STRATASCAN

Geophysical Survey Report

Glapthorn Road, Oundle, Northamptonshire.

for

Archaeological Solutions

July 2011

Job ref.2919

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REGISTERED IfA ORGANISATION

Document Title:	**Geophysical Survey Report Glapthorn Road, Oundle, Northamptonshire.**
Client:	**Archaeological Solutions**
Stratascan Job No:	**J2919**
Techniques:	**Detailed magnetic survey (gradiometry)**
National Grid Ref:	**TL 035 889**

Plate 1 : View along southern boundary

Plate 2 : View along eastern boundary

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LIST OF FIGURES

1 SUMMARY OF RESULTS

A detailed gradiometry survey was conducted over 2.9 hectares of grassland at Glapthorn Road, Oundle and identified a number of possible archaeological cut features spread across the entire survey area with the majority present in the eastern half. The survey has also found evidence of a former cricket square, possible former sports/goal posts, magnetic spikes, magnetic debris and areas of magnetic disturbance associated with field boundaries and a service.

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned to undertake a geophysical survey of an area outlined for development. This survey forms part of an archaeological investigation being undertaken by Archaeological Solutions.

2.2 Site location

The site is located at OS ref. TL 035 889, with Hillfield Road to the north and west of the survey area and Glapthorn Road to the east which is on the north western side of Oundle village in Northamptonshire.

2.3 Description of site

The survey area is approximately 2.9ha of generally flat grassland with hedgerows to the north, south and east and a small area of woodland to the west.

2.4 Geology and soils

The site is divided into two separate types of geology, the eastern half being Limestone and the western half Clay formations. No drift geology is present within the area. (http://maps.bgs.ac.uk/geologyviewer_google/googleviewer.html).

No details of the overlying soils have been recorded due to the urban nature of the site (Soil Survey of England and Wales, Sheet 04, Eastern England).

2.5 Site history and archaeological potential

No specific details were available to Stratascan.

2.6 Survey objectives

The objective of the survey was to locate any features of possible archaeological significance in order that they may be assessed prior to development.

2.7 Survey methods

Detailed magnetic survey (gradiometry) was used as an efficient and effective method of locating archaeological anomalies. More information regarding this technique is included in the Methodology section below.

3 METHODOLOGY

3.1 Date of fieldwork

The fieldwork was carried out on 27th July 2011. Weather conditions during the survey were dry and overcast.

3.2 Grid locations

The location of the survey grids has been plotted in Figure 2 together with the referencing information. Grids were set out using 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.

3.3 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.

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

3.4.1 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.

3.4.2 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.

3.4.3 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.

3.5 Processing, presentation of results and interpretation

3.5.1 Processing

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 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)

Following this minimal processing, an interpolation process was applied to the processed data (Figure 5).

3. *Interpolation* (Enhances the data by increasing the number of points displayed and has the effect of smoothing the data set).

3.5.2 Presentation of results and interpretation

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 (Figure 03), together with a greyscale plot of the processed data (Figure 04). Magnetic anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing for the site (Figure 05).

4 RESULTS

The following list of numbered headings refer to anomaly labels on the interpretation plots (Figures 05).

No probable archaeological features have been identified within the survey area.

Possible Archaeology

1. A number of positive linear anomalies representing cut features of a possible archaeological origin. These features are evident across the majority of the survey area with the largest concentration within the east of the site.

2. A number of amorphous area anomalies, possibly associated with archaeological cut features, are evident within the eastern half of the site. These features lack any recognisable shapes or formations so may be of a different origin.

3. A significant number of discrete positive anomalies, representing possible archaeological pits, are scattered across the field. The largest concentration of these features is evident in the eastern half of the site.

4. A number of magnetic 'spikes' (strong focussed values with associated antipolar response) indicate ferrous metal objects. Although most of these are likely to be modern rubbish, some may be of archaeological interest. Particular attention may be paid to those found in association with other potentially archaeological anomalies.

Other Anomalies

5. 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.

6. A number of strong magnetic responses, which are possibly associated with former sporting equipment, such as goal posts, are evident within the survey area.

7. A large square area of moderately strong magnetic responses, probably associated with a former cricket square, is evident within the centre of the field.

5 CONCLUSION

The geophysical survey has identified a number of possible archaeological features across the area in the form of cut features and possible pits. The majority of these features are within the Limestone in the east of the site and some may therefore be geological in origin. Further investigations of these features are recommended to determine their true origins.

Former sporting features, such as a cricket square and possible sports/goal posts, are evident around the survey area. Magnetic disturbance, a small area of magnetic debris and a number of magnetic spikes are also evident within the site.

6 REFERENCES

British Geological Survey, n.d., *website* (http://maps.bgs.ac.uk/geologyviewer_google/googleviewer.html)

Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 04 Eastern England.*

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 *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.

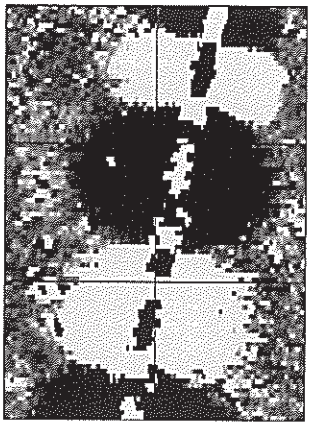
Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement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

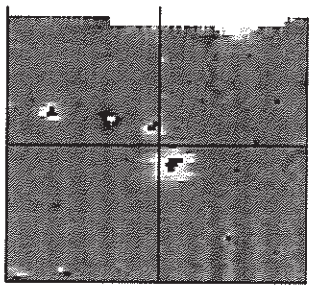
APPENDIX B – Glossary of magnetic anomalies

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

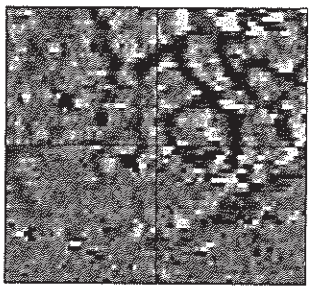


This consists of a single positive anomaly with an associated negative response. There should be no separation between the two polarities of response. These responses will be created by a single feature. The interpretation of the anomaly will depend on the magnitude of the magnetic measurements. A very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

Positive anomaly with associated negative response

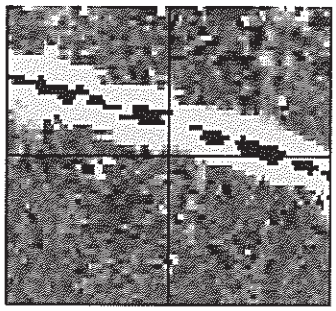
See bipolar and dipolar.

Positive linear



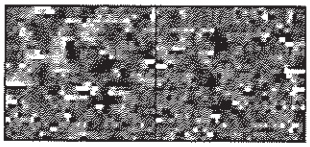
A linear response which is entirely positive in polarity. These are usually related to in-filled cut features where the fill material is magnetically enhanced compared to the surrounding matrix. They can be caused by ditches of an archaeological origin, but also former field boundaries, ploughing activity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

Positive linear anomaly with associated negative response



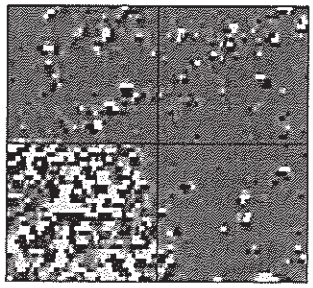
A positive linear anomaly which has a negative anomaly located adjacently. This will be caused by a single feature. In the example shown this is likely to be a single length of wire/cable probably relating to a modern service. Magnetically weaker responses may relate to earthwork style features and field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

Positive point/area



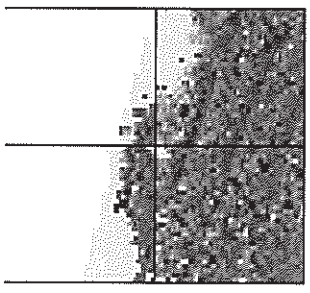
These are generally spatially small responses, perhaps covering just 3 or 4 reading nodes. They are entirely positive in polarity. Similar to positive linear anomalies they are generally caused by in-filled cut features. These include pits of an archaeological origin, possible tree bowls or other naturally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

Magnetic debris



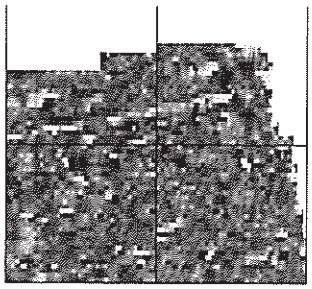
Magnetic debris consists of numerous dipolar responses spread over an area. If the amplitude of response is low (+/-3nT) then the origin is likely to represent general ground disturbance with no clear cause, it may be related to something as simple as an area of dug or mixed earth. A stronger anomaly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

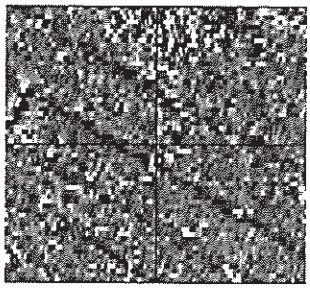


A linear response which is entirely negative in polarity. These are generally caused by earthen banks where material with a lower magnetic magnitude relative the background top soil is built up. See also ploughing activity.

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).

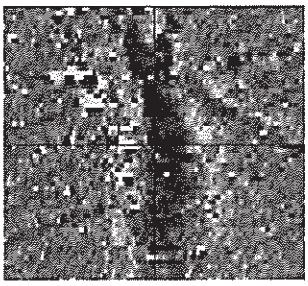
Strength of response

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.

N

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Site centred on NGR: TL 035 889

Client: ARCHAEOLOGICAL SOLUTIONS

Project Title: GEOPHYSICAL SURVEY - GLAPTHORNE ROAD, OUNDLE, NORTHAMPTONSHIRE

Job No. 2919

Subject: LOCATION PLAN OF SURVEY AREA

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REGISTERED ORGANISATION

Scale		
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Plot: A3	Checked by: PPB	Issue No.: 01
Survey date: JULY 11	Drawn by: SDH	Figure No.: 01

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

OS GRID REFERENCES	
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B	484526.08, 213575.43

Client

ARCHAEOLOGICAL SOLUTIONS

Project Title — Job No. 2919

GEOPHYSICAL SURVEY - GLAPTHORNE ROAD, OUNDLE, NORTHAMPTONSHIRE

Subject

LOCATION AND REFERENCING OF SURVEY GRIDS

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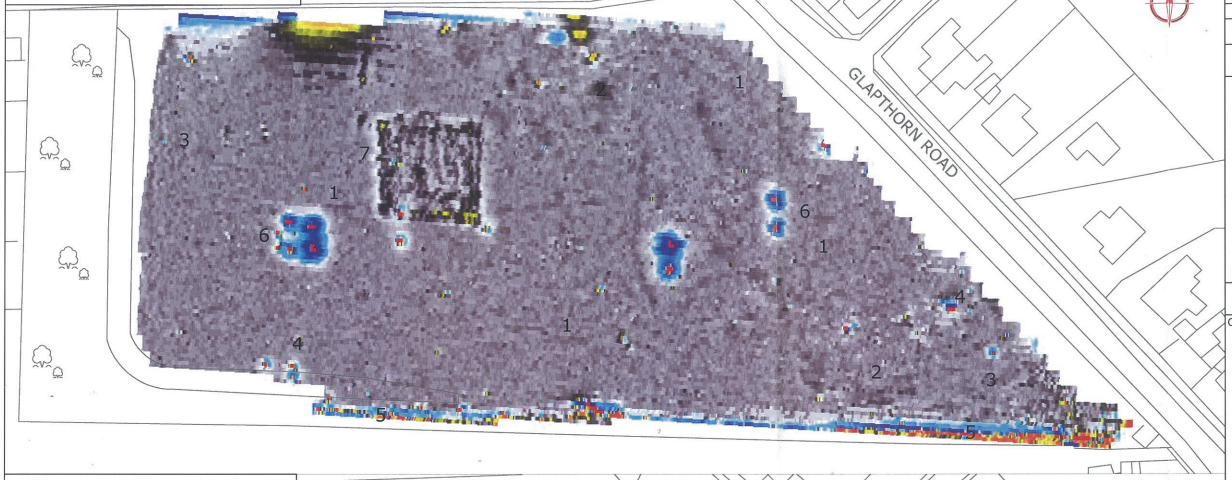
Plot	Checked by	Issue No.
A3	PPB	01
Survey date	Drawn by	Figure No.
JULY 11	SDH	02

COLOUR PLOT OF GRADIOMETER DATA SHOWING EXTREME VALUES



GREYSCALE PLOT OF MINIMALLY PROCESSED GRADIOMETER DATA

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

COLOUR PLOT

Plotting parameters

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

+100nT

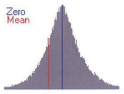
-100nT

GREYSCALE PLOT

Client

Plotting parameters

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



-3nT +3nT

+3nT

-3nT

Client

ARCHAEOLOGICAL SOLUTIONS

Project Title Job No. 2919

GEOPHYSICAL SURVEY - GLAPTHORNE ROAD, OUNDLE, NORTHAMPTONSHIRE

Subject

COLOUR AND GREYSCALE PLOTS OF MINIMALLY 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.
JULY 11	SDH	03

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

Client

Plotting parameters

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

Zero Mean

-2nT +2nT

+2nT

-2nT

Client

ARCHAEOLOGICAL SOLUTIONS

Project Title Job No. 2919

GEOPHYSICAL SURVEY - GLAPTHORNE ROAD, OUNDLE, NORTHAMPTONSHIRE

Subject

GREYSCALE PLOT OF PROCESSED GRADIOMETER DATA

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A3	PPB	01
Survey date	Drawn by	Figure No.
JULY 11	SDH	04

Amendments

Issue No.	Date	Description
-	-	-
-	-	-

KEY

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
- Moderate strength discrete anomaly - probable thermoremanent feature
- Widely spaced curving parallel linear anomalies - probably related to ridge-and-furrow

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
- Moderate strength discrete anomaly - possible thermoremanent feature
- Magnetic spike - probable ferrous object

OTHER ANOMALIES

- Closely spaced parallel linear anomalies - probably related to agricultural activity such as ploughing
- 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
- Scattered magnetic debris
- Moderately strong background magnetic disturbance - probably associated with a former cricket square
- Large magnetic spike - possibly associated with former sports equipment

Client

ARCHAEOLOGICAL SOLUTIONS

Project Title — Job No. 2919

GEOPHYSICAL SURVEY - GLAPTHORNE ROAD, OUNDLE, NORTHAMPTONSHIRE

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.**
JULY 11	SDH	05