highways england

A303 Stonehenge

Amesbury to Berwick Down

Electrical Resistance Tomography and Borehole Survey Report

April 2019

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Executive Summary

This report presents the results of an Electrical Resistance Tomography (ERT) and borehole survey undertaken as part of the A303 Amesbury to Berwick Down road improvement scheme (hereafter referred to as the Scheme). The survey was undertaken in parallel with a programme of confirmatory trial trenching on land at Parsonage Down East proposed for construction of a new highway embankment and for deposition of excavated material (‘the site’).

The site had previously been included in a programme of non-intrusive archaeological geophysical survey of the entire Scheme boundary and the new road alignment had been previously evaluated by trial trenching in connection with the 2004 scheme (see the Environmental Statement submitted with the Application for Development Consent for the Scheme dated October 2018 (the ES) (paragraphs 6.6.86 – 6.6.87). The conclusions of the ES were informed by the results of that previous geophysical survey and trial trenching, allowing a robust assessment of baseline (see ES paragraphs 6.6.15 and 6.6.86 – 6.6.87), approach to mitigation (see ES Section 6.8) and likely significant effects (see ES paragraph 6.4.1 (f) and section 6.9 and tables 6.10 to 6.12: paragraph 6.9.25 refers to the previous trial trenching). The purpose of the fieldwork described in this report was to confirm the results of the previous survey and trenching and therefore the conclusions of the Environmental Statement.

The ERT survey has located a series of stratigraphic units across the site. The survey area is situated on the Winterbourne Stoke bypass north of the village and is located in the position of the proposed highway embankment across a chalk coombe. These relate to the locations of dry river valley deposits and buried soils and the results have detailed their likely thickness and distribution of deposits. The results of each transect display a consistent pattern of deposition across the coombe. There is consistently a higher resistivity band in the centre of the pseudo-sections which likely related to a flint gravel lag deposit measuring 2 m thick. Below this there is a generally homogenous lower resistivity response that likely relates to more silty/chalk-sandy/clay deposits, albeit likely containing significant stone inclusions. These deposits are thickest at the lower portion of the dry river valley in the south-east of the site (Transect 3 and 4). At the base of this there is consistently an interface between this deposit and the chalk bedrock, most likely caused by a process of weathering.

While the ERT survey has shown the general location and thickness of deposits, it is likely that subtle changes in stratigraphy have not been clearly identified within these results. However, the accompanying borehole survey goes some way towards elucidating this. A subcircular feature in Transect 4, identified as a possible pond barrow in the gradiometer survey, corresponds well with the increased thickness of colluvium (up to 3 m) recorded at that location within a borehole (BH 4), and is interpreted as a probable geological solution feature. The limitations of the survey therefore do not affect the confirmation presented in the report of the baseline conditions, assessment of effects and mitigation approach identified in the ES.

Six boreholes were drilled until structural chalk was encountered. The deposits recovered from the boreholes along the transects are typical of a chalkland valleys, with chalk rock overlain by Coombe deposits deposited as a result of freeze/thaw processes during the Pleistocene, overlain by Holocene colluvial deposits. In two coring locations (BH 5 and BH 6) a dark brown flinty silty clay soil was recorded within the Coombe deposits themselves. If *in situ*, this would be interpreted as an interstadial buried soil, most likely of Windermere

date. The clarity of the boundaries indicate that this may not be an *in situ* soil, but possibly a clay-with-flint lined dissolution pipe formed as a result of periglacial processes.

The survey evaluated in this report confirms the results of the previous survey and trenching and therefore confirms the conclusions of the Environmental Statement.

1 Introduction

1.1 Project background

1.1.1 Wessex Archaeology Ltd has been appointed as Archaeological Contractor by AECOM Mace WSP Joint Venture (AmW, the Technical Partner) on behalf of Highways England (the Employer) to undertake a programme of archaeological evaluation for the A303 Stonehenge project ('the Scheme').

1.1.2 An Archaeological Evaluation Strategy Report (AESR) [1] sets out the general and specific principles guiding the strategies for field-based investigations. An Overarching Written Scheme of Investigation (OWSI) [2] accompanying the AESR details the methods and techniques employed during the archaeological evaluation. The AESR and OWSI were approved by the Heritage Monitoring and Advisory Group (HMAG: comprising representatives of Wiltshire Council Archaeology Service, the National Trust and Historic England).

1.1.3 The requirement for and scope of the Earth Resistance Tomography (ERT) and borehole survey formed part of a Site Specific Written Scheme of Investigation (SSWSI) [3] [4] for archaeological evaluation of land north and west of Winterbourne Stoke, which detailed the aims and methodologies to be used. This guiding document was approved by Wiltshire Council Archaeology Service (WCAS) on behalf of the Local Planning Authority (LPA), as the land lies outside the Stonehenge, Avebury and Associated Sites World Heritage Site (WHS). The land is proposed for construction of a new highway embankment and for deposition of excavated material ('the site').

1.2 Scope of the document

1.2.1 The site had previously been included in a programme of non-intrusive archaeological geophysical survey of the entire Scheme boundary and the new road alignment had been previously evaluated by trial trenching in connection with the 2004 scheme. The conclusions of the ES were informed by the results of this geophysical survey and trial trenching, allowing a robust assessment of baseline (see ES paragraph 6.6.15), approach to mitigation (see ES section 6.8) and likely significant effects (see ES paragraph 6.4.1 (f) and section 6.9 and tables 6.10 to 6.12: paragraph 6.9.25 refers to the previous trial trenching). The purpose of the fieldwork described in this report was to confirm the results of the previous survey and trenching and therefore the conclusions of the Environmental Statement.

1.2.2 This document details the results of the ERT and borehole survey of the site, in accordance with the approved SSWSI. Where relevant, the report notes the limitations of the survey, the data collected and the interpretation put forward: these limitations do not affect the confirmation presented in the report of the baseline conditions, assessment of effects and mitigation approach identified in the ES.

1.2.3 The results of the archaeological evaluation trenching proposed in the SSWSI are reported separately [5].

2 Site Description

2.1 Location, topography and geology

2.1.1 The ERT and Borehole survey was undertaken within a parcel of land (survey ref. NW9a) on Parsonage Down, bounded to the south by Scotland Lodge Farm, to the east by the B3083, to the north by Cherry Lodge, and to the west by a field boundary leading onto open agricultural land on Parsonage down. The survey area ('the site') is situated north of Winterbourne Stoke on the route of the proposed bypass, encompassing a landscaped highway embankment and chalk fill area. It is located 450 m west of the village of Winterbourne Stoke, 1.8 km south of Shrewton in the county of Wiltshire (Figure 1).

2.1.2 The topography of the site is relatively complex, being located at the junction of three valleys. The most prominent of these traverses the area on a sinuous north-west to south-east alignment. A second enters the area from the south-west corner, and heads towards the centre of the field, at around 80 m above Ordnance Datum (aOD). The highest point is in the centre of the western part of the site, where there is a slight promontory at approximately 106 m aOD. There is also a rise from the centre of the area (80 m aOD) to the north-eastern part of the field (102 m aOD), with the lowest point lying in the south-east corner of the site (78 m aOD). In addition, there is a gradual slope from the eastern boundary (107 m aOD) to the north-eastern corner at 96 m aOD.

2.1.3 The solid geology comprises Cretaceous chalk of the Seaford Formation. Superficial deposits of head clay, silt, sand, and gravel, are recorded which relate closely to the topography in NW9a [5]. Two bands of this enter the area from the north-east and south-east, converging in the centre of the field and then continuing westwards towards the south-east corner.

2.1.4 The soils underlying the NW9a are likely to consist of brown rendzinas of the 343h (Andover 1) association across the north, with grey rendzinas of the 342a (Upton 1) association in the north, and humic rendzinas of the 341 (Icknield) association in the south-west. NW9b and NW9c are mostly covered by grey rendzinas of the 342a (Upton 1) association, with an area of brown rendzinas of the 343h (Andover 1) association in the west of NW9b [6]. Soils derived from such geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey.

2.2 Archaeological background

Introduction

2.2.1 A Historic Environment Baseline Assessment [7] has presented the known and potential archaeological baseline for the proposed A303 Amesbury to Berwick Down road improvement scheme. The study area for this covered a 500 m wide corridor either side of the DCO limits and considered all heritage assets up to and including the 20th century. Relevant parts of this are summarised below.

Chronology

- **Pleistocene (c. 2.6 ma – 11.7 ka)** The first of two epochs that constitute the upper, middle and lower Palaeolithic and form the Quaternary period.

- **The Holocene (c. 11.7 ka – present day)** The present epoch following the end of the last main glacial period, includes the Mesolithic and later periods referred to below.

Archaeological overview

2.2.2 The archaeological overview below is summarised from that provided in the Archaeological evaluation report for Winterbourne Stoke West [8]

- **Palaeolithic and Mesolithic** (**c. 1,000,000–4000 BC**) Evidence relating to the Palaeolithic period is particularly scarce in the Stonehenge part of the WHS and its environs. Traces of occupation become more conspicuous during the Mesolithic, though this is mostly focussed in the eastern part of the WHS.

- **Early–Middle Neolithic (c. 4000–2900 BC), Late Neolithic (c. 2900–2200 BC) and Early–Middle Bronze Age (c. 2200–1600 BC and c. 1600–1200 BC)** The traditional understanding of the Early Neolithic landscape is of woodland quickly cleared by early farmers. However, more recent evidence has led to a recognition that the landscape was more complex in terms of woodland use, clearance, regrowth, and seasonality: generally, the landscape of the Stonehenge environs is described as 'open' [9]

- **Middle–Late Bronze Age (c. 1600–1200 BC – c. 1200–700 BC), Iron Age (c. 800 BC– AD 43) and Roman (AD 43–410)** The Stonehenge landscape was transformed in the middle of the 2nd millennium BC when 'its sacred and ceremonial significance seems to have diminished sharply; a more mundane agricultural regime of farmsteads and fields took over or intensified noticeably' [10]

- **Early medieval (AD 410–1066), medieval (AD 1066–1540), Post-medieval and 20th Century (AD 1540–2000)** Traces of medieval cultivation and other forms of activity are more evident across the landscape to the west and north of Winterbourne Stoke, in contrast to within the WHS. The relative paucity of recorded archaeological evidence relating to the medieval period is likely to reflect the use of this landscape as pasture in the rural hinterland and on the periphery of nearby settlements.

Summary of the archaeological resource

2.2.3 The area covered by this survey is located 2.7 km outside of the western perimeter of the WHS. It is situated within a landscape containing nationally and regionally important multi-period archaeology. Although the site does not contain any scheduled monuments, but there is a pair of closely spaced ring ditches identified from aerial photographs and interpreted as probable round barrows. The southern one of these is noted as being incomplete. A further ring ditch has also been identified from aerial photographs, 185 m to the north-east.

2.2.4 Numerous cropmarks associated with a field system have been previously recorded across the site and the surrounding downland from aerial photographs. These are predominantly orientated on a north-south/east-west rectilinear system and are possibly associated with an extensive area of co-axial field systems and lynchets. These are likely to date from the Later Prehistoric and Roman period and may be associated with activity at the Scotland Lodge enclosure to the south. This field system was re-used in the medieval and Post-medieval periods, with traces of ridge and furrow being visible as cropmarks within some of the embanked field units.

2.2.5 In the north-eastern part of the site, an oval enclosure and numerous pits of an unknown date have also been identified by geophysical survey [11].

2.2.6 Trial trenching in 2003 [12] and more recently in 2018 [8] recorded Holocene colluvial deposits in-filling a dry valley running along part of the length of the 2003 Area J/Area 4 (which coincides with area NW9a of the current scheme, which corresponds to the northern half of NW9 containing Transects 1 to 3 on Figure 1). This broad and amorphous anomaly was also identified in the 2018 gradiometer survey (**13055**; [13]). The general sedimentary sequence across the Site included weathered chalk bedrock, periglacial calcareous coombe deposits, moderately deep deposits of largely homogeneous unbanded, silty colluvium including buried soils all overlain by a brown silty clay loam ploughsoil. The colluvial sequence appears to have accumulated over an extended period from the end of the last glacial or postglacial period, through to the medieval period and, therefore, has the potential to provide a detailed local landscape history.

Recent investigations in the area

2.2.7 A more recent gradiometer survey of the area was undertaken in April 2018 [13]. This confirmed the presence of many of the aforementioned features, including a circular and penannular feature which are thought to be associated with round barrows of probable Bronze Age origin, although it is speculated that the penannular anomaly to the south may relate to a hengiform monument and could perhaps be earlier. A further ring-ditch and a previously unidentified pond barrow have been hypothesised in the south-west of the area.

2.2.8 A small ovoid enclosure and numerous pit-like anomalies have also been identified and numerous linear anomalies associated with lynchet features and a co-axial field system also correlate with previously recorded cropmarks.

2.2.9 In addition, a broad and amorphous anomaly traverses the centre of NW9a (**13055**). This relates to a dry-river valley (aka coombe) and was subsequently targeted by the ERT and borehole survey.

2.2.10 Evaluation trenching across NW9 was undertaken between August and October of 2018 [8]. Deposit sequences in the vicinity of the borehole transects (primarily in evaluation trenches 713, 715, 718, 985 and 1223) revealed an active ploughsoil over varying depths of colluvium above Chalk bedrock. Few if any archaeological features or deposits of significance were encountered in these trenches: single tree-throw hollows were recorded in trenches 715 and 1223; a single post-hole was recorded in Trench 715; a Food Vessel containing cremated human bone from Trench 985 was the only occurrence of any significance from these trenches.

3 Methodology

3.1 Introduction

3.1.1 The ERT survey was undertaken by Wessex Archaeology's in-house geophysics team between 5th and 8th March 2018. Weather at the time of the survey was generally dry throughout, with some limited rainfall. The borehole survey was undertaken by a geotechnical ground investigation company (Ground Technology Sevices) under the guidance of a Wessex Archaeology geoarchaeologist between the 13th and 14th September 2018/

3.1.2 The ERT survey adhered to the methodology set out below, prepared in accordance with guidelines and recommendations published by Historic England [14], European Archaeological Council [15], and by the Chartered Institute for Archaeologists [16].

3.2 Aims and objectives

3.2.1 The specific aims of the ERT and borehole survey were:

- To provide information about the nature and interpretation of any anomalies identified;
- To determine the presence, absence and extent of buried archaeological features;
- To use the borehole data to interpret the geophysical results and provide information on the stratigraphic units across the site, in particular relating to the locations, thickness and distribution of deposits of potential archaeological significance, such as dry river valley deposits and buried soils; and
- To produce this interpretive report on the findings of the fieldwork and to inform the development of an archaeological mitigation strategy for the Scheme[1].

3.3 Fieldwork methodology

3.3.1 A brief description of the survey technique is provided below. Further details of the specific geophysical and survey equipment, methods and processing are described in **Appendix A - C**.

3.4 ERT Survey specification

3.4.1 The ERT data was collected using an IRIS Syscal Pro with up to 72 electrodes arranged with a spacing of 1 m between electrodes. These were positioned along a series of linear transects distributed across NW9a and were targeted at a key area where the route crosses dry valleys (coombes).

3.4.2 ERT works by injecting electrical current into the ground between a pair of electrodes and measuring the voltage between another pair. By repeating these measurements along an array of probes on the surface, and using a number of different electrode separations, it is possible to determine changes in resistivity

[1] The approach to archaeological mitigation for the Scheme is set out in section 6.8 of the ES

(Ω·m) with increasing depth. Different subsurface materials respond differently to this applied electrical current and generally, areas with high clay content are characterised by lower resistivity values, and those with low clay content, such as sands and gravel or bedrock, will be displayed as higher resistivity. However, the specific resistivity values for any material are dependent on lithology, ground-water content, and porosity.

3.4.3 Prior to the recording of ERT data points a resistance measurement (Rs check) is taken of the whole dipoles to check that all the electrodes are correctly connected and that there is good ground contact. If this indicated that the line was open (electrode not correctly connected), improvements were made to the contact resistances at the ground surface, thus reducing the collection of 'bad' data points.

3.4.4 A Leica RTK GNSS GPS instrument, which is precise to approximately 0.02 m, was used to record the position of each electrode. This GPS data was used to correct the ERT profiles for topographic changes.

3.5 Data processing

3.5.1 Data from the ERT survey were processed using the commercially available RES2DINV software to produce topographically corrected pseudo sections. Where necessary, 'bad' data points were removed in order to avoid erroneously high or low data values before the calculation of an inverted model. Such values do not represent true resistivity measurements and are usually caused by systematic or random noise due to poor ground contact.

3.5.2 An inversion process is undertaken to convert the apparent resistivity values into pseudo-sections of estimated subsurface resistivity. The inversion routine used by the RES2DINV program is an iterative process based on the smoothness-constrained least-squares method. The results of this are then plotted against the depth for each midpoint in the electrode configuration. The main advantage of this method is that the damping factor and roughness filters can be adjusted to suit different types of data.

3.5.3 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.

3.6 Borehole Survey

3.6.1 A percussive window sampling rig (Terrier type) was used to extract sleeved cores one metre in length and 100mm in diameter. The rig was operated by experienced engineers from Ground Technology Services Ltd, under the supervision of a suitably experienced member of the Wessex Archaeology geoarchaeological team.

3.6.2 The cores were split and described in the field, with selected key sequences being identified for retention. These cores were resealed and marked with site code, borehole number and sample depth, before being returned to the Wessex Archaeology laboratory at Salisbury for further investigation.

3.6.3 Interpretations were made regarding the probable depositional environments and formation processes of the sampled deposits. This data was then tabulated by borehole and depth (**Appendix C**).

3.6.4 Before drilling commenced, service plans were consulted, and all locations were scanned using a tool for detecting services. Boreholes were located after drilling using RTK GNSS GPS equipment.

3.6.5 Following the fieldwork, the deposit records obtained from the boreholes were entered into industry-standard software (Rockworks™ v17.0). From this a cross section of the deposits with a x5 vertical exaggeration was produced allowing the deposits to be examined, in order to better understand the sedimentary sequence within the dry valley and to determine the presence or absence of buried deposits or features below the colluvium.

4 Survey results and interpretation

4.1 Introduction

4.1.1 The ERT survey results are presented as a series of colour-scale pseudo-sections with annotative interpretations. These are presented at the same vertical and horizontal scale, with a vertical exaggeration of 1.5. In order to enhance the resistivity contrasts, the pseudo-sections for each profile has been assigned the same logarithmic colour scale (**Figures 2 and 3**). This is designed to enhance lower resistivity features, as well as facilitate comparison across the entire dataset. Low resistivity values are displayed as blue (c. 0 – 90 Ω·m) and high resistivity as red/purple (c. 180 – 250+ Ω·m).

4.1.2 The interpretation of the ERT dataset highlights the presence of archaeologically relevant topographic features and provides information on the identifiable stratigraphic units across the site. It also considers corroborative data provided by the results of the accompanying borehole survey which was targeted on the location of ERT Transect 4.

4.1.3 It is important to stipulate that all the depths referred to in this report are approximate levels below the current ground surface. As the ERT profile data is topographically corrected, these values are given in metres relative to the Ordnance Survey Datum (m OD).

4.1.4 It should be noted that the specific resistivity response of the ERT survey depends on moisture contrasts in the soil, and that these fluctuate depending on the time of year, weather, vegetation, etc. Excessive disturbance can also impede the ability of geophysical techniques to detect archaeology. It may therefore be the case that more features are present than it has been possible to identify through the geophysical survey.

4.2 ERT survey results and interpretation

4.2.1 A total of four ERT transects were recorded across the Site (**Figure 2**). These were located perpendicular to a broad and amorphous anomaly identified in a preceding gradiometer survey (**13055**; [13]). This relates to a dry-river valley likely to contain coombe deposits that is also very apparent as a topographic feature in the area.

4.2.2 A single ERT transect was selected for investigation by means of a borehole survey and the results of this are presented separately within this report (**Section 4.3**). For ease of comprehension, these are cross referenced within the relevant results section for the ERT survey results (Transect 4) and the implications of this are referred to within the discussion section.

4.2.3 The technique has been successful in defining different subsurface materials that may be associated with coombe deposits, as well other deposits of possible archaeological interest. In the following section, the survey results for each pseudo-section are discussed in terms of their geophysical and topographic character.

Transect 1

4.2.4 Transect 1 is located in the centre of the northern part of the Site and is the longest of the ERT profiles collected in this area, covering 108 m. It is orientated on an east-northeast – west-southwest alignment and traverses the entire breadth of the **13055**, which measures 90 m in this location. It also covers a strong dipolar anomaly which is associated with a modern service in the centre of the transect (**13064**).

4.2.5 The topography of the transect is highest in the west-southwest extent at 84.5 m aOD. It then declines gradually towards the centre of the transect, with the lowest position recorded at 80.4 m aOD. It then steadily rises again to 82.5 m aOD in the east-northeast.

4.2.6 The uppermost part of the pseudo-section for Transect 1 is visible as a relatively low resistivity response (**1a**). This measures 1 – 2 m thick and is characterised by values in the order of 50 - 100 Ω·m. It is most likely associated with a deposit of silty-clay material, although the resistivity values are slightly higher than one might expect for such a deposit. It is probable that this is due to a significant level of stone inclusions. As a significant amount of flint was visible on the surface during the survey it is probable that this is associated with a stone (flint) rich silty clay deposit.

4.2.7 Below this low resistivity response (**1a**), are two higher resistivity bands (**1b**; **1c**). These are located between 15 m and 28 m, and 40 m and 90 m along the transect. They are represented by values measuring between 100 and 150 Ω·m, which is suggestive of a concentration of resistant material such as stone. It is likely therefore that this is associated with a stony/gravel lag deposit.

4.2.8 In the central and east-northeast part of the pseudo-section, between 30 and 100 m along the transect, is an area of lower resistivity (**1d**). This is represented by values in the order of 50 - 100 Ω,m and is characteristic of a less resistant material such as silt/sand/clay. As was identified within **1a**, it is likely that there is a significant level of stone inclusions within this and it is probable that this represents colluvial material infilling the dry river valley.

4.2.9 On the west-southwest side of Transect 1 there is a moderately high resistivity response which is between 100 – 130 Ω,m. This is attributable to the edge of the coombe deposit and is most likely associated with chalk bedrock (**1e**). The slightly lower resistivity response on this edge may suggest that there is an interface of more weathered chalk, but this is quite poorly defined.

4.2.10 At the centre and lower part of the pseudo-section there is a further area of moderately higher resistivity (**1f**). This gradually increases with depth from 100 Ω,m to around 120 Ω,m. This is thought to be associated with the base of the dry river valley at around 75 m aOD and is associated with chalk bedrock. Again, the slightly lower resistivity values (110 Ω,m) may relate to a weathered chalk interface at the base of this feature.

Transect 2

4.2.11 Transect 2 is situated south-west of Transect 1, west of the centre of NW9a. It is orientated on northwest – southeast alignment and extends for a total distance 89 m. It covers part of a south-easterly offshoot of the amorphous anomaly identified in gradiometer survey (**13055**), which measures 52 m wide in this location. The feature is quite well defined in the gradiometer survey but loses clarity towards the north-west where it likely joins with the main branch of the dry river valley.

4.2.12 The topographic profile of the transect is relatively gentle, but rises from the centre towards both the northwest and southeast. The highest recorded position is the southeast-most point at 84.2 m aOD, with the northwest peak at 83.7 m aOD. The lowest point is approximately in the centre of the profile at 81.7 m aOD.

4.2.13 In contrast to Transect 1, within the uppermost part of the pseudo-section for Transect 2, there is no clearly defined band of low resistivity response above the band of more resistant material (**2a**). Whilst there is certainly an amount of ploughsoil within this area, this may suggest that it is of limited depth in this area. Despite this, there is a very poorly defined distinction identifiable between the upper and lower deposit to the northwest and southeast of this at **2b** and **2c**.

4.2.14 The moderately high resistivity band is visible in the centre of the pseudo-section between 15 and 55 m (**2a**). This is represented by recorded values between 100 and 140 Ω·m. It is likely associated with a concentration of resistant material such as stone and probably relates to a stony/gravel lag deposit within the coombe.

4.2.15 Below this and in the centre of the pseudo-section, between 15 and 80 m along the transect, is an area of lower resistivity (**2d**). This is represented by values in the order of 50 - 100 Ω,m and is characteristic of a less resistant material such as silt/sand/clay. This is approximately 4 m thick and is visible between 77 and 81 m aOD. Given the slightly higher than anticipated values, it is likely that there is a significant level of stone inclusions within this and it is probable that this represents colluvial material infilling the dry river valley.

4.2.16 Below **2d** is an area of moderately higher resistivity (**2e**). This gradually increases with depth from 100 Ω,m to around 140 Ω,m. It is thought to be associated with the base of the dry river valley at around 76 m aOD. The slightly lower resistivity values in the upper part of this (110 Ω,m) also suggest that there may be a weathered chalk interface between the chalk bedrock and the coombe deposits.

Transect 3

4.2.17 This transect is located 275 m south-east of Transect 1 and is positioned on the same northeast – west-southwest orientation. It extends for 88 m and is also targeted on the main branch of the dry river valley feature (**13055**). This is quite poorly defined in this area of the gradiometer survey, but faintly visible as a weak, 83 m wide anomaly. In the centre of this is a continuation of the modern service which is identifiable as a strong dipolar response (**13064**).

4.2.18 The topography of the transect is highest in the west-southwest extent at 79.5 m aOD. It then declines gradually towards the east-northeast. The profile plateaus slightly in the centre with a consistently low position of 77.5 m aOD recorded for a distance of around 10 m. It then rises gradually to 79.1 m aOD in the east-northeast.

4.2.19 Within the uppermost part of the pseudo-section for Transect 3, there is a high resistivity response (**3a**). This is located between 33 and 77 m along the profile and is characterised by readings in the order of 110 – 220 Ω·m. This is notably higher than was identified in Transect 1 and 2, which may suggest that a more concentrated band of resistant material may be present in this part of the feature.

4.2.20 To the east-northeast and west-southwest of this, there are poorly defined areas of lower resistivity either side of **3a**. These are most likely associated with a deposit of silty-clay material within the upper part of the coombe (**3b**; **3c**).

4.2.21 Below this and in the centre of the pseudo-section, between 20 and 75 m along the transect, is an area of lower resistivity (**3d**). This is represented by values in the order of 50 - 100 Ω,m and is characteristic of a less resistant material such as silt/sand/clay. This is approximately 5-6 m thick and is visible between 75 and 69 m aOD. Although this is defined as being predominantly low resistivity, it is likely that there is a significant level of stone inclusions within this. It is notably thicker than similar deposits identified in Transect 1 and 2, which likely suggest that these deposits are increasing in depth as the feature descends down the river valley towards the south-east.

4.2.22 At the base of the pseudo-section, there are two areas of higher resistivity (**3e**; **3f**). These are located on either side of **3d** and are represented by values ranging from 110 – 180 Ω,m, with that in the east-northeast being more consistently higher resistivity (**3f**). Both these responses are thought to be associated with chalk bedrock at the base of the dry river valley around 69 – 68 m aOD. The gap in the centre between these may suggest that the base of the coombe feature extends beyond the depth achieved by this survey.

Transect 4

4.2.23 Transect 4 is the shortest recorded profile measuring 72 m in length. It is also the only ERT transect to be accompanied by a purposeful borehole survey and the salient results of this will be combined within the subsequent discussion and are presented within **Figure 3**.

4.2.24 This transect is located in the south-eastern corner of NW9a and is located over part of the dry river valley anomaly (**13055**), which has curved towards a more easterly trajectory at this location. The southern boundary of the dry river valley anomaly is not clearly identifiable within the gradiometer survey due to the presence of a modern field boundary and track.

4.2.25 Within this part of the gradiometer survey, the response of the dry river valley feature is also slightly more variable and complex, with numerous weakly positive and negative elements visible. In addition, a sub-circular feature was hypothesised as a possible Bronze Age pond barrow on the northern edge of the feature (**13003**). This is visible in the gradiometer survey as a circular negative response containing a central positive anomaly that is likely associated with a large depression or pit. This has not been previously identified within the WSHER and it is equally possible that this represents a geological solution hollow.

4.2.26 The topographic profile of Transect 4 declines from the north to the south, with the highest recorded position at 78.5 m aOD. The base of the southern part of the profile plateaus around 76 m aOD, but inclines again into the adjacent field to the south.

4.2.27 Across the entirety of the uppermost part of the pseudo-section for Transect 4 is a relatively low resistivity response (**4a**). This measures 1 – 2 m thick and is characterised by values in the order of 50 - 100 Ω·m. It is most likely associated with a deposit of silty-clay material, most likely attributable to a thick ploughsoil and subsoil.

4.2.28 At the northern end of Transect 4, there is a slightly thicker band of low resistivity at **4b**. This is located between 50 and 63 m along the profile and is likely associated with an increased depth of silty-clay material. This corresponds with the location of a hypothesised possible Bronze Age pond barrow and could therefore be associated with such a feature. However, as has been previously alluded to, it is not possible to distinguish this from a geological solution hollow based on these results alone. The borehole survey (Borehole 2) suggests there is a significant depth of light brown friable chalk-sandy clay to a depth of 3.6 m below the ground surface. The borehole survey identified the chalk-sandy clay as predominantly colluvium, having been mobilised by agricultural activity further up slope then transported down slope by colluvial processes such as slope wash.

4.2.29 Within the central and southern part of Transect 4 there is a high resistivity band recorded between 0 and 42 m (**4c**). This measures approximately 2 – 3 m thick and extends to a maximum depth of 72 m aOD. The recorded values associated with this measure between 120 – 250 Ω·m. It is most likely associated with a deposit of resistant stone-rich material such as flint gravel and may be associated with lag deposits associated with the dry river valley. Within the borehole survey deposits containing abundant flint, up to 90% of the composition within Borehole 5, were located within a similar depth range.

4.2.30 Below this there is a relatively thick band of lower resistivity that is visible across the pseudo-section. This is characterised by values in the order of 110 Ω·m, which is consistent with a silty/chalk-sandy/clay material. This is slightly higher than the values recorded within deposits at a similar depth within Transects 1 – 3. This suggests that the deposits at the lower (south-eastern) part of the dry river valley are characterised by colluvial deposits with more abundant stone (flint/chalk) inclusions. They are also slightly thicker, being up to 5 m deep (at 67 m aOD). Such deposits are consistent with those recorded within the borehole survey.

4.2.31 At the very base, and along the northern edge of the pseudo-section there is a very subtle increase in resistivity values. This is between 100 and 130 Ω·m and is most likely associated with a slightly more resistant material. It is probable that this is associated with chalk bedrock at the base of the coombe. While this is not immediately apparent from the ERT survey alone, the accompanying borehole survey confirms this to be the case.

4.2.32 In the western part of Transect 4 there is no higher resistance response corresponding with the southern edge of the dry river-valley. This suggests that it has not been reached within the depth achieved by this survey and likely extends further to the south into the adjacent field. Such an interpretation is supported by the fact that the topography increases sharply beyond the field's extent.

4.3 Borehole survey results and interpretation

4.3.1 The borehole survey consisted of six boreholes (BH) drilled along a 68 m transect orientated north to south along the line of ERT Transect 4. The transect was located in the south-eastern corner of NW9a and located over part of the dry river valley anomaly (**13055**), which runs west to east at this location.

4.3.2 The transect was located on the lower slopes of the dry valley or coombe with BH1 at the northern end of the transect located at 78.61 m aOD and BH6 at the lower southern end located at 75.88 m aOD.

4.3.3 All boreholes were drilled until structural bedrock was encountered.

4.3.4 One of the archaeological evaluation trenches (**715**) [8] was located between 5m and 15m to the east of the borehole transect and ERT transect 4, running north northwest to south southeast. The deposits exposed within the section of trench **715** [8] were recorded as 0.3m of dark grey silty clay plough soil over 0.31m of light brown sandy silty loam over off-white chalk with occasional sub-rounded flint nodules. The above description is broadly commensurate with the topsoil/ploughsoil, B horizon and upper part of the Holocene colluvium described below.

4.3.5 The general sequence of deposits encountered and recorded in the borehole survey was as follows:

- <u>Topsoil/ploughsoil</u>: this was comprised of a medium brown dry silty clay loam with a granular blocky structure, common small sub-angular (SA) flint and chalk inclusions, and a clear/gradual lower boundary.

- <u>B horizon (subsoil)</u>: this was a light brown friable chalk-sandy silty clay with a blocky structure, frequent SA small flint and chalk inclusions and a clear/gradual lower boundary.

- <u>Lag deposit</u>: this was comprised of large flint inclusions in a brown silty/chalk-sandy clay matrix. It was only recorded in two boreholes (BH2 and BH5) and represents the coarser element of a colluvial deposit that has remained, whilst finer material has been washed away.

- <u>Holocene colluvium</u>: this was encountered in all boreholes and was typically comprised of a light brown poorly sorted friable silty/chalk-sandy clay. Often with an increase in chalk gravels with depth.

- <u>Possible buried </u>soil: this was recorded sandwiched within soliflucted chalk deposits within two boreholes (BH5 and BH6) and was recorded as a compact dark brown flinty silty clay with a granular/blocky structure. However, particularly in BH6, the lower boundary of the soil in both boreholes was sharp to clear and distinctive and not gradual or diffuse as seen in more typical soil profiles. The clarity of the boundaries indicate that this may not be an *in situ* soil (which would be of probable Windermere Interstadial date), but possibly a clay-with-flint lined dissolution pipe formed as a result of periglacial processes.

- <u>Structureless chalk deposits (Coombe chalk)</u>: this was encountered in all boreholes at depths below the ground surface ranging from 1.8 m in BH1 to 4.0 m in BH2.

- Structural chalk: this consisted of the *in situ* cretaceous chalk bedrock.

5 Discussion

5.1 ERT survey

5.1.1 The ERT survey has located a series of stratigraphic units across the site. These relate to the locations of dry river valley deposits and buried soils and the results have detailed their likely thickness and the distribution of deposits.

5.1.2 The results of each transect display a consistent pattern of deposition across the coombe. There is consistently a higher resistivity band in the centre of the pseudo-sections which likely related to a flint gravel lag deposits measuring 2 m thick. Below this there is a generally homogenous lower resistivity response that likely relates to more silty/chalk-sandy/clay deposits, albeit also containing flint gravel inclusions. These deposits are thickest at the lower portion of the dry river valley in the south-east of the site (Transect 3 and 4). At the base of this there is consistently an interface between this deposit and the chalk bedrock, most likely caused by a process of weathering.

5.1.3 While the ERT survey has shown the general location and thickness of deposits, it is likely that subtle changes in stratigraphy have not been clearly identified within these results. However, the accompanying borehole survey goes some way towards elucidating this. The limitations of the survey therefore do not affect the confirmation presented in the report of the baseline conditions, assessment of effects and mitigation approach identified in the ES.

5.1.4 Two of the ERT transects (Transects 1 and 3) are located over a modern service, which was previously identified in the gradiometer survey. This fuel pipeline is not visible in the ERT survey data.

5.2 Borehole survey

5.2.1 The results of the borehole survey show that a typical sequence of superficial deposits overlie the solid chalk bedrock, with Pleistocene periglacial coombe deposits (up to 1.7 m thick) being overlain by Holocene colluvium of generally 1.5-2 m thickness, with 3 m being recorded within a probable solution feature in BH2. Of particular interest is a possible Interstadial buried soil within the periglacial deposits.

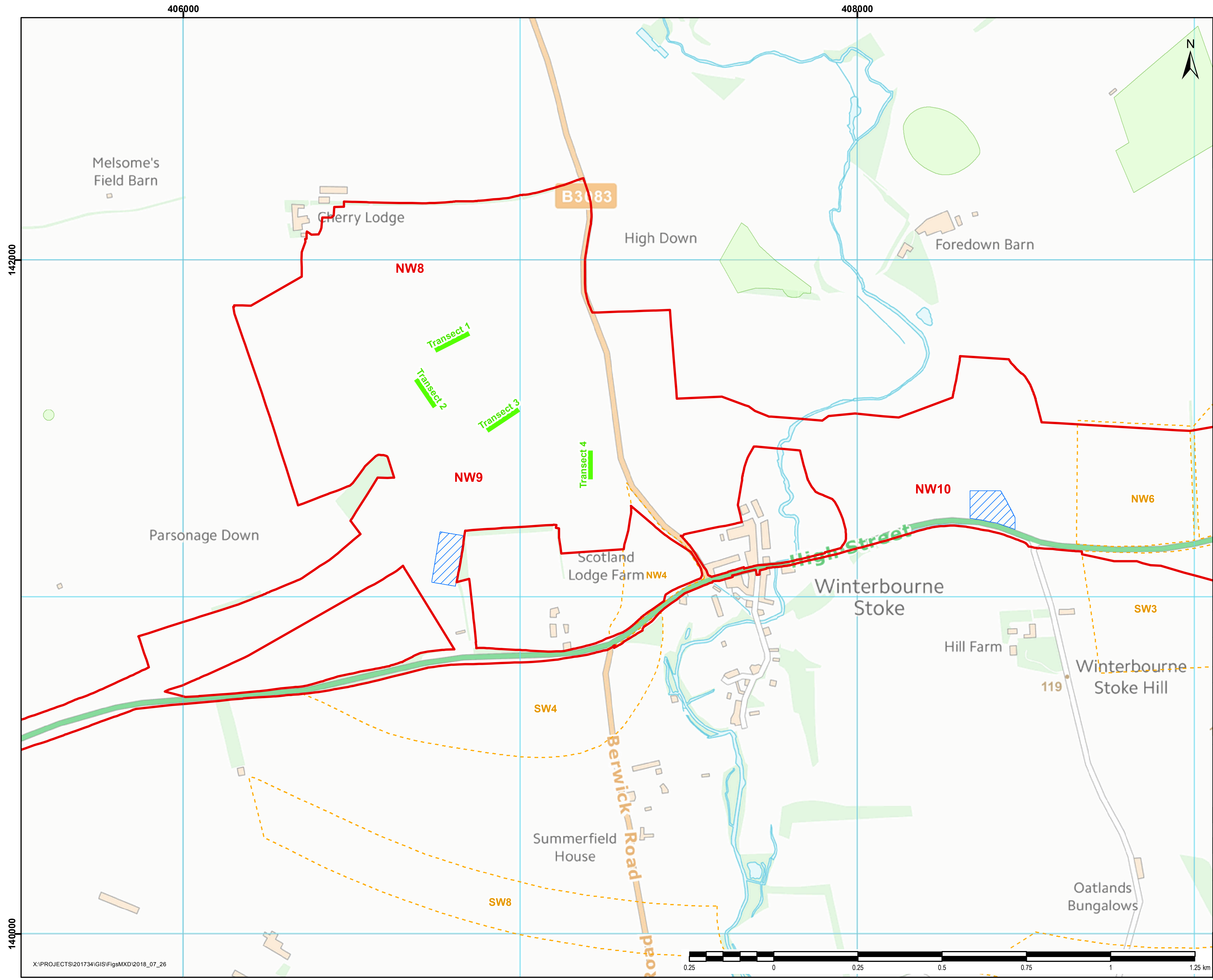
5.2.2 The soil deposits interpreted as a buried soil were recorded in two of the boreholes (BH5 and BH6) and located towards the top of the periglacial coombe deposits, close to the boundary with the overlying Holocene colluvium. The soil was well developed and thick (up to 0.37 m thick in BH5) and if *in situ* may have developed within the Windermere interstadial, a period where evidence of human activity may be represented, before being buried by soliflucted chalk deposits after a return to periglacial conditions. However, the clarity of the boundaries indicate that this may not be an *in situ* soil, but possibly a clay-with-flint lined dissolution pipe formed as a result of periglacial processes.

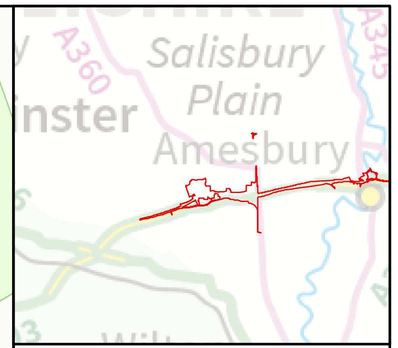
5.3 Conclusions

5.3.1 In conclusion, the combination of ERT and targeted borehole survey has been successful in fulfilling the overarching aims for the evaluation programme. It has helped confirm the extent and character of the dry river valley (coombe) and the likely distribution of deposits of potential archaeological significance, and therefore the approach to archaeological mitigation for the Scheme.

5.3.2 In summary, then, the survey evaluated in this report confirms the results of the previous survey and trenching and therefore confirms the conclusions of the Environmental Statement.

Figures





NOTES / LEGEND

- DCO boundary
- GPR Survey Area
- Previous Survey Area
- Scheduled Monument
- ERT Transects

Revision Details	By / Check	Date	Suffix

Purpose of issue

Client
Highways England

Working on behalf of highways england

Project Title

A303 AMESBURY TO BERWICK DOWN

Drawing Title

ERT AND BOREHOLE SURVEY

FIGURE 1

SITE AND TRANSECT LOCATIONS

Designed	Drawn	Checked	Approved	Date
RM	RM			15/03/2019

Internal Project No. 201734

Scale @ A3 1:10,000 | Zone

Highways England
Temple Quay House
2 Temple Quay
Bristol
BS1 6PN

AmW
AECOM + mace + WSP

Drawing Number
Highways England PIN | Originator | Volume | Rev
Location | Type | Role | 1 | Number

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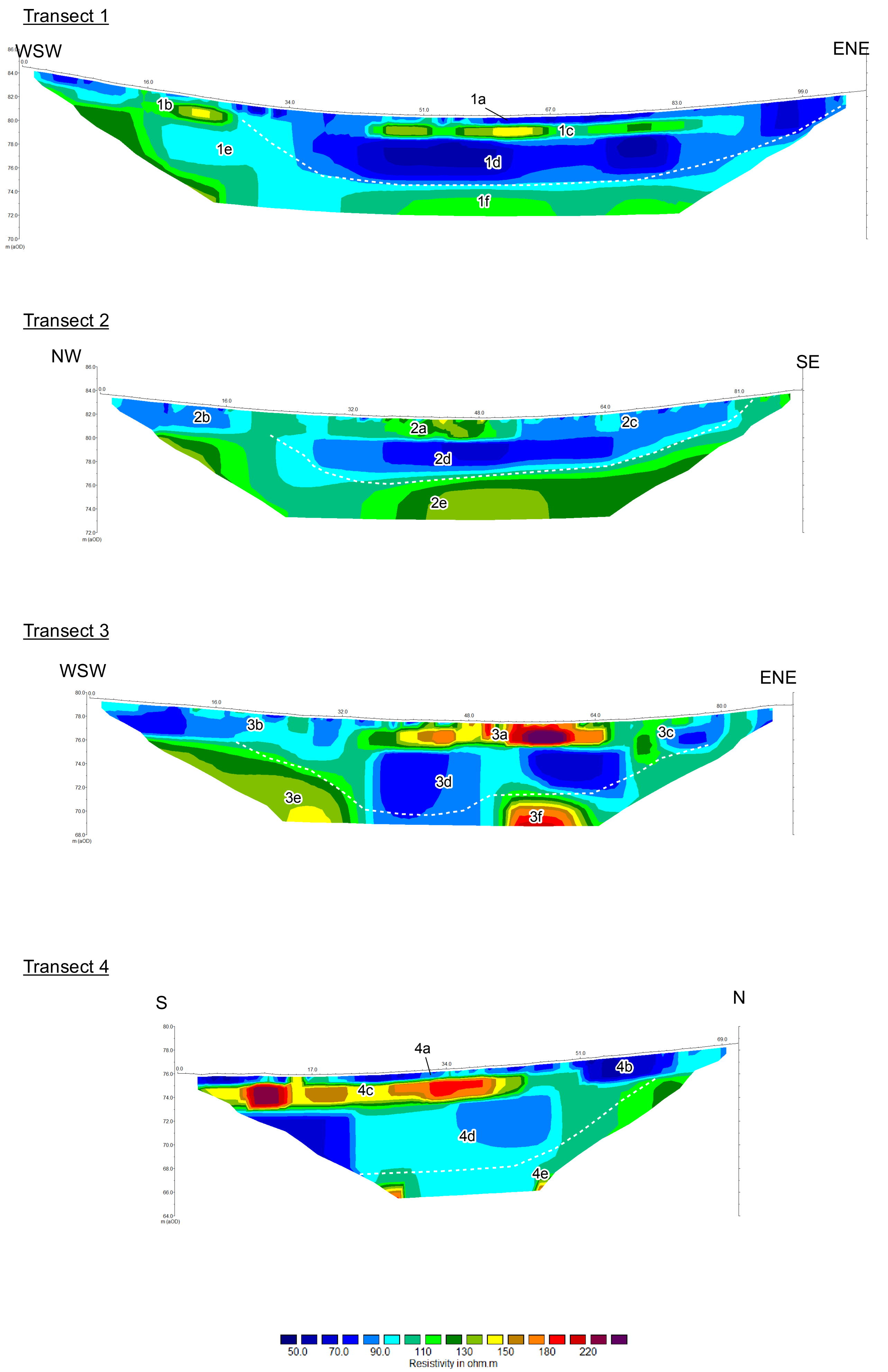

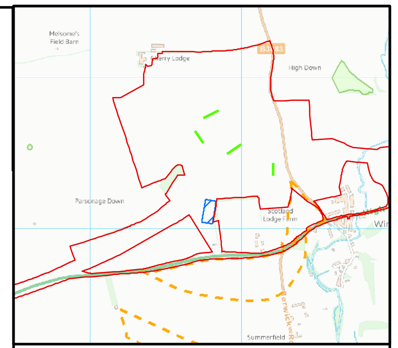

DCO boundary

ERT Transects

OS Basemapping:
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Revision Details	By / Check	Date	Suffix

Purpose of issue

Client
Highways England

Working on behalf of highways england

Project Title

A303 Amesbury to Berwick Down

Drawing Title

ERT AND BOREHOLE SURVEY

FIGURE 1

ERT SURVEY RESULTS

Designed	Drawn	Checked	Approved	Date
NLC	NLC			15/03/2019

Internal Project No. 201738

Scale @ A3 1:5,000 | Zone

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2 Temple Quay
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AmW
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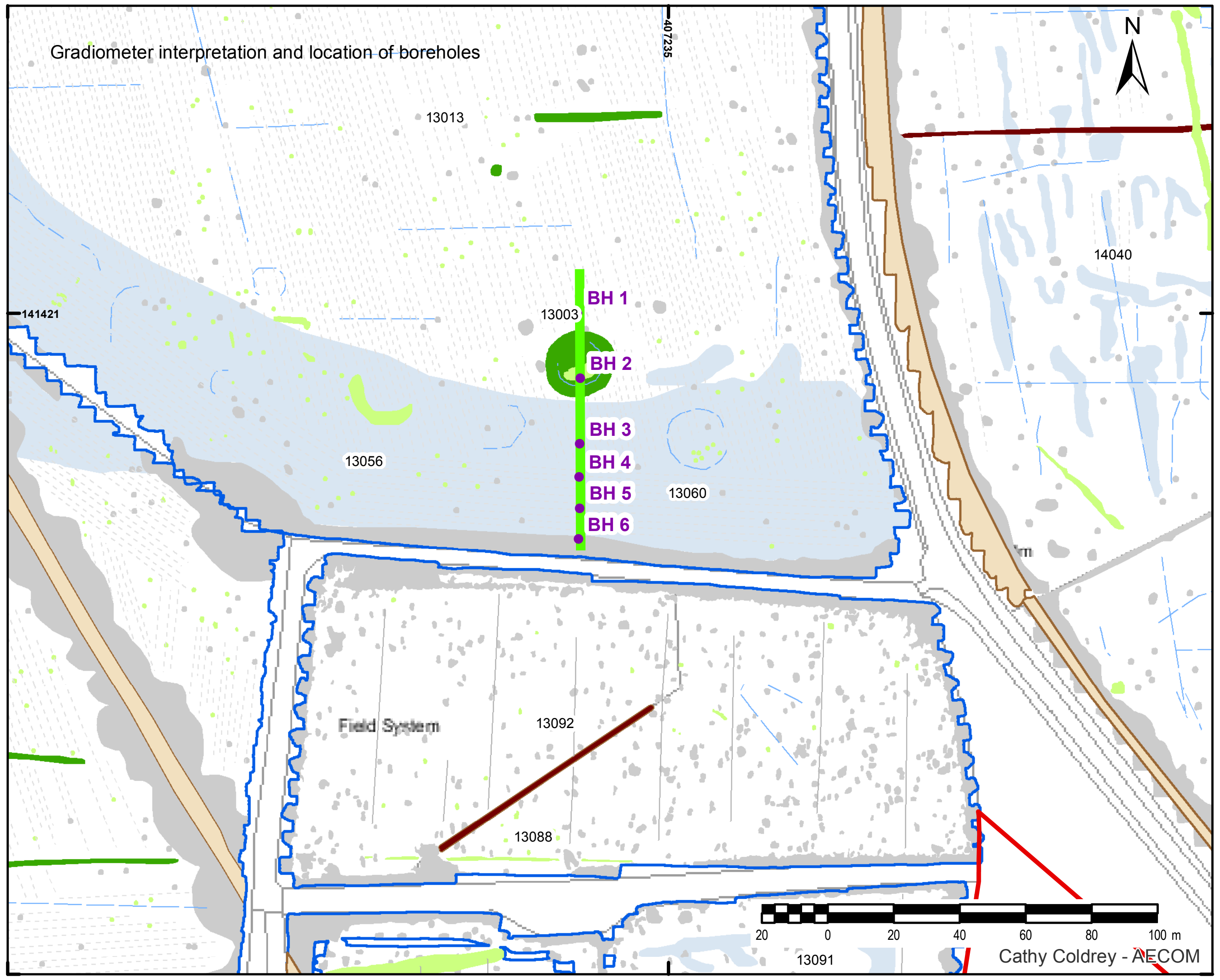
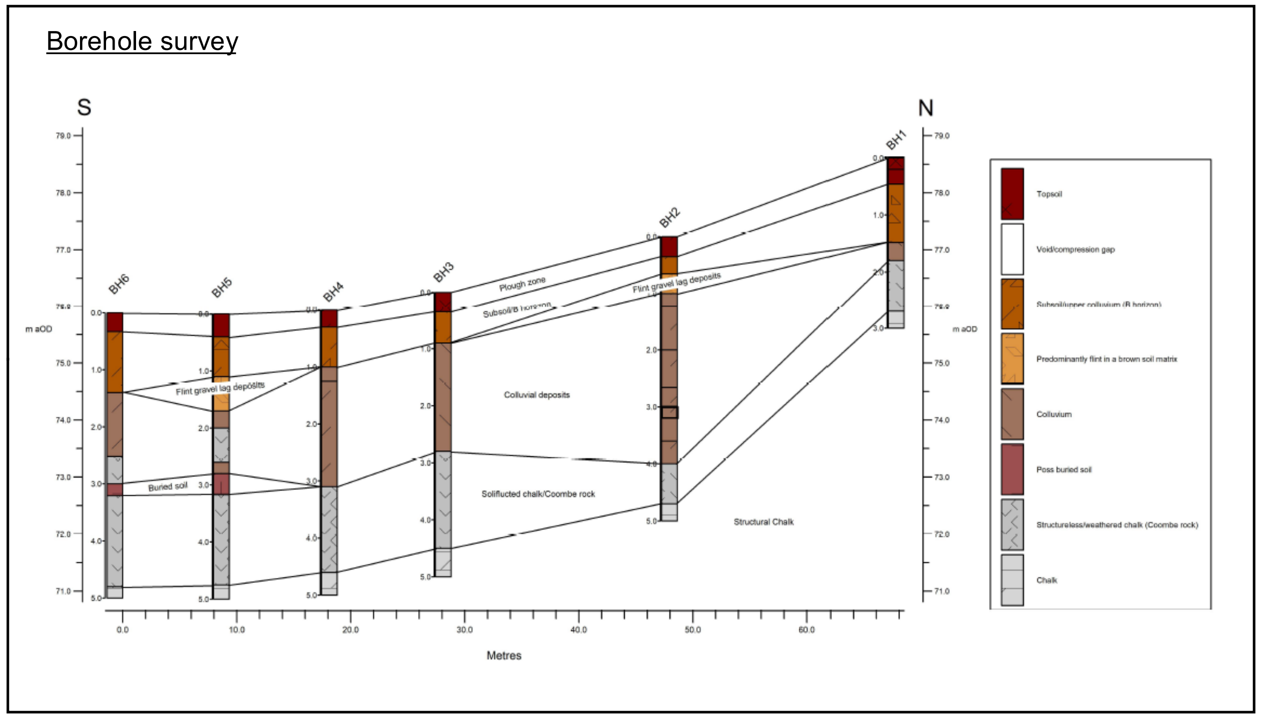
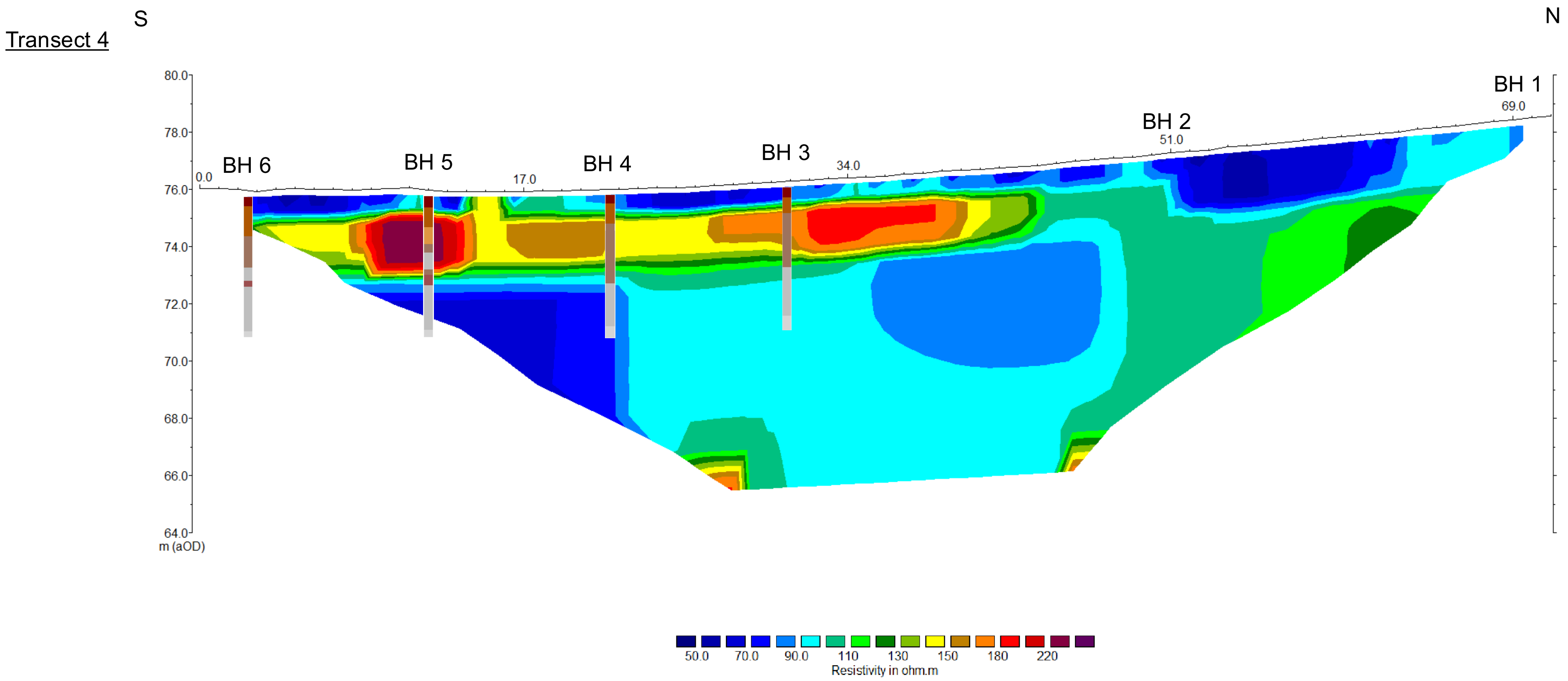
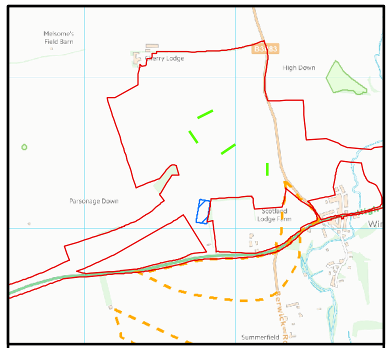
Drawing Number
Highways England PIN | Originator | Volume | Rev
Location | Type | Role | Number









DCO boundary

ERT Transects

Detailed survey extent

Revision Details	By / Check	Date	Suffix

Purpose of issue

Client
Highways England

Working on behalf of highways england

Project Title

A303 Amesbury to Berwick Down

Drawing Title

ERT AND BOREHOLE SURVEY

FIGURE 1

ERT SURVEY RESULTS

Designed	Drawn	Checked	Approved	Date
NLC	NLC			15/03/2019

Internal Project No. 201738

Scale @ A3 1:2,000 | Zone

Highways England
Temple Quay House
2 Temple Quay
Bristol
BS1 6PN

AmW
AECOM + mace + WSP

Drawing Number
Highways England PIN | Originator | Volume
Location | Type | Role | Number
Rev

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Abbreviations List

AESR	Archaeological Evaluation Strategy Report
AmW	AECOM, Mace, WSP Joint Venture
DCO	Development Consent Order
EIA	Environmental Impact Assessment
ERT	Electrical Resistance Tomography
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HIA	Historic Impact Assessment
HMAG	Heritage Monitoring and Advisory Group
OS	Ordnance Survey
OUV	Outstanding Universal Value
OWSI	Overarching Written Scheme of Investigation
RTK	Real-Time Kinematic
WA	Wessex Archaeology
WCAS	Wiltshire County Archaeology Service
WHS	World Heritage Site
WSHER	Wiltshire and Swindon Historic Environment Record

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Appendices

Appendix A ERT Survey Equipment and Data processing

A.1 Survey methods and equipment

5.3.4 ERT data were acquired using an IRIS Syscal Pro with up to 72 electrodes arranged with a spacing of 2.5 m between electrodes. The system uses four of these electrodes at a time to measure each reading. By varying the position and separation of the four electrodes used, the position along each transect and the depth of the reading can be controlled. A series of roll-along sequences was created prior to the commencement of the survey using ElectrePro software, which was then uploaded onto the switch console. This then runs through the sequence(s), automatically switching between probes used. Readings are logged automatically on the Prosys Switch system and then downloaded to a computer for processing.

5.3.5 Readings are taken by passing an electrical current through the ground and measuring the resistivity within the path the current takes. The electrical resistivity of the earth is dependent partly upon the chemical and geological composition of the soils and the geometry of the electrode array used but also largely upon the soil moisture content. Wet, briny environments will typically exhibit low electrical resistivity, whereas dry sands will exhibit high resistivity. Very low resistivity values can also be obtained where a large conductive structure such as a steel pipe or a reinforced concrete structure is present.

5.3.6 Typical ERT surveys consist of the collection of a series of linear transects with electrodes spaced at regular intervals along the line. The type of array, the number of electrodes used and the separation between them dictates the maximum depth of investigation of the survey. The array used is determined by the application and requirements of the site. If transects are collected on a regular grid the individual 2D transects can be combined and processed to give a 3D output although it is recommended that 3D ERT data is collected from a grid of electrodes using appropriate equipment rather than collecting individual 2D transects.

5.3.7 A number of standard arrays are available for use in an ERT survey, including Wenner alpha, Wenner beta, Wenner gamma, dipole-dipole, Wenner-Schlumberger, pole-pole, and pole-dipole. The array selection is important as the array chosen can dictate the form of the anomaly in the data, signal strength, the depth of investigation, horizontal data coverage and the sensitivity of the array to vertical and horizontal changes in the subsurface resistivity. For full 3D surveys the use of either the pole-pole, pole-dipole or dipole-dipole arrays is recommended as other arrays have poorer data coverage near the edges of the survey grid. It should be noted that it is possible to use other arrays for 3D surveys.

5.3.8 The Wenner alpha array is most commonly used by Wessex Archaeology as it is a robust array that is sensitive to vertical changes in the subsurface resistivity and has the highest signal to noise ratio compared to the other main arrays. The one drawback to this array that it is less sensitive to horizontal changes and this sensitivity drops as the electrode separation is increased.

A.2 Post-Processing

5.3.9 The ERT data collected during the survey are downloaded from the ERT system using ImagerPro 2006, then processed and analysed using commercial software (RES2DINV). This software allows for the inversion of the collected 2D transects in isolation and the inversion of several 2D transects collected in a regular grid at the same time. The software uses the least-squares and smoothness-constrained least-squared inversion methods. The parameters of the particular inversion can be altered to suit the data being processed more closely and can also incorporate topographic data during the inversion process. The inversion process creates a model and calculates the resistivity values that would have been recorded over it from this model. By comparing the model data with the field data, an error value can be calculated, and the software goes through a number of iterations to minimise this error by altering the modelled values. A more detailed description of the different variations of the smoothness-constrained least-squares method can be found in Loke (2016 [17]).

5.3.10 Typical inversion parameters that may be altered include:

- Robust inversion – This option is typically used where sharp boundaries exist between subsurface bodies that would be smeared by the standard least-squares inversion method. The robust model constrain inversion method minimises the absolute changes in the resistivity values producing models with sharp interfaces;
- Smoothing of model resistivity values – This is used for particularly noisy data sets where the smoothness constraint used in the standard least-squares inversion method is not sufficient on its own.

5.3.11 Typical displays of the data used during processing and analysis:

- 3D Output – Outputs of 3D models generated in the Rockworks software package;
- 2D Vertical Pseudo-Section – Presents each ERT transect in a vertical view with distance along the profile expressed along the x axis and depth along the y axis. Topography data can be displayed along with the inverted data. The varying resistivity is expressed using a colour scale;
- 2D Horizontal Pseudo-Slice – Presents the data as a series of successive plan views of the variation in resistivity from the surface to the deepest inversion layer. The variation in resistivity is represented using a colour scale.

Appendix B Borehole logs

Location:	407207.06 141421.1	Borehole ID:	BH 1	Comments: 201738 Winterbourne Stoke Bypass	
Level (top):	78.61m aOD	Drg:			

Depth		Sediment description	Interpretation	Unit
Mbg	mOD			
0 – 0.2	78.61 – 78.41	Void	compression gap	
0.2 – 0.46	78.41 – 78.15	Medium brown dry silty clay loam, granular blocky structure, common small SA flint and chalk inclusions. Clear/gradua lower boundary.	Plough soil	
0.46 – 1.48	78.15 – 77.13	Light brown friable chalk-sandy silty clay, blocky structure, frequent SA small flint and chalk inclusions.	Colluvium	
1.48 – 1.8	77.13 – 76.81	Very light brown compact silty clay matrix containing abundant chalk gravels (50%)		
1.8 – 2.7	76.81 – 75.91	Light grey/white structureless chalk	Coombe chalk	
2.7 – 3.0	75.91 – 75.61	Structural chalk	Bedrock	

Location:		**407207.83** **141401.33**	**Borehole ID:**	**BH 2**	**Comments: 201738** **Winterbourne Stoke Bypass**	
Level (top):		**77.23m aOD**	**Drg:**			
Depth		**Sediment description**			**Interpretation**	**Unit**
Mbg	**mOD**					
0 – 0.35	77.23 – 76.88	Medium brown dry silty clay loam, granular blocky structure, common small SA flint and chalk inclusions. Clear lower boundary			Plough soil.	
0.35 – 0.65	76.88 – 76.58	Light brown dry silty clay loam, blocky structure, clear lower boundary			B horizon	
0.65 – 1.0	76.58 – 76.23	Abundant large flints in a brown soil matrix			Lag deposit	
1.0 – 1.22	76.23 – 76.01	Void			compression gap	
1.22 – 1.53	76.01 – 75.7	Light brown friable chalk-sandy silty clay, blocky structure, frequent SA small flint and chalk inclusions.			Colluvium	
1.53 – 2.0	75.7 – 75.23	Light brown friable chalk-sandy clay, blocky structure, frequent SA small flint and chalk inclusions.				
2.0 – 2.66	75.23 – 74.57	Void			compression gap	
2.66 – 3.0	74.57 – 74.23	Light brown friable chalk-sandy clay, blocky structure, frequent SA small flint and chalk inclusions. Chalk and flint inclusions, increasing in size and quantity with depth.			Colluvium	
3.0 – 3.2	74.23 – 74.03	Void			compression gap	
3.2 – 3.6	74.03 – 73.63	Light brown friable chalk-sandy clay becoming lighter with depth, blocky structure, frequent SA small flint and chalk inclusions increasing in size and frequency with depth.			Colluvium	
3.6 – 4.0	73.63 – 73.23	Very light brown compact silty clay matrix containing abundant chalk gravels (50%)				
4.0 – 4.7	73.23 – 72.53	Light grey/white structureless chalk			Coombe chalk	
4.7 – 5.0	72.53 – 72.23	Structural chalk			bedrock	

Location:	407207.74 141381.51	Borehole ID:	BH 3	Comments: 201738 Winterbourne Stoke Bypass
Level (top):	76.25m aOD	Drg:		

Depth		Sediment description	Interpretation	Unit
Mbg	mOD			
0 – 0.35	76.25 – 75.9	Medium brown dry silty clay loam, granular blocky structure, common small SA flint and chalk inclusions. Clear lower boundary.	Plough soil	
0.35 – 0.9	75.9 – 75.35	Light brown dry silty clay loam, blocky structure, gradual lower boundary	B horizon	
0.9 – 2.8	75.35 – 73.55	Light brown friable chalk-sandy silty clay, blocky structure, frequent SA small flint and chalk inclusions.	Colluvium	
2.8 – 4.5	73.55 – 71.75	Light grey/white structureless chalk	Coombe chalk	
4.5 – 5.0	71.75 – 71.25	Structural chalk	bedrock	

Location:	407207.48 141371.52	Borehole ID:	BH 4	Comments: 201738 Winterbourne Stoke Bypass
Level (top):	75.93m aOD	Drg:		

Depth		Sediment description	Interpretation	Unit
Mbg	mOD			
0 – 0.3	75.93 – 75.63	Medium brown dry silty clay loam, granular blocky structure, common small SA flint and chalk inclusions. Clear lower boundary.	Plough soil	
0.3 – 1.0	75.63 – 74.93	Light brown dry silty clay loam, blocky structure, common SA flint inclusions, clear lower boundary	B horizon	
1.0 – 1.25	74.93 – 74.68	Void	compression gap	
1.25 – 3.1	74.68 – 72.83	Light brown friable chalk-sandy clay becoming lighter with depth, blocky structure, frequent SA small flint and chalk inclusions increasing in size and frequency with depth.	Colluvium	
3.1 – 4.6	72.83 – 71.33	Light grey/white structureless chalk	Coombe chalk	
4.6 – 5.0	71.33 – 70.93	Structural chalk	bedrock	

Location:	407207.65 141362.06	Borehole ID:	BH 5	Comments: 201738 Winterbourne Stoke Bypass
Level (top):	75.86m	Drg:		

Depth		Sediment description	Interpretation	Unit
Mbg	mOD			
0 – 0.4	75.86 – 75.46	Medium brown dry silty clay loam, granular blocky structure, common small SA flint and chalk inclusions. Clear lower boundary.	Plough soil	
0.4 – 1.1	75.46 – 74.76	Medium brown dry silty clay loam, blocky structure, abundant SA flint inclusions, clear lower boundary	B horizon	
1.1 – 1.7	74.76 – 74.16	Medium brown chalk-sandy clay matrix containing 90% flint gravels	lag deposit	
1.7 – 2.0	74.16 – 73.86	Light brown friable chalk-sandy clay becoming lighter with depth, blocky structure, frequent SA small flint and chalk inclusions increasing in size and frequency with depth.	Colluvium	
2.0 – 2.6	73.86 – 73.26	Light grey/white structureless chalk	Coombe chalk?	
2.6 – 2.8	73.26 – 73.06	Light brown friable chalk-sandy silty clay, blocky structure, frequent SA small flint and chalk inclusions.	Colluvium/transition zone between underlying soil and overlying Coombe chalk	
2.8 – 3.17	73.06 – 73.69	Dark brown silty clay flinty soil with a granular blocky structure, sharp disrupted lower boundary with some evidence of the movement of soil into the underlying structureless chalk.	Buried soil (interbedded within soliflucted structureless coomb chalk, possible Allerod soil??, just seems a little too well developed and thick for that)	
3.17 – 4.75	73.69 – 71.11	Light grey/white structureless chalk	Coombe chalk	
4.75 – 5.0	71.11 – 70.86	Weathered chalk	Bedrock chalk	

Location:	407207.25 141352.72	Borehole ID:	BH 6	Comments: 201738 Winterbourne Stoke Bypass
Level (top):	75.88.m	Drg:		

Depth		Sediment description	Interpretation	Unit
Mbg	mOD			
0 – 0.33	75.88 – 75.55	Medium brown dry silty clay loam, granular blocky structure, common small SA flint and chalk inclusions. Clear/gradual lower boundary.	Plough soil	
0.33 – 1.4	75.55 – 74.44	Medium brown friable chalk-sandy clay, blocky structure, frequent SA small flint and chalk inclusions, flints increasing in size and frequency with depth.	B horizon	
1.4 – 2.52	74.44 – 73.36	Light brown friable chalk-sandy silty clay, blocky structure, frequent SA small flint and chalk inclusions.	Colluvial deposits	
2.52 – 3.0	73.36 – 72.88	Light grey/white structureless chalk	Coombe chalk?	
3.0 – 3.21	72.88 – 72.67	Dark brown silty clay flinty soil with a granular blocky structure, sharp lower boundary.	Buried soil? soil seems too compact to be just residual material that's fallen down the borehole. But lower boundary seems to sharp for soil to be real.	
3.21 – 4.8	72.67 – 71.08	Light grey/white structureless chalk	Coombe chalk	
4.8 – 5.0	71.08 – 70.88	Weathered chalk	Bedrock chalk	

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