

Geophysical Survey Report

**Proposed East Limerick Solar Farm in
Ballyhaukish, Ballycahill, Coolalough, Coolscart, Gotoon, Kilfrush,
Knocklong, Millfarm & Newtown townlands, County Limerick**

Client

Harmony Solar East Limerick Ltd.

Detection License

25R0032

TAG Project

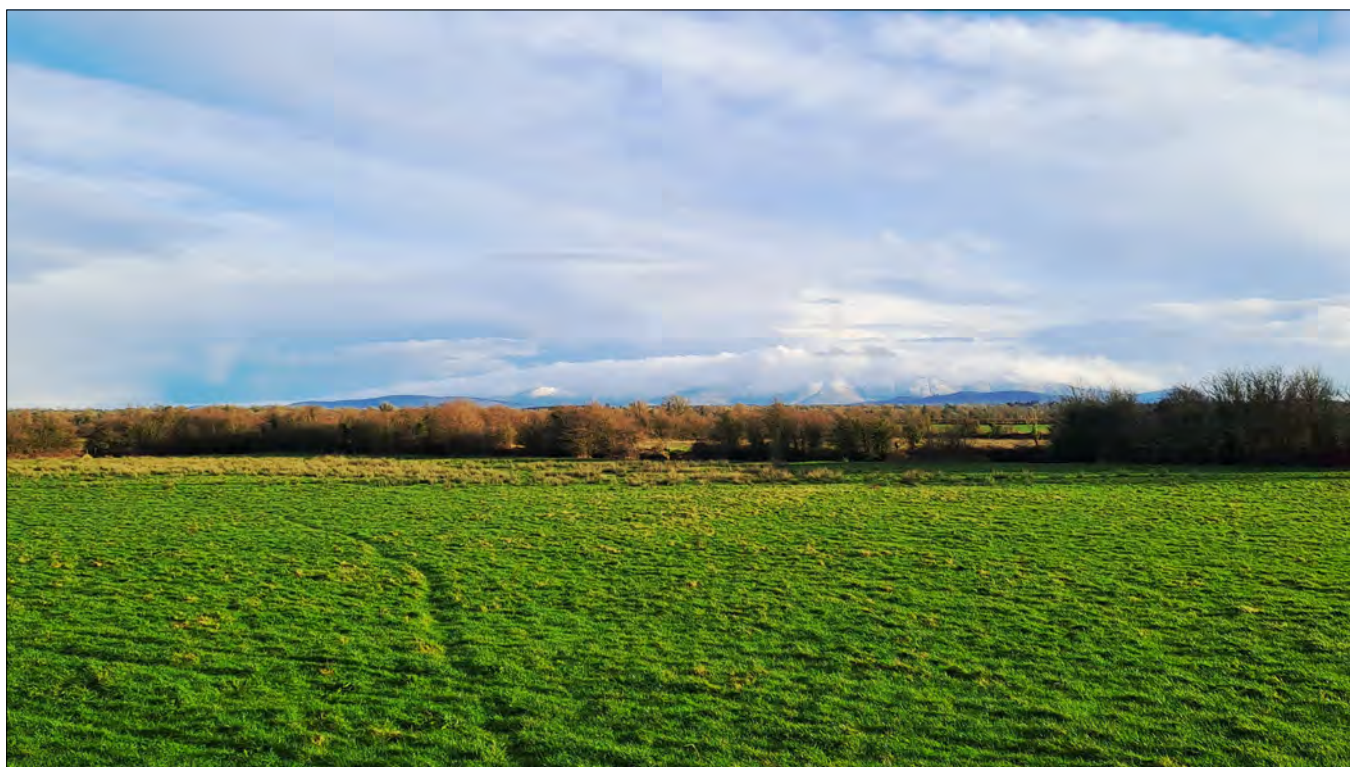
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TARGET GEOPHYSICAL SURVEY REPORT 2025IE01: PROPOSED EAST LIMERICK SOLAR FARM IN BALLYHAUGHISH, BALLYCAHILL, COOLALOUGH, COOLSCART, GOTOON, KILFRUSH, KNOCKLONG, MILLFARM & NEWTOWN TOWNLANDS, COUNTY LIMERICK

PROJECT BACKGROUND

Target Archaeological Geophysics was appointed by Harmony Solar East Limerick Ltd. to undertake a geophysical survey in connection with a proposed solar farm development situated on the outskirts of Hospital, in east County Limerick, in the townlands of Ballycahill, Ballyhaughish, Coolalough, Coolscart, Gotoon, Kilfrush, Knocklong, Millfarm and Newtown. The site of the proposed development, which is sub-divided into 8 land parcels (Parcels A-H) and 4 proposed access roads (AR1-AR4), encompasses c.213ha of agricultural land situated E and W of the R513, extending from the Mahore River N-NW of Hospital, as far S as the townland boundary between Knocklong West, Knocklong and Ballycahill. A total 157.13ha of high resolution magnetometer survey was completed in 99 areas within the boundary of the proposed development, examining all lands available at the time of fieldwork.

The geophysical survey of the site forms part of a pre-planning archaeological assessment being undertaken prior to proposed development, and was carried out under license from the National Monuments Service, Department of Housing, Local Government & Heritage (detection license 25R0032), with the following objectives:

- to identify geophysical anomalies of possible archaeological origin within the investigation areas
- accurately locate these anomalies and present the findings in graphical format
- describe the anomalies and discuss their likely provenance in a written report

ITM central coordinates: North-South 570019, 636896 – 530369 631992

Townlands: Ballycahill, Ballyhaughish, Coolalough, Coolscart, Gotoon, Kilfrush, Knocklong, Millfarm, Newtown
County: Limerick

Landuse: Good quality grazed pasture, poorly maintained pasture, bog

Landscape, soils, geology

The proposed development is situated c.82-102m above sea level within an agricultural landscape used primarily for grazing. Soils of the locality comprise of Elton series fine loamy drift (1000x), river alluvium (5RIV) and Howardstown clayey drift (0760c), overlying Ballysteen formation dark muddy limestone and shale, Lower limestone shale, and Cappagh white formation red-white sandstone and conglomerate (Irish National Soils Map, 1:250,000k, V1b, 2014 and Geological Survey of Ireland Spatial Resources, Public Data Viewer Series).

Archaeology

The site of proposed development lies within a rich archaeological landscape containing numerous recorded monuments and places from the early prehistoric through to the late medieval periods. These include the 13th century medieval settlement at Hospital, numerous barrows, earthworks, ringfort/rath remains and enclosures; the sites of 2 mills; and further to the W the barrow complex, cursus and satellite remains documented on and around Knockainey Hill.

The following extract from the National Monuments Service SMR database provides summary details of the constraint areas for all RMPs situated within and at the immediate perimeter of the proposed development:

SMR No.	Townland	Class	ITM East	ITM North
LI032-144	Millfarm	Water mill - unclassified	570056	636629
LI040-029	Coolscart	Enclosure	569976	635625
LI040-036	Coolalough	Bowl-barrow	571756	635361
LI040-079	Knocklong	Ringfort-rath	570731	632614
LI040-185	Ballycahill	Earthwork	570135	632389
LI040-194001	Coolalough	Earthwork	571525	635338

LI040-200	Gotoon (Smallcounty By.)	Barrow-unclassified	570041	634386
LI040-219	Newtown (Clanwilliam By., Caherconlish	Earthwork	568987	633006
LI040-233	Coolscart	Ditch barrow	570081	635677
LI040-242	Coolalough	Earthwork	571555	635523
LI040-246	Coolalough	Ditch barrow	571828	635431
LI040-257	Coolalough	Ring-barrow	571626	635332
LI040-258	Coolalough	Ditch barrow	571445	635308
LI040-263	Ballycahill	Earthwork	570084	632289
LI040-278	Kilfrush	Ditch barrow	570616	632775
LI040-286	Ballycahill	Ditch barrow	570457	632445

Geophysical technique

High-resolution recorded magnetometry (fluxgate gradiometry)

Report issue

4th May 2025

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Detection license no.

25R0032

Client

Harmony Solar East Limerick Ltd.

1 SURVEY METHODOLOGY

1.1 Survey locations

- 1.1.1 A total 157.13ha of high resolution recorded magnetometry was undertaken within the boundary of the proposed development. The geophysical survey was completed in 99 survey areas as follows:

Geophysical survey areas	Parcel(s)/Proposed Access Road	Townland(s)
1-13	A	Ballyhaughish, Millfarm
14-15	AR1	Millfarm
16-30	B	Coolscart
31	AR2	Coolscart
32-38	AR3	Gotoon
39-45	C	Gotoon
46-59	D	Coolalough
60-71	E	Newtown
72-89	F, G	Ballycahill
90	AR4	Ballycahill
91-99	H	Kilfrush, Knocklong

1.2 Instrumentation

- 1.2.1 The geophysical survey employed an advanced multichannel fluxgate gradiometer system combined with cm precision GPS, recording magnetometer (fluxgate gradiometer) and GPS data simultaneously at rates of 50Hz and 1Hz respectively. The geophysical data were acquired along parallel instrument traverses 3.42m in width, with the instrumentation operating in 'tow configuration' for use with an ATV.
- 1.2.2 The following table provides summary details of the field instrumentation used during this work and the spatial resolution at which the geophysical survey was undertaken:

Technique	Sensor spacing	Sample rate	Instrumentation	Sensitivity/precision	No. of data
Magnetometry (fluxgate gradiometry)	0.38m	50Hz	Multi-channel fluxgate gradiometer array	<75pT/√Hz @ 1Hz (1000mm baseline)	7,142,160
GPS	3.80m	1Hz	Trimble R10 (VRS mode)	<0.1m	178,563

- 1.2.3 The instrumentation and software employed for this geophysical survey were configured to apply a spatial resolution of c.60 magnetometer measurements per m². This spatial resolution meets with ease the 'Level 3 – Characterisation' EAC Guidelines for geophysical survey in archaeology (Schmidt et al, 2016).

1.3 Data processing

- 1.3.1 Post-fieldwork geophysical survey data processing was undertaken as follows:

Process	Description
a)	Positioning of geophysical data based on real-time GPS measurements (WGS84 Geodetic CRS)
b)	Zero median transect processing for multi-sensor magnetometer data collected along parallel transects
c)	Transformation from WGS84 geodetic CRS to ITM (IRENET95) projected CRS
d)	Gridding (ordinary kriging)
e)	Export in greyscale format georeferenced in ITM (IRENET95)

- 1.3.2 To maintain the integrity of the processed geophysical data, and correlation with the original on-site measurements, no further processing, filtering or 'smoothing' of the data was undertaken.

- 1.3.3 Additionally, GPS measurements acquired during the geophysical fieldwork were extracted from the geophysical survey data files and processed as follows:

Process	Description
a)	Merging of GPS measurements from all survey areas
b)	Transformation from WGS84 geodetic CRS to ITM (IRENET95) projected CRS
c)	Gridding (bicubic spline interpolation)
d)	Export in colour format georeferenced in ITM (IRENET95)

1.4 Data display

- 1.4.1 Figure 1 highlights the location of the proposed development including the extent of each land parcel (A-H) and the proposed access roads (AR1-AR4) at scales of 1:225,000 & 1:25,000.
- 1.4.2 Figure 2 displays the soil and geological context for the site and the surrounding landscape (scale of 1:30,000).
- 1.4.3 Figure 3 presents the locations of RMPs within the surrounding landscape highlighting also all RMPs situated within and at the immediate perimeter of the proposed development (scale 1:20,000).
- 1.4.4 Figures 4-9 present the elevation data acquired during fieldwork at scales of 1:3000, 1:3500, 1:4000 and 1:5000.
- 1.4.5 Summary greyscales of the geophysical survey results from areas 1-99 (parcels A-H/proposed access roads AR1-AR4), are presented in figures 10-17 at scales of 1:1750, 1:2000, and 1:3000. 1:1500 greyscale displays of the geophysical results from areas 1-99 are provided in figures 18-41.
- 1.4.6 Summary interpretation diagrams based on the results from geophysical survey in areas 1-99 (parcels A-H/proposed access roads AR1-AR4), are presented in figures 42-49 at scales of 1:1750, 1:2000 and 1:3000. 1:1500 scale interpretation diagrams are also provided in figures 50-73, numbers included on figures 50-73 referring to notable anomalies, which are discussed in the results section of this report.

2 GENERAL CONSIDERATIONS

2.1 Ground conditions & access

- 2.1.1 The site of the proposed development occupies undulating agricultural land comprising of good quality pasture, poor quality pasture and bog. 157.13ha of geophysical survey was completed within a total proposed development footprint of 213ha, corresponding to 74% of the site investigated by geophysical survey. All existing field boundaries, modern surfaces and areas of poor terrain were excluded from fieldwork. It should be noted that exceptionally poor terrain in Parcel G prevented a full geophysical examination of LI040-185 and LI040-263, and no geophysical survey was conducted N of LI040-286.

2.2 Modern ferrous

- 2.2.1 An abundance of small-scale ferrous responses are apparent in the results from the geophysical survey. These are a common occurrence in magnetometer data and relate mostly to modern metallic debris contained in the topsoil. Broad ferrous responses are also evident in the results, mostly at the perimeter of survey in proximity to existing field boundaries, farm buildings, metal fencing and ESB pylons. Ferrous responses are not referred to in the results section of this report unless deemed relevant.

2.3 Recent landuse

- 2.3.1 The geophysical survey data also highlight numerous responses associated with recent landuse. These include remnants of former/suspected former field boundaries and possible field drains, some depicted on historic mapping; past cultivation regimes characterised by closely spaced parallel linear anomalies; modern magnetic disturbance relating to recent landscaping; former dwellings/property boundaries; and buried land drains. Responses associated with recent landuse are not discussed in the results section of this report

unless deemed relevant. The following table, however, summarises in which geophysical survey locations these response types were recorded:

Anomalies relating to recent landuse	Geophysical survey area(s)
Former boundaries (historic mapping), suspected former boundaries/field drains	2-6, 8-13, 15, 16-24, 26-30, 35-36, 39-41, 44-45, 46-59, 60-61, 63-70, 72-78, 79-81, 83-89, 90, 91-99
Past cultivation	2-6, 8, 11, 13, 17, 28, 33, 37, 39, 41, 44, 46-52, 54, 61, 63, 68, 77, 80-81, 87, 93, 95-96, 99
Modern magnetic disturbance, former dwellings/property boundaries	4, 6, 12, 14, 26-28, 30, 42, 45, 48-49, 52, 54, 57, 59, 64, 73, 75-76, 79, 93, 95
Buried land drains	5, 24, 27, 94, 99

2.4 Natural soil/geological variation

- 2.4.1 Natural soil/geological variations are also evident in the survey results, apparent as broad areas of increased positive/negative variation, notably in areas 11 and 18-19 (parcels A-B); clusters of large positive/negative response in areas 54-57 (parcel D); and fragmented positive/negative linear anomalies in areas 20-21, 26-27, 43, 45 and 60-62 (parcels B, C, D, E). These responses are not included on the interpretation diagrams and no reference to them is made in the results section of this report.
- 2.4.2 Suspected lightning induced anomalies are also present in the results in areas 4-6, 8-9, 11 and 13 (parcel A); 15 (AR1); 16, 18-19 and 22 (parcel B); 33 and 35 (AR2); 40 and 44-45 (parcel C); 46-48, 50-51, 54, 56-58 (parcel D); 63, 66, 69-71 (parcel E); 72 and 75-76 (parcel F); 80, 87-89 (parcel G); 91, 93, 95 and 99 (parcel H). These responses are not referred to in the results section of this report.

3 GEOPHYSICAL SURVEY RESULTS

3.1 General overview

- 3.1.1 The results from geophysical survey demonstrate a 'noisy' magnetic background within a range of approximately $\pm 3.5\text{nT}$, the greyscale plots of the geophysical data have, therefore, been generated using a broad dynamic range of $-5/+6\text{nT}$.
- 3.1.2 The geophysical survey has successfully recorded buried archaeological remains relating to 6 out of a total 16 RMPs situated within/at the immediate perimeter of the proposed development. These include structural remains relating to LI032-144 (water mill) to the E in area 2; enclosure LI040-029 in areas 22-24; ditch barrow LI040-233 to the NE in area 23; earthwork LI040-194001 to the NE in area 58; ditch-barrow LI040-258 in area 58 to the NW; and ditch-barrow LI040-278 to the W in area 95. 2 further enclosures recorded on a slight rise to the S-SW in area 54 are thought to relate to earthwork LI040-242, c.50-60m to the E of the RMPs recorded location.
- 3.1.3 No clear representation of buried remains associated with RMPs LI040-200 (barrow – unclassified), LI040-246 (ditch barrow), LI040-257 (ring-barrow), earthworks LI040-219, LI040-185 and LI040-263 is presented by the geophysical data from areas 38, 56, 57, 61 and 83-84. Broad magnetic disturbance at the south-eastern edge of area 57, in proximity to LI040-036 (bowl-barrow), suggests remnants of this monument are unlikely to have been detected due to recent landscaping. As previously mentioned in Section 2.1.1 more complete investigation of earthworks LI040-185 and LI040-263 was prevented by poor terrain in Parcel G which was unsuitable to geophysical survey, with survey adjacent to ringfort-rath LI040-079 also prevented due to poor terrain.
- 3.1.4 In addition to the RMPs the geophysical survey has successfully recorded in areas 2, 22-24, 58 and 95, 1 large enclosure complex, 3 suspected ringfort-rath sites, and 70 small circular/sub-circular enclosures, potential barrows/hut sites, have been identified by the geophysical survey in areas 4-6, 8, 11, 15, 18-20, 30, 35, 41, 44-45, 47-52, 54-57, 59, 63-65, 67-70, 75, 77-78, 86, 88, and 93-96. 2 of the small circular enclosures recorded by the geophysical survey are situated beyond the proposed development boundary at the eastern and western perimeters of AR1 and AR3, in areas 15 and 35.
- 3.1.5 Potential archaeological responses have also been recorded by the geophysical survey in areas 6, 8, 18-19, 46-48, 50-52, 54, 56-58, 70-71, 77, 89, 93, 96 and 99. The precise significance of these anomalies, however, remains cautious due a range of factors, including limited magnetic contrast, increased magnetic background, natural soil/geological variation and modern ferrous/magnetic disturbance. A recent landuse, natural soil/geological and/or modern ferrous origin for some of these anomalies should not be discounted.
- 3.1.6 Numerous poorly defined anomalies, weak linear/curvilinear trends, discrete positives, and clusters of small-scale positive/negative responses are apparent throughout the results from this geophysical survey. The majority of these demonstrate no clear character or patterning to warrant an archaeological interpretation, and are in most cases expected to relate to effects from recent landuse, natural soil/geological variation and/or modern ferrous. Unless deemed relevant no further reference to these anomalies is made in the results section of this report.

3.2 Survey results (figures 10-73)

- 3.2.1 The following table of survey results provides a description of notable responses recorded by this geophysical survey and suggests their likely provenance:

Proposed East Limerick Solar Farm in Ballyhaukish, Ballycahill,
Coolalough, Coolscart, Gotoon, Kilrush, Knocklong, Millfarm & Newtown townlands, Co. Limerick

Table of results							
Parcel A: geophysical survey areas 1-13							
Area(s)	Resp.(s)	Interpretation legend					Description & likely provenance
		Arch.	? Arch.	B/F	Unc.	Tr.	
2	1	✓					Rectangular structure 12m x 7m in diameter relating to LI032-144, in proximity to substantial earthworks observed S of the River Mahore.
3	2				✓		Cluster of small-scale positives uncertain in origin. A recent landuse and/or natural soil/geological origin is suggested.
4-6	3-13	✓	✓		✓	✓	Enclosure complex comprising of 3 large circular/sub-rectangular ditched enclosures (3-5), 2 adjoining (3-4), with 2 enclosure annexes E-NE (6-7), and well-defined circular enclosures at the interior. Sub-circular enclosure remains (8) are indicated to the NE, as are 3 small circular enclosures E/SE (9) & SW (10-11), a potential road (12) extending N-S then NE-SW, and a possible defining boundary (13) NE-SW. Combined 3-13 encompass an area 400m E-W x 270m NE-SW, and occupy elevated ground overlooking the River Mahore to the NW-NE. Numerous poorly defined positive/negative responses and trends are also indicated by the results, and the potential significance of number of these should not be discounted.
8	14-17	✓	✓		✓	✓	Poorly defined sub-circular enclosure/potential rath/ringfort (14), c.28m in diameter, with sub-rectangular network of poorly defined linear responses and trends/potential external ditch/field system remains (15-17) N-SE. Interpretation of 15-17 remains tentative, many of these responses are barely visible above the magnetic background, with natural soil/geological variations also present in the data.
11	18-21	✓				✓	Small circular enclosure (18) c.6m in diameter at southern survey edge, with potentially significant curvilinear trends to N (19), NW (20) and SE (21). Interpretation of 19-21 remains cautious due to increased background variation across area 11 and 'noise' from recent landuse/land division.
13	22					✓	Curvilinear trend of potential interest, possibly a small enclosure c.10m in diameter. A natural soil/geological and/or recent landuse origin should not be dismissed.
AR1: geophysical survey areas 14-15							
15	23	✓					Small circular enclosure c.8m in diameter located to the E beyond the limits of AR1.

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Table of results							
Parcel B: geophysical survey areas 16-30							
Area(s)	Resp.(s)	Interpretation legend					Description & likely provenance
		Arch.	? Arch.	B/F	Unc.	Tr.	
18	24-25	✓	✓				Small circular enclosure (24) c.6m in diameter, and possible further enclosure (25) to the N. An increase in the magnetic background across area 18 due to soil/geological variation and recent landuse has complicated interpretation of the results.
19	26-27	✓	✓			✓	Small circular enclosure c.12m in diameter, with small-scale anomalies of note at the interior/perimeter. The significance of sub-rectangular trends (27) to the NE remains uncertain.
20	28	✓					Small circular enclosure c.7m in diameter eroded to the E by a modern field boundary.
22-24	29-30	✓			✓	✓	Large (29) and small enclosure (30) c.44m and 8m in diameter corresponding to LI040-029 and LI040-233, 29 surviving as an earthwork traversed by 2 modern field boundaries. A cluster of small-scale positives and trends of potential note has been recorded c.25m S-SE of 30.
27	31					✓	Circular trend, potentially a small enclosure c.6m in diameter. Interpretation remains cautious, and a recent landuse and/or natural soil/geological origin should be considered.
28	32					✓	Circular trend, potentially a small enclosure c.12m in diameter. Interpretation remains cautious due to this anomaly's limited contrast and increased soil/geological variation across area 28.
30	33-35	✓				✓	Small circular enclosure (33) c.11m in diameter with curvilinear trends (34-35) of potential note to the NW and NE. Interpretation has been complicated by increased soil/geological variation and modern ferrous disturbance from an adjacent farm/private residence.
AR3: geophysical survey areas 32-38							
35-36	36-39	✓			✓	✓	Curvilinear/rectilinear trends (36-38) and small-scale positives extending eastwards in to AR3, with small circular enclosure 39 (area 36), c.5m in diameter, located beyond the route of the proposed access road. Interpretation has been complicated by a southerly increase in soil/geological variation from area s35-37 and the limited width of the investigation corridor.

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Table of results							
Parcel C: geophysical survey areas 39-45							
Area(s)	Resp.(s)	Interpretation legend					Description & likely provenance
		Arch.	? Arch.	B/F	Unc.	Tr.	
39	40-41					✓	Curvilinear trends of potential note. A recent landuse and/or natural soil/geological origin should not be discounted.
41	42	✓					Small circular enclosure c.10m in diameter interrupted by suspected former boundary/field drain to the E.
44	43-44	✓			✓	✓	Circular enclosure, probable rath/ringfort, c.30m in diameter with linear trends and discrete positives of potential note, and a possible further small enclosure (44) suggested by a curving trend to SE. Interpretation of 44 remains uncertain and a natural soil/geological and/or recent landuse origin should not be discounted.
45	45-46	✓					2 small circular enclosures 8-10m in diameter situated on elevated and low-lying terrain respectively.
Parcel D: geophysical survey areas 46-59							
46	47-49		✓				Rectilinear/sub-rectangular anomalies of potential note, 47-48 possibly representing former properties/property boundaries bordering the R513, although none are indicated on historic mapping, An archaeological interpretation for sub-rectangular enclosure 49, which measures c.36m x 27m in diameter, remains uncertain. Multiple linear anomalies, possible former field boundaries/land divisions/field drains, traversing area 46 NE-SW and NW-SE have complicated interpretation.
47-48	50-59	✓	✓		✓	✓	Possible circular enclosure (50), group of 6 enclosures (51-56), further enclosures (57-58) and circular trend (59), these c.10-12m in diameter, 55 potentially recut as suggested by overlapping circular ditches indicated in the results. 53 to the N may potentially represent 2 conjoined enclosures. Combined 51-56 demonstrate a formal circular layout measuring c.98m NE-SW by 105m NW-SE.
49	60-61	✓					Conjoined enclosures (60), c.18m and 9m in diameter, and further small circular enclosure (61) c.10m in diameter. Interpretation has been complicated by an abundance of former/suspected former field boundaries/land divisions/field drains and increased natural soil/geological variation.
50	62-65	✓	✓				Small circular enclosures (62-64) c.8-10m in diameter and possible further enclosure (65), similar in size, bordering 63. Interpretation has been complicated by increased natural soil/geological variation to the N and an abundance of former/suspected former field boundaries/land divisions/field drains.

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Area(s)	Resp.(s)	Interpretation legend					Description & likely provenance
		Arch.	? Arch.	B/F	Unc.	Tr.	
51	66-72	✓	✓		✓	✓	5 small circular enclosures (66-70) c.8-11m in diameter, overlying broader concentrations of linear/sub-rectangular anomalies and trends to the W (71) and E (72). The significance of 71-72 remains unclear. These anomalies may potentially relate to ditch/field system remains not contemporary with 66-70.
52	73-75	✓	✓				Small circular enclosure c.8m in diameter and curvilinear anomalies (74-75) of potential note. 74-75 may potentially relate to ditch/field system remains not contemporary with 73.
54	76-80	✓	✓			✓	4 small circular enclosures c.6-13m in diameter, 76-77 situated on a slight rise and potentially representing a more accurate location for LI040-242. Rectilinear response and trend (80) border 78 to the NE and may be significant. Interpretation remains cautious, however, given the proximity of a former field boundary immediately to the E.
55	81-82	✓			✓	✓	Single (81) and conjoined enclosures (82) c.8-14m in diameter, 82 defined by an outer ditch and possible bank demonstrating a combined width of c.3m.
56	83-86	✓	✓		✓	✓	4 small circular enclosures (83-86), c.6-12m in diameter, 86 encompassed by a sub-rectangular ditch uncertain in origin, which may potentially relate to more recent field system/land divisions.
57	87-96	✓	✓			✓	6 small circular enclosures (87-92), c.6-12m in diameter, 89 bordering the north-western limit of LI040-036, 90-92 situated in close proximity to one another. Responses 93-94 likely represent the 'detectable' levelled remains of LI040-036, magnetic disturbance at this location suggesting this monument has been subjected to recent landscaping/modern disturbance. Trends of potential note have also been recorded N-NW (95-96).
58	97-100	✓	✓		✓	✓	Rectangular-shaped earthwork LI040-194001 (97), c.20m in diameter, with internal circular enclosure, ditch-barrow LI040-258 (98) c.8m in diameter, discrete positives (99) of possible significance and circular trend (100). The possibility that 100 relates to recent landuse and/or natural soil/geological variation should not be dismissed.
59	101-102	✓				✓	Single (101) and conjoined (102) enclosures c.8m and 12m in diameter, 101 located at the edge of a modern field boundary, 102 bound to the N by a broad region of magnetic disturbance.

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Table of results							
Parcel E: geophysical survey areas 60-71							
Area(s)	Resp.(s)	Interpretation legend					Description & likely provenance
		Arch.	? Arch.	B/F	Unc.	Tr.	
63-64	103-104	✓			✓		Small circular enclosures c.7m in diameter.
65	105-106	✓				✓	Small circular enclosure (105) and circular trend (106) of potential note, both c.6m in diameter. A recent landuse and/or natural soil/geological explanation for 106 should not be discounted.
67	107-108	✓				✓	Small circular enclosure (107) and group of circular trends (108) of potential note, c.11 and 8m in diameter. A recent landuse and/or natural soil/geological explanation for 108 should not be ignored.
68	109-110	✓				✓	Small circular enclosure (109) c.8m in diameter and curvilinear trend (110) of potential note. A recent landuse and/or natural soil/geological explanation for 110 should not be ignored.
69	111-114	✓				✓	Small circular enclosures (111-113) c.7m in diameter, and curvilinear trend (114) of potential note. A natural soil/geological and/or recent landuse origin for 114 should also be considered.
70	115-116	✓	✓				Small circular enclosure (115) c.8m in diameter, and possible segment of enclosure ditch (116). A recent landuse and/or natural soil/geological origin for 116 should also be considered.
71	117		✓				Possible circular enclosure c.8m in diameter. A recent landuse and/or natural soil/geological origin should also be considered.
Parcel F: geophysical survey areas 72-78							
75	118	✓			✓	✓	Circular enclosure, probable rath/ringfort, c.35m in diameter, with sub-circular ditch type features and trends at the interior.
77	119-123	✓	✓		✓	✓	Circular enclosure (119) c.11m in diameter, possible circular enclosure (120) c.9m in diameter, trends and groups of small-scale positives (121-123) uncertain in origin. An archaeological interpretation for curving trends 23 should not be discounted.
78	124-125	✓				✓	Circular enclosure (124) c.12m in diameter, and curving trend (125). 125 likely relates to natural soil/geological variation and/or recent landuse.

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Table of results							
Parcel G: geophysical survey areas 79-89							
Area(s)	Resp.(s)	Interpretation legend					Description & likely provenance
		Arch.	? Arch.	B/F	Unc.	Tr.	
80-81	126-127					✓	Curving trends indicating possible enclosure remains. Interpretation is cautious and a recent landuse and/or natural soil/geological explanation should also be considered.
84	128-129				✓		Clusters of small-scale positives of uncertain origin. The potential that 128-129 represent pit remains or burnt/fired material should not be ignored. A natural soil/geological and/or recent landuse is also plausible.
86	130	✓					Conjoined enclosures c.8m in diameter eroded to the E by an existing field boundary.
87	131-138				✓	✓	Curving trend (131) and small-scale positives of uncertain origin (132-138). Interpretation of 131-138 remains uncertain.
88	139-140	✓					Conjoined enclosures (139) and single enclosure (140), c.8m in diameter, 140 cut to the S by a suspected former boundary.
89	141-143		✓			✓	Possible small enclosures (141-142) and trend (143) c.9m in diameter, 142 disturbed by a suspected former field boundary.
Parcel H: geophysical survey areas 91-99							
91	144-145				✓		Clusters of small-scale positives of uncertain origin. An archaeological interpretation for 144-145 should not be dismissed.
93	146-149	✓	✓		✓		Small circular enclosure (146), possible enclosure (147), both c.8-10m in diameter, and small-scale positives (148-149).
94	150	✓					Small circular enclosure c.6m in diameter disturbed to the W by an existing field boundary.
95	151-155	✓			✓	✓	2 Small-circular enclosures (151-152), 151 corresponding to LI040-278, with further curving trends and small-scale positives (153-155) present. A recent landuse and/or natural soil/geological origin for 153-155 should be considered.
96	156-159	✓	✓				1 small circular enclosure (156) and 3 possible enclosures (157-159). The possibility that 157-159 may instead relate to natural soil/geological variation and/or recent landuse should not be dismissed.
98-99	160-164		✓			✓	Curving trends (160-162), possible enclosure (163) c.6-9m in diameter, and cluster of small-scale positives (164). A recent landuse and/or natural soil/geological explanation for 160-162 and 164 should not be discounted.

4 CONCLUSION

- 4.1 The results from geophysical survey at the site of the proposed solar farm display a 'noisy' magnetic background much of which is expected to derive from recent landuse and natural soil/geological variation. 99 areas of geophysical survey were completed within the available portions of the proposed development. Remains associated with 6 out of a total 16 RMPs situated within/at the immediate perimeter of the site were recorded (LI032-144, LI040-029, LI040-233, LI040-194001, LI040-258, LI040-278). Poor terrain in parcel G precluded examination of RMPs LI040-185, LI040-263 and LI040-286, and no responses of an archaeological nature were recorded in the vicinity of LI040-200, LI040-246 and LI040-257.
- 4.2 Previously unknown archaeological sites were also identified by the geophysical survey within the site of the proposed solar farm. These included a large enclosure complex in areas 3-6 (parcel A); 3 probable ringforts in areas 8, 44 and 75 (parcels A, C and F); and a further 70 small enclosures in parcels A-H (areas 4-6, 8, 11, 15, 18-20, 30, 35, 41, 44-45, 47-52, 54-57, 59, 63-65, 67-70, 75, 77-78, 86, 88, and 93-96). Responses of further archaeological potential were also identified by the geophysical survey in 21 areas, although the precise significance of these remains inconclusive.
- 4.3 The most significant discovery made by this geophysical survey represents the enclosure complex recorded in areas 3-6 (parcel A). This comprises of 3 large circular/sub-circular ditched enclosures with well-defined circular enclosures at the interior, several enclosure annexes, smaller outlying enclosure remains, a probable road and possible defining boundary. The results demonstrate that the enclosure complex recorded in areas 3-6 relates to a high status settlement overlooking the River Mahore. The geophysical data from Parcel D also display a significantly impressive number of previously unknown archaeological remains, 40 small enclosures in total, probably barrows, some of which are conjoined. The possibility that a number of these small enclosures represent potential hut sites should not be discounted.
- 4.4. The survey results also display a wide variety of anomalies associated with recent landuse including remnants of past cultivation, numerous former/suspected former boundaries, possible field drains, buried land drains, former properties/property boundaries, as well as responses from modern ferrous/magnetic disturbance. An abundance of responses indicative of natural soil/geological variation are also indicated in the results, as are a number of suspected lightning induced anomalies.

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Bing Maps: <https://www.bing.com/maps>

Geological Survey of Ireland Spatial Resources, Public Data Viewer Series:

<https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228>

Google Maps: <https://www.google.com/maps>

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APPENDIX

Technical Information: magnetometry

MAGNETOMETRY

Introduction

Magnetometry represents one of a suite of geophysical techniques employed in archaeological prospection to inform invasive work such as trial trenching and excavation.

Frequently used to determine the often non-visible boundaries of archaeological remains, magnetometer surveys enable archaeologists to identify the location, form and extent of a diverse array of archaeological features no longer visible at the surface.

Buried archaeological remains successfully identified using magnetometry include sites such as enclosure systems and deserted villages, hillforts and military encampments, henges and tumuli, villa/castle foundations, ecclesiastical settlements and formal gardens.

Background to application

The basis for use of magnetometry in archaeological prospection derives from the abundance of natural iron oxides in most soils, and our ability to measure subtle variations in the magnetic properties of these iron oxides caused by human activity. Discrete variations in soil magnetism associated with buried archaeological remains derive typically from in situ burning and organic enrichment of the soil, through activities such as cooking and heating; pottery manufacture and metal working; as well as use of fired building materials such as ceramic tiles and brick. These burnt, fired and organic rich deposits create subtle magnetic contrasts visible as discrete magnetic anomalies superimposed on the earth's geomagnetic field.



1. Magnetometer survey data in greyscale format highlighting pit remains SE of an enclosure and Roman villa.



2. Burnt-fired debris uncovered during excavation of the highlighted area SE of the same enclosure and Roman villa.

Magnetometer surveys conducted in both commercial and research archaeological investigations enable determination of the location, form and extent of buried archaeological remains. Data acquired from these surveys can be quickly generated into georeferenced images and interpretation layers to inform subsequent trial trenching and excavation.

Technology

TARGET provides precise mapping and characterization of buried archaeological remains by employing an array of highly stable and sensitive fluxgate gradiometers, combined with an advanced data logging system and cm precision GPS. This state-of-the-art geophysical instrumentation, which is capable of collecting extremely dense data sets, permits detailed high-resolution survey of archaeological sites from as small as 1ha in size, to larger scale investigation of sites up to 150ha or more.

High resolution magnetometer surveys are undertaken as standard, recording data at c.5cm intervals with probe separations of 0.3m for precise measurement and characterization of buried archaeological remains. This spatial resolution meets with ease the 'Level 3 – Characterisation' EAC Guidelines recommendation for geophysical survey in archaeology (Schmidt et al, 2016).

Instrumentation is used in combination with cm precision GPS and data collected along parallel traverses with the system installed in 'tow configuration' for use with an ATV or in push mode.

Data Display

Greyscale plots are the most common format for displaying magnetometer data. This display format assigns a cell to each datum according to its location on the grid. The display of each data point is conducted at very fine increments, allowing the full range of values to be displayed within a given data set. This display method also enables the identification of discrete responses barely visible above natural 'background' magnetic variation on site.

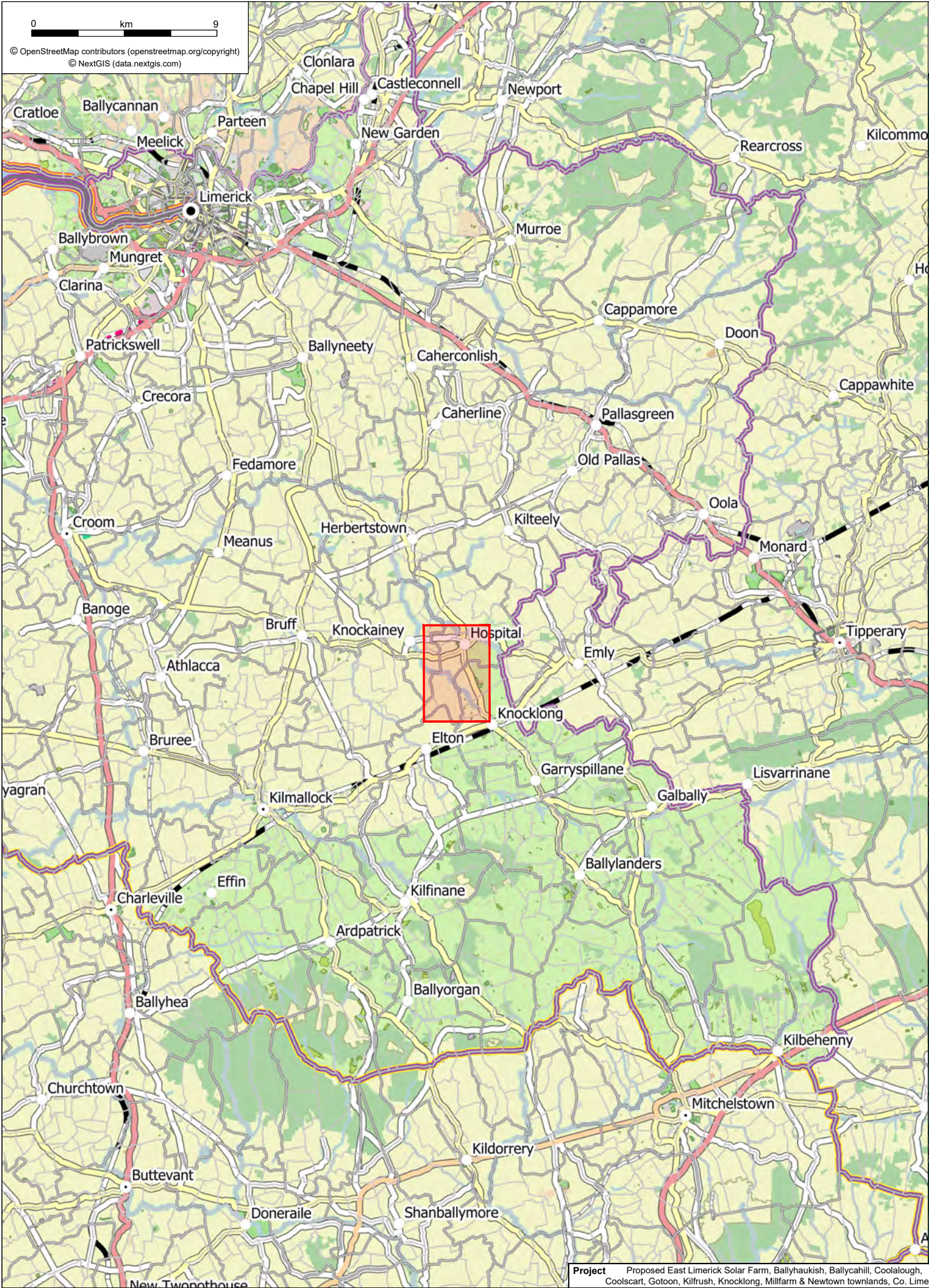
6. Greyscale from survey at the site of a deserted medieval village.

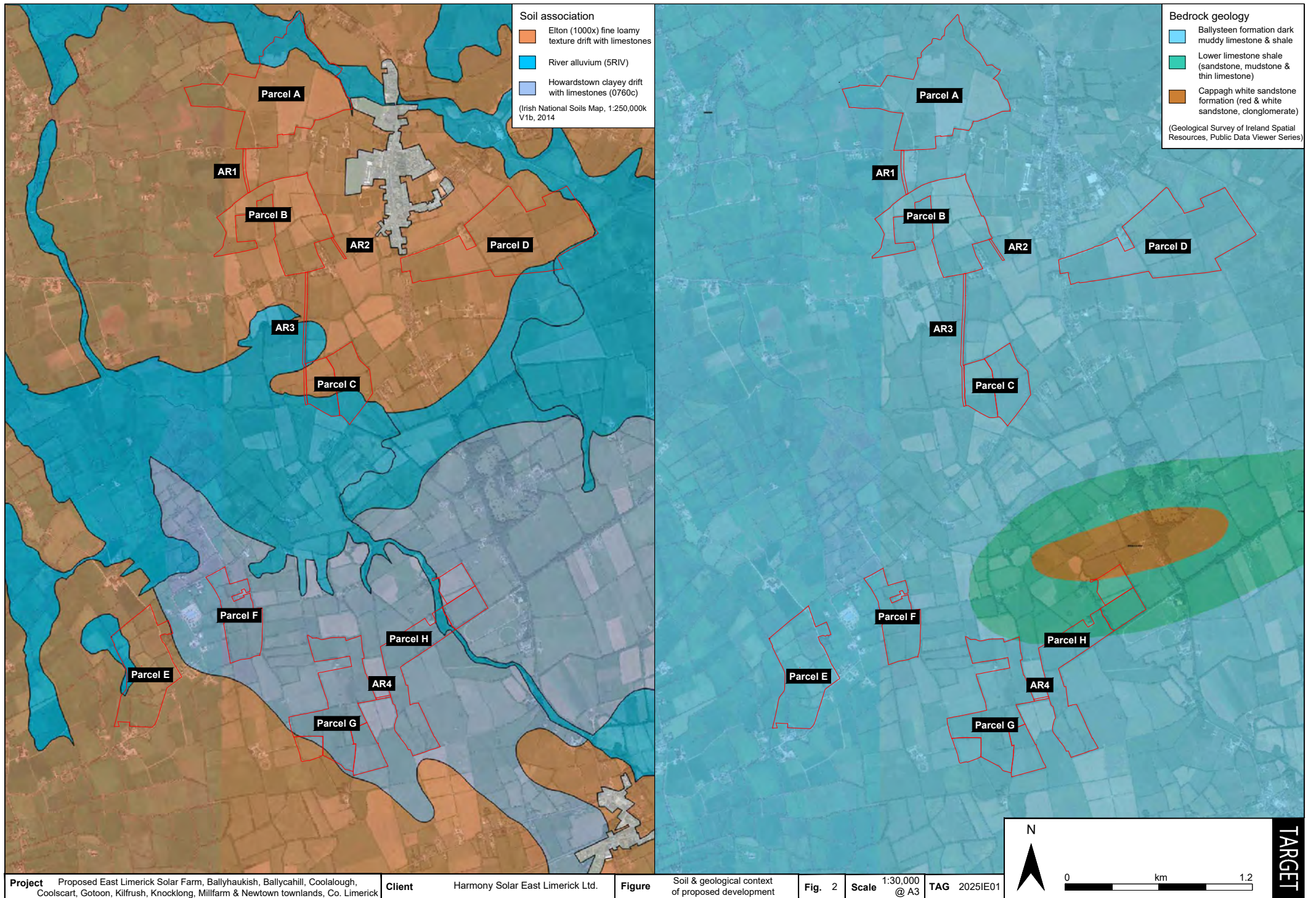


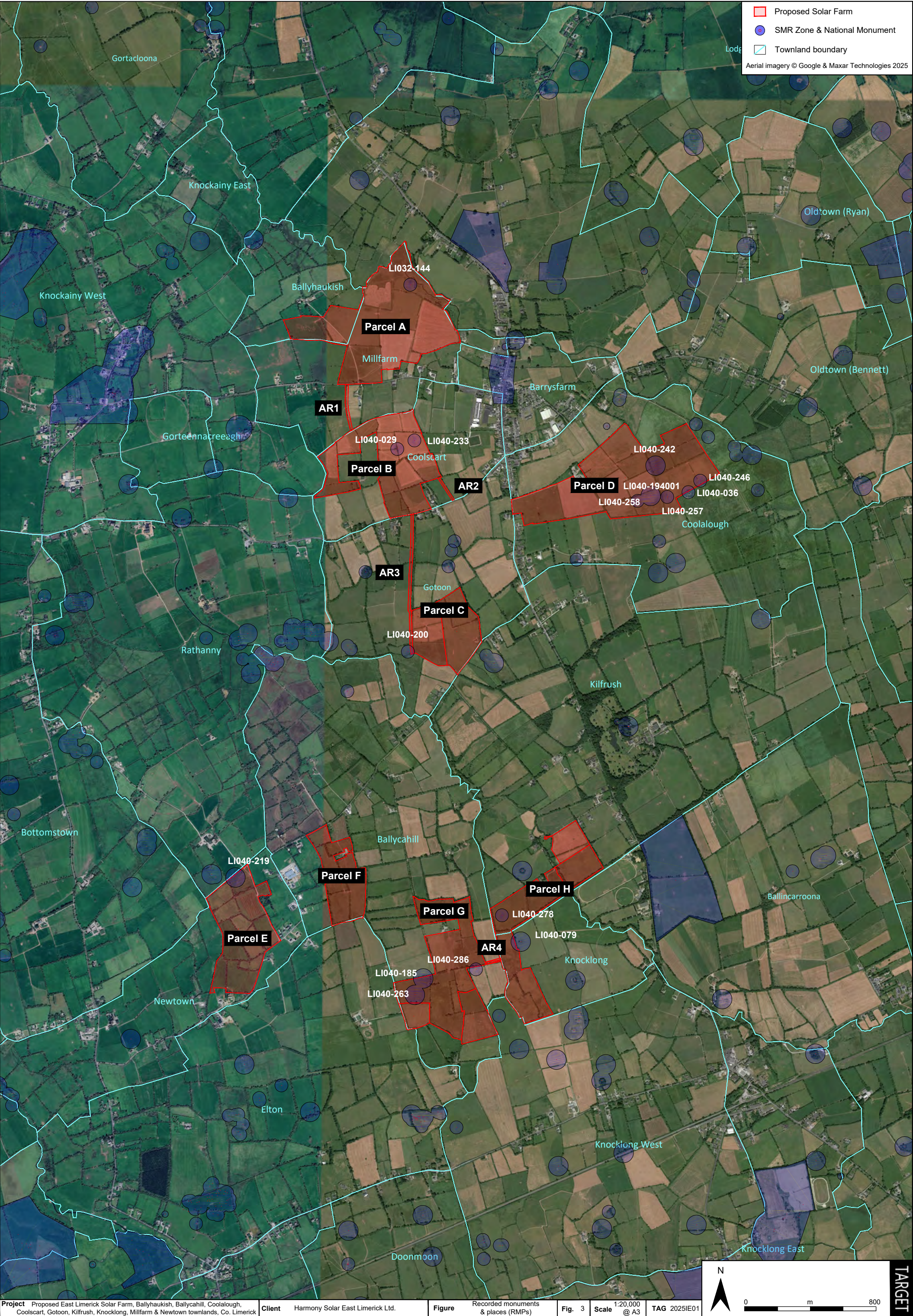
XY trace plots provide a near-perspective representation of measurements along individual lines of data recorded from each magnetometer sensor. The XY trace format is used as a conventional method for identifying responses of modern ferrous debris, and also as an aid in identifying locations of potential industrial features, such as kilns and metal working.

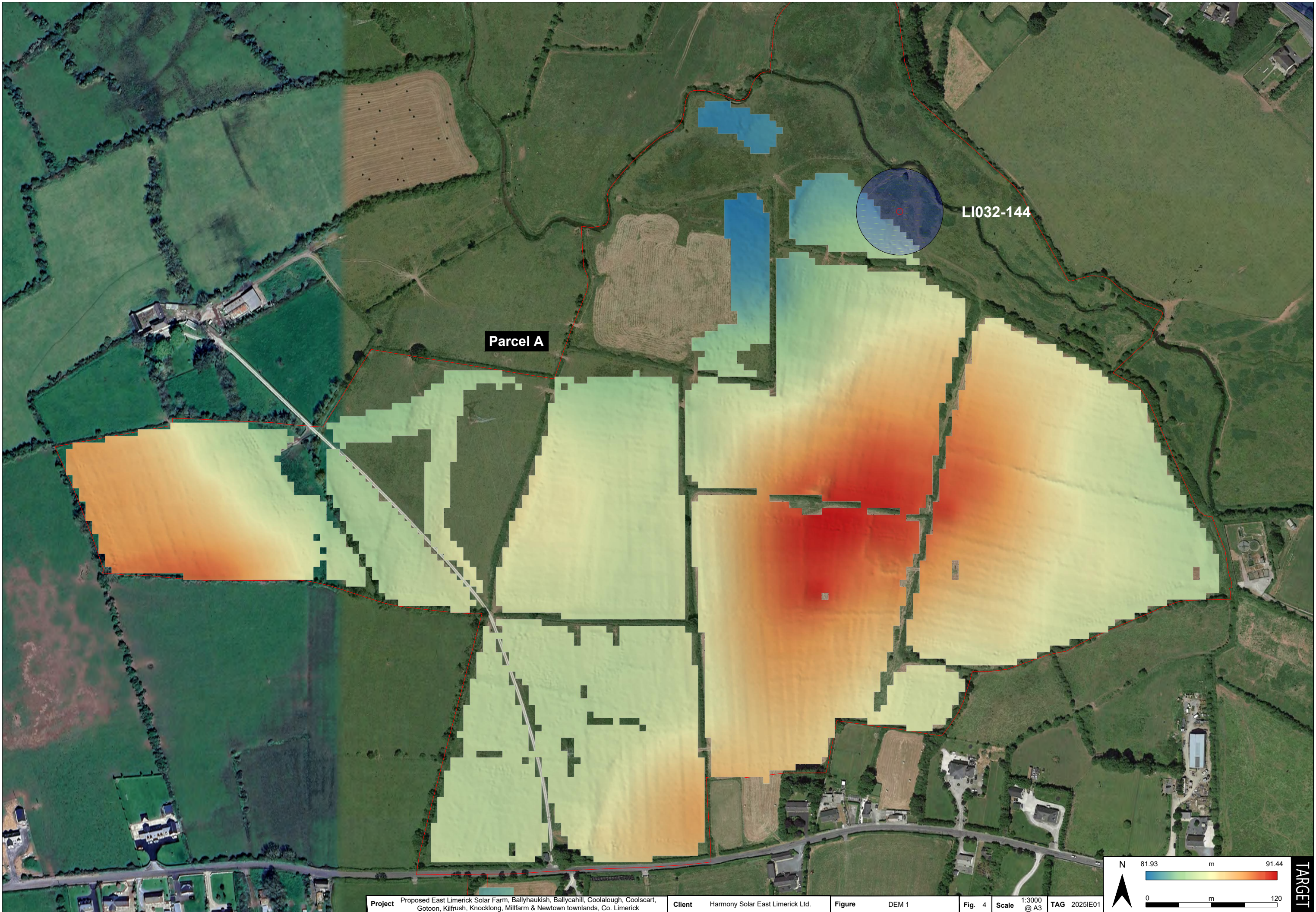
7. XY trace from survey at the site of a deserted medieval village.





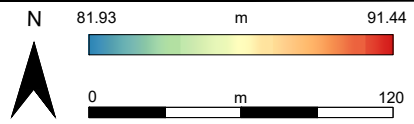






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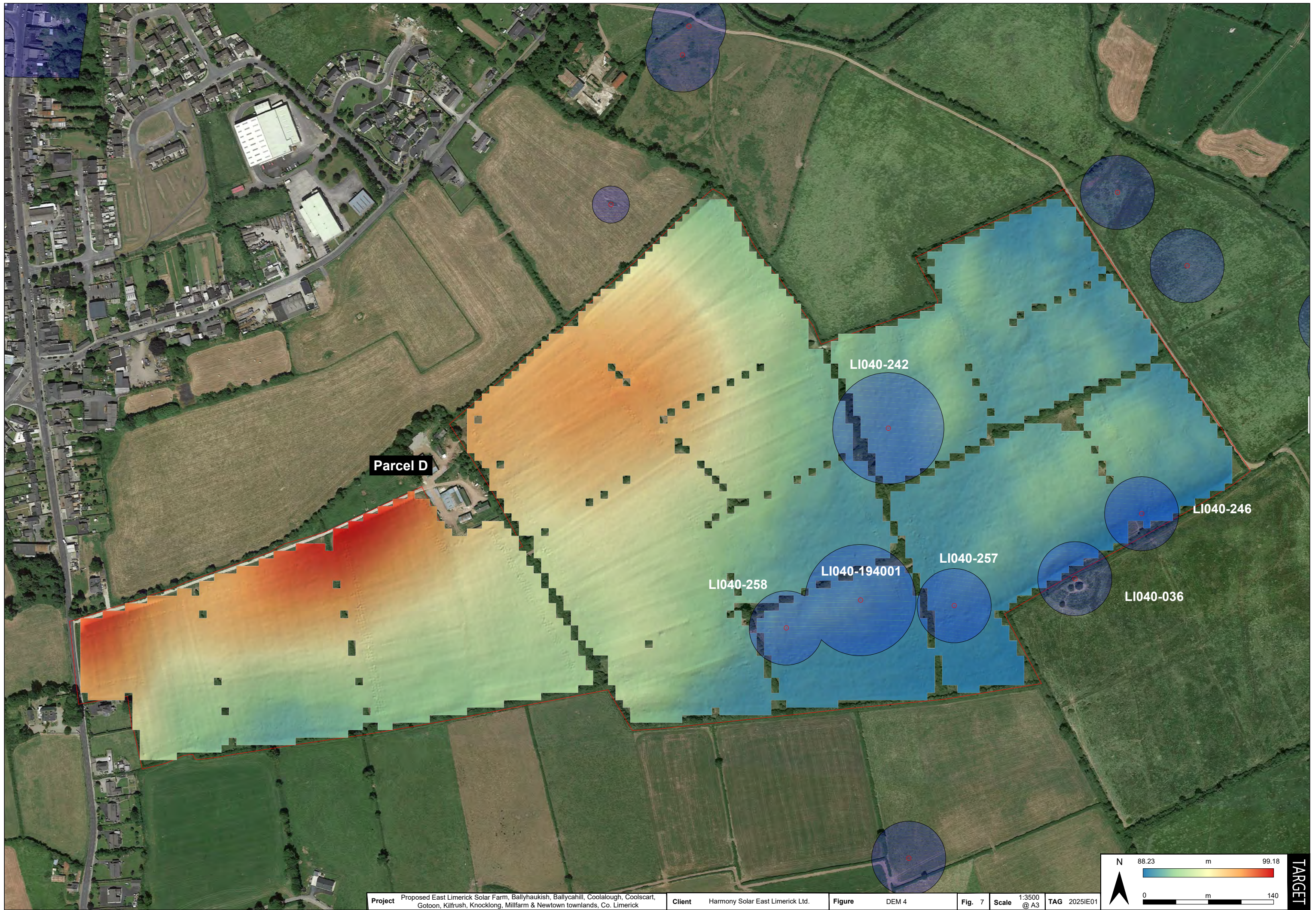
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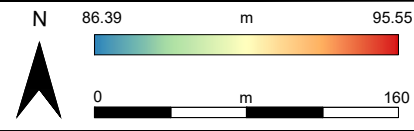
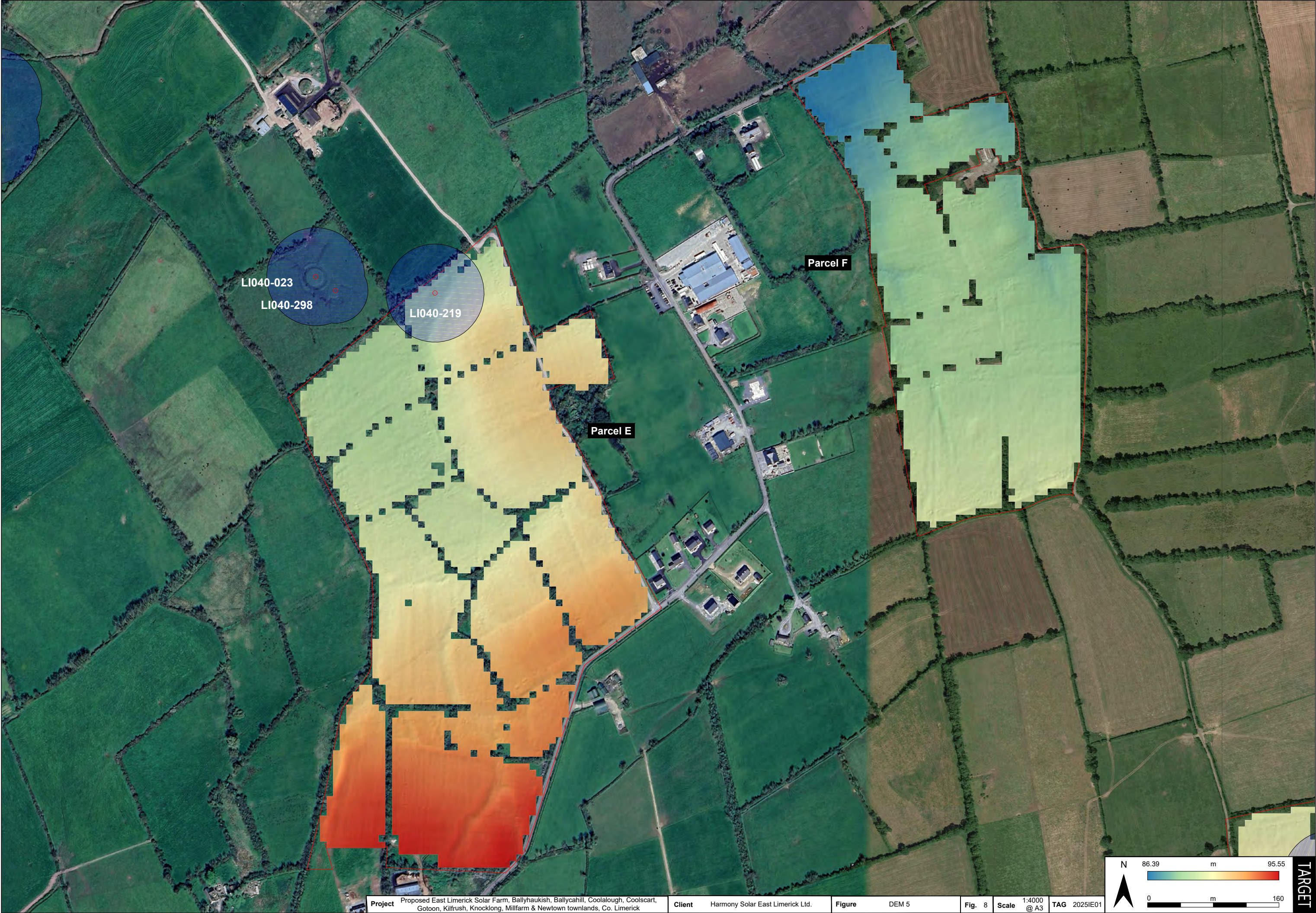


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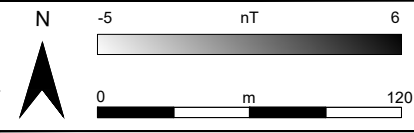
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Figure Summary greyscale 1

Fig. 10

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Parcel D
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Client Harmony Solar East Limerick Ltd.

Figure Summary greyscale 4

Fig. 13

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TAG 2025IE01



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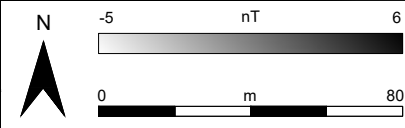


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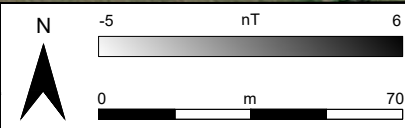
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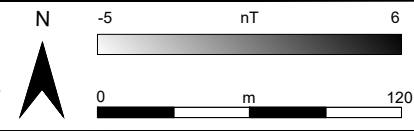
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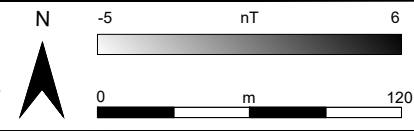




**Parcel F
(areas 72-78)**











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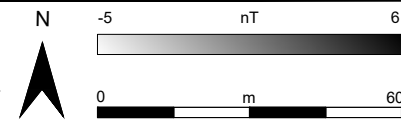
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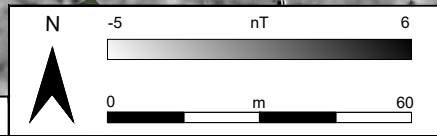
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Client Harmony Solar East Limerick Ltd.

Figure Greyscale 4

Fig. 21

Scale 1:1500
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TAG 2025IE01



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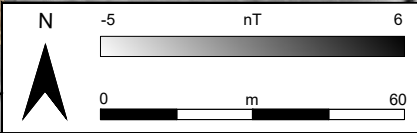
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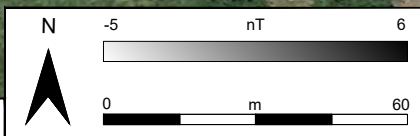


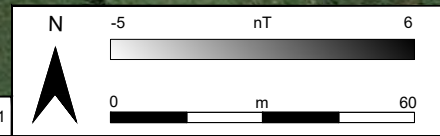
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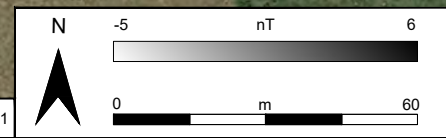














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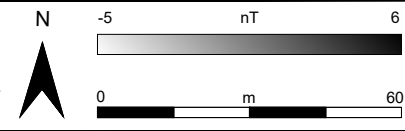
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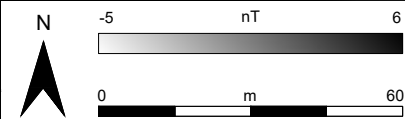
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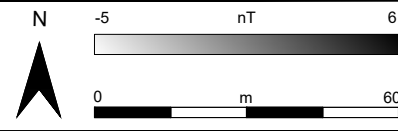
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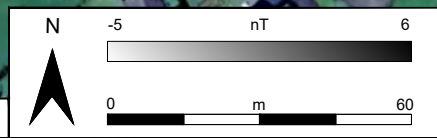
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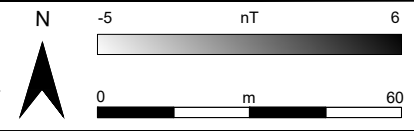
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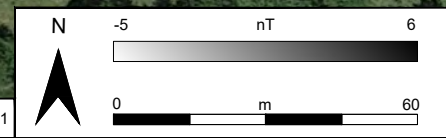
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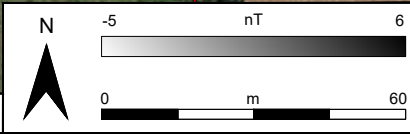
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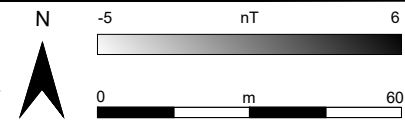
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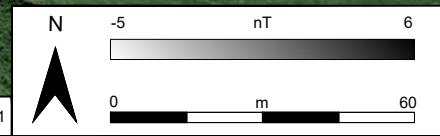
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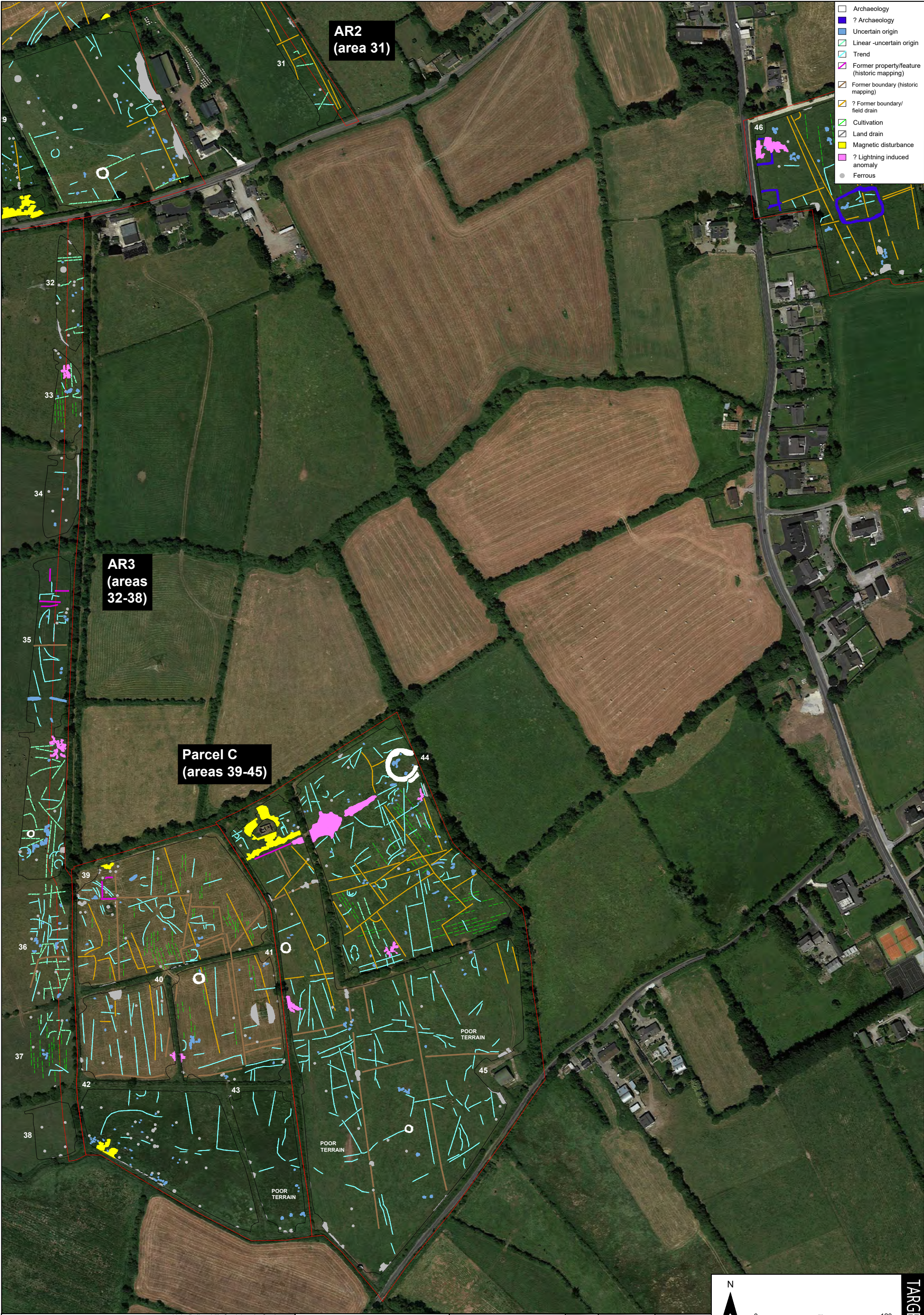


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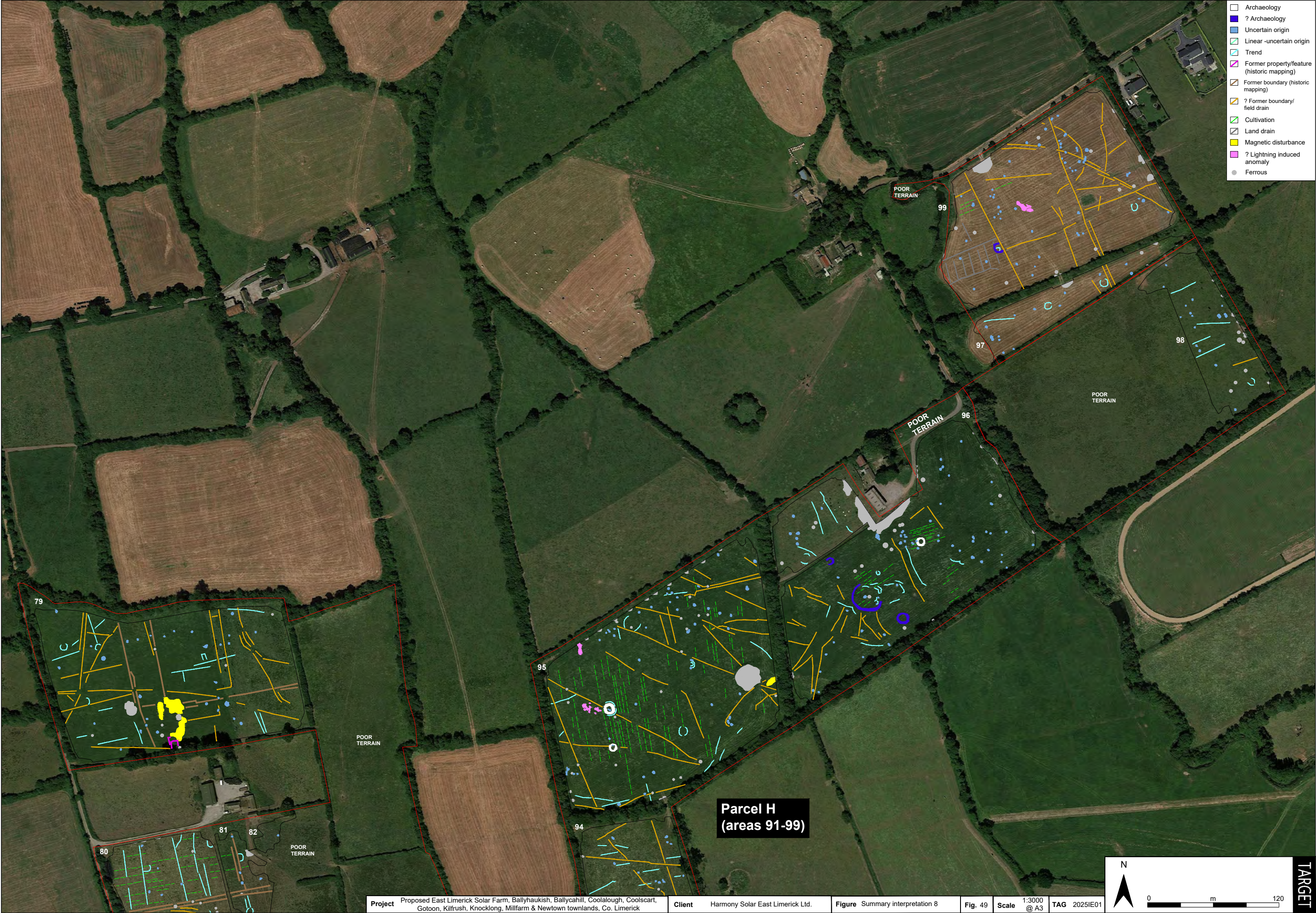
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- Trend
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- Cultivation
- Land drain
- Magnetic disturbance
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- Ferrous



0 m 70

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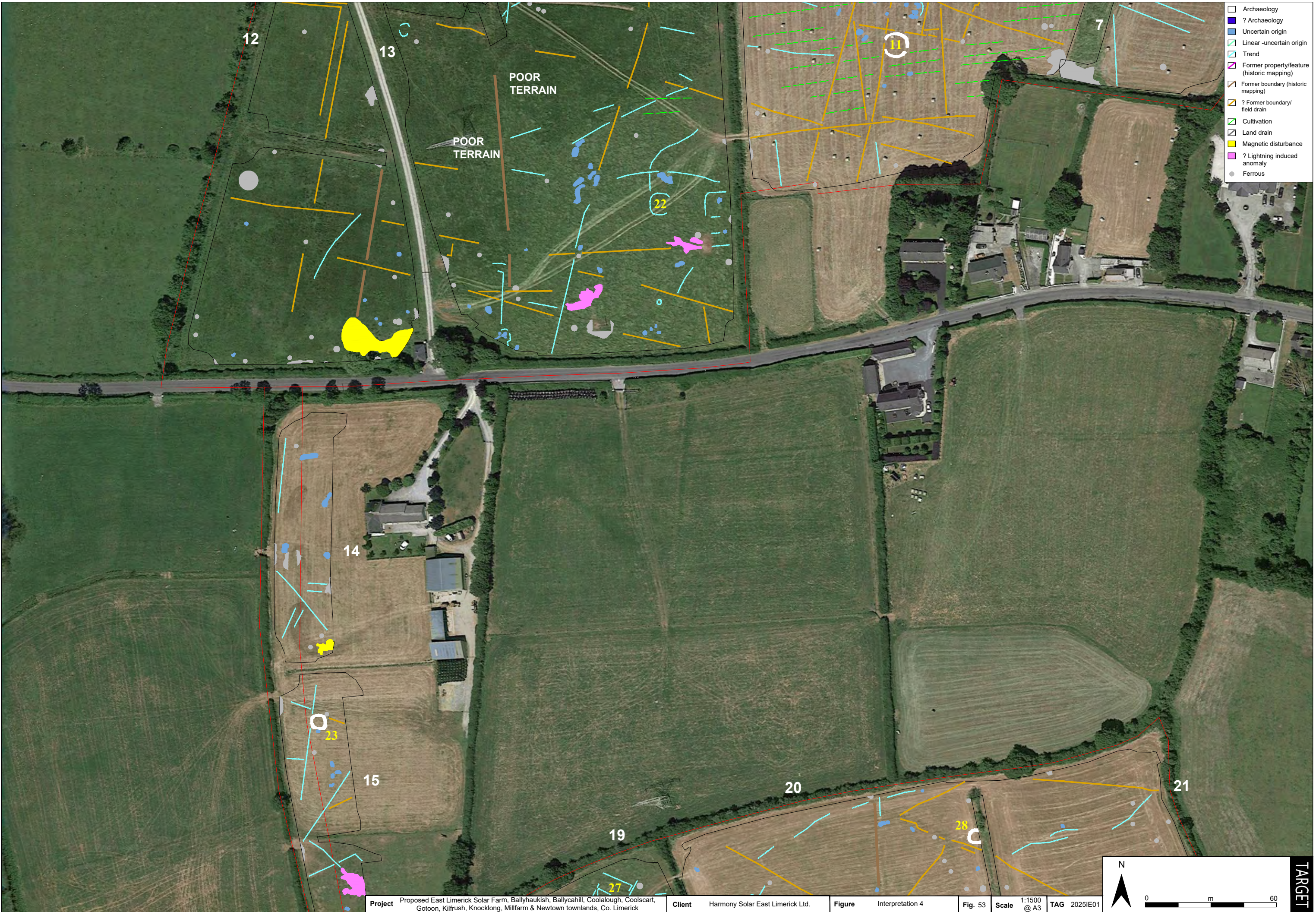




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- Archaeology
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- Cultivation
- Land drain
- Magnetic disturbance
- ? Lightning induced anomaly
- Ferrous

Project Proposed East Limerick Solar Farm, Ballyhaikish, Ballycahill, Coolalough, Coolscart, Gotoon, Kilfrush, Knocklong, Millfarm & Newtown townlands, Co. Limerick

Client Harmony Solar East Limerick Ltd.

Figure Interpretation 4

Fig. 53

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TAG 2025IE01



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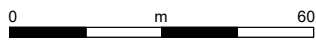
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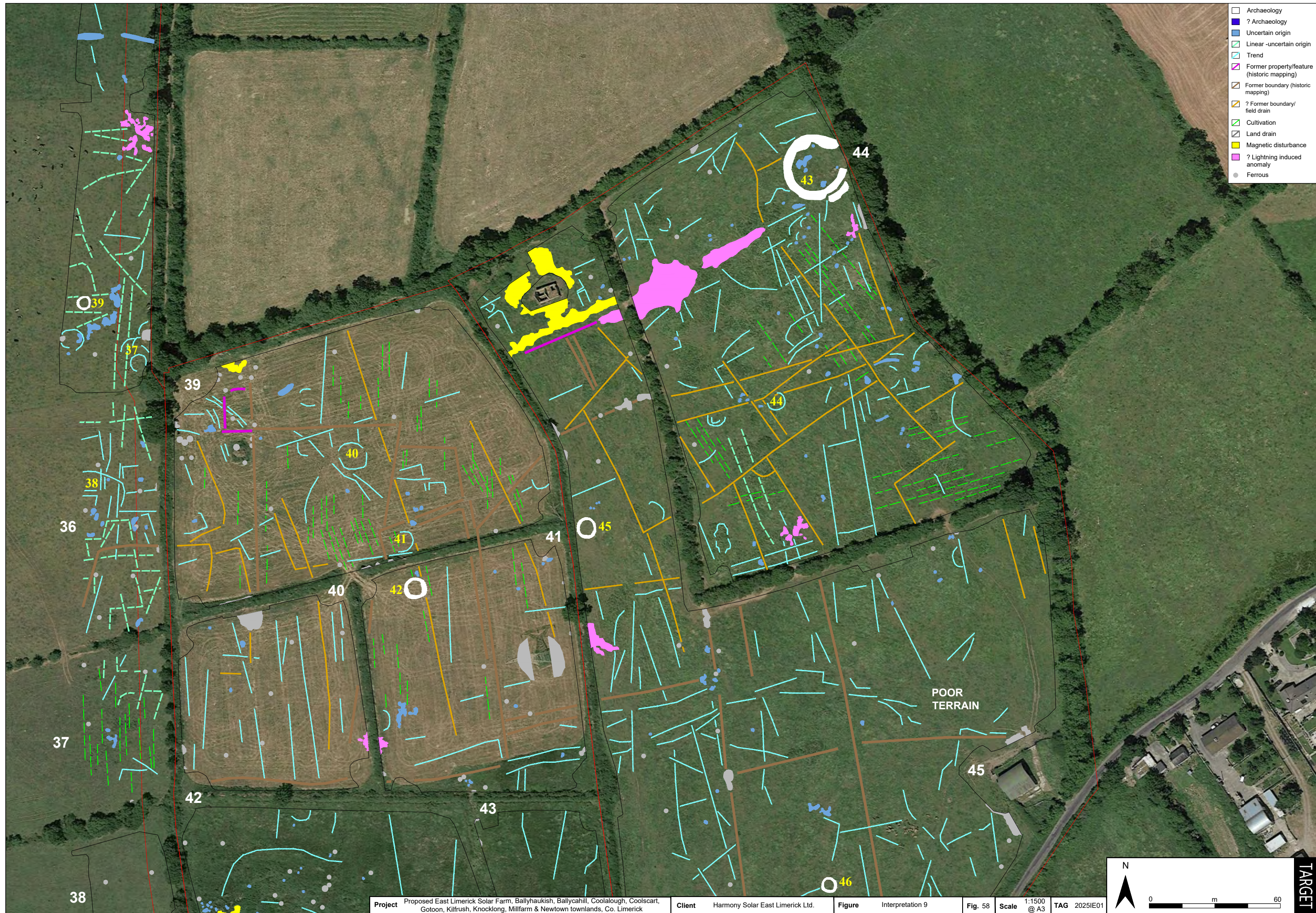


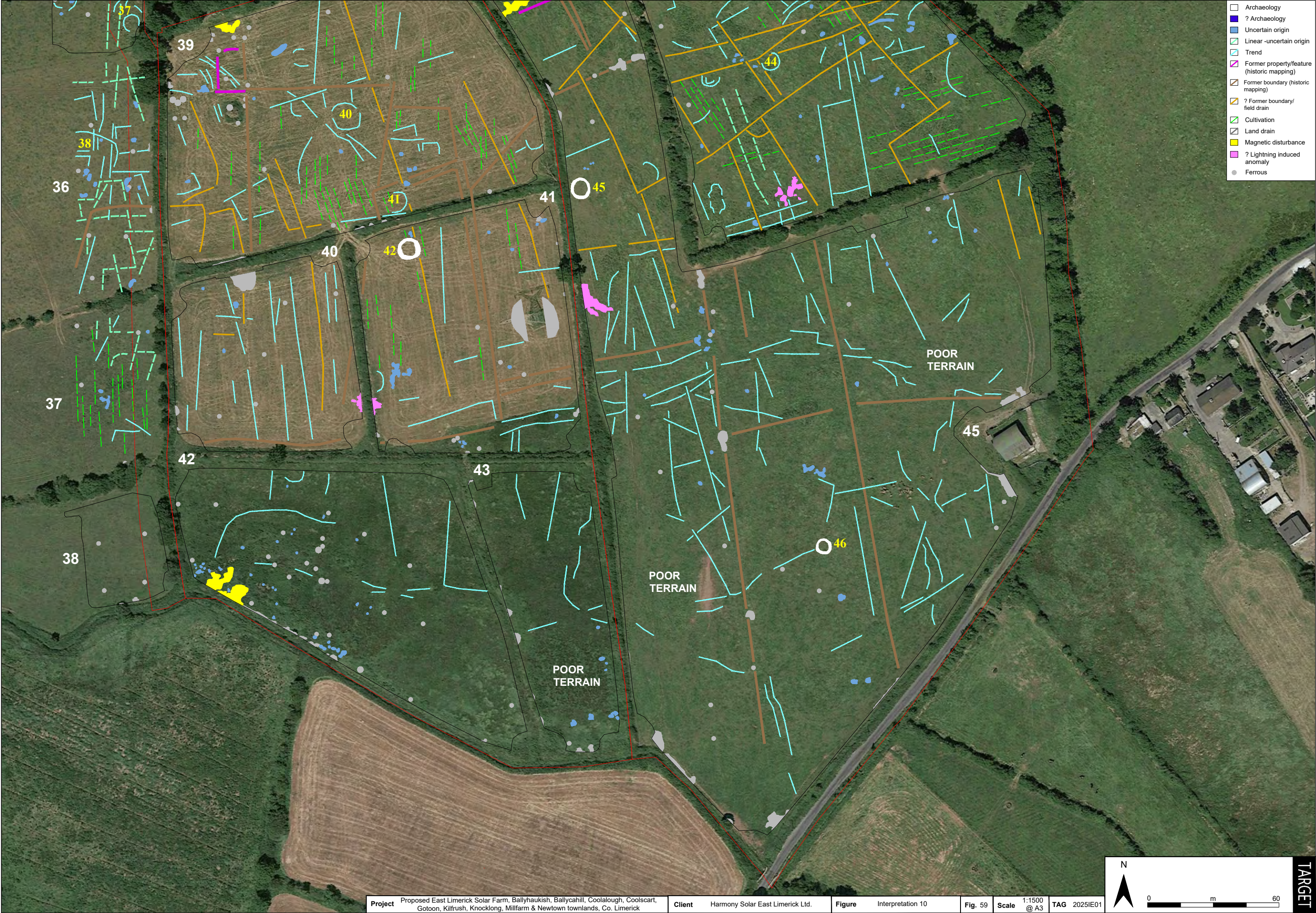


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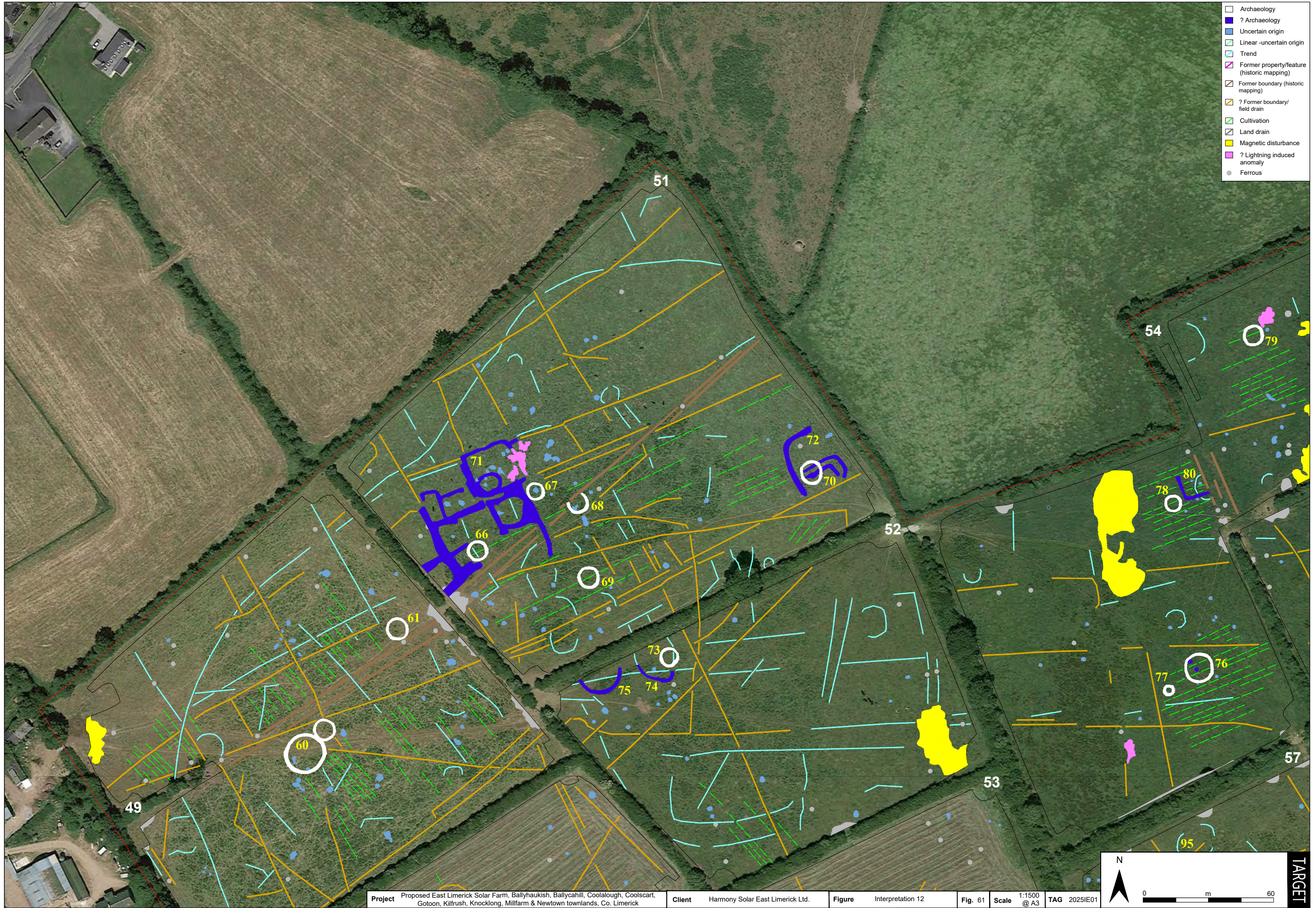


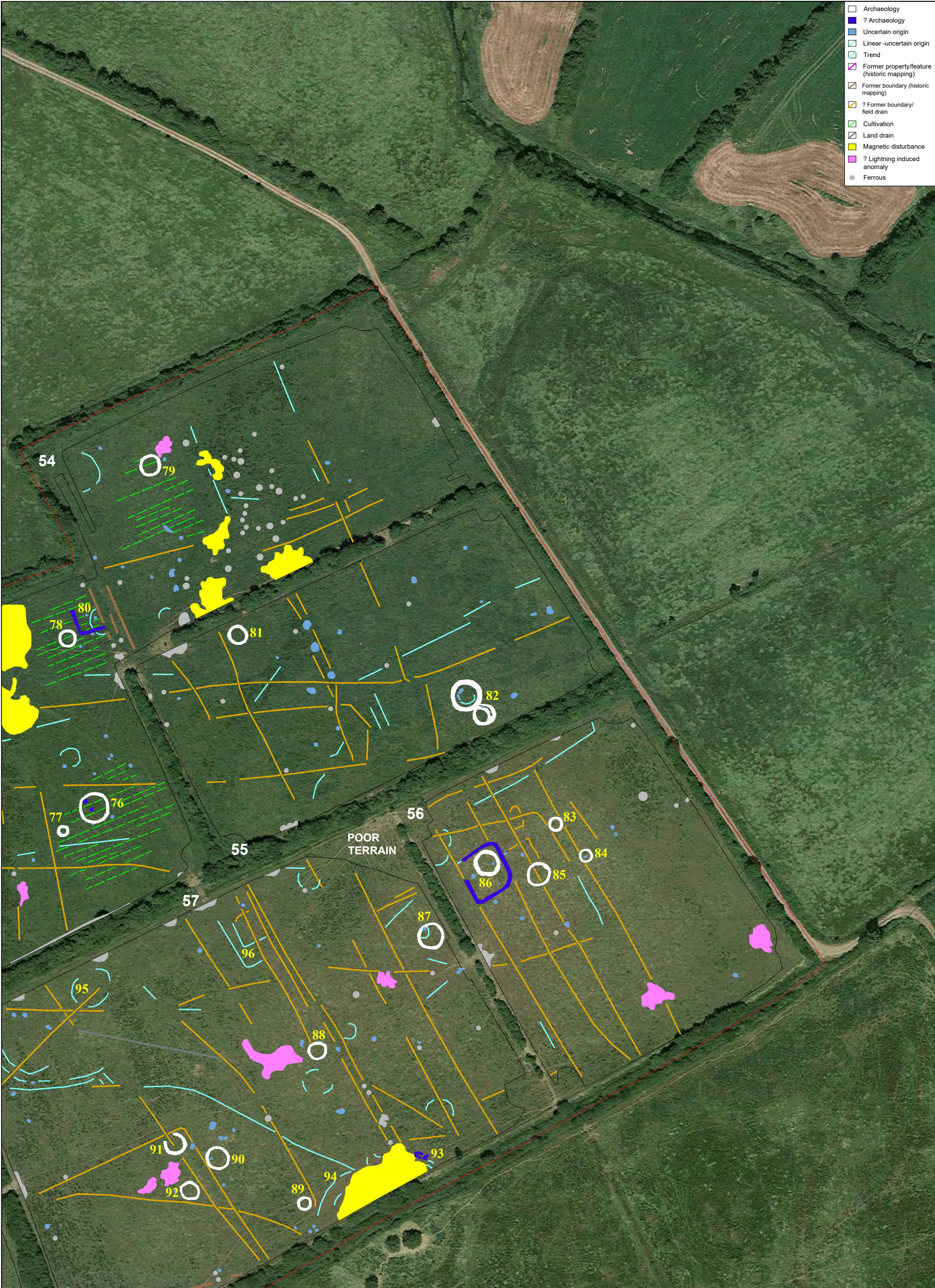




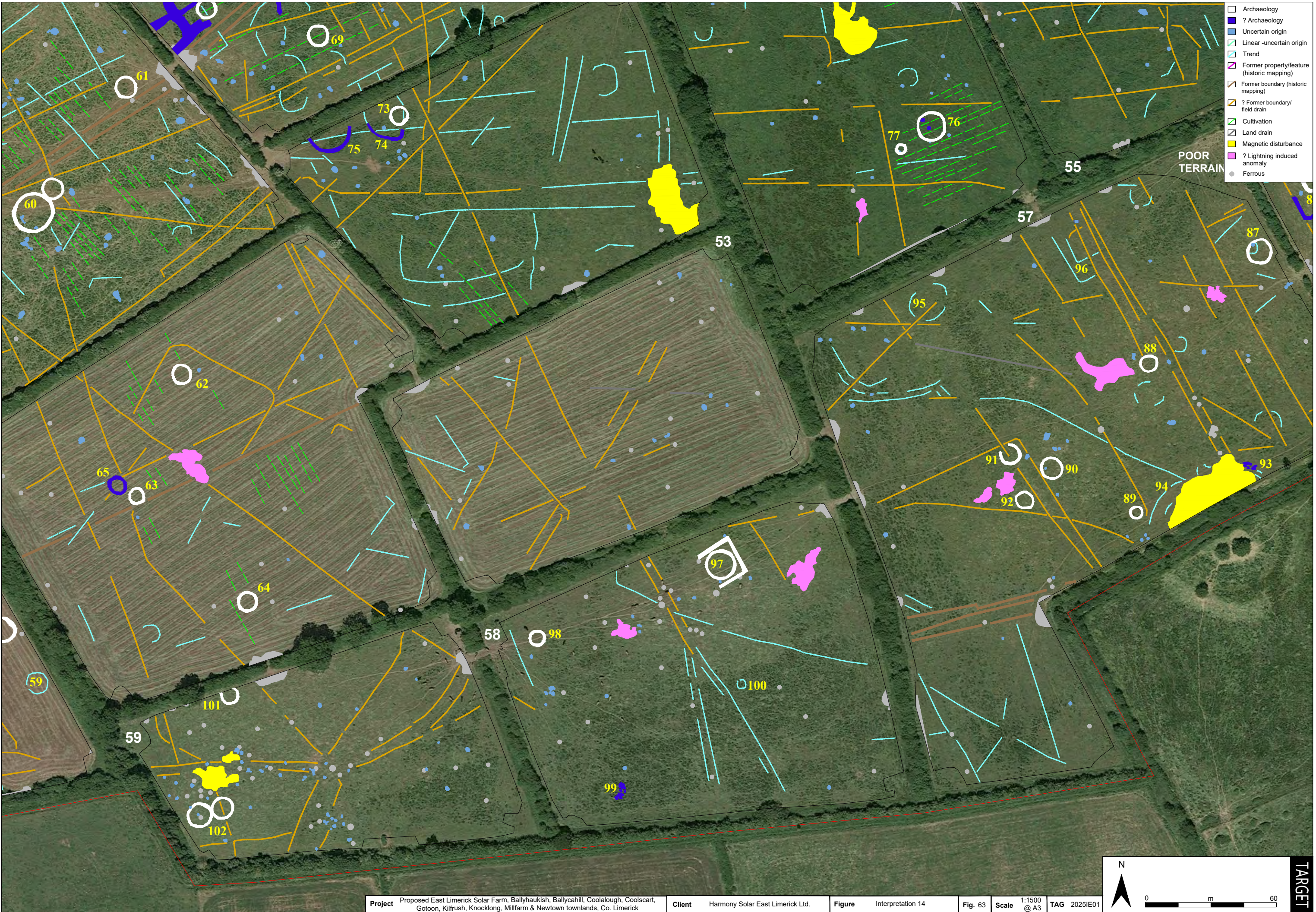








- Archaeology
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- ▨ Trend
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- Magnetic disturbance
- ? Lightning induced anomaly
- Ferrous



- Archaeology
- ? Archaeology
- Uncertain origin
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- Land drain
- Magnetic disturbance
- ? Lightning induced anomaly
- Ferrous





- Archaeology
- ? Archaeology
- Uncertain origin
- Linear -uncertain origin
- Trend
- Former property/feature (historic mapping)
- Former boundary (historic mapping)
- ? Former boundary/field drain
- Cultivation
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Project Proposed East Limerick Solar Farm, Ballyhaughish, Ballycahill, Coolalough, Coolscart, Gotoon, Kilfrush, Knocklong, Millfarm & Newtown townlands, Co. Limerick

Client Harmony Solar East Limerick Ltd.

Figure Interpretation 15

Fig. 64

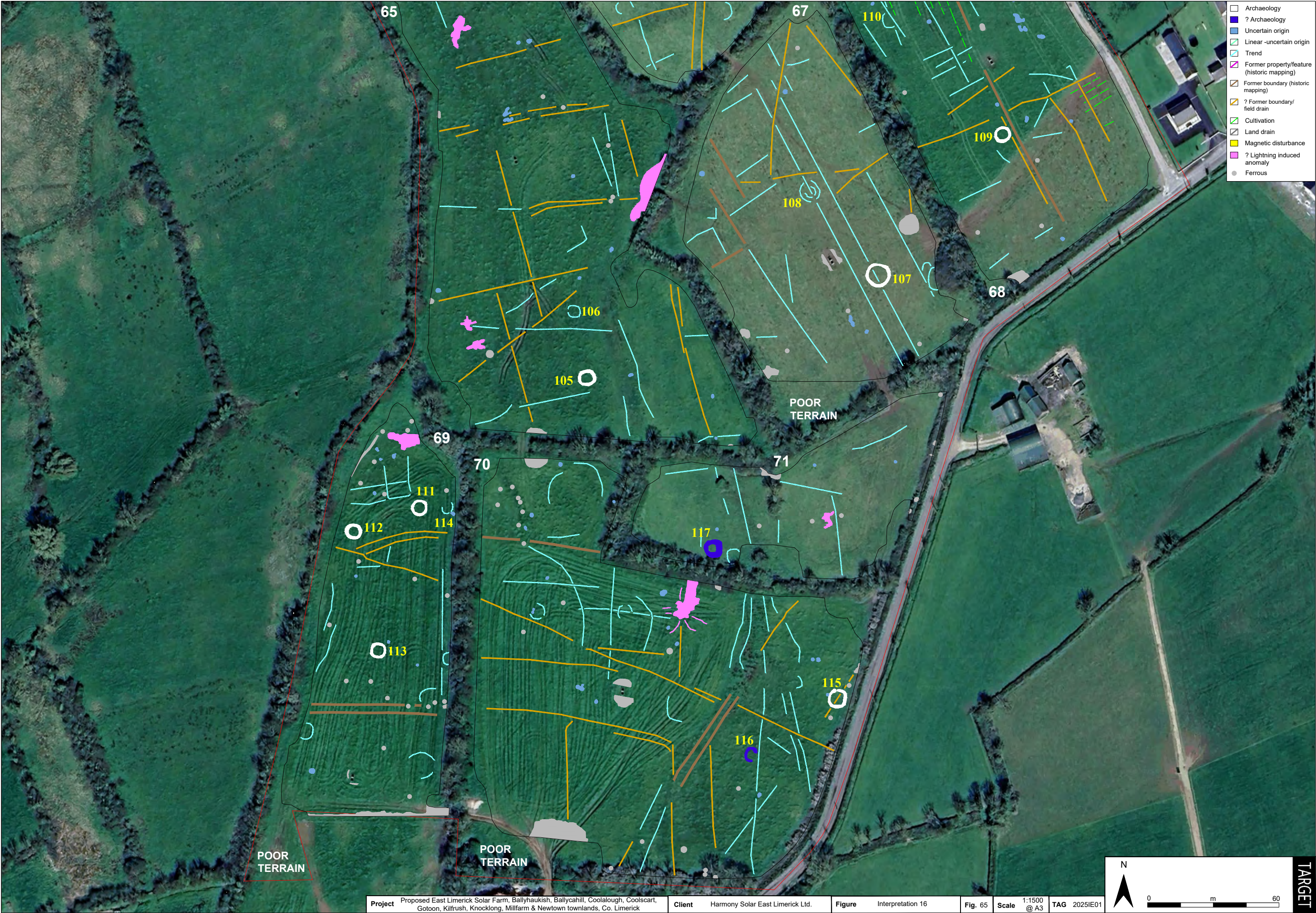
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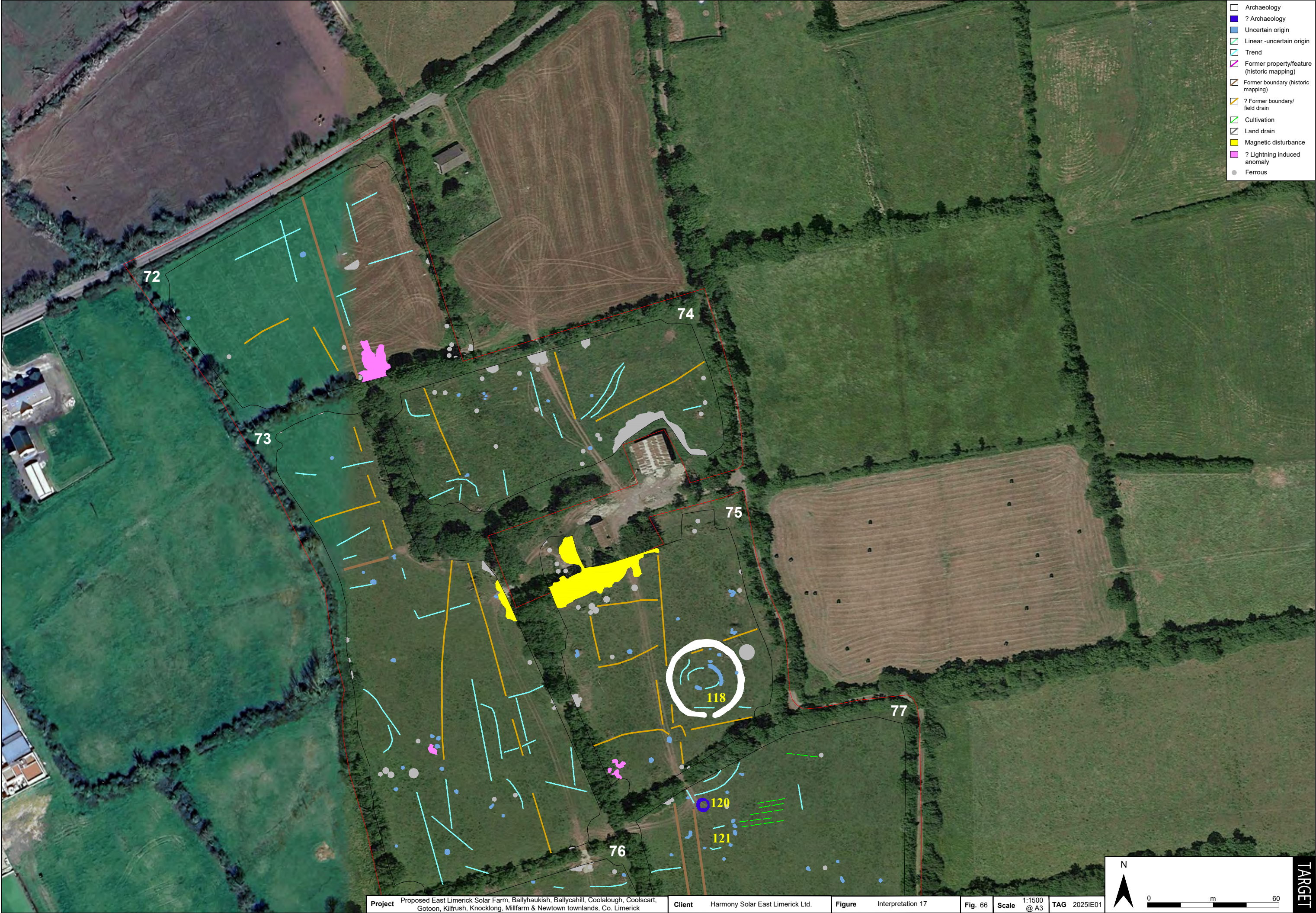
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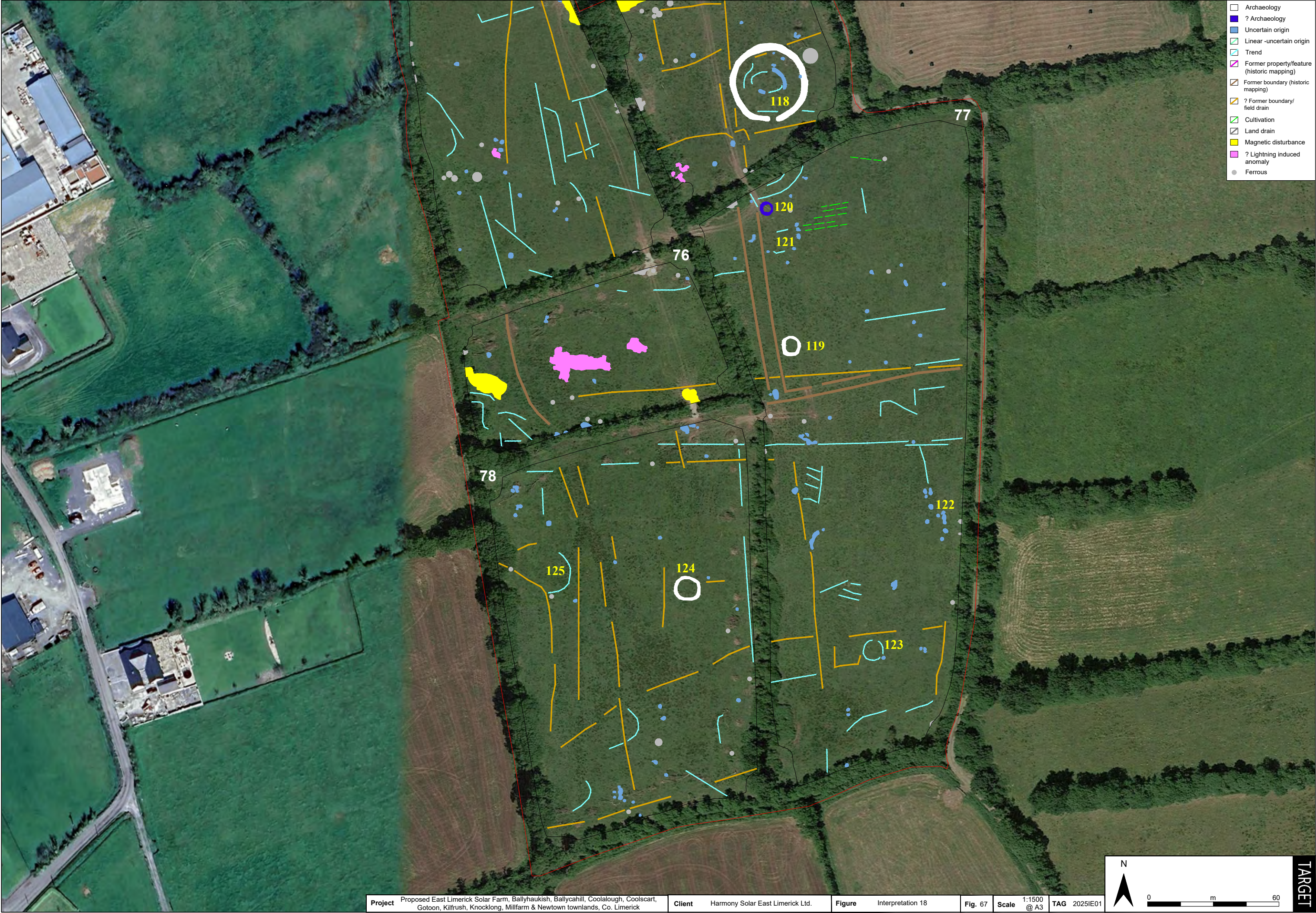


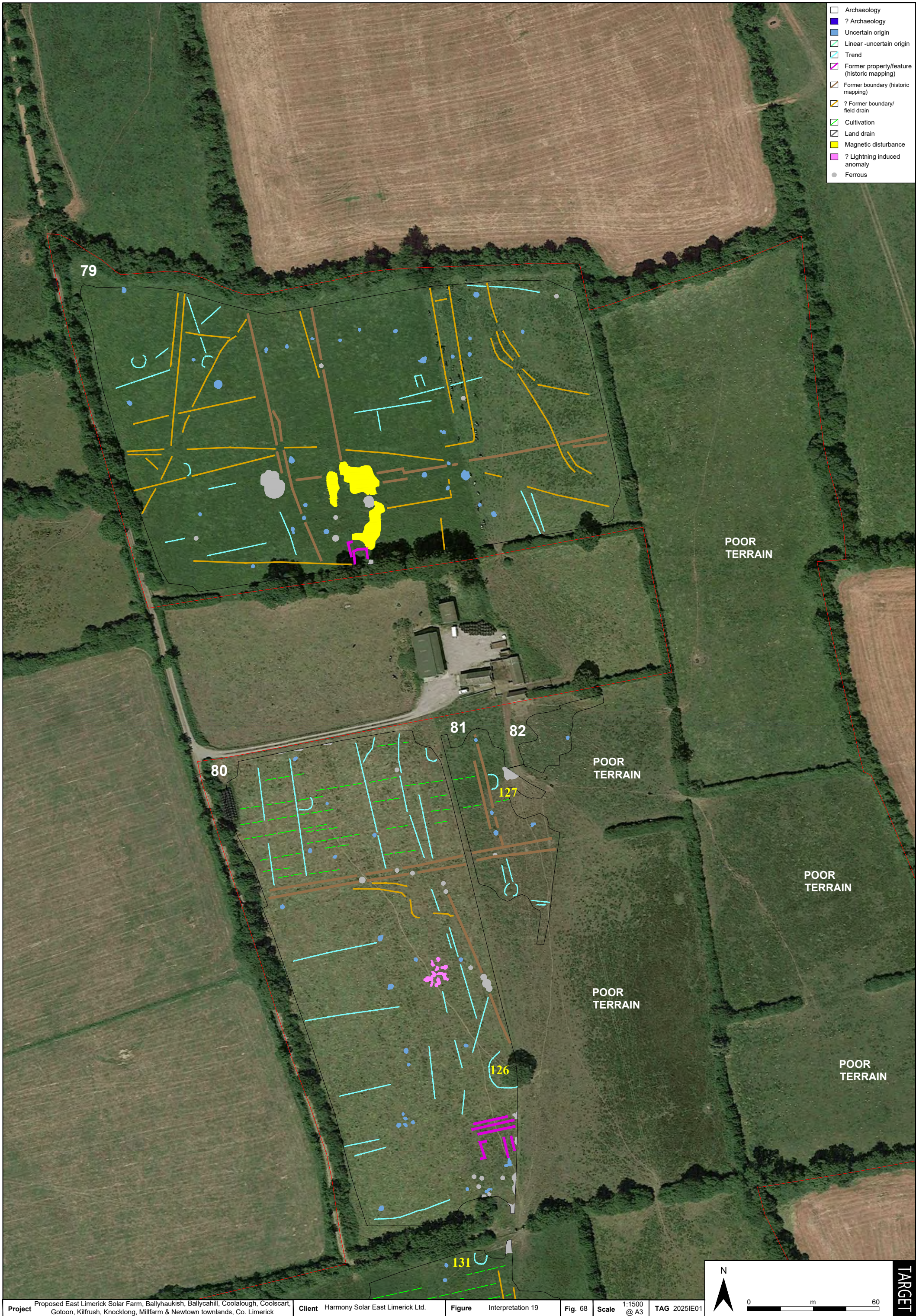
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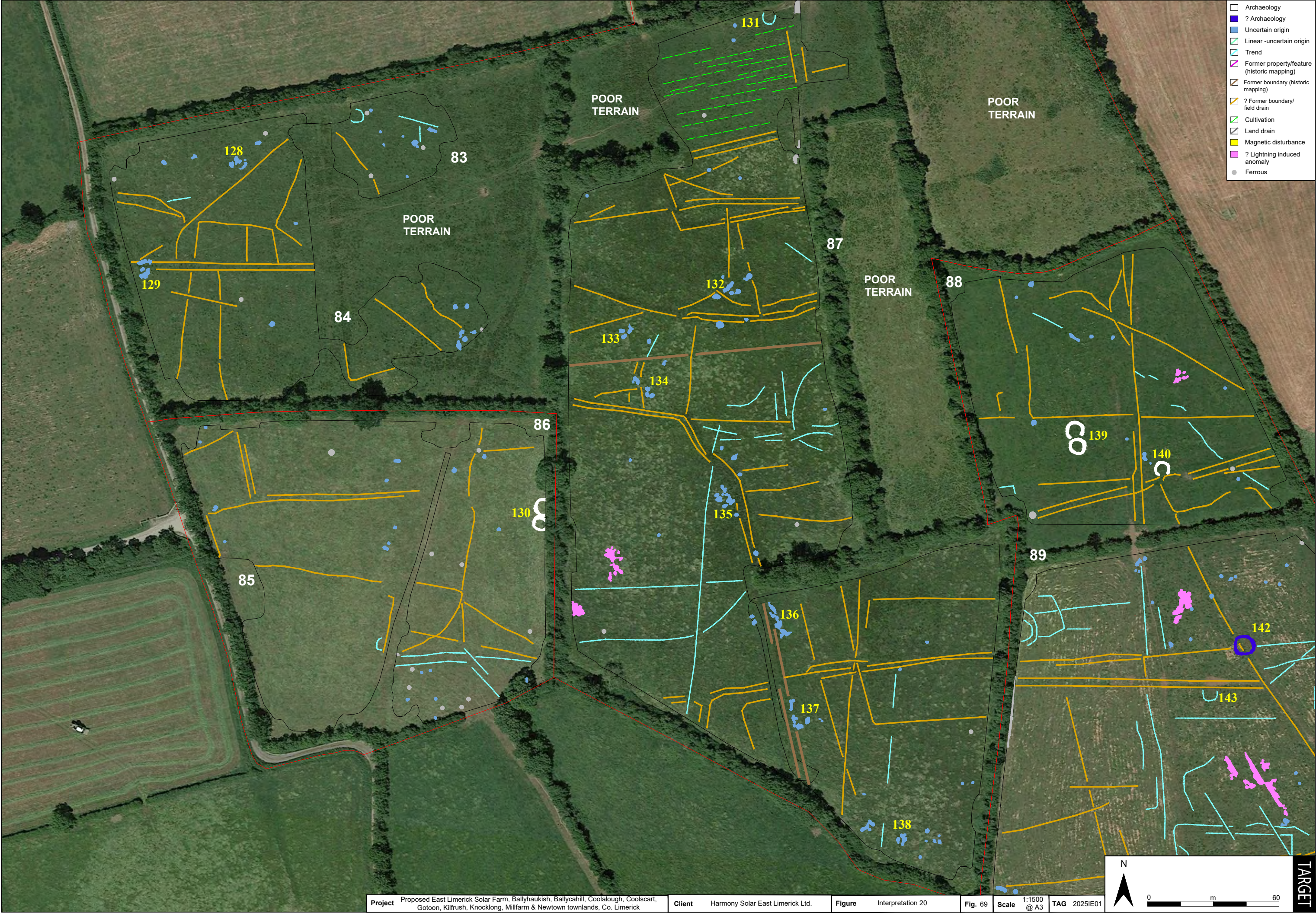
TARGET













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