Note: Outline Planning Application (OPA) Site Boundary

The following report was produced prior to the finalisation of the application site boundary. The final application site boundary is shown on Figure 1.1 in ES Appendix 1.1. Therefore, references within the report to the site boundary do not reflect the site area and site boundary submitted with the OPA.

The reports were correct at the time of preparation, and all information within the Environmental Statement assessment reflects the latest relevant information.

GEOPHYSICAL SURVEY REPORT

GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Otterpool, Kent

Client
Oxford Archaeology

For
Arcadis

Survey Report
11903

Date
January 2018

Incorporating

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and

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GEOPHYSICAL SURVEY REPORT

Project name:
Otterpool, Kent

SUMO Job reference:
11903

Client:
Oxford Archaeology
For:
Arcadis

Survey date:
Oct – Dec 2017

Report date:
24 Jan 2018

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Jon Tanner BSc MSc PCIfA

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TABLE OF CONTENTS

LIST OF FIGURES

DIGITAL CONTENT (Archive Data CD/DVD)

- Minimally Processed Greyscale Images and XY Trace Plots in DWG format
- Digital Copies of Report Text and Figures (both PDF and native formats)

1 SUMMARY OF RESULTS

This report covers the results from a 220ha magnetic survey over scattered parcels of land at Otterpool, Kent. Prior to the survey, four ring ditch features were known from aerial photographs to lie within the footprint of the geophysical blocks. In addition to identifying these four rings, three extra similar sites have been recorded. Furthermore, several archaeological complexes / foci have been successfully mapped. These include numerous ditched enclosures and tracks / droveways and several extensive field systems, possible small settlements and a wide track with numerous pits of unknown function. The small settlements are possibly Iron Age or earlier farmsteads, and the results from one area are very tentatively likened to a small Roman villa.

In addition to recording archaeological features, the survey has identified old boundaries, land drains, service pipes, possible areas of UXO, and mapped differing geological responses, including a former river / stream channel.

2 INTRODUCTION

2.1 Background synopsis

The work was commissioned by Oxford Archaeology via Arcadis who acting on behalf of Folkestone & Hythe District Council and Cozumel Estates. It was undertaken prior to an outline planning application for a new garden settlement – Otterpool Park – to accommodate up to 8,500 homes(use class C2 and C3) and use class D1, D2, A1, A2, A3, A4, B1a, B1b, B2, C1 development with related highways, green and blue infrastructure (access, appearance, landscaping, layout and scale matters to be reserved).

2.2 Site details

NGR / Postcode	220 ha area centred on TR119 361 / CT21 4JD
Location	The Site comprises a large area of land between the M20 and the B2067 and Aldington Road close to the village of Lympne, Kent and bisected by the A20 Ashford Road.
HER/SMR	Kent
District	Folkestone and Hythe
Parish	Saltwood: Areas 1 & 2 Lympne: Areas 5(S), 6, 7, 8, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28 Stanford: Area 18 Sellindge: Areas 3, 5(N),12, 13, 17
Topography	A gently undulating landscape
Current Land Use	Agricultural and recreational, plus the edge of residential, industrial and commercial areas
Geology / soils	Solid: sandstones and limestones of the Hythe Formation; sandstone, siltstone and mudstone of the Sandgate Formation; sandstone of the Folkestone Formation, and mudstones of the Atherfield Clay and Weald Clay Formations. Superficial: head clay deposits and silts and clay, silt, sand and gravel alluvium along the course of the East Stour River (BGS 2018).
Archaeology	The Archaeological Zones are taken from the *Archaeological Appraisal and Fieldwork Strategy* (*AAAFS*) document (Arcadis 2017).

Zone B: Prehistoric ring ditches in the centre of this zone. Archaeology remains relating to settlement activity likely in the vicinity. Medieval Harringe Court – potential for archaeological remains.

Zone D: Two known barrow sites (probably Bronze Age). Settlement activity could extend into areas around each barrow. Evidence could date from periods either side.

Zone F: Roman Road of Stone Street: Some potential for isolated Roman finds around this feature.

Zone G: Neolithic axe found in centre. Likely to be an isolated find.

Zone H: Roman Road of Stone Street: Some potential for isolated Roman finds around this feature.

Survey Methods	Magnetometer survey (fluxgate gradiometer) hand held and cart
Study Area	220 ha

2.3 Aims and Objectives

To locate and characterise any anomalies of possible archaeological interest within the study area. The work forms part of an ongoing archaeological evaluation of this large development site.

3 METHODS, PROCESSING & PRESENTATION

3.1 Standards & Guidance

This report and all fieldwork have been conducted in accordance with the latest guidance documents issued by Historic England (EH 2008) (then English Heritage), the Chartered Institute for Archaeologists (CIfA 2014) and the European Archaeological Council (EAC 2016).

3.2 Survey methods

Detailed magnetic survey was chosen as an efficient and effective method of locating archaeological anomalies.

Technique	Instrument	Traverse Interval	Sample Interval
Magnetometer	Bartington Grad 601-2	1.0m	0.25m
Magnetometer	Cart System	1.0m	0.125m

More information regarding this technique is included in Appendix A.

3.3 Data Processing

The following basic processing steps have been carried out on the data used in this report:

De-stripe; de-stagger; interpolate

3.4 Presentation of results and interpretation

. The presentation of the results for each site involves a grey-scale plot of processed data. Magnetic anomalies are identified, interpreted and plotted onto the 'Interpretation' drawings. The minimally processed data are provided as a greyscale image in the Archive Data Folder with an XY trace plot in CAD format. A free viewer is available: https://viewer.autodesk.com

When interpreting the results, several factors are taken into consideration, including the nature of archaeological features being investigated and the local conditions at the site (geology, pedology, topography etc.). Anomalies are categorised by their potential origin. Where responses can be related to other existing evidence, the anomalies will be given specific categories, such as: *Abbey Wall* or *Roman Road*. Where the interpretation is based largely on the geophysical data, levels of confidence are implied, for example: *Probable*, or *Possible Archaeology*. The former is used for a confident interpretation, based on anomaly definition and/or other corroborative data such as cropmarks. Poor anomaly definition, a lack of clear patterns to the responses and an absence of other supporting data reduces confidence, hence the classification *Possible*.

4 RESULTS

The survey has been divided into twenty-eight survey areas (Areas 1-28) but Areas 9, 10, 11, 14, 15 and 16 were subsequently removed from the project). Specific anomalies have been given numerical labels [1] [2] *which appear in the text below, as well as on the Interpretation Figures. The results are discussed numerically by Area. Numbers in (114) refer to known archaeological features recorded in the AAAFS document.*

4.1 *Area 1 / Figures 5 & 6 / Archaeology Zone F*

No magnetic responses have been recorded that could be interpreted as being of archaeological interest. A cropmark enclosure (1*12*) is recorded in the field immediately to the north but there is no evidence for any associated features in the dataset extending into this survey area.

4.2 *Area 2 / Figure 7 / Archaeology Zone F*

No magnetic responses have been recorded that could be interpreted as being of archaeological interest.

4.3 *Area 3 / Figures 8 & 9 / Archaeology Zone B*

There is a small ring ditch at [1] measuring approximately 12m in diameter, with possible adjoining ditches (though the latter are poorly defined). To the north-east is a second ring feature [2], 15m across, and once again this appears to be associated with weak linear responses indicative of ditches. A series of linear trends are visible at [3] which indicate ditch / field systems presumably originally associated with the nearby ring ditches.

An early course [4] of a tributary to the East Stour River is probably the cause of the band of natural responses running through Area 3.

4.4 ***Area 4 / Figure 10 / Archaeology Zone B***

A curvilinear anomaly [5] could indicate part of an oval shaped enclosure which appears to extend to the north outside of the site. There are several linear and rectilinear responses [6] which may represent a series of paddocks or a field system; the results are part of an archaeological complex identified in Area 5 to the south.

4.5 ***Area 5 / Figures 11,12, 13 & 14 / Archaeology Zone B*** *A small circular feature is recorded directly to the east – it may relate to RAF Lympne*

Linear and rectilinear anomalies [7] in the north-east of this survey area form a complex of small enclosures and paddocks, with probable trackways and pit-like features. This extends into Area 4 (above). There appears to be a gap where there are no ditches, but the results are confused by the presence of a series of land drains which are scattered throughout the area. A small cluster of anomalies [8] have been interpreted as being uncertain in origin, but they may just be burnt features given the context of the responses.

It is possible that the linear responses at and around [9] form a large, but incomplete, enclosure with associated tracks or droveways. However, the responses are poorly defined, and the full extent of any feature is confused by numerous natural striations in the data. To the east is a stronger L-shaped anomaly [10]; this appears to join with [9]; if correct then it is tempting to interpret the poorly defined trends [11] as forming a smaller, internal enclosure, but this is tentative.

There is a long linear anomaly [12] which may be a prehistoric boundary and at [13] a smaller cluster of responses / trends which have some archaeological potential.

Further to the south are two more small clusters of anomalies which appear to be of archaeological interest. One at [14] comprises three conjoined ditch lengths and possible internal features set within an open-sided rectilinear enclosure. The other group [15] is not so clear but the results suggest a second enclosure; once again natural striations are confusing the picture.

4.6 ***Area 6 / Figures 15 & 16 / Archaeology Zone H***

There is a well-defined length of ditch [16] in the west of this survey area and it is possible that it forms one side of an enclosure, if it is associated with a similar response in Area 7 [19]. Several short ditch lengths and other features [17] are clearly part of the complex [18] also in Area 7.

4.7 ***Area 7 / Figures 15 & 16 / Archaeology Zones G and H***

The rectilinear features at [18] (which extend into Area 6) could indicate a small farmstead or settlement. The magnetic responses are not totally dissimilar to results found on small Roman villa sites, but there is usually far more magnetic enhancement. Therefore, unless the area has been badly plough-damaged, any such interpretation is speculative. Ditch [19] has already been referred to as possibly forming an enclosure with a ditch [16].

A semi-circular trend in the data [20] has clear archaeological potential despite the weak magnetic response; a ditch may extend to the north.

4.8 ***Area 8 / Figures 15 & 16 / Archaeology Zone G***

No magnetic responses have been recorded that could be interpreted as being of archaeological interest.

4.9 ***Area 9 excluded from project.***

4.10 ***Area 10 excluded from project.***

4.11 ***Area 11 excluded from project.***

4.12 ***Area 12 / Figure 17 / Archaeology Zone B***

No magnetic responses have been recorded that could be interpreted as being of archaeological interest.

4.13 ***Area 13 / Figure 17 / Archaeology Zone B***

No magnetic responses have been recorded that could be interpreted as being of archaeological interest.

4.14 ***Area 14 excluded from project***

4.15 ***Area 15 excluded from project***

4.16 ***Area 16 excluded from project***

4.17 ***Area 17 / Figures 18 & 19 / Archaeology Zone B*** *Three round barrows (58, 113 and 115) are recorded on aerial photographs, as is a double ditched feature (114).*

A number of ring ditches have been identified in the magnetic data; these are listed below, starting in the north and moving south.

A single ring *c.*17m diameter [21] - *not previously recorded.*

A single, slightly irregular ring *c.*15m diameter – poorly defined on the south [22] - *not previously recorded.*

A large, single ring *c.*60m diameter – with tentative curving ditches / gullies inside [23] - *barrow 58.*

An annular response c.40-45m across – only the southern side is visible magnetically; there may be an internal gulley / ditch [24] - *barrow 113.*

A single, slightly irregular ring *c.*30m in diameter [25] - *not previously recorded.*

A double ring ditch; outer ring *c.*40m and inner ring *c.*30m in diameter [26] - *feature 114.*

A single, slightly irregular ring c.17m diameter [27] - *barrow 115.*

Therefore, three new rings have been identified and whilst some appear to have internal gullies or ditches, it is unclear whether there are internal pits as there are numerous such responses in the dataset which could be archaeological or natural. Thus interpretation remains uncertain.

In addition to the 'new' rings, the magnetic data have identified three new archaeological foci or clusters. There is a swathe of ditches and enclosures [28] which would seem to indicate fields, paddocks and possible dwellings aligned along a meandering 'track'. There are also many large pit-like anomalies which clearly respect the line of the ditches and as such the interpretation of the whole complex is uncertain, but definitely of archaeological interest. To the south of this is a large, irregularly shaped enclosure ditch [29] and numerous other ditch features which suggest multi-phased activity, either related to [28] or possibly to [23]. Similarly, it is unclear how the features relate to the third focus of features [30] which comprise another irregular enclosure and numerous ditches, again indicative of differing periods of activity. Whether it is contiguous with [23] and [24] is impossible to say, based on the geophysics alone.

4.18 ***Area 18 / Figure 20 / Archaeology Zone D***

No magnetic responses have been recorded that could be interpreted as being of archaeological interest.

4.19 ***Area 19 / Figures 21 & 22 / Archaeology Zone H***

No magnetic responses have been recorded that could be interpreted as being of archaeological interest.

4.20 ***Area 20 / Figures 23 & 24 / Archaeology Zone H***

No magnetic responses have been recorded that could be interpreted as being of archaeological interest.

4.21 ***Area 21/ Figures 23 & 24 / Archaeology Zone H***

No magnetic responses have been recorded that could be interpreted as being of archaeological interest.

4.22 ***Area 22 / Figures 23 & 24 / Archaeology Zone H***

No magnetic responses have been recorded that could be interpreted as being of archaeological interest.

4.23 ***Area 23 / Figures 25 & 26 / Archaeology Zone H***

Linear and rectilinear anomalies [31] form a cluster of small enclosures similar to those in Area 5 [7]; they are clearly of archaeological interest, but it is not known what period they might date from.

4.24 ***Area 24 / Figures 23 & 24 / Archaeology Zone H***

No magnetic responses have been recorded that could be interpreted as being of archaeological interest.

4.25 ***Area 25 / Figure 27 / Archaeology Zone H***

No magnetic responses have been recorded that could be interpreted as being of archaeological interest.

4.26 ***Area 26 / Figures 25 & 26 / Archaeology Zone H***

No magnetic responses have been recorded that could be interpreted as being of archaeological interest.

4.27 ***Area 27 / Figures 25 & 26 / Archaeology Zone H***

No magnetic responses have been recorded that could be interpreted as being of archaeological interest.

4.28 ***Area 28 / Figures 25 & 26 / Archaeology Zone H***

No magnetic responses have been recorded that could be interpreted as being of archaeological interest.

4.29 ***Uncertain***

It is inevitable that on a survey of such size, there will be numerous responses that are difficult to interpret with high degrees of confidence; they could be archaeological, agricultural, modern or natural. As a consequence, such responses are assigned to this category – *Uncertain.* While they are not generally thought to represent archaeological features, the fact that certain areas have clear concentrations of archaeological responses (many of which appear to be plough damaged) means that an archaeological interpretation cannot be ignored.

4.30 ***Former Field Boundary***

A number of old field boundaries have been identified; where there is supporting map evidence they are recorded as 'corroborated' otherwise, even though they follow clear field divisions, they are 'uncorroborated'. The results are confusing in places as sometimes boundaries are visible as both negative and positive magnetic responses, a difference which reflects the nature of the backfill or original material used in construction.

4.31 ***Agricultural – Ploughing / Land Drains***

Parallel trends in the data reflect modern ploughing; there is no evidence for any ridge and furrow cultivation practices in the results.

Numerous land drains are visible in the data from many of the survey areas and they are usually depicted by lines of small dipole anomalies, either isolated or in small groups. In Areas 20, 21 and 24 the drains are particularly clear and follow a 'classic' herringbone pattern.

4.32 ***Natural / Geological / Pedological / Topographic***

Localised variations in the magnetic properties of the differing bedrocks and soils result in changes in the 'background' levels of magnetic 'noise'. Sometimes the differences are quite subtle but on other occasions the results have a marked effect on the data. In Areas 3 and 17, for example, two effects are clearly visible. The course of a former tributary of the East Stour River has already been referred to in Area 3, anomaly [4], and this clearly follows the western boundary of Area 17; old alluvial deposits are clearly visible as a zone of amorphous magnetic responses within a channel. Elsewhere in Area 17 the natural responses comprise

linear striations which reflect the bedrock formation; they are particularly strong here compared to similar responses in Areas 5, 7, 12, 13, 19 and 25.

4.33 ***Ferrous / Magnetic Disturbance***

There are numerous scattered, isolated strong ferrous responses, which, in the absence of any other evidence, are all assumed to be modern in origin. Sometimes such responses reflect former tracks or field boundaries, as is possibly the case in Areas 7 and 25.

The ferrous responses in Area 18 are slightly different as they create a 'pock-marked' effect throughout the field; it is possible that this could indicate UXO. In Area 5 there are clusters of ferrous responses which could also indicate UXO, especially as this area is recorded as having high potential for unexploded debris (T Allen *pers. comm*.) but precise locations are not known. (The '*UXO Desk Study and Risk Assessment'* Zetica Ltd., May 2017, may indicate that other areas with ferrous noise are be considered to have UXO potential).

Small service pipes are recorded in many of the survey areas.

Ferrous responses close to boundaries are due to adjacent fences and gates. Smaller scale ferrous anomalies ("iron spikes") are present throughout the data and their form is best illustrated in the XY trace plots. These responses are characteristic of small pieces of ferrous debris (or brick / tile) in the topsoil and are commonly assigned a modern origin. Only the most prominent of these are highlighted on the interpretation diagram.

5 DATA APPRAISAL & CONFIDENCE ASSESSMENT

5.1 Historic England guidelines (EH 2008) Table 4 states that the average magnetic response on the local geologies is poor to good. The results from this survey suggest that the nature of the surviving archaeology has a greater effect on the success of the technique rather than the local geology.

6 CONCLUSION

6.1 The magnetic survey has confirmed the location of four previously recorded ring ditches and identified a further three such features. Settlement / farmstead complexes have also been mapped together with tracks and droveways. In one instance there are alignments of pits following a meandering course across the fields.

In addition to recording archaeological features, the survey has identified old boundaries, land drains, service pipes and possible areas of UXO. It is also possible to see differing geological responses, including a former river / stream channel, in the magnetic data.

7 REFERENCES

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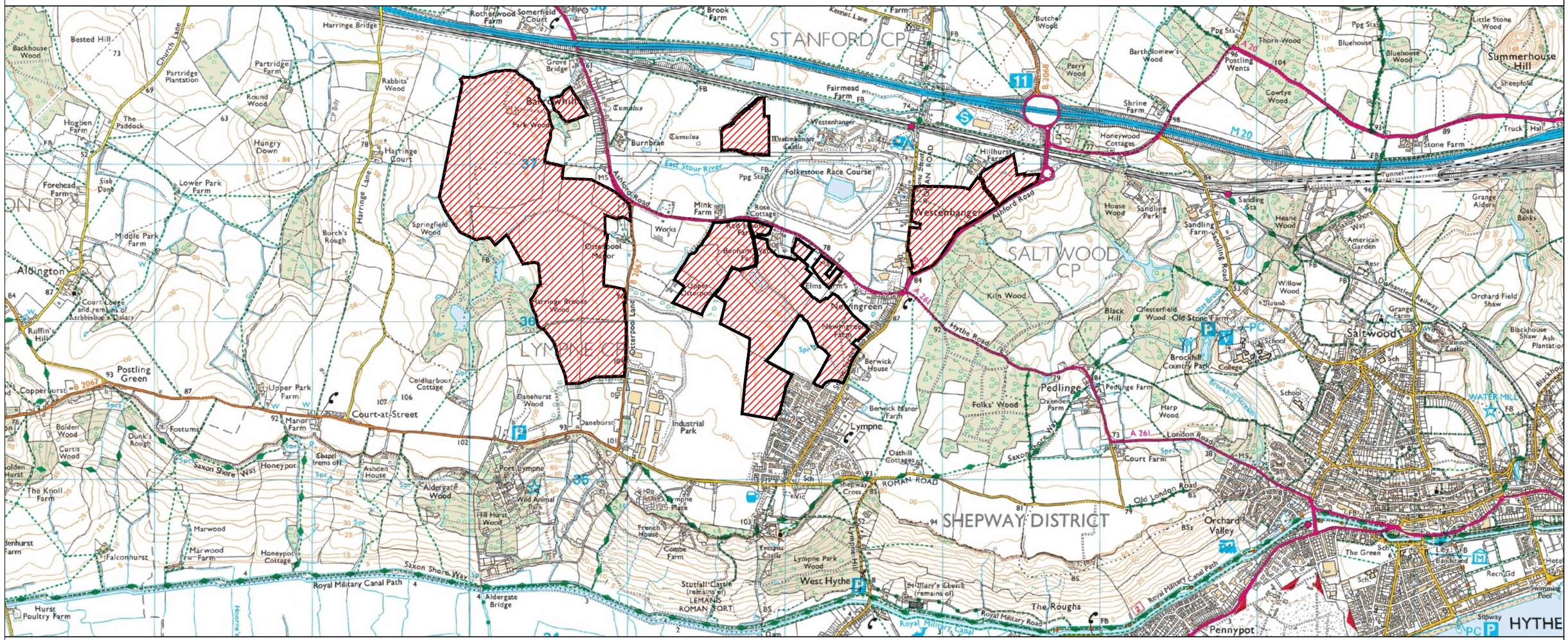
EH 2008 *Geophysical Survey in Archaeological Field Evaluation.* English Heritage, Swindon https://content.historicengland.org.uk/images-books/publications/geophysical-survey-in-archaeological-field-evaluation/geophysics-guidelines.pdf/



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Site Location

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sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title: Site Location Diagram

Client: Oxford Archaeology

Project: 11903 Otterpool

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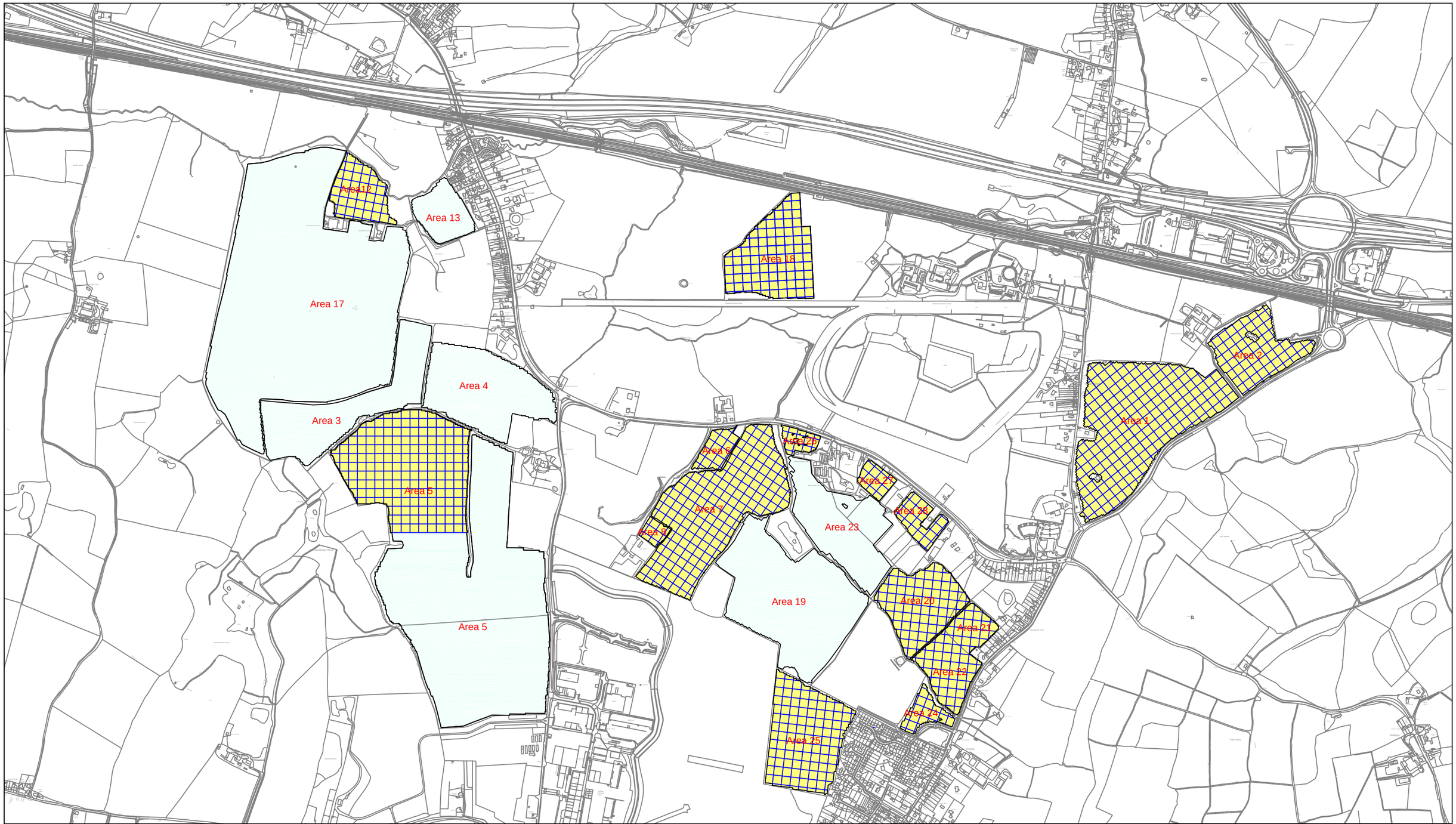

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Hand-held magnetometer survey areas showing 30m grids

Cart-mounted magnetometer survey areas

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title: Location of Survey Areas

Client: Oxford Archaeology

Project: 11903 Otterpool

Scale: 0 metres 625
1:12500 @ A3

Fig No: 02

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sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title:
Magnetometer Survey [All Areas]
Greyscale Plots

Client:
Oxford Archaeology

Project:
11903 Otterpool

Scale:
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Fig No:
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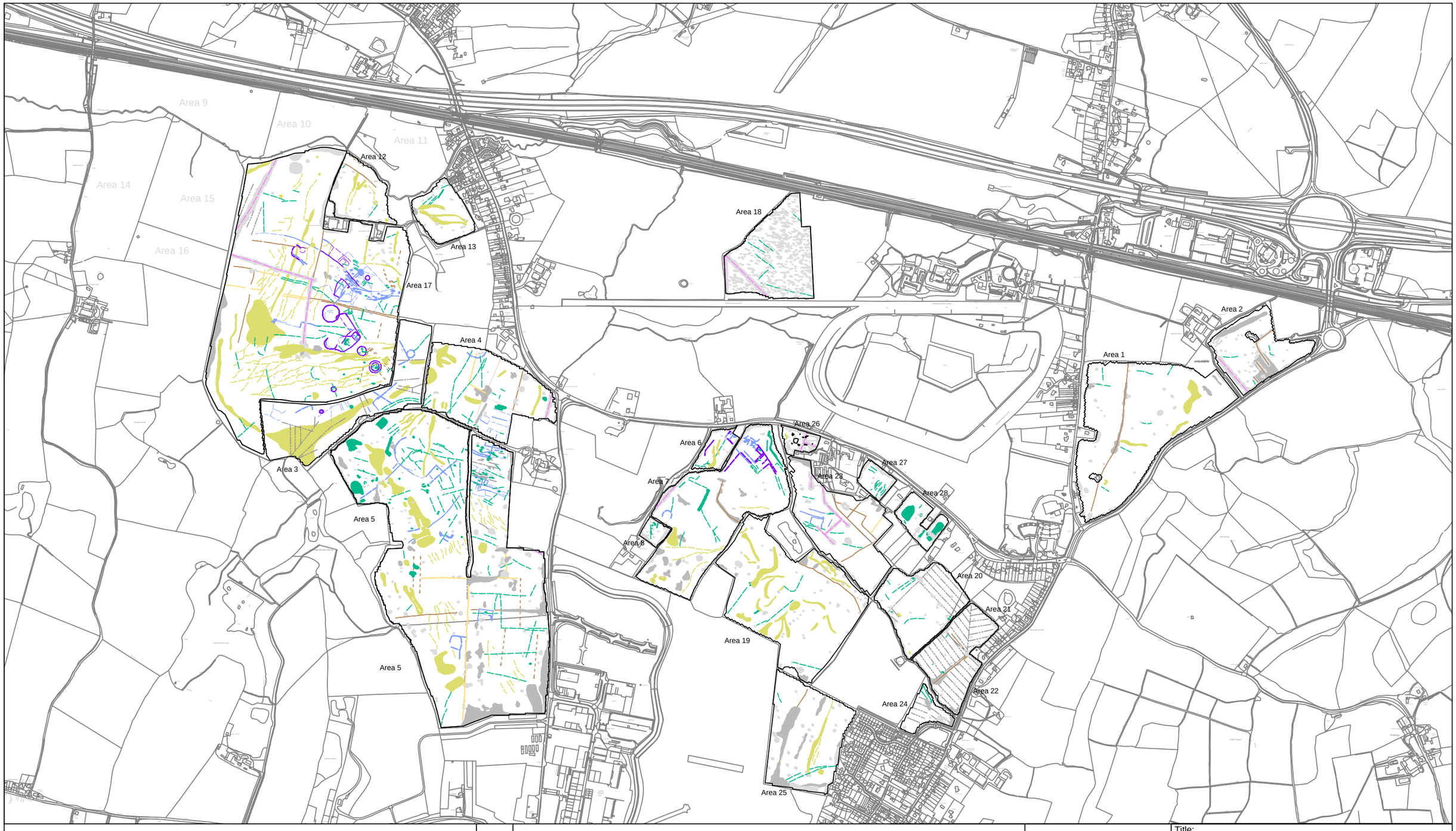

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KEY

	Probable Archaeology (discrete / trend)		Former Field Boundary (corroborated / conjectural)
	Possible Archaeology (discrete / trend / zone)		Agricultural / ploughing
	Uncertain Origin (discrete / trend / zone)		Pipe / Drain
	Natural (discrete / zone)		Ferrous / Magnetic Disturbance

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title: Magnetometer Survey [All Areas] Interpretation

Client: Oxford Archaeology

Project: 11903 Otterpool

Scale: 0 metres 625
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Fig No: 04

Area 1

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sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title:
Magnetometer Survey [Area 1]
Greyscale Plot

Client:
Oxford Archaeology

Project:
11903 Otterpool

Scale:
0 metres 125
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Fig No:
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KEY

	Former Field Boundary - Corroborated
	Uncertain (trend)
	Natural
	Ferrous / Magnetic Disturbance

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GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

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Project: 11903 Otterpool

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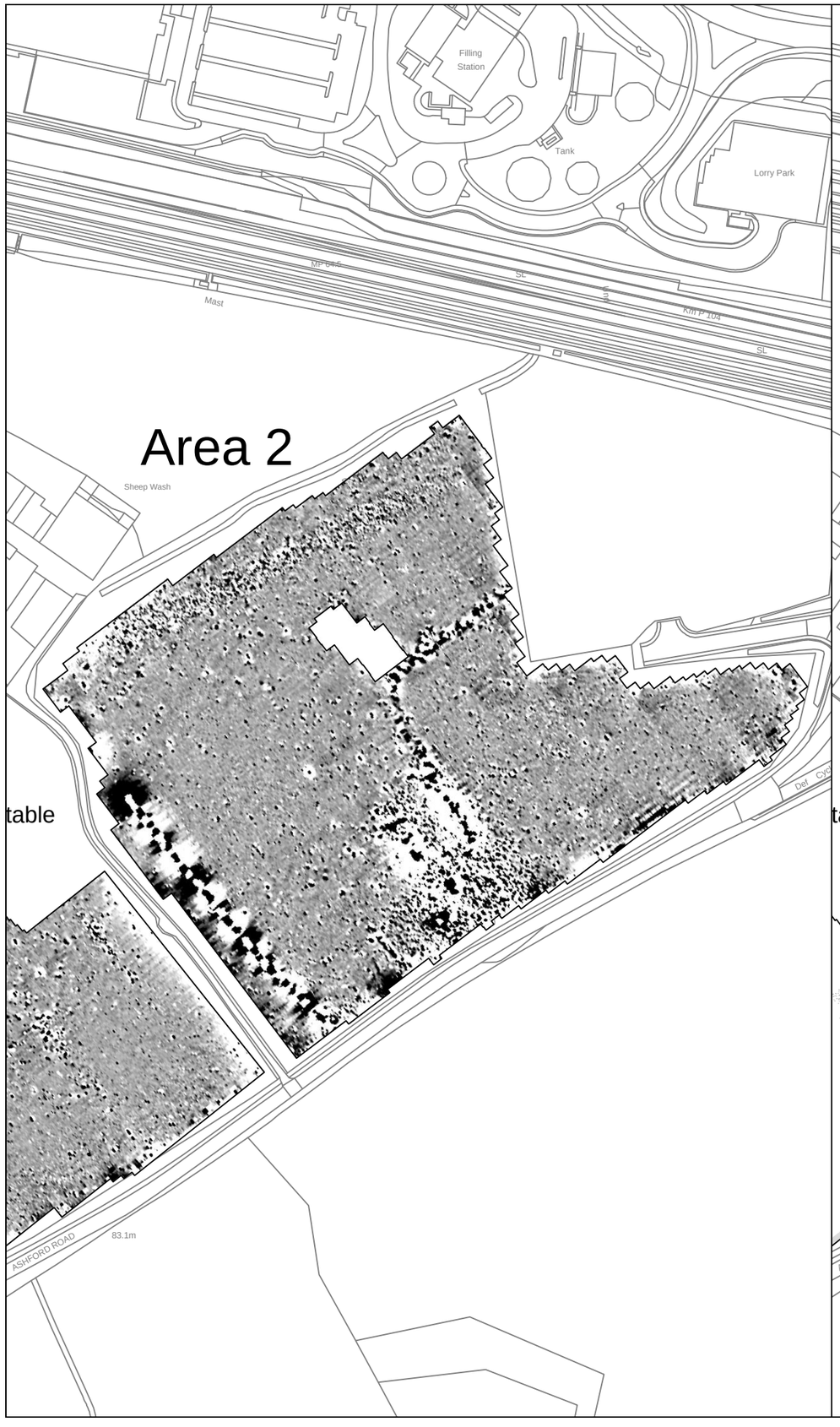

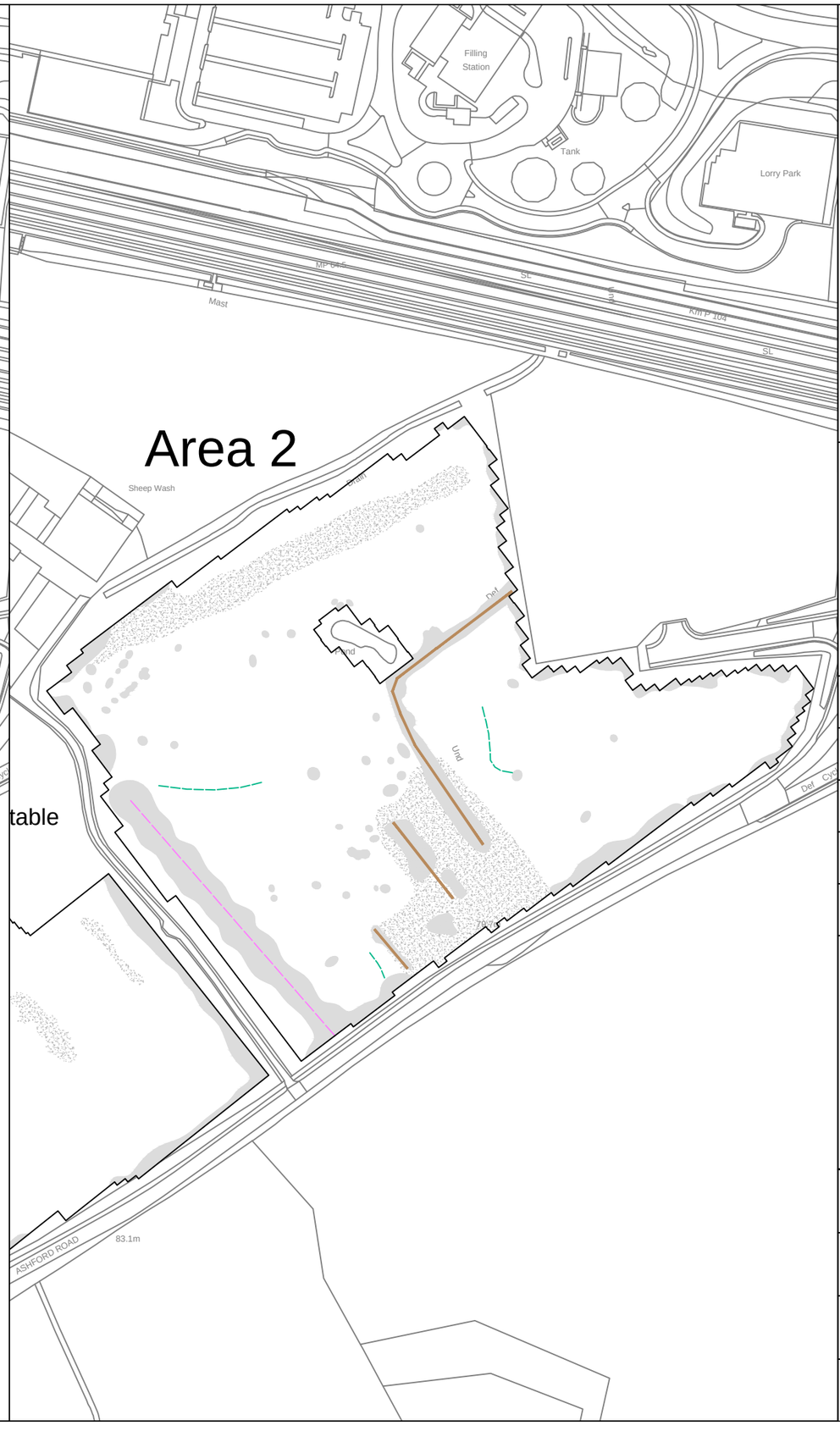

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KEY

	Former Field Boundary - Corroborated
	Uncertain (trend)
	Pipe
	Ferrous / Magnetic Disturbance

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title:
Magnetometer Survey [Area 2]
Greyscale Plot and Interpretation

Client:
Oxford Archaeology

Project:
11903 Otterpool

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Fig No:
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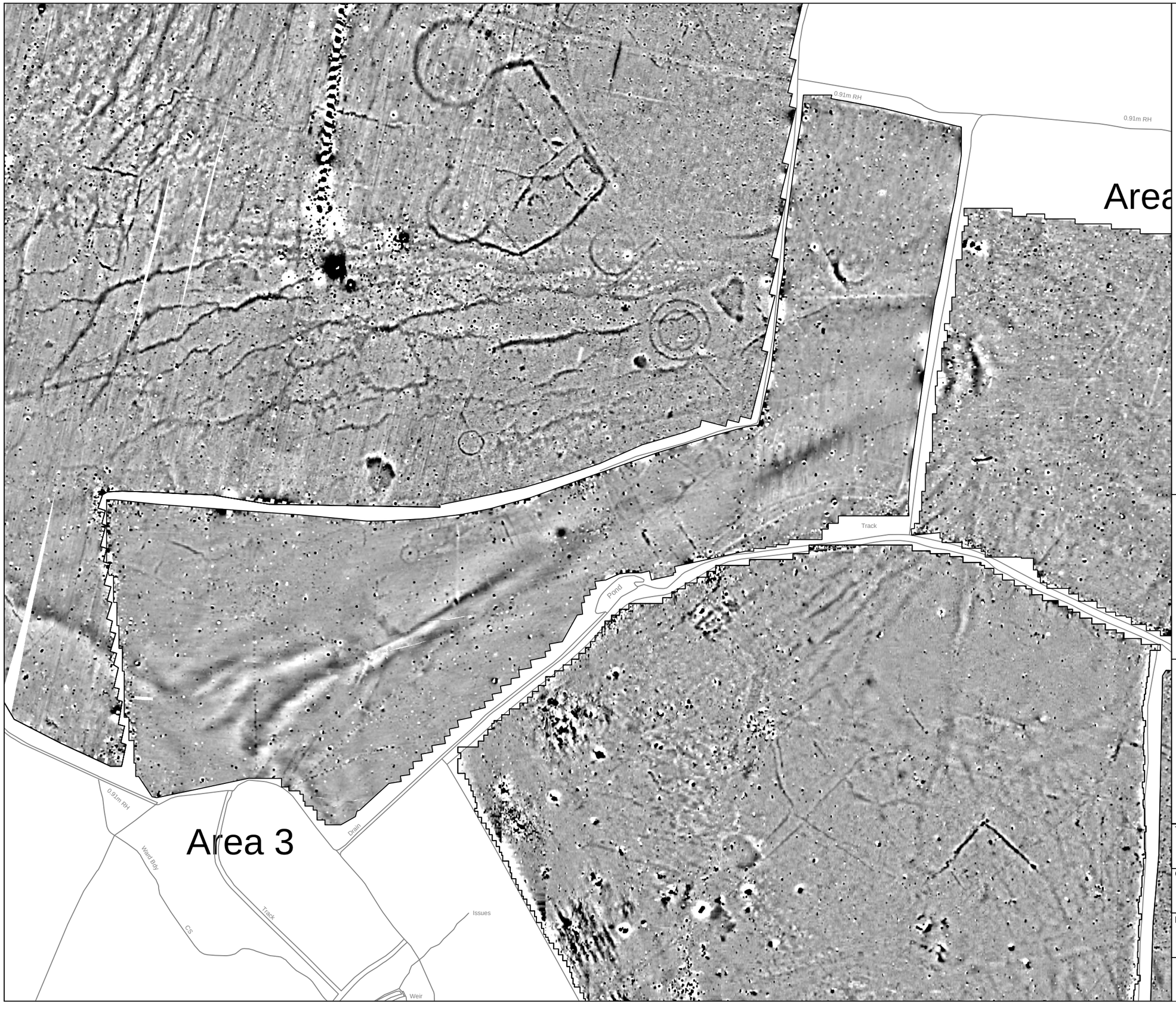

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sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title:
Magnetometer Survey - [Area 3]
Greyscale Plot

Client:
Oxford Archaeology

Project:
11903 Otterpool

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Fig No:
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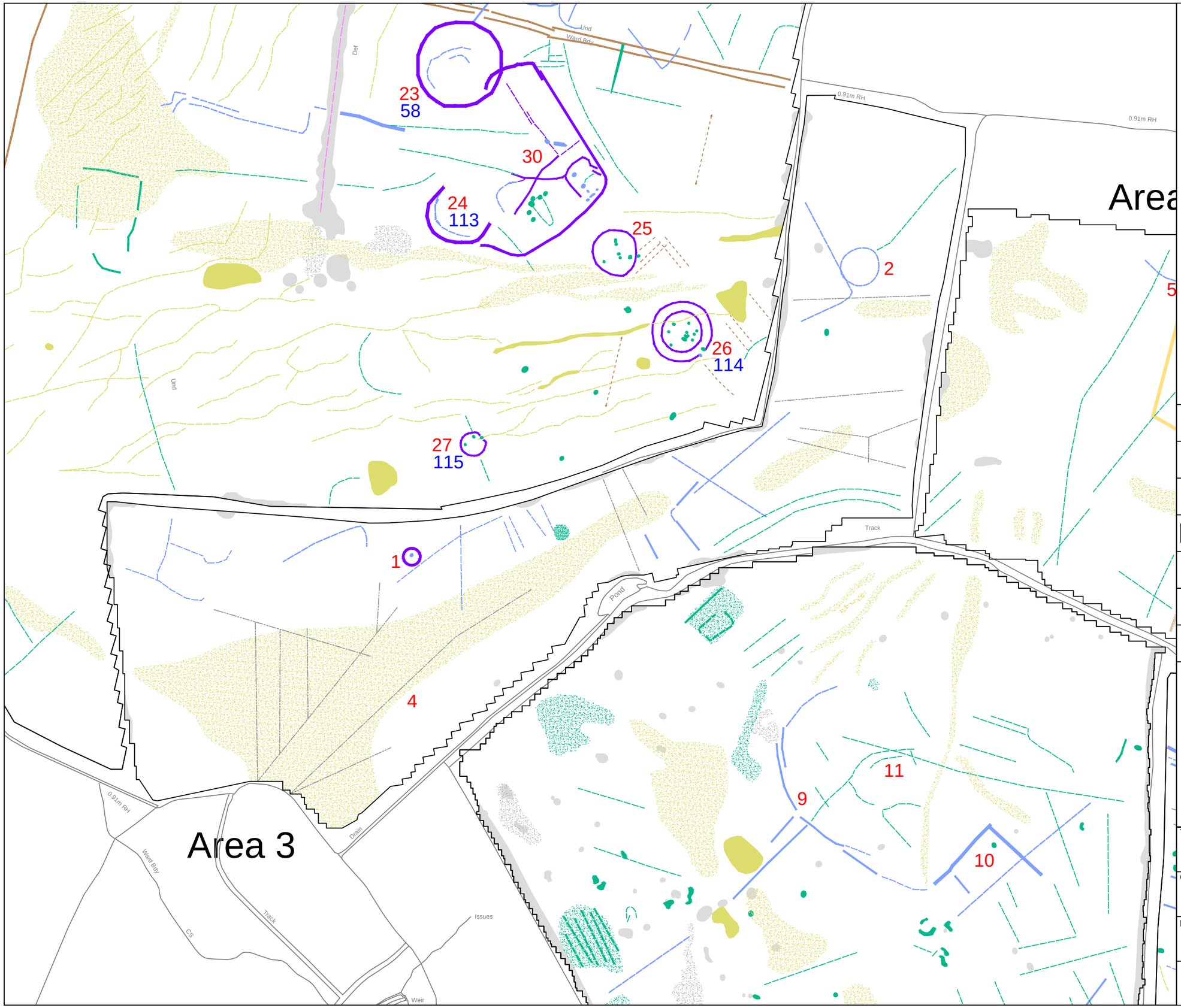

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KEY

- Probable Archaeology (discrete)
- Possible Archaeology (discrete / trend)
- Uncertain (discrete / trend / zone)
- Natural
- Drain
- Ferrous / Magnetic Disturbance

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

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Client: Oxford Archaeology

Project: 11903 Otterpool

Scale: 0 metres 125
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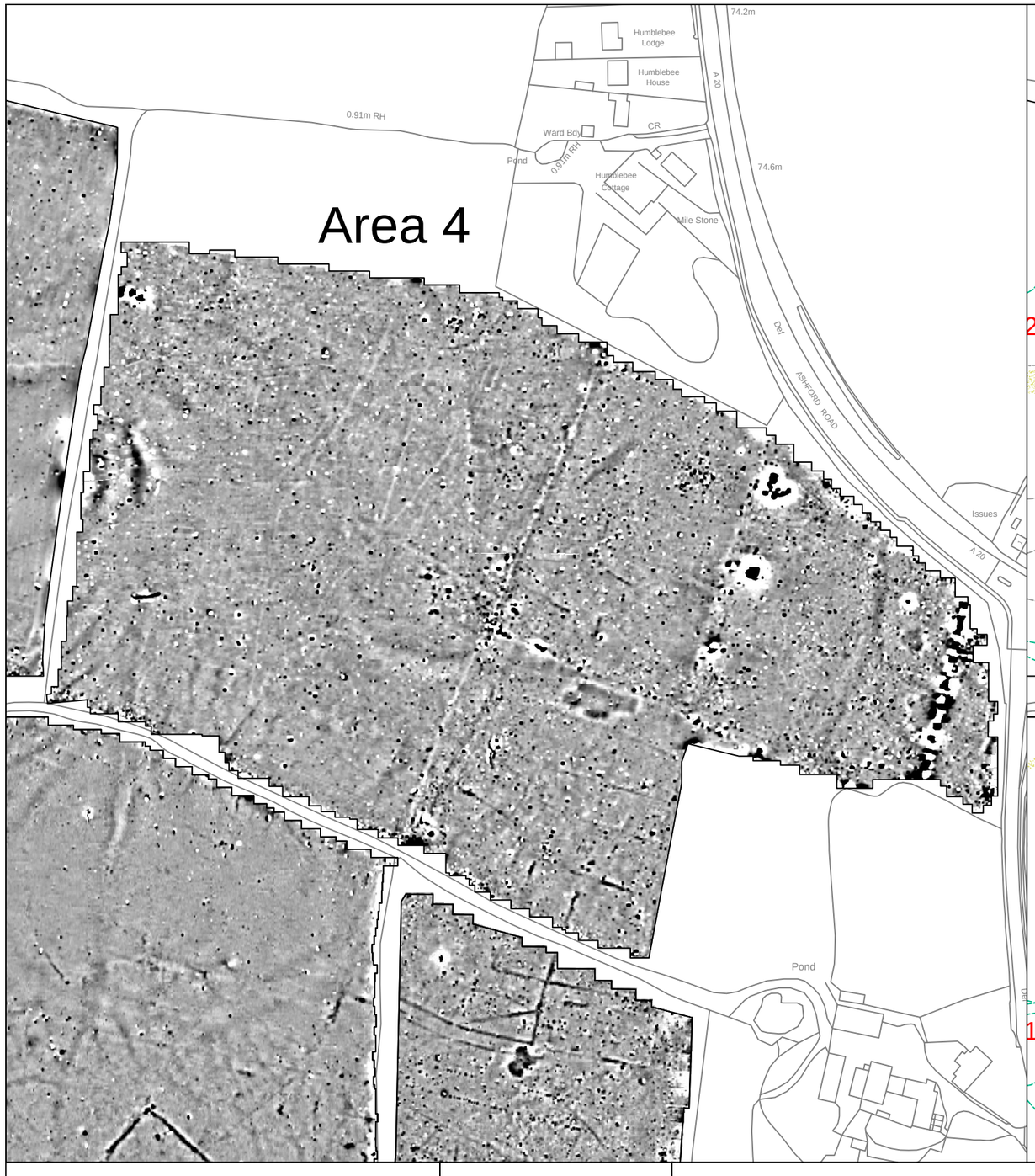

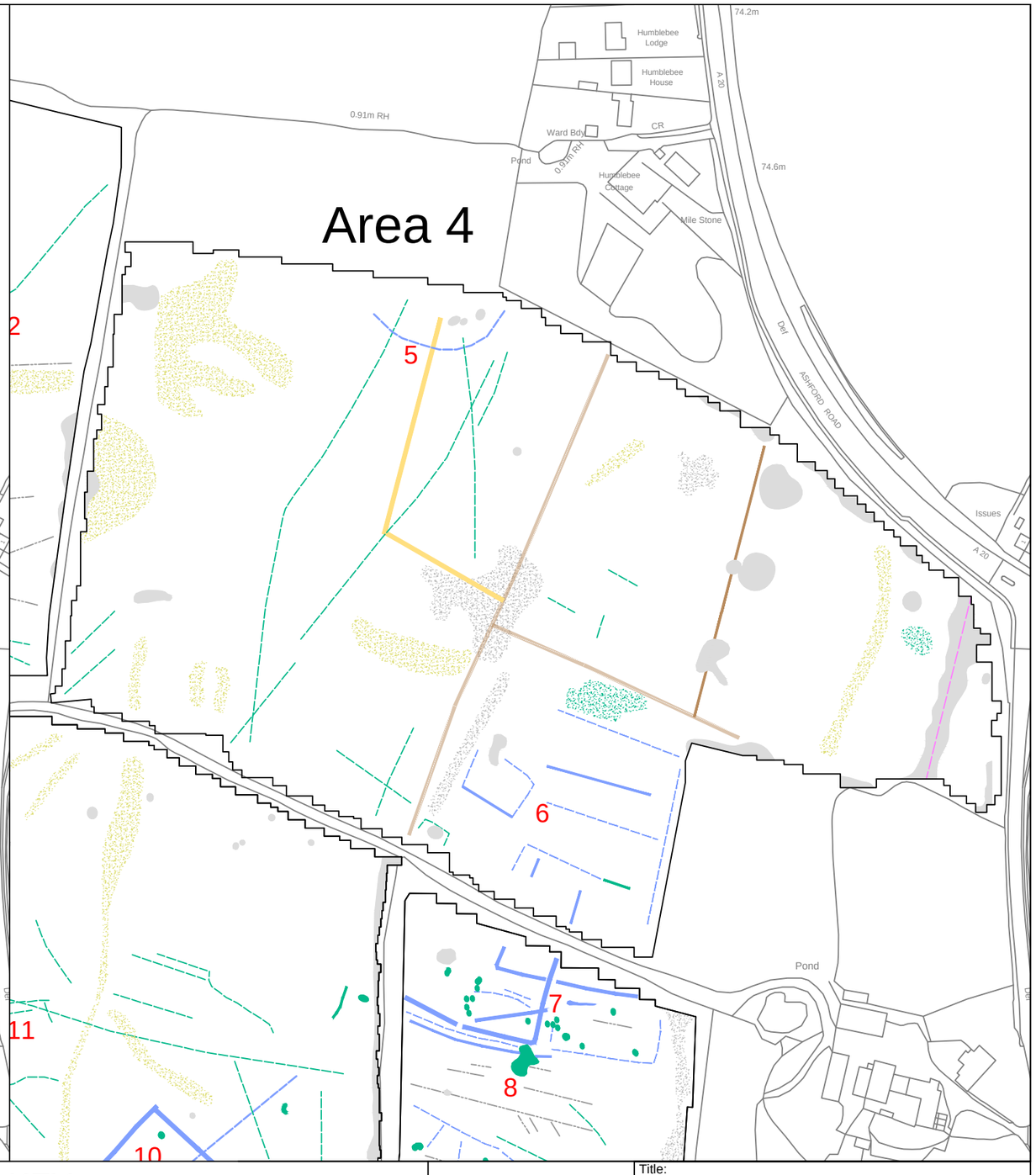

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	Uncertain origin (discrete / trend / zone)		Pipe
	Former Field Boundary - corroborated		Magnetic Disturbance
	Former Field Boundary - conjectural		Ferrous

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

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Greyscale Plot and Interpretation

Client: Oxford Archaeology

Project: 11903 Otterpool

Scale: 0 metres 125
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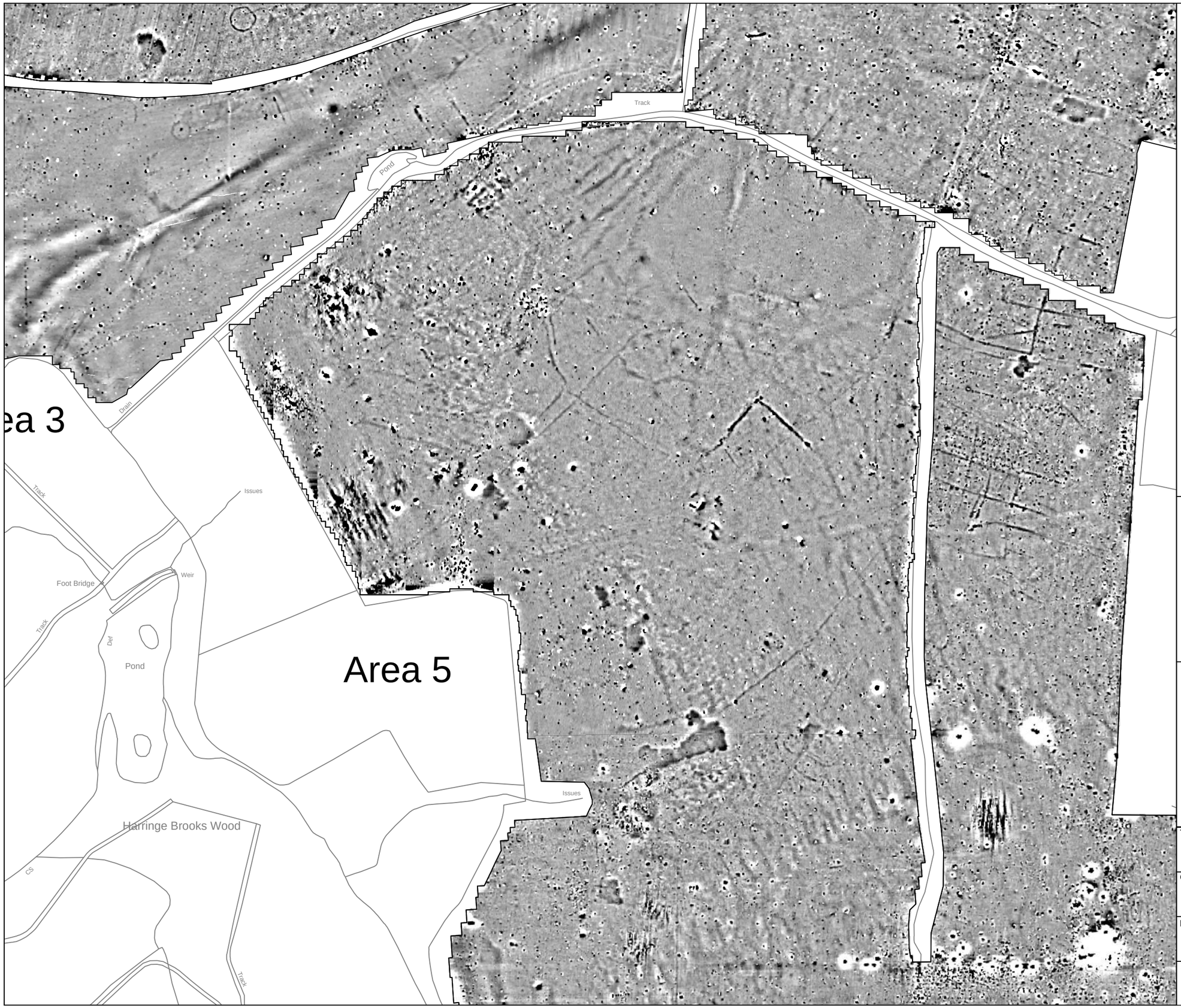
Fig No: 10



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sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

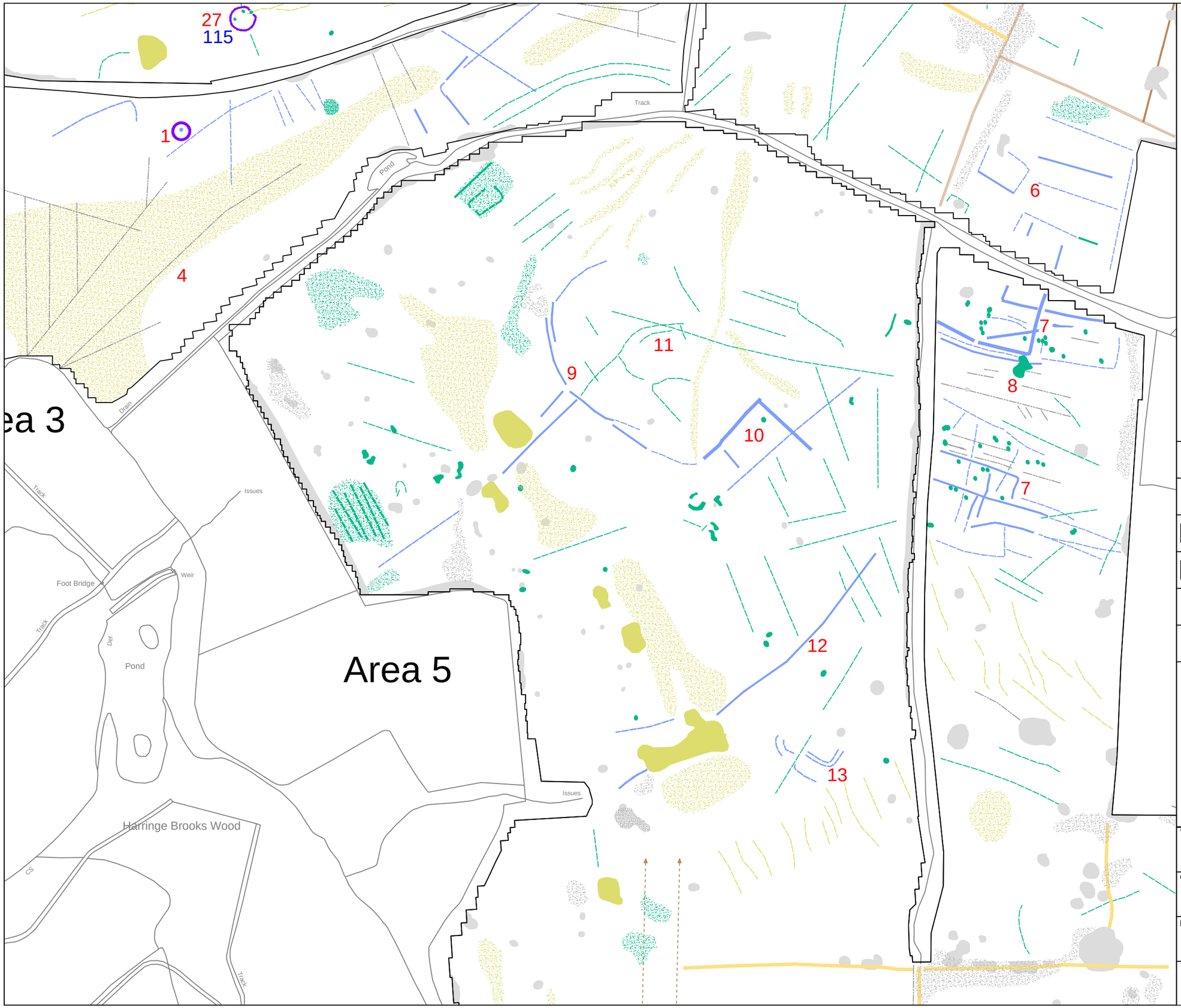
Title:
Magnetometer Survey - [Area 5 North]
Greyscale Plot

Client:
Oxford Archaeology

Project:
11903 Otterpool

Scale:
0 metres 125
1:2500 @ A3

Fig No:
11



KEY

	Possible Archaeology (discrete / trend)
	Uncertain origin (discrete / trend / zone)
	Natural (discrete / zone / trend)
	Former Field Boundary (conjectural)
	Ferrous / Magnetic Disturbance

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title:
Magnetometer Survey - [Area 5 North]
Interpretation

Client:
Oxford Archaeology

Project:
11903 Otterpool

Scale:
0 metres 125
1:2500 @ A3

Fig No:
12

N

2
nT
-1

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

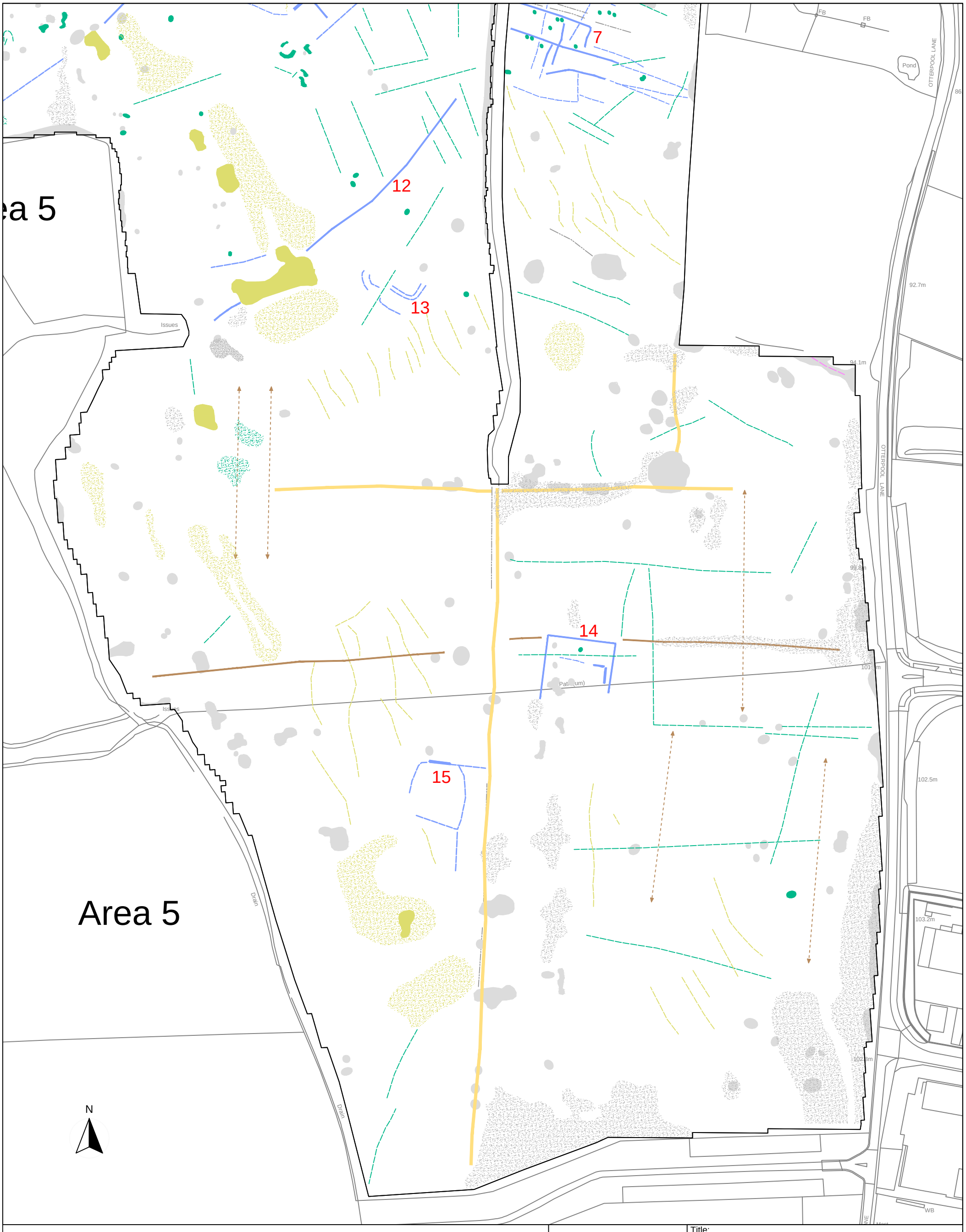
Title: Magnetometer Survey [Area 5 South] Greyscale Plot

Client: Oxford Archaeology

Project: 11903 Otterpool

Scale: 0 metres 125
1:2500 @ A3

Fig No: 13



KEY

	Possible Archaeology (discrete / trend)		Former Field Boundary (corroborated / conjectural)
	Uncertain origin (discrete / trend / zone)		Drain
	Natural (discrete / trend / zone)		Ferrous / Magnetic Disturbance
	Agricultural		

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

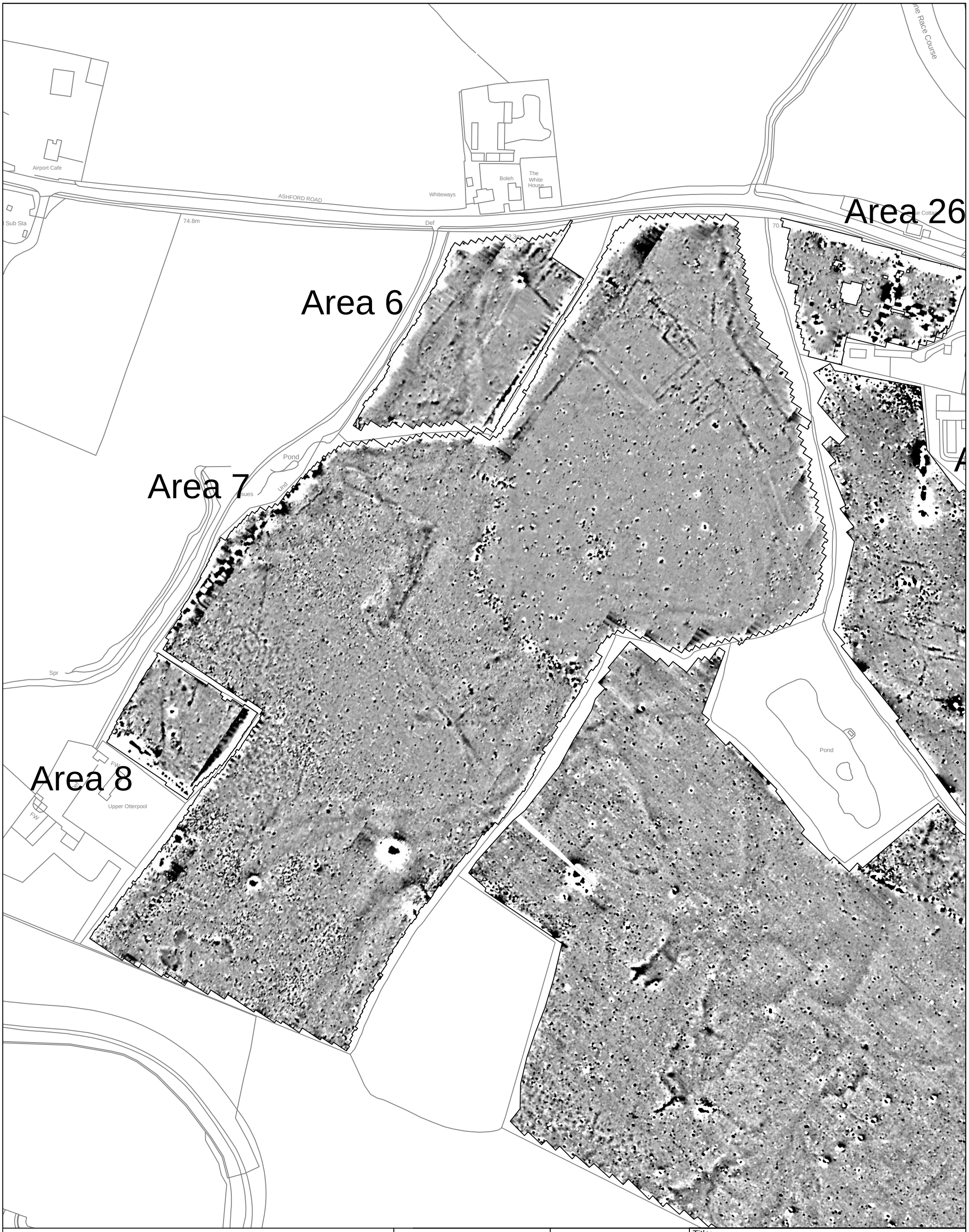
Title: Magnetometer Survey [Area 5 South] Interpretation

Client: Oxford Archaeology

Project: 11903 Otterpool

Scale: 0 metres 125
1:2500 @ A3

Fig No: 14



N

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-1

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

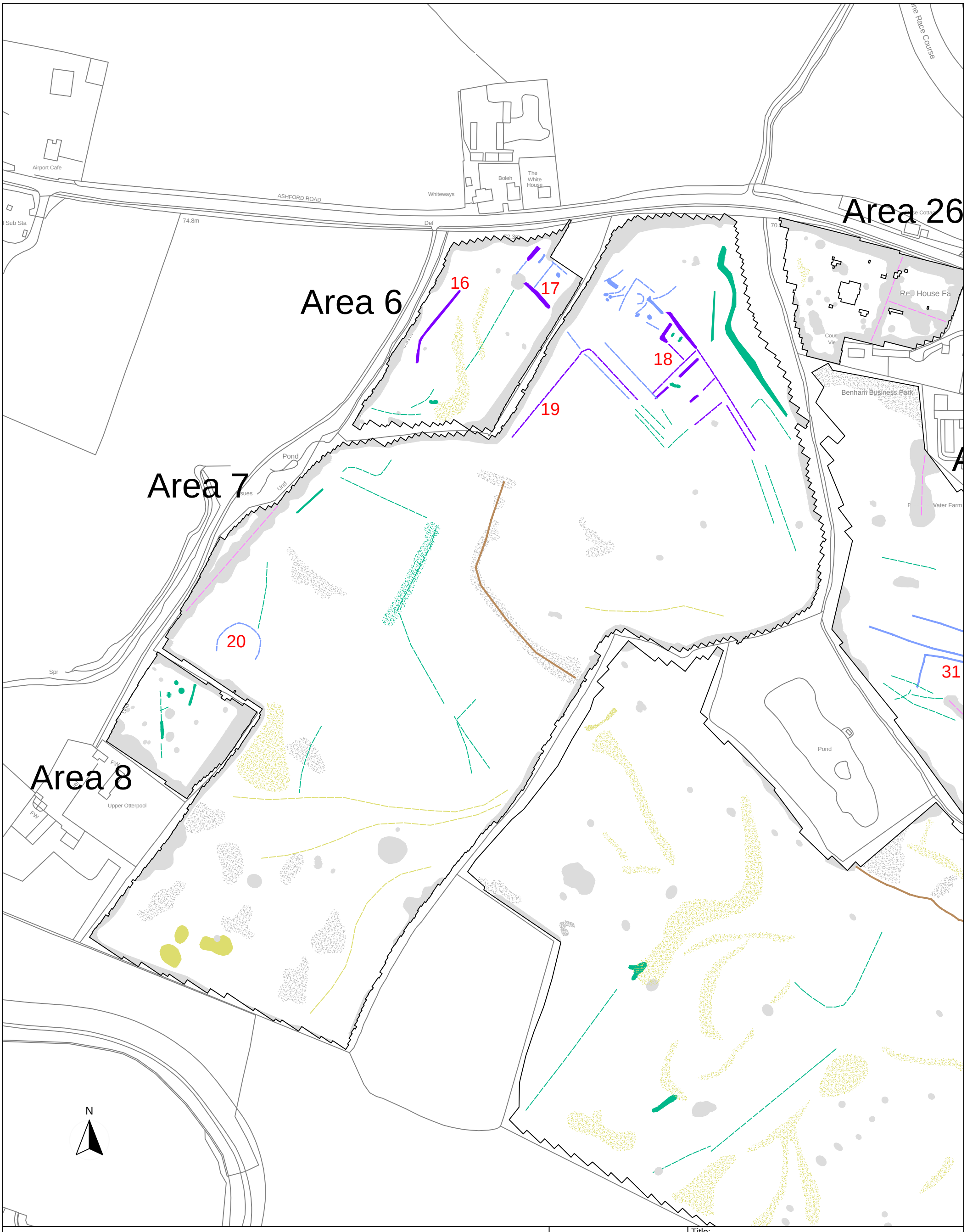
Title:
Magnetometer Survey [Areas 6, 7 and 8]
Greyscale Plots

Client:
Oxford Archaeology

Project:
11903 Otterpool

Scale:
0 metres 125
1:2500 @ A3

Fig No:
15



KEY

	Probable Archaeology (discrete / trend)		Natural (discrete / trend / zone)
	Possible Archaeology (discrete / trend)		Pipe
	Uncertain (discrete / trend / zone)		Ferrous / Magnetic Disturbance
	Former Field Boundary - corroborated		

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

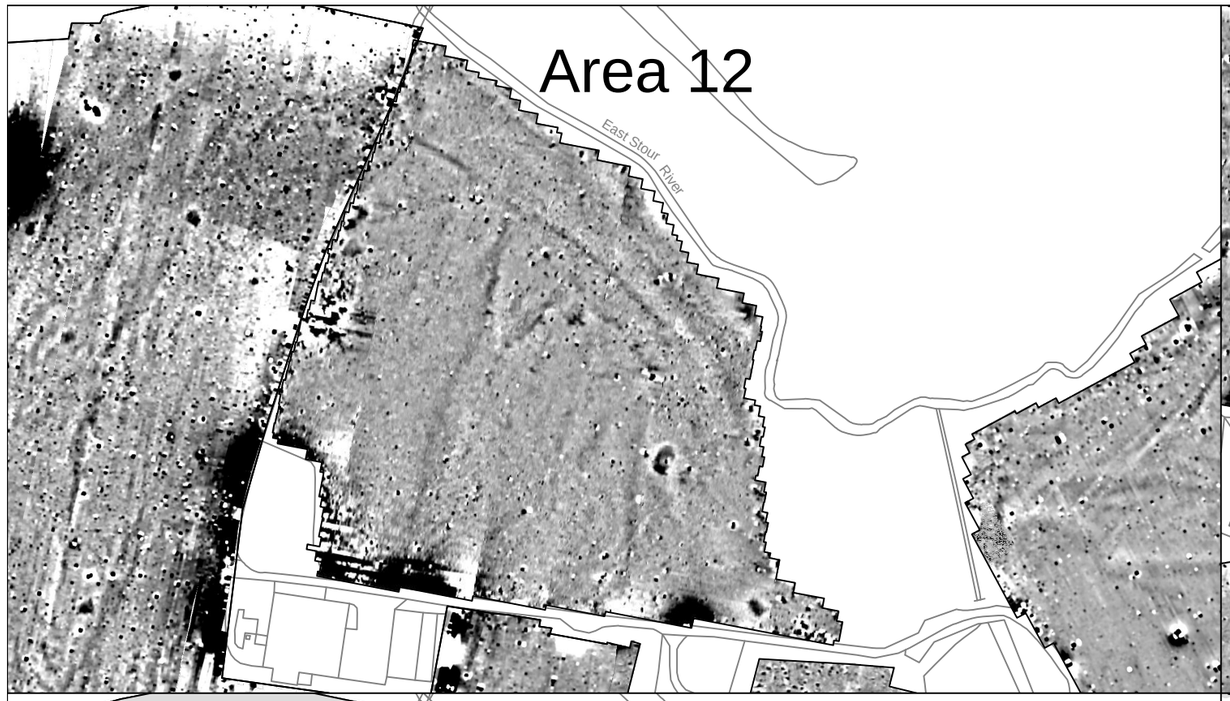
Title: Magnetometer Survey [Areas 6, 7 and 8] Interpretation

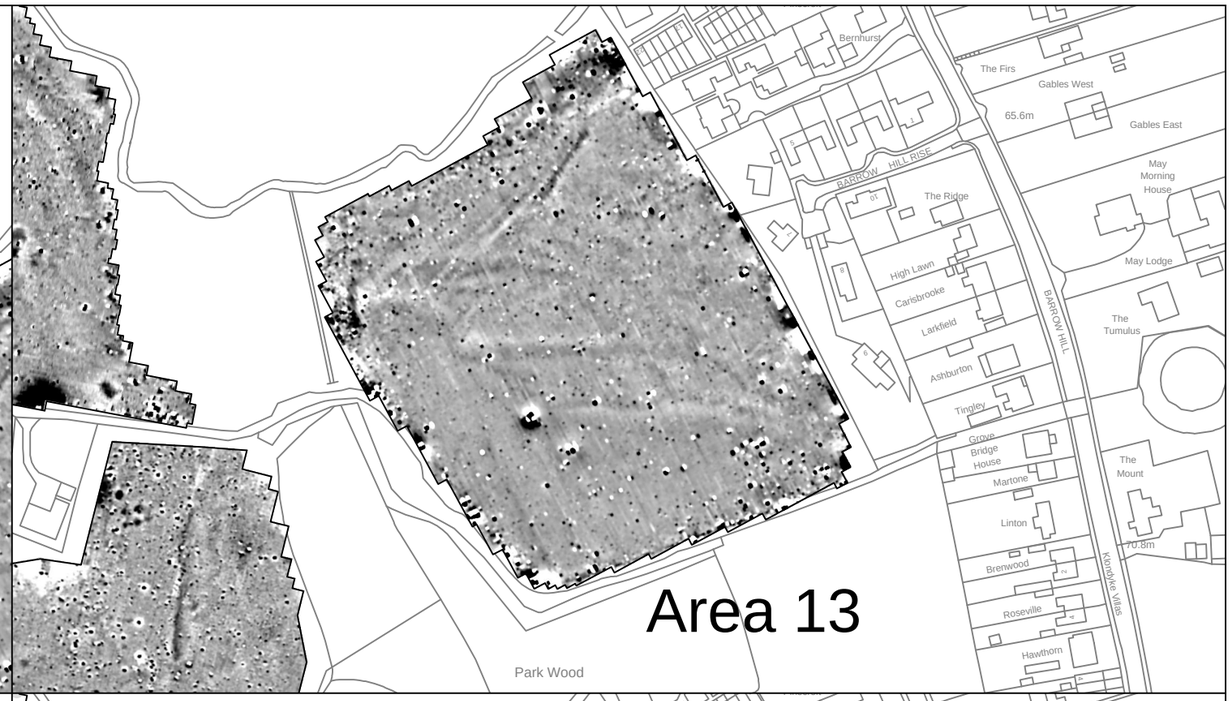
Client: Oxford Archaeology

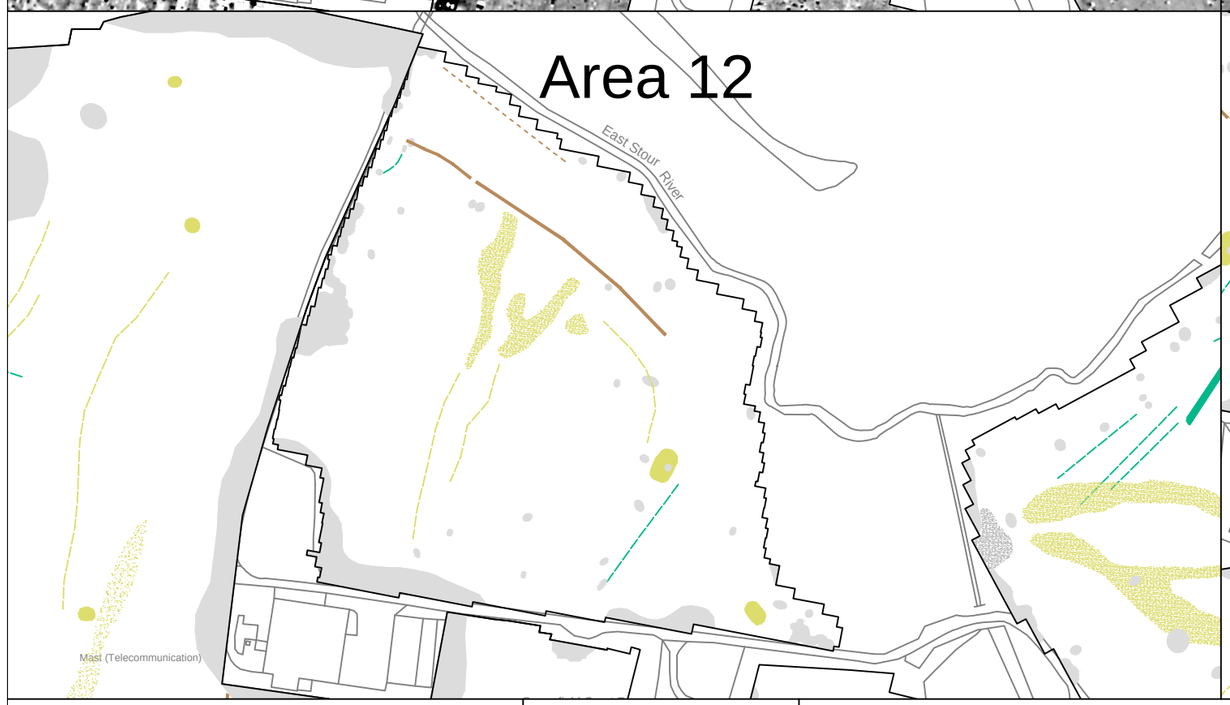
Project: 11903 Otterpool

Scale: 0 metres 125
1:2500 @ A3

Fig No: 16







N

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nT
-1

KEY

	Former Field Boundary - corroborated		Agricultural
	Uncertain (discrete / trend)		Ferrous / Magnetic Disturbance
	Natural (zone / trend)		

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title: Magnetometer Survey [Areas 12 and 13] Greyscale Plots and Interpretation

Client: Oxford Archaeology

Project: 11903 Otterpool

Scale: 0 metres 125
1:2500 @ A3

Fig No: 17

Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title:
Magnetometer Survey [Area 17]
Greyscale Plot

Client:
Oxford Archaeology

Project:
11903 Otterpool

Scale:
0 metres 150
1:3000 @ A3

Fig No:
18

Area 12

Area 17

East Stour River

Somerfield Court Farm

Solar Panels

Park Wood

Issues

Mast (Telecommunication)

FB

FB

Und

Ward Bdy

Def

Und

0.91m RH

Track

Pond

Pond

N

21

22

29

28

23
58

30

24
113

25

2

26
114

27
115

1

4

11

KEY

	Probable Archaeology (discrete anomaly / trend)		Former Field Boundary (corroborated / conjectural)
	Possible Archaeology (discrete / trend / increased response)		Field Drain / Pipe
	Uncertain Origin (discrete anomaly / trend)		Ploughing
	Natural (discrete / trend / increased response)		Ferrous / Magnetic Disturbance

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

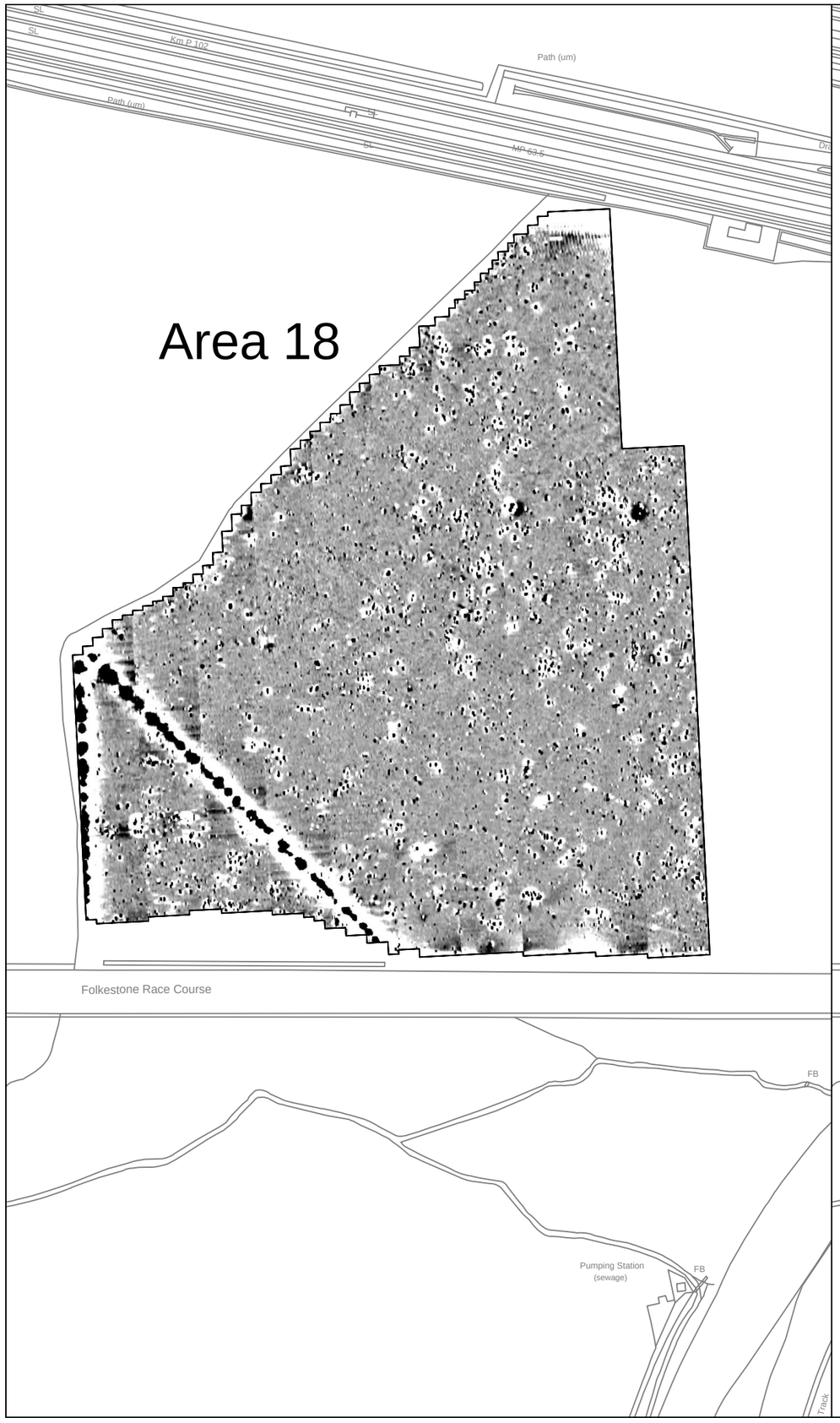
Title: Magnetometer Survey [Area 17] Interpretation

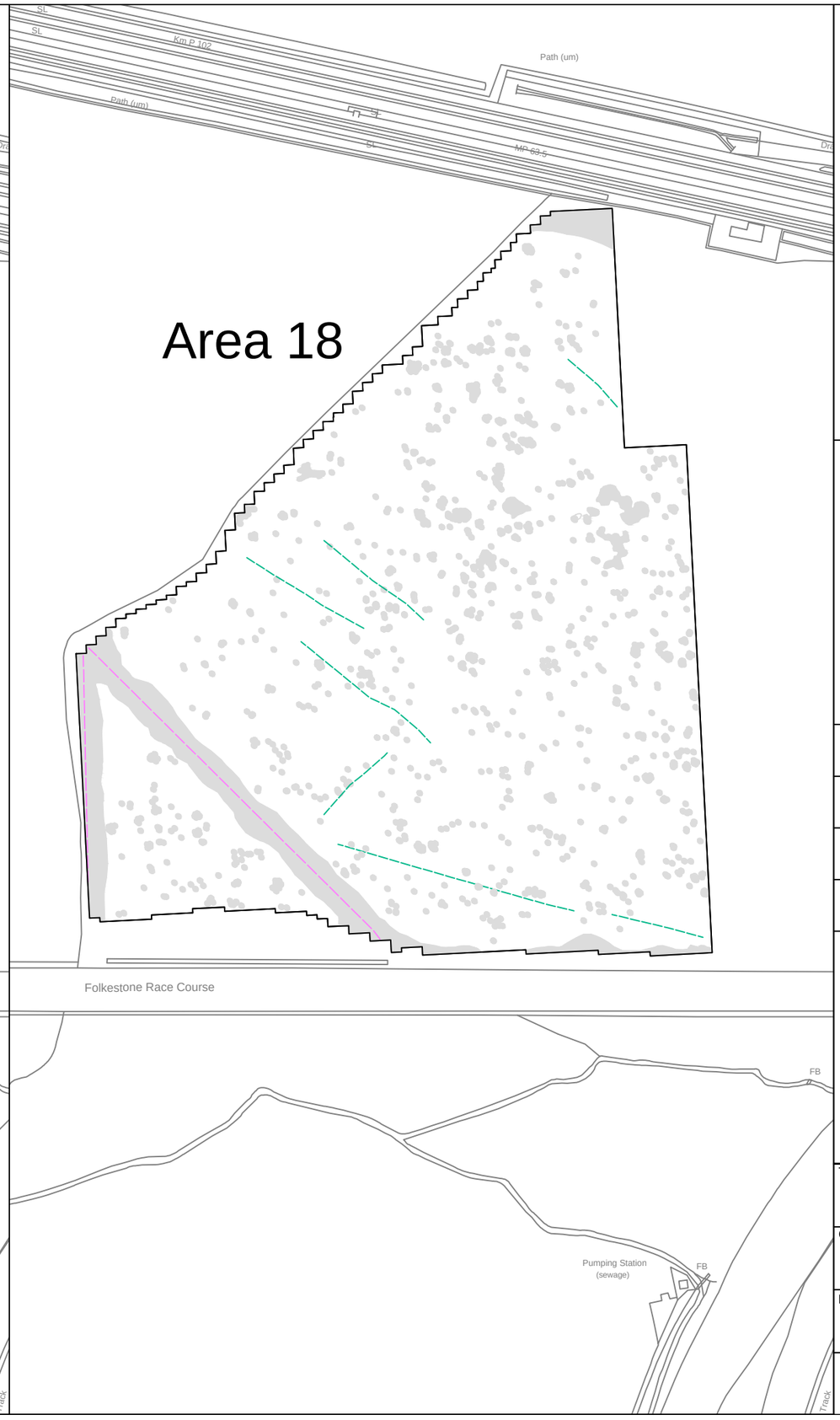
Client: Oxford Archaeology

Project: 11903 Otterpool

Scale: 0 metres 150
1:3000 @ A3

Fig No: 19





N

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nT
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KEY

	Uncertain (trend)
	Pipe
	Ferrous

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

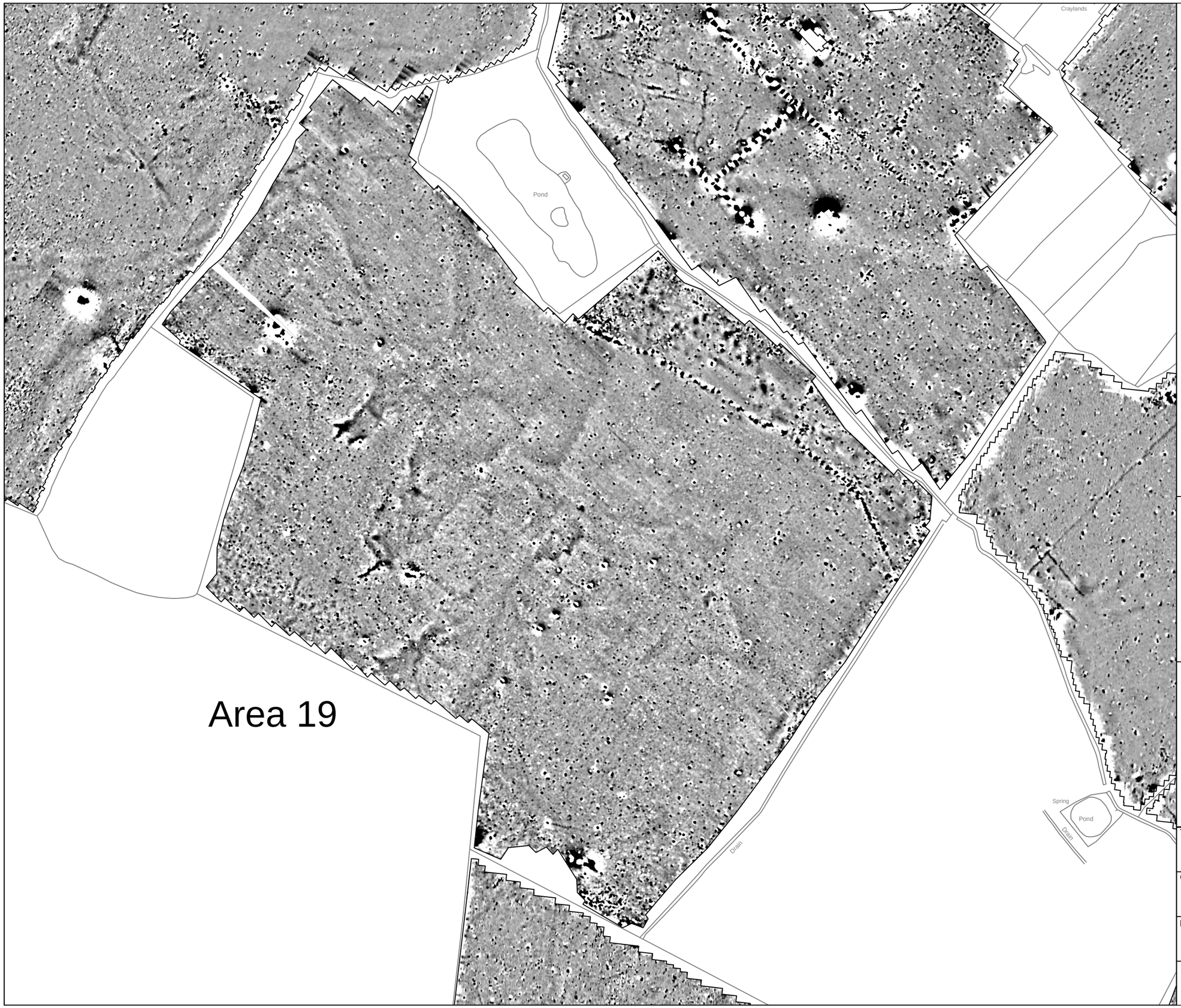
Title:
Magnetometer Survey [Area 18]
Greyscale Plot and Interpretation

Client:
Oxford Archaeology

Project:
11903 Otterpool

Scale:
0 metres 125
1:2500 @ A3

Fig No:
20



N

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nT
-1

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title:
Magnetometer Survey [Area 19]
Greyscale Plot

Client:
Oxford Archaeology

Project:
11903 Otterpool

Scale:
0 metres 125
1:2500 @ A3

Fig No:
21

Area 19

Pond

Craylands

Drain

Spring

Pond

Drain

N

KEY

	Former Field Boundary (corroborated)
	Uncertain (discrete / trend)
	Natural
	Ferrous / Magnetic Disturbance

sumo Survey

GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title:
Magnetometer Survey [Area 19]
Interpretation

Client:
Oxford Archaeology

Project:
11903 Otterpool

Scale:
0 metres 125
1:2500 @ A3

Fig No:
22

Title: Magnetometer Survey [Areas 20, 21, 22 and 24] Greyscale Plots

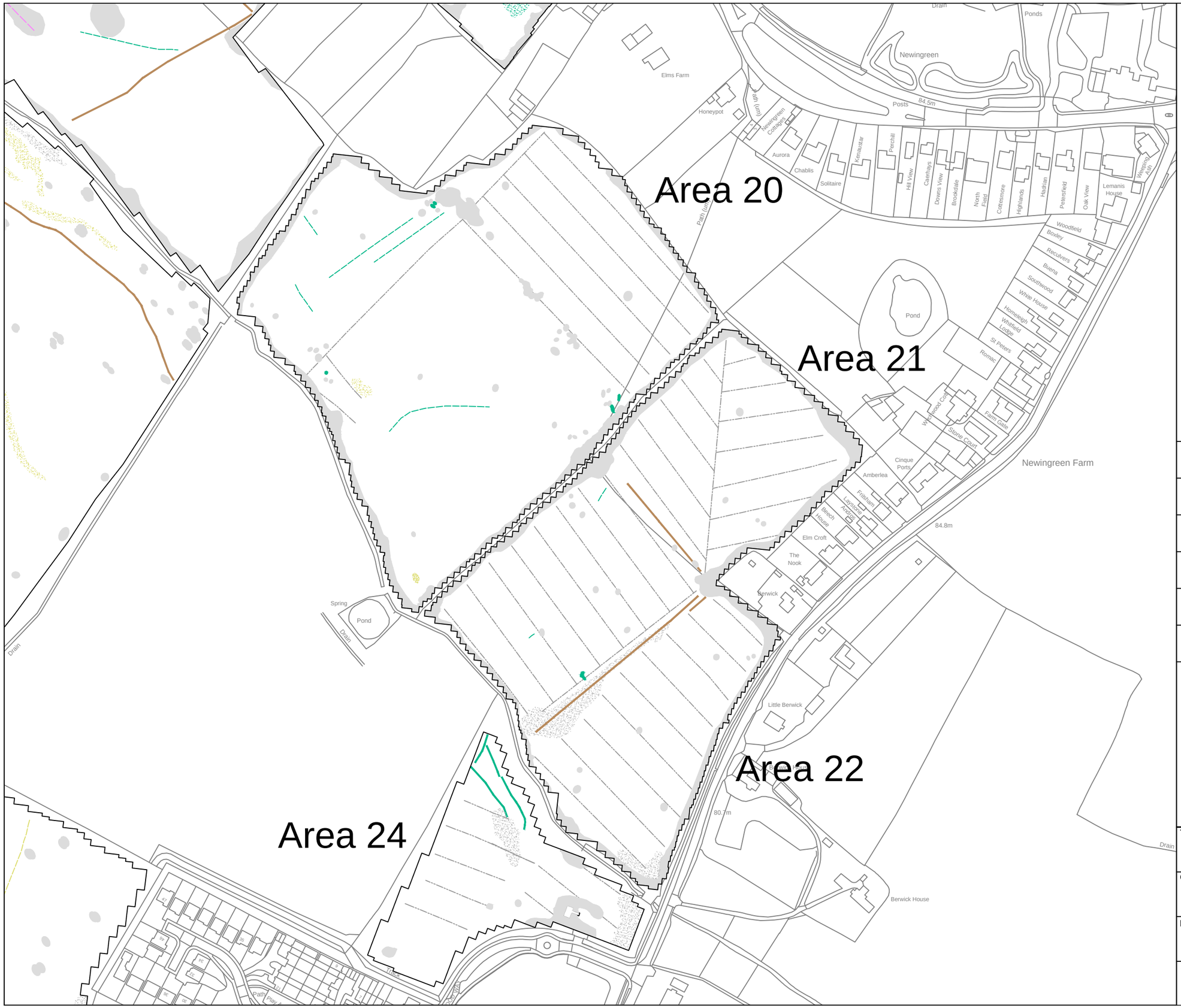
Client: Oxford Archaeology

Project: 11903 Otterpool

Scale: 0 metres 125

1:2500 @ A3

Fig No: 23



N

KEY

	Former Field Boundary (corroborated)
	Uncertain (discrete / trend)
	Natural (zone)
	Drain
	Ferrous / Magnetic Disturbance

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

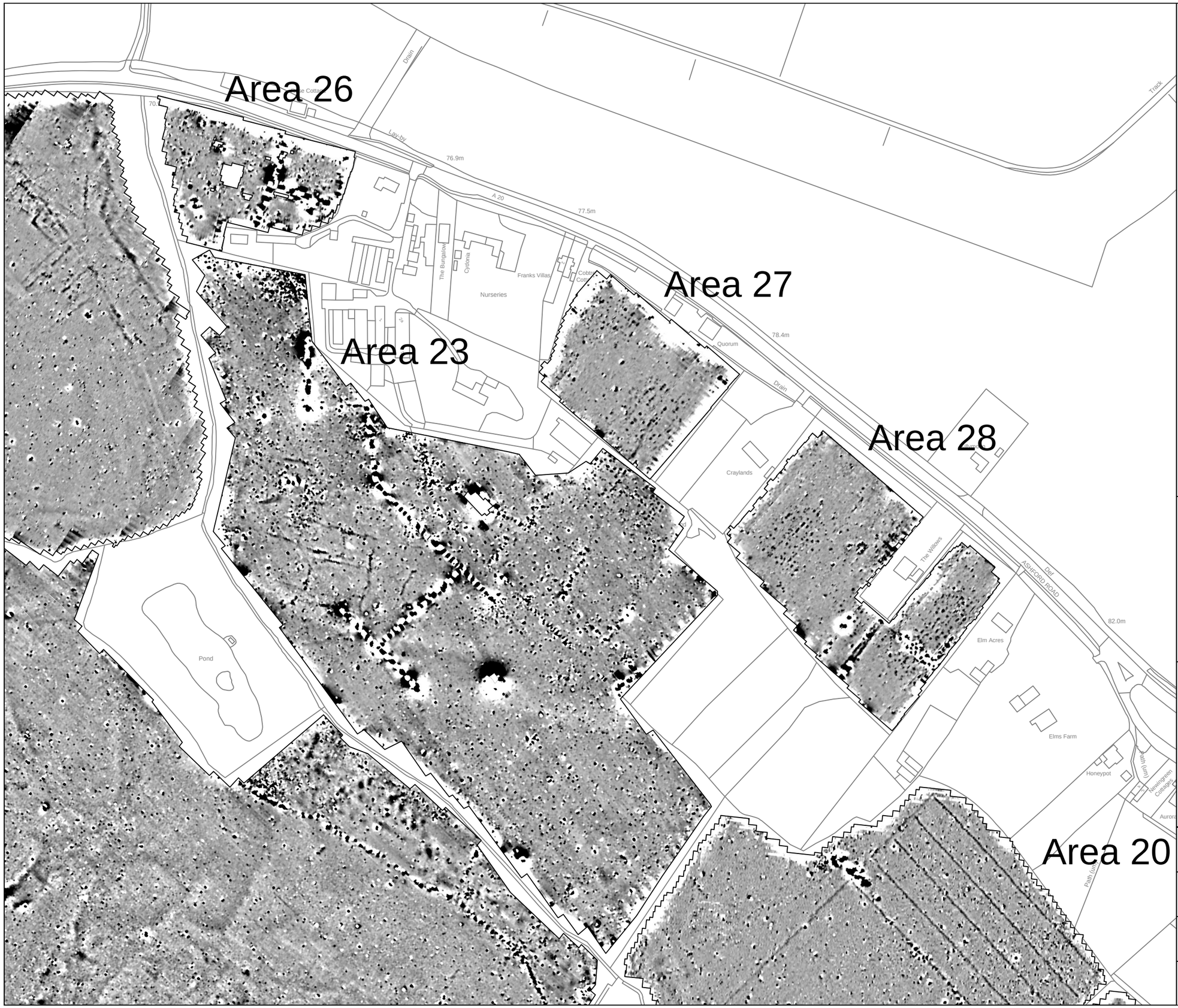
Title: Magnetometer Survey [Areas 20, 21, 22 and 24] Interpretation

Client: Oxford Archaeology

Project: 11903 Otterpool

Scale: 0 metres 125
1:2500 @ A3

Fig No: 24



N

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nT
-1

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

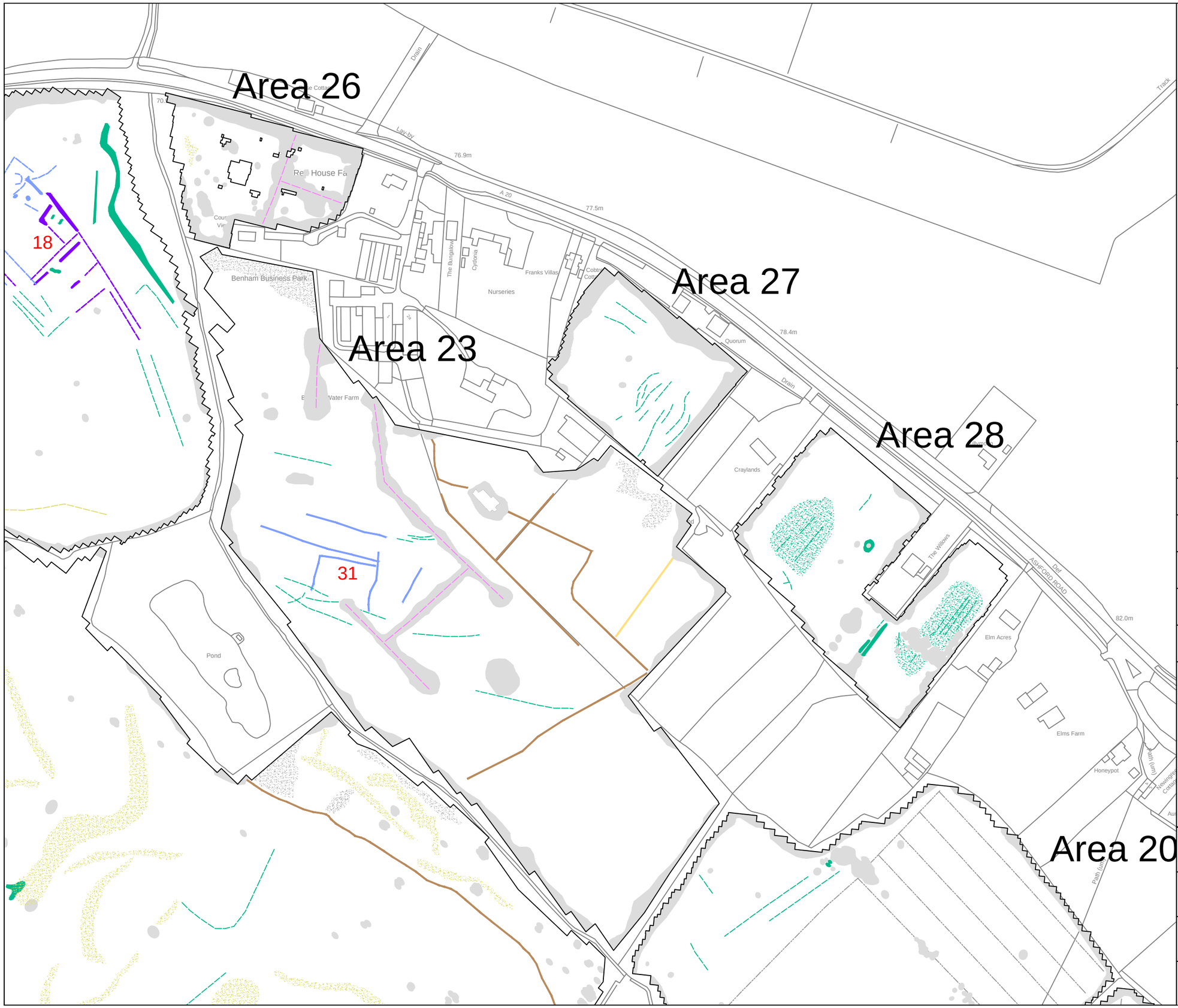
Title: Magnetometer Survey [Areas 23, 26, 27 and 28] Greyscale Plots

Client: Oxford Archaeology

Project: 11903 Otterpool

Scale: 0 metres 125
1:2500 @ A3

Fig No: 25



N

KEY

	Possible Archaeology
	Uncertain Origin (discrete / trend)
	Uncertain Origin (increased response)
	Former Field Boundary (corroborated / conjectural)
	Natural (zone)
	Pipe
	Ferrous / Magnetic Disturbance

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

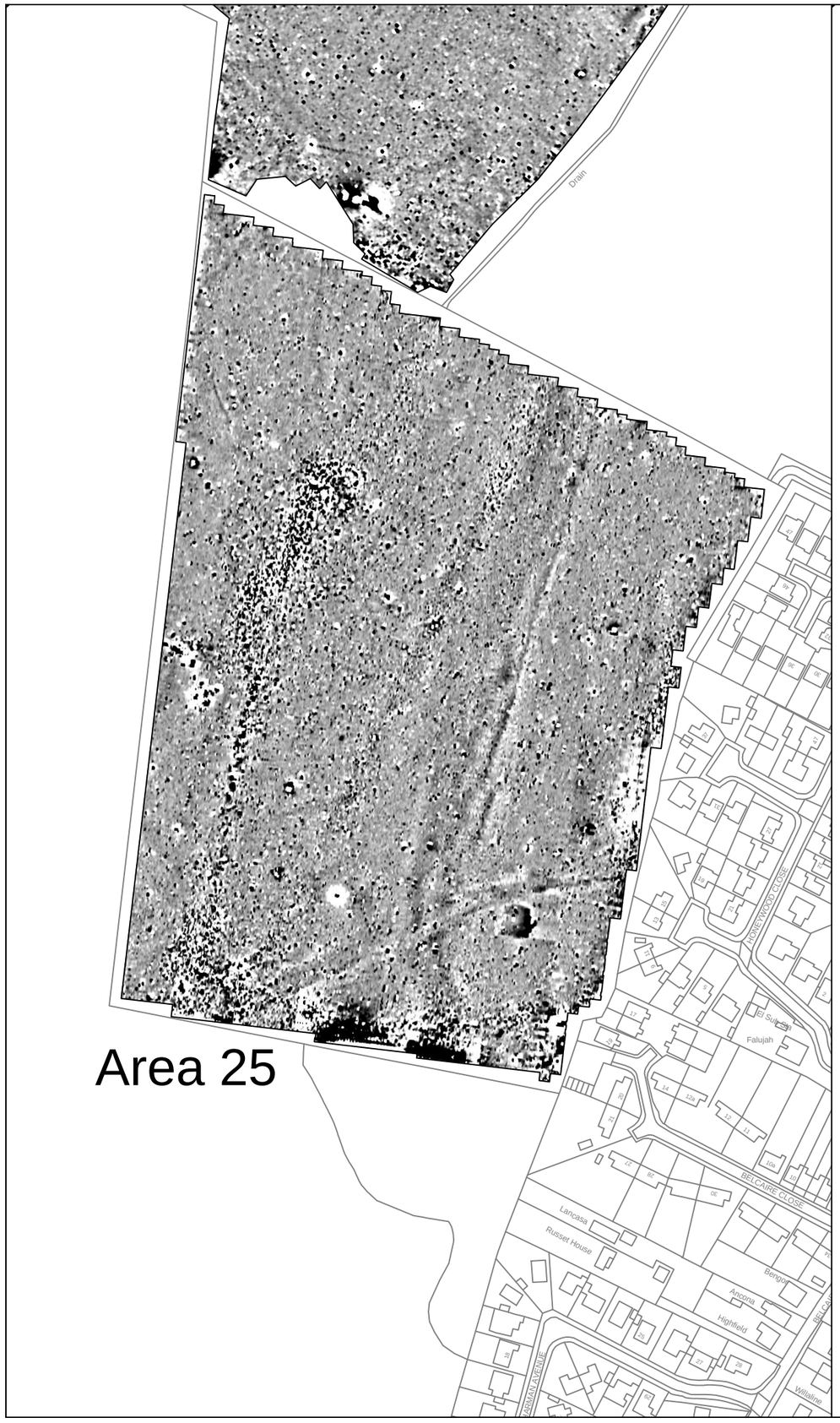
Title: Magnetometer Survey [Areas 23, 26 27 and 28] Interpretation

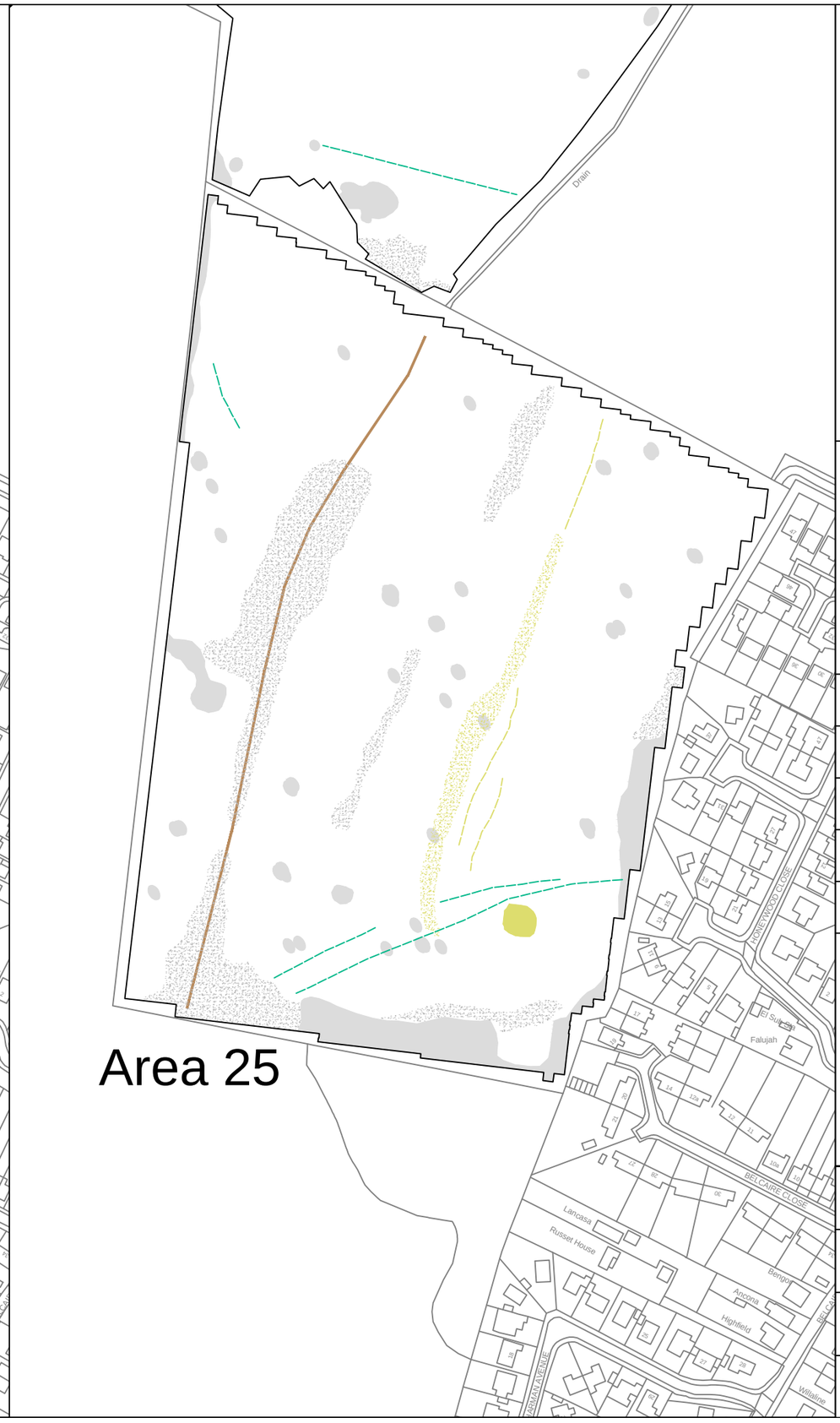
Client: Oxford Archaeology

Project: 11903 Otterpool

Scale: 0 metres 125
1:2500 @ A3

Fig No: 26





N

2
nT
-1

KEY

	Former Field Boundary - corroborated
	Uncertain (trend)
	Pipe
	Ferrous / Magnetic Disturbance

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title: Magnetometer Survey [Area 25]
Greyscale Plot and Interpretation

Client: Oxford Archaeology

Project: 11903 Otterpool

Scale: 0 metres 125
1:2500 @ A3

Fig No: 27

Appendix A - Technical Information: Magnetometer Survey Method

Grid Positioning

For hand held gradiometers the location of the survey grids has been plotted together with the referencing information. Grids were set out using a Trimble R8 Real Time Kinematic (RTK) VRS Now GNSS GPS system.

An RTK GPS (Real-time Kinematic Global Positioning System) can locate a point on the ground to a far greater accuracy than a standard GPS unit. A standard GPS suffers from errors created by satellite orbit errors, clock errors and atmospheric interference, resulting in an accuracy of 5m-10m. An RTK system uses a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier it measured, and the mobile units compare their own phase measurements with those they received from the base station. This results in an accuracy of around 0.01m.

Technique	Instrument	Traverse Interval	Sample Interval
Magnetometer	Bartington Grad 601-2	1m	0.25m

Instrumentation: Bartington *Grad* 601-2

Bartington instruments operate in a gradiometer configuration which comprises fluxgate sensors mounted vertically, set 1.0m apart. The fluxgate gradiometer suppresses any diurnal or regional effects. The instruments are carried, or cart mounted, with the bottom sensor approximately 0.1-0.3m from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is measured in nanoTesla (nT). The sensitivity of the instrument can be adjusted; for most archaeological surveys the most sensitive range (0.1nT) is used. Generally, features up to 1m deep may be detected by this method, though strongly magnetic objects may be visible at greater depths. The Bartington instrument can collect two lines of data per traverse with gradiometer units mounted laterally with a separation of 1.0m. The readings are logged consecutively into the data logger which in turn is daily down-loaded into a portable computer whilst on site. At the end of each site survey, data is transferred to the office for processing and presentation.

Data Processing

Zero Mean Traverse	This process sets the background mean of each traverse within each grid to zero. The operation removes striping effects and edge discontinuities over the whole of the data set.
Step Correction (De-stagger)	When gradiometer data are collected in 'zig-zag' fashion, stepping errors can sometimes arise. These occur because of a slight difference in the speed of walking on the forward and reverse traverses. The result is a staggered effect in the data, which is particularly noticeable on linear anomalies. This process corrects these errors.

Display

Greyscale/ Colourscale Plot	This format divides a given range of readings into a set number of classes. Each class is represented by a specific shade of grey, the intensity increasing with value. All values above the given range are allocated the same shade (maximum intensity); similarly, all values below the given range are represented by the minimum intensity shade. Similar plots can be produced in colour, either using a wide range of colours or by selecting two or three colours to represent positive and negative values. The assigned range (plotting levels) can be adjusted to emphasise different anomalies in the data-set.

Interpretation Categories

In certain circumstances (usually when there is corroborative evidence from desk-based or excavation data) very specific interpretations can be assigned to magnetic anomalies (for example, *Roman Road, Wall,* etc.) and where appropriate, such interpretations will be applied. The list below outlines the generic categories commonly used in the interpretation of the results.

Archaeology / Probable Archaeology	This term is used when the form, nature and pattern of the responses are clearly or very probably archaeological and /or if corroborative evidence is available. These anomalies, whilst considered anthropogenic, could be of any age.
Possible Archaeology	These anomalies exhibit either weak signal strength and / or poor definition, or form incomplete archaeological patterns, thereby reducing the level of confidence in the interpretation. Although the archaeological interpretation is favoured, they may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
Industrial / Burnt-Fired	Strong magnetic anomalies that, due to their shape and form or the context in which they are found, suggest the presence of kilns, ovens, corn dryers, metal-working areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.
Former Field Boundary (probable & possible)	Anomalies that correspond to former boundaries indicated on historic mapping, or which are clearly a continuation of existing land divisions. Possible denotes less confidence where the anomaly may not be shown on historic mapping but nevertheless the anomaly displays all the characteristics of a field boundary.
Ridge & Furrow	Parallel linear anomalies whose broad spacing suggests ridge and furrow cultivation. In some cases, the response may be the result of more recent agricultural activity.
Agriculture (ploughing)	Parallel linear anomalies or trends with a narrower spacing, sometimes aligned with existing boundaries, indicating more recent cultivation regimes.
Land Drain	Weakly magnetic linear anomalies, quite often appearing in series forming parallel and herringbone patterns. Smaller drains may lead and empty into larger diameter pipes, which in turn usually lead to local streams and ponds. These are indicative of clay fired land drains.
Natural	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions.
Magnetic Disturbance	Broad zones of strong dipolar anomalies, commonly found in places where modern ferrous or fired materials (e.g. brick rubble) are present.
Service	Magnetically strong anomalies, usually forming linear features are indicative of ferrous pipes/cables. Sometimes other materials (e.g. pvc) or the fill of the trench can cause weaker magnetic responses which can be identified from their uniform linearity.
Ferrous	This type of response is associated with ferrous material and may result from small items in the topsoil, larger buried objects such as pipes, or above ground features such as fence lines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.
Uncertain Origin	Anomalies which stand out from the background magnetic variation, yet whose form and lack of patterning gives little clue as to their origin. Often the characteristics and distribution of the responses straddle the categories of *Possible Archaeology* / *Natural* or (in the case of linear responses) *Possible Archaeology* / *Agriculture*; occasionally they are simply of an unusual form.

Where appropriate some anomalies will be further classified according to their form (positive or negative) and relative strength and coherence (trend: weak and poorly defined).

Appendix B - Technical Information: Magnetic Theory

Detailed magnetic survey can be used to effectively define areas of past human activity by mapping spatial variation and contrast in the magnetic properties of soil, subsoil and bedrock. Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.1 nanoTeslas (nT) in an overall field strength of 48,000 (nT), can be accurately detected.

Weakly magnetic iron minerals are always present within the soil and areas of enhancement relate to increases in *magnetic susceptibility* and permanently magnetised *thermoremanent* material.

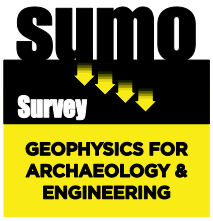
Magnetic susceptibility relates to the induced magnetism of a material when in the presence of a magnetic field. This magnetism can be considered as effectively permanent as it exists within the Earth's magnetic field. Magnetic susceptibility can become enhanced due to burning and complex biological or fermentation processes.

Thermoremanence is a permanent magnetism acquired by iron minerals that, after heating to a specific temperature known as the Curie Point, are effectively demagnetised followed by re-magnetisation by the Earth's magnetic field on cooling. Thermoremanent archaeological features can include hearths and kilns; material such as brick and tile may be magnetised through the same process.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement allowing assessment and characterisation of subsurface features. Material such as subsoil and non-magnetic bedrock used to create former earthworks and walls may be mapped as areas of lower enhancement compared to surrounding soils.

Magnetic survey is carried out using a fluxgate gradiometer which is a passive instrument consisting of two sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field whilst the lower sensor measures the same field but is also more affected by any localised buried feature. The difference between the two sensors will relate to the strength of a magnetic field created by this feature, if no field is present the difference will be close to zero as the magnetic field measured by both sensors will be the same.

Factors affecting the magnetic survey may include soil type, local geology, previous human activity and disturbance from modern services.



- Archaeological
- Geophysical
- Laser Scanning
- Measured Building
- Topographic
- Utility Mapping

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