WHCK17

WESTENHANGER CASTLE, LYMPNE, KENT

GEOPHYSICAL SURVEY

commissioned by Arcadis

February 2018

HEADLAND ARCHAEOLOGY

REGISTERED CIfA ORGANISATION

WESTENHANGER CASTLE, LYMPNE, KENT

GEOPHYSICAL SURVEY

commissioned by Arcadis

February 2018

This report adheres to the quality standard of ISO 9001:2008

PROJECT INFO:

HA Project Code **WHCK17** / NGR **TR 1220 3700** / Parish **Stanford** / Local Authority **Kent County Council** / OASIS Ref. **headland5-307898**

PROJECT TEAM:

Project Manager **Sam Harrison** / Author **Sam Harrison** / Fieldwork **Ross Bishop, David Harrison, Glyn Sheldrick, Olivier Vansassenbrouck** / Graphics **Sam Harrison, Mano Kapazoglou, Rafael Maya-Torcelly**

Approved by **Sam Harrison** ....

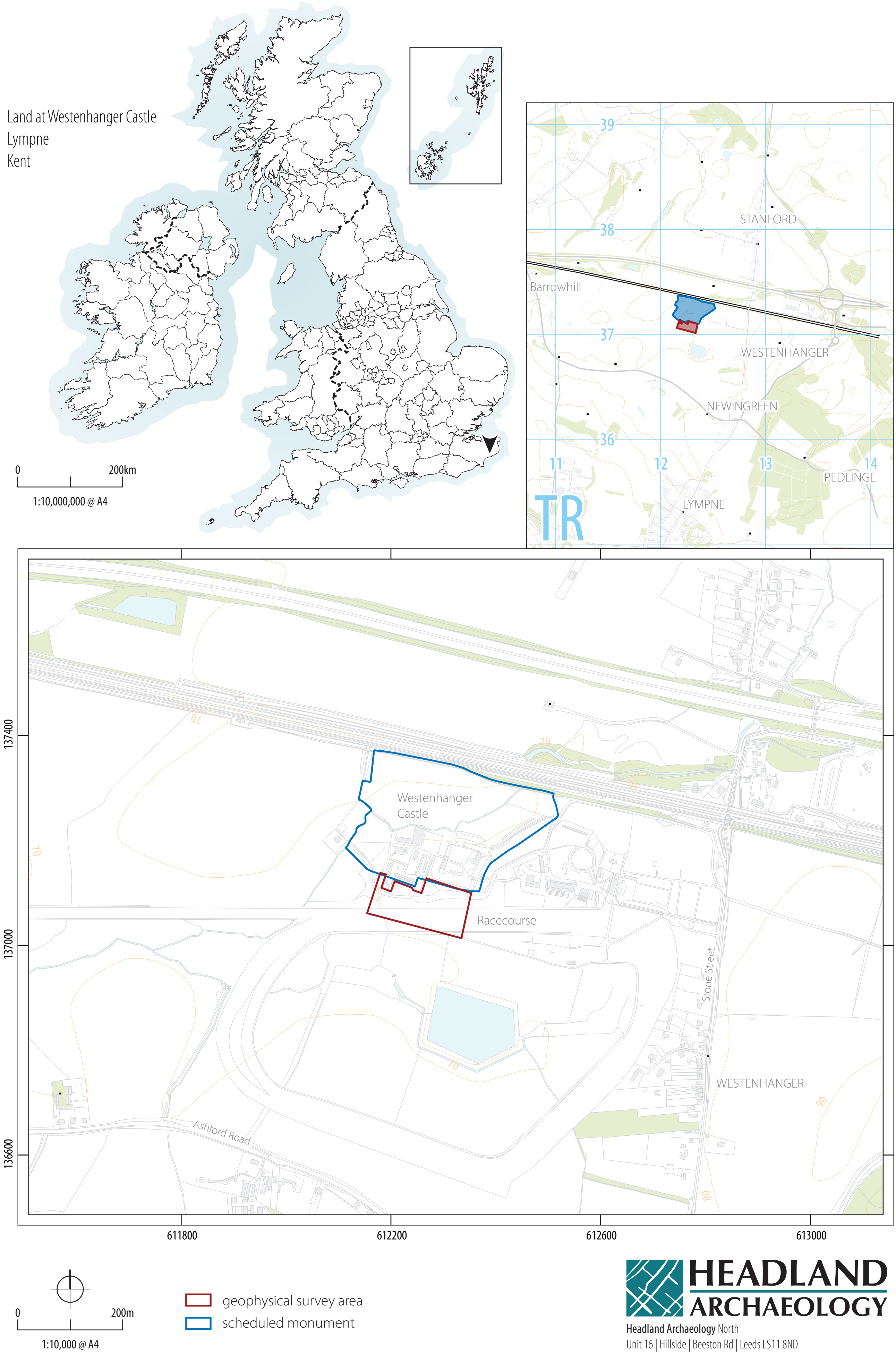
Headland Archaeology North
Unit 16 | Hillside | Beeston Rd | Leeds LS11 8ND
t 0113 387 6430
e north@headlandarchaeology.com
w www.headlandarchaeology.com

PROJECT SUMMARY

Headland Archaeology (UK) Ltd undertook a combined magnetometer, earth resistance and ground penetrating radar survey at Westenhanger Castle, Lympne, Kent, over an area where it is thought there may be the sub-surface remains of a former garden created in the Tudor period. Anomalies corresponding with three boundaries recorded on historic mapping have been tentatively identified. Two of these boundaries are thought to possibly locate the southern and eastern extent of a 'walled orchard', recorded on the historic mapping. These anomalies are consequently interpreted as of possible archaeological potential as it has been postulated that this 'walled orchard' previously defined the extent of the Tudor garden. No anomalies specifically thought to be due to features within the garden are identified; most of the survey area has likely been extensively landscaped having been incorporated within Folkestone Racecourse for more than a century. However, other linear anomalies located within the 'walled orchard' and perpendicular to the mapped boundaries may have some archaeological potential based on their alignment but the shallow depth at which they have been recorded may preclude against this. The majority of the anomalies identified during the survey almost certainly reflect current and recent ground conditions and usage.

CONTENTS

LIST OF ILLUSTRATIONS



ILLUS 1 Site location

Headland Archaeology North
Unit 16 | Hillside | Beeston Rd | Leeds LS11 8ND
t 0113 387 6430
e north@headlandarchaeology.com
w www.headlandarchaeology.com

WESTENHANGER CASTLE, LYMPNE, KENT

GEOPHYSICAL SURVEY

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by Arcadis, to undertake a geophysical (magnetometer, earth resistance and ground penetrating radar) survey of the possible location of the Tudor Garden at Westenhanger Castle, Lympne (see Illus 1). The survey was carried out as part of a wider series of surveys to assess the potential for archaeological remains across the footprint of the proposed Otterpool Park Garden City scheme, and therefore to assess the impact of the proposed development on the historic environment.

The work was undertaken in accordance with a Written Scheme of Investigation (Bishop 2017), produced on behalf of the client and approved by Kent County Council, and was undertaken in accordance with guidance contained within the National Planning Policy Framework (DCLG 2012). All work was undertaken in line with current best practice (Chartered Institute for Archaeologists 2014, English Heritage 2008).

The survey was carried out in two separate periods; between September 18th to September 22nd and October 9th to October 12th, 2017.

1.1 SITE LOCATION, LAND-USE AND TOPOGRAPHY

The area of survey occupies a roughly rectangular parcel of land covering approximately 1.4 hectares, centred on NGR 612265, 137092, immediately south of Westenhanger Castle, which incorporates part of the former Folkstone Racecourse. The majority of the survey area was under short grass (see Illus 2 and Illus 6 – Area 1) being formerly part of the racecourse; the southern limit of the racecourse was defined by railings which had been removed on the northern side of the course. The remainder of the survey area comprised a small area of lawn (see Illus 3 and Illus 6 – Area 2), and a hardcore track and parking area (see Illus 4, Illus 5 and Illus 6 – Area 3). Due to the different types of ground cover slightly different areas were suitable for survey by each technique.

Topographically the site is flat being situated at 72m above Ordnance Datum.

1.2 GEOLOGY AND SOILS

The underlying solid geology comprises sedimentary bedrock of the Sandgate Formation. This is overlain by Head - clays and silts (NERC 2017). The soils are classified in the Soilscape 22 association, characterised as loams with naturally high groundwater (Cranfield University 2017).

2 ARCHAEOLOGICAL BACKGROUND

Westenhanger Castle is a scheduled monument (List Entry 1020761) and is classified as a fortified manor house dating to at least the 14th century. The land was passed to the crown (Henry VIII), in the 16th century, where it was enhanced for royal use. These improvements consisted of further fortification to the walls, the addition of a deer park, a shallow moat and irrigation channels, and more importantly a walled garden or orchard containing a pond documented in 1559 (Historic England 2017).

A statement of significance (Clover and Davies 2017) of Westenhanger Castle has been produced. This state 'the evidence for the garden being walled comes from historic mapping. An enclosed rectangular field adjoining the southern arm of the moat, likely to be the former Tudor garden, is shown on the 1797 Ordnance Survey (OS) map and on the Stanford tithe map of 1839. The tithe award states that this field was under pasture at the time but was known as 'walled orchard'. Further areas of orchard are shown to the south along the causewayed entrance to Westenhanger, which survived as a track at this time, and to the north-east of the manor house.

The interpretations and conclusion contained in this report are based on the assumptions made in the report.

3 SURVEY OBJECTIVES

The general aim of the geophysical survey was to provide sufficient information to establish the presence/absence, character and extent of any archaeological remains within the survey area. This will, therefore, enable an assessment to be made of the impact of the proposed development on any sub-surface archaeological remains if present.

The specific archaeological objectives of the geophysical survey were:

- to identify any anomalies potentially associated with the Tudor Garden;
- to provide information about the nature and possible interpretation of any anomalies identified; and
- to prepare a report summarising the results of the survey.

4 METHODS

4.1 MAGNETOMETER SURVEY

Magnetic survey methods rely on the ability of a variety of instruments to measure very small magnetic fields associated with buried archaeological remains. A feature such as a ditch, pit or kiln can act like a small magnet, or series of magnets, that produce distortions (anomalies) in the earth's magnetic field. In mapping these slight variations, detailed plans of sites can be obtained as buried features often produce reasonably characteristic anomaly shapes and strengths (Gaffney & Gater 2003). Further information on soil magnetism and the interpretation of magnetic anomalies is provided in Appendix 1.

The survey was undertaken using four Bartington Grad601 sensors mounted at 1m intervals (1m traverse interval) onto a rigid carrying frame. The system was programmed to take readings at a frequency of 10Hz (allowing for a 10-15cm sample interval) on roaming traverses (swaths) 4m apart. These readings were stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system was linked to a Trimble R8s Real Time Kinetic (RTK) differential Global Positioning System (dGPS) outputting in NMEA mode to ensure a high positional accuracy for each data point.

MLGrad601 and MultiGrad601 (Geomar Software Inc.) software was used to collect and export the data. Terrasurveyor V3.0.32.4 (DWConsulting) software was used to process and present the data.

4.2 EARTH RESISTANCE SURVEY

Earth resistance survey methodology involves the insertion of four electrodes into the ground with an electrical current induced into it. Two electrodes known as the current electrodes introduce the electrical current and two potential electrodes recording the voltage at a given point, which indicates the local resistivity.

The earth resistance survey was undertaken using a Geoscan RM15 and integral multiplexer set up as a twin probe array, to take readings at 0.5m intervals on traverses 1m apart within 30m by 30m grid squares, allowing 3600 readings to be recorded in each grid square. The mobile probe spacing was 0.5m with the remote probes 15m apart and at least 20m away from the grid under survey. The mobile probe spacing of 0.5m gives an approximate depth penetration of 1m for most archaeological features. These readings were stored in the memory of the instrument and later downloaded for processing and interpretation. Geoplot 4.0 (Geoscan Research) software was used to process and present the data.

4.3 GROUND PENETRATING RADAR SURVEY

Ground penetrating radar (GPR) works by discharging a short pulse of energy into the ground with reflections being returned from the interfaces between different materials in the ground. The amplitude of these returns depends on the change in velocity of the radar wave as it crosses these interfaces. A measure of these velocities is given by the dielectric constant of that material. The travel times are recorded for each return on the radargram and an approximate conversion made to depth by calculating or assuming an average dielectric constant. An advantage of a GPR survey is its capability to be used in a variety of ground conditions and supply the user with an estimation of depth. This technique even works in cluttered environments which would usually prevent other geophysical techniques being used.

Drier materials such as sand, gravel and rocks, i.e. materials which are less conductive (or more resistant), will permit the survey of deeper sections than wetter materials such as clays which are more conductive (or less resistant). Penetration can be increased by using longer wavelengths (lower frequencies) but at the expense of resolution. As the antennae emit a 'cone' shaped pulse of energy an offset target showing a perpendicular face to the radar wave will be'seen' before the antenna passes over it. A resultant characteristic diffraction pattern is thus built up in the shape of a hyperbola. A classic target generating such a diffraction is a pipe when the antenna is travelling across the line of the pipe. However, it should be pointed out that if the interface between the target and its surroundings does not result in a marked change in velocity then only a weak hyperbola will be seen, if at all.

The Utsi Electronics Trivue Ground Penetrating Radar was used during the survey with a multi-frequency set up. The 500MHz frequency was selected to best evaluate the survey area and give better target definition. This antenna has an approximate maximum depth penetration of 1m.

Data was recorded at 0.05m intervals on transects at 0.5m separation with a measuring wheel recording the distance covered by the instrument. Data were collected on a mobile tablet device and later transferred to a secure server for processing back in the office.

ReflexW was used to process and display the data. Each radargram has been assessed and those anomalies thought to be significant were noted. A degree of simplicity has been assigned to the recorded responses to aid in the description of the data.

Time slices were created from the processed datasets by obtaining an average of the data through 3 nanosecond (ns) windows. The time slices are shown in Illus14 (Timeslice A-D) and Illus 15 (Timeslice E-G). Example radargrams from the survey are shown in Illus 17.

The survey has recorded data through a 21ns window. It has been estimated that the subsurface velocity is 0.07m/ns following constant velocity tests on the data. This measurement was used for the time-to-estimated-depth conversion, giving an approximate maximum depth of 0.7m. Penetration depth is likely to have been reduced by the prevailing loamy soils with naturally high groundwater.

4.4 REPORTING

A general site location plan is shown in Illus 1 at a scale of 1:10,000. Illus 2 to Illus 5 are general site condition photographs. Illus 6 is a 1:1,000 scale survey location plan showing the magnetometer GPS swath data, earth resistance grids and GPR transect locations. The survey area overlying the six-inch Ordnance Survey (OS) map (1888–1913) is reproduced in Illus 7 also at 1:1,000 scale. Detailed plots of the fully processed (greyscale) and minimally processed (XY traceplot) magnetic data are presented, together with an accompanying interpretative plot are presented at a scale of 1:1,000 in Illus 8, Illus 9 and Illus 10. Data from the earth resistance survey in processed, unprocessed and interpretation formats are shown in Illus 11, Illus 12 and Illus 13 also at 1:1000 scale. GPR timeslices are displayed in Illus 14 and Illus 15 at 1:1,500 scale. A 1:1,000 plan of the GPR interpretation is shown in Illus 16. Example radargrams are depicted in Illus 17. A combined interpretation illustration with the historical OS 1888–1913 and Stanford Tithe map is depicted in Illus 18.

Technical information on the equipment used, data processing and magnetic survey methodology is given in Appendix 1. Appendix 2 details the survey location information and Appendix 3 describes the composition and location of the site archive. Data processing details are presented in Appendix 4. A copy of the OASIS entry (Online Access to the Index of Archaeological Investigations) is reproduced in Appendix 5. The Section 42 Licence from Historic England is detailed in Appendix 6.

The survey methodology, report and any recommendations comply with the Written Scheme of Investigation (Bishop 2017) and guidelines outlined by Historic England (English Heritage 2008) and by the Chartered Institute for Archaeologists (CIfA 2014). All illustrations from Ordnance Survey mapping are reproduced with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

The illustrations in this report have been produced following analysis of the data in 'raw' and processed formats and over a range of different display levels. All illustrations are presented to most suitably display and interpret the data from this site based on the experience and knowledge of management and reporting staff.

5 RESULTS AND DISCUSSION

The results of the magnetometer and resistance surveys are divided between those anomalies interpreted as of likely modern origin and those considered to have some archaeological potential. The radar anomalies are discussed by depth; shallow (between 0m and 0.34m) and deep (between 0.34m and 0.67m.

5.1 MAGNETOMETER SURVEY (ILLUS 8, 9 AND 10)

Modern anomalies

Ferrous anomalies, characterised as individual 'spikes', are typically caused by ferrous (magnetic) material, either on the ground surface or in the top-soil. Little importance is normally given to such anomalies unless there is any supporting evidence for an archaeological interpretation. These anomalies are assumed to be modern in origin and therefore of no archaeological significance.

An area of magnetic disturbance around the south-eastern edge of Area 1 is due to the proximity of the railings on the southern edge of the racecourse. The magnetic disturbance on the northern edge of Area 1 and in Area 2 is due to surveying across, or up to, the edge of areas of hardstanding.

Dipolar linear (L) anomaly, L1, running east-west across Area 1 is located along the former line of railings which marked the northern side of the racecourse and is caused by a sub-surface pipe. To the immediate north of this anomaly, and on broadly the same alignment, is a second linear anomaly, L2. This anomaly is interpreted as a possible pipe or culvert; several manhole covers were noted in the vicinity.

In Area 3 another linear anomaly, L3, has been identified, aligned south-west/north-east. Due to the disturbed nature of the data

ILLUS 2 Field 1, looking north

and the small size of Area 3, it is impossible to give a confident interpretation. However, it is considered most likely that the feature has a modern origin, probably being caused by another pipe or culvert. This anomaly clearly corresponds with anomaly L9 in the radar data but has not been identified in the resistance data.

In the east of Area 1, a series of parallel linear trend anomalies aligned south-west/north-east are likely caused by field drains to drain the racecourse.

Anomalies of possible archaeological interest

Weak and fragmentary linear anomalies, L4 and L5, have been recorded in the east and south of Area 1 respectively, aligned oblique to the racecourse. Features corresponding with both of these anomalies are recorded on historical OS mapping and may locate the boundary of the 'walled orchard' which in turn is thought may define the limit of the Tudor garden. Anomalies in the radar and resistance data in the same location might provide supporting evidence for this interpretation.

Three weak linear trend anomalies, L6, L7 and L8, are located at right angles to L5 and are parallel to L4. The cause of these anomalies is uncertain and there are no corresponding features recorded on the historical mapping. However, they are aligned perpendicular to the line of the 'walled orchard' which may suggest contemporaneity and therefore a possible archaeological origin has been ascribed to these anomalies.

5.2 EARTH RESISTANCE SURVEY (ILLUS 11, 12 AND 13)

Modern anomalies

Several high resistance (HR) linear anomalies have been identified in the dataset. Anomaly HR1 corresponds to linear magnetic anomaly L2 and to anomaly L1 in the radar data and is interpreted as a culvert.

The high resistance linear, HR5, aligned north-west/south-east, terminates at HR1 and is interpreted as a pipe draining into the larger culvert, HR1. This feature was not identified as an anomaly by either of the other two surveys.

Three further high resistance linear anomalies, HR2, HR3 and HR4, aligned east/west and 20m apart are identified. HR2 clearly follows the former line of the northern edge of the racecourse and HR4 clearly follows the southern edge. HR3 is equidistant between HR2 and HR4. HR2 clearly correlates with DL1 in the magnetic data and L9 in the radar data. All three anomalies clearly relate to the line of the boundary rails separating the flat and jump racing courses.

Other areas of high resistance throughout the site, such as HR9 in Area 2, are thought most likely to be caused by modern ground

ILLUS 3 Field 2, looking north

disturbance/compaction although a possible archaeological cause cannot be discounted.

Anomalies of possible archaeological interest

HR6 and HR7, located in the south-west of Area 1, comprise two weak, parallel, high resistance anomalies approximately 25m in length and 4m apart. HR7 corresponds with L8 in the GPR data and also L5 in the magnetic data and so matches the recorded position of the 'walled orchard' and therefore may also be associated with the Tudor garden.

High resistance anomaly HR8 in Area 2, aligned east/west, also corresponds with a boundary feature recorded on the historic mapping which is thought to demarcate the extent of the 'walled orchard'. Therefore, this anomaly is also interpreted as of archaeological potential.

5.3 GROUND PENETRATING RADAR SURVEY (ILLUS 14, 15, 16 AND 17)

Shallow anomalies (up to 0.34m)

As is usual in most GPR surveys the majority of the most clearly defined anomalies are recorded from the layers closest to the surface and there are several high reflector anomalies within the first 0.07m (Timeslice A). It is thought likely that due to the shallow depth and the degree of landscaping that a modern cause for most of these anomalies is likely.

Most obvious is linear (L) anomaly L1 which clearly corresponds with magnetic and resistive anomalies L2 and HR1 respectively and which has been interpreted as a culvert.

L2 aligns with resistance anomaly HR2 and is likely associated with the former railings that marked the northern side of the racecourse.

Also, visible at the shallowest depth are parallel linear anomalies L3 and L4 which broadly correlate with resistive anomaly HR3, again probably relating to the racecourse layout.

Three parallel anomalies, L5, L6 and L7 are also identified aligned north-north-east/south-south-west towards the eastern side of Area 1. These anomalies do not correspond with any anomalies in either of the other two data sets and they are only identified at this shallowest depth. For this reason, they are interpreted as of likely modern origin although they are broadly perpendicular to L8 (see below) and therefore may have some archaeological potential.

Also, only identified at this depth is L8. This anomaly is on the same alignment as HR6 and HR7 in the resistance data and L5 in the magnetic data and corresponds broadly with the boundary defining the 'walled orchard'. Despite the shallow depth of this anomaly, it is

ILLUS 4 Field 1, looking north

interpreted as of some archaeological potential due to its correlation with the position of the 'walled orchard'.

In Timeslice B (0.07 to 0.14m) anomalies L3 to L8 inclusive are no longer identified but there is greater resolution within the area of hardcore and another linear anomaly, L9, (in Area 3) is clearly identifiable. This anomaly corresponds with L3 in the magnetic data and is interpreted as another pipe or culvert. L1 is also better defined and the outline of rectilinear (RL) anomalies RL1 and RL2 start to appear.

Positive reflectors L10 and L11, both aligned east/west in Area 1, are also more clearly defined at this depth. Both are on the same alignment as the racecourse and are consequently interpreted as of modern origin.

RL1 and RL2 become more pronounced in Timeslice C (0.14m to 0.24m). The clear linearity of the responses suggests that they may be due to structural remains.

Only L1, R1 and R2 are clearly visible at depths down to 0.34m in Timeslice D.

Deeper anomalies (from 0.34m to 0.67m)

At the greater depth, no additional anomalies are identified with only L1 and RL2 clearly still identifiable as discrete anomalies at the greatest depth.

6 CONCLUSION

The three survey techniques (magnetometry, earth resistance and ground penetrating radar) have provided useful results although not necessarily complementary data sets. However, the former boundaries of the 'walled orchard' recorded on historic mapping have possibly been recorded in all three datasets. These boundaries have previously been postulated as possibly marking the extent of the Tudor garden. In all three cases, the anomalies are weak and not clearly defined which may indicate a poor degree of preservation. No definite internal features which might suggest garden features have been identified, although linear trend anomalies in the magnetometer and radar data are perpendicular to the 'walled orchard' and may, therefore, have some archaeological potential.

After correlation with historic mapping, it has been noted that a pond, which is recorded from 1839 (Clover and Davies 2017), has not been identified in any of the survey techniques. The cause of this is uncertain, with landscaping of the racecourse a possible basis for a lack of geophysical response in this area.

Overall the survey has not provided any conclusive proof for the survival of features associated with the Tudor garden. However, the surveys have identified features mapped in the late 19th century which have been proposed as forming the boundaries of the Tudor garden. On this basis, the survey can be deemed to have been at least partially successful.

ILLUS 5 Field 2, looking north

7 REFERENCES

Bishop R 2017 ***Westenhanger Castle, Hythe, Kent: Written Scheme of Investigation for Geophysical Survey*** [unpublished client document] Headland Archaeology, Ref WHCK17

Chartered Institute for Archaeologists (CIfA) 2014 ***Standard and guidance for archaeological geophysical survey*** (Reading) http://www.archaeologists.net/sites/default/files/CIfAS&Geophysics_1.pdf accessed 27 November 2017

Clover K & Davies T 2017 ***Westenhanger Castle, Lympne, Kent Statement of Significance*** [unpublished client document] Arcadis

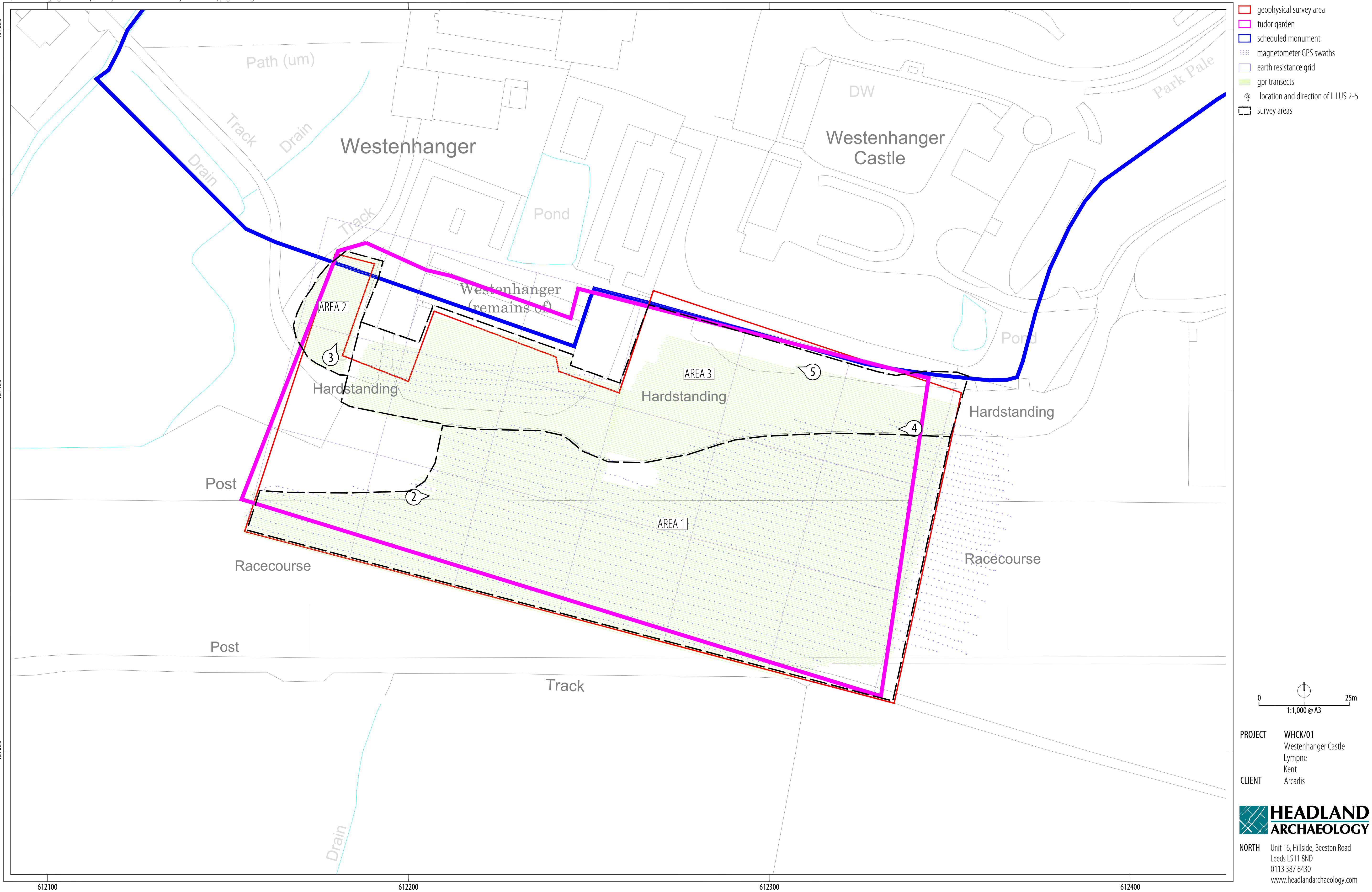
Cranfield University 2017 ***Cranfield Soil and Agrifood Institute Soilscapes*** www.landis.org.uk/soilscapes/ accessed 25 October 2017

Department of Communities and Local Government (DCLG) 2012 ***National Planning Policy Framework*** https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf accessed 27 November 2017

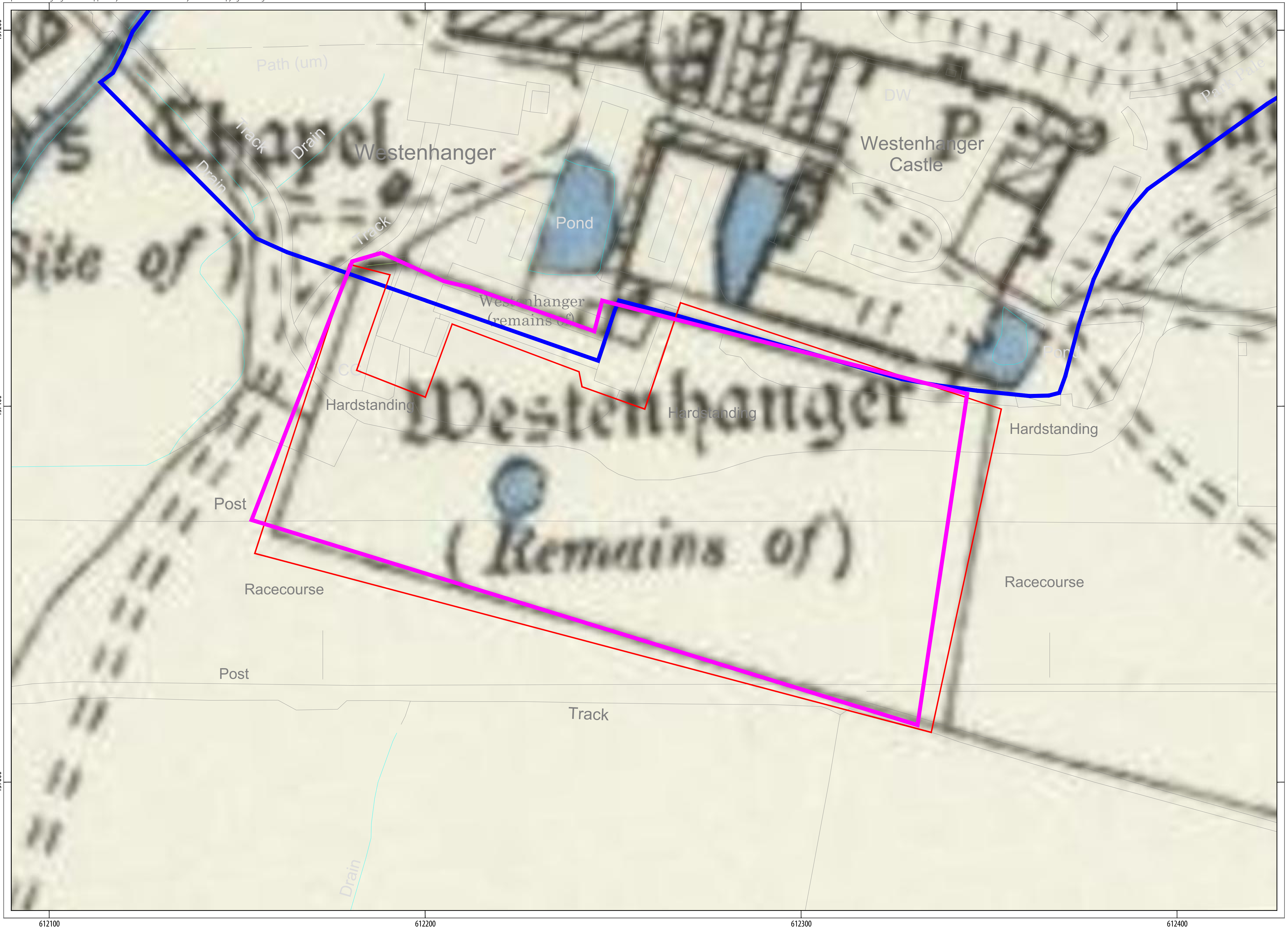
English Heritage 2008 ***Geophysical Survey in Archaeological Field Evaluation: Research and Professional Services Guidelines*** (2nd edn) http://content.historicengland.org.uk/images-books/publications/geophysical-survey-in-archaeological-field-evaluation/geophysics-guidelines.pdf accessed 27 November 2017

Gaffney C & Gater J (2003) ***Revealing the Buried Past: Geophysics for Archaeologists*** Stroud

Natural Environment Research Council (NERC) 2017 ***British Geological Survey*** http://www.bgs.ac.uk/ accessed 27 November 2017



ILLUS 6 Survey location showing magnetometer GPS swath data, earth resistance grids and GPR transects



geophysical survey area
tudor garden
scheduled monument

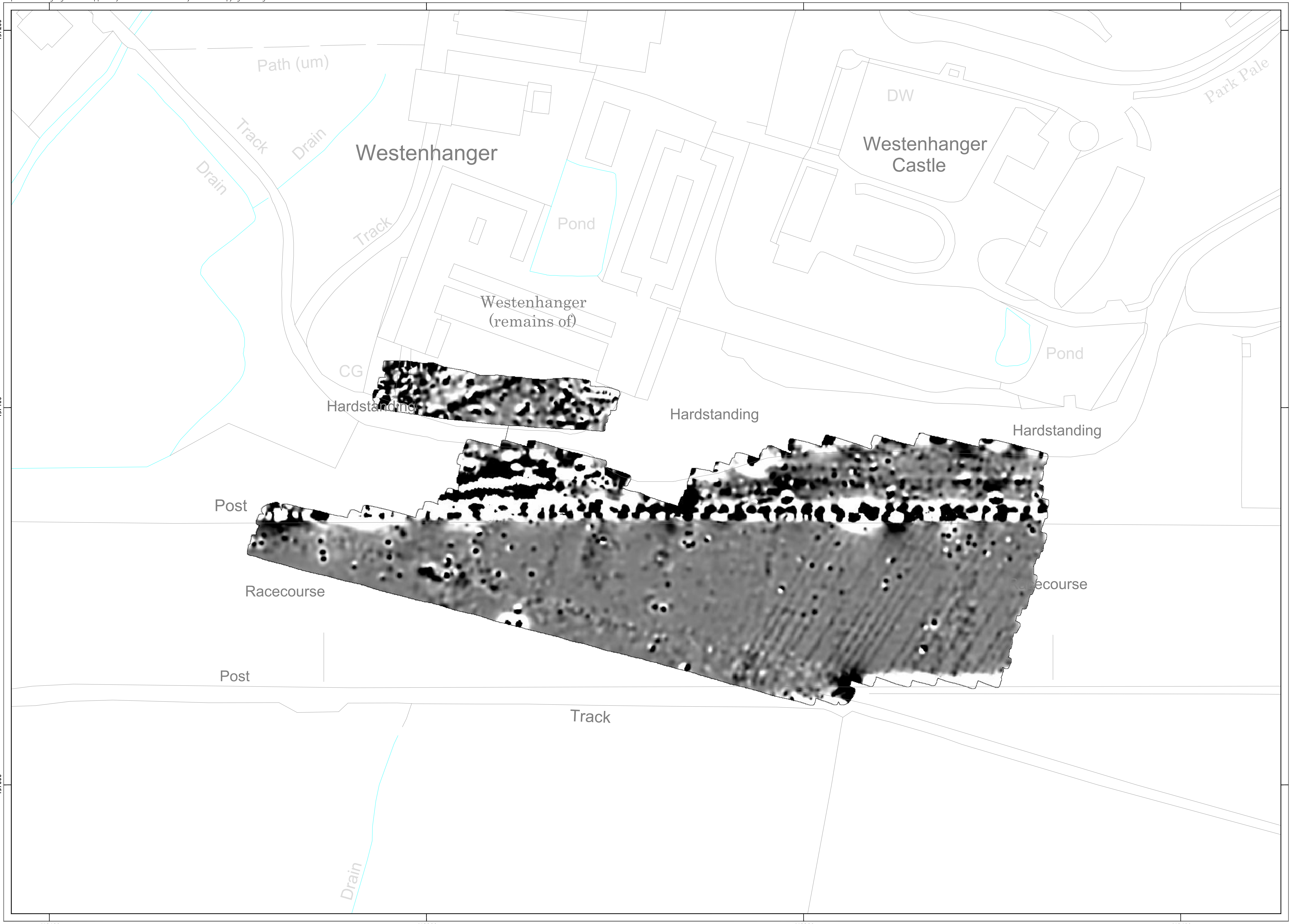
0 25m
1:1,000 @ A3

PROJECT WHCK/01
Westenhanger Castle
Lympne
Kent
CLIENT Arcadis

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 7 Survey location overlying 1888–1913 six inch OS map



ILLUS 8 Processed greyscale magnetometer data

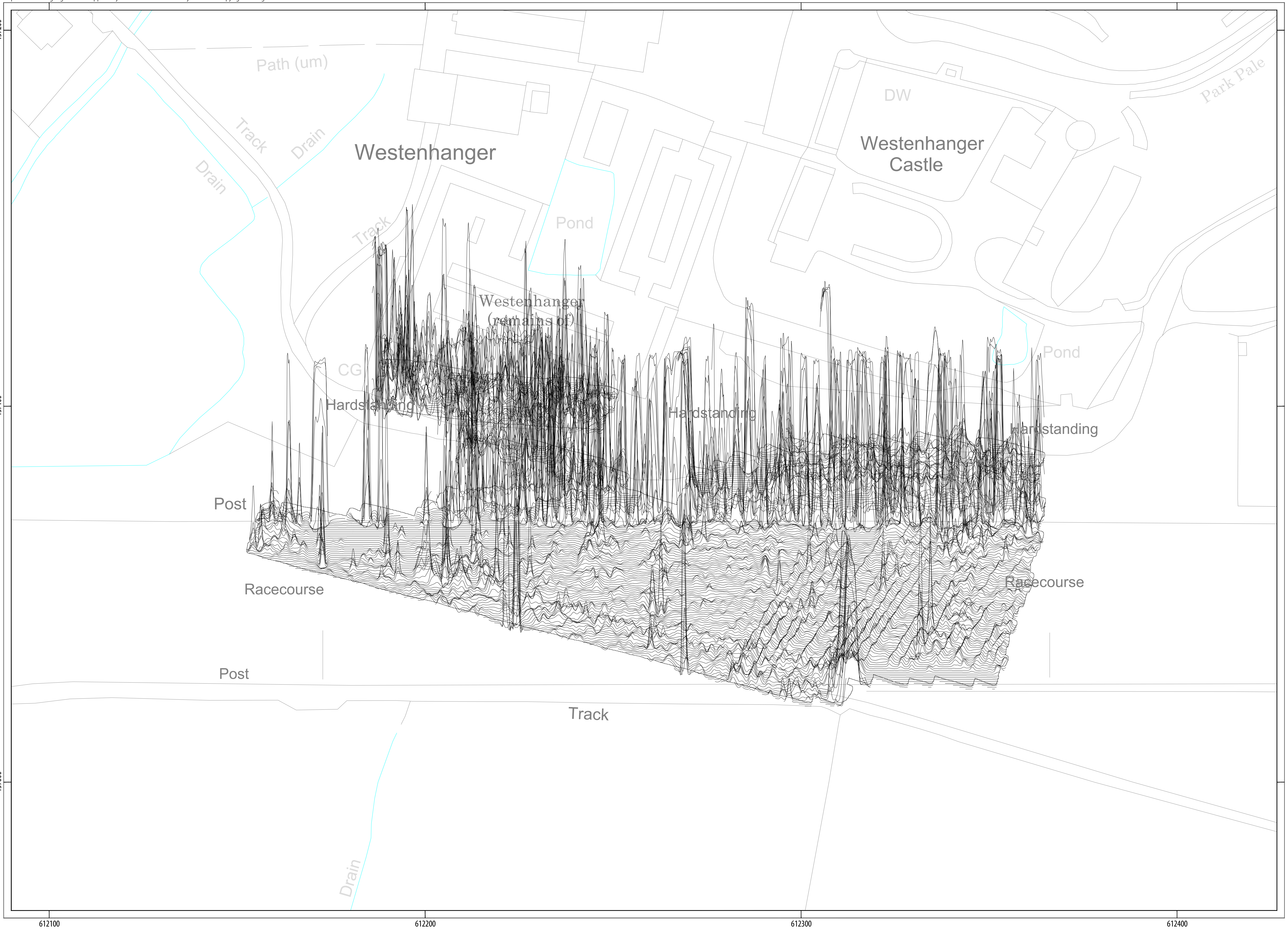
nT
-3.0 3.0

0 25m
1:1,000 @ A3

PROJECT WHCK/01
Westenhanger Castle
Lympne
Kent
CLIENT Arcadis

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com



PROJECT WHCK/01
Westenhanger Castle
Lympne
Kent

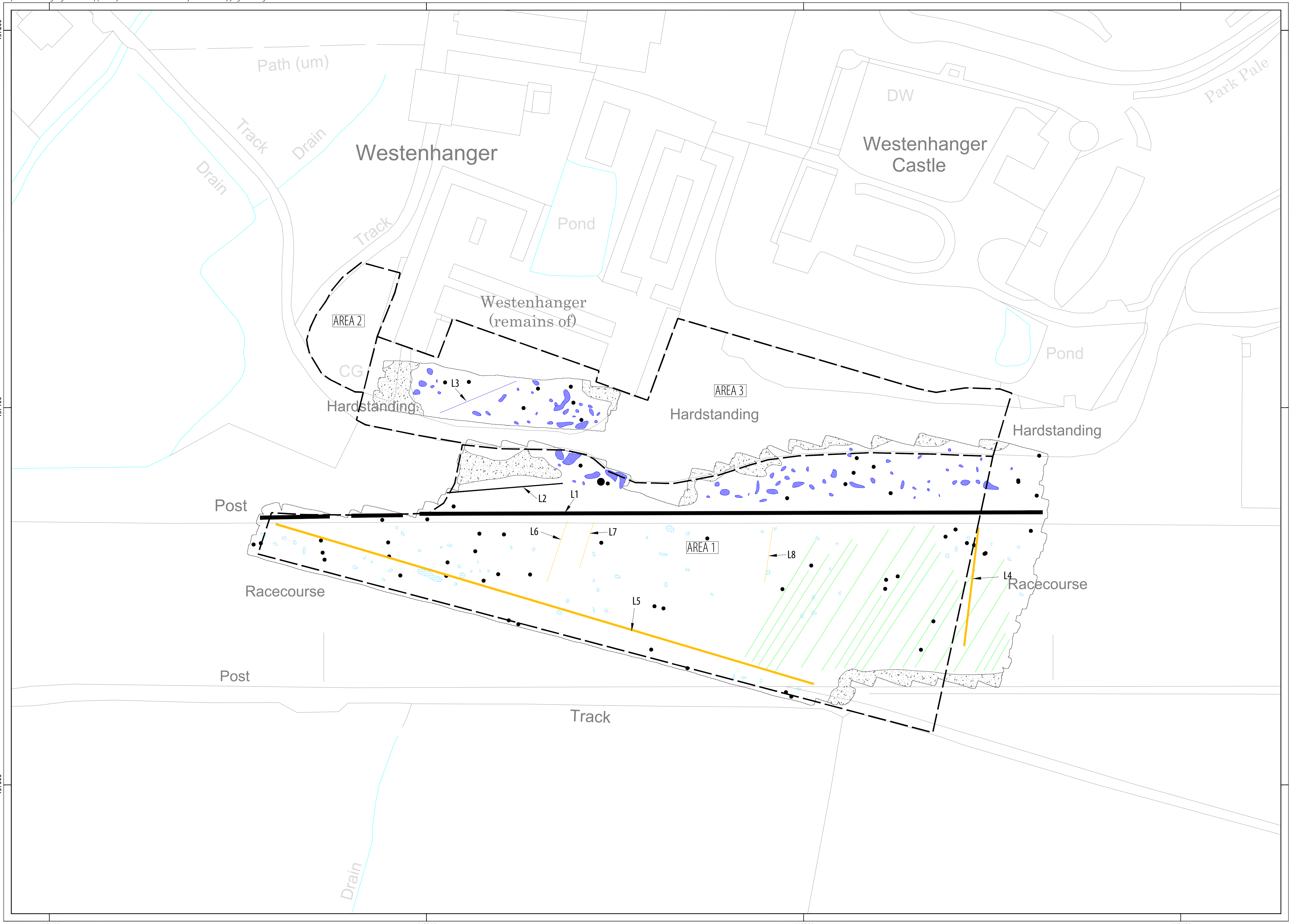
CLIENT Arcadis

HEADLAND ARCHAEOLOGY

NORTH

Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 9 XY trace plot of minimally processed magnetometer data



survey areas

TYPE OF ANOMALY	INTERPRETATION
dipolar isolated	ferrous material
magnetic disturbance	ferrous material
linear	pipe
linear	drain?
magnetic enhancement	geology?
magnetic enhancement	modern?
linear	pipe/culvert?
linear	archaeology?
linear	former boundary/archaeology?

0 25m
1:1,000 @ A3

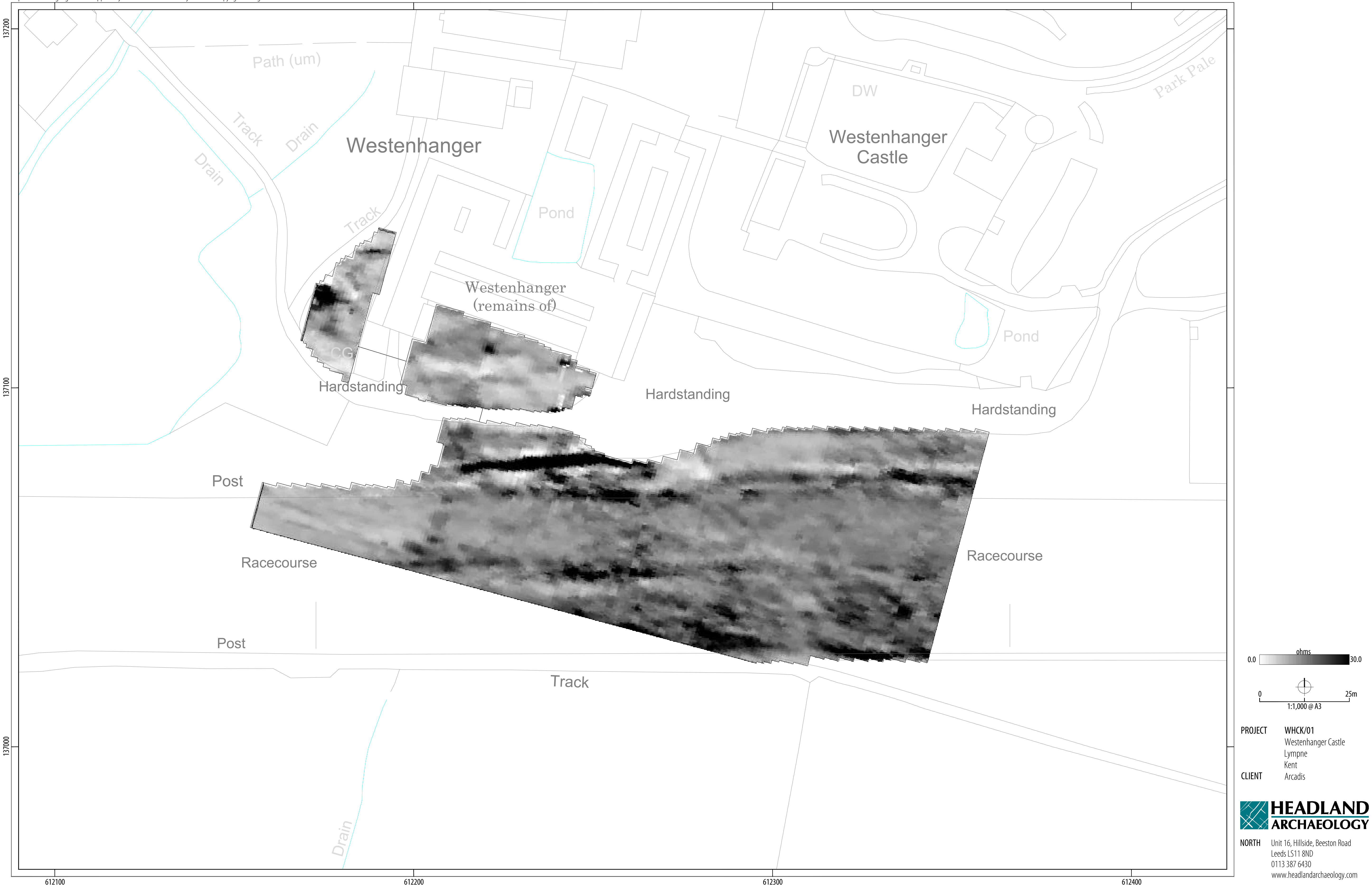
PROJECT WHCK/01
Westenhanger Castle
Lympne
Kent

CLIENT Arcadis

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 10 Interpretation of magnetometer data

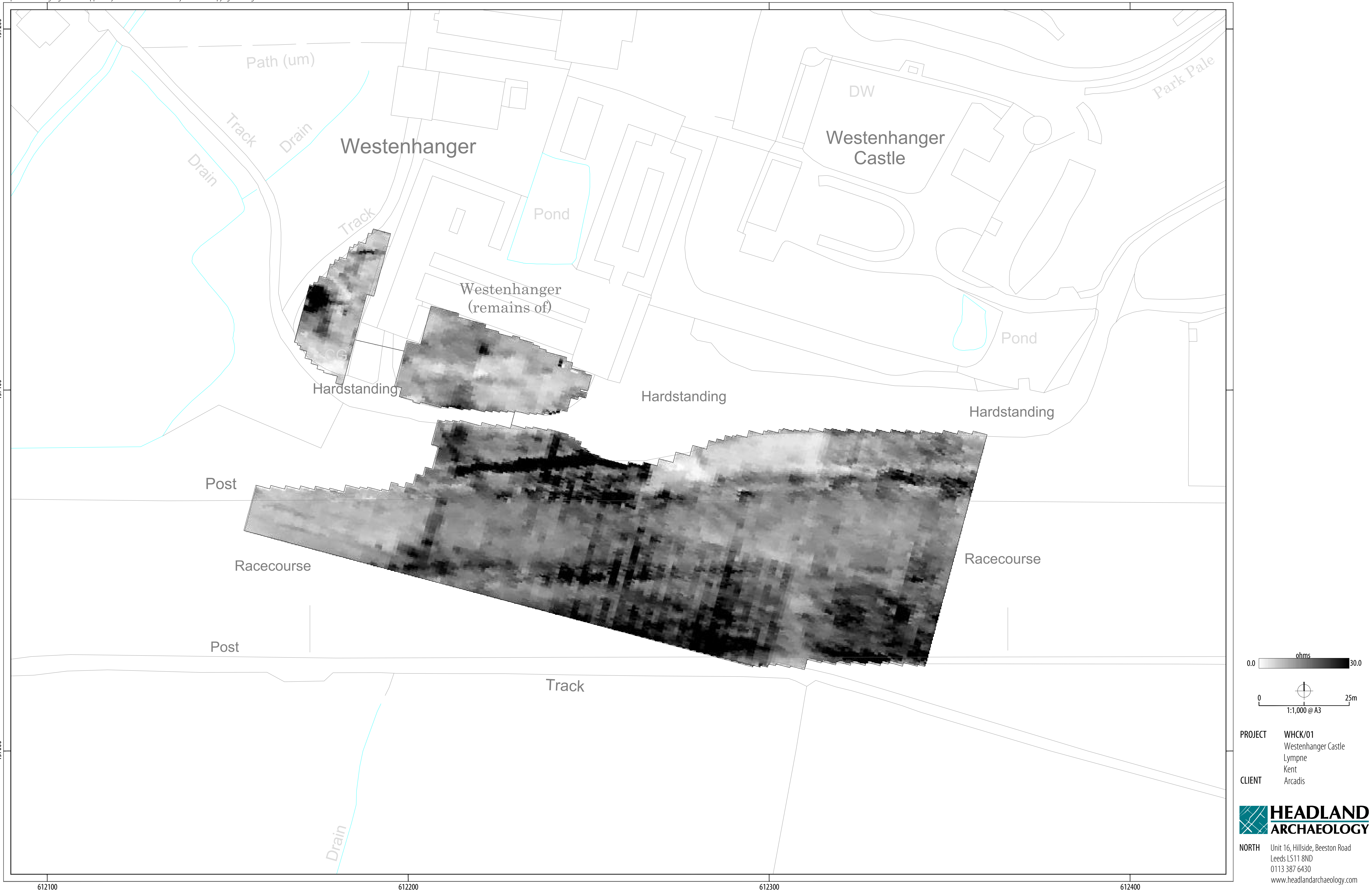


PROJECT WHCK/01
Westenhanger Castle
Lympne
Kent

CLIENT Arcadis

HEADLAND ARCHAEOLOGY
NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 11 Processed greyscale earth resistance data



PROJECT WHCK/01
Westenhanger Castle
Lympne
Kent
CLIENT Arcadis

HEADLAND ARCHAEOLOGY
NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 12 Minimally processed greyscale earth resistance data

survey areas

TYPE OF ANOMALY		INTERPRETATION
	area	compacted material
	linear	pipe
	linear	archaeology?/wall?

0 25m
1:1,000 @ A3

PROJECT WHCK/01
Westenhanger Castle
Lympne
Kent

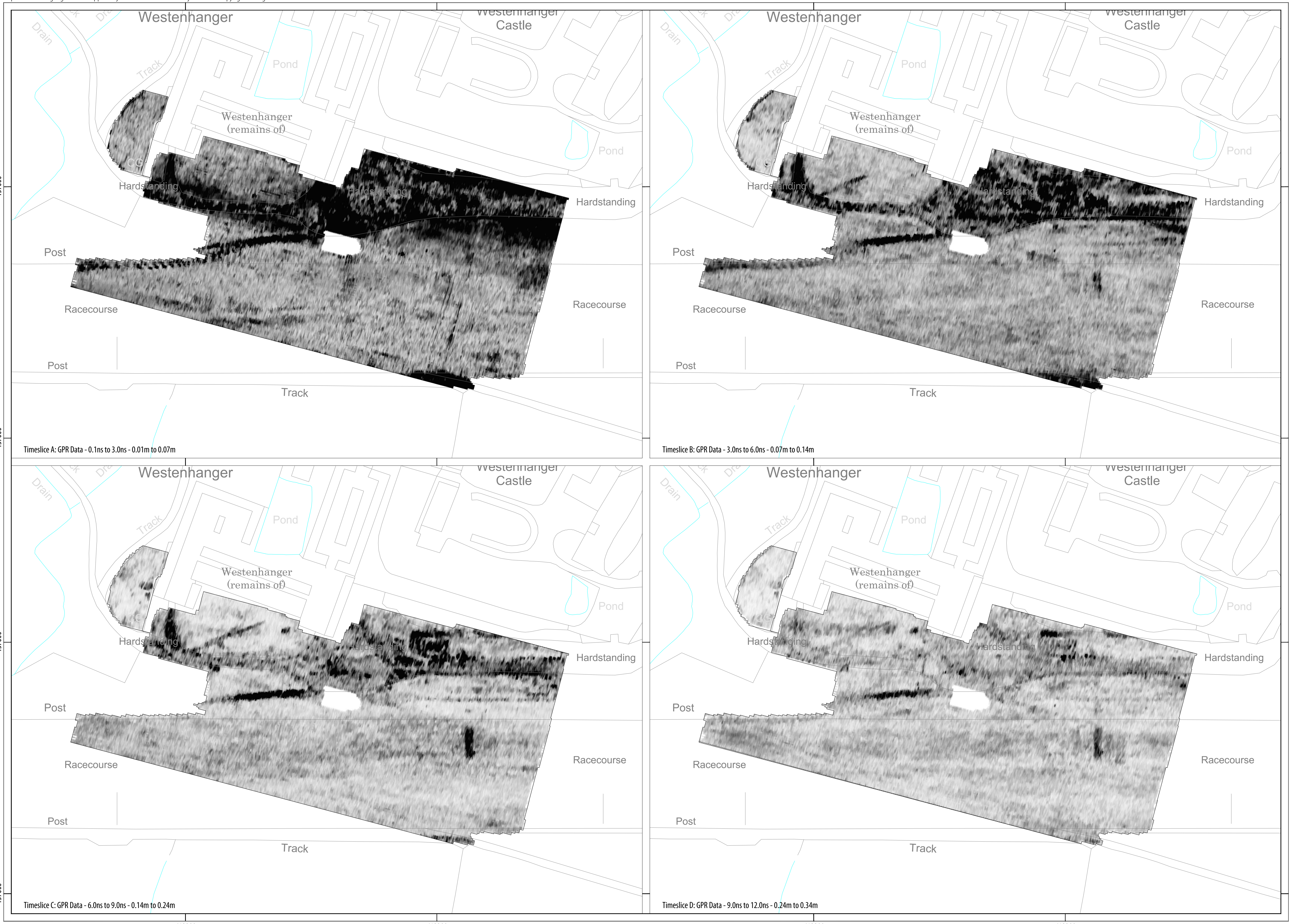
CLIENT Arcadis

HEADLAND ARCHAEOLOGY

NORTH

Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 13 Interpretation of earth resistance data



0 50m
1:1,500 @ A3

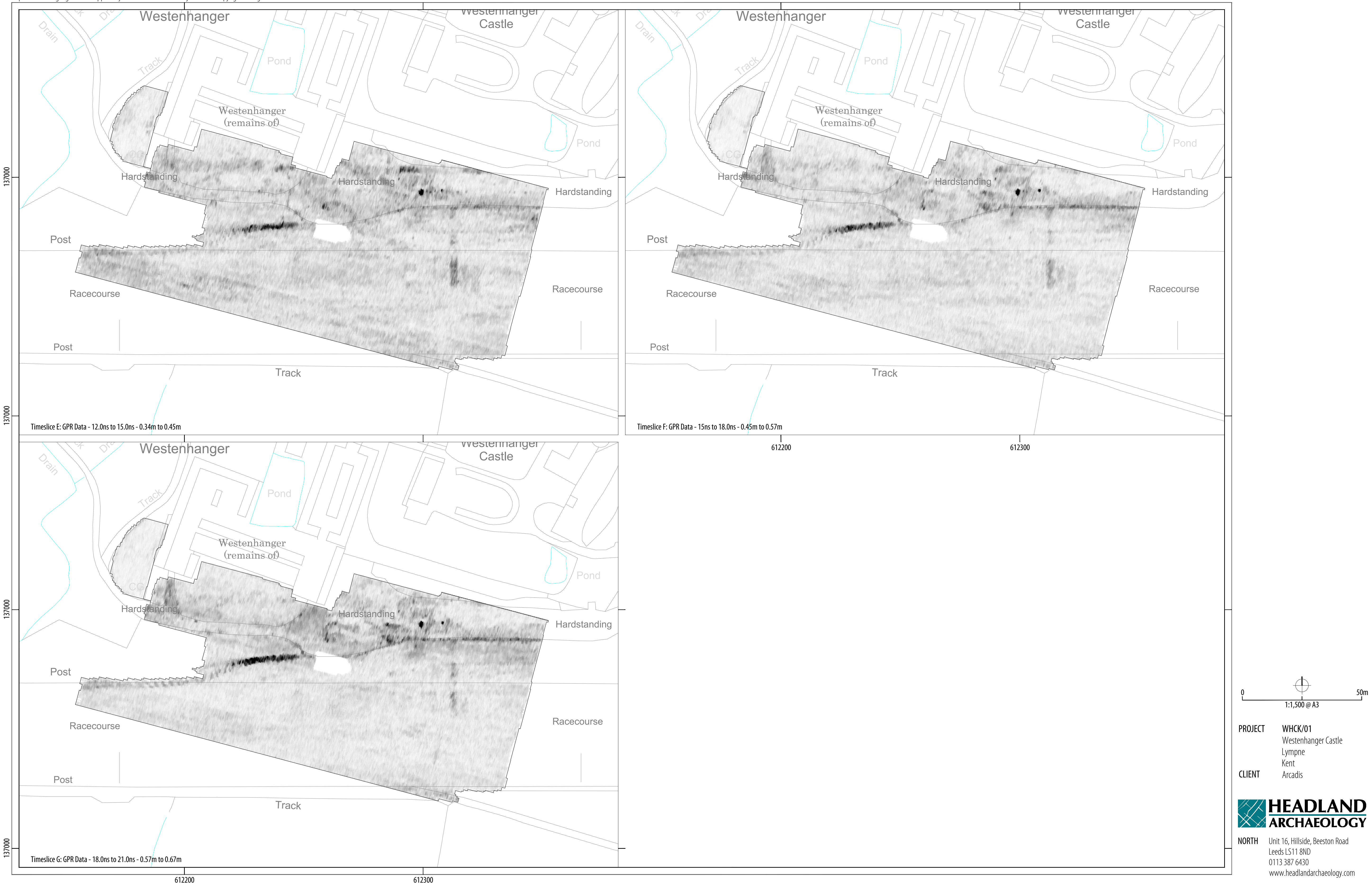
PROJECT WHCK/01
Westenhanger Castle
Lympne
Kent

CLIENT Arcadis

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 14 Timeslices of GPR data - 0.1ns to 12ns



PROJECT WHCK/01
Westenhanger Castle
Lympne
Kent

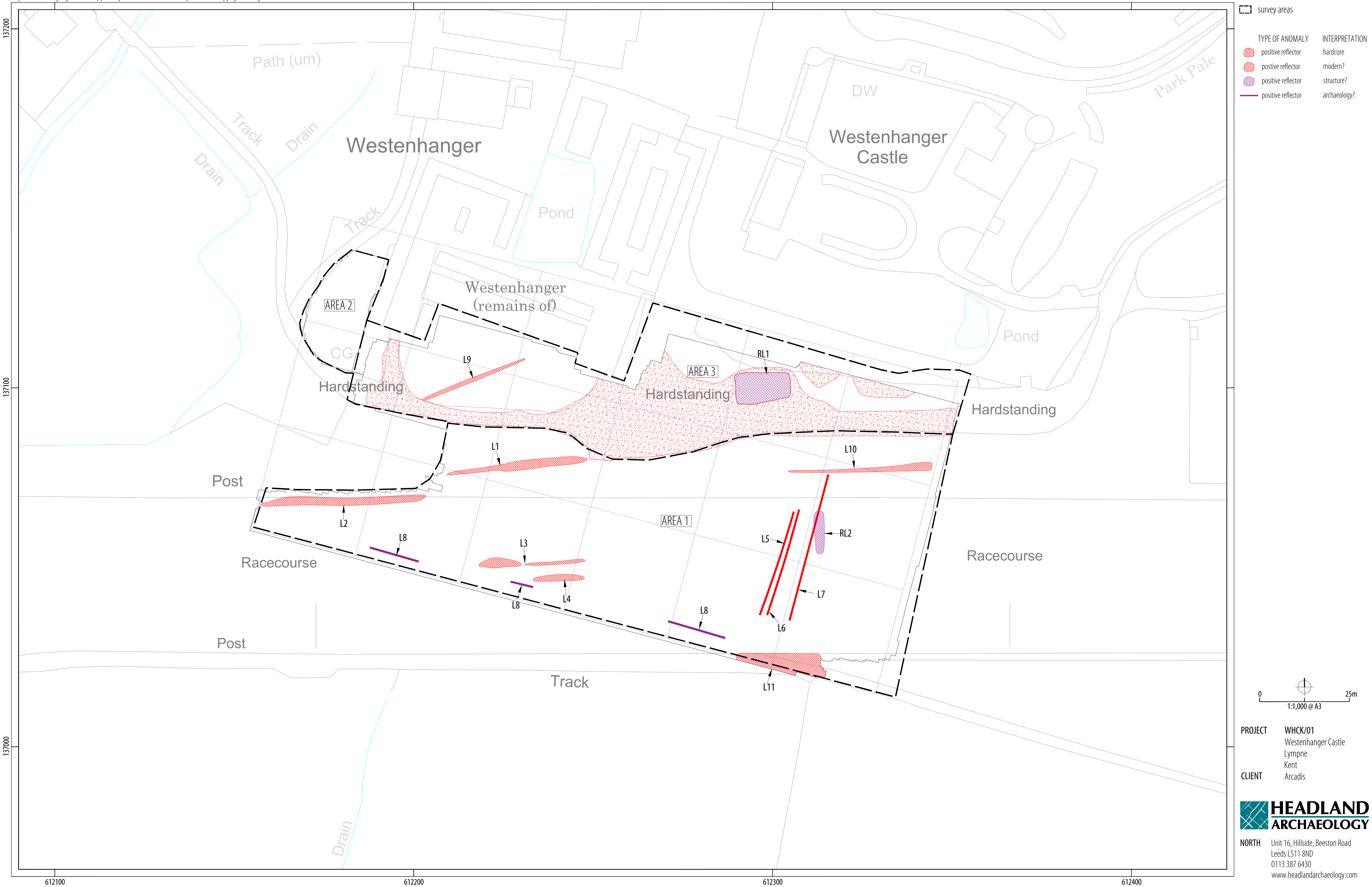
CLIENT Arcadis

HEADLAND ARCHAEOLOGY

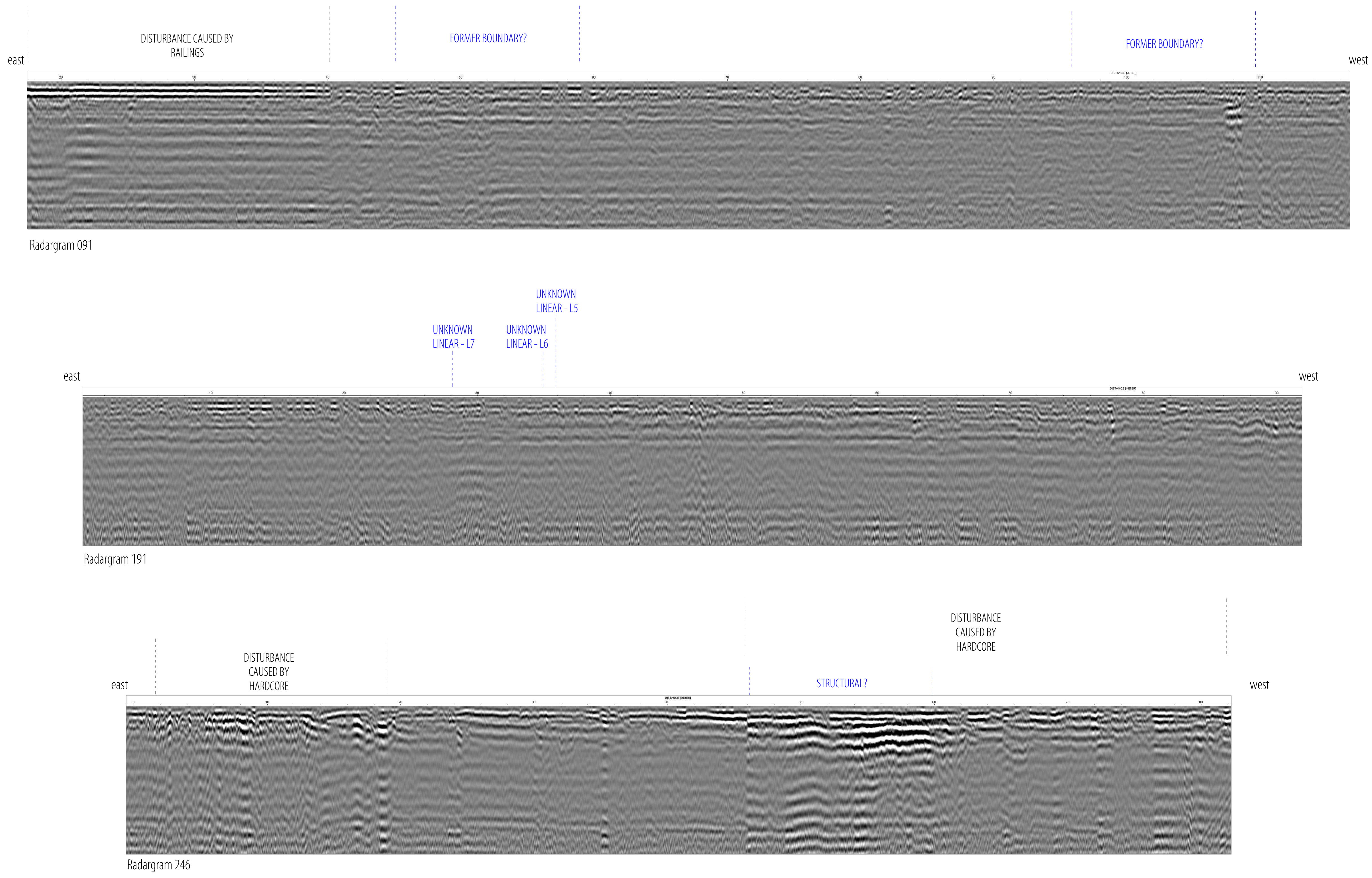
NORTH

Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 15 Timeslices of GPR data – 12ns to 21ns



ILLUS 16 Composite interpretation of GPR data showing anomalies from all depths



not to scale

PROJECT WHCK/01
Westenhanger Castle
Lympne
Kent

CLIENT Arcadis

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 17 Selected radargrams

0 25m
1:1,000 @ A3

PROJECT WHCK/01
Westenhanger Castle
Lympne
Kent
CLIENT Arcadis

HEADLAND ARCHAEOLOGY

NORTH Unit 16, Hillside, Beeston Road
Leeds LS11 8ND
0113 387 6430
www.headlandarchaeology.com

ILLUS 18 Combined Interpretation overlying 1888-1913 six inch OS map (top) and 1839/40 Stanford Tithe Map

8 APPENDICES

APPENDIX 1 MAGNETOMETER SURVEY

Magnetic susceptibility and soil magnetism

Iron makes up about 6% of the earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haematite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms so that by measuring the magnetic susceptibility of the topsoil, areas, where human occupation or settlement has occurred, can be identified by virtue of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected.

The magnetic susceptibility of a soil can also be enhanced by the application of heat. This effect can lead to the detection of features such as hearths, kilns or areas of burning.

Types of magnetic anomaly

In the majority of instances, anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However, some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can, therefore, remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes)—These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of magnetic disturbance—These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Linear trend—This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies—Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on an XY trace plot) on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often, therefore, be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies—Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

APPENDIX 2 SURVEY LOCATION INFORMATION

An initial survey base station was established using a Trimble VRS differential Global Positioning System (dGPS). The magnetometer data were georeferenced using a Trimble RTK differential Global Positioning System (Trimble R8s model).

Temporary sight markers were laid out using a Trimble VRS differential Global Positioning System (Trimble R8s model) to guide the operator and ensure full coverage. The accuracy of this dGPS equipment is better than 0.01m.

The survey data were then super-imposed onto a base map provided by the client to produce the displayed block locations. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if coordinates are measured off hard copies of the mapping rather than using the digital coordinates.

Headland Archaeology cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

APPENDIX 3 GEOPHYSICAL SURVEY ARCHIVE

The geophysical archive comprises an archive disk containing the raw data in XYZ format, a raster image of each greyscale plot with associate world file, and a PDF of the report.

The project will be archived in-house in accordance with recent good practice guidelines (http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_3). The data will be stored in an indexed archive and migrated to new formats when necessary.

APPENDIX 4 DATA PROCESSING

The gradiometer data has been presented in this report in processed greyscale and minimally processed XY trace plot format. Data collected using RTK GPS-based methods cannot be produced without minimal processing of the data. The minimally processed data has been interpolated to project the data onto a regular grid and de-striped to correct for slight variations in instrument calibration drift and any other artificial data. A high pass filter has been applied to the greyscale plots to remove low frequency anomalies (relating to survey tracks and modern agricultural features) in order to maximise the clarity and interpretability of the archaeological anomalies. The data has also been clipped to remove extreme values and to improve data contrast.

The earth resistance data has been presented in this report in process and unprocessed greyscale format. Processes used in the production of the earth resistance plots include a despike to remove spurious readings, edge matching to remove grid edge discontinuities present in twin probe arrays, and a low pass filter that removes high frequency small scale special detail.

The ground penetrating radar data has been presented in processed format, to aid in the interpretation of the survey. Processing of the raw data involved the adjustment of time-zero to coincide with the actual ground surface, background and noise removal, and the application of an AGC gain function to enhance late reflectors.

APPENDIX 5 OASIS DATA COLLECTION FORM: ENGLAND

OASIS ID: headland5-290290

Project details	
Project name	Westenhanger Castle, Lympne, Kent
Short description of the project	Headland Archaeology (UK) Ltd undertook a combined magnetometer, earth resistance and ground penetrating radar survey at Westenhanger Castle, Lympne, Kent, over an area where it is thought there may be the sub-surface remains of a former garden created in the Tudor period. Anomalies corresponding with three boundaries recorded on historic mapping have been tentatively identified. Two of these boundaries are thought to possibly locate the southern and eastern extent of a 'walled orchard', recorded on the historic mapping. These anomalies are consequently interpreted as of possible archaeological potential as it has been postulated that this 'walled orchard' previously defined the extent of the Tudor garden. No anomalies specifically thought to be due to features within the garden are identified; most of the survey area has likely been extensively landscaped having been incorporated within Folkestone Racecourse for more than a century. However, other linear anomalies located within the 'walled orchard' and perpendicular to the mapped boundaries may have some archaeological potential based on their alignment but the shallow depth at which they have been recorded may preclude against this. The majority of the anomalies identified during the survey almost certainly reflect current and recent ground conditions and usage.
Project dates	Start: 22-09-2017 End: 09-10-2017
Previous/future work	Not known / Not known
Any associated project reference codes	WHCK - Sitecode
Type of project	Field evaluation
Site status	Scheduled Monument (SM)
Current Land use	Grassland Heathland 3 - Disturbed
Monument type	MANOR HOUSE Medieval
Significant Finds	N/A None
Significant Finds	N/A None
Methods & techniques	'Geophysical Survey'
Development type	Extensive green field commercial development (e.g. shopping centre, business park, science park, etc.)
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Pre-application
Solid geology (other)	Sandgate Formation
Drift geology (other)	Head
Techniques	Magnetometry/Resistivity - area/ Ground penetrating radar
Project location	
Country	England
Site location	KENT SHEPWAY STANFORD Westenhanger Castle, Lympne, Kent
Study area	1.4 Hectares
Site coordinates	TR 1220 3700 51.092358096957 1.030718221646 51 05 32 N 001 01 50 E Polygon
Project creators	
Name of Organisation	Headland Archaeology
Project brief originator	Consultant
Project design originator	Headland Archaeology
Project director/manager	Harrison, S
Project supervisor	Bishop, R; Harrison, D
Type of sponsor/funding body	Developer

Project archives	
Physical Archive E xists?	No
Digital Archive recipient	In house
Digital Contents	'other'"
Digital Media available	'Geophysics'
Paper Archive Exists?	No
Project bibliography 1	
Publication type	Grey literature (unpublished document/manuscript)
Title	Westenhanger Castle, Lympne, Kent: Geophysical Survey
Author(s)/Editor(s)	Harrison, S.
Date	2018
Issuer or publisher	Headland Archaeology
Place of issue or publication	Edinburgh
Description	A4 Bound report and PDF/A
Entered by	Sam Harrison (sam.harrison@headlandarchaeology.com)
Entered on	1 February 2018

SECTION 42 LICENCE

Historic England

SOUTH EAST OFFICE

Mr Tom Davies
ARCADIS
1st Floor Glass Wharf
Temple Quay
Bristol
BS2 0FR

Direct Dial: 01483 252038

Our ref: AA/051051

Dear Mr Davies

Ancient Monuments and Archaeological Areas Act 1979 (as amended) section 42 - licence to carry out a geophysical survey

WESTENHANGER CASTLE, STONE STREET, WESTENHANGER, KENT CT21 4HX
Case No:SL00159540
Monument no : 1020761

I refer to your application dated 27 April 2017, to carry out a geophysical survey at the above site.

Historic England is empowered to grant licences for such activity and I can confirm that we are prepared to do so as set out below.

By virtue of powers contained in section 42 of the 1979 Ancient Monuments and Archaeological Areas Act (as amended by the National Heritage Act 1983) Historic England hereby grants permission for geophysical survey of WESTENHANGER CASTLE, for the areas shown on the map that accompanied your application (copy attached). This permission is subject to the following conditions.

1. The permission shall only be exercised by Tom Davies on behalf of Arcadis, and their nominated contractor Headland Archaeology Ltd and by no other person. It is not transferable to another individual.

2. The permission shall commence on 8 May 2017 and shall cease to have effect on 8 May 2018.

3. A full report summarising the results of the geophysical survey and their interpretation shall be sent in hard copy to Amanda Kearsey at the address below and electronic (pdf) format to Peter.kendall@HistoricEngland.org.uk, copied to Paul.Linford@HistoricEngland.org.uk no later than after the completion of the survey.

4. The enclosed questionnaire shall be completed and appended to the survey report. For convenience an electronic version of this questionnaire can be

Historic England

SOUTH EAST OFFICE

downloaded from http://HistoricEngland.org.uk/advice/technical-advice/archaeological-science/geophysics.

5. A copy of the report shall also be sent (in their preferred format) to the local Historic Environment Record (HER). The local HER's contact details can be found at http://www.heritagegateway.org.uk/gateway/chr/default.aspx.

6. A record signposting your investigation shall be made with the Archaeology Data Service using their online OASIS Data Collection form no later than after completion of the survey. Please see http://oasis.ac.uk/ for details or contact oasis@HistoricEngland.org.uk for information and training.

This letter does not carry any consent or approval required under any enactment, bye-law, order or regulation other than section 42 of the 1979 Act (as amended).

You are advised that the person nominated under this licence to carry out the activity should keep a copy of this licence in their possession in case they should be challenged whilst on site.

Yours sincerely

Peter Kendall
Principal Inspector of Ancient Monuments
E-mail: Peter.kendall@HistoricEngland.org.uk
cc

EASTGATE COURT 195-205 HIGH STREET GUILDFORD SURREY GU1 3EH
Telephone 01483 252020
HistoricEngland.org.uk

Headland Archaeology South & East
Building 68C | Wrest Park | Silsoe | Bedfordshire MK45 4HS
t 01525 861 578
e southandeast@headlandarchaeology.com

Headland Archaeology Midlands & West
Unit 1 | Clearview Court | Twyford Rd | Hereford HR2 6JR
t 01432 364 901
e midlandsandwest@headlandarchaeology.com

Headland Archaeology North
Unit 16 | Hillside | Beeston Rd | Leeds LS11 8ND
t 0113 387 6430
e north@headlandarchaeology.com

Headland Archaeology Scotland
13 Jane Street | Edinburgh EH6 5HE
t 0131 467 7705
e scotland@headlandarchaeology.com

www.headlandarchaeology.com