CLONASLEE FLOOD RELIEF SCHEME

Appendix 16.7: Geophysical Survey Report

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Clonaslee Flood Relief Scheme, Co. Laois: Archaeological Geophysical Survey

Archaeological Management Solutions

Prepared for RPS Group

By Finn Melia

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AMS Cultural Heritage Consultancy Limited trading as Archaeological Management Solutions

Company Registration No. 721173

Fahy's Road, Kilrush, Co. Clare. V15 C780

T +353 (0)65 906 2878

www.ams-consultancy.com

Disclaimer

The results, conclusions and recommendations contained within this report are based on information available at the time of its preparation. Whilst every effort has been made to ensure that all relevant data have been collated, the authors and AMS accept no responsibility for omissions and/or inconsistencies that may result from information becoming available subsequent to the report's completion.

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Summary

This report describes the results of an Archaeological Geophysical Survey under consent No.: 24R0216, issued to Finn Melia of Archaeological Management Solutions (AMS). Surveys were carried out at three sites along the banks of the Clodiagh river in the townland of Clonaslee Co. Laois, as part of the Clonaslee Flood Relief Scheme.

The survey area comprised 2ha across three sites, the southern survey area comprises 0.5ha, the central study area comprises 0.8ha, and the northern survey area comprises 0.7ha. The investigation comprised a high-resolution Magnetometry and Electromagnetic Induction (EMI) Survey undertaken in March 2024.

The survey of the sites successfully characterised the extent of potential archaeological deposits. The responses across the survey areas were generally good, revealing some possible archaeological features.

GS-01 presented several anomalies including a former water course, as depicted on the 1837 first-edition six-inch OS map. Additionally several linear and rectilinear anomalies with possible archaeological significance were identified. The EMI survey revealed a large high contrast area cutting through the middle that is possibly archaeological or modern in-fill.

GS-02 presented many potentially archaeological significant anomalies including a circular curvilinear anomaly visible in both the magnetometry and EMI data sets, and a curvilinear anomaly.

The anomalies identified in GS-03 area were representative of dipolar anomalies which may be ferrous materials and several strongly positive magnetic responses that may indicate potential pits that may be of archaeological significance.

Please note that the National Monuments Service of the Department of Housing, Local Government and Heritage, the National Museum of Ireland (NMI) and local authorities may issue recommendations/conditions.

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Abbreviations and Definitions

Abbreviation	Definition
AMS	Archaeological Management Solutions
GIS	Geographical Information System
GSI	Geological Survey of Ireland
ITM	Irish Transverse Mercator
NIAH	National Inventory of Architectural Heritage
NMI	National Museum of Ireland
NMS	National Monuments Service
OS	Ordnance Survey
SMR	Sites and Monuments Record
WMS	Web Map Service
ZoN	Zone of Notification
LCC	Laois County Council

Coordinate System

All grid coordinates in this report use the Irish Transverse Mercator (ITM) coordinate reference system unless otherwise stated.

1 Introduction

1.1 Project Background

This report describes the results of an Archaeological Geophysical Survey undertaken by Archaeological Management Solutions (AMS) for RSP Group/LCC on 27 March 2024 for the proposed Clonaslee Flood Relief Scheme (Consent No.: 24R0216). Surveys were undertaken within the townland of Clonaslee, Co. Laois (Figure 1). The surveys were carried out as part of an archaeological assessment of three works areas for the proposed Flood Relief Scheme in Clonaslee, Co. Laois within the Lands Made Available (LMA) for the project.

The Clonaslee Flood Relief Scheme (FRS) aims to address the flood risks to the town from the Clodiagh river that flows through the centre of Clonalsee. The scheme encompasses three main areas: Brittas Wood (GS-01), Chapel Street (GS-02), and Tullamore Road (GS-03). Each area addresses specific flood defences and proposes various construction elements. In Brittas Wood, the development includes the construction of a debris trap using concrete poles to catch fallen trees and large debris, preventing blockages at Clonaslee bridge. An impermeable clay embankment will also be built to mitigate flood risks caused by potential blockages at the debris trap. Chapel Street will see reinforcement of its existing stone wall with a secondary reinforced concrete wall, aimed at widening and strengthening the barrier against flood threats. In the Tullamore Road area, a secondary flood defence embankment made of impermeable clay will be constructed, offset from the existing embankment. This embankment will be topped with grass to prevent overflow. Furthermore, a low reinforced concrete retaining wall within the Irish Water Integrated Constructed Wetlands (ICW) grounds will be installed to prevent out-of-bank flooding and safeguard the ICW from increased flood risks.

These planned works aim to address specific flood defence needs in each area, incorporating measures to accommodate future flood risk increases due to climate change while prioritizing environmental considerations such as wildlife and vegetation protection.

1.2 Geophysical Survey Area

The Clonaslee FRS consists of three survey areas (GS-01, GS-02, and GS-03) comprising a total of 2ha. The survey areas are in the townland of Clonaslee within the Civil Parish of Kilmanman and Barony of Tinnahinch, Co. Laois. The sites are located along the western banks of the Clodiagh river that flows northwards through Clonaslee town. GS-01 is a 0.5ha area and is comprised of a grassland field that sloped slightly from west to east. The middle survey area (GS-02) is a 0.8ha grassland field that was relatively flat. GS-03 is a 0.7ha area comprising 2 zones of 0.2ha to the east of the river - which was

not surveyable due to being a tarmacked road with no access permitted - and 0.5ha to the west of the river consisting of a grassland field used primarily for grazing.

The investigation comprised a high-resolution Magnetometry survey and Electromagnetic Induction (EMI) survey undertaken in March 2024 which characterised the extent of potential archaeological deposits.

1.3 Purpose and Scope of this Assessment

The purpose of the geophysical survey was to identify any potential archaeological deposits that might be present in the 2ha of survey area. The surveys were carried out under consent No.: 24R0216, issued to Finn Melia of Archaeological Management Solutions (AMS) by the National Monuments Service to record archaeological activities. The survey comprised high-resolution magnetic gradiometry directed by Finn Melia and supported by Liamóg Roche and Jeff O'Neill.

1.4 Topography, Soils and Geology

The Brittas wood survey area (GS-01) comprises a single pasture field, covered in grassland and sloping to the east. The local soils primarily consist of a moderately draining fine loamy drift, with the easterly portion of the survey area consisting of poor draining river alluvium. GS-01 comprises quaternary deposits primarily consisting of till derived from limestones, with the quaternary of the easterly portion of the survey area consisting of alluvium (GSI 2024). The bedrock comprised thick flaggy sandstone and thin siltstone (Clonaslee member; GSI 2024).

The chapel street survey area (GS-02) comprised flat grassland with local soils of both fine loamy drift and river alluvium in the eastern portion of the survey area. The quaternary for GS-02 is the same as that of GS-01, consisting primarily of till derived from limestones, with the easterly portion of the survey area consisting of alluvium (GSI 2024). The bedrock of GS-02 like GS-01 consists of thick flaggy sandstone and thin siltstone (Clonaslee member; GSI 2024).

Tullamore Road survey area (GS-03) consists of a flat grassland field primarily used for pasture. The soils in this survey area consist of a moderately-draining, fine loamy drift. The quaternary consisted primarily of till derived from limestones, with the easterly portion of the survey area consisting of alluvium (GSI 2024). GS-03 has a bedrock of primarily of sandstone, mudstone & thin limestone (Lower Limestone Shale, GSI 2024), with the northern portion of the area having a bedrock of Dark muddy limestone, and shale (Ballysteen Formation, GSI 2024).

These soils and geology are generally suitable for a magnetometry survey and EMI, which were chosen as the most appropriate methods of assessment. The pockets of alluvial deposits may cause

weak anomalies in the magnetometry, or no contrasts at all, however the EMI survey will be unaffected.

1.5 Aims and Objectives

The aim of the archaeological geophysical survey was to identify potential archaeological remains. This aim was achieved using the following objectives:

- Identify any geophysical anomalies of possible archaeological origin within the specified survey area.
- Accurately locate these anomalies and present the findings in map form.
- Describe the anomalies and discuss their likely provenance in a written report.
- Incorporate all the above into a report for the Client.
- Preparation and submission of archives of the project data and reports.

2 Archaeological and Historical Background

2.1 Recorded Monuments and Recorded Archaeological Sites

The design proposal for the project will not directly impact any recorded archaeological sites; however, areas of high archaeological potential do exist within 500m of one or more of the survey areas. There are five sites recorded on the Site and Monuments Record (SMR) in the surrounding area: LA002-019----, a children's burial ground, LA002-010----, a chapel, LA002-012002-, a cross-slab, LA002-012001-, a cross-slab, and LA002-011----, a fortified house.

Table 1: Recorded archaeological sites within 500m of the site.

SMR No.	Classification	Townland	ITM Easting	ITM Northing
LA002-019----	Children's burial ground	Brittas	631492	710684
LA002-010----	Chapel	Clonaslee	631674	711002
LA002-012002-	Cross-slab	Clonaslee	631703	711121
LA002-012001-	Cross-slab	Clonaslee	631725	711149
LA002-011----	Fortified house	Ballynakill	632128	711302

2.2 Previous Archaeological Investigations

There are no previous excavations recorded on excavations.ie within the proposed survey areas. However, monitoring of topsoil stripping was conducted in the vicinity of the Tullamore Road survey area on the 22nd and 23rd March 2019. Murphy International Ltd. were appointed main contractor for improvement works to the Tullamore Water Supply Scheme being undertaken by Irish Water. Monitoring took place in the verges to the south and west of the treatment plant in which 2 linear drainage features orientated east-west were uncovered. However, no archaeological finds, features or deposits were uncovered.

2.3 NMI Topographical Finds

There are no stray finds recorded in the National Museum of Ireland's (NMI) online Finds Database, as available on Heritage Maps, within the immediate area of the development, although this dataset is limited.[1]

[1] https://heritagemaps.ie/WebApps/HeritageMaps/index.html this database only includes finds recorded in the National Museum of Ireland's (NMI) topographical files up to 2010 and is often found to be inaccurate and unreliable. [Accessed: 17 April 2024].

2.4 Cartographic Evidence (Historical OS Maps)

The Ordnance Survey (OS) maps of the Clonaslee FRS study areas indicate that little change has occurred since the first-edition was produced in 1837. At GS-01 (the Brittas wood survey area), the first-edition six-inch historic mapping shows several divisions among field boundaries and three triangular fields. The divisions were primarily removed creating the field boundaries as they are today, at the time of the 25-inch map (1897) and the six-inch Cassini (1940) maps. The historic maps for survey area GS-02 indicate that at the time of the first-edition in 1837 the field was larger, extending to the river in the south, and includes a water course feeding in to the river. By the time of the 25-inch map (1897) and the six-inch Cassini (1940) maps the field had been divided with a house and garden being added to the southern portion of the survey area, along with a house being added to the east just outside the survey area. The water course marked on the first-edition was missing and presumably in-filled. In addition a building outside the survey area to the northeast was utilised as a smithy by the time of the 25-inch map and the six-inch Cassini maps. The Tullamore Road (GS-03) survey area has had little change since the first-edition OS map, with the field boundaries located in the same place as they are today. One change did occur by the time of the 25-inch map and the six-inch Cassini maps where an additional boundary split the field to the east of the river in two, though this boundary is no longer present.

3 Methodology

3.1 Personnel

The Geophysical Survey was directed by Finn Melia under consent No.: 24R0216. The survey comprised high-resolution Magnetometry and EMI, undertaken by Finn Melia, Liamóg Roche and Jeff O'Neill. The report has been written by Finn Melia.

3.2 Magnetometry Survey

The survey employed a detailed magnetometer survey, recording the vertical magnetic gradient i.e. a fluxgate magnetometer. This technique measures variations in the magnetic properties of the soils. It is widely used in archaeological geophysical prospection due to its ability to detect and map a broad range of subsurface archaeological remains, including ditches and pits and burnt or fired features associated with metalworking and pottery production (Aspinall *et al*. 2008).

3.2.1 Data Capture

The survey recorded the vertical magnetic gradient, i.e., a fluxgate magnetometer. Five Sensys FGM650 fluxgate gradiometer probes were mounted on a Sensys MAGNETO MX PDA 5 Channel cart system; each probe was spaced 0.5m apart. The magnetometer data were acquired gridlessly with Sensys MonMX Lite Software, connected to a Carlson BRX7 GNSS Smart Antenna RTK GPS, achieving a spatial resolution of 0.1m accuracy. Data were collected at ten times per second along the lines.

3.2.2 Data Processing

The magnetometry and GPS data were processed through Geoserver followed by DLMGPS 4.01-12 and finalised in Sensys MAGNETO 3.01-14. MAGNETO software was used for trace correction and equalisation.

3.2.3 Data Visualisation

The data were brought into QGIS as a GeoTIFF for display and interpretation as greyscale images.

3.3 Electromagnetic Induction Survey

The EMI technique has a long history of successfully identifying archaeology via the collection of in-phase and quadrature data (Colani 1966; Colani & Aitken 1966; Howell 1966) to characterise the magnetic and conductivity properties of the underlying soil.

3.3.1 Data Capture

The EMI data was acquired using a GF Instruments CMD Mini-Explorer (Bonsall et al. 2013). The instrument collected both quadrature (later referred to here as apparent electrical conductivity)

data and in-phase data simultaneously. An apparent electrical conductivity (or EC_a) survey produces data which are the reciprocal of apparent electrical resistivity data. Thus, a high conductivity anomaly, such as that caused by a ditch, will produce a comparable low resistance anomaly. In-phase data responds to the magnetic content of the underlying soil, as such in-phase data is similar to magnetic susceptibility data, it is referred to here as apparent magnetic susceptibility (MS_a).

The horizontal coplanar (HCP) configuration (in the vertical dipole orientation or the 'full depth' range) was used (as opposed to the half depth range offered by the horizontal dipole orientation ('Low') option). The depth range for the vertical dipole (recording data from three levels simultaneously) is 0.5m, 1.0m and 1.8m below the sensor. Quadrature data were acquired in mS/m to a resolution of 0.1 mS/m, and the in-phase data were acquired in ppt to a resolution of 0.1ppt.

The CMD Mini-Explorer was mounted on a cart and acquired data gridlessly connected to a Carlson BRX7 GNSS Smart Antenna RTK GPS, achieving a spatial resolution of 0.1m accuracy. The data were collected along traverses spaced 0.5m apart, with data collected every 0.3 seconds along the traverse. The data were collected in continuous mode by a time-based sample trigger connected via bluetooth to the instrument and the RTK GPS. The data were stored in an automatic data logger and downloaded to a field computer.

3.3.2 Data Processing

The EC_a data were automatically converted to apparent electrical resistivity (or ER_a) data in GF Instruments CMD PC download Software and are displayed in ohm metres. Both ERa and MSa data were gridded in Surfer to a spatial resolution of 0.5m x 0.25m.

3.3.3 Data Visualisation

The data were brought into QGIS as a GeoTIFF for display and interpretation as greyscale images. The analysis of archaeological features using HCP conductivity and in-phase derived data is somewhat complicated due to a signal polarity change. The polarity shift in HCP occurs at depths greater than 1m. This means that the polarity of data from HCP Level 3 at a depth of investigation of 1.8m, is reversed, i.e., low conductivity/magnetic susceptibility anomalies appear high and vice versa. It is worth noting that this polarity change is an inherent characteristic of HCP coils and has been well-documented over the last 25 years by various studies (Tabbagh 1986; Linford 1998; Simpson et al. 2009). Despite this potential confusion, the polarity shift does not hinder the ability to differentiate between anomalous contrasts and background responses, and all the datasets presented still reveal clear archaeological features.

3.4 Data Management, Processing, and Interpretation

This project used QGIS (Version 3.22.14) as a Geographical Information System (GIS) to manage the project. QGIS is an open-source GIS which can be used to create, edit, visualise, analyse and publish geospatial information.[2] This project used the long-term release version of the software (3.18.1) as the basic platform to access, view and analyse the geophysical visualisations produced in Snuffler. QGIS also allowed us to compare the visualisations with other relevant geospatial databases, record the analysis through digitising the morphology and magnitude of anomalies identified, and output a table catalogue of this analysis and corresponding maps.

For the purposes of this project, the following datasets were also accessed and/or downloaded:

- Tailte Éireann historical maps and orthographic photographs of the Study Areas, viewed online;[3]
- Sites and Monuments Record (SMR) point and polygon vectors as a Web Map Service (WMS);[4]
- National Inventory of Architectural Heritage (NIAH) point vector (downloaded from www.archaeology.ie);
- Rivers and lakes as a WMS (downloaded from https://gis.epa.ie/GetData);
- National soils database as a vector layer (downloaded from https://gis.epa.ie/GetData/Download);
- Townlands vector layer.[5]

The following vector layers were generated for the project:

- A polygon for the Study Area;
- Polygons for each identified geophysical anomaly.

The dimensions of individual anomalies were calculated in QGIS using the measure tools. All anomalies are defined by polygons.

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[2] QGIS. Quantum GIS v3.18.1. https://www.qgis.org/en/site/

[3] Accessed from https://maps.archaeology.ie/HistoricEnvironment/

[4] SMR data accessed from https://data.gov.ie/dataset/national-monuments-service-archaeological-survey-of-ireland

[5] Vector layer downloaded from www.townlands.ie; townland names confirmed against the OS townlands list from https://data.gov.ie/dataset/townland.

3.5 Standards

The Geophysical Survey and report follow the recommendations outlined by relevant best practice guidance documents as a minimum standard (Bonsall *et al*. 2014; David *et al*. 2008; Gaffney *et al*. 2002; Schmidt *et al*. 2015). Geophysical data, shapefiles, figures and the text have been archived following the recommendations of the Archaeology Data Service (Schmidt & Ernenwein 2011). Raw geophysical data and GIS shapefiles are available in the archive.

4 Results and Interpretation

4.1 Magnetometry Interpretation

The Magnetometry data (Figure 6, Figure 7 and Figure 8) and the Magnetometry interpretation (Figure 9, Figure 10 and Figure 11) should be cross-referenced with the descriptions (below) for a discussion of the anomalies.

The Magnetometry survey of the sites successfully characterised the extent of potential archaeological deposits. The responses across the survey areas were generally good, revealing some possible archaeological features. Of the three areas surveyed, most of the potential archaeological anomalies revealed were located within GS-02. Additionally some anomalies were identified in GS-01 and GS-03, the majority of those common dipolar (ferrous) responses. Other than commonly identified dipolar or ferrous responses, the most significant archaeological features identified were:

- Weak positive linear anomalies (M1-03 and M1-04) may be representative of a pre–OS map field system or trackway or they may be of more archaeological significance, M1-09 and M1-10 may be related to the former water course (Figure 9), depicted on the 1837 first-edition six-inch OS.
- A weakly positive curvilinear anomaly M2-01 that may represent a possible ditch feature which may form an enclosing element, such as a ring-ditch (Figure 10).
- Anomalies M2-04 represent a weak area of enhanced magnetic response, the area of enhancement contains a series of potential pit like features in a circular alignment that may be representative of a potential enclosure (Figure 10).

4.1.1 GS-01

M1-01 – This is a weak positive rectilinear anomaly. Approximately 12m in length, this anomaly may represent a possible ditch, potentially a pre-OS map field system.

M1-02 – This is a weak positive linear anomaly. Approximately 14m in length, this anomaly may represent a ditch that may be a pre-OS map field system or this anomaly may represent either, an archaeological or natural source.

M1-03 – This is a weak positive linear anomaly. Approximately 18m in length, this anomaly may represent a ditch that may be a pre-OS map field system or part of a trackway. This anomaly may represent either, an archaeological or natural source.

M1-04 – This is a weak positive linear anomaly. Approximately 18m in length, this anomaly may represent a ditch that may be a pre-OS map field system or part of a trackway. This anomaly may represent either, an archaeological or natural source.

M1-05 – This is a spread of strongly magnetic dipolar anomalies, approximately 26m x 14m. This is an anomaly that has produced a signal suggesting an area of burning. This could include a hearth, a *fulacht fiadh*, a furnace, a kiln, a burnt spread, a charcoal spread or any other combustion-related event, including modern or recent bonfires. This area of positive magnetic enhancement may have an archaeological or natural cause, that could include occupational disturbance, imported soil or ploughed out archaeological remains.

M1-06 – This is a spread of strongly magnetic dipolar anomalies, approximately 15m x 8m. This is an anomaly that has produced a signal suggesting an area of burning. This could include a hearth, a *fulacht fiadh*, a furnace, a kiln, a burnt spread, a charcoal spread or any other combustion-related event, including modern or recent bonfires. This area of positive magnetic enhancement may have an archaeological or natural cause, that could include occupational disturbance, imported soil or ploughed out archaeological remains.

M1-07 – This is a strong magnetic response with an irregular shape approximately 25m x 10m in size. This is an area of magnetic enhancement, that may have an archaeological or natural cause, that could include occupational disturbance, imported soil or ploughed out archaeological remains. This anomaly may also be related to this area of the field being previously forested as seen on the 1st edition OS map.

M1-08 – This is a strong positive magnetic response approximately 4m x 2m in size. This may represent a possible pit or an area of burning or dumping. This area of enhancement may signify an occupationally enhanced soil or a natural feature.

M1-09 – This is a strong positive curvilinear anomaly approximately 48m in length. This anomaly may represent a historical field boundary or the former water course, as depicted on the 1837 first-edition six-inch OS. It also corresponds to later boundaries seen on the 25-inch OS map and 6-inch Cassini OS map.

M1-10 – This is a weak positive linear anomaly approximately 31m in length. This anomaly may represent the former water course, as depicted on the 1837 first-edition six-inch OS or a historic field boundary as it corresponds to boundaries present on the later 25-inch OS map and 6-inch Cassini OS map.

M1-11 – This is a curvilinear positive anomaly approximately 19m in length. This may represent a possible ditch. This strongly magnetic anomaly and may represent either, an archaeological or natural source.

M1-12 – This is a strong magnetic response approximately 3m x 2m. This is an anomaly that has produced a signal suggesting an area of burning. This could include a hearth, a *fulacht fiadh*, a furnace, a kiln, a burnt spread, a charcoal spread or any other combustion-related event, including modern or recent bonfires. This area of positive magnetic enhancement may have an archaeological or natural cause, that could include occupational disturbance, imported soil or ploughed out archaeological remains.

4.1.2 GS-02

M2-01 – This is a weakly curvilinear positive anomaly, approximately 55m in length producing a subcircular anomaly with an internal diameter of approximately 20m. This may represent a possible ditch that may be an enclosing element. This weakly magnetic anomaly and may represent either, an archaeological or natural source.

M2-02 – This is a curvilinear positive anomaly approximately 64m in length. This may represent a possible ditch. This strongly magnetic anomaly and may represent either, an archaeological or natural source.

M2-03 – This is a spread of strongly magnetic dipolar anomalies approximately 31m in length. This area of enhanced magnetic response may represent a pre-OS map field system. This is an area of positive magnetic enhancement. This may have an archaeological or natural cause, that could include occupational disturbance, imported soil or ploughed out archaeological remains.

M2-04 – This is an area of enhanced magnetic response approximately 11m x 12m. Within this area of enhancement there is a spread of dipolar and pit like responses in circular alignment, with a larger potential pit or area of burning in the centre, this may potentially represent an enclosure or hut site. This area of enhancement may have an archaeological or natural cause.

M2-05 – This is a strong linear positive anomaly approximately 64m in length. This is a strongly magnetic anomaly and may represent either, an archaeological or natural source. This linear anomaly may represent a historic field boundary as it corresponds with a field boundary present on the 25-inch OS map.

M2-06 – This is an area of enhanced magnetic response approximately 23m in length. This area of enhancement is over a spread of dipolar responses in curvilinear alignment, this may potentially

represent an enclosing element. This area of enhancement may have an archaeological or natural cause.

M2-07 – This is a curvilinear positive anomaly approximately 16m in length. This may represent a possible ditch. This magnetic anomaly and may represent either, an archaeological or natural source.

M2-08 – This is a weak positive linear anomaly. Approximately 12m in length, this anomaly may represent a ditch that may be a pre-OS map field system or part of an enclosing element. This anomaly may represent either, an archaeological or natural source.

M2-09 – This is an anomalous negative curvilinear trend approximately 14m in length. This may represent a possible ditch. This magnetic anomaly and may represent either, an archaeological or natural source.

M2-10 – This is a weak positive linear anomaly. Approximately 6m in length, this anomaly may represent a ditch that may be a pre-OS map field system or part of an enclosing element. This anomaly may represent either, an archaeological or natural source.

4.1.3 GS-03

M3-01 – This is an angular positive anomaly approximately 4m x 3m. This strong positive magnetic response may represent a pit or an area of in-situ burning. This anomaly may represent either, an archaeological or natural source.

M3-02 – This is an angular positive anomaly approximately 3m x 2m. This strong positive magnetic response may represent a pit or an area of in-situ burning. This anomaly may represent either, an archaeological or natural source.

M3-03 – This is an angular positive anomaly approximately 1m x 1m. This strong positive magnetic response may represent a pit or an area of in-situ burning. This anomaly may represent either, an archaeological or natural source.

M3-04 – This is an area of positive magnetic enhancement approximately 12m x 7m and overlays anomalies M3-01 to M3-03 and may be representative of an area of in-situ burning. This area of magnetic enhancement may have an archaeological or natural cause, that could include occupational disturbance, imported soil or ploughed out archaeological remains.

M3-05 – This is an area of enhanced magnetic response containing a spread of dipolar anomalies approximately 6m x 6m. This area of enhancement has produced a signal suggesting an area of burning. This could include a hearth, a burnt mound, a burnt spread, a furnace, a kiln, a charcoal

spread or any other combustion-related event, including modern or recent bonfires. This anomaly may represent either, an archaeological, modern or natural source.

4.2 EMI Survey Interpretation

The EMI ER_a data and EMI MS_a data are given for two Depth(s) of Investigation (DoI) for 1m DoI and 1.8m DoI. The data can be seen for GS-01 in Figures 12—15, for GS-02 in Figures 16—19 and for GS-03 in Figures 20—23. The interpretations can be seen for GS-01 in Figure 24, for GS-02 in Figure 25 and for GS-03 in Figure 26. The anomalies are numbered in the interpretation figures, and these should be cross-referenced with the descriptions (below) of each anomaly.

4.2.1 GS-01

E1-01 – This is a curvilinear anomaly approximately 74m in length. This anomaly may represent the former water course as it corresponds to its location as depicted on 1837 six-inch OS map, with the contrast potentially being strengthened by boundaries in the same location as depicted on the 1897 25-inch OS maps and the 1940 six-inch Cassini historical map.

E1-02 – This anomaly is an area of enhanced contrast approximately 45m x 6m. This enhanced contrast may relate to this part of the survey area previously being forested as depicted on 1837 six-inch OS map. This anomaly may represent either, an archaeological or natural source.

E1-03 – This anomaly is an area of enhanced contrast approximately 72m x 11m. This anomaly contains numerous opposing responses in linear alignments. This may have an archaeological or natural cause, that could include imported soil, ploughed out archaeological remains, field drainage systems or an area of wet or poorly draining soil.

E1-04 – This anomaly is an area of enhanced contrast approximately 24m x 22m. Within this area of enhancement there are several strong responses that are possible ferrous materials. This anomaly may represent either, an archaeological, modern or natural source.

E1-05 – This anomaly is an area of enhanced contrast approximately 27m x 17m. Within this area of enhancement there are several strong responses that are possible ferrous materials. This anomaly may represent either, an archaeological, modern or natural source.

4.2.2 GS-02

E2-01 – This anomaly is an irregularly shaped area of enhanced contrast approximately 41m x 28m. This anomaly may have an archaeological or natural cause, that could include occupational disturbance, imported soil or ploughed out archaeological remains.

E2-02 – This anomaly is a subcircular area of strong contrasting resistance approximately 20m in internal diameter. This anomaly may represent a ditch that may be indicative of the presence of an enclosure or enclosing element. This anomaly may represent either, an archaeological or natural source.

E2-03 – This anomaly is a curvilinear area of contrast approximately 80m in length. This anomaly may represent a ditch that may be part of an enclosing element. This anomaly may represent either an archaeological or natural source.

E2-04 – This anomaly is an area of enhanced contrast approximately 71m x 12m. Within this area of enhancement there are several strong responses that are possible ferrous materials. This anomaly may represent either, an archaeological, modern or natural source.

E2-05 – This anomaly is an area of enhanced contrast approximately 31m x 7m. Within this area of enhancement there are several strong responses that are possible ferrous materials. This anomaly may represent either, an archaeological, modern or natural source.

4.2.3 GS-03

E3-01 – This anomaly is an area of enhanced contrast approximately 42m x 14m. This anomaly may have an archaeological or natural cause, that could include occupational disturbance, imported soil or ploughed out archaeological remains.

E3-02 – This anomaly is an area of enhanced contrast approximately 4m x 4m. Within this area of enhancement there is a strong response that is a possible ferrous material. This anomaly may represent either, an archaeological, modern or natural source.

E3-03 – This anomaly is an area of enhanced contrast approximately 30m x 7m. This anomaly may have an archaeological or natural cause, that could include occupational disturbance, imported soil or ploughed out archaeological remains.

5 Conclusions

The magnetometry and EMI surveys of the sites successfully characterised the extent of potential archaeological deposits. The responses across the survey areas were generally good, revealing some possible archaeological features.

GS-01 presented several anomalies including a field boundary visible on the 1st edition six-inch, the 25-inch OS maps and 6-inch Cassini OS map. Importantly, the former water course, as depicted on the 1837 first-edition six-inch OS, was identified as E1-01 and M1-09. Additionally several linear and rectilinear anomalies with possible archaeological significance were identified, along with two areas of strong magnetic responses that may indicate potential areas of burning. Additionally the results of the EMI survey revealed a large hight contrast area cutting through the middle that is possibly archaeological or modern in-fill.

GS-02 presented some potentially archaeological significant anomalies with a circular curvilinear anomaly visible in both the magnetometry and EMI data sets, a curvilinear anomaly, an area of magnetic enhancement containing several pits, that may represent parts of a structure, and a number of areas of strong magnetic responses that have a signal that may have an archaeological or natural cause, that could include occupational disturbance, imported soil or ploughed out archaeological remains.

The anomalies identified in GS-03 area were representative of dipolar anomalies which may be ferrous materials and several strongly positive magnetic responses that may indicate potential pits that may be of archaeological significance.

5.1 Statement of Indemnity

The geophysical properties of subsurface features must contrast sufficiently with the surrounding soils/background variation and ‘noise’ to enable them to be detected and mapped using geophysical methods. As such, the clarity and definition of buried features can vary considerably, with some having well-defined signatures while others, lying on the threshold of background noise, are only barely visible or not visible at all, in geophysical imagery. A lack of geophysical anomalies cannot be taken to imply a lack of archaeological features.

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Figures

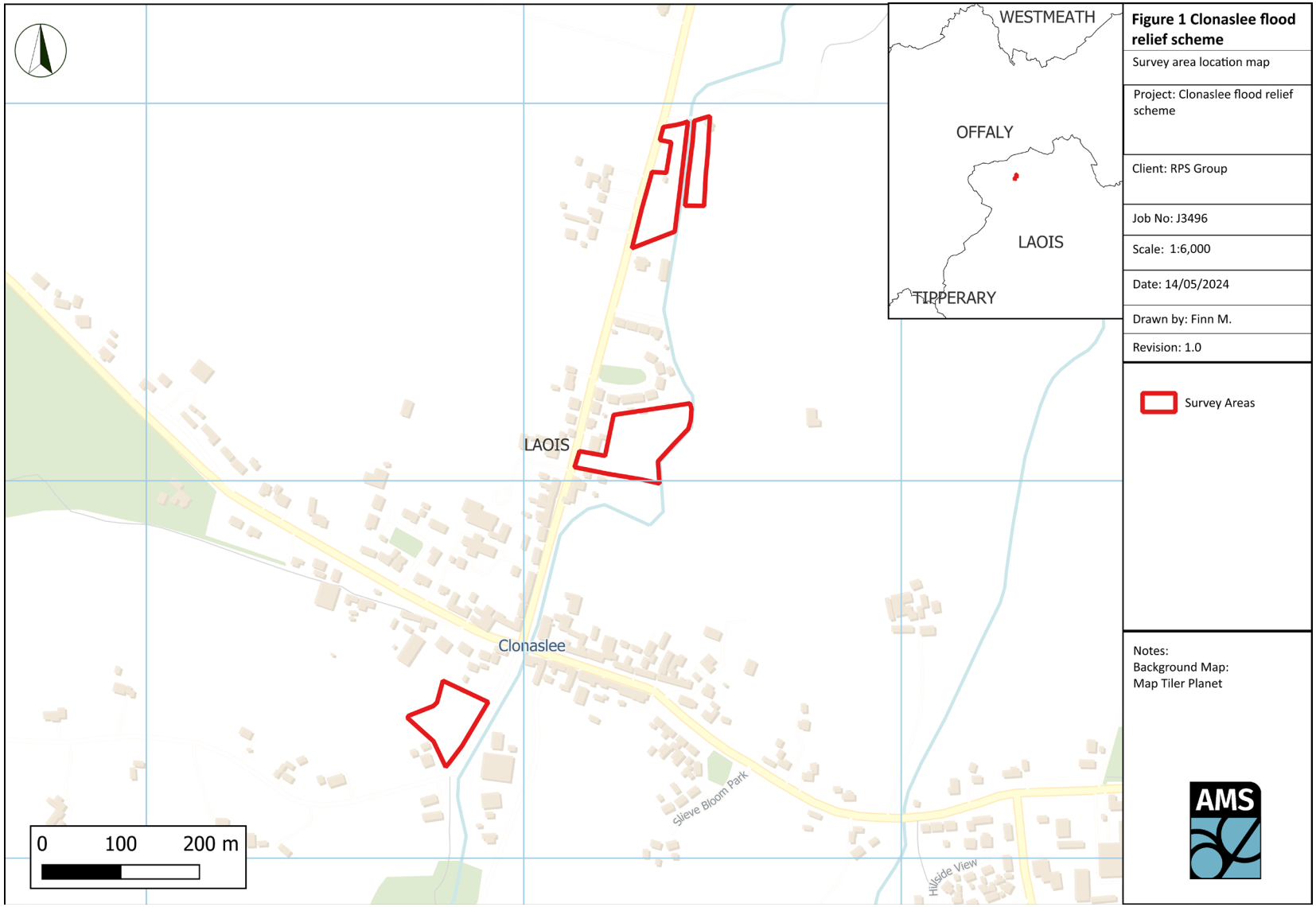

Figure 1. Clonaslee Site Location Map

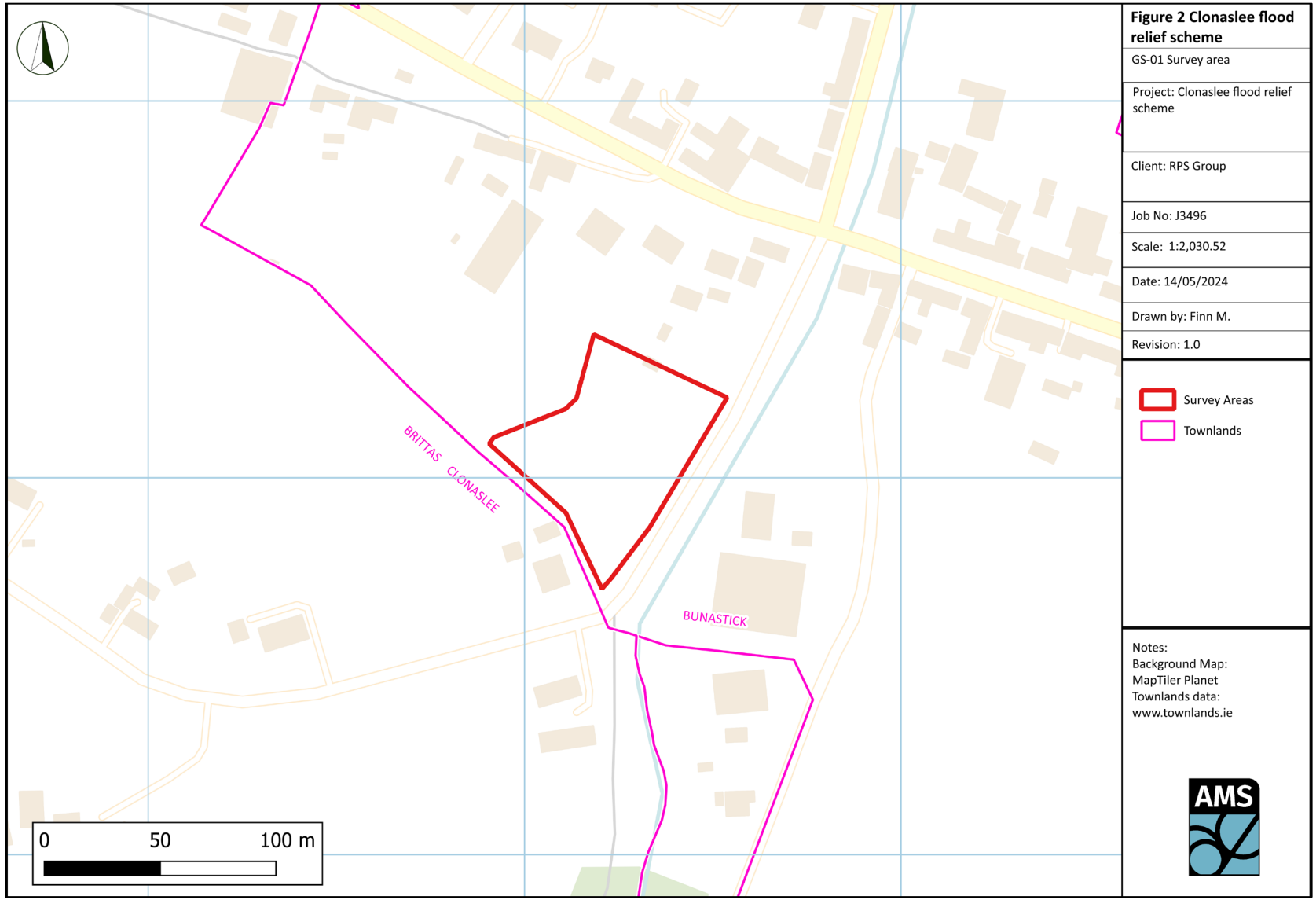

Figure 2. Clonaslee GS-01 Survey Area

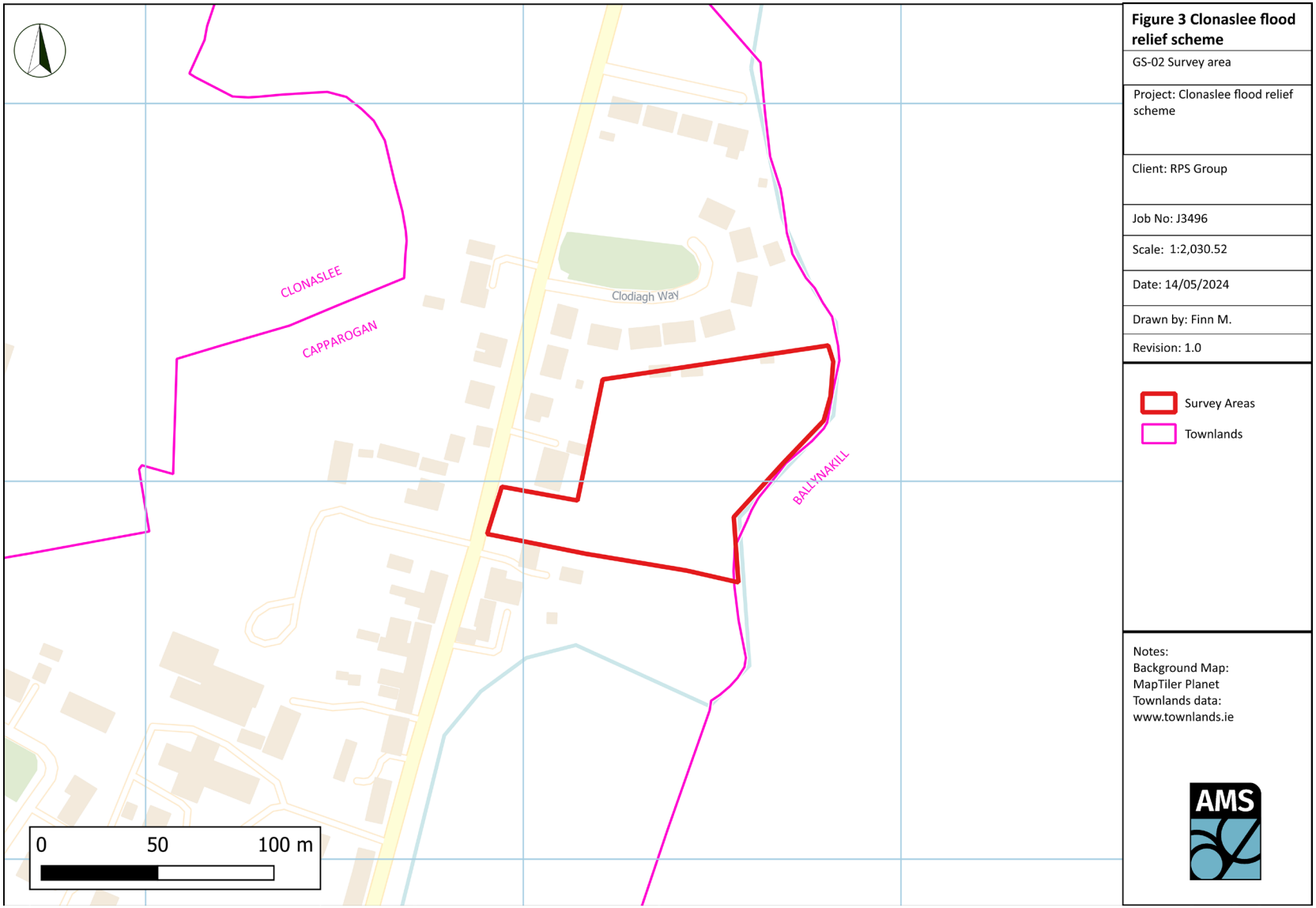

Figure 3. Clonaslee GS-02 Survey Area

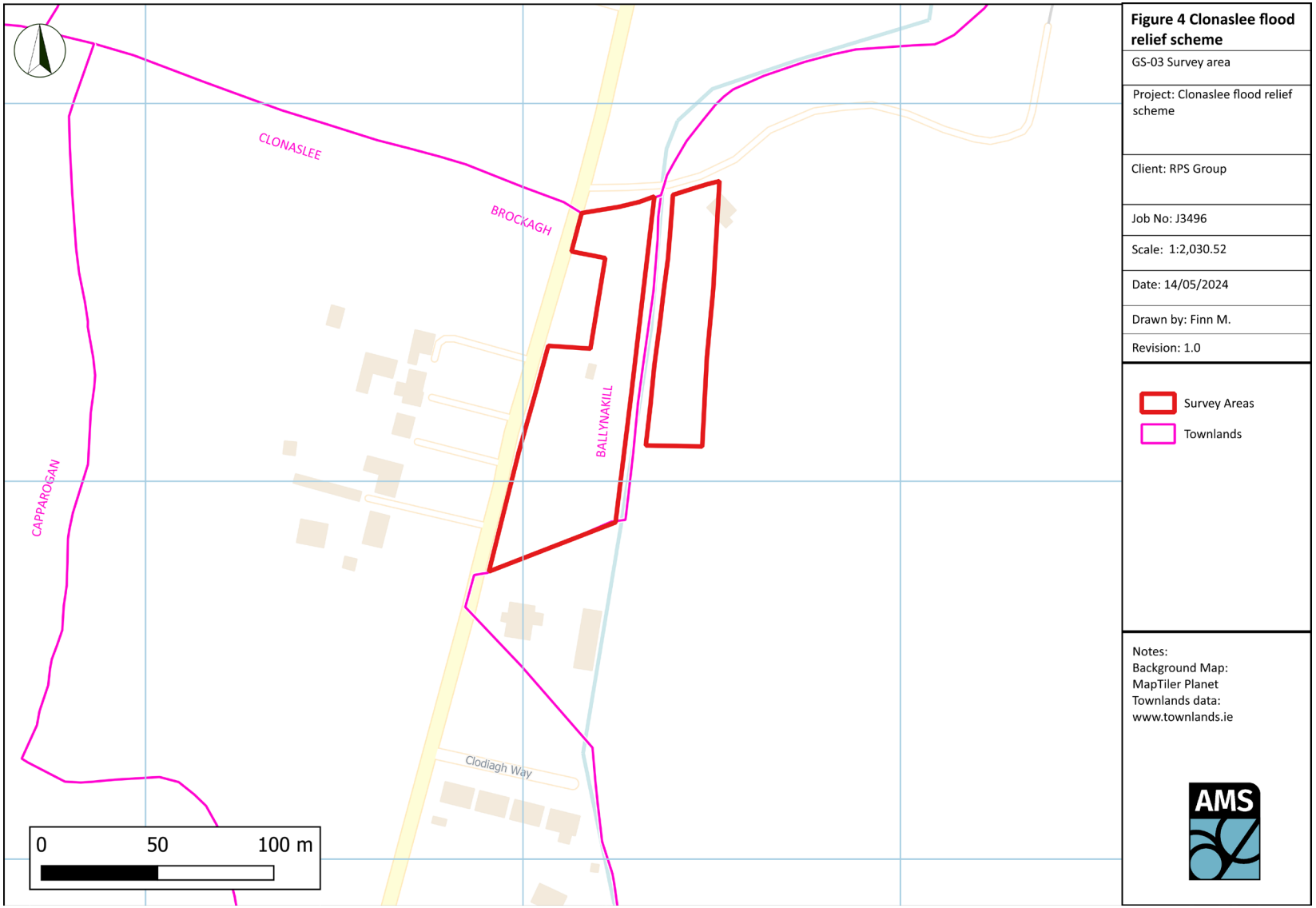

Figure 4. Clonalsee GS-03 Survey Area

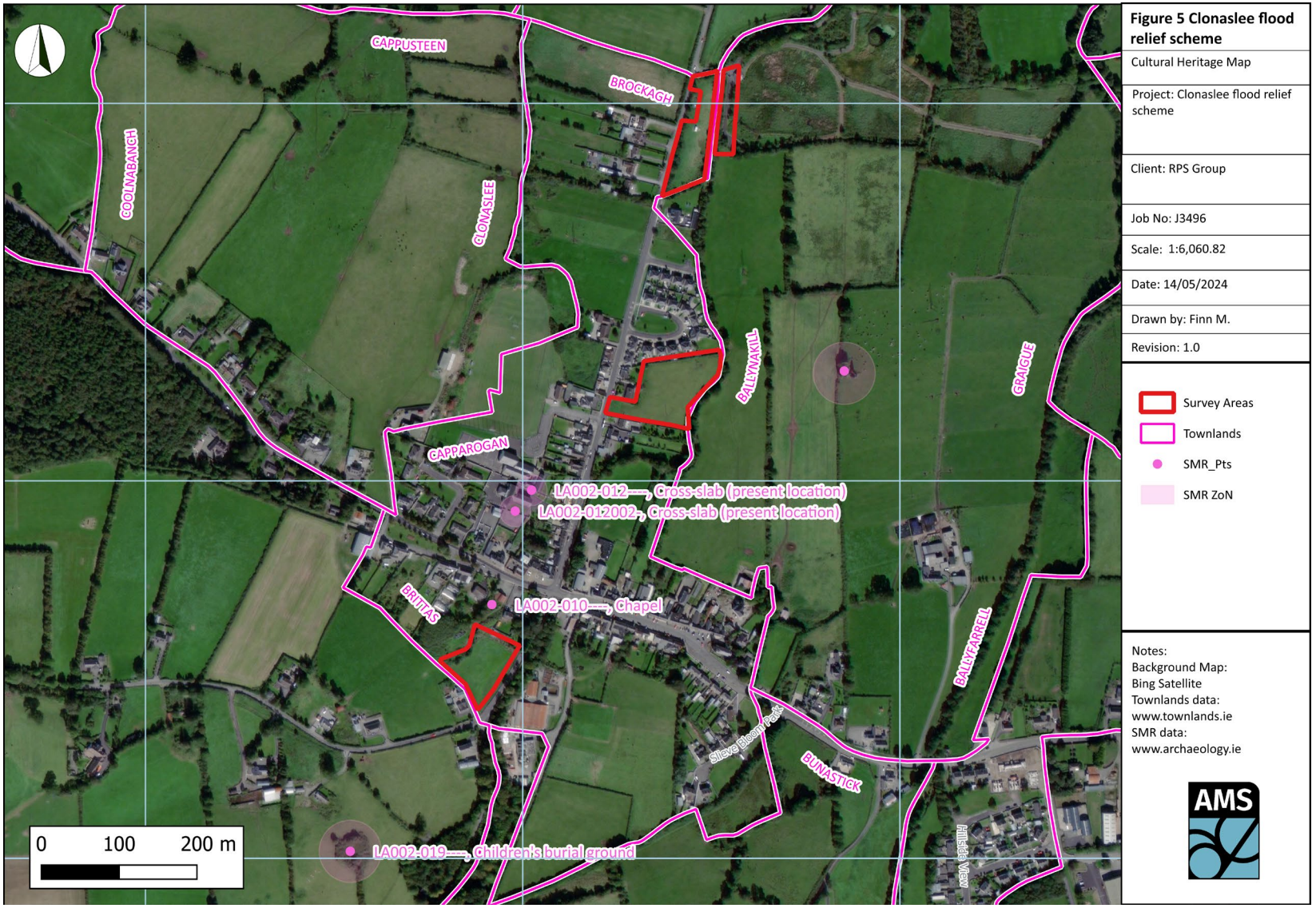

Figure 5. Clonaslee Cultural Heritage Map

Figure 6. GS-01 Magnetometry Data

Figure 7. GS-02 Magnetometry Data

Figure 8. GS-03 Magnetometry Data

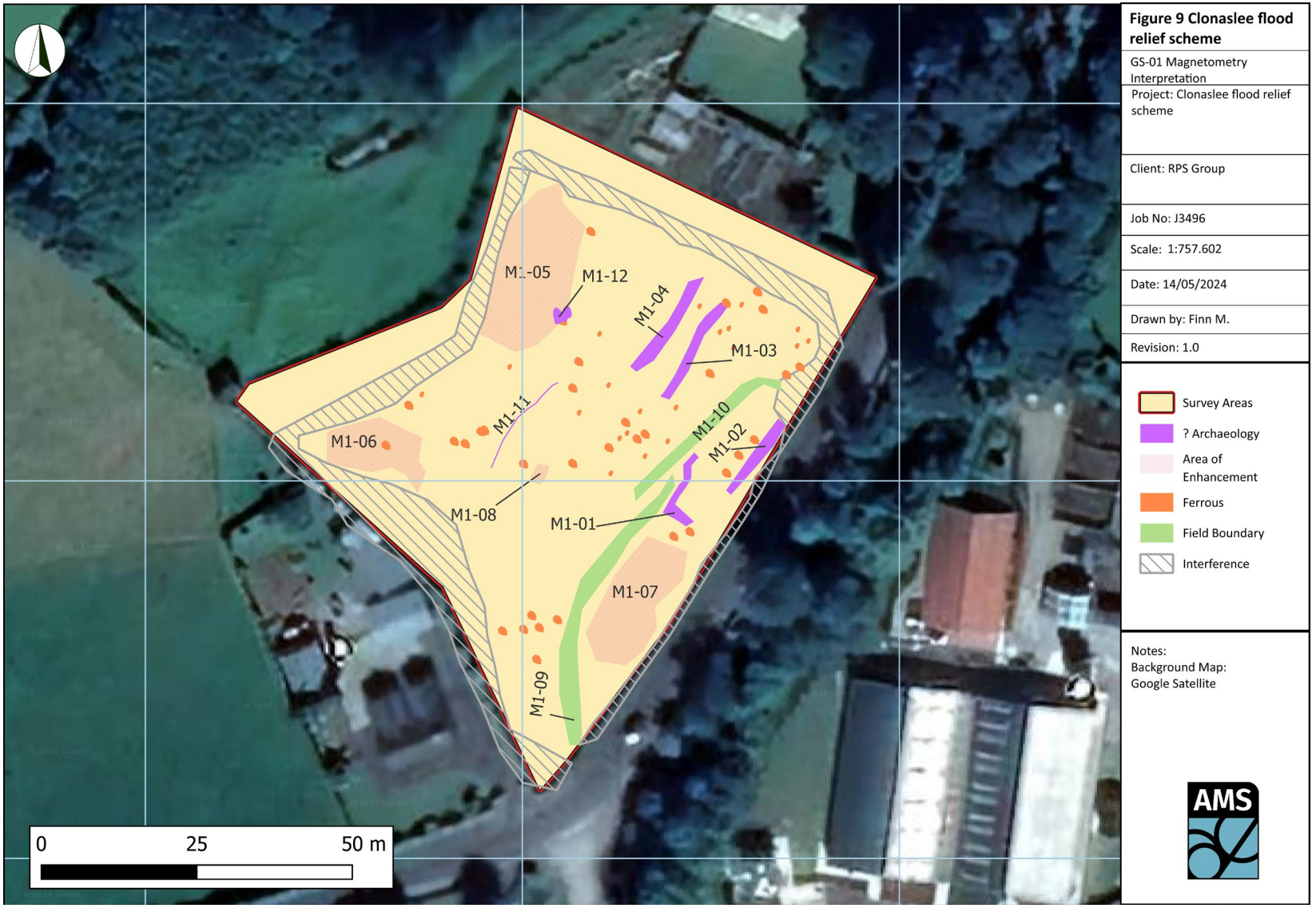

Figure 9. GS-01 Magnetometry Interpretation

Figure 10. GS-02 Magnetometry Interpretation

Figure 11. GS-03 Magnetometry Interpretation

Figure 12. GS-01 EMI Apparent Electrical Resistivity; DOI 1m

Figure 13. GS-01 EMI Apparent Electrical Resistivity; DOI 1.8m

Figure 14. GS-01 EMI Apparent Magnetic Susceptibility; DOI 1m

Figure 15. GS-01 EMI Apparent Magnetic Susceptibility; DOI 1.8m

Figure 16. GS-02 EMI Apparent Electrical Resistivity; DOI 1m

Figure 17. GS-02 EMI Apparent Electrical Resistivity; DOI 1.8m

Figure 18. GS-02 EMI Apparent Magnetic Susceptibility; DOI 1m

Figure 19. GS-02 EMI Apparent Magnetic Susceptibility; DOI 1.8m

Figure 20. GS-03 EMI Apparent Electrical Resistivity; DOI 1m

Figure 21. GS-03 EMI Apparent Electrical Resistivity; DOI 1.8m

Figure 22. GS-03 EMI Apparent Magnetic Susceptibility; DOI 1m

Figure 23. GS-03 EMI Apparent Magnetic Susceptibility; DOI 1.8m

Figure 24. GS-01 EMI Interpretation

Figure 25. GS-03 EMI Interpretation

Figure 26. GS-03 EMI Interpretation