Archaeology South-East

ASE

GEOARCHAEOLOGICAL INVESTIGATIONS AT AREAS 9, 10 AND 11, HERMITAGE QUARRY, MAIDSTONE, KENT

NGR: 572115,155680

A POST-EXCAVATION ASSESSMENT AND UPDATED PROJECT DESIGN REPORT

ASE Project No: 160834
Site Code: OWH13

ASE Report No: 2017237
OASIS ID - archaeol6-286514

By Dr Matt Pope and Alice Dowsett

With contributions by
Dr John Whittaker, Dr Nathalie Marini, Dr Rowena Banerjea and Jake Wilson
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Abstract

This report presents the results of an archaeological and geoarchaeological investigations by Archaeology South-East at the Areas 9, 10 and 11, Hermitage Quarry, Maidstone, Kent between 22nd September and 10th November 2016. The fieldwork was commissioned by CgMs Consulting in advance of quarrying.

This was the second phase of work at the site with the aim of the identifying fine-grained deposits holding palaeoenvironmental and archaeological potential. During the previous phase of the project, one set of deposits was broadly dated to a period spanning from the end of the planet's penultimate cold stage, which is referred to as Marine Isotope Stage 6 or the Saalian (which begins approximately 191,000 years before present) and the beginning of the last interglacial climate stage before the present one, which is referred to as MIS 5e or the Eemian/Ipswichian (which begins approximately 130,000 years before present). These fine-grained deposits have survived within an apparent solution structure (doline) which was associated with a widespread network of narrow vertical fissures in the rock (gulls) and further doline structures.

The current programme of works involved the removal of topsoil and head deposits as a preparatory phase for ragstone extraction. These were monitored to identify possible fissure (gulls) and solution features (dolines) with the potential to retain deposits significant to our understanding of the Pleistocene and the Palaeolithic in Britain in a plateau context. Five of these were evaluated, four were confirmed as gulls, and a fifth identified as dry valley feature was sampled for geoarchaeological and palaeoenvironmental analyses.

Sedimentological studies confirmed the fine-grained and low-energy nature of the sediment infills of the dry valley feature, but differing slightly to the sediment composition of the gull sampled in the previous phase of work. This phase of work proved the dry valley sediments to hold low potential for palaeoenvironmental evidence.

The report concludes that no further analysis work is required at this stage, although future archaeological work at the site continues to be of significance. No immediate publication of the results is necessary.

The report is written and structured so as to conform to the standards required of post-excavation analysis work as set out in the National Planning Policy Framework (HM Gov 2012) and older documents Management of Research Projects in the Historic Environment (MoRPHE), Project Planning Notes 3 (PPN3): Archaeological Excavation (English Heritage 2008). Analysis of the geoarchaeological context, and environmental material has assessed the potential of the site archive to address the original research agenda, as well as assessing the significance of those findings.

CONTENTS

TABLES

FIGURES

1.0 INTRODUCTION

1.1 Site Location

1.1.1 For this phase of work the 'site' consists of two parcels of land; one made up of sections from Phases 9, 10 and 11 of quarrying, and one in the slightly lower part of the quarry, comprising smaller sections from phases 19-22 of quarrying (Figures 1, 2 and 3). Areas 9-11 form the next programmed phase of quarrying at Oaken Wood, Hermitage Quarry, Maidstone, Kent (NGR: 572115 155680).

1.2 Geology and Topography

1.2.1 Areas 9, 10 and 11 are situated on roughly level ground at c. 90m AOD, slightly rising to the east. All three parcels of land were coppice woodland before works commenced. Areas 19-22 are situated at the base of the quarry.

1.2.2 The British Geological Survey viewer (BGS 2016) shows the northern two thirds of the proposed quarry as being Hythe Formation bedrock (interbedded sandstone and limestone) sealed by superficial Head deposits. The southern third is shown as Sandgate Formation bedrock (sandstone, siltstone and mudstone). Both solid formations date to the Cretaceous period.

1.2.3 Hermitage Quarry has been documented as exposing gull and doline-like features within the Hythe beds. Gulls are widened joints in the Cretaceous bedrock and dolines are solution structures. Both features are presumed to be infilled with Pleistocene and, potentially, Holocene sediments. These features have been demonstrated to have potential for the preservation of primary context artefactual material from Palaeolithic, Mesolithic and later prehistoric periods. Two recently investigated localities, Glaston in Rutland (Cooper et al 2012) and Beedings, West Sussex, have produced nationally important artefactual assemblages from such features dating to the Early Upper Palaeolithic (Pope and Wells 2008; Pope 2009; Pope et al 2013).

1.3 Scope of the Project

1.3.1 Following the results of the archaeological and geoarchaeological evaluation and watching brief, carried out by Archaeology South-East at Areas 8 and 9, Hermitage Quarry, between 1st October and 12th November 2015, it was established that the site contains geological features (gulls or fissures and dolines), which have the potential to preserve archaeological/ geoarchaeological artefacts and ecofacts.

1.3.2 In accordance with this, Archaeology South-East was commissioned by CgMs Consulting to undertake further geoarchaeological and archaeological investigations.

1.3.3 An Updated Project Design for geoarchaeological investigation (ASE 2016a) was submitted to KCC for approval prior to the commencement of fieldwork and it was understood that methods used on site would be developed to fit in with the quarry work. All works were carried out in accordance with the CIfA standards and guidance and the standard KCC specification for fieldwork and geo-archaeological investigation (KCC 2015a; KCC 2015b). Any variations to the scope of work were agreed with CgMs Consulting Ltd prior to implementation.

1.3.4 The fieldwork was undertaken by ASE between 22nd September and 10th November 2016. The project was managed by Jon Sygrave and fieldwork was undertaken by Matt Pope, Jake Wilson, and Alice Dowsett.

1.4 Circumstances and Dates of Work

1.4.1 The current phase of work follows on from a number of previous archaeological investigations at Hermitage Quarry. In chronological order these are:

Desk Based Assessment (Oxford Archaeology 2010) commissioned by Tom La Dell Landscape Architects (on behalf of Gallagher Aggregates Ltd May 2010.

Air Photo Analysis (Deegan 2012) commissioned by CgMS March 2012.

Environmental Archaeological Assessment (Quest 2013) commissioned by CgMS 2013.

Watching Brief (Archaeology South-East 2014) commissioned by CgMs December 2013 – May 2014.

Watching Brief and Geoarchaeological evaluation commissioned by CgMs October-November 2015.

Landscape assessment report (Archaeology South-East 2016c) commissioned by CgMs 2016

Current Watching Brief and Geoarchaeological investigation commissioned by CgMs September-November 2016.

1.5 Fieldwork methodology

1.5.1 Areas 9, 10 and 11 were the main focus of the monitoring and were initially stripped of all woodland, topsoil and subsoil, there was then a bulk reduction of head deposit (Figures 2 and 3). All intrusive ground works were monitored, when appropriate, by an archaeologist/geoarchaeologist.

1.5.2 All excavation areas were machine stripped using a tracked mechanical 360° excavator. All mechanical excavation was undertaken using toothed and toothless ditching buckets and, when appropriate, under the direct supervision of experienced archaeologists.

1.5.3 An archaeologist monitored the topsoil reduction during which no archaeological or geological features were observed. The two potential post-medieval quarry pits identified within the current watching brief area in the DBA and landscape assessment reports (OA 2010; ASE 2016c) were not observed.

1.5.4 Once topsoil reduction was complete, the surface of a Head deposit was exposed, which overlies the Kentish ragstone to a depth of c. 2.0 m. One of the research aims of the fieldwork was to determine whether gull/doline features continue across the site and if so, whether they occur in a predictable pattern. As head reduction took place, the monitoring archaeologist walked the area in

order to identify potential areas of deformation, which could indicate gull or doline features beneath.

1.5.5 Five locations were identified, based on topographic low points and soft ground conditions as likely candidates for doline or gull features. These were named G1 to G5 and all run in an east/west direction across the site (Figure 4).

1.5.6 When potential gull features where identified during the ground reduction, a senior geo-archaeologist experienced in the assessment of such features attended site. A larger 'gull', G5 (Figure 2) was examined particularly closely due its different appearance, and was later deemed to be a dry valley. This dry valley feature was found in two parts; the upper part was present in section and the lower part was present as a depression and change in geology in the ground. After discussion with the site manager, this dry valley was left undisturbed and in section, for purposive geoarchaeological sampling. It was agreed that the depression in the ground was to be investigated by the careful machine excavation of a test pit.

1.5.7 Following the identification of potential gull and fissure features (G1-5) it was decided that the dry valley sequence (G5) in particular required a purposive programme of geoarchaeological investigation. The lower section of the dry valley was excavated using a machine fitted with a flat bladed bucket to a maximum depth of 1.2 m. The upper section was left as a section profile, parallel to the side of the quarry from the initial machine excavation of this area of the quarry. Both upper and lower sections of the dry valley feature were recorded in section, and sampled for sediment bulk samples, dating, and sediment micromorphology.

1.5.8 All other gulls (G1-G4) were deemed to be unsuitable for sampling due to containing too much Head deposit, and lack of fine-grained deposits, to yield any reliable results.

1.5.9 Following the purposive geoarchaeological investigation, a watching brief was maintained to check for archaeological remains and geoarchaeologically interesting deposits within the remaining Head and identify the location of gull and doline features once the ragstone was reached.

1.5.10 No archaeological remains were found during the reduction of the head deposit across the site, or from the excavation of the dry valley (G5).

1.5.11 Areas 19-22 (located at the base of the quarry) were already stripped down to bedrock, and any gull features present were surveyed and photographed in order to continue to create a distribution map of these features across the quarry.

1.5.12 All exposed sections were recorded by photography and written record. The exposed and accessible section of the dry valley feature allowed detailed and safe recording (Figure 5).

1.6 Recording and Sampling Strategy

1.6.1 A full digital photographic record was maintained. The photographic record also includes working shots to represent more generally the nature of the fieldwork.

1.6.2 This second phase of work provided an opportunity to further examine geological deformation and deposition during the Quaternary Period, following investigations carried out by ASE in 2015. It was anticipated prior to works on Areas 9, 10 and 11 that further gulls, fissures or dolines, with the potential to preserve high resolution archaeological and palaeoenvironmental evidence, would be encountered. On-site sampling methodology, processing and recording was undertaken within the guidelines laid out by English Heritage (2002).

1.6.3 Sampling was focussed on the dry valley feature due to its stability, accessibility, and potential to provide reliable results. It also required further investigation due to its differing geology to that of other gulls.

1.7 Organisation of the Report

1.7.1 This post-excavation assessment (PXA) and updated project design (UPD) has been prepared in accordance with the guidelines laid out in Management of Research Projects in the Historic Environment (MoRPHE), Project Planning Notes 3 (PPN3): Archaeological Excavation (English Heritage 2008).

1.7.2 The report seeks to place the results from Areas 9, 10 and 11 of Hermitage Quarry (hitherto referred to together as 'the site') within the local geological and archaeological setting; to quantify and summarise the results; specify their significance and potential, including any capacity to address the original research aims, listing any new research criteria; and to lay out what further analysis work is required to enable their final dissemination, and what form the latter should take.

1.7.3 Following on from previous archaeological work at the site conducted by Archaeology South-East (ASE 2014; ASE 2016b) work at the site ran as a single project, with the finds and environmental archives all recorded under the previous site code: OWH13.

2.0 ARCHAEOLOGICAL AND GEOARCHAEOLOGICAL BACKGROUND

2.1 Overview

2.1.1 Existing documents relating to the site include: a desk-based assessment (OA 2010) covering the broader archaeological background for the site and subsequent historic landscape assessment report (ASE 2016c) which included a site visit intended to confirm the archaeological origin of the features identified within the DBA report and to identify and briefly record any additional features; an Environmental Archaeological Assessment (QUEST 2012) examining the potential of soils on the site, an aerial photographic analysis (Deegan 2012) and a geoarchaeological evaluation undertaken by ASE in 2015 (ASE 2016b) . The information within these documents is not repeated in full here.

2.1.2 There are no scheduled monuments at the site, which is designated as 'Ancient and Semi-Natural Woodland' by English Nature. The site has been considered to have low-moderate potential for prehistoric to medieval archaeology (OA 2010; ASE 2016c). The majority of the landscape features identified by the aerial photographic assessment are likely to be post-medieval in date. Two of these, both considered to be possible post-medieval quarry pits were noted within the current watching brief area.

2.1.3 The pollen analyses carried out by QUEST (2012) took samples from the top and subsoils at the site. This demonstrated that pollen and seeds survived within these deposits that characterised the surrounding woodland and areas of cultivation.

2.1.4 The geoarchaeological evaluation undertaken by ASE in 2015 (ASE 2016b) proved the presence of capture points for Pleistocene sediments within the gull and doline features, which have scientific and archaeological potential. OSL results dated the top 2 metres of one gull to between 153 ± 14 and 133 ± 16 kya (MIS 6 and MIS 5e). The gulls in particular were concluded to be of significant archaeological importance, due to their low-energy, datable depositional environments and palaeoenvironmental potential. A single piece of possible Palaeolithic worked flint was also collected during this work.

3.0 RESEARCH AIMS

3.1 Original Research Aims

3.1.1 Due to the potential for Pleistocene deposits to survive at the site site specific research aims were developed for the project (ASE 2013). These were to ascertain:

- Whether gull/doline features continue across the site and if so whether they occur in a predictable pattern
- Whether further fine grained deposits can be shown to survive and if these also date to MIS 6-5e
- Whether gull/doline features contain geoarchaeological/archaeological artefacts/ecofacts
- The character, date, and quality of ancient remains and deposits and their potential for further study
- How they might be affected by the development of the site
- What options should be considered for mitigation
- To make public the results of the investigation, subject to any confidentiality restrictions.

3.2 Aims arising from first phase of fieldwork

3.2.1 These aims arose from the first phase of fieldwork (ASE 2016b).

3.2.2 Geoarchaeological Research Aims

GRA1: How best can the distribution of gulls and dolines be mapped/anticipated ahead of each expansion phase?

GRA2: What is the relationship between the gulls, dolines and dry valley features, how do the formation processes of each relate to each other?

GRA3: What is the total time-depth of sediments preserved through the vertical extent of the gull features? What are the agents of sediment formation at depth?

GRA4: What is the source of sediment accumulating within the gull and doline features? Is it all locally derived or does it contain a significant windblown (loessic) component?

GRA5: What is the palaeoenvironmental potential of the gull and dolines fills? How variable is geochemistry through the sediments and what are the implications for the survival of vertebrate fauna, invertebrates, pollen and other indicators.

3.2.3 Academic Research Aims

ARA1: Do the gulls and dolines within the quarry preserve evidence for past human behaviour in the form of artefacts and what does this tell us about human use of the Lower Greensand plateau?

ARA2: How do the capture points help us understand the wider distribution of Pleistocene sediment capture points and along for more detailed interpretation of extant find-spot data from sources such as the HER and the TERP (The English River Project) mapping.

ARA3: Do the fine grained sediments within the gull and doline features allow for datable sediment correlations with the deeper loessic sequences of the Cretaceous plateaus in Northern France (Picardy/Normandy/Pas de Calais).

3.3 Research Framework Interfaces

3.3.1 Work at the site has the potential to address a number of strategic research and conservation themes identified in the current Research and Conservation Framework for the British Palaeolithic. These comprise:

- Theme 3: Dating Frameworks
- Theme 4: Curation and Conservation
- Theme 5: Dealing with Development

3.3.2 Research priorities and strategies identified in the South East Research Framework (SERF) Research Agenda that are pertinent to the site include:

- Colluvial/solifluction/aeolian deposits
- Identification of areas of colluvial/solifluction deposits that may contain undisturbed or minimally disturbed concentrations of Palaeolithic remains (cf Red Barns)
- More attention to "brickearth", and characterisation as colluvial or aeolian (or fluvial)
- Mapping and dating of loessic sediments, and modelling of likelihood of any contained Palaeolithic remains

4.0 ARCHAEOLOGICAL RESULTS

4.1 Summary

4.1.1 Observations (detailed in Section 4.2 below) on the gulls (G1-4) and dry valley (G5) present in the Hythe Beds exhibited varying potential to retain fine-grained sediment (Figure 4).

4.1.2 Of these five features observed in Areas 9, 10 and 11, four were filled with contorted Head deposits and one (G5) was found to be filled with a significant sedimentary sequence. This sequence was indicative of a dry valley; comprising glauconitic sands and sub-rounded boulders overlain by silts and loess, in turn overlain by Head. A suite of samples, comprising bulk samples for particle size, pollen and micropalaeontology, and two Kubiena tins placed across potential land-surfaces, were retrieved from G5 upper and lower sections (Figure 5).

4.1.3 No artefacts were recovered during this phase of work and no standard archaeological features identified.

4.1.4 Areas 19-22 (located at the base of the quarry) were already excavated down to bedrock, and any gull features present were surveyed and photographed. These features presented no opportunity for sampling.

4.1.5 The environmental samples ultimately deposited as part of the archive are dependent on specialist recommendations and regional archive requirements.

Context sheets	2
Section sheets	2
Plans sheets	0
Colour photographs	0
B&W photos	0
Digital photos	55
Context register	0
Drawing register	0
Watching brief forms	11
Trench Record forms	0

Table 1: Quantification of site paper archive

Bulk finds (quantity e.g. 1 bag, 1 box, 0.5 box 0.5 of a box)	0
Registered finds (number of)	0
Flots and environmental remains from bulk samples	0
Palaeoenvironmental specialists sample samples (e.g. columns, prepared slides)	6
Waterlogged wood	0
Wet sieved environmental remains from bulk samples	0

Table 2: Quantification of artefact and environmental samples

4.2 Results Areas 9, 10 and 11: Features G1 to G5

4.2.1 Features G1-G4 (Figure 4)

These features were exposed in section and partially in plan during the removal of the head deposit. They presented a conical fissures in the exposed top of the Lower Greensand Hythe Beds and appeared to be the linear continuation of gulls exposed in the quarry working face. At the point they were exposed they appeared to also open up locally in circular features when viewed in plan, possibly through solution. G1 and G3 were broadly circular, (9.5m and 7.m in diameter respectively), while G2 (4m x 8.36m) and G4 (5m x 9.5m) were more irregular in shape.

They were all seen to be filled by a heavily mixed and contorted head deposits of dark orange brown silty clay with sub-angular ragstone inclusions. The conical top of the fissures was seen to contain this coarse-grained head deposits to the base of the extraction level. At no point was either artefactual of faunal material encountered in this deposit.

In terms of palaeoenvironmental potential the fill of these features contained neither fine-grained low energy deposits indicative of good preservation environments for pollen, mollusc or microfauna. Nor were the deposits considered suitable for dating.

The assessment methodology therefore continued to prove itself in successfully identifying these capture points during the head extraction phase and allowing rapid assessment of the sedimentary context and local potential on a feature by feature basis in the field. In this case, it was quickly determined that no further action was needed. It should be noted that these gulls will continue laterally to the south and preservation conditions are likely to change unpredictably along their course.

4.2.2 Feature G5 (Figures 4-6)

One of the anomalies was of more interest (G5). This was identified as two slightly offset sections of a shallow dry valley sequence exposed cutting north south through the site.

The sections are broadly characterised as follows:

G5 Upper Section: preserves finer grained silt and clay deposits, finely bedded in places, but otherwise massive and unstructured.

G5 Lower Section: preserves the basal part of the dry valley sequence grading up from coarser sands with rounded Hythe Beds boulders, into finer sands and silts.

The following detailed sedimentary sequence was observed below modern topsoil:

G5 Upper Section

UNIT I. Head deposit: Dark Brown Sandy Silt. Mixed deposit, rooted and infrequent ragstone inclusions. Maximum thickness: 0.40m.

UNIT II. Loess: Light Brown. Mix of soil deposits: silts, sands and clays, finely bedded in places but otherwise massive and unstructured Likely not windblown deposit. No inclusions. Maximum thickness: 0.75m.

UNIT III. Sand: yellow sand, small flint gravel inclusions. Maximum thickness: 0.10m.

UNIT IV. Head rubble deposit: orange brown silty clay with frequent gravel. Maximum thickness: 1.10m.

UNIT V. Silt: Dark Brown silt with organic inclusions and rooting. Maximum thickness: 1.20m.

UNIT VI. Sand: Green sand with infrequent ragstone inclusions, organic staining and mineralisation. Maximum thickness: 0.40m.

G5 Lower Section

UNIT VII. Head deposit: Orange Brown silty clay rubble with frequent ragstone inclusions, inward slumping and cone shaped.

UNIT VIII. Clay: Red Brown clay deposit.

UNIT IX. Bedded Sands: Orange Brown coarser sands, grading up to finer grained sand deposits, with Dark Brown bedding in places. Potential pedogenesis. Large Hythe Beds boulders of rounded ragstone at the outer limits of the lowest part of the dry valley.

This sequence showed clear fine grained sedimentation through Units II and IX and indicated it being a more significant sediment trap than Features 1-4.

4.2.3 Column and bulk samples were taken from these sequences (Figure 5 and Table 3) and are reported on below.

5.0 ENVIRONMENTAL AND SEDIMENT ASSESSMENTS

5.1 Samples taken

5.1.1 Table 3 lists the samples taken during the fieldwork.

Depth	Sample Number	Feature	Sample Type	Purpose
0.80-1.05m	G5.1	5	column	Micromorphology
0.80-0.85m	G5.2	5	bulk	Palaeoenvironmental /particle size
0.90-0.95m	G5.3	5	bulk	Palaeoenvironmental /particle size
1.00-1.05m	G5.4	5	bulk	Palaeoenvironmental /particle size
0.90-1.15m	G5.5	5	column	Micromorphology
0.90-0.95m	G5.6	5	bulk	Palaeoenvironmental /particle size
1.00-1.05m	G5.7	5	bulk	Palaeoenvironmental /particle size
1.10-1.15m	G5.8	5	bulk	Palaeoenvironmental /particle size

Table 3. Geoarchaeological samples taken from Feature G5, the dry valley.

5.2 **Micropalaeontology** by Dr John E. Whittaker

5.2.1 Introduction

This part of the report provides the results of 6 samples taken for micropalaeontological analysis. The fine grained deposits (Units II and IX) from the dry valley sequence (feature G5) were sampled for micropalaeontological remains. No micropalaeontological analysis has been undertaken before this study.

5.2.2 Materials and Methods

Analysis for foraminifera and ostracods, was undertaken on samples G5.2-G5.4 and G5.6-G5.8 (Table 3). Processing was undertaken in the following manner. Each sample was broken up into smaller pieces, placed in a ceramic bowl and dried thoroughly in an oven. Sodium carbonate was then added (to help remove the clay fraction) and boiling water was poured over the sample. After soaking, each sample was then washed through a 75 micron sieve with hand-hot water, and the resulting residue decanted back into the bowl for drying in the oven. Due to the sediments being sands, silty sands and silty clays, they broke down easily. After final drying the residues were placed in labelled plastic bags. Picking was undertaken by first dry-sieving each sample into >500, >250,>150 and >75 micron fractions, then a small amount at a time from each fraction deposited onto a picking tray. Observation was undertaken using a light microscope and, in this case, no foraminifera or ostracods were found.

5.2.3 Results

The microfaunal analysis of the 6 samples from the dry valley sequence yielded no results. The sediments were barren of contemporary foraminifera, ostracods and other micropalaeontological evidence. There were a small number of fossil agglutinating foraminifera, which come from the Lower Cretaceous (Lower Greensand), to which Kentish Ragstone belongs. The residues from the lower section contain a greater frequency of cemented ragstone, as well as iron mineral, and glauconite. The upper part of the section is comprised of finer sand, with frequent iron minerals.

5.2.4 Significance and Potential

This micropalaeontological analysis produced no results and it therefore can be assumed that the depositional environment, or post depositional processes, have negatively affected microfaunal preservation within the sediments. This does not mean that micropalaeontological analysis will not yield results elsewhere across the site, but it does mean that it is less likely. It can therefore be inferred, that there is low potential for microfaunal preservation.

5.3 Particle size analysis and pollen assessment – by Dr Nathalie A.F. Marini

5.3.1 Non-Technical Summary

Particle size analysis and pollen assessment was instigated at the Hermitage Quarry site in order to: (1) characterise the deposits; (2) assess the preservation, concentration and main taxa of the pollen assemblage. The results of the exercise indicate deposits dominated by silt with sand and clay, with a higher silt content between the upper and lower parts of the sequence. Pollen was absent from the sequence. No further work is recommended.

5.3.2 Introduction

Sediments filling the apparent dry valley feature (G5), were sampled for pollen and particle size analysis, as detailed in Table 3.

This part of the report summarises the findings arising out of the particle size analysis and pollen assessment undertaken by Quaternary Scientific (QUEST), University of Reading in connection with proposed development at Hermitage Quarry, Hermitage Lane, Maidstone, Kent. Quaternary Scientific were commissioned by Archaeology South-East. Archaeological and geoarchaeological field investigations undertaken at the site identified a natural gully or fissure feature with the potential to contain archaeological artefacts and/or ecofacts. Six bulk samples (G5.2, G5.3, G5.4, G5.6, G5.7 and G5.8), from G5 lower and upper section, were submitted for particle size analysis and pollen assessment with the aim of: (1) characterising the deposits and (2) ascertaining the preservation, concentration and main pollen taxa and providing a preliminary reconstruction of the local vegetation cover.

5.3.3 Method: Particle Size Analysis

Six samples were selected for particle size analysis. Prior to particle size distribution analysis by laser granulometry (range 0.01-2000 microns) a representative sample was gathered from the main bulk sample. The sample was then mixed with a spatula to form a homogenous 'paste'. A sub-sample was placed on a plastic watchglass and a weak dispersant solution (c. 0.5ml 3.3% Calgon) was added in order to aid dispersion of the material (Blott et al 2004). Physical disaggregation on a clean watchglass with a rubber pestle was carried out. Any particles observed to be greater than 2mm were removed. The sample was then washed with distilled water into the analyser. Particle size distribution measurements for particles falling within the size range 0.01 to 2000 microns was measured by laser granulometry using a Malven Mastersizer 3000. Each sample was run in duplicate and the results of the two runs averaged. The results are displayed in Table 1, Figures 1-2 and Excel Appendix enclosed.

Method: Pollen Assessment

Six samples were prepared for an assessment of the pollen content. For each sample, a sub-sample of 4g of air dried sediment was extracted as follows: (1) sampling a standard volume of sediment (1ml); (2) adding two tablets of the exotic clubmoss Lycopodium clavatum to provide a measure of pollen concentration in each sample; (3) deflocculation of the sample in 1% Sodium pyrophosphate; (4) sieving of the sample to remove coarse mineral and organic fractions (>125µm); (5) acetolysis; (6) removal of finer minerogenic fraction using Sodium polytungstate (specific gravity of 2.0g/cm3); (7) mounting of the sample in glycerol jelly. Each stage of the procedure was preceded and followed by thorough sample cleaning in filtered distilled water. Quality control is maintained by periodic checking of residues, and assembling sample batches from various depths to test for systematic laboratory effects. Pollen grains and spores were identified using the University of Reading pollen type collection and the following sources of keys and photographs: Moore et al (1991); Reille (1992). The assessment procedure consisted of scanning the prepared slides, and recording the concentration and preservation of pollen grains and spores, and the principal taxa on four transects (10% of the slide). The results are displayed in Table 2.

Results and Interpretation: Particle Size Analysis

The results of the particle size analysis are displayed in Tables 4-6. The results indicate that the composition of the two groups of samples, from the lower and upper sections, is fairly different. The three samples from the lower section (G5.2, G5.3 and G5.4) are similar in composition, each dominated by silt (45-46%), with sand (37-40%) and clay (14-16%). By contrast, the three samples from the upper part of the section (G5.6, G5.7 and G5.8), contain a greater silt content (65-74%) with sand (15-25% and clay (8-10%).

Detailed results as presented in Figure 2 confirm that samples G5.2, G5.3 and G5.4, from the lower section, show a similar profile with two peaks of volume percentage of particles, around 1-10 microns and 100-400 microns, and a much lower percentage between 10-100 microns. However, samples G5.6, G5.7 and G5.8, from the upper part of the section, present a contrasting profile to those

from the lower section, with a single volume percentage peak of particles ranging from 10 to 100 microns (see also Excel Appendix file).

Table 4. Clay, Silt and Sand percentage results, Hermitage Quarry, Hermitage Lane, Kent

SAMPLE	CLAY (0.01-2 µ)	SILT (2-63 µ)	SAND (63-2000 µ)
G5 Lower Section G5.2	16.29	45.78	37.93
G5 Lower Section G5.3	14.37	45.06	40.57
G5 Lower Section G5.4	14.39	46.58	39.03
G5 Upper Section G5.6 (0-0.05)	10.6	74.15	15.25
G5 Upper Section G5.7 (0.10-0.19)	8.79	66.82	24.39
G5 Upper Section G5.8 (0.23-0.25)	8.95	65.29	25.76

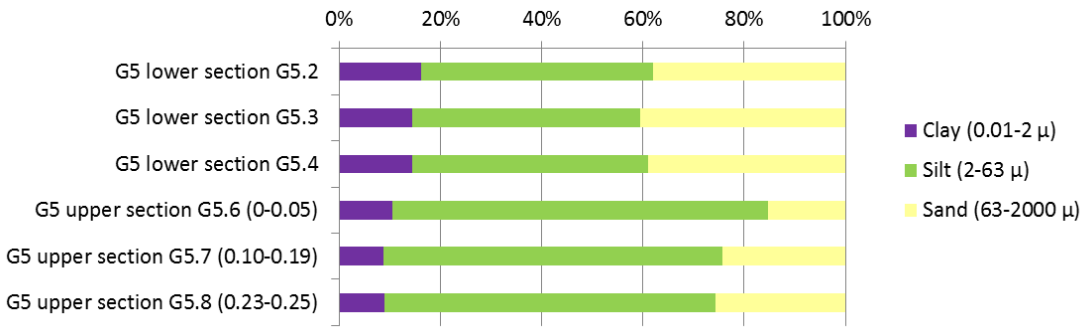

Table 5. Clay, Silt and Sand percentage results from the dry valley feature, G5

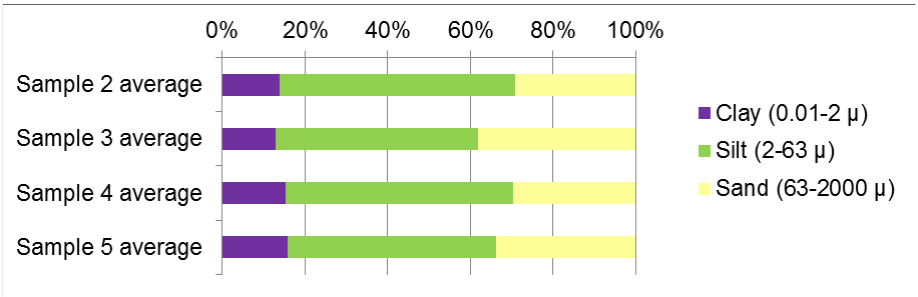

Table 6 Clay, Silt and Sand percentage results from G5,

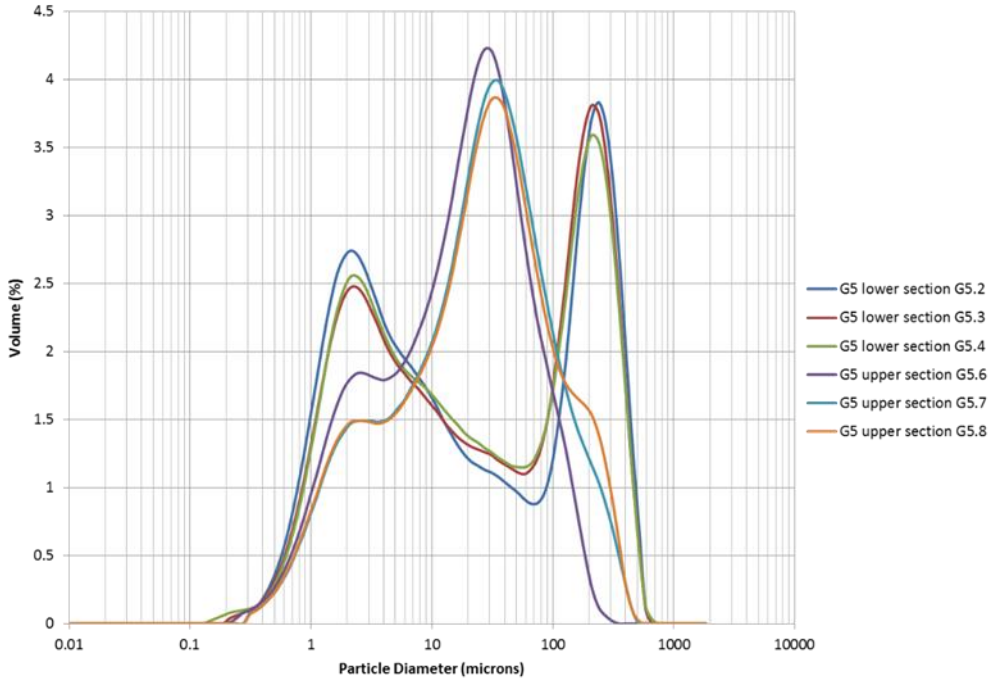

Table 7. Percentage volume of the particle size analysis, Hermitage Quarry, Hermitage Lane, Kent.

5.2.5 Results and Interpretation: pollen assessment

The results of the assessment demonstrate the absence of pollen and spores in all samples (Table 8). A negligible amount of microcharcoal was recorded in samples from the G5 Upper Section (samples G5.6, G5.7 and G5.8).

As a consequence of this, it is not possible to provide a reconstruction of the former vegetation or human activities on the basis of these results, and no further work is recommended. Various physical and chemical processes impact upon the concentration and preservation of pollen, and it is impossible to be certain which or how many of these might have resulted in the lack of remains recorded in the sample.s

Table 8. Results of the pollen assessment

		G5.2	G5.3	G5.4	G5.6	G5.7	G5.8
Latin name	**Common name**						
Total Land Pollen (grains counted)		0	0	0	0	0	0
Concentration*		0	0	0	0	0	0
Preservation**		0	0	0	0	0	0
Microcharcoal Concentration***		0	0	0	1	1	1
Suitable for further analysis		**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

*Key: *Concentration: 0 = 0 grains; 1 =1-75 grains, 2 = 76-150 grains, 3 =151-225 grains, 4 = 226-300, 5 =300+ grains per slide; **Preservation: 0 = absent; 1 = very poor; 2 = poor; 3 = moderate; 4 = good; 5 = excellent; ***Microcharcoal Concentration: 0 = none, 1= negligible, 2 = occasional, 3 = moderate, 4 = frequent, 5 = abundant*

5.3 **Micromorphology summary** by Dr R.Y. Banerjea

5.3.1 The full micromophology report is given in Appendix 1. The executive summary is repeated here for reference.

5.3.2 Micromorphology identified seven microstratigraphic units (MU): 1-3 within the upper section, the upper 18cm of monolith G5.5; and 4-7 within the lower section, the upper 10.5cm of G5.1 MU1-3 shows evidence of on-going pedogenic processes and biological reworking as is a common feature in palaeosols, but there are three visible horizons indicative of a former soil profile. MU4-7 are interpreted as depositions of wind blown sands deriving from the greensand formation, whereby MU5 has been more reworked and oxidised, and possibly represents a former stabilised surface horizon, or former landsurface before further burial. No anthropogenic material or microfossil evidence was identified in thin-section, and consequently, no further environmental archaeological analysis of the deposits within the sequence is recommended.

6.0 POTENTIAL & SIGNIFICANCE OF RESULTS

6.1 Realisation of the original research aims

6.1.2 The Original Project Aims have been addressed in this phase of work in the following ways:

1. Whether gull/doline features continue across the site and if so whether they occur in a predictable pattern

   Gull/doline features continue across the sampled area, supporting the existing concept that they are likely to continue across the entire extent of quarry expansion area. They are also accompanied by at least one dry valley feature, which is characterised by rounded ragstone boulders, indicating the past presence of a possible stream/river.

2. Whether further fine grained deposits can be shown to survive and if these also date to MIS 6-5e

   Two dating samples were taken, but given the nature of the sediments, it was important to assess the potential of the Palaeoenvironmental preservation before undertaking any expensive dating. Given the virtual absence of preserved palaeoenvironmental indicators or evidence of human activity, dating work is not considered useful in this instance

3. Whether gull/doline features contain geoarchaeological/ archaeological artefacts/ecofacts

   No archaeological material was recovered from this phase, and it was found that no palaeoenvironmental material was preserved in the dry valley context.

4. The character, date and quality of ancient remains and deposits and their potential for further study

   The palaeoenvironmental preservation in the dry valley feature is poor, it can be concluded that the palaeoenvironmental potential for further study is low.

5. How they might be affected by the development of the site?

   The quarrying process will destroy all gulls, doline and valley fills in their entirety, within the footprint of the quarry and to the extraction depth of the quarry.

6. What options should be considered for mitigation?

   The method in place: watching brief during the deposit reduction of head followed by geoarchaeological sampling, proved successful in the previous phase, with regard to gaining good dating and archaeological material. This may allow us to manage these features differently in future, and focus our attention on the gull anomalies, which have found to be of greater interest. The work has benefited from the help of experienced quarry workers and managers, in helping to identify potential features. This expertise and awareness has been enhanced by the provision of a toolbox talk, briefing quarry workers on artefact

and faunal identification. Future phases of work at the site should involve tool box sessions where necessary when staff turn-over requires.

7. To make public the results of the investigation, subject to any confidentiality restrictions.

This a unique opportunity to further explore the wider potential of theragstone landscapes, to promote Gallaghers' responsible approach to sustainable extraction.

6.1.3 Revised Research Aims were developed in the previous Post Excavation Assessment (ASE 2016b). The results of the current phase of work are not sufficient to be able to address these revised aims further.

6.2 Significance and potential of the geoarchaeological dataset

6.2.1 The Gull's/Dolines (G1-G4) and dry valley feature (G5) identified during this phase of work, did not contain significant archaeological or geoarchaeological remains. They have, however, further confirmed the presence of fine-grained sediment traps, which have the potential to hold stratified archaeological deposits.

6.2.2 The sequence of sediments found in feature G5 demonstrated that it is part of a dry valley; the sub rounded greensand boulders at the base, indicated weathering caused by water flow under periglacial conditions. Soil micromorphology has determined the presence of ancient landsurfaces within the dry valley fills. The samples assessed for micropaleontology and pollen, have, however, proved it to be negative for palaeoenvironmental evidence.

6.2.3 All Gull features so far encountered, and including features G1 to G4 of this phase, have only been explored to the depth revealed by the head clearance phase (in general 2-4m below ground level). At these depths the funnel-like surface openings are exposed and accessible for assessment, and it was within this zone that fine-grained sediments dating to MIS 6-5e were located in the previous phase of work (ASE 2016b), The lower parts of the sediments within the gull features have yet to assessed in any part of the quarry. This is because we have yet to develop a safe working methodology to assess the vertical limestone faces >10m in depth and produced by the dynamite-blasting extraction methodology. Until these are able to be assessed, the age range, palaeoenvironmental and archaeological potential of these lower gull fill deposits remains unknown. It should also be noted that even when the upper conical part of these gulls is filled with coarse grained head, finer grained sediments appear to be present at depth.

6.3 Conclusions and recommendations

6.3.1 The work has shown that the dry valley feature (G5) is distinct from the gulls/dolines present across the site.

6.3.2 Given that the palaeoenvironmental investigation of the dry valley yielded little information, it should be inferred that other dry valley sequences in the area are likely to be similarly unprofitable for palaeoenvironmental evidence. It is therefore recommended that no further palaeoenvironmental work is

undertaken on the dry valley. They still, however, have potential for containing other types of archaeological evidence.

6.3.3 This second phase of work in Areas 9, 10 and 11 and areas 19-22 of Hermitage Quarry, has proved the presence of a greater number of capture points for fine-grained deposits within gulls/dolines

6.3.4 This reinforces earlier observations made within Hermitage Quarry and the nearby Loose Valley, that the plateau and interfluve zones of the Lower Greensand Hythe Beds around Maidstone provide an extensive landscape of Pleistocene capture points.

6.3.5 Given recent and historical records of both artefactual and faunal material from Hythe Beds gulls, these deposits should be considered as having demonstrated, but as yet unquantified, scientific and archaeological potential. Given the rarity of extensive plateau contexts in the region with widespread capture points, and the historical absence of systemic investigation, the gulls should be considered of significant archaeological importance. These structural features, in offering low-energy, datable depositional environments with small-scale spatial resolution and palaeoenvironmental potential, offer the missing counterpart to the extensive valley-based fluvial records for the Pleistocene in the region.

6.3.6 The programme of watching brief during clearance of head followed by targeted field assessment of contexts preserving fine-grained sediment consistent with Pleistocene age has so far proved to be an effective and measured response. It is recommended that this approach is continued for future phases with the one amendment following the current assessment that dry valleys need not be sampled for paleoenvironmental evidence.

6.3.7 Continued, phased monitoring with appropriately qualified staff as well as continued liaison with quarry management continues to be the most appropriate use of resources.

7.0 PUBLICATION

7.1 Overview

7.1.1 No publication is required at this stage of works at the site. Nevertheless the significance of previous results, combined with future work at the site, may merit future publication in an appropriate journal.

7.2 Artefacts and Archive Deposition

7.2.1 The site archive is currently held at the offices of ASE. Following completion of all post-excavation work, including any publication work, the site archive will be deposited with the appropriate local museum (Maidstone).

BIBLIOGRAPHY

ASE 2013, Hermitage Quarry, Oaken Wood, Kent: Stage 1 Geoarchaeological Investigation Project Design

ASE 2014, Geoarchaeological Watching Brief Report: Oaken Wood, Hermitage Quarry Maidstone, Kent.

ASE 2016a, Hermitage Quarry, Oaken Wood, Kent, Geo-archaeological Investigation, Updated Project Design

ASE 2016b, Geoarchaeological Investigations and Archaeological Assessment of Pleistocene Sediment Capture Points and Landscape at Areas 8 and 9, Hermitage Quarry, Hermitage Lane, Maidstone, Kent.

ASE 2016c, *Oaken Wood, Ditton, Kent: Level 1 archaeological assessment,* Archaeology South-East, unpublished report 2016083

BGS. 2016. *British Geological Survey, Geology of Britain Viewer*

Blott, S, Croft, D.J, Pye, K, Sayene, S.E, and Wilson, H.E. (2004) Particle Size Analysis by Laser Diffraction. Forensic Geoscience: Principles, *Techniques and Applications* **232**, 63-73.

Deegan, A. (2012). Air photo analysis at Oaken Wood, Kent

Cooper, L., S Thomas, M Beamish, A Gouldwell, S Collcutt, J Williams, RM Jacobi, A Currant and T Higham. An Early Upper Palaeolithic Open-air Station and Mid-Devensian Hyaena Den at Grange Farm, Glaston, Rutland, UK. Proceeding of the Prehsitoric Society, 78: 73-94

English Heritage (2002). *Environmental Archaeology: A Guide to the Theory and Practice of Methods, from Sampling and Recovery to Post-excavation and Geoarchaeology: Using earth sciences to understand the archaeological record*

English Heritage (2008). *Management of Research Projects in the Historic Environment (MoRPHE), Project Planning Notes 3 (PPN3): Archaeological Excavation*

Oxford Archaeology 2010. Oaken Wood, Ditton, Kent. A desk-based assessment. Unpublished grey lit report 4633

Pope, M, R. Dinnis, A. Milks, P. Toms & C. Wells. 2013. 'A Middle Palaeolithic to Early Upper Palaeolithic succession from an open air site at Beedings, West Sussex' Quaternary International.

Pope, M., L. Blundell, H. Cutler and B. Scott. 2015. At the Headwaters of the English Channel River. In N. Ashton and C. Harris. No Stone Unturned: Essays in Honour of Roger Jacobi.

QUEST 2012. Hermitage Quarry Westerly Extension: A summary report on the environmental archaeological assessment of three ancient woodlands in Kent

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ACKNOWLEDGEMENTS

ASE would like to thank Chris Clarke of CgMs Consulting for commissioning the work and for his assistance throughout the project, and Wendy Rogers County Archaeologist Kent County Council for her guidance and monitoring.

HER Summary

Site code	OWH13					
Project code	6297					
Planning reference	N/A					
Site address	Areas 9-11,Hermitage Quarry, Hermitage Lane, Maidstone Kent					
District/Borough	Maidstone					
NGR (12 figures)	572115 155680					
Geology	Hythe Formation overlain by Head					
Fieldwork type	Eval	~~Excav~~	WB	~~HBR~~	~~Survey~~	Geoarch.
Date of fieldwork	22nd September and 10th November 2016.					
Sponsor/client	CgMs Consulting					
Project manager	Jon Sygrave					
Project supervisor	Matt Pope / Jake Wilson					
Period summary	Palaeolithic	~~Mesolithic~~	~~Neolithic~~	~~Bronze Age~~	~~Iron Age~~	
	~~Roman~~	~~Anglo-Saxon~~	~~Medieval~~	~~Post-Medieval~~	~~Other~~	
Project summary **(100 word max)**	The programme of works involved the removal of topsoil and head deposits as a preparatory phase for ragstone extraction. These were monitored to identify possible fissure (gulls) and solution features (dolines) with the potential to retain deposits significant to our understanding of the Pleistocene and the Palaeolithic in Britain in a plateau context. Five of these were evaluated, four were confirmed as gulls, and a fifth identified as dry valley feature was sampled for geoarchaeological and palaeoenvironmental analyses.					
Museum/Accession No.	N/A					

OASIS Form

OASIS ID: archaeol6-286514

Project details	
Project name	GEOARCHAEOLOGICAL INVESTIGATIONS AT AREAS 9, 10 AND 11, HERMITAGE QUARRY, MAIDSTONE, KENT
Short description of the project	The programme of works involved the removal of topsoil and head deposits as a preparatory phase for ragstone extraction. These were monitored to identify possible fissure (gulls) and solution features (dolines) with the potential to retain deposits significant to our understanding of the Pleistocene and the Palaeolithic in Britain in a plateau context. Five of these were evaluated, four were confirmed as gulls, and a fifth identified as dry valley feature was sampled for geoarchaeological and palaeoenvironmental analyses.
Project dates	Start: 22-09-2016 End: 10-11-2016
Type of project	Field evaluation
Current Land use	Other 7 - Mineral extraction
Project location	
Country	England
Site location	KENT MAIDSTONE EAST FARLEIGH Hermitage Quarry
Site coordinates	TQ 572115 155680 50.917549367884 0.236821700463 50 55 03 N 000 14 12 E Point
Project creators	
Name of Organisation	Archaeology South-East
Project brief originator	CgMs Consulting
Project director/manager	Jon Sygrave
Project supervisor	Matt Pope
Entered by	Jim Stevenson (Jim.stevenson@ucl.ac.uk)
Entered on	5 June 2017

Appendix 1: Micromorphology Report

QUEST
QUATERNARY SCIENTIFIC

University of Reading

HERMITAGE QUARRY, HERMITAGE LANE, MAIDSTONE, KENT

Micromorphology Report

Site code: OWH13

Date: 26th May 2017

Written by: Dr R.Y. Banerjea

QUEST, School of Archaeology, Geography and Environmental Science, Whiteknights, University of Reading, RG6 6AB

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http://www.reading.ac.uk/quest

DOCUMENT HISTORY

REVISION	DATE	PREPARED BY	SIGNED	APPROVED BY	SIGNED	REASON FOR ISSUE
v1	26/05/17	R. Banerjea		N. Marini		

CONTENTS

1. NON-TECHNICAL SUMMARY

Micromorphology identified seven microstratigraphic units (MU): 1-3 within the upper section, the upper 18cm of monolith G5.5; and 4-7 within the lower section, the upper 10.5cm of G5.1 MU1-3 shows evidence of on-going pedogenic processes and biological reworking as is a common feature in palaeosols, but there are three visible horizons indicative of a former soil profile. MU4-7 are interpreted as depositions of wind blown sands deriving from the greensand formation, whereby MU5 has been more reworked and oxidised, and possibly represents a former stabilised surface horizon, or former landsurface before further burial. No anthropogenic material or microfossil evidence was identified in thin-section, and consequently, no further environmental archaeological analysis of the deposits within the sequence is recommended.

2. INTRODUCTION

This report summarises the findings arising out of the micromorphological analysis undertaken by Quaternary Scientific (QUEST), University of Reading in connection with Archaeology South-East. Archaeological and geoarchaeological watching brief and evaluation were undertaken at Hermitage Quarry, Hermitage Lane, Kent. Previous micromorphological analysis at Hermitage Quarry Kent in order to identify the presence geological features (gull or fissure), whereby one micromorphology sample was collected from a potential doline feature, anomaly 4, at Hermitage Quarry, to ascertain if there is a soil horizon, and if there is any evidence for human activity within it (Banerjea 2016). This micromorphology report found that there was no anthropogenic material

and no evidence for a soil horizon, but rather slower, periodic accumulations of sediment within anomaly 4 (Banerjea 2016).

This micromorphology analysis examines two monoliths, G5.1 from the lower section, and G5.5 from the upper section of the sequence, in order to establish the presence of a potential palaeosol, and to understand the sediment formation processes more widely. The results of the particle size analysis indicate deposits dominated by silt with sand and clay, with a higher silt content between the upper and lower parts of the sequence. Pollen was absent from the sequence (Marini 2017).

3. METHODS

Two thin-sections measuring 11.5 x 7.5cm were prepared from the upper 18 cm monolith G5.5 with a 1cm overlap, and one thin-section was prepared from a sub-sample collected from the upper 10.5 cm of monolith G5.1. The procedure followed is the University of Reading standard protocol for thin section preparation. The samples were oven-dried to remove all moisture and then impregnated with epoxy resin while under vacuum. The impregnated samples are then left overnight so that the resin can enter all of the pores. The samples are then placed in an oven to dry for 18 hours at 70˚C before they are clamped and cut to create a 1cm slice through the sample. The surface of the 1cm slice is flattened and polished by grinding on the Brot. The prepared surface of the 1cm slice is then mounted onto a frosted slide and left to cure. This is followed by cutting off the excess sample, so the sample is down to a thickness of 1-2 mm. The mounted sample is ground down to approximately 100 µm in thickness using the BROT. The 100 µm section was lapped on a Logitech LP30 precision lapping machine to the standard geological thickness of 30 µm.

Micromorphological investigation is carried out using a Leica DMLP polarising microscope at magnifications of x40 - x400 under Plane Polarised Light (PPL), Crossed Polarised Light (XPL), and where appropriate Oblique Incident Light (OIL). Thin-section description is conducted using the identification and quantification criteria set out by Bullock *et al.* (1985) and Stoops (2003), with reference to Courty *et al.* (1989) for the related distribution and microstructure, Mackenzie & Adams (1994) and Mackenzie & Guilford (1980) for rock and mineral identification, and Fitzpatrick (1993) for further identification of features such as clay coatings. Tables of results use the descriptions, inclusions and interpretations format used by Matthews (2000) and Simpson (1998). Photomicrographs are taken using a Leica camera attached to the Leica DMLP microscope.

Micromorphology enables the following properties to be examined at magnifications of x40 - x400 under PPL, XPL and OIL: thickness, bedding, particle size, sorting, coarse:fine ratio, composition of the fine material, groundmass, colour, related distribution, microstructure, orientation and distribution of inclusions, the shape of inclusions, and finally the inclusions to be identified and quantified. In addition, post-depositional alterations can be identified and quantified such as: effects on the microstructure by mesofaunal bioturbation and cracking due to shrink-swell of clays

or trampling; translocation of clays and iron; chemical alteration such as the neoformation of minerals such as vivianite and manganese; organic staining as a result of decayed plant material; and excremental pedofeatures such as insect casts and earthworm granules.

The results of the soil micromorphology analysis are to be included in an updated version of this report.

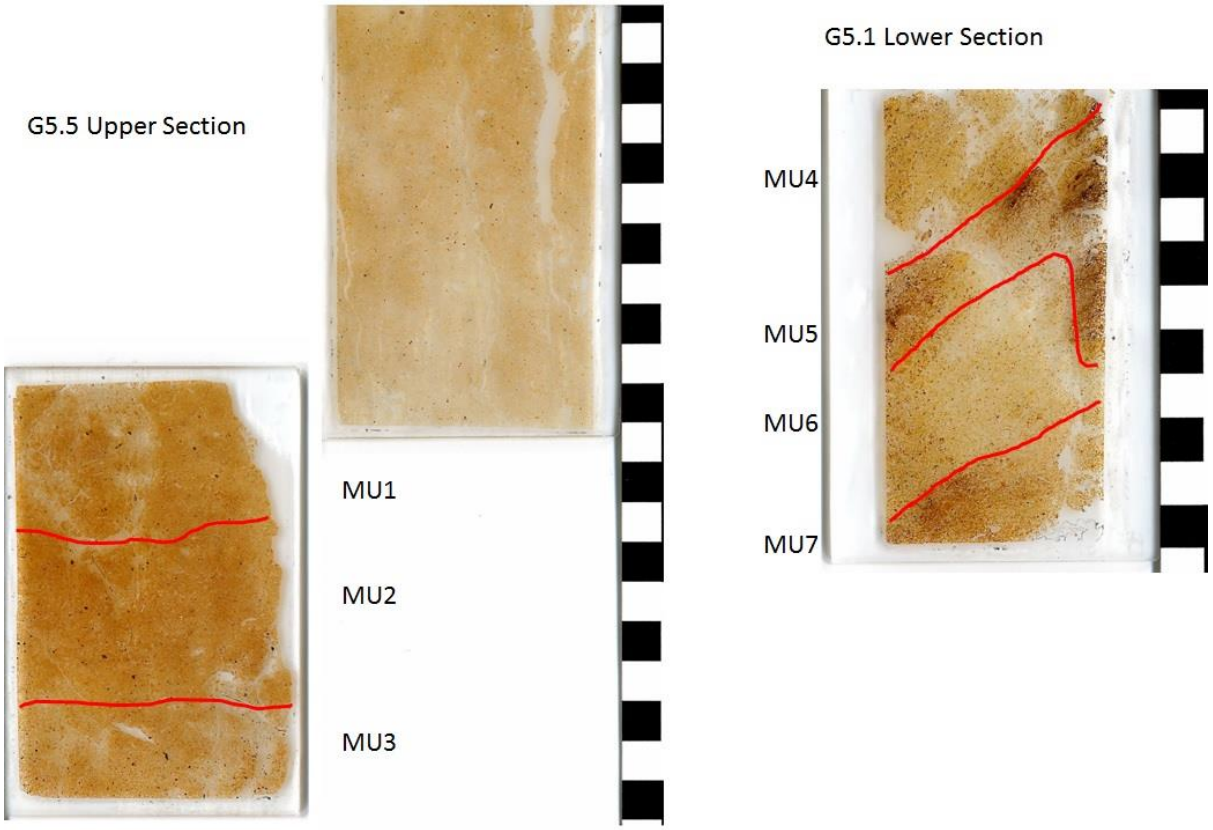


Figure 1: Scan of thin-sections from the upper section (left) and lower section (right), and their corresponding microstratigraphic units, Hermitage Quarry, Kent.

4. RESULTS & INTERPRETATION OF THE MICROMORPHOLOGY

Micromorphology descriptions for each deposit are recorded in Table 1, the frequency and types of inclusions within these deposits are recorded in Table 2, and the abundance of post-depositional alterations and pedofeatures within the deposits is recorded in Table 3. To determine the deposit type classification, each deposit was grouped using the following diagnostic sedimentary attributes and inclusions which provide crucial information concerning the origin of inclusions, transportation mechanisms of particles and the deposition processes. To ascertain the origin of sediment components descriptions were made of particle size, shape, and the composition of the coarse and fine fraction, particularly the frequency of rock, minerals and anthropogenic inclusions (Table 2). The depositional events are characterised by the following

sedimentary attributes: sorting, related distribution, orientation and distribution of the inclusions (Table 1), and bedding structure (Table 2).

Understanding the formation processes for deposits is crucial to interpreting the depositional pathways of rock fragments and minerals, any anthropogenic debris such as charred wood and artefacts, and other types of plant remains and microfossils (Matthews 2010; Schiffer 1987). Analysis of post-depositional features provides crucial information concerning the effects of weathering, preservation conditions (Bisdom *et al* 1982; Brady & Weil 2002; Breuning-Madsen *et al* 2003; Canti 1999; Courty *et al* 1989) and stratigraphic integrity of the deposit (Canti 2003; Canti 2007; Courty *et al* 1989; Macphail 1994).

Seven microstratigraphic units (MU) were identified (Fig. 1): 1-3 within the upper section, the upper 18cm of monolith G5.5; and 4-7 within the lower section, the upper 10.5cm of G5.1

4.1. Origin of materials

No anthropogenic material was identified in any of the microstratigraphic units (Table 2). All microstratigraphic units consisted of geological inclusions that are present in the layers associated with the local Hythe formation (English Heritage 2011): quartz, plagioclase, muscovite (mica), glauconite, and fragments of flints all occur in varying abundances with differences between the upper and lower sections (Table 2). MU 1-3, upper section, mainly contain quartz (60-70%), with low levels of glauconite (5-10%), plagioclase (<5%), and muscovite (<5%). MU 4-7 contain more glauconite (20-35%) and plagioclase (10-15%), and less quartz (35-40%) than the lower sections.

There are also differences in particle size and sorting between the upper and lower sections: MU 1 & 2 have a sandy silt loam/ silt loam particle size and MU 1-3 are all unsorted (Table 1). MU 4-7 have a loamy sand particle size and are either moderately or poorly sorted (Table 1). MU 1-3 show more compaction than MU4-7: they have an embedded and coated related distribution; whereas MU4-7 are linked and coated (where the fine material forms bridges and coats the coarse components) (Table 1).

4.2. Sediment formation processes

MU1-3 in the upper section, G5.5, show evidence of soil forming processes and biological reworking. The inclusions show no preferred orientation or distribution pattern (unoriented, unrelated, random, and unreferred), and have mesofaunal channels and chambers in the microstructure (Tables 1 & 3). The boundaries between MU1 and 2, and MU2 and 3 are wavy and diffuse as a result of biological reworking.

MU4-7 in the lower section, G5.1, have formed as a result of successive periodic depositions of sediment that form microlaminations, indicative of accumulation processes (Goldberg & Macphail 2006). MU4, 6 and 7 are moderately sorted and have moderately oriented sand particles that are linear and sometimes banded aligned with parallel to basal boundary; all bands inclined at 45^{o} (Table 1) resulting from a slope in the profile. Glauconite particles are rounded or sub-rounded in

shape; whereas quartz grains are generally sub-rounded or sub-angular. Rounding can result from abrasion as a result of wind or water transportation. MU5 is poorly sorted and has weakly oriented sand particles that are linear and sometimes banded aligned with parallel to basal boundary; again all bands inclined at 45^{0} (Table 1). Clays within MU5 have linear and banded orientation, aligned parallel with basal boundary, and are discussed further below. MU5 shows evidence of biological reworking: the basal boundary is wavy and diffuse and there are more mesofaunal/root channels and chambers in the microstructure (Table 1).

4.3. Post-depositional alterations

There is significant clay illuviation in both the upper and lower sections (Table 3), and represent different phases of clay illuviation, which can result from more than one pedogenic process (Kühn *et al* 2010, 235). Furthermore, both the upper and lower sections show evidence for disturbed pedofeatures in the form of fragmented compound and microlaminated clay coatings (Table 3) (Federoff *et al* 2010), where previous phases of clay illuviation have subsequently been reworked. Mica weathering (Bisdom *et al* 1982) and iron staining has impregnated some clay coatings. Iron nodules also appear as disturbed pedofeatures; although some iron mottling, particularly in MU5 shows evidence for alternating wetting and drying cycles (Lindbo *et al.* 2010).

Former bioturbation channels in MU1-3 have been infilled with slightly greyer (XPL) sandy silt loam, silt loam sediment, and modern root activity is evident in MU2 by fragments of ferruginous roots in channels (Table 2).

5. DISCUSSION

MU1-3 shows evidence of on-going pedogenic processes and biological reworking as is a common feature in palaeosols (Federoff *et al* 2010; French 2003; Kühn *et al* 2010; Retallack 2001). There are three visible horizons indicative of a former soil profile, but there have been subsequent successive phases of biological reworking represented by both silty clay infillings of former root or mesofaunal channels, and fragments of modern, ferruginous roots within channels.

MU4-7 are interpreted as depositions of wind blown sands deriving from the greensand formation, whereby MU5 has been more reworked and oxidised, and possibly represents a former stabilised surface horizon, or former landsurface before further burial.

No anthropogenic inclusions were identified in these thin-sections, nor were any microfossils of palaeoenvironmental benefit.

6. CONCLUSIONS & RECOMMENDATIONS

The upper and lower sequences show a palaeosol in the upper section and series of blown sand units in the lower section. No anthropogenic material or microfossil evidence was identified in thin-section, and consequently, no further environmental archaeological analysis of the deposits within the sequence is recommended.

7. REFERENCES

Banerjea, R.Y. (2016) Hermitage Quarry, Hermitage Lane, Maidstone, Kent – Micromorphology report, Unpublished report, Quest University of Reading, 10p.

Bisdom, E.B.A., Stoops, G., Delvigne, J., Curmi, P., Altemuller, H.J. (1982) Micromorphology of Weathering Biotite and Its Secondary Products. Pedologie, XXXII, 2, p. 225-252.

Brady, N.C., Weil, R.R. (2002) The Nature and Properties of Soils. Upper Saddle River, NJ: Prentice Hall.

Breuning-Madsen, H., Holst, M.K., Rasmussen, M., Elberling, B. (2003). Preservation within Long Coffins Before and After Barrow Construction. Journal of Archaeological Science 30, p. 343-350.

Bullock, P., Fedoroff, N., Jongerius, A., Stoops, G., Tursina, T. (1985) Handbook for thin section description. Wolverhampton: Waine Reasearch.

Canti, M.G. (1999) The Production and Preservation of Faecal Spherulites: Animals, Environment and Taphonomy. Journal of Archaeological Science 26, p. 251-258.

Canti, M.G. (2003) Earthworm Activity and Archaeological Stratigraphy: A Review of Products and Processes. Journal of Archaeological Science 30, p. 135-148.

Canti, M.G. (2007) Deposition and taphonomy of earthworm granules in relation to their interpretive potential in Quaternary stratigraphy. Journal of Quaternary Science 22 (2), p. 111-118.

Courty, M.A., Goldberg, P., Macphail, R. (1989) Soils and micromorphology in archaeology. Cambridge: Cambridge University Press.

English Heritage (2011) Strategic Stone Study: A building stone atlas of Kent. Communities and Local Government, British Geological Survey and English Heritage.

Federoff, N., Courty, M. A., Guo, Z. (2010) Palaeosoils and relict soils. . In: Stoops, G., Marcelino, V. and Mees, F. (eds): Interpretation of Micromorphological features in soils and regoliths. Elsevier, p. 623-662.

French, C. (2003) Geoarchaeology in Action. New York and Oxford: Routledge

Goldberg, P. and Macphail, R.I. (with Matthews, W.) (2006) Practical and Theoretical Geoarchaeology. Malden, Oxford and Victoria: Blackwell publishing.

Kühn, P., Aguilar, J., Miedema, R. (2010) Textural pedofeatures and related horizons. In: Stoops, G., Marcelino, V. and Mees, F. (eds), Interpretation of Micromorphological features in soils and regoliths. Elsevier, p. 217-250.

Mackenzie, W.S., Adams, A.E. (1994) A Colour Atlas of Rocks and Minerals in Thin Section. New York: John Wiley and Sons.

Mackenzie, W.S.,Guilford, C. (1980) Atlas of Rock Forming Minerals. Harlow: Longman Group Ltd.

Macphail, R.I. (1994) The reworking of urban stratigraphy by human and natural processes. In (H.K. Kenward Ed.), Urban-Rural Connexions: Perspectives from Environmental Archaeology. Oxbow, Oxford, p. 13-43.

Marini N.A.F (2017) Hermitage Quarry Hermitage Lane Maidstone, Kent - Particle size analysis and Pollen assessment report, Unpublished report, Quest University of Reading, 6p.

Matthews, W. (2000) Micromorphology of occupation sequences. In (R. Matthews, J.N. Postgate) Contextual analysis of use of space at two Bronze Age sites. http://ads.ahds.ac.uk/catalogue

Matthews, W. (2010) Geoarchaeology and taphonomy of plant remains and microarchaeological residues in early urban environments in the Ancient Near East. Quaternary International 214, p. 98-113.

Retallack, G. J. (2001) Soils of the past: an introduction to palaeopedology.. Wiley.

Schiffer, M.B. (1987) Formation Processes of the Archaeological Record. University of Utah Press

Simpson, I. (1998) Early Land Management at Tofts Ness, Sanday, Orkney: the evidence of thin section micromorphology. In (C.M. Mills, G. Coles Eds.) Life on The Edge: human settlement and marginality. Oxford: Oxbow

Stoops, G. (2003) Guidelines for Analysis and Description of Soil Thin Sections. Madison: Soil Science Society of America.

Table 1: Description of sediment attributes for microstratigraphic units, Hermitage Quarry, Kent

Deposit type	Slide number	MU number	Basal Boundary	Particle size	Sorting	Fine material	Groundmass	Colour	Related distibution	Microstructure	Inclusions: Orientation and Distribution
Palaeosol	G5.5 Upper Section/ A	1	N/A	Sandy silt loam/ Silt loam	Unsorted	Mineral	Grano and porostriated	Orange, light brown, PPL: orange, greyish brown, XPL.	Embedded and coated	Channels 15% Chambers 10%	Unoriented, unrelated, random and unreferred
	G5.5 Upper Section/ B		Wavy, diffuse, pedological	Sandy silt loam/ Silt loam	Unsorted	Mineral	Grano and porostriated	Orange, light brown, PPL: orange, greyish brown, XPL.	Embedded and coated	Channels 15% Chambers 10%	Unoriented, unrelated, random and unreferred
		2	Wavy, diffuse, pedological	sandy silt loam/ sandy loam	Unsorted	Mineral	Grano and porostriated. Mosaic speckled	Orange, light brown, PPL: orange, greyish brown, XPL.	Embedded and coated	Channels 15% Chambers 10%	Unoriented, unrelated, random and unreferred

		3	N/A	Loamy sand	Unsorted	Mineral	Grano and porostriated. Mosaic speckled	Orange, light brown, PPL: orange, greyish brown, XPL.	Embedded and coated	Channels 15% Chambers 10%	Unoriented, unrelated, random and unreferred
Blown sand	G5.1 Lower section	4	Clear, distinct sedimentological-diffuse in places	Loamy sand	Moderately sorted	Mineral	Grano and poro striated. Dotted	Orange brown, PPL; Orange, XPL.	Linked and coated, and embedded and coated	Chambers 10% Spongey	Moderately oriented sand particles. Linear and sometimes banded aligned with parallel to basal boundary. All bands inclined at 45°
Stablised blown sand		5	Wavy, diffuse, sedimentological	Loamy sand	Poorly sorted	Mineral	Grano and poro striated. Parallel striated. Dotted	Orange, dark brown, PPL; orange, very dark orange brown, XPL.	Linked and coated, and embedded and coated	Chambers 10% Channels 10% Spongey	Weakly oriented sand particles. Linear and sometimes banded aligned with parallel to basal boundary. All bands inclined at 45°. Clays have linear and banded orientation-aligned parallel with basal boundary.

Blown sand		6	Clear, distinct sedimentological-diffuse in places	Loamy sand	Moderately sorted	Mineral	Grano and poro striated. Dotted	Orange brown, PPL; orange, dark brown, XPL.	Linked and coated, and embedded and coated	Chambers 10% Spongey	Moderately oriented sand particles. Linear and sometimes banded aligned with parallel to basal boundary. All bands inclined at 45°
		7	N/A	Loamy sand	Moderately sorted	Mineral	Grano and poro striated. Dotted	Orange, dark brown, PPL; orange, very dark orange brown, dark brown, XPL.	Linked and coated, and embedded and coated	Vughs	Moderately oriented sand particles. Linear and sometimes banded aligned with parallel to basal boundary. All bands inclined at 45°

Table 2: Percentage of inclusions within microstratigraphic units, Hermitage Quarry, Kent

Deposit type	Slide number	Unit number	Thickness on slide (cm)	Bedding	Rock Fragments	Minerals						Organic/Plant remains
					Flint	Quartz	Microcline	Plagioclase	Muscovite	Glauconite	Iron	Plant tissue ferruginous
Palaeosol	G5.5 Upper Section/ A	1	10.8	Massive	*	*****			*	**	**	
	G5.5 Upper Section/ B		4.0-4.2	Massive		*****			*	**	**	
		2	3.5-4.0	Massive		*****			*	**	**	**
		3	2.0-2.5	Massive	*	*****	*	*	*	*	**	
Blown sand	G5.1 Lower secton	4	3.3	Microlaminated		****		**	*	****	**	
Stablised blown sand		5	1.5-4.0	Microlaminated		****		**	*	***	***	
Blown sand		6	3.2	Microlaminated		****		**		****	**	

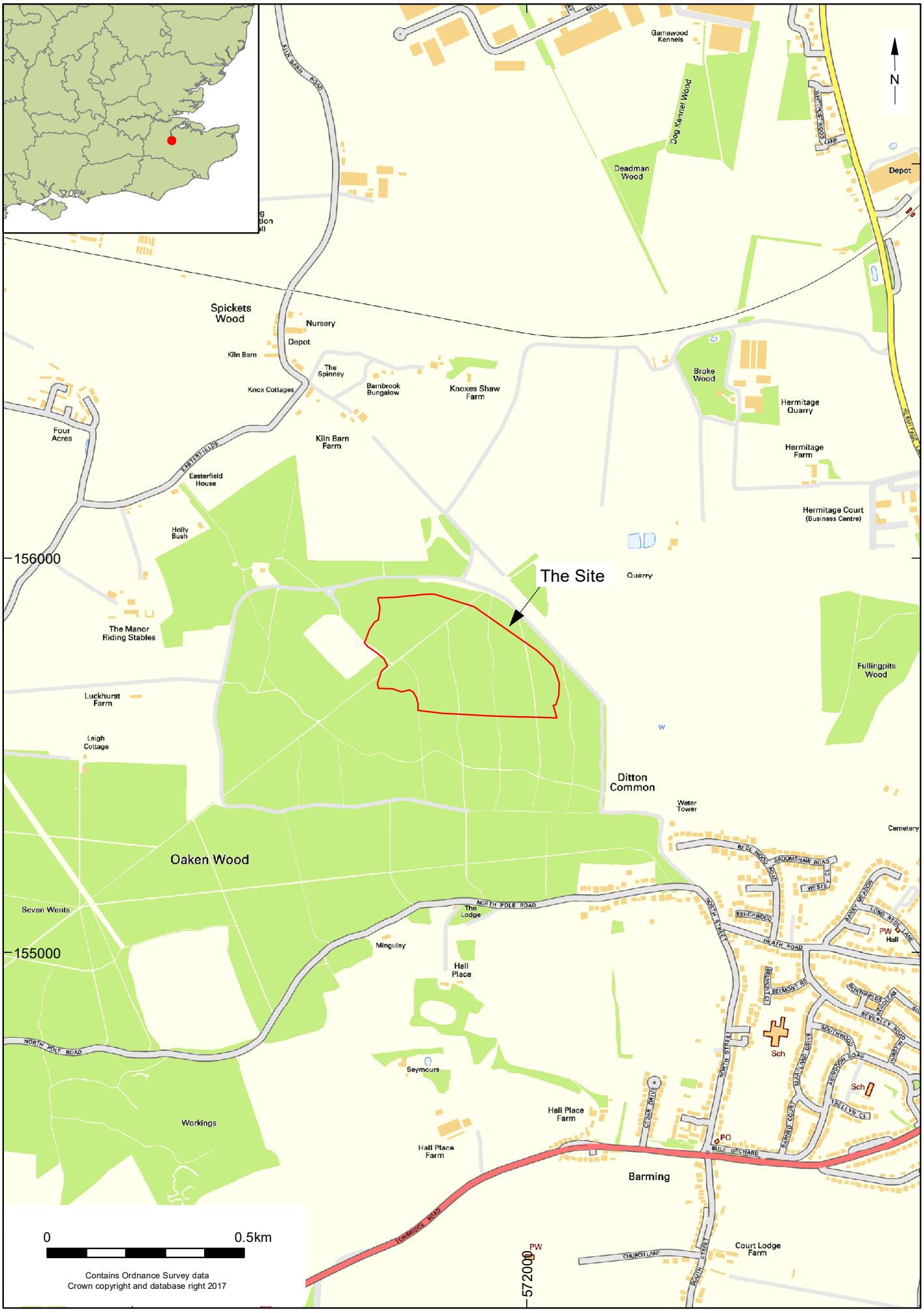
		7	2.2	Microlaminated		****		**	*	***	***	

*Key: ****** Very dominant >70%; ***** Dominant 50-70%; **** Common 30-50%; *** Frequent 15-30%; ** Few 5-15%; * Very few <5%*

Table 3: Type and percentage of post-depositional within microstratigraphic units, Hermitage Quarry, Kent

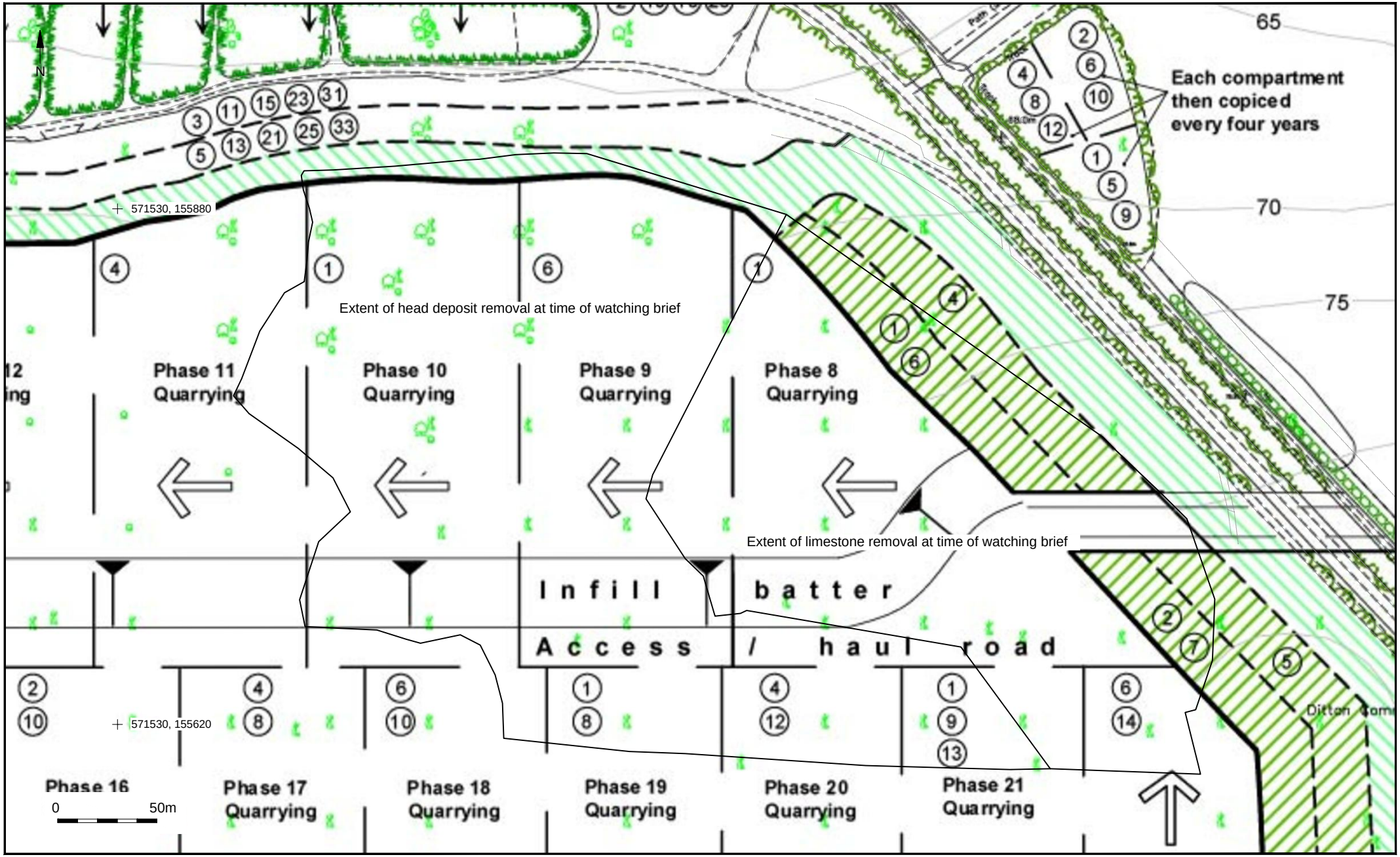
Deposit type	Slide number	Unit number	Weathering									Bioturbation
			Translocation								Chemical alteration	Microstructure effects
			Silty Clay Coatings: moderately/ strongly	Compound	Fragmented: microlaminated	Fragmented: compound	Clay coatings fragmented	Clay coatings microlaminated	Clay coatings unlaminated	Iron	Mica weathering	Mesofaunal / root bioturbation
Palaeosol	G5.5 Upper Section/ A	1	●●●	●●●					●●●	●●●	●●	●●●●●
	G5.5 Upper Section/ B		●●●	●●●					●●●	●●●	●●	●●●●●
		2	●●●	●●●	●●	●●			●●●	●●●	●●	●●●●●
		3	●●●	●●●●●		●●●					●●	●●●●●
Blown sand	G5.1 Lower section	4					●●	●●	●●●●	●●●		●●●●
Stabl ised blow n		5		●●●●●					●●	●●●●●		●●●●●
Blown sand		6						●●	●●●●	●●●	●●●	●●●●
		7		●●●●●			●●●●			●●●●●	●●●	

Key: ●●●●● Very abundant >20%; ●●●● Abundant 10-20%; ●●● Many 5-10%; ●● Occasional 2-5%; ● Rare <2%

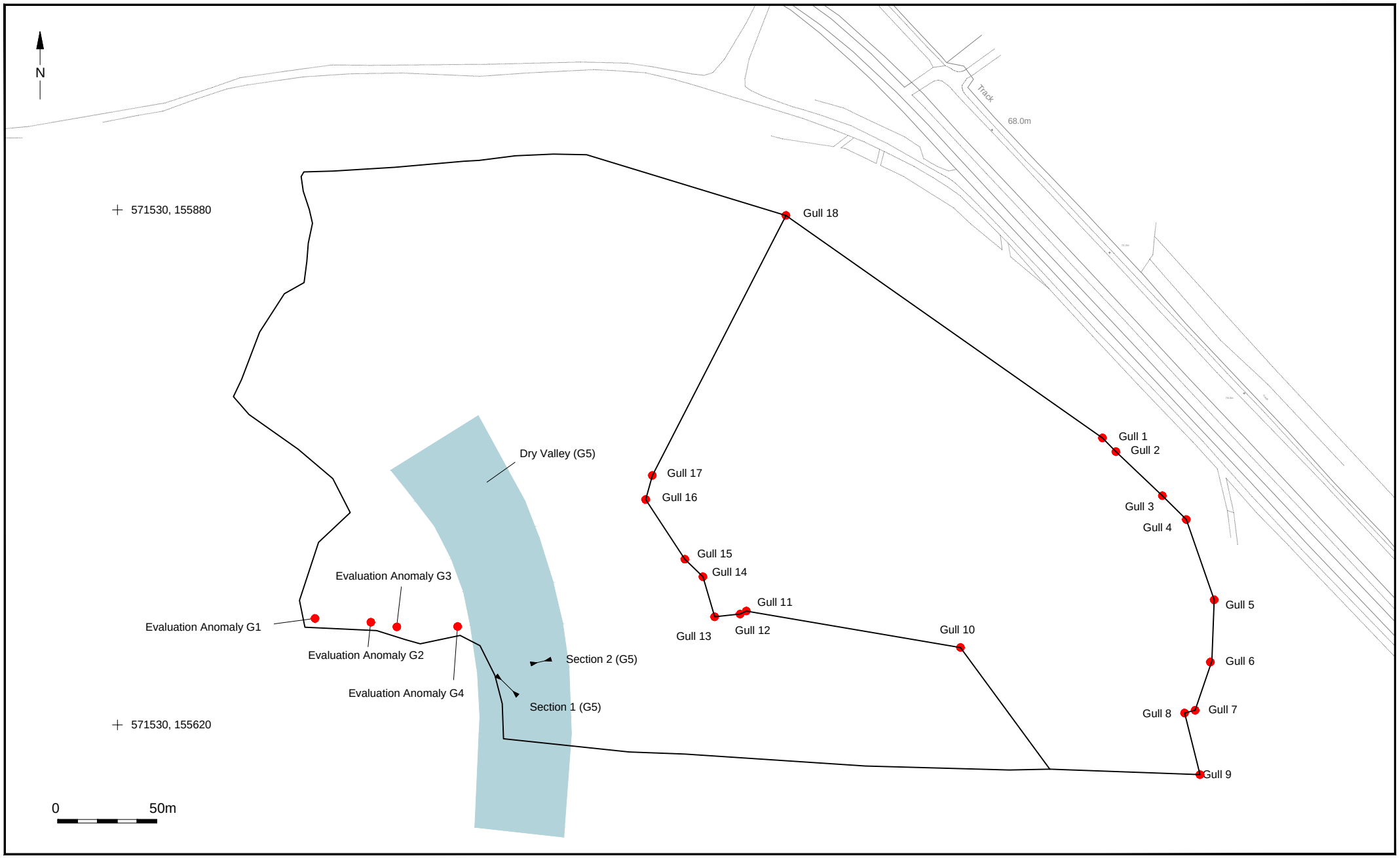


© Archaeology South-East		Areas 9, 10 and 11, Hermitage Quarry	Fig. 1
Project Ref: 160834	June 2017	Site location	
Report Ref: 2017237	Drawn by: JLR		

© **Archaeology South-East**		Areas 9, 10 and 11, Hermitage Quarry	Fig. 2
Project Ref: 160834	June 2017	Monitored areas	
Report Ref: 2017237	Drawn by: JLR		

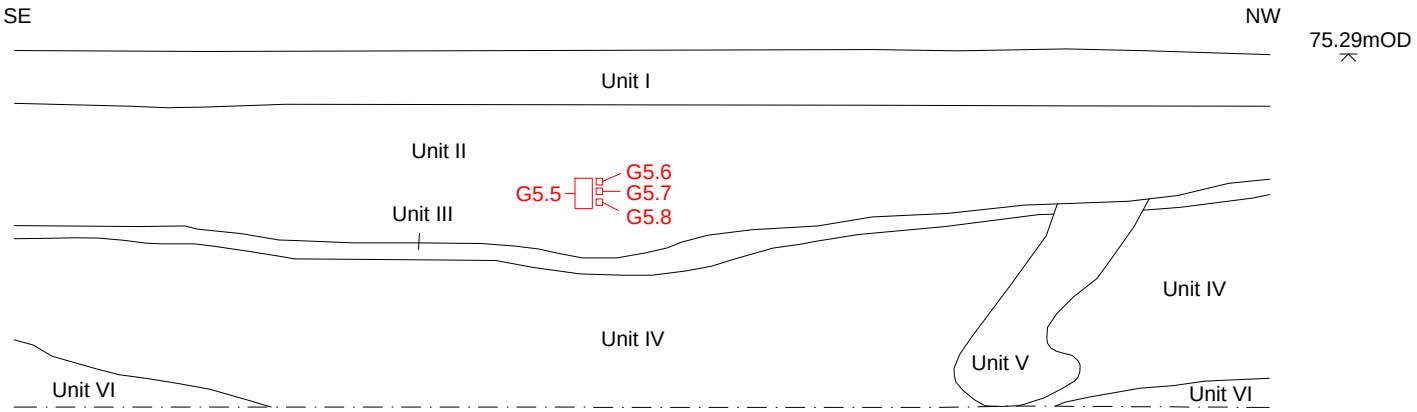


© Archaeology South-East		Areas 9, 10 and 11, Hermitage Quarry	Fig. 3
Project Ref: 160834	June 2017	Monitored areas in relation to quarry phasing	
Report Ref: 2017237	Drawn by: JLR		

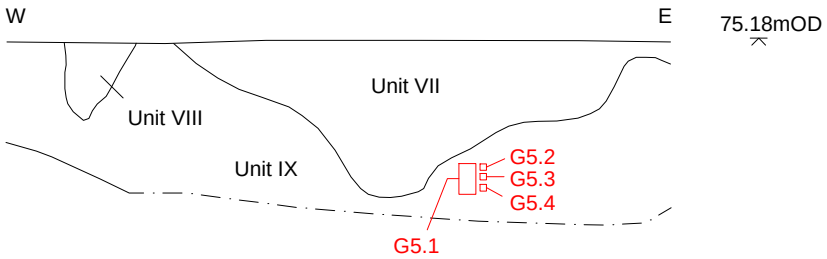


© **Archaeology South-East**		Areas 9, 10 and 11, Hermitage Quarry	Fig. 4
Project Ref: 160834	June 2017	Location of Gulls/Doline features and dry valley section G5	
Report Ref: 2017237	Drawn by: JLR		

Section 1 (upper section)



Section 2 (lower section)



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Section 1 (upper) looking south-west

Section 1 (upper) looking south-east

Section 2 (lower) looking north

© **Archaeology South-East**		Areas 9, 10 and 11, Hermitage Quarry	Fig. 5
Project Ref: 160834	June 2017	Sections and photographs of dry valley G5	
Report Ref: 2017237	Drawn by: JLR		

Gull 6

Gull 9

Gull 10

Gull 11

Gull 12

© **Archaeology South-East**		Areas 9, 10 and 11, Hermitage Quarry	Fig. 6
Project Ref: 160834	June 2017	Seclrcted photographs of Gull features	
Report Ref: 2017237	Drawn by: JLR		

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