Historic England

Geophysics

Down House, Downe, London Borough of Bromley
Report on Geophysical Surveys, April 2018

Neil Linford, Paul Linford and Andrew Payne

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DOWN HOUSE, DOWNE, LONDON BOROUGH OF BROMLEY

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SUMMARY

Ground Penetrating Radar (GPR), earth resistance surveys and magnetic surveys were conducted at Down House, Downe, London Borough of Bromley, following a request from the English Heritage Trust who manage the site. Down House was the former home of Charles Darwin and the house and gardens now serve as a museum celebrating his life, work and family. The aim of the geophysical survey was to help locate a number of possible short-lived structures known to have been constructed in the garden, including a pigeon house and outdoor douche both recorded in Darwin's correspondence. The GPR survey (0.3ha) covered the majority of the open lawn areas, including the paddock to the south of the gardens, and revealed possible wall type anomalies and service runs. Earth resistance survey (0.2ha) complemented the GPR coverage over the lawn and also provided additional coverage in areas of more dense vegetation which was impossible to access with other techniques. Finally, a magnetic survey (0.2ha) provided useful confirmation of ferrous services identified with the other two techniques. Interpretation of the data is complicated in part by the keyhole nature of the coverage, although some possibly significant structural or garden feature remains have been suggested from the results.

CONTRIBUTORS

The geophysical fieldwork was conducted by Neil Linford, Paul Linford and Andrew Payne.

ACKNOWLEDGEMENTS

The authors are grateful to our colleagues at Down House from the English Heritage Trust for providing access and assistance to allow the survey to take place.

ARCHIVE LOCATION

Fort Cumberland, Portsmouth.

DATE OF SURVEY

The fieldwork was conducted between 17th to 20th April 2018 and the report completed on 6th August 2018. The cover image shows a view over the main lawn back towards Down House.

CONTACT DETAILS

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INTRODUCTION

Earth resistance, magnetic and Ground Penetrating Radar (GPR) surveys were conducted at Down House, Downe, London Borough of Bromley, following a request from the English Heritage Trust who manage the site. Down House was the former home of Charles Darwin and the house and gardens now serve as a museum celebrating his life, work and family. The aim of the geophysical survey was to help resolve questions about the survival of remains of outbuildings and structures known to have been constructed in the garden, recorded in Darwin's correspondence and supported, in part, by surviving accounts for some of the materials used. The results will contribute to improved visitor information and inform future conservation and management. The work addresses Historic England Action Plan objective 5.6 "Support English Heritage in its care of the National Heritage Collection".

A previous geophysical survey was commissioned by English Heritage shortly after the site came into guardianship, but was concentrated over the orchard area to the south west of the house outside of the current area of investigation (Bartlett 1999). The aim of this original survey was to test for the possible location of gravel paths to reconstruct the garden design during Darwin's residency. The current survey was targeted over areas of lawn and more mature planting immediately to the south of the house close to the well, where it was thought Darwin had an outside shower (douche) constructed, and over a small area close to the walled garden that might possibly have been the final location of his pigeon house after it was moved from its original position closer to the house. The survey was also extended beyond the garden to cover the paddock area to the southwest.

Well drained fine silty over clayey, clayey and fine silty, often very flinty, soils of the Carstens association (581d), have developed over chalk bedrock of the Lewes Nodular, Seaford, and Newhaven Chalk Formations (undifferentiated); this is overlain by superficial clay-with-flints, a formation consisting of mixed clay, silt, sand and gravel (Soil Survey of England and Wales 1983; Geological Survey of Great Britain 1998). Surface conditions were generally down to well-kept lawn within the gardens, interrupted by formal planting and, in places, quite dense vegetation with mature specimen trees. Weather conditions were sunny and dry throughout the field work, with exceedingly clement temperatures for the time of year.

METHOD

Earth resistance survey

A series of 30m grids were established with a Trimble R8 GNSS (Figure 1) and surveyed using a Geoscan RM85 resistance meter with an internal multiplexer

and a PA5 electrode frame in the Twin-Electrode configuration. This arrangement allowed two separate surveys, with electrode separations of 0.5m and 1.0m, to be collected simultaneously. The 0.5m electrode separation coverage was designed to detect near-surface anomalies in the upper 0.5m of the subsurface whilst the 1.0m separation survey allowed anomalies to a depth of about 1-1.25m to be detected. For the 0.5m electrode separation survey readings were taken at a density of 0.5m x 0.5m whilst for the 1.0m separation survey they were taken at a density of 0.5m x 1.0m.

Extreme values caused by high contact resistance were suppressed from both datasets using an adaptive thresholding median filter with radius 1m (Scollar et al. 1990). The results for the near-surface 0.5m electrode separation survey are depicted as a linear greyscale image in Figure 3 superimposed on the OS map. Figures 6 and 7 show the minimally processed data from both the 0.5m and 1.0m electrode separation datasets presented as trace plots and linear and equal area greyscale images, from the main lawn and presumed location of the pigeon house respectively. To gain insight into the burial depth of anomalies, data from both the 0.5 and 1.0m separation datasets were combined and inverted using Geotomo Software's Res3DInv version 2.15 and the results are depicted as depth slices in Figure 9.

Magnetometer survey

Two 30m grids were established with a Trimble R8 GNSS (Figure 1) and surveyed using a Bartington Grad 601 dual fluxgate gradiometer. Measurements were taken at 0.25 m intervals along parallel traverses separated by 1.0 m. Post-survey, the median value of each traverse was subtracted from all measurements on that traverse (Zero Median Traverse) to correct for heading errors and instrument drift. A linear greyscale image of the magnetometer data is presented in Figure 4 superimposed on the OS base map. Minimally processed versions of the magnetic data are shown as a trace plot in Figure 8(A) and as a greyscale image in Figure 8(B).

Ground Penetrating Radar survey

A 3d-Radar MkIV GeoScope Continuous Wave Step-Frequency (CWSF) Ground Penetrating Radar (GPR) system was used to conduct the survey collecting data with a multi-element DXG1820, ground coupled antenna array (Linford *et al.* 2010). A roving Trimble R8 Global Navigation Satellite System (GNSS) receiver, together with a second R8 base station receiver established using the Ordnance Survey (OS) VRS Now correction service, was mounted on the GPR antenna array to provide continuous positional control for the survey. Measurements were collected along the instrument swaths shown on Figure 2. For this survey the system was towed manually across the site instead of using a motorised vehicle. Data were acquired at a 0.075m x 0.075m sample interval across a

continuous wave stepped frequency range from 40MHz to 2.99GHz in 4MHz increments using a dwell time of 3ms. A single antenna element was monitored continuously to ensure data quality during acquisition together with automated processing software to produce real time amplitude time slice representations of the data as each successive instrument swath was recorded in the field (Linford 2013).

Post-acquisition processing involved conversion of the raw data to time-domain profiles (through a time window of 0 to 50ns), adjustment of time-zero to coincide with the true ground surface, background and noise removal, and the application of a suitable gain function to enhance late arrivals. Representative profiles from the GPR survey are shown on Figure 10. To aid visualisation amplitude time slices were created from the entire data set by averaging data within successive 2.5ns (two-way travel time) windows (e.g. Linford 2004). An average sub-surface velocity of 0.104m/ns was assumed following constant velocity tests on the data, and was used as the velocity field for the time to estimated depth conversion. Each of the resulting time slices therefore represents the variation of reflection strength through successive ~0.13m intervals from the ground surface, shown as individual greyscale images in Figure 11. Further details of both the frequency and time domain algorithms developed for processing this data can be found in Sala and Linford (2012).

RESULTS

Earth resistance survey

A graphical summary of the significant earth resistance anomalies, [**r1-27**], discussed in the following text is shown superimposed on the base OS map data in Figure 12.

Main Lawn

A rectilinear pattern of high and low resistance anomalies [**r1-5**] can be discerned beneath the lawn adjacent to the SW facing wall of Down House, sharing the same alignment. These are partially replicated as slight topographical variation and faint parch-marks visible at the time of the fieldwork. The arrangement is suggestive of a previous formal garden layout consisting of pathways [**r1**] and [**r4**], planting beds [**r2**] and [**r5**], and tree-planting pits [**r3**]. While the majority of the pathway anomalies appear to be caused by remains at relatively shallow depths (~0.35 to 0.55m), some are more strongly represented in the 1m electrode separation data [**r4**] suggesting material buried at greater depth (~0.75 to 1.25m) which might be indicative of more substantive, possibly structural, remains. These could perhaps represent a series of partially robbed out wall footings associated with the original C17th house, with the general orientation of the earlier buildings perpetuated in the

design of the current house. The broad, particularly low resistance, anomalies [**r5**] sharing the same alignment may represent further planting beds, a pond or perhaps some other form of ditch or water retentive feature although there is no corresponding GPR response.

A large high resistance anomaly [**r6**] west of [**r5**] appears to share the same alignment as [**r1-5**] and to extend beyond the accessible survey beneath the raised planting beds at the north-western edge of the lawn. The response to [**r6**] is also strongly resolved in the deeper penetrating 1.0m electrode separation data and, perhaps, represents a dense spread of rubble or masonry material extending to some depth. Nearby a discrete high resistance anomaly [**r7**] also appears to represent the response to a causative feature at depth as it is only resolved in the 1m separation dataset suggesting an overburden of at least ~0.75m. It may be tempting to associate this with the original buried mill-stone used for Darwin's earthworm experiments thought to have been conducted in this area, however, at 4m in diameter it is far too large. One further low resistance anomaly [**r8**] on the same alignment as [**r1-5**] appears in the western corner of the survey area, in both the 0.5 and 1.0m datasets, and may represent the remains of planting bed (cf [**r5**]) or trench associated with [**r6**].

Two parallel linear service pipe trenches [**r9**] correspond with anomalies in both the magnetic ([**m1**] and [**m5**]) and GPR ([**gpr15**] and [**gpr16**]) data. The southernmost has only been very weakly detected suggesting a less substantive trench perhaps containing a smaller pipe. Both anomalies are resolved to an equal degree in both the 0.5 and 1.0m separation datasets suggesting a burial depth in the region of 0.35. – 0.75 m. It is possible that the northernmost trench is responsible for the apparent discontinuity separating the two low resistance anomalies [**r5**] and the pipe trench is thus a later feature cut through the remains of an earlier rectangular planting bed. The service trenches appear to run towards the concentration of high resistance responses [**r10**] close to the large yew trees and may, possibly, continue in the same direction heading to the former cisterns recorded under the site of the modern visitor toilet facilities (Keystone Archaeology 1996), although no evidence for this has been found due to the current planting beds and pathways obscuring the response here.

The collection of high resistance anomalies at [**r10**] includes some that are resolved strongly in the 1.0m separation dataset, suggesting they extend downwards to some depth. The root systems of trees can cause strong earth resistance anomalies in their immediate vicinity owing to their effect on local soil moisture but in this case the anomalies appear sub-rectangular and are not radially distributed around the tree trunks. It is therefore possible that the buried remains of a structure are located here, its function perhaps related to the service trenches or, alternatively, perhaps further remains related to the putative formal garden layout [**r1-5**].

The edges of a raised mound displaying spring flowering plants at the time of the survey appear as high resistance responses of varying strength [**r11**] and [**r12**]. While the former are relatively weak anomalies following the oval shape of the western and northern edges of the mount, [**r12**] at the eastern side appears more linear and exhibits extremely high resistance values ~80-144 ohms. This suggests buried stonework and the electrodes did indeed strike stone when inserted at this location, and the current mound may possibly cover the remains of an earlier structure. The centre of the mound [**r13**] exhibits lower values more typical of the background levels for the garden. This might simply be a topographic effect due to the mound of soil or, perhaps, reflect the remains of a previous planting bed or similar feature.

A sinuous curvilinear anomaly [**r14**] most clearly defined in the near surface data passes close to [**r10**] and then continues north towards the house where it joins one of the linear anomalies [**r1**]. Its course is close to that of the current garden path in this location, although not entirely coincident with it, so it may indicate a previous routing that passed closer to the yew trees, preserved either as soil compaction or due to a layer of gravel or similar material.

A second, slightly broader, sinuous curvilinear low resistance anomaly following a similar route [**r15**] may also represent another former line of the path and it also lies beneath the tree covered mound, rather than skirting around it as the current path does. To the west of [**r15**] the earth resistance survey has detected a localised high resistance anomaly [**r16**] that surrounds the covered hole visible on the surface, detected in both 0.5 and 1m separation data sets, suggesting perhaps a surrounding masonry or brick lining.

To the eastern side of [**r15**], on the highest part of the tree covered mound, a high resistance anomaly [**r17**], detected in both the 0.5m and 1.0m data sets, might be due to buried brickwork, concrete or masonry, possibly the remains of a rectangular platform. Multiple linear high resistance responses [**r18**] adjacent to [**r17**] to the east are suggestive of further structural remains, on a similar alignment to [**r1-5**].

Further to the north, adjacent to Down House and around the capped well head areas of low resistance [**r19**] are likely to represent organic soil enrichment, with the clearest examples occurring within the cottage garden. A linear low resistance anomaly [**r20**] here heading towards the cottage is interpreted either as a small service pipe trench, a former drainage ditch or the response to a pathway. More complex anomalies at [**r21**] closer to the cottage may again be garden planting related or, perhaps, drainage services such as a soak-away. A near-surface anomaly [**r22**] may represent a pathway or boundary with a pile of wood-chips also evident here as a high resistance response [**r23**].

Pigeon House

A high resistance anomaly due to the foundations of the walled garden is found at [**r24**] with other, more tentative increases above the background also evident around the edges of the survey, including rectangular responses [**r25**] and [**r26**] possibly due to a former planting bed. A discrete near-surface anomaly [**r27**] of raised values, some 2-3m across, may possibly be associated with a garden structure or even a tree root ball, although this remains a speculative interpretation without further investigation.

Magnetic survey

A graphical summary of the significant magnetic anomalies, [**m1-5**], discussed in the following text, is shown superimposed on the base OS map data on Figure 13.

Main Lawn and Paddock

A ferrous service pipe [**m1**] corresponds with [**r9**] and intersects with a second ferrous service [**m2**] crossing the paddock, although it is unclear if the two are directly connected. Strong disturbance is also found associated with the metal fence [**m3**] and along the curving trackway [**m4**] passing through the paddock. A weaker more interrupted anomaly [**m5**] runs parallel to [**m1**] and is suggestive of a second possible service that may have been removed or, perhaps, does not contain a ferrous pipe.

Ground Penetrating Radar survey

A graphical summary of the significant GPR anomalies, [**gpr1-21**], discussed in the following text, is shown superimposed on the base OS map data in Figure 14.

Main Lawn and Paddock

Significant reflections have been recorded to approximately 30ns before the signal begins to become attenuated. The very near-surface data shows the slight depression along the compacted curving path through the paddock as a multiple reflection [**gpr1**] persisting through the entire data set. Parallel linear anomalies [**gpr2**] evident between 2.5 and 7.5ns (0.13 to 0.38m) perhaps suggest the presence of ferrous edging to [**gpr1**], corroborating the intense magnetic response [**m4**], although this may also be due to a cinder base to the path perhaps. A more amorphous near-surface response [**gpr3**] crosses the paddock diagonally and may represent a more direct route to the walled garden gate shown on the historic mapping (OS Historic County Mapping Series: Kent 1891 – 1921 Epoch 2), passing close to a group of rectilinear anomalies [**gpr4**]

around the mound of a mature tree just beyond the main garden fence. It is unclear whether the response to [**gpr4**], and indeed the mound itself, is due to the tree roots or, perhaps, associated with more significant underlying remains. The bark surface laid down around the cedar tree on the main lawn has also produced a high amplitude response [**gpr5**].

Over the main lawn two broad linear anomalies [**gpr6**] and [**gpr7**] appear to run orthogonally from the front of the house correlating with [**r1-5**], parch marks and a slight raised topographic feature. Anomalies [**gpr6**] and [**gpr7**] are formed from parallel linear anomalies in the near-surface, between approximately 5 and 12.5ns (0.26 to 0.64m), before the response changes to a more planar reflector continuing to a depth of 30ns (1.53m). There is also evidence for a low amplitude anomaly [**gpr8**] perhaps suggesting a discontinuity between [**gpr6**] and [**gpr7**]. The dimensions (3.5m x 15m) and depth extent of [**gpr6**] and [**gpr7**] suggest interpretation, perhaps, as structural remains rather than a more ephemeral garden path or planting bed. This may, potentially provide evidence for the original C17th house on the site and may also include anomalies further to the south at [**gpr9**] and linear responses [**gpr10**] crossing the lawn in the near-surface data.

Other possibly structural remains are found at [**gpr11**], behind the yew tree close to the open area of collapse, and a more ambiguous response at [**gpr12**], although this may be due to former planting beds. There are also a series of discrete, near-surface anomalies [**gpr13**] similar to the response from the reconstructed mill-stone [**gpr14**] in the garden.

The two service runs crossing the lawn are also replicated in the GPR data, with a weak, low amplitude anomaly [**gpr15**] found along the course of the strong ferrous response [**m1**] ([**r9**]), while the more ambiguous magnetic response [**m5**] correlates with stronger reflector [**gpr16**] between 7.5 and 10.0ns (0.38 to 0.51m). The course of [**gpr15**] runs through a low amplitude response [**gpr17**], possibly a former planting bed which appears to be closely aligned with [**gpr9**] and [**r7**] to the north. There is also some suggestion of a spur from [**gpr16**] heading southeast to the raised mound demarked by [**r11**] and [**r12**]

The ferrous anomaly [**m2**] is replicated by a high amplitude anomaly [**gpr18**] between 7.5 and 12.5ns (0.38 to 0.64m), which is apparently interrupted by deliberate breaks at 6m intervals along its course, perhaps suggesting a field drain or soak-away. Both [**gpr15**] and [**gpr16**] pass close to a complex rectilinear anomaly [**gpr19**] found between 7.5 and 25.0ns (0.38 to 1.23m), located on the course of a slight surface depression [**gpr20**] against the edge of the paddock. The function of [**gpr20**] is unclear, or whether it is related to either of the pipe runs or soak-away drain. It is possible that [**gpr19**] is related to a small building or, perhaps, some form of water management system,

perhaps associated with a subtle ditch-type anomaly [**gpr21**] underlying [**gpr1**].

CONCLUSIONS

The three geophysical techniques used for the survey have successfully produced complementary data sets and suggest the presence of a rectilinear garden or building design on a similar orientation to Down House. Despite the presence of some corresponding topographic features on the lawn, also appearing as parch marks, there are no apparent indications of this design captured by the historic mapping suggesting, perhaps, these anomalies may relate to parts of the earlier C17th house on the site. Other possible structural remains are more difficult to fully interpret due, mainly, to the keyhole nature of the available survey area around the mature areas of planting. Two service runs mapped across the lawn may also be significant and could indicate water management from the former storage cisterns by the house to provide a supply to the walled garden and greenhouse. Additional remains under the paddock also indicate the presence of a soak-away or land drain together with another small, possibly related structure. Given the importance of water management to the house and garden at Down, and the great effort required to raise water from the well, the significance of these features could, perhaps, be investigated further.

It has not been possible to unambiguously locate remains of Darwin's douche (shower) referred to in his correspondence although this is perhaps unsurprising given that it was a potentially unique structure for which no known parallels exist. A characteristic geophysical signature is therefore difficult to deduce, however, the possible buried masonry anomaly at [**r17**] would merit further investigation given its dimensions and proximity to the well. Given the confines of its location amid a modern planting bed, it was only possible to use earth resistance survey around the site of the well and, despite its capstone being visible on the surface the survey has not detected any obvious anomaly in the vicinity. This perhaps suggests it is in-filled with material of similar electrical properties to the surrounding clay soil. Likewise, no obvious evidence for Darwin's pigeon house has been detected although this is less surprising as George Darwin mentions it blowing over in a gale in 1882 (Darwin 1882-1887), suggesting that it had no subsurface foundation.

LIST OF ENCLOSED FIGURES

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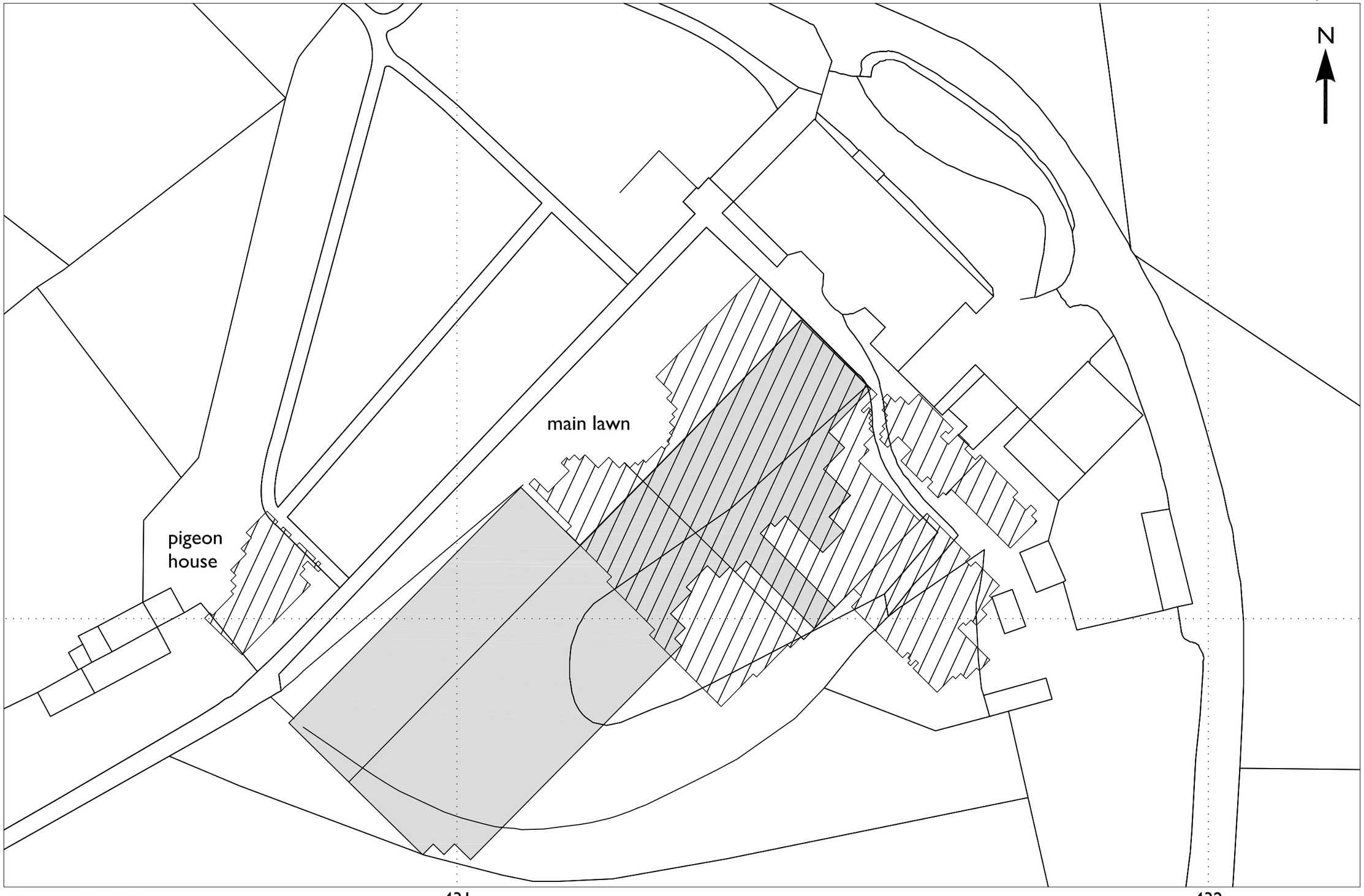
Figure 1

DOWN HOUSE, DOWNE, LONDON BOROUGH OF BROMLEY

Location of earth resistance and magnetometer surveys, April 2018

TQ4361



0 30m

1:500

Earth resistance survey

Magnetometer survey

Geophysics Team 2018

Historic England

Figure 2

DOWN HOUSE, DOWNE, LONDON BOROUGH OF BROMLEY

Location of GPR instrument swaths, April 2018

TQ4361

N

2018-04-17-011

2018-04-18-014

2018-04-19-002

2018-04-18-021

2018-04-19-014

611

431

432

0 30m

1:500

2018-04-19-010 Location of selected GPR profiles shown on Figure 10

Ground Penetrating Radar survey swaths

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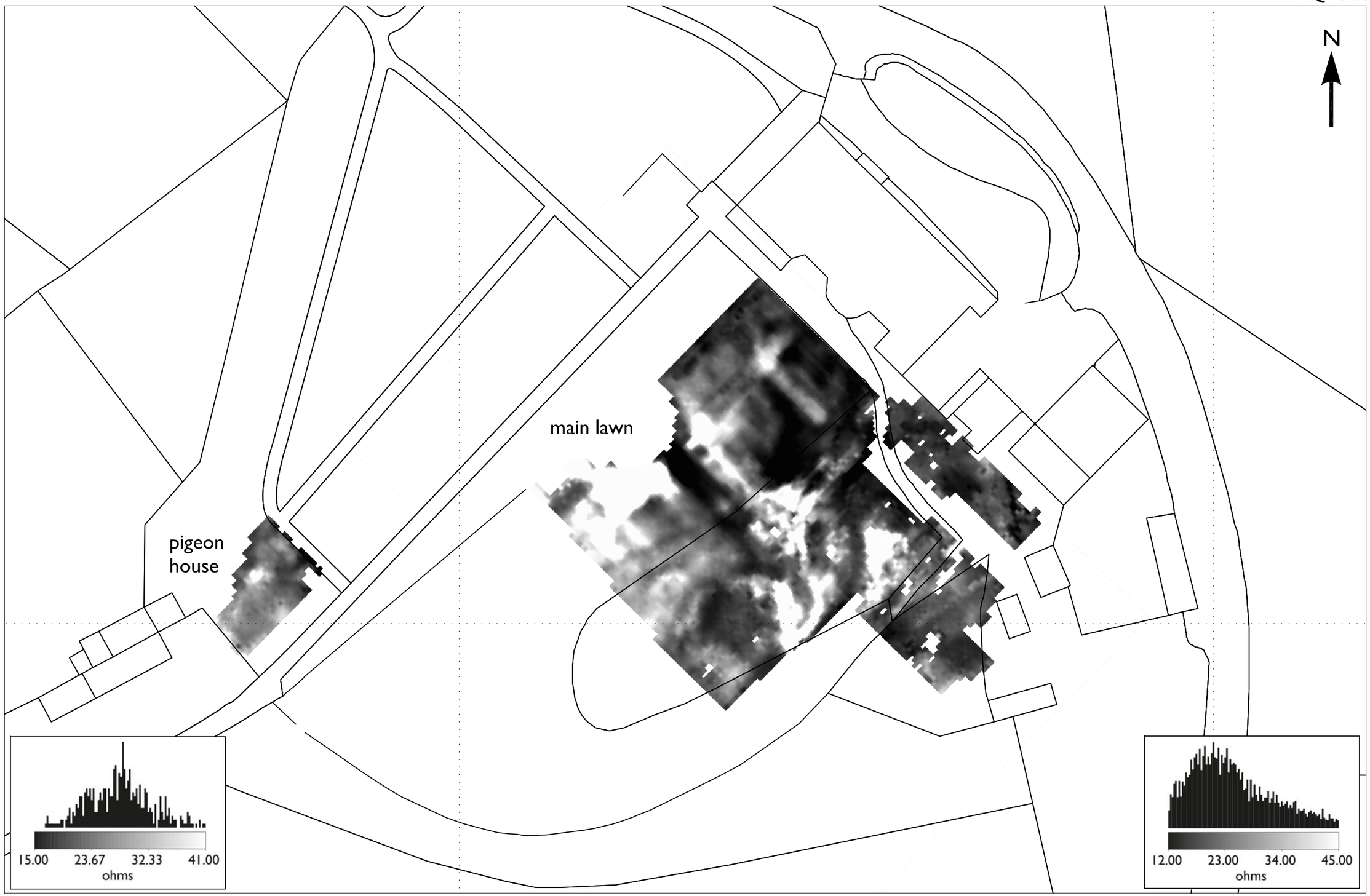
Figure 3

DOWN HOUSE, DOWNE, LONDON BOROUGH OF BROMLEY

Location of 0.5m mobile probe spacing earth resistance survey, April 2018

TQ4361



0 30m

1:500

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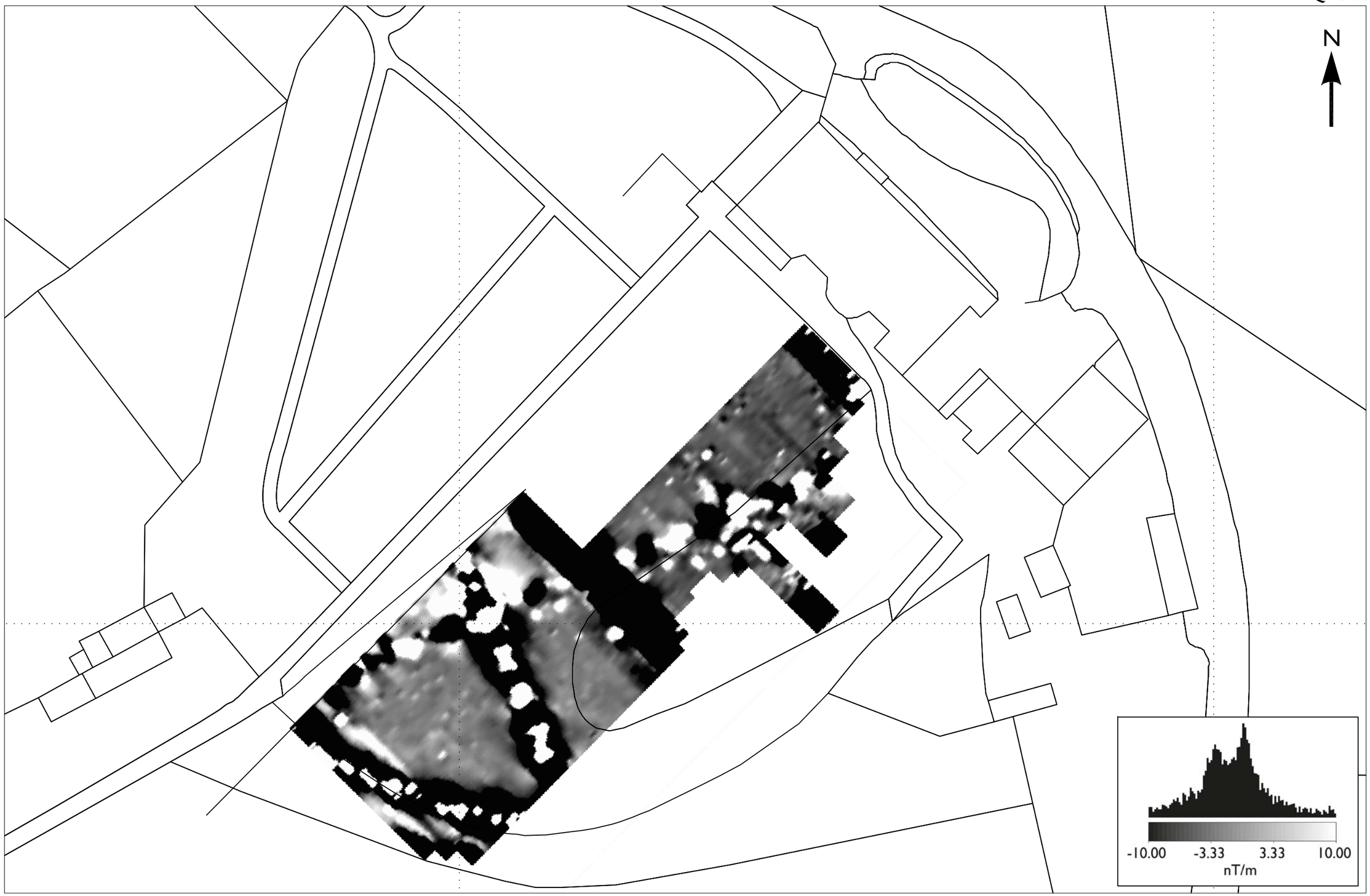
Figure 4

DOWN HOUSE, DOWNE, LONDON BOROUGH OF BROMLEY

Location of magnetometer survey, April 2018

TQ4361



0 30m

1:500

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Figure 5

DOWN HOUSE, DOWNE, LONDON BOROUGH OF BROMLEY

GPR amplitude time slice between 7.5 - 10.0ns (0.38 - 0.51m), April 2018

TQ4361

N

2018-04-17-011

2018-04-18-014

2018-04-19-002

2018-04-18-021

2018-04-19-014

611

431

432

0 30m

1:500

2018-04-19-010 Location of selected GPR profiles shown on Figure 10

Low High

relative reflector strength

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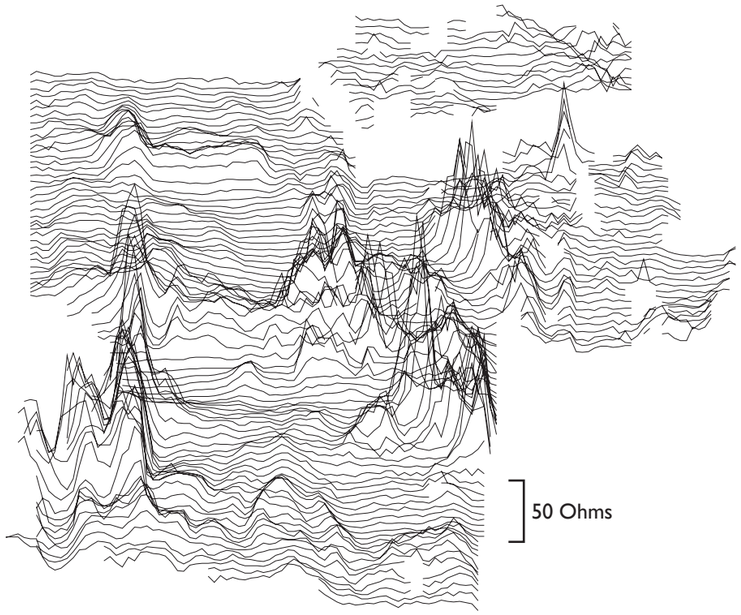
Figure 6

DOWN HOUSE, DOWNE, LONDON BOROUGH OF BROMLEY

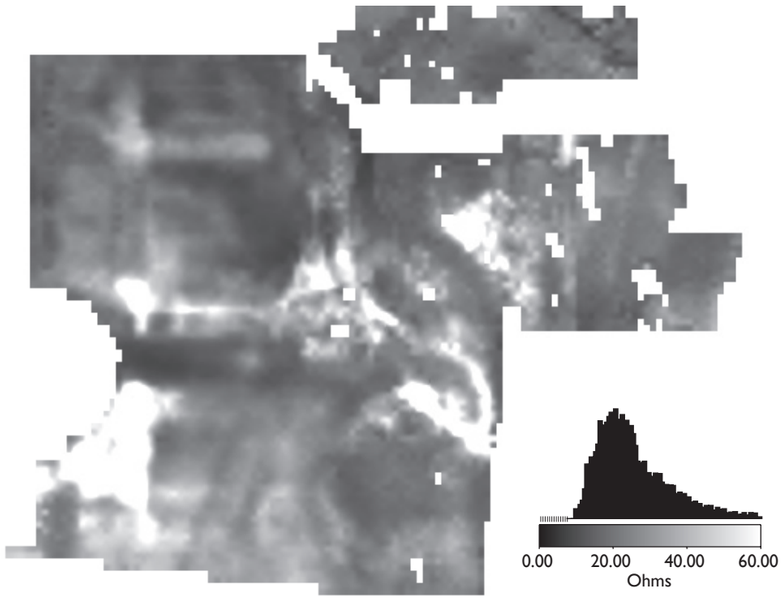
Earth resistance survey of main lawn, April 2018

0.5m mobile probe separation data

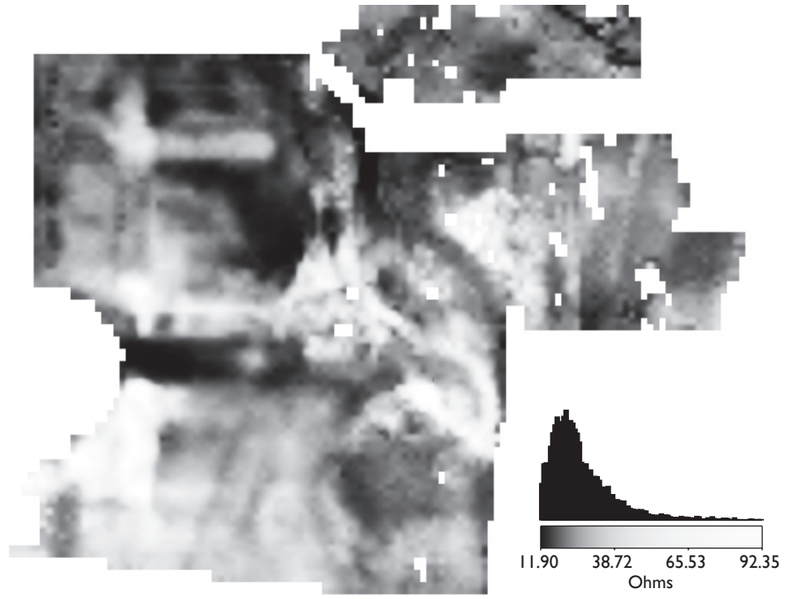
(A) Trace plot of minimally processed data



(B) Linear greyscale image of minimally processed data

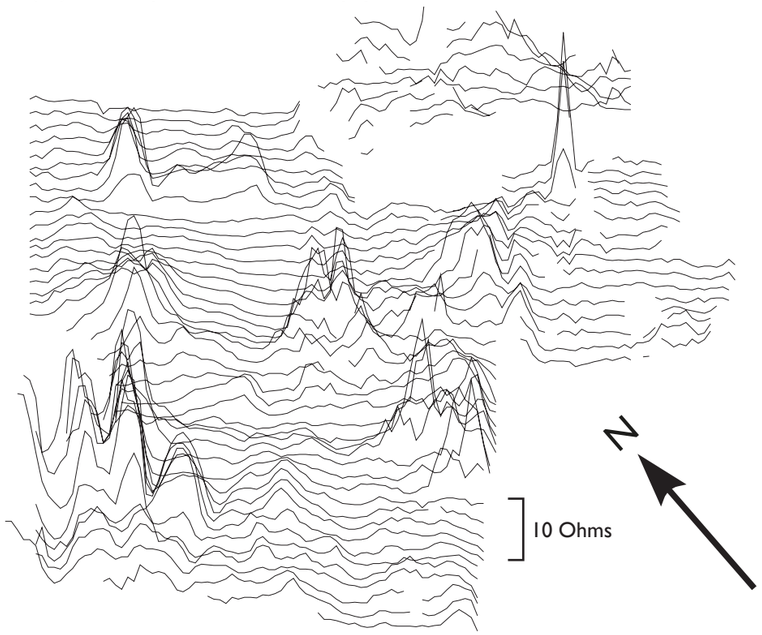


(C) Equal area greyscale image of minimally processed data

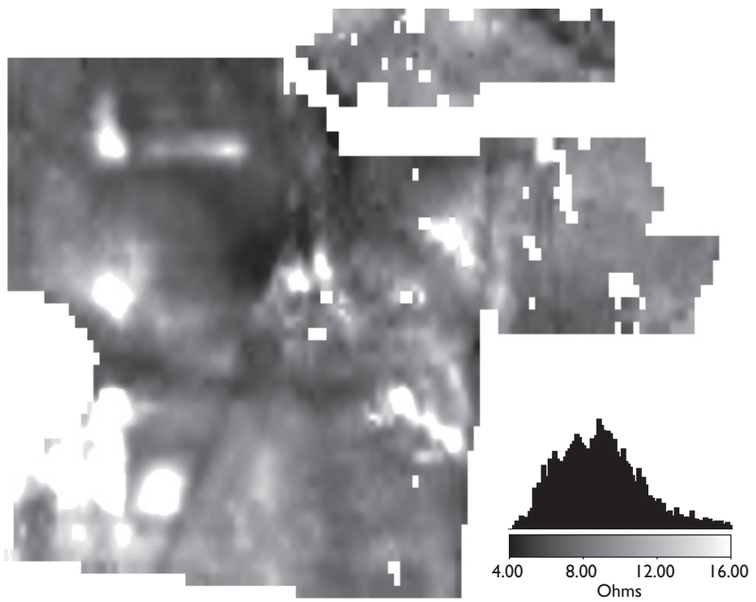


1.0m mobile probe separation data

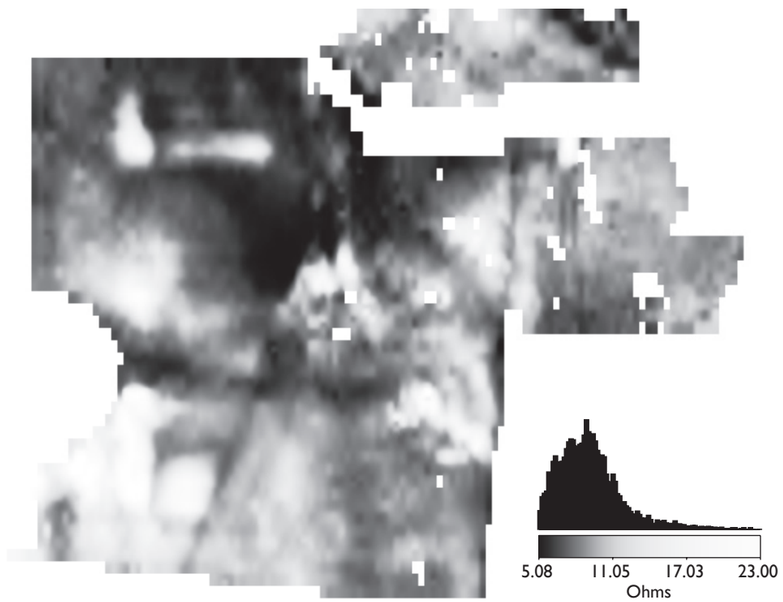
(D) Trace plot of minimally processed data



(E) Linear greyscale image of minimally processed data



(F) Equal area greyscale image of minimally processed data



N

0 60m

1:500

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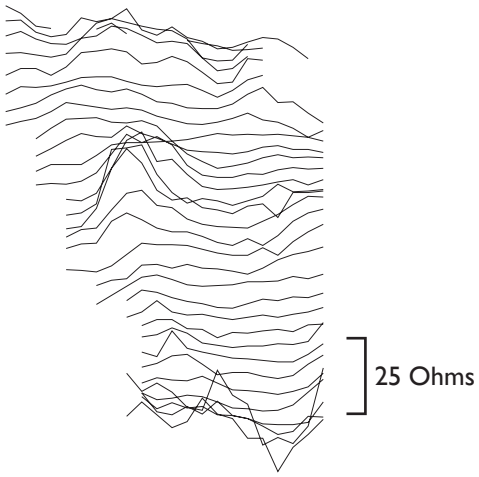
DOWN HOUSE, DOWNE, LONDON BOROUGH OF BROMLEY

Figure 7

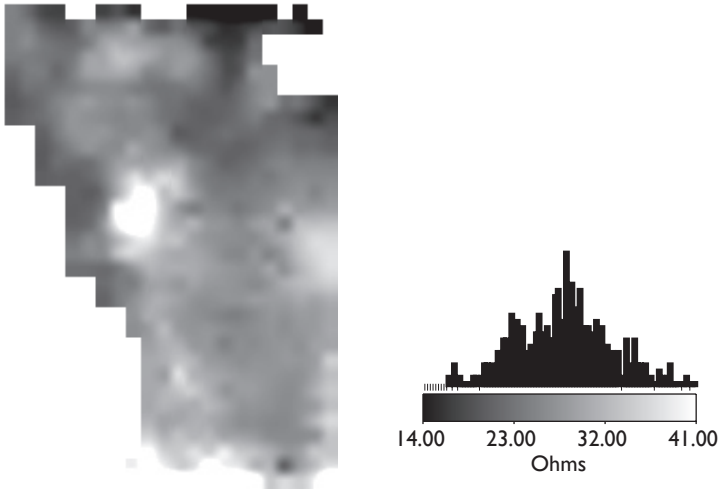
Earth resistance survey of the pigeon house, April 2018

0.5m mobile probe separation data

(A) Trace plot of minimally processed data

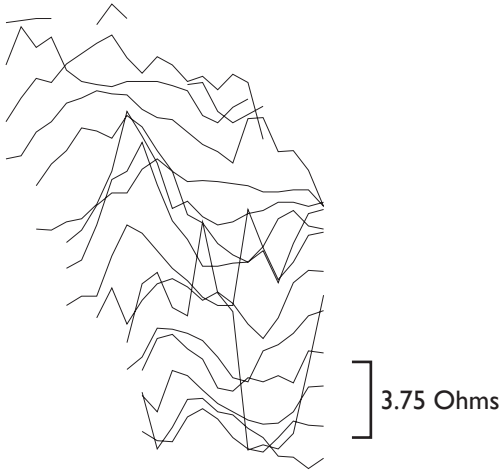


(B) Equal area greyscale image of minimally processed data

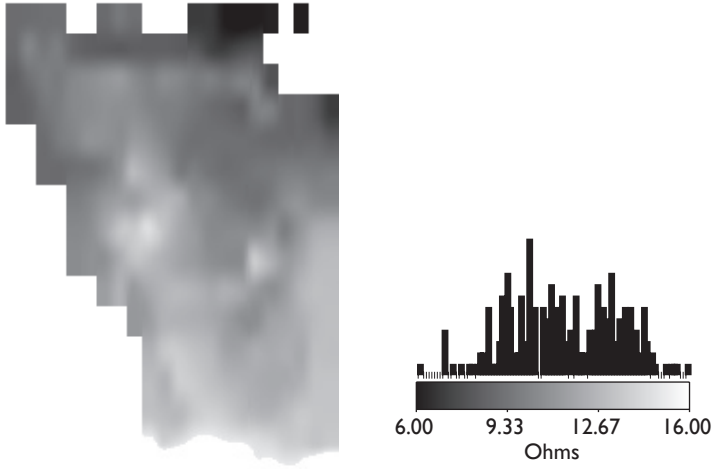


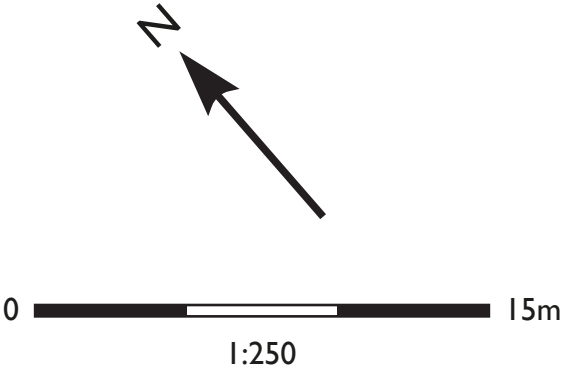
1.0m mobile probe separation data

(C) Trace plot of minimally processed data



(D) Equal area greyscale image of minimally processed data





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Historic England

DOWN HOUSE, DOWNE, LONDON BOROUGH OF BROMLEY

Figure 8

Magnetometer survey of main lawn, April 2018

(A) Trace plot minimally processed data

(B) Linear greyscale image of minimally processed data

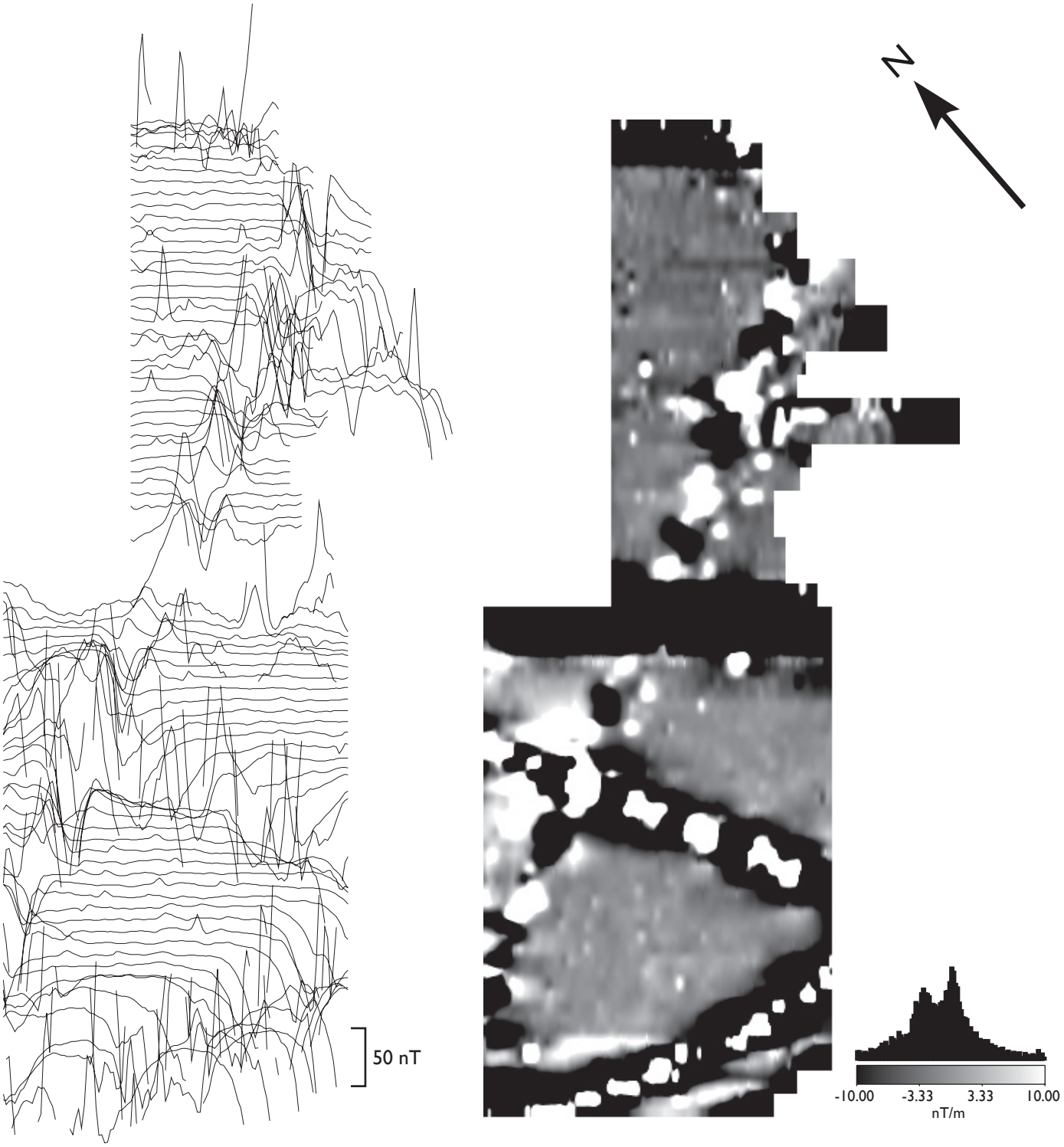

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Figure 9

DOWN HOUSE, DOWNE, LONDON BOROUGH OF BROMLEY

Earth resistance depth slices after inversion of 0.5m and 1.0m separation datasets, April 2018

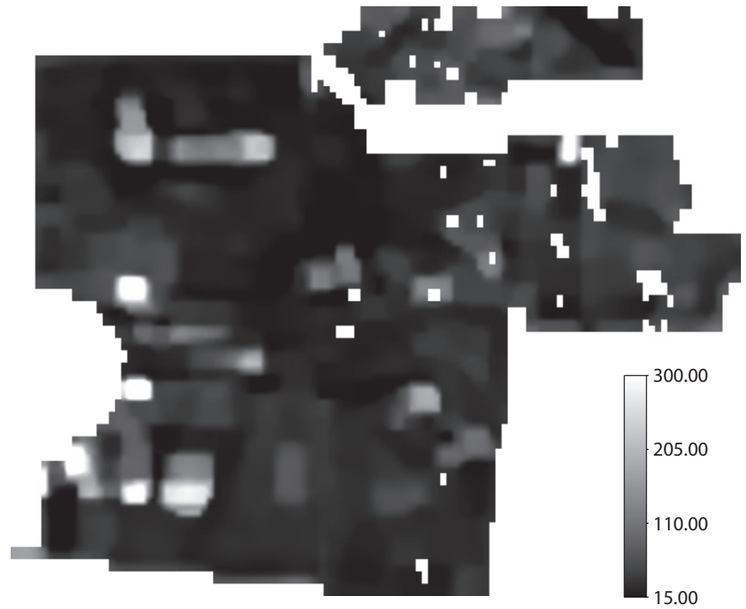
N

Main lawn

(A) 0.0 - 0.32m

(B) 0.32 - 0.75m

(C) 0.75 - 1.25m



300.00
205.00
110.00
15.00
ohm.m

0 60m

1:500

Pigeon house

(D) 0.0 - 0.32m

(E) 0.32 - 0.75m

(F) 0.75 - 1.25m

180.00
133.33
86.67
40.00
ohm.m

0 15m

1:250

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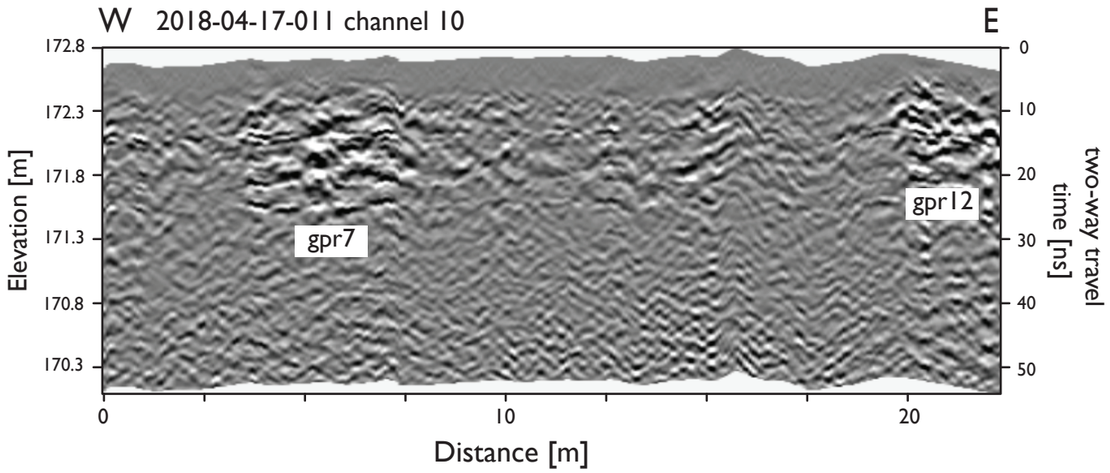
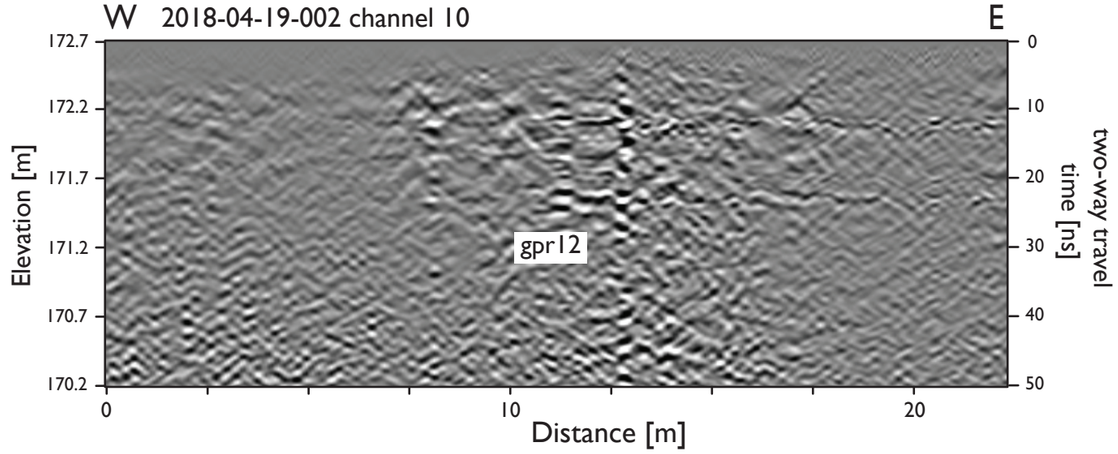
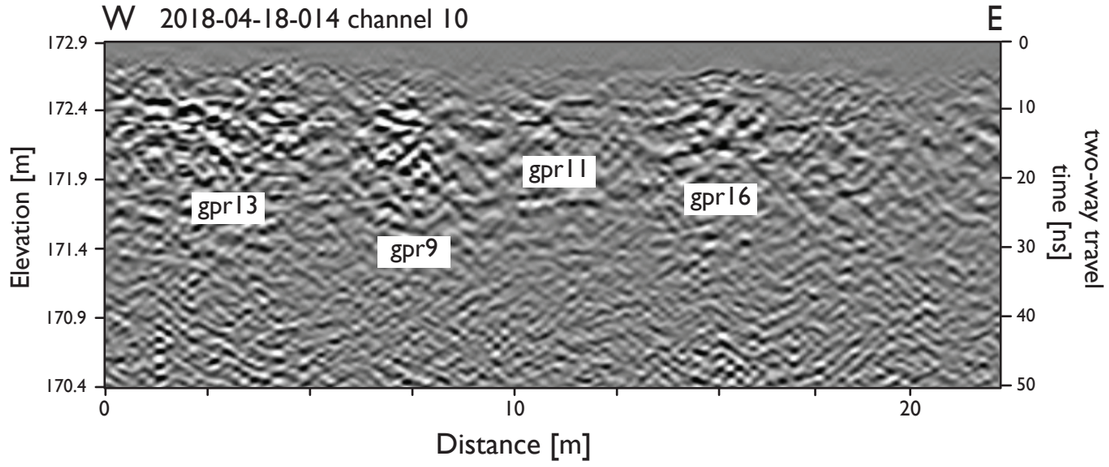
DOWN HOUSE, DOWNE, LONDON BOROUGH OF BROMLEY

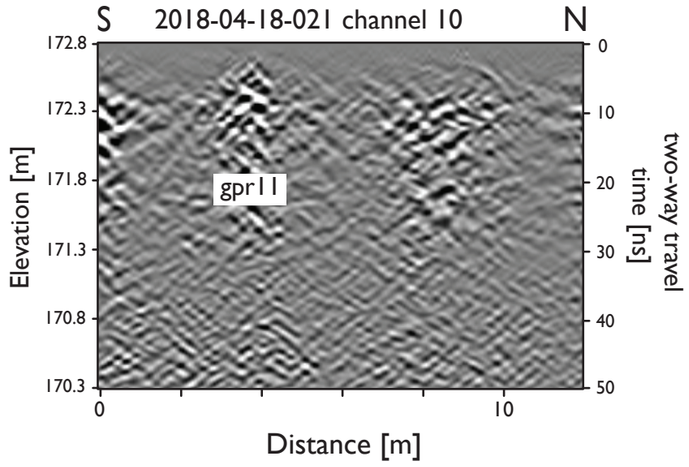
Figure 10

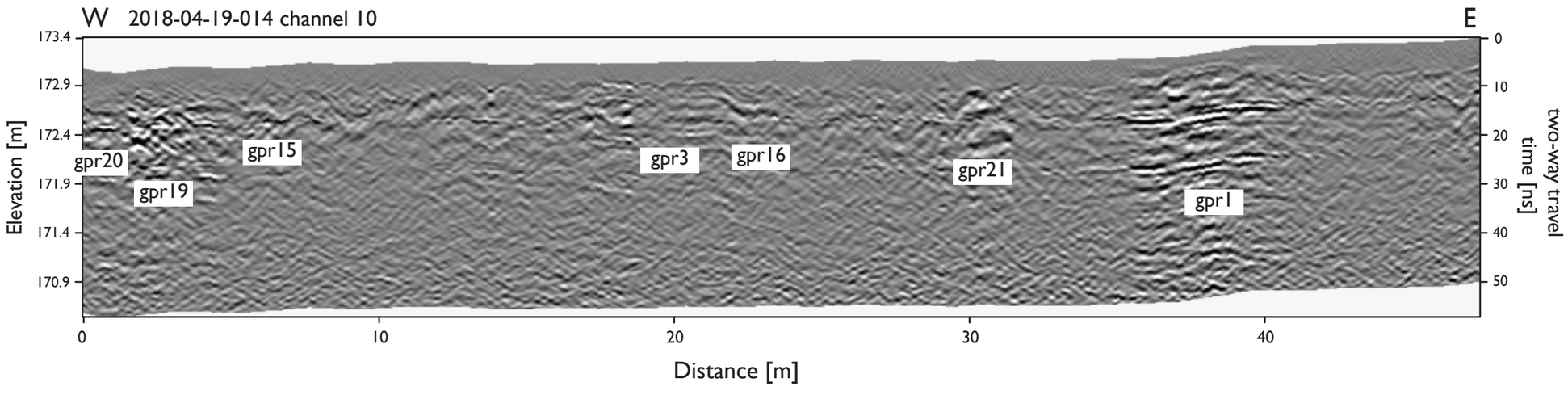
Topographically corrected GPR profiles, April 2018

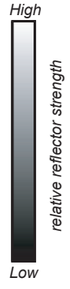












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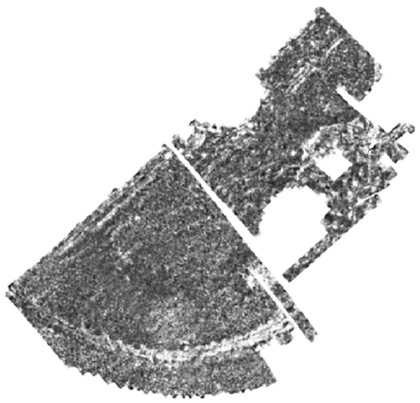
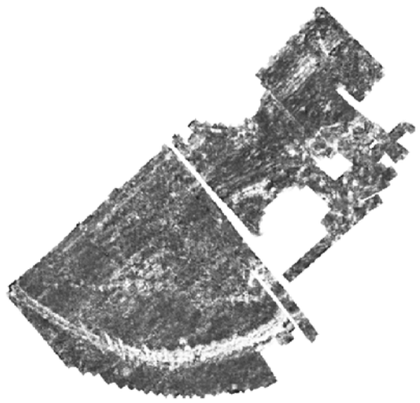
DOWN HOUSE, DOWNE, LONDON BOROUGH OF BROMLEY
GPR amplitude time slices between 0.0 - 37.5ns (0.0 - 1.91m), April 2018

Figure 11

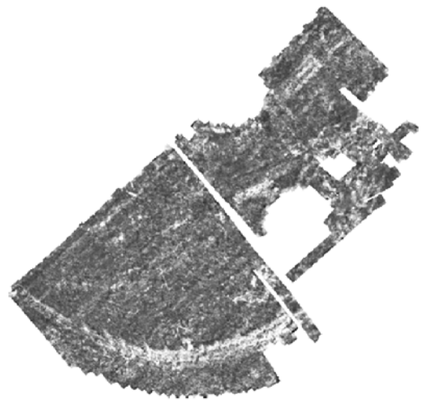
0 - 2.5ns (0.0 - 0.13m)



2.5 - 5.0ns (0.13 - 0.26m)



5.0 - 7.5ns (0.26 - 0.38m)

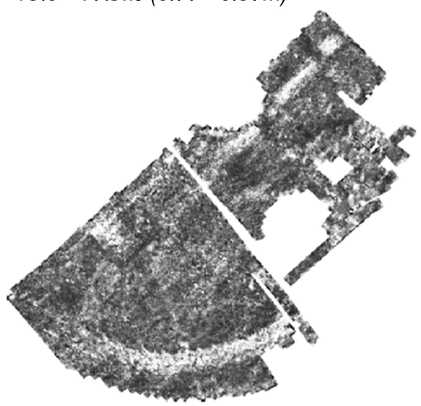


7.5 - 10.0ns (0.38 - 0.51m)

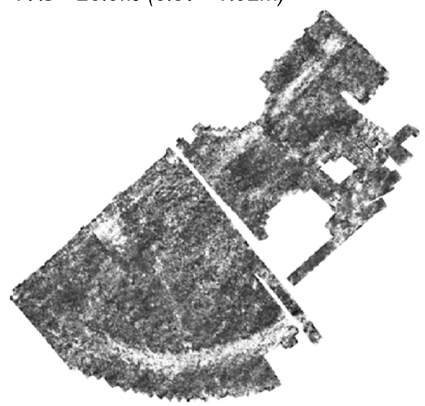
10.0 - 12.5ns (0.51 - 0.64m)

12.5 - 15.0ns (0.64 - 0.77m)

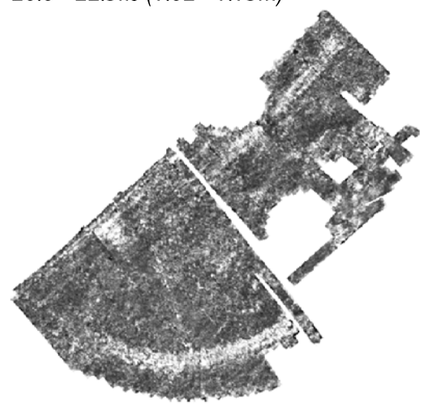
15.0 - 17.5ns (0.77 - 0.89m)



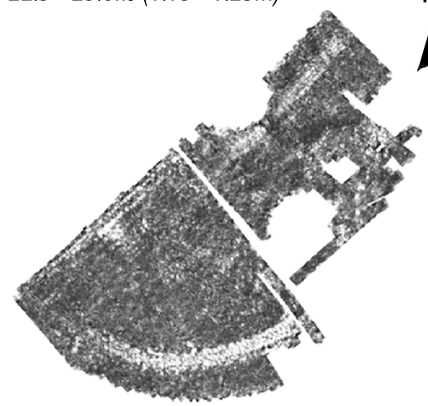
17.5 - 20.0ns (0.89 - 1.02m)



20.0 - 22.5ns (1.02 - 1.15m)

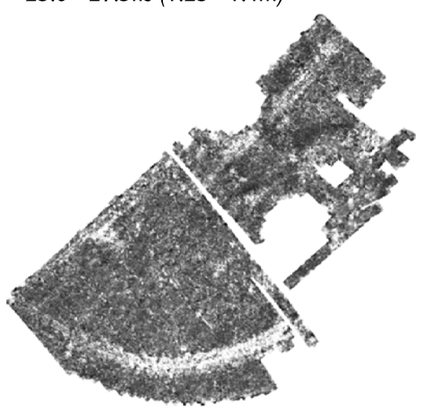


22.5 - 25.0ns (1.15 - 1.23m)



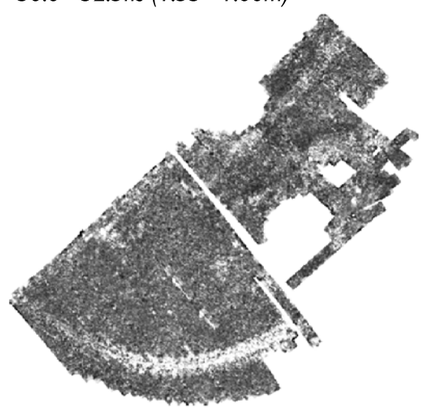
N

25.0 - 27.5ns (1.23 - 1.4m)

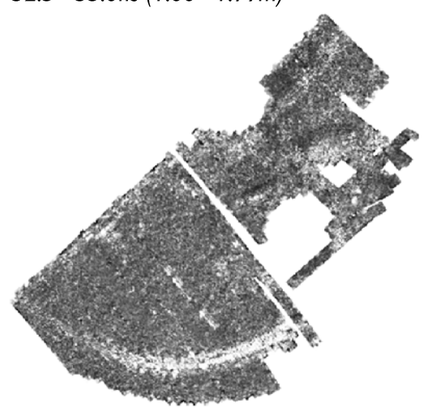


27.5 - 30.0ns (1.4 - 1.53m)

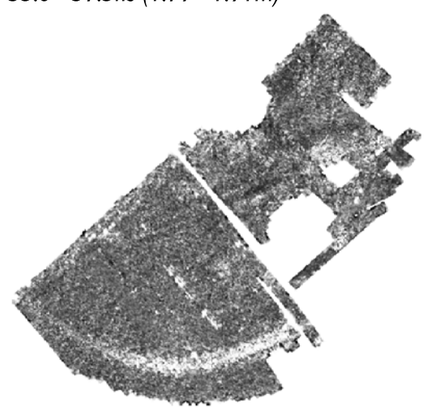
30.0 - 32.5ns (1.53 - 1.66m)



32.5 - 35.0ns (1.66 - 1.79m)



35.0 - 37.5ns (1.79 - 1.91m)



Low — *High*
relative reflector strength

0 — 60m
1:1250

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Figure 12

DOWN HOUSE, DOWNE, LONDON BOROUGH OF BROMLEY

Graphical summary of significant earth resistance anomalies, April 2018

TQ4361

N

main lawn

pigeon house

r1 r2 r3 r4 r5 r6 r7 r8 r9 r10 r11 r12 r13 r14 r15 r16 r17 r18 r19 r20 r21 r22 r23 r24 r25 r26 r27

611

431

432

0 30m

1:500

deeply buried high resistance

high resistance

low resistance

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Figure 13

DOWN HOUSE, DOWNE, LONDON BOROUGH OF BROMLEY

Graphical summary of significant magnetic anomalies, April 2018

TQ4361

N

m1

m3

m1

m5

m5

m3

m1

m2

m4

611

431

432

0 30m

1:500

positive magnetic

negative magnetic

magnetic noise

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Figure 14

DOWN HOUSE, DOWNE, LONDON BOROUGH OF BROMLEY

Graphical summary of significant GPR anomalies, April 2018

TQ4361

N

gpr6
2018-04-17-011
gpr8
gpr7
gpr10
gpr9
gpr5
gpr12
2018-04-18-014
13
14
gpr17
15
2018-04-19-002
2018-04-18-021
20
gpr13
16
gpr11
2018-04-19-014
gpr15
gpr19
gpr16
13
611
20
gpr3
gpr4
gpr2
gpr3
gpr18
gpr1
gpr21

431

432

0 30m

1:500

2018-04-19-010 Location of selected GPR profiles shown on Figure 10

low amplitude reflectors

high amplitude reflectors

anomalies of known or recent origin

Geophysics Team 2018

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