Prosiect Maen Hir

Solar a Storio Ynni

Preliminary Environmental Information Report

Volume III

Appendix 8-2: Written Scheme of Investigation

Prosiect Maen Hir - September 2024

EN010156

lightsource bp

bp

Cotswold Archaeology

Prosiect Maen Hir Anglesey

Prosiect Maen Hir Ynys Mon

Written Scheme of Investigation
for Archaeological Site Surveys

for:
Lightsource SPV 204 Ltd

CA Project: CR1763

August 2024

Andover Cirencester Milton Keynes Suffolk

Prosiect Maen Hir, Anglesey

Written Scheme of Investigation for Archaeological Site Surveys

CA Project: CR1763

Document Control Grid						
Revision	Date	Author	Checked by	Status	Reasons for revision	Approved by
A	5 August 2024	Derek Evans and Marta Perlinska	–	Internal review	–	Derek Evans
B	9 August 2024	Derek Evans and Marta Perlinska	–	Client review	Revisions in line with client comments	Derek Evans

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1. INTRODUCTION

1.1. This document is a Written Scheme of Investigation (WSI) by Cotswold Archaeology (CA) for archaeological site surveys to be undertaken as part of Prosiect Maen Hir, Anglesey. This WSI has been prepared for Lightsource SPV 204 Ltd.

1.2. The survey results will inform a Development Consent Order application for a solar generating station with a capacity of over 350 megawatts (MW) (AC) and associated development, which is to be submitted to the Planning Inspectorate.

1.3. The scope of the surveys was defined in discussions with Heneb (the Archaeological Advisors to Ynys Mon/Isle of Anglesey Council). This WSI will be submitted to Heneb for review.

1.4. This WSI has been guided in its composition by:

- *Standard and guidance for archaeological geophysical survey* (CIfA 2020);
- *Management of Research Projects in the Historic Environment (MoRPHE) PPN 3: Archaeological Excavation* (Historic England 2015); and
- *Management of Research Projects in the Historic Environment: The MoRPHE Project Managers' Guide* (Historic England 2015).

The site

1.5. For the purposes of the surveys, the application site has been split into four areas:

- Maen Hir North (c. 377ha);
- Maen Hir Central (c. 317ha);
- Maen Hir South A (c. 191ha); and
- Maen Hir South B (c. 399ha).

1.6. The application site as a whole is approximately 1,284ha in extent. It is located within north Anglesey (NGR: 240923 388564). It is near to the settlements of Amlwch and Llannerch-y-medd, and is close to Parys Mountain and Llyn Alaw reservoir. The application site is comprised mainly of pastoral/arable fields, along with the site of a former Oil Depot and fields utilised for wind turbines.

1.7. The bedrock geology at the site varies. From north to south, it comprises: New Harbour Group Mica schist and psammite (formed in the Ediacaran Period); South Stack Formation psammite and pelite (formed in the Ediacaran Period); Ordovician

Rocks mudstone and sandstone (formed in the Ordovician Period); Central Anglesey Shear Zone and Berw Shear Zone schist and mica (formed in the Ediacaran and Cambrian Periods); Coedana Complex Hornfel (formed in the Ediacaran Period); Coedana Granite (formed in the Ediacaran Period); and Central Anglesey Shear Zone and Berw Shear Zone schist and hornblende (formed in the Ediacaran and Cambrian Periods). The bedrock geology is overlain in the majority of the site by Devensian Diamicton Till (formed in the Quaternary Period), although patches of superficial alluvial clays, silts, sands and gravels are present in places (BGS 2024).

2. ARCHAEOLOGICAL BACKGROUND

2.1. A detailed archaeological background for the proposed application site is set out in a desk-based heritage assessment (CA 2024). The following text presents a brief, site-focused summary derived from this source, which should be referred to for a full background.

Palaeolithic (500,000 BC–10,000 BC) and Mesolithic (10,000 BC–4000 BC)

2.2. There is a low potential for Palaeolithic or Mesolithic remains within the application site.

Neolithic (4000 BC–2400 BC)

2.3. There is a moderate potential for Neolithic remains within the application site. A Neolithic chambered tomb and stones with prehistoric cupmarks carved into them are located within Maen Hir South A. Furthermore, previous archaeological works within Maen Hir Central have recorded two Neolithic pits and an urned cremation burial.

Bronze Age (2400 BC–700 BC)

2.4. There is extensive evidence for Bronze Age activity across the application site and the surrounding area.

2.5. Several Bronze Age standing stones are within close proximity to Maen Hir North, South A and South B.

2.6. A small number of Bronze Age round barrows and burial chambers survive as earthworks within the vicinity of the application site. Previous archaeological investigations have also recorded numerous ring ditches in the vicinity of Maen Hir North, Central and South B, and these may represent the remains of further round barrows.

2.7. A number of Bronze Age burnt mounds have been recorded within and around Maen Hir North and South.

Iron Age (700 BC–AD 43) and Roman (AD 43–AD 410)

2.8. There is evidence for extensive Iron Age and Roman activity within the application site and its environs.

2.9. A small, sub-circular enclosure recorded on LiDAR Imagery towards the centre of Maen Hir South B may represent an Iron Age settlement.

2.10. The cropmarks of three possible Iron Age enclosures have been recorded within and around the western part of Maen Hir Central.

2.11. Extensive Iron Age and Roman settlement was recorded *c*. 380m north of Maen Hir North. This comprised a defensive enclosure, ditches, pits, a livestock enclosure and roundhouses.

2.12. The projected route of a Roman road is suggested to pass through the southern part of Maen Hir South B.

2.13. The Scheduled remains of a Roman enclosure are located *c*. 300m north-west of Maen Hir North.

Early medieval (AD 410–1066) and medieval (1066–1539)

2.14. It is likely that the application site formed part of the rural hinterland to the settlements and farmsteads that surrounded the site from the early medieval period onwards. Discrete areas of potential ridge and furrow earthworks have been noted on LiDAR Imagery within Maen Hir North, Central and South; these are potentially the remnants of medieval agricultural fields.

2.15. Several medieval watermills were recorded along the course of the Afon Wygyr to the south-west of Plas Bodewryd in Maen Hir North, indicating that this river was a focus for flour production in the medieval period.

2.16. Within the eastern part of Maen Hir Central, medieval agricultural features and a potential house or church platform are recorded.

Post-medieval (1540–1800) and modern (1800–present)

2.17. The application site remained predominantly rural in these periods.

2.18. The boundaries of the fields that form the application site are likely to date to the post-medieval period. Some, but not all, are depicted on the 1840s Tithe Maps of the area.

2.19. Cartographic sources from the 19th and 20th centuries document small, isolated areas of stone quarrying within the application site.

2.20. A small number of former farmsteads/homesteads and/or farm buildings are shown within the application site on 19th and 20th century mapping.

2.21. The site of a former oil depot is located within Maen Hir North. This depot was constructed in the 1970s and went out of use by 1990. It is now largely demolished, although some concrete foundations and railways survive.

3. AIMS AND OBJECTIVES

3.1. The objective of the surveys is to provide further information on the likely archaeological resource within the site, including its presence/absence, character, extent, date and state of preservation.

4. METHODOLOGY

4.1. The surveys will comprise:

- geophysical (magnetometry) surveys of Maen Hir North, Central, South A and South B;
- electromagnetic survey of a *c*. 20ha area; and
- Unmanned Aerial System (UAS) LiDAR and multispectral surveys of four sub-areas.

4.2. The following text discusses the methodologies to be employed.

Geophysical surveys

4.3. As noted, the application site has been split into four areas. The geophysical surveys will be undertaken by three sub-contractors, operating under the management of CA:

- Maen Hir North (c. 377ha): SUMO GeoSurveys;
- Maen Hir Central (c. 317ha) and South A (c. 191ha): Magnitude Surveys;
- Maen Hir South B (c. 399ha): TerraDat.

4.4. Each of these organisations has provided a Project Design/WSI for their element of the works. These are appended to this WSI (Appendix A), and should be referred to for details of the proposed methodologies.

Electromagnetic survey

4.5. A targeted electromagnetic survey be conducted over a *c*. 20ha area within Maen Hir Central and/or Maen Hir South A. This survey will be undertaken by Magnitude Surveys. The proposed methodology is outlined in the Magnitude Surveys Project Design/WSI (Appendix A of the present WSI). The final scope of the electromagnetic survey will be defined in the light of the geophysical (magnetometry) survey results, and will be confirmed in an addendum to this WSI.

UAS LiDAR and multispectral surveys

4.6. Upon completion of the geophysical and electromagnetic surveys, four parcels will be identified for UAS LiDAR and multispectral survey, in order to verify the results of the geophysical and electromagnetic surveys. The four parcels will measure a combined total of *c*. 40ha. Their locations will be defined in the light of the geophysical and electromagnetic survey results, and will be confirmed in an addendum to this WSI. The LiDAR and multispectral surveys will be undertaken by CA.

LiDAR

4.7. The UAS LiDAR survey will be undertaken using a Matrice 350 RTK Unmanned Aerial System, equipped with RTK capability and a DJI Zenmuse L2 sensor. Scanning data will be viewed in real time and converted into point cloud in the office using DJI Terra.

4.8. The LiDAR survey will be carried out in line with *Using Airborne Lidar in Archaeological Survey: Light Fantastic*; 2nd Edition (English Heritage 2018).

4.9. The resulting point cloud will be further processed to obtain high-resolution DSM (Digital Surface Model) and DTM (Digital Terrain Model). They will be overlapped with the other results using ESRI ArcPro software and analysed to inform and enhance the results of the survey, as well as to verify the quality and precision of the geophysical survey.

Multispectral imagery survey

4.10. The multispectral survey will be undertaken using a DJI Mavic 3 Enterprise – Multispectral UAS able to record in Red, Red Edge and Near Infrared bands.

4.11. The data will be processed to obtain high-quality multispectral images (raster format). They will be overlapped with the other results using ESRI ArcPro software and analysed to inform and enhance the results of the survey, as well as to verify the quality and precision of the geophysical survey.

5. POST-EXCAVATION, REPORTING AND ARCHIVING

Reporting

5.1. Illustrated typescript reports will be prepared on each of the surveys. Draft reports will be distributed to Lightsource SPV 204 Ltd and Heneb for review prior to finalisation. All copies of the reports (draft and final) will be issued in pdf format.

5.2. In accordance with the Welsh Language Standards (No. 1) Regulations (2015), the report(s) will have a non-technical summary in both Welsh and English. The Welsh translations will be prepared by an appropriate translation contractor sub-contracted to Cotswold Archaeology/the geophysical survey contractors.

5.3. A digital (pdf) copy of the final report(s) will be made available for public viewing via CA's *Archaeological Reports Online* web page (http://reports.cotswoldarchaeology.co.uk).

Archive deposition

5.4. The project archive will adhere to the *National Standard and Guidance to Best Practice for Collecting and Depositing Archaeological Archives in Wales* (National Panel for Archaeological Archives in Wales 2017) and the *RCAHMW Guidelines for Digital Archives* (2015).

5.5. The final report(s) will be deposited with the National Museum for Wales, Amgueddfa Cymru. Copies of the final report(s) will also be submitted to Heneb for incorporation into the Historic Environment Record (HER) and the Royal Commission on the Ancient and Historical Monuments of Wales. Submission will be in line with *Guidance for the Submission of Data to the Welsh Historic Environment Records (HERs)* (The Welsh Archaeological Trusts 2022).

6. PROGRAMME

6.1. Provisional survey and reporting timescales for the geophysical and electromagnetic surveys are set out in the sub-contractor WSIs/Project Designs appended to the current WSI (Appendix A).

6.2. It is anticipated that UAS LiDAR and multispectral survey will take five days to complete on site. Data processing and production of the report is anticipated to take a further two weeks to complete.

7. PROJECT STAFF

7.1. This project will be under the management of Derek Evans, MCIfA, Project Manager, CA. Day-to-day responsibility will, however, rest with the survey teams, who will be on-site throughout the project.

8. HEALTH, SAFETY AND ENVIRONMENT

8.1. CA will conduct all works in accordance with the Health and Safety at Work Act 1974 and all subsequent health and safety legislation, as well as the CA Health and Safety and Environmental policies and the CA Safety, Health and Environmental Management System (SHE). Any client/developer/Principal Contractor policies and/or procedures will also be followed. A site-specific Construction Phase Plan (form SHE 017) will be formulated prior to commencement of fieldwork.

9. INSURANCES

9.1. CA holds Public Liability Insurance to a limit of £15,000,000 and Professional Indemnity Insurance to a limit of £10,000,000.

10. MONITORING

10.1. Notification of the start of site works will be made to Heneb so that there will be opportunities to visit the site and check on the quality and progress of the work.

11. QUALITY ASSURANCE

11.1. CA is a Registered Organisation (RO) with the Chartered Institute for Archaeologists (RO Ref. No. 8). As a RO, CA endorses the Code of Conduct (CIfA 2019) and the *Standard and guidance for commissioning work or providing consultancy advice on archaeology and the historic environment* (CIfA 2014; updated October 2020). All CA Project Managers hold Member status within the CIfA.

11.2. CA operates an internal quality assurance system as follows: projects are overseen by a Project Manager, who is responsible for the quality of the project. The Project Manager reports to the Chief Executive, who bears ultimate responsibility for the

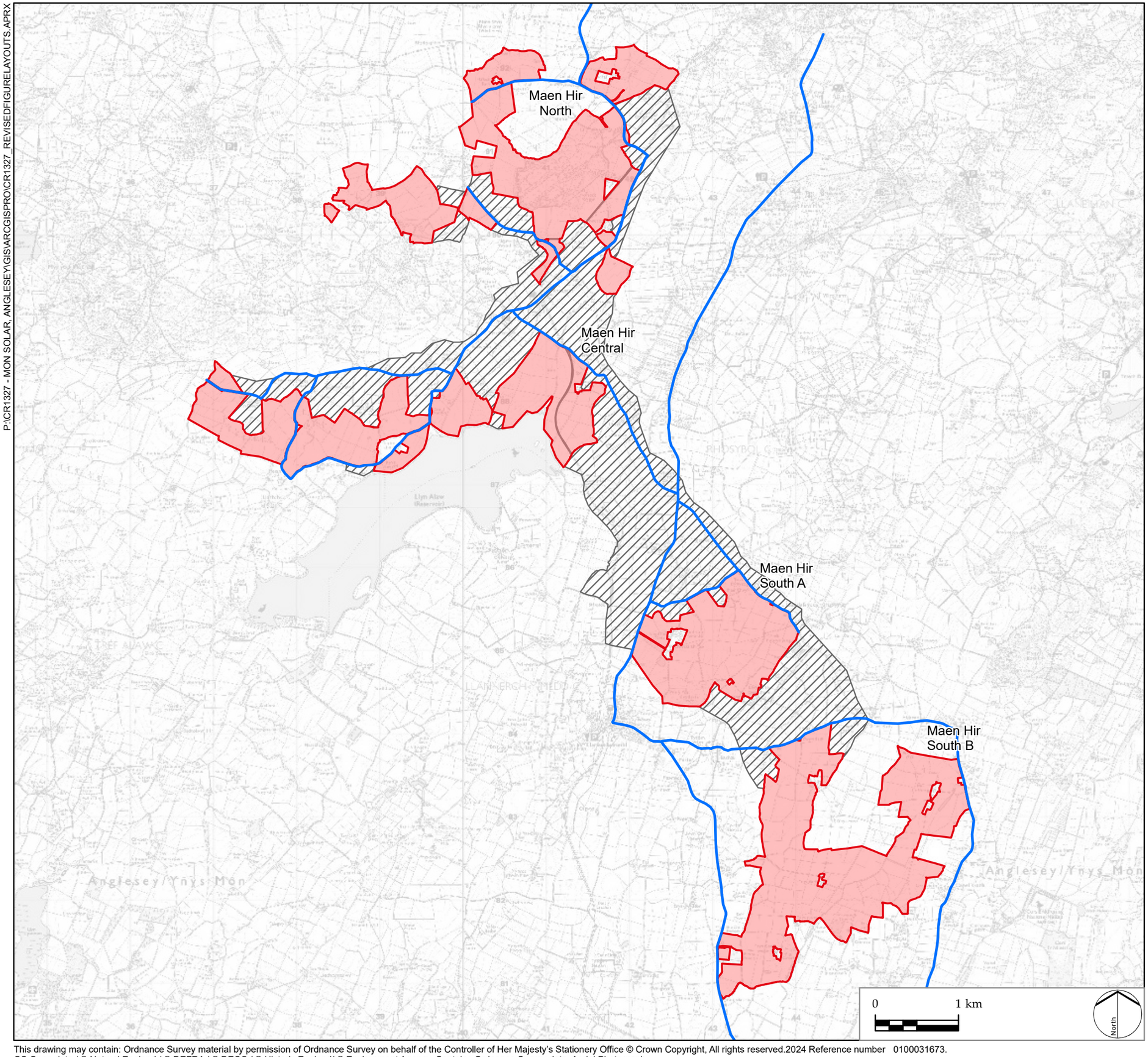
conduct of all CA operations. Matters of policy and corporate strategy are determined by the Board of Directors and, in cases of dispute, recourse may be made to the Chairman of the Board.

12. REFERENCES

British Geological Survey 2024 *BGS Geology Viewer* https://www.bgs.ac.uk/map-viewers/bgs-geology-viewer/ Accessed 5 August 2024

Cotswold Archaeology 2024 *Prosiect Maen Hir, Anglesey: Heritage Desk-Based Assessment* CA Report: **CR1327_2**

P:\CR1327 - MON SOLAR, ANGLESEY\GIS\ARCGISPRO\CR1327_REVISEDFIGURELAYOUTS.APRX



LEGEND

- Site Boundary
- Cable route corridor
- Highway works

lightsource bp

PROJECT TITLE

PROSIECT MAEN HIR

DRAWING TITLE

Site location plan

ISSUED BY	Andover	T:	01264 347 630
DATE	09/07/2024	DRAWN	DL
SCALE @A3	1:45,000	CHECKED	JS
STATUS	Draft	APPROVED	JS

DWG. NO. 1

No dimensions are to be scaled from this drawing.
All dimensions are to be checked on site.
Area measurements for indicative purposes only.

Sources: Ordnance Survey, Natural Resource Wales, Isle of Anglesey County Council

APPENDIX A: SUB-CONTRACTOR WSIS/PROJECT DESIGNS

(Follow)

PROJECT DESIGN & RISK ASSESSMENT METHOD STATEMENTS FOR GEOPHYSICAL SURVEY

Maen Hir, Angelsey

Client
Cotswold Archaeology

For
Lightsource Renewable UK Development Ltd

Ref. No.
SUMO-15339

OASIS Ref. No.
Sumogeop1-526920

Date
July 2024

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T: 01684 592266

geosurveys@sumoservices.com
www.sumoservices.com

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5 REPORTING AND ARCHIVING

6 STAFFING

7 WORKING PRACTICES AND STANDARDS

8 HEALTH AND SAFETY

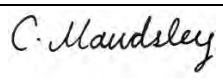
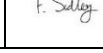
9 INSURANCES

Appendix A STANDARD RISK ASSESSMENT

Appendix B COSHH Documents

Surveyors:

	Signature
	Signature
	Signature
	Signature

Prepared By	Signature	Date	Approved By	Signature	Date
Charlotte Mawdsley		*19.07.24*	*Fiona Sidley*		*19.07.24*

1 INTRODUCTION, SITE LOCATION

1.1 **SUMO GeoSurveys** on behalf of **SUMO Services Ltd** has been contracted to carry out a geophysical survey.

1.2 This survey forms part of the programme of pre-determination archaeological works required by the archaeological advisor to the Planning Authority.

1.3 The site consists of c. 324.6 hectares of land at Maen Hir, Anglesey (See Figure 1).

1.4 The site work will take place on a date yet to be confirmed.

1.5 Preliminary results will be available on a rolling weekly basis.

1.6 Final report is typically available 2 weeks after completion of fieldwork.

2 SURVEY OBJECTIVE (S)

2.1 To determine the presence/absence of archaeological features. The results of the survey will inform the requirement and scope for further archaeological investigation.

3 CRITERIA FOR THE SELECTION OF THE GEOPHYSICAL METHOD

3.1 Bedrock geology: New Harbour Group - Mica schist and psammite.
Superficial geology: Till, Devensian - Diamicton (BGS 2024).

3.2 Archaeology: Extract taken from draft Historic Environment Desk-Based Assessment, Maen Hir, Angelsey. Cotswold Archaeology, July 2024.

The assessment has identified that these is a moderate potential for sporadic Neolithic remains within the Site. Evidence of the period is recorded solely within Maen Hir Central, where an excavation recorded two pits containing organic remains. The assessment has identified that the evidence for the Bronze Age is extensively recorded across the Site and the study area. These remains consist of round barrows placed with prominent high and low-lying positions within the landscape, multiple burnt mounds and multiple standing stones, and findspots. Within and around Maen Hir North and South there are Bronze Age burnt mounds, in particular one burnt mound had associated pits and postholes located near to a water course. Furthermore, recorded within the study area are also a number of Scheduled Bronze Age standing stones, in particular within proximity to Maen Hir North and South parts of the Site. The assessment has recorded extensive Iron Age settlement within the Site and study area. Extensive Late Prehistoric and Roman settlement was recorded c.380m to the north of Maen Hir North, comprising a defensive enclosure, ditches, pits, livestock enclosure and roundhouses. In addition, the Scheduled remains of a Roman enclosure are located c.300m to the north-west of the Site

3.3 Detailed magnetic survey has been selected as the most suitable technique for this site as it can detect a wide range of features including those that may be associated with later prehistoric occupation and medieval settlement such as ditches, land boundaries and agricultural features, including ridge and furrow. It is also fast and more suited to prospection over large survey areas.

3.4 There are no Scheduled Monuments on the site thus Scheduled Monument Consent is not required.

4 SITE METHODOLOGY

4.1 A temporary grid system will be established over the site and marked out using wooden pegs or canes. The location of the grid will be set out using an RTK GPS system theoretically accurate to some 0.01m and referenced to OS co-ordinates.

Dependent upon access agreements and ground conditions, either a cart or hand-held system will be employed.

4.2.1 **Cart System:** Data will be collected using a cart carrying four paired Bartington magnetic sensors (see below). Each data point is geographically referenced using an on-board Trimble RTK survey grade GPS system. Readings will be taken at 0.125m centres along traverses 1.0m apart.

4.2.2 **Hand-Held:** Data will be collected using a Bartington Grad 601-2. The instrument consists of two paired sensors (see below) and readings are logged at 0.25m centres along traverses 1.0m apart across 30m grids. The collection of data at 0.25m centres provides an appropriate methodology balancing cost and time with resolution as per Historic England guidelines.

4.3 **Sensors:** Two sensors mounted 1m horizontally apart and 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.

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

5 REPORTING AND ARCHIVING

5.1 The report for the survey will comprise a written section describing the background to the survey, the methodologies used and a discussion of the results. The text will be illustrated using plots of the results using CAD to overlay the results and interpretations over the base mapping. The format for these drawings will either be A3 or A1 depending on the size and configuration of the survey areas.

5.2 Processing of the data will be carried out using the specialist software ***Anomaly*** and ***GeoSub,*** sometimes ***Geoplot***. 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 'equalising' the background levels with respect to adjacent traverses (Zero mean traverse). 'Despiking' is very occasionally performed to remove the anomalies resulting from small iron objects often found on agricultural land but this practice is not favoured as it creates a ‘false’ dataset. Once the basic processing has levelled the background it is then possible to carry out further processing including de-stagger and interpolation to emphasise the archaeological or man-made anomalies.

5.3 The presentation of the CAD drawings will include:

- a general location plan
- detailed site location showing the grid position
- grey scale plots of the minimally processed and processed data
- Interpretation plot showing anomalies identified
- XY Trace Plots

5.4 As a minimum the report will contain;

- Non-technical summary and Welsh translation
- Introductory statement
- Aims and purposes of the evaluation
- Methodology
- Results, including a confidence rating for the results and their interpretation
- Conclusion
- Plans/plots, including interpretive plans of the results
- References
- Archive statement

5.5 The archaeological DBA will be consulted, along with historic mapping of the survey area to inform the interpretation of anomalies located during the survey. The degree of uncertainty pertaining to influences drawn from the results will also be discussed.

5.6 The project archive will adhere to The National Standard and Guidance to Best Practice for Collecting and Depositing Archaeological Archives in Wales 2017 (National Panel for Archaeological Archives in Wales).

5.7 The full report will be submitted to the HER and adhere to the Guidance for the Submission of Data to the Welsh Historic Environment Record (HERs) (2018). A digital copy of the archive will be sent to the Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW) as per their guidelines.

5.8 In accordance with the Welsh Language Standards (No. 1) Regulations (2015) the report will have a non-technical summary in both Welsh and English.

5.9 **Data Management plan**

Project ID / OASIS ID
SUMO-15339 / sumogeop1-526920
Project Name
Maen Hir, Anglesey
Project Description
Detailed magnetic survey over approx. 324.6ha
Client
Cotswold Archaeology on behalf of Lighthouse Renewable UK Development Ltd
Project Manager
Rebecca Fradgley
Field Leader
TBC
Date DMP created
19.07.24

Date DMP last updated

19.07.24

Version

1

Technique - data

Detailed magnetic survey.

Manual – cart - other

ATV/Cart Handheld magnetometers.

Documentation and metadata

All documentation and data produced so far are stored on SUMO servers in a specific job file.

Data storage, access and back-up

- SUMO Secure server during the project life set up in a RAID configuration (a RAID configuration incorporates a level of data redundancy meaning if a single hard drive in fails data can still be restored).
- Snap shots of the data will be made at several intervals during the day to allow data to be restored for up to 30 days if changed / deleted.
- Once the final report has been completed data will be moved onto NAS drive set up in a RAID configuration.
- All data is backed up to an off-site location (Cloud storage).

ADS or other depository - Costs

ADS has not been requested, all data, reports and corresponding documentation will be securely stored by SUMO.

Digital files and data to be selected for archiving

- Raw data in XYZ format .csv and .png plus .pgw world file
- Processed data as .png plus .pgw world file
- Survey written report .pdf
- Survey photos .png
- CAD and Vector graphics (interpretations) in .dwg format

Notes

6 SELECTION STRATEGY FOR THE RETAINED ARCHIVES AND DATA MANAGEMENT PLAN

6.1 All raw data is stored in an internal RAID configured NAS drive. This allows for a single drive to fail and data to be recreated. This data is also backed up to the cloud for online storage so in the event of a catastrophic failure of the drive or damage such as water ingress or fire a safe, offsite copy of the data.

6.2 The project archive will adhere to The National Standard and Guidance to Best Practice for Collecting and Depositing Archaeological Archives in Wales 2017 (National Panel for Archaeological Archives in Wales). The archive will be forwarded to the HER at CPAT and to the National Monuments record RCAHMW.

6.3 All data is included within the archive and the backup archives in the event of needing to be recovered. This includes but is not limited to,

- Raw data in XYZ format .csv and .png plus .pgw world file
- Processed data as .png plus .pgw world file
- Survey written report .pdf
- Survey photos .png
- CAD and Vector graphics (interpretations) in .dwg format

6.4 Please see Data Management Plan in section 11.

7 STAFFING

7.1 Site work will be carried out by an appropriate number of field teams (led by an Experienced Team Leader) to complete the work within the given timescale. The Team will be co-ordinated from designated offices personnel, where the first point of contact for the client and site team will be:

Project Officer	Rebecca Fradgley	07917 416847	rebecca.fradgley@sumoservices.com
Team Leader	TBC		

8 WORKING PRACTICES AND STANDARDS

8.1 All site work and reporting will be carried out in accordance with the latest guidance documents issued by Historic England (EH 2008) (then English Heritage), the Chartered Institute for Archaeologists (CIfA 2014, updated 2020), the European Archaeological Council (EAC 2016)

8.2 **SUMO GeoSurveys** is a trading name of **SUMO GeoSurveys Limited** which is a **Registered Organisation** and as such is committed to upholding the standards and policies set out by the **Chartered Institute for Archaeologists**.

8.3 **SUMO GeoSurveys** (through its parent company **SUMO Services Ltd**) is a member of the **EuroGPR Association**

9 HEALTH AND SAFETY

9.1 Colin Carnachan, Company Secretary is the responsible post holder for Health & Safety matters; **SUMO** also employs an external Health & Safety advisor who can be consulted if necessary.

9.2 All **SUMO** team leaders are first-aid trained, with all of our field operatives being part of a rolling programme of first-aid training.

9.3 All **SUMO** field teams are equipped with mobile phones for use in an emergency.

9.4 In the event of an emergency the team will immediately stop work and report the incident to the relevant emergency services and **SUMO** head office. If it is safe to do so they will administer first-aid and render assistance to any emergency teams on site.

9.5 **SUMO** will monitor the general safety arrangements and will communicate any further requirements / short falls to the client.

9.6 **SUMO** site personnel will be equipped with full Personal Protective Equipment (PPE).

9.7 In the event of an Accident: all **SUMO** site operatives are trained to Appointed Persons standard and all vehicles carry first aid kits. In the event of a serious injury/accident dial 999.

9.8 In case of minor injury, the closest **A & E Hospital** – see Figure 2.

9.9 **Welfare Facilities** – see Figure 3.

9.10 **Emergency Contacts**
In the event of an accident staff to report in accordance with Sumo Ltd's Health and Safety Policy and in accordance with RIDDOR.

Name	Company	Role	Telephone
Colin Carnachan	SUMO Services Ltd	Managing Director	02392 415020
Simon Haddrell	SUMO GeoSurveys	Operations Director	01684 592266
Rebecca Fradgley	SUMO GeoSurveys	Project Officer	07917 416847
TBC	SUMO GeoSurveys	On site Team Leader	
Vas Tsamis	Cotswold Archaeology	Client	07793 085211

10 INSURANCES

10.1 **SUMO** carries a limit of £10 million Employers liability insurance.

10.2 **SUMO** carries a limit of £10 million Public liability insurance and Products liability insurance.

10.3 **SUMO** carries a limit of £10 million Professional Indemnity insurance

Figure 1
Site Location

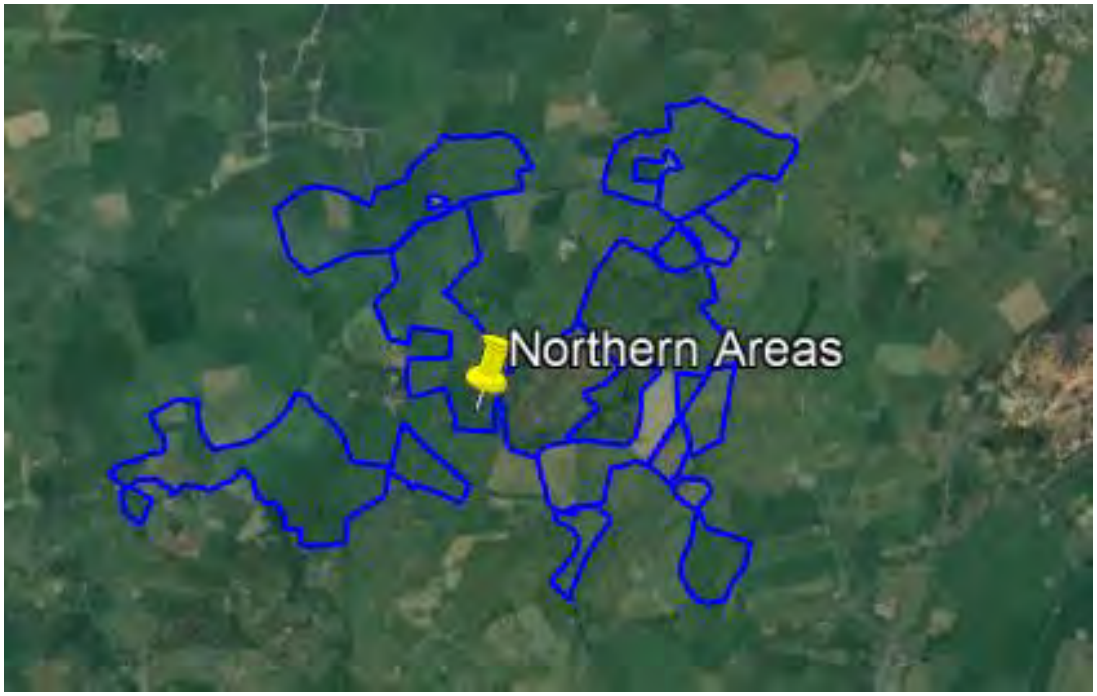


Figure 2
Nearest Hospital

Ysbyty Gwynedd Hospital, Penrhosgarnedd, Bangor, LL57 2PW.
Tel: 01248 384384.

Figure 3
Welfare Facilities

Surveyors will use client site facilities only with prior permission. In the event that welfare facilities are not available at the site, then staff will use local public amenities.

Hand gel / wipes / water carrier for hand washing at remote locations must be carried at all time. The team Leader is responsible for re-stocking these when away from the office.

The closest public amenities are at:
Amlwch Public Toilets, Lon Goch, Amlwch LL68.

Magnitude Surveys

Geophysical Survey
Written Scheme of Investigation

Maen Hir, Anglesey

On behalf of Cotswold Archaeology

MSSH1831

August 2024

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Magnitude Surveys

Project Background

1 Introduction

1.1 This document details a Written Scheme of Investigation for a geophysical survey to be undertaken by Magnitude Surveys Ltd (MS) for Cotswold Archaeology.

1.2 The survey comprises a maximum of c. 509 hectares (ha) of pasture, located across two areas, at Llanbabo (SH 39550 87996, Fig. 2) and Llandyfrydog (SH 43077 85011, Fig 3), Anglesey, Wales.

1.3 The geophysical survey will comprise hand-pulled/quad-towed, cart-mounted, or hand-carried GNSS-positioned fluxgate gradiometer survey, and a hand-pulled, cart-mounted or hand-carried GNSS-positioned electromagnetic (EM) survey. Magnetic survey measures subtle changes in the earth's magnetic field caused by subsurface features. Magnetometer surveys are generally the most cost effective and suitable geophysical technique for the detection of archaeology in England. Electromagnetic survey measures both the soil's electrical conductivity and magnetic susceptibility and is a complementary technique to the magnetometry.

1.4 The survey will be conducted in line with the recommendations of the historic environment team at Welsh HER and the current best practice guidelines produced by Historic England (David *et al.,* 2008), the Chartered Institute for Archaeologists (2020), and the European Archaeological Council (Schmidt *et al.,* 2015).

2 Objectives

2.1 The objective of this geophysical survey is to assess the subsurface archaeological potential of the survey area.

2.2 The results of the geophysical survey programme will be used to inform intrusive evaluation and/or mitigation.

3 Quality Assurance

3.1 Magnitude Surveys (MS) is one of the largest independent providers of near-surface geophysical survey for archaeological applications in the UK. Our Health and Safety, Quality, and Environmental Management, Systems are certified to ISO 45001, 9001, and 14001 standards. We are also UVDB Accredited through Achilles and hold a Constructionline Silver membership.

3.1 Magnitude Surveys is a Registered Organisation of the Chartered Institute for Archaeologists (CIfA), the chartered UK body for archaeologists, a corporate member of ISAP (International Society for Archaeological Prospection), and a corporate member of FAME (the Federation of Archaeological Managers and Employers).

3.2 The survey will be conducted in line with the current best practice guidelines produced by Historic England (David et al., 2008), the Chartered Institute for Archaeologists (CIfA, 2020) and the European Archaeological Council (Schmidt et al., 2015). Our reports are worked on by staff throughout the company under processes that ensure compliance with all standard archaeological geophysics guidelines applied in the UK.

3.3 The flexibility of our bespoke, modular geophysical survey equipment allows our survey teams to maintain productivity in the face of unforeseen constraints, while ensuring that any concerns held by landowners are addressed in a sensitive way. Our survey methodology incorporates the use of a secure live data-streaming protocol that allows for data to be processed and checked in real-time while the team are still on site. This procedure ensures that any negative impacts on the quality of data collected can be immediately identified, meaning that any issues which occur during restricted periods of land access, can be addressed while the team are still on site.

3.4 All works will be undertaken in accordance with this WSI as approved by the Local Authority Archaeological Officer/Senior Historic Environment Advisor.

4 Capacity and Programme

4.1 Staff resources will be drawn from a pool of 40+ employees, including office-staff who undertake reporting/management, depending on the specific programme requirements. All members of staff are directly employed by Magnitude Surveys and are either British nationals, or are in possession of appropriate work visas and/or settled status in the UK.

4.2 Magnitude Surveys has the capacity to provide up to 8 full-time survey teams, each of which consists of 2 surveyors.

4.3 The survey is anticipated to commence in or after August 2024, pending approval of this WSI and confirmation of access arrangements.

4.4 The detailed programme for Magnetic survey will be defined pending confirmation of access arrangements, and confirmation of the ability to use ATV-towed arrays. Indicatively, it would be possible to complete survey of this area in approximately 5 weeks using an average of two survey teams using ATV-towed arrays.

4.5 The programme for targeted electromagnetic geophysical survey will be defined based on the scope of those areas. It is however, anticipated that this will be completed as soon as is practicable following completion of the magnetometer survey.

4.6 The survey teams will consist of two surveyors, and on-site operations will have a dedicated Project Officer monitoring fieldwork from the office, and conducting liaison for land access. General operational matters pertaining to the survey programme and reporting will be overseen by a senior Project Officer in the role of Project Lead. Due to the complexity of this project, additional oversight and support will be provided by a company director.

4.7 The Project Lead will complete all necessary pre-start liaison activities and the preparation of Health and Safety documents prior to the survey. They will be responsible for survey planning and ensuring all fieldwork and reporting activities are undertaken to a high standard within the agreed timescales.

5 Geographical Background

5.1 The underlying geology of the survey area largely comprises undifferentiated interbedded Ordovician mudstones, sandstones and conglomerates. Unnamed Igneous intrusions are also present within the northeastern corner of the Llandyfrydog section of the survey area (British Geological Survey, 2024).

5.2 Superficial deposits primarily consist of Devensian diamicton Till, with two bands of alluvium running through the east of the Llanbabo section of the survey area (British Geological Survey, 2024).

5.3 Slowly permeable seasonally wet acid loamy and clayey soils are present across the two survey areas (Soilscapes, 2024).

6 Archaeological Background

6.1 The following is a summary of a Historic Environment Desk-Based assessment provided by Cotswold Archaeology (Sanigar, 2024).

6.2 Three pieces of Mesolithic worked flints were recorded near to the shore of Llyn Alaw adjacent to the southern section of the survey area, perhaps suggesting that activity during this period may have been focussed upon the edge of water courses or former marshland in the area.

6.3 An excavation was undertaken within the northern section of the survey area, where two pits containing organic remains were identified and radiocarbon dated to the Neolithic period. Urned cremation remains were also identified.

6.4 Archaeological investigations have recorded numerous Bronze Age ring-ditches indicative of potential round barrows, located in both elevated and low-lying positions across the DBA study area. The presence of these potential round barrows could indicate that the site is located within a funerary landscape.

6.5 Evidence of Iron Age activity around the survey area is limited to a quern stone and pieces of slag close to the shore of Llyn Alaw, suggesting potential settlement within the vicinity of these findspot locations. Furthermore, cropmarks indicating three enclosures, are also located within and around the west of the survey area.

6.6 From the early-Medieval period onwards, the survey area was part of the rural hinterland of a series of settlements. An early-Medieval settlement is recorded c. 1km east of the survey area.

6.7 Medieval agricultural features and a platform potentially related to a Medieval house or church are recorded within the survey area. The platform is known as ‘Cae Hen Eglwys’ or ‘Old Church Field’. No extant earthworks are however apparent from LiDAR data, which may indicate that subsequent agricultural activity has affected the preservation of any remains.

6.8 Individual farm buildings and two former agricultural buildings of post-Medieval date have been identified within the survey area through depictions on 19th/20th century historical mapping.

7 Survey Methodology

7.1 Geophysical survey will comprise the magnetic and electromagnetic methods as described in the following table. Magnetic survey measures subtle changes in the earth's magnetic field caused by subsurface features. Electromagnetic survey measures both the soil's electrical conductivity and magnetic susceptibility and is a complementary technique to the magnetometry. Magnetometer surveys are generally the most cost effective and suitable geophysical technique for the detection of archaeology in England.

7.2 Table of survey strategies:

Method	Instrument	Traverse Interval	Sample Interval
Magnetic	Bartington Instruments Grad-13 Digital Three-Axis Gradiometer	1 m	200Hz reprojected to 0.125m
Electromagnetic Induction – Conductivity and Magnetic Susceptibility	GF Instruments CMD Mini Explorer in HCP orientation	1m	5Hz reprojected to 0.25m

7.3 The proposed programme of geophysical surveys has been designed following consultation with Cotswold Archaeology. Any decisions to extend the survey area, and/or confirmation of areas of interest for the application of subsequent techniques will be made in consultation with Cotswold Archaeology.

7.4 This programme of works will commence with c. 509ha of magnetic survey located at Llanbabo (Figure 2) and Llandyfrydog (Figure 3). This phase of works is designed to provide reliable baseline data for determining the current archaeological potential of the site. A targeted EM survey may subsequently be conducted over a c. 20ha area within the larger survey area.

7.5 Positional referencing will be undertaken through the use of a multi-channel, multi-constellation GNSS Smart Antenna RTK GPS outputting in NMEA mode, to ensure high positional accuracy of collected measurements. The RTK GPS is accurate to 0.008m + 1ppm in the horizontal and 0.015m + 1ppm in the vertical.

7.6 Magnetic, EM and GPS data will be stored on an SD card within MS' bespoke datalogger. The datalogger is continuously synced, via an in-field Wi-Fi unit, to servers at the offices of Magnitude Surveys. This allows for data collection, processing, and visualisation to be monitored in real-time as fieldwork is ongoing.

7.7 A navigation system is integrated with the RTK GPS, and used to guide the surveyors. Data will be collected by traversing the survey area along lines designed to intersect known/expected features at an angle of approximately 30°, ensuring a balance between maximising the possibility of resolving features, and efficient collection and processing.

7.8 The magnetic survey system will comprise Bartington Instruments Grad-13 Digital Three-Axis Gradiometers mounted in parallel, with each sensor 1m apart. The Grad-13 sensors are capable of measuring both magnetic gradient, and total-field, with a greater sensitivity and less instrument-noise than traditional single-axis fluxgate gradiometers. The EM survey will be collected separately from the gradiometer survey on either a hand-carried or cart-based system depending on the chosen instrument.

8 Data Processing

8.1.1 Magnetic data will be processed in bespoke software produced by MS. Processing steps conform to the EAC and Historic England guidelines for 'minimally enhanced data' (see Section 3.8 in Schmidt et al., 2015: 33 and Section IV.2 in David et al., 2008: 11).

Sensor Calibration - The sensor array is calibrated using a bespoke in-house algorithm, which conforms to Olsen et al. (2003).

Zero Median Traverse - The median of each sensor traverse is calculated within a specified range and subtracted from the collected data. This removes striping effects caused by small variations in sensor electronics.

Projection to a Regular Grid - Data collected using RTK GPS positioning requires a uniform grid projection to visualise data. Data are rotated to best fit an orthogonal grid projection and are resampled onto the grid using an inverse distance-weighting algorithm.

Interpolation to Square Pixels - Data are interpolated using a bicubic algorithm to increase the pixel density between sensor traverses. This produces images with square pixels for ease of visualisation.

8.1.2 EM data will be processed in bespoke in-house software produced by MS. Processing steps conform to the EAC and Historic England guidelines for ‘minimally enhanced data’ (see Section 3.8 in Schmidt et al., 2015: 33 and Section IV.2 in David et al., 2008: 11).

Zero Median Traverse – The median of each sensor traverse is calculated within a specified range and subtracted from the collected data. This removes striping effects caused by small variations in sensor electronics.

Projection to a Regular Grid – Data collected using RTK GPS positioning requires a uniform grid projection to visualise data. Data is rotated to best fit an orthogonal grid projection and is resampled onto the grid using an inverse distance-weighting algorithm.

Interpolation to Square Pixels – Data is interpolated using a bicubic algorithm to increase the pixel density between sensor traverses. This produces images with square pixels for ease of visualisation.

9 Data Interpretation

9.1 The report will present the gradient of the sensors' total field data as greyscale images, as well as the total field data from the upper and/or lower sensors, where appropriate. The gradient of the sensors minimises external interferences and reduces the blown-out responses from ferrous and other high contrast material. However, the contrast of weak or ephemeral anomalies can be reduced through the process of calculating the gradient. Consequently, some features can be clearer in the respective gradient or total field datasets. Multiple greyscale images at different plotting ranges will be used for data interpretation.

9.2 The EM interpretation is partly derived from the quadrature phase, which is a proxy for apparent electrical conductivity. These datasets roughly correspond with a bulk soil volume equated to c. 0.16m, 0.35m and 0.60m deep, respectively. However, as the EM is measuring a bulk soil volume, it will be sensitive to features above and below these theoretical exploration depths. The second set of EM interpretation is derived from the in-phase component of the EM response which relates to the soil's magnetic susceptibility. The in-phase roughly corresponds with a bulk soil volume of half that of the quadrature-phase. The different receiving coil responses will be referred to as I1, I2, and I3 configurations for the magnetic susceptibility and C1, C2, and C3 configurations for the conductivity. These depths will be described as comparatively shallow, middle, and deep soil volumes, respectively. From this point onward, the respective quadrature-phase and in-phase datasets will be referred to as EM conductivity and EM magnetic susceptibility, respectively.

9.3 Geophysical results will be interpreted using greyscale images and XY traces in a layered environment, overlaid against OS Open Data, satellite imagery, historical maps, LiDAR data, and soil and geology mapping. Google Earth (2024) will also be consulted, to compare the results with recent land use.

9.4 Geodetic position of results – All vector and raster data will be projected into OSGB36 (ESPG27700) and provided upon request in ESRI Shapefile (.SHP) and Geotiff (.TIF) respectively. Figures will be provided with raster and vector data projected against OS Open Data.

10 Report

10.1 Preliminary greyscale results of the magnetic survey will be provided to the client while survey work is ongoing, a preliminary draft interpretation of the magnetic survey results will also be provided one week after survey work has been completed. Depending on the complexity of the survey results, the preliminary draft interpretations will highlight key anomalies of interest as a minimum.

10.2 A detailed report of the survey will be produced after data collection is completed. The report will be produced in accordance with the Guidance for the submission of Data to the Welsh Historic Environment Records (HERs) and a digital copy will be submitted to the HER (The Welsh Archaeological Trust, 2022). The final report will include as standard:

- Abstract – In both English and Welsh in accordance with the 2015 Welsh Language regulations.
- Introduction – Details survey location and client details.
- Objectives – Details survey objectives.
- Quality Assurance – Details the expertise of Magnitude Surveys and Magnitude Surveys employees undertaking the work.
- Geographic Background – Details the soils and geology of the survey area.
- Archaeological Background – Details a brief summary of the archaeological and historical background of the survey area and its immediate environs. While this will not be an exhaustive assessment, it will draw on elements relevant to the results obtained during survey.
- Survey Considerations – Details specific points of note for each survey area, including topography, upstanding obstructions or neighbouring objects.
- Survey Methodology – Details survey strategy employed, instruments used, data collection strategy, data processing and visualisation methods.

- Data Interpretation – Details data visualisation and interpretation workflows. The interpretation classifications that will be used will include: Archaeology Probable (Strong, Weak, Spread); Archaeology Possible (Strong, Weak, Spread); Natural Geology (Strong, Weak, Spread); Recent Agricultural – Mapped (Polygon or Line) and Recent Agricultural - Unmapped; Ridge and Furrow; Drainage Feature; Recent Industry; Service; Ferrous (Spike or Trend); Undetermined (Strong, Weak); Other Magnetic Disturbance.

- Results – Details the results and interpretation of the geophysical survey, both in a general context and in terms of specific anomalies of archaeological interest. Geophysical results will be discussed in combination with available supporting interpretative evidence.

- Conclusions

- References

- Project Metadata

- Figures – The survey location and individual survey areas will be presented. Georeferenced raster images of the minimally enhanced data, enhanced data (if used), XY traces and corresponding interpretations will be displayed at appropriate scales. Interpretations will also be displayed over satellite imagery, historical mapping, and LiDAR - as applicable - to provide further context for the interpretations. All figures will include a detailed scale bar, north arrow, and key.

11 Archiving

11.1 MS maintains an in-house digital archive, which is based on Schmidt and Ernenwein (2013). This archive stores the collected measurements, minimally processed data, georeferenced and un-georeferenced images, XY traces and a copy of the final report. A copy of this archive will be included on a disk with a final printed report, if required.

11.2 MS will follow the National Standard and Guidance to Best Practice for Collecting and Depositing Archaeological Archives in Wales (National Panel of Archives in Wales, 2017) and digital archiving guidance of the Royal Commission on the Ancient and Historical Monuments Wales (Edwards, 2015).

11.3 MS contributes reports to the ADS Grey Literature Library upon permission from the client, subject to any dictated time embargoes.

12 Copyright

12.1 Copyright and intellectual property pertaining to all reports, figures and datasets produced by Magnitude Services Ltd is retained by MS. The client is given full licence to use such material for their own purposes. Permission must be sought by any third party wishing to use or reproduce any IP owned by MS.

13 References

British Geological Survey, 2022. Geology of Britain. Baldock, Hertfordshire. [http://mapapps.bgs.ac.uk/geologyofbritain/home.html/]. Accessed 01/08/2024.

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Soilscapes, 2022. Cranfield University, National Soil Resources Institute. [http://landis.org.uk]. Accessed 01/08/2024.

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14 Project Metadata

MS Job Code	MSSH1831
Project Name	Maen Hir, Anglesey
Client	
Survey Techniques	Magnetometry, Electromagnetic Induction – Conductivity and Magnetic Susceptibility.
Survey Size (ha)	509ha (Maximum Extent)
Survey Dates	TBC
Project Lead	Isabella Carli BA MA ACIfA
Project Officer	Daniel Wilkinson BA (Hons)
Timetable	TBC
HER Event No	TBA
OASIS No	N/A
S42 Licence No	N/A
Archive Location	In house
Report Version	0.1

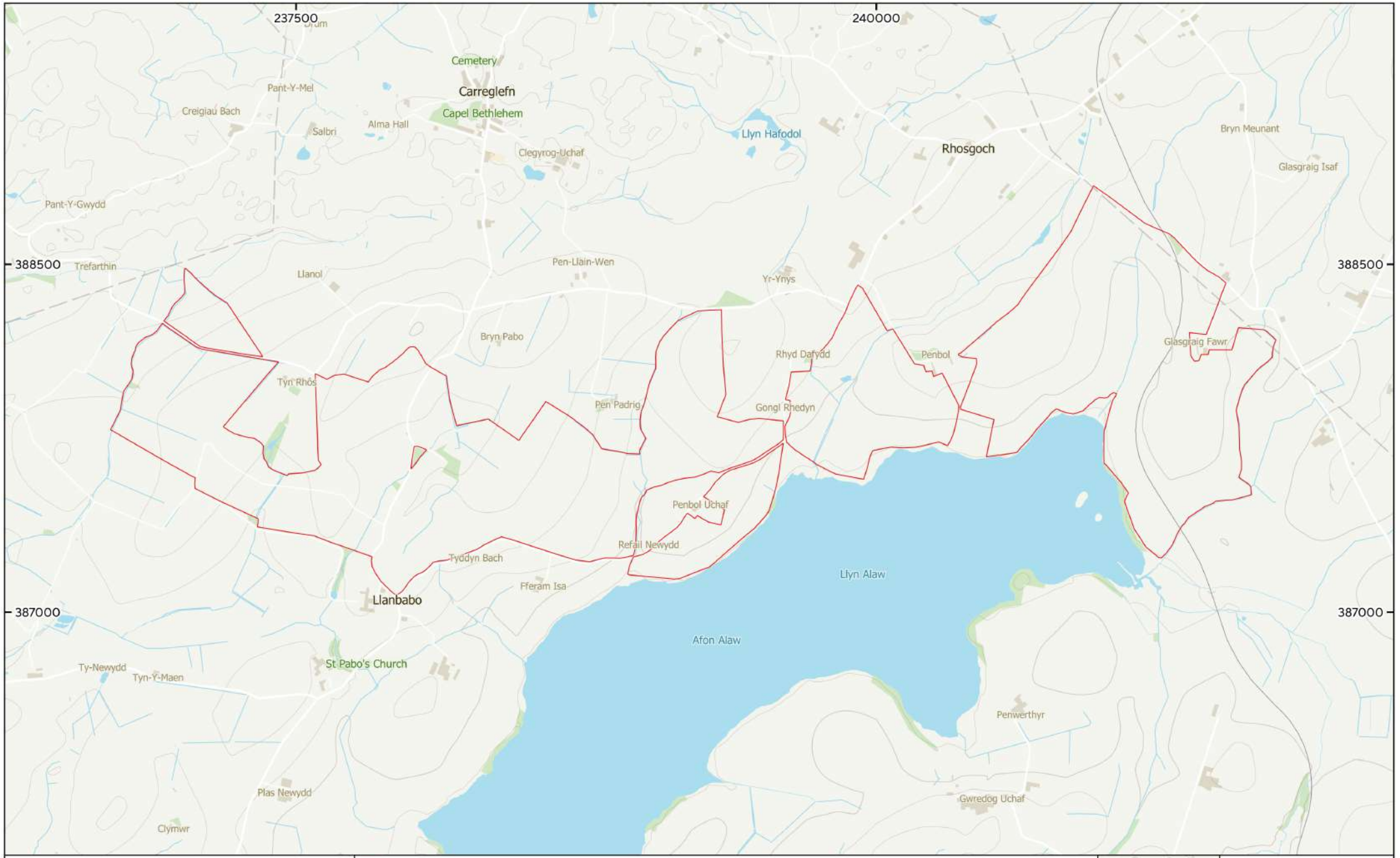
15 Document History

Version	Comments	Author	Checked By	Date
0.1	WSI	Daniel Wilkinson BA (Hons)	IC, PSJ	02 August 2024

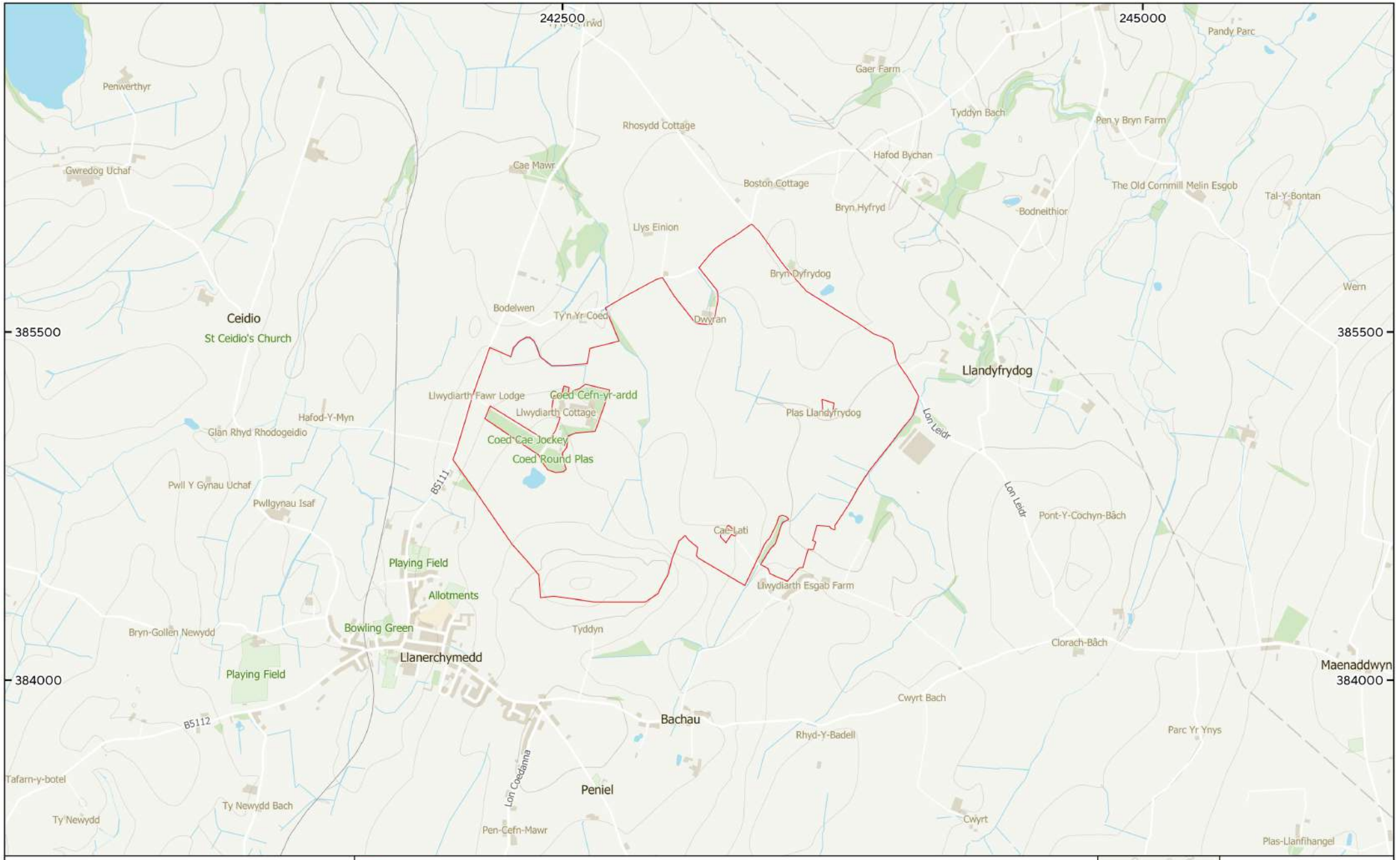
MSSH1831: Maen Hir, Anglesey
Figure 1 - Geophysical Survey Location
1:50,000 @ A4

Geophysical Survey Location

0 1 2 km



MSSH1831: Maen Hir, Anglesey
Figure 2 - Geophysical Survey Areas (North)
1:15,000 @ A3



MSSH1831: Maen Hir, Anglesey
Figure 3 - Geophysical Survey Areas (South)
1:15,000 @ A3

Survey Areas

Magnitude Surveys

0 150 300 450 600 m

Magnitude Surveys

01274 926020
3 Captain Street, Bradford, BD1 4HA

WRITTEN SCHEME OF INVESTIGATION FOR GEOPHYSICAL SURVEY

Location

PROSIECT MAEN HIR, YNYS MÔN

Unit 1
Link Trade Park
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TERRA DAT
down to earth geophysics

Job reference: 8726
Date: July 2024
Version: 1

WRITTEN SCHEME OF INVESTIGATION FOR GEOPHYSICAL SURVEY

Location

PROSIECT MAEN HIR, YNYS MÔN

Author	**Christian Bird**
Reviewer	**Dr Tim Young**
Job Reference	**8726**
Date	**24/07/2024**

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1. Non-technical summary

This written scheme of investigation (WSI) details the methodology for a geophysical survey programme at the proposed *Prosiect Maen Hir*, an approximately 1200 ha solar farm development across the northeast of the isle of Anglesey.

Prosiect Maen Hir will have a capacity of over 350 megawatts (MW) of clean, renewable electricity. An application for a Development Consent Order is to be submitted for the solar farm's construction. The proposals include infrastructure for generating and storing renewable energy, supplying this electricity to the grid, and the accesses and temporary compounds required for construction.

The full Maen Hir site is split into three sub-areas. This WSI relates to the South area. The South area measures ~399 ha and is centred on the farmstead of Ynys Bach (NGR 244322, 382215)

This WSI has been prepared by Christian Brid (TerraDat (UK) Ltd) to define the scope of works and their methodology. This WSI is to be approved by Gwynedd Archaeological Trust (GAT) before the survey is undertaken in its capacity as archaeological advisor to the local planning authority.

Towed magnetic gradiometry is proposed as the primary survey method; experience of similar sites suggests that an average of 20 ha acquisition (per team) a day should be possible.

All work will conform to the Chartered Institute for Archaeologists Standard and Guidance for Geophysical Survey (CIfA December 2014) and will be undertaken by suitably qualified staff to the highest professional standards.

A report containing all relevant information will be produced upon completion of the survey. The geophysical survey will comply with guidelines outlined by English Heritage (now Historic England) (David *et al.* 2008), the Chartered Institute for Archaeologists (CIfA 2014) and Europae Archaeologiae Consilium (EAC) (Schmidt *et al.* 2016).

2. Introduction and project background

This written scheme of investigation (WSI) details the methodology for a geophysical survey programme at the proposed *Prosiect Maen Hir*, an approximately 1200 ha solar farm development across the northeast of the isle of Anglesey (Plate 1).

Prosiect Maen Hir will have a capacity of over 350 megawatts (MW) of clean, renewable electricity. An application for a Development Consent Order is to be submitted for the solar farm's construction. The proposals include infrastructure for generating and storing renewable energy, supplying this electricity to the grid, and the accesses and temporary compounds required for construction.

The full Maen Hir site is split into three sub-areas (North, Central and South [further divided into South A and South B]). This WSI relates to the area 'South B'. Plate 1 shows the location of the full Site; Plate 2 shows the arrangement of the three areas; Plate 3 details South B. South B measures ~397 ha and is centred on the farmstead of Ynys Bach (NGR 244322, 382215).

This WSI has been prepared by Christian Bird (TerraDat (UK) Ltd) to define the survey's scope of work and methodology. This WSI is to be approved by Gwynedd Archaeological Trust (GAT) before the survey is undertaken in its capacity as archaeological advisor to the local planning authority.

All work will conform to the Chartered Institute for Archaeologists Standard and Guidance for Geophysical Survey (CIfA December 2014) and be undertaken by suitably qualified staff to the highest professional standards.

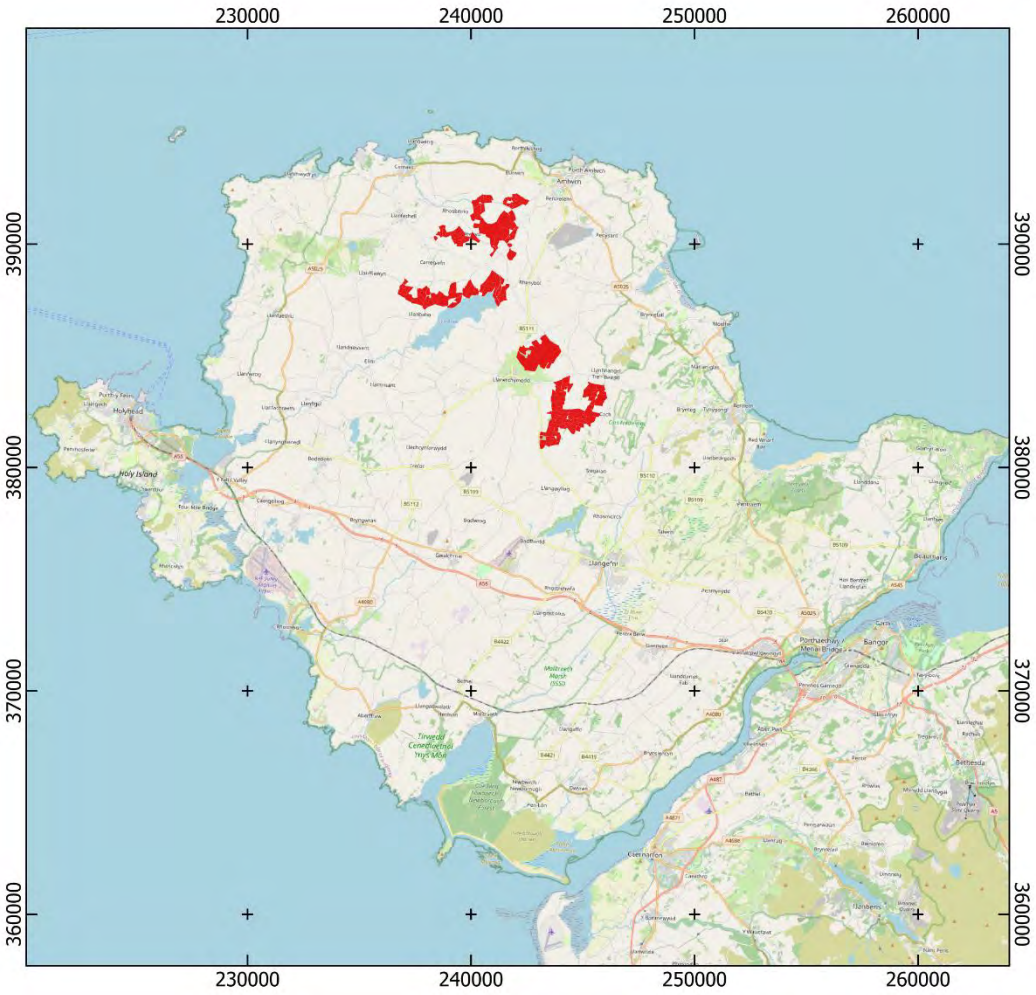

Plate 1 *– Location of Prosiect Maen Hir*

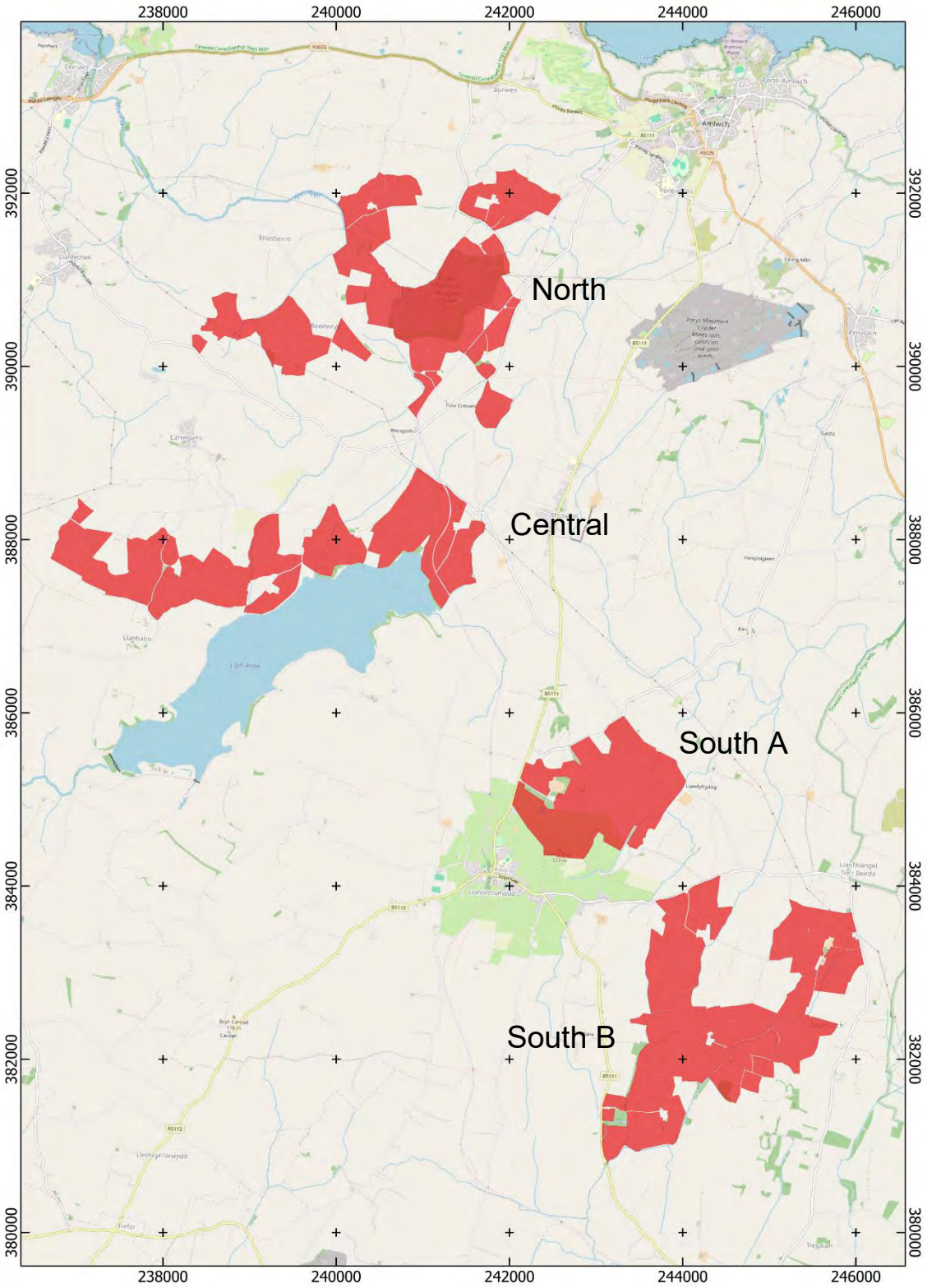

Plate 2 *– Arrangement of the four survey areas*

3. Site Description

The proposed development site encompasses four adjacent areas. The Historic Environment Desk-Based Assessment (DBA) conducted by Cotswold Archaeology (Sanigar, 2024) subdivides the Site into North, Central, and South (further divided into A and B areas) (Plate 2).

Maen Hir South B is located approximately 1.5 km east of Llanerch-y-medd, covering around 399 hectares (Plate 3). Situated in a rural setting, its boundaries are defined by a mixture of hedgerows, ditches, fence lines, and cloddiau (drystone/boulder walls with earth bank).

The Site is primarily surrounded by an open pastoral landscape, featuring numerous farmsteads and small hamlets. The study area is predominantly agricultural, characterised by small to large pastoral fields interspersed with pockets of woodland and scattered farmsteads.

Maen Hir South lies within the West Central Anglesey landscape character area (LCA), a substantial part of Anglesey's rural heartland. The topography is generally undulating, reflecting its underlying geology, particularly the Coedana Granites. This geology creates several rocky outcrops, which are distinctive features of this part of the island. These outcrops and small areas of semi-natural habitats – including hedges, trees, and mires – are scattered throughout the area within a matrix of improved agricultural grassland (Isle of Anglesey County Council 2011).

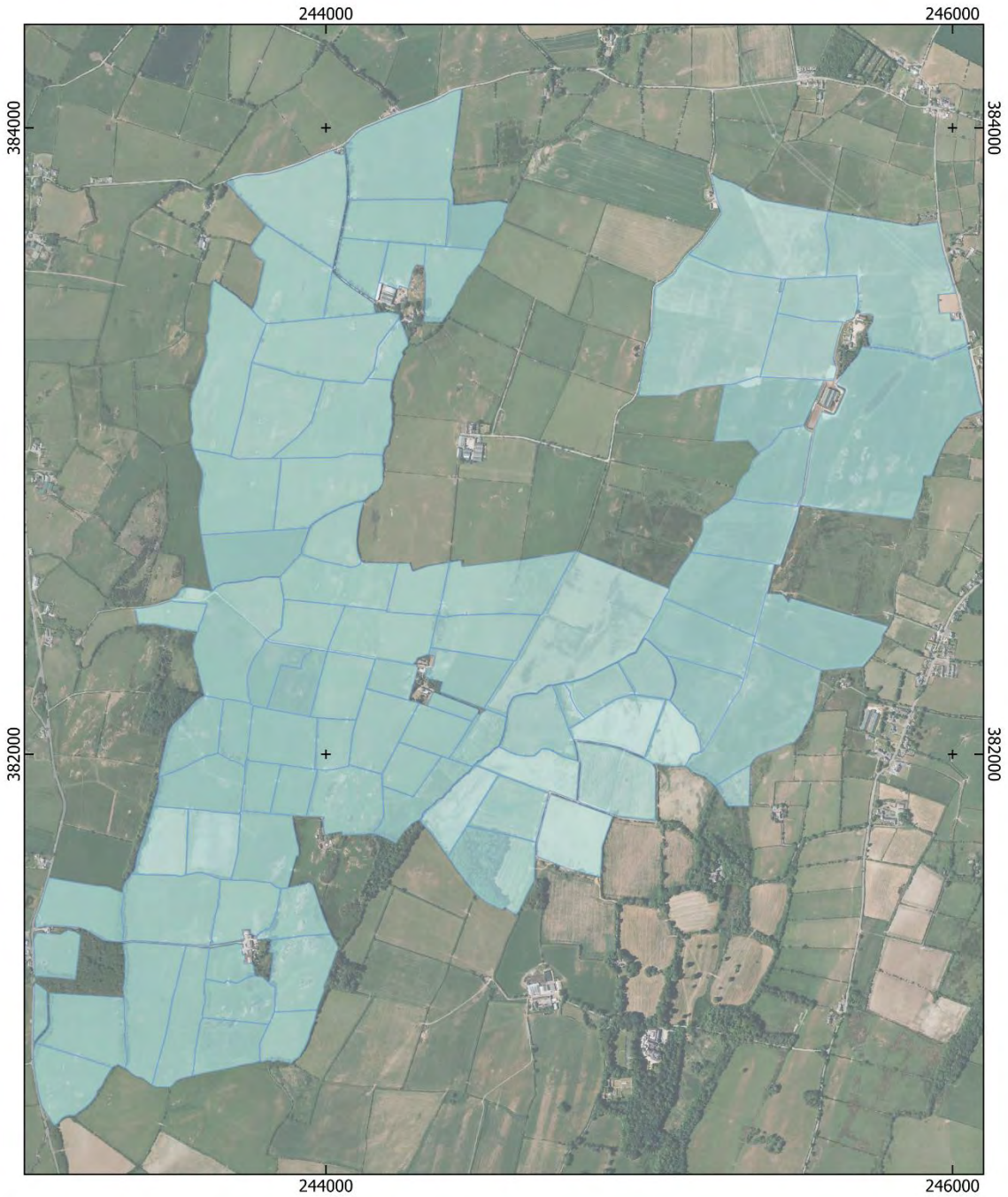

Plate 3 *– Detail of the survey area at Maen Hir South B*

3.1 Solid Geology

Maen Hir South B overlies four differing types of bedrock (Plate 4) and will be summarised from north to south. The northernmost bedrock within this area is hornfels of the Coedana Complex, a metamorphic bedrock formed between 635 and 541 million years ago during the Ediacaran period. The next is the Coedana Granite, formed in the Ediacaran period, bounded to the south by the Central Anglesey Shear Zone, with hornblende schists passing SE into undifferentiated schists. A small area in the SE of the survey passes onto undifferentiated Ordovician mudstones (BGS 2024).

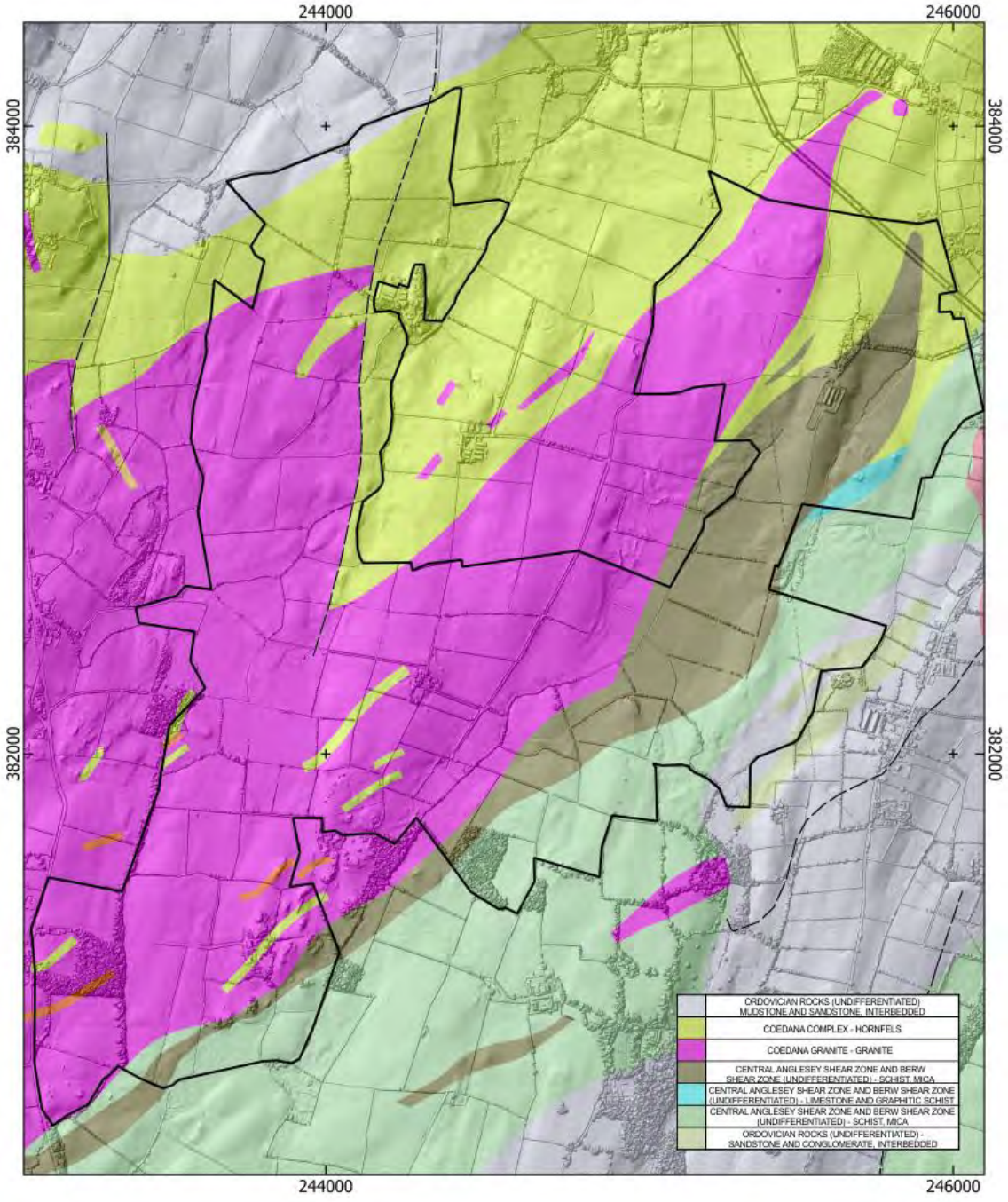

***Plate 4** – Solid geology of the Site and surrounding area (BGS 2024)*

3.2 Superficial Geology

Quaternary-age Devensian Diamicton Till mantles the majority of the Site. Till is defined as unsorted and unstratified drift, generally over-consolidated, deposited directly by and underneath a glacier without subsequent reworking by water from the glacier. It consists of a heterogeneous mixture of clay, sand, gravel, and boulders varying widely in size and shape. Smaller patches of alluvial sand, silts and clays (BGS 2024) are located within the site boundary of Maen Hir South.

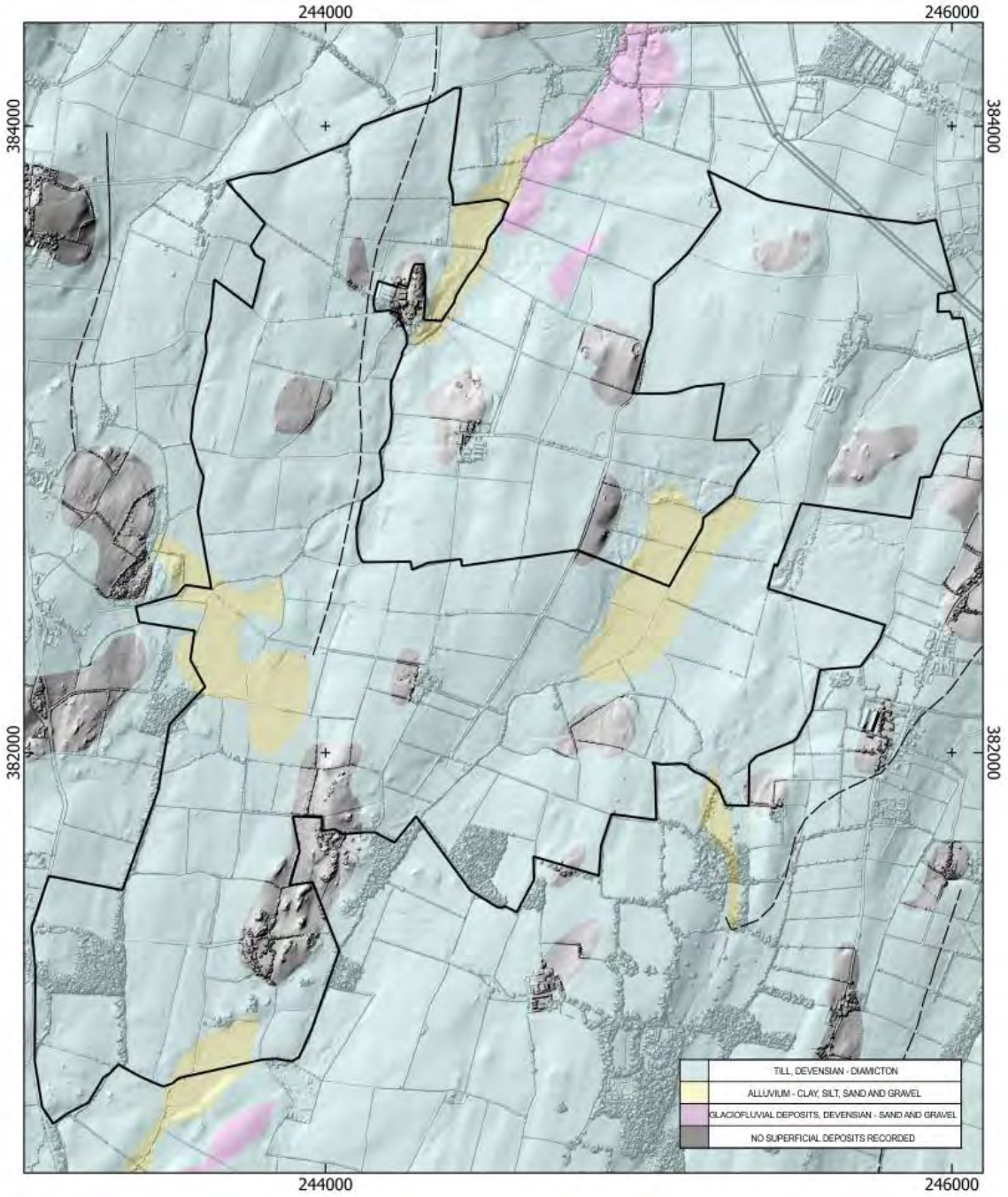

Plate 4 *– Superficial (drift) geology of the Site and surrounding area (BGS 2024)*

3.3 Soils

Test pitting within the Site recorded a topsoil measuring between 0.22m and 0.32m thick, overlying a thin subsoil measuring 0.06m in thickness. The archaeological horizons were encountered between 0.24m and 0.38m below the ground surface (Hopewell et al. 2007).

An excavation located within the southern part of the Site recorded a ploughsoil and subsoil matrix measuring between 0.42m and 0.48m in thickness, overlying a natural geology comprising a compact reddish-brown clay with some grey banding (CR Archaeology 2016).

3.4 Effect of Geology on Geophysics

There may be an effect on the data recorded at Maen Hir South due to magnetic minerals within and derived from the granite bedrock. The thickness of the overlying till deposits will be important in nullifying the effects of the magnetic minerals in the rocks. However, there are few unrestricted borehole records in the area, and it is not known how thick the till deposits are likely to be; however, bedrock does appear to outcrop in patches across the survey area (Plate 4).

The English heritage guidance 'Geophysical Survey in Archaeological Field Evaluation' (Table 4, 2008) states that *thermoremanent effects can preclude survey over some igneous rock types (e.g. basalts); however, others (e.g. cornish granites) seem to be relatively unaffected*. The total magnetic intensity maps of Anglesey (BGS, Plate 5) show an elevated magnetic response due to igneous rocks beneath the Site. However, the magnetic anomaly at the Site is weaker than that caused by the Cornubian batholith beneath Cornwall.

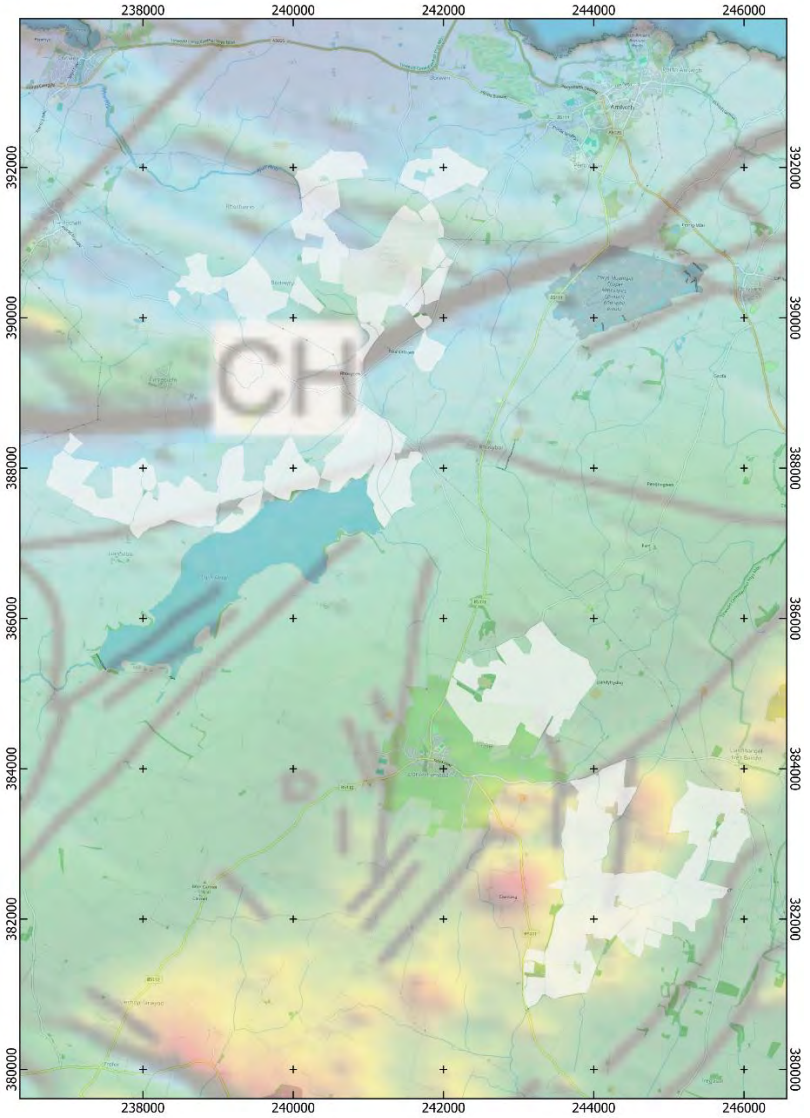

Plate 5 *– Total magnetic inbtensity map of the survey area*

4. Archaeological and historical background

4.1 Archaeology

Cotswold Archaeology (CA) has conducted a Heritage Environment Desk-Based assessment of the Site (Sanigar, 2024), and the following archaeological background has been adapted from this Document.

Maen Hir South B contains no designated historic assets such as Listed Buildings, Scheduled Monuments, World Heritage Sites, Registered Parks and Gardens, Registered Battlefields, or Conservation Areas. Plate 6 shows the locations of Listed Buildings and Scheduled monuments close to Maen Hir South B.

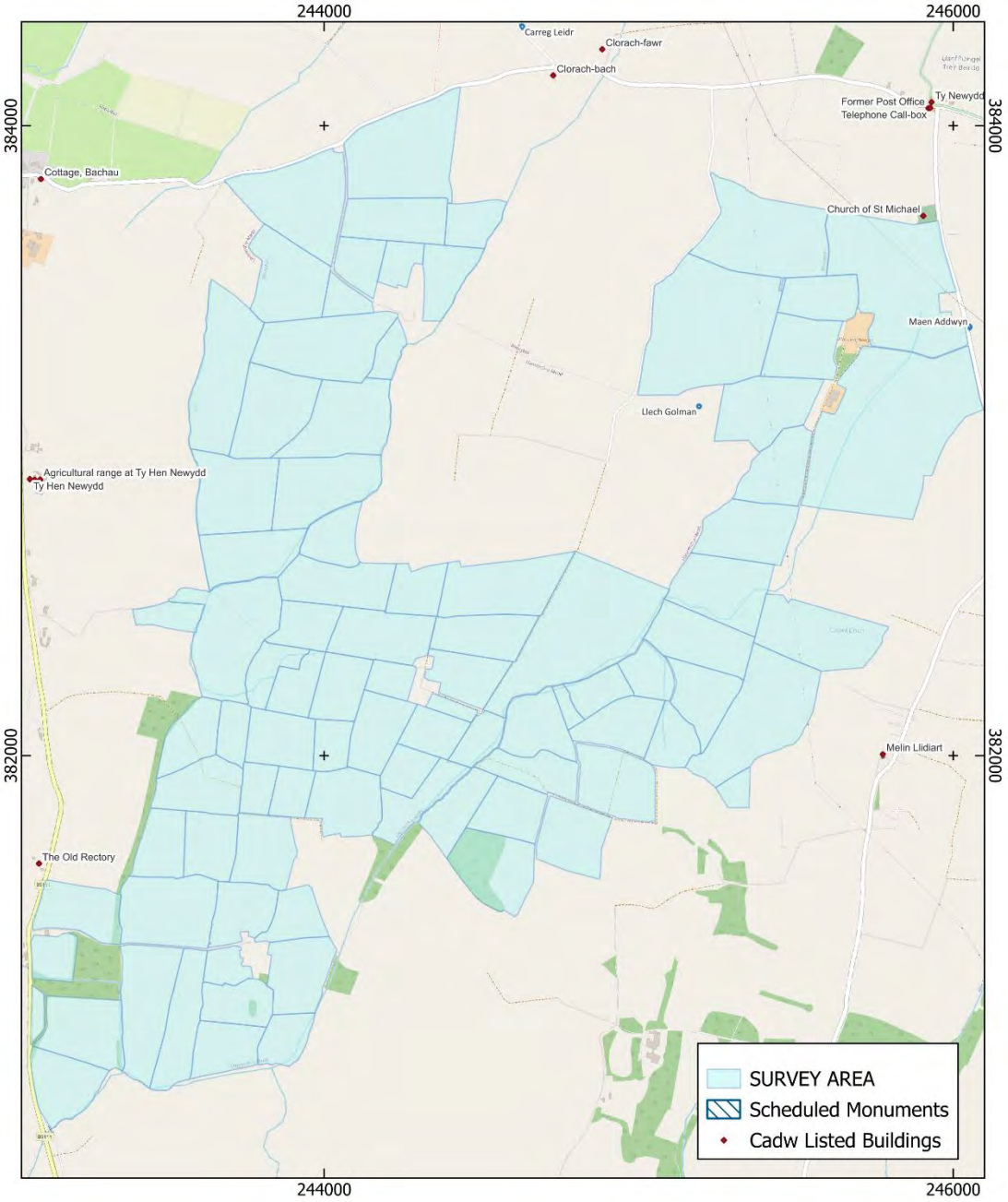

***Plate 6** – Scheduled Monuments and listed buildings close to Maen Hir South B*

Numerous archaeological investigations have been conducted within Maen Hir South. Key findings include:

- A possible Bronze Age copper alloy ingot was discovered during a metal detector survey 1.5 km north of the Site.
- Mesolithic worked flint was found 800 meters west of the Site by a fieldwalking survey.
- A Late Bronze Age gouge was uncovered during a 2004 metal detecting survey 900 meters east of the Site.

In 2017, an evaluation revealed no significant features but suggested background prehistoric activity through unstratified worked flint. Additionally, a standing stone assessed along the Highway Works route may date back to the Bronze Age or post-medieval period.

Surveys and excavations within the site centre discovered artefacts from the Roman, medieval, and post-medieval periods, along with a prehistoric enclosure indicating settlement. Furthermore, excavations for the Rhosgoch to Stanlow Shell Oil Pipeline between 1972 and 1974 uncovered burnt mounds and a possible medieval settlement.

4.1.1 Bronze age

Several Bronze Age sites are located near Maen Hir South A and B, including a burnt mound or metal working site 1.4km north, partially destroyed by the Shell pipeline. Excavations revealed pits, postholes, slag, and charcoal. Another possible burnt mound was found 740m west. Nearby, round barrows and circular earthworks are recorded, such as a barrow 520m west and a cropmark 300m west. Significant monuments include the Scheduled Llech Golman standing stone 60m west, Maen Addwyn immediately east, and the Llys Einion Standing Stone 120m north. Rock art indicating Bronze Age settlement is found in Maen Hir South A. Bronze Age metalwork, including axes and a spear, have been discovered within the area, indicating extensive prehistoric activity.

4.1.2 Iron age

A potential late prehistoric or Iron Age settlement is recorded in the centre of Maen Hir South B, identified through a geophysical survey as a small sub-circular enclosure named Ynys Bach, covering 0.11 hectares. This enclosure, visible as a shallow earthwork in LiDAR imagery, features a substantial bank and a 3m-wide ditch with evidence of internal settlement. Despite its compact size and non-defensive location, testing within the enclosure revealed archaeological horizons but no artefactual evidence. The settlement's layout, typical of courtyard house settlements, suggests houses built into or closely adjoining the enclosure bank, indicating a possible late prehistoric or Roman date.

A potential late prehistoric/Roman settlement is recorded c.980m to the south of Maen Hir South, comprising many curvilinear, rectangular and square features as a series of cropmarks. These features have not been investigated to ascertain their form, function or date.

In summary, evidence of late prehistoric/Iron Age settlement and findspots are recorded within the Site. The assessment has identified that the Site's landscape was extensively settled during the Iron Age, with some settlement sites crossing over to the Roman period, illustrating the continuity of occupation within well-established settlements spanning multiple periods. Therefore, there is potential for further archaeological remains associated with these known settlement sites, such as agricultural features or previously unknown settlements, to be located within the Site.

4.1.3 Roman

Within Maen Hir South B is a concentration of potential Roman archaeological remains, including a small sub-circular enclosure typical of courtyard house settlements where houses cluster around a central space. Similar enclosures in northwest Wales have been dated to the Romano-British period, sometimes built over earlier timber roundhouses. A nearby findspot of a flat circular copper alloy object, possibly a coin or token, supports a Roman date. This Site is located 1.1km north of a suggested route of a Roman road.

A section of potential Roman road is located within the southern area of Maen Hir South B, oriented east to west. This road may be part of a Roman route crossing from Beaumaris to Holyhead. The Talwrn Archaeology Group traced a series of probable early roads, each 5 meters wide or wider, between hedge banks and suggested they are of Roman origin. However, these roads have not been investigated to confirm their date and character.

During the Roman period, roads were often focal points for various activities such as burials, religious sites, artefact deposition, agriculture, and settlement. This is supported by multiple findspots of coins, pottery, and a bead approximately 1 km west of Maen Hir South B. If the road is indeed Roman, further Roman activity could be present on either side of the route within the southern area of Maen Hir South B.

The Scheduled Bodafon Mountain Hut Groups, located 1.7 kilometres northeast of Maen Hir South B, contain hut circles with stone foundations and were inhabited into the Roman period, with midden evidence dating to the 2nd and 3rd centuries AD Undated earthworks covering 300 by 200 meters, possibly a Roman farmstead, are found 500 meters south of the Site, and undated small mounds, potentially Roman funerary monuments, are identified 190 meters south of the Site along a possible Roman road.

4.1.4 Early medieval

Two early medieval holy wells, Ffynonn Cybi and Ffynnon Seiriol, are located approximately 470m northeast of Maen Hir South B. St Cybi, a 6th-century bishop from Cornwall who later settled in Wales, founded a monastery at Holyhead and was known as Cybi Felyn due to his sun-tanned complexion from his travels to meet his friend St Seiriol, who established a cell at Penmon Priory. Near these wells, a nunnery site is marked on an 1818-1823 Ordnance Survey map about 540m northeast of Maen Hir South B, though no physical evidence confirms its existence. Additionally, a 7th-11th century incised stone is located in the yard of St Michael's Church, 10m north of Maen Hir South B.

The Site likely served as the agricultural landscape surrounding early medieval settlements, typically near religious centres or churches. Although few early medieval churches remain due to later reconstruction, the area shows significant religious and social activity through the presence of holy wells, a suggested nunnery, and incised stones.

4.1.5 Medieval

A circular cropmark about 330m east and west of Maen Hir South B may indicate a ring-motte, a type of defended medieval settlement. Another defended medieval settlement is recorded 990m southwest of Maen Hir South B. Additionally, a medieval battle site, possibly from 1194 between Llywelyn ap Gruffydd and loyalist forces, is located approximately 1.4km west of Maen Hir South B, 1.5km southwest of the Cable Route Corridor, and 810m west of the Highway Works, suggested by the placename' cae cyrch gwyddel' or 'field of the bloody Manx/Irishman.'

The Site likely formed the agricultural hinterland beyond the villages and settlements in the study area. Archaeological evidence indicates that the medieval landscape was rural, dotted with churches that served as focal points for small hamlets and farmsteads, along with a few water mills on watercourses. Although there is limited evidence of medieval field boundaries, with only two recorded as above-ground earthworks, it is possible that additional agricultural features, such as ridge and furrow patterns or field boundaries, may survive below ground as the landscape evolved over time.

4.1.6 Post-medieval

Potential remains of ridge and furrow are present in discrete locations on aerial photographs throughout the Site. These remains are all on differing orientations compared to the direction of modern cultivation lines, possibly indicating that the present large fields were once divided into small land parcels and utilised for arable farming.

5. Aims and Objectives

This WSI sets out a program of geophysical survey to meet the standard required by The Chartered Institute for Archaeologist's Standard and Guidance for archaeological geophysical survey (2014).

The primary objective of the geophysical survey will be to locate and describe any detectable archaeological features present. The survey will provide context and insight as a standalone document and facilitate the subsequent fieldwork phase by indicating the detected features' location, character, extent, and potential significance.

A report will be produced with sufficient detail to allow the archaeological resource to be better understood and to improve the outcome of the subsequent watching brief.

6. Methodology

6.1 Overview

Magnetic gradiometry (measurement of the vertical gradient of the Earth's magnetic field, using two sensors, one positioned above the other typically at 1.0m separation) developed from magnetometry (measurement of the Earth's magnetic field strength, using a single sensor) to free magnetic surveys from the constraint of requiring base-station measurements to compensate for diurnal variation in field strength.

The identified magnetic anomalies (i.e. areas with a magnetic gradient that deviates from that of the typical site background) may be due to the influence of one of three main magnetic properties: ***ferromagnetism*** (that exhibited by a magnetic object of ferrous metal), ***remanent magnetism*** (a permanent sympathetic magnetic field acquired during the cooling of a hot object, commonly seen in both fixed archaeological features such as hearths, as well as portable materials, such as ceramic building material [CBM]) and most importantly of all, ***magnetic susceptibility*** ([MS], a measure of the temporary sympathetic magnetic field generated by a body in an ambient field). Typically, weathering elevates the magnetic susceptibility, so soils have a higher MS than their parent rock. Anthropogenic processes (particularly heating) may also enhance MS. Thus, the fills of archaeological cut features typically show a higher magnetic susceptibility than the substrate into which they are cut (and thus appear as positive anomalies). There are exceptions to this sense of susceptibility contrast – for instance, where a cut feature is filled by stone with low magnetic susceptibility. For structures built of stone, there is typically

a stronger contrast between the lower MS stonework and higher MS occupation deposits (meaning that stone walls, drains, etc., usually show negative magnetic anomalies).

Ferrous materials usually strongly influence the magnetic gradient but to a limited spatial extent. These anomalies typically show strong negative and positive components (so a small iron object appears as a black/white dot on the plots). Accumulations of iron objects may generate a speckled appearance – typical, for instance, of the sites of former wire fences. The remanent magnetic fields of CBM may also produce speckled textures – brick rubble will appear similar to a spread of ferrous debris but with lower magnitude 'spikes'.

6.2 Technique

The survey will use an implementation of magnetic gradiometry employing an array of multiple gradiometers deployed on a lightweight non-magnetic cart. Cart-based systems have four great advantages over manually-deployed instruments:

- Firstly the cart enables the use of up to 5 (for the *Sensys Magneto MXPDA*) or 8 (for the *Sensys Magneto MXV3*) sensors at 0.5m spacing – producing double the traverse density compared with a standard manual instrument (e.g. the Bartington Grad601);
- the cart imposes a rigid alignment on the multiple sensors, which, together with the recording of location by GPS, eliminates the slight 'between traverse' locational errors in manually-acquired data, across an effective swath width of 2m and 3.5m for the MPXDA and MXV3 respectively;
- the use of GPS for data location means there is no requirement for gridding fields as with conventional instruments, saving a considerable investment in field time;
- the sensors employed by these systems operate at up to 200Hz (although typically only up to 100Hz in the configuration to be used here), which permits data acquisition with the larger cart system to be at rates compatible with its towing by ATV of speeds of up to 15km/h.

The approach to be adopted for this survey is to employ the vehicle-towed MXV3 for all the larger fields and to use the smaller manually-pushed cart (MPXDA) for smaller fields where the vehicle towed system would not be sufficiently manoeuvrable (generally for those areas <2Ha)

The resultant data lie on 0.5m-spaced traverses, with sub-100mm spacing between readings along the traverses.

6.3 Data Processing

The gradiometry data are acquired using *SENSYS* proprietary software *MONMX*, which produces a data file for each acquired survey line. These files are compiled in *DLMGPS*, which locates each gradiometry data point using the GPS data; coordinates are calculated based on the location of each sensor within the array, thus creating a single swathe of gradiometry data up to 3.5m wide. The software applies a constant median filter to normalise the data within each swathe; the data are then exported as raw ASCII files. The plug-in software *Geoserver* is used to transform the coordinates from lat, long (WGS84) to national grid coordinates (OSGB36).

The ASCII files output from *DLMGPS* are further processed using TerraDat proprietary software *MagMerge* (Plate 7) to remove any poor-quality data (sensor drop-outs/data spikes etc/overlapping data.) and apply 50Hz and rolling median filters. The 50Hz filter removes artefacts principally associated with electrical power lines, while the median filter equalises the background data across the swathes within a dataset, removing any apparent striping between them. Plate 8 shows an example of raw data alongside filtered data. Table 1 details the processing steps that are applied to the ASCII data;

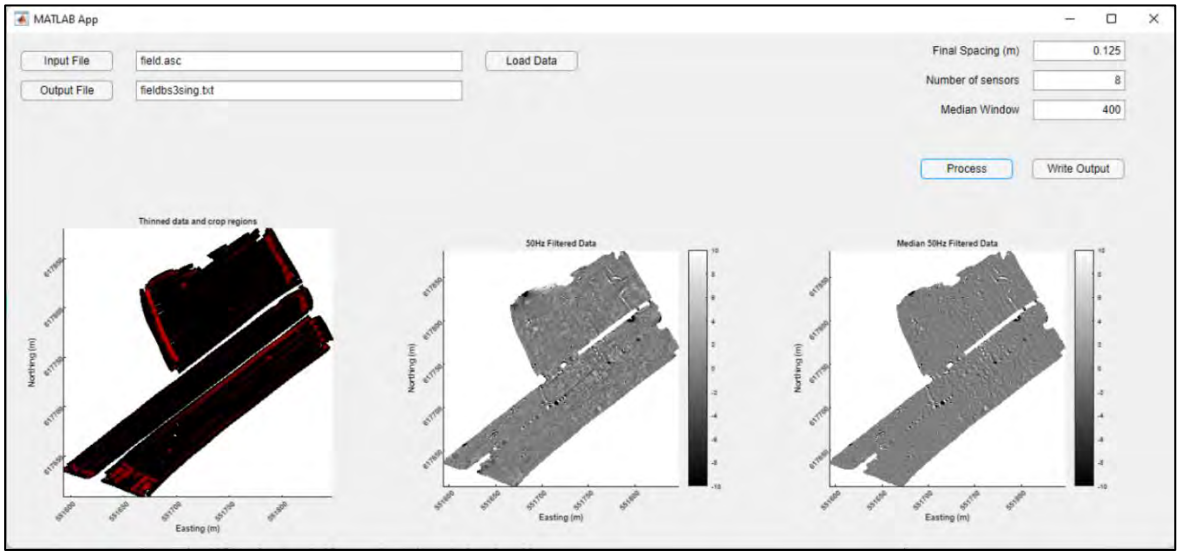

Plate 7: *TerraDat proprietary software MagMerge*

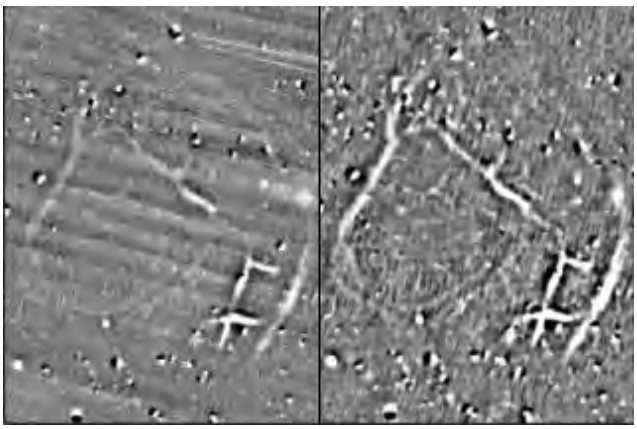

Plate 8: *Raw data (left) and filtered data (right)*

Processing Step	Description
Raw data input	Raw data (.asc) file is imported, and X,Y,Z,gradient,Time_stamp,sensor columns are retained. All other columns are removed.
Truncate Time_Stamp	Alphanumeric Time_stamp variable is truncated to the last digits (e.g. L1_20221007-095821_GZ.prm becomes 95821) to create unique IDs for each line.
Create line_number	Variable 'line_number' (i.e. 1 to #lines) is created by identifying all unique 'Time_stamp' values.
Rolling median	The median filter is calculated per line, per sensor, on values within -/+20nT and removed from the gradient to create a new 'GM' column. The rolling median filter has a window length of 400 data points centred on the input value. Therefore, the first and last 200 data points do not have sufficient information to calculate the median. In these cases, the first value calculated is applied back to the start of the line, and the last value calculated is filled forward to the end of the line. In practical terms, the median window length is equivalent to 10m of data acquisition.
Filter 50Hz Noise	50Hz noise from electrical utilities is removed through wavelet analysis, signal decomposition, and a 50Hz Bandstop filter. Both methods yield similar results. Multiple combinations of Median and 50Hz filters are created (i.e. G50, G50M, G50BS and G50BSM) for comparison.
Calculate Mean Spacing	Mean along-track spacing is calculated.
Thin data	Data are thinned to specified output resolution using the calculated mean spacing
Crop overlapping data	Calculate bounding polygons around each line of data. Remove data located within reverse-ordered overlapping polygons.
Display Data	Plot thinned data and cropped areas, plot 50Hz filtered data, plot median filtered data.
Write output file	Write output file containing thinned data with X,Y,Z, gradient,Time_stamp,sensor,Gm,G50,G50M,linenum,G50BS,G50BSM.
Write output GPS	Write output X,Y,Z gps file using centre (actual GPS) data.

***Table 1**: Processing steps applied to the raw magnetic gradiometry data.*

The magnetic gradiometry data is output as raw and filtered 'XYZ' files in .CSV format. The height data from the GPS is also output as an approximately 3m x 0.125m resolution DTM of the Site. These files are gridded in Oasis Montaj, using minimum curvature gridding and a grid cell size of 0.125m. Once the data is gridded and an appropriate colour scale applied, the data is exported as high-resolution GeoTiff images (900 DPI) before being imported into the open-source GIS software qGIS. Features of interest are then digitised to produce summary archaeological interpretation plans. These are integrated with the DTM to allow consideration of any identified archaeological features within the Site's topography. Final figures are created in CorelDraw and .SHP files are exported to be sent with the report.

6.4 Constraints

The main limitation of magnetic surveys is that the nearby presence of metallic (ferrous) features/debris can mask the more subtle response from the target features. Magnetic solar storms may cause occasional fluctuations in readings. The size and depth of the target feature will affect its detectability. Constraints on data acquisition include excess vegetation, extremely soft or rough ground and the presence of obstacles (particularly where made of steel (e.g. electric fences and animal feeding troughs). The presence of igneous bedrock can have a detrimental effect on magnetic gradiometry data, as discussed in section 3.4.

6.5 Monitoring

GAT will be contacted approximately one week prior to the commencement of site works.

7. Post-fieldwork programme

7.1 Site archive: Geophysical Survey

An ordered and integrated project archive will be prepared in accordance with guidelines set out by Schmidt (2011) and in the EAC Guidelines for the Use of Geophysics in Archaeology (Schmidt et al., 2015).

7.2 Reports and archive deposition

7.2.1 Report to client

Copies of all reports associated with the geophysical survey will be submitted to the CA and GAT for approval upon completion. Digital copies will be provided in pdf format if required.

The client report will contain, as a minimum, the following elements:

- Concise, non-technical summary of the results
- Introductory statements and project background
- Aims and purposes of the survey
- Methodology, including a description of and reasoning behind the geophysical survey technique
- Detailed plans of the site and survey results. All processing techniques used will be accompanied by a full justification statement.
- Written description
- Written interpretation of results along with illustrated interpreted site plan
- Statement of local and regional context
- Conclusions as appropriate
- Index to and location of the digital archive
- Bibliography

7.2.2 Deposition

Final versions of the approved report will be deposited with the Gwynedd Historical Environment Record (HER) and the National Monuments Record (NMR). Material deposited will be prepared and deposited per guidance for the Submission of Data to the Welsh Historic Environment Records (WAT 2018).

7.2.3 Summary reports for publication

A short report will be submitted to 'Archaeology in Wales' or made available for incorporation within reporting arising from the survey, as deemed most appropriate at the time.

7.2.4 Notification of important remains

Where it is considered that remains have been revealed that may satisfy the criteria for statutory protection, Terradat will submit a preliminary notification of the remains to Cadw.

8. Resources and timetable

8.1 Standards

Terradat (UK.) Ltd works to the standards and guidance provided by the Chartered Institute for Archaeologists.

8.2 Staff

The project will be undertaken by suitably qualified and experienced Terradat staff. Overall management of the project will be undertaken by Christian Bird (07966 934350). Interpretation and quality control will be by Dr Tim Young (GeoArch).

8.3 Survey approach and timetable

It is anticipated that the ultimate client land agent will have contacted landowners and tenant farmers before the survey, and an assumption of unrestricted access has been made for planning; however, it is anticipated that daily access will be arranged in coordination with the contract manager and the tenant farmers.

The timetable is provisional but realistic and based on an average daily coverage rate for similar regional-scale surveys conducted by TerraDat elsewhere. It is anticipated that the survey will be conducted in September 2024. Two teams will be deployed, and the survey will take three weeks.

9. Environmental Protection

Geophysical surveys, by their very nature, are non-invasive and involve minimal disturbance to the ground and environment. Usually, our work has a lower impact than routine agricultural activities. The sections below represent our company's environmental policy.

- **Marking out survey grids or profiles**: No marking out will be required.

- **Vehicular access:** the main form of access in the survey area will be by van or 4X4 vehicle. The Sensys Magneto MXV3 will be towed by a lightweight ATV (Honda Fourtrax Quad Bike or equivalent). The survey team will avoid, wherever possible, any activity where ground damage may be caused.

- **Chemical use:** No hazardous chemicals or substances are anticipated for use in this project.

- **Noise:** No excessive amounts of machinery noise arise from our activities.

- **Site tidiness:** Any litter, survey consumables or packaging materials will be removed from the Site and properly disposed of by TerraDat.

- **Groundwater hazards:** None of the proposed activities will cause any chemical or erosional contamination of waterways, streams or groundwater.

10 Plant and Equipment

Transit-type vans and 4x4 vehicles will transport the survey crew and survey equipment to the Site.

The geophysical survey equipment will comprise a SENSYS Magneto MXV3 8-Channel magnetometer system towed behind a lightweight ATV (John Deere Gator/quad bike)

The *Sensys Magneto MXV3,* comprises eight fluxgate gradiometer probes installed at 0.5m sensor separation on the trailer (Plate 5). A network-corrected RTK GPS provides real-time GPS positioning. This system allows for acquiring 0.5m horizontal resolution gradiometry data within a 3.5m wide swathe. The trailer is towed across the survey area behind an ATV (Plate 9) at speeds of ~15 km/h.

Plate 9 *– John Deer Gator and Sensys Magneto MXV3*

11 Health and Safety

TerraDat staff should refer to the TerraDat Health and Safety Manual. TerraDat has attained OHSAS 18001 status.

12 Quality Control

TerraDat has attained BS EN ISO 9001:2010 and ISO 14001:2004. The proposed quality management arrangements for this project are contained in the Quality Manual issued by the TerraDat Directors (a copy of which can be sent if requested). Throughout the duration of the project, daily records will be maintained for quality audit purposes in order to ensure that the arrangements are effective and appropriate for the work being carried out. All work carried out and issued by TerraDat is in accordance with BS 5930: 2015 (site investigation).

13 References

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