East Anglia ONE North Offshore Windfarm

Appendix 20.5

Geomorphological Baseline

Environmental Statement
Volume 3

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Table of Contents

20.5 Geomorphological Baseline 1
20.1 Introduction 1
20.2 Survey Methodology 1
20.3 Geomorphological Baseline 2

Appendix 20.5 is supported by the tables listed below.

Table Number	Title
Table A20.5.1	Geomorphological characteristics of the Hundred River: Reach 1 Upstream of Coldfair Green
Table A20.5.2	Geomorphological characteristics of the Hundred River: Reach 2 Coldfair Green to Aldringham
Table A20.5.3	Geomorphological characteristics of the Hundred River: Reach 3 Aldringham to Sheepwash Crossing
Table A20.5.4	Geomorphological characteristics of the Hundred River: Reach 4 Downstream of Sheepwash Crossing

Appendix 20.5 is supported by the photographs listed below.

Plate Number	Title
Plate A20.1	Extensive vegetation growth in dry, shallow channel
Plate A20.2	Low energy flows in silt-bed channel
Plate A20.3	Wide, shallow silt-bed channel with low energy glide flows
Plate A20.4	Locally wide floodplain with dense riparian vegetation growth
Plate A20.5	Extensive growth of in-channel vegetation in parts of the reach
Plate A20.6	Wide, shallow channel with low energy glide flows

Glossary of Acronyms

ES	Environmental Statement

Glossary of Terminology

Applicant	East Anglia ONE North Limited.
Cable sealing end compound	A compound which allows the safe transition of cables between the overhead lines and underground cables which connect to the National Grid substation.
Cable sealing end (with circuit breaker) compound	A compound (which includes a circuit breaker) which allows the safe transition of cables between the overhead lines and underground cables which connect to the National Grid substation.
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.
Development area	The area comprising the onshore development area and the offshore development area (described as the 'order limits' within the Development Consent Order).
East Anglia ONE North project	The proposed project consisting of up to 67 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.
East Anglia ONE North windfarm site	The offshore area within which wind turbines and offshore platforms will be located.
European site	Sites designated for nature conservation under the Habitats Directive and Birds Directive, as defined in regulation 8 of the Conservation of Habitats and Species Regulations 2017 and regulation 18 of the Conservation of Offshore Marine Habitats and Species Regulations 2017. These include candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation and Special Protection Areas.
Evidence Plan Process	A voluntary consultation process with specialist stakeholders to agree the approach to the EIA and the information required to support HRA.
Horizontal directional drilling (HDD)	A method of cable installation where the cable is drilled beneath a feature without the need for trenching.
Jointing bay	Underground structures constructed at intervals along the onshore cable route to join sections of cable and facilitate installation of the cables into the buried ducts.
Landfall	The area (from Mean Low Water Springs) where the offshore export cables would make contact with land, and connect to the onshore cables.
Link boxes	Underground chambers within the onshore cable route housing electrical earthing links.
Mitigation areas	Areas captured within the onshore development area specifically for mitigating expected or anticipated impacts.

National electricity grid	The high voltage electricity transmission network in England and Wales owned and maintained by National Grid Electricity Transmission
National Grid infrastructure	A National Grid substation, cable sealing end compounds, cable sealing end (with circuit breaker) compound, underground cabling and National Grid overhead line realignment works to facilitate connection to the national electricity grid, all of which will be consented as part of the proposed East Anglia ONE North project Development Consent Order but will be National Grid owned assets.
National Grid overhead line realignment works	Works required to upgrade the existing electricity pylons and overhead lines (including cable sealing end compounds and cable sealing end (with circuit breaker) compound) to transport electricity from the National Grid substation to the national electricity grid.
National Grid overhead line realignment works area	The proposed area for National Grid overhead line realignment works.
National Grid substation	The substation (including all of the electrical equipment within it) necessary to connect the electricity generated by the proposed East Anglia ONE North project to the national electricity grid which will be owned by National Grid but is being consented as part of the proposed East Anglia ONE North project Development Consent Order.
National Grid substation location	The proposed location of the National Grid substation.
Natura 2000 site	A site forming part of the network of sites made up of Special Areas of Conservation and Special Protection Areas designated respectively under the Habitats Directive and Birds Directive.
Onshore cable corridor	The corridor within which the onshore cable route will be located
Onshore cable route	This is the construction swathe within the onshore cable corridor which would contain onshore cables as well as temporary ground required for construction which includes cable trenches, haul road and spoil storage areas.
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.
Onshore development area	The area in which the landfall, onshore cable corridor, onshore substation, landscaping and ecological mitigation areas, temporary construction facilities (such as access roads and construction consolidation sites), and the National Grid Infrastructure will be located.
Onshore infrastructure	The combined name for all of the onshore infrastructure associated with the proposed East Anglia ONE North project from landfall to the connection to the national electricity grid.
Onshore preparation works	Activities to be undertaken prior to formal commencement of onshore construction such as pre–planting of landscaping works, archaeological investigations, environmental and engineering surveys, diversion and laying of services, and highway alterations.

Onshore substation	The East Anglia ONE North substation and all of the electrical equipment within the onshore substation and connecting to the National Grid infrastructure.
Onshore substation location	The proposed location of the onshore substation for the proposed East Anglia ONE North project.
Transition Bay	Underground structures at the landfall that house the joints between the offshore export cables and the onshore cables.

20.5 Geomorphological Baseline

20.1 Introduction

1. This report presents the results of a geomorphological walkover survey that was undertaken to identify the main geomorphological characteristics of each of the main river watercourses that could potentially be impacted by the proposed East Anglia ONE North project.

2. This report is intended to be a factual summary of the baseline geomorphology of the main watercourses within the onshore development area, and does not present any further interpretation or assessment of potential impacts and geomorphological responses. This report should be read in conjunction with Environmental Statement (ES) ***Chapter 20 Water Resources and Flood Risk***.

20.2 Survey Methodology

3. A targeted geomorphological walkover survey was undertaken in July 2018 to characterise the baseline geomorphology of the three main watercourses that could potentially be affected by the proposed East Anglia ONE North project (***Figure 20.1***):

   - Hundred River: The onshore cable corridor would cross the watercourse downstream of Aldringham. Furthermore, the catchment would contain the majority of the onshore development area;
   - Leiston Beck: The southern part of the catchment would contain a short section of the onshore cable corridor, although there would be no direct interaction with the surface drainage network; and
   - Friston Watercourse: The onshore substation and National Grid infrastructure location near Friston is located within the catchment, although there would be no direct interaction with the surface drainage network.

4. The targeted geomorphological walkover survey considered a variety of factors, including:

   - Flow conditions, including dominant flow types and the degree of variability within each reach.
   - Channel form, including planform, width and depth variation, bank form and condition, substrate types and the type and presence of bed forms such as pools, riffles and bars.
   - Floodplain characteristics, including connectivity to the river channel and the structure of the riparian zone.

- Evidence of channel modification, including enlargement and re-sectioning, artificial bank protection, embankments and in-channel structures.

20.3 Geomorphological Baseline

20.3.1 Hundred River

5. The Hundred River has a catchment area of approximately 26km^2. The river rises near East Green, from where it flows south towards Knodishall and Coldfair Green. From here, it flows in a south-easterly direction towards the coast. The river flows to the south of The Meare at Thorpeness (to which it is connected via a sluice), from where it flows southwards along the landward edge of the coastal dune system until it discharges to the sea via a sluice to the south of The Haven. The Hundred River catchment would contain the majority of the onshore cable corridor.

6. For the purposes of this baseline summary, the river has been divided into four reaches:

- Reach 1: Upstream of Coldfair Green. Part of the onshore development area is located adjacent to this reach.
- Reach 2: Coldfair Green to Aldringham. This reach is located to the north of the onshore cable route.
- Reach 3: Aldringham to Sheepwash Crossing. The river would be crossed by the onshore cable route at the upstream end of this reach.
- Reach 4: Downstream of Sheepwash Crossing. This reach is located downstream of the onshore development area.

7. The main characteristics of each reach are summarised in ***Table A20.5.1*** to ***TableA20.4***. These demonstrate that the Hundred River has a low sinuosity planform that has been extensively straightened prior to the 1880s. As a result of these modifications, the watercourse typically has a uniform trapezoidal channel with steep, shallow banks. The river is largely dominated by depositional processes, reflecting the low energy of the system, with natural silt beds and evidence of considerable fine sedimentation in parts of the channel. Flows are typically shallow and uniform.

Table A20.5.1 Geomorphological Characteristics of the Hundred River: Reach 1 Upstream of Coldfair Green

Parameter	Main characteristics
Planform	This reach has largely been straightened (possibly for land drainage and agricultural purposes). Analysis of historical mapping suggests that this occurred prior to the 1880s.
Channel form	This reach consists of a dry channel with steep, shallow and largely stable banks. Although the banks are largely natural, areas of artificial channel reinforcement were observed downstream of Knodishall Common.
Substrate conditions	The channel bed was obscured by extensive vegetation growth at the time of the survey (***Plate A20.1***).
Flow conditions	The river was dry at the time of the walkover survey, and the extent of in-channel vegetation growth suggests that this reach is unlikely to support significant flows for much of the year.
Floodplain characteristics	The narrow floodplain is largely composed of agricultural land, although this is replaced by areas of woodland and open grassland at the downstream end of the reach at Knodishall Common.
In-channel and riparian vegetation	The channel was dominated by extensive vegetation growth (including reeds) at the time of the survey (***Plate A20.1***).
Character photograph	 **Plate A20.1 Extensive Vegetation Growth in Dry, Shallow Channel**

Table A20.5.2 Geomorphological Characteristics of the Hundred River: Reach 2 Coldfair Green to Aldringham

Parameter	Main characteristics
Planform	This reach has a low sinuosity with wide, low amplitude meanders. Sub-reaches are very straight, which suggests that the reach has been straightened in the past. Analysis of historical mapping suggests that this occurred prior to the 1880s.
Channel form	The banks are low, steep to near-vertical, and composed of fine sediment that appears to be cohesive (***Plate A20.2***). The banks are largely stable, although some undercutting of the bank toe was apparent in parts of the reach.
Substrate conditions	The bed is comprised of fine sediment (e.g. silts and fine sands) (***Plate A20.2***). Extensive fine sedimentation was evident in the channel margins, alongside partially vegetated silt bars.
Flow conditions	Flows in this reach are dominated by shallow, low energy glide flows which were barely perceptible in places. At the time of the survey, the water was clear with very low turbidity. A large proportion of the flow is likely to be derived from the discharge of treated effluent from the Coldfair Green sewage works.
Floodplain characteristics	In the upstream part of the reach, the narrow floodplain is bounded by domestic gardens and grassland. The floodplain becomes wider and better connected to the floodplain further downstream, where it is bounded by woodland and arable fields.
In-channel and riparian vegetation	Very little vegetation was observed in the channel, although some emergent and marginal plants have colonised stable silt bars in the channel margins.
Character photograph	 **Plate A20.2 Low-Energy Flows in Silt-Bed Channel**

Table A20.5.3 Geomorphological Characteristics of the Hundred River: Reach 3 Aldringham to Sheepwash Crossing

Parameter	Main characteristics
Planform	The river has a gently meandering planform in this reach, with low-amplitude meanders and evidence of historical re-sectioning. As with upstream reaches, analysis of historical mapping suggests that this occurred prior to the 1880s.
Channel form	The banks are shallow and steep, and are much lower than in the upstream reach. They are largely stable and well-vegetated, although evidence of toe scour was observed in parts of the reach. The channel is very uniform, with limited geomorphological diversity (***Plate A20.3***).
Substrate conditions	The bed and banks are both composed of fine sediments (e.g. silts and fine sands). Areas of fine sediment deposition were observed throughout the reach.
Flow conditions	This reach is largely characterised by shallow water with barely perceptible glide flows. Turbidity was generally low at the time of the survey, although this increased in areas where flow energy was further reduced (e.g. by fallen tree limbs).
Floodplain characteristics	In the upstream end of the reach, the floodplain is wider than in upstream reaches, and dominated by grazing land and areas of woodland (***Plate A20.4***). The floodplain is drained by an extensive ditch system which is well connected with the main river channel. The floodplain becomes much wider at the downstream end of the reach, where the channel flows through floodplain wetlands (The Fens).
In-channel and riparian vegetation	Extensive areas of in-channel vegetation growth are interspersed with reaches with clear open water were observed during the survey (***Plate A20.3*** and ***Plate A20.5***). Considerable vegetation growth was apparent in the riparian zone, including Himalayan balsam (*Impatiens glandulifera*) at the upstream end of the reach, near the proposed crossing point.

Parameter	Main characteristics
Character photograph	 **Plate A20.3 Wide, Shallow Silt-Bed Channel with Low Energy Glide Flows**  **Plate A20.4 Locally Wide Floodplain with Dense Riparian Vegetation Growth**

Parameter	Main characteristics
	 **Plate A20.5 Extensive Growth of In-Channel Vegetation in Parts of the Reach**

Table A20.5.4 Geomorphological Characteristics of the Hundred River: Reach 4 Downstream of Sheepwash Crossing

Parameter	Main characteristics
Planform	The river has a low sinuosity, highly straightened planform in this reach. The river is connected by a sluice to The Meare, an area of wetland that was enlarged and turned into a boating lake in the early 1900s. Analysis of historical mapping demonstrates that part of this area supported channels and areas of open water that were directly connected to the river prior to the 1880s. Downstream of The Meare, the river follows a straight course until it flows into the sea through a tidal outfall. This was present as a pumping station on historical mapping from 1884.
Channel form	The wide, open channel has very shallow, stable, steep to near-vertical banks (***Plate A20.6***). There is a weir located towards the upstream end of the reach, which raises water levels to supply The Meare.
Substrate conditions	Highly turbid water obscured the bed at the time of the survey. However, the substrate is likely to be dominated by fine sediment. Deposition is likely to be the dominant geomorphological process.
Flow conditions	Flow conditions were dominated by uniform, low energy glides (***Plate A20.6***). The reach upstream of the weir is impounded. The water was highly turbid at the time of the survey.

Parameter	Main characteristics
Floodplain characteristics	The wide, flat floodplain is generally composed of woodland or wet grassland habitats, which appear to be well connected to the river channel. The floodplain is drained by an extensive ditch system which is well connected with the main river channel.
In-channel and riparian vegetation	Very little in-channel vegetation growth was observed at the time of the survey. Extensive riparian tree cover adjacent to and downstream of The Meare, becoming more open further downstream.
Character photograph	 **Plate A20.6 Wide, Shallow Channel with Low Energy Glide Flows**

20.3.2 Leiston Beck

9. Leiston Beck has a catchment area of approximately 16km^2. The beck rises near Leiston Abbey, from where it flows in an easterly direction through Sizewell Belts and Marshes. It then flows in an artificial channel along the coast in a northerly direction until it discharges into the sea alongside the Minsmere River (the neighbouring catchment to the north) at Minsmere Sluice. The southern part of the Leiston Beck catchment would contain a short section of the onshore cable corridor.

10. The Leiston Beck has very similar geomorphological characteristics to the Hundred River, with very little geomorphological diversity, a uniform trapezoidal channel with shallow, near vertical banks, and very low energy flows. The bed

and banks are largely composed of fine grained materials (e.g. silts and fine sands), and depositional processes are dominant.

20.3.3 Friston Watercourse

11. The Friston Watercourse, which has catchment area of approximately 6km^2, rises near the village of Friston from where it flows southwards towards Firs Farm. From here, it flows eastwards to the north of Black Heath Wood before turning southwards into the Alde Estuary. The tidal reach of the river is known as Ham Creek. The onshore substation and National Grid substation near Friston are located within the catchment of the Friston Watercourse.

12. The Friston Watercourse is largely composed of a uniform, straightened (or entirely artificial) drainage channel, bounded by a network of smaller drains which in places reflect the historical meandering course of the river. The river connects into a highly sinuous tidal creek (Ham Creek) below Mean High Water, which itself drains into the Alde Estuary. The upper estuary contains a moderately sinuous channel at Mean Low Water, bounded on both banks by extensive mudflats. These become much narrower in the lower estuary (the River Ore), which is much more constrained.

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