Archaeological Services
University of Durham

Kent International Gateway, near Maidstone, Kent

geophysical survey

on behalf of

CgMs Consulting

Report 2210
July 2009

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Contents

1. Summary

The project

1.1 This report presents the results of a geophysical survey conducted in advance of the proposed development of land between Bearsted and the M20 motorway in Kent. The works comprised 20 blocks of geomagnetic survey within the 113ha application site.

1.2 The works were commissioned by CgMs Consulting and conducted by Archaeological Services Durham University.

Results

1.3 Many geomagnetic anomalies were identified across the application site. The majority of these anomalies relate to post-medieval and modern features. Parts of the application site were woodland until relatively recently and the boundaries of those woods, as well as many former field boundaries and tracks, have been identified across the site. Many of these features are shown on early OS maps.

1.4 More recent features which have also been detected across the application site comprise land drains and service pipes, and areas of ground disturbance. Examples of the latter include areas of deforestation, areas adjacent to the motorway and the local railway line, and the locations of former outbuildings associated with a 19th-century workhouse.

1.5 Some weak and diffuse anomalies detected in some areas may reflect local geomorphological features, such as the former stream courses in Areas 8 and 9.

1.6 Occasional features of possible archaeological origin have been identified in Areas 1, 3, 8/9, 14 and 15. These generally comprise possible ditch remains. The pit features identified in Areas 14 and 15 are almost certainly post-medieval clay pits, from which the area derives its name.

1.7 Probable traces of former ridge and furrow cultivation were identified in Areas 2, 3, 14 and 15.

2. Project background

Location (Figures 1 & 2)

2.1 The study area comprised 113ha of land between Bearsted and the M20 motorway, in the parishes of Bearsted and Hollingbourne, Kent (NGR centre: NZ 5813 1555). The application site is bounded by the M20 motorway to the north-east and by farmland and housing to the west and south. Twenty blocks of survey totalling 93ha were conducted across 19 land parcels. Areas of woodland, farmyard and utility access were not surveyed (detailed in para. 4.2 below).

Development proposal

2.2 The application site is for the proposed construction of the Kent International Gateway.

Objective

2.3 The principal aim of the survey was to assess the nature and extent of any sub-surface features of potential archaeological significance within the application site, so that an informed decision may be made regarding the nature and scope of any further scheme of archaeological works that may be required in advance of development.

Methods statement

2.4 The survey was undertaken in accordance with instructions from the client and a methods statement prepared by Archaeological Services, and was monitored by Simon Mason and Adam Single of Kent County Council.

Dates

2.5 Fieldwork was undertaken between 5th May and 11th June 2009. This report was prepared between 12th June and 2nd July 2009.

Personnel

2.6 Fieldwork was conducted by Jamie Armstrong, Matt Claydon, Edward Davies (Supervisor), David Graham, Joanne Lathan, Adam Rodgers, Natalie Swann and Richie Villis (Supervisor). This report was prepared by Edward Davies and Duncan Hale (the Project Manager) with illustrations by David Graham.

Archive/OASIS

2.7 The site code is **KIG09**, for **K**ent **I**nternational **G**ateway 20**09**. The survey archive will be supplied on CD to the client for deposition with the project archive in due course. Archaeological Services Durham University is registered with the **O**nline **A**cces**S** to the **I**ndex of archaeological investigation**S** project (OASIS). The OASIS ID number for this project is **archaeol3-61056**.

3. Archaeological and historical background

3.1 A desk-based assessment of the archaeological potential of the study area was conducted by WSP Environmental in 2005.

3.2 A large number of archaeological investigations related to the Channel Tunnel Rail Link (CTRL) increased the archaeological understanding of the general area and of specific sites within the general area.

3.3 The Kent Sites and Monuments Record (SMR) lists many archaeological sites and events that are located near to the application site. Several SMR entries relate to prehistoric material including flint and pottery scatters and two Bronze Age barrows.

3.4 Recent evaluation work at the motorway services area suggested that Romano-British settlement might extend south of the M20 (WSP 2005). The most significant evidence for Roman activity in the wider area is the villa at Thurnam.

3.5 The evidence for medieval activity comprises a few isolated finds of coins, small industrial sites, agricultural features and recorded settlements.

4. Landuse, topography and geology

4.1 At the time of survey the application site comprised 25 land parcels of mixed land-use totaling approximately 113ha; it was possible to conduct survey in 19 of these, totaling approximately 93ha.

4.2 It was not possible to conduct survey in the small areas of woodland, farmyard and utility access (Areas 1a, 4a, 4b, 5a and 7). Access to Area 11 was not granted by the farmer and therefore this was not surveyed. Large parts of Area 12 were covered by scrub, which prevented data collection in places; this area was divided into two, to enable survey from two directions, so that as much as possible could be surveyed.

Area	Size (ha)	Landuse (NS – not surveyed)	Topography	NGR (TQ)
1	2.80	pasture	level	8225 5475
1a	-	NS, utility access	level	8210 5476
2	8.60	arable (wheat)	level	8210 5500
3	9.35	arable (wheat)	level with steep rise in north-west	8190 5510
4	5.97	arable (wheat)	sloping from south and east to north-west corner	8170 5540
4a	-	NS, farmyard	level	8172 5222
4b	0.73	NS, woodland	level	8155 5540

5	2.83	pasture	level	8150 5540
5a	1.76	NS, woodland	level	8140 5540
6	4.39	pasture	steep sloping ground from south to north	8125 5525
7	3.53	NS, woodland		8100 5540
8 & 9	9.94	now combined into one field of arable (barley)	sloping from north-east to south and west	8120 5550
10a	1.12	pasture	sloping from east to west	8110 5560
10b	0.74	hay meadow	sloping from east to west	8118 5565
11	2.1	NS, arable (barley) & pasture	sloping from north-west to south-east	8090 5555
12a/b	4.45	scrub/waste land	sloping from south-east to north-west	8140 5570
13	11.40	arable (wheat)	sloping from north-west to south-east	8100 5600
13a	0.59	pasture	sloping from north-west to south-east	8105 5580
13b	0.59	pasture	level	8080 5594
13c	0.31	pasture	level	8083 5589
13d	0.47	pasture	level	8075 5590
13e	0.17	pasture	level	8083 5595
13f	0.16	pasture	level	8085 5595
14	4.46	arable (wheat)	sloping from south-east to north-west	8070 5610
15	24.67	arable (wheat)	sloping from north-west to south-east	8050 5620

4.3 The survey areas did not contain visible earthworks except for Area 6, which contained rectilinear earthworks in the southern corner and a steep bank at its northern end.

4.4 The elevation of the study area varied from 50-70m OD.

4.5 The underlying solid geology of the area comprises Cretaceous strata of upper Folkestone Formation sandstone and Gault mudstone, with some superficial sand and gravel.

5. Geophysical survey

Standards

5.1 The survey and reporting were conducted in accordance with English Heritage guidelines, *Geophysical survey in archaeological field evaluation 2nd edition* (David, Linford & Linford 2008); the Institute for Archaeologists' Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden 2002); and the Archaeology Data Service *Geophysical Data in Archaeology: A Guide to Good Practice* (Schmidt 2002).

Technique selection

5.2 Geophysical survey enables the relatively rapid and non-invasive identification of sub-surface features of potential archaeological significance and can involve a suite of complementary techniques such as magnetometry, earth electrical resistance, ground-penetrating radar, electromagnetic survey and topsoil magnetic susceptibility survey. Some techniques are more suitable than others in particular situations, depending on site-specific factors including the nature of likely targets; depth of likely targets; ground conditions; proximity of buildings, fences or services and the local geology and drift.

5.3 In this instance, based on desk-based assessment and aerial photographic cropmark evidence, it was considered likely that cut features such as ditches and pits might be present on the site, and that other types of feature such as trackways, former field boundaries, wall foundations and fired structures (for example kilns and hearths) might also be present.

5.4 Given the anticipated shallowness of targets and the non-igneous geological environment of the study area a geomagnetic technique, fluxgate gradiometry, was considered appropriate for detecting the types of feature mentioned above. This technique involves the use of hand-held magnetometers to detect and record anomalies in the vertical component of the Earth's magnetic field caused by variations in soil magnetic susceptibility or permanent magnetisation; such anomalies can reflect archaeological features.

Field methods

5.5 A 30m grid was established across each survey area and tied-in to known, mapped Ordnance Survey points using a Leica GS50 global positioning system (GPS) with subsequent RINEX correction.

5.6 Measurements of vertical geomagnetic field gradient were determined using Bartington Grad601-2 dual fluxgate gradiometers. A zig-zag traverse scheme was employed and data were logged in 30m grid units. The instrument sensitivity was set to 0.1nT, the sample interval to 0.25m and the traverse interval to 1.0m, thus providing 3600 sample measurements per 30m grid unit.

5.7 Data were downloaded on site into a laptop computer for initial processing and storage and subsequently transferred to a desktop computer for processing, interpretation and archiving.

Data processing

5.8 Geoplot v.3 software was used to process the geophysical data and to produce both continuous tone greyscale images and trace plots of the raw (unfiltered) data. The greyscale images and interpretations are presented in Figures 2-11; the trace plots are provided in Figures 12 and 13. Area 15 was too large to be usefully displayed in its entirety as a single trace plot, and so samples of that area are represented by this means. In the greyscale images, positive magnetic anomalies are displayed as dark grey and negative magnetic anomalies as light grey. A palette bar relates the greyscale intensities to anomaly values in nanoTesla.

5.9 The following basic processing functions have been applied to each dataset:

clip	clips, or limits data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic.
zero mean traverse	sets the background mean of each traverse within a grid to zero; for removing striping effects in the traverse direction and removing grid edge discontinuities.
destagger	corrects for displacement of anomalies caused by alternate zig-zag traverses.
interpolate	increases the number of data points in a survey to match sample and traverse intervals. In this instance the data have been interpolated to 0.25m x 0.25m intervals, except Areas 3 and 15 which could only be interpolated to 0.25m x 0.5m due to their size.

Interpretation: anomaly types

5.10 Colour-coded geophysical interpretation plans are provided. Three types of geomagnetic anomaly have been distinguished in the data:

positive magnetic	regions of anomalously high or positive magnetic field gradient, which may be associated with high magnetic susceptibility soil-filled structures such as pits and ditches.
negative magnetic	regions of anomalously low or negative magnetic field gradient, which may correspond to features of low magnetic susceptibility such as wall footings and other concentrations of sedimentary rock or voids.
dipolar magnetic	paired positive-negative magnetic anomalies, which typically reflect ferrous or fired materials (including fences and service pipes) and/or fired structures such as kilns or hearths.

Interpretation: features

General comments

5.11 Colour-coded archaeological interpretation plans are provided.

5.12 Except where stated otherwise in the text below, positive magnetic anomalies are taken to reflect relatively high magnetic susceptibility materials, typically sediments in cut archaeological features (such as furrows, ditches or pits) whose magnetic susceptibility has been enhanced by decomposed organic matter or by burning.

5.13 Small, discrete dipolar magnetic anomalies have been detected in all of the survey areas. These almost certainly reflect items of near-surface ferrous and/or fired debris, such as horseshoes and brick fragments, and in most cases have little or no archaeological significance. A sample of these is shown on the geophysical interpretation plans, however, they have been omitted from the archaeological interpretation plans and the following discussion.

5.14 Several features are common to many of the survey areas. Chains of intense dipolar magnetic anomalies have been detected aligned north-west/south-east along the northern boundaries of Areas 2, 3, 4 and 5. Other chains of intense dipolar magnetic anomalies on the same axis have been detected along the northern edges of Areas 12, 13 and 14, while miscellaneous others have been detected in Areas 2, 3, 6 and 13a. These almost certainly reflect ferrous service pipes. Further ferrous pipes almost certainly lie immediately adjacent to some of the surveyed areas.

5.15 Irregularly-shaped concentrations of dipolar magnetic anomalies have been detected in Areas 2, 4, 9, 12a, 12b and 13. These are likely to reflect areas of disturbed ground, where it has either been excavated and back-filled with ferrous/fired litter and rubble or has had ferrous/fired material dumped on top of it. In Areas 4 and 9, two such patches detected along the northern boundary are likely to reflect material dumped during the construction of the railway. The concentrations detected in Areas 12a, 12b and 13 may reflect a former construction compound associated with the railway and/or motorway.

Area 1

5.16 Some extremely weak and diffuse positive magnetic anomalies have been detected in the central part of this area. Such anomalies are typically associated with soil-filled features and some of those detected here appear to form rectilinear patterns; these could reflect the heavily truncated remains of small ditched enclosures or paddocks. Occasionally such weak anomalies are only present in the topsoil/ploughsoil, the original features having been completely plouged-out but with the relatively high magnetic susceptibility material of their former fills remaining in the ground, albeit dispersed; this is a possible explanation of the anomalies here.

5.17 Two large dipolar magnetic anomalies were detected in this area, the more westerly of which corresponds to farm machinery.

Area 2

5.18 A series of very weak, parallel, positive magnetic anomalies aligned broadly north-east/south-west almost certainly reflect traces of former ridge and furrow cultivation.

5.19 Two linear magnetic anomalies, one comprising many small dipolar magnetic anomalies and the other generally positive, were detected aligned north-west/south-east across this area. The north-easterly band of small anomalies corresponds to a narrow strip of woodland shown on the 1908 OS 1:2500 map and the other is shown as a field boundary on the same map.

5.20 Areas of magnetic disturbance which were detected immediately north and west of 'White Heath' almost certainly correspond to former structures (also shown on the 1908 OS 1:2500 map) associated with the 'Hollingbourne Union Workhouse' that used to occupy the site.

5.21 Service pipes were also detected.

Area 3

5.22 A series of very weak, parallel, positive magnetic anomalies also aligned broadly north-east/south-west has been detected across most of his field. These anomalies almost certainly reflect traces of former ridge and furrow cultivation.

5.23 Many very small, irregular, positive magnetic anomalies detected in the northern and eastern parts of this field have no apparent archaeological significance. Two very weak positive magnetic lineations in this area could possibly reflect soil-filled features, possibly former ditches.

5.24 A diffuse band of small dipolar magnetic anomalies aligned north-west/south-east across the central part of the area is likely to reflect a former field boundary.

5.25 Service pipes were also detected.

Area 4

5.26 A herringbone pattern of small dipolar magnetic anomalies was detected in the western part of the field. These anomalies almost certainly reflect clay land drains.

5.27 A narrow curvilinear band of dipolar magnetic anomalies along the southern boundary corresponds to an existing track.

5.28 A service pipe and areas of disturbed ground were also detected.

Area 5

5.29 Three straight and narrow positive magnetic anomalies were detected aligned north-south in the north-eastern part of the field. Other similar, though weaker, anomalies were detected elsewhere in the field. These are all likely to reflect land drains.

5.30 Several very broad and generally weak positive magnetic anomalies detected across this field are likely to reflect geological variation.

5.31 A service pipe was also detected.

Area 6

5.32 In the south-eastern corner of the field several positive and dipolar magnetic anomalies were detected, which form a rectilinear pattern. These anomalies correspond to upstanding earthworks and are likely to represent recent enclosures or paddocks.

5.33 The data in the northern part of the field are particularly smooth. Early OS editions show this area to be woodland until at least the mid-20th century.

5.34 Several very broad and generally weak positive magnetic anomalies detected across this field are likely to reflect geological variation.

5.35 A service pipe was also detected.

Areas 8 and 9

5.36 These areas were surveyed as one, as there was no boundary between them.

5.37 A narrow band of intense dipolar magnetic anomalies along the southern boundary reflects hardcore materials in an existing track.

5.38 Other occasional clusters of small dipolar magnetic anomalies correspond to the location of a former track between Areas 8 and 9.

5.39 In the central-northern part of Area 9 there are some extremely weak positive magnetic lineations, which could possibly reflect traces of former soil-filled ditches.

5.40 Two weak, sinuous positive magnetic anomalies detected at the northern and western corners of this field appear to reflect former stream courses.

5.41 Areas of disturbed ground were also detected.

Area 10a and 10b

5.42 With the exception of those reflecting a low concentration of ferrous/fired materials and the surrounding wire fences, no other anomalies were identified in this area.

Area 12

5.43 Where survey was possible within this area of scrubland (which included a motorcycle scrambling track), it generally detected a high concentration of intense dipolar magnetic anomalies, which probably reflects backfill or overburden of ferrous/fired materials, perhaps associated with a former construction compound.

5.44 A service pipe was also detected.

Area 13

5.45 Several straight narrow lines of small dipolar magnetic anomalies across much of this area almost certainly reflect clay land drains.

5.46 Several linear positive magnetic anomalies in the north-western part of this field correspond to the former boundaries of woodland shown on the 1st edition OS 1:2500 map. Much of this area, including all of the south-eastern half, was woodland at the turn of the last century. A broad band of small dipolar magnetic anomalies which was detected aligned north-east/south-west across this area corresponds to a former track (and associated structures) through the woodland from Barty Farm. Some weak positive magnetic anomalies in the south-eastern part of the field may reflect ground disturbance associated with the removal of trees there.

5.47 Service pipes were also detected.

Areas 13a-13f

5.48 These small enclosures and paddocks around Bridge Farm had to be surveyed separately. The magnetic anomalies reflect existing wire fences, utilities, outbuildings and ferrous/fired materials.

5.49 A rectangular concentration of intense dipolar magnetic anomalies in Area 13c corresponds to a sand pit used for horses.

5.50 Service pipes were also detected.

Area 14

5.51 Some positive magnetic anomalies across this area may reflect land drains or early field and woodland boundaries. Some eastern parts of the field are shown as woodland on early OS editions.

5.52 A series of very weak, parallel, positive magnetic anomalies aligned parallel with the long field boundaries in the west of the field could reflect traces of former ridge and furrow cultivation.

5.53 A series of discrete positive magnetic anomalies was detected in the central and north-eastern parts of this field, which is known locally as 'Clay Pits'. The majority of these anomalies almost certainly reflect soil-filled features such as pits. Some of the weaker anomalies here could however reflect ground disturbance associated with deforestation.

5.54 A service pipe was also detected.

Area 15

5.55 The most prominent magnetic anomaly in this field corresponds to a former curvilinear track, aligned north-east/south-west, which is now ploughed over but still used as a path and bridleway. Several other strong magnetic anomalies were detected to either side of the former track, and almost all of these correspond to former field boundaries shown on early OS maps.

5.56 A few weaker positive magnetic anomalies may reflect earlier, pre-Ordnance Survey field boundaries or other soil-filled features.

5.57 Several discrete positive magnetic anomalies were detected in the eastern part of this field, which appear to be a continuation of the pits detected in Area 14.

5.58 Some very weak, parallel, positive magnetic anomalies in the south-western part of the field could reflect traces of former ridge and furrow cultivation.

6. Conclusions

6.1 Geomagnetic surveys were conducted over a large area between Bearsted and the M20 motorway in Kent, prior to the determination of a planning proposal for the Kent International Gateway.

6.2 Many geomagnetic anomalies were identified across the application site. The majority of these anomalies relate to post-medieval and modern features. Parts of the application site were woodland until relatively recently and the boundaries of those woods, as well as many former field boundaries and tracks, have been identified across the site. Many of these features are shown on early OS maps.

6.3 More recent features which have also been detected across the application site comprise land drains and service pipes, and areas of ground disturbance. Examples of the latter include areas of deforestation, areas adjacent to the motorway and the local railway line, and the locations of former outbuildings associated with a 19^{th}-century workhouse.

6.4 Some weak and diffuse anomalies detected in some areas may reflect local geomorphological features, such as the former stream courses in Areas 8 and 9.

6.5 Occasional features of possible archaeological origin have been identified in Areas 1, 3, 8/9, 14 and 15. These generally comprise possible ditch remains. The pit features identified in Areas 14 and 15 are almost certainly post-medieval clay pits, from which the area derives its name.

6.6 Probable traces of former ridge and furrow cultivation were identified in Areas 2, 3, 14 and 15.

7. Sources

David, A, Linford, N, & Linford, P, 2008 *Geophysical Survey in Archaeological Field Evaluation, 2^{nd} edition*. English Heritage

Gaffney, C, Gater, J, & Ovenden, S, 2002 *The use of geophysical techniques in archaeological evaluations*. Technical Paper **6**, Institute for Archaeologists

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0 1km
scale 1:25 000 - for A4 plot

survey area
application site

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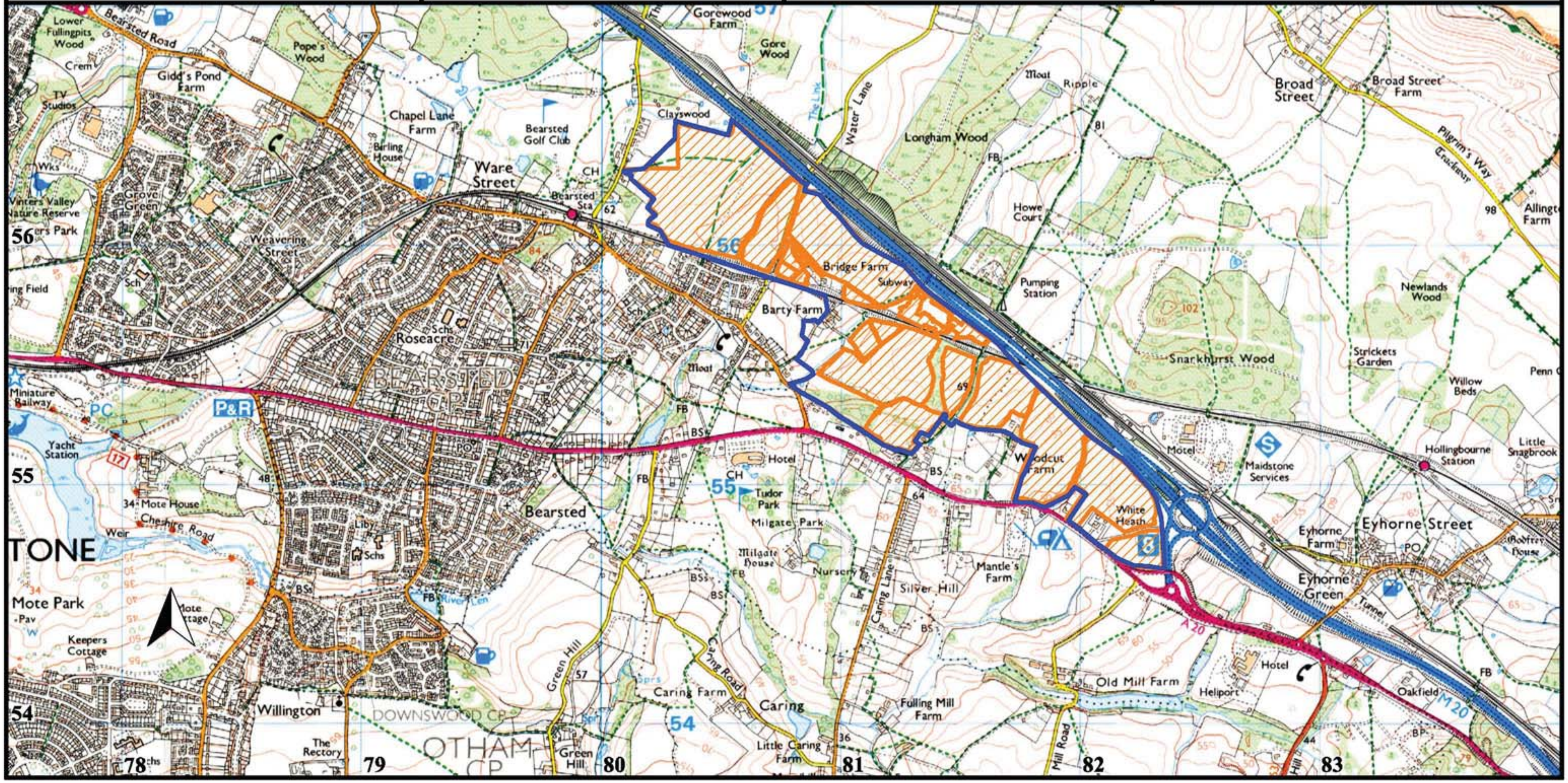
Figure 1
Study area



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0 300m
scale 1:7500 - for A3 plot

application site

5.00
4.17
3.33
2.50
1.67
0.83
0
-0.83
-1.67
-2.50
-3.33
-4.17
-5.00 nT

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Figure 2
Geophysical survey overview

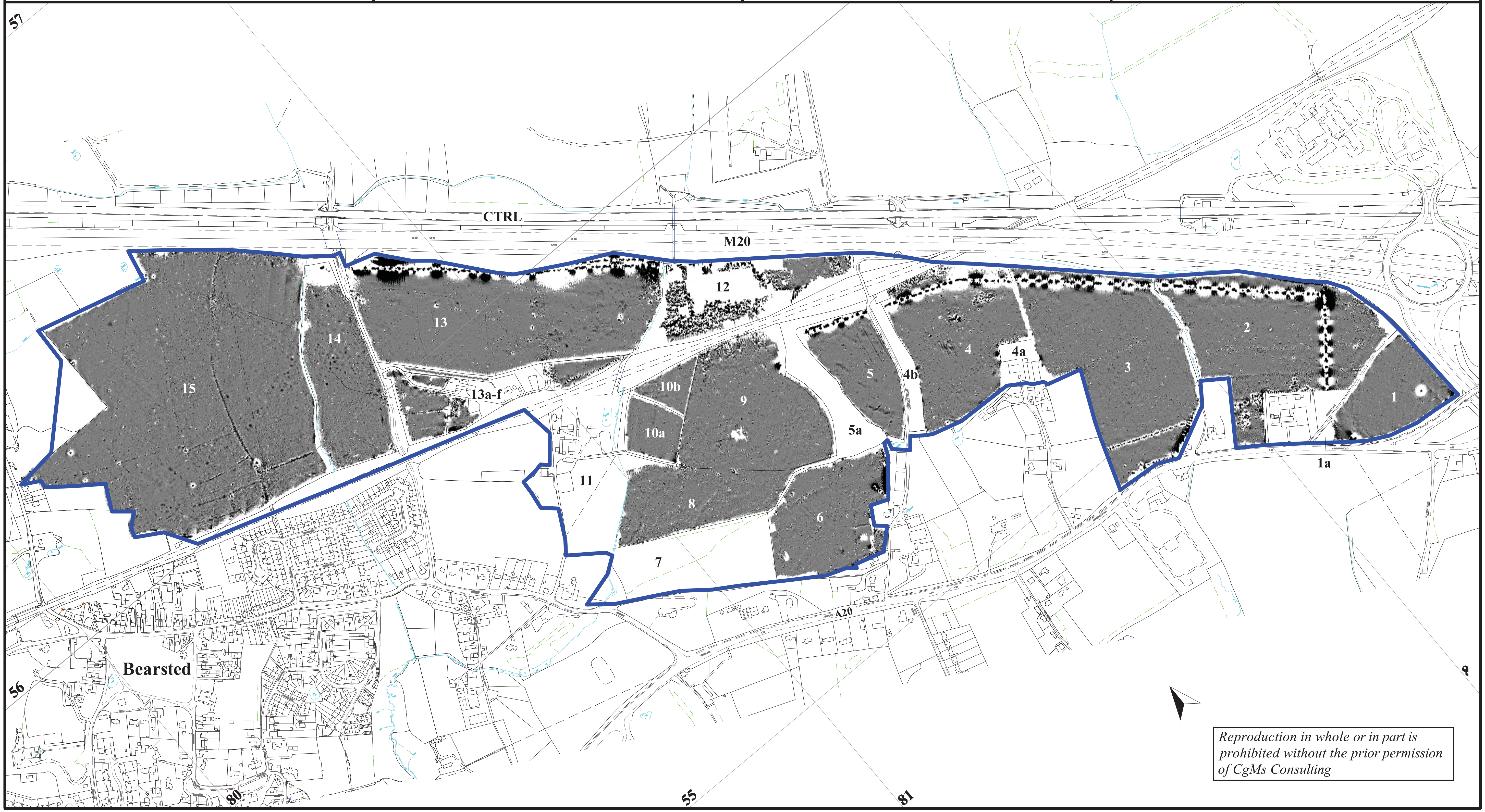

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Figure 3

Areas 1-4 geophysical survey

outline of survey area
application site
positive magnetic anomalies
dipolar magnetic anomalies

0 50m
scale 1:1000 - for A0 plot

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Figure 4

Areas 1-4 geophysical interpretation

outline of survey area
application site
soil-filled features
service pipes
orientation of ridge and furrow
disturbed area
land drains
former field boundary

0 50m
scale 1:1000 - for A0 plot

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Figure 5

Areas 1-4 archaeological interpretation

outline of survey area

application site

Area 8 & 9: 3.00, 2.50, 2.00, 1.50, 1.00, 0.50, 0, -0.50, -1.00, -1.50, -2.00, -2.50, -3.00 nT

Areas 5-6, 10, 12, 13: 5.00, 4.17, 3.33, 2.50, 1.67, 0.83, 0, -0.83, -1.67, -2.50, -3.33, -4.17, -5.00 nT

0 50m

scale 1:1000 - for A0 plot

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Figure 6

Areas 5-13f geophysical survey

outline of survey area
application site
positive magnetic anomalies
dipolar magnetic anomalies

0 50m
scale 1:1000 - for A0 plot

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Figure 7

Areas 5-13f geophysical interpretation


M 20
Area 13
Area 12
Area 5
Area 10b
Area 13f
Area 13e
Area 13b
Area 13a
Area 10a
Area 13c
Area 13d
Area 14
Area 8 & 9
Area 6
former track
sand pit
Water
former stream course
CRISMILL ROAD
POND
Pond
ROUNDWELL
ASHFORD ROAD
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outline of survey area
application site
soil-filled features
service pipes
orientation of ridge and furrow
disturbed area
land drains
former field boundary
0
50m
scale 1:1000 - for A0 plot
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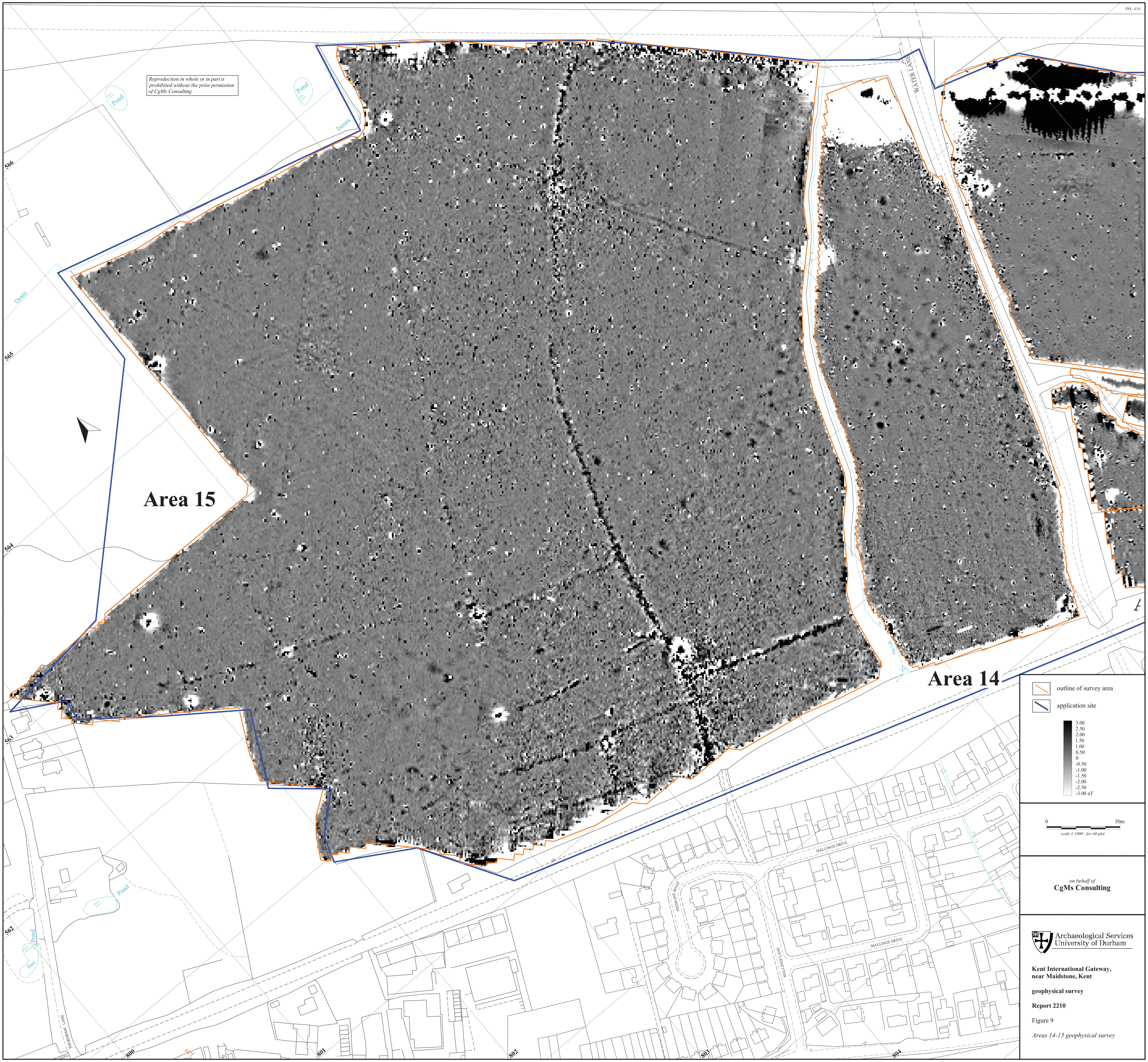
Figure 8
Areas 5-13f archaeological interpretation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Area 15
Area 14
Pond
Issues
Drain
WATER LANE
MALLINGS DRIVE
MALLINGS LANE
PRIMROSE ROAD
THURNHAM LANE
566
565
564
563
562
800
801
802
803
804
outline of survey area
application site
3.00
2.50
2.00
1.50
1.00
0.50
0
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00 nT
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50m
scale 1:1000 - for A0 plot
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Figure 9
Areas 14-15 geophysical survey

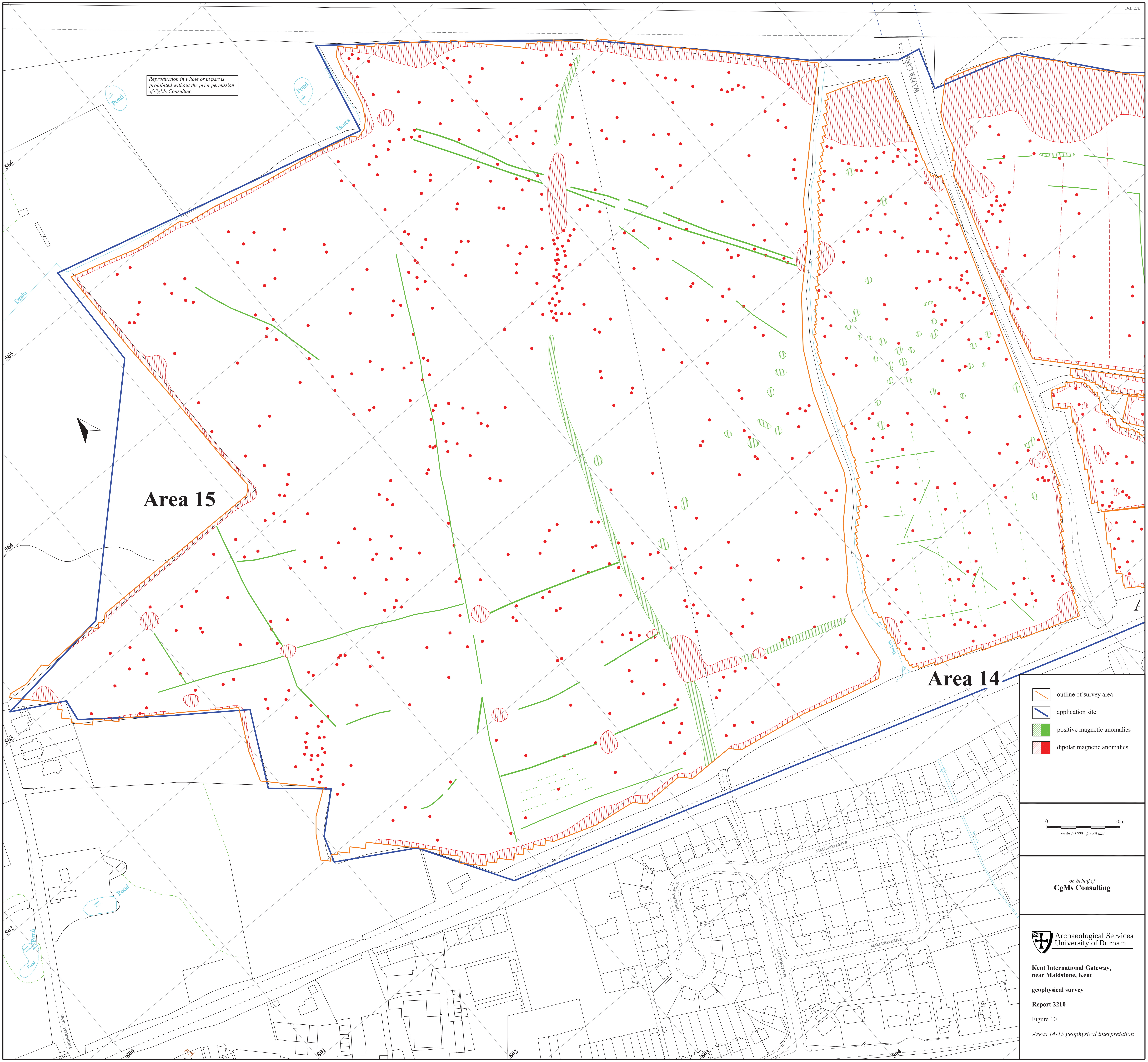

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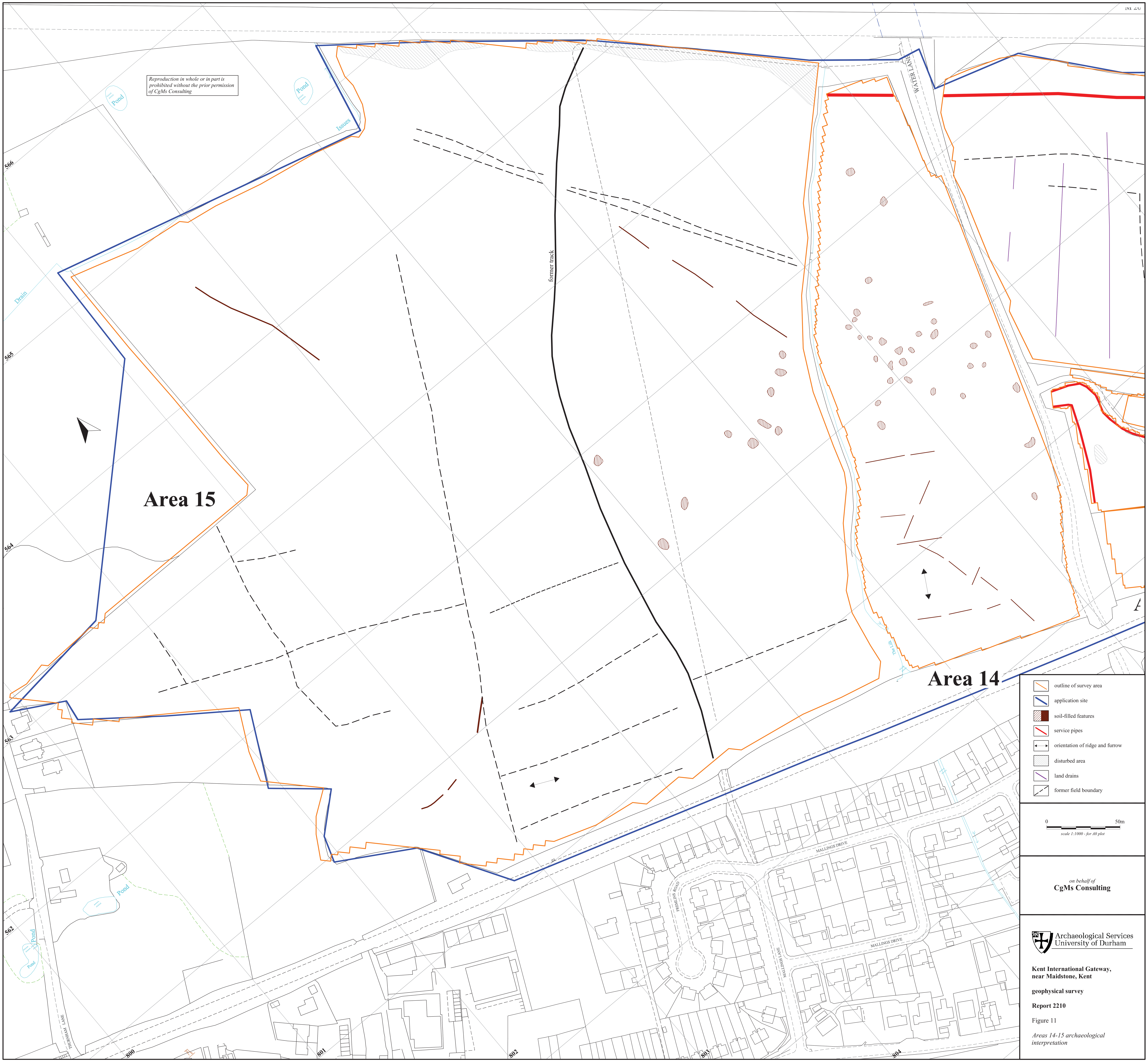
Figure 10

Areas 14-15 geophysical interpretation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Pond
Pond
Issues
Drain
WATER LANE
former track
Area 15
Area 14
MALLINGS DRIVE
MALLINGS DRIVE
MALLINGS LANE
FREMLINS ROAD
THURNHAM LANE
566
565
564
563
562
800
801
802
803
804
outline of survey area
application site
soil-filled features
service pipes
orientation of ridge and furrow
disturbed area
land drains
former field boundary
0
50m
scale 1:1000 - for A0 plot
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Figure 11
Areas 14-15 archaeological interpretation

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Figure 12: Trace plots of geomagnetic data

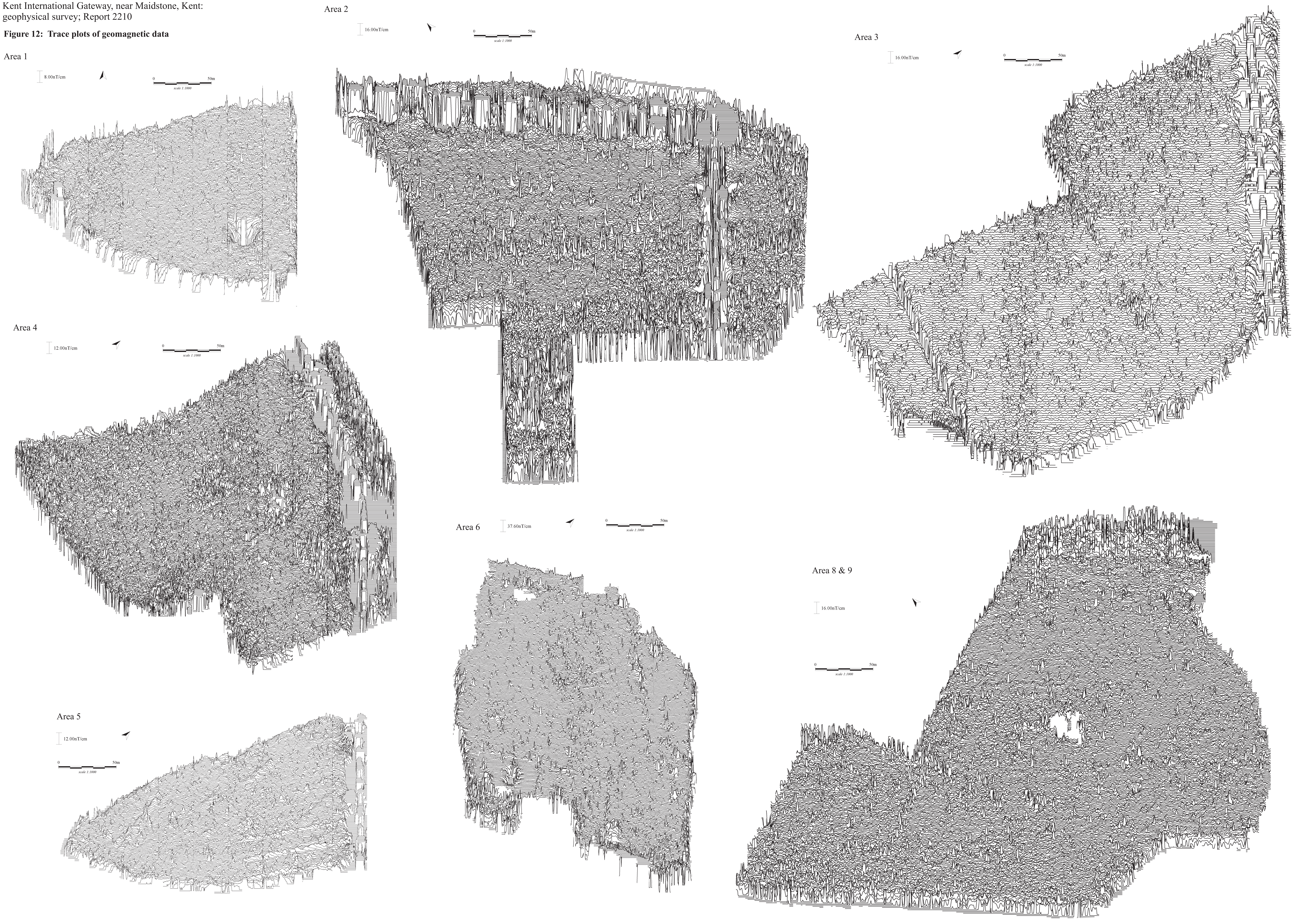

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Figure 13: Trace plots of geomagnetic data