Geophysics Report

Commissioned by Sonairte in fulfilment of project “SONAIRTE – Protecting Our Heritage” supported by the Heritage Council under the Community Heritage Grant Scheme 2021 (Grant CH12252).

IRISH GEOPHYSICAL AND ARCHAEOLOGICAL SURVEYS

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Report on

ARCHAEOGEOPHYSICAL SURVEY
(consent no. 21R0088)

at

NINCH TD.
Co. Meath

by

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(Irish Geophysical and Archaeological Surveys)

for

Sonairte – The National Ecology Centre"

and

An Chomhairle Oidhreachta
The Heritage Council

(I.G.A.S. Job No. 20#0991)

July 2021

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1. Summary

At the request of Finola O'Carroll MA, consultant archaeologist (Blackfriary Archaeological Field School), on behalf of Dr. Kim Reilly (Chair of Sonairte - The National Ecology Centre), Ian Elliott conducted an archaeo-geophysical survey at Ninch [ITM 701276E 647360N] (Fig. 1). Detailed fluxgate gradiometer survey was carried out across a single field, adjacent to Ninch West House, the Sonairte centre. The survey is being undertaken as part of a Heritage Council-grant-aided project to assess the further archaeological and historical potential of the site, which is close to a recorded monument (Me028-004 – Earthwork), known as "The Rath". Under Consent 21R0088, survey was conducted on 28th April 2021.

The survey was conducted in the sloping field to the south and west of Ninch West House, between it and the recorded earthwork monument, and above the northern bank of the adjacent tidal River Nanny. The results of this geophysical survey do not absolutely confirm the existence of any additional archeologically-significant structures or monumental remains; they do, however, suggest that there exist the remnants of a possible complex of enclosures or barrow burials, and multiple series' of ancient cultivation ridges; the latter could be associated with the habitation of the recorded earthwork, or with other historic or pre-historic occupation of the site.

2. Purpose of Survey

Sonairte - The National Ecology Centre have been awarded funding from The Heritage Council under the Community Heritage Grant Scheme 2021. The project, entitled "Sonairte -Surveys of Archaeological Heritage 2021" (Grant no. CH08557) will assess the archaeological and historical significance of potential heritage on the site, including the recorded monument (ME028-004), locally called "The Rath",

3. The Site

3.1 Location and description

The site of the present survey is a field situated in the Ninch West area of Laytown, Co. Meath. It is located just to the west and south west of the Sonairte centre, which is accommodated in the yards, outbuildings and gardens of Ninch West House (Fig. 2). The western side of the site is bounded by a wooded area, and within that, in an elevated situation, stands the recorded earthwork monument Me028-004. Due to the presence of mature trees and shrubs, and other overgrowth around and about the

earthwork, this area proved inaccessible to survey on this occasion. It was also apparent that even the more-open parts of this area had been subjected to quarrying in times past.

The undulating site, with the exception of a north-western almost-triangular plateau, generally slopes downhill, north-to-south, perpendicular to the adjacent R150 public roadway, towards the tidal estuary of the River Nanny.

The main body of the site is currently set out in a field of pasture, and habitually grazed by cattle. It is generally bounded by hedgerows to the north and west, and an old garden-wall to the east, with timber post-and-rail and wire stock fencing forming a secure perimeter throughout.

The sloping site varies in elevation from approximately 4m to 20m O.D., and measures in area approximately 1.2 hectares.

3.2 Solid Geology and Soils

The solid geology of this site, on the north bank of the River Nanny, is likely to be Visean Carboniferous limestone (*Atlas of Ireland* 1979 RIA pp14-5). Bedrock is not generally exposed at the site; instead it is covered by boulder clay, which is the result of glacier action during the last glaciation.

The soil encountered in the area is likely to be a grey-brown podzolic of the Dunboyne Series, derived from a parent material of Limestone and Shale |Drift and Irish Sea Drift (Finch, T.F. et al, *Soils of County Meath*, An Foras Talúntais 1983).

4 Historical and Archaeological Background to the Site

The earthwork (Me028-004) is the only known archaeological feature or monument at the present site. Known locally as “The Rath”, it is not depicted on the O.S mapping, but a “Sand Pit” is recorded in the vicinity. In general, the hinterland of Sonairte is recognized to be rich in archaeological remains, and another recorded monument potentially dating to the Iron Age (ME028-006 - Barrow) lies some 450m to the east of the present site (Fig. 3).

RMP no.	Monument type	Townland	Distance from site centre
ME028-004----	Earthwork	NINCH	125m W
ME028-055----	Redundant record - cropmark	CORBALLIS (Skreen By.)	290m SSW
ME028-059----	Enclosure	NINCH	300m NNE
ME028-054----	Enclosure	CORBALLIS (Duleek Upper By.)	330m SSW
ME028-024----	Battery	NINCH	395m WSW
ME028-006----	Barrow - mound barrow	NINCH	500m ENE
ME028-097003-	Ring-ditch	CORBALLIS (Duleek Upper By.)	530m S
ME028-096001-	Ring-ditch	CORBALLIS (Duleek Upper By.)	555m SSE
ME028-097002-	Ring-ditch	CORBALLIS (Duleek Upper By.)	560m S
ME028-097001-	Enclosure	CORBALLIS (Duleek Upper By.)	565m S
ME028-096002-	Ring-ditch	CORBALLIS (Duleek Upper By.)	570m SSE
ME028-052----	Enclosure	NINCH	570m WNW
ME028-094----	Ringfort - rath	CORBALLIS (Duleek Upper By.)	585m SE
ME028-005----	Enclosure	CORBALLIS (Duleek Upper By.)	620m S
ME028-095----	Ring-ditch	CORBALLIS (Duleek Upper By.)	750m SE
ME028-069001-	Ring-ditch	CORBALLIS (Duleek Upper By.)	810m
ME028-003----	Church	BALLYGARTH	
ME028-003001-	Graveyard	BALLYGARTH	
ME028-003002-	Armorial plaque	BALLYGARTH	825m SW
ME028-002----	Castle - tower house	BALLYGARTH	830m SW
ME028-069----	Ringfort - rath	CORBALLIS (Duleek Upper By.)	835m SE
ME028-098----	Ringfort - rath	JULIANSTOWN EAST	845m WNW
ME028-101----	Enclosure	NINCH	900m NW

Additional archaeological and historical studies are being undertaken by Ms Finola O'Carroll and Mr Brendan Matthews.

5. Instrumentation

Fluxgate gradiometry (magnetic) survey was employed in the present project.

The survey locations were recorded using Topcon Differential GPS (DGPS) equipment, facilitating accurate mapping and allowing for follow-up archaeological excavation as necessary, as well as any future extension of the survey to other parts of the site.

We proceeded with a detailed **fluxgate gradiometer survey,** utilising a Geoscan Research FM36/FM256/CF6 fluxgate gradiometer system.

Fluxgate gradiometry allows for relatively rapid ground cover over open pastureland, while offering the further advantage over other methods of geophysical survey of being able to detect, record and accurately map the broadest range of subsurface features, monuments and artefacts. These include ditches, hearths, kilns, pits, and more generalised soil disturbance, which are detected through the highly localised variations they generate in the earth's magnetic field.

6. Methodology

6.1 Survey

The survey was conducted in generally dry, warm and gently breezy weather on 28th April 2021.

A fixed GPS survey station was earlier established in the field, on a manhole cover immediately to the south of the garden, and its position recorded relative to the structure of Ninch West House. This allowed for the survey to be tied into National Grid/ITM, facilitating the accurate mapping of the geophysical survey results, and the planning of future, follow-up investigations. Data were plotted using AutoCad LT.

Using the DGPS, an array of 20m x 20m survey panels ("grids") were set out.

Starting in the north-western corner of each grid, the fluxgate gradiometer survey was carried out along successive 20m ENE and WSW traverses, spaced 2m apart. Readings of the localised magnetic field gradient were recorded to the nearest tenth of a nanoTesla (nT) at 25cm intervals along each traverse. The combined dual-gradiometer data yielded an effective survey resolution of 0.25m x 1.0m, or 1600 soundings per 20m x 20m grid. A total of 28 grids, or *ca*. 1.1 hectares, were subjected to fluxgate gradiometer survey (Fig. 4).

The survey data were downloaded and assembled, utilising Geoscan Research's *Geoplot 3.00* software. The data were of generally good quality, with little survey interference or "noise", except as described later. Standard processing techniques were used to inter-balance the individual grids, with the **Zero Mean Grid** processing function applied to ensure that the grids were mutually balanced, with **Edge Match** being additionally applied to four grids. **Zero Mean Traverse** was used to reduce any slight residual striping effects or similar defects within the individual grids, usually resulting from individual instrument drift/misalignment or heading errors. The composite data sets from the two gradiometers were **Merged** to produce the combined composite with the effective resolution of 0.25 x 1.0 m. The raw data have been clipped and plotted at ±10nT, where 0nt represents the nominal net background (undisturbed) magnetic signal registered at a magnetically "quiet" reference location identified and fixed within the site (Fig. 5).

6.2 Data Processing

Minimal and justifiable processing, utilising Geoplot®'s suite of process functions, is generally applied to raw data where strictly necessary, for the purposes of reducing data defects, replacing erroneous data, improving the interpretability of results, and enhancing the visual appearance and presentation of the dataset. The most commonly applied corrections are to reduce visual imbalances between the datasets of individual grids, and striping effects within, caused by inevitable "drift" of the magnetic and electronic

balance of the fluxgate gradiometer instrument during the finite time taken to complete their individual surveys. These drifting effects are minimised by frequent re-balancing of the instruments throughout the course of the survey at the established “nominally-zero” magnetic datum point.

The **Despike** function was applied, in order to reduce the overwhelming effect of anomalies caused by “iron-spikes” on surrounding data. **Zero Mean Traverse** was applied again to reduce residual striping effects due to any slight mismatch in the datum level of the two instruments. The effects of other localised and distracting “noisy readings” within the dataset were minimised by the application of the **Low Pass Filter** processing function.

The data were further smoothed by the application of the **Interpolate** process, twice in the Y-direction, the visual effect of which is to generate a plot at the improved resolution of 0.25 x 0.25m. The processed data are displayed, as a greyscale plot, clipped and plotted at ±5nT (Fig. 6).

Contrasts in the fluxgate gradiometer data were good; limited "noise” and other disturbances are consistent with agricultural usage of the site. While this interference may have a masking effect on weaker underlying “archaeological” anomalies, considerable detail is generally visible, where possible archaeologically-significant deposits and features would be present.

7. Results and interpretation

The survey results, as represented by the processed data set, have been analysed in detail. Anomalous features contrasting with the background, surrounding data have been identified where present. They have been interpreted according to their relative strengths, morphology and data treatment history, and according to inferences drawn from experience and knowledge of local geological, topographical, historical, archaeological, agricultural and modern interference conditions. Generally speaking, and given most suitable soils, disturbed areas of a site will have acquired an enhanced (positively increased) magnetic signature; the relative strength of the magnetism displayed will indicate the likely source or mechanism involved. Where natural (undisturbed, and magnetically-'neutral') subsoil has been excavated in the past, the back-filled void tends to have an enhanced (more-positive) magnetic signature due to the presence of an increased volume or concentration of organically-richer soil, topsoil or other material, usually with typical values of no more than a couple of nanoTesla (nT). Note that any re-deposited, unmixed up-cast subsoil would tend to generate a lesser magnetism (i.e. more-negative) than the surrounding material. The longer these different deposits exist in situ (e.g. since antiquity), then the smoother the magnetic signatures that they tend to display. Thus we can generate an interpretive plot of the magnetic signatures across a site. A descriptive illustration of the interpretation has been drawn for the data set (Fig. 7).

The dataset is dominated more by broad areas of "noise", rather than by more-subtle anomalies that might be associated with probable archaeologically-significant features. Such broad areas of interference tend to "drown out" any weaker underlying anomalies, but unfortunately there is very little that can be done by way of processing to reduce, let alone eliminate the effect. It is, however, instructive to comment on each of the "disturbances". Firstly, a broad area of magnetic disturbance is evident at the north of the survey area, situated on the high ground, previously referred to as the terrace (A). The primary cause of this interference is the redundant metal utility pole, which behaves like a magnetic antenna under the influence of the background Earth magnetic field. There is a second broad area of interference (B) on the lower, flatter ground between the house and the river, which can be safely associated with the presence of a rudimentary concrete septic tank, which is probably reinforced throughout with steel, particularly evident on the 2m x 3m (approx.) lid. Note that the anomalies look very different in character (Fig 6); the reason is that the steelwork of the pole generating the first anomaly (A) is localised to a small point on the ground, but then projects vertically (mostly) upwards ABOVE the ground surface, whereas the steelwork of the tank generating the second anomaly (B) is buried BELOW, or otherwise spread out parallel to, the ground surface. A third broad area of interference (C) is evident just to the west. In reality this can be resolved to much more localised foci, each with jumbled magnetism of varying strength, which indicates more-generalised ground disturbance, with possible localised surface burning. This probably results from periods of hedgerow clearance. A more-intense bi-polar magnetic signal (D) may indicate the presence of old iron fencing or gate materials.

A broader linear disturbed area some 20m to the east could be the remains of another boundary, although it is more likely to represent the remnant traces of the pathway that once extended towards the river, passing the western gable of Ninch West House, and then curving west towards the position of the more-modern, and recently-erased, boundary just mentioned. This path is represented as a roadway on the 1771 map of the area (Fig. 8) - note that the house is here rather fancifully depicted as standing well to the west of its actual, and current, position; the representation of a "belvedere" close to the position of the monumental earthwork may further suggest that the map represented the tastes of the then-landowner rather than reality!

The general lack of former boundaries elsewhere within the surveyed area is notable, as the data clearly record what must be cultivation furrows, on three or more orientations (F, G and H), each running approximately parallel to the contours of the slope at each location, with a pitch of approximately 3m (Fig. 9). On sloping land, serried cattle or sheep tracks are frequently encountered, but these "ridges/furrows" appear too uniform, so it is more realistic to settle on cultivation as the likely cause of these magnetic signatures. In particular, the cultivation ridges and/or furrows, are uniform and continuous along the relatively flat "terrace" at the top of the site. With the additional observation that that they don't appear to respect any current, or earlier recorded, field divisions, the evidence indicates that they clearly pre-date the present roads and fences, and more than likely the present house and gardens, and its antecedents. This could, therefore, be evidence of agricultural activity associated with habitation of the recorded earthwork, which might be medieval, or even earlier. So, agricultural activities have, apparently, left their signature on the landscape and, magnetically, in the soils.

A broader weak linear anomaly (K) traverses grids 7 and 8, fading out as it crosses grid 9 towards the north-east of the survey. Initially the inclination was to consider this feature as part of the presumed cultivation complex, as it was similar to the other probable furrows; and that should probably be expected anyway, as all are created in an identical soil complex. However, upon review, it is possible that this feature, set as it is on a slightly divergent orientation, may be a lane or a track-way, which heads more-or-less directly towards the earthwork, from the direction of the present house. Regarding interpretation of the anomaly, the track is likely to be the lighter, and less-magnetic, band. It is probably constituted of magnetically-"quiet" deposits of stony gravels or mineral soil. It is flanked by shallow depressions or drains (which appear darker). Whereas the field is starting to slope fairly steeply down from the terrace at that point, a review of the site photographs (Plates 1 & 3) suggests that the slope breaks to a level at about this location, most evident against the background hedge, to the centre left edge of Plate 3. This interpretation would need to be verified by further visual analysis on site.

A number of weak annular or circular anomalies are present, centred on grids 15 and 16 (L). Upon reviewing the data, it appears that the "furrows" are interrupted at this location, suggesting that these enclosures are later, but this is by no means certain. In a "noisier" environment or data-set, these low-contrast anomalies would be imperceptible, and, in reality, they may have a minimal physical expression. They may exist only as "ghost" features, which are only detectable by geophysical survey because of differential (top-) soil mineralisation. The structures or features might have made only minimal intrusion,

or retain a low residual impact, on the subsoil layer beneath. Furthermore, later activity inevitably has "blurred" the evidence. Most apparent within the complex, and located in the middle of grid 15, is a circular anomaly of c. 7m diameter (L), representative of a narrow and shallow ditch or trench. The feature is possibly a burial barrow, although it has minimal surface expression. Alternatively, it may be the wall foundation trench of a large hut or a small enclosure, the former with a circular central habitation surface of c.3-4m diameter, or the latter with a central hut of the same size. Outside this 7m feature is the weak trace of a further probable roughly-circular enclosure of c. 25m diameter (M). Within this is another possible enclosure of c 10m diameter (N). Just to the east the larger enclosure is intersected by another enclosure of 20m diameter (P), although their relative temporality, or those of any of these possible features, is indeterminate without further investigation. Another enclosure of 12-14m (R) appears to intersect both R and M. As noted, these are weak anomalies, and their identification, let alone their interpretation is relatively speculative. Thus they may represent the detectable remnants of an extended complex of barrows. The general lack of noise or magnetic disturbance also lends some credence to the latter interpretation, as well as the location overlooking the river to the south.

Elsewhere throughout the site there are scattered isolated, or "discrete", anomalies; some are weak and broadly within the field-strength range associated with buried archaeological features, e.g. pits, while some are slightly stronger which we tend to assign to more recent disturbance or the presence of debris in the topsoil. A few are stronger still, and being bi-polar in character, can be safely associated with ferrous debris in the soil. This analysis is broadly presumptive, and ordinarily we would expect archaeological test excavation to be available to confirm these findings. Often, also, clear patterns or clustering might tend to provide additional persuasiveness towards an archaeologically-significant origin, or otherwise. Also, some may be caused by the extraction of stones or tree-roots, for example, or from geological effects such as erosion.

And, while there are a number of isolated magnetic anomalies throughout the site, which is to be expected in a region that has likely endured human occupation for millennia, it is worth noting that there is little evidence of the broad spreads of "plough-soil debris", caused by deposition of farmyard manure and other waste (along with fragmented implements), that is frequently encountered in the rich agricultural terrain of this county. The most likely explanation is that the sloping character of this site never lent itself to prolonged exploitation through tillage, and its associated fertilisation. A number of anomalies could nevertheless be generated by debris scattered owing to the proximity of Ninch West House and its associated domestic activities.

The interpretation and antiquity of all of the above suggested archaeological features remain to be verified by appropriate archaeological test excavation, or other analysis.

8. Conclusions and recommendations

The present survey has indicated that the site is relatively lacking in definite archaeological structures or features. Aside from the possible enclosure-, or, perhaps, barrow-, complex in the centre of the site, most of the significant or dominant magnetic anomalies can each be afforded modern interpretations, with the notable exception being the multiple series of probable agricultural ridges and furrows. That these anomalies, with their cultivation origins, are one of the main, and probably archaeologically-significant, features to emerge from the survey seems an appropriate result, considering the present-day association of the site with Sonairte – the National Ecology Centre

Finally, although fluxgate gradiometer survey is an extremely powerful and versatile method of archaeological prospection, and can generate a detailed image of the sub-surface geo-physiology, it may not detect all sub-surface remains (due to their nature, depth of burial or limited spatial extent, interference, or other circumstances) and so absence of anomalies need not indicate absence of archaeology. Some limited test excavation is normally recommended as a control in apparently sterile areas.

Acknowledgment

This project is funded by a grant from The Heritage Council.
Grateful thanks are due to Mr Luk Van Doorslaer (landowner); Dr Kim Reilly (Chair of Sonairte) and Ms Finola O'Carroll MA (consultant archaeologist/project leader).

Appendix 1. Outline of *Geoplot*® Processing Functions

Despike

The Despike function can be used to automatically (a) locate and remove random, spurious readings often present in resistance data and (b) locate and remove random "iron spikes" often present in gradiometer and magnetometer data.

Edge Match

The Edge Match function may be used to remove grid edge discontinuities. These are often present in Twin Electrode resistance surveys as a result of improper placement of the remote electrodes.

Interpolate

The Interpolate function may be used to increase or decrease the number of data points in a survey. Increasing the number of data points can be used to create a smoother appearance to the data. Interpolate can also be used to make the sample and traverse intervals of differently sampled composites match; this is essential, for example, prior to combining them into one composite or prior to generating a correlation plot.

Low Pass Filter

The Low Pass Filter function may be used to remove high frequency, small scale spatial detail. It is useful for smoothing data or for enhancing larger weak features.

Merge

The Merge function enables the combination of the equivalent pre-processed data composites from a pair of gradiometers operated in dual mode.

Zero Mean Grid

The Zero Mean Grid function sets the background mean of each grid to zero. It is useful for removing grid edge discontinuities often found in gradiometer or similar bipolar data.

Zero Mean Traverse

The Zero Mean Traverse function sets the background mean of each traverse within a grid to zero. It is useful for removing striping effects in the traverse direction which often occur in Fluxgate gradiometer data. This also has the effect of removing grid edge discontinuities at the same time.

Appendix 2. Survey grid layout

Ninch, Co. Meath. Sitename “ninch”. Consent no. 21R0088

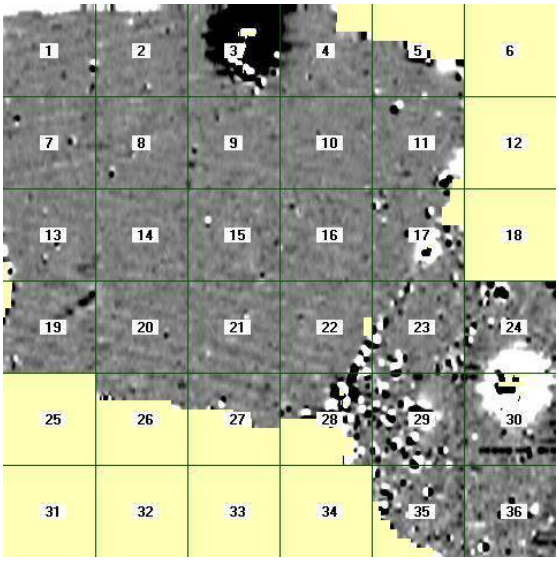
Grid-names

nin01m.plm

	nin01m	nin02m	nin03m	nino4m	nin05m				
	nin10m	nin09m	nin08m	nin07m	nin06m				
	nin11m	nin12m	nin13m	nin14m	nin15m				
	nin21m	nin20m	nin19m	nin18m	nin17m	nin16m			
		nin22m	nin23m	nin24m	nin25m	nin26m			
					nin28m	nin27m			

Dir 1st traverse →

Geoplot process numbers



Appendix 3. Data processing history

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"sample interval"
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"Instrument"
"master grid"
"grid size"
"log zero drift on/off" or "averaging on/off"
"Data units"
"Process function(s)"
"
"

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"nin1mya"
"28-04-2021"
"12:46:49"
"E"
"120 m"
"120 m"
"2 m"
".25 m"
"Gradiom."
"FM36"
"nin01ma"
"20 m"
"20 m"
"On"
"Data"
"1"
"nT"
"3.01"
" 4"
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"Em3B Em15T Em9T Em36T"
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"FM36"
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"3.01"
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"nin1myb"
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"Pos.Thresh. = 5  Neg.Thresh. = -5"
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"Interpolate Y, Expand - SinX/X, x2"
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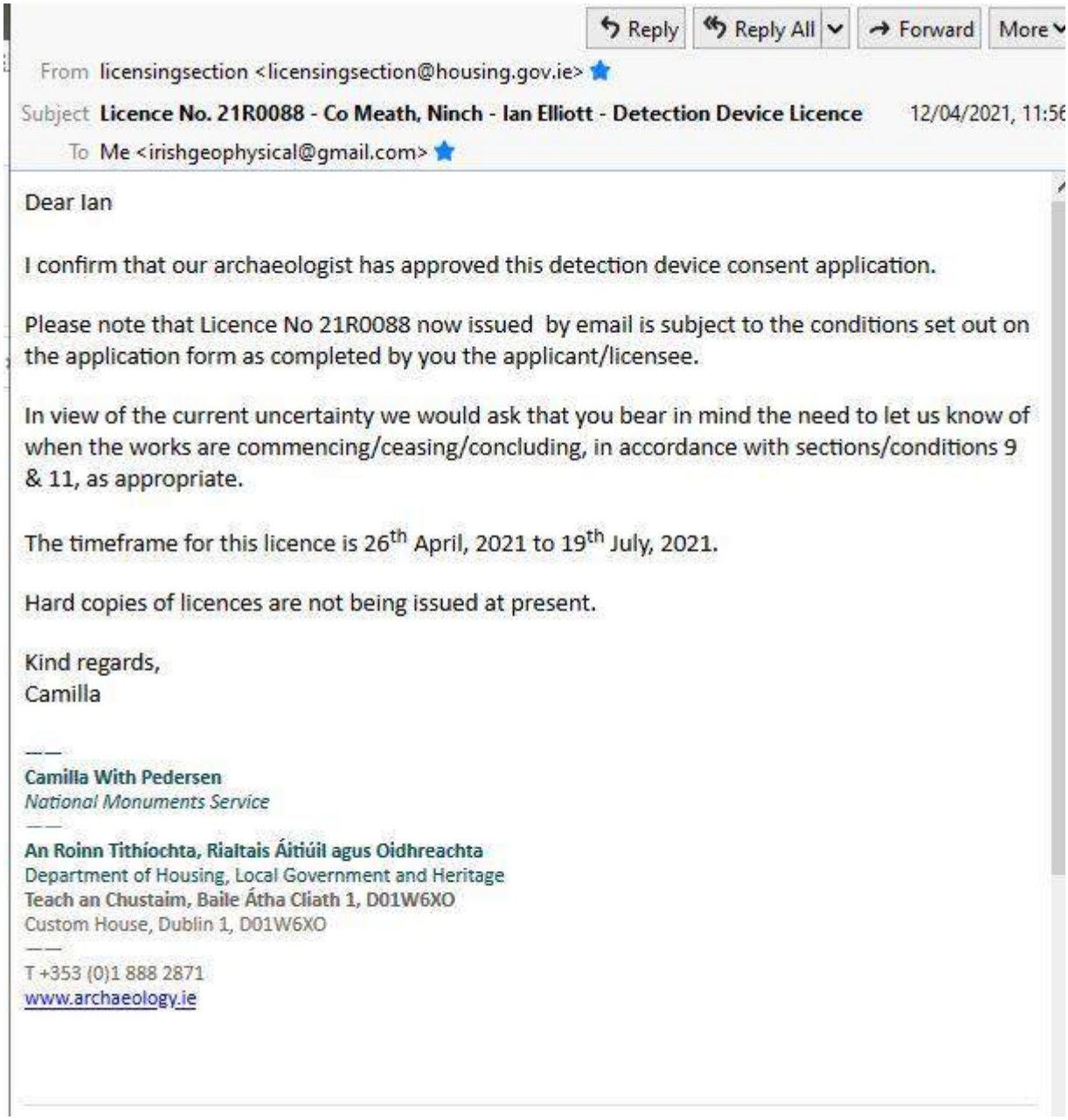
Appendix 4. Consent



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From licensingsection <licensingsection@housing.gov.ie>

Subject **Licence No. 21R0088 - Co Meath, Ninch - Ian Elliott - Detection Device Licence** 12/04/2021, 11:56

To Me <irishgeophysical@gmail.com>

Dear Ian

I confirm that our archaeologist has approved this detection device consent application.

Please note that Licence No 21R0088 now issued by email is subject to the conditions set out on the application form as completed by you the applicant/licensee.

In view of the current uncertainty we would ask that you bear in mind the need to let us know of when the works are commencing/ceasing/concluding, in accordance with sections/conditions 9 & 11, as appropriate.

The timeframe for this licence is 26th April, 2021 to 19th July, 2021.

Hard copies of licences are not being issued at present.

Kind regards,
Camilla

——
Camilla With Pedersen
National Monuments Service
——
An Roinn Tithíochta, Rialtais Áitiúil agus Oidhreachta
Department of Housing, Local Government and Heritage
Teach an Chustaim, Baile Átha Cliath 1, D01W6XO
Custom House, Dublin 1, D01W6XO
——
T +353 (0)1 888 2871
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Plates (Ninch, Co. Meath)

Plate 1: View from NW of site, looking E towards Ninch West House and “Sonairte”.

Plate 2: View from NW of site, looking S towards tidal River Nanny beyond field boundary.

Plate 3: Looking NW from field boundary beside house, towards plateau, and earthwork beyond.

Plate 4: View fom SW corner of site, looking NE towards house, with riverside boundary to right.

Fig. 1. Ninch, Co. Meath. Extract from OS Discovery Series Sh43, showing site location.

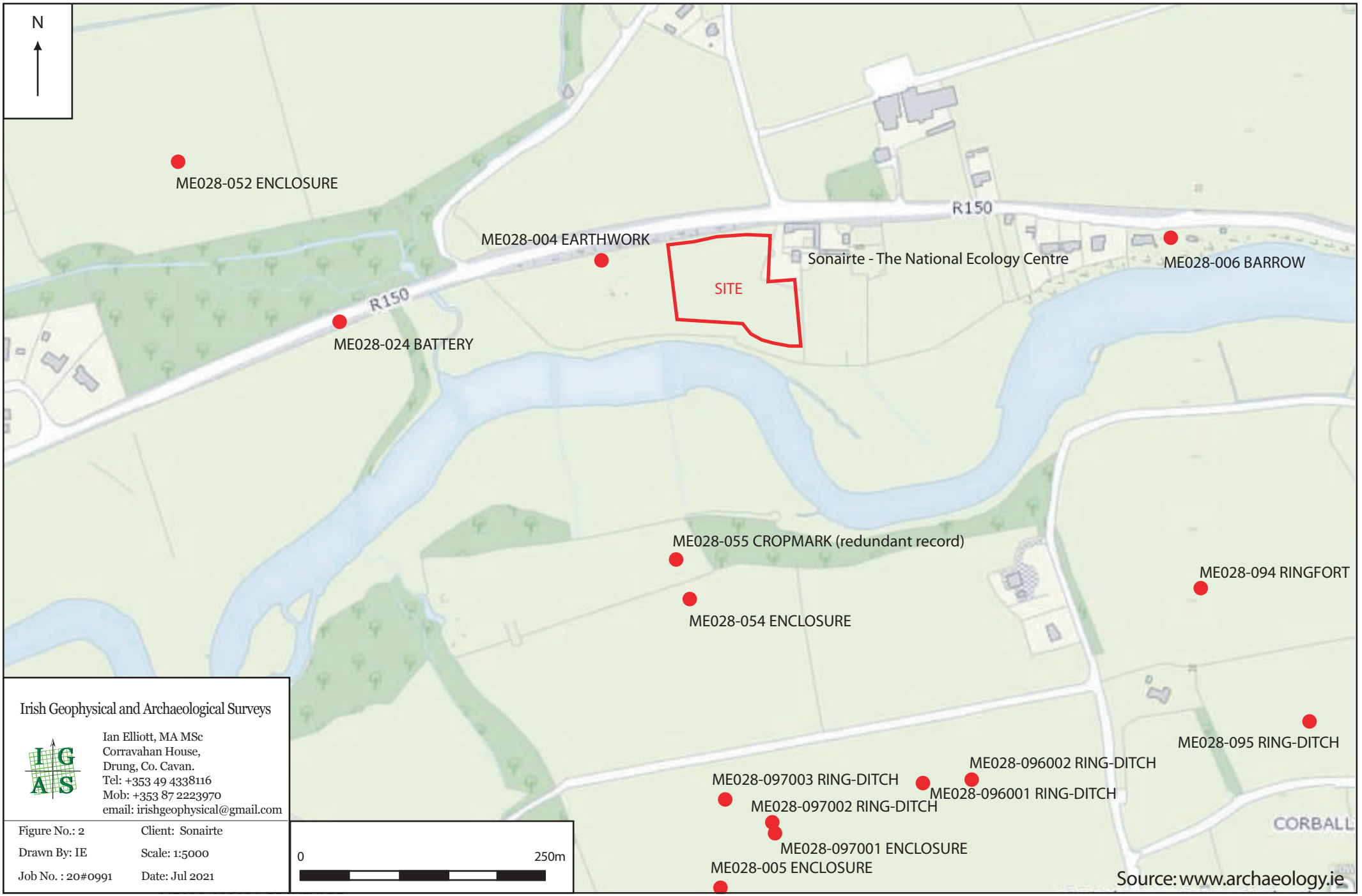

Fig. 2 Ninch, Co. Meath. Extract from OS mapping showing survey location.

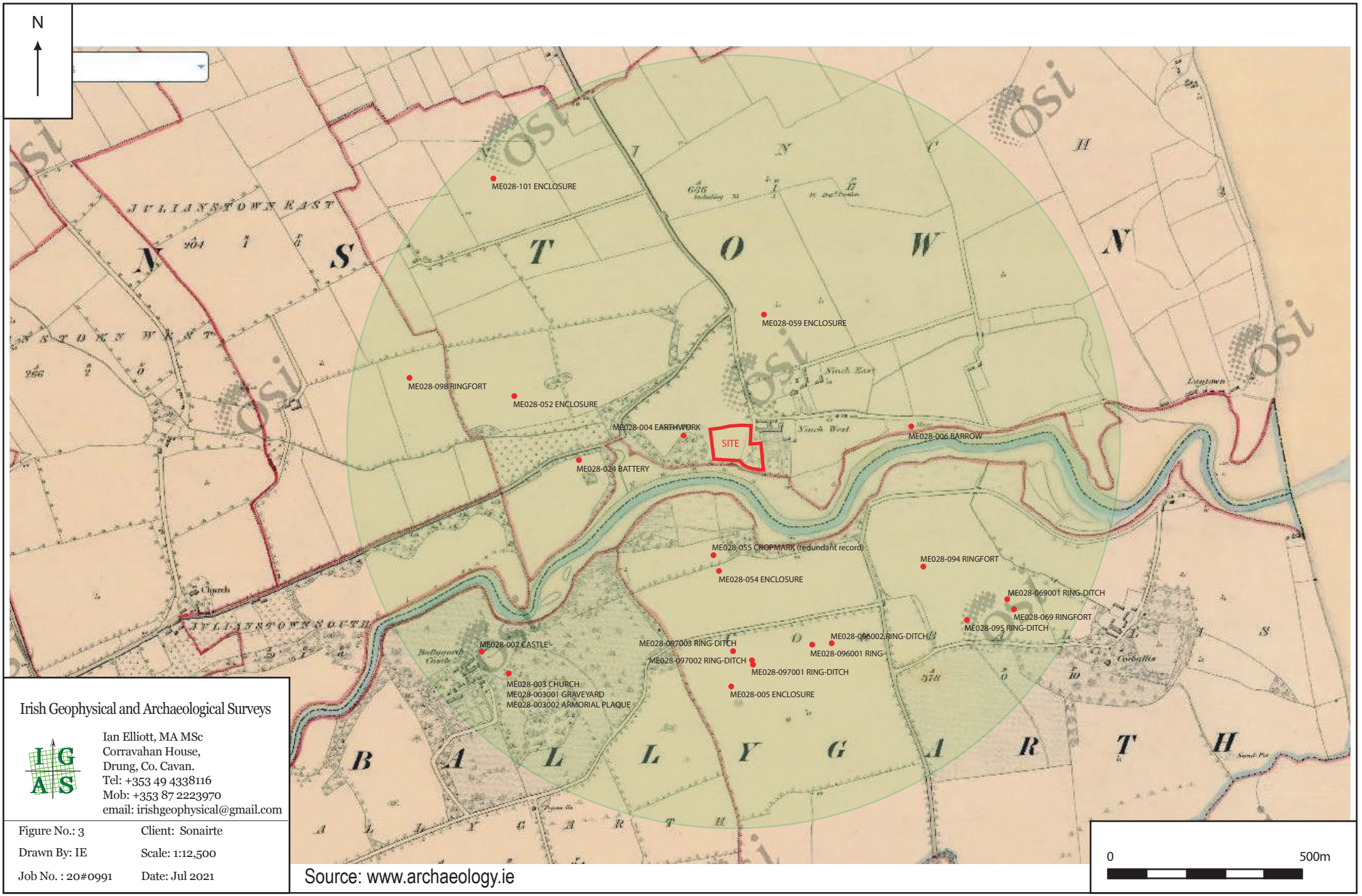

Fig. 3 Ninch, Co. Meath. Extract from OS six-inch 1st edn., showing RMP sites within 1km of site.

Fig. 4 Ninch, Co. Meath. Survey layout.

Fig. 5 Ninch, Co. Meath. Raw survey data.

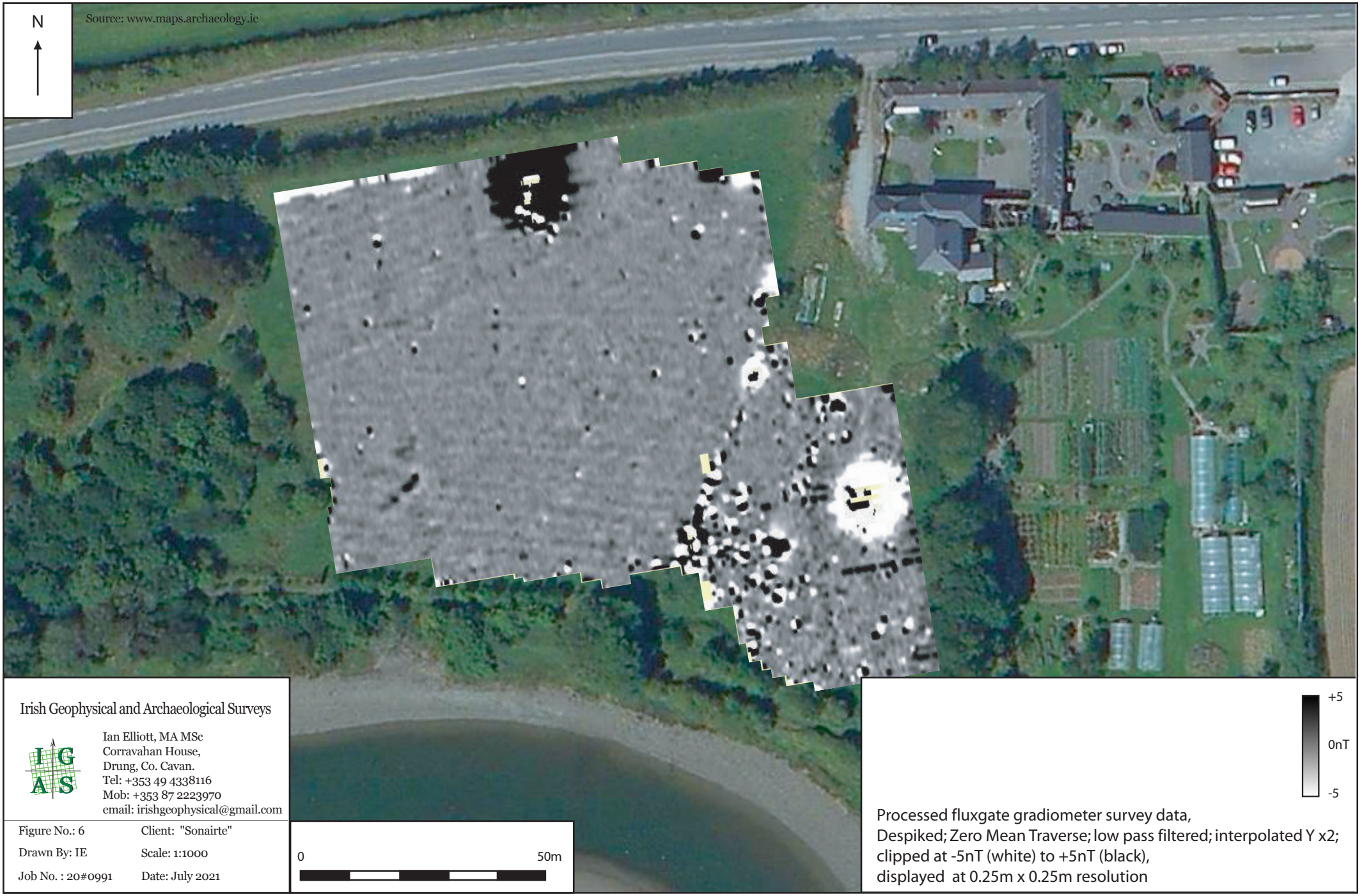

Fig. 6 Ninch, Co. Meath. Processed survey data.

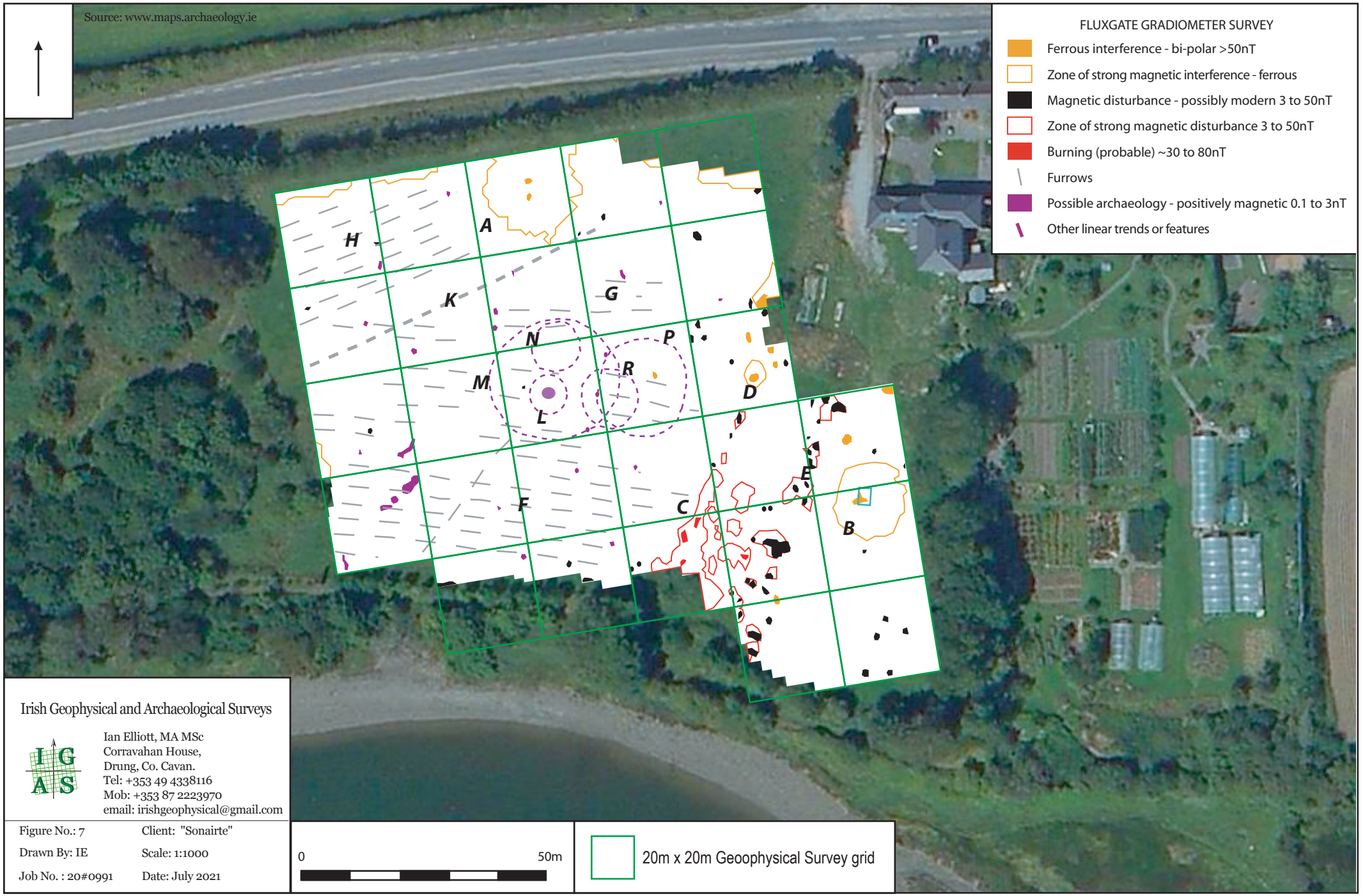

Fig. 7 Ninch, Co. Meath. Interpretation of geophysical survey data.

Fig. 8 Ninch, Co. Meath. Samuel Bouie's map of 1771 published by Egerton.

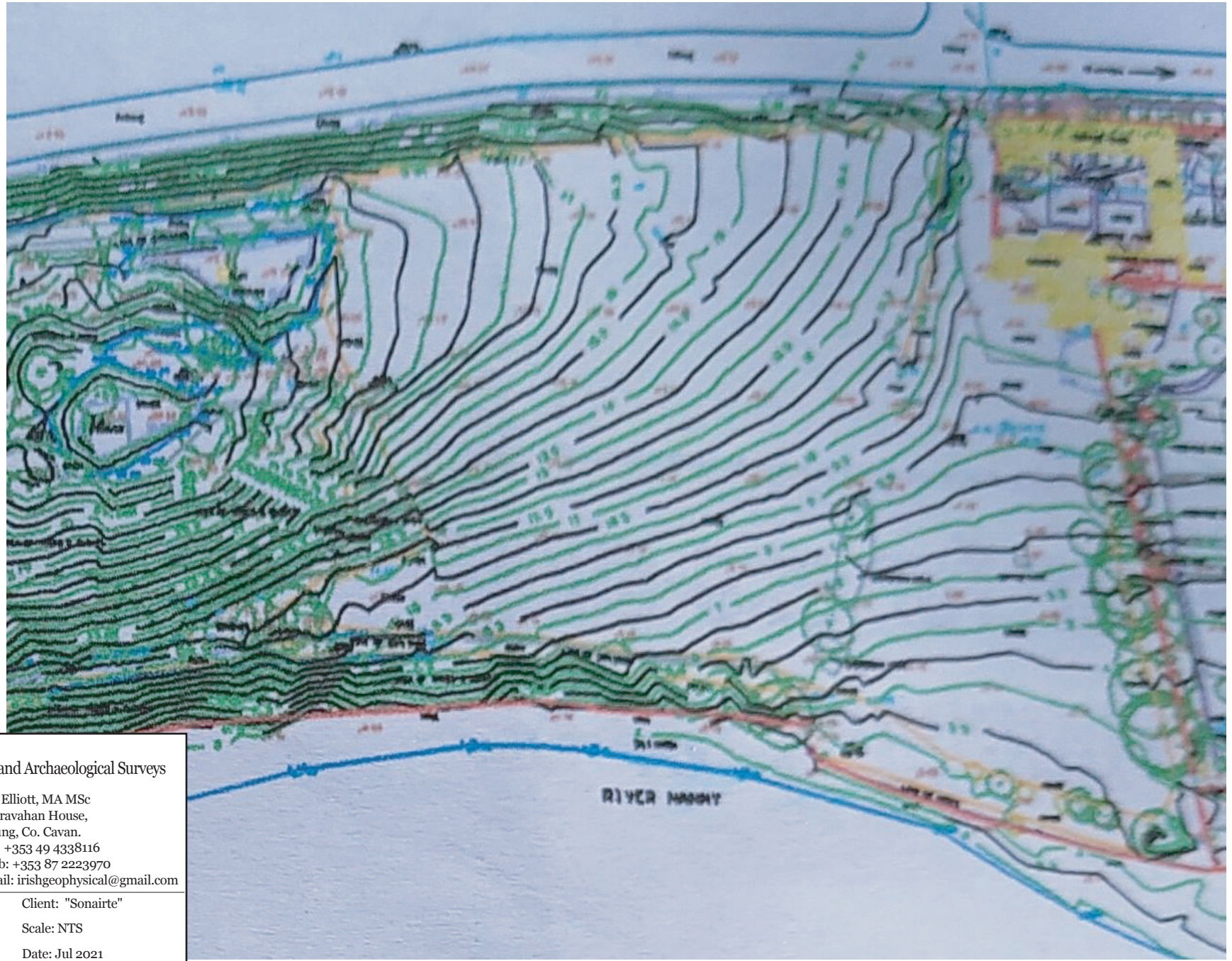

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Fig. 9 Ninch, Co. Meath. Celtic Surveys Ltd. site survey of c. 2008