Archaeological watching brief of additional service trench works at Hartlebury Castle, Hartlebury, Worcestershire

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Archaeological works at Hartlebury Castle, Hartlebury, Worcestershire

Graham Arnold (project leader)

With contributions by Rob Hedge

Illustrations by Carolyn Hunt

Summary

An archaeological watching brief was undertaken at Hartlebury Castle, Hartlebury, Worcestershire (NGR SO 8363 7124) on additional works following a new car park, drainage and services for an adjacent café and visitor centre. It was commissioned by the Hartlebury Castle Preservation Trust. A planning application was granted by Wychavon District Council (W/14/0159), subject to archaeological monitoring. Groundworks for the car park, paths and drainage were reported in June 2017.

A separate planning application for an above ground gas tank was submitted by Hartlebury Castle Preservation Trust to Wychavon District Council for permission for the installation of an above ground gas tank and enclosure fence (17/01358/FUL). The proposed tank is in the vicinity of an underground ice house related to the castle.

It was considered by the Aidan Smith, Archaeology and Planning Advisor for Wychavon and Malvern Hills District Councils, that construction of the proposed tank had the potential to have an adverse impact on the ice house.

A ground penetrating radar survey was carried out to establish the location of the ice house and inform the application (SUMO 2017). This survey revealed the presence of features in the footprint of the gas tank which were thought to have the potential to represent the ice house. Mr Smyth advised that further evaluation was required to establish whether the identified features relate to the ice house. A 1m test pit in the location of the gas tank was originally proposed.

A new service trench was also being excavated in the same location and these works were monitored by an archaeologist as part of the on-going watching brief. This revealed a 20th Century demolition deposit from a brick boundary wall and related buttressing.

No structural evidence of the underground ice house was revealed during the works and it was concluded that the structure will not be impacted by the proposed installation of an above ground gas tank. No further significant archaeology was revealed during the monitoring of additional service pipe trench in the open field to the northwest of the car park.

Report

1 Background

1.1 Reasons for the project

An archaeological watching brief was undertaken at Hartlebury Castle, Hartlebury, Worcestershire (NGR SO 8363 7124) on additional works following a new car park, drainage and services for an adjacent café and visitor centre. It was commissioned by the Hartlebury Castle Preservation Trust. A planning application was granted by Wychavon District Council (W/14/0159), subject to archaeological monitoring. Groundworks for the car park, paths and drainage were reported in June 2017.

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It was considered by the Aidan Smith, Archaeology and Planning Advisor for Wychavon and Malvern Hills District Councils, that construction of the proposed tank has the potential to have an adverse impact on the ice house.

A ground penetrating radar survey was carried out to establish the location of the ice house and inform the application (SUMO 2017). This survey revealed the presence of features in the footprint of the gas tank which could potentially represent the ice house but could be rubble or made ground. Mr Smyth advised that further evaluation was required to establish whether the identified features relate to the ice house.

The project conforms to the requirements of the Wychavon District Council Planning Officer and for which a project proposal (including detailed specification) was produced (WA 2017).

The project also conforms to the *Standard and guidance: Archaeological field evaluation Standard and guidance: Archaeological watching brief* (CIfA 2014a), *Standards and guidelines for archaeological projects in Worcestershire* (WCC 2010),

2 Aims

The aim of the project was to:
• To record any archaeological evidence relating to the Civil War.
• To record any other archaeological evidence that may be identified during the course of the works.

• Gather information and prepare a report which, beyond reasonable doubt, will inform decision making.

The objectives of the project were to:

• Determine the presence or absence of archaeological deposits, in particular whether features identified by Ground Penetrating Radar survey relate to the ice house, another structure or are natural in origin.

• Identify their location, nature, date and preservation.

• Assess their significance.

• Assess the likely impact of the proposed development.

3 Methods

3.1 Personnel

The project was led by Graham Arnold (BA (hons.), MSc); who joined Worcestershire Archaeology in 2009 and has been practicing archaeology since 2002, assisted by Jamie Wilkins (BA (hons.)). The project managers responsible for the quality of the project was Tom Rogers (BA (hons.); MSc), and Robin Jackson (BA (hons.); ACIfA). Illustrations were prepared by Carolyn Hunt (BSc (hons.); PG Cert; MCIfA). Finds analysis and photography was undertaken by Rob Hedge (MA Cantab).

3.2 Documentary research

An archaeological desk-based assessment (DBA) was undertaken on behalf of The Hartlebury Castle Preservation Trust (Cornah and Robson-Glyde 2014). A Ground Penetrating Radar Survey was undertaken in the area of the proposed gas tank due to the vicinity of the Ice house (SUMO 2017). This highlighted anomalies, with a proposal to dig a 1m hand test pit in the area. It transposed that the pipe trench for a new LV cable ran over this area and was monitored by an archaeologist.

3.3 Fieldwork strategy

A detailed specification has been prepared by Worcestershire Archaeology (WA 2017).

Fieldwork was undertaken between 13 November and 23 November 2017. The site reference number used by the Historic Environment Record to record archaeological "events", and site code used in the archive is WSM 68500 and WSM 69555.

One pipe trench was monitored in the area of the proposed gas tank. , amounting to just over 57m in length and 0.60m wide, a maximum of 1.15m deep. The location of the trench is indicated in Figure 5. The location of the proposed gas tank is also highlighted. A further pipe trench 0.60m wide and 1.20m deep was also monitored across the open field to the north-east, with natural topsoil, subsoil and geology noted. No finds or features were recovered or observed.

Deposits considered not to be significant were removed under archaeological supervision using a 360º tracked excavator, employing a toothless bucket. Subsequent excavation was undertaken by hand. Clean surfaces were inspected and selected deposits were excavated to retrieve artefactual material and environmental samples, as well as to determine their nature. Deposits were recorded according to standard Worcestershire Archaeology practice (WA 2012). On completion of excavation, trenches were reinstated by replacing the excavated material.

3.4 Structural analysis

All fieldwork records were checked and cross-referenced. Analysis was effected through a combination of structural, artefactual and ecofactual evidence, allied to the information derived from other sources.

3.5 Artefact methodology

3.5.1 Artefact recovery policy

Recovery of artefacts was undertaken according to standard Worcestershire Archaeology practice (WA 2012). In the event no artefacts pre-dating the modern period were identified. with 19th or 20th Century modern glass, brick, clinker and cbm from a former retaining wall recorded. The bricks were machine made with modern mortar and measured 9" x 4 1/2" x 3". Only a sample of artefacts were retained, which included blue and white porcelain and an engraved bone toothbrush.

3.6 Statement of confidence in the methods and results

The methods adopted allow a high degree of confidence that the aims of the project have been achieved

4 Results

4.1 Structural analysis

The trench recorded is shown in Fig 5.

Main deposit descriptions

Trench 4

Maximum dimensions: Length: 57.00m Width: 0.60m Depth: 0.74 – 1.15m

Orientation: E-W

Context	Classification	Description	Depth below ground surface (b.g.s) – top and bottom of deposits
400	Topsoil	Dark greyish brown friable sandy loam with frequent glass cbm charcoal and vegetation rooting.	0.00 – 0.48m
401	Made ground	Loose dark brownish black ash, clicker layer in a silty sand matrix with frequent bricks from wall, glass, charcoal and porcelain. 20th Century dump deposit from demolition of brick revetment / retaining wall and buttress.	0.48 – 0.70m
402	Made ground	Compact mid brownish orange clayey sand with frequent charcoal. Made ground or bank material from up cast related to moat in north. Modern disturbance.	0.70 – 1.15m +

5 Synthesis

The archaeological monitoring of groundworks in the area of the proposed gas tank indicated that anomalies highlighted on the GPR survey (SUMO 2017 – Appendix 1) related to 20th Century demolition rubble. This is thought to be from an outbuilding in the area first recorded on the 1821 inclosure map (Cornah and Robson-Glyde 2014). This was later replaced by a brick boundary or retaining wall and buttressing by the time of the 1888 OS map and still existed on the 1927 OS map. This suggests an early 20th Century date for the date of demolition. The bricks were machine made with modern mortar and measured 9" x 4 1/2" x 3". Only a sample of artefacts were retained, which included two fragments of blue and white porcelain and an engraved bone toothbrush (Plate 3). These deposits corresponded with the anomalies on the GPR survey (SUMO 2017).

No structural evidence of the underground Ice house was revealed during the works and the structure will not be impacted by the proposed installation of an above ground gas tank. No further significant archaeology was revealed during the monitoring of the additional service pipe trench in the open field to the north-west of the car park.

6 Publication summary

Worcestershire Archaeology has a professional obligation to publish the results of archaeological projects within a reasonable period of time. To this end, Worcestershire Archaeology intends to

use this summary as the basis for publication through local or regional journals. The client is requested to consider the content of this section as being acceptable for such publication.

*An archaeological watching brief was undertaken on behalf of Hartlebury Castle Preservation Trust at Hartlebury Castle, Hartlebury, Worcestershire (*SO 8363 7124*). The works related to additional service trenches related to previous works in constructing a car park and the proposed installation of an above ground gas tank and enclosure fence, in close proximity to an underground Ice house relating to the castle. A ground penetrating radar survey was carried out to establish the location of the ice house and inform the application. This survey revealed the presence of features in the footprint of the gas tank which could potentially represent the ice house but could be rubble or made ground. A service trench running across this location was monitored by an archaeologist, which revealed the anomalies related to the 20th Century brick rubble. This is thought to be from an outbuilding in the area first recorded on the 1821 inclosure map. This was later replaced by a brick boundary or retaining wall. and buttressing. This suggests an early 20th Century date for the date of demolition. A sample of artefacts were retained from the deposit, which included two fragments of blue and white porcelain and an engraved bone toothbrush. No evidence of the Ice house structure was revealed during works and no further significant archaeology was present in the other service trenches in the open field to the north-west of the car park.*

7 Acknowledgements

Worcestershire Archaeology would like to thank the following for their kind assistance in the successful conclusion of this project, Gary Kelly, Foreman and Jason Grant, Works Manager, Walsh Construction, Ross Hetherington, Rodney, Melville and Partners, Peter White, Fresh Life Consulting and Aidan Smyth, Archaeology and Planning Officer for Wychavon and Malvern Hills District Councils.

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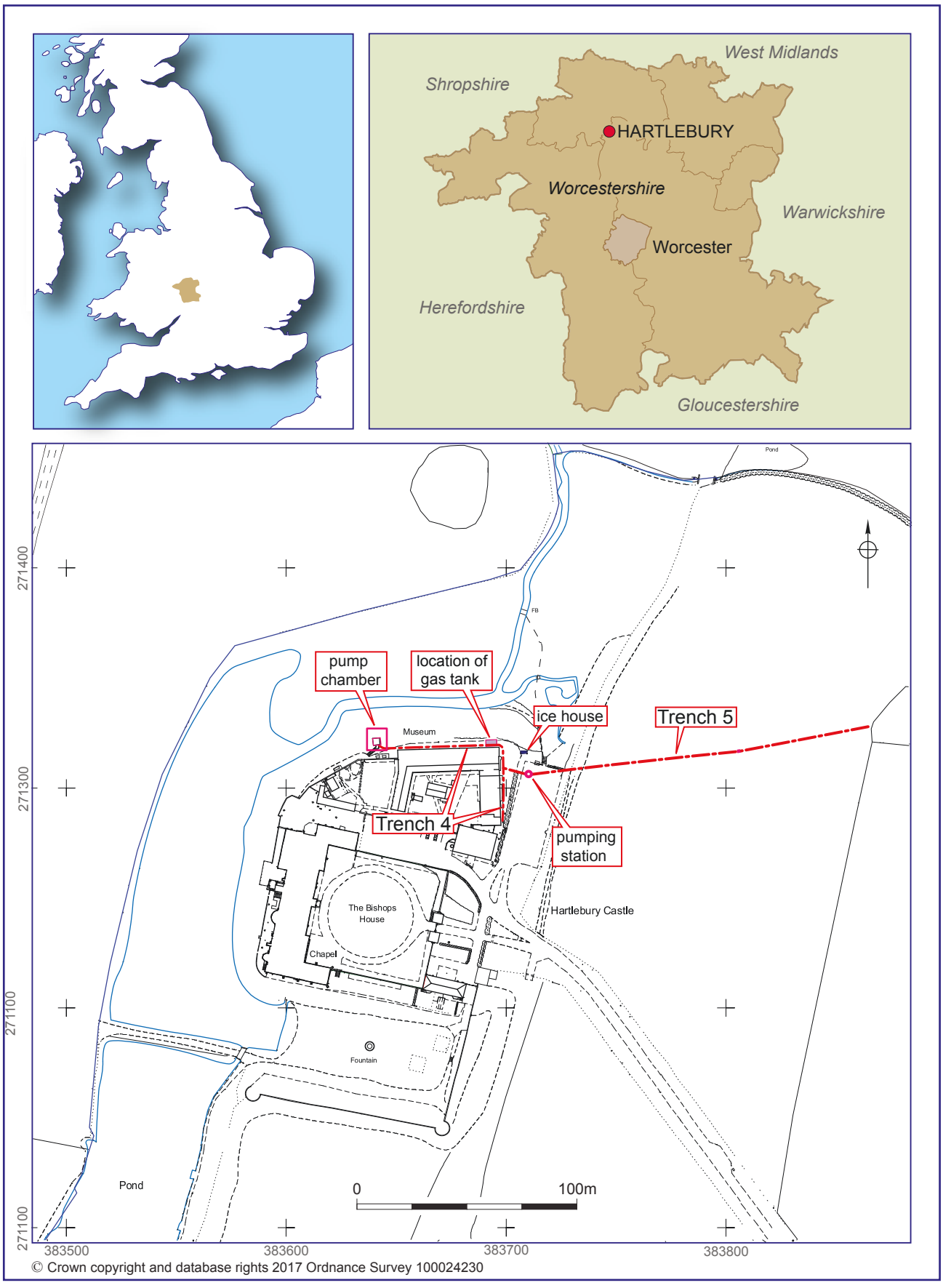
Figures



Location of the site (based upon Rodney Melville + Partners Dwg No 01) *Figure 1*

Plates

Plate 1 Trench 4 through proposed gas tank location. 2 x1m scales looking west. Gas tank location is at 1m scale in the foreground.

Plate 2 Sample section of trench 4, showing topsoil, clinker demolition deposit and disturbed natural at base.

Plate 3 Bone toothbrush retrieved from deposit (401) 8cm scale.

Plate 4 Proposed gas tank location fenced off around trench 4. 2 x 1m scales.

Plate 5 Sewer service trench in carpark with modern hardcore, surfacing and natural sands.

Plate 6 Location of service trench after backfilling. Ran across open field to existing sewer. View Southeast towards Hartlebury Castle.

Appendix 1 Geophysical survey report

GEOPHYSICAL SURVEY REPORT

GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Hartlebury Castle Car Park

Client
Worcestershire County Council

Survey Report
11949

Date
October 2017

Incorporating

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and

STRATASCAN LTD

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GEOPHYSICAL SURVEY REPORT

Project name:
Hartlebury Castle Car Park

SUMO Job reference:
11949

Client:
Worcestershire County Council

Survey date:
20 October 2017

Report date:
30 October 2017

Field co-ordinator:
Richard Fleming

Report written by:
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CAD illustrations by:
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Figure 4	1:100	GPR Survey– Timeslices at 0.43-0.48m and 0.64-0.69m
Figure 5	1:100	GPR Survey – Interpretation with Example Radargrams

1 SUMMARY OF RESULTS

A Ground Penetrating Radar (GPR) survey was conducted over approximately 100m² at the Hartlebury Castle in Worcestershire to determine the extent of the ice house prior to installation of a gas tank. There is no clear evidence of the ice house, but discrete and complex features found to the west of its entrance may be associated. However, these features could also be related to rubble or different type of material. Further anomalies are associated with buried surfaces and possible obstructions/small buried objects.

2 INTRODUCTION

2.1 Background synopsis

SUMO Surveys were commissioned to undertake a geophysical survey at Hartlebury Castle, Worcestershire. This survey forms part of an investigation being undertaken by **Worcestershire County Council.**

2.2 Site details

NGR / Postcode	SO 837 713 / DY11 7XZ
Location	The site is located to the north-east of the Hartlebury Castle and Carriage Museum, and comprises hard surface areas. Some other areas were unsurveable due to small trees and shrubs.
District	Worcestershire
Civil Parish	Hartlebury CP
Geology	Solid: Helsby Sandstone Formation – sandstone. Superficial: none recorded (BGS 2017).
Soils	Bromsgrove (541b), well drained reddish coarse loamy soils mainly over soft sandstone, but deep in places (SSEW 1983).
Archaeology	The following is taken from Heritage Gateway Website: The ice house was built in the 18th century. The entrance is a rough sandstone arch leading into ground on side of moat. The condition of the entrance is poor filled with rubbish.
Survey Methods	Ground Penetrating Radar (GPR) survey
Study Area	c. 100m² north east to the Carriage Museum.

2.3 Aims and Objectives

The objective of the survey was to provide information about the extent of the known ice house prior to installation of a gas tank.

3 METHODS, PROCESSING & PRESENTATION

3.1 Standards & Guidance

This report and all fieldwork have been conducted in accordance with the latest guidance documents issued by Historic England (EH 2008) (then English Heritage) and the Chartered Institute for Archaeologists (IfA 2002 & CIfA 2014).

3.2 Survey methods

Ground Penetrating Radar was used as an efficient and effective method in detecting archaeological remains and other buried obstructions.

More information regarding this technique is included in Appendix A.

3.3 Data Processing & Interpretation

Each radargram has been studied and those anomalies thought to be significant were noted and classified as detailed below. Inevitably some simplification has been made to classify the diversity of responses found in radargrams. This abstraction is then employed as the primary source for producing the interpretation plot, but is not itself reproduced in the report.

i. Strong and weak discrete reflector.

These may be a mix of different types of reflectors but their limits can be clearly defined. Their inclusion as a separate category has been considered justified to emphasise anomalous returns which may be from archaeological targets and would not otherwise be highlighted in the analysis.

ii. Complex reflectors.

These would generally indicate a confused or complex structure to the subsurface. An occurrence of such returns, particularly where the natural soils or rocks are homogeneous, would suggest artificial disturbances. These are subdivided into both strong and weak giving an indication of the extent of change of velocity across the interface, which in turn may be associated with a marked change in material or moisture content.

iii. Point diffractions.

These may be formed by a discrete object such as a stone or a linear feature such as a small diameter pipeline being crossed by the radar traverse (see also the second sentence in iv. below)

iv. Convex reflectors and broad crested diffractions.

A convex reflector can be formed by a convex shaped buried interface such as a vault or very large diameter pipeline or culvert. A broad crested diffraction as opposed to a point diffraction can be formed by (for example) a large diameter pipe or a narrow wall generating a hybrid of a point diffraction and convex reflector where the central section is a reflection off the top of the target and the edges/sides forming diffractions.

v. Planar returns.

These may be formed by a floor or some other interface parallel with the surface. These are subdivided into both strong and weak giving an indication of the extent of change of velocity across the interface which in turn may be associated with a marked change in material or moisture content.

vi. Inclined events.

These may be a planar feature but not parallel with the survey surface. However, similar responses can be caused by extraneous reflections. For example, an “air-wave” caused by a

strong reflection from an above ground object would produce a linear dipping anomaly and does not relate to any sub-surface feature. Normally this is not a problem as the antennae used are shielded, but under some circumstances these effects can become noticeable.

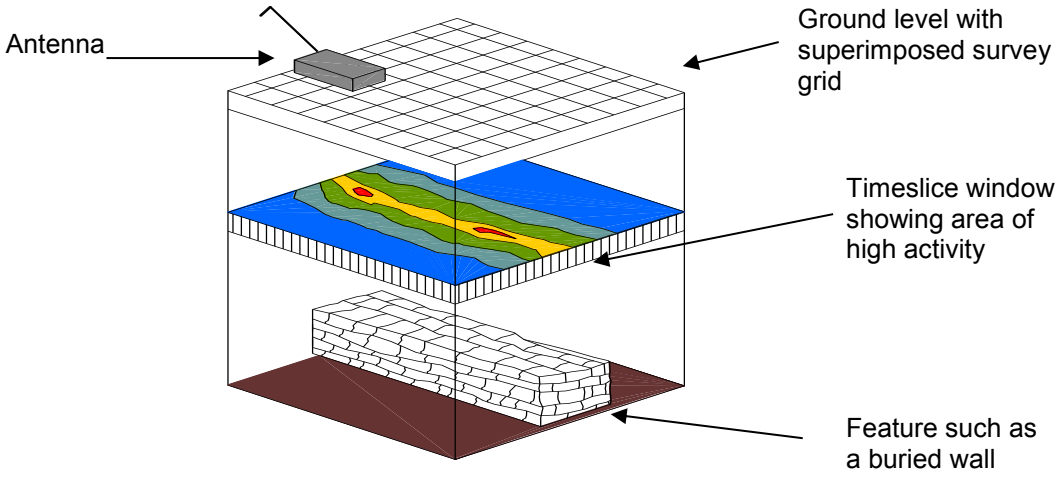
vii. Conductive surface.

The radiowave transmitted from the antenna has its waveform modulated by the ground surface. If this ground surface or layers close to the surface are particularly conductive a 'ground coupled wavetrain' is generated which can produce a complex wave pattern affecting part or all of the scan and so can obscure the weaker returns from targets lower down in the ground.

viii. A category for "focused ringing" has been included as this type of anomaly can indicate the presence of an air void. This is created by the signal resonating within the void, but with a characteristic domed shape due to the "velocity pull-up effect".

Timeslice plots

In addition to a manual abstraction from the radargrams, a computer analysis was also carried out. The radar data is interrogated for areas of high activity and the results presented in a plan format known as timeslice plots. In this way it is easy to see if the high activity areas form recognisable patterns.



The GPR data is compiled to create a 3D file. This 3D file can be manipulated to view the data from any angle and at any depth within a range. The 3D file can be sampled to produce activity plots at various depths. As the radar is actually measuring the time for each of the reflections found, these are called "time slice windows". Plots for various time slices have been included in the report. Based on an average velocity calculations have been made to show the equivalent depth into the ground.

The weaker reflections in the time slice windows are shown as dark colours namely blues and greens. The stronger reflections are represented by brighter colours such as light green, yellow, orange and red.

Reflections within the radar image are generated by a change in velocity of the radar from one medium to another. It is not unreasonable to assume that the higher activity anomalies are related to marked changes in materials within the ground such as foundations or surfaces within the soil matrix.

3.4 Presentation of results

The location of the survey area and referencing information is provided in Figure 2. Depth slices of collected data are provided at 0.27-0.32m, 0.32-0.37m, 0.43-0.48m, 0.64-0.69m, in Figures 3 to 4. Interpretation of data with accompanying example radargrams is provided in Figure 5.

4 RESULTS

4.1 Weak complex and discrete features have been identified at depths between 0.50 and 0.55m. These are thought to be related to madeground or rubble, but their origin remains unclear and due to their location, they could be associated with the ice house.

4.2 Strong complex and discrete anomalies have been detected to the north to the Carriage Museum of Hartlebury Castle at the depths between 0.50-0.60m. Some of them coincident with the location of proposed gas tank. It is not clear exactly what is causing these responses. They are potentially made ground or obstructions.

4.3 A buried surface was found at the 0.70m depth.

5 DATA APPRAISAL & CONFIDENCE ASSESSMENT

The data across the areas shows a sufficient contrast between strong complex and discrete responses and that of the background response, suggesting that the underlying geology is conducive to GPR survey, with the depth of penetration being approximately 1.80m. Potential anomalous areas have been detected, indicating that the survey has been effective.

6 CONCLUSION

The survey at Hartlebury Castle has revealed possible features that could be related to ice house but their origin is not clear as they could be madeground or rubble. The area next to the ice house entrance was unsurveyable due to shrubs. Further possible obstructions, small buried objects and buried surface have been detected. The depths of these features vary from between 0.50 and 0.70m.

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Appendix A - Technical Information: Ground Penetrating Radar

Grid locations

The location of the survey traverses has been plotted in Figure 2. Traverses were carried out on a 0.5m orthogonal grid.

Survey equipment and configuration

Two of the main advantages of radar are its ability to give information of depth as well as work through a variety of surfaces, even in cluttered environments which normally prevent other geophysical techniques being used.

A short pulse of energy is emitted into the ground and echoes are 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 (see below).

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 pipeline 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 surrounds does not result in a marked change in velocity then only a weak hyperbola will be seen, if at all.

The Ground Penetrating Impulse Radars used was GSSI Dual Frequency system manufactured by GSSI. This system collects data using 300MHz and 800MHz simultaneously. 0.5m parallel traverses were used to record the data in the area.

Sampling interval

Readings were taken at 0.05m intervals with traverse intervals of 0.5m. All survey traverse positioning was carried out using a Trimble S6 Robotic Total Station.

Depth of scan and resolution

The average velocity of the radar pulse is calculated to be 0.1m/nsec which is typical for the type of sub-soils on the site. With a range setting of 100nsec this equates to a maximum depth of scan of 2m but it must be remembered that this figure could vary by ± 10% or more. A further point worth making is that very shallow features are lost in the strong surface response experienced with this technique.

Under ideal circumstances the minimum size of a vertical feature seen by a 200MHz (relatively low frequency) antenna in a damp soil would be 0.1m (i.e. this antenna has a wavelength in damp soil of about 0.4m and the vertical resolution is one quarter of this wavelength). It is interesting to compare this with the 400MHz antenna, which has a wavelength in the same material of 0.2m giving a theoretical resolution of 0.05m. A 900MHz antenna would give 0.09m and 0.02m respectively.

Data capture

Data is displayed on a monitor as well as being recorded onto an internal hard disk. The data is later downloaded into a computer for processing.

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82 83 84 85 86

N

Site Location

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

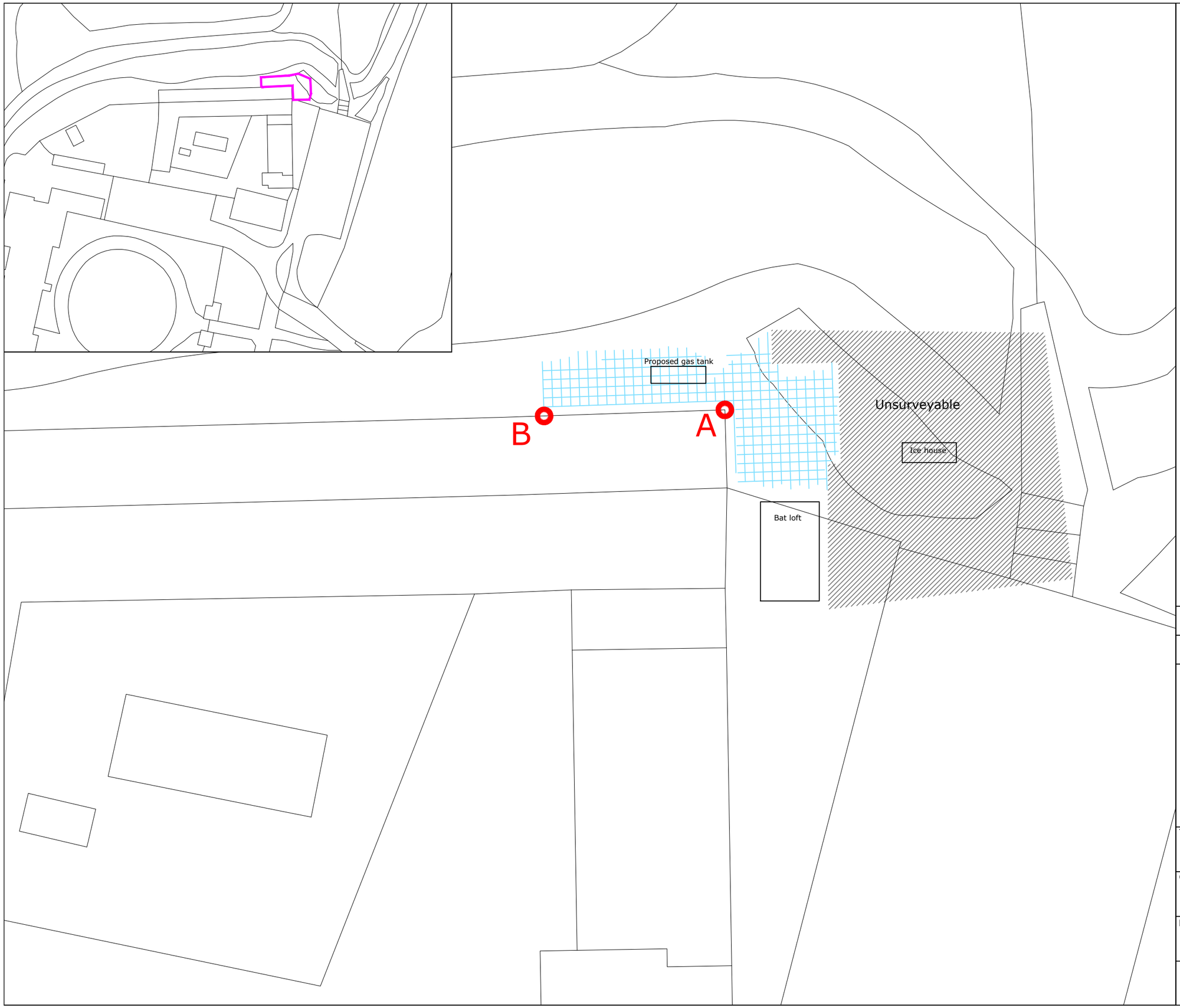
Title:
Site Location Diagram

Client:
Worcestershire County Council

Project:
SOR11949 - Hartlebury Castle Car Park

Scale:
0 metres 1500
1:25000 @ A3

Fig No:
01



A-B	Base line along the building
	Radar traverse

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

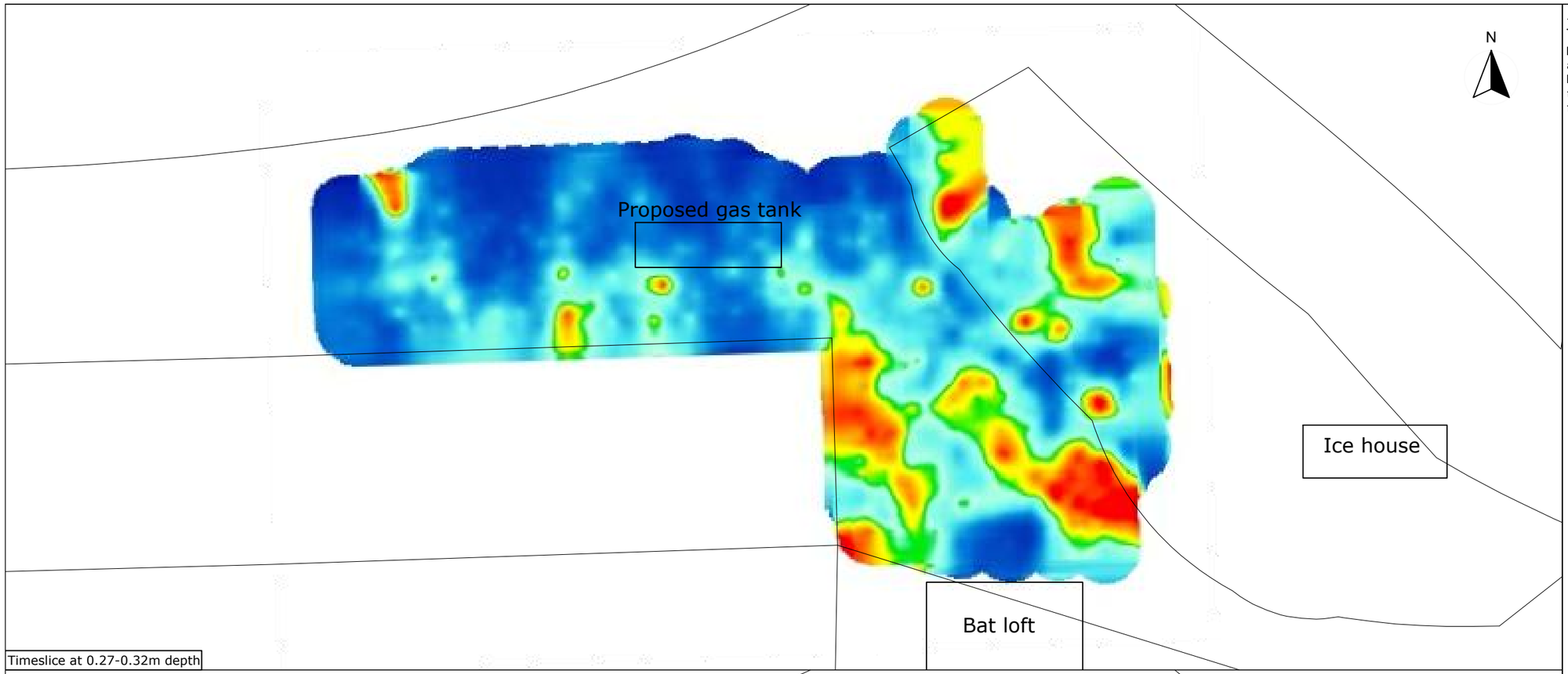
Title:
Location of Survey Area

Client:
Worcestershire County Council

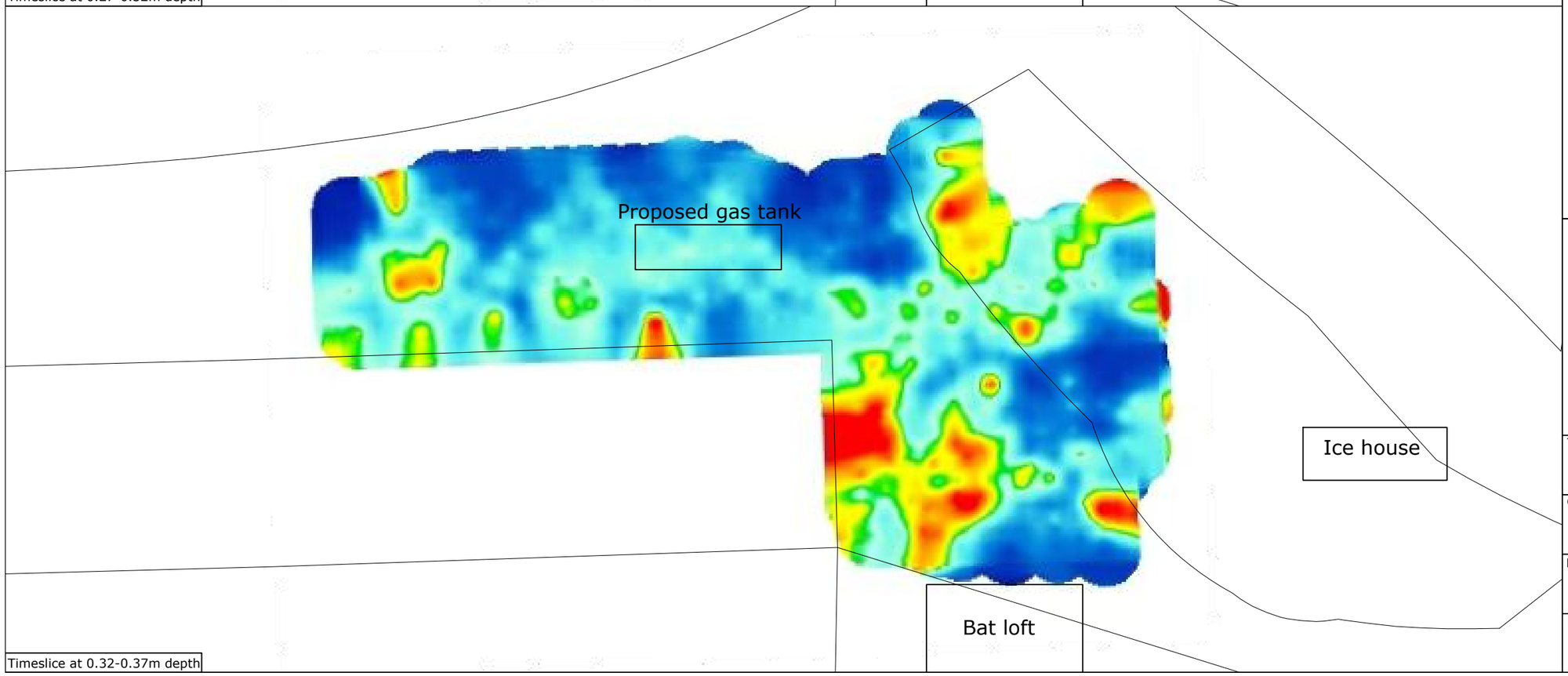
Project:
SOR11949 - Hartlebury Castle Car Park

Scale:
0 metres 10
1:200 @ A3

Fig No:
02



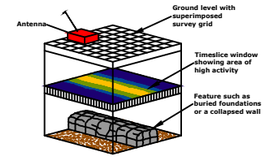
Timeslice at 0.27-0.32m depth



Timeslice at 0.32-0.37m depth

TIMESLICE PLOTS

In addition to a manual abstraction from the radargrams, a computer analysis was carried out. The radar data is interrogated for areas of high activity and the results presented in a plan format known as timeslice plots. In this way it is easy to see if the high activity areas form recognisable patterns.

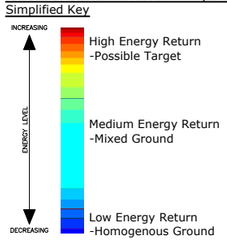


The GPR data is compiled to create a 3D file. This 3D file can be manipulated to view the data from any angle and at any depth within range. The data was then modelled to produce activity plots at various depths. As the radar is actually measuring the time for each of the reflections found, these are called "time slice windows". Plots for various time slices have been included in the report. Calculations, based on an average velocity, have been made to show the equivalent depth into the ground. The data was sampled between different time intervals effectively producing plans at different depths into the ground.

The weaker reflections in the time slice windows are shown as dark colours namely blues. The stronger reflections are represented by brighter colours such as light green, yellow, orange and red.

Reflections within the radar image are generated by a change in velocity of the radar from one medium to another. It is not unreasonable to assume that the higher activity anomalies are related to marked changes in materials within the ground such as buried foundations or surfaces within the soil matrix.

Colour Scale for Timeslice 'Activity' Plots and Simplified Key



sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

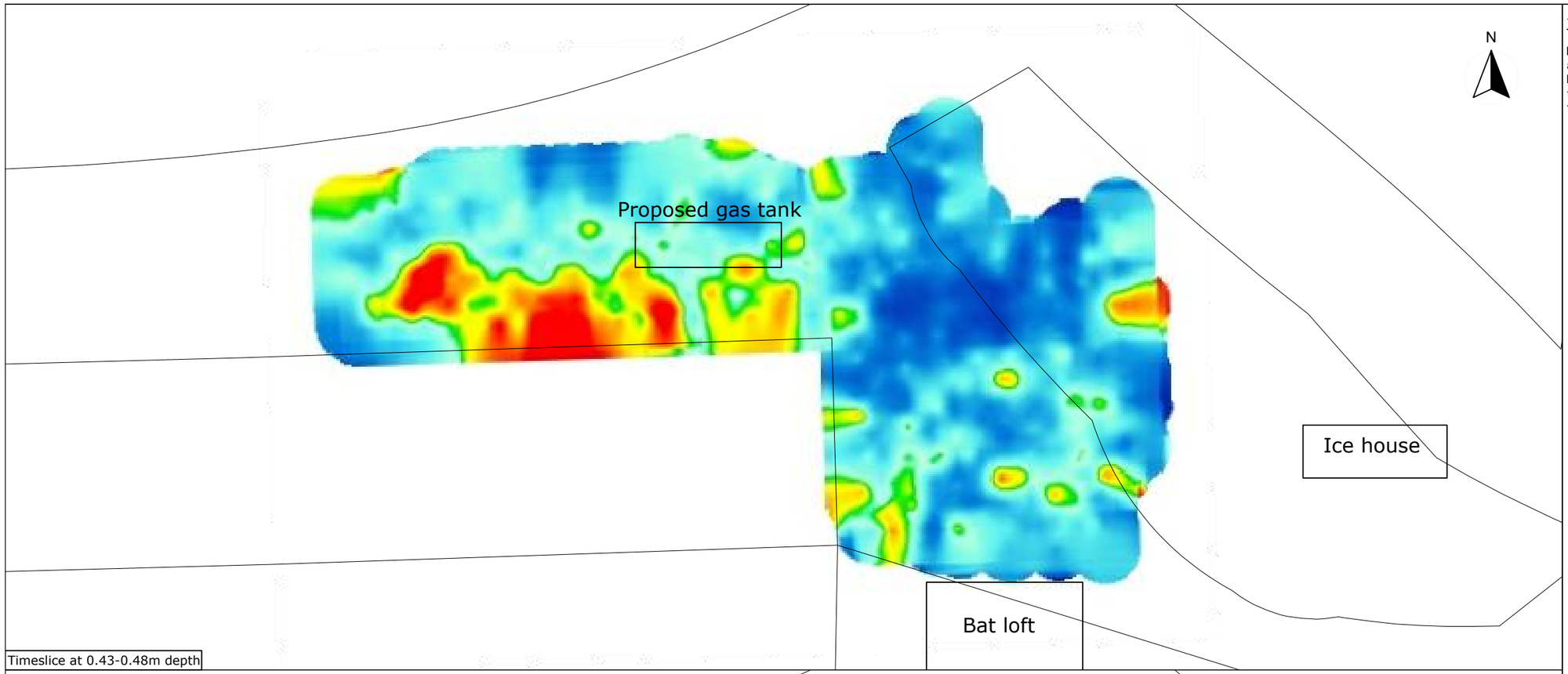
Title:
GPR Survey - Timeslices
at 0.27-0.32m and 0.32-0.37m

Client:
Worcestershire County Council

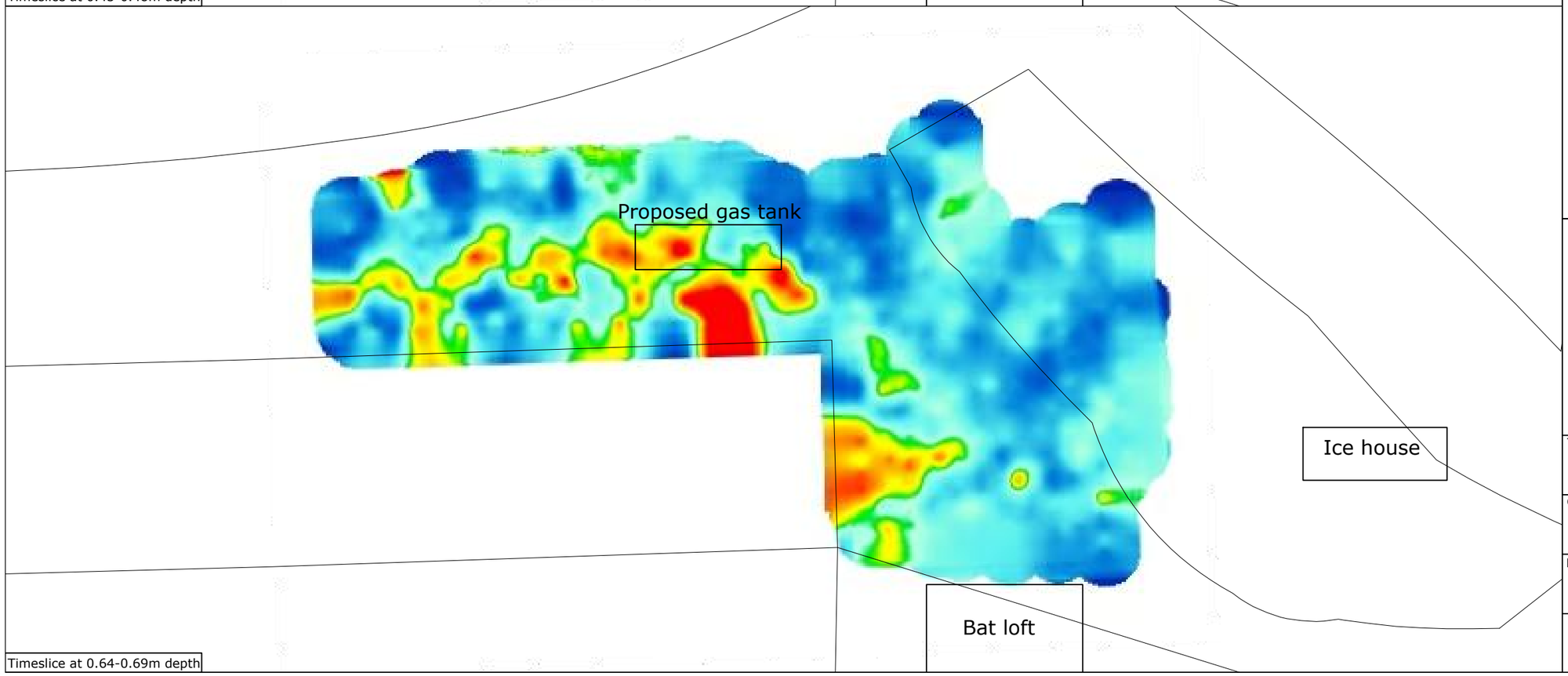
Project:
SOR11949 - Hartlebury Castle Car Park

Scale:
0 metres 5
1:100 @ A3

Fig No:
03



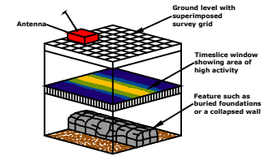
Timeslice at 0.43-0.48m depth



Timeslice at 0.64-0.69m depth

TIMESLICE PLOTS

In addition to a manual abstraction from the radargrams, a computer analysis was carried out. The radar data is interrogated for areas of high activity and the results presented in a plan format known as timeslice plots. In this way it is easy to see if the high activity areas form recognisable patterns.

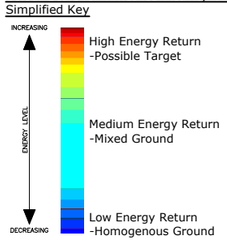


The GPR data is compiled to create a 3D file. This 3D file can be manipulated to view the data from any angle and at any depth within range. The data was then modelled to produce activity plots at various depths. As the radar is actually measuring the time for each of the reflections found, these are called "time slice windows". Plots for various time slices have been included in the report. Calculations, based on an average velocity, have been made to show the equivalent depth into the ground. The data was sampled between different time intervals effectively producing plans at different depths into the ground.

The weaker reflections in the time slice windows are shown as dark colours namely blues. The stronger reflections are represented by brighter colours such as light green, yellow, orange and red.

Reflections within the radar image are generated by a change in velocity of the radar from one medium to another. It is not unreasonable to assume that the higher activity anomalies are related to marked changes in materials within the ground such as buried foundations or surfaces within the soil matrix.

Colour Scale for Timeslice 'Activity' Plots and Simplified Key



sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

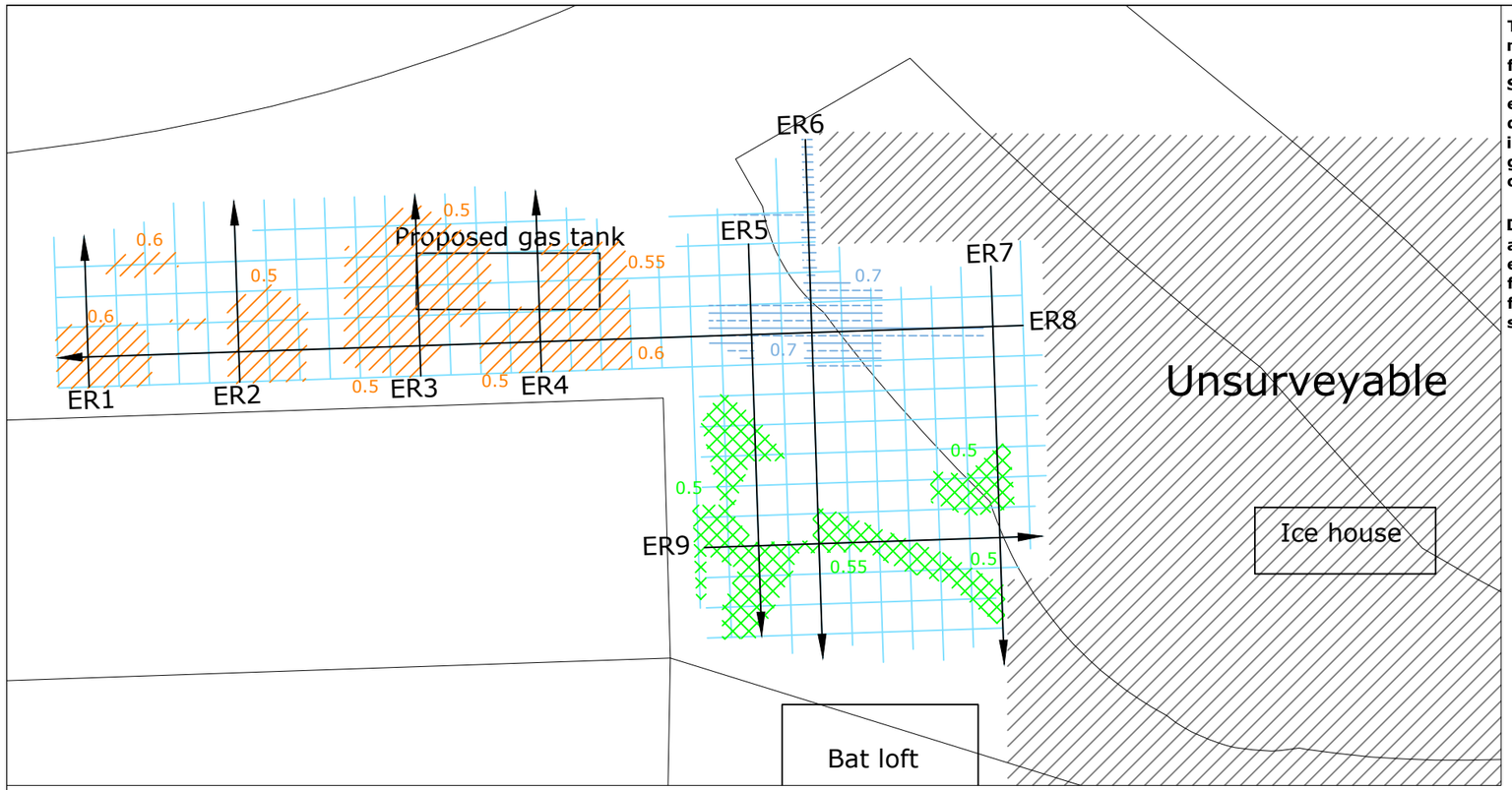
Title:
GPR Survey - Timeslices
at 0.43-0.48m and 0.64-0.69m

Client:
Worcestershire County Council

Project:
SOR11949 - Hartlebury Castle Car Park

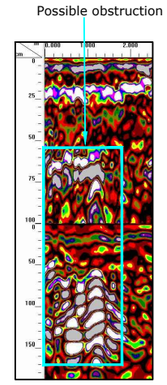
Scale:
0 metres 5
1:100 @ A3

Fig No:
04

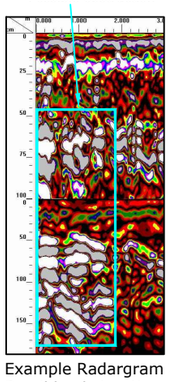


The performance of the technologies employed in non-invasive surveys can be adversely affected by factors outside of Stratascan's control. Whilst Stratascan uses all due diligence and reasonable endeavours it does not warrant that 100% detection can be achieved. Irrespective of the information provided by a geophysical survey, any ground works should be undertaken with extreme caution.

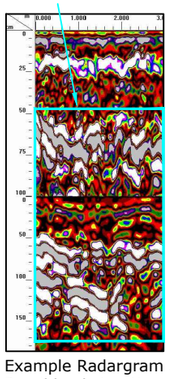
Dual Fregency GSSI radar is collected with 300MHz and 800MHz antennae simultaneously. The example radargrams show data from both frequencies. The top section shows the high frequency (800MHz) data, while the bottom section shows the low frequency (300MHz) data.



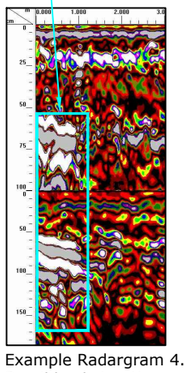
Example Radargram 1.
Possible obstruction.



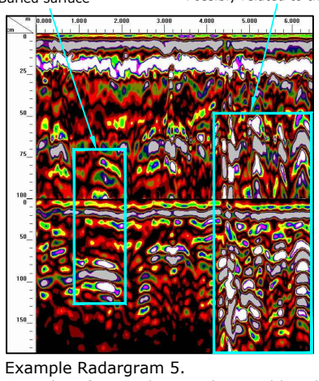
Example Radargram 2.
Possible obstruction.



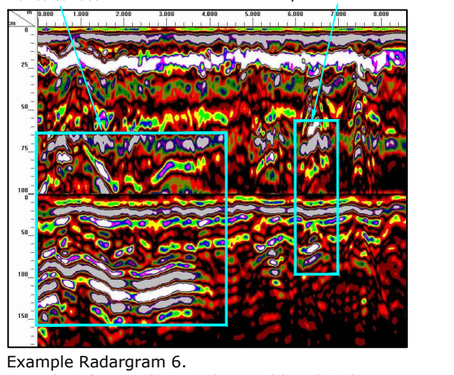
Example Radargram 3.
Possible obstruction.



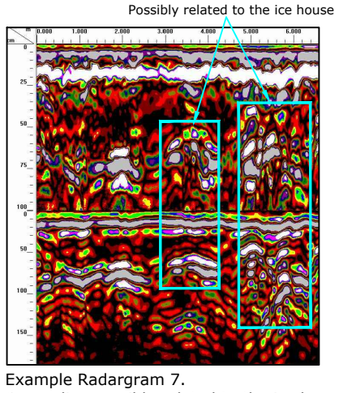
Example Radargram 4.
Possible obstruction.



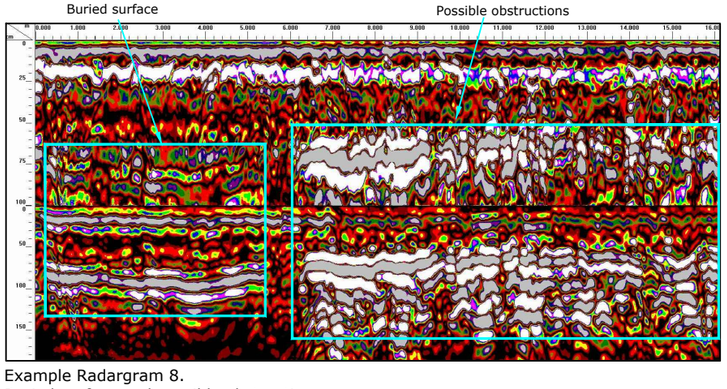
Example Radargram 5.
Buried surface and anomaly possibly related to the ice house.



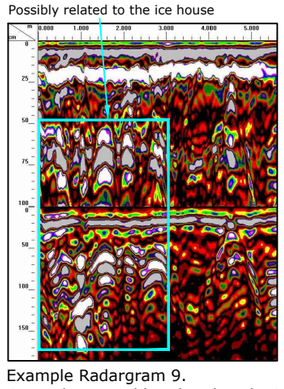
Example Radargram 6.
Buried surface and anomaly possibly related to the ice house.



Example Radargram 7.
Anomalies possibly related to the ice house.



Example Radargram 8.
Buried surface and possible obstructions.



Example Radargram 9.
Anomalies possibly related to the ice house.

N

KEY

	Complex and discrete anomaly possibly associated with ice house
	Complex and discrete anomaly possibly related to buried object / obstruction
	Feature related to buried surface
0.60	Depth to the top of the feature (in m)
	Example radargram

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

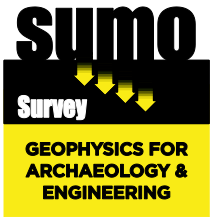
Title:
GPR Survey - Interpretation with Example Radargrams

Client:
Worcestershire County Council

Project:
SOR11949 - Hartlebury Castle Car Park

Scale:
0 metres 5
1:100 @ A3

Fig No:
05



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

SUMO Services Ltd, incorporated under the laws of England and Wales,
Company Registration No.4275993.
Registered Office Unit 8 Hayward Business Centre, New Lane, Havant, Hampshire, PO9 2NL

Appendix 2 Technical information

The archive (site code: WSM 68500 and 69555)

The archive consists of:

3	Field progress reports AS2
3	Photographic records AS3
119	Digital photographs
1	Drawing number catalogues AS4
1	Scale drawings
4	Trench record sheets AS41
1	Box of finds
1	CD-Rom/DVDs
1	Copy of this report (bound hard copy)

The project archive is intended to be placed at:

Worcestershire County Museum
Museums Worcestershire
Hartlebury Castle
Hartlebury
Near Kidderminster
Worcestershire DY11 7XZ
Tel Hartlebury (01299) 250416