THAMES VALLEY

ARCHAEOLOGICAL

SERVICES

SOUTH WEST

Proposed Wind Turbine Site, Gorvin Farm, Woolsery, Bideford, Devon

Geophysical Survey (Magnetic)

by Tim Dawson

Site Code: GFW13/226

(SS 2887 1961)

Proposed Wind Turbine Site, Gorvin Farm, Woolsery, Bideford, Devon

Geophysical Survey (Magnetic) Report

For Mosscliff Environmental Ltd

by Tim Dawson

Thames Valley Archaeological Services

(South West) Ltd

Site Code GFW 13/226

October 2014

Summary

Site name: Proposed Wind Turbine Site, Gorvin Farm, Woolsery, Bideford, Devon

Grid reference: SS 2887 1961

Site activity: Magnetometer survey

Date and duration of project: 17th September 2014

Project manager: Steve Ford

Site supervisor: Tim Dawson

Site code: GFW 13/226

Area of site: 1.02ha

Summary of results: Several magnetic anomalies were recorded by the geophysical survey for the proposed wind turbine bases and cable trenches although only two of these are likely to be of archaeological origin. The remaining anomalies probably reflect agricultural activity and buried or near-by ferromagnetic objects.

Location of archive: The archive is presently held at Thames Valley Archaeological Services, Reading in accordance with TVAS digital archiving policies.

Report edited/checked by: Steve Ford✓ 21.10.14
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Proposed Wind Turbine Site, Gorvin Farm, Woolsery, Bideford, Devon
A Geophysical Survey (Magnetic)

by Tim Dawson

Report 13/226b

Introduction

This report documents the results of a geophysical survey (magnetic) carried out on a small area of land located to the south-west of Gorvin Farm, Woolsery, near Bideford, Devon (SS 2887 1961) (Fig. 1). The work was commissioned by Ms Lucy Boulton of Mosscliff Environmental Ltd, The Innovation Centre, University of Exeter Campus, Exeter, Devon, EX4 4RN.

Planning permission has been sought from Torridge District Council for the installation of two 11kW wind turbines and associated services(ref: 1/0647/2014/FUL). As a consequence of the possibility of archaeological deposits existing on the site which may be damaged or destroyed by development, a geophysical survey was required to better inform the planning process and create a plot so a targeting strategy can be employed to subsequent anomalies with trial trench evaluation.

This is in accordance with the Department for Communities and Local Government's National Planning Policy Framework (NPPF 2012) and the District's policies on archaeology. The field investigation was carried out to a specification approved by Mr Stephen Reed, Archaeological Officer with Devon County Council Historic Environment Team. The fieldwork was undertaken by Nicholas Dawson and Tim Dawson on 17th September 2014 and the site code is GFW 13/226.

The archive is presently held at Thames Valley Archaeological Services, Reading in accordance with TVAS digital archiving policies.

Location, topography and geology

Gorvin Farm is c. 4.3 km west of the focus of the settlement of Woolfardisworthy or Woolsery in the Torridge district of North Devon and situated in the neck of the Hartland peninsula. Bideford is the nearest town. The proposed site for the two wind turbines is *c.*400m south-west of the farmyard (Fig. 2). A 145m long cable would link the western turbine to that nearer the farm, which would in turn be linked by a 390m cable to an outbuilding close to the centre of the central farm complex. Each turbine base would require the excavation of a 5.3m square trench to a depth of 1.05m.

The greater part of the proposal site (Fig. 1) is set on a west to east ridge with a maximum height of 182m above Ordnance Datum (aOD) (Pl. 1-4). Both fields are currently pasture bounded by mixed hedges over banks of stone and earth with a worn earth and rubble track linking the gate between the fields to the farmyard to the north-east. There are open fields to the north, east and south of the site, the latter separated from it by the road between Summerwell Farm and Gorvin Cross, but the area to its west is dominated by a conifer plantation. The underlying solid geology comprises Crackington Formation carboniferous sedimentary sandstone (BGS 1980).

Conditions during the survey were dry and overcast with the initial dew quickly evaporating to leave the ground dry and hard.

Site history and archaeological background

A desk-based assessment has highlighted the presence of a number of heritage assets in the region of the proposal site, several of which are scheduled ancient monuments and listed buildings (Tabor 2013). In summary, the site lies within a rich Bronze Age monumental landscape with groups or alignments of often well-preserved round barrows on Welsford and Bursdon Moors, as well as in the Gorvin area itself. It has been suggested that there may have been significantly more which have been destroyed (Bayer 1996, 20-1). In addition, there are circular enclosures on Welsford and Summerwell Moors which are likely to be broadly contemporary (Dyer and Manning 2000, 3). The survey area itself is located in a field which contains a round barrow of presumed Bronze Age date. Further similar barrows are present within the adjacent fields to the north, east and south with still more in the wider area. It is considered possible that contemporary occupation sites, unrecorded levelled round barrows or other non-monumental funerary deposits may lie in within the vicinity. Aerial photography has highlighted the presence of crop or parch marks in the same field as the proposed turbines which may indicate the presence of buried archaeological features.

Although not recorded specifically within the Historic Environment Record, field boundaries comprising earth and stone banks over much of the south-west peninsula are considered to have medieval or earlier origins. Here, those around Gorvin Farm, which is documented from medieval times with physical remains from post-medieval times, may have their origins prior to the 19th century when they were first mapped in detail.

Methodology

Sample interval

Data collection required a temporary grid to be established across the survey area using wooden pegs at 20m intervals with further subdivision where necessary. Readings were taken at 0.25m intervals along traverses 1m apart. This provides 1600 sampling points across a full 20m × 20m grid (English Heritage 2008), providing an appropriate methodology balancing cost and time with resolution. A series of grid squares were laid out on three different orientations in order to cover the area of the two proposed turbine bases and the cable trench linking them both to the farm buildings to the north-east (Fig. 2).

The Grad 601-2 has a typical depth of penetration of 0.5m to 1.0m. This would be increased if strongly magnetic objects have been buried in the site. Under normal operating conditions it can be expected to identify buried features >0.5m in diameter. Features which can be detected include disturbed soil, such as the fill of a ditch, structures that have been heated to high temperatures (magnetic thermoremnance) and objects made from ferro-magnetic materials. The strength of the magnetic field is measured in nano Tesla (nT), equivalent to 10^{-9} Tesla, the SI unit of magnetic flux density.

Equipment

The purpose of the survey was to identify geophysical anomalies that may be archaeological in origin in order to inform a targeted archaeological investigation of the site prior to development. The survey and report generally follow the recommendations and standards set out by both English Heritage (2008) and the Institute for Archaeologists (2002, 2011).

Magnetometry was chosen as a survey method as it offers the most rapid ground coverage and responds to a wide range of anomalies caused by past human activity. These properties make it ideal for fast yet detailed survey of an area.

The detailed magnetometry survey was carried out using a dual sensor Bartington Instruments Grad 601-2 fluxgate gradiometer. The instrument consists of two fluxgates mounted 1m vertically apart with a second set positioned at 1m horizontal distance. This enables readings to be taken of both the general background magnetic field and any localised anomalies with the difference being plotted as either positive or negative buried features. All sensors are calibrated to cancel out the local magnetic field and react only to anomalies above or below this base line. On this basis, strong magnetic anomalies such as burnt features (kilns and hearths) will give a high response as will buried ferrous objects. More subtle anomalies such as pits and ditches, can be seem from their

infilling soils containing higher proportions of humic material, rich in ferrous oxides, compared to the undisturbed subsoil. This will stand out in relation to the background magnetic readings and appear in plan following the course of a linear feature or within a discrete area.

A Trimble Geo7X handheld GPS system with sub-decimetre accuracy was used to tie the site grid into the Ordnance Survey national grid. This unit offers both real-time correction and post-survey processing; enabling a high level of accuracy to be obtained both in the field and in the final post-processed data.

Data gathered in the field was processed using the TerraSurveyor software package. This allows the survey data to be collated and manipulated to enhance the visibility of anomalies, particularly those likely to be of archaeological origin. The table below lists the processes applied to this survey, full survey and data information is recorded in Appendix 1.

Process	**Effect**
Clip from -5.00 to 5.00 nT	Enhance the contrast of the image to improve the appearance of possible archaeological anomalies.
De-stripe: median, all sensors	Removes the striping effect caused by differences in sensor calibration, enhancing the visibility of potential archaeological anomalies.
De-spike: threshold 1, window size 3×3	Compresses outlying magnetic points caused by interference of metal objects within the survey area.
Move (Area: Top 40, Left 0, Bottom 139, Right 79) to X 40, Y 0	For the turbine bases and adjoining cable survey the cable trench grids had to be moved by 10m to fit into TerraSurveyor's processing system.
De-stagger: all grids, both by -1 intervals	Cancels out effects of site's topography on irregularities in the traverse speed.

Once processed, the results are presented as a greyscale plot shown in relation to the site (Fig. 3), followed by a second plan to present the abstraction and interpretation of the magnetic anomalies (Fig. 4). Anomalies are shown as colour-coded lines, points and polygons. The grid layout and georeferencing information (Fig. 2) is prepared in EasyCAD v.7.58, producing a .FC7 file format, and printed as a .PDF for inclusion in the final report.

The greyscale plot of the processed data is exported from TerraSurveyor in portable network graphics (.PNG) format, a raster image format chosen for its lossless data compression and support for transparent pixels, enabling it to easily be overlaid onto an existing site plan. The data plot is rotated to orientate it to north and combined with grid and site plans in Adobe InDesign CS5.5, creating .INDD file formats. Once the figures are finalised they are exported in .PDF format for inclusion within the finished report.

Results

The survey recorded a wide range of magnetic anomalies across the survey area. Two positive anomalies, probably indicating the presence of buried cut features such as ditches and pits, possibly archaeological in origin, were noted in the eastern turbine base **[Fig. 4: 1, 2]**. The first of these is a weak curvilinear anomaly **[1]** that may indicate the presence of a shallow buried ditch, its shape suggesting it may be of archaeological interest, while the second is a discreet strong irregularly-shaped positive anomaly **[2]**, possibly a buried pit-type feature.

The remaining anomalies recorded by the survey are most likely modern in origin. A series of parallel positive linear anomalies in the eastern turbine base **[3]** are probably caused by deep agricultural activity as are another set in the north-eastern cable trench area **[4]**. Another type of anomaly consisting of two parallel lengths of linear positive anomaly with a slightly more negative anomaly between them was recorded at three points in the survey **[5, 6, 7]**. It is thought these anomalies reflect agricultural disturbance in the subsoil. An area of magnetic interference was detected in the western turbine base **[8]** which, due to its strong linear response, most likely indicates the presence of a modern service. Further magnetic disturbance was recorded along the hedgerow which separates the two fields and at the northern end of the cable trench grids **[9]**, both of which reflect the presence of near-by metal fencing and disused farm machinery. An area of scattered strong positive and negative magnetic responses in a similar location to **[9]** indicates the presence of buried ferromagnetic debris. Four strong dipolar magnetic spikes were detected in the western turbine base and along the course of the cable trench and probably represent buried ferrous objects.

Conclusion

The geophysical survey of the locations of the proposed wind turbine bases and cable trench identified several magnetic anomalies, two of which may be archaeological in origin. Of these, a weak curvilinear anomaly may be of particular interest due to the close proximity to the site of several Bronze Age round barrows. The remaining anomalies are likely to be agricultural in origin, whether ploughing or drainage, with some being caused by near-by fencing and farm equipment.

References

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BGS, 1980, *British Geological Survey*, 1:50,000, Sheet 307/308, Solid and Drift Edition, Keyworth

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Appendix 1. Survey and data information

Turbine bases and connecting cable

Raw data

Direction of 1st Traverse: 356.11267 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 2047.5

Dimensions
Composite Size (readings): 160 x 180
Survey Size (meters): 40 m x 180 m
Grid Size: 20 m x 20 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 100.00
Min: -100.00
Std Dev: 4.29
Mean: 5.37
Median: 5.13
Composite Area: 0.72 ha
Surveyed Area: 0.52 ha

Source Grids: 13
1 Col:0 Row:0 grids\03.xgd
2 Col:0 Row:1 grids\04.xgd
3 Col:0 Row:2 grids\05.xgd
4 Col:0 Row:3 grids\06.xgd
5 Col:0 Row:4 grids\07.xgd
6 Col:0 Row:5 grids\08.xgd
7 Col:0 Row:6 grids\09.xgd
8 Col:0 Row:7 grids\10.xgd
9 Col:0 Row:8 grids\11.xgd
10 Col:1 Row:0 grids\01.xgd
11 Col:1 Row:1 grids\02.xgd
12 Col:1 Row:7 grids\12.xgd
13 Col:1 Row:8 grids\13.xgd

Processed data

Max: 5.00
Min: -5.00
Std Dev: 2.10
Mean: 0.11
Median: 0.00

Processes: 6
1 Base Layer
2 DeStripe Median Sensors: All
3 Despike Threshold: 1 Window size: 3x3
4 De Stagger: Grids: All Mode: Both By: -1 intervals
5 Clip from -5.00 to 5.00 nT
6 Move (Area: Top 40, Left 0, Bottom 139, Right 79) to *x*40, *y*0

West field cable trench

Raw data

Direction of 1st Traverse: 286.37095 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 2047.5

Dimensions
Composite Size (readings): 80 x 180
Survey Size (meters): 20 m x 180 m
Grid Size: 20 m x 20 m
X Interval: 0.25 m
Y Interval: 1 m

Stats
Max: 100.00
Min: -100.00
Std Dev: 5.74
Mean: -2.24
Median: -2.48
Composite Area: 0.36 ha
Surveyed Area: 0.33345 ha

Source Grids: 9
1 Col:0 Row:0 grids\01.xgd
2 Col:0 Row:1 grids\02.xgd
3 Col:0 Row:2 grids\03.xgd
4 Col:0 Row:3 grids\04.xgd
5 Col:0 Row:4 grids\05.xgd
6 Col:0 Row:5 grids\06.xgd
7 Col:0 Row:6 grids\07.xgd
8 Col:0 Row:7 grids\08.xgd
9 Col:0 Row:8 grids\09.xgd

Processed data

Max: 5.00
Min: -5.00
Std Dev: 1.78
Mean: 0.14
Median: 0.01

Processes: 5
1 Base Layer
2 DeStripe Median Sensors: All
3 Despike Threshold: 1 Window size: 3x3
4 De Stagger: Grids: All Mode: Both By: -2 intervals
5 Clip from -5.00 to 5.00 nT

East field cable trench

Raw data

Direction of 1st Traverse: 291.57376 deg
Collection Method: ZigZag
Sensors: 2 @ 1.00 m spacing.
Dummy Value: 2047.5

Dimensions
Composite Size (readings): 80 x 80
Survey Size (meters): 20 m x 80 m
Grid Size: 20 m x 20 m
X Interval: 0.25 m
Y Interval: 1 m

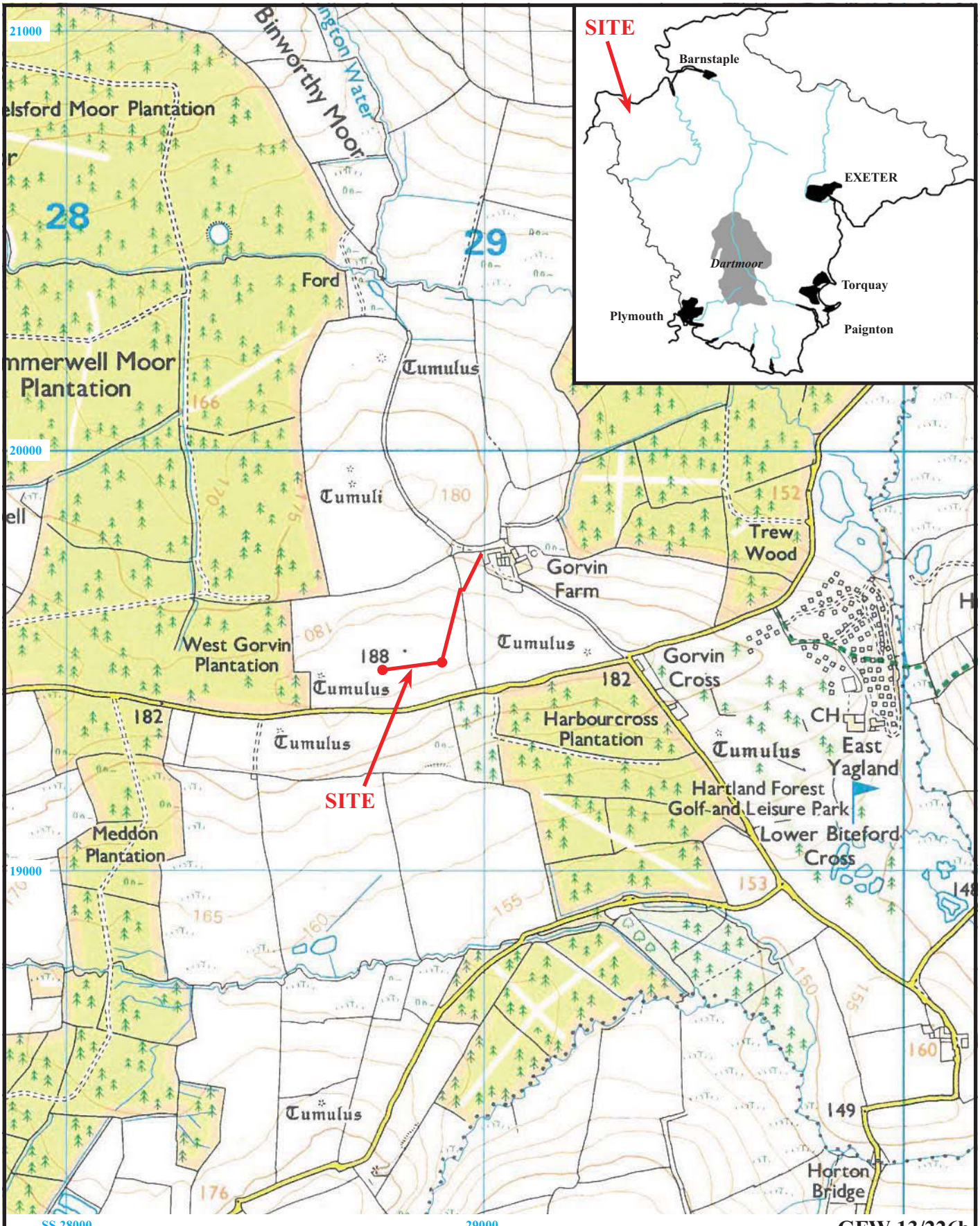
Stats
Max: 100.00
Min: -100.00
Std Dev: 16.41
Mean: -3.28
Median: -3.24
Composite Area: 0.16 ha
Surveyed Area: 0.1497 ha

Source Grids: 4
1 Col:0 Row:0 grids\01.xgd
2 Col:0 Row:1 grids\02.xgd
3 Col:0 Row:2 grids\03.xgd
4 Col:0 Row:3 grids\04.xgd

Processed data

Max: 5.00
Min: -5.00
Std Dev: 2.61
Mean: 0.12
Median: -0.01

Processes: 5
1 Base Layer
2 DeStripe Median Sensors: All
3 Despike Threshold: 1 Window size: 3x3
4 De Stagger: Grids: All Mode: Both By: -2 intervals
5 Clip from -5.00 to 5.00 nT



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Proposed Wind Turbine Site, Gorvin Farm, Woolsery, Bideford, Devon, 2014
Geophysical Survey (Magnetic)

Figure 1. Location of site within Gorvin Farm and Devon.

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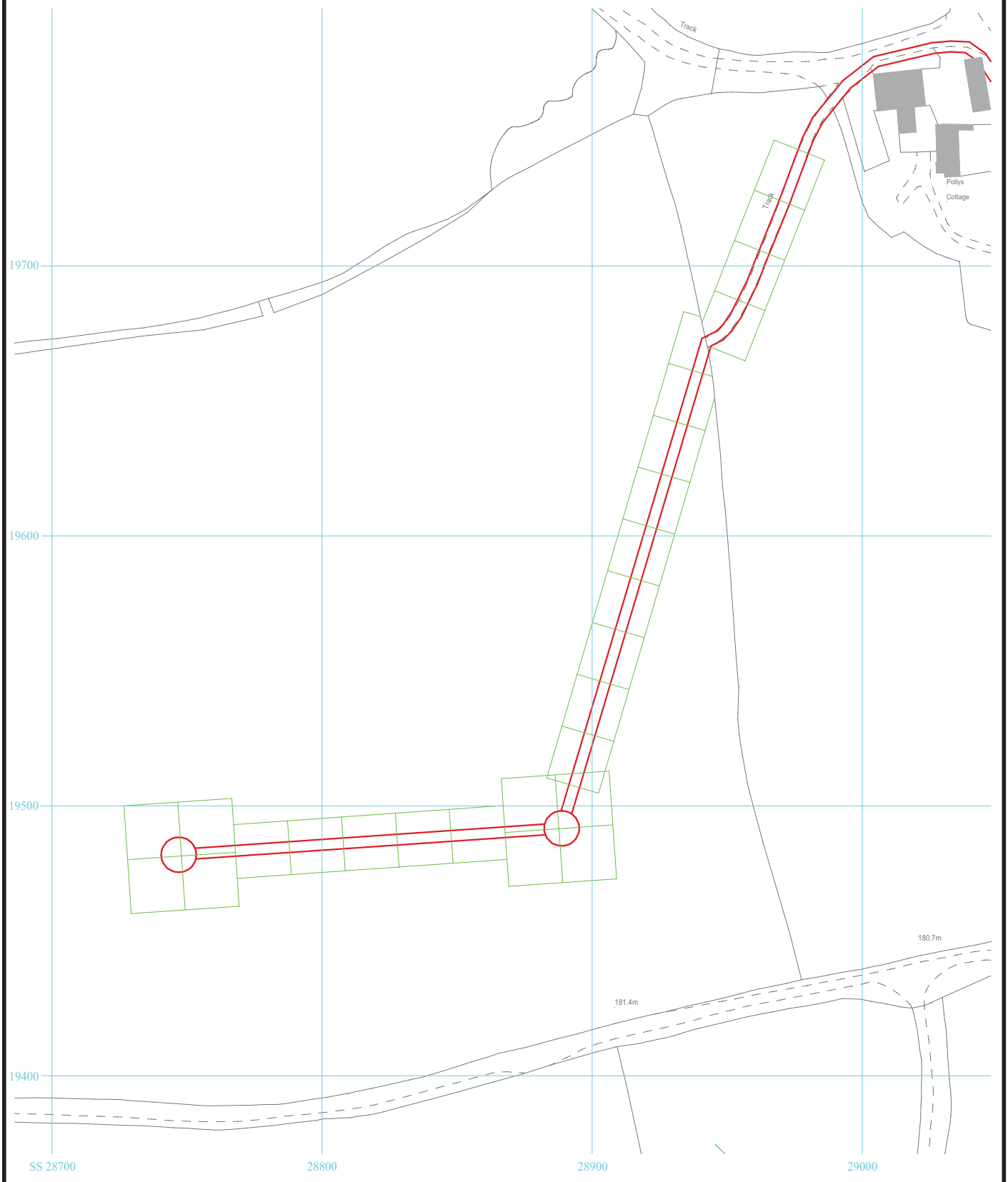

GFW 13/226b

N

Proposed Wind Turbine Site, Gorvin Farm, Woolsery, Bideford, Devon, 2014 Geophysical Survey (Magnetic)

Figure 2. Survey grid layout.

0 50m

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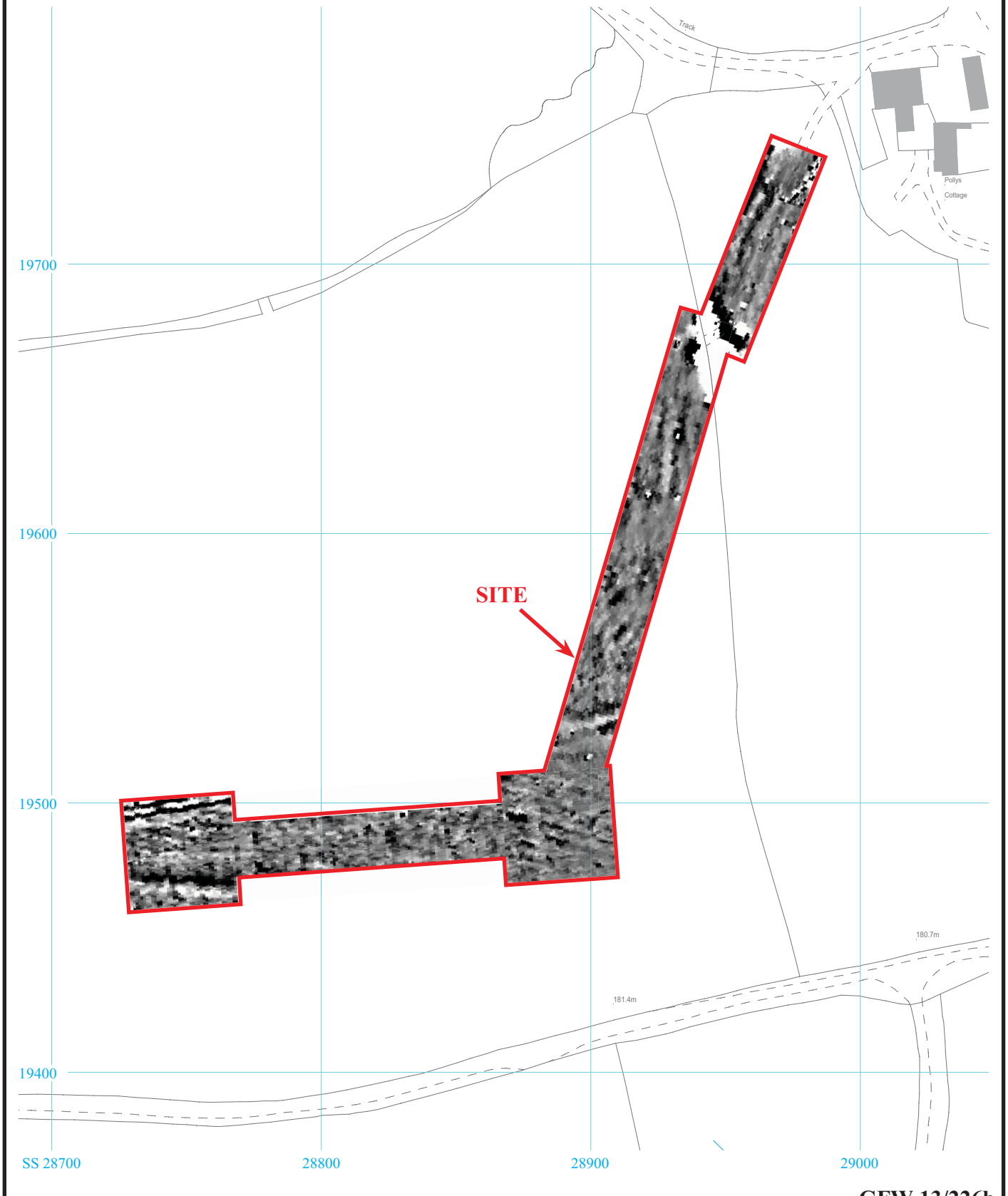

GFW 13/226b

N

Proposed Wind Turbine Site, Gorvin Farm, Woolsery, Bideford, Devon, 2014
Geophysical Survey (Magnetic)

Figure 3. Plot of minimally processed gradiometer data.

0m 100m

+5 nT

-5 nT

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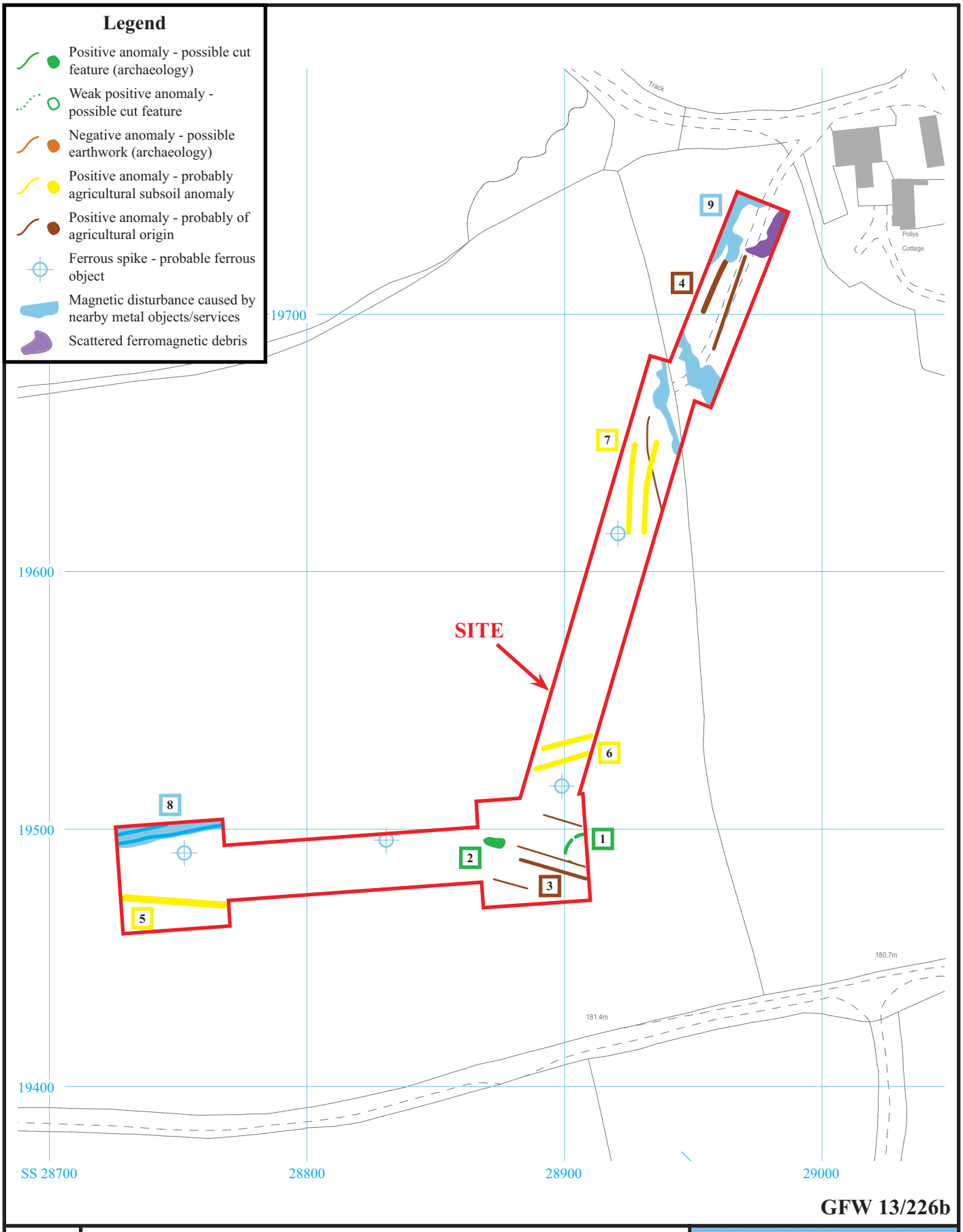

GFW 13/226b

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Proposed Wind Turbine Site, Gorvin Farm, Woolsery, Bideford, Devon, 2014
Geophysical Survey (Magnetic)

Figure 4. Interpretation plot.

0m 100m

THAMES VALLEY ARCHAEOLOGICAL SERVICES SOUTH WEST

Plate 1. Proposed wind turbine base area, looking west towards round barrow.

Plate 2. West field cable trench, looking north-east.

Plate 3. West field cable trench, looking south up the slope.

Plate 4. East field cable trench (following the track), looking north-east towards Gorvin Farm.

TIME CHART

	Calendar Years
Modern	AD 1901
Victorian	AD 1837
Post Medieval	AD 1500
Medieval	AD 1066
Saxon	AD 410
Roman	AD 43
Iron Age	BC/AD 750 BC
Bronze Age: Late	1300 BC
Bronze Age: Middle	1700 BC
Bronze Age: Early	2100 BC
Neolithic: Late	3300 BC
Neolithic: Early	4300 BC
Mesolithic: Late	6000 BC
Mesolithic: Early	10000 BC
Palaeolithic: Upper	30000 BC
Palaeolithic: Middle	70000 BC
Palaeolithic: Lower	2,000,000 BC

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