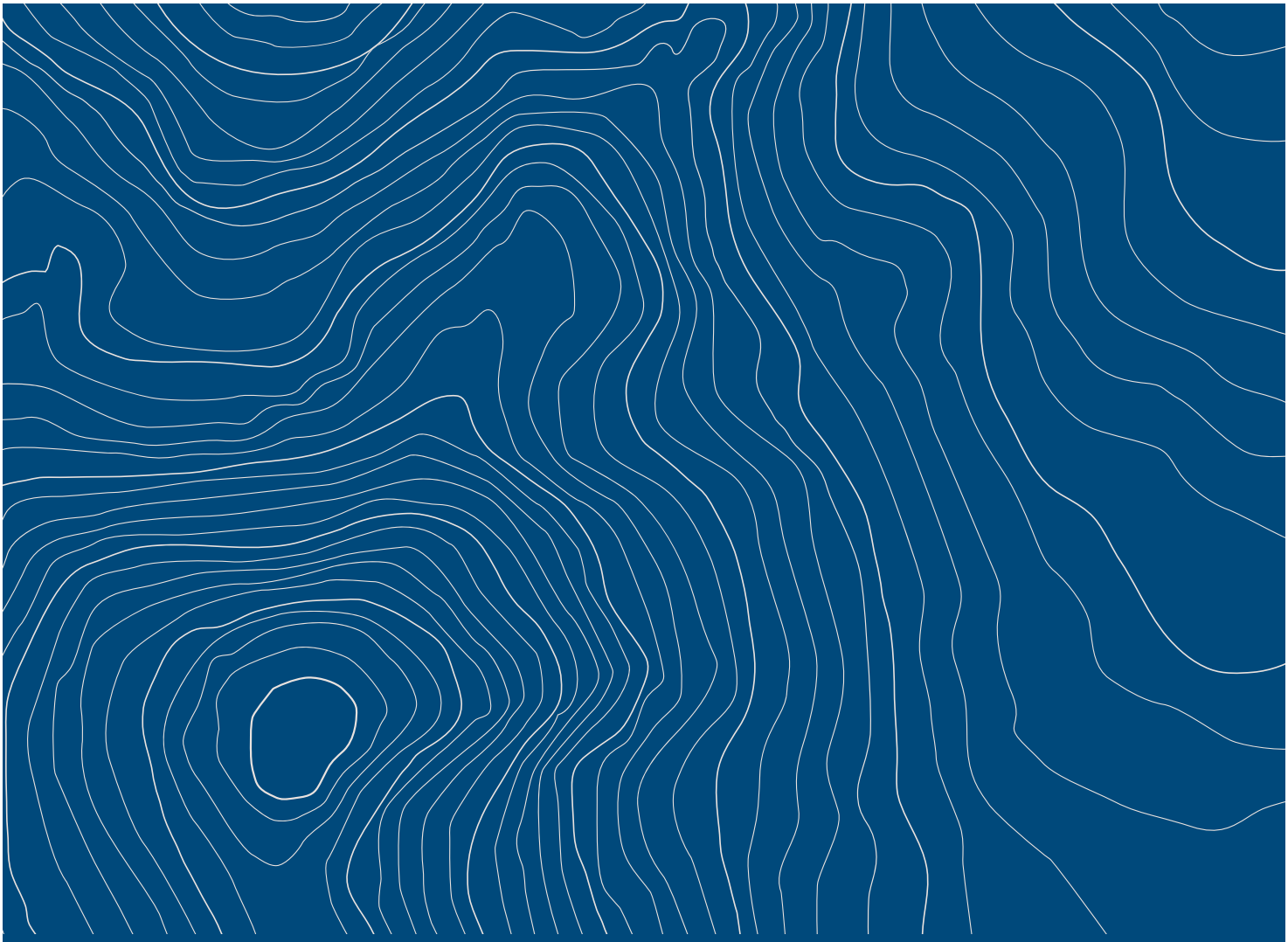

DublinArray
Generation for generations

EIAR Volume 4: Offshore Infrastructure
Technical Appendices
Appendix 4.3.13-2
Stage 1 Geoarchaeological Report

Kish Offshore Wind Ltd

RWE SLR GoBe APEM Group

www.dublinarray-marineplanning.ie

Dublin Array Offshore Wind Farm EIAR

Stage 1 Geoarchaeological Report

Date: December 2021

Revision: 1

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Glossary

Term	Definition
Before Present (BP)	The specified number of years before AD 1950, used in radiocarbon dating.
Dublin Array	The proposed Dublin Array offshore wind farm project; the term covers all elements within the proposed development, both onshore and offshore.
Export Cable Corridor (ECC)	The specific corridor of seabed, seaward of Mean High Water Springs (MHWS), within which the export cables will be located.
Holocene	Period of time that followed the Pleistocene, beginning around 11,700 BP and continues through to the present. It is the second of two epochs in the Quaternary.
Last Glacial Maximum (LGM)	The most recent time during the Pleistocene that the ice sheets were at their greatest extents. In Britain and Ireland this is dated to between 34,000 BP and 12,000 BP.
Mesolithic	Prehistoric period dating from 10,000 BP to 4000 BP.
Pleistocene	Period of time, known as the 'Ice Age', that began approximately 2.6 million years ago and lasted until 11,700 year ago. It is the first of two epochs in the Quaternary.
Quaternary	Unit of time in the geological history of the earth, beginning *c.* 2.6 million years ago and continuing through to the present day.

Acronym	Definition
BIIS	British-Irish Ice Sheet
BC	Before Christ
BP	Before Present
BSB	Below Seabed
CD	Chart Datum
COWRIE	Collaborative Offshore Wind Research into the Environment
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assesment Report
IGH	Irish Geological Heritage Programme
ISB	Irish Sea Basin
ISIS	Irish Sea Ice Stream
LGM	Last Glacial Maximum
MA	Maritime Archaeology Ltd.

OD	Ordnance Datum
RSL	Relative Sea-level

1 Non-technical summary

1.1.1 Maritime Archaeology (MA) has been commissioned by GoBe Consultants on behalf of Saorgus Energy Ltd and Innogy Renewables Ireland Ltd (a wholly owned subsidiary of Innogy SE) (the Applicant) to provide a geoarchaeological assessment of the existing borehole data from the offshore study area related to the Dublin Array Offshore Wind Farm (Dublin Array), prior to the preparation of the updated Environmental Impact Assessment Report (EIAR).

1.1.2 This report reviews the project-specific borehole logs collected during geotechnical investigations by Glover Site Investigations Ltd in September 2008 ahead of the original Environmental Impact Statement (EIS) (Saorgus Energy Limited, 2013a; 2013b). The existing logs will be used in order to generate geoarchaeological data in support of the updated EIA.

1.1.3 During this assessment it was concluded that the core logs assessed in this report do not contain evidence of geoarchaeological potential. The glacial deposits that were identified likely consist of silty reworked sand as a result of the hydrodynamic environment of the Kish and Bray Banks.

1.1.4 No further work is recommended on the three cores assessed for this report, however as there is potential to impact deposits of archaeological importance in the area, future geotechnical works should observe the national regulations ahead of such works. It is therefore recommended by Maritime Archaeology that there is a commitment from the Client to ensure that an archaeological method statement is produced ahead of any further geotechnical campaigns to ensure that a staged geoarchaeological assessment can take place.

2 Introduction

2.1 Project background

2.1.1 Dublin Array is located on the Kish and Bray Banks, approximately 10 km off the east coast of Ireland, immediately south of Dublin. Dublin Array has a proposed electrical generating capacity of up to 1 GW. The offshore wind farm will be located within an area of 54 km², in water depths ranging from 2 to 30 m. The project is being developed under the names of Kish Offshore Wind Ltd and Bray Offshore Wind Ltd.

2.1.1 The project was initially developed by Saorgus Energy Ltd, a privately-owned Irish company specialising in the development of large wind energy sites in Ireland. However, in March 2018 Innogy Renewables Ireland Ltd entered into a 50:50 partnership with Saorgus Energy to take the project forward. In July 2020 the global renewable energy portfolios of E.ON and innogy combined to form a new company called RWE Renewables.

2.1.2 RWE Renewables is wholly owned by RWE AG. It is one of four subsidiary companies which also include RWE Generation, RWE Power and RWE Supply and Trading. RWE Renewables is a leading global renewable energy company, with more than 3,500 employees and activities in 15 countries globally. RWE Renewables has considerable experience in developing, constructing and operating renewables assets both independently, and together with project partners and investors. It invests in a broad range of technologies and has experience with onshore and offshore wind, hydro power, solar, battery storage and research and development (R&D) phase technologies. RWE Renewables is the second largest offshore wind developer in the world and the third largest renewable energy company in Europe.

2.1.3 RWE Renewables built and now operates the United Kingdom's (UK) first ever commercial scale wind farm, North Hoyle which it completed in 2004. RWE Renewables currently has over 2.5GW of offshore wind projects in operation internationally. The project study area comprises the Wind Farm Area, and the Export Cable Corridor (ECC) up to MHWS (as illustrated in Figure 1). This is to ensure overlap with the onshore archaeological works.

2.2 Archaeological background

2.2.4 An archaeological baseline assessment was previously undertaken by Headland Archaeology (2012) ahead of the Environmental Impact Statement (EIS) which was prepared and submitted in 2013 (Saorgus Energy Limited 2012; 2013a; 2013b).

2.2.5 The archaeological assessment was undertaken within the proposed study area of Dublin Array, both onshore and offshore of the south Dublin and north Wicklow coast. The assessment included: a review of readily available literary and cartographic sources; an assessment of side scan sonar and offshore magnetometer data; a site visit; and an outline of recommended further archaeological work; no geoarchaeological work was undertaken.

2.2.6 An updated marine archaeological baseline assessment has been developed (Volume 5 Chapter 13: Technical Baseline Report Marine Archaeology, Maritime Archaeology, 2021) ahead of the EIAR.

2.3 Aims and objectives

2.3.7 The primary aim of this report is to review previously collected project-specific geotechnical data in order to generate geoarchaeological data in support of the updated EIAR.

2.3.8 The objectives this geoarchaeological assessment are to:

- undertake an initial interpretation of the submerged deposits in relation to known information on archaeology and palaeoenvironment within the study area;
- characterise the potential for submerged terrestrial deposits and prehistoric features of archaeological importance in the area of impact;
- put forward proposals for further analysis or dating of the recovered core material.

3 Baseline review

3.1.1 In this section, the geological history of the site and surrounding region will be discussed in order to provide context and inform conclusions with respect to the potential for encountering archaeological deposits (Pleistocene or Holocene) within the study area.

3.1.2 The Dublin Array Offshore Wind Farm is located in the western Irish Sea Basin (ISB), approximately 10km off the Dublin and Wicklow coast. The project-specific boreholes collected and assessed for environmental indicators were recovered from the northern area of the wind farm on the Kish Bank (Figure 1).

3.1.3 During the Quaternary, much of Northern Europe experienced extensive ice-sheet cover during a number of glaciation events. The most recent of these glacial events was in the Last Glacial Maximum (LGM), *c.* 34,000 BP to 12,000 BP (Clark *et al.* 2012; Chiverrell *et al.* 2013). During this event, an ice-sheet, known as the British-Irish Ice Sheet (BIIS) merged across much of Britain and Ireland. The BIIS began forming in the northern and upland area before advancing across the landscape, marine and terrestrial, creating various glacial environments where sediments were deposited or eroded depending on the stage of ice sheet advance or retreat (Scourse *et al*. 2019).

3.1.4 The BIIS extended into the Celtic Sea to reach its maximum limits *c.* 25.3-24.5 ka, before collapsing with rapid marginal retreat to the northern Irish Sea Basin (ISB) (Chiverrell *et al*. 2018). This retreat was largely a result of the Irish Sea Ice Stream (ISIS), the largest marine terminating ice stream draining the former BIIS. The main axis of the ISIS flowed from north to south through the ISB, with catchment areas in southern Scotland, northern England, Ireland and Wales (Scourse *et al.* 2019).

3.1.5 The retreat of the ISIS is the primary agent responsible for the glacial stratigraphy and geomorphology of the current ISB (Chiverrell *et al.* 2013). Significant amounts of sediment were eroded and reworked with variable thicknesses of glaciogenic deposits, referred to as 'Irish Sea Till', forming (Eyles and McCabe, 1989). These deposits are composed of shelly, grey and muddy, unsorted sediments with some angular clasts. By approximately 22,500 – 21,200 years BP ice had retreated to a line just south of the Study Area. Ice sheet decay slowed thereafter with episodic meltwater discharge (Chiverrell *et al.* 2013).

3.1.6 Following the retreat of the BIIS, relative sea-level rose *c.* 120m globally and the climate warmed at approximately 11,200 BP, the beginning of the Holocene period. Large areas of habitable land emerged and palaeogeographic and relative sea-level models have indicated that the Study Area could have been a terrestrial landscape as early as 11,000 BP (Sturt *et al*. 2013) through to 7,500 BP (Shennan *et al*. 2008).

3.1.7 These expanses of land exploited by humans and animals were subsequently inundated and the palaeolandscapes were preserved beneath the Irish Sea. These landscapes are believed to be similar to those in the North Sea, which have been extensively researched (Gaffney *et al.* 2007, Gaffney *et al.* 2009; Lost Frontiers Project 2015-2020*)*. Until recently, it was only areas of the eastern Irish Sea that were surveyed as part of the West Coast Palaeolandscapes Project (Fitch *et al.* 2011). In 2018, the Irish Sea was surveyed by the Lost Frontiers Project, however data and subsequent interpretations are yet to be published.

3.1.8 Within the Study Area intertidal mud deposits have been recorded buried beneath the Kish Bank, *c.* -30m to -35m below Chart Datum (CD), indicating the presence of palaeoshorelines (Westley and Edwards 2017: 265). Furthermore, evidence for *in situ* intertidal peat beds and a submerged forest have been recorded *c.* 1km south of the Study Area, near Bray Harbour, Co. Wicklow. The remains of the submerged forest were first discussed by Praegar (1896), in which he describes 'some stumps and boughs of trees […] embedded in a compact layer of peat' (Praegar, 1896: 155). Bolton re-surveyed this submerged forest in 1999, however, only three trees were partially exposed. Samples obtained from the trees returned a radiocarbon date of 6,180 (+/- 80) years BP (early Neolithic). In 2001 the beach levels dropped by an average of 1m and this time 35 trees were exposed at low tide. However, no samples were taken. This site was also listed in Brooks and Edwards (2006) Ireland sea-level database, with samples taken dated to 7432-7832 cal. BP (late Mesolithic) and the palaeoshore mean sea level listed as -3.6m (Mitchell, 1976).

3.1.9 Further to this, a side scan sonar and magnetometer survey carried out in 2009 in advance of the Environmental Impact Statement (Saorgus Energy Limited 2012; 2013a; 2013b) indicated a dark area that may represent a relict submerged landscape within the Study Area (Headland Archaeology, 2009: Appendix 11). Based on the abovementioned RSL models, this is possibly dated from the mid to late Mesolithic period.

3.1.10 The maximum marine transgression occurred around 6000 BP, at the onset of the Neolithic period, with sea level rising to as much as 4m above the current sea level in many coastal areas (Waddell, 1998).

3.1.11 There are two Geological Heritage areas, as set out by the Irish Geological Heritage Programme (IGH), within the Study Area and wider area. The first is a natural well created by a hydrological phenomenon located on Dalkey Island (Site code DLR006). The second is located along the Killiney foreshore by the Shanganagh Cliffs, where deposits of Quaternary till, lain down *c.*20,000 years ago as a result of subglacial deposit movement, are evidenced (Site code DLR007).

4 Methodology

4.1 Geotechnical investigations

4.1.1 The geotechnical investigations were undertaken by Glover Site Investigations from the 13th to 26th of September 2008. A total of three boreholes were collected by means of cable percussion boring methods. The seabed levels at the location of the boreholes ranged from 4.5m-13.1m bCD.

4.1.2 The boreholes were drilled with a Dando 2000 rig using shell and auger techniques from a large jack-up vessel capable of working in 28m of water. The jack-up was moved to the site by means of a large tug. The diameter of the bore was 200mm, using temporary casing and boring tools and extending to a maximum of 20m (Glover Site Investigations, 2008).

4.1.3 Sediments samples were logged (Appendix 1) and collected as bulk and or bag samples and taken back to the laboratory for further testing (Glover Site Investigations, 2008).

4.2 Geoarchaeological assessment

4.2.4 There is currently no published Irish guidance for geoarchaeological investigations and assessments available for geotechnical material collected in the offshore zone, however guidance published in *the European Journal of Sustainable Development* (2014) on Geotechnical Field and Laboratory Investigation Procedures Pertinent to the Development of Commercial On-Shore Wind Farms in Ireland (Quille, 2014) has been followed for this report.

4.2.5 It should be noted that the above guidance only refers to geotechnical investigations for onshore windfarms. Therefore, the methodology for the assessment of marine geotechnical core logs for deposits of archaeological potential has been formulated according to staged approach as described in UK guidance documents published by The Crown Estate (2010), Collaborative Offshore Wind Research into the Environment (COWRIE, 2011), and English Heritage (2011). The UK guidance for archaeological assessments has been chosen on basis of its close geographical, historical and cultural links as well as the recent increase in offshore renewable wind projects fully incorporating marine archaeological studies in the EIAR processes.

4.2.6 The proposed staged approach is composed of the following elements:

- Stage 1 – Desk Based Assessment: Archaeological review of geotechnical logs (This report)
- Stage 2 – Splitting and recording geotechnical cores
- Stage 3 – Sub-sampling and assessment
- Stage 4 – Analysis and dating

4.2.7 This project format is designed to flow sequentially with each phase leading to the subsequent phase of work, or representing the end of the assessment if the findings of any stage show that no further work is necessary.

4.2.8 Geotechnical data can support the characterisation of the seabed geology and morphology. The information can contribute towards understanding the geomorphological evolution of a landscape prior to and during inundation. This, in turn, can help focus attention on areas with the highest archaeological potential. This is achieved through the identification and analysis of:

- Microfossils such as pollen (used as a regional proxy indicator);
- Macrofossils such as insect, rodent and mollusc remains, as well as waterlogged plant remains including seeds and wood (all site-specific indicators which provide comment on vegetation type, rates of change etc.);
- Foraminifera, molluscs and diatoms provide data on coastal sites, sea-level rise as well as global climate change. Foraminifera and diatoms should ideally be analysed in conjunction with each other; and
- The collection of material suitable for dating, such as: radiocarbon dating, optically stimulate luminescence (OSL), electron spin resonance (ESR), amino acid racemisation (AAR), palaeomagnetism, event stratigraphy, biostratigraphy and/or lithostratigraphy dating (to provide a site chronology).

4.2.9 The geoarchaeological assessment for Dublin Array was undertaken based on the data provided by the appointed geotechnical contractor, Glover Site Investigations, in three core logs (Appendix 1). The logs were assessed by Maritime Archaeology for the potential to contain archaeological or paleoenvironmental material.

4.2.10 The documentary evidence was assessed stratigraphically for each individual borehole. The results were then reviewed against the current knowledge of the geomorphological sediments within the proposed development area to improve the understanding of the deposits represented within the cores. The results of this geoarchaeological assessment are presented in Section 5.

5 Results

5.1.1 The three boreholes collected represent the Kish Bank area of the planned turbine locations. No cores from the ECC or the Bray Bank were collected in the 2008 geotechnical campaign and therefore no cores from this area have been assessed. The location of the cores was determined based on engineering requirements.

5.1.2 The general geology of the area, as understood from British Geological Survey maps (Geological Survey of Ireland, 2014), is bedrock consisting of Lower and Middle to upper Jurassic mudstone, sandstone and evaporite overlain by Quaternary glacial deposits comprising Late Pleistocene to Early Holocene sands and gravels.

5.1.3 The boreholes assessed do not penetrate further down than 20m below the sea bed (mBSB) and show that only the upper deposits, consisting of marine slightly silty sand deposits, have been retrieved (Glover Site Investigations, 2008). The logs demonstrate that the firmness of the sediment increases with depth, with loose silty sand closer to the surface and very firm sand at greater depths (as summarised in Table 1). The hydrodynamic environment of the Kish and Bray Banks means that the surface sand layers are active, constantly mobilised and deposited during successive tidal cycles at varying depths (Wheeler *et al.* 2000). Therefore, the deposits analysed in this report are expected to have been excessively reworked as a result of this mobility.

5.1.4 Quaternary glacial deposits comprising Late Pleistocene to Early Holocene sands and gravels are of very limited archaeological or geoarchaeological potential, which is why no further work is recommended on the bulk and bag samples collected as further discussed in Section 6.

5.1.5 However, as stated above, intertidal mud deposits have been recorded buried beneath the Kish Bank, *c.* -30m to -35m bCD, indicating the presence of palaeoshorelines (Westley and Edwards 2017: 265). Therefore, further coring has the potential to reach and expose these archaeologically important deposits. Furthermore, the core data has not indicated any potential to contain glacial till (boulder clay), which overlays sandy deposits further inshore towards Dublin Bay and Killiney Bay, as discussed in Section 3.

5.1.6 This report has generated geoarchaeological data by assessing geotechnical data in support of the palaeogeographic interpretation and has concluded that the cores do not hold geoarchaeological potential.

5.1.7 An initial interpretation of the submerged deposits in relation to known information on archaeology and palaeoenvironment within the development area has been undertaken and presented in Sections 3 and 5.

5.1.8 The potential for submerged terrestrial deposits and prehistoric features of archaeological importance in the area of impact based on the understanding of the collected material has deemed that the deposits retained are of no geoarchaeological interest.

5.1.9 As the conclusion is that there is no archaeological potential within the core material, no further work is recommended to be undertaken on the deposits.

Table 1 – Summary of geotechnical boreholes collected by Glover Site Investigations (2008)

Core ID	Depth (mBSB)	Depth (mCD)	Soil description	Easting (UTM)	Northing (UTM)	Comments
BH01	0.00-3.00	-4.5 to -7.5	Loose grey silty fine to medium SAND with a trace of fine gravel and occasional shells	704193	5909287	Seabed was -4.50m (bCD). Casing diameter was 200mm, 20m in length.
	3.00-10.00	-7.5 to -14.5	Dense grey silty fine to coarse SAND with a trace of fine to medium gravel and occasional shells			
	10.00-15.00	-14.5 to -19.5	Dense grey slightly silty fine to medium SAND with occasional shells			
	15.00-20.00	-19.5 to-24.5	Very dense grey slightly silty to fine medium SAND with occasional shells			
BH02	0.00-3.20	-13.1 to -16.3	Medium dense grey slightly silty fine to medium SAND with occasional cobbles	704617	5905637	Seabed was -13.10m (bCD). Casing diameter was 200mm, 19.10m in length.
	3.20-10.00	-16.3 to -23.1	Dense grey slightly silty fine to medium SAND with a trace of fine gravel and occasional shells			
	10.00-12.00	-23.1 to -25.1	Dense grey slightly silty fine to medium SAND with occasional shells			
	12.00-19.10	-25.1 to -32.2	Very dense grey slightly silty fine to medium SAND with occasional shells			

Core ID	Depth (mBSB)	Depth (mCD)	Soil description	Easting (UTM)	Northing (UTM)	Comments
BH03	0.00-6.00	-7.30 to -13.3	Medium dense grey silty fine to medium SAND with occasional shells	705549	5905637	Seabed was -7.30m (bCD). Casing diameter was 200mm, 20m in length.
	6.00-10.00	-13.3 to -17.3	Very dense grey slightly silty fine to medium SAND with occasional shells			
	10.00-12.30	-17.3 to -19.6	Dense grey slightly silty fine to medium SAND with occasional shells			
	12.30-20.00	-19.6 to -27.3	Very dense grey slightly silty fine to medium SAND with occasional shells			

6 Conclusions and recommendations

6.1.1 In conclusion, the core logs assessed in this report do not contain evidence of geoarchaeological potential. As discussed in Section 5, the glacial deposits that were identified likely consist of silty reworked sand as a result of the hydrodynamic environment of the Kish and Bray Banks.

6.1.2 Despite the potential to successfully date the shell inclusions within the deposits, the results of such dating would not contribute to an increased understanding of the geoarchaeological potential in the area. It would also not be possible to distinguish the stratigraphy of such material, partly because of the reworking of the deposits as further discussed above, but also because of the approach taken when retaining the samples, effectively rendering the data inadequate.

6.1.3 No further work is recommended on the three cores assessed for this report and the staged approach as described in Section 4 is expected to stop at Stage 1. Should further core samples be collected from the study area it is recommended that an archaeological Method Statement is produced to ensure that important geoarchaeological information is collected and a staged approach to the assessment of deposits is included.

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8 Figures

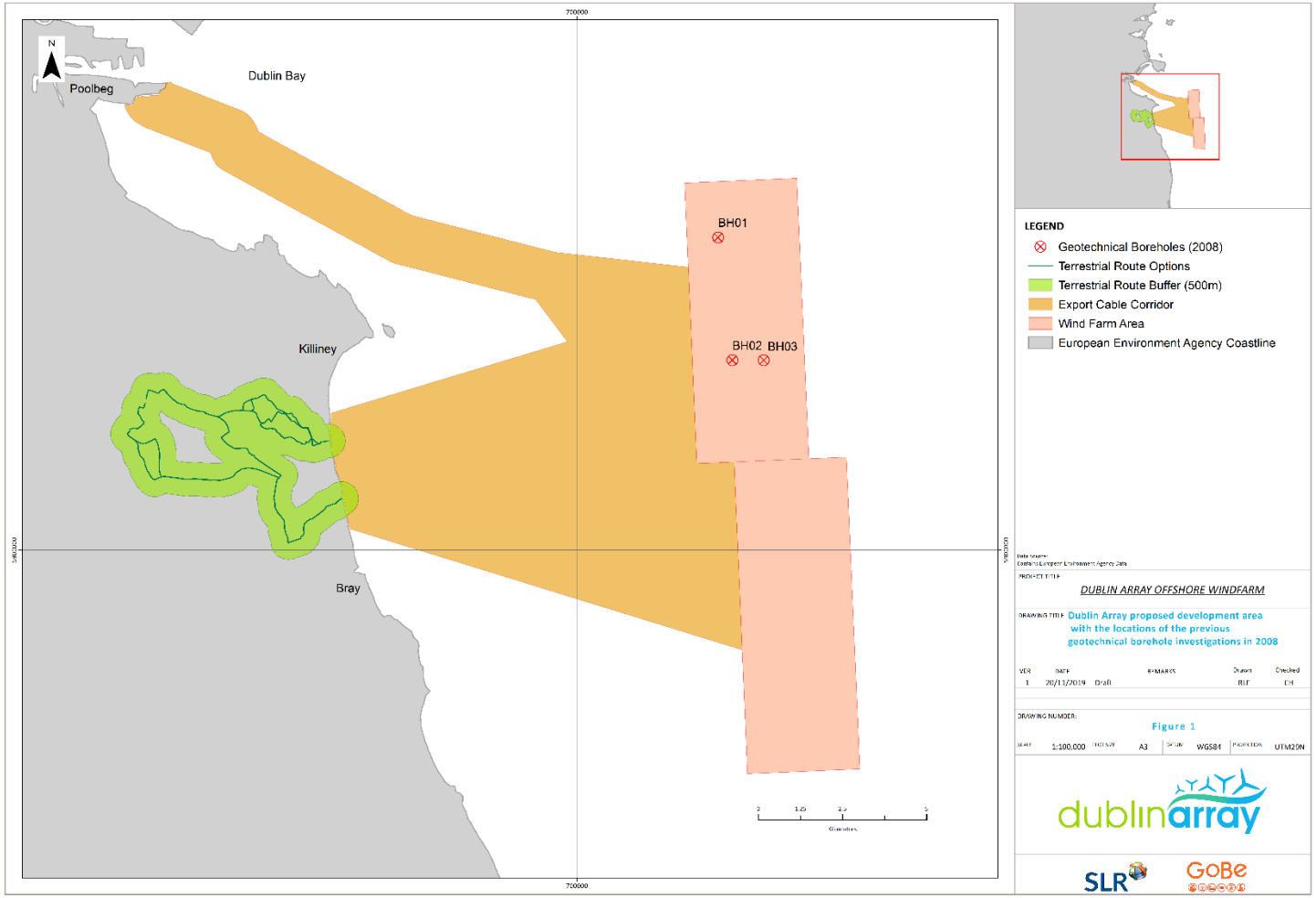

Figure 1 Map of the development area and core locations

Appendix 1 Core Logs by Glover Site Investigations (2008)

Glover Site Investigations Ltd

Site	Borehole Number
Proposed Windfarm Kish & Bray Banks off Co Dublin and Co Wicklow	BH01

Boring Method	Casing Diameter	Ground Level (mCD)	Client	Job Number
Cable Percussion	200mm cased to 20.00m	-4.50	Saorgus Energy Ltd	08-0585
	Location	**Dates**	**Engineer**	**Sheet**
	337649.9 E 228972 N	13/09/2008-16/09/2008		1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mCD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.45 0.00	SPT N=7 B			1,2/1,2,2,2			Loose grey silty fine to medium SAND with a trace of fine gravel and occasional shells		
1.00-1.45 1.00	SPT N=8 B			2,2/2,2,2,2		(3.00)			
2.00-2.45 2.00	SPT N=8 B			1,2/1,2,3,2					
3.00-3.45 3.00	SPT N=43 B			5,6/9,10,12,12	-7.50	3.00	Dense grey silty fine to coarse SAND with a trace of fine to medium gravel and occasional shells		
4.00-4.45 4.00	SPT N=37 B			6,7/8,9,10,10					
5.00-5.45 5.00	SPT N=45 B			5,7/9,10,13,13					
6.00-6.45 6.00	SPT N=43 B			4,7/9,9,12,13		(7.00)			
7.00-7.45 7.00	SPT N=38 B			6,8/8,9,10,11					
8.00-8.45 8.00	SPT N=36 B			5,6/8,9,10,9					
9.00-9.45 9.00	SPT N=33 B			4,8/8,9,7,9					
10.00-10.45	SPT N=36			5,6/7,8,10,11	-14.50	10.00			

Remarks	Scale (approx)	Logged By
	1:50	dc/kl
	Figure No. 08-0585.BH01	

Glover Site Investigations Ltd

Site Proposed Windfarm Kish & Bray Banks off Co Dublin and Co Wicklow			**Borehole Number** BH01
Boring Method Cable Percussion	**Casing Diameter** 200mm cased to 20.00m	**Ground Level (mCD)** -4.50	**Client** Saorgus Energy Ltd	**Job Number** 08-0585
	Location 337649.9 E 228972 N	**Dates** 13/09/2008-16/09/2008	**Engineer**	**Sheet** 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mCD)	Depth (m) (Thickness)	Description	Legend	Water
10.00	B						Dense grey slightly silty fine to medium SAND with occasional shells		
11.00-11.45 11.00	SPT N=42 B			5,7/8,10,11,13					
12.00-12.45 12.00	SPT N=37 B			3,6/8,8,9,12		(5.00)			
13.50-13.95 13.50	SPT N=37 B			5,7/8,9,10,10					
15.00-15.45 15.00	SPT N=62 D			7,10/12,15,17,18	-19.50	15.00	Very dense grey slightly silty fine to medium SAND with occasional shells		
16.50-16.95 16.50	SPT N=65 D			8,11/12,16,18,19		(5.00)			
18.00-18.45 18.00	SPT N=56 D			7,10/12,13,15,16					
19.50-19.95 19.50	SPT N=51 D			8,9/10,13,14,14			Complete at 20.00m		
					-24.50	20.00			

Remarks

Scale (approx)	Logged By
1:50	dc/kl

Figure No. 08-0585.BH01

Glover Site Investigations Ltd

Site Proposed Windfarm Kish & Bray Banks off Co Dublin and Co Wicklow			**Borehole Number** BH02
Boring Method Cable Percussion	**Casing Diameter** 200mm cased to 19.10m	**Ground Level (mCD)** -13.10	**Client** Saorgus Energy Ltd	**Job Number** 08-0585
	Location 338022.6 E 225316.9 N	**Dates** 21/09/2008-26/09/2008	**Engineer**	**Sheet** 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mCD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.45 0.00	SPT N=14 B			1,2/3,3,3,5			Medium dense grey slightly silty fine to medium SAND with occasional cobbles		
1.00-1.45 1.00	SPT N=13 B			2,2/3,2,4,4		(3.20)			
2.00-2.45 2.00	SPT N=17 B			3,4/3,5,4,5					
3.00-3.45 3.00	SPT N=51 B			5,7/9,11,14,17	-16.30	3.20	Dense grey slightly silty fine to medium SAND with a trace of fine gravel and occasional shells		
4.00-4.45 4.00	SPT N=42 B			4,7/8,10,12,12					
5.00-5.45 5.00	SPT N=41 B			5,6/8,10,11,12					
6.00-6.45 6.00	SPT N=67 B			7,8/11,15,18,23		(6.80)			
7.00-7.45 7.00	SPT N=48 B			6,8/10,12,12,14					
8.00-8.45 8.00	SPT N=47 B			7,9/10,12,13,12					
9.00-9.45 9.00	SPT N=47 B			6,8/10,13,12,12					
10.00-10.45	SPT N=44			6,7/10,11,12,11	-23.10	10.00			

Remarks

Scale (approx)	Logged By
1:50	DC/KL

Figure No. 08-0585.BH02

Glover Site Investigations Ltd

Site Proposed Windfarm Kish & Bray Banks off Co Dublin and Co Wicklow			**Borehole Number** BH02
Boring Method Cable Percussion	**Casing Diameter** 200mm cased to 19.10m	**Ground Level (mCD)** -13.10	**Client** Saorgus Energy Ltd	**Job Number** 08-0585
	Location 338022.6 E 225316.9 N	**Dates** 21/09/2008-26/09/2008	**Engineer**	**Sheet** 2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mCD)	Depth (m) (Thickness)	Description	Legend	Water
10.00	B						Dense grey slightly silty fine to medium SAND with occasional shells		
11.00-11.45 11.00	SPT N=40 B			7,8/9,9,10,12		(2.00)			
12.00-12.45 12.00	SPT N=60 B			8,10/13,15,16,16	-25.10	12.00	Very dense grey slightly silty fine to medium SAND with occasional shells		
13.50-13.95 13.50	SPT N=61 B			10,13/14,15,16,16					
15.00-15.45 15.00	SPT N=56 B			8,11/12,12,16,16		(7.10)			
16.50-16.95 16.50	SPT N=62 B			7,10/13,15,16,18					
18.00-18.45 18.00	SPT N=57 B			9,11/12,14,15,16					
					-32.20	19.10	Complete at 19.10m		

Remarks

Scale (approx)	Logged By
1:50	DC/KL

Figure No. 08-0585.BH02

Glover Site Investigations Ltd

Site	Borehole Number
Proposed Windfarm Kish & Bray Banks off Co Dublin and Co Wicklow	BH03

Boring Method	Casing Diameter	Ground Level (mCD)	Client	Job Number
Cable Percussion	200mm cased to 20.00m	-7.30	Saorgus Energy Ltd	08-0585
	Location: 338954.6 E 225303.1 N	Dates: 17/09/2008-19/09/2008	Engineer	Sheet: 1/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mCD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.45 0.00	SPT N=17 B			2,3/4,5,4,4			Medium dense grey silty fine to medium SAND with occasional shells		
1.00-1.45 1.00	SPT N=15 B			3,3/3,4,5,3					
2.00-2.45 2.00	SPT N=14 B			2,3/3,3,4,4					
3.00-3.45 3.00	SPT N=14 B			2,2/3,4,3,4		(6.00)			
4.00-4.45 4.00	SPT N=15 B			3,3/3,4,4,4					
5.00-5.45 5.00	SPT N=16 B			3,4/3,4,4,5					
6.00-6.45 6.00	SPT N=68 B			7,12/13,16,18,21	-13.30	6.00	Very dense grey slightly silty fine to medium SAND with occasional shells		
7.00-7.45 7.00	SPT N=54 B			8,10/11,13,15,15					
8.00-8.45 8.00	SPT N=53 B			9,10/11,13,13,16		(4.00)			
9.00-9.45 9.00	SPT N=51 B			8,11/10,10,13,18					
10.00-10.45	SPT N=43			7,8/9,10,12,12	-17.30	10.00			

Remarks	Scale (approx)	Logged By
	1:50	DC/KL
	Figure No. 08-0585.BH03	

Glover Site Investigations Ltd

Site	Borehole Number
Proposed Windfarm Kish & Bray Banks off Co Dublin and Co Wicklow	BH03

Boring Method	Casing Diameter	Ground Level (mCD)	Client	Job Number
Cable Percussion	200mm cased to 20.00m	-7.30	Saorgus Energy Ltd	08-0585
	Location	**Dates**	**Engineer**	**Sheet**
	338954.6 E 225303.1 N	17/09/2008-19/09/2008		2/2

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mCD)	Depth (m) (Thickness)	Description	Legend	Water
10.00	B						Dense grey slightly silty fine to medium SAND with occasional shells		
11.00-11.45 11.00	SPT N=42 B			6,7/9,10,11,12		(2.30)			
12.00-12.45 12.00	SPT N=54 B			3,4/5,15,16,18	-19.60	12.30			
							Very dense grey slightly silty fine to medium SAND with occasional shells		
13.50-13.95 13.50	SPT N=55 B			8,9/12,13,14,16					
15.00-15.45 15.00	SPT N=65 B			9,11/13,16,18,18					
						(7.70)			
16.50-16.95 16.50	SPT N=57 D			7,10/12,15,14,16					
18.00-18.45 18.00	SPT N=58 D			10,11/13,14,16,15					
19.50-19.95 19.50	SPT N=66 D			10,14/15,17,16,18			Complete at 20.00m		
					-27.30	20.00			

Remarks

Scale (approx)	Logged By
1:50	DC/KL

Figure No. 08-0585.BH03