COLEWOOD RESERVOIR

ROCHESTER

KENT

Electrical Resistivity Tomography Survey Report

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CONTENTS

1 INTRODUCTION 1
1.1 Project background 1

2 METHODOLOGY 2
2.1 Introduction 2

3 RESULTS AND INTERPRETATION 3
3.1 Introduction 3
3.2 Survey results and interpretation 3

4 CONCLUSION 4

FIGURES

Figure 1 Site location and transects
Figure 2 Electrical Resistivity Tomography methodology
Figure 3 Profile 1 Resisitivity model and interpretation
Figure 4 Profile 2 Resisitivity model and interpretation
Figure 5 Profile 3 Resisitivity model and interpretation
Figure 6 Profile 4 Resisitivity model and interpretation
Figure 7 Profile 5 Resisitivity model and interpretation

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Summary

An Electrical Resistivity Tomography survey was conducted over land at Colewood Reservoir near Rochester, Kent, approximately centred upon OS NGR 570555 169347. The project was commissioned to investigate the appearance of sinkholes at the Site with the aim of identifying any further, near surface voids.

The Site lies to the West of Rochester, Kent, and is immediately South of the M2 and comprises two concrete reservoirs with associated access tracks and infrastructure, surrounded by fencing.

The Site occupies a north-facing slope and the surrounding area has been modified by the M2 immediately to the North, East and West and by the Channel Tunnel Rail Link to the South. The solid geology underlying the Site is Chalk, overlain by a succession of sands, clays and marls of the Thanet Beds.

Five resistivity profiles were acquired at the Site which confirmed that the geology of the area was that of a sandy soil overlying the sand and silts of the Thanet Beds.

The top of the Thanet Beds lies at approximately 90 – 91m above OD and the resistivity of this layer decreases with depth, presumably due to an increase in groundwater content. The base of the Thanet Beds and top of the Chalk bedrock was not identified in any of the five transects.

The resistivity models do not appear to have identified any voids in any of the five profiles. The only area of increased resistivity was at the southern end of profile 1 and the values here were not sufficiently high enough to indicate the presence of a void. This area of increased resistivity is more likely to represent an area of dewatering or an increase in porosity, which may be related to the sinkhole which has developed nearby.

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Acknowledgements

The Electrical Resistivity Tomography survey was commissioned by Tim Archer of Arrow Geophysics on behalf of South East Water.

The fieldwork was directed by Paul Baggaley and assisted by Ben Urmston and Ross Lefort. Paul Baggaley processed and interpreted the geophysical data and wrote this report. Illustrations were prepared by Ken Lymer. The project was managed on behalf of Wessex Archaeology by Paul Baggaley.

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1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by Arrow Geophysics, on behalf of South East Water, to carry out a geophysical survey of land at Colewood Reservoir, near Rochester, Kent (**Figure 1**), hereafter 'the Site'. The Site is approximately centred upon OS NGR 570555 169347.

1.1.2 The project was initiated following the appearance of a number of sink holes at the surface, immediately adjacent to, and partially undercutting the reservoir structure. The aim of the project was to establish the presence/absence and extent of possible voids within the Site.

1.1.3 This report presents a brief description of the methodology followed, the survey results and interpretation of the geophysical data.

1.1.4 The Site lies to the West of Rochester, Kent, and is immediately South of the M2 (**Figure 1**). The Site comprises two concrete reservoirs with associated access tracks and infrastructure, surrounded by fencing which restricted the area available for survey.

1.1.5 The Site occupies a north-facing slope and the surrounding area has been modified by the M2 immediately to the North, East and West and by the Channel Tunnel Rail Link to the South.

1.1.6 The solid geology underlying the Site is Chalk, which is overlain by a succession of sands, clays and marls of the Thanet Beds.

2 METHODOLOGY

2.1 Introduction

2.1.1 A geophysical specification was prepared by Wessex Archaeology to investigate the Site. The methodology consisted of acquiring Electrical Resistivity Tomograpghy data using a Campus Tigre system with up to 64 electrodes arranged at a spacing of 1-2m. To make an individual reading requires just four electrodes at any one time in a Wenner Array with two electrodes for the current and two to measure the resistance. The system was controlled via a laptop which automatically selected the electrodes required for each reading (**Figure 2**).

2.1.2 The system used all the available electrodes at ever increasing electrode spacings to acquire a complete data set. This consists of 620 readings if all 64 electrodes are used. In order to ensure data quality the system acquires at least three readings for each electrode configuration and only accepts the reading if the error is less than 5%.

2.1.3 The data will be processed using RES2DINV software to provide a two-dimensional inversion of the data incorporating the topography recorded along the electrode array. The inversion process creates a model from which it calculates the resistivity values that would be recorded over it. By comparing the calculated data with the field data an error value can be calculated and the software then proceeds through a number of iterations to minimise the error between the calculated and acquired field data by altering the pseudo-section.

2.1.4 Individual electrode positions were recorded using a Leica Viva RTK GNSS system, which is precise to within 0.05m.

2.1.5 The geophysical survey was conducted by Wessex Archaeology's in-house geophysics team on the 26th February and 1st March 2010.

3 RESULTS AND INTERPRETATION

3.1 Introduction

3.1.1 Five survey lines were acquired within the Site. Results are presented as a series of resistivity models with interpretations (**Figures 3** to **7**). It should be noted that the RES2DINV software displays the results with varying amounts of vertical exaggeration depending on the length of the profile.

3.1.2 Electrical resistivity tomography effectively samples the bulk properties of the material through which the electrical currents pass and there may be features in the data sets which are too small to be detected by this technique.

3.1.3 The interpretation of the profiles described below is based only on the resistivity datasets and would be subject to revision should any geotechnical or other geophysical information be made available.

3.1.4 Resistivity values for a material depend on the lithology, ground water content and porosity. Any large voids would be expected to appear in the models as areas of very high resistivity as air filled voids are poor conductors of electricity.

3.2 Survey results and interpretation

3.2.1 Generally all five of the profiles acquired at the Site show an upper layer with resistivity values of 40-50 ohm metres, overlying a deeper layer with resistivity values of 20-30 ohm metres. The interface between these two layers is at approximately 90m aOD and so is not seen on Profile 4 where the base of the model is at 90.5m aOD.

3.2.2 Chalk bedrock normally has a resistivity value of 50 – 100 ohm metres, therefore the two layers present in the profiles at this Site are likely to be a sandy soil layer which is c.1m thick on most profiles, overlying the Thanet Beds which are sand, silts and marls, extending down to at least 87m aOD.

3.2.3 The resistivity values of the Thanet Beds layer decrease with depth on profiles 1, 2 and 3. This is probably due to increasing groundwater content with depth.

3.2.4 Profile 1 is the only line of data showing high resistivity values, notably at the southern end of the profile (**Figure 3**). This corresponds to the area where the land has failed at the corner of the reservoir. The resistivity values in this area are 80-90 ohm metres, which suggests that there is not a void underneath this profile. However, this high resistivity anomaly may be due to an increase in the pore space or dewatering of the material in this region. The high resistivity values at the northern end of Profile 1 are thought to be caused by the concrete base of the fence which was immediately adjacent to the electrode at this end of the profile.

3.2.5 Profile 2 was located along the southern bank of the reservoir and shows just the two simple layers of sandy soil overlying Thanet Beds (**Figure 4**). There are no significant anomalies in this profile.

3.2.6 Profile 3 is parallel to Profile 2 but situated approximately 1m lower down the bank and extending further to the west, into the area of valves at the edge of the Site (**Figure 5**). Most of this profile is showing that the Thanet Beds are near the surface along the base of the bank with very little overburden. There is a high resistivity anomaly of 60 ohm metres towards the western end of the profile but this is thought to be an artefact in the data caused by the road which intersects the profile at 78-80m.

3.2.7 Profiles 1, 2 and 3 all had electrodes adjacent to areas where the voids were visible at the surface. However, as only Profile 1 has a high resistivity anomaly, it appears that the surface expression of the void is not the cause of this anomaly.

3.2.8 Profiles 4 and 5 extend from the western bank of the reservoir towards the road. Profile 4 is intersected by an area of subsidence at 8.5 – 11m and projecting this area of subsidence forward it would intersect Profile 5 at 7-9.5m. Both of these profiles show a slight increase in resistivity to the east of this area of subsidence but there is no evidence of voids in these profiles (**Figure 6** and **7**).

4 CONCLUSION

4.1.1 The resistivity models produced from the five profiles at the Site confirm that the geology of the area is that of a sandy soil overlying the sand and silts of the Thanet Beds.

4.1.2 The top of the Thanet Beds is at approximately 90 – 91 m above OD and the resistivity of this layer increase with depth, presumably due to an increase in groundwater content. The base of the Thanet Beds and top of the Chalk bedrock was not identified in any of the five transects.

4.1.3 The resistivity models do not appear to have identified any voids in any of the five profiles. The only area of increased resistivity was at the southern end of profile 1 and the values here were not sufficiently high enough to indicate the presence of a void. This area of increased resistivity is more likely to represent an area of dewatering or an increase in porosity, which may be related to the sinkhole which has developed nearby.

4.1.4 This Site appears to be experiencing punctuated development of voids and ground conditions may have changed since the data were acquired.

4.1.5 The results and subsequent interpretation of geophysical surveys should not be treated as an absolute representation of the underlying features. It is normally only possible to prove the nature of anomalies through intrusive means, such as trial excavations.