5. FIELDWORK ALONG THE VALLEY OF THE DEE

5.1 Archaeological methodology

The principal method of investigation is fieldwalking, whereby the surface of recently ploughed fields is scanned by eye in order to systematically collect and record stone tools and other traces of prehistoric activity (Illus 5.1).

Individual fields are selected on the basis of suitability, availability, and their proximity to known Mesolithic or other lithic findspots. That is, the ground surface has to have been recently ploughed or 'opened', and the agricultural regime and time of year should be such that fieldwalking will not disturb the crop. It is worth noting that project work has not attempted to target or sample representative landscape types along the River Dee. Some locations and landscapes have therefore been omitted from the survey work to date. While this 'walk on availability' approach provides fairly random archaeological cover, there are, of course, biases at play such as those relating to particular agricultural schemes or trends, though no attempt has yet been made to analyse these (see 8.5 'Further work').

Desktop survey for each prospective site includes searching records such as Canmore, the Aberdeenshire Historic Environment Record, and Discovery and Excavation in Scotland for known archaeology and previous work, as well as information on the geology and topography. A pre-fieldwork visit is important to ascertain conditions and significant topographic features such as terrace surfaces and palaeochannels, as well as parking and access. Once contact has been made with landowners and farmers to ensure permissions and provide information about the project, individual fields are walked throughout the spring. In general, the group walks transects across the whole field at a spacing of roughly 2m. That is to say that walkers are spaced at 2m intervals and scan the ground to a distance of 1m either side of them, giving a coverage of 100% of the field surface. Very occasionally, wider transects are walked. Where recorded, the transect spacing is noted in the field details below. Individual finds, or groups of finds (usually comprising worked stone), are bagged and the position plotted using GPS (Illus 5.2; Garmin Etrex 10, or similar). GPS resolution is up to 3m. Fieldwalking is always more

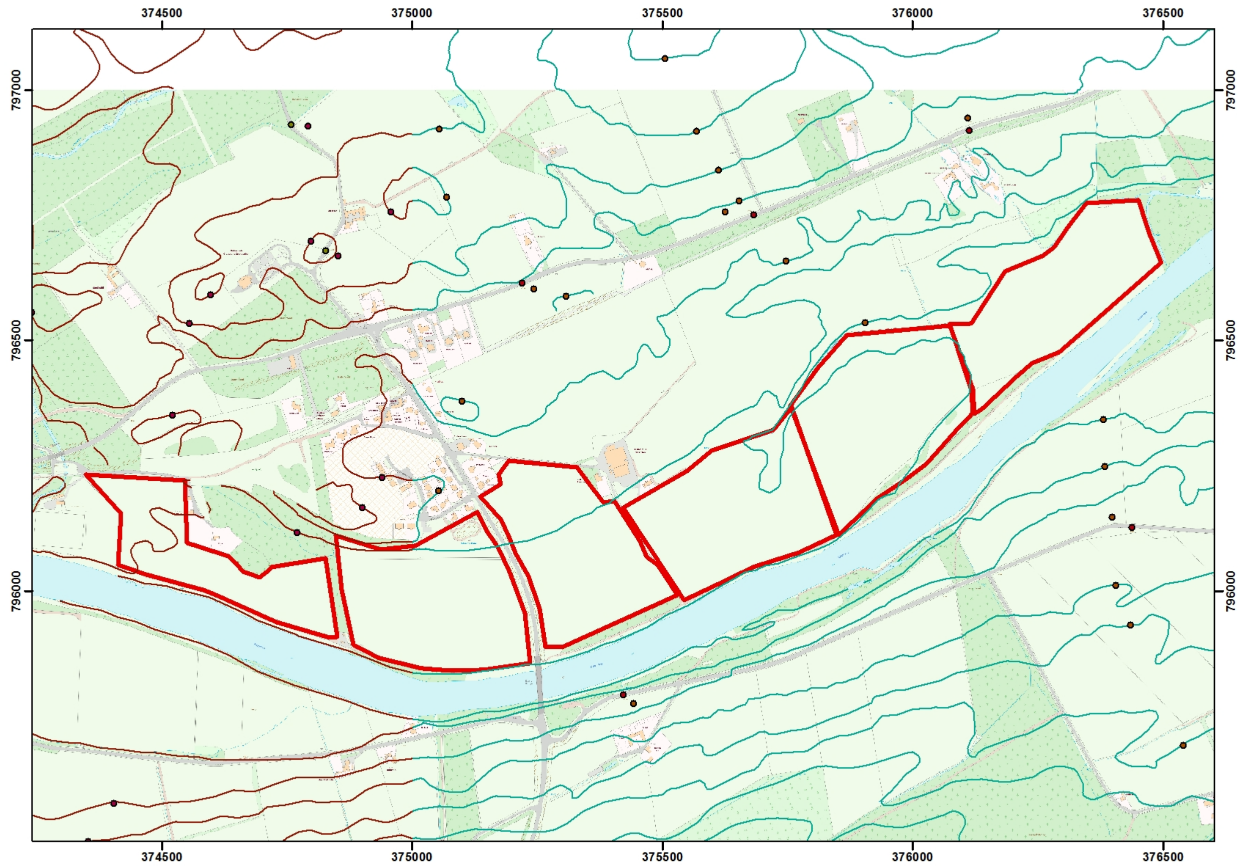
Illus 5.1 Fieldwalking being undertaken by members of Mesolithic Deeside

Illus 5.2 Using the GPS

productive after rainfall, and the beneficial effect of frost or recent snowmelt has also been noted (Illus 5.3). While the expertise of group members varies, by working together it is possible for all to gain experience.

The lithics recovered are all examined and catalogued by a professional lithic specialist (for the present project this was Ann Clarke). While most pieces are bagged as single finds, where there has been a concentration of material some bags might contain multiple finds. Each bag is given a find number and coordinates. Pieces are identified by raw material, type, sub-type and classification (for definitions see Wickham-Jones 1990: 57–8) and the data are recorded on an Excel spreadsheet. Blades, complete flakes, cores and retouched pieces are all measured individually. Given the nature of a fieldwalked collection – in particular the lack of secure archaeological context, as well as uncertainties regarding the size, distribution and character of the original assemblage, and the possibility of further collections from any one field or adjoining fields (Wickham-Jones 2020b) – detailed analyses are not undertaken on most of the individual assemblages.

Illus 5.3 Fieldwalking in frost



Illus 5.4 The area of geophysical survey at Nethermills Farm

Instead, in order to characterise the sites, a table of lithic types is made along with a brief description of each assemblage, noting any chronologically significant types or other distinctive finds. Pie charts of elements such as blade/flake proportions and core types help to compare the nature of individual sites. The basic site summaries (lithic catalogues, summary tables and pie charts) are relayed back to the group at frequent intervals in order to help to shape future research design (for a discussion of the common types of stone tools and methods of making them see Ballin 2021a).

Once the lithic analysis is complete, regular density plots of individual fields are produced (by Irvine Ross in the case of the present project), and these can be grouped to highlight trends along the river or in discrete locations. As the work has progressed, information relating to the geology and geomorphology of the sites has been added by Tipping and Kinnaird, as well as the results of any relevant palaeoenvironmental research. In this way, it is possible to build a detailed picture of the survival of prehistoric archaeology along the river and the contexts that have favoured human activity.

While Mesolithic Deeside research continues, this report presents the results of fieldwork undertaken to the end of 2019. Three sites (East Park, Heughhead and Nethermills 4), have been test pitted or excavated, and more detailed reports from this work are included below (see 7 'Test pitted sites'), after the results of fieldwalking.

5.2 Topographic and electromagnetic ground conductivity survey of fields at Milton Cottage and Nethermills Farm (MC, NM1–NM5), Crathes

Richard Bates

A geophysical topographic and aerial survey was conducted along the River Dee near Crathes in order to provide background information for the archaeological fieldwork by mapping topographic information related to the river terraces in that reach (Illus 5.4). The survey was undertaken as part of the ongoing archaeological investigation. Survey was conducted by the Earth and Environmental Sciences School of the University of St Andrews in February 2017 using a CMD ground conductivity meter (Illus 5.5) and Phantom 3 drone. Weather at the site prior to survey had been dry and the fields were not saturated.

5.2.1 Aims of the survey

The aim of the remote sensing survey was to provide background information to the archaeological fieldwork. Specifically, the survey had the following objectives:

- Acquire topographic data to produce a detailed (cm resolution) elevation map of the site.
- Provide complete coverage aerial photography for the site.
- Measure ground electrical conductivity across key terrace features where archaeological fieldwalking had identified finds.
- Measure magnetic susceptibility across terraces with archaeological finds.

The results of such a survey should provide important information to facilitate understanding of artefact distribution across the site and in particular the relationship between the location of finds and the palaeo-geomorphology of the River Dee.

5.2.2 Methodology: topography and aerial photography

Topographic survey and aerial photography have typically been performed from light aircraft with specialised mapping equipment. Recent developments with unmanned aerial vehicles (UAVs) fitted with high-resolution cameras means that both topographic survey and photographic analysis can be achieved cost-effectively. Topographic survey is carried out through structure-from-motion (SfM) photogrammetry techniques in specialised software and, when applied together with ground control points, it can achieve very high, near continuous, cover survey.

For this survey a Phantom Pro 3 (DJI Ltd) with onboard FC300X 12MP f/2.8 Sony Exmore lens and sensor were used with ground control points supplied from a differential GNSS unit, model HIPER RTK-DGPS (Topcon). The GNSS unit provided points to +/-1.5cm lateral and +/-2.5cm vertical resolution. The software program DroneDeploy was used to create flight plans for full coverage with a minimum of 70% overlap. Targets for ground control included 40cm crosses plus additional unique features on the site such as gate posts and wall terminations. The survey was divided into a number of flight blocks with each block estimated to be achieved within one flight with adequate battery left at the end of the flight for safe return to base. A minimum of five ground control points were used per individual flight block.

Data processing was accomplished using Agiscoft PhotoScan with the following routine:

- Initial (auto) photo alignment
- Generation of sparse point cloud
- Geo-referencing and optimisation of camera model parameters
- Adjustment to ground control markers
- Dense point cloud construction
- Manual editing of dense cloud for outliers
- Mesh model
- Digital terrain builder
- Orthomosaic
- Export

Final results were imported as point clouds and orthomosaics into ArcMap (ESRI). Where the digital photography was taken under optimal light conditions, that is with flat light at midday, further colour balancing was not required. However, orthomosaics produced with strong light variation required colour balancing to saturation levels to match those acquired at more uniform light conditions. This was performed within ArcMap after histogram analysis of colours.

5.2.3 Methodology: electromagnetic ground conductivity mapping

Electromagnetic techniques have been extensively developed and adapted over the last 15 years to map lateral and vertical changes in ground conductivity. Rather than directly applying an electrical current to the ground as with direct current resistivity methods, an alternating current is applied to a primary transmitter coil, usually at the ground surface, which creates a changing magnetic field and thus, on passage through the ground, secondary eddy currents are created that are proportional to the ground conductivity. For further details of this procedure reference should be made to standard geophysical texts (for example, Telford et al 1991), manufacturers' technical notes (Geonics Technical notes TN6 and 7, http://www.geonics.com/html/technicalnotes.html, and CMD Short Guide http://www.gfinstruments.cz/index.php?menu=gi&smenu=iem&cont=cmd_&ear=dl), and geophysical guides for best practice in archaeological investigations produced by English Heritage and others (Schmidt et al 2015). Typical survey results for FDEM surveys are contour maps of ground conductivity and magnetic susceptibility values and 2D pseudo-geoelectric sections of conductivity.

This survey was carried out in accordance with the general guidance provided by English Heritage in 2008. It was conducted using a CMD Explorer electromagnetic ground conductivity meter (Gf Instruments) to measure surface ground conductivity and magnetic susceptibility. The specifications for this instrument are provided in a data sheet on the manufacturer's website at http://www.gfinstruments.cz).

The CMD Explorer uses a varying electromagnetic field to measure changes in near-surface conductivity simultaneously with three coil separations at 1.48m, 2.82m and 4.49m giving effective exploration depths of approximately 2.2m, 4.2m and 6.7m in vertical dipole arrangement (coils horizontal) and 1.1m, 2.1m and 3.3m in horizontal dipole arrangement (coils vertical), using an operating frequency of 10kHz. Both apparent conductivity and in-phase ratios are measured simultaneously with the instrument at discrete intervals using the differential GNSS unit. Positional information was transmitted directly via cable to the CMD Explorer data logger. Further information on the dGPS system is available from the manufacturer at https://www.topconpositioning.com/.

Illus 5.5 Using the ground conductivity meter

The meter is particularly sensitive to changes in apparent ground conductivity resulting from changes in soil and rock type. For example, clays and silts are typically more conductive to electrical currents than sands and gravels; saturated, and in particular saline saturated, ground is typically more conductive than non-saturated ground. The instrument is also sensitive to metallic structures and sources of electromagnetic radiation. The instrument is portable and can be carried by a person or towed behind a small vehicle; Illus 5.5 shows the instrument in use on the site, where it was carried.

The instrument is factory calibrated but is also calibrated to free-air zero at site. It was configured for this survey using the vertical dipole arrangement (see above). No formal grid was established at site, but the operator surveyed on a pattern of broadly north/south profiles approximately 5m apart.

5.2.4 Topography

Illus 5.6 shows the general topography of the area.

5.2.5 Ground conductivity

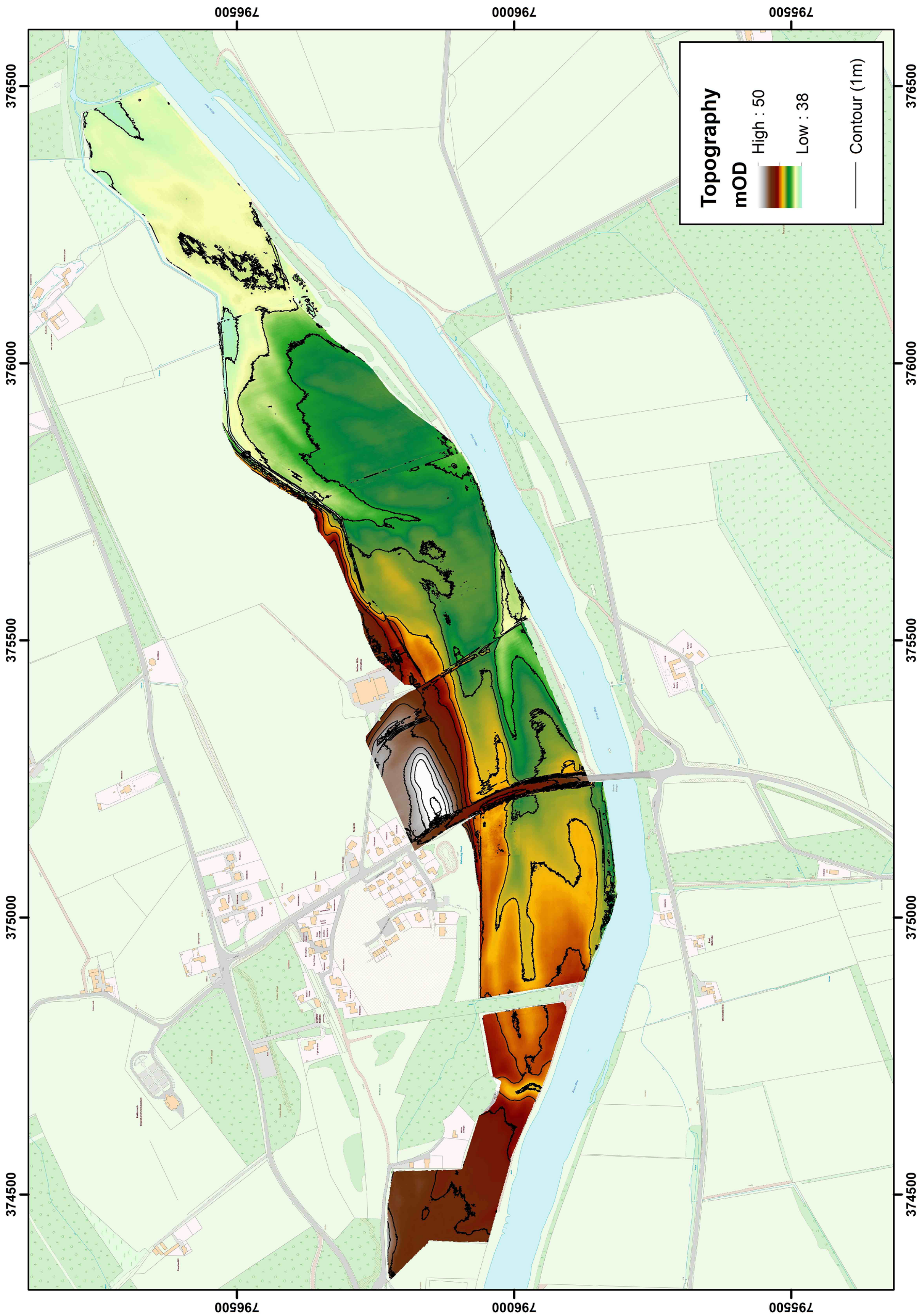
The map of ground conductivity derived from the largest coil separation that averages values down to approximately 6m beneath the ground surface (Illus 5.7) shows generally very low conductivity with a range of values from 4 to 8mS/m. Despite the low range, distinct patterns of ground type were recorded that likely correlate with the changes in elevation interpreted as the different terrace and channel areas. Higher conductivity is also noted around field boundaries and these are likely to be due to the presence of metal such as fences and gates. To the east, a zone of very low conductivity was mapped in an approximately north/south orientation across the easternmost part of field MC1.

5.2.6 Magnetic susceptibility

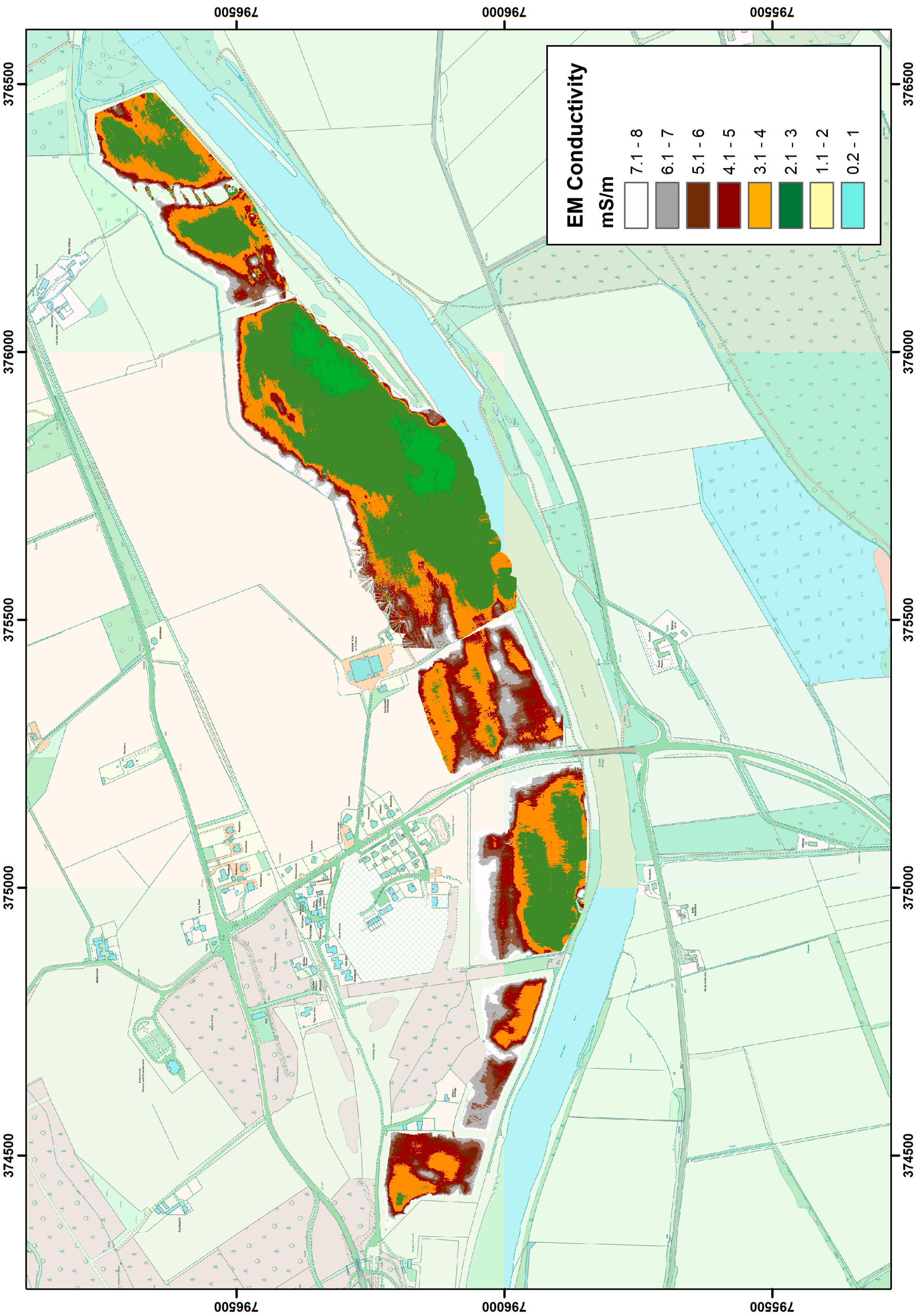
The map of magnetic susceptibility (Illus 5.8) shows a small variation in signature with high positive values associated with the metallic fences surrounding the fields, with metal gates and farm machinery usually located at the corners of the field. Note that the field NM3 operated as a piggery in the 1970s.

5.2.7 Discussion

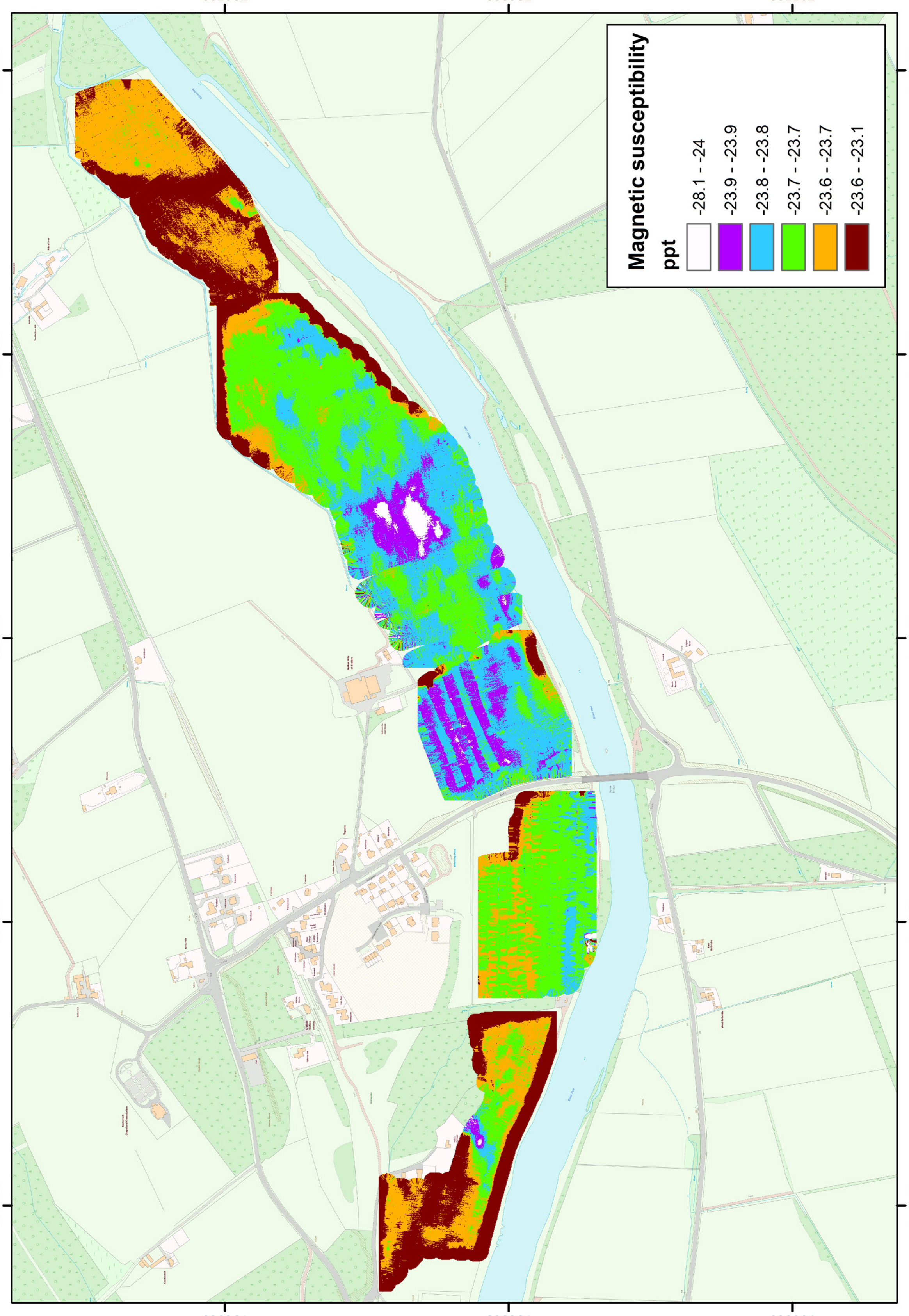
Illus 5.9 shows the topography, ground conductivity and magnetic susceptibility plotted out together with the combined finds scatters from previous fieldwalking exercises across the sites at Nethermills Farm. The scatter patterns follow distinct topographic and electric conductivity signatures, providing clear confirmation of the way in which they appear to follow a particular geomorphological feature, namely the Camphill Terrace (see 4.2 'The terraces of the Dee'; Illus 4.8). While the lack of similar research relating to the higher Maryfield Terrace at this point hinders interpretation of the significance of this finding, the current research suggests that for much of the Mesolithic the Camphill Terrace provided an attractive surface for human activity.



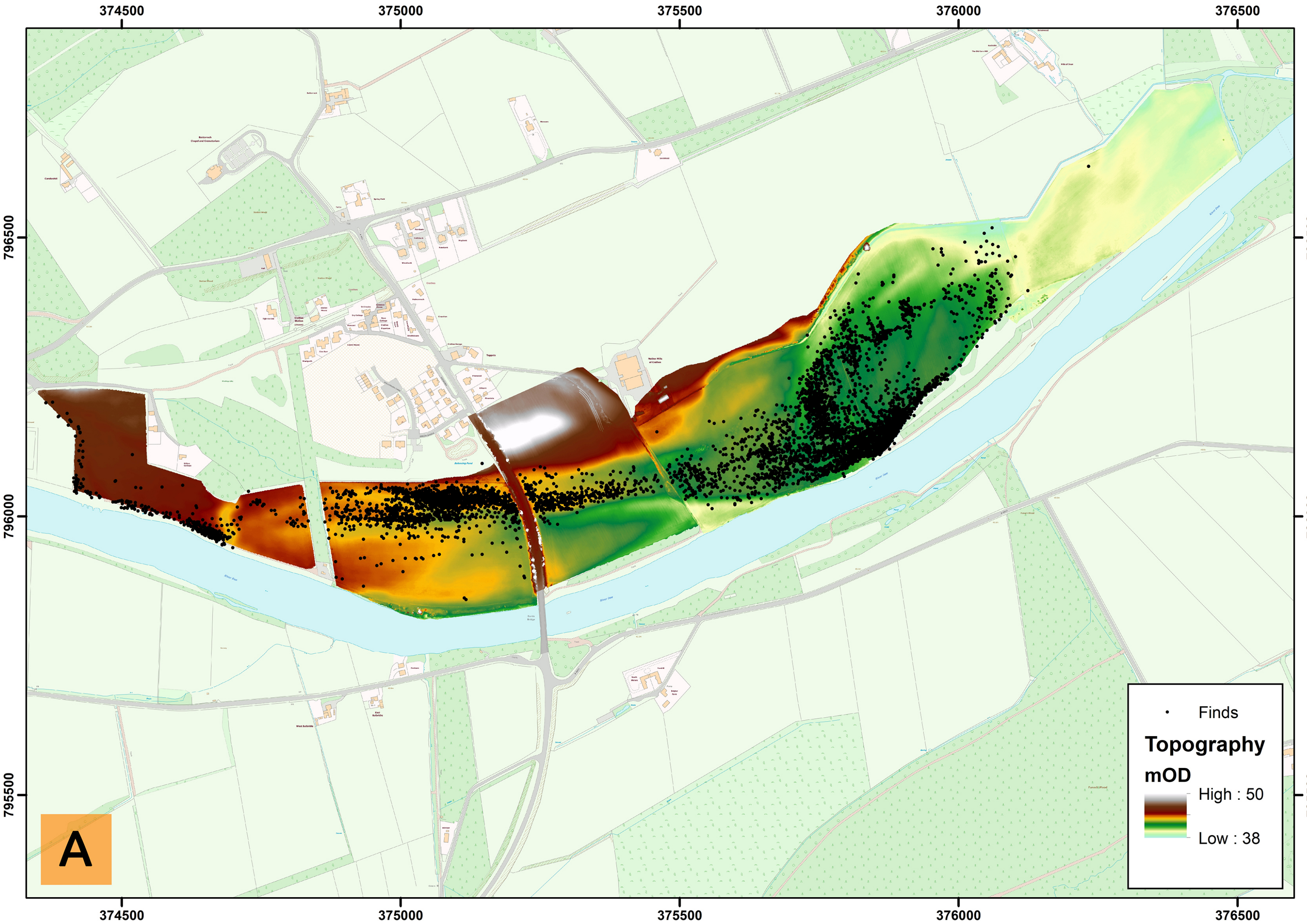
Illus 5.6 The topographical survey



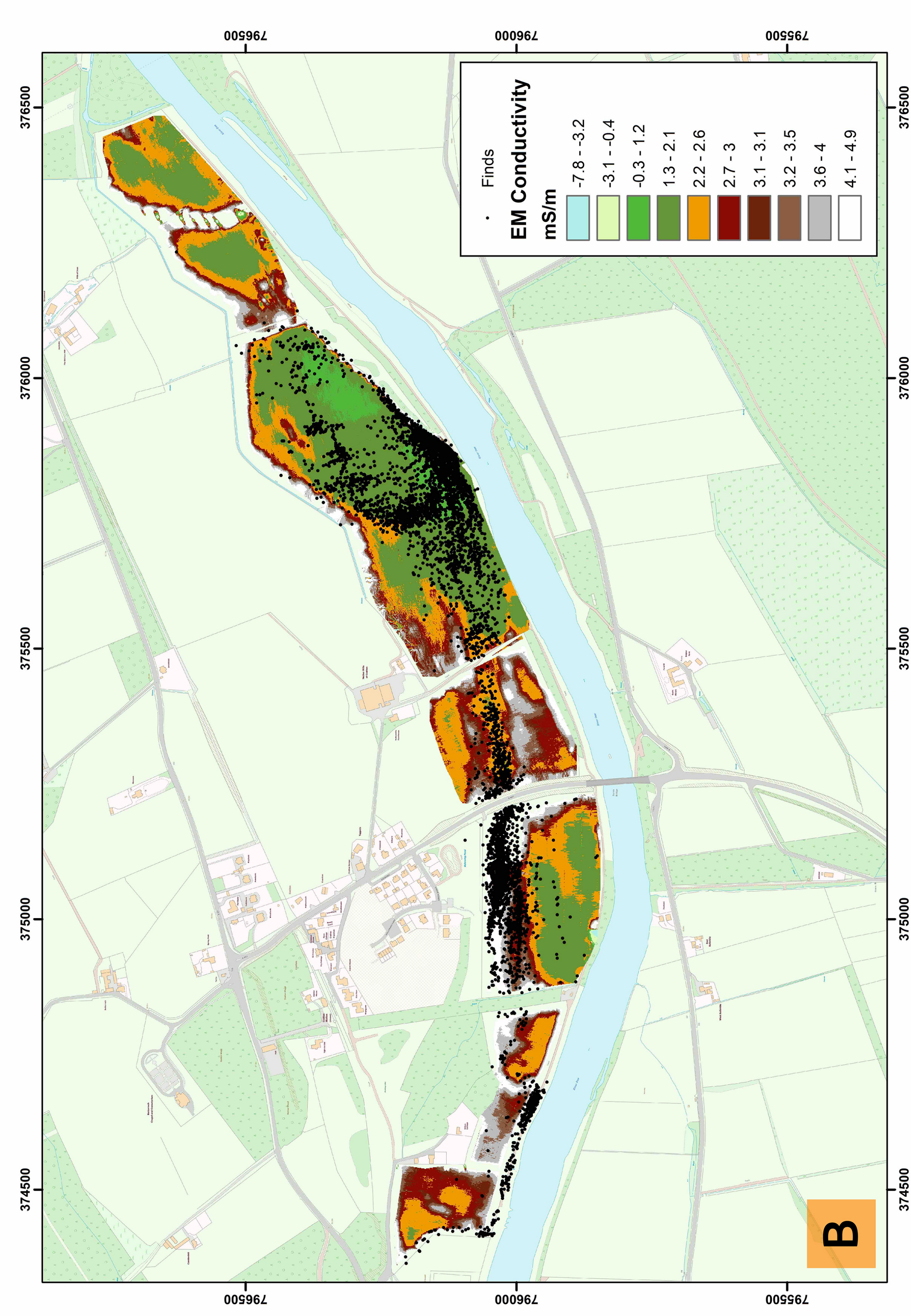
Illus 5.7 Results of the ground conductivity survey



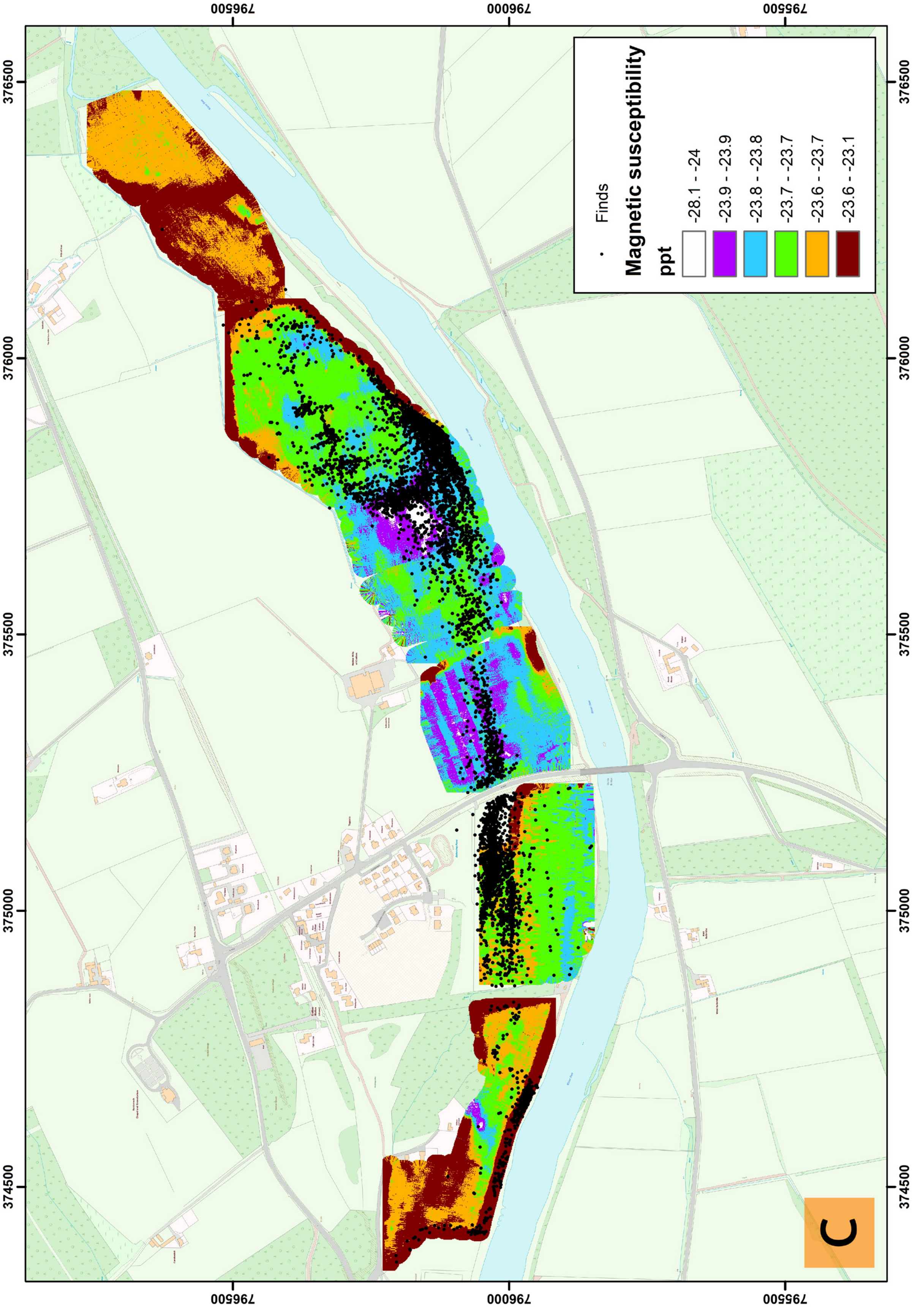
Illus 5.8 Results of the magnetic susceptibility survey



Illus 5.9 Finds from previous (OFARS) fieldwalking exercises plotted against **A** the topography, **B** ground conductivity and **C** magnetic susceptibility at Nethermills Farm. Fieldwalking by Mesolithic Deeside reveals a wider lithic distribution in NM4 (Illus 6.24)



Finds
EM Conductivity
mS/m
-7.8 - -3.2
-3.1 - -0.4
-0.3 - 1.2
1.3 - 2.1
2.2 - 2.6
2.7 - 3
3.1 - 3.1
3.2 - 3.5
3.6 - 4
4.1 - 4.9
B
796500
796000
795500
376500
376000
375500
375000
374500



Finds
Magnetic susceptibility
ppt
-28.1 - -24
-23.9 - -23.9
-23.8 - -23.8
-23.7 - -23.7
-23.6 - -23.7
-23.6 - -23.1
796500
796000
795500
376500
376000
375500
375000
374500
C