STRATASCAN

Geophysical Survey Report

Tregunnel Hill, Newquay

for

Exeter Archaeology

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1 SUMMARY OF RESULTS

Detailed magnetic survey, resistance survey and a ground penetrating radar survey were trialled over an area at Tregunnel Hill, Newquay. From these trial surveys a magnetic survey was chosen as the appropriate technique to carry out across the total area of c.3.87ha. The survey identified a number of anomalies possibly relating to former enclosure boundaries across the site as well as evidence for pits and ditches.

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned by Exeter Archaeology to undertake a geophysical survey at Tregunnel Hill, Newquay to assess the archaeological implications of a proposed development.

2.2 Site location

The site is located at Tregunnel Hill, Newquay at OS ref. SW 805 612.

2.3 Description of site

The survey area consists of approximately 3.87ha of elevated undulating pasture land. The underlying geology is Lower Devonian (British Geological Survey South Sheet, Fourth Edition Solid, 2001). The soils of the area are Powys soils; they are shallow well drained loamy soils which lie over rock, with some bare rock locally (Soil Survey of England and Wales, Sheet 5 South West England).

2.4 Site history and archaeological potential

The archaeological assessment by Exeter Archaeology (2008) describes the site as being located in an area with high potential for later prehistoric archaeology. The remains of a terraced Middle Bronze Age settlement and an Iron Age cemetery have been identified by previous excavations 200m to the west, and part of an Iron Age and Romano-British settlement has been excavated a similar distance to the north west.

A pilot geophysical survey was undertaken by Geophysical Surveys of Bradford (GSB Prospection) on part of the site in 1998. This survey (which is cited in Exeter Archaeology, 2008) identified linear features which were interpreted as possible former field boundaries.

2.5 Survey objectives

The objective of the survey was to locate any anomalies that may relate to archaeological features, in particular to attempt to identify evidence for any continuation of the terracing or the Iron Age cemetery discovered nearby.

2.6 Survey methods

Trial surveys of both detailed magnetometry and earth resistance were carried out over an area of 3300m² and a further trial using ground penetrating radar was carried out over part of the above area totalling some 2000m². From these trial surveys magnetometry was chosen as the appropriate technique to carry out across a total area of c.3.87ha. More information regarding these techniques is included in the Methodology section below.

3 METHODOLOGY

3.1 Date of fieldwork

The fieldwork was carried out over 5 days from the 28th January to 1st February 2008 when the weather was fine and dry.

3.2 Grid locations

The location of the survey grids has been plotted in Figure 2 together with the referencing information.

3.3 Description of techniques and equipment configurations

3.3.1 Magnetic Gradiometry

Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.2 nanoTesla (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 sensor has a 1m separation between the sensing elements so enhancing the response to weak anomalies.

3.3.2 Earth Resistance

This method relies on the relative inability of soils (and objects within the soil) to conduct an electrical current, which is passed through them. As resistivity is linked to moisture content, and therefore porosity, hard dense features such as rock will give a relatively high resistivity response, while features such as a ditch which retains moisture give a relatively low response.

The resistance meter used was an RM15 manufactured by Geoscan Research incorporating a multiplexer MPX15 with a mobile Twin Probe Array. The Twin Probes are separated by 0.5m and the associated remote probes were positioned approximately 15m outside the grid. The instrument uses an automatic data logger, which permits the data to be recorded as the survey progresses for later downloading to a computer for processing and presentation.

3.3.3 Ground Probing Radar

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 (see 3.4.2 below).

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 Probing Impulse Radar used was an IDS MF (multi-frequency) radar system manufactured by Ingegneria Dei Sistemi (IDS), collecting both 200 and 600MHz data.

3.4 Sampling interval, depth of scan, resolution and data capture

3.4.1 Sampling interval

Magnetometer

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

Resistivity

The resistance survey was carried out with a 0.5m probe separation taking samples every 0.5m along traverses 0.5m apart. This equates to 3600 samples in a full 30x30m grid.

GPR
The survey was carried out using the MF central antenna only, collecting four parallel channels of 600MHz monostatic, 600Mhz cross polar, 200Mhz monostatic and 200Mhz cross polar within a bands 0.42m wide spaced 1m centres. This is shown on Figures 13&14 but note that the 600MHz monostatic and 600MHz cross polar are along the same line.

3.4.2 Depth of scan and resolution

Magnetometer
The Grad 601 has a typical depth of penetration of 0.5m to 1.0m. This would be increased if strongly magnetic objects have been buried in the site. The collection of data at 0.25m centres provides an appropriate methodology balancing cost and time with resolution.

Resistance
A probe spacing of 0.5m will give a typical depth of penetration of 0.5m to 1.0m.

GPR
The average velocity of the radar pulse is calculated to be 0.1m/ns, which is typical for the type of sub-soils on the site. The maximum depth of scan achieved was approximately 3m 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 600MHz antenna, which has a wavelength in the same material of 0.13m giving a theoretical resolution of 0.03m. A 900MHz antenna would give 0.09m and 0.02m respectively.

3.4.3 Data capture

Magnetometer
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 job, data is transferred to the office for processing and presentation.

Resistance
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 job, data is transferred to the office for processing and presentation.

GPR
Data is recorded directly onto a laptop on site. The data is later copied into a PC for processing and interpretation.

3.5 Processing, presentation of results and interpretation

3.5.1 Processing

Magnetometer
Processing is performed using specialist software known as *Geoplot 3*. 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. 'Despiking' is also performed to remove the anomalies resulting from small iron objects often found on agricultural land. 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 processed magnetometer data used in this report:

Zero mean traverse	*Last mean square fit = off*
Despike	*X radius = 1 Y radius = 1* *Threshold = 3 std. dev.* *Spike replacement = mean*

Resistivity
The processing was carried out using specialist software known as *Geoplot 3* and involved the 'despiking' of high contact resistance readings and the passing of the data though a low pass filter.

The following schedule shows the processing carried out on the processed resistance plots.

Despike	*X radius = 1 Y radius = 1* *Threshold = 3 std. dev.*

	Spike replacement = mean
Low pass filter	*X radius = 2* *Y radius = 2* *Weighting = Gaussian*
Interpolation	*x2 linear x & y*

GPR
An IDS 'Full Standard Process' was used to process the data. This process consists of;

Vertical band pass filter
Move start time
Background removal
Linear gain
Smoothed gain

3.5.2 Presentation of results and interpretation

Magnetometer
The presentation of the data for the survey involves a print-out of the raw data, both as grey scale (Figure 3) and trace plots (Figures 4&5), together with a grey scale plot of the processed data (Figure 6). Magnetic anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing for the site (Figure 7).

Resistance
The presentation of the data for the site involves print-outs of the raw data as a grey scale plot (Figure 8), together with grey scale plots of the processed data (Figure 9). Anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing (Figure 10).

GPR
Manual abstraction
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.

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 in order 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

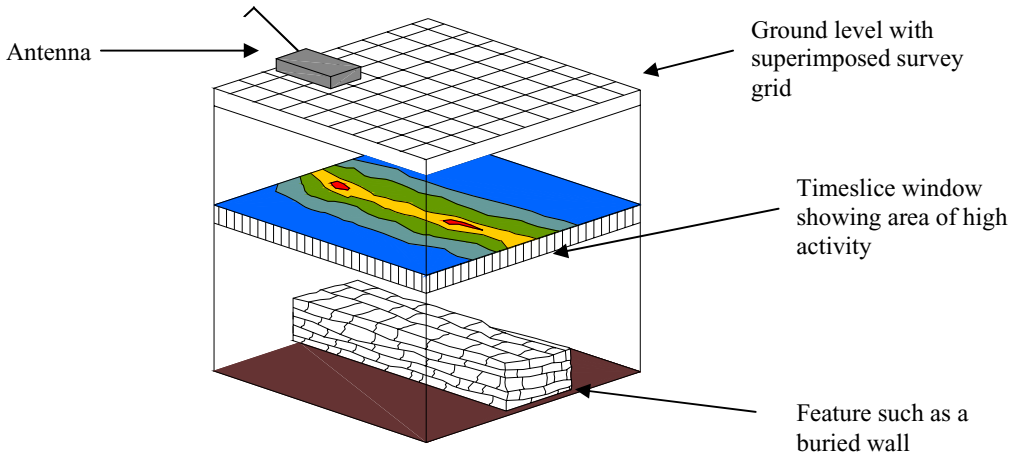
interface, which in turn may be associated with a marked change in material or moisture content.

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 4. 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.

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 (Figures 11 and 12). 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 that can be manipulated to view the data from any angle and at any depth within 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 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 and greens. The stronger reflections are represented by brighter colours such as light green, yellow, orange, red and white (see key provided in Figures 11 and 12).

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.

4 RESULTS

The trial survey employed all three techniques over the sample area in Plot C, and magnetometry and earth resistance in Plot D.

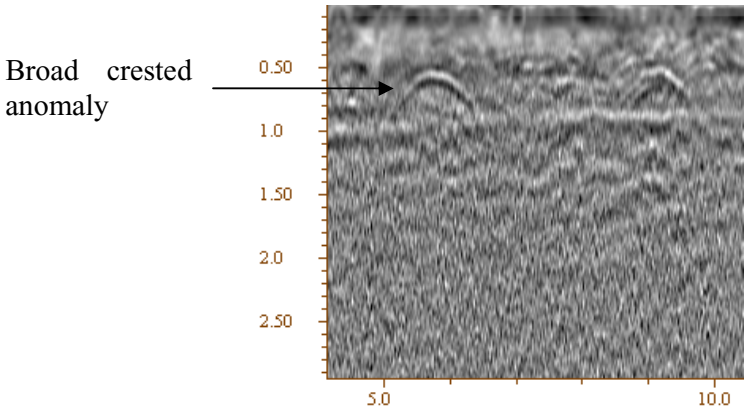
Trial Earth Resistance Survey

Plot C
The area shows a gradual change from high resistance in the north to low resistance in the south. This variation is likely to be a result of increasing depth to the underlying bedrock. A number of discrete low resistance anomalies are also seen across the area; these may represent cut features of archaeological origin, however these anomalies do not correlate with any noticeable anomaly in the radar data (Example Radargram 3).

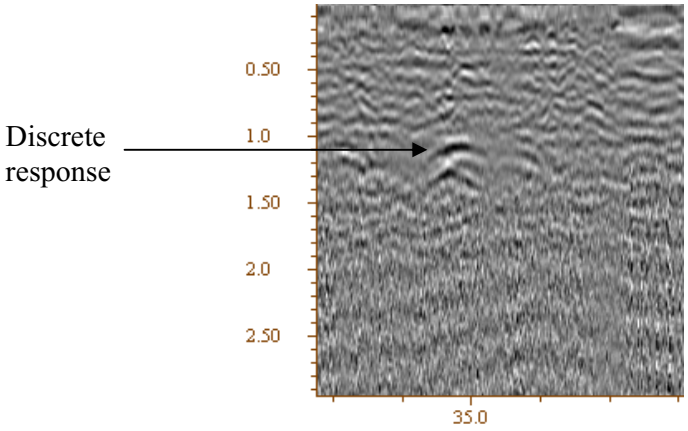
Plot D
The area shows a similar gradient, in this case from high resistance in the north west to low resistance in the south east. Again, this is likely to indicate increasing depth to the bedrock. It is interesting to note that the high resistance in the north west of the area is higher than that in the north of Plot C, and shows a marked discontinuity from the general trend. This may suggest a sudden change in ground conditions or bedrock depth between the two survey areas. Once again, a number of more localised anomalies may represent cut features of archaeological origin.

Trial Radar

The following two radiograms have been selected to demonstrate the type of anomalies seen in the radar data.

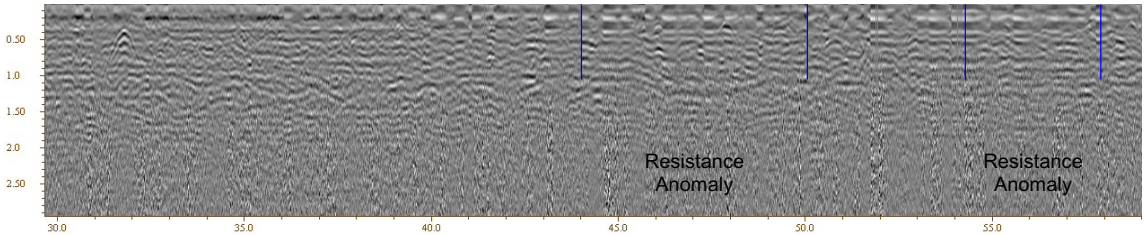


Example Radargram 1. Extract taken from traverse TAA20031, 4-10m (shown on Figure 13). Broad crested anomoly highlights.



Example Radargram 2. Extract taken from traverse LAA10072, 33-38m (shown on Figure 14). Discrete feature highlighted.

Strong discrete anomalies are observed across the survey area with the larger of these occurring in the south. These responses relate to possible buried objects. Both broad crested anomalies possibly relating to buried objects and broad crested and discrete responses possible evidence of structural remains or ground disturbance are also visible across the trial GPR survey area.



Example Radargram 3. Extract taken from traverse LAA10078, 30-59m. The traverse crosses two low resistance anomalies at 44-50m & 54-58m, as labelled. Neither of these anomalies nor the rock head is apparent in the radargram.

Magnetic Survey

The site contains a general scatter of magnetic debris; this is consistent with semi-urban use.

Plot A

The magnetic survey in Plot A showed generally high magnetic readings. The majority of the area is covered by areas of magnetic debris indicating possible ground disturbance. This correlates with the GSB scanning in 1998.

Plot B

Plot B included an area of previous geophysical survey and contained a significant number of positive area anomalies indicating cut features of possible archaeological origin. The greater part of these anomalies appears to be related to former enclosure boundaries. Negative area anomalies forming possible former earthworks can be seen in two groups within Plot B both associated with positive area anomalies. Three positive anomalies with associated negative response observed in the area are probably due to near surface ferrous material. A linear anomaly running in a north-east to south west direction is seen in Plot B and appears to relate to one of the positive anomalies with negative response. This anomaly is a probable pipe or service, possibly terminating in a valve or similar fitting. Areas of magnetic disturbance are also seen in Plot B and relate to nearby metallic objects such as a pipe or fence.

Plot C

Plot C also includes a significant number of positive area anomalies indicating cut features of possible archaeological origin. The majority of these features appear to be related to former enclosure boundaries; negative area anomalies are observed corresponding with these indicating possible former earthworks. Further positive area anomalies can be seen within Plot C including a large anomaly in the south-west that may be due to a large pit or pond. A possible thermoremnant feature is seen near the eastern margin, and may be worth investigating further. Two positive anomalies with associated negative response observed in the area are likely to be due to near surface ferrous material. Two linear anomalies running in a north-east to south west direction are observed in the north-west corner of Plot C and are probable pipes or services. The western most of these anomalies appears to be a continuation of the similar anomaly seen in Plot B. Several linear anomalies can be seen in the centre of Plot C and are

probably agricultural in origin. Areas of magnetic disturbance relate to nearby metallic objects such as a pipe or fence.

Plot D
Positive anomalies indicating cut features of possible archaeological origin were spread throughout Plot D. A single linear negative area anomaly is observed in the west of Plot D associated with a positive linear area anomaly and running in a north-east to south-west direction. These anomalies probably relate to a possible bank and ditch. Two possible thermoremnant features can be seen in the north of Plot D associated with nearby positive anomalies, and are worthy of further investigation. Agricultural marks can be seen running in a north-east to south-west direction. Four dipolar anomalies are observed probably due to ferrous objects. Areas of magnetic disturbance can also be seen associated with these.

5 CONCLUSION

In the geophysical survey carried out at Tregunnel Hill, Newquay the three techniques trialled were found to have little correlation in the location of anomlalies.

The trial resistance survey did not highlight many features that may be archaeological in origin although in Plot C generally higher resistance readings occurred in the north of the survey suggesting a change in the geology or pedology from north to south. High resistance readings in Plot D may represent possible structural remains or compacted ground.

In the GPR data the main anomalies observed were discrete or broad crested anomalies occurring across the trial area. These anomalies may represent buried objects, structural remains or compacted ground. However, the spread of these anomalies makes interpretation difficult.

Of the three techniques trialled, the magnetic survey was the most successful at identifying potential archaeological features and the technique was therefore used for the full survey. Cut features and earthworks of possible archaeological origin were observed across the survey area. The majority of these features look as though they may be former enclosure boundaries. Other cut features occur across the site indicating potential pits and ditches. Two thermoremnant features are seen in Plot D indicating areas of magnetic enhancement and may be associated with nearby cut features. Some evidence for agricultural activity is observed in Plot C and Plot D but no evidence for phasing could be seen in either. Areas of magnetic disturbance and debris may have obscured archaeological features within the survey. This was limited to the edges of the survey however and does not greatly impact on the results.

No obvious evidence of the Iron Age cemetery or the Bronze Age terracing is apparent within the survey data.

6 REFERENCES

British Geological Survey, 2001. *Geological Survey Ten Mile Map, South Sheet, Fourth Edition (Solid)*. British Geological Society.

Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 5 Southwest England*.

Exeter Archaeology 2008 *Archaeological Assessment of Land at Tregunnel Hill, Newquay, Cornwall* Exeter Archaeology

APPENDIX A – **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 *thermoremnant* 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.

Thermoremnance 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. Thermoremnant archaeological features can include hearths and kilns and material such as brick and tile may be magnetised through the same process.

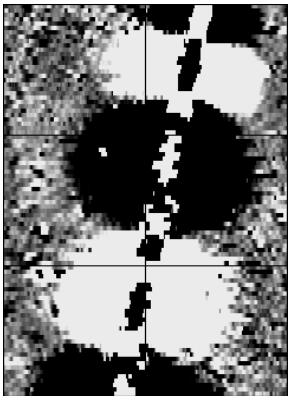
Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement 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 either 0.5 or 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.

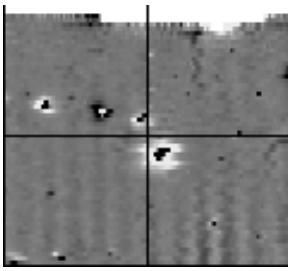
APPENDIX B – Glossary of magnetic anomalies

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

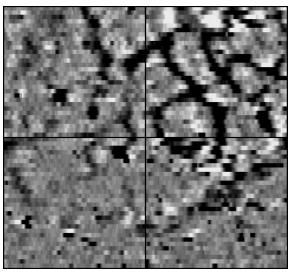


This consists of a single positive anomaly with an associated negative response. There should be no separation between the two polarities of response. These responses will be created by a single feature. The interpretation of the anomaly will depend on the magnitude of the magnetic measurements. A very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

Positive anomaly with associated negative response

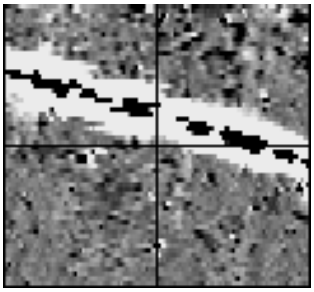
See bipolar and dipolar.

Positive linear



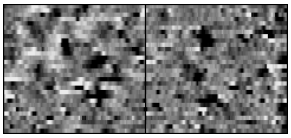
A linear response which is entirely positive in polarity. These are usually related to in filled cut features where the fill material is magnetically enhanced compared to the surrounding matrix. They can be caused by ditches of an archaeological origin, but also former field boundaries, ploughing activity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

Positive linear anomaly with associated negative response



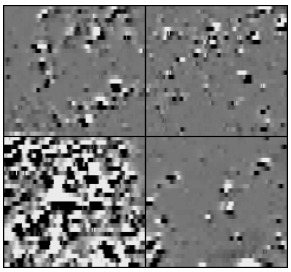
A positive linear anomaly which has a negative anomaly located adjacently. This will be cause by a single feature. In the example shown this is likely to be a single length of wire/cable probably relating to a modern service. Magnetically weaker responses may relate to earthwork style features and field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

Positive point/area



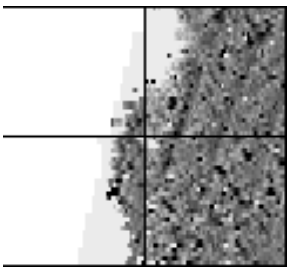
These are generally spatially small responses, perhaps covering just 3 or 4 reading nodes. They are entirely positive in polarity. Similar to positive linear anomalies they are generally caused by in filled cut features. These include pits of an archaeological origin, possible tree bowls or other naturally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

Magnetic debris



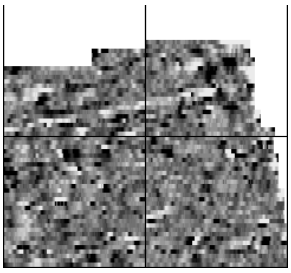
Magnetic debris consists of numerous dipolar responses spread over an area. If the amplitude of response is low (+/-3nT) then the origin is likely to represent general ground disturbance with no clear cause, it may be related to something as simple as an area of dug or mixed earth. A stronger anomaly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

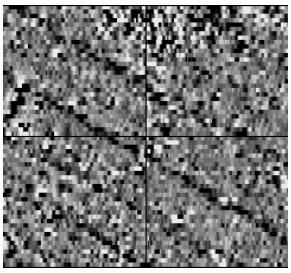


A linear response which is entirely negative in polarity. These are generally caused by earthen banks where material with a lower magnetic magnitude relative the background top soil is built up. See also ploughing activity.

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

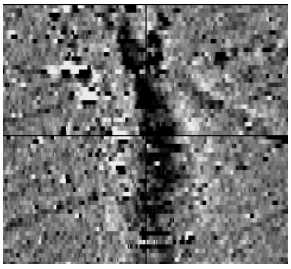
The amplitude of a magnetic response is an important factor in assigning an interpretation to a particular anomaly. For example a positive anomaly covering a $10m^2$ area may have values up to around 3000nT, in which case it is likely to be caused by modern magnetic interference. However, the same size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

Thermoremnant response

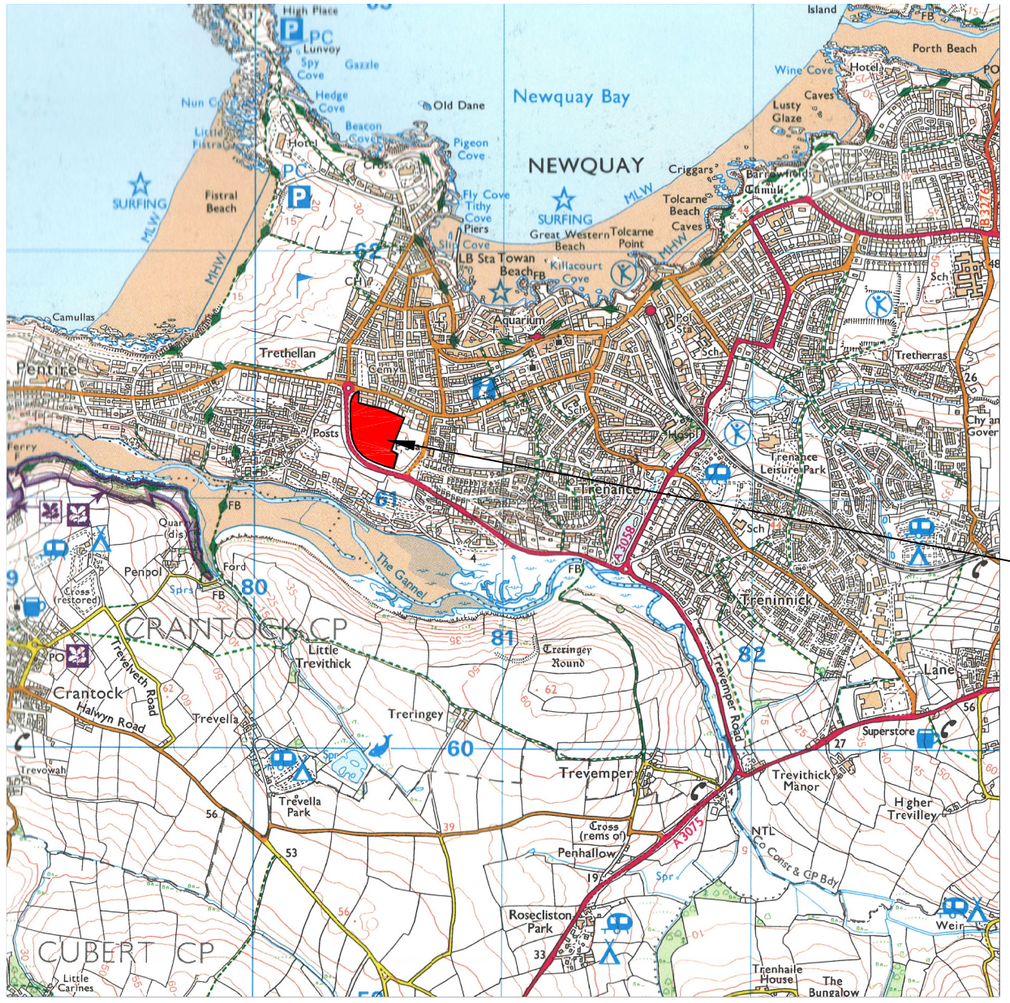
A feature which has been subject to heat may result in it acquiring a magnetic field. This can be anything up to approximately +/-100 nT in value. These features include clay fired drains, brick, bonfires, kilns, hearths and even pottery. If the heat application has occurred insitu (e.g. a kiln) then 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.



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Site centred on NGR SW 805 612

Client
EXETER ARCHAEOLOGY

Project Title — Job No. 2446
TREGUNNEL HILL, NEWQUAY

Subject
LOCATION PLAN OF SURVEY AREA

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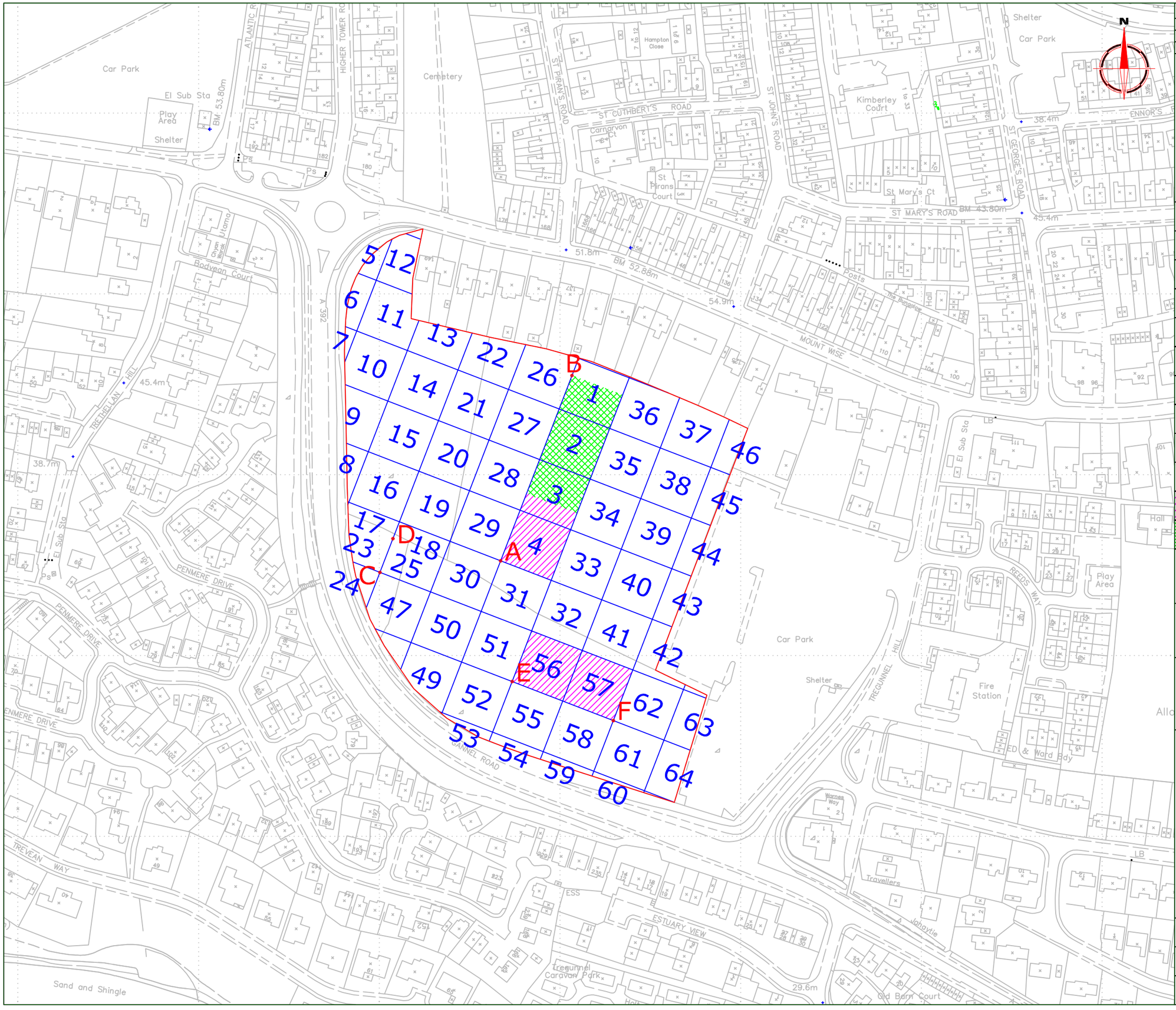
Scale 1:25000 (0m 500 1000m)

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	Drawn by	Figure No.
JAN 2008	JC	01



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

OS GRID REFERENCES

A	180466.6, 061252.4
B	180506.1, 061354.9
C	180403.2, 061231.1
D	180407.8, 062150.6
E	180473.0, 061185.7
F	180529.0, 061164.1
32	Grid Number
	Survey Grid
	Magnetic Gradiometry Survey
	Resistance Survey
	Resistance and GPR Survey

Client

EXETER ARCHAEOLOGY

Project Title — Job No. 2446

TREGUNNEL HILL, NEWQUAY

Subject

LOCATION AND REFERENCING OF SURVEY GRIDS

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Scale 1:2000 — 0m 20 40 60 80 100m

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	**Drawn by**	**Figure No.**
JAN 2008	JC	02

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters

Maximum +5nT (black)
Minimum -5nT (white)

-3SD +3SD

+5nT

-5nT

Client

EXETER ARCHAEOLOGY

Project Title — Job No. 2446

TREGUNNEL HILL, NEWQUAY

Subject

PLOT OF RAW GRADIOMETER DATA

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REGISTERED ORGANISATION IFA

Scale 1:1000 — 0m 10 20 30 40 50

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	Drawn by	Figure No.
JAN 2008	JC	03

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters

+40nT

(*Positive values displace above the trace line. Hidden values have not been plotted. Data clipped between -200 and 0nT*)

200nT
160nT
120nT
80nT
40nT
0nT

Client

EXETER ARCHAEOLOGY

Project Title — Job No. 2446

TREGUNNEL HILL, NEWQUAY

Subject

TRACE PLOT OF GRADIOMETER DATA SHOWING POSITIVE VALUES

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Scale 1:2000 — 0m 20 40 60 80 100m

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	**Drawn by**	**Figure No.**
JAN 2008	JC	04

Plotting parameters

-40nT

(*Negative values displace above the trace line. Hidden values have not been plotted*)

-200nT
-160nT
-120nT
-80nT
-40nT
0nT

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Client

EXETER ARCHAEOLOGY

Project Title — Job No. 2446

TREGUNNEL HILL, NEWQUAY

Subject

TRACE PLOT OF GRADIOMETER DATA SHOWING NEGATIVE VALUES

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Scale 1:2000 — 0m 20 40 60 80 100m

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	**Drawn by**	**Figure No.**
JAN 2008	JC	05

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters

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

-3SD +3SD

+2nT

-2nT

Client

EXETER ARCHAEOLOGY

Project Title — Job No. 2446

TREGUNNEL HILL, NEWQUAY

Subject

PLOT OF PROCESSED GRADIOMETER DATA

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Scale 1:1000 (0m 10 20 30 40 50)

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	Drawn by	Figure No.
JAN 2008	JC	06

Plot C

Plot B

Plot A

Plot D

A 392

GANNEL ROAD

PENMERE DRIVE

N

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

KEY

- Positive anomaly with associated negative response - ferrous object
- Agricultural mark
- Positive linear anomaly - cut feature of possible archaeological origin
- Positive area anomaly - cut feature of possible archaeological origin
- Weak positive area anomaly - cut feature of possible archaeological origin
- Negative linear anomaly - possible former earthwork
- Negative area anomaly - possible former earthwork or bank
- Weak negative area anomaly - possible former earthwork or bank
- Possible thermoremnant feature such as site of fire or hearth
- Area of magnetic disturbance- related to nearby metallic objects such as a pipe or fence
- Area of magnetic debris - evidence of ground disturbance
- Pipe or service

Client

EXETER ARCHAEOLOGY

Project Title — Job No. 2446

TREGUNNEL HILL, NEWQUAY

Subject

ABSTRACTION AND INTERPRETATION OF GRADIOMETER ANOMALIES

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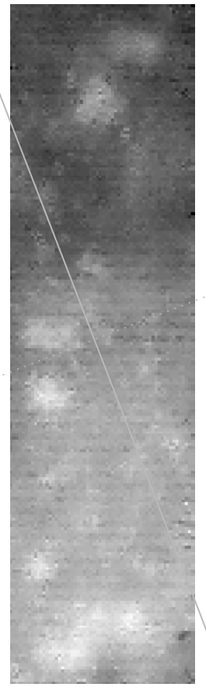
Scale 1:1000 — 0m 10 20 30 40 50

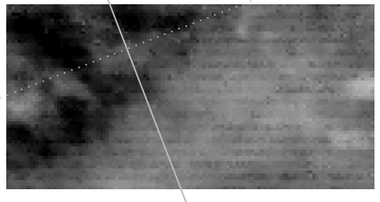
Plot	Checked by	Issue No.
A3	PPB	01
Survey date	Drawn by	Figure No.
JAN 2008	JC/RA	07

Plot C

Plot B



Plot A



Plot D

Car Park

Shelter

GANNEL ROAD

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters Plot C

Maximum +105Ω (black)
Minimum +65Ω (white)

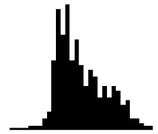
-3SD +3SD

+105Ω

+65Ω

Plotting parameters Plot D

Maximum +105Ω (black)
Minimum +65Ω (white)



-3SD +3SD

+105Ω

+65Ω

Client

EXETER ARCHAEOLOGY

Project Title Job No. 2446

TREGUNNEL HILL, NEWQUAY

Subject

PLOT OF 'DESPIKED' RAW RESISTANCE DATA

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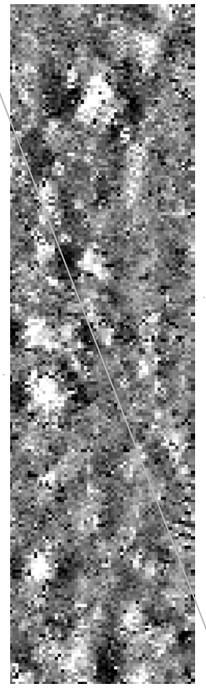
Scale 1:1000

0m 10 20 30 40 50

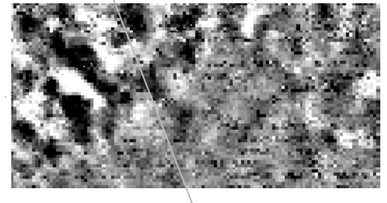
Plot	Checked by	Issue No.
A3	PPB	01
Survey date	**Drawn by**	**Figure No.**
JAN 2008	JC	08

Plot C

Plot B



Plot A



Plot D

Car Park

Shelter

GANNEL ROAD

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Plotting parameters Plot C

Maximum +3SD (black)
Minimum -3SD (white)

-3SD +3SD

+3SD

-3SD

Plotting parameters Plot D

Maximum +3SD (black)
Minimum -3SD (white)

-3SD +3SD

+3SD

-3SD

Client

EXETER ARCHAEOLOGY

Project Title Job No. 2446

TREGUNNEL HILL, NEWQUAY

Subject

PLOT OF PROCESSED
RESISTANCE DATA

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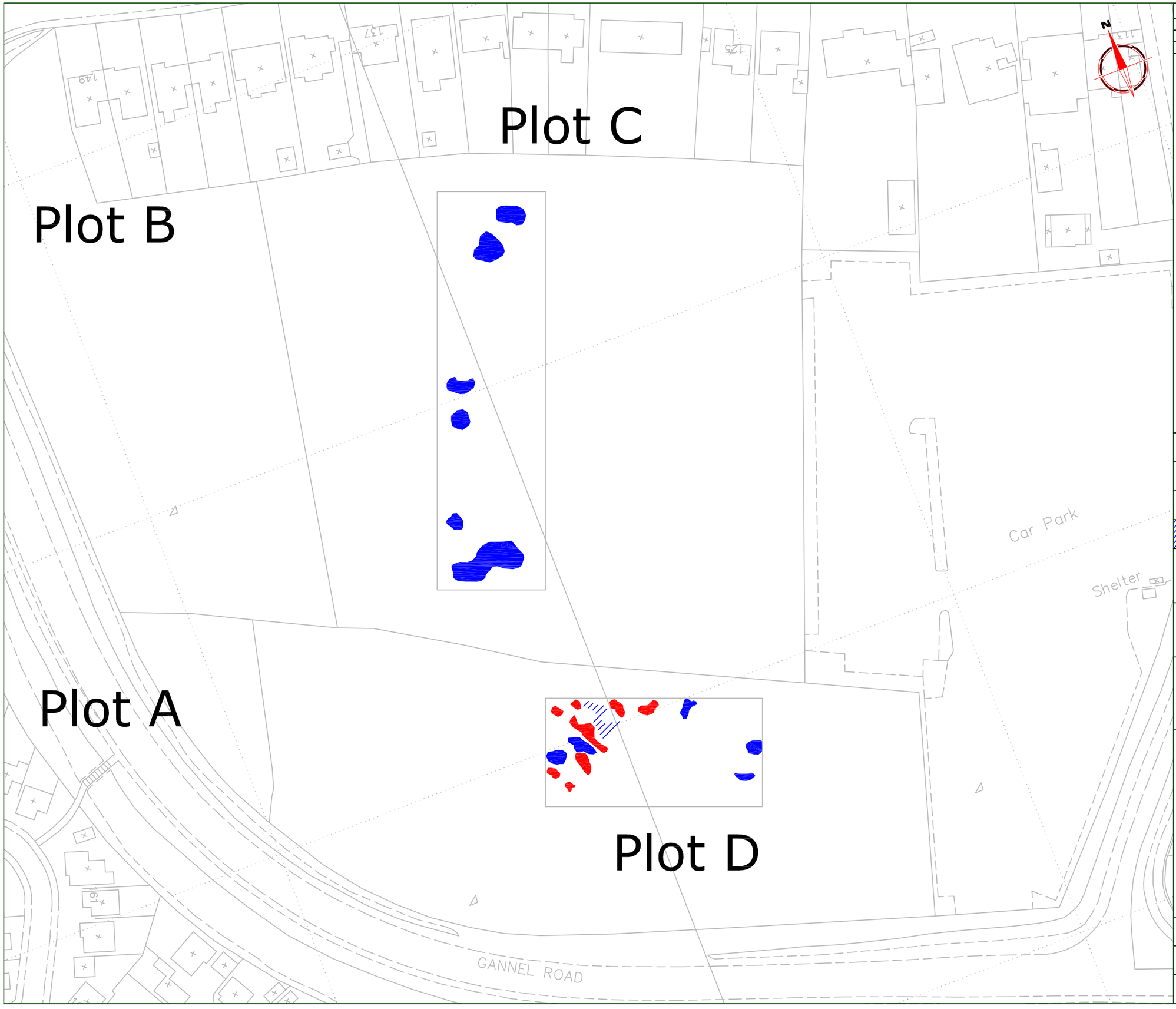
REGISTERED ORGANISATION IFA

Scale 1:1000 0m 10 20 30 40 50

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	Drawn by	Figure No.
JAN 2008	JC	09



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

KEY

	High resistance area anomaly - possible structural remains or compacted ground
	Low resistance area anomaly - possible cut feature
	Moderately low resistance area anomaly - possible cut feature

Client

EXETER ARCHAEOLOGY

Project Title — Job No. 2446

TREGUNNEL HILL, NEWQUAY

Subject

ABSTRACTION AND INTERPRETATION OF RESISTANCE ANOMALIES

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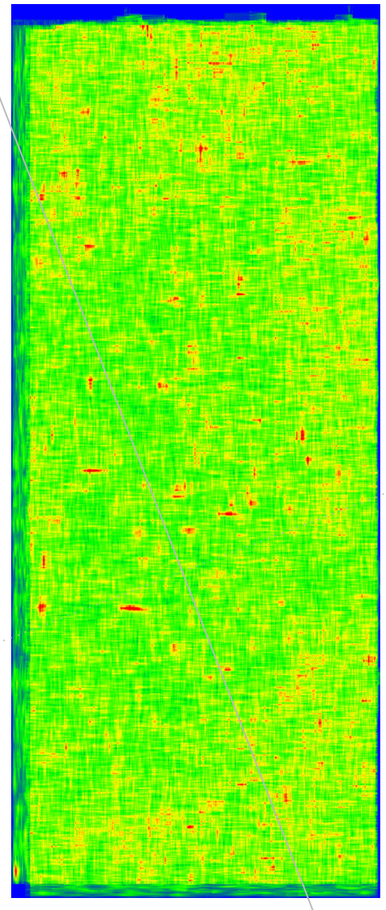
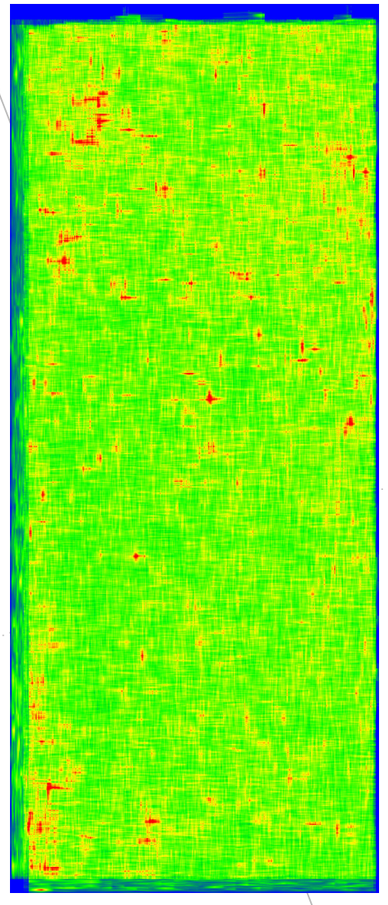
Scale 1:1000 (0m 10 20 30 40 50)

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	Drawn by	Figure No.
JAN 2008	RA	10

GPR TIMESLICE PLOT 0 - 0.5M



GPR TIMESLICE PLOT 0.5 - 1M



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Colour Scale for Timeslice 'Activity' Plots and Simplified Key

INCREASING

DECREASING

High Energy Return
-Possible Archaeological Target

Medium Energy Return
-Mixed Ground

Low Energy Return
-Homogenous Ground

Client

EXETER ARCHAEOLOGY

Project Title

TREGUNNEL HILL, NEWQUAY

Job No. 2446

Subject

GPR TIMESLICE PLOTS 0 - 1M

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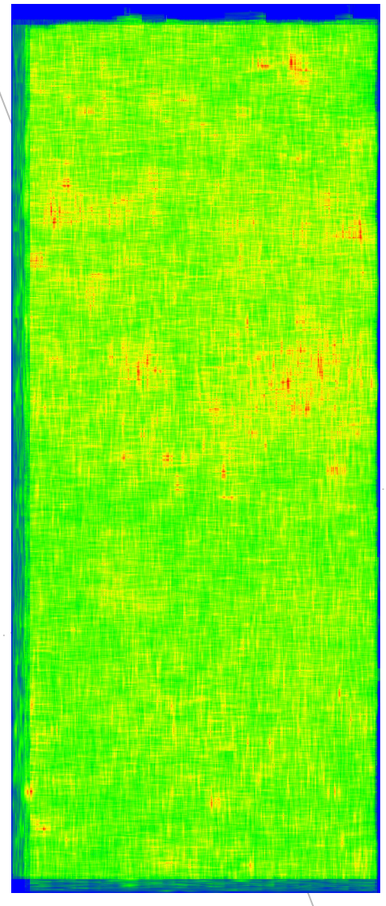
REGISTERED ORGANISATION IFA

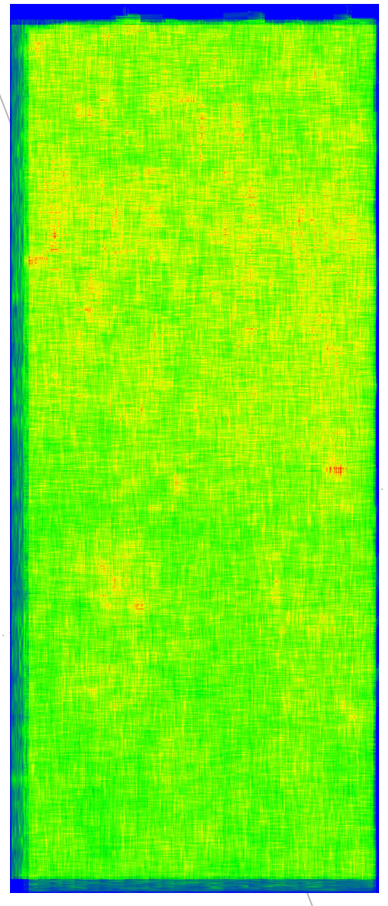
Scale 1:500 0m 5 10 15 20 25m

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	Drawn by	Figure No.
JAN 2008	JC	11

GPR TIMESLICE PLOT 1 - 1.5M



GPR TIMESLICE PLOT 1.5 - 2M



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Colour Scale for Timeslice 'Activity' Plots and Simplified Key

INCREASING

DECREASING

High Energy Return
-Possible Archaeological Target

Medium Energy Return
-Mixed Ground

Low Energy Return
-Homogenous Ground

Client

EXETER ARCHAEOLOGY

Project Title — Job No. 2446

TREGUNNEL HILL, NEWQUAY

Subject

GPR TIMESLICE PLOTS 0 - 1M

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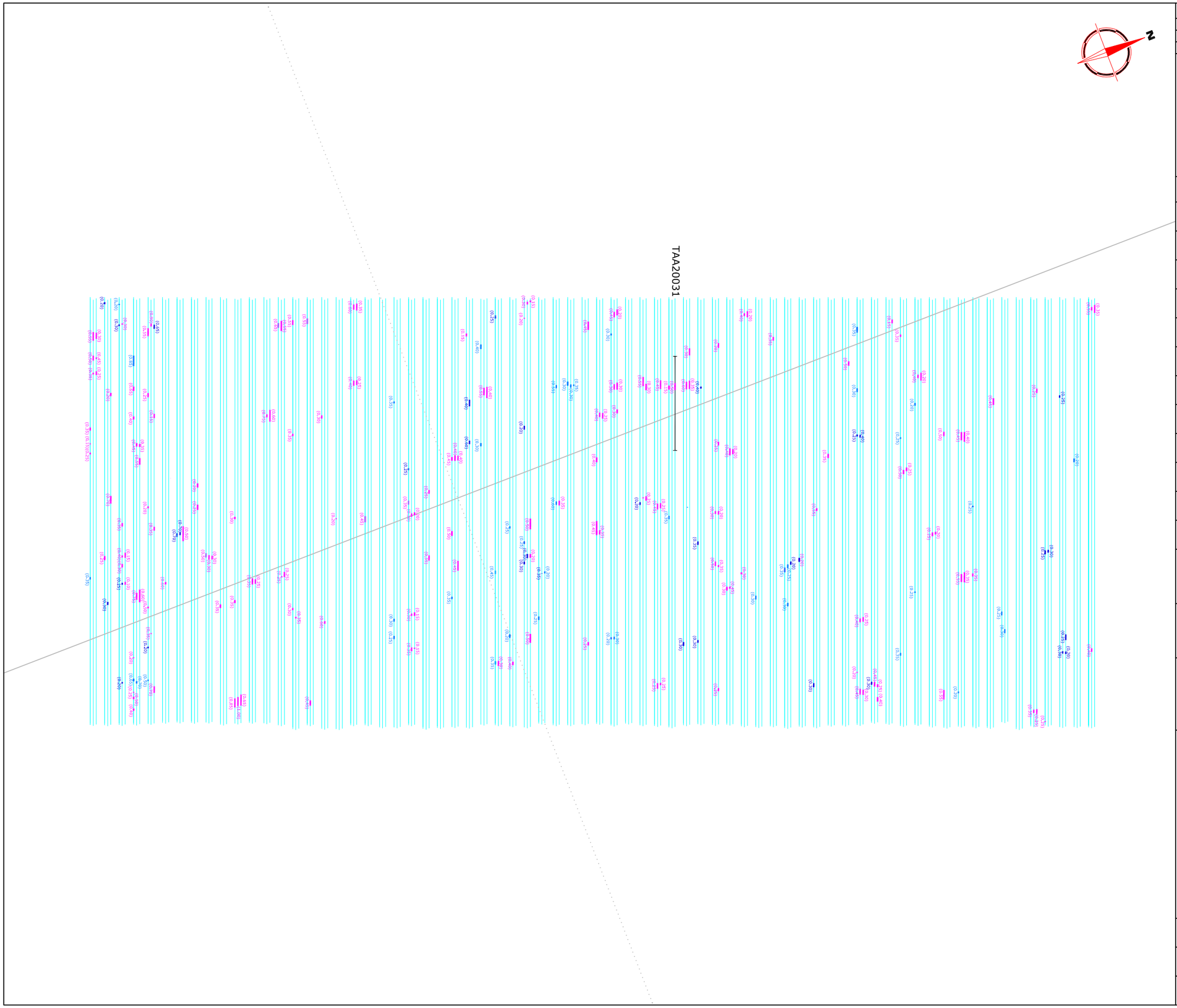
Scale 1:500 — 0m 5 10 15 20 25m

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	Drawn by	Figure No.
JAN 2008	JC	12



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

RADAR ABSTRACTION KEY

	Strong Discrete
	Weak Discrete
	Strong Complex
	Weak Complex
	Point Diffraction
	Broad Crested
	Strong Planar
	Weak Planar
	Focused Ringing
	Conductive Surface
	Inclined Event
0.25	Depth to top of feature [m]

Client

EXETER ARCHAEOLOGY

Project Title — Job No. 2446

TREGUNNEL HILL, NEWQUAY

Subject

GPR ABSTRACTION
E-W TRAVERSES

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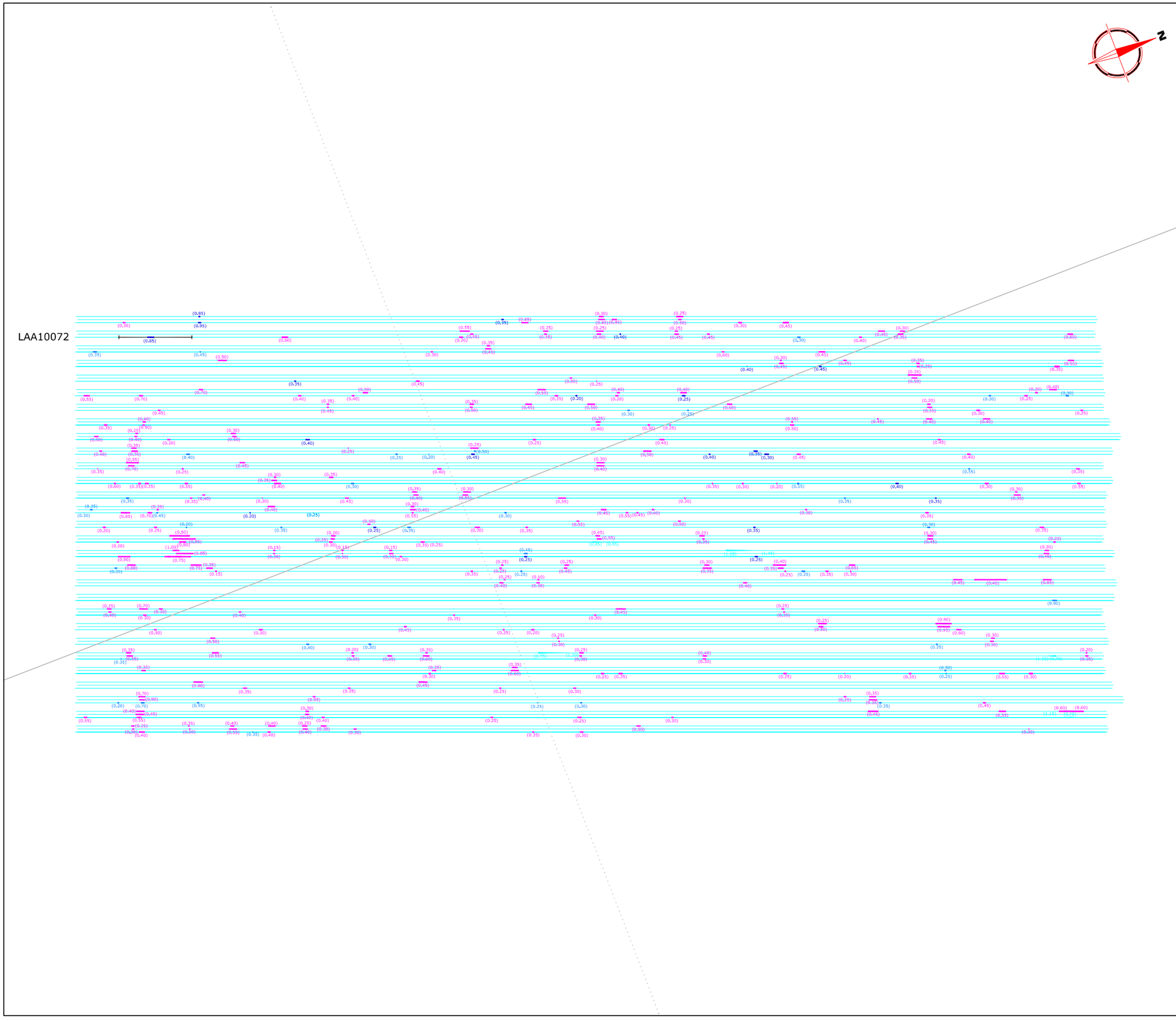
REGISTERED ORGANISATION IFA

Scale 1:250 — 0m 5 10m

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	Drawn by	Figure No.
JAN 2008	JC	13



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

RADAR ABSTRACTION KEY

	Strong Discrete
	Weak Discrete
	Strong Complex
	Weak Complex
	Point Diffraction
	Broad Crested
	Strong Planar
	Weak Planar
	Focused Ringing
	Conductive Surface
	Inclined Event
0.25	Depth to top of feature [m]

Client

EXETER ARCHAEOLOGY

Project Title — Job No. 2446

TREGUNNEL HILL, NEWQUAY

Subject

GPR ABSTRACTION
N-S TRAVERSES

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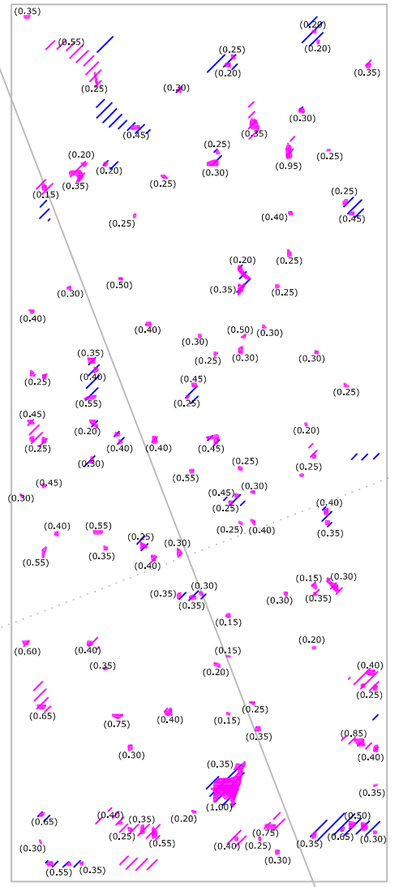
Scale 1:250 — 0m 5 10m

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	Drawn by	Figure No.
JAN 2008	JC	14



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

KEY

	Discrete area - possible buried object
	Broad crested and discrete responses - possible evidence of structural remains or ground disturbance
	Broad crested anomalies - possibly relating to buried objects
(0.25)	Depth to top of feature [m]

Client

EXETER ARCHAEOLOGY

Project Title — Job No. 2446

TREGUNNEL HILL, NEWQUAY

Subject

TRIAL GPR INTERPRETATION

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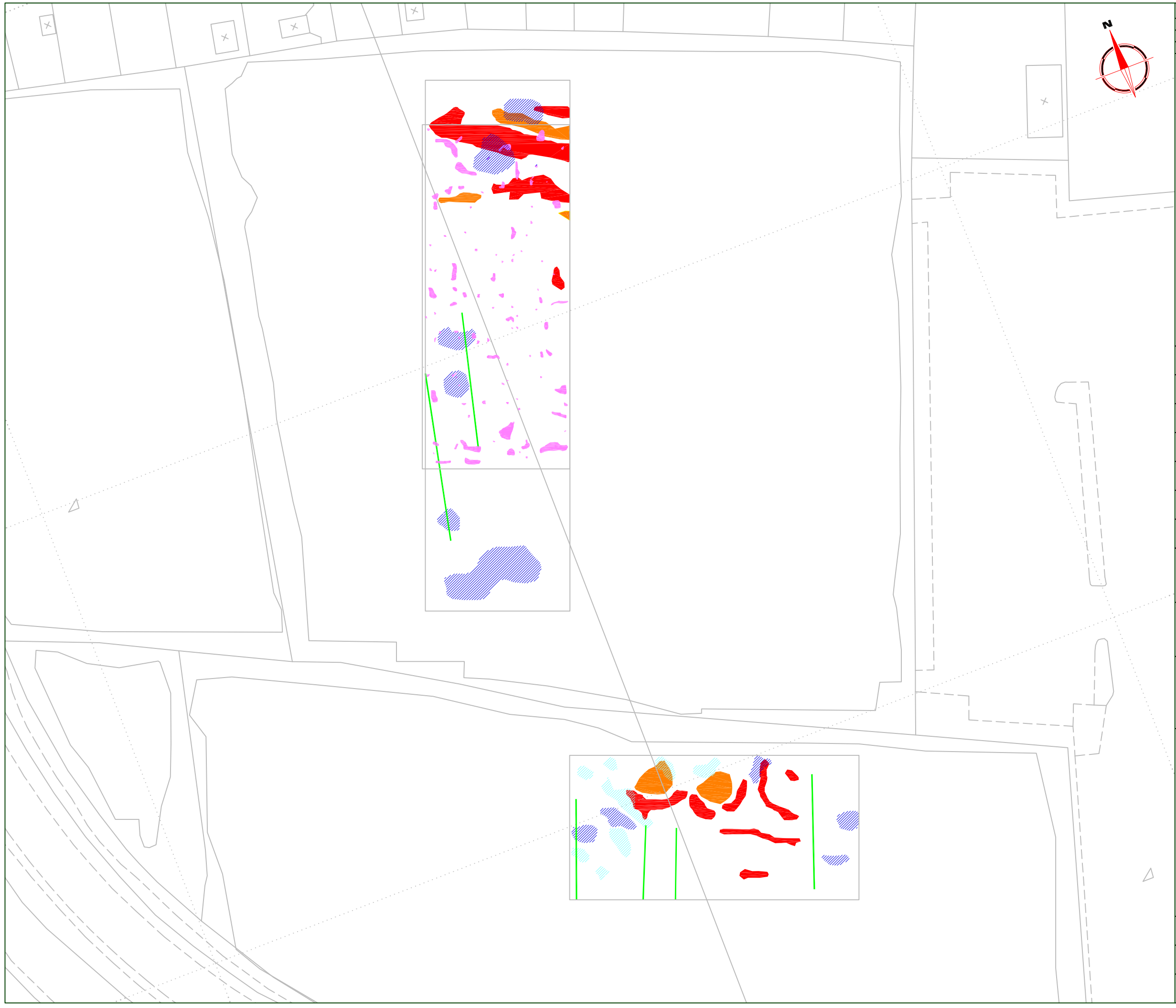
Scale 1:500 (0m 5 10 15 20 25m)

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	Drawn by	Figure No.
JAN 2008	JC	15



Amendments

Issue No.	Date	Description
-	-	-
-	-	-

KEY

	Positive magnetic anomaly - possible cut feature
	Negative magnetic anomaly - possible earthwork or bank
	Linear megnetic anamaly - agricultural mark
	Low resistance anomaly - possible cut feature
	High resistance anomaly - possible structural remains or compacted ground
	Discrete or broad-crested radar anomaly - possible buried object

Client

EXETER ARCHAEOLOGY

Project Title — Job No. 2446

TREGUNNEL HILL, NEWQUAY

Subject

COMBINED INTERPRETATION OF MAGNETIC, RESISTANCE AND RADAR ANOMOLIES

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Scale 1:750 — 0m 5 15 30m

Plot	Checked by	Issue No.
A3	PPB	01
Survey date	Drawn by	Figure No.
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