RAMPION OFFSHORE WIND FARM

Desk-Based Assessment of Geoarchaeological Potential

Onshore Cable Route Corridor and Substation

E.ON

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1 OVERVIEW

This section outlines geoarchaeological potential for 55 identified zones along the proposed cable route study area. These zones have been identified on the basis of landform, solid and superficial geology in order to classify them according to the nature of the Quaternary sediment, likely geoarchaeological potential and suggested mitigation strategy.

This has been achieved through the generation of seven classifications of geoarchaeological sedimentary context (hereafter referred to as GSC) encountered on the proposed cable route. This characterisation was developed to provide generic information for the range of deposits likely to be encountered along the cable route and to provide suggested approaches towards investigation/mitigation ahead of and during the construction phase.

The anticipated nature and potential of each GSC has been characterised in this document on the basis of BGS geological mapping, the results of previous geotechnical and geoarchaeological studies (both local and regional) and cross-referencing with the West Sussex HER records, to define aspects of linked archaeological potential.

This document should be used in conjunction with ES Figure 25.3, maps 1 - 9. These maps show the cable route zoned into 55 separate segments and in Table.1 each segment is classified accruing to one or more GSC.

For each segment the range of deposits and potential (see Part 3), and suggested indicative methodological approach toward mitigation (see Part 4) can be generated.

Table 1: Zoned Areas of geoarchaeological potential.

GSC Zone	Solid	Superficial	GSC Code	Notes
Figure 25.3, 1 of 9				
1	Chalk	Alluvium	ADH	Beneath Modern Beach
2	Chalk	Alluvium	ADH	Beneath Made Ground
3	Chalk	Raised Beach	RDB/ADP	
4	Chalk	Head	UHD -RBD	
Figure 25.3, 2 of 9				
5	Chalk	Alluvium	ADH	
6	Chalk	Head	UHD -RBD	
7	Chalk	Head	UHD -RBD	
8	Chalk	Chalk	SSF	
9	Chalk	Head	DVD	
10	Chalk	Chalk	SSF	

GSC Zone	Solid	Superficial	GSC Code	Notes
11	Chalk	Head	DVD	
Figure 25.3, 3 of 9				
12	Chalk	Chalk	SSF	
13	Chalk	Head	DVD	
14	Chalk	Chalk	SSF	
15	Chalk	Head	DVD	
16	Chalk	Chalk	SSF	
Figure 25.3, 4 of 9				
17	Chalk	Clay-with-Flints	CWF	
18	Chalk	Chalk	SSF	
19	Chalk	Head	DVD - ADH	Alluvium in lower reaches
20	Chalk	Alluvium	ADH-ADP	Pleistocene terrace deposit will underlay Holocene alluvium
21	Chalk	Head	DVD - ADH	Alluvium in lower reaches
22	Chalk	Chalk	SSF	
Figure 25.3, 5 of 9				
23	Chalk	Head	DVD	
24	Chalk	Chalk	SSF	
25	Chalk	Head	DVD	
26	Chalk- U. Greensand - Gault	Solid	UDH - SSF	
Figure 25.3, 6 of 9				
27	Gault	Head	UDH - SSF	
28	Folkestone Beds (L.Greensand)	Head	UDH - SSF	Artefact-rich zone
29	Gault	Head	UDH - SSF	
30	Weald Clay	Alluvium	ADH - ADP	
31	Weald Clay	Weald Clay	UDH - SSF	
32	Weald Clay	Alluvium	ADH - ADP	
33	Weald Clay	Weald Clay	UDH - SSF	
Figure 25.3, 7 of 9				
34	Weald Clay	Head	UDH - ADH	Alluvium in lower reaches

GSC Zone	Solid	Superficial	GSC Code	Notes
35	Weald Clay	Weald Clay	UDH - SSF	
36	Weald Clay	Head	UDH - ADH	Alluvium in lower reaches
37	Lower Greensand	Weald Clay	UDH - SSF	
38	Lower Greensand	Head	UDH	
39	Folkestone Beds	Folkestone Beds	UDH - SSF	Artefact-rich zone
40	Folkestone Beds	Head	UDH	Alluvium in lower reaches
41	Lower Greensand	Lower Greensand	UHD- SSF	
42	Lower Greensand	Head	UDH	
43	Lower Greensand	Lower Greensand	UHD- SSF	
44	Weald Clay	Terrace Deposits	ADP	
Figure 25.3, 8 of 9				
45	Weald Clay	Terrace Deposits	ADP	
46	Weald Clay	Alluvium	ADH	
47	Weald Clay	Weald Clay	UHD	
48	Weald Clay	Alluvium	ADH	
49	Weald Clay	Weald Clay	UHD	
50	Weald Clay	Terrace Deposits	ADP	
51	Weald Clay	Weald Clay	UHD	
52	Weald Clay	Alluvium	ADH	
Figure 25.3, 9 of 9				
53	Weald Clay	Weald Clay	UHD	
54	Weald Clay	Alluvium	ADH	
55	Weald Clay	Weald Clay	UHD	

2 LANDSCAPE CONTEXT OF THE CABLE ROUTE: LANDFORMS AND GEOLOGICAL STRUCTURES (BASELINE DATA)

In order to understand and anticipate the likely distribution of GSCs along the cable route, it is first necessary to understand the overall landscape framework of the local environment. Conceptually this is best achieved by conceiving of the route as a series of landform blocks, defined in part by the underlying geology and by processes of landscape development which together have given rise to the overall structure of the environment and thus controlled the distribution of GSCs.

Four overarching processes have combined to create the landscape of the onshore cable route study area, operating to different time scales and under different climatic regimes.

2.1 Landform 1: The Wealden Anticline

Tectonic uplifting of outcropping Cretaceous rocks of the Wealden Anticline provides the fundamental structure of this landscape. From the southerly extent of the route moving northwards, the Chalk outcrops as a series of dip and scarp slopes orientated perpendicular to the axis of major Wealden anticlinorum. With a dip slope originating at sea level, this chalk climbs to a maximum height of 216m OD at Truleigh Hill before the main north facing scarp slope of the South Downs delimits the Weald. Across the Weald the cable route crosses successive outcrops of the Upper Greensand, Gault Clay and Lower Greensand which have here been folded into a local eroded anticlinal structure.

The outcrops of solid Cretaceous rock give rise to ridges and scarps preserving GSC including Head deposits (See 3.6 below) and Clay with Flints (see 3.4 below) (Gallois 1965).

2.2 Landform 2: West Sussex Coastal Plain

Marine processes of high energy erosion and low energy deposition under intertidal conditions have operated periodically on the southern limits of the cable. These processes are controlled by global temperature levels which have varied during the past half million years of the Pleistocene to give rise to 100,000 year cycles of global cooling and warming, the latter associated with sea level rise and the former with falling sea level, to a maximum drop of 150m below OD. These processes can be traced across the southern part of the cable route through the distribution of raised beach deposits and associated periglacial Head. At least one Raised Beach, dating to 250,000 years BP is known to be represented on the cable route, but both higher and lower raised beaches are possible. These processes have given rise to a distinct landform known as the West Sussex Coastal Plain, a laterally extensive area of low-lying, gently falling landscape separating the foot of the South Downs (at approximately 5m OD from the modern coastline) (Bates et al 1998; Bates and Briant 2009; Roberts and Parfitt 1999).

The West Sussex Coastal Plain preserves GSC including Raised Beach deposits (see 3.3 below) and Head deposits (see 3.6 below).

2.3 Landform 3: Dry Valleys

The landscape of the South Downs chalk escarpment, and to a lesser degree the flanks of Wealden Ridges, is characterised by incised dry valleys, so-named because they currently do not contain any water sources. However, they have the appearance of being controlled by fluvial processes, having sinuous, asymmetric profiles, and link across the West Sussex Coastal Plain with fluvial channels draining eventually into the English Channel. Undoubtedly, at periods during the Pleistocene these were parts of active fluvial systems but other processes such as gelifluction (periglacial slope movement) and snow field development have contributed immensely to their development.

The dry valleys preserve GSC including Dry Valley Deposits (see 3.5 below) and may, at their lower extents, preserve Holocene alluvium (see 3.1 below).

2.5 Landform 4: River Valleys

After the escarpment, the major landform of the cable route is the Adur Valley, a significant fluvial system draining a significant portion of the central Weald and one of four major rivers to breach the South Downs in Sussex. It has an extensive history of development having been an established fluvial river draining into the English Channel River system for at least 250,000 years. At least three terraces of preserved fluvial gravel can be identified on the flanks of its valley. The cable route crosses the River Adur through part of its course through the Chalk downlands. Here the wide, flat-bottomed profile with clearly demarked valley edges indicates an alluvial depositional regime indicating a significant estuarine depositional regime during the development of this valley (Bates 2010a; Burrin 1983; Burrin and Jones 1991; Jennings 1985; Long et al 2000; Waller and Hamilton 2000; Waller and Long 2010)

The Adur and Tarring/Brooklands fluvial channels preserve GSCs including Holocene alluvium (see 3.1 below), basal Pleistocene alluvium (see 3.2 below) and may also contain inter-digitated layers of Head/Dry Valley deposits (see 3.5 and 3.6 below).

3 GEOARCHAEOLOGICAL SEDIMENTARY CONTEXTS: CHARACTER AND POTENTIAL

The proposed cable route provides a transect across an archaeologically rich landscape characterised by diverse, but clearly definable, landforms and sedimentary contexts. As such the geoarchaeological potential of this landscape can be addressed in terms of characterisation of segments along the proposed cable route on the following criteria:

<u>Sedimentary Context</u>

Nature of the landform and depositional environment describing likely depositional regime/process, time span represented and depth.

<u>Archaeological and Palaeoenvironmental Potential</u>

Characterised on a relative low, medium, high criteria.

Archaeological potential is assessed on the basis of current knowledge of each deposit type within the region and on the basis of regional frameworks under development as part of the Kent County Council-managed South East Region Research Framework. High archaeological potential as been assessed as such either on the basis of frequency of finds within the deposits type, or on the basis of the academic significance and contexts of finds which may be rare (e.g. Palaeolithic artefacts).

Palaeoenvironmental potential has been rated on the basis of likely preservation of useful indicators (e.g. molluscs, plant macrofossils, pollen, insects or fauna). For example the palaeoenvironmental potential for alluvial deposits is rated as high, but for decalcified clay with flints, low.

<u>Vulnerability</u>

This criterion has been assessed on the basis of the likely effects of the development on the resource. ‘Low’ to ‘Moderate’ suggests that the resource is widely distributed (vertically and horizontally) and/or resistant to effects such as changes in drainage (e.g. Head Deposits), whereas ‘High’ suggest that the impact of development could significantly alter preservation conditions (e.g. of Peat deposits or anaerobic alluvium).

3.1 Alluvial Deposits (Holocene)

GSC Zoning Code: **ADH**

Extensive deep sequences of clays, silts and sands relating to a range of depositional environments including high energy, sand and gravel braided river deposits, intertidal estuarine mudflats, fine-grained fluvial low energy overbank deposits.

As part of alluvial sequences, significant and laterally extensive peat deposits may be present, representing the infilling of channels, cut off from the main fluvial regime by changing patterns of hydrology.

Archaeological Potential: Pleistocene to Modern HIGH

Palaeoenvironmental Potential: Variable but locally VERY HIGH

Vulnerability: Organic and anaerobic deposits will be at HIGH RISK

3.2 Alluvial Deposits (Pleistocene)

GSC Zoning Code: **ADP**

The flanks of the Adur Valley may preserve Pleistocene fluvial terrace deposits buried beneath overlying Head deposits or else outcropping close to the surface. These are known within the valley to be both fossiliferous, occasionally associated with Pleistocene organic palaeoenvironmental remains and Palaeolithic artefacts. The deposits will comprise high energy sands and gravels but also potential exists for low energy clay silt alluvium, localised peat preservation and inter-digitated fine and coarse-grained Head deposits of Pleistocene age.

Archaeological Potential: Pleistocene dating and human activity HIGH

Palaeoenvironmental Potential: Variable but locally HIGH

Vulnerability: If organics or faunal material is present HIGH RISK

3.3 Raised Beach Deposits

GSC Zoning Code: **RBD**

The potential for encountering Raised Beach deposits should be considered high across the entire Coastal Plain landform and to the crest of the first downland ridge. The deposits will comprise coarse to fine sands, very rounded flint gravel (with potential for exotic clasts), fine grained silts and clay of intertidal and terrestrial facies. Depending on the degree of decalcification, potential exists for the preservation of faunal remains from large mammals such as mammoth down to important invertebrate fossils. Palaeolithic artefacts have been found in the local area associated with these deposits. The deposits will in many cases be capped by Head deposits including the Brickearths of the West Sussex Coastal Plain.

Archaeological Potential: Pleistocene dating and human activity HIGH

Palaeoenvironmental Potential: Variable but locally HIGH

Vulnerability: If faunal material is present HIGH RISK

3.4 Clay with Flints

GSC Zoning Code: **CWF**

These comprise decalcified clay of varying depths resulting from the in-situ geo-chemical and subaerial weathering of remnant Tertiary Deposits and the surface of the Chalk geology. The contact between the base of Clay with Flints and the underlying Chalk is abrupt but undulating and largely controlled by solution processes. Depressions can form on the ground surface of the downland ridges as a result and become localised depositional environments.

In the Chilterns, east Kent and the Surrey North Downs these capture points have preserved Palaeolithic archaeology (Pope 2000). In rare cases refitting material has been recovered from fine-grained facies associated with larger solution structures (dolines) (Scott-Jackson 2000).

Archaeological Potential: Pleistocene dating/ human activity MODERATE

Palaeoenvironmental Potential: LOW (unless calcareous)

Vulnerability: MODERATE

3.5 Dry Valley Deposits

GSC Zoning Code: **DVD**

These comprise a wide range of deposits including Holocene colluvium (slope wash), Pleistocene gelifluction gravels (calcareous and decalcified) and basal high energy fluvial deposits (Nailbourne Deposits). Fine grained facies of silt and clay can also be found to infill periglacial ice wedge structures, both linear and polygonal) on the flanks of dry and fluvial valleys.

The colluvium represents a crucial GSC for reconstructing Holocene landscape change directly relating to the Chalk downlands and associated archaeological field monuments. The colluvium has the potential to provide records of changing vegetation, human impact on the landscape and agricultural activities through preserved plant remains, pollen, molluscs and associated human occupation material. Colluvial sequences can be several metres in depth and have complex sequences for phasing, discernable only through careful sampling.

The lower, periglacial facies have potential for palaeoenvironmental evidence (mollusc and faunal material), artefacts and sediments datable through OSL. Fine grained silts associated with periglacial structures (ice wedges, polygons) have potential to preserve in-situ artefact signatures.

Archaeological Potential: MODERATE to HIGH in colluvium.

Palaeoenvironmental Potential: MODERATE

Vulnerability: MODERATE

3.6 Undifferentiated Head Deposits (Gault Clay and Lower Greensand)

GSC Zoning Code: **UHD**

The superficial Head deposits of the Wealden geologies have been subject to little systematic study. Some Head deposits have been poorly characterised and may comprised the upper facies of unmapped fluvial sequences, some clearly originate from the Downs and may preserve calcareous micro-depositional environments.

Within the cable route study area they are of especial interest because of the clustering of Palaeolithic flintwork, some of clear Middle Palaeolithic character, along the Greensand ridges between Truleigh Hill and Henfield. In this area the Head deposits should be subjected to careful mapping, characterisation and systematic collection of flintwork. The latter will also be important for identifying undisturbed Mesolithic material with possible associated palaeoenvironmental evidence from this preferred habitat.

Archaeological Potential: MODERATE but untested

Palaeoenvironmental Potential: MODERATE but untested

Vulnerability: MODERATE

3.7 Structural Surface Features (Cretaceous Geology)

GSC Zoning Code: **SSF**

Solid geologies give rise to localised depositional contexts including solution features (hollows and dolines) and joint controlled faults and fissures (gulls). These have potential for the survival of prehistoric archaeology and palaoenvironmental potential. Their occurrence will be localised (Topley 1875; Worssam 1963; Jacobi 2007; Pope 2009)

Archaeological Potential: MODERATE but untested

Palaeoenvironmental Potential: MODERATE but untested

Vulnerability: MODERATE

4 INDICATIVE METHODOLOGICAL APPROACHES FOR GSCs

In terms of further assessment and mitigation, the following indicative methodological approaches identify archaeological remains or deposits rich in palaeoenvironmental potential.

The entire route is considered in terms of geoarchaeological potential, however large areas of surface geology mapped as essential solid would be subject to walk over survey to identify Structural Surface Features (SSF) such as solution hollows and fissures (see 3.7 above).

Should fine grained archaeology or sites be encountered through the following forms of survey, mitigation through excavation or, in the case of exceptional archaeology, preservation in-situ will be developed through consultation with West Sussex County Council (WSCC).

4.1 Alluvial Deposits (Holocene)

GSC Zoning Code: **ADH**

- Survey by borehole for the recovery of undisturbed samples for palaeoenvironmental assessment ahead of construction phase.
- Geophysical survey to establish channel structure e.g. Bates 2010
- Targeted excavation and recovery of undisturbed samples for palaeoenvironmental assessment.
- Watching brief, especially on fluvial-terrestrial interface zones identified through the borehole mapping.

4.2 Alluvial Deposits (Pleistocene)

GSC Zoning Code: **ADP**

- Machine dug geoarchaeological test pits on the flanks of the Adur Valley.
- Targeted watching brief based on mapped distribution from above.
- Recovery of undisturbed samples for palaeoenvironmental assessment.

4.3 Raised Beach Deposits

GSC Zoning Code: **RBD**

- Survey by borehole for the recovery of undisturbed samples for palaeoenvironmental assessment.
- Watching brief, especially on intertidal-terrestrial interface zones identified through the borehole mapping.

4.4 Clay with Flints

GSC Zoning Code: **CWF**

- Walk over survey after initial stripping of the cable route

- Geophysical Survey to identity potential doline features.
- Watching brief.

4.5 Dry Valley Deposits

GSC Zoning Code: **DVD**

- Excavation of cross valley transect for sampling and recording by machine prior to cable construction. Eg Bell 1983; Allen 2005.
- Excavation of buried land surfaces identified during the cutting of the transect.

4.6 Undifferentiated Head Deposits (Chalk, Gault Clay, Weald Clay and Lower Greensand)

GSC Zoning Code: **UHD**

- Walk over survey after initial stripping of the cable route.
- Geophysical Survey to identity potential doline features.
- Targeted excavation of structural features identified.
- Watching brief.

4.7 Structural Surface Features (Cretaceous Solid Geology)

GSC Zoning Code: **SSF**

- Walk over survey after initial stripping of the cable route.
- Targeted excavation of structural features identified.
- Watching brief.

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