East Anglia TWO Offshore Windfarm

Outline Landfall Construction Method Statement

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Table of Contents

1	**Introduction**	**1**
1.1	Overview	1
1.2	Landfall Site Description	2
1.3	Rationale for Use of Trenchless Technique at Landfall	3
3	**Geotechnical Investigations**	**4**
4	**Design**	**6**
5	**Drilling Methodology**	**7**
5.1	DCO Compliance	7
5.2	Site Set Up	7
5.3	Excavations	8
5.4	HDD Drilling	8
5.5	Working Hours	9
6	**Drilling Fluid**	**10**
6.1	Purpose of Drilling Fluid	10
6.2	Drilling Fluid Management	10
6.3	Measures to Prevent Drilling Fluid Break-Out	10
6.4	Bentonite Mud Break-Out Response Planning	11
7	**Potential Environmental Effects of Bentonite Mud Break-Out**	**13**
7.1	Leiston-Aldeburgh Site of Special Scientific Interest	13
7.2	Consideration of Potential Impacts	13
8	**Cliff Stability**	**16**
9	**References**	**18**
Appendix 1:	**Figures**	**19**

Glossary of Acronyms

Cefas	Centre for Environment Fisheries and Aquaculture Science
DCO	Development Consent Order
HDD	Horizontal Directional Drill
OSPAR	Oslo/Paris Convention (for the Protection of the Marine Environment of the North-East Atlantic)
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest

Glossary of Terminology

Applicant	East Anglia TWO Limited.
Construction consolidation sites	Compounds associated with the onshore works which may include elements such as hard standings, lay down and storage areas for construction materials and equipment, areas for vehicular parking, welfare facilities, wheel washing facilities, workshop facilities and temporary fencing or other means of enclosure.
East Anglia TWO project	The proposed project consisting of up to 75 wind turbines, up to four offshore electrical platforms, up to one construction, operation and maintenance platform, inter-array cables, platform link cables, up to one operational meteorological mast, up to two offshore export cables, fibre optic cables, landfall infrastructure, onshore cables and ducts, onshore substation, and National Grid infrastructure.
Horizontal directional drilling (HDD)	A method of cable installation where the cable is drilled beneath a feature without the need for trenching.
HDD temporary working area	Temporary compounds which will contain laydown, storage and work areas for HDD drilling works.
Landfall	The area (from Mean Low Water Springs) where the offshore export cables would make contact with land and connect to the onshore cables.
Offshore export cables	The cables which would bring electricity from the offshore electrical platforms to the landfall. These cables will include fibre optic cables.
Offshore cable corridor	This is the area which will contain the offshore export cables between offshore electrical platforms and landfall.
Onshore cables	The cables which would bring electricity from landfall to the onshore substation. The onshore cable is comprised of up to six power cables (which may be laid directly within a trench, or laid in cable ducts or protective covers), up to two fibre optic cables and up to two distributed temperature sensing cables.
Trenchless technique	A method of installation that allows ducts and cables to be installed under an obstruction or area without breaking open the ground and digging a trench (examples of such techniques include horizontal directional drilling, thrust boring, auger boring and pipe ramming).
Transition bay	Underground structures at the landfall that house the joints between the offshore export cables and the onshore cables.

1 Introduction

1.1 Overview

1. This Outline Landfall Construction Method Statement forms part of a set of documents that supports the Development Consent Order (DCO) application (the Application) for the East Anglia TWO Offshore Windfarm project (the Project) submitted by East Anglia TWO Limited (the Applicant).

2. Works to be undertaken for the Project includes (amongst other things) the construction of the landfall, where up to two offshore export cables and up to two fibre optic cables are brought ashore by trenchless technique.

3. Requirement 13 of the ***draft DCO*** (APP-023) relates to the preparation of a Landfall Construction Method Statement and states:

   "13.(1) No part of Work Nos. 6 or 8 may commence until a method statement for the construction of that part of Work No. 6 or Work No. 8 has been submitted to and approved by the relevant planning authority.

   (2) The method statement referred to in paragraph (1) must be implemented as approved."

4. This Outline Landfall Construction Method Statement presents an overview of the information to be presented within the final Landfall Construction Method Statement, such as construction information, environmental considerations and bentonite mud break-out response planning associated with the landfall construction. It does not include details on the construction of transition bays; onshore cables; temporary construction consolidation sites; haul road; or access, which are also located within Work No. 8. The extent of Works Nos. 6 and 8 are shown in the ***Works Plans (Offshore), Sheet 1 of 1*** (APP-010), and ***Works Plans (Onshore) Sheet 1 of 12*** (APP-003), and are shown together in Figure 1, Appendix 1 of this document.

5. Construction of the landfall by trenchless technique allows the offshore export cables to be installed under the cliffs, beach and intertidal area without breaking open the ground and digging an open trench through these features. Examples of such techniques include Horizontal Directional Drilling (HDD), direct pipe and pipe ramming.

6. For the purpose of this Outline Landfall Construction Method Statement, it is assumed that HDD is the adopted trenchless technique. The final Landfall Construction Method Statement will be drafted to reflect the particular trenchless technique adopted.

1.2 Landfall Site Description

7. Up to two offshore export cables will make landfall north of Thorpeness in Suffolk. This site was chosen based on an appraisal of constraints and engineering feasibility from both offshore and onshore perspectives (see ***Chapter 4 Site Selection and Assessment of Alternatives*** (APP-052) and ***Appendix 4.6 Coastal Processes and Landfall Site Selection*** (APP-447).

8. The landfall is characterised by a shingle beach at the wave break point, with a raised terrace of shingle at the base of low-lying cliffs (approximately 10m above ordnance datum) which are partially vegetated by grasses, gorse and other small shrubs. The beach is designated as a Site of Special Scientific Interest (SSSI) for a rich mosaic of habitats including acid grassland, heath, scrub, woodland, fen, open water and vegetated shingle, and is managed by Natural England. There are no formal coastal defences associated with flood prevention or coastal stability at the landfall location. At the landfall the HDD entry pit will be a minimum setback distance of 85m from the cliff top to ensure the integrity of the cliff is not compromised during construction and to allow for natural coastal erosion during operation. The eastern end of the HDD ducts will be buried under the sea bed beyond the intertidal zone.

9. Closest to the coast, the bathymetry of the offshore cable corridor (within Work No. 6) is dominated by an exposed rock outcrop (known as the Coralline Crag) with an irregular surface formed of southwest-northeast oriented ridges between 0.5m and 2m high. The Coralline Crag underpins coastal processes along this section of the coastline which are critical to the coastal processes associated with the water cooling processes and sea defences for the Sizewell B nuclear power station. The known extent of the Coralline Crag is shown in ***Figure 1***, Appendix 1 of this document.

10. The length of the HDD will be influenced by the cable design and the HDD drill profile (i.e. the angle of the bore). It is envisaged that the length of the HDD would not exceed 2km. This is within the capability of HDD works demonstrated by other HDD projects completed in the UK. The final length of the HDD will be determined during the detail design process based on geology, drill profile and punchout seabed conditions.

1.3 Rationale for Use of Trenchless Technique at Landfall

11. The Applicant's commitment to a trenchless technique at the landfall to avoid potential impacts on the Suffolk coastline as part of the embedded mitigation of the Projects is anticipated to:

- Avoid direct physical disruption to the nearshore Sizewell Bank;
- Avoid direct physical disruption to the outcrop of Coralline Crag;
- Avoid direct physical disruption to the ness at Thorpeness;
- Avoid interruption of circulatory sediment transport pathways;
- Avoid disturbance to the alongshore sediment transport processes;
- Reduce the risk of suspended sediment (during construction) affecting the Sizewell B Nuclear Power Station's cooling water infrastructure;
- Avoid the need for cable protection measures in the intertidal and shallowest nearshore zones;
- Minimise the need for cable protection measures elsewhere across the sea bed; and
- Avoid interaction with the beach at Thorpeness.

3 Geotechnical Investigations

13. Key to ensuring that the design of the trenchless technique is appropriate for the location and can be constructed safely, is understanding ground conditions at the landfall. Detailed onshore and offshore geotechnical investigations will be conducted at the landfall in order to characterise ground conditions, establish the chemical and mechanical properties of the ground and identify the hydrology and hydrogeology of the site and inform the detail design of the trenchless technique solution. Desktop geotechnical studies indicate the ground conditions to be made up of glacial till, crag group and London clay formations. Sufficient flexibility exists in the range of trenchless techniques available (and in the case of HDD, the capacity of drill rigs and range of drill heads available) and the design options available (i.e. HDD profile) to ensure a suitable trenchless technique can be delivered at the landfall within the bounds of that assessed within the Application.

14. Specifically, onshore investigations at the landfall will include:

- Boreholes: Drilled to underlying rockhead and providing a profile of soil characteristics through the full depth. There will be a minimum of two boreholes onshore. Boreholes will be securely capped on completion;
- Hydrological monitoring: At least one of the above-mentioned boreholes will be fitted with hydrological monitoring equipment (i.e. stand pipe and piezometer) to provide ongoing data on groundwater hydrology;
- Trial Pits: Localised excavations to approximately 3-4m depth in the locations of possible HDD entry pits to identify measures necessary to facilitate construction. Trial pits will be reinstated upon completion;
- Geotechnical, chemical and environmental laboratory testing: Testing undertaken on samples retrieved during the investigation to provide detailed ground soil profile characteristics and parameter to aid design; and
- Cliff stability monitoring: Installation of vibration monitoring equipment to establish design parameters and baseline conditions to benchmark against during the HDD drilling works.

15. Onshore geotechnical investigations will be conducted with a small workforce operating from mobile temporary welfare units. Equipment and machinery will be modest in size and likely to be towed by 4x4 vehicles and mid-sized excavators for completion of trial pits. No equipment or machinery associated with the landfall will be operated or stored within the Leiston/Aldeburgh Site of Special Scientific Interest (SSSI).

16. Investigations will also be conducted offshore from a vessel, which will provide data to support the HDD design. This will primarily include:

- Boreholes: Drilled in the nearshore area along the potential HDD drill line routes, drilled to rockhead and providing a profile of soil characteristics through the full depth, and associated laboratory testing;
- Bathymetric survey: Providing detailed information for water depths and topography of the seabed; and
- Geophysical survey: Mapping geological features of the seabed, including a focus on confirming the extent of the Coralline Crag within the identified offshore cable corridor.

4 Design

17. The HDD design will be undertaken post consent and will rely on inputs from onshore and offshore pre-construction site investigations as well as information from the detailed cable system design.

18. The design (including tolerances) will be included within the final Landfall Construction Method Statement, and will identify the following:

- HDD entry pit locations (which (based on coastal erosion studies) will be located a setback distance of 85m from the cliff top to ensure the integrity of the cliff is not compromised and to allow for natural coastal erosion);
- HDD punch out locations (it is likely that the HDD punch out locations will be to the south of the Coralline Crag outcrop (see ***Figure 7.7 Offshore Cable Corridor and Landfall*** (APP-109) shown on ***Figure 1***, Appendix 1 of this document, thereby avoiding direct physical disruption to the nearshore Sizewell Bank, the Coralline Crag outcrop, and the ness at Thorpeness; and avoiding interruption of circulatory sediment transport pathways and disturbance to the alongshore sediment transport processes;
- HDD drill line routes between the entry pits and the punch out locations, the separation between drill lines being dictated by parameters from the cable design; and
- HDD drill profiles, dictated by parameters from the cable design.

19. Output from the design phase will also provide recommendations on the drilling methodology to be adopted to best suit the ground conditions and mitigation measures to ensure the stability of the cliffs on the shoreline.

5 Drilling Methodology

5.1 DCO Compliance

20. Prior to commencement of the HDD works, relevant requirements of the ***draft DCO*** (APP-023) will be complied with, such as Requirement 20 (Archaeology); Requirement 21 (Ecological Management Plan); and Requirement 28 (Traffic).

21. Where conflict arises between archaeological or environmental constraints or obligations, the Applicant will liaise with the relevant stakeholders and seek agreement on the optimal, acceptable solution for the Project.

5.2 Site Set Up

22. Prior to commencement of the HDD works, the general site area will be prepared to a suitable level to facilitate the drilling works and temporary accommodation will be installed to serve the workforce.

23. This will include activities such as:

- Installation of access to works (i.e. temporary haul road installation along the onshore cable route from Sizewell Gap, if not already constructed for the onshore cable route construction);
- Preparation of the HDD temporary working area, up to 7,000m^2 (to accommodate the HDD works) and a temporary construction consolidation site up to 7,040m^2 in area (to serve the landfall and onshore cable route construction). Typically, this will involve:
  - Stripping and storing (bunding) topsoil in accordance with the approved Soil Management Plan (as part of the Code of Construction Practice secured by Requirement 22 of the ***draft DCO*** (APP-023));
  - Installing geotextile to the sub-surface; and
  - Laying and compacting suitable stone material to form a working surface.
- Installation of welfare facilities for the workforce including connection of services such as water, power, lighting and telecoms services;
- Installation of security fencing or other means of enclosure in line with the details approved under Requirement 17 of the ***draft DCO*** (APP-023). Consideration will be given to the use of appropriately coloured wooden hoarding where views of the fencing and landfall construction area are visible from public rights of way;
- Installation of temporary lighting in line with the approved Artificial Light Emissions Management Plan (as part of the Code of Construction Practice secured by Requirement 22 of the ***draft DCO*** (APP-023)); and

- Installation of site surface water and site drainage system in line with the approved Surface Water and Drainage Management Plan (as part of the Code of Construction Practice secured by Requirement 22 of the ***draft DCO*** (APP-023)).

5.3 Excavations

24. HDD entry pits, from where the drilling works will be conducted, will be excavated at each of the designated locations. The Project will require two HDDs to be installed to accommodate each of the offshore export cables. The impact assessment undertaken by the Applicant provides for up to four HDDs to ensure contingency in the design and delivery of the Project. The Applicants confirm however that should only two HDDs be required and constructed by the Project, no further HDDs will be undertaken.

25. Excavations will be benched or shored as necessary to provide a safe working environment with defined access and entry points for the workforce.

26. Excavated topsoil will be stored in a designated area and will be kept separate from subsoil to prevent contamination, in line with the approved Soil Management Plan (as part of the Code of Construction Practice secured by Requirement 22 of the ***draft DCO*** (APP-023)).

5.4 HDD Drilling

27. HDD drill rig(s) and ancillary equipment will be delivered to the site via flatbed heavy goods vehicles and offloaded adjacent to the drill entry locations. An anchor (typically sheet piles) will be installed at each drill location to ensure the rig is securely anchored.

5.4.1 Rig Set-Up

28. An indicative layout for the HDD drill rig set up will be presented within the final Landfall Construction Method Statement and will reflect HDD works design and the nature of the equipment to be used.

5.4.2 Pilot Hole

29. Following all preparation works, drilling of the pilot hole will commence. A drill bit connected to the gyro steering system and drill pipes will form the 'drill string'. Drilling fluid (bentonite mud) is jetted through the drill string and out through nozzles within the drill bit. The fluid then mixes with arisings from the drilling action and is transported back through the drilled hole to the surface.

30. Directional control is achieved via the gyro steering assembly and directional survey of the drill progress are completed at regular intervals (usually at every point the drill advances one ‘pipe’ length).

31. It is common for the pilot hole to stop a short distance from the punch out location on the sea bed (the stop short point). The pilot string will then be retracted through the hole for reaming to commence. On completion of reaming, the hole will be advanced to punch out on the sea bed.

5.4.3 Reaming

32. On completion of the pilot hole, the drill string will be retracted, and the first reaming head attached to increase the pilot hole diameter. A bull nose attached to the front of the reamer and stabilisers behind ensure the assembly is guided through the pilot hole. As with the pilot hole, drilling fluid will transport cuttings back to the onshore site to be recycled. Upon reaching the stop short point, the string will be retracted, and the next sized reamer attached to continue widening the hole. This process will continue until the desired size necessary to accommodate the cable duct assembly is achieved.

33. Upon completion of the reaming process to the stop short point, a final assembly will be installed to the drill string and advanced through the final distance to punch out through the sea bed. The final assembly will be withdrawn from the bore and the pull back assembly will be installed to facilitate the pullback of cable ducts from offshore to onshore.

5.4.4 Pull Back

34. The cable ducts to be installed will be positioned at the HDD punch out locations (offshore). The pull back assembly (attached to the drill string) will be advanced from the HDD punch out locations to an offshore support vessel to allow the attachment each duct.

35. Each duct will be pulled back through each bore by the HDD drill rig positioned onshore (with support from the offshore support vessel), to the HDD entry point.

5.5 Working Hours

36. Use of the HDD technique at the landfall will require 24-hour working at certain times due to the nature of the works, typically during HDD drilling.

37. Continuous periods of construction, such as those associated with trenchless techniques, are permitted within Requirement 23 of the ***draft DCO*** (APP-023) subject to the timing and duration of such construction works being approved by the relevant planning authority.

6 Drilling Fluid

6.1 Purpose of Drilling Fluid

38. HDD drilling is undertaken with the help of a viscous drilling fluid (typically bentonite mud), which is usually a mixture of water and bentonite (a non-toxic clay commonly used in farming practices). The bentonite mud is continuously pumped to the cutting head or drill bit to facilitate the removal of cuttings, stabilise the bore, cool the cutting head, and lubricate the passage of the duct.

6.2 Drilling Fluid Management

39. Drilling fluid will be recycled as far as practicable by separating the drill cuttings which the drilling fluid recovers from the cutting head, allowing the cleaned drilling fluid to be reused time and again in a closed drilling fluid cycle. This reduces the use of raw materials (in particular water and bentonite) and reduces the time taken for the drilling progress to be completed.

40. Drilling fluid which is returned to the surface will undergo treatment to separate the drill cuttings through a variety of mechanical methods. The spoil from this process will be collected and disposed of in line with the approved Site Waste Management Plan (as part of the Code of Construction Practice secured by Requirement 22 of the ***draft DCO*** (APP-023)).

41. Excess drilling fluid will be stored in tanks to manage the expected volumes and where necessary, removed from site.

6.3 Measures to Prevent Drilling Fluid Break-Out

42. HDD drilling at the landfall carries a potential risk of drilling fluid (or bentonite mud) break-out from the bore due to the bentonite mud being forced through small fractures in the ground at pressure. However, bentonite mud breakouts in these circumstances are rare, as the bentonite is a thixotropic fluid of high viscosity which seals the wall of the drill by the bentonite entering and sealing fissures within the bore.

43. A number of measures will be adopted to prevent or minimise the risk of bentonite breakout and to mitigate its impact in the unlikely event that it occurs, as detailed below and in ***Section 6.4***.

44. Ground investigations will be undertaken to establish the ground conditions along the HDD drill profile as described above, allowing a suitable HDD design to be established. Ground investigations will influence such matters as the equipment to be used; HDD entry pit and punch out locations; HDD drill profile; HDD drill depth below ground; bentonite viscosity; the pilot hole diameter; and subsequent

reaming diameter(s), all of which will minimise the risk of bentonite mud break-out during HDD drilling.

45. During HDD drilling, the bentonite mud pressure and fluid levels within the mud tanks will be monitored. Where bentonite mud pressure loss or reductions in returns to the mud tanks is detected, the operator will reduce the bentonite mud pressure within the bore where possible, thereby reducing the risk of bentonite mud break-out.

46. To mitigate the risk of bentonite mud break-out in the location of the HDD entry pit during the pilot hole stage (one of the most sensitive sections of the HDD drill), casing will be installed in the first ca. 100m of the HDD drill. The casing will remain in place for the duration of the pilot hole drilling and will provide physical containment of bentonite mud within the casing. Upon completion of the pilot hole and prior to the first reaming the casing will be extracted by the HDD drill rig.

6.4 Bentonite Mud Break-Out Response Planning

47. In the unlikely event that a bentonite mud break-out is confirmed, drilling works will be reduced or halted, with bentonite mud re-introduced periodically under pressure to plug the break-out channel. Should this prove unsuccessful, additional products known as loss circulation materials will be introduced to plug the point of mud egress. These loss circulation materials will be mixed and pumped into the HDD drill via the drill string. Once the plug has been left to set for the required period, the drilling works will resume with careful observation of the break-out location.

48. Where bentonite mud break-out is confirmed to have occurred, a visual inspection will be undertaken along the HDD drill line route to identify the location and extent of the bentonite mud break-out and sandbags (available on site) will be used to contain the bentonite mud. The Applicant will advise the relevant planning authority and relevant statutory nature conservation body within 24 hours of a bentonite mud break-out being confirmed and discuss how the bentonite mud will be removed.

49. Means to remove the bentonite include collecting with a flexible hose and pump or similar method. The collected material will be transported directly to an approved waste management facility or returned to the works area and reused. The affected area will be flushed with clean water if agreed with the relevant statutory nature conservation body.

50. In the unlikely event that a bentonite mud break-out is confirmed to have occurred, no new HDD bores will commence until the break-out is investigated and a review of the HDD design parameters is undertaken to establish whether

any modifications to the HDD design and construction method statement are necessary to reduce the risk of further break-outs. Such modifications may include changes to the HDD drill profile, bentonite mud mixture or drilling pressures.

51. Contact details for the relevant planning authority and relevant statutory nature conservation body will be provided within the final Landfall Construction Method Statement for ease of reference.

7 Potential Environmental Effects of Bentonite Mud Break-Out

7.1 Leiston-Aldeburgh Site of Special Scientific Interest

52. The Leiston-Aldeburgh SSSI contains a rich mosaic of habitats including acid grassland, heath, scrub, woodland, fen, open water and vegetated shingle. This mix of habitats in close juxtaposition, and the associated transition communities between habitats, is unusual in the Suffolk Coast and Heaths. The variety of habitats support a diverse and abundant community of breeding and overwintering birds, a high number of dragonfly species and many scarce plants.

53. On the vegetated shingle there is a gradual transition between the strandline community and the shingle heath resulting from increasing stability and distance from tidal influence. On the open shingle, sea-kale *Crambe maritima* and yellow hornedpoppy *Glaucium flavum* are frequent with the irregularly occurring sea spurge *Euphorbia paralias*. The stable shingle areas support many species including early hair-grass *Aira praecox*, the nationally scarce sand catchfly *Silene conica*, dune fescue *Vulpia fasciculata*, bur medick *Medicago minima*, suffocated clover *Trifolium suffocatum* and sea pea *Lathyrus japonicus* (Natural England 2020).

54. It should be noted that HDD avoids any interaction with Leiston-Aldeburgh SSSI. As such, the intertidal features of the Leiston-Aldeburgh SSSI will not be affected directly by the construction of the landfall.

7.2 Consideration of Potential Impacts

55. The Leiston-Aldeburgh SSSI is a nationally designated site which meets the published selection criteria for national designation. The SSSI contains viable areas of coastal vegetated shingle, a habitat type listed in Annex I of the EU Habitats Directive (‘perennial vegetation of stony banks’). It supports a unique range of flora and fauna that are adapted to the harsh conditions that are present at such locations.

7.2.1 Breakout at Sea

56. As discussed in ***Section 6***, HDD drilling is undertaken with the help of a viscous fluid known as drilling mud. It is typically a mixture of water and bentonite (a non-toxic naturally occurring clay commonly used in farming practices). Bentonite is recognised by the Centre for Environment Fisheries and Aquaculture Science (Cefas) as being fully biodegradable and is on the Oslo/Paris convention (for the Protection of the Marine Environment of the North-East Atlantic) (OSPAR)) ‘List

of Substances Used and Discharged Offshore which are considered to Pose Little or No Risk to the Environment'[1].

57. Bentonite mud could potentially be lost to sea at the HDD punch out location, either during the punching out, reaming or duct installation. This could cause the bentonite mud to settle on intertidal shingle habitat and have potential smothering effects. However, in marine environments the smothering effect is less problematic because seawater degrades the drilling fluid, causing the bentonite to flocculate and be rapidly dispersed within one tidal cycle (Rigall 2018). Owing to the rapid dispersal and short-term nature of potential bentonite mud release, it is not considered to be of significance. Any risk of bentonite mud break-out will be further minimised by robust HDD design and control measures which will be defined within the final Landfall Construction Method Statement.

7.2.2 Surface Breakout on Land

58. As previously described in ***Section 6.3***, given the design measures to be adopted to minimise the risk of surface-breakout of bentonite mud, it is considered that there is no impact pathway for surface-breakout on the Leiston-Aldeburgh SSSI.

59. In the unlikely event that a bentonite mud break-out is confirmed to have occurred, the measures outlined in ***Section 6.4***, ***Bentonite Mud Break-Out Response Planning*** above will be implemented.

7.2.3 Subsurface Breakout on Land

60. As previously described in ***Section 6.3***, given the design measures to be adopted to minimise the risk of surface-breakout of bentonite mud, it is considered that there is no impact pathway for subsurface breakout on the Leiston-Aldeburgh SSSI.

61. The design of the final HDD works will be subject to a hydrogeological risk assessment, to be undertaken pre-construction to consider and assess the risk to groundwater from the works and ensure the protection of existing water abstractions (if any).

62. In the event of a bentonite mud break-out, bentonite mud may be lost to the ground (i.e. subsurface). This exposure pathway could lead to potential degradation to the chemical status and quality of groundwater aquifers. The Leiston-Aldeburgh SSSI is designated due to the acid grassland, heath, scrub, woodland, fen, open water and vegetated shingle habitats that it supports. Given that the underlying ground at the landfall is partly associated with the Leiston-

[1] OSPAR List of Substances available at: https://www.cefas.co.uk/data-and-publications/ocns/downloads-and-useful-links/

Aldeburgh SSSI, due to the interaction between SSSI habitats (wetland such as fen, marsh and swamp and standing open water) and where they are located in proximity to the potential areas for subsurface breakout, it is considered to be a high sensitivity receptor.

63. A sub-surface breakout would however be a small and involve a localised release of biodegradable material. Bentonite is a thixotropic fluid of high viscosity which seals the wall of the drill by the bentonite entering and sealing fissures within the bore, minimising the risk of a significant loss of drilling to surrounding ground (subsurface breakout).

8 Cliff Stability

64. The Applicant recognises the importance of ensuring the integrity of cliffs under which the HDD drill lines are routed, during construction and operation of the Project.

65. The HDD entry pit locations onshore will be located a setback distance of 85m from the cliff top to ensure the integrity of the cliff is not compromised and to allow for natural coastal erosion during operation of the Project.

66. The transition bay will be located a setback distance of at least 85m from the current mapped top of the cliff line. The outline design of the HDD is approximately 10m below the beach level of the cliff line even at the maximum predicted 100-year erosion extent. The depth of the HDD will be deeper below the toe of the existing cliffs, potentially between 15m and 20m below the toe level. This is to ensure the integrity of the cliff is not compromised and to account for natural coastal erosion during the operational life of the Projects.

67. The British Geological Survey Geological Map Sheet 191 (solid and drift) 1:50,000 shows a thin strip of Lowestoft Till formation outcropping along the cliff line to the north of Thorpeness. The anticipated thickness (depth) and geometry of the superficial deposits is such that directional drilling is expected to pass through these and be within the underlying bedrock (Crag Group) where the HDD passes under the current cliff line.

68. HDD uses rotary rather than percussive drilling and only minor vibrations are expected. The detailed design will be developed to take into account the anticipated levels of vibration from the proposed drilling equipment to ensure the integrity of the cliff.The HDD drill profile will be established to take into account the capacity/size of the HDD drill rig being utilised and the vibration levels generated by the rig, to ensure the integrity of the cliff is not compromised during HDD drilling. The HDD drill profile will ensure the HDD bores can achieve the maximum possible depth beneath the cliffs in order to minimise the impact of the HDD drilling on the stability of the cliffs.

69. Vibration monitoring will be undertaken in the vicinity of the cliffs as part of the site investigation works to gather background data on vibration levels under normal conditions. This data will be examined to establish a suitable vibration limit which will be maintained during HDD drilling to ensure the integrity of the cliffs are maintained.

70. Vibration monitoring points will then be undertaken in the vicinity of the cliffs for the duration of the HDD drilling. The HDD drill rig operators will monitor vibration

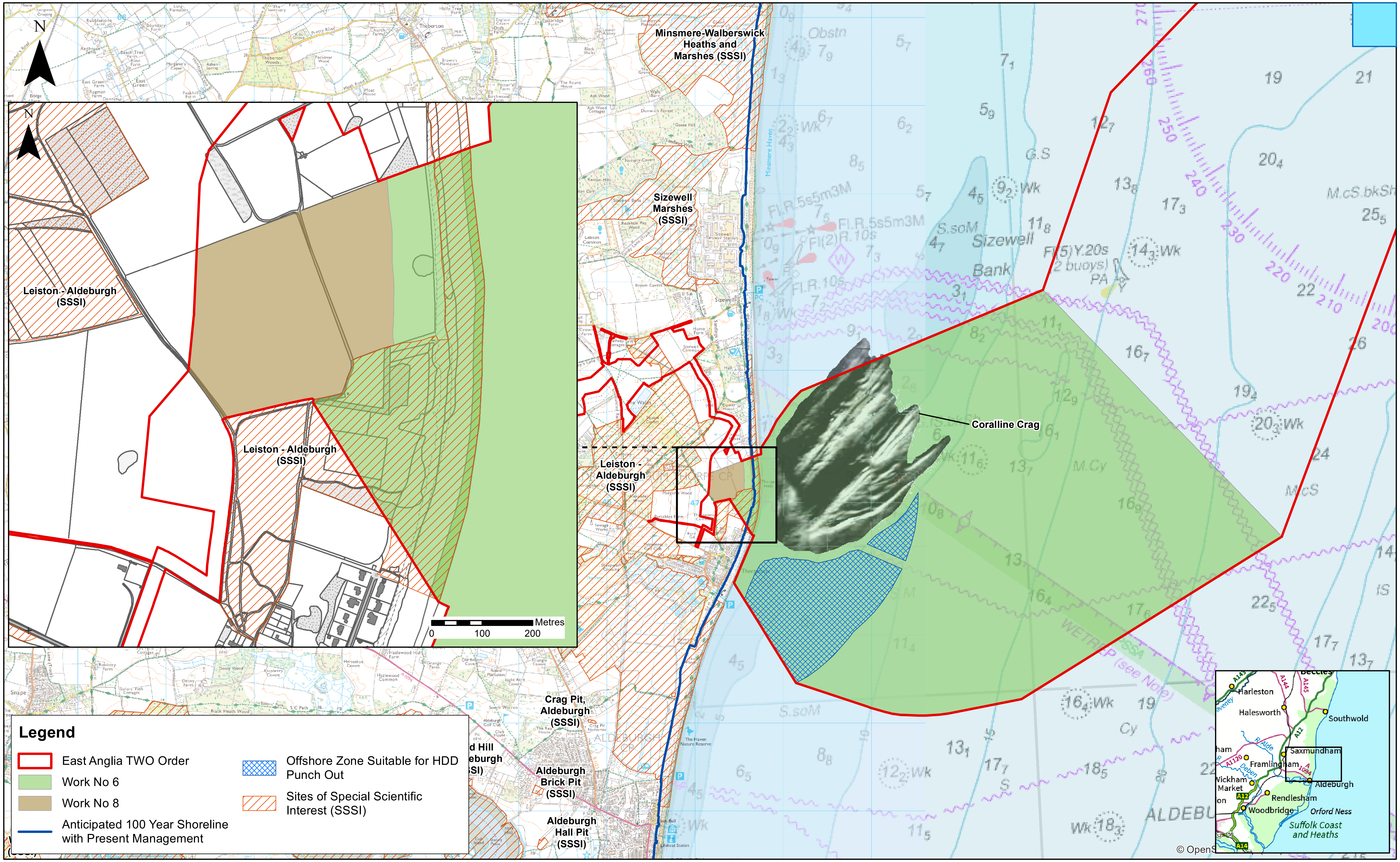
levels, modify the HDD drilling to avoid the maximum vibration limit from being exceeded. Where the maximum vibration limit is exceeded, HDD drilling will be stopped, and the method statement reviewed so as to maintain the maximum vibration limit on recommencement of HDD drilling.

71. The Landfall Construction Method Statement will include further information on the vibration monitoring to be undertaken to ensure the integrity of the cliffs is not compromised.

9 References

Rigall, T. (2018). HDD Feasibility Report: Cable Landfall Site at Happisburgh for Vanguard and Boreas Windfarms, U.K. Report No. 20171201RA-FR01

Appendix 1: Figures



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				Prepared:	AB
1	26/10/2020	AB	First Issue.	Checked:	BD
				Approved:	PP

SCOTTISHPOWER RENEWABLES

1:40,000 Scale @ A3

Kilometres 0 1 2

East Anglia TWO

Landfall (including Extent of Work No. 6 and 8, Coralline Crag and Preferred HDD Punch Out Area)

Drg No	EA2-DEV-DRG-IBR-001185
Rev	1
Date	26/10/20
Figure	1

Coordinate System: BNG
Datum: OSGB36

D:\Box Sync\PB4842 EA 1N and 2\PB4842 EA 1N and 2 Team\E. TECHNICAL DATA\E03 GIS\EA1N_EA2_Examination\Figures\Outline Landfall Construction Method Statement\EA2_OffshoreCableCorridorLandfall_RH_20201026.mxd