10	452770	204250
D11	452770	204280
D12	452770	204310
D13	452770	204340
D14	452800	204340
D15	452800	204310
D16	452800	204280
D17	452800	204250
D18	452800	204220
D19	452830	204250
D20	452830	204280
D21	452830	204310
D22	452830	204340
D23	452860	204340
D24	452860	204310
D25	452860	204280
D26	452860	204250
D27	452860	204250
D28	452890	204280
D29	452890	204310
D30	452890	204340
D31	452890	204370
D32	452920	204310
D33	452920	204280

Archeox
Archaeology of East Oxford
www.archeox.net

■ Donnington Survey Location
High : 99m OD
Low : 58m OD

0 1 km

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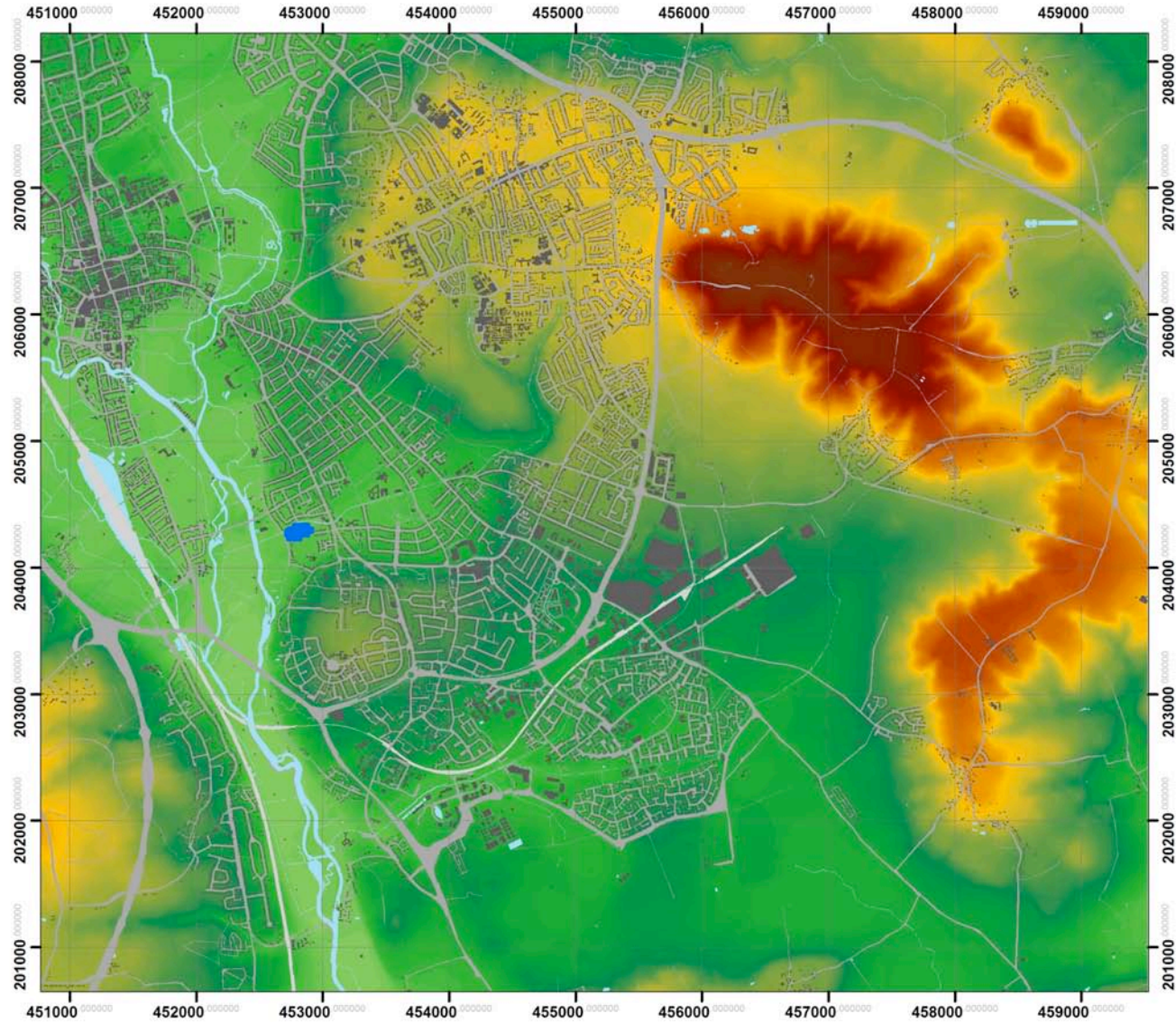
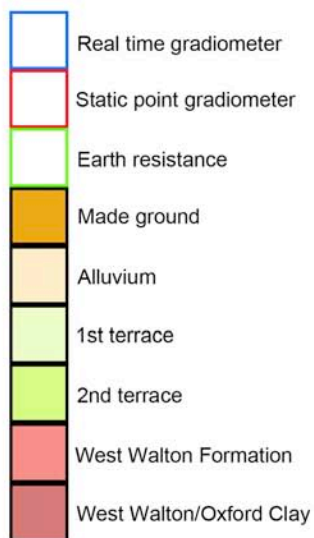


Figure 1. Location of Donnington Recreation Ground survey within East Oxford



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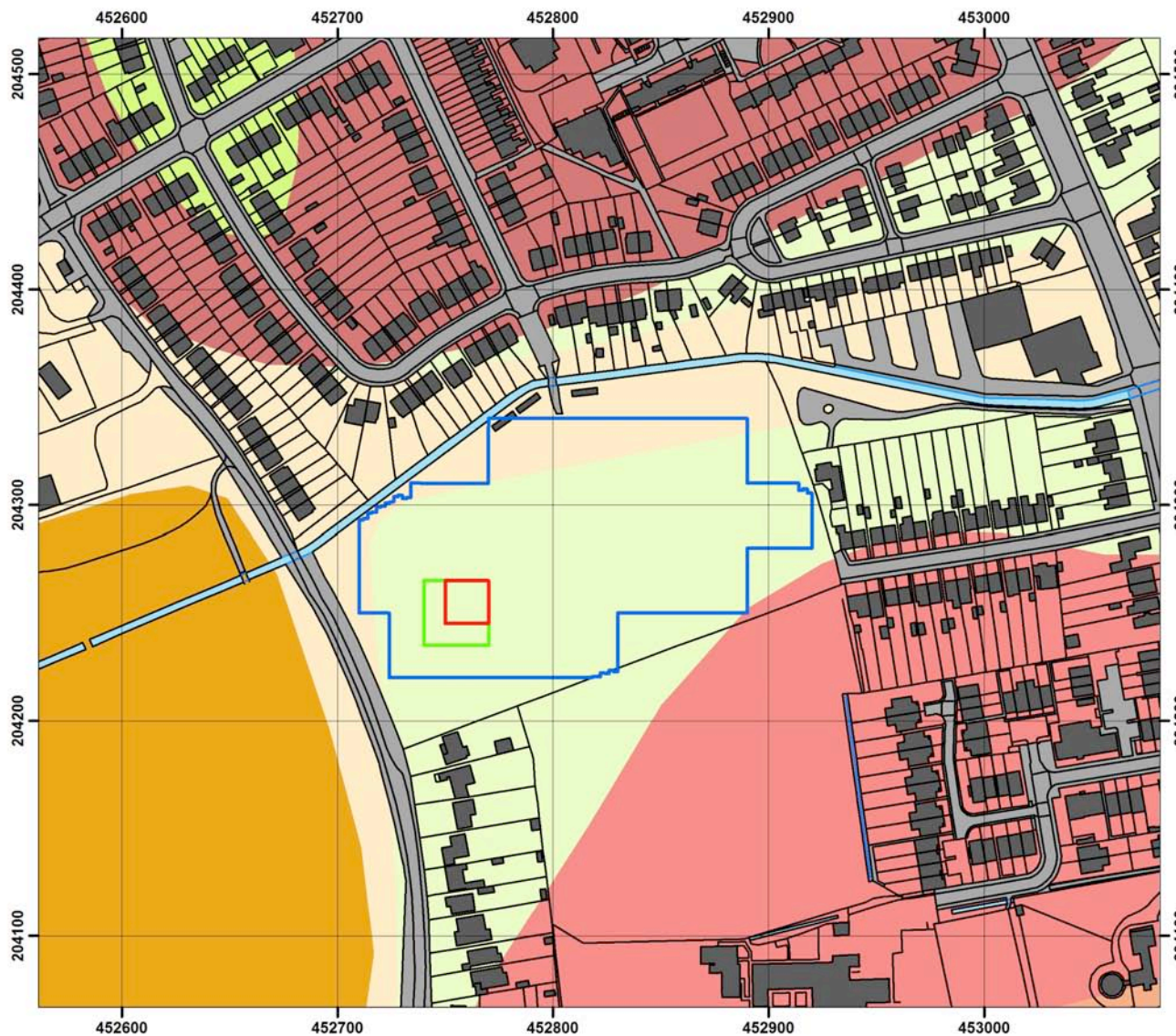


Figure 2. Survey area with solid, superficial and modern geology (data provided by British Geological Survey © NERC all rights reserved)

- Realtime gradiometer
 - Static point gradiometer
 - Earth resistance
- LIDAR_DTM**
 m OD
- 62.71m OD
 -
 -
 - 55.32m OD



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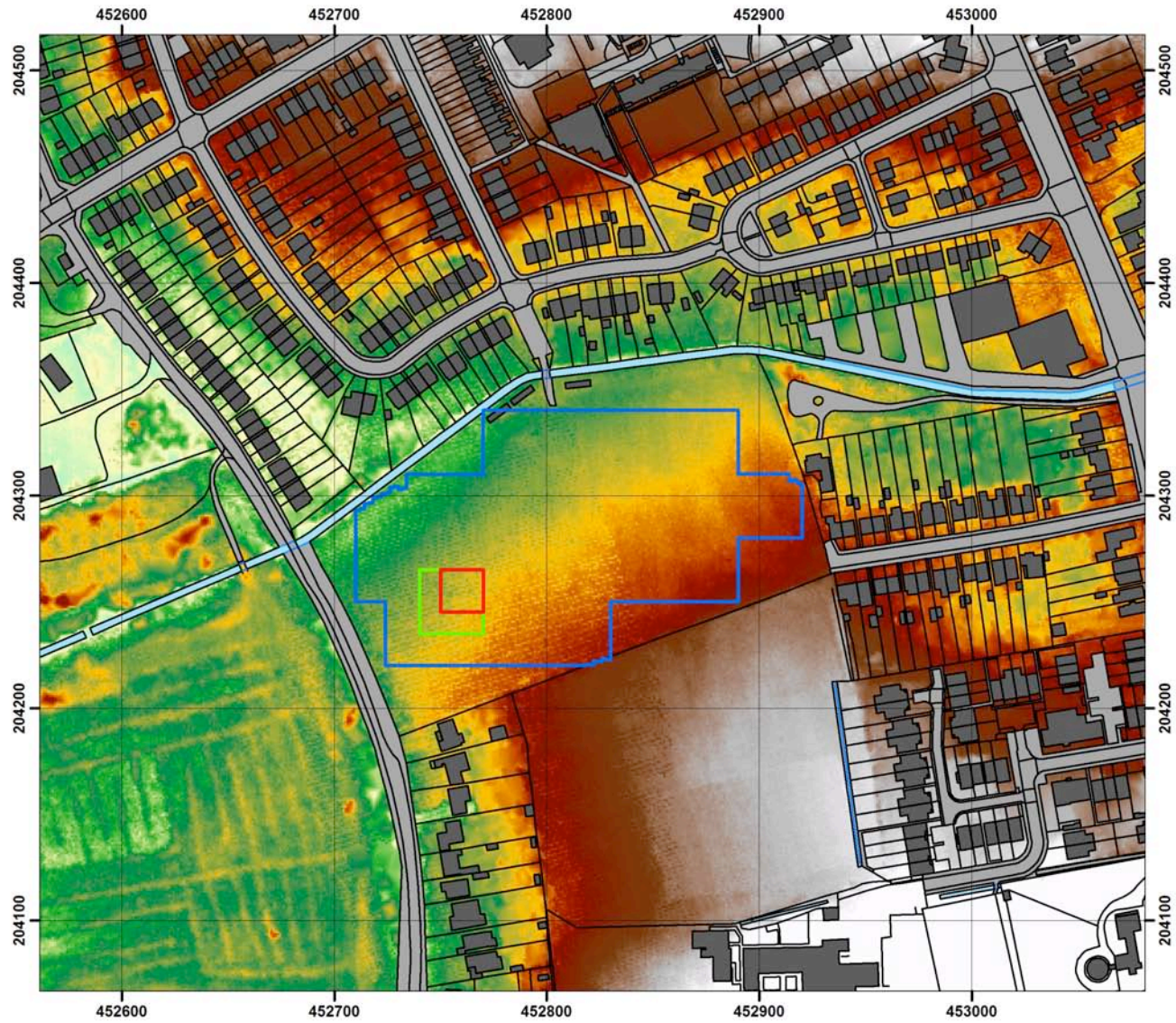


Figure 3. Survey area and local topography. 1m LiDAR DTM based on © Environment Agency/Geomatics Group data

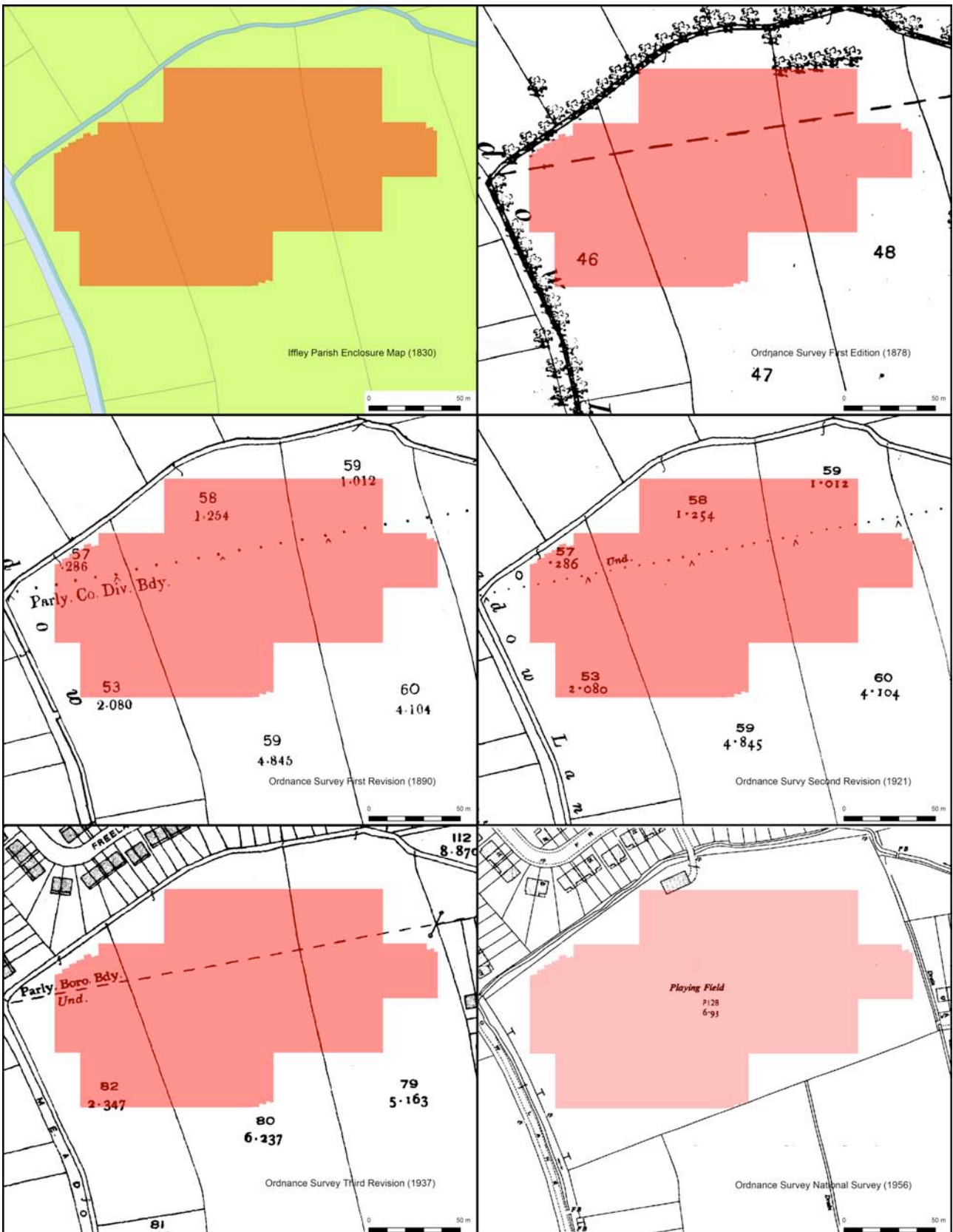


Figure 4. Historic mapping of the survey area. Mapping © Crown Copyright and Landmark Information Group Limited 2014



Figure 5. Aerial photograph of survey area in 1945. Image from Google Earth

- Realtime gradiometer
- Static point gradiometer
- Earth resistance
- X June 2012 survey pegs



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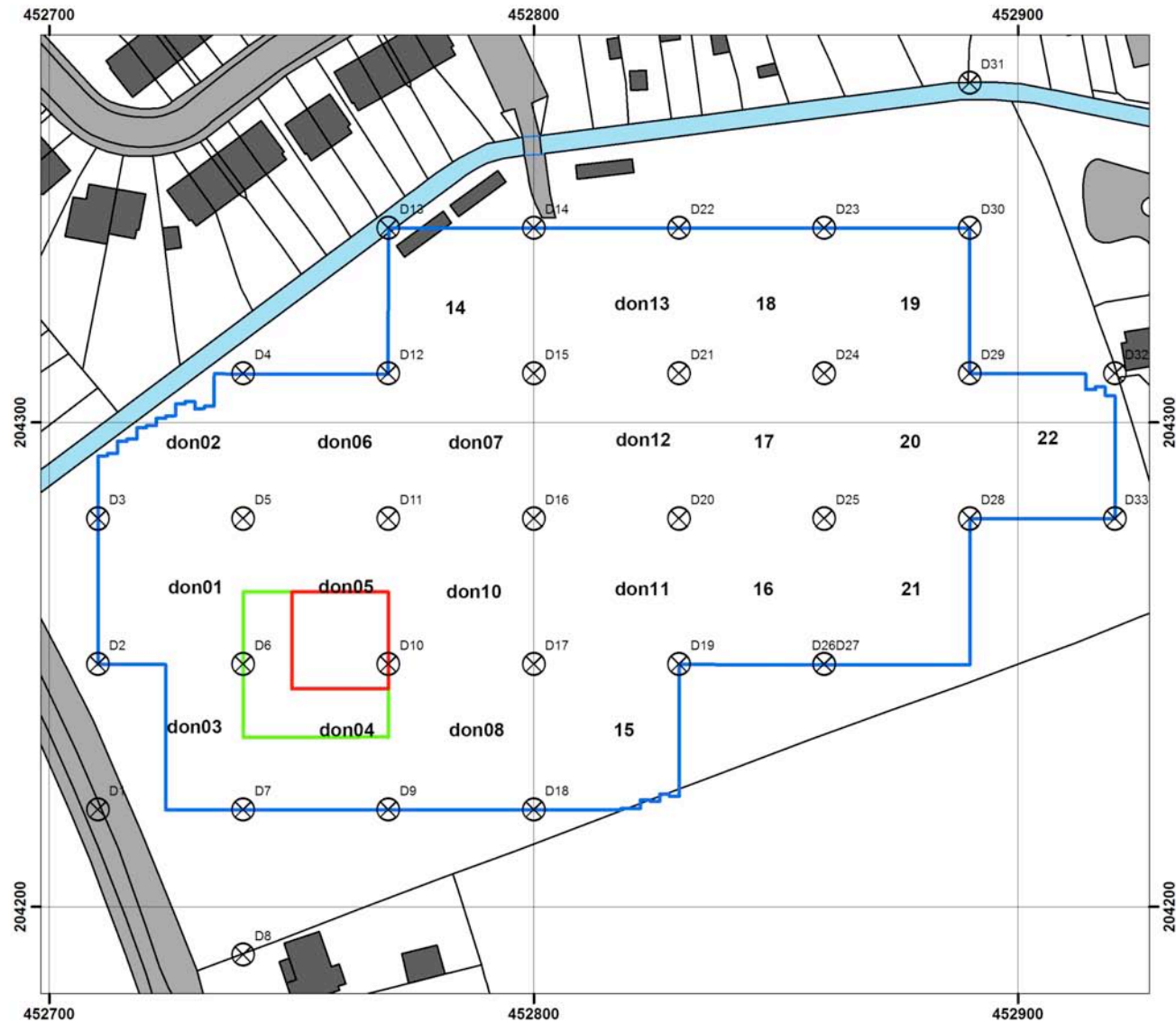


Figure 6. Survey grid location. Grid peg location data in appendix 1.

Donnington_2012_raw

nT
High : 100
Low : -100



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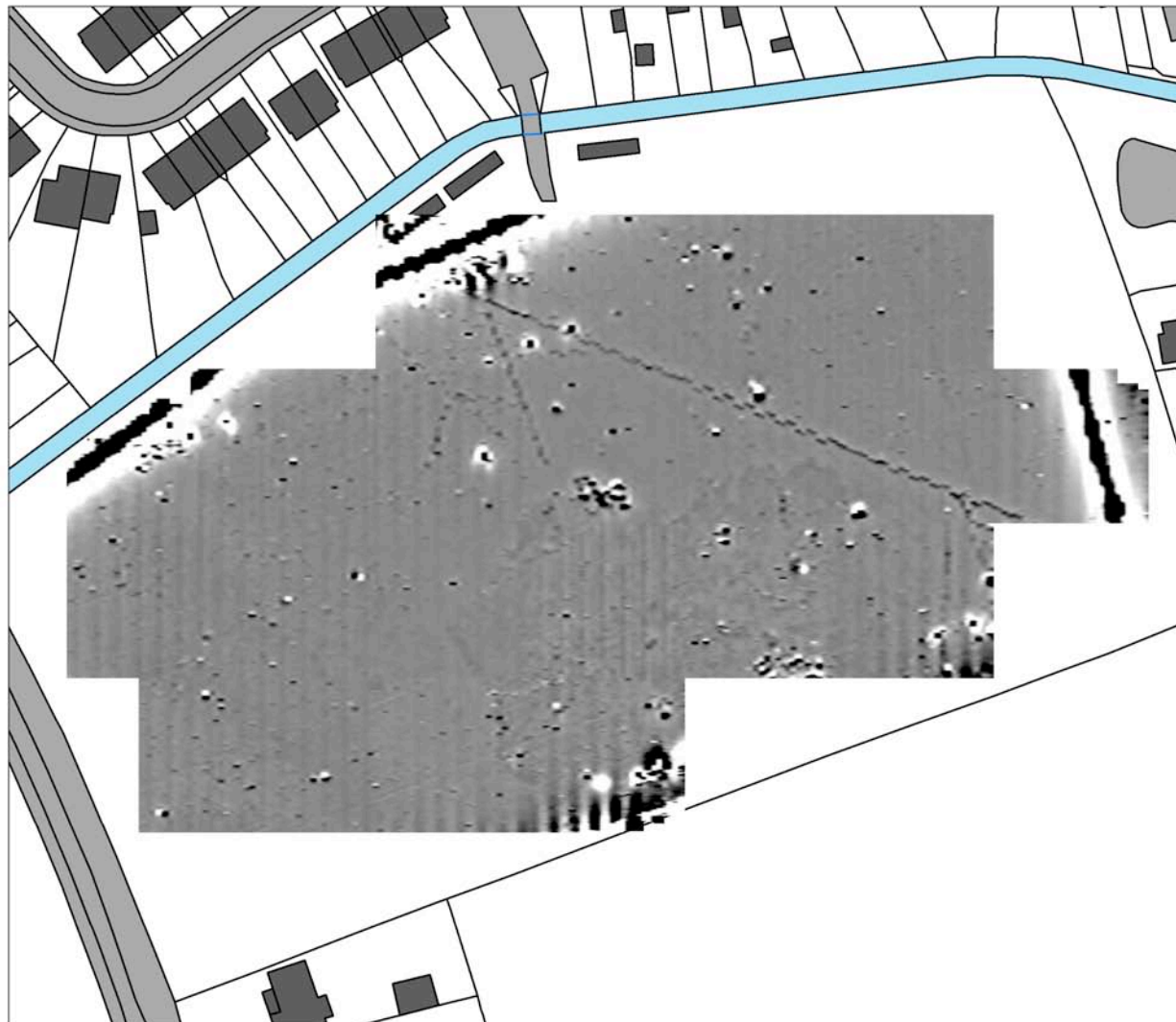


Figure 7. Unprocessed real time gradiometer survey data (grey scale)

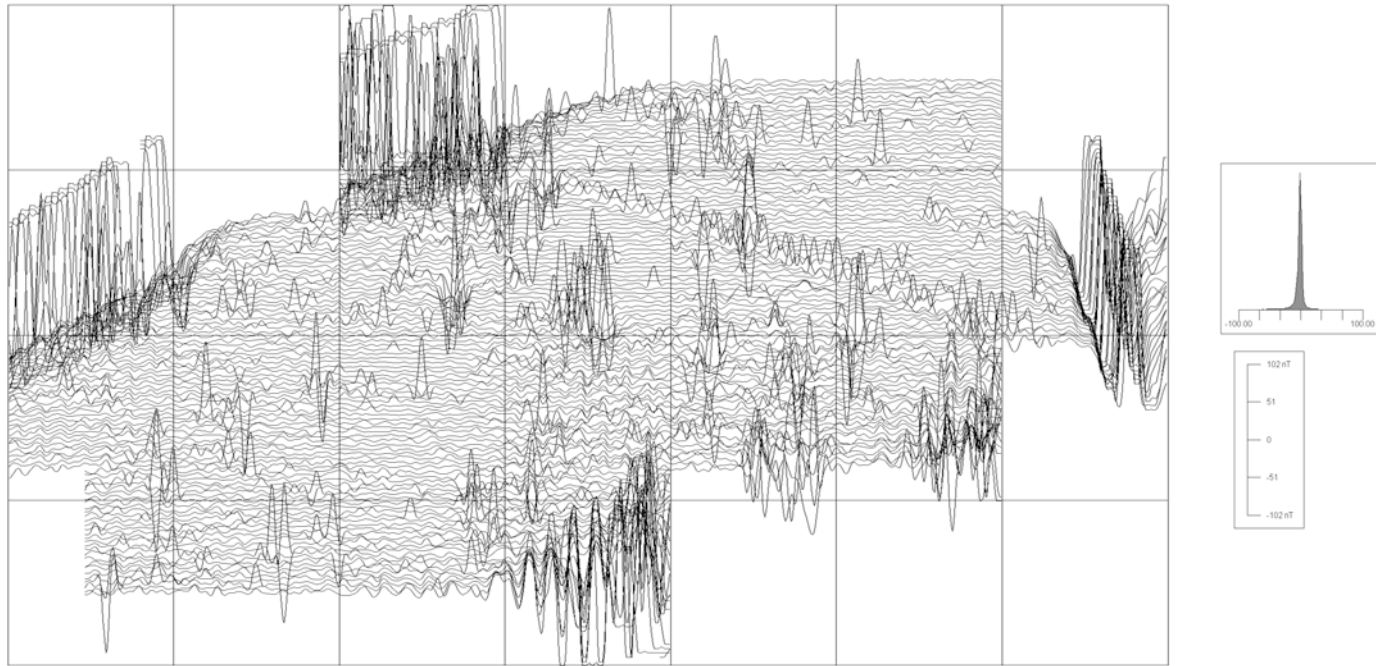


Figure 8. Unprocessed real time gradiometer survey data (stacked trace)

Donnington 2012 processed

nT
High : 7.89
Low : -8.52

0 30 m



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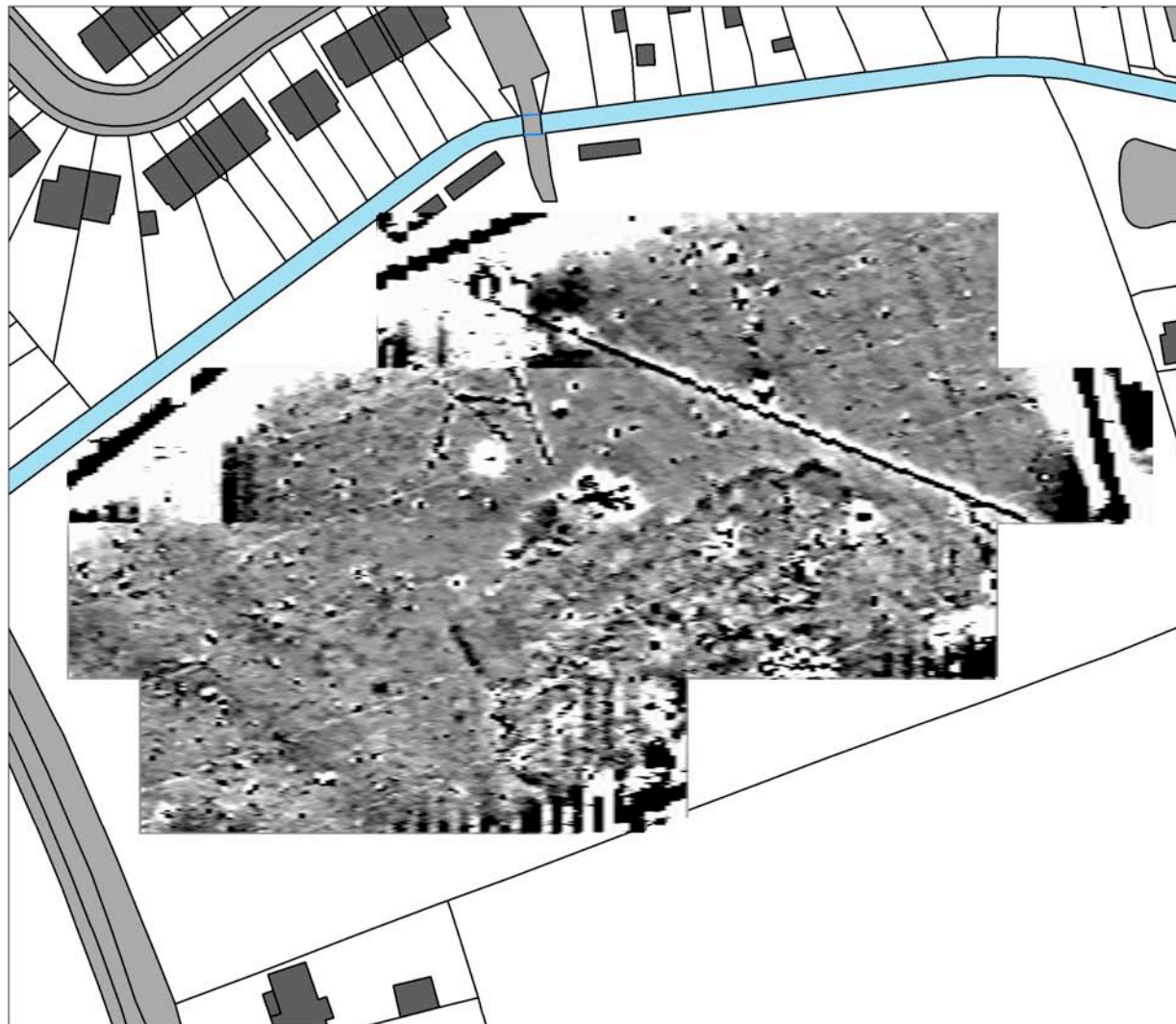





Figure 9. Processed real time gradiometer data (grey scale)

-  Archaeology
-  Archaeology (probable)
-  Archaeology (possible)
-  Archaeology (trend)
-  Geological trend
-  Land drain
-  Made ground
-  Ferrous item
-  Magnetic disturbance

Donnington 2012 processed

nT

High : 7.89
Low : -8.52

0 30 m



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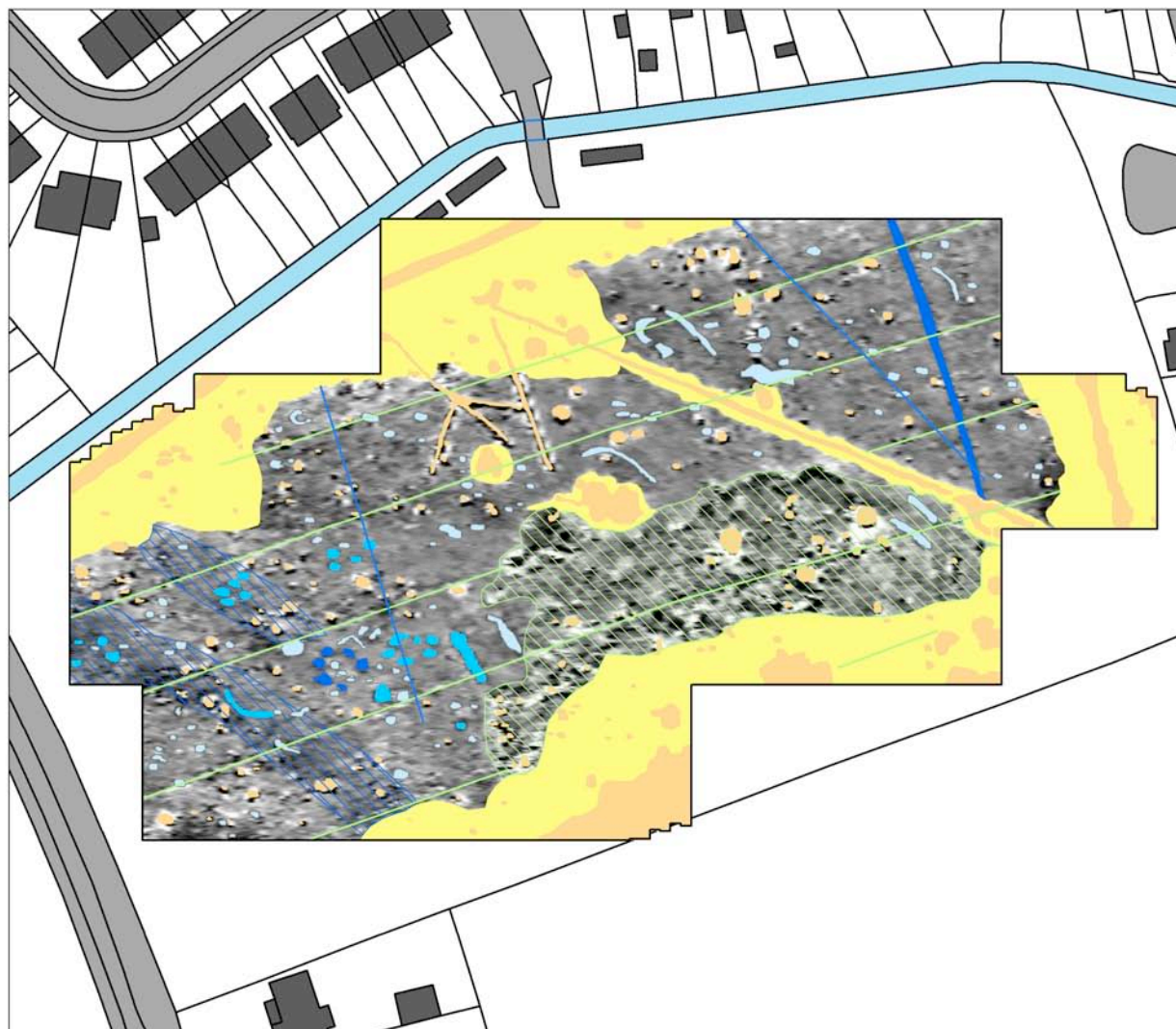


Figure 10. Processed real time gradiometer data and interpretation

- Archaeology
- Archaeology (probable)
- Archaeology (possible)
- Archaeology (trend)
- Geological trend
- Land drain
- Made ground
- Ferrous item
- Magnetic disturbance

0 30 m

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Figure 11. Interpretation of real time gradiometer survey data

- Archaeology
- Archaeology (probable)
- Archaeology (possible)
- Archaeology (trend)
- Geological trend
- Land drain
- Made ground
- Ferrous item
- Magnetic disturbance

- Static point gradiometer
- Earth resistance
- Real time gradiometer

0 30 m



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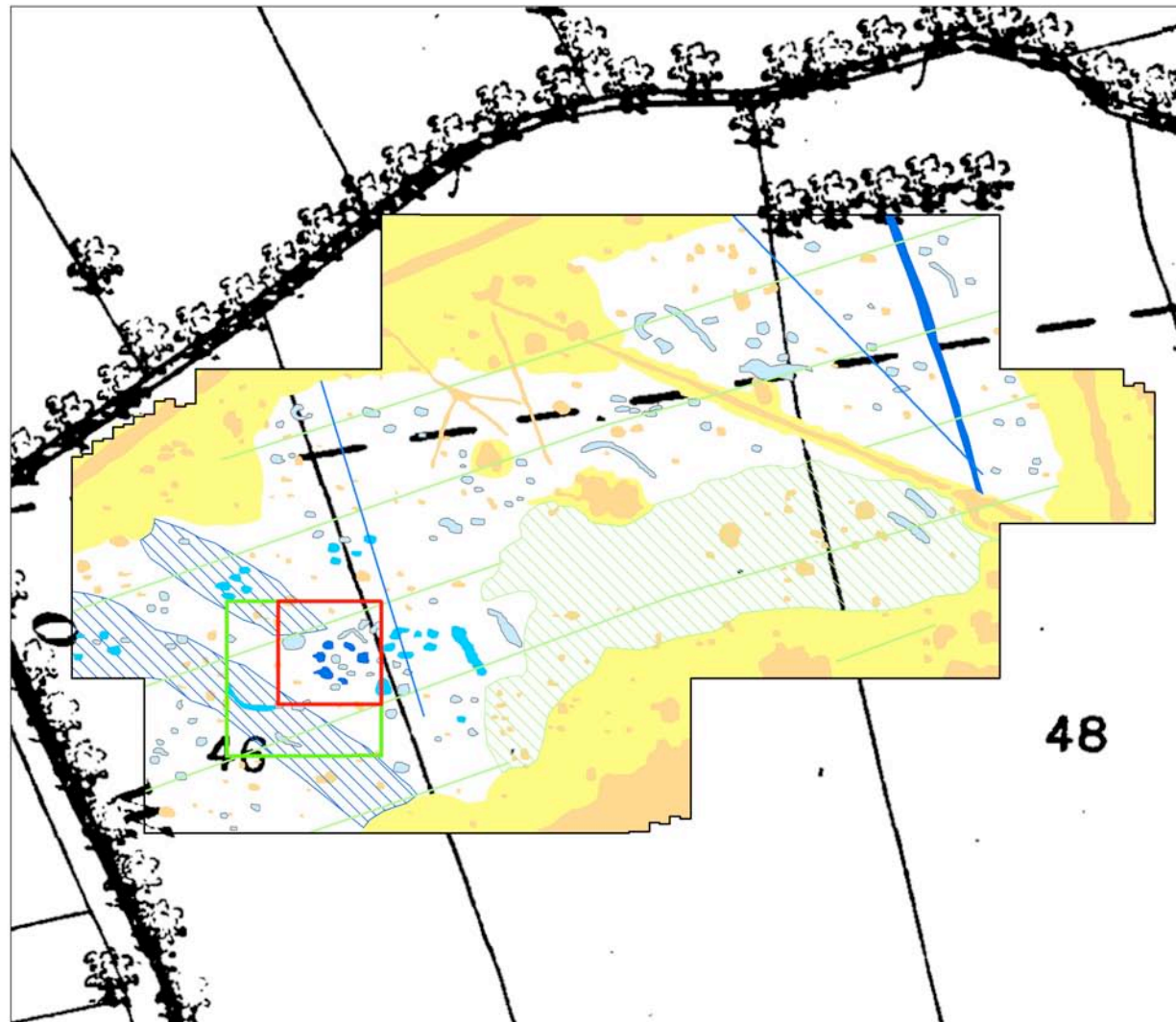


Figure 12. Survey interpretation with historic mapping c.1880 © Crown Copyright and Landmark Information Group Limited 2014

Legend

- Static point gradiometer
- Earth resistance

Donnington 2012 processed

nT

- High : 7.89
- Low : -8.52

0 35 m

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Figure 13. Location of earth resistance and static point gradiometer surveys relative to real time gradiometer data

- Extent of static point survey
- Extent of 'pit' features from static point survey

Earth Resistance survey (ohms)



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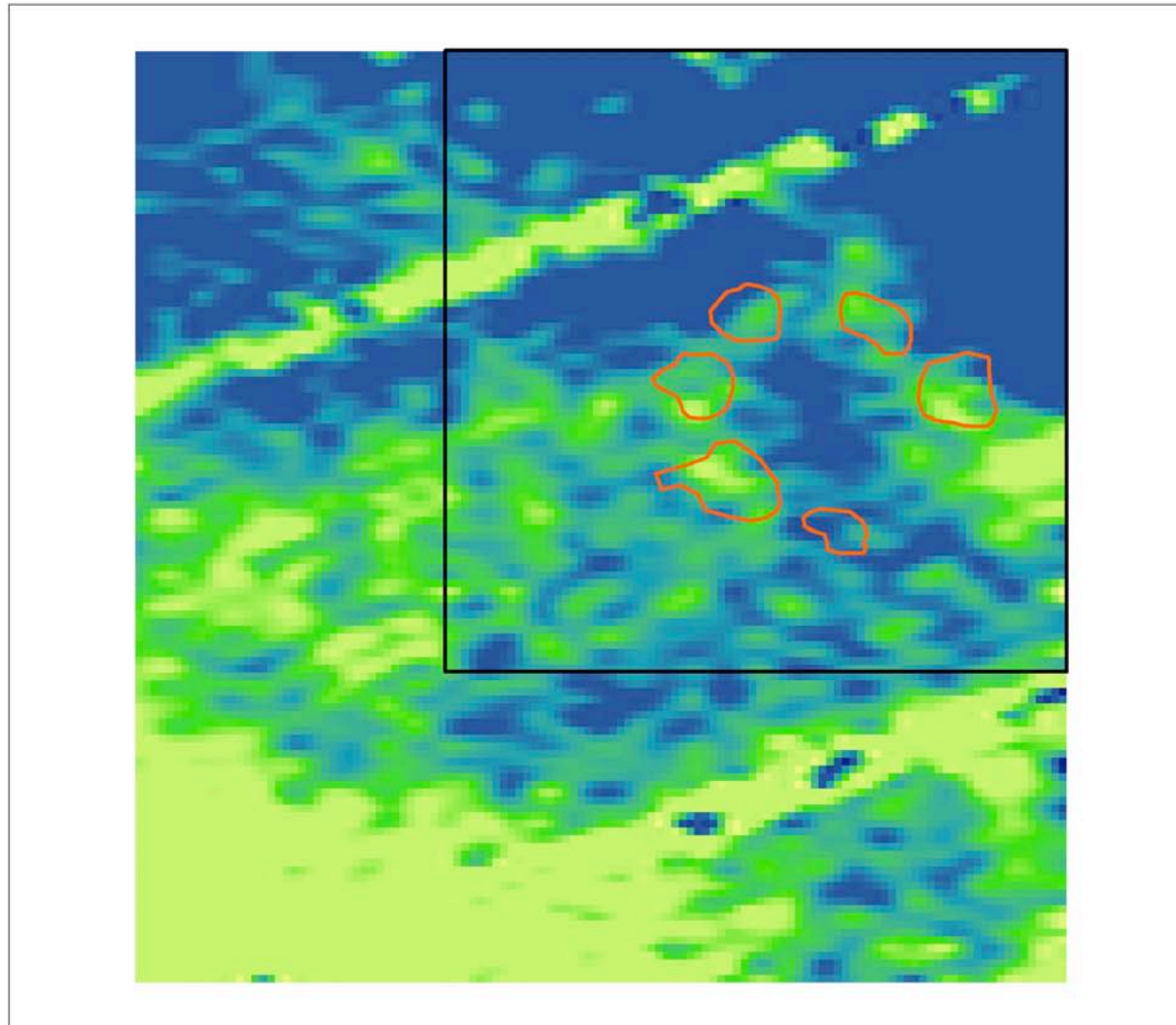


Figure 14. Earth resistance survey data with transcribed static point gradiometer features (red)

donstatic1.tif

nT
High : 3
Low : -3



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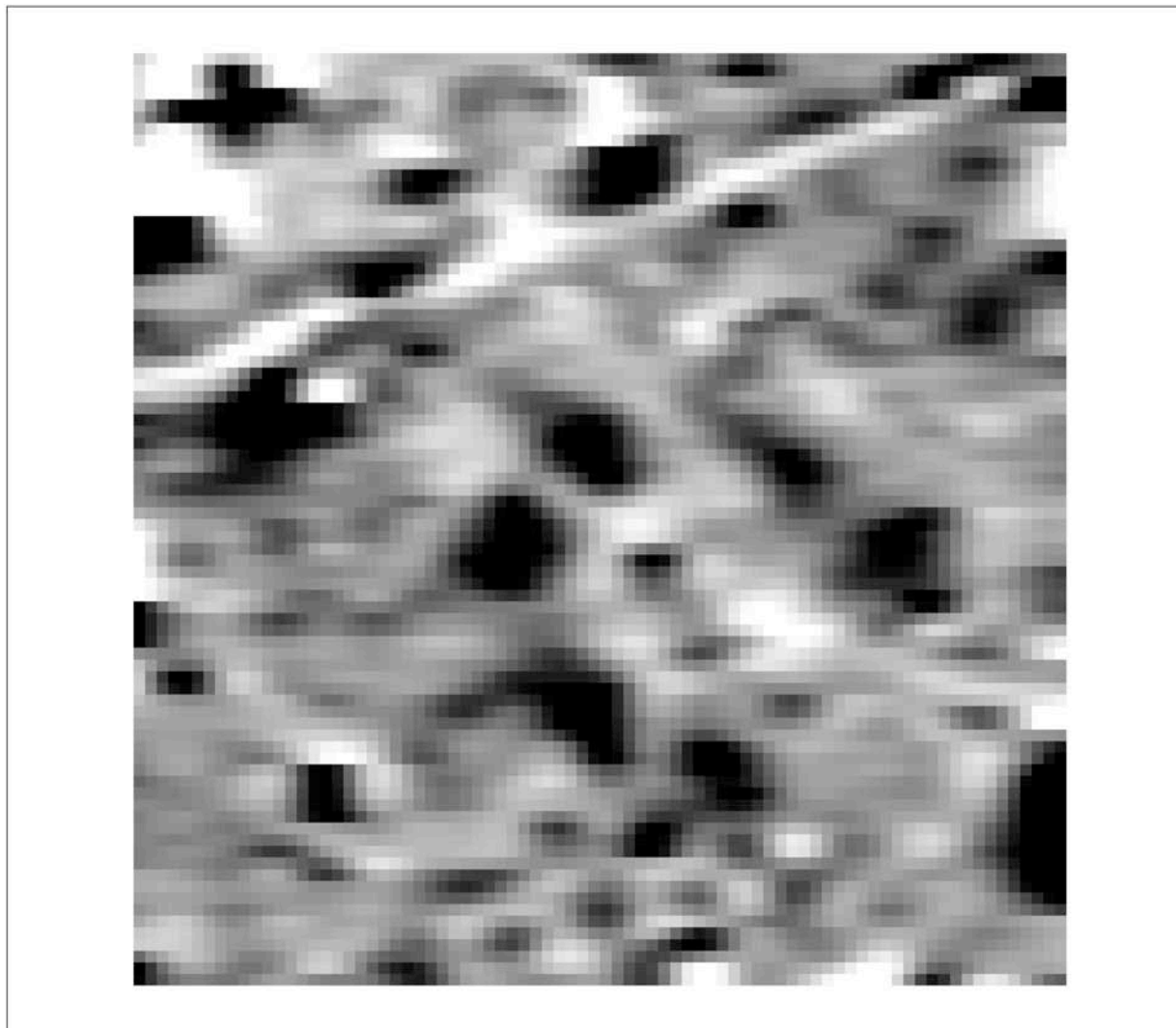


Figure 15. Grey scale plot of static point gradiometer survey