Research Report Series 67/2023

Meon Valley Archaeology and Heritage Group, Meonstoke, Hampshire

Report on Geophysical Survey, September 2023

Paul Linford and Megan Clements

Geophysics

Meon Valley Archaeology and Heritage Group, Meonstoke, Hampshire

Report on Geophysical Survey, September 2023

Paul Linford and Megan Clements

Shavards Farm, Shavards Lane Meonstoke, Hampshire	Dobby Field Stocks Lane Meonstoke, Hampshire
NGR: SU6155020692	SU6159620483

Print: ISSN 2398-3841
Online: ISSN 2059-4453

The Research Report Series incorporates reports by Historic England's expert teams, their predecessors and other researchers. Many Research Reports are interim, to make available the results of specialist investigations in advance of full publication. Although subject to internal quality assurance, they are not usually refereed externally and their conclusions may sometimes have to be modified in the light of information not available at the time of the investigation. Where no final project report is available, readers should consult the author before citing these reports.

For more information email Res.reports@HistoricEngland.org.uk or write to:

Historic England
Fort Cumberland
Fort Cumberland Road
Eastney
Portsmouth PO4 9LD

Summary

An electrical resistance tomography (ERT) survey was conducted in two fields to the east of Meonstoke, Hampshire, to investigate a low resistance anomaly identified through earth resistance surveys carried out by the Meon Valley Archaeology and Heritage Group. The ERT survey has determined the feature is of geological origin and likely represents either a narrow band of clay between layers of Cretaceous chalk, or groundwater draining along the interface between the chalk units.

Contributors

The geophysical field work was conducted by Megan Clements, Paul Linford, Andrew Payne, Joan Terry, Alison Smalley and Malcolm Smalley.

Acknowledgements

The Meon Valley Archaeology and Heritage Group and Historic England are grateful for the landowners' permission to access and survey the land. The cover image shows Paul Linford, Megan Clements and Malcolm Smalley setting up the ERT system at ERT1 (photo taken by Alison Smalley).

Archive location

Historic England, Fort Cumberland, Fort Cumberland Road, Portsmouth, PO4 9LD.

Date of survey/research/investigation

The survey was conducted on the 7th of September.

Contact details

Paul Linford, Geophysics Principal, Historic England, Fort Cumberland, Fort Cumberland Road, Portsmouth, PO4 9LD. Tel:+44 (0) 2392856749 Email: Paul.Linford@HistoricEngland.org.uk

Alison Smalley, Meon Valley Archaeology and Heritage Group Trustee. Email@ enquiries@mvahg.co.uk

Contents

Introduction

Three electrical resistance tomography (ERT) profiles were conducted in fields east of Meonstoke, Hampshire. The area has been under investigation by the Meon Valley Archaeology and Heritage Group (MVAHG), who have conducted numerous earth resistance surveys there from 2014 to the present. The Historic England Geophysics Team provided initial geophysical training to the group and continuing support in the form of equipment loans and advice. Recently MVAHG requested advice for further investigation of a large, low resistance anomaly that resembles a large sub-circular ditch surrounding a local high point in the landscape east of the village of Meonstoke. Previous archaeological investigations by the group within the circuit of this potential ditch, including the excavation of a Bronze Age ring ditch cut by Saxon pits and a crouched burial radiocarbon dated to the middle Iron Age, lent weight to the conjecture that this anomaly could be of archaeological origin. However, a geological origin could not be discounted given the anomaly's positional correlation with the boundary between the lower and middle Cretaceous chalk. An ERT survey was suggested as a relatively rapid, non-invasive method to determine whether the anomaly was anthropogenic or geological. The Geophysics Team offered to carry out this work as the HE ERT equipment was due for periodic testing and a new member of staff needed training in its operation, thus the Meonstoke site provided a fortuitous test target close to Portsmouth.

The profile ERT1 lies entirely over Holywell Nodular Chalk formation bedrock while ERT2 is largely over Holywell Nodular Chalk, stretching into Zig Zag Chalk formation to the east. ERT3 lies over Zig Zag Chalk with a layer of superficial Head deposits of clay, silt, sand and gravel at its eastern end. Soils are of the Blewbury Association (key 511d) of freely draining lime-rich soils in the north and Upton 1 (key 342a) shallow lime-rich soils over chalk or limestone further south (Soil Survey of England and Wales 1983). Fieldwork was carried out on the 7th September 2023 when the weather was extremely hot with a maximum temperature in excess of 30 degrees Celsius after a week of hot, dry weather.

Method

Electrical Resistance Tomography

Three 63-metre long ERT profiles were measured each consisting of a line of 64 electrodes spaced 1m apart. The profiles were located using a Trimble R8s Global Navigation Satellite System (GNSS) receiver adjusted to the National Grid Transformation OSTN15 using the Trimble VRS Now Network RTK delivery service. This uses the Ordnance Survey's GNSS correction network (OSNet) and gives a stated accuracy of 0.01-0.015m per point with vertical accuracy being half as precise. The profiles were located based upon the earlier MVAHG earth resistance survey to obtain two cross-sections of the low resistance putative ditch anomaly across its north-western (ERT1) and north-eastern (ERT2) quadrants. The third profile, ERT3, was positioned across the easternmost part of the anomaly where its edges gradually become less well-defined and its appearance more diffuse. This location was motivated in part by the prospect that follow-up excavation would be possible in this field. Positioning was constrained by the western field boundary and it was not possible to extend this profile across the upslope edge of the ditch anomaly. Once each profile was established, the individual electrode positions (E1-64) and heights were recorded using the GNSS system. The location of the profiles superimposed onto base Ordinance Survey (OS) mapping is depicted in Figure 1.

Earth resistance measurements were made with a Campus Tigre multiplexed earth resistance meter controlled by ImagerPro2006 software running on a field laptop computer. The expanding Wenner alpha electrode configuration was employed owing to its high signal to noise ratio. To guarantee data quality, contact resistance tests were conducted on all electrodes before each section was measured and any electrodes with poor electrical contact were re-seated and the surrounding soil moistened to ensure all contact resistances were less than 1500 Ω. However, soil conditions were found to be generally conducive and only two electrodes from section ERT1 required this treatment.

Data from the profiles were inverted to infer subsurface resistivity models using Geotomo Software's Res2dinv software (version 3.56.39), with the measurements of the electrode positions incorporated to allow topographic correction. Error estimation during the inversion used the robust inversion method (absolute errors or the L1 norm) which is more tolerant of discontinuities between adjacent cells and thus tends to resolve boundaries between layers more sharply than the standard least mean squares inversion. Colour images of the output model profiles are shown in Figure 2 accompanied by inset maps showing their locations superimposed onto OS and geological mapping as well as the MVAHG earth resistance data.

Results

Colour-scale images of the output model profiles, with insets showing the location of the profiles, geological data produced by the British Geological Survey (2023), and earth resistance survey results conducted by the Meon Valley Archaeology and Heritage Group (2014-2023) can be found in Figure 2.

Profiles ERT1 and ERT2 both show a 3 to 4m thick, almost horizontal, low resistance layer with resistivities between 25-70 ohm-m (coloured blue and green in Figure 2), which outcrops within the sections at about 70m O.D. Above and below this are layers of higher resistivity, with values above 90 ohm-m (orange and red in Figure 2) which would be consistent with the chalk bedrock geology. Comparison with the geological mapping and section for the area (Geological Survey of Great Britain 1998) suggests the low resistance layer coincides in position and elevation with the interface between the lower- and middle-Cretaceous chalk groups (here the Zig Zag and Holywell Nodular chalk formations respectively). The low resistance layer is most likely to represent a narrow band of clay separating the two chalk members or possibly water drainage along the interface between the two chalk layers.

Profile ERT3 was positioned to the south of ERT1 and ERT2 where the ground surface is at a lower elevation (65 m O.D. at the upper, western, end of ERT3) and does not extend onto the middle Cretaceous Holywell nodular chalk. The lower resistivity layer does, however, appear to have been partially detected between the 0m and 22m positions (dark and light blue in Figure 2). While this appears at a lower elevation than in ERT1 and ERT2, there is some suggestion in both that the layer dips towards their southern ends. The underlying lower Cretaceous Zig Zag chalk exhibits slightly lower resistivity values in ERT3, down to about 70 ohm-m (yellow and green in Figure 2 as well as orange and red as before), likely due to surface water drainage into this lower-lying field from the higher land to the west. At the eastern end of profile ERT3, a second narrow low resistance layer (less than 40 ohm-m, dark blue in Figure 2) about 1.5m thick has been detected at the surface between the 40m and 63m positions. This low resistance layer corresponds to an area of superficial glacial Head deposits mapped by the BGS. Head deposits comprise of clay, silt, sand and gravel, a combination which is both more conductive and more moisture retentive, thus accounting for the lower electrical resistivity in this location.

Conclusions

Three earth resistance tomography profiles were measured over a broad sub-circular low resistance anomaly to determine whether it was likely due to an archaeological ditch or the result of natural geology. The profiles detected an approximately horizontal, 3m thick layer of lower electrical resistivity, which meets the surface at an elevation of 70m OD and extends south from sections ERT1 and ERT2 into the low hill. This same layer was also partially detected in section ERT3 in addition to a second area of low resistance corresponding with an area of superficial Head deposits recorded on geological mapping. An anthropogenic ditch would be expected to exhibit a U- or V-shaped profile and would have been entirely contained within profiles ERT1 and ERT2. However, this was not observed in the measured sections which are consistent with the mapped geology. The low resistance layer is likely to represent either a narrow band of clay between the lower and middle Cretaceous chalk, or groundwater draining along the interface between these two geological units.

List of Enclosed Figures

References

British Geological Society 2023. "British Geology Viewer." Retrieved 13/09/2023, 2023, from https://geologyviewer.bgs.ac.uk/.

Geological Survey of Great Britain 1998 Fareham, Geological Survey of England and Wales, Sheet 316. Solid and Drift Edition. Southampton, The Director General of the Ordnance Survey.

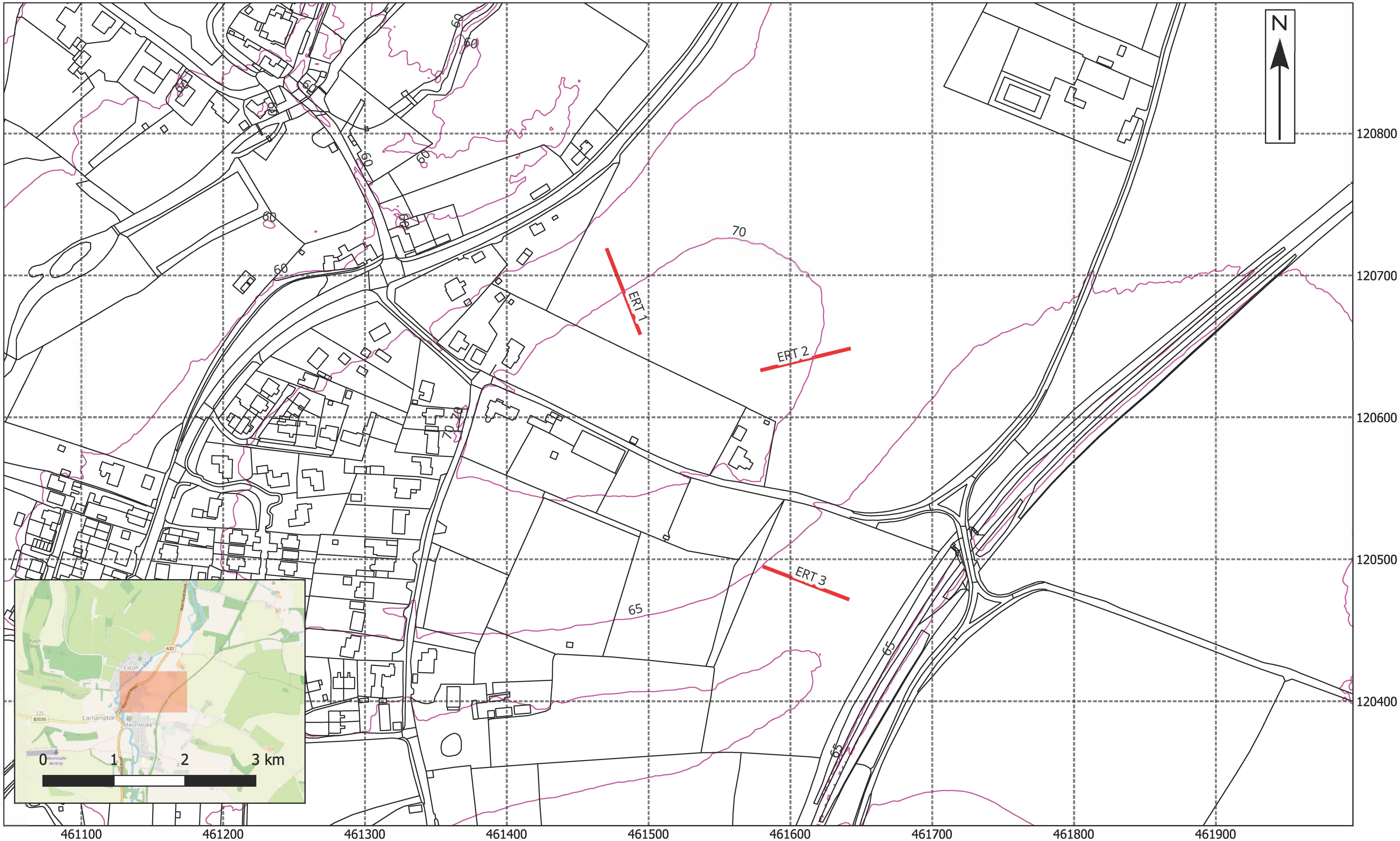
Meon Valley Archaeology and Heritage Group 2014-2023 Earth Resistance Surveys of the Meon Valley.

Soil Survey of England and Wales 1983 Soils of England and Wales, Sheet 6 - South East England, 1:250,000 scale soil map, Lawes Agricultural Trust, Harpenden.

Figure 1

MEON VALLEY ARCHAEOLOGY AND HERITAGE GROUP, MEONSTOKE, HAMPSHIRE

Location of electrical resistivity tomography profiles, September 2023



0 100 200 300 m

1:2500

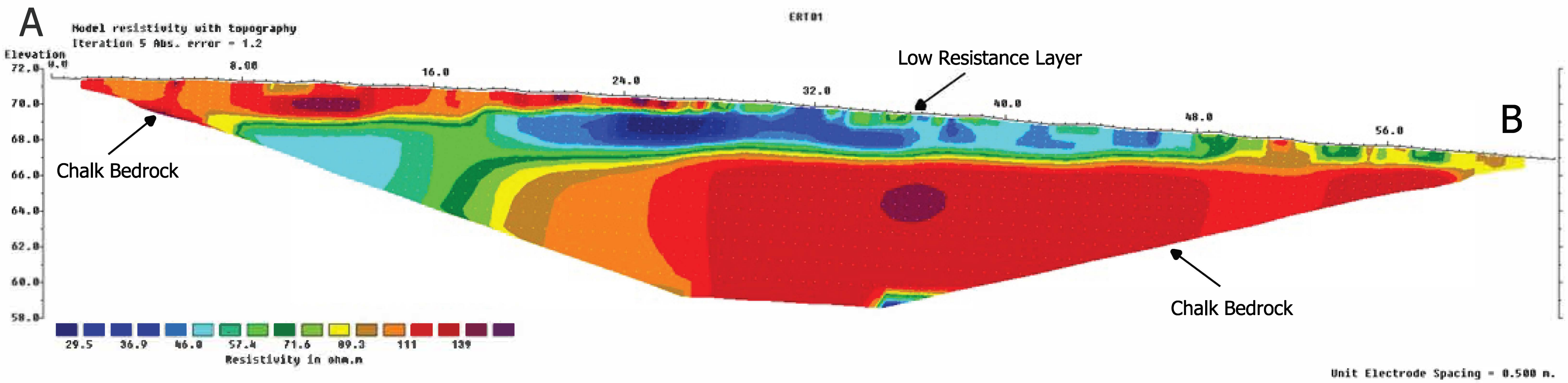
Location of ERT profiles

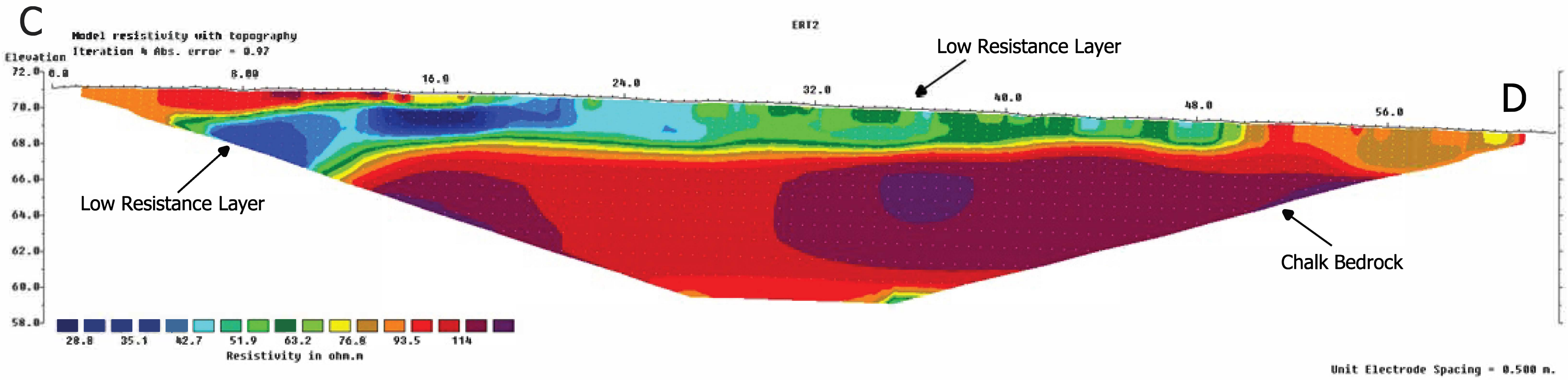
Historic England

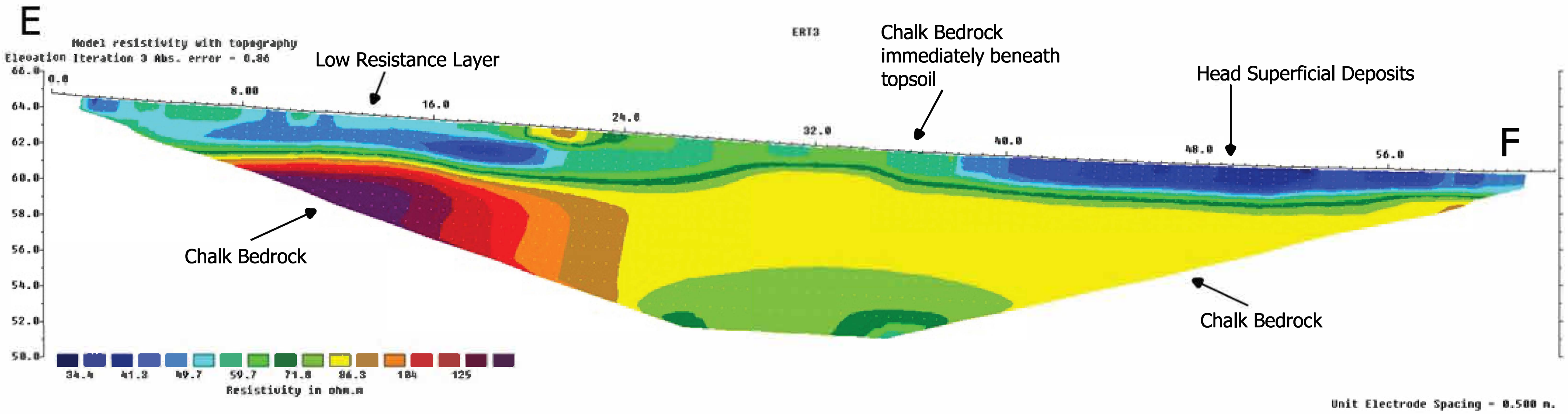
Geophysics Team 2023

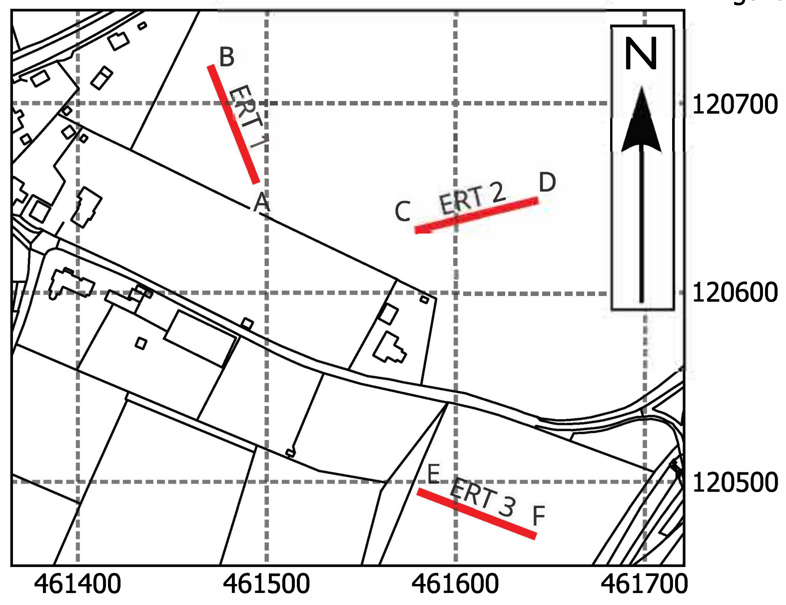
MEON VALLEY ARCHAEOLOGY AND HERITAGE GROUP, MEONSTOKE, HAMPSHIRE

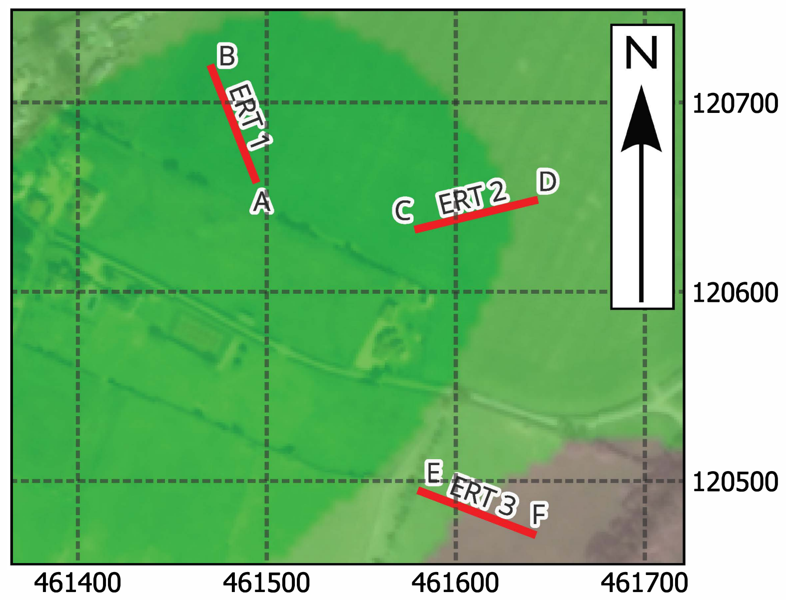
Electrical resistivity tomography profiles, September 2023

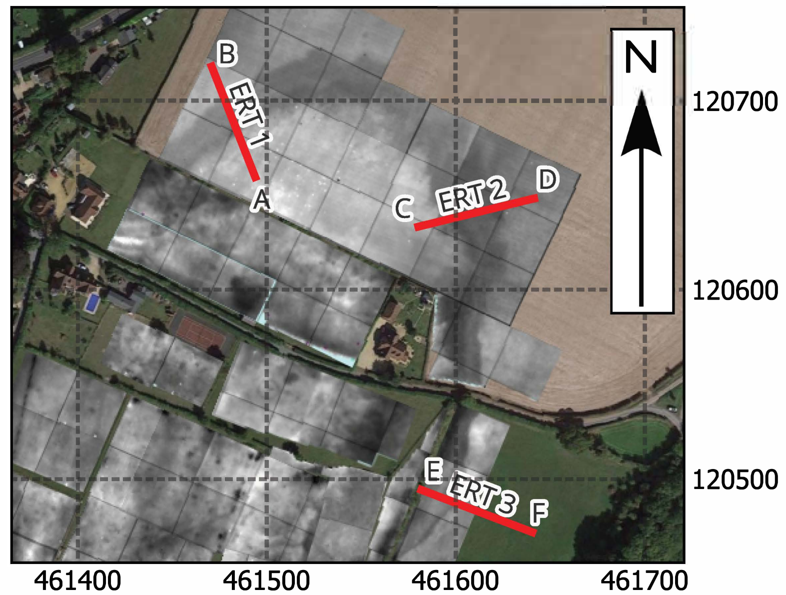












0 50 100 150 m

1:4000

Historic England

Geophysics Team 2023

Historic England's Research Reports

We are the public body that helps people care for, enjoy and celebrate England's historic environment.

We carry out and fund applied research to support the protection and management of the historic environment. Our research programme is wide-ranging and both national and local in scope, with projects that highlight new discoveries and provide greater understanding, appreciation and enjoyment of our historic places.

More information on our research strategy and agenda is available at HistoricEngland.org.uk/research/agenda.

The Research Report Series replaces the former Centre for Archaeology Reports Series, the Archaeological Investigation Report Series, the Architectural Investigation Report Series, and the Research Department Report Series.

All reports are available at HistoricEngland.org.uk/research/results/reports. There are over 7,000 reports going back over 50 years. You can find out more about the scope of the Series here: HistoricEngland.org.uk/research/results/about-the-research-reports-database.

Keep in touch with our research through our digital magazine *Historic England Research* HistoricEngland.org.uk/whats-new/research.

ISSN 2398-3841 (Print)
ISSN 2059-4453 (Online)