GEOPHYSICAL SURVEY REPORT

STRATASCAN™

SUMO Survey Services SUMO Group Member

Project name:

Croome Old Church

Client:

Friends Of Croome

April 2015

Job ref:

J8069

Report author:

Thomas Richardson MSc ACIfA

GEOPHYSICAL SURVEY REPORT

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Croome Old Church

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J8069

Techniques:

Ground Penetrating Radar
Gradiometry

Survey date:

25th March 2015

Site centred at:

SO 884 446

Post code:

WR8 9DW

Field team:

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1 SUMMARY OF RESULTS

Ground penetrating radar (GPR) and detailed gradiometer surveys were conducted over approximately 0.5 and 0.9 hectares of grassland respectively. The survey has identified a number of anomalies that are likely to be associated with structural remains including the former church, gatehouse and a probable walled garden. A number of other possible areas of structural remains have been identified, however it is not possible to determine their origin with any degree of confidence. The remaining anomalies are of modern origin or relate to Capability Brown's landscaping of the area. These include culverts and underground services.

2 INTRODUCTION

2.1 *Background synopsis*

Stratascan were commissioned to undertake a geophysical survey to locate the remains of a former church and any other archaeological features at Croome Court. This survey forms part of an archaeological investigation being undertaken by the Friends of Croome.

2.2 *Site location*

The site is located to the north-west of Croome Court, Worcestershire at OS ref. SO 884 446.

2.3 *Description of site*

The survey area is approximately 0.9 hectares of grassland. The area covers the lawns to the immediate north-west of Croome Court, which has a gentle west facing slope.

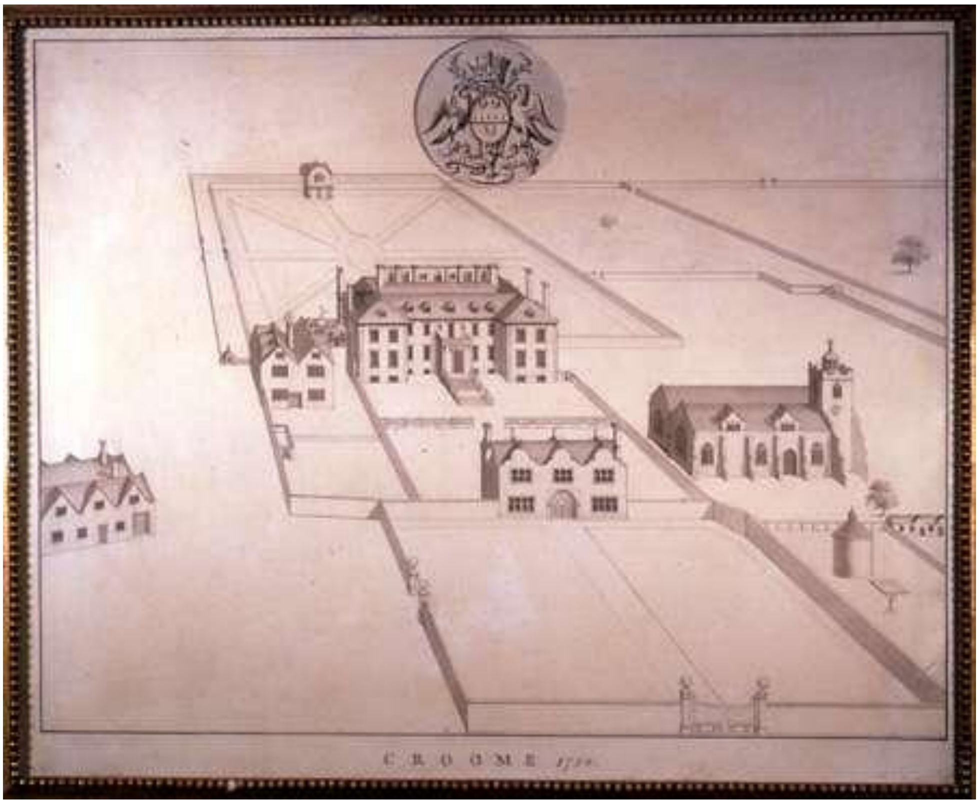
2.4 *Geology and soils*

The underlying geology is Branscombe Mudstone Formation – Mudstone across the west of the site, and Branscombe Mudstone Formation – Siltstone, Dolomitic across the east (British Geological Survey website). The drift geology is Alluvium – Clay, Silt, Sand and Gravel for the west of the site, and River Terrace Deposits (undifferentiated) – Sand and Gravel for the east (British Geological Survey website).

The overlying soils are known as Evesham 2 which are typical slowly permeable calcareous clayey soils (Soil Survey of England and Wales, Sheet 3, Midland and Western England).

2.5 Site history and archaeological potential

The original church at Croome was demolished in the 1750s by the 6th Earl of Coventry, when replacing the adjacent Jacobean house with what is now Croome Court (The Churches Conservation Trust 2015). The layout of the house and park was designed by Lancelot 'Capability' Brown. Brown's designs included landscaping of the area where the church is thought to have stood, making exact location of the church from historic documentation difficult. The drawing below shows the location and layout of the church in the mid-18th century, shortly before demolition (SWAG 2014).



A previous earth resistance survey of the area has identified anomalies likely to relate to a former gatehouse, and a system of culverts put in during landscaping of the area by Brown. An area of high resistance response to the north-west of Croome Court has been identified as possibly being rubble relating to the former church (SWAG 2014).

2.6 Survey objectives

The objective of the survey was to locate any features relating to the former church and any other anomalies of possible archaeological origin.

2.7 *Survey methods*

This report and all fieldwork have been conducted in accordance with both the English Heritage guidelines outlined in the document: *Geophysical Survey in Archaeological Field Evaluation, 2008* and with the Chartered Institute for Archaeologists document *Standard and Guidance for Archaeological Geophysical Survey.*

Given the potential for buried wall features, GPR was used as an efficient and effective method of locating archaeological anomalies. In additional detailed magnetic survey (gradiometry) was used to give the best view of existing anomalies. More information regarding these techniques is included in Appendix A.

2.8 *Processing, presentation and interpretation of results*

2.8.1 *Processing*

Radar

Processing is performed using specialist software (Mala Rslicer). There are a wide range of filters available, the application of which will vary depending on the project. The most commonly used are:

Gain	Amplification to correct for weakening of signal with depth.
DC-Shift	Re-establishes oscillation of the radar pulse around the zero point)
Dewow / Ringdown Removal	Removes low frequency, down-trace instrument noise
Bandpass Filtering	Suppresses frequencies outside of the antenna's peak bandwidth thus reducing noise
Background Removal	Can remove ringing, instrument noise and minimize the near-surface 'coupling' effect
Migration	Collapses hyperbolic tails (also known as 'diffractions') back towards the reflection source
Amplitude Envelope	Simplifies pulses for production of time-slice maps by summing peak values, regardless of polarity, over a given time-window.

Gradiometer

Processing is performed using specialist software. This can emphasise various aspects contained within the data but which are often not easily seen in the raw data. Basic processing of the magnetic data involves 'flattening' the background levels with respect to adjacent traverses and adjacent grids. Once the basic processing has flattened the background it is then possible to carry out further processing which may include low pass filtering to reduce 'noise' in the data and hence emphasise the archaeological or man-made anomalies.

The following schedule shows the basic processing carried out on all minimally processed gradiometer data used in this report:

1. *Destripe* (Removes striping effects caused by zero-point discrepancies between different sensors and walking directions)

2. *Destagger* (Removes zigzag effects caused by inconsistent walking speeds on sloping, uneven or overgrown terrain)

2.8.2 Presentation of results and interpretation

Radar

If a number of radargrams are collected over a grid, or in conjunction with GPS data, it is possible to reconstruct the entire dataset into a 3D volume. This can then be resampled to compile 'plan' maps (time slices) of response strength at increasing time offsets (typically converted to show approximate depth), thus simplifying the visualisation of how anomalies vary beneath the surface across a survey area. The close centred traverses of the Mala MIRA make for effective time slices, which are included at a number of depths.

Gradiometer

The presentation of the data for each site involves a print-out of the minimally processed data both as a greyscale plot and a colour plot showing extreme magnetic values. Magnetic anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing for the site.

3 RESULTS

Radar

The GPR survey conducted at Croome Court has identified a number of anomalies that may relate to structural remains. The following list of anomalies refers to labels on the interpretation plots.

A Rectilinear discrete responses in the centre of the site. These are likely to relate to the former walls of the church, buttresses and related internal structures.

B A number of discrete and complex anomalies to the centre of the site. These are likely to relate to graves.

C Linear and rectilinear discrete responses and complex area responses in the east of the site. These are likely to relate to former walls and structures relating to the gatehouse.

D Rectilinear discrete responses in the west of the site. These are indicative of former walls and possibly paths, and are likely to relate to a walled garden.

E A small discrete response in the north-western corner of Anomaly D. This may relate to structural remains or a former garden feature.

F Planar and complex responses across the site. These are indicative of buried surfaces, and are possible evidence of structural remains.

G Isolated discrete responses in the south-west of the site. These may relate to structural remains.

H Linear point diffractions in the west of the site. These are related to culverts.

I Linear point diffractions in the east of the site. This is indicative of a service.

J Areas of weak responses seen in timeslices. These are of unknown origin, but may relate to landscaping of the area.

K Weak linear anomalies seen in timeslices. These are of unknown origin.

L A linear null response running through the south of the site. This is likely to relate to a service or drainage trench.

M Complex responses related to a modern footpath.

Gradiometer
The detailed magnetic gradiometer survey conducted at Croome Court has identified a number of anomalies that have been characterised as being of a *possible* archaeological origin.

The difference between *probable* and *possible* archaeological origin is a confidence rating. Features identified within the dataset that form recognisable archaeological patterns or seem to be related to a deliberate historical act have been interpreted as being of a probable archaeological origin.

Features of possible archaeological origin tend to be more amorphous anomalies which may have similar magnetic attributes in terms of strength or polarity but are difficult to classify as being archaeological or natural.

The following list of numbered anomalies refers to numerical labels on the interpretation plots.

3.1 Probable Archaeology

No probable archaeology has been identified within the survey area.

3.2 *Possible Archaeology*

1 A 'mottled' area of moderate strength positive responses in the east of the site. This may relate to landscaping of the area or a spread of brick from former structures.

2 Positive linear anomalies across the west of the site. These are indicative of former cut features, and may be of archaeological origin or relate to landscaping of the area.

3 Small discrete positive anomalies across the site. These are indicative of small former cut features, such as backfilled pits or where a tree once stood, and may be of archaeological or natural origin.

3.3 *Medieval/Post-Medieval Agriculture*

No medieval or post-medieval agriculture has been identified within the survey area.

3.4 *Other Anomalies*

4 High amplitude linear anomalies in the west of the site. These are related to culverts.

5 An area of scattered magnetic debris in the west of the site. This is likely to be modern in origin.

6 Areas of magnetic disturbance are the result of substantial nearby ferrous metal objects such as fences and underground services. These effects can mask weaker archaeological anomalies, but on this site have not affected a significant proportion of the area.

7 A number of magnetic 'spikes' (strong focussed values with associated antipolar response) indicate ferrous metal objects. These are likely to be modern rubbish.

4 DATA APPRAISAL & CONFIDENCE ASSESSMENT

Gradiometer

The amount of landscaping in the area means that any weak archaeological features are unlikely to show up in a gradiometer survey. There should however, still be the potential of locating anomalies relating to structural remains, such as those being searched for in this survey. The survey has located a large area of disturbance that appears to correspond well with the locations of structures identified on historic mapping and within the GPR survey. It can therefore be said that the gradiometer survey has been effective.

Radar

The GPR survey has identified a number of anomalies likely to relate to structural remains. There is little background 'noise' across the site, allowing for a good clarity of survey. Overall the GPR survey has been effective, however there are areas, particularly in the east of the probable former church (Anomaly A) where features are fading out. There could be a number of reasons for this including the features becoming less substantial, or getting deeper due to the landscaping of the area. The areas where this appears to be happening are small, and as such do not have a significant effect on the interpretation of the data.

5 CONCLUSION

The survey at Croome Court has identified a number of anomalies relating to former structures in the area. The former church has been identified to the north of the west wing of Croome Court, approximately 45m east of the area identified by the previous resistivity survey. The tower, nave and several buttresses are clearly identifiable, whilst a linear anomaly coming out of the south of the nave is likely to relate to the southern aisle visible on the 18th century drawing of the area (see page 4). Discrete anomalies in the GPR data to the north of the church are likely to relate to a graveyard.

Further structural remains can be seen to the east of the church. These correlate well with the previous resistivity survey, and are likely to relate to the former gatehouse and associated walls. Linear anomalies within the gatehouse may relate to internal walls. To the west of the church a probable walled garden can be seen, with a probable feature, such as a statue, in the north-western corner.

There are a number of other anomalies across the site that may relate to further structural remains, however their origin cannot be determined with any confidence. One such area is in the vicinity of where the church was interpreted to be located from the resistivity survey. Anomalies are present in both the gradiometer and GPR survey, however it is likely that these are related to the landscaping of the area rather than structural remains.

The remaining anomalies are of modern origin or relate to Capability Brown's landscaping of the area. These include culverts and underground services.

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APPENDIX A – METHODOLOGY & SURVEY EQUIPMENT

Gradiometer

Grid locations

The location of the survey grids has been plotted together with the referencing information. Grids were set out using a Leica 705auto Total Station and referenced to suitable topographic features around the perimeter of the site or a Leica Smart Rover RTK GPS.

An RTK GPS (Real-time Kinematic Global Positioning System) can locate a point on the ground to a far greater accuracy than a standard GPS unit. A standard GPS suffers from errors created by satellite orbit errors, clock errors and atmospheric interference, resulting in an accuracy of 5m-10m. An RTK system uses a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier it measured, and the mobile units compare their own phase measurements with those they received from the base station. A SmartNet RTK GPS uses Ordnance Survey's network of over 100 fixed base stations to give an accuracy of around 0.01m.

Survey equipment and gradiometer configuration

Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.2 nanoTeslas (nT) in an overall field strength of 48,000nT, can be accurately detected using an appropriate instrument.

The mapping of the anomaly in a systematic manner will allow an estimate of the type of material present beneath the surface. Strong magnetic anomalies will be generated by buried iron-based objects or by kilns or hearths. More subtle anomalies such as pits and ditches can be seen if they contain more humic material which is normally rich in magnetic iron oxides when compared with the subsoil.

To illustrate this point, the cutting and subsequent silting or backfilling of a ditch may result in a larger volume of weakly magnetic material being accumulated in the trench compared to the undisturbed subsoil. A weak magnetic anomaly should therefore appear in plan along the line of the ditch.

The magnetic survey was carried out using a dual sensor Grad601-2 Magnetic Gradiometer manufactured by Bartington Instruments Ltd. The instrument consists of two fluxgates very accurately aligned to nullify the effects of the Earth's magnetic field. Readings relate to the difference in localised magnetic anomalies compared with the general magnetic background. The Grad601-2 consists of two high stability fluxgate gradiometers suspended on a single frame. Each gradiometer has a 1m separation between the sensing elements so enhancing the response to weak anomalies.

Sampling interval

Readings were taken at 0.25m centres along traverses 1m apart. This equates to 3600 sampling points in a full 30m x 30m grid.

Depth of scan and resolution

The Grad 601-2 has a typical depth of penetration of 0.5m to 1.0m, though strongly magnetic objects may be visible at greater depths. The collection of data at 0.25m centres provides an optimum methodology for the task balancing cost and time with resolution.

Data capture

The readings are logged consecutively into the data logger which in turn is daily down- loaded into a portable computer whilst on site. At the end of each site survey, data is transferred to the office for processing and presentation.

Radar

Sampling interval

Readings were taken at 0.08m intervals with traverse intervals of 0.08m. 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.

APPENDIX B – BASIC PRINCIPLES OF MAGNETIC SURVEY

Detailed magnetic survey can be used to effectively define areas of past human activity by mapping spatial variation and contrast in the magnetic properties of soil, subsoil and bedrock.

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

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

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

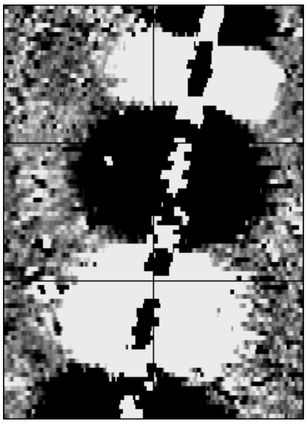
Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement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

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

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

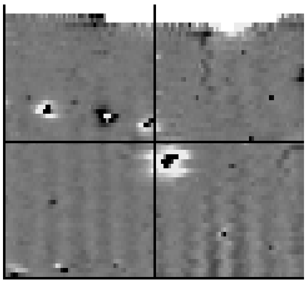
APPENDIX C – GLOSSARY OF MAGNETIC ANOMALIES

Bipolar



A bipolar anomaly is one that is composed of both a positive response and a negative response. It can be made up of any number of positive responses and negative responses. For example a pipeline consisting of alternating positive and negative anomalies is said to be bipolar. See also dipolar which has only one area of each polarity. The interpretation of the anomaly will depend on the magnitude of the magnetic field strength. A weak response may be caused by a clay field drain while a strong response will probably be caused by a metallic service.

Dipolar

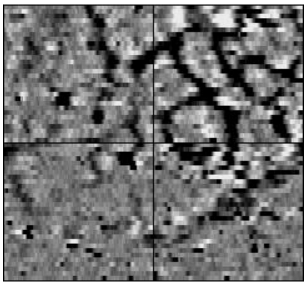


This consists of a single positive anomaly with an associated negative response. There should be no separation between the two polarities of response. These responses will be created by a single feature. The interpretation of the anomaly will depend on the magnitude of the magnetic measurements. A very strong anomaly is likely to be caused by a ferrous object.

Positive anomaly with associated negative response

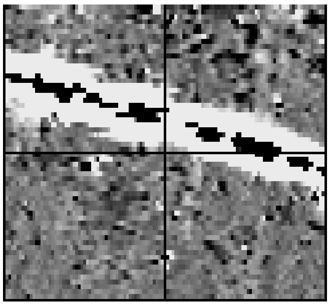
See bipolar and dipolar.

Positive linear



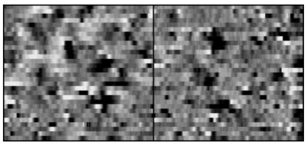
A linear response which is entirely positive in polarity. These are usually related to in-filled cut features where the fill material is magnetically enhanced compared to the surrounding matrix. They can be caused by ditches of an archaeological origin, but also former field boundaries, ploughing activity and some may even have a natural origin.

Positive linear anomaly with associated negative response



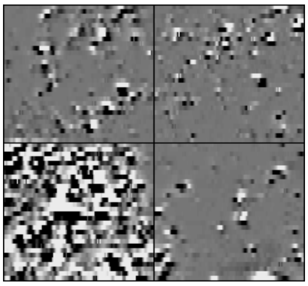
A positive linear anomaly which has a negative anomaly located adjacently. This will be caused by a single feature. In the example shown this is likely to be a single length of wire/cable probably relating to a modern service. Magnetically weaker responses may relate to earthwork style features and field boundaries.

Positive point/area



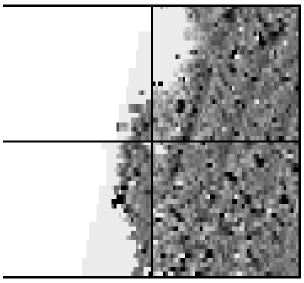
These are generally spatially small responses, perhaps covering just 3 or 4 reading nodes. They are entirely positive in polarity. Similar to positive linear anomalies they are generally caused by in-filled cut features. These include pits of an archaeological origin, possible tree bowls or other naturally occurring depressions in the ground.

Magnetic debris



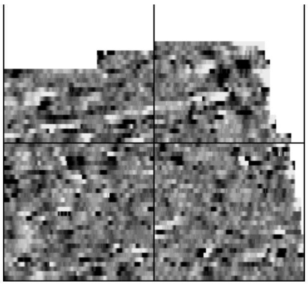
Magnetic debris consists of numerous dipolar responses spread over an area. If the amplitude of response is low (+/-3nT) then the origin is likely to represent general ground disturbance with no clear cause, it may be related to something as simple as an area of dug or mixed earth. A stronger anomaly (+/-250nT) is more indicative of a spread of ferrous debris. Moderately strong anomalies may be the result of a spread of thermoremanent material such as bricks or ash.

Magnetic disturbance



Magnetic disturbance is high amplitude and can be composed of either a bipolar anomaly, or a single polarity response. It is essentially associated with magnetic interference from modern ferrous structures such as fencing, vehicles or buildings, and as a result is commonly found around the perimeter of a site near to boundary fences.

Negative linear

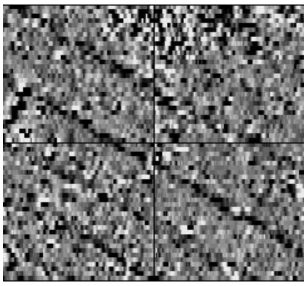


A linear response which is entirely negative in polarity. These are generally caused by earthen banks where material with a lower magnetic magnitude relative to the background top soil is built up. See also ploughing activity.

Negative point/area

Opposite to positive point anomalies these responses may be caused by raised areas or earthen banks. These could be of an archaeological origin or may have a natural origin.

Ploughing activity



Ploughing activity can often be visualised by a series of parallel linear anomalies. These can be of either positive polarity or negative polarity depending on site specifics. It can be difficult to distinguish between ancient ploughing and more modern ploughing. Clues such as the separation of each linear, straightness, strength of response and cross cutting relationships can be used to aid this, although none of these can be guaranteed to differentiate between different phases of activity.

Polarity

Term used to describe the measurement of the magnetic response. An anomaly can have a positive polarity (values above 0nT) and/or a negative polarity (values below 0nT).

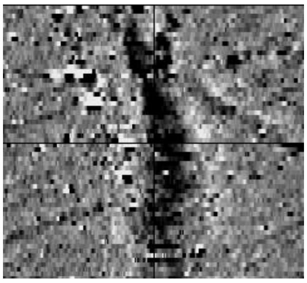
Strength of response

The amplitude of a magnetic response is an important factor in assigning an interpretation to a particular anomaly. For example a positive anomaly covering a 10m^2 area may have values up to around 3000nT, in which case it is likely to be caused by modern magnetic interference. However, the same size and shaped anomaly but with values up to only 4nT may have a natural origin. Colour plots are used to show the amplitude of response.

Thermoremanent response

A feature which has been subject to heat may result in it acquiring a magnetic field. This can be anything up to approximately +/-100 nT in value. These features include clay fired drains, brick, bonfires, kilns, hearths and even pottery. If the heat application has occurred in situ (e.g. a kiln) then the response is likely to be bipolar compared to if the heated objects have been disturbed and moved relative to each other, in which case they are more likely to take an irregular form and may display a debris style response (e.g. ash).

Weak background variations



Weakly magnetic wide scale variations within the data can sometimes be seen within sites. These usually have no specific structure but can often appear curvy and sinuous in form. They are likely to be the result of natural features, such as soil creep, dried up (or seasonal) streams. They can also be caused by changes in the underlying geology or soil type which may contain unpredictable distributions of magnetic minerals, and are usually apparent in several locations across a site.

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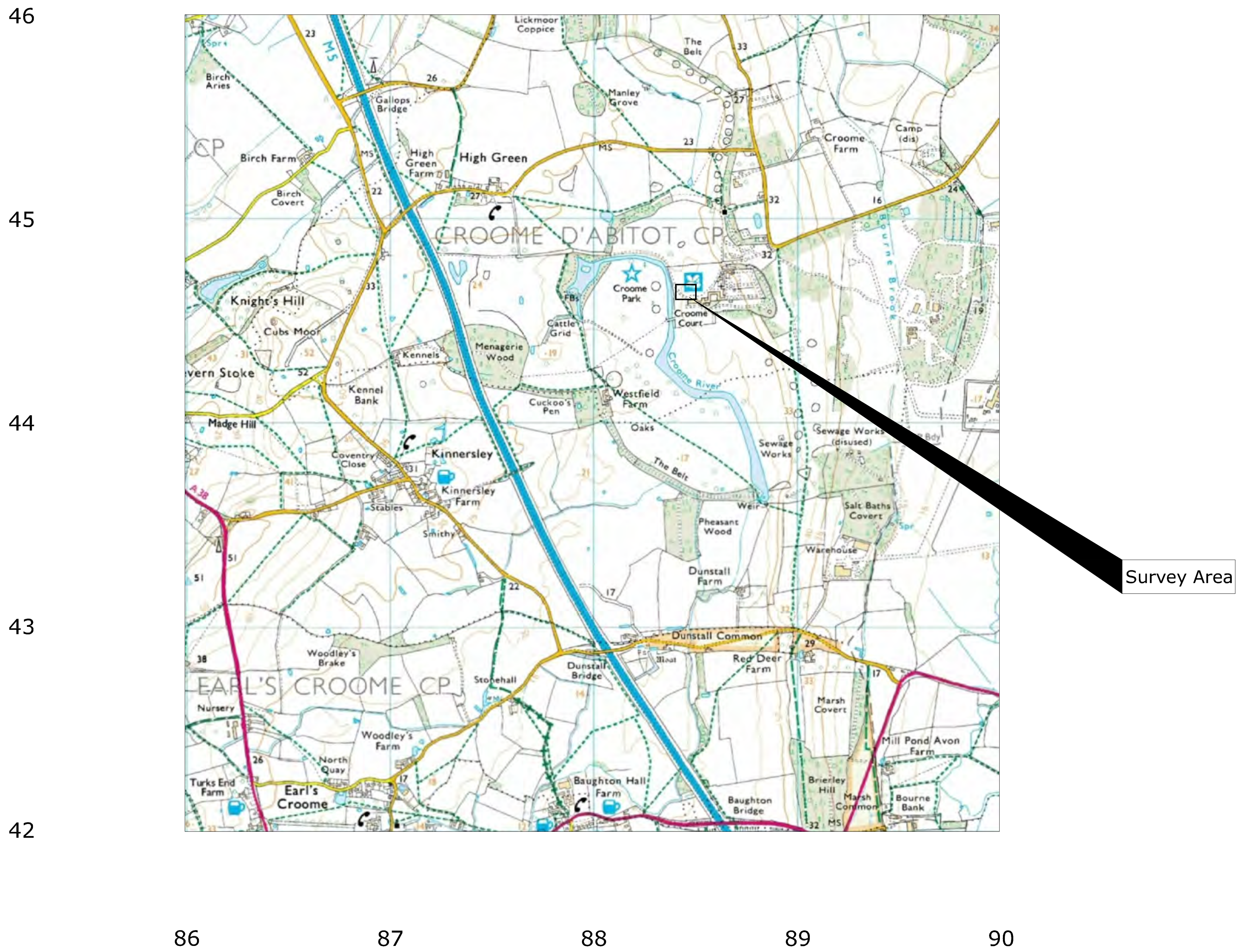

N

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Site centred on NGR SO 884 446

Client
FRIENDS OF CROOME

Project Title
CROOME OLD CHURCH

Job No. 8069

Subject
LOCATION PLAN OF SURVEY AREA

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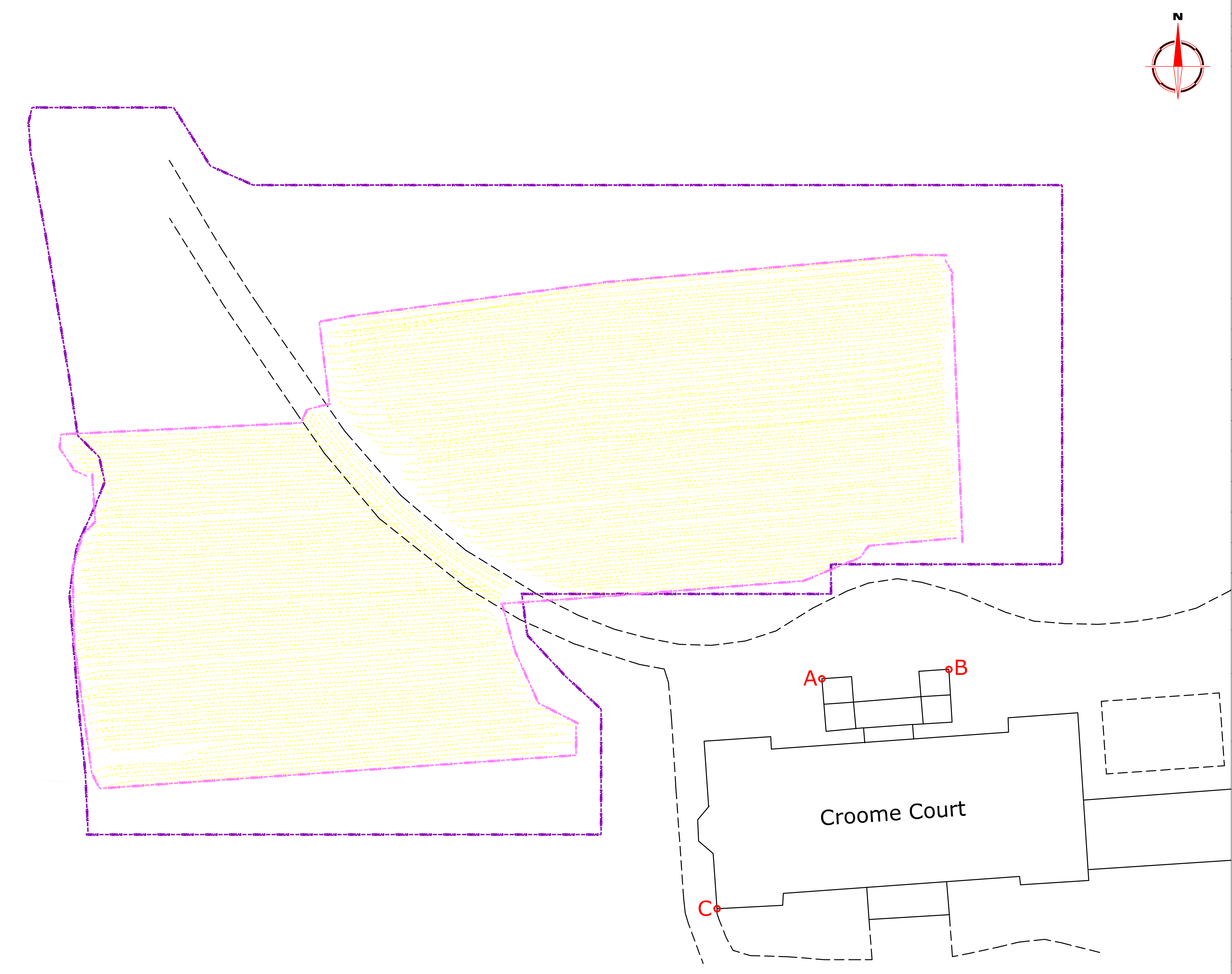
Scale	Plot	Checked by	Issue No.	Survey date	Drawn by	Figure No.
1:25000 (0m – 500 – 1000m)	A3	PPB	01	MARCH 15	MU	01



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

KEY

	Gradiometer survey area
	GPR survey area
	Radar traverse

OS GRID REFERENCES

A	388475.31, 244616.19
B	388491.98, 244617.46
C	388461.57, 244586.04
A-C	Base points

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Project Title — Job No. 8069
CROOME OLD CHURCH

Subject
GPR AND GRADIOMETER SURVEY - LOCATION OF SURVEY GRIDS AND REFERENCING

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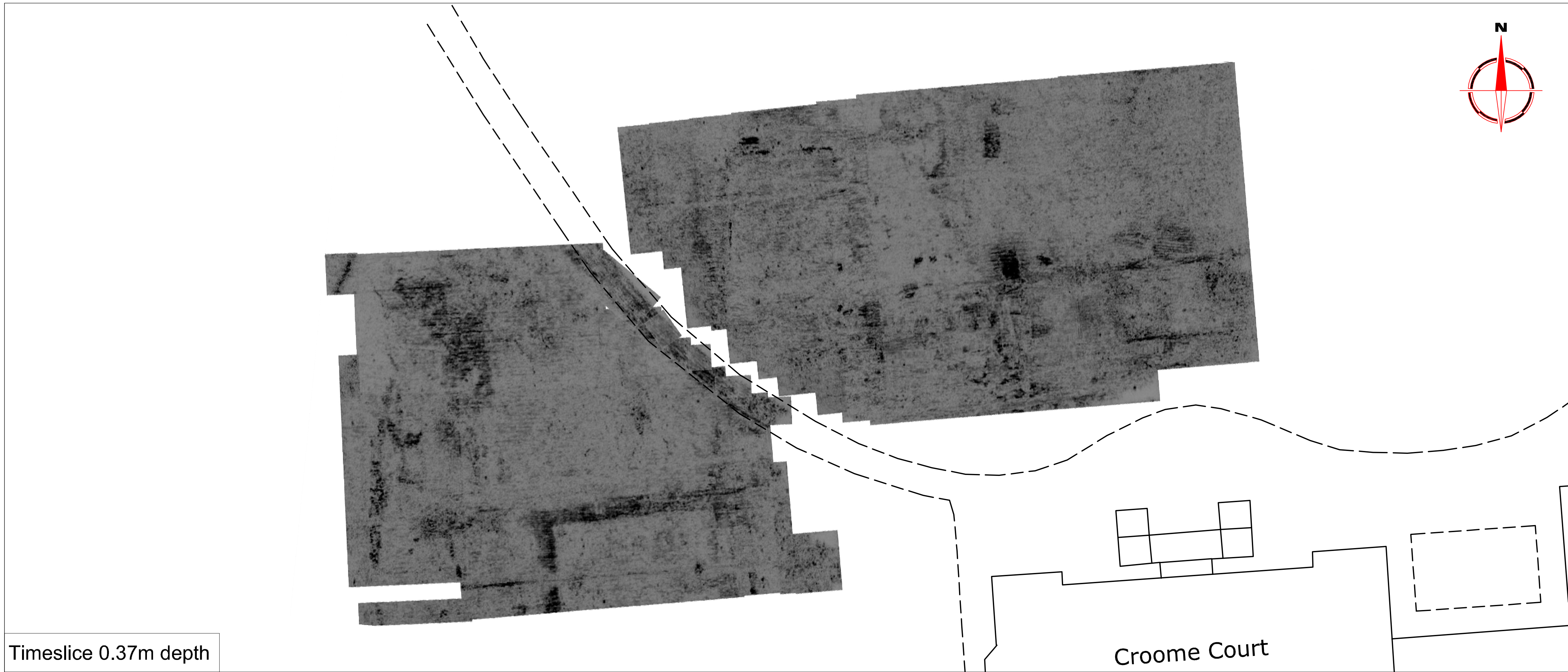
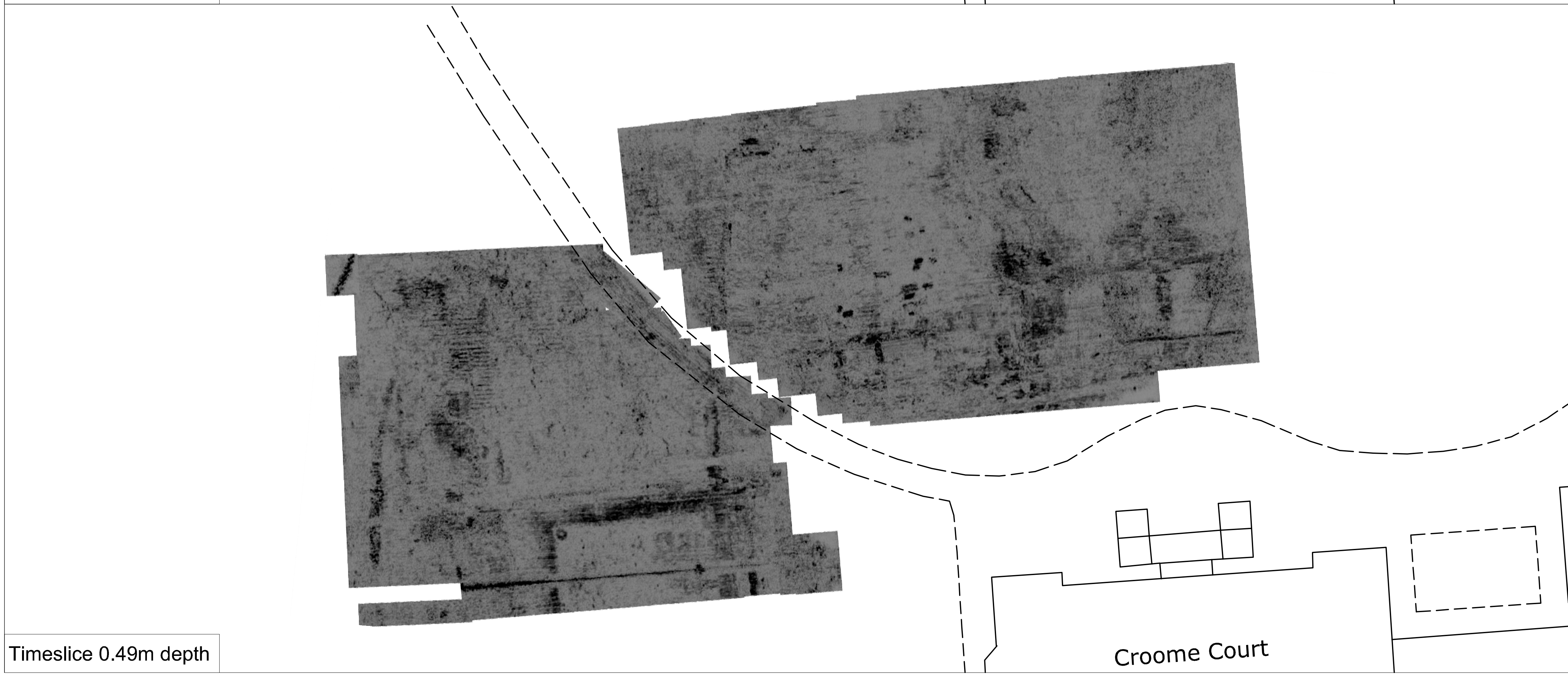
Scale 1:500 (0m, 5, 10, 15, 20, 25m)

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	**Drawn by**	**Figure No.**
MARCH 15	MU	02



Timeslice 0.37m depth



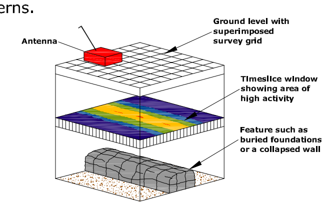
Timeslice 0.49m depth

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

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.

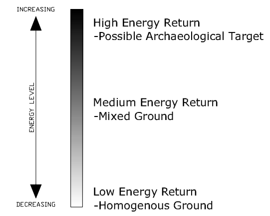


The GPR data is compiled to create a 3D file. This 3D file can be manipulated to view the data from any angle and at any depth within range. The data was then modelled to produce activity plots at various depths. As the radar is actually measuring the time for each of the reflections found, these are 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 white and grey colours. The stronger reflections are represented by black colour.

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



Client

FRIENDS OF CROOME

Project Title — Job No. 8069

CROOME OLD CHURCH

Subject

GPR SURVEY - TIMESLICES AT 0.37 AND 0.49m DEPTH

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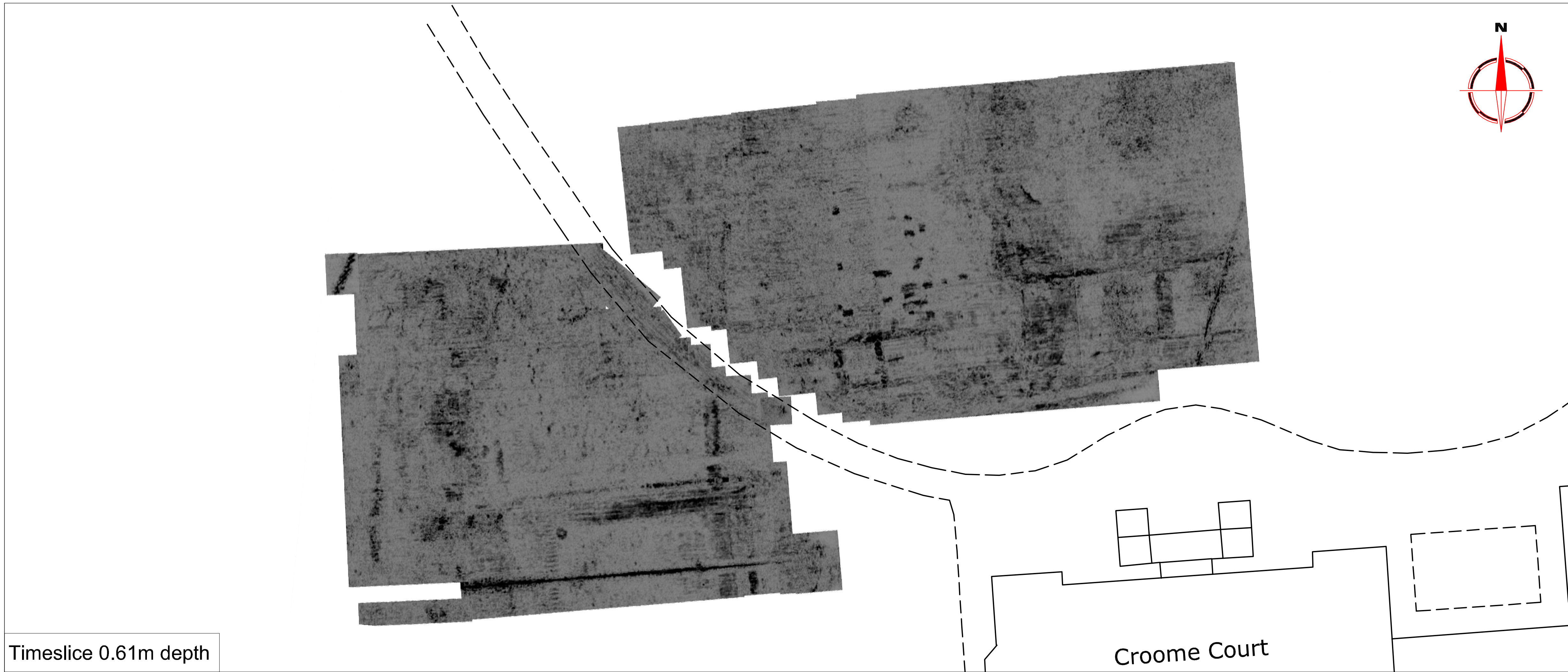
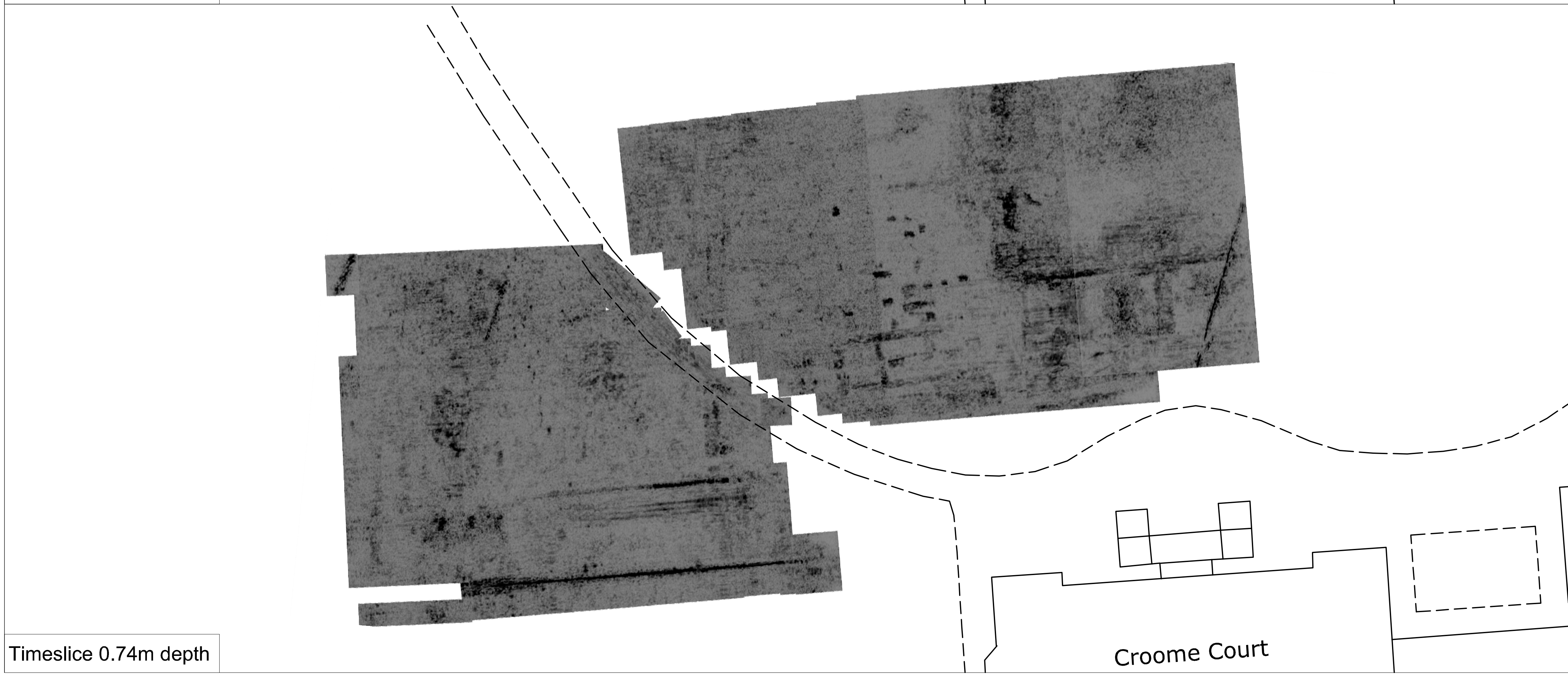
Scale 1:600 — 0m 4 8 12 16 20m

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	**Drawn by**	**Figure No.**
MARCH 15	MU	03



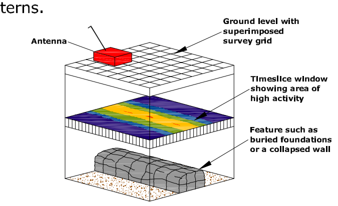


Amendments

Issue No.	Date	Description
-	-	-
-	-	-

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.



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The weaker reflections in the time slice windows are shown as white and grey colours. The stronger reflections are represented by black colour.

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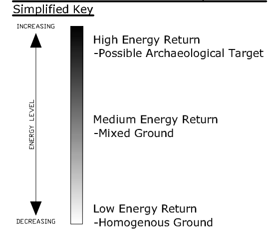
Colour Scale for Timeslice 'Activity' Plots and Simplified Key



Client

FRIENDS OF CROOME

Project Title — Job No. 8069

CROOME OLD CHURCH

Subject

GPR SURVEY - TIMESLICES AT 0.61 AND 0.74m DEPTH

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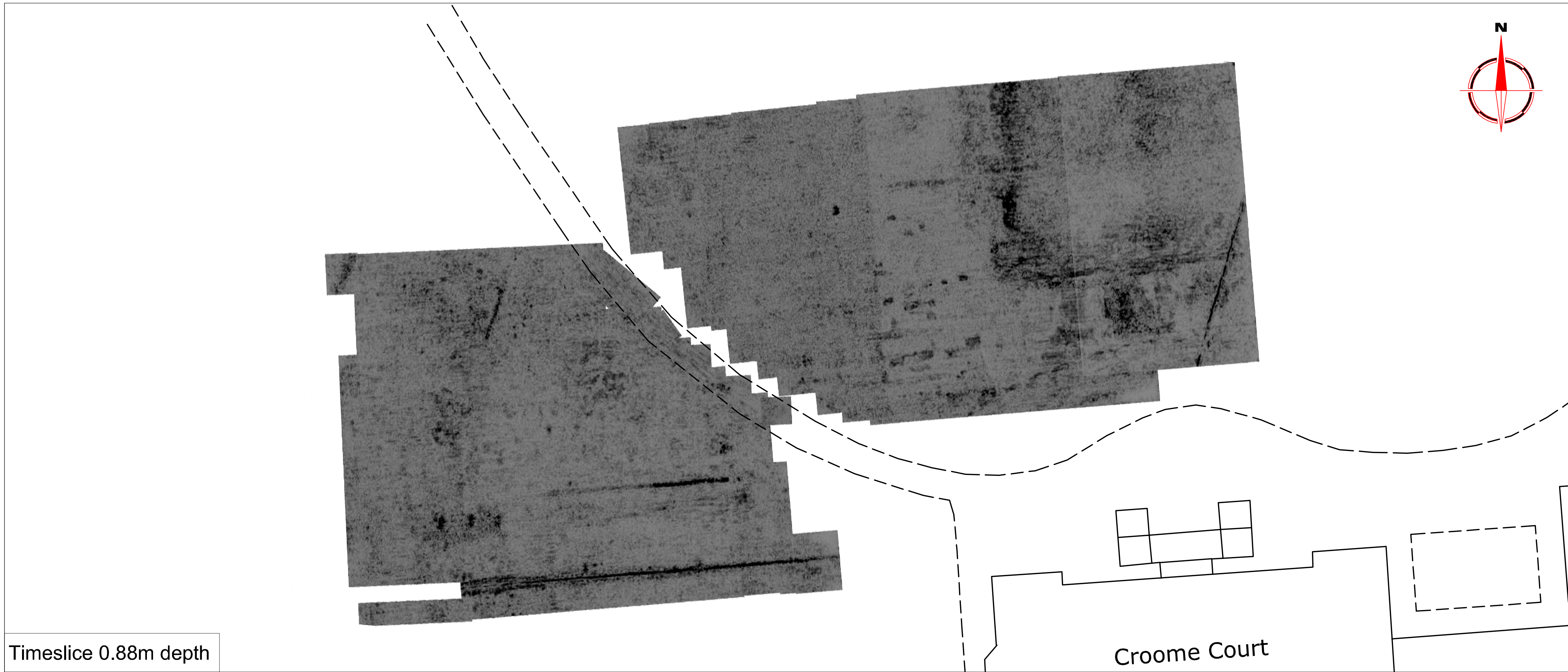
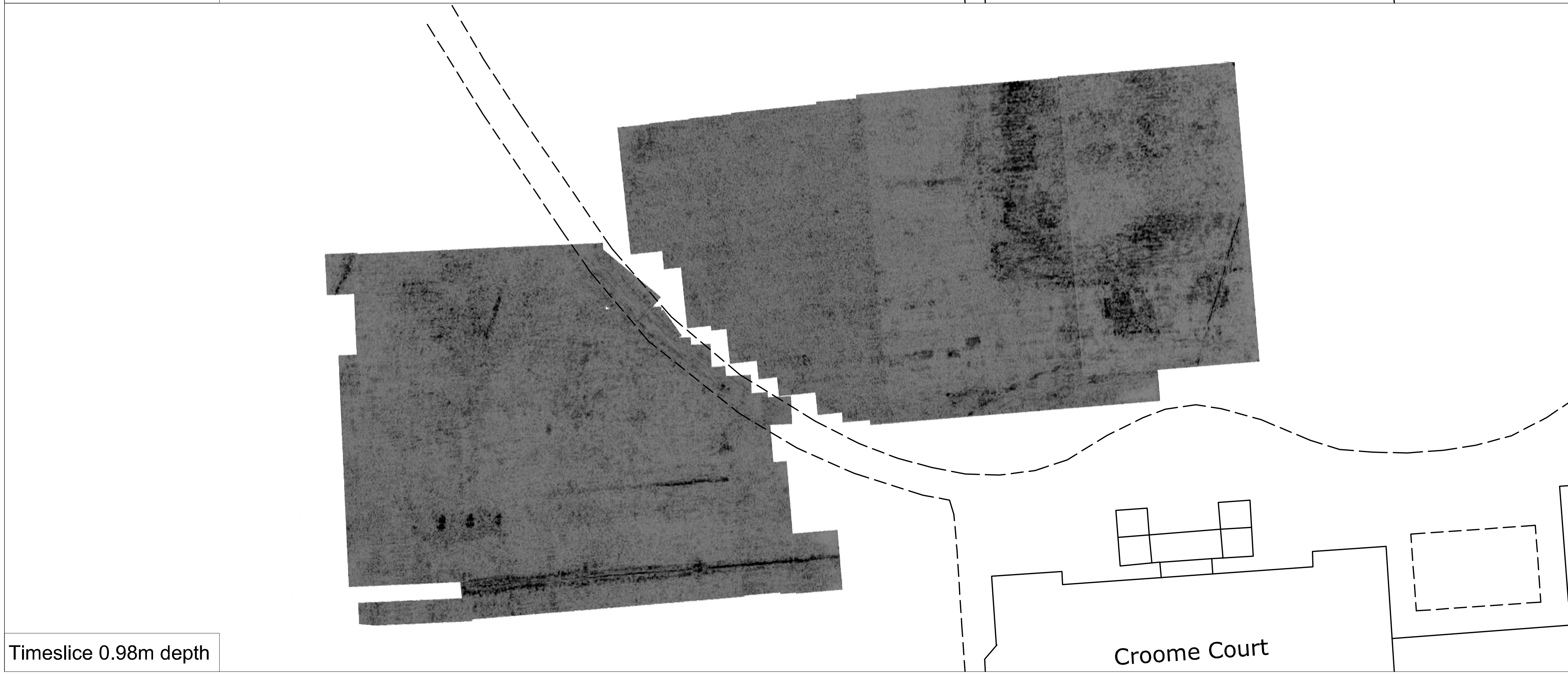
Scale 1:600 — 0m 4 8 12 16 20m

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	**Drawn by**	**Figure No.**
MARCH 15	MU	04





Amendments

Issue No.	Date	Description
-	-	-
-	-	-

TIMESLICE PLOTS

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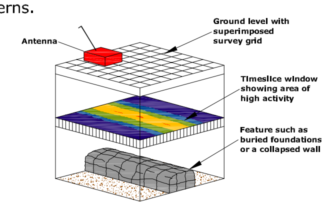

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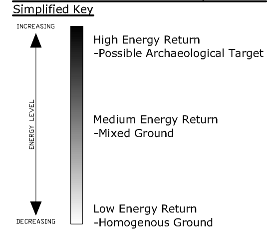
Colour Scale for Timeslice 'Activity' Plots and Simplified Key



Client

FRIENDS OF CROOME

Project Title | Job No. 8069

CROOME OLD CHURCH

Subject

GPR SURVEY - TIMESLICES AT 0.88 AND 0.98m DEPTH

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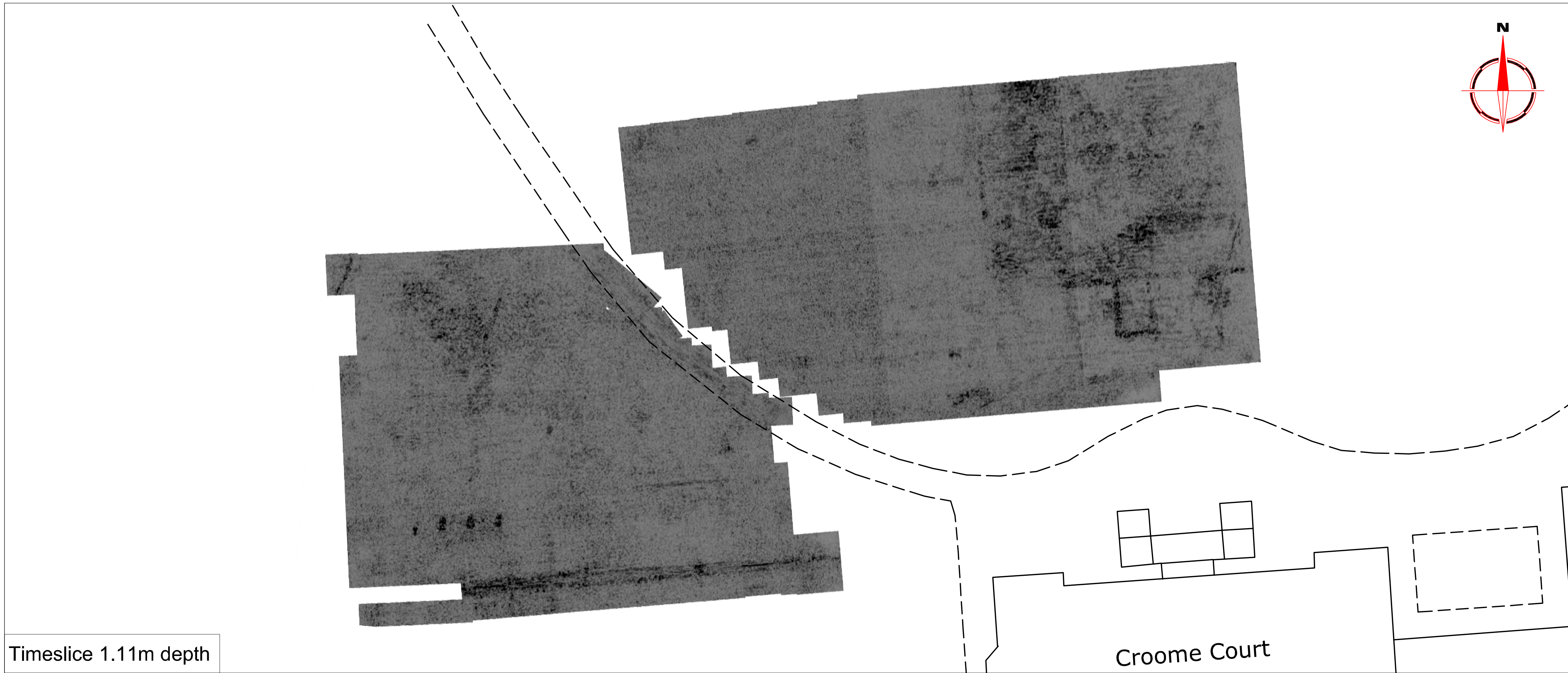
SUMO GROUP MEMBER

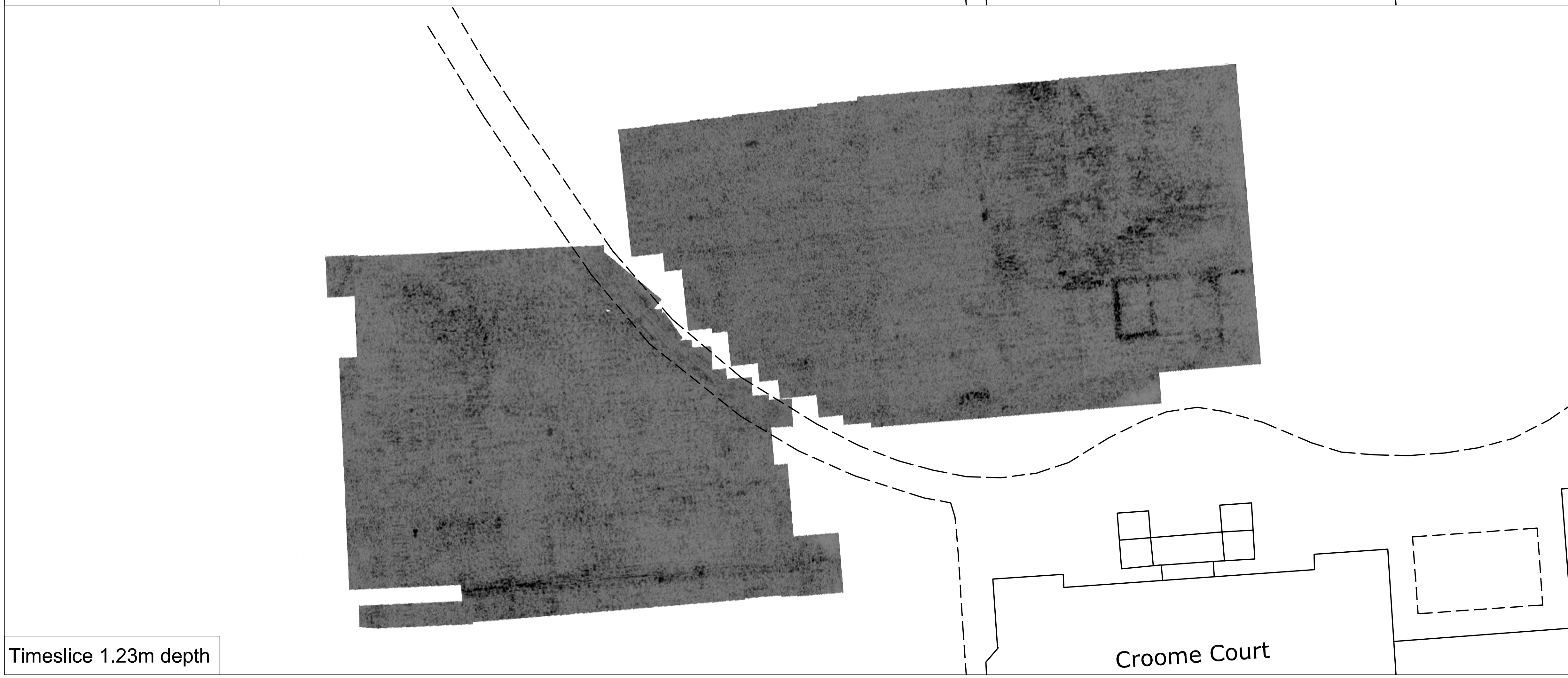
Scale 1:600

0m 4 8 12 16 20m

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	**Drawn by**	**Figure No.**
MARCH 15	MU	05



Timeslice 1.11m depth



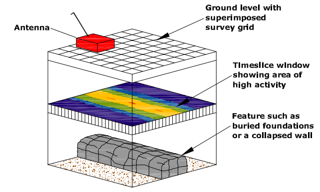
Timeslice 1.23m depth

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

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.



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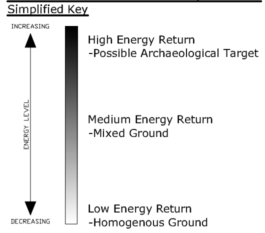
Colour Scale for Timeslice 'Activity' Plots and Simplified Key



Client

FRIENDS OF CROOME

Project Title — Job No. 8069

CROOME OLD CHURCH

Subject

GPR SURVEY - TIMESLICES AT 1.11 AND 1.23m DEPTH

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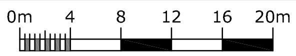
Scale 1:600



Plot	Checked by	Issue No.
A3	PPB	01
Survey date	**Drawn by**	**Figure No.**
MARCH 15	MU	06

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

KEY

- Anomalies possibly relating to the church
- Anomalies probably relating to former gatehouse
- Anomalies probably relating to structural remains of an archaeological origin
- Anomalies possibly relating to structural remains of an archaeological origin
- Possible graves
- Possible remains of uncertain origin
- Planar and complex anomalies - may relate to buried surface with interspersed structural remains
- Possible linear anomaly of uncertain origin
- Possible service
- Culvert
- Null response - possible service or drainage trench
- Modern footpath
- 0.4 Depth to top of anomaly in metres
- Survey area

Client

FRIENDS OF CROOME

Project Title Job No. 8069

CROOME OLD CHURCH

Subject

GPR SURVEY - INTERPRETATION

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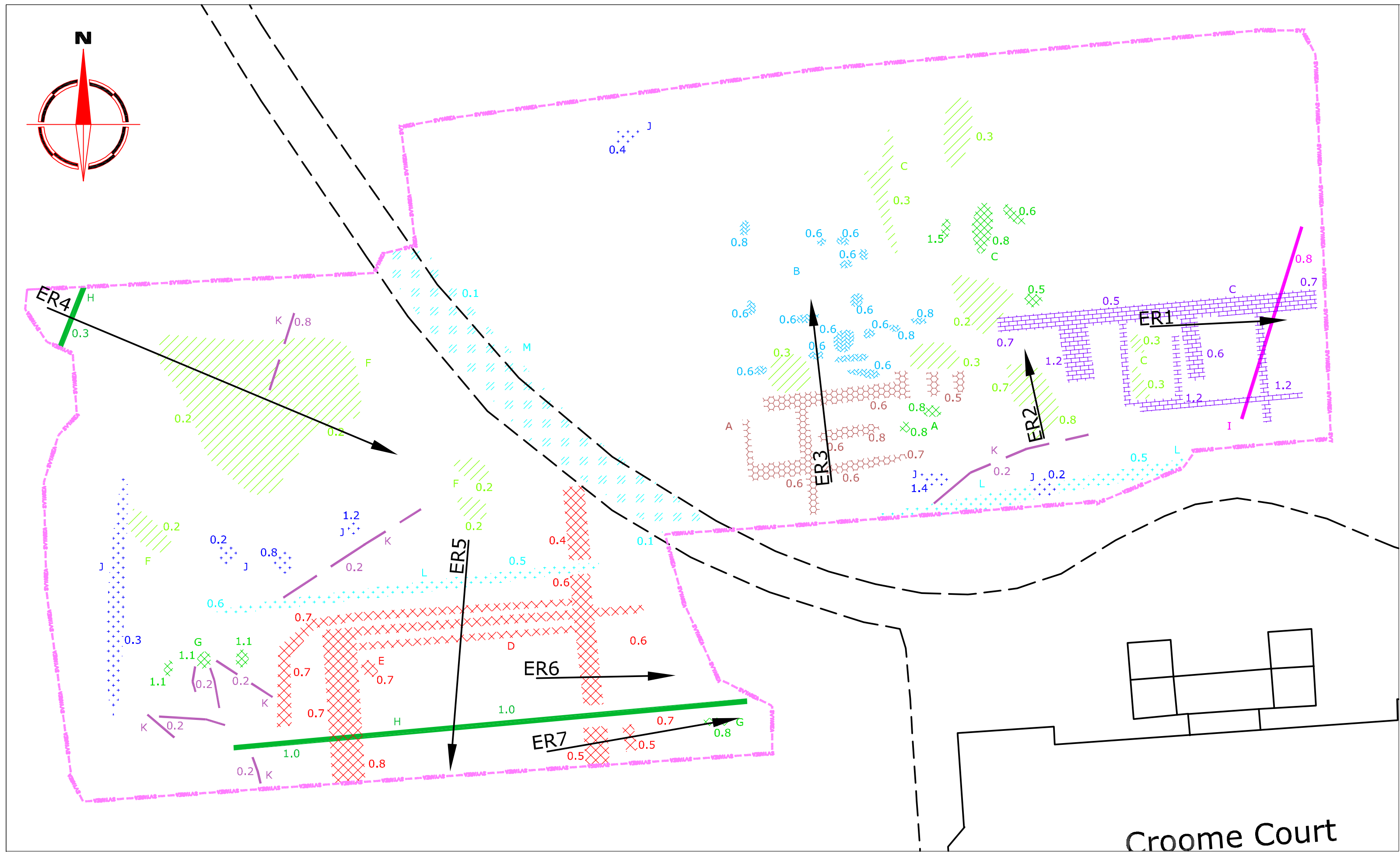
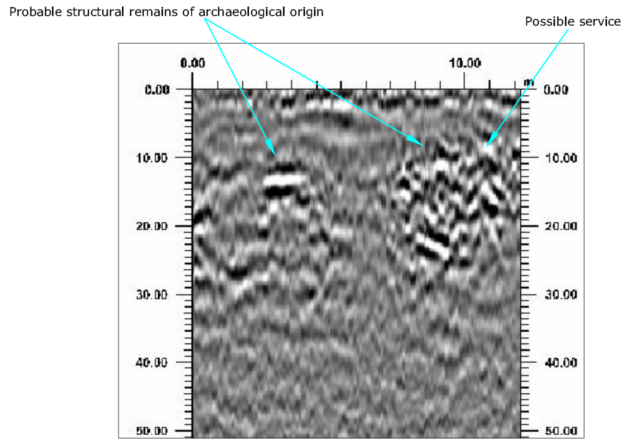
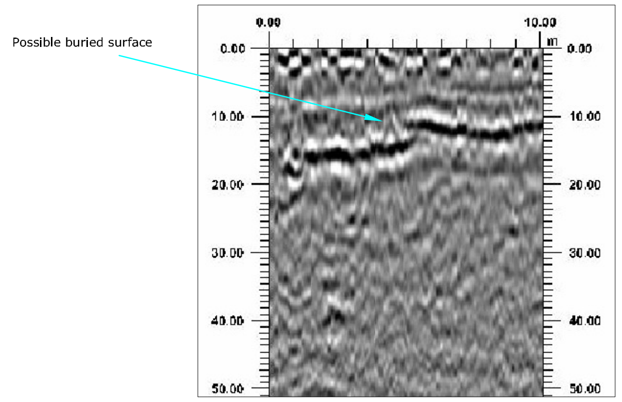
SUMO GROUP MEMBER

Scale 1:500 (0m, 5, 10, 15, 20, 25m)		
Plot A3	Checked by PPB	Issue No. 01
Survey date MARCH 15	Drawn by MU	Figure No. 07

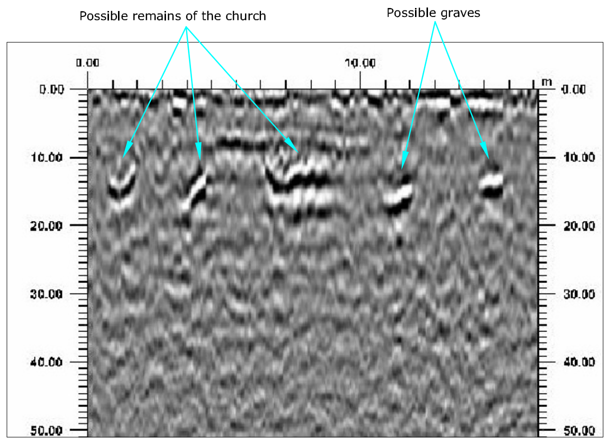




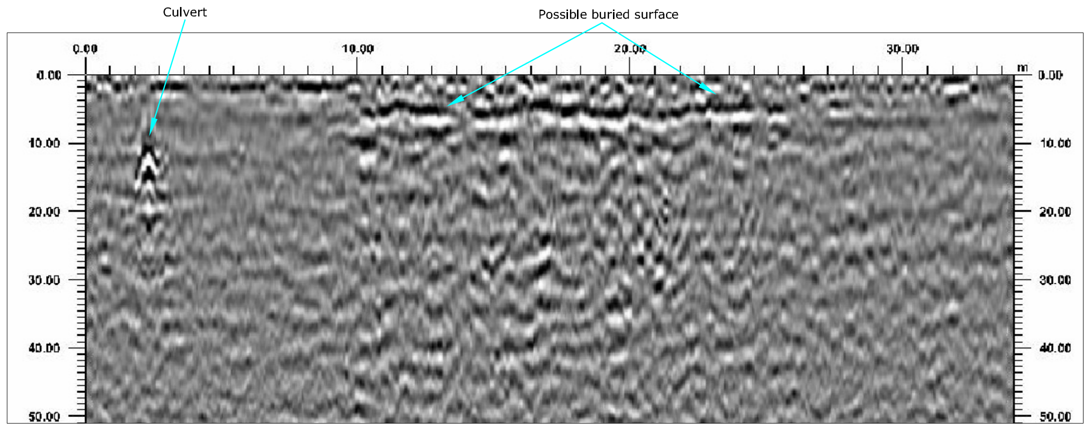
Example Radargram 1.
Anomalies probably relating to structural remains of archaeological origin and possible service.



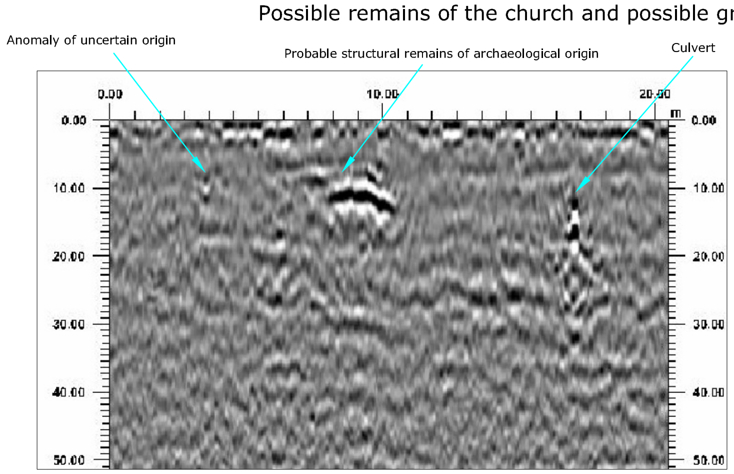
Example Radargram 2.
Planar feature possibly relating to buried surface.



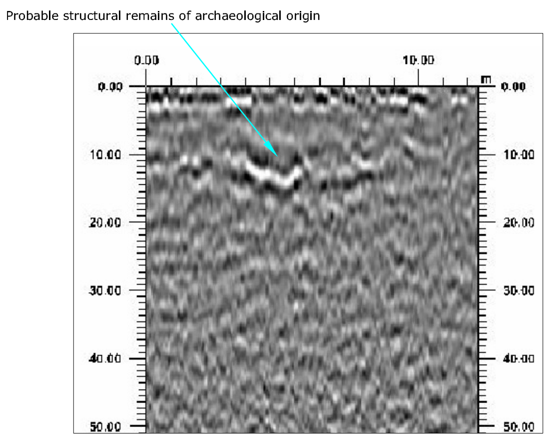
Example Radargram 3.
Possible remains of the church and possible graves.



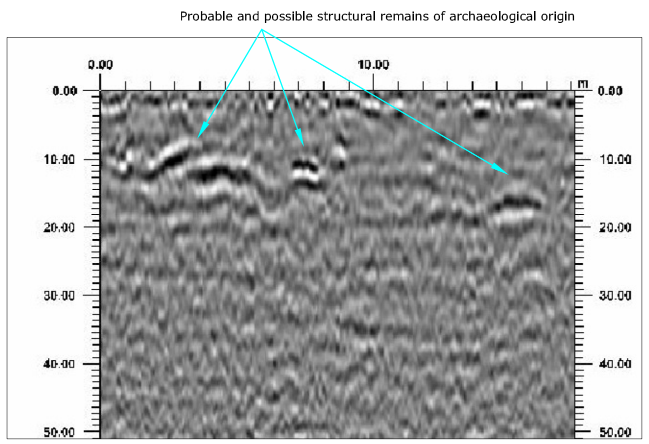
Example Radargram 4.
Culvert and planar feature possibly relating to buried surface.



Example Radargram 5.
Anomalies probably relating to structural remains of archaeological and uncertain origin and culvert.



Example Radargram 6.
Anomalies probably relating to structural remains of archaeological origin.



Example Radargram 7.
Anomalies probably and possibly relating to structural remains of archaeological origin.

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

KEY

- Anomalies possibly relating to the church
- Anomalies probably relating to former gatehouse
- Anomalies probably relating to structural remains of an archaeological origin
- Anomalies possibly relating to structural remains of an archaeological origin
- Possible graves
- Possible remains of uncertain origin
- Planar and complex anomalies - may relate to buried surface with interspersed structural remains
- Possible linear anomaly of uncertain origin
- Possible service
- Culvert
- Null response - possible service or drainage trench
- Modern footpath
- 0.4 Depth to top of anomaly in metres
- Survey area

Client
FRIENDS OF CROOME

Project Title — Job No. 8069
CROOME OLD CHURCH

Subject
GPR SURVEY - INTERPRETATION WITH EXAMPLE RADARGRAMS

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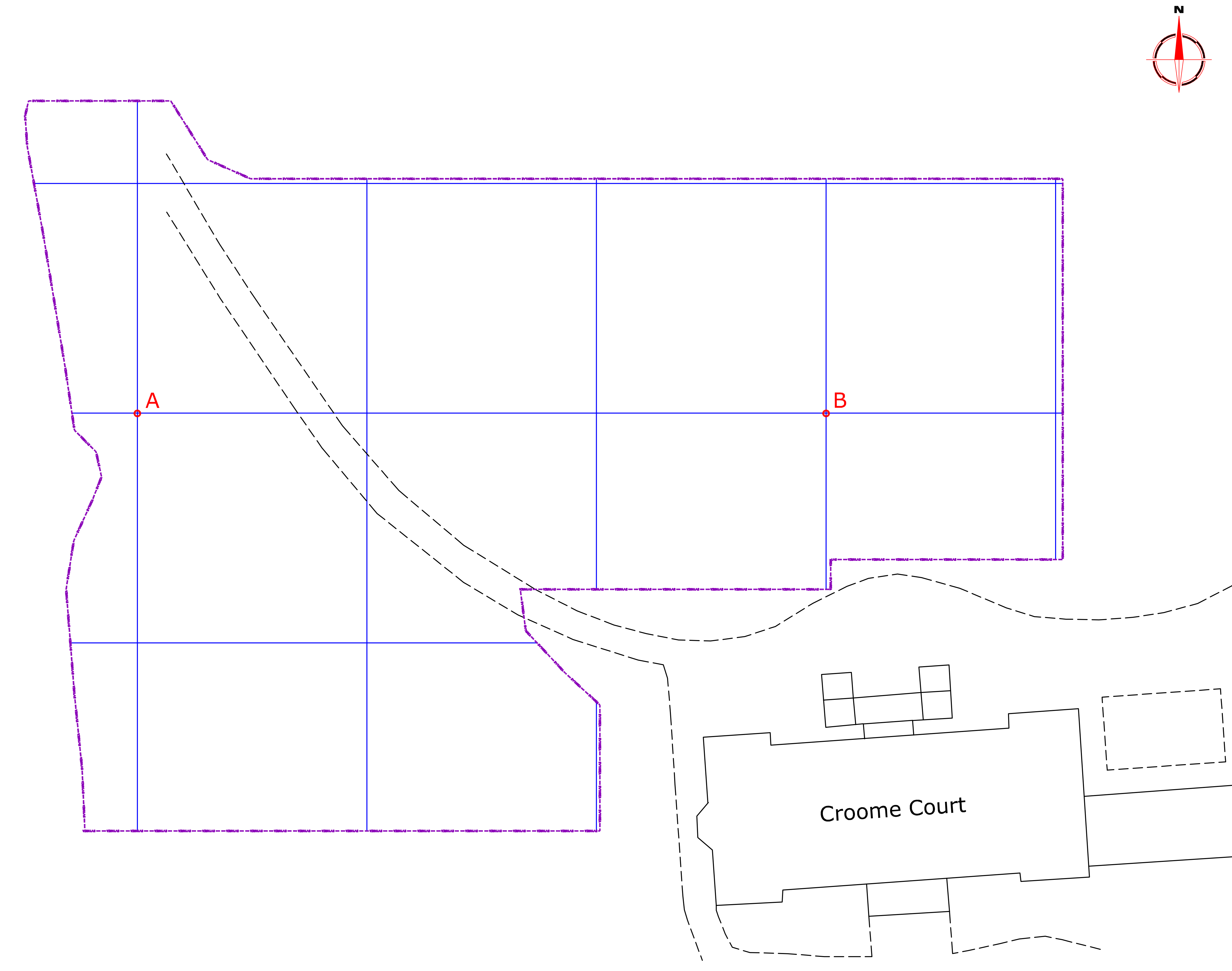
SUMO GROUP MEMBER

Scale 1:600 — 0m 4 8 12 16 20m

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	**Drawn by**	**Figure No.**
MARCH 15	MU	08



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

KEY

	Survey area
	Survey grid

OS GRID REFERENCES

A	388385.92, 244650.30
B	388475.92, 244650.30

Client
FRIENDS OF CROOME

Project Title — Job No. 8069
CROOME OLD CHURCH

Subject
GRADIOMETER SURVEY - LOCATION OF SURVEY GRIDS AND REFERENCING

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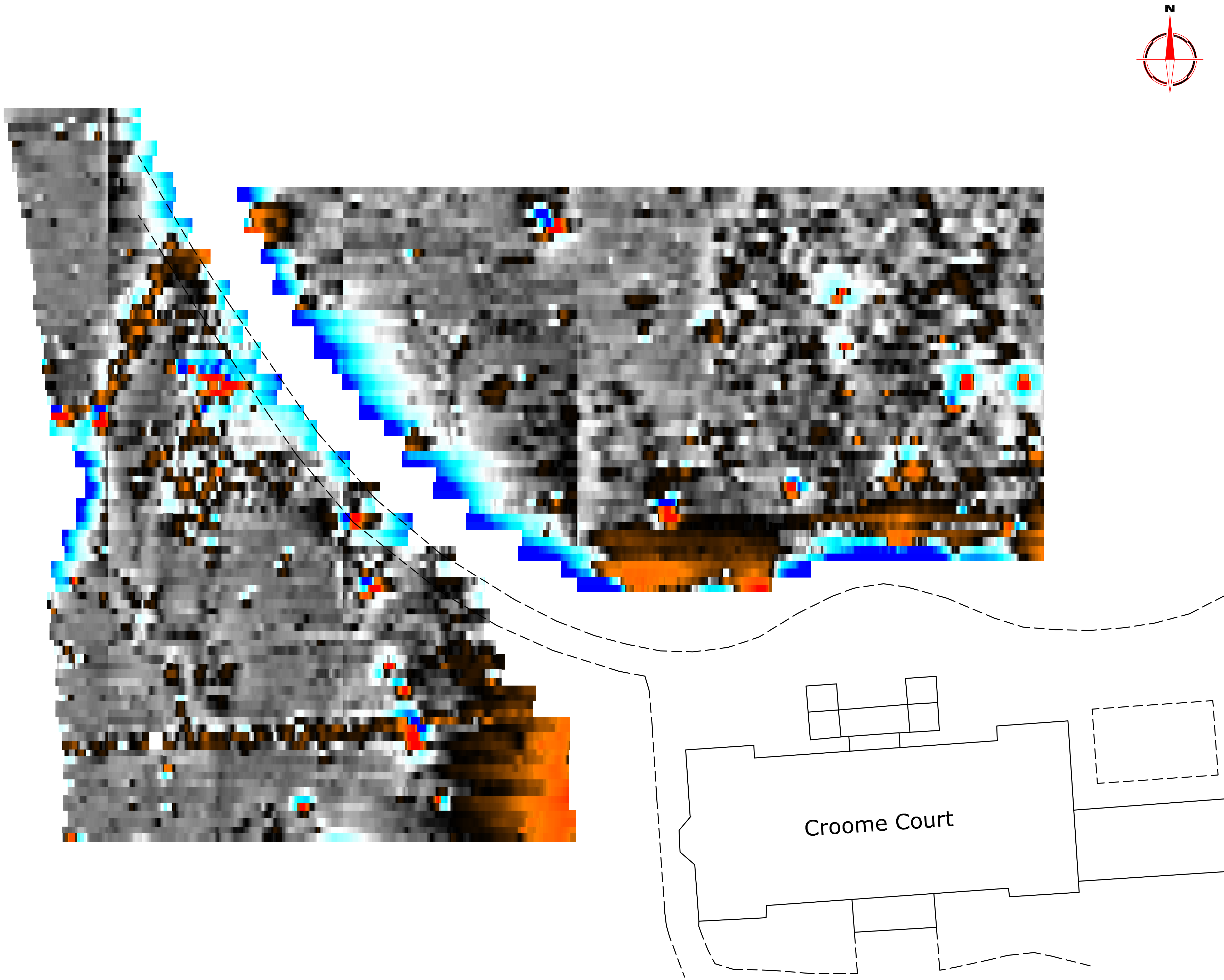
Scale 1:500 (0m, 5, 10, 15, 20, 25m)

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	**Drawn by**	**Figure No.**
MARCH 15	MU	09



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters

Maximum +100nT (red)
Minimum -100nT (blue)

+100nT
+25nT
+3nT
-3nT
-25nT
-100nT

Client
FRIENDS OF CROOME

Project Title
CROOME OLD CHURCH

Job No. 8069

Subject
COLOUR PLOT OF GRADIOMETER DATA SHOWING EXTREME VALUES

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SUMO GROUP MEMBER

Scale 1:500 (0m, 5, 10, 15, 20, 25m)

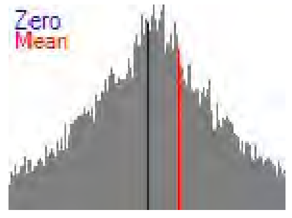
Plot	Checked by	Issue No.
A3	PPB	01
Survey date	**Drawn by**	**Figure No.**
MARCH 15	TR	10

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters

Maximum +2nT (black)
Minimum -2nT (white)



Client

FRIENDS OF CROOME

Project Title — Job No. 8069

CROOME OLD CHURCH

Subject

PLOT OF MINIMALLY PROCESSED GRADIOMETER DATA

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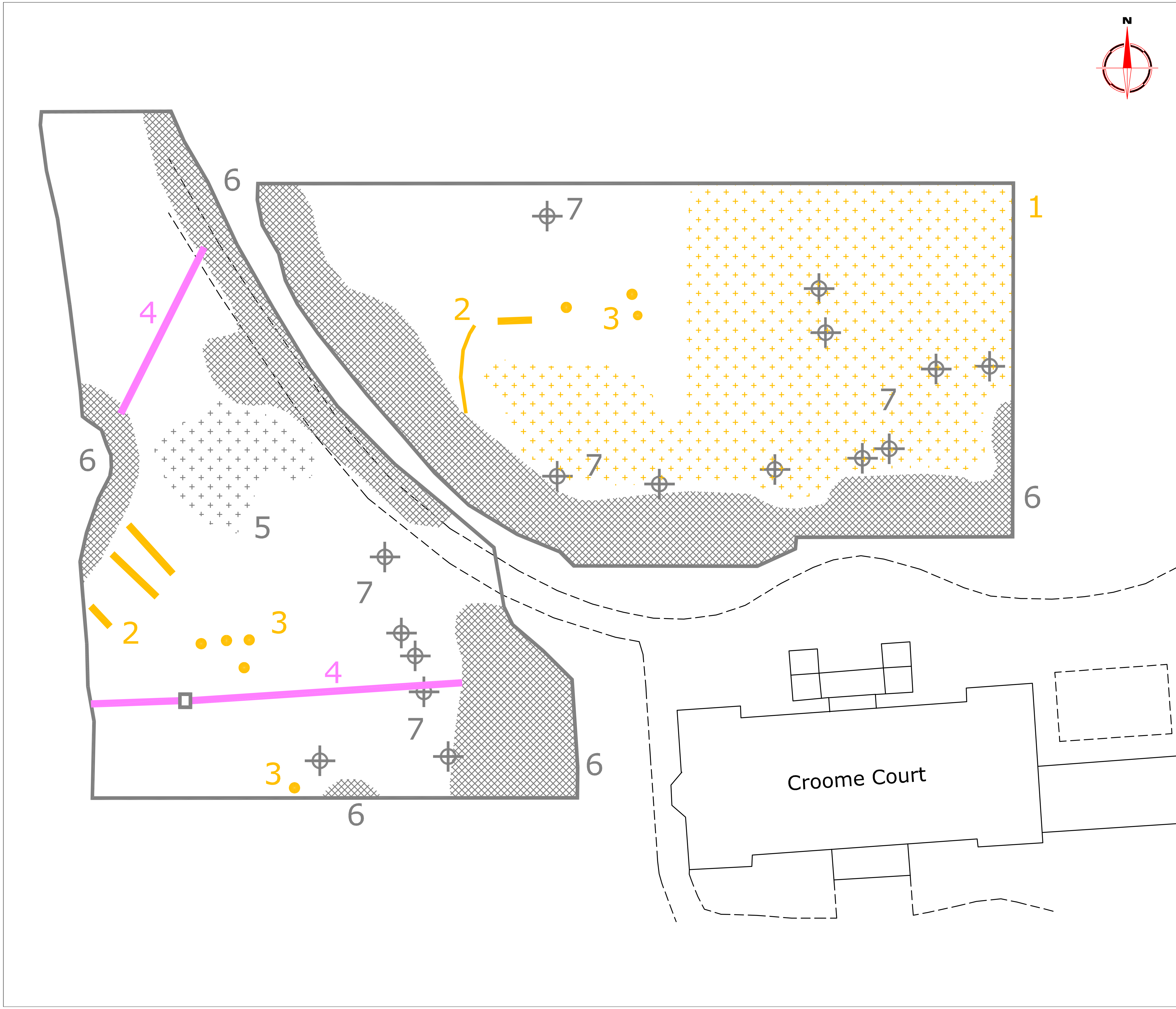
SUMO GROUP MEMBER

Scale 1:500 — 0m 5 10 15 20 25m

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	**Drawn by**	**Figure No.**
MARCH 15	TR	11



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

PROBABLE ARCHAEOLOGY

- Positive anomaly / weak positive anomaly - probable cut feature of archaeological origin
- Negative anomaly / weak negative anomaly - probable bank or earthwork of archaeological origin

POSSIBLE ARCHAEOLOGY

- Positive anomaly / weak positive anomaly - possible cut feature of archaeological origin
- Negative anomaly / weak negative anomaly - possible bank or earthwork of archaeological origin
- 'Mottled' area of positive responses possibly related to landscaping

MEDIEVAL/POST-MEDIEVAL AGRICULTURE

- Widely spaced curving parallel linear anomalies - probably related to ridge-and-furrow
- Closely spaced parallel linear anomalies - probably related to agricultural activity such as ploughing
- Linear anomaly - related to a former field boundary present on available mapping

OTHER ANOMALIES

- Linear anomaly - probably related to pipe, cable or other modern service
- Linear anomaly - possibly related to land drain
- Magnetic disturbance associated with nearby metal object such as service or field boundary
- Strong magnetic debris - possible disturbed or made ground
- Scattered magnetic debris
- Area of amorphous magnetic variation - probable natural (e.g. geological or pedological) origin
- Magnetic spike - probable ferrous object

Client

FRIENDS OF CROOME

Project Title — Job No. 8069

CROOME OLD CHURCH

Subject

ABSTRACTION AND INTERPRETATION OF GRADIOMETER ANOMALIES

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Scale 1:500 (0m, 5, 10, 15, 20, 25m)

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	**Drawn by**	**Figure No.**
MARCH 15	TR	12