SBES24

Swansea Battery Energy Storage System (BESS), Swansea

GEOPHYSICAL SURVEY REPORT

PLANNING REF. pre-application

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For DWD on behalf of Statkraft
11/02/2025

HEADLAND ARCHAEOLOGY

PROJECT INFORMATION:

PROJECT NAME	Swansea Battery Energy Storage System (BESS), Swansea
TYPE OF WORK	Geophysical Survey
PLANNING REF.	Pre-application
PARISH NO.	n/a
CONSULTANT/AGENT	DWD
CLIENT	Statkraft
PROJECT CODE	SBES24
NGR	NGR SN 264960 200913
PARISH	Mawr Community
LOCAL AUTHORITY	Swansea Council
FIELDWORK DATES	09/01/2025
OASIS REF.	
ARCHIVE REPOSITORY	Headland Archaeology

PROJECT TEAM:

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PROJECT SUMMARY

Headland Archaeology (UK) Ltd was commissioned by DWD (the Consultant) on behalf of Statkraft (the Client) to undertake a geophysical (magnetometer) survey on land south-east of the Swansea North Substation, Swansea where a new battery energy storage system (BESS) is proposed. This geophysical survey report will be submitted in support of any future planning application for the development. The results may also inform archaeological strategy, if required.

The survey has primarily recorded anomalies of natural, agricultural (recent cultivation) and modern activity. A single anomaly of uncertain origin, identified to the south of the proposed development area, is considered most likely to be due to modern or agricultural activity. No anomalies of a likely archaeological origin have been recorded by the survey.

The broadly receptive nature of the geology allied with the magnitude and resolution of the recorded anomalies indicates that there was likely sufficient magnetic contrast, for the detection of sub-surface archaeological features, if present. It is therefore considered that the results of the survey provide a good indication of the archaeological potential of the site which is therefore assessed as very low.

CRYNODEB O'R PROSIECT

Comisiynodd DWD (yr Ymgynhorwr) Headland Archaeology (UK) Ltd ar ran Statkraft (y Cleient) i ymgymryd arolwg geoffisegol (magnetomedr) ar tir i yr de-ddwyrain o Swansea North Substation, Abertawe lle mae system storfa ynni batri newydd (BESS) yn cael ei cynnig. Bydd adroddiad arolwg geoffisegol hwn yn cael ei gyflwyno i gefnogi ynrhyw cais cynllyunio ar gyfer y datblygiad yn y dyfodol. Gall y caluniadau hyn hefyd cyfarwyddo strategaeth archeolegol yn y dwyfodol, os oes angen.

Yn bennaf, cofnododd yr arolwg anomaleddau o darddiad naturiol, amaethyddol (amaethyddu diweddar) a gweithgaredd modern. Un anomaledd o darddiad ansicr yn cael ei ystyried, yn mwyaf tebygol, i fod o ganlyiad o gweithgaredd modern neu amaethyddol. Ni cofnoddodd yr arolwg anomaleddau sydd yn tebygol o darddiad archeolegol.

Mae natur derbyniol y daeareg gyda maint a chydraniad yr anomeleddau yn arddangos cyferbyniad magnetig digonol ar gyfer datgelu nodweddion archeolegol isarwyeb, os yn bresennol. Am hyny, ystyrir bod canlyniadau yr arolwg yn rhoi arwydd da o yr potesial archaeolegol y safle sydd felly wedi ei asesu yn isel iawn.

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SWANSEA BATTERY ENERGY STORAGE SYSTEM (BESS), SWANSEA

GEOPHYSICAL SURVEY REPORT

1. INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by DWD (the Consultant) on behalf of Statkraft (the Client), to undertake a geophysical (magnetometer) survey south-east of the Swansea North Substation, Swansea where a new 100MW battery energy storage system (BESS) is proposed (Illus 1). This geophysical survey report will be submitted in support of any future planning application for the development. The results may also inform archaeological strategy, if required.

The survey was undertaken in accordance with the requirements of Planning Policy Wales 2024 (Edition 12, Ch.6 The Historic Environment), and with the Written Scheme of Investigation for Geophysical Survey (WSI) (Headland Archaeology 2025).

The WSI was produced to the standards laid down in the European Archaeological Council's guideline publication, EAC Guidelines for the Use of Geophysics in Archaeology (Europae Archaeologia Consilium 2016) and the Chartered Institute for Archaeologists' (CIfA) Standard and Guidance for Archaeological Geophysical Survey (CIfA 2020). The survey was carried out in line with the same best practice guidelines.

The survey was carried out on January 9th, 2025, and was completed the same day.

1.1. SITE LOCATION, TOPOGRAPHY AND LAND-USE

The proposed development area (PDA - site) is located north-west of the village of Cwmrhdyceirw, on the outskirts of Swansea, centred at NGR SN 264960 200913, and is approximately 6.4 hectares in area. It comprises parts or all of four pasture fields in a single block (Illus 2 and Illus 3). Approximately 2 hectares could not be surveyed due to construction activity (Illus 4). The PDA was subsequentially revised following completion of the survey the survey. The site is largely flat and uniform, ranging between 80m Above Ordnance Datum (AOD) and 84m AOD.

The site is bordered to the west by the Swansea North Substation and by other pasture fields to the east, south and north.

1.2. GEOLOGY AND SOILS

The solid bedrock geology underlying the site comprises mudstone, siltstone and sandstone of the Grovesend Formation, a sedimentary bedrock formed between 359.2 and 299 million years ago during the Carboniferous period.

Diamicton (Till) superficial deposits formed between 116 and 11.8 thousand years ago during the Quaternary period overlay the bedrock across all of the site (NERC 2025).

The soils are classified in Soilscape 6 and are described as freely draining, slightly acidic, loams (Cranfield University 2025).

2. ARCHAEOLOGICAL BACKGROUND

The archaeological background below is adapted from a Heritage Impact Assessment (HIA) produced for the proposed scheme (Headland Archaeology - 2025).

The HIA established that there are non-designated boundary field banks within the PDA and two designated historic assets within 1km of the PDA.

The nearest designated historic assets are the scheduled earthworks of Fforest Newydd, approximately 1.7km north-west of the site. This is a defensive oval enclosure that dates to the later prehistoric period.

An online search of available HER data (archwilio.org.uk) indicates that the nearest non-designated historic asset is a former manorial watermill, Llangyfelach, located approximately 1.7 km to the south-west, which dates to the medieval period. However, no remains have ever been found of this structure.

A rapid review of historic mapping suggests that the site has been agricultural in character since at least the 19th century, comprising a field system of four fields of pasture and marginal land.

3. AIMS, METHODOLOGY & PRESENTATION

3.1. AIMS AND OBJECTIVES

The principal objectives of the geophysical survey were to gather information to establish the presence/absence, character, and extent of any archaeological remains within the PDA, and thereby support any forthcoming planning application and inform any further investigation strategies.

The aims of the survey were:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified,
- to therefore determine the likely presence/absence and extent of any buried archaeological features, or other geophysical anomalies, and provide an interpretation, and
- to produce a comprehensive site archive and report.

3.2. METHODOLOGY

Magnetic survey methods rely on the ability of a variety of instruments to measure very small magnetic fields associated with buried archaeological remains. A feature such as a ditch, pit or kiln can act like a small magnet, or series of magnets, that produce distortions (anomalies) in the earth's magnetic field. In mapping these slight variations detailed plans of sites can be obtained, as buried features often produce reasonably characteristic anomaly shapes and strengths (Gaffney & Gater 2003). Further information on soil magnetism and the interpretation of magnetic anomalies is provided in Appendix 1.

Magnetometry is the most widely used geophysical survey technique in archaeology as it can quickly evaluate large areas and, under favourable conditions, identify a wide range of archaeological features including infilled cut features such as large pits, gullies and ditches, hearths, and areas of burning, and kilns and brick structures. It is therefore good at locating settlements of all periods, prehistoric field systems and enclosures, and areas of industrial or modern activity, amongst others. It is less successful in identifying smaller features such as post-holes and small pits (except when using a non-standard sampling interval), unenclosed (prehistoric) settlement sites and graves or burial grounds. However, magnetometry is by far the single most useful technique and was assessed as the best non-intrusive evaluation methodology for this site.

The survey was undertaken using a hand carried system comprising a four-sensor array deploying Sensys FGM650/10 sensors mounted at 1m intervals (1m traverse interval) onto a rigid frame. The system was programmed to take readings at a frequency of 100Hz (allowing for a 1-2cm sample interval) on roaming traverses (swaths) 4m apart. These readings were stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system was linked to a Leica GS18 Real Time Kinetic (RTK) differential Global Positioning System (dGPS) outputting in NMEA mode to ensure a high positional accuracy for each data point. MonMX (Sensys Ltd) software was used to collect and export the data.

3.3. DATA PRESENTATION AND TECHNICAL DETAIL

A general site location plan is shown in Illus 1 at a scale of 1:7,500. Illus 2 to Illus 4 inclusive are site condition photographs. Illus 5 shows the location and direction of the site condition photographs and unsurveyed areas at a scale of 1:2,500. Illus 6 to Illus 8 inclusive show the fully processed (greyscale) data, minimally processed (XY trace plot) data and the interpretative plan, also at a scale of 1:2,500.

Technical information on the equipment used, data processing and magnetic survey methodology is given in Appendix 1. Appendix 2 details the survey location information and Appendix 3 describes the composition and location of the site archive. Data

processing details are presented in Appendix 4. A copy of the OASIS entry (Online Access to the Index of Archaeological Investigations) is reproduced in Appendix 5.

The survey methodology, report and any recommendations comply with the Written Scheme of Investigation (Headland Archaeology 2025), and guidelines outlined by Europae Archaeologia Consilium (EAC 2016) and by the Chartered Institute for Archaeologists (CIfA 2020).

The illustrations in this report have been produced following analysis of the data in 'raw' (minimally processed) and processed formats and over a range of different display levels. All illustrations are presented to display and interpret the data to best effect. The interpretations are based on the experience and knowledge of Headland Archaeology management and reporting staff.

4. RESULTS & DISCUSSION

4.1. SITE CONDITIONS

Magnetometer survey is generally recommended over any sedimentary geology, but results can be variable over mudstone and sandstone bedrock geologies (English Heritage 2008; Table 4).

The magnetic background is largely homogenous. However, there are noted variations in F1 and F4 where broad, amorphous, curvilinear anomalies are recorded. These possibly align with changes in topography or could be due to variation within the superficial till deposits.

Against this magnetic background, anomalies of predominantly agricultural, modern, and geological origin have been recorded although a single anomaly of uncertain origin has also been identified.

The magnitude and resolution of the anomalies indicates that there was likely sufficient magnetic contrast, for the detection of sub-surface archaeological features, if present, notwithstanding the limitations of magnetometer survey to identify the types, sizes and period of archaeological features as described in Section 3.2.

Surface conditions were generally very good (Illus 2 to Illus 3) and consequently data quality was also good with only minimal post-processing required. An area of approximately 2 hectares could not be surveyed due to construction related activities (Illus 4).

The anomalies recorded by the survey are discussed below according to their interpreted origin.

4.2. ANOMALIES OF FERROUS AND MODERN ORIGIN

Ferrous anomalies, characterised as individual 'spikes', are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris is common on most sites, often being introduced into the topsoil during manuring or tipping/infilling. There is no obvious clustering of the 'spike' responses, so these anomalies are likely to be indicative of a random distribution of modern ferrous debris in the plough-soil.

A very high magnitude linear dipolar anomaly (Illus 8 – SP1) aligned broadly north-west to south- east in the southern corner of F3 and in F4 records the location of a buried service pipe.

A narrow band of highly magnetically enhanced anomalies recorded along the south-eastern edge of the survey area in F1 (Illus 8) corresponds with an area subjected to recent farming activity seen on recent satellite imagery (Google Earth 2025) and is probably caused by imported material used to create a track.

A small magnetically enhanced anomaly recorded in the south-west of F1, is due to a ferrous livestock feeder.

4.3. ANOMALIES OF AGRICULTURAL ORIGIN

Low magnitude, parallel linear anomalies of an agricultural origin have been recorded in fields F1 and F3. These correspond with former ploughing regimes also visible on satellite imagery (Google Earth 2025).

4.4. ANOMALIES OF GEOLOGICAL ORIGIN

As mentioned in Section 4.1 the magnetic background is generally uniform across most of the PDA. Within F1 and F2, however, some slight

variation is recorded. These comprise of weakly enhanced sinuous anomalies possibly aligning with changes in local topography, such as slight depressions, and could be caused by accumulations of magnetically enhanced natural material in those depressions.

4.5. ANOMALIES OF POSSIBLE OR PROBABLE ARCHAEOLOGICAL ORIGIN

No anomalies of a possible or probable archaeological origin have been recorded by the survey.

4.6. ANOMALIES OF UNCERTAIN ORIGIN

In the south of F3, to the south of the PDA, a low magnitude linear anomaly has been interpreted as of uncertain origin (Illus 8 – U1) on the basis that it cannot be confidently interpreted in any other category. This anomaly does not correspond with any mapped or obvious landscape feature, neither does it share an alignment with current and former field boundaries or with the direction of recent cultivation. However, given the very low magnitude and vague appearance of U1 it is assessed as most likely of modern or agricultural origin.

5. CONCLUSION

The survey has primarily recorded anomalies caused by natural, agricultural (recent cultivation) and modern activity. A single anomaly interpreted as of uncertain origin in an areas south of the PDA, is considered likely to be most likely of modern or agricultural origin.

No anomalies of a likely archaeological origin have been recorded by the survey.

The broadly receptive nature of the geology allied with the magnitude and resolution of the recorded anomalies indicates that there was likely sufficient magnetic contrast, for the detection of sub-surface archaeological features, if present. It is therefore considered that the results of the survey provide a good indication of the archaeological potential of the site which is therefore assessed as very low.

6. REFERENCES

Chartered Institute for Archaeologists (ClfA) 2020 Standard and guidance for archaeological geophysical survey (Reading) https://www.archaeologists.net/sites/default/files/ClfAS%26GGeophysics_3.pdf accessed 14th January 2025

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Gaffney, C & Gater, J 2003 Revealing the Buried Past: Geophysics for Archaeologists Stroud

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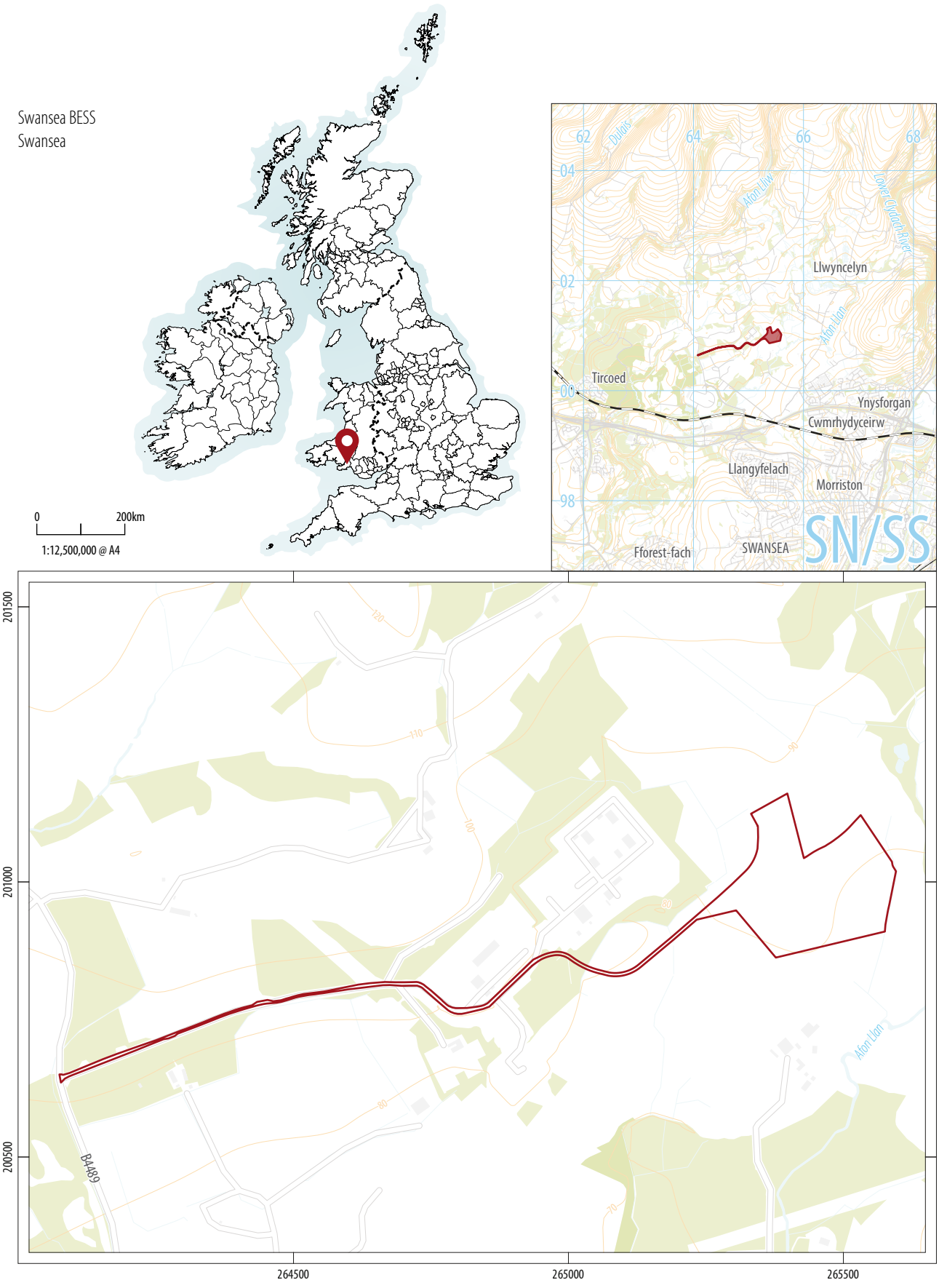
Welsh Government 2024 Planning Policy Wales Edition 12, February 2024 https://www.gov.wales/sites/default/files/publications/2024-07/planning-policy-wales-edition-12.pdf accessed 14th January 2025



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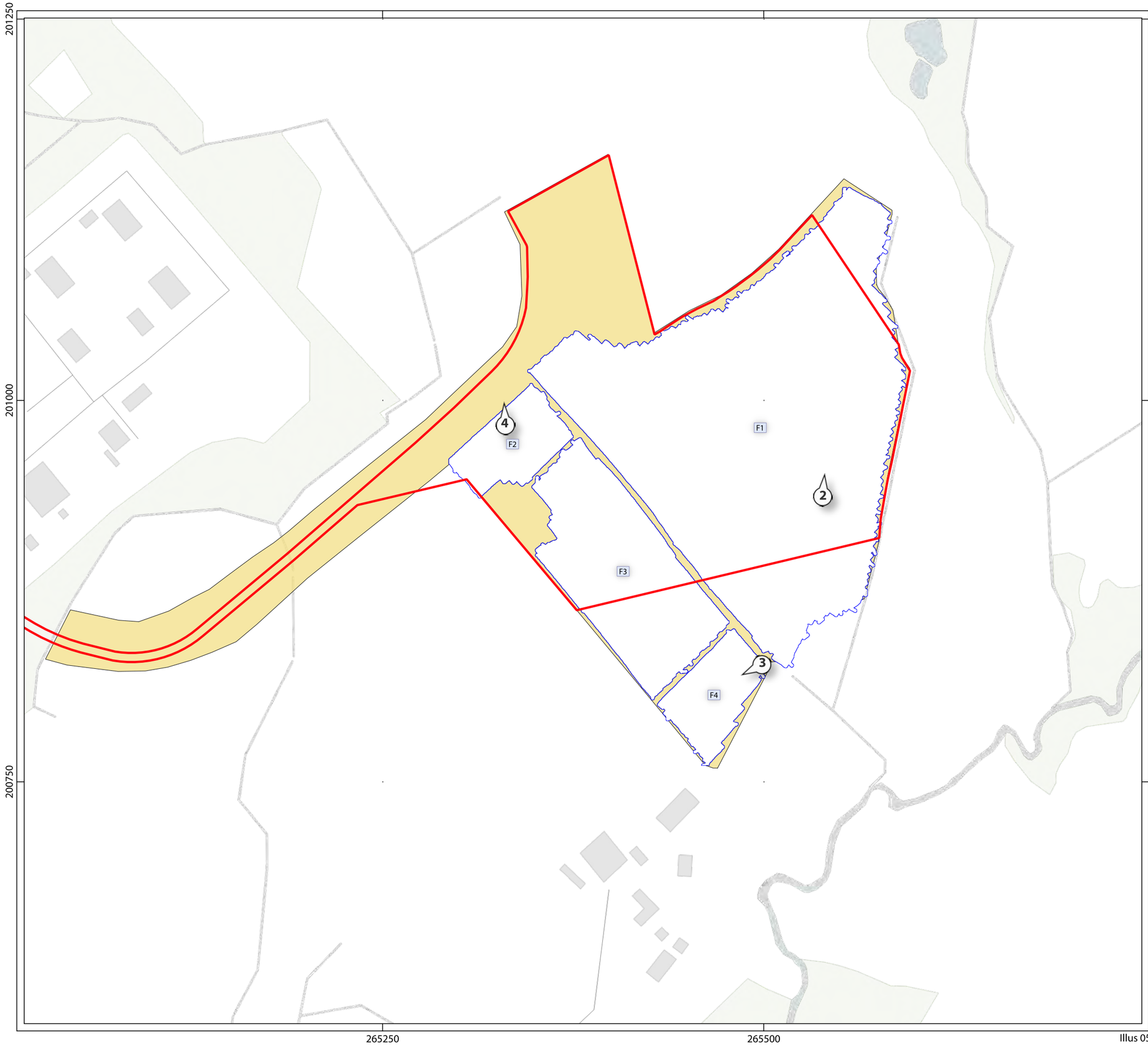
ILLUS 1 Site location

Illus 2 F1, looking north

Illus 3 F4, looking south-west

Illus 4 F2, unsuitable for survey looking north



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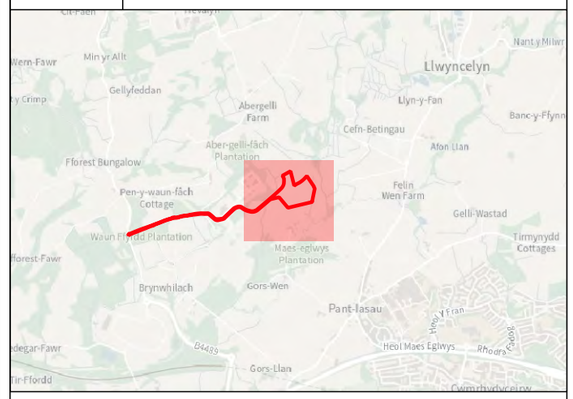

Key

- Proposed Development Area
- Survey Extent
- Location and Direction for Illus 02 to 04
- Unsuitable Survey Area

0 50 100 m

Site:	SBES24
Created by:	KSS
Checked by:	SH
Version:	v1.4
Date:	11/02/2025
Scale:	1:2,500 @ A3

Illus 05 - Survey location showing photograph locations and unsuitable survey areas

N

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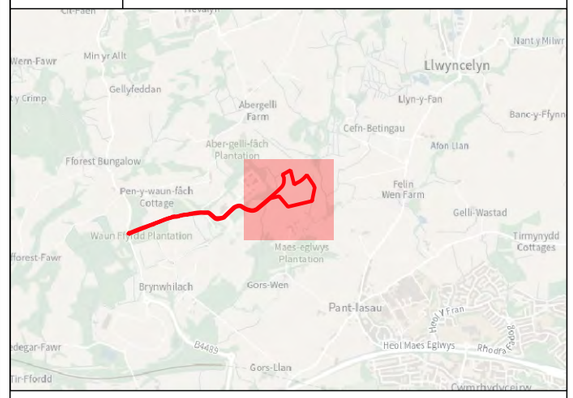

Key

Survey Extent

+2nT

-1nT

0 50 100 m

Site:	SBES24
Created by:	KSS
Checked by:	SH
Version:	v1.4
Date:	11/02/2025
Scale:	1:2,500 @ A3

Illus - 06 Processed greyscale magnetometer data

201250

201000

200750

F1

F2

F3

F4

265250

265500

N

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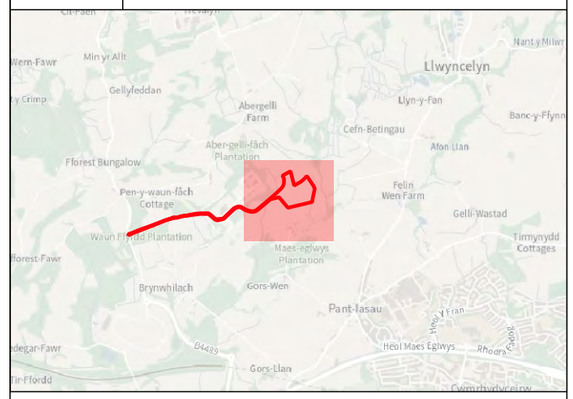

Key

Survey Extent

XY Trace (25nT/cm)

0 50 100 m

Site:	SBES24
Created by:	KSS
Checked by:	SH
Version:	v1.4
Date:	11/02/2025
Scale:	1:2,500 @ A3

Illus - 07 XY trace plot of minimally processed magnetometer data

201250

201000

200750

265250

265500

F1

F2

F3

F4

U1

SP1

N

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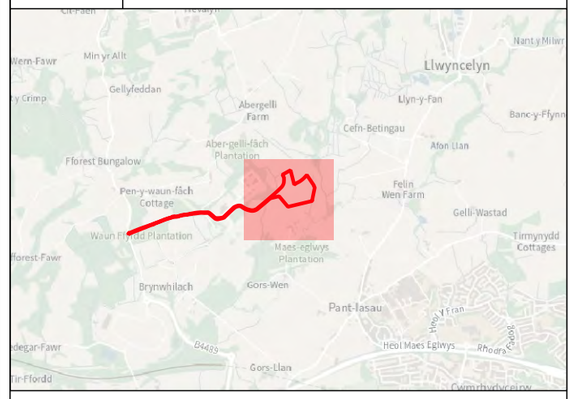

Key

- Survey Extent
- Ferrous Objects
- Agriculture
- Natural
- Service
- Magnetic Disturbance (Above Ground)
- Magnetic Disturbance (Below Ground)
- Uncertain

	Abbreviation
SP	Service Pipe
U	Uncertain

0 50 100 m

Site:	SBES24
Created by:	KSS
Checked by:	SH
Version:	v1.4
Date:	11/02/2025
Scale:	1:2,500 @ A3

Illus - 08 Interpretation of magnetometer data

7. APPENDICES

APPENDIX 1 MAGNETOMETER SURVEY

Magnetic susceptibility and soil magnetism

Iron makes up about 6% of the earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haematite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms so that by measuring the magnetic susceptibility of the topsoil, areas where human occupation or settlement has occurred can be identified by virtue of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of the topsoil, subsoil, and rock, into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected.

The magnetic susceptibility of a soil can also be enhanced by the application of heat. This effect can lead to the detection of features such as hearths, kilns, or areas of burning.

Types of magnetic anomaly

In most instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However, some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes)

These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being introduced into the topsoil during manuring.

Areas of magnetic disturbance

These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Lightning-induced remnant magnetisation (LIRM)

LIRM anomalies are thought to be caused in the near surface soil horizons by the flow of an electrical current associated with lightning strikes. These observed anomalies have a strong bipolar signal which decreases with distance from the spike point and often appear as linear or radial in shape.

Linear trend

This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies

Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on

an XY trace plot) on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies

Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

APPENDIX 2 SURVEY LOCATION INFORMATION

The magnetometer data was collected and is geo-located based on survey grade Real Time Kinetic (RTK) differential Global Positioning System (dGPS) used on both hand-carried and towed systems. The accuracy of this dGPS equipment is better than 0.01m. The GPS systems output in NMEA mode in real time, with a visual guide of survey tracks and any survey area boundaries displayed on a tablet device in view of the survey operator to ensure full coverage. Any survey area boundaries are uploaded as a string of co-ordinates or shapefile to the tablet prior to the commencement of survey.

APPENDIX 3 GEOPHYSICAL SURVEY ARCHIVE

The geophysical archive comprises an archive disk containing the raw data in XYZ format, a raster image of each greyscale plot with associate world file, and a PDF of the report.

The project will be archived in-house in accordance with recent good practice guidelines (http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_3). The data will be stored in an indexed archive and migrated to new formats when necessary.

APPENDIX 4 DATA PROCESSING

The gradiometer data has been presented in this report in processed greyscale and minimally processed XY trace plot format.

Data collected using RTK GPS-based methods cannot be produced without minimal processing of the data. The minimally processed data has been interpolated to project the data onto a regular grid and de-striped to correct for slight variations in instrument calibration drift, heading errors and any other artificial data.

The XY data has been clipped to remove extreme values and to improve the interpretability of the data.

APPENDIX 5 OASIS ARCHIVE