

Hampshire Water Transfer and Water Recycling Project

Environmental Statement – Appendix 7.10 World War II Crash Site Pigeon House Farm Technical Note and geophysical survey report

VOLUME NUMBER: 6

PLANNING INSPECTORATE SCHEME NUMBER: WA010002

APPLICATION DOCUMENT REFERENCE: 6.2

APFP REGULATION: 5(2)(a)

May 2026

Version 0



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**Southern
Water** 

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Addendum Appendix 7.10 World War II Crash Site Pigeon House Farm Technical Note and geophysical survey report

1. The following document forming Environmental Statement (ES) Appendix 7.10 World War Crash Site Pigeon Farm Technical Note and geophysical survey report, Volume II (Document reference 6.2, DCO Volume 6) was submitted as an appendix of the Preliminary Environmental Information (PEI) Report.
2. This document has been included as an appendix to the ES Chapter 7 Archaeology and cultural heritage, Volume I (Document reference 6.1, DCO Volume 6) to provide additional information on the WWII plane crash site located near Pigeon House Farm and the results of the detailed gradiometer and ground penetrating radar survey that was conducted to identify the location of the crash site.
3. This appendix also serves to present the process of the identification of the World War II Crash Site and associated work conducted to better locate the crash site. As such these documents have been included as drafted prior to the submission of the PEI Report.
4. As such, this document includes references to terminology and documents in place at the point in time the geophysical survey was carried out. This appendix should as a result be read in conjunction with ES Chapter 7 Archaeology and cultural heritage, Volume I (Document reference 6.1, DCO Volume 6) and associated appendices.

Note / Memo

**HaskoningDHV
Water & Maritime**

To: [REDACTED]
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Date: 03 October 2023
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Our reference: PC3194-WM-ME-231003-0842
Classification: Project related
Checked by: [REDACTED]

Subject: WWII Crash Site Pigeon House Farm

1 Introduction

1.1 Purpose of this note

This note is intended to provide an overview of the known information relating to the crash site of the WWII RAF plane near Pigeon House Farm. This will include information on the expected location of the crash site as well as the condition of any in-situ remains.

The site is believed to be located within the close vicinity of the proposed Water for Life transfer pipeline route. As a result, this note will highlight the need for further investigative work to better understand the positioning of this site to allow for ongoing scheme development to ensure that the crash site, which constitutes a controlled site under the Protection of Military Remains Act 1986, will not be unduly disturbed. Any intrusive works that may disturb the crash site would require a licence and it is currently MoD policy to refuse applications for licencing where human remains or live ordnance are anticipated to be present.

In addition to any statutory controls on the crash site, the potential survival of the remains of the pilot mean that the site should be treated with the respect due to a War Grave.

1.2 Circumstances of the crash and subsequent recovery attempts

On the 6th of November 1940, the Hawker Hurricane of Sgt Hubert Adair was shot down over the Portsmouth area by German Luftwaffe pilot Helmut Wick (Saunders, 2009). Sgt Adair's plane has been traced to a crash site at Pigeon House Farm (Saunders, 2009). Following the forceful collision of the plane with the ground, the craft burst into flames. The aircraft continued burning for three days before the wreckage and its surrounding crater were filled in with earth by workers on the farm (Saunders, 2009). While the site was attended at the time by the Army and RAF, no attempt was made to recover the aircraft or Sgt Adair's body at the time of the crash, and Sgt Adair was posted missing.

a formal identification (Saunders, 2009), meaning that Sgt Adair officially remains missing. This suggests the potential for wreckage and debris from the aircraft and human remains to survive on site.

1.3 Present location of the crash

The crash site is referenced within the Historic Environment Records (HERs) for Winchester and Portsmouth. However, only a six-figure grid reference is recorded and the locational accuracy for this point cannot be relied on.

Photographs of the 1979 excavation are presented in Figures 1 and 2. These provide some indication of the location of the crash site. Figure 1 shows the excavation from the south, looking north towards the crest of Portsdown Hill. To the right of the photo, shown in Figure 1, is an electricity pylon. To the left of the pylon, in the field behind, is an overhead line carried on row of wooden posts which can be seen from the middle to the left of the frame leading to a road shown on the left-hand side of the photo. This photograph would place the location of the excavation in the south-east part of the field to the south of Pigeon House Farm.



Figure 1 Photograph showing a south-eastern view of the 1979 Excavation at Pigeon House Farm (Saunders, 2009)



Figure 2 Photograph of 1979 Excavation (Hunt, 2007)

Figure 2 appears to depict the same area being excavated as is shown in Figure 1, with the photograph instead taken from the opposite direction, looking northwards down Portsdown Hill towards Pigeon House Farm. The notable locating feature in this image is a barn visible in the background of the photo, which is seen roughly perpendicular to the line of sight over the excavation, suggesting a location on the eastern side of the field, close to Pigeon House Lane.

These features in both Figure 1 and Figure 2 are visible in a present-day aerial image of Pigeon House Farm (as presented in Figure 3). Circled in yellow in Figure 3 is a pylon matching the location of the one visible in Figure 1 with its close proximity to the bend in Pigeon House Lane. With a barn visible opposite this pylon, matching the positional features within the excavation photographs, this provides some indication of the potential area of the crash site.

The results from the geophysical survey carried out for Southern Water have not provided conclusive evidence for material relating to the aircraft wreckage within the areas surveyed to the northern end of the field. This also suggests the need to extend the area surveyed to the south of the area currently excavated.



Figure 3 Google Earth image showing the location of the identifiable barn (circled in blue) and pylon (circled in yellow) at Pigeon House Farm.

Considering the locations of these features, there is an argument for positioning the wreckage in the position illustrated in Figure 4. This is closer to the road and further south than the location provided by the Winchester HER (MPM1373) and is to the south of the area that has currently been subject to geophysical survey.

A watercolour painting by Alexander McKee, painted on the night of the crash (not reproduced), suggests that the site was located close to Pigeon House Lane, with a military ambulance visible behind a hedge in close proximity to the crash, although there are no further landmarks that would fix this scene. Saunder's account suggest that this location was close to that of the excavation team's vehicle (visible in Figure 1) and also suggests that the crash site was '200 yards' from where Bob Ware, another eyewitness, took shelter under a farm cart, presumably at Pigeon House Farm.

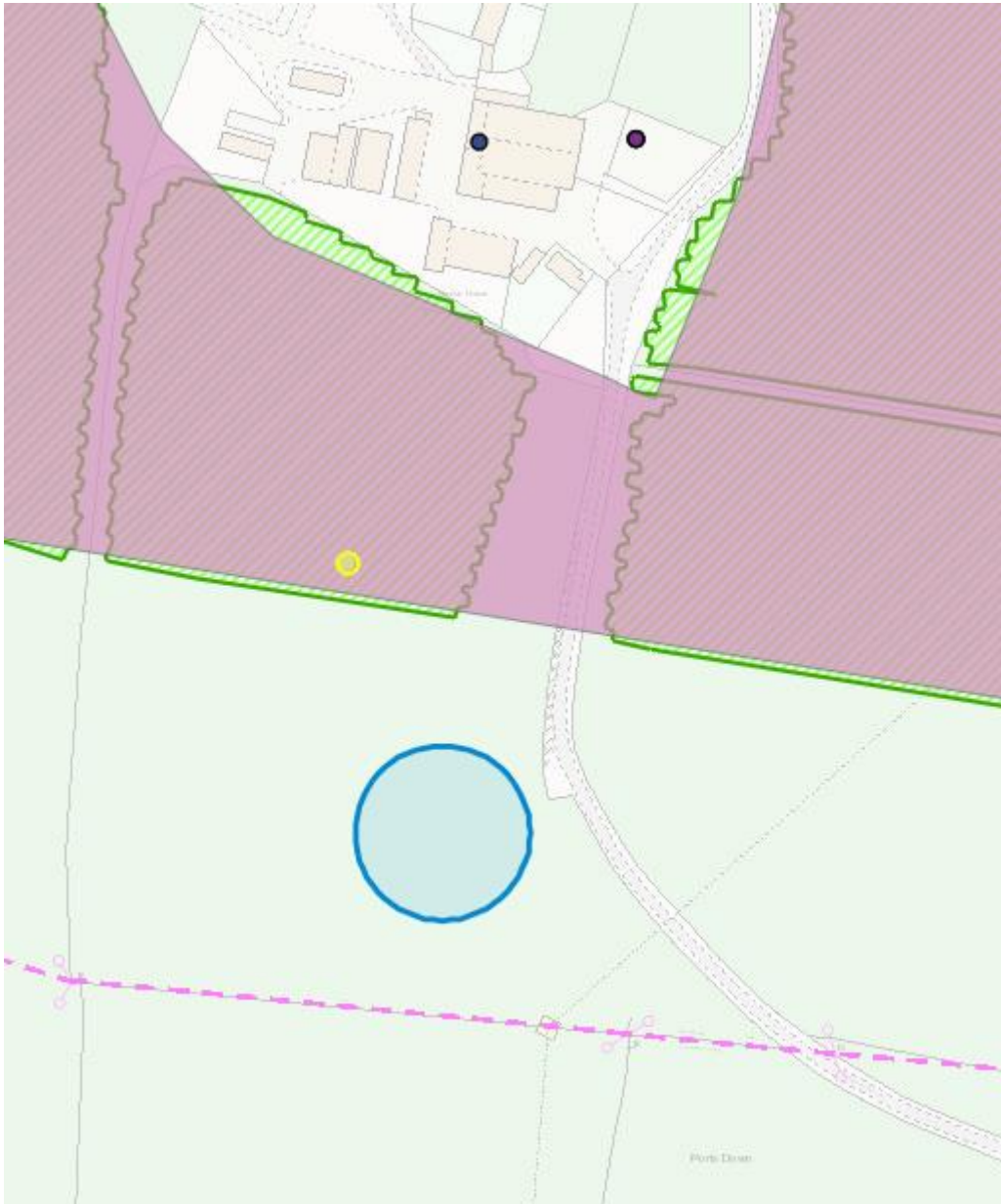


Figure 4 Map showing the location of the potential site of the WWII wreckage (blue circle) compared to the HER location (yellow highlight) and extent of geophysical survey (green hatch) and site boundary (purple shade). OS mapping from MOATA SW: Water for Life Hampshire © Crown copyright and database rights (2022) OS (WU298530)

It should be noted, however, that during the 1979 excavation two trenches were dug, and there is a chance that the images were not taken of the trench in which aircraft material was excavated from.

In addition, magnetometry survey relies on detecting variation within the earth's magnetic field. This typically derives from the presence of ferrous material, as well as areas of intensive heating or disturbance. While there is a reasonable expectation that an excavation of the size of that carried out in 1979 would be discernible as magnetic anomalies, particularly when accompanied by burnt material, it is not possible to take the absence of such anomalies as proof of absence, particularly when the larger ferrous parts of the aircraft (engine block, guns and armour plate) are recorded as having been recovered.

1.4 Recommendations and Conclusions

It appears likely that the site of the crashed aircraft is located slightly to the south of the proposed pipeline route and associated working areas, but this location cannot be taken as confirmed and it is still possible that the crash may be located within the present site boundary.

Consequently, to provide more conclusive evidence of the exact location of the crash, without disturbing the protected site, it would be helpful to extend the geophysical surveying being carried out in the north of the field adjacent to Pigeon House Farm to the southern part of the field.

Both magnetometry and Ground Penetrating Radar (GPR) surveying should also be conducted over the proposed cable route and extended over the field more widely to ensure that the potential crash sites are within the survey area. The use of two different techniques providing complementary data gathered by identifying different types of geophysical anomaly would provide significantly more confidence in identifying the potential crash site. Non-intrusive geophysical survey work would not require a licence.

It is likely that intrusive works within the proposed site boundary would need to be licenced in any case (MoD Policy usually requires a licence for works within 100m of a crash site), but a clearer understanding of the location of the crash would allow any constraint to works to be better managed and disturbance of the site to be avoided.

2 References

Hunt, B. (2007) 'Surface Sites – Memorials Sergeant HH Adair', *Portsmouth Tunnels*. Available at: http://www.portsdown-tunnels.org.uk/surface_sites/memorials/hurricane_crash_p1.html

Saunders, A. (2009) *Finding the Few*. Grub Street Publishing: London.



Hampshire Water Transfer – Additional Surveys

Detailed Gradiometer and
Ground Penetrating Radar Survey Report

Document Ref.: 275081.02
January 2024



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Unit R6
Sheaf Bank Business Park
Prospect Road
Sheffield
S2 3EN

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Document Information

Document title Hampshire Water Transfer - Additional Surveys
Document subtitle Detailed Gradiometer and Ground Penetrating Radar Survey Report
Document reference 275081.02

Commissioned by Southern Water Service Ltd
Address Southern House
Yeoman Road
Worthing West
Sussex
BN13 13X

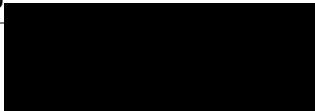
Site location Pigeon House Lane, Southwick and Widley, Winchester
County Hampshire
National grid reference 464642 106938 (SU 64642 06938)

WA project code 275081
Dates of fieldwork 04 – 08/12/2023

Fieldwork directed by
Project management by
Document compiled by
Contributions from
Graphics by



Quality Assurance

Issue	Date	Author
1	03/01/2024	RP 



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Summary

A detailed gradiometer and ground penetrating radar (GPR) survey were conducted over land at Pigeon House Lane, Southwick and Widley, Hampshire (centred on NGR 464642 106938). The project was commissioned by Southern Water Service Ltd with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features. A key objective of this additional survey is to identify the crash site of a WWII RAF plane near Pigeon House Farm. The survey forms part of an ongoing programme of archaeological works being undertaken in support of a planning application for the Hampshire Water Recycling and Water Transfer Project. The development consists of a new treatment process to turn treated water into purified recycled water at a new Water Recycling plant south of Havant and the associated new water pipeline.

The site comprises two arable fields covering an area of 4.1 ha. The geophysical survey was undertaken between 04 – 08 December 2023.

The gradiometer survey has identified an area of potential past human activities. A fragmented curvilinear outer ditch together with a smaller pen-annular ditch, forms a possible ring-ditch surrounded by a small enclosure, which could relate to wider prehistoric activities in the area. Its weak magnetic signature and absence from GPR data, make this interpretation tentative.

The location of one of the two reported trenches, excavated in 1979 to locate the site of a WWII crash site has been identified in the southern field in the gradiometer and GPR survey. The location corresponds to the one identified from 1945 – 46 aerial photographs of the area and photographs from the 1979 excavation. There is no evidence for a second trench in the data.

There are numerous highly magnetic anomalies identified throughout the gradiometer data. While this has the potential to limit the ability to identify archaeological features, the anomalies are relatively sparse and do not affect the GPR data. It is therefore considered unlikely that it has limited the survey.

The remaining anomalies are thought to be modern or natural. The modern anomalies relate to a path and made ground.

Acknowledgements

Wessex Archaeology would like to thank Southern Water Service Ltd for commissioning the geophysical survey. The assistance of Platon Kostelletos and Thomas Swannick is gratefully acknowledged in this regard.

The fieldwork was undertaken by Filippo Carrozzo, Jake Bishop and Callum Jervis. Brett Howard and Rok Plesnicar processed the data. Brett Howard and Amy Dunn interpreted the geophysical data. Rok Plesnicar wrote the report with contributions from Matt Lester. The geophysical work was quality controlled by Tom Richardson. Illustrations were prepared by Rok Plesnicar. The project was managed on behalf of Wessex Archaeology by Patricia Edwards.



Hampshire Water Transfer - Additional Surveys

Detailed Gradiometer and Ground Penetrating Radar Survey Report

1 INTRODUCTION

1.1 Project background

- 1.1.1 Wessex Archaeology was commissioned by Southern Water Service Ltd to carry out a geophysical survey at Pigeon House Lane, Southwick and Widley, Hampshire (centred on NGR 464642 106938) (**Figure 1**). The survey forms part of an ongoing programme of archaeological works being undertaken in support of a planning application for Hampshire Water Recycling and Water Transfer Project. The development consists of a new treatment process to turn treated water into purified recycled water at a new Water Recycling plant south of Havant and associated new water pipeline; Water for Life.
- 1.1.2 A key objective of this survey is to identify the crash site of a WWII RAF plane near Pigeon House Farm. The crash site is believed to be located close to the proposed Water for Life scheme and is a controlled site under the Protection of Military Remains Act 1986.

1.2 Scope of document

- 1.2.1 This report presents a brief description of the methodology followed by the detailed survey results and the archaeological interpretation of the geophysical data.

1.3 The site

- 1.3.1 The site is located 2 km south-east of the village of Southwick and 2.5 km west of Widley in the county of Hampshire.
- 1.3.2 The survey comprises 4.1 ha of agricultural land, currently utilised for crop and pasture divided into two land parcels. The entire site was subjected to ground penetration radar (GPR) survey whereas the gradiometer survey was carried out in the southern field covering an area of 2.3 ha. This is due to the northern half of the area already being surveyed as part of an earlier phase of gradiometer survey for the Water for Life scheme. The site is bounded by Pigeon House Farm to the north, Pigeon House Lane to the east, and further agricultural land to the south and west.
- 1.3.3 The site is on a slight incline sloping from 66 m above Ordnance Datum (aOD) at the northern edge to 85 m aOD at the southern edge.
- 1.3.4 The solid geology comprises Chalk of the Portsdown Chalk Formation in the northern portion of the site and Spetisbury Chalk Member to the south (BGS 2023).
- 1.3.5 The soils underlying the site are likely to consist of grey rendzinas soils of the 342a (Upton 1) association (SSEW SE Sheet 6 1983). Soils derived from such geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer and GPR survey.



2 ARCHAEOLOGICAL BACKGROUND

2.1 Introduction

2.1.1 The archaeological and historical background set out below has considered the recorded historic environment within a 1 km study area of the site. The following archaeological background is not exhaustive but discusses known heritage assets relevant to the interpretation of the geophysical survey data. It uses publicly available online resources such as the Historic Environment Record (HER) for Hampshire, the National Heritage List for England (NHLE) and historical Ordnance Survey mapping (OS) (National Library of Scotland (NLS)). All distances discussed are from the nearest site boundary.

2.2 Summary of the archaeological resource

Designated heritage assets

2.2.1 The scheduled monument of Fort Widley (NHLE: 1001862) is situated 900 m south of the site. The fort is one of many built to protect Portsmouth from a rearward, land-based attack during the Victorian Period. There are no other designated heritage assets within 1 km of the site.

Prehistoric

2.2.2 A Mesolithic flint blade and waste flakes were found approximately 200 m north of the site. Further worked flints of either Neolithic or Bronze Age origin were found 800 m west of the site.

2.2.3 An area of Bronze and Iron age activity is located approximately 250 m south-east of the site. Evidence for this activity includes a bowl barrow and inhumation, but also several post holes and pits. At least two of these pits are associated with Bronze Age cremation burials. Two additional Bronze Age round barrows, located 200 m south-west of the site, were identified from earthworks in 1955. No traces of the earthworks remain visible on the surface.

2.2.4 Several Iron Age findspots have been identified within the 1 km study area. The first, 140 m south of the site, contained Iron Age and medieval pottery. The second is located 330 m south of the site near Smithwick Crossroads and also consists of pottery sherds. Finally, Iron Age pottery and lynchets were found during the widening of the B2177, 450m west of the site.

Romano-British

2.2.5 A circular pit feature with associated postholes containing Romano-British pottery was found just below the crest of one of the highest points of Portsdown Hill, 200 m south-west of the site. A mid-3rd century AD Roman coin was found 410 m south-west of the site at the foot of Portsdown Hill.

Medieval

2.2.6 Immediately to the north of the site, approximately where Pigeon House Farm currently stands, is the location of the former medieval village of Wallsworth. Lynchets are visible around the farm, but no settlement earthworks are evident on the surface.

2.2.7 A Saxon cemetery was found 260 m south-east of the site, near to the Bronze Age bowl barrow. The cemetery comprised seventeen burials, three of which contained grave goods. Remnants of a flint trackway, possibly associated with a lookout tower for the Saxon Shore Fort at Porchester, is located 200 m south-west of the site.



2.2.8 Pinsley Motte is located approximately 650 m west of the site. Post-medieval chalk extraction has removed much of the associated earthworks. Several isolated finds of medieval pottery have been uncovered in the region. Two pits containing medieval pottery and faunal remains located south-west of the motte may be associated with the bailey.

Modern

2.2.9 There are numerous sites of WWII activity within and in the vicinity of the site. The closest to the survey area is that of a WWII Hurricane crash located in the southern field of the survey area. The plane was piloted by Sergeant Hubert Adair and crashed near Pigeon House Farm on 6 November 1940. Following the crash, the surrounding wreckage and crater were backfilled by farm workers. No attempt at this time was made to recover the aircraft or remains of the pilot. During excavations conducted by Wealden Aviation Archaeological Group in 1979 two trenches were excavated within the site to identify the crash site. Reports of this excavation note the removal of remnants of the aircraft, including the engine, guns, and some human remains. Accounts suggest that not all of the wreckage was recovered, and the Portsmouth Coroner could not confirm the identity of the pilot sufficiently to allow a formal identification. The crash site's location was not formally located, and the locational accuracy cannot be relied on (Saunders 2009).

2.2.10 The site of a WWII anti-air battery and remains of a concrete command post are located 700 m north-west of the site. A nest of WWII Spigot mortar mountings was located 760 m south of the site on Fitzpatric Crescent. The site was filled in during the 1950s to provide land for housing.

2.2.11 An extensive deep air raid shelter and tunnel system constructed in 1942 in Portsdown Hill is located 370 m south of the site. A slit trench system, filled in 1948 to build council estate, was located 900 m south of the site on Clacton Road. An anti-tank ditch, constructed in 1940 out of a light railway cutting, is located 450 m south-east of the site.

Undated

2.2.12 Flint foundations have been identified 550 m ESE of the site. The foundations have not been accurately dated.

2.3 Recent investigations in the immediate vicinity

Geophysical survey

2.3.1 The current survey forms part of an ongoing programme of archaeological works being undertaken in support of a planning application for Hampshire Water Recycling and Water Transfer Project. Previous works include a detailed gradiometer survey undertaken by Wessex Archaeology's in-house geophysics team between March and September 2023 (Wessex Archaeology 2023). The survey comprised 275.2 ha of land on a linear route for 25 km from Bedhampton in the south-east to Fishers Pond in the north-west. This was successful in identifying anomalies of archaeological interest, including a ring ditch associated with prehistoric settlement or funerary activity, as well as a large number of coherent ferrous responses.

3 METHODOLOGY

3.1 Introduction

3.1.1 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team between 4 – 8 December. Field conditions at the time of the survey were acceptable throughout the period of survey. An overall coverage of 2.1 ha was achieved with the



gradiometer survey and 3.6 ha with the GPR survey. The remaining area was covered by verges and field boundaries.

- 3.1.2 The methods and standards employed throughout the geophysical survey conform to current best practice, and guidance outlined by the Chartered Institute for Archaeologists' (CIfA 2014) and European Archaeologiae Consilium (Schmidt *et al.* 2015).

3.2 Aims and objectives

- 3.2.1 The aims of the survey comprise the following:

- To determine, as far as is reasonably possible, the nature of the detectable archaeological resource within a specified area using appropriate methods and practices; and
- To inform either the scope and nature of any further archaeological work that may be required; or the formation of a mitigation strategy (to offset the impact of the development on the archaeological resource); or a management strategy.

- 3.2.2 In order to achieve the above aims, the objectives of the geophysical survey are:

- To conduct a geophysical survey covering as much of the specified area as possible, allowing for on-site obstructions;
- To clarify the presence/absence of anomalies of archaeological potential; and
- Where possible, to determine the general nature of any anomalies of archaeological potential.
- To identify the location of the known plane crash

3.3 Fieldwork methodology

- 3.3.1 The cart-based gradiometer system used a Carlson BRX-7 RTK GNSS instrument, which receives corrections from a network of reference stations operated by the Ordnance Survey (OS). Such instruments allow positions to be determined with a precision of 0.02 m in real-time and therefore exceeds European Archaeologiae Consilium recommendations (Schmidt *et al.* 2015).

- 3.3.2 The detailed gradiometer survey was undertaken using four Sensys FGM650/3 magnetic gradiometers spaced at 1 m intervals and mounted on a non-magnetic cart. Data were collected with an effective sensitivity of $\pm 8 \mu\text{T}$ over $\pm 1000 \text{ nT}$ range at a rate of 100 Hz, producing intervals of 0.02 m along transects spaced 4 m apart.

- 3.3.3 The GPR survey was conducted using an Impulse Radar Raptor 45, 8 channel antenna, with a central frequency of 450 MHz. The multi-channel GPR system uses separate shielded transmitter and receiver antennae, towed by a motorised vehicle. The data were recorded every 4 cm, with a horizontal profile spacing of 8.5 cm, and a time window of 100 ns in the zigzag method.

- 3.3.4 The vehicle based GPR system provides real-time positioning, enabling full site coverage without the need to set up individual grid nodes. However, to ensure survey accuracy, the boundaries of the survey extent were established using a real-time kinematic (RTK) Global Navigation Satellite System (GNSS) instrument. This system allowed positions to be determined with sub-decimetres accuracy and therefore exceeds EAC recommendations (Schmidt *et al.* 2015).



3.4 Data processing

- 3.4.1 Data from the survey were subjected to minimal correction processes. These comprise a 'Destripe' function (± 5 nT thresholds), applied to correct for any variation between the sensors, and an interpolation used to grid the data and discard overlaps where transects have been collected too close together.
- 3.4.2 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.
- 3.4.3 **Data processing (GPR)**
- 3.4.4 Data from the survey were subjected to common radar signal correction processes. These comprise wobble correction, bandpass, gain and filtering to remove frequency noise, background removal, Kirchhoff migration, and a Hilbert transformation. These steps are standard processing procedure and produce the highest quality resolution data for interpretation and presentation.
- 3.4.5 The approximate depth conversion for the 450 MHz antenna has been calculated on the assumption that the GPR pulses travel through the ground with an average speed of 0.114 m/ns. To determine this velocity, radargrams were analysed for suitable hyperbolic reflections of the GPR pulse through the subsurface deposits. It is possible to determine the average velocity of the GPR pulse through the ground more precisely if excavated features at a known depth can be identified and cross-referenced in the data.
- 3.4.6 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.

Table 1 Relative velocity to depth conversion based on a dielectric constant of 6.93 for the 450 MHz antenna

Time Slice	Time (ns)	Depth (mm)
1	0.0 - 2.15	0.0 - 0.1
2	2.15 - 4.3	0.1 - 0.21
3	4.3 - 6.45	0.21 - 0.31
4	6.45 - 8.59	0.31 - 0.41
5	8.59 - 10.74	0.41 - 0.51
6	10.74 - 12.89	0.51 - 0.62
7	12.89 - 15.04	0.62 - 0.72
8	15.04 - 17.19	0.72 - 0.82
9	17.19 - 19.34	0.82 - 0.92
10	19.34 - 21.48	0.92 - 1.03
11	21.48 - 23.63	1.03 - 1.13
12	23.63 - 25.78	1.13 - 1.23
13	25.78 - 27.93	1.23 - 1.33
14	27.93 - 30.08	1.33 - 1.44
15	30.08 - 32.23	1.44 - 1.54
16	32.23 - 34.38	1.54 - 1.64
17	34.38 - 36.52	1.64 - 1.74
18	36.52 - 38.67	1.74 - 1.85
19	38.67 - 40.82	1.85 - 1.95
20	40.82 - 42.97	1.95 - 2.05



4 GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION

4.1 Introduction

Gradiometer

- 4.1.1 The detailed gradiometer survey has identified magnetic anomalies across the site. Results are presented as a series of greyscale plots and archaeological interpretations at a scale of 1:1500 (**Figures 2 – 3**). The data are displayed at -2 nT (white) to +3 nT (black) for the greyscale image.
- 4.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous responses, burnt or fired objects, and magnetic trends (**Figure 3**). Full definitions of the interpretation terms used in this report are provided in **Appendix 2**.
- 4.1.3 Numerous ferrous anomalies are visible throughout the dataset. These are presumed to be modern in provenance and are not referred to, unless considered relevant to the archaeological interpretation.
- 4.1.4 It should be noted that small, weakly magnetised features may produce responses that are below the detection threshold of magnetometers. It may therefore be the case that more archaeological features may be present than have been identified through geophysical survey.
- 4.1.5 Gradiometer survey may not detect all services present on site. This report and accompanying illustrations should not be used as the sole source for service locations and appropriate equipment (e.g., CAT and Genny) should be used to confirm the location of buried services before any trenches are opened on site.

GPR

- 4.1.6 Results are presented as greyscale timeslice plots and archaeological interpretations at a scale of 1:2500 (**Figures 4 – 5**).
- 4.1.7 The 450 MHz antenna used in this survey has the potential of detecting features to a depth of 2 – 3 m in optimal conditions, however, the total depth reached varies depending on the specific conditions of each area.
- 4.1.8 All features are described in terms of their geophysical character. It is important to stipulate that all the depths referred to in this report are approximate levels below the current ground surface.
- 4.1.9 It should be noted that small, waterlogged, or low contrast features may produce responses that are below the detection threshold the geophysical instruments. Excessive disturbance can also impede the ability of geophysical techniques to detect archaeology. It may therefore be the case that more archaeological features may be present than have been identified through these methods.
- 4.1.10 The geophysical survey techniques may also not detect all services present on site. This report and accompanying illustrations should not be used as the sole source for service locations and appropriate equipment (e.g. CAT and Genny) should be used to confirm the location of buried services before any trenches are opened on site.

4.2 Gradiometer survey results and interpretation

- 4.2.1 The gradiometer survey has identified anomalies that indicate possible archaeological activities as well as an indication of a plane crash on site.



- 4.2.2 In the southern part of the gradiometer survey a weak positive curvilinear anomaly at **4000 (Figure 3)** has been detected. It is up to 2 m wide and 51 m long indicating a possible shallow ditch-like feature. This could pertain to a field boundary which predates available maps. A weak positive semi-circular anomaly at **4001** has been identified 8 m to the south of **4000 (Figure 3)**. The anomaly is 1.5 m wide and has a diameter of 10 m. This indicates a possible ring ditch feature, which may relate to a roundhouse ditch or round barrow. Together these anomalies indicate a small enclosure encircling the ring ditch of possible prehistoric origin due to the morphology of the features. Further investigations would be required to confirm this interpretation as the features are not clear in the gradiometer data.
- 4.2.3 A strong positive rectilinear area of increased magnetic response at **4002** has been identified 35 m to the north of **4000 (Figure 3)**. It is 3 m wide and 6 m long on a north – south orientation. It indicates a pit-like feature and likely relates to the location of a trench made during the excavation in 1979 to identify the Hurricane crash site.
- 4.2.4 A broad irregular area of increased magnetic response at **4003** is located in the south-eastern corner of the site. It occupies an area of 50 m by 82 m and indicates a spread of magnetically enhanced material on the surface. These kinds of anomalies are indicative of made ground. This could obscure any other trenches excavated during the investigation in 1979.
- 4.2.5 There is a large amount of magnetically strong dipolar anomalies across the site. This is indicative of modern fertilisation practises and can make identification and interpretation of small or weaker anomalies difficult. However, the dipolar anomalies are fairly sparse so any impact on the identification of archaeological anomalies is thought to be limited.
- ### 4.3 GPR survey results and interpretation
- 4.3.1 A high amplitude rectilinear anomaly at **5000** is located in the eastern portion of the southern field (**Figure 5**). It is 3 m by 6 m large on a north-east to south-west orientation, visible on Timeslices 5 – 14 (0.41 m – 1.44 m below present ground level (bpgl)). The anomaly comprises complex responses indicating a rectilinear area of disturbed ground. The GPR transect LP2_85 (**Figure 6**) shows the depth of the feature to be 2.55 m which corresponds with the reported depth of the trench of 9 feet (2.74 m). This feature corresponds with the assumed location of one of the 1979 investigation trenches to locate the site of the downed Hurricane.
- 4.3.2 A broad, linear, high amplitude anomaly has been identified in the south-eastern part of the survey area, at **5001 (Figure 5)**. It is 62 m long by 3 m wide and it likely extends beyond the southern border of the survey area. It is visible in Timeslices 2 – 10 (0.1 m – 1.03 m bpgl). It corresponds with a path visible in aerial photography.
- 4.3.3 Numerous broad linear anomalies have been identified across the survey area on an east – west orientation (**Figure 5**). These anomalies are identified in Timeslices 4 – 45 (0.31 – 4.30 m bpgl) and appear to slide from the south towards the north and are associated with local geology.
- 4.3.4 Several linear trends and numerous ferrous anomalies (**Figure 5**) have been identified throughout the survey area which are likely a consequence of modern agricultural practices.



5 DISCUSSION

- 5.1.1 The gradiometer survey has identified an area of potential past human activities. A fragmented curvilinear outer ditch together with a smaller pen-annular ditch, forms a possible ring-ditch surrounded by a small enclosure, which could relate to wider prehistoric activities in the area. Its weak magnetic signature and absence from GPR data, make this interpretation tentative.
- 5.1.2 The location of one of the two reported trenches, excavated in 1979 to locate the site of a WWII crash site has been identified in the southern field in the gradiometer and GPR survey. The location corresponds to the one identified from 1945 – 46 aerial photographs of the area and photographs from the 1979 excavation. The rectilinear morphology of the feature additionally corroborates this interpretation. There is no evidence for a second trench in the data.
- 5.1.3 There are numerous highly magnetic anomalies identified throughout the gradiometer data. These indicate the presence of a spread of ferrous or fired material, likely the result of recent agricultural practices. While this has the potential to limit the ability to identify archaeological features, the anomalies are relatively sparse and do not affect the GPR data. It is therefore considered unlikely that it has limited the survey.
- 5.1.4 The remaining anomalies are thought to be moder or natural. The modern anomalies relate to a path and made ground.



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APPENDICES

Appendix 1 Survey equipment and data processing

Survey methods and equipment

Gradiometer

The magnetic data for this project were acquired using a non-magnetic cart fitted with four SenSys FGM650/3 magnetic gradiometers. The instrument has eight sensor assemblies fixed horizontally 0.5 m apart allowing four traverses to be recorded simultaneously. Each sensor contains two fluxgate magnetometers arranged vertically with a 0.6 m separation and measures the difference between the vertical components of the total magnetic field within each sensor array. This arrangement of magnetometers suppresses any diurnal or low frequency effects.

The gradiometers have an effective resolution of $\pm 8 \mu\text{T}$ over $\pm 1000 \text{ nT}$ range. All of the data are then relayed to a CS35 tablet, running the MONMX program, which is used to record the survey data from the array of FGM650/3 probes at a rate of 100 Hz. The program also receives measurements from a GPS system, which is fixed to the cart at a measured distance from the sensors, providing real time locational data for each data point.

The cart-based system relies upon accurate GPS location data which is collected using a Leica Captivate system with rover and base station. This receives corrections from a network of reference stations operated by the Ordnance Survey and Leica Geosystems, allowing positions to be determined with a precision of 0.02m in real-time and therefore exceed the level of accuracy recommended by European Archaeologiae Consilium recommendations (Schmidt *et al.* 2015) for geophysical surveys.

Data may be collected with a higher sample density where complex archaeological anomalies are encountered, to aid the detection and characterisation of small and ephemeral features. Data may be collected at up to 0.01 m intervals along traverses spaced up to 0.25m apart.

Post-processing

The magnetic data collected during the detail survey are downloaded from the Bartington system for processing and analysis using both commercial and in-house software. This software allows for both the data and the images to be processed in order to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

As the scanning data are not as closely distributed as with detailed survey, they are georeferenced using the GPS information and interpolated to highlight similar anomalies in adjacent transects. Directional trends may be removed before interpolation to produce more easily understood images.

Typical data and image processing steps may include:

- Destripe – Applying a zero-mean traverse in order to remove differences caused by directional effects inherent in the magnetometer;
- Destagger – Shifting each traverse longitudinally by a number of readings. This corrects for operator errors and is used to enhance linear features;



- Despike – Filtering isolated data points that exceed the mean by a specified amount to reduce the appearance of dominant anomalous readings (generally only used for earth resistance data)

Typical displays of the data used during processing and analysis:

- Greyscale – Presents the data in plan view using a greyscale to indicate the relative strength of the signal at each measurement point. These plots can be produced in colour to highlight certain features but generally greyscale plots are used during analysis of the data.
- XY Plot – Presents the data as a trace or graph line for each traverse. Each traverse is displaced down the image to produce a stacked profile effect. This type of image is useful as it shows the full range of individual anomalies. XY plots can be made available upon request.



GPR

The ground penetrating radar (GPR) data will be collected using a cart-mounted shielded antenna with central frequency suitable for the types of target being investigated. Lower frequency antennae are able to acquire data from deeper below the surface, whereas higher frequencies allow high resolution imaging of near-surface targets at the expense of deep penetration. The exact make and model of equipment varies.

The depth of penetration of GPR systems is determined by the central frequency of the antenna and the relative dielectric permittivity (RDP) of the material through which the GPR signal passes. In general, soils in floodplain settings may have a wide range of RDPs, although around 8 may be considered average, resulting in a maximum depth of penetration of approximately 2.5 m with the GPR signal having a velocity of approximately 0.1 m/ns.

The GPR beam is conical in shape, however, and whilst most of the energy is concentrated in the centre of the cone, the GPR signal illuminates a horizontal footprint, which becomes wider with increasing depth. At the maximum depth of the antenna, it becomes impossible to resolve any feature smaller than the horizontal footprint for the corresponding depth. The size of the footprint is dependent upon central frequency, and its size increases as the central frequency decreases.

The vertical resolution is similarly dependent upon the central frequency; for a 400 MHz antenna, features of the order of 0.05 m may be resolved vertically. Antennae with lower frequencies can therefore penetrate more deeply but are less resolute in both horizontal and vertical directions. Choice of antenna frequency is guided largely by the anticipated depth to the target and the required resolution.

GPR data for detailed surveys are collected along traverses of varying length separated by 0.5 m with cross lines collected running perpendicular to these traverses at wider separations. The data sampling resolution is governed by the data logger and a minimum separation of 0.05 m between traces is collected for all surveys, in accordance with European Archaeologiae Consilium recommendations (Schmidt *et al.* 2015).

Post-Processing

The radar data collected during the detail survey are downloaded from the GPR system for processing and analysis using commercial software (GPR Slice). This software allows for both the data and the images to be processed to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

Typical data and image processing steps may include:

- Gain – Amplifies GPR data based upon its position in the profile, which boosts the contrast between anomalies and background. A wobble correction is also applied during this step;
- Background Filter - is used to remove banding noises that are seen across the radargrams
- Bandpass – Removes GPR data lying outside a specified range, which removes high- and low-frequency noise.



Typical displays of the data used during processing and analysis:

- Timeslice – Presents the data as a series of successive plan views of the variation of reflector energy from the surface to the deepest recorded response. The variation in amplitude is represented using a greyscale with black indicating high amplitude and white indicating low amplitude responses.
- Radargram – Presents each radar profile in a vertical view with distance along the profile expressed along the x axis and depth along the y axis. The amplitude variation is expressed using a greyscale.



Appendix 2 Geophysical interpretation

The interpretation methodology used by Wessex Archaeology separates the anomalies into four main categories: archaeological, modern, agricultural, and uncertain origin/geological.

The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided into three groups, implying a decreasing level of confidence:

- Archaeology – used when there is a clear geophysical response and anthropogenic pattern.
- Possible archaeology – used for features which give a response, but which form no discernible pattern or trend.
- Area of archaeology – used when an area have high potential for archaeology, however, features could not be clearly identified

The modern category is used for anomalies that are presumed to be relatively modern in date:

- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be observed.

The agricultural category is used for the following:

- Former field boundaries – used for ditch sections that correspond to the position of boundaries marked on earlier mapping.
- Historic cultivation – used for broad and diffuse linear anomalies that are considered to indicate areas of former ridge and furrow.
- Agricultural feature – used for well-defined narrow linear responses, usually aligned parallel to existing field boundaries.
- Drainage – used to define the course of ceramic field drains that are visible in the data as a series of repeating bipolar (black and white) responses.

The uncertain origin/geological category is used for features when the form, nature and pattern of the anomaly are not sufficient to warrant a classification as an archaeological feature. This category is further sub-divided into:

- Increased magnetic response – used for areas dominated by indistinct anomalies which may have some archaeological potential.
- Trend – used for low amplitude or indistinct linear anomalies.
- Geology – used for diffuse edged spreads considered to relate to shallow geological deposits. They can be distinguished as areas of positive, negative, or broad bipolar (positive and negative) anomalies.



- Geomorphology – used for clear edged spreads considered to relate to shallow geological deposits. They can be distinguished as areas of positive, negative, or broad bipolar (positive and negative) anomalies



Appendix 3 OASIS form

OASIS Summary for wessexar1-521780

OASIS ID (UID)	wessexar1-521780
Project Name	Geophysical Survey at Hampshire Water Transfer - Additional Surveys
Sitename	Hampshire Water Transfer - Additional Surveys
Sitecode	275081
Project Identifier(s)	275081 - Hampshire Water Transfer - Additional Surveys
Activity type	Geophysical Survey, MAGNETOMETRY SURVEY, GROUND PENETRATING RADAR SURVEY
Planning Id	
Reason For Investigation	Planning: Pre application
Organisation Responsible for work	Wessex Archaeology
Project Dates	04-Dec-2023 - 08-Dec-2023
Location	Hampshire Water Transfer - Additional Surveys NGR : SU 64642 06938 LL : 50.858349984150934, -1.082956614392666 12 Fig : 464642,106938
Administrative Areas	Country : England County/Local Authority : Hampshire Local Authority District : Winchester Parish : Southwick and Widley
Project Methodology	<p>The cart-based gradiometer system used a Carlson BRX-7 RTK GNSS instrument, which receives corrections from a network of reference stations operated by the Ordnance Survey (OS). Such instruments allow positions to be determined with a precision of 0.02 m in real-time and therefore exceeds European Archaeologiae Consilium recommendations (Schmidt et al. 2015).</p> <p>The detailed gradiometer survey was undertaken using four Sensys FGM650/3 magnetic gradiometers spaced at 1 m intervals and mounted on a non-magnetic cart. Data were collected with an effective sensitivity of $\pm 8 \mu\text{T}$ over $\pm 1000 \text{ nT}$ range at a rate of 100 Hz, producing intervals of 0.02 m along transects spaced 4 m apart.</p> <p>The GPR survey was conducted using an Impulse Radar Raptor 45, 8 channel antenna, with a central frequency of 450 MHz. The multi-channel GPR system uses separate shielded transmitter and receiver antennae, towed by a motorised vehicle. The data were recorded every 4 cm, with a horizontal profile spacing of 8.5 cm, and a time window of 100 ns in the zigzag method.</p> <p>The vehicle based GPR system provides real-time positioning, enabling full site coverage without the need to set up individual grid nodes. However, to ensure survey accuracy, the boundaries of the survey extent were established using a real-time kinematic (RTK) Global Navigation Satellite System (GNSS) instrument. This system allowed positions to be determined with sub-decimetres accuracy and therefore exceeds EAC recommendations (Schmidt et al. 2015).</p>

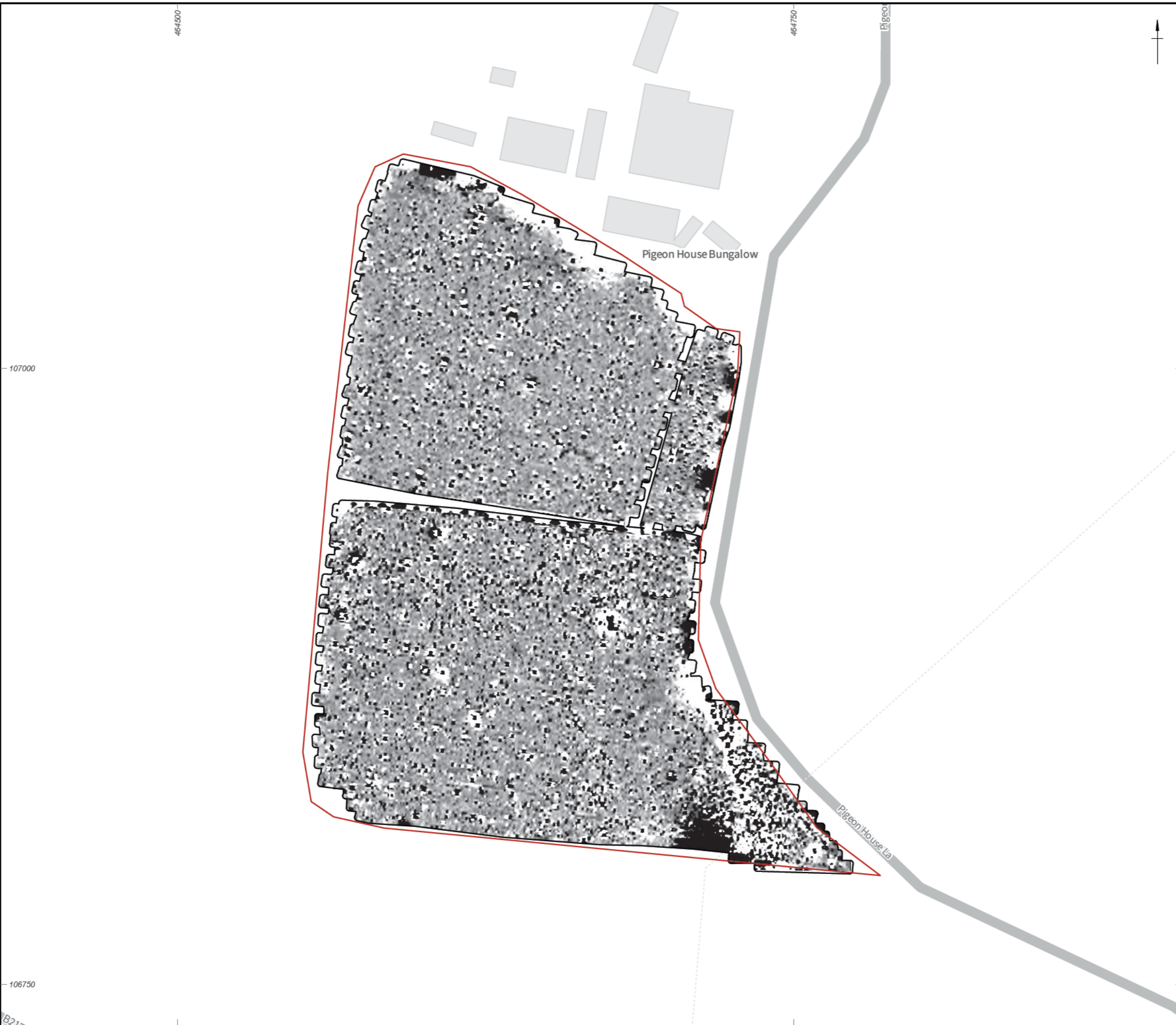
Project Results	<p>The gradiometer survey has identified an area of potential past human activities. A curvilinear outer ditch which is delimiting the area towards the north has not been identified towards the south. Together with a smaller pen-annular ditch, they form a possible small enclosure, which could relate to wider prehistoric activities in the area. Its weak magnetic signature and absence from GPR data, make this interpretation tentative at best.</p> <p>A location of one of the two reported trenches, excavated in 1979 has been identified in the southern field in the gradiometer and GPR survey. The location broadly corresponds to the one identified from the old photographic evidence. The rectilinear morphology of the feature additionally confirms the interpretation.</p> <p>An area of increased magnetic response was identified in the south-eastern corner of the site. It indicates man-made ground which could obscure other features within the area. A path has been identified, crossing this area in GPR results, which corroborate with the interpretation of man-made ground.</p>
Keywords	
Funder	Private or public corporation Southern Water Service LTD
HER	Winchester HER - unRev - STANDARD
Person Responsible for work	Patricia Edwards
HER Identifiers	
Archives	



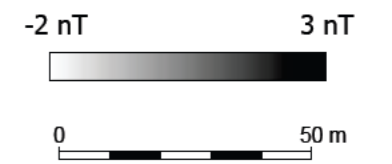
- Site boundary
- Detailed gradiometer survey extent
- GPR survey extent

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Date: 22/12/2023	Created by: LJ	Revision: 0	Scale: 1:5,000 at A4	
Figure 1: Site location and survey extents				



- Site boundary
- Detailed gradiometer survey extent



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Scale: 1:1500	Revision: 0	

Figure 2: Magnetic gradiometer survey - greyscale plots



- Site boundary
- Detailed gradiometer survey extent
- Possible archaeology
- Increased response
- Ferrous

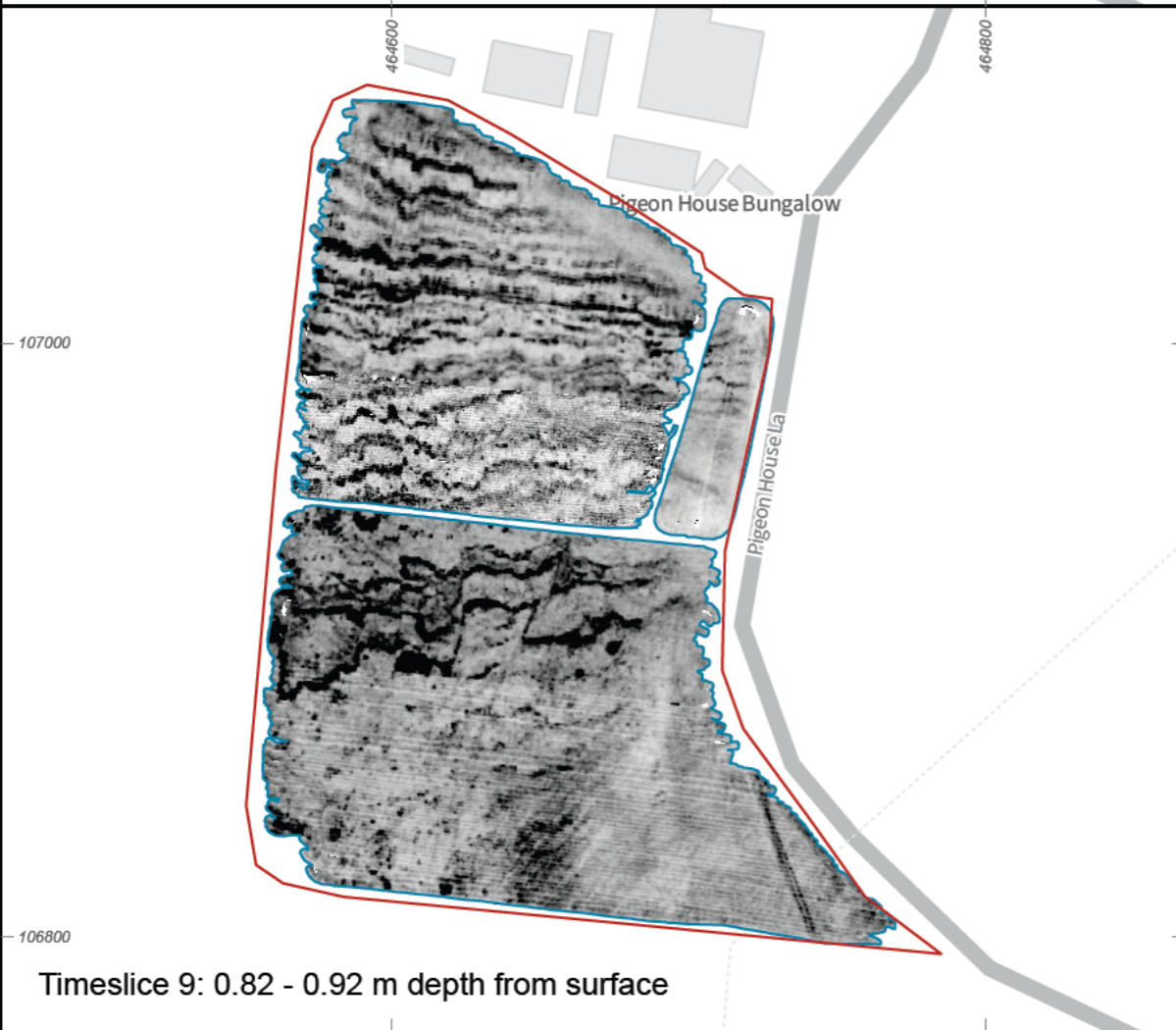
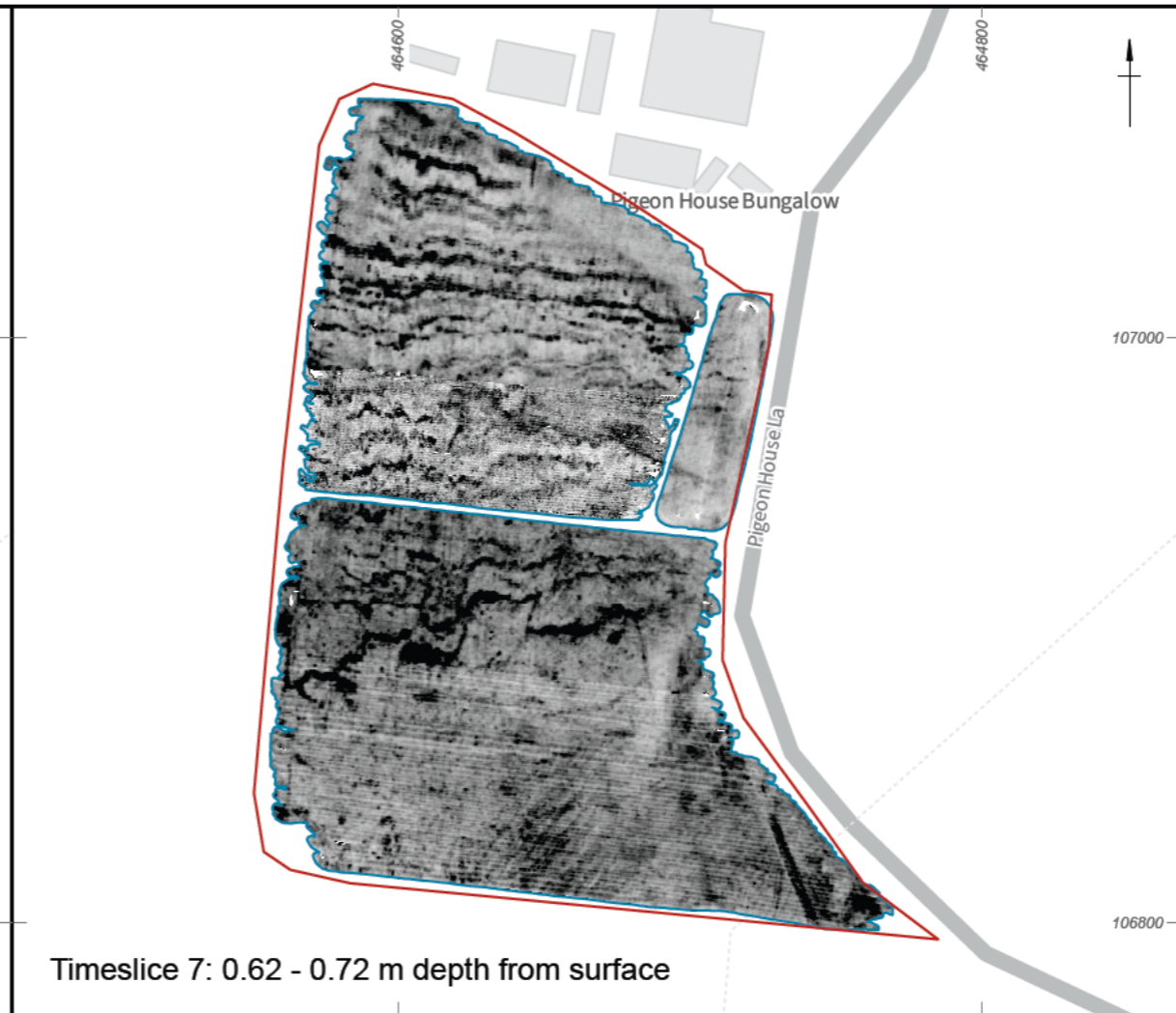
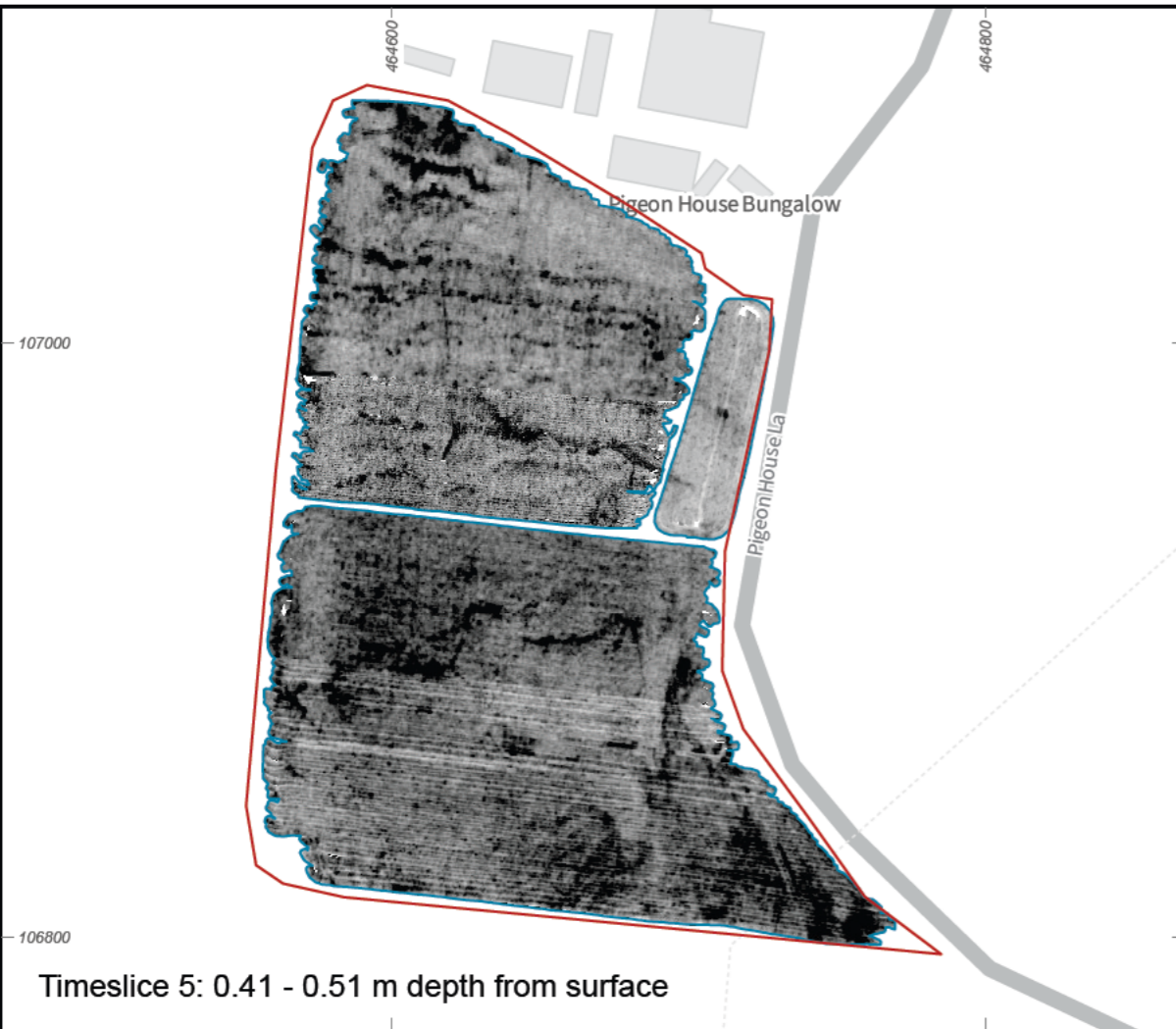
0 50 m

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Figure 3: Magnetic gradiometer survey - interpretation



▭ Site boundary
▭ GPR Survey Extent
▭ Transects

↑
 107000
 106800

464600 464800

Pigeon House Bungalow
 Pigeon House La

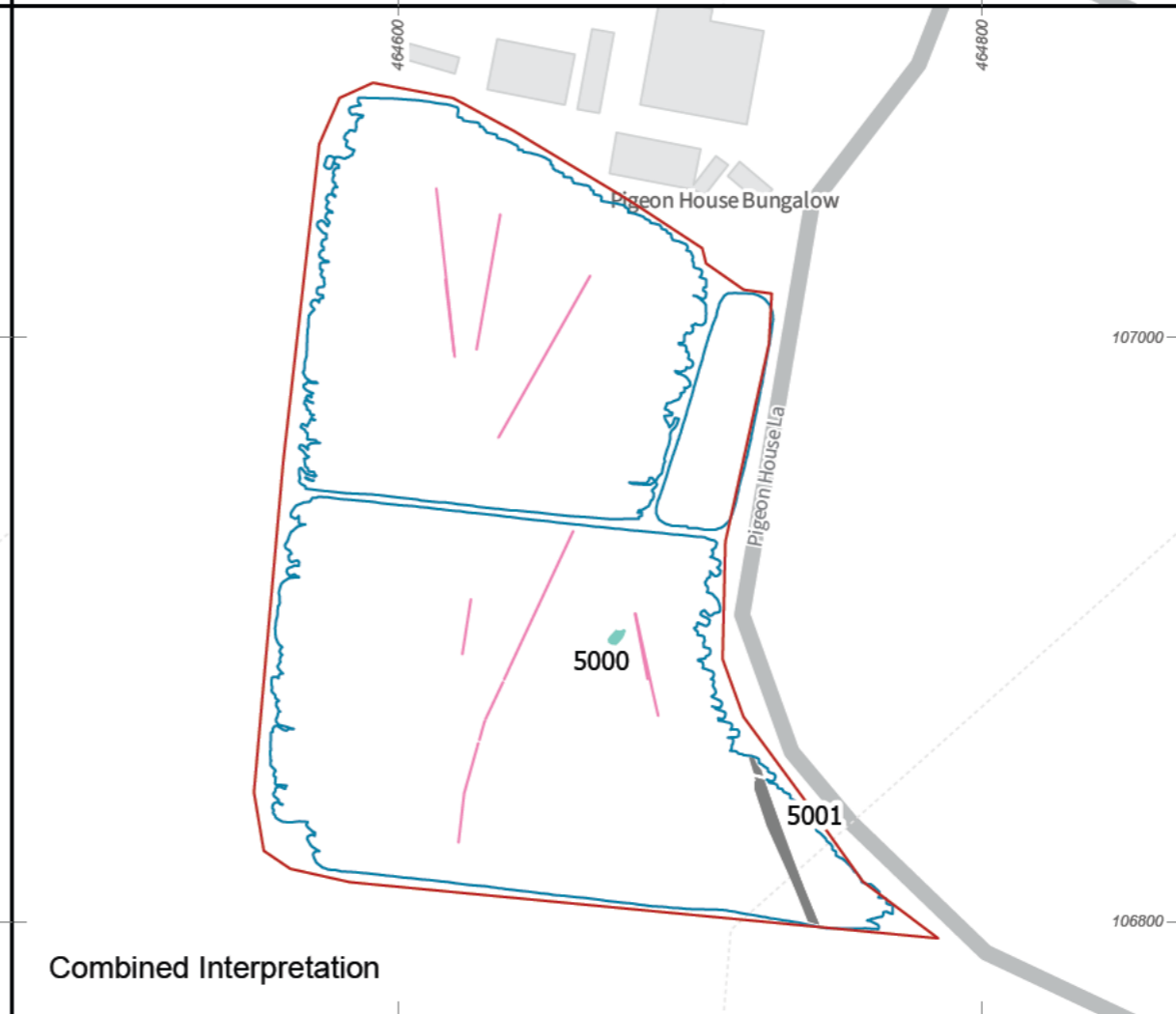
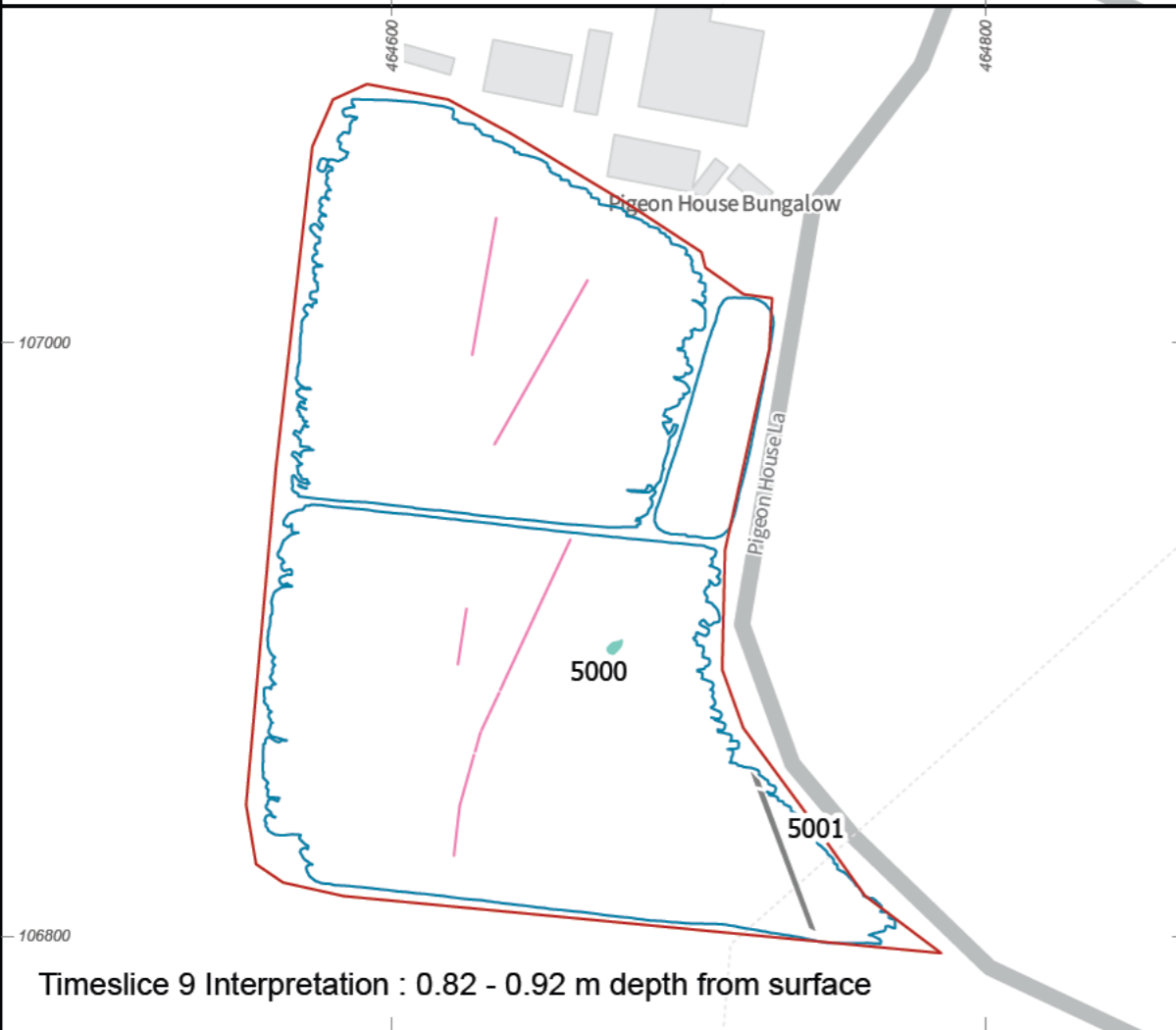
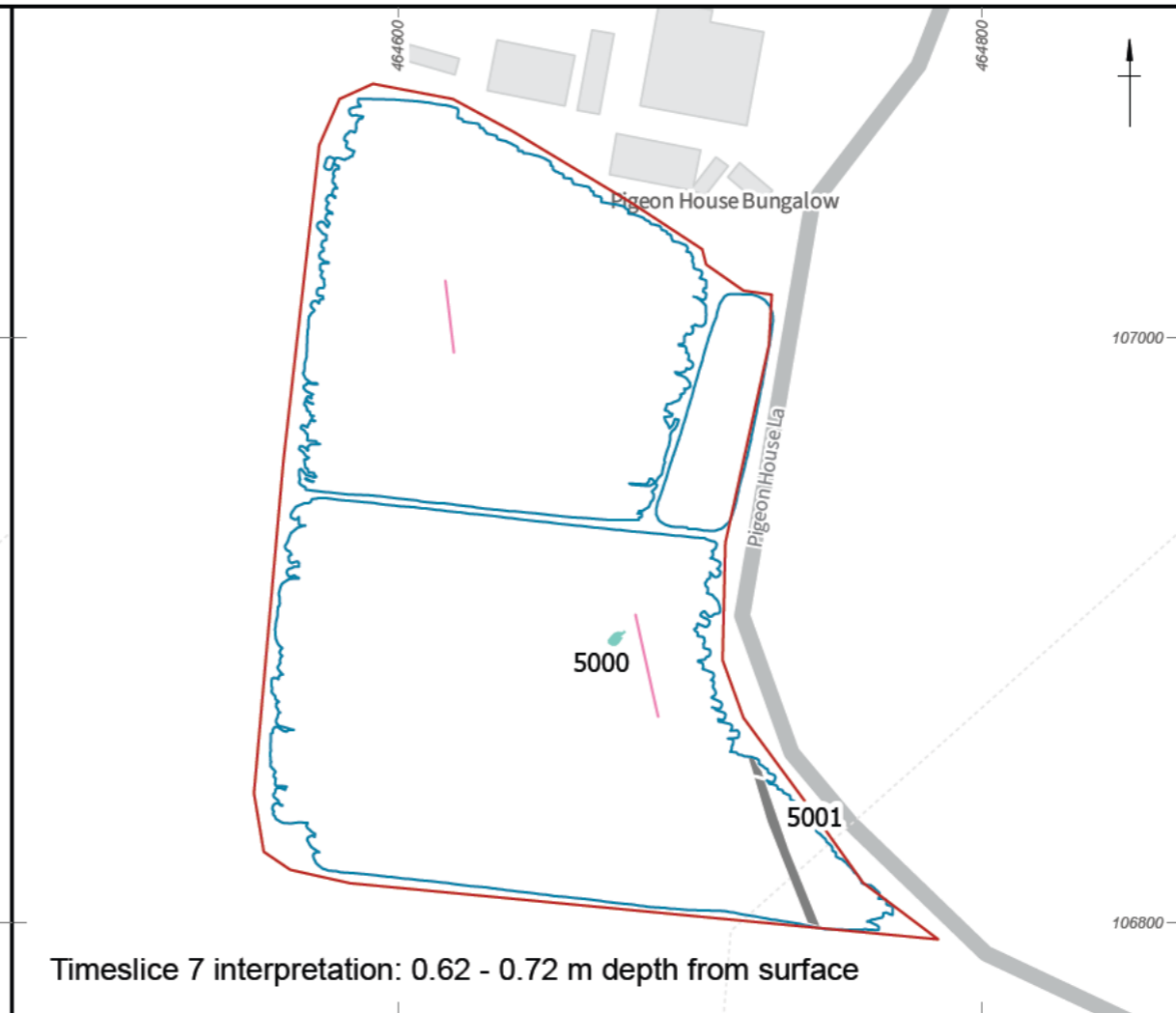
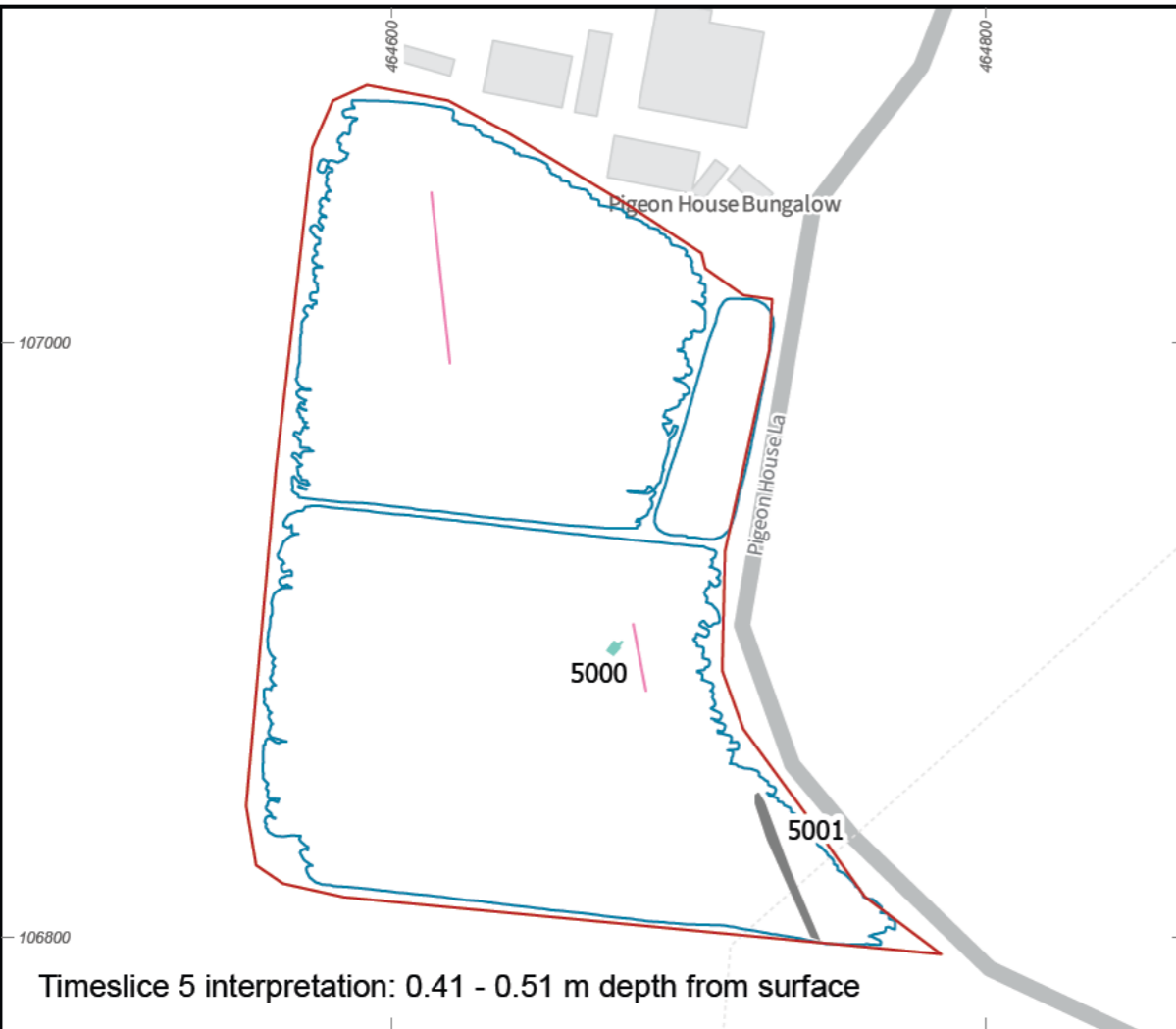
Low amplitude High amplitude

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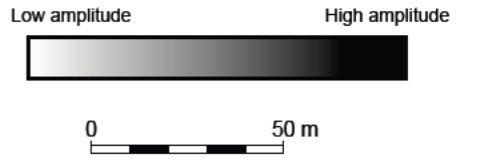
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Figure 4: Ground Penetrating Radar survey results - timeslice greyscale



- ▭ Site boundary
- ▭ GPR Survey Extent
- ▭ Possible archaeology
- ▭ High amplitude response
- ▭ Trend



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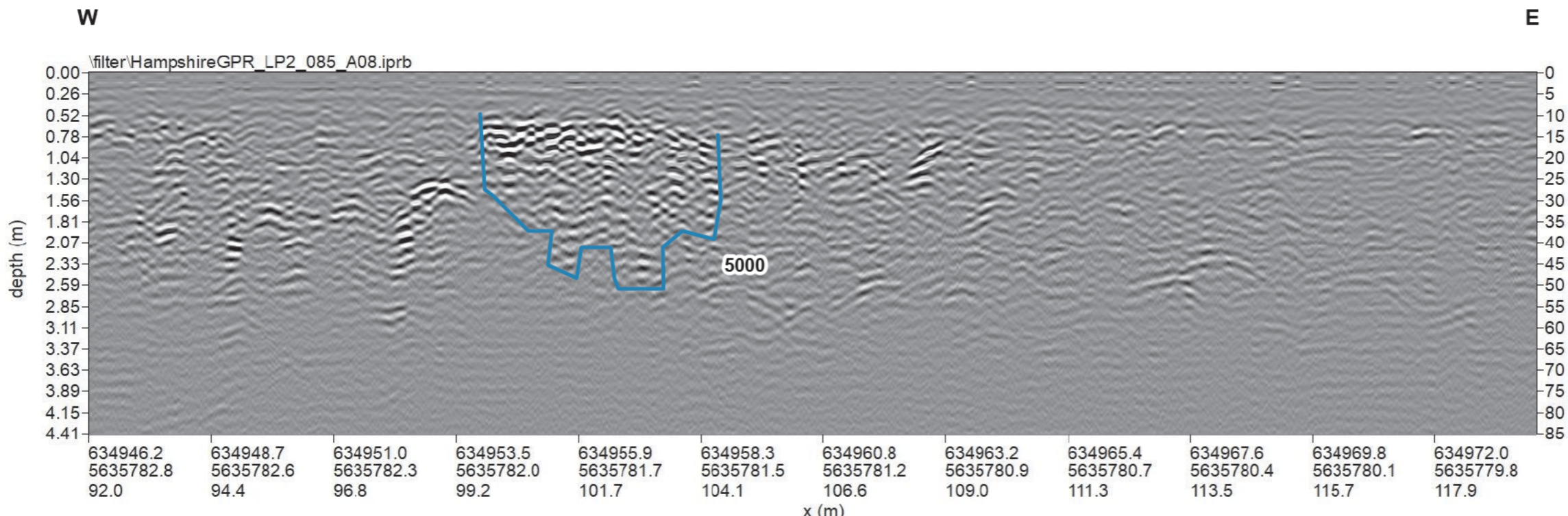
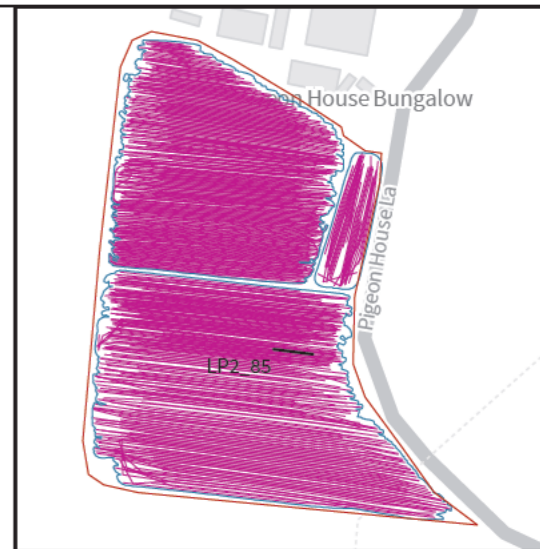
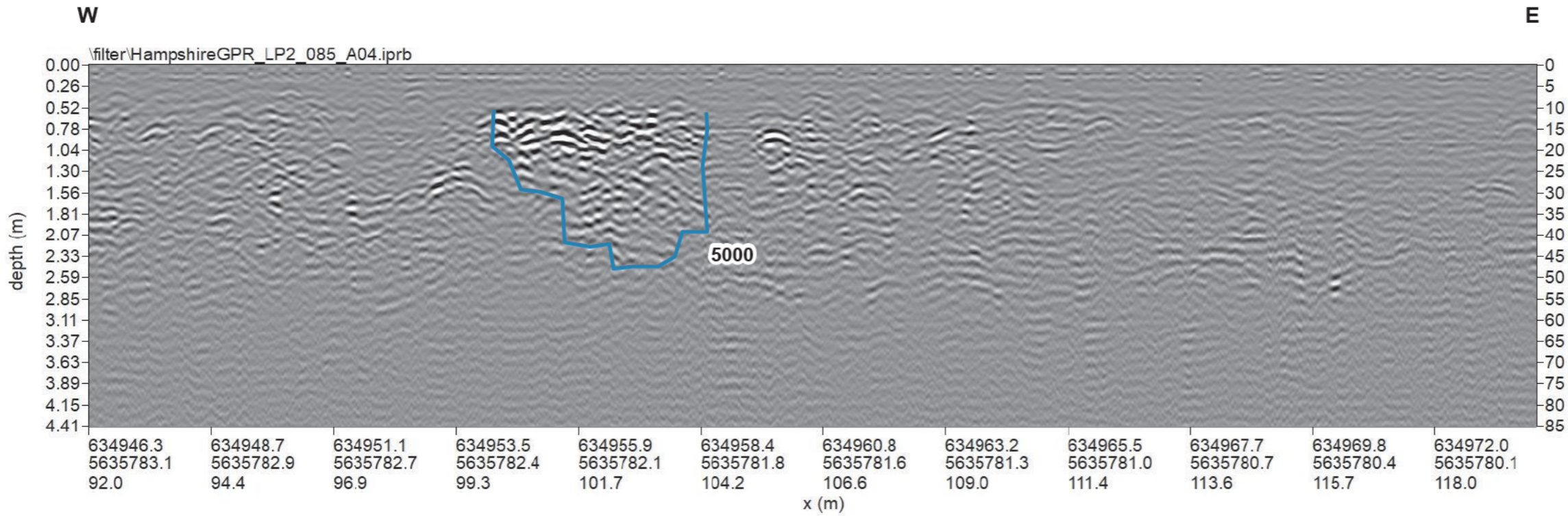
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Figure 5: Ground Penetrating Radar survey results - interpretation



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Figure 6: GPR transect - LP2_85



Wessex Archaeology Ltd registered office Portway House, Old Sarum Park, Salisbury, Wiltshire SP4 6EB
Tel: 01722 326867 Fax: 01722 337562 info@wessexarch.co.uk [REDACTED]



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