UK Onshore Scheme

Environmental Statement

Volume 2 Document ES-2-B.02

Chapter 06

Intertidal Zone (Proposed Underground DC Cable)

VKL-08-39-G500-009

August 2017

Co-financed by the European Union
Connecting Europe Facility

Environmental Statement Volume 2			
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Glossary & Abbreviations

Glossary of Terms	
Term	**Meaning**
base scheme design	The design of the UK Onshore Scheme for the purposes of the planning application.
Biotope	The combination of physical environment (habitat) and its distinctive assemblage of conspicuous species.
Burial depth	The actual distance between the cable and the seafloor above. The planned distance between the 'normal' seafloor level and the cable.
Cumulative Effect	Impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the Project (European Commission 1999). Generally considered to be the same impact but from different projects e.g. underwater noise from two separate projects combining to affect marine mammals
Direct impact	Impacts that result from a direct interaction between a Project activity and the receiving environment.
Effect	The consequence of impacts, usually measureable. Effects only occur when an activity or environmental impact is present within an environment that is sensitive to it.
Impact	The consequence of an activity, predicted change in the baseline environment.
Indirect impact	Impacts on the environment, which are not a direct result of the Project/Project activities, often produced away from the activity or as a result of a complex pathway. For example loss of habitat from trenching, leading to reduction in prey species availability, having an indirect impact on predators. Indirect impacts are sometimes referred to as second or third level impacts, or secondary impacts (European Commission 1999).
Infauna	The animals living in the sediments of the seabed.
Intertidal	An area of a seashore that is covered at high tide and uncovered at low tide.
Landfall	The area between Mean Low Water Springs and Mean High Water Springs where the Onshore and Offshore Schemes meet.
Limits of Deviation	These define the maximum extents of the corridor for which planning permission is sought and within which proposed DC cable route may be installed.
Offshore Scheme	The subsea DC cable (crossing Danish, German, Dutch and UK waters).
Runnel	A small channel of water.
Transition Joint Pit	Buried concrete pit where onshore and submarine cables are physically jointed together.

Glossary of Terms	
Term	**Meaning**
UK Onshore Scheme	UK Onshore Scheme from MLWS to the connection point comprising underground AC and DC cables, converter station and access road.
Zone of Influence	The spatial extent over which the activities are predicted to have an impact on the receiving environment.

List of Abbreviations	
Abbreviation	**Meaning**
AC	Alternating Current
AEZ	Archaeological Exclusion Zones
BP	Before Present
BAP	Biodiversity Action Plan
BGS	British Geological Survey
CPT	Cone Penetration Tests
CEMP	Construction Environmental Management Plan
CEA	Cumulative effect assessment
°C	Degrees Celsius
DC	Direct Current
EMF	Electromagnetic Field
EA	Environment Agency
EIA	Environmental Impact Assessment
ES	Environmental Statement
EC	European Community
EUNIS	European Union Nature Information System
GPS	Global Positioning System
GES	Good Environmental Status
HVDC	High Voltage Direct Current
HE	Historic England
HER	Historic England Record
HDD	Horizontal Directional Drilling
MARPOL	International Convention for the Prevention of Pollution from Ships
IMO	International Maritime Organisation
JNCC	Joint Nature Conservation Committee

List of Abbreviations	
Abbreviation	**Meaning**
km	Kilometre
LoD	Limits of Deviation
LCC	Lincolnshire County Council
LHER	Lincolnshire Historic Environment Record
RCZA	Lincolnshire Rapid Coastal Zone Assessment
LPA	Local Planning Authority
MCAA	Marine and Coastal Access Act, 2009
MCZ	Marine Conservation Zone
MMO	Marine Management Organisation
MPS	Marine Policy Statement
MPA	Marine Protected Area
MSFD	Marine Strategy Framework Directive
MCA	Maritime and Coastguard Agency
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
m	Metre
NGVL	National Grid Viking Link Limited
NIMF	Nationally Important Marine Features
NE	Natural England
NERC	Natural Environment and Rural Communities
nm	Nautical Mile
OS	Ordnance Survey
PWA	Protection of Wrecks Act 1973
PAD	Protocol for Archaeological Discovery
RCZAS	Rapid Coastal Zone Assessment Survey
rMCZ	Recommended Marine Conservation Zone
RYA	Royal Yachting Association
SMP	Shoreline Management Plan
SSSI	Site of Special Scientific Interest
SNS	Southern North Sea
SAC	Special Area of Conservation

List of Abbreviations	
Abbreviation	**Meaning**
SPA	Special Protection Area
SSC	Suspended Sediment Concentrations
REC	The Humber Regional Environmental Characterisation
TJP	Transition Joint Pit
UKHO	UK Hydrographic Office
UK	United Kingdom
WFD	Water Framework Directive
WSI	Written Scheme of Investigation
ZoI	Zone of Influence

1 Introduction

1.1 Introduction

1.1.1 This chapter has been prepared by RPS. It reports the results of baseline studies and the assessment of the potential impacts of the proposed DC cable route of the UK Onshore Scheme on the coastal processes, benthic ecology and archaeology within the intertidal zone. Other topics which relate to the Proposed Underground DC Cable within the intertidal zone but are not considered in the current Chapter include chapter 7 Geology & Hydrology (ES-2-B.03), chapter 8 Water Resources & Hydrology (ES-2-B.04); and chapter 13 Socio-economics & Tourism (ES-2-B.09).

1.1.2 Table 1.1 below sets out the structure of the Environmental Statement (ES) with respect to the intertidal zone. Figure 6.1 shows the proposed landfall site together with the UK Onshore and Offshore Schemes.

Table 1.1 Environmental Statement: Intertidal Zone

ES Reference	ES Volume	ES Chapter	Content
ES-2-B.02	**2**	**06**	**Main Report: The Proposed Underground DC Cable**
ES-3-B.01	3	06	Figures: The Proposed Underground DC Cable
ES-4-B.02	4	06	Technical Appendices: The Proposed Underground DC Cable

1.1.3 As indicated above, this Chapter is multidisciplinary, covering three aspects of relevance to the intertidal zone:

- Coastal processes (covering the physical processes in operation at the intertidal zone and morphology);
- Intertidal benthic ecology (i.e. the benthic habitats and species associated with the sediments present at the proposed landfall); and
- Intertidal archaeology.

Chapter Structure

1.1.4 The remainder of this Chapter is structured as follows:

- Section 2. Approach to Assessment. Describes the discipline-specific assessment methods in accordance with relevant guidance.

- Section 3. Basis of Assessment. This Sets out the key assumptions which have been made in undertaking the impact assessment.
- Section 4. Planning Policy and Legislative Considerations. Summarises the key points of planning policy and legislation considered as part of the assessment.
- Section 5. Baseline Conditions. Reports the results of desktop and field studies undertaken to establish existing conditions.
- Section 6. Potential Impacts. Identifies the potential impacts on the intertidal zone which may occur as result of construction and operation.
- Section 7. Mitigation. Identifies the mitigation which is proposed including measures which are incorporated into the siting, design and construction of the Proposed Underground DC Cable.
- Section 8. Residual Effects. Reports the residual effects which remain taking into account proposed mitigation and identifies whether these are significant or not.
- Section 9. Cumulative Effects. Identifies the inter-project cumulative effects which may occur together with other developments.
- Section 10. Summary of Assessment. Provides a summary of the key findings of the impact assessment.
- Section 11. References.

2 Approach to Assessment

2.1 Approach to Assessment

2.1.1 This section describes the approach to the identification and assessment of impacts resulting from the construction, operation and decommissioning of the UK Onshore Scheme on the intertidal zone including intertidal ecology, archaeology and coastal processes.

Summary of Consultation

Scoping Opinion Review - Coastal Processes

2.1.2 Table 2.2 summarises the relevant consultation responses on the onshore elements of the Project relating to coastal processes received during scoping consultation (for both the UK Onshore Scheme and Offshore Scheme) prior to and during preparation of the ES and which were considered in this Chapter.

Table 2.2 Scoping Opinion Responses – Coastal Processes

Stakeholder	Summary of Consultation	Where Addressed
Environment Agency (EA)	Monitoring of all coastal flood defences would be required. Easier for man-made than for natural sea defences.	NGVL will undertake a detailed site investigation and maintain close liaison with the EA during the design process and before commencement of installation activities, to ensure the integrity of the defences and their foundation are not compromised; see construction measures in Table 7.17 and residual effects in in section 8.

Table 2.2 Scoping Opinion Responses – Coastal Processes		
Stakeholder	**Summary of Consultation**	**Where Addressed**
	We are pleased to note that the crossing of the sea defences is currently anticipated to be via Horizontal Directional Drilling (HDD). We would welcome further discussions on the methodology and temporary works to facilitate the cable installation once the detail has been determined. We note the Transition Joint Pits will be buried. The reception pits required to facilitate the HDD techniques will need to be bunded to a height equivalent to the adjacent defences. There may be issues with tidal inundation during construction, (which has not been mentioned in the Scoping Report), so this should be taken into consideration.	See methodology of HDD discussed in project description in The Proposed Underground DC Cable (Chapter 05), impact assessment in section 6 and discussion of residual effects in section 8.
	The identified potential impacts from the construction of the Scheme should set out the risks associated with crossing the large defences at the landfall.	Potential impacts of damage to coastal defences are assessed in section 6.
	Information on the decommissioning elements is requested, specifically whether the ducts will remain in situ or be removed once the pipeline is no longer required. The ducting should be buried sufficiently deep under the sea defences so that if there is a need to install piling along the frontage in the future there will be scope to do so.	The depth of the ducts will be determined taking into account a more detailed understanding of ground conditions based on further site investigation. Decommissioning is discussed in Section 6. and specifically 6.3.58 (also see The Proposed Underground DC Cable (Chapter 05)).

Table 2.2 Scoping Opinion Responses – Coastal Processes		
Stakeholder	**Summary of Consultation**	**Where Addressed**
	There are no assurances to the future approach to flood risk management along the coast and it remains the Applicant's responsibility to ensure that there is sufficient coverage of their cables in the intertidal area and any localised re-profiling of the beach to the design profile occurs after the cables are laid. The future of the flood risk management approach along these important frontages will be determined by the outcomes of the Saltfleet to Gibraltar Point Strategy.	Potential impact of changes to beach morphology and implications for cable burial and the risk of exposure is assessed in section 6.
	The landfall locations have the potential to impact on the delivery of our flood risk management works, Lincshore. Therefore we will require close liaison and discussions to ensure that we can coexist in this area, for the durations of our nourishment scheme.	NGVL will remain in close liaison with the EA regarding interaction between beach Lincshore and the DC Cable Route. Discussion of residual effects in section 8.
Royal Yachting Association (RYA)	The aspect of this project that is of interest to the RYA is cable landfall. In this respect we note the intention to bury the cables, however if that is not possible for whatever reason then the RYA would wish to be consulted if it was planned to use rock armour/mattress and the water depth a Chart Datum was reduced by more than 5% as a result.	Cable protection material will not be deposited within the intertidal area (see construction measures in section 7).

Scoping Opinion Review - Benthic Intertidal Ecology

2.1.3 Table 2.3 summarises the relevant consultation responses on the onshore elements of the Project relating to benthic intertidal ecology received during scoping consultation (for both the UK Onshore Scheme and Offshore Scheme) prior to and during preparation of the environmental statement and which were considered in this Chapter.

Table 2.3 Scoping Opinion Responses – Benthic Intertidal Ecology		
Stakeholder	**Summary of Consultation**	**Where Addressed**
Marine Management Organisation (MMO)	The offshore scoping report states that if an "open cut" installation method is undertaken in the intertidal area, this will involve using mechanical diggers to construct a trench across a section of the beach. Consideration should be given as to how the intertidal areas will be accessed by the machinery required to do any such works, and any impacts assessed and included in the ES.	Potential temporary habitat loss/disturbance by installation and associated operations is assessed in section 6.
EA	If the intertidal habitats in the proposed landfall site are similar to the habitats that have been previously monitored for the Lincshore assessment, the proposed survey method for the landfall (a Phase I intertidal ecology survey) would be adequate. If the initial Phase I survey identifies that the landfall site would impact different habitats to those previously monitored locally, a more detailed data baseline survey of these habitats may be required.	See paragraph 2.1.16 and Phase 1 Intertidal Survey Report (Volume 4: Chapter 6, Appendix 6.1)
	Appropriate methods for the impact assessment of intertidal ecology are proposed.	Impact assessment in section 6.
	Potential impacts on water quality within the intertidal zone are mentioned but water quality is not considered as a receptor. If marine water quality is to be addressed in another section of the EIA, it would be helpful to include signposting to it.	Changes to water quality are assessed Under coastal processes in section 6.

Scoping Opinion Review - Intertidal Archaeology

2.1.4 Table 2.4 summarises the relevant consultation responses on the onshore elements of the Project relating to intertidal archaeology received during scoping consultation (for both the UK Onshore Scheme and Offshore Scheme) prior to and during preparation of the environmental statement and which were considered in this Chapter.

Table 2.4 Scoping Opinion Responses – Intertidal Archaeology		
Stakeholder	**Summary of Consultation**	**Where Addressed**
Historic England (HE)	We advise that Archaeology and Cultural Heritage will need to be considered in more depth at this stage in order to ensure that the selection process takes account of impacts on heritage assets alongside all other factors. HE notes that the landfall site will involve no permanent above ground infrastructure. We advise, regarding selection of a preferred option, that in historic environment terms the main issues to consider relate to the direct impacts on archaeological remains across onshore, intertidal and marine environments. We refer to recorded archaeological remains on the foreshore at the three option sites. They concentrate on the possibility of encountering peat and other remains associated with the submerged forest which covers the wider area, from Mablethorpe to Ingoldmells and note that this is particularly relevant for site LF2 (one of three shortlisted landfalls and not brought forward), with the lack of access points at this location leading to the possibility of haulage along the foreshore from Anderby Creek Sea Road increasing the potential impact on heritage assets. We recommend that the applicant is also guided by the advice of the Historic Environment Officer at Lincolnshire County Council, who provides specialist archaeological advice to East Lindsey District Council.	See the baseline characterisation in section **Error! Reference source not found.** and an assessment of potential impacts to seabed prehistory and seabed features in section 6.

Table 2.4 Scoping Opinion Responses – Intertidal Archaeology		
Stakeholder	**Summary of Consultation**	**Where Addressed**
	Historic England notes that the proposal is not to conduct a walk-over survey, and has no concerns in principle regarding this approach at the current time. However, we would comment that whilst the potential information yielded might be limited, if any erosion has occurred, some lower sediments may be revealed. More importantly, instead of a walkover survey, we advise that the project will need to consider how you will investigate these sub-surface deposits and assess the risk of landfall on them. We assume that other than reference to the Rapid Coastal Zone Assessment, and Historic England's peat database, the next approach of the project would be to commission some form of auger/borehole survey in transects across the preferred landfall locations, to inform the creation of a deposit model which will be necessary in understanding the archaeological potential of this area.	Further consultation subsequent to this response is outlined in paragraph 2.1.6 and Table 2.6.
Lincolnshire County Council (LCC)	Baseline in terms of HER entries and additional information is required. It is unclear whether any of this information is required with respect to the intertidal zone.	Baseline description in section **Error! Reference source not found.**.
MMO	The Routeing Criteria in the offshore scoping report states that known wrecks are to be avoided by 100 m; and that other areas of archaeological significance are to be avoided by an appropriate buffer zone. This issue should be addressed within the ES.	The Project will adopt an avoidance strategy for the anomalies although no Archaeological Exclusion Zones (AEZs) are recommended at this time. See impact assessment in section 6.6 and construction measures in Table 7.19.

Table 2.4 Scoping Opinion Responses – Intertidal Archaeology		
Stakeholder	**Summary of Consultation**	**Where Addressed**
	The offshore scoping report states that if the open cut method is employed, this will involve using mechanical diggers to construct a trench across a section of the beach. With regards to the "open cut" installation method, particular attention should be given to this with any archaeological Written Scheme of Investigation prepared for the ES.	Impact assessment in section 6.6 and construction measures in Table 7.19.
	The ES prepared for this project should also include reference to the Protection of Military Remains Act 1986, as this act is applicable to military vessels and aircraft lost during war or peacetime operations and it is applied both within the UK and overseas. (Further information and particular reference to military aircraft, can be found at: https://www.gov.uk/guidance/aviation-archaeology).	See assessment of impacts to known and potential seabed features in section 6.6.
	The closest known munitions are thought to be located 4.2 km from the submarine cable corridor. The ES should give attention to the acquisition of survey data to allow for munitions and wreck (vessel or aircraft) identification along the coastline from landfall LF1a [the proposed landfall at Boygrift, East Lindsey], with an appropriate professional review and interpretation that includes archaeological expertise.	Baseline description in section **Error! Reference source not found.**.
	Particular attention should be given to the palaeo-environmental evidence mentioned in the offshore scoping report, with detailed consideration given to avoidance strategies. Similar attention is necessary for the heritage assets identified within the intertidal zone.	Impact assessment in section 6.6 and construction measures in Table 7.19.

Additional Consultation – Benthic Intertidal Ecology

2.1.5 Table 2.5 summarises the relevant consultation responses on the intertidal elements of the Project relating to benthic intertidal ecology received during the development of the project prior to and during preparation of the environmental statement and which were considered in this Chapter.

Table 2.5 Additional Consultation – Benthic Intertidal Ecology

Stakeholder	Summary of Consultation	Where Addressed
NE	The survey methodology and timing of the survey was agreed with NE on 27th June 2016 by correspondence, prior to the commencement of the surveys.	Paragraph 2.1.16 and Phase 1 Intertidal Survey Report (Volume 4: Chapter 6, Appendix 6.1)

Additional Consultation – Intertidal Archaeology

2.1.6 Table 2.6 summarises the relevant consultation responses on the intertidal elements of the Project relating to intertidal archaeology received during the development of the project prior to and during preparation of the environmental statement and which were considered in this Chapter.

Table 2.6 Additional Consultation – Intertidal Archaeology

Stakeholder	Summary of Consultation	Where Addressed
HE, letter dated 30th November 2016	On receipt of a letter from NGVL dated 6th October 2016 Historic England notes that the proposal is not to conduct a walk-over survey, and has no concerns in principle regarding this approach at the current time. The next approach of the project would be to commission some form of auger/borehole survey in transects across the preferred landfall locations, to inform the creation of a deposit model which will be necessary in understanding the archaeological potential of this area.	Letter to HE dated 8th February 2017
HE, letter dated 21st February 2016	Desk Based Assessment (DBA) and Wessex Archaeology technical report from 2016 and GEL Factual Report requested. View remains that [an auger/borehole survey] will provide necessary information to understand the archaeological potential of the area. The four cores are not considered sufficient to create a deposit model for the affected area of the landfall site.	Letter to HE dated 29th March 2017

Scope of Assessment

2.1.7 The assessment of impacts to benthic intertidal ecology, intertidal archaeology and coastal processes from the DC Cable Route will be undertaken using the specific sensitivity, magnitude and significance criteria set out in this Chapter. This methodology is consistent with the assessment of intertidal impacts in the Environmental Impact Assessment (EIA) for the Offshore Scheme. The assessment will consider potential direct and indirect, spatial and temporal impacts associated with the construction area between the Mean Low Water Spring (MLWS) mark and the Mean High Water Spring (MHWS) mark.

Spatial Scope

2.1.8 The spatial scope of the assessment comprises the intertidal zone of the Limits of Deviation of the proposed landfall which is 200 m x 250 m, which covers an area 0.05 km^2. All works will be confined to this area. See Figure 6.1 which shows the spatial scope of the assessment, i.e. the proposed landfall site at Boygrift in East Lindsey.

Temporal Scope

2.1.9 For potential impacts on coastal processes and benthic intertidal ecology receptors, the emphasis of the temporal scope will be on construction, operation and decommissioning activities for the proposed DC Cable Route. Impacts are expected to be temporary for these disciplines. For impacts on intertidal archaeology receptors, the assessment will focus on the construction of the Project and potential impacts are generally expected to be permanent.

Identification of Baseline Conditions – Desk Studies

2.1.10 All desktop studies and sources of information reviewed in identifying baseline conditions have focused on the proposed landfall section of the Project.

Coastal Processes

2.1.11 The assessment has been informed by a range of publically available data and literature sources. The data sources utilised for Chapter 6 include, but are not limited to, the following:

- Data from the Environment Agency's (EA) Anglian Coastal Monitoring Programme;
- Southern North Sea Sediment Transport Study (Ref:6-1);
- The Flamborough Head to Gibraltar Point Shoreline Management Plan (Ref:6-2); and
- Other relevant recent EIA studies, such as the Lincshore Renourishment 2016 - 2020 (Ref:6-3) and the Triton Knoll Electrical System (Ref:6-4).

Benthic Intertidal Ecology

2.1.12 NGVL commissioned a Phase I intertidal walkover survey of the proposed landfall to inform the baseline description and assessment (see paragraph 2.1.16). The data acquired through this

survey has been supplemented, where necessary, by a review of published information and consultation with relevant bodies. The data sources used in this Chapter include, but are not limited to the following:

- EIA studies for the Triton Knoll Electrical System (Ref:6-4);
- Monitoring studies of benthic intertidal communities within the EA's Lincshore area (Ref:6-3); and
- UKSeaMap, European Nature Information System (EUNIS) predicted habitats.

Intertidal Archaeology

2.1.13 Baseline information has been acquired with regard to known and potential historic environment resources within the intertidal zone that could be affected by the construction and operation of the Project (see Phase 1 Intertidal Archaeology Report (Volume 4: Chapter 6, Appendix 6.2)). Such resources include features and deposits of archaeological and palaeoenvironmental interest exposed at low tide as well as those sealed beneath the current surface material across the intertidal zone.

2.1.14 A site visit was undertaken in November 2015 during the landfall site selection process, although the key sources of information used to inform the intertidal archaeology baseline were desk based, and included:

- The Lincolnshire Historic Environment Record (LHER), comprising data for terrestrial and marine archaeological sites, find spots and archaeological events;
- The United Kingdom Hydrographic Office (UKHO) data for charted wrecks and obstructions;
- Results of the Yorkshire and Lincolnshire Rapid Coastal Zone Assessment (RCZA) undertaken on behalf of English Heritage (now Historic England; Buglass and Brigham, 2008);
- The National Heritage List for England maintained by Historic England, comprising data of designated heritage assets including sites protected under the Protection of Military Remains Act 1986 and the Protection of Wrecks Act 1973;
- Shoreline Management Plans;
- Historic maps of the area; and
- Other material held at the Lincolnshire Archives (Lincoln) and at appropriate local libraries.

Identification of Baseline Conditions – Field Studies

2.1.15 The field study undertaken to identify benthic intertidal baseline conditions have focused on the proposed landfall section of the Project.

Benthic Intertidal Ecology

2.1.16 A site specific Phase I intertidal ecology walkover survey was undertaken at the proposed landfall site in July 2016 (see Phase 1 Intertidal Survey Report (Volume 4: Chapter 6, Appendix 6.1)). This involved surveying all intertidal habitats between MHWS and MLWS within the landfall corridor. The survey was undertaken following guidance set out in the Joint Nature Conservation Committee (JNCC) Marine Monitoring Handbook (Ref:6-5), i.e. Procedural Guideline No. 3-1 'In situ intertidal biotope recording' and in the 'Handbook for Marine Intertidal Phase I Biotope Mapping Survey' (Ref:6-6). All intertidal biotopes[1] present were identified using on-site sediment sampling and analysis and their extents mapped with the aid of aerial photography and hand-held Global Positioning System (GPS) recorders. Intertidal habitats on the beach were mapped using biotopes defined by the JNCC. Notes were made on the presence of features in the intertidal zone, e.g. shellfish beds, drainage channels, potential Annex I habitats, and, where present, target noted in the intertidal biotope map (Figure 6.3). The survey methodology and timing of the survey was agreed with Natural England on 27th June 2016 by correspondence, prior to the commencement of the surveys.

Intertidal Archaeology

2.1.17 Due to the on-going beach renourishment works undertaken by the EA at the proposed landfall, a detailed intertidal archaeology walkover survey was not considered necessary in order to confirm the presence of any surface-based features or deposits. HE agreed with this approach following letter correspondence sent to HE and Lincolnshire County Council (LCC) on 10th November 2016 (see Table 2.6).

Approach to Assessment

Assessment Guidance

2.1.18 The impact assessment for benthic intertidal ecology is based on the 'Guidelines for Ecological Impact Assessment in Britain and Ireland, Marine and Coastal' (Institute for Ecology and Environmental Management; Ref:6-7).

2.1.19 The impact assessment for intertidal archaeology was undertaken in line with the 'Coastal Defence and the Historic Environment' guidance document (English Heritage 2003, currently under review).

2.1.20 The methods employed for the assessment of impacts to intertidal zone receptors have been adapted to ensure comparability with the assessment methods to be employed for the voluntary EIA being produced for the marine component of the proposed Viking Link route in UK waters,

[1] A biotope is an area of habitat with uniform environmental conditions and a specific assemblage of plants and animals

which extends from the UK/Netherlands median line to MHWS. This ensures that the intertidal zone assessment, covered in both EIAs, is consistent in the two documents.

Assessment Criteria - Sensitivity or Value of Receptors

2.1.21 The value of ecological features is dependent upon their biodiversity, social and economic value within a geographic framework of appropriate reference (Ref:6-8). The most straightforward context for assessing ecological value is to identify those habitats and species that have a specific biodiversity value recognised through international or national legislation or through local, regional or national conservation plans (e.g. Annex I habitats under the Habitats Directive, Biodiversity Action Plans (BAPs), Nationally Important Marine Features (NIMFs), existing and recommended Marine Conservation Zones (MCZ and rMCZ, respectively)). Only a very small proportion of marine habitats and species fall within the legislative or policy framework and, therefore, evaluation must also assess value according to the functional role of the habitat or species. For example, some features may not be protected under conservation legislation in themselves, but may be functionally linked to features of high conservation value.

2.1.22 The sensitivity of ecological receptors is defined by an assessment of the combined vulnerability of the receptor to a given impact and the likely rate of recoverability to pre-impact conditions. Vulnerability is defined as the susceptibility of a habitat, community or species (i.e. the components of a biotope) to damage, or death, from a specific external factor. Recoverability is the ability of the same features to return to a state close to that which existed before the activity or event which caused change. It is dependent on its ability to regenerate, regrow, recruit or recolonise, depending on the extent of damage incurred.

2.1.23 These assessments have been combined with the assessed status (i.e. the level of designation/ importance) of the affected receptor which reflects its conservation value and the overall sensitivity of a receptor to an impact then identified from a five point scale as presented in Table 2.7.

Table 2.7 Sensitivity Criteria (Intertidal Zone)

Sensitivity	Description
High	The receptor has little or no capacity to absorb change without fundamentally altering its present character. For example, one or more combinations of: · Severe or persistent damage over a large area or to the entire population/habitat; · Recovery to baseline conditions > 5 years; · The receptor is a designating feature of an International protected site, e.g. European Natura 2000 or RAMSAR site; and/or · Receptor is very rare/unique/economically valuable or ecologically important.

Table 2.7 Sensitivity Criteria (Intertidal Zone)	
Sensitivity	**Description**
Medium	The receptor has moderate capacity to absorb change without significantly altering its present character; however some damage to the receptor will occur. For example, one or more combinations of: · Localised or medium term damage/disturbance to population/habitat; · Recovery to baseline conditions within 1-5 years; · The receptor is designated as a national site, e.g. Special Site of Scientific Interest (SSSI), Nature Reserve, MCZ; and/or · Uncommon or moderately valuable economically or ecologically but not rare or unique.
Low	The receptor is tolerant of change without significant detriment to its character. Some minor damage to the receptor may occur. For example, one or more combinations of: · Localised or short term damage/disturbance to portion of the population/habitat; · Recovery to baseline conditions within 1 year; and/or · The receptor is neither rare, unique or of significance in terms of economic or ecological value.
Negligible	The receptor is tolerant to change with no effect on its character.

Assessment Criteria - Magnitude of Impacts

2.1.24 The magnitude of an impact is determined based on an assessment of the following attributes of the impact: spatial extent; duration (i.e. short, medium or long term); frequency; reversibility; and timing. These factors are then considered together to determine the likely consequences on ecological functionality and conservation objectives of the intertidal receptors. The overall magnitude is identified from a four point scale as presented in Table 2.8.

Table 2.8 Impact Magnitude Criteria (Intertidal Zone)	
Magnitude	**Description**
High	Total loss or major alteration to key elements/features of the baseline conditions such that post development character/composition of baseline condition will be fundamentally changed.
Medium	Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition of the baseline condition will be materially changed.
Low	Minor shift away from baseline conditions. Changes arising from the alteration will be detectable but not material; the underlying character/composition of the baseline condition will be similar to the pre-development situation.

Table 2.8 Impact Magnitude Criteria (Intertidal Zone)	
Magnitude	**Description**
Negligible	Very little change from baseline conditions. Change is barely distinguishable, approximating to a "no change" situation.

Assessing the Significance of Effects

2.1.25 The significance of the effect upon intertidal receptors is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The particular method employed for the intertidal zone assessment is presented in Table 2.9.

Table 2.9 Assessment of Significance (Intertidal Zone)				
Magnitude of Impact	**Sensitivity or Value of Receptor**			
	High	**Medium**	**Low**	**Negligible**
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Negligible	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

3 Basis of Assessment

3.1 The Proposed Underground DC Cable

3.1.1 The assessment of impacts on receptors within the intertidal zone (for coastal processes, benthic intertidal ecology and intertidal archaeology disciplines) is based on the Project Description which is summarised below. See The Underground Cable (Chapter 5) for a full description of the Proposed Underground DC Cable from the landfall to the converter station.

3.1.2 The submarine cables will be joined to onshore cables in a Transition Joint Pit (TJP) landward of the existing sea defences. The submarine cables will be placed into pre-installed intertidal ducts which will extend from the TJP (precise position subject to survey), underneath the sea defences, to a location between the MHWS and the MLWS. Four ducts will be installed: one for each power cable, the fibre optic cable and a fourth duct to act as a spare.

3.1.3 In order to protect the integrity of the sea defences a trenchless installation technique, such as Horizontal Directional Drilling (HDD), will be adopted to install the ducts. HDD is a technique whereby a hole is typically drilled from shore under any sea defences, dune systems or sensitive features, to a point a suitable distance offshore, usually several hundred metres. A duct is inserted into the drilled hole which is then used as the duct into which the cables are installed.

3.1.4 HDD operations utilise drilling fluids and additives such as bentonite, to assist in maintaining the integrity of the drilled hole and to transport the cutting materials out of the hole as drilling progresses. The choice of drilling mud required will be selected by the contractor on the basis of drilling performance and environmental constraints. The majority of drilling fluids are biodegradable and have no harmful effect on the surrounding environment. It is extremely unlikely that any drilling fluids will be discharged into the marine environment.

3.1.5 Drilling fluid breakouts that may occur from the end of the duct will be dealt with by containing the flow within a small bunded pit, likely to be adjacent to the TJP. The drilling mud is then either pumped via a mud return line to the holding pits/tanks located onshore, or collected by a vacuum tanker. Any residual mud can then be cleaned up. The normal practice of having a supply of filled sandbags on site to contain any such breakouts will be followed.

3.1.6 The ends of the ducts will be located underneath the beach level, awaiting arrival of the submarine cables. The likely duration of these works is 1 - 2 months per duct/per excavation. Beach access may be required during this operation for inspection of the end of the duct. If required, an excavator would excavate a pit typically 5 m x 5 m footprint per duct/per excavation. Small sections of the beach will be inaccessible to the public for limited periods, although transit along the beach will still be possible.

3.1.7 The end of the duct accepting the cable will be dug out using an excavator. There may be a requirement for a temporary coffer dam in the beach for excavation of the duct and installation.

Material excavated will be left adjacent to the pit and refilled after the cable pull-in. The submarine cable would either be floated to the exit point of the duct, or lowered onto the beach and pulled along the beach using an excavator and/or rollers. An alternative solution is for the cable barge to ground itself on the beach at low tide for the cable to then be led to the ducts using a temporary roller path.

3.1.8 The submarine cable would then be connected to the messenger wire pre-installed in the duct, and winched from a position close to the TJP at the western end of the pre-installed duct whereupon it can be jointed to the onshore cables.

3.1.9 The cable is then installed away from the beach either using a plough or trencher or via excavator to MLWS. The typical excavated trench would be 1 m wide, with the material replaced after cable installation. For the purposes of the impact assessment it is assumed that the open trench will be from the sea defence to the MLWS, which is approximately 250 m.

3.1.10 Beach access will be required during excavation inspection of the end of the duct and pull-in of the submarine cables. For this, excavators would be required and small sections of the beach will be inaccessible to the public for a limited period, although transit along the beach will still be possible.

3.1.11 The likely duration for each cable pull will be from 1 - 2 days to one week. The installation sequence for each of the submarine cables and the fibre optic cable is likely to be similar. As the offshore installation sequence has not been decided, the temporary works on the beach may be removed between cable pull-in operations.

Design Measures

3.1.12 The design measures are incorporated into the design of the Project. All design mitigation is identified in the Register of Mitigation (Chapter 17). Table 3.10 and Table 3.11 present design measures that NGVL is committed to adopting for the coastal processes and benthic intertidal ecology disciplines, respectively. The assessments are based on the impacts with these design measures taken into account.

Table 3.10 Design mitigation – coastal processes
Proposed Mitigation Measure
Trenchless techniques will be used to cross the sea defence. Any potential damage to the sea defences as a result of the HDD works will be mitigated through the careful design of the trenchless technique.

Table 3.11 Design mitigation - benthic intertidal ecology
Proposed Mitigation Measure
Preferred method of installation in the intertidal zone will be by trenchless methods.
Cable protection material will not be deposited within the intertidal area.

4 Planning Policy and Legislative Considerations

4.1 Introduction

4.1.1 This section provides a summary of the planning polices and legislative framework in the UK which is relevant to the assessment presented in this Chapter and the relevant marine licensing requirements that apply to the installation, operation (including maintenance and repair) and decommissioning of the intertidal elements of the proposed DC Cable Route.

4.2 Marine Planning and Licensing

UK Marine Policy

4.2.1 In order to rationalise planning in the marine environment, a UK Marine Policy Statement (MPS) has been prepared in accordance with Section 44 of the Marine and Coastal Access Act 2009 (MCAA; discussed below) as the system that will direct marine planning activities. The document sets out the policies intended to help achieve sustainable development in the UK marine areas and provides the framework for preparing marine plans and for taking decisions that affect the marine environment. Marine plans provide more detailed policy and spatial guidance at a country or regional level.

4.2.2 The MCAA requires all public authorities taking authorisation or enforcement decisions that affect, or might affect, the UK marine area do so in accordance with the MPS and relevant marine plans unless relevant considerations indicate otherwise. Authorities taking decisions that affect, or might affect, the UK marine area which are not authorisation or enforcement decisions must have regard to the MPS and relevant marine plans.

UK Marine Plans

4.2.3 Responsibility for the development of marine plans in the UK has been delegated to the MMO. They provide policy and spatial guidance for specific areas and help ensure that decisions within a plan area contribute to the delivery of UK, national and any area specific policy objectives. Marine plans in UK coastal areas overlap slightly with the area of jurisdiction of local planning authorities (LPAs), i.e. marine planning covers the area up to MHWS whereas LPAs' responsibilities extend to the MLWS. LPAs are expected to play an important role in the marine planning process, leading to the integration of land-use plans and marine plans, where they overlap. 11 marine plans are being developed including inshore and offshore areas. The landfall for the Project crosses Area 3 (East Inshore Plan; discussed below).

East Inshore and Offshore Marine Plans

4.2.4 The East Inshore Marine Plan area (Area 3) was the one of the first marine plans prepared for English seas. The East Inshore Marine Plan includes the coastline stretching from Flamborough Head to Felixstowe, extending from mean high water spring out to 12 nautical miles, including inland areas such as the Broads and other waters subject to tidal influence. The East Offshore Marine Plan area (Area 4) covers the marine area from 12 nautical miles out to the maritime borders with the Netherlands, Belgium and France and is discussed further in the offshore ES.

4.2.5 The vision for the East Marine Plan Areas is to achieve by 2034, sustainable, effective and efficient use of the East Inshore and East Offshore Marine Plan Areas, leading to economic development while protecting and enhancing the marine and coastal environment, offering local communities new jobs, improved health and well-being.

4.2.6 In assessing marine licence applications, the MMO must determine whether the activities of the proposed project are compatible with the objectives of the relevant marine plans/s.

4.2.7 The East Inshore and Offshore Marine Plans, contain eleven objectives which will be delivered through 38 policies. The policies cover a wide range of topics including activities and users, economic, social and environmental considerations and cross-cutting issues such as the join up between decision-making on land and at sea and opportunities for coexistence. The key policies relevant to the intertidal zone (and therefore this Chapter) are outlined below, a more detailed assessment of the project against the marine plan policies can be found in the offshore ES:

- Preference should be given to proposals for cable installation where the method of installation is burial. Where burial is not achievable, decisions should take account of protection measures for the cable that may be proposed by the applicant;
- Cumulative impacts affecting the ecosystem of the East marine plans and adjacent areas (marine, terrestrial) should be addressed in decision-making and plan implementation; and
- Proposals that may affect heritage assets should demonstrate, that they will avoid or where not possible minimise compromise or harm elements which contribute to the significance of the heritage asset and, where applicable, mitigate against any impacts.

4.3 Marine Licensing

4.3.1 The Marine and Coastal Access Act 2009 (MCAA) came in to force on 6th April 2011 and provides the framework for the marine licensing system. The Act modernises previous licencing process and provides a more streamlined, transparent, and effective licensing system. The MMO is responsible under Part 4 of the MCAA for administering marine licensing of activities related to construction or removal of any substance or object in UK territorial waters, through the issue of Marine Licences.

4.3.2 A Marine Licence is required for the installation and operation (maintenance and repair) of the Project within UK inshore waters and therefore a Marine Licence would apply to the section of the cable in territorial waters, i.e. between MHWS and the 12nm limit, including the intertidal zone.

4.3.3 As discussed above in paragraph 4.2.3, there is an overlap between the jurisdiction of the MMO which extends landwards to MHWS and the jurisdiction of LPAs which extend seawards to MLWM. Within this area of overlap, the Project will need to apply for a marine licence under the MCAA (see NGVL ES for the Offshore Scheme for further details) and apply for planning permission to the relevant LPA in accordance with the Town and Country Planning Act 1990. This intertidal assessment is therefore presented within both the offshore and onshore ESs for the Project.

4.4 Protected Areas

Natura 2000 sites

4.4.1 European Community (EC) Council Directive 92/43/EC on the conservation of natural habitats and of wild fauna and flora (Habitats Directive) and EC Council Directive 2009/147/EC on the conservation of wild birds (Birds Directive) enable European Union Member States to work together within the same legislative framework to protect Europe's most valuable species and habitats, irrespective of political or administrative boundaries. Special Areas of Conservation (SACs), designated under the Habitats Directive, and Special Protected Areas (SPAs), designated under the Birds Directive, provide protection for Europe's most valuable species and habitats within a network of protected sites, collectively known as Natura 2000 sites.

4.4.2 The Conservation of Habitats and Species Regulations 2010 (as amended) transpose the Habitats Directive into law on land and in territorial waters (up to 12 nm limit) of England and Wales. The Offshore Marine Conservation (Natural Habitats &c.) Regulations 2007 (as amended in 2010) transpose the Habitats Directive into law for UK offshore waters. These regulations are collectively referred to as 'the Habitats Regulations' (see the Habitats Regulations Assessment).

Marine Conservation Zones

4.4.3 A key component of the MCAA is the provision of powers to the appropriate authority to designate Marine Conservation Zones (MCZs). MCZs protect a range of nationally important marine wildlife, habitats, geology and geomorphology, and can be designated anywhere in English and Welsh territorial and UK offshore waters. One of the objectives when selecting MCZs is to ensure that an ecologically coherent network is achieved. MCZs therefore aim to complement the existing Natura 2000 sites and the marine components of Sites of Special Scientific Interest (SSSIs) and Ramsar sites.

4.4.4 Under Section 126 of the MCAA, all determining authorities have a duty to consider MCZs during marine licence decision making. To meet the requirements of Section 126, the MMO has introduced a MCZ assessment process which will be integrated into the marine licence decision making procedures. A report to inform the MCZ assessment for the Project is presented as part of the NGVL ES for the Offshore Scheme (Technical Appendix L). No MCZs were identified to have an impact pathway from the UK Onshore Scheme.

Protected Species

4.4.5 Certain species are protected by international, European and national wildlife legislation throughout the UK. This protection status has been considered when undertaking the baseline characterisation. Where protected species were recorded as present or likely to be present in the baseline characterisation, these have been considered when determining their value or importance for the purposes of the impact assessment. The relevant legislation which affords protection to species include:

- The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended) transpose the EC Habitats Directive and EC Birds Directive into national law;
- The Conservation of Habitats and Species Regulations 2010;
- The Wildlife and Countryside Act 1981 (as amended); and
- The Natural Environment and Rural Communities (NERC) Act (2006).

Intertidal Archaeology

4.4.6 As part of the scoping consultation, the statutory consultee Historic England requires that the legislation described below is considered during the assessment of impact. On consideration of this legislation and prior to work being conducted, a Project specific Written Scheme of Investigation (WSI) for Archaeological Remains and a Protocol for Archaeological Discovery (PAD) are required to minimise disturbance and destruction of archaeological features and set out a methodology for investigation.

Protection of Wrecks Act 1973

4.4.7 Under the Protection of Wrecks Act 1973 (PWA), wrecks and wreckage of historical, archaeological or artistic importance can be protected by way of designation. It is an offence to carry out certain activities in a defined area surrounding a wreck that has been designated, unless a licence for those activities has been obtained. Offences include:

- Tampering with, damaging or removing any part of a vessel;
- Carrying out diving or salvage without permits;
- Removing objects from the wreck site; and
- Depositing, so as to fall and lie abandoned on the seabed, anything that would obliterate the site, obstruct access to it, or damage any part of the wreck.

4.4.8 Under the PWA, protection is provided for wrecks that are designated as dangerous due to their contents and is administered on a UK-wide basis by the Maritime and Coastguard Agency (MCA) through the Receiver of Wreck.

Ancient Monuments and Archaeological Areas Act 1979

4.4.9 Although primarily land based, in recent years the Ancient Monuments and Archaeological Areas Act 1979 has also been used to provide some level of protection for underwater sites. The Act provides for the scheduling of monuments, which encompasses buildings, structures or work, cave or excavation, vehicle, vessel, aircraft or other moveable structure. To be eligible for scheduling, a monument must be of national importance. Sites range from standing stones to deserted medieval villages, and include recent structures such as collieries and wartime pillboxes.

Protection of Military Remains Act 1986

4.4.10 The Protection of Military Remains Act is used to provide protection for military wrecks of both aircraft and ships. All military aircraft are automatically protected under this legislation. The Act is administered by the Ministry of Defence (MoD) notably the Royal Air Force for aircraft and the Royal Navy for vessels. Under this Act, vessels may be designated either as a protected place or as a controlled site.

4.4.11 Wrecks are designated by name and can be designated as protected places even if the location of the site is not known. Thus, the wreckage of a UK military aircraft is automatically a protected place even if the physical remains have not been previously discovered or identified. Shipwrecks need to be specifically designated, and designation as a protected place applies only to vessels that sank after 4th August 1914. The Act makes it an offence to interfere with a protected place, to disturb the site or to remove anything from it, unless licensed to do so by the MoD.

4.5 The European Marine Strategy Framework Directive

4.5.1 The European Marine Strategy Framework Directive (MSFD) (2008/56/EC) of 17th June 2008 was transposed into UK legislation on 15th July 2010. The Directive requires Member States to prepare national strategies to manage their seas to achieve Good Environmental Status (GES) by 2020. The MSFD applies to waters beyond one nautical mile and has been implemented in the UK by the Marine Strategy Regulations 2010.

4.5.2 The MSFD does not state a specific programme of measures that Member States should adopt to achieve GES except for the establishment of Marine Protected Areas (MPAs). Broadly GES for the marine environment means that marine waters are:

- Ecologically diverse;
- Clean, healthy and productive; and
- Used sustainably, so that the needs of current and future generations are safeguarded.

4.5.3 Annex I of the Directive lists eleven high level descriptors of GES. These relate to: biological diversity; non-indigenous species; commercially exploited fish and shellfish; food webs; human-induced eutrophication; sea floor integrity; hydrographical conditions; contaminants; contaminants in fish and other seafood; marine litter; and introduction of energy (including

underwater noise). Consideration of these descriptors has been made when undertaking the assessment presented within this Chapter.

4.6 Water Framework Directive

4.6.1 The Water Framework Directive (WFD) was adopted in October 2000 and came into force in December 2000. The WFD established a framework to protect and improve the ecological health of European waters, including inland surface waters (rivers and lakes), transitional waters, coastal waters and groundwater. Protection of coastal waters under the WFD extends from the mean low water mark up to one nautical mile from shore and requires that licensed projects or activities do not cause deterioration in a water body.

4.6.2 In the UK, for licence applications in this zone, the MMO must ensure that the Marine Licence decision is compatible with the objectives of the WFD and any river basin management plan. In England, the EA is the competent authority for the WFD and it advises the MMO on WFD issues before a licensing decision is made. Its assessments and conclusions inform the MMO decision. The WFD assessment for the Project is presented within the NGVL ES for the Offshore Scheme (Technical Appendix P).

4.7 Local Planning Policy and Strategy

East Lindsey District Council Emerging Local Plan

4.7.1 ELDC has now produced the Submissions Modifications Draft Version of its Local Plan which will guide growth and development in East Lindsey up to 2031. The Local Plan will be made up of a Core Strategy and Settlement Proposals and once adopted, will comprise the statuary development plan for ELDC, replacing the 2007 Local Plan. The emerging Core Strategy has progressed to draft stage and as such, can only be given limited weight as a material consideration due to its early stage of preparation.

4.7.2 Strategic Policy 11 (SP11) - Historic Environment:

1. The Council will support proposals that secure the continued protection and enhancement of heritage assets in East Lindsey, contribute to the wider vitality and regeneration of the areas in which they are located and reinforce a strong sense of place.

3. Where a heritage asset is classed as at risk, redevelopment or enabling development which does not harm the asset will be supported particularly where a use would benefit the wider community.

4.7.3 Strategic Policy 17 (SP17) – Coastal East Lindsey:

2. The Council will support improvements to the existing flood defences, the creation of new flood defences and infrastructure associated with emergency planning.

5. All relevant development will need to provide adequate flood mitigation.

4.7.4 Strategic Policy 23 (SP23) – Landscape:

2. The Council will ensure that the distinctive character of the District's landscapes whether they are of cultural, natural or historic significance, will not be compromised. In particular, the highest level of protection will be given to the Lincolnshire Wolds Area of Outstanding Natural Beauty, which is designated at a national level because of its landscape quality.

3. The Council will support development that conserves and enhances designated and historic landscapes (Winceby Battlefield, Lincolnshire Wolds, Coastal Country Park, Conservation Areas, Historic Parks and Gardens, setting of listed buildings within the landscape) as focal points for widening and improving the visitor experience.

4.7.5 Strategic Policy 24 (SP24) - Biodiversity and Geodiversity:

1. Development proposals should seek to protect and enhance the biodiversity and geodiversity value of land and buildings, and minimise fragmentation and maximise opportunities for connection between natural habitats.

2. The Council will protect sites designated internationally, nationally or locally for their biodiversity and geodiversity importance, species populations and habitats identified in the Lincolnshire Biodiversity Action Plan and the Natural Environment and Rural Communities (NERC) Act 2006.

4.7.6 Strategic Policy 28 (SP28) – Infrastructure and S106 Obligations:

1. Infrastructure s will be supported provided they are essential in the national interest; contribute to sustainable development, and respect the distinctive character of the district.

2. Infrastructure s should be accompanied by an impact assessment that shows how the proposal impacts on the landscape or local setting of the area, including individual and cumulative effects. It should identify what steps have been taken to minimize its effects and the alternative options that have been considered.

3. The Council will support the delivery of infrastructure where it contributes to sustaining local communities.

4. Where appropriate, developer contributions will be sought towards the delivery of infrastructure where it is shown to be necessary for the development to proceed, and where it will not compromise the viability of the scheme.

5. The Council will only support proposals for development where it has been shown that adequate capacity is available or can be provided by the utility providers to meet the additional loads associated with serving the development.

Lincolnshire County Council Natural Environment Strategy 2012 - 2018

4.7.7 This strategy, together with three other strategies forms the overarching Environmental Management Strategy. The Natural Environment Strategy outlines outcomes that the council aims to achieve by through this strategy. These goals include, but are not limited to:

- *Lincolnshire's countryside, coastline and towns are much richer in biodiversity by 2018;*

- *The natural environment of Lincolnshire is more resilient to climate change, the impacts of which are better understood;* and
- *Planning policy balances promotion of sustainable growth and economic regeneration with the protection and enhancement of the natural environment. This will be achieved by liaison with Local Planning Authorities and through the Council's Minerals and Waste and Local Transport Planning Policy functions.*

Lindsey County Council (Sandhills) Act 1932

4.7.8 The Lindsey County Council (Sandhills) Act 1932 ("the Act") was introduced to regulate construction on certain land within Lindsey, Lincolnshire. The Act gave the council the ability to limit further destruction to the dunes above the high water mark of ordinary tides through licencing of new buildings and allowing the council to take possession of land where ownership could not be verified. Lindsey County Council was abolished in 1974 and replaced by Lincolnshire County Council ("the Council"). The Council have stated that the proposed landfall site selected by National Grid Viking Link ("NGVL") falls within the area controlled by the Act.

4.7.9 Certain sections of the Act have been repealed. However, section 9 which places restrictions on construction activities on certain areas of land were saved from repeal. The area of land that the Act applies to is above the high water mark of ordinary tides. Therefore the Act applies only to the top several metres of the intertidal zone.

5 Baseline Conditions

5.1 Study Area

5.1.1 The study area comprises the intertidal zone of the landfall site at Boygrift in East Lindsey (see Figure 6.1). The intertidal zone, also referred to as the foreshore and littoral zone, is the area exposed to the air at low tide (above the MLWS tide level) and submerged beneath seawater at high tide (up to the MHWS tide level).

5.1.2 The Zone of Influence (ZoI) is described for each potential impact for each discipline, within the spatial scope described in paragraph 2.1.8. See Table 5.12, Table 5.13 and Table 5.14 for the ZoI relating to impacts on coastal processes, benthic intertidal ecology and intertidal archaeology, respectively.

Zone of Influence - Coastal Processes

5.1.3 The identified potential aspects, i.e. activities associated with the Project which could lead to impacts on physical conditions and marine processes during installation, operation (including repair and maintenance) and decommissioning are presented in Table 5.12**Error! Reference source not found.**. For each impact, the assessment considered the identified Project aspects which could cause the impact (and their respective ZoI), and from these the largest ZoI was selected, resulting in a worst case assessment.

Table 5.12 Identification of potential impacts and their zones of influence – coastal processes

Project Phase	Project Activity	Aspect	Potential Impact	Receptor	Zone of Influence
Installation and decommissioning	Cable burial and removal	Trenching, excavation of 5 m x 5 m exit pit in intertidal zone over four occasions. Installation of coffer dam.	Changes to beach morphology	Beach morphology	Defined landfall area as shown in Figure 6.1
Operation	Presence of cables	Cable burial depth	Potential changes to beach morphology and implications for cable	Intertidal area	Defined landfall area (Figure 6.1)

Table 5.12 Identification of potential impacts and their zones of influence – coastal processes					
Project Phase	**Project Activity**	**Aspect**	**Potential Impact**	**Receptor**	**Zone of Influence**
			burial and the risk exposure		
Installation, operation and decommissioning	Cable burial, repair and removal	Trenching, HDD	Damage to coastal defences	Coastal defences	Defined landfall area (Figure 6.1)
Installation, operation and decommissioning	Cable burial, repair and removal	Trenching	Change in SSC and subsequent deposition	Water quality	700 m*
Installation, operation and decommissioning	Cable burial, repair and removal	High faecal bacteria concentrations from overflow drains during storm events. Presence of project vessels (routine vessel/ ballast water discharge) and land vehicles.	Changes to water quality	Bathing water quality	Immediate vicinity of project vessels (i.e. within 10's of metres), vicinity of emergency overflow drains
* 700 m is the distance from the edge of the submarine cable corridor at which modelled SSC arising from jetting in the subtidal environment falls below 10 mg/l based on cable installation at the cable corridor centre-line.					

Zone of Influence - Benthic Intertidal Ecology

5.1.4 The identified potential aspects, i.e. activities associated with the Project which could lead to impacts on benthic intertidal ecology during installation, operation (including repair and maintenance) and decommissioning are presented in Table 5.13**Error! Reference source not found.**. For each impact, the assessment considered the identified Project aspects which could cause the impact (and their respective ZoIs), and from these the largest ZoI was selected, resulting in a worst case assessment.

Table 5.13 Identification of potential impacts and their zones of influence – benthic intertidal ecology

Project Phase	Project Activity	Aspect	Potential Impact	Receptor	Zone of Influence
Installation and decommissioning	Cable burial	Excavation of 5 m x 5 m exit pit in intertidal zone over four occasions. Installation of coffer dam.	Temporary loss/disturbance of habitat	Intertidal sandy habitats	100 m^2
		Excavation of four 250 m (approx.) long cable trenches between exit pit and MLWS (exit pit assumed to be at MHWS)			1000 m^2
		Works on intertidal zone associated with installation of cables			The defined landfall area (se Figure 6.1 and Figure 6.3)
Installation and decommissioning	Cable burial	Excavation of four 250 m (approx.) long cable trenches between exit pit and MLWS (exit pit assumed to be at MHWS)(dry conditions, at near-low water)	SSC dispersion, deposition and smothering	Intertidal species	The defined landfall area' up to 700 m (by jetting in subtidal zone)
Installation, operation and decommissioning	Cable burial, repair and maintenance and cable removal	Release of hydrocarbons, sewage discharge or chemical spill	Accidental pollution	Intertidal sandy habitats and species	Immediate vicinity of source, within landfall area

Table 5.13 Identification of potential impacts and their zones of influence – benthic intertidal ecology					
Project Phase	**Project Activity**	**Aspect**	**Potential Impact**	**Receptor**	**Zone of Influence**
Operation	Operation of cables	Emission of EMF, 130 m across cable centre line	Electromagnetic field effects	Intertidal species	0.03 km^2
Operation	Operation of cables	Emission of heat, 1 m wide Immediately above each cable	Heating effects	Intertidal species	500 m^2

Zone of Influence - Intertidal Archaeology

5.1.5 The identified potential aspects, i.e. activities associated with the Project which could lead to impacts on marine archaeology during installation, operation (including repair and maintenance) and decommissioning are presented in Table 5.14. For each impact, the assessment considered the identified Project aspects which could cause the impact (and their respective ZoI), and from these the largest ZoI was selected, resulting in a worst case assessment.

Table 5.14 Identification of potential impacts and their zones of influence – intertidal archaeology				
Project phase	**Aspect**	**Potential Impact**	**Receptor**	**Zone of Influence**
Installation and decommissioning	Cable burial using ploughing, jet trenching and/or mechanical trenching methods	Direct damage/destruction to assets, and/or their physical setting, buried within the sediments	Known and potential prehistory receptors, maritime receptors and aviation receptors	30 m
Installation and decommissioning	Changes to the hydrodynamic and sedimentary regimes due to spoil removal and	Increased protection to, or deterioration of, assets resulting in a beneficial or adverse effect on assets in the vicinity	Known and potential intertidal prehistory receptors, maritime receptors	Immediate vicinity of restricted area

Table 5.14 Identification of potential impacts and their zones of influence – intertidal archaeology				
Project phase	**Aspect**	**Potential Impact**	**Receptor**	**Zone of Influence**
	distribution caused by trenching operations		and aviation receptors	
Operation	Scheduled and unplanned maintenance works	Localised damage/destruction to assets, and/or their physical setting, buried within the seabed sediments.	Known and potential seabed prehistory receptors, maritime receptors and aviation receptors	The defined landfall area and immediate surrounding area

5.1.6 The baseline is described for coastal processes, benthic ecology and archaeology for the intertidal zone at the proposed landfall site. This section details the receptors for each discipline within the intertidal zone which may be susceptible to potential impacts from activities relating to the installation of the cables.

5.2 Baseline Description

Coastal Processes

5.2.1 The proposed landfall site lies within the Lincolnshire coast, with a tidal range of 6 m on mean spring tides and 2.8 m on mean neap tides. Tidal currents are directed towards the north on the ebb and to the south on flood. Flow directions deviate in some instances around nearshore banks, for example banks to the north east of Skegness (Ref:6-2). The predominant wave direction along this frontage is from the north east.

5.2.2 The beaches along the Lincolnshire coast are typically characterised by medium sands which grade into more varied sands, gravelly sands and mixed sediments further offshore. The intertidal area within the region varies, with more extensive beaches to the north of Mablethorpe where beaches are up to 1 km wide and to the south of Skegness where beaches are up to 400 m wide. The proposed landfall lies between Mablethorpe and Skegness and in this section of coastline the beaches are typically narrower, usually less than 150 to 200 m wide (Ref:6-4).

5.2.3 The proposed landfall site lies within a section of shoreline that is subject to a long term recorded trend of erosion, with a recorded net erosion rate of -1.3 m/yr from 1890 to 2000 (based on analysis of historic Ordnance Survey (OS) mapping data presented in Ref:6-9). It has been

suggested that this erosional pattern is potentially related to the shape of the coastline (convex) driving a high degree of exposure to wave energy.

5.2.4 Historically, erosion of the thin veneer of sands along this shoreline occurred, exposing (and leading to the erosion of) the underlying tills. To counter this process, the EA began a major beach renourishment scheme (known as 'Lincshore') in 1994, running from Mablethorpe to Skegness (Figure 6.2 presents an image of the beach renourishment in operation, with the proposed landfall also marked). Monitoring of the Lincshore scheme is undertaken annually by the EA and this is used to identify sections of the shoreline where beach levels fall below threshold levels.

5.2.5 The morphology observed along this section of shoreline, and at the proposed landfall, is therefore significantly influenced by the beach renourishment undertaken by the EA and the subsequent erosion of the sediment placed on the beach.

5.2.6 Whilst the Lincshore scheme acts to maintain beach levels, and in doing so, offsets the natural tendency for erosion along this shoreline, it does not prevent the net southerly longshore drift along the frontage. A range of predicted net drift rates are available at various locations along this length of the coast (as summarised in Ref:6-1), with potential transport rates of the order of 100,000 m^3 per year (Ref:6-3).

5.2.7 Sediments for the renourishment are sourced from a number of offshore, licensed dredge areas. Renourished sediments are reported by the EA (Ref:6-3) to range in size from 0.55 to 0.75 mm sand. This is noted to be coarser than the native sediment, with pre-renourishment sediments believed to be fine to medium sands (0.2 – 0.3 mm in diameter) (Ref:6-10).

5.2.8 The frontage at the proposed landfall site consists of a long strip of sandy beach backed by a large concrete sea wall with a narrow strip of vegetated dunes forming an embankment behind, which together form the main sea defence.

5.2.9 The current Lincshore scheme runs from 2016 – 2020. The intention of the current scheme is to maintain beach levels and manage tidal flood risk in the interim period while the Saltfleet to Gibraltar Point Flood Risk Management Strategy is developed. This strategy, when completed, will inform tidal flood and erosion risk management along this shoreline for the next 100 years. The EA carried out a renourishment campaign in 2015 and this has been followed by a further campaign during the summer of 2016.

Benthic Intertidal Ecology

5.2.10 The baseline intertidal ecology at the proposed landfall is detailed in the intertidal survey report, see Phase 1 Intertidal Survey Report (Appendix 6.1 (ES-4-B.02); note the figures in the appendix present an outline of the general landfall study area and do not represent the specific red line boundaries of the proposed landfall). The proposed landfall site consists of a long strip of sandy beach backed by a large concrete sea wall with a narrow strip of vegetated dunes forming an embankment behind, which together form the main sea defence. The Boygrift Drain outfall is located in the north of the submarine cable corridor, emerging from the intertidal slope in the mid shore and extending out into the lower shore, close to the MLWS. The habitat map produced from the Phase I intertidal walkover survey undertaken in July 2016 is presented in Figure 6.3.

5.2.11 Nine EUNIS habitats were identified at the proposed landfall and are listed in Table 5.15. This included six Level 5 biotopes and two Level 4 biotopes. Further information on these biotopes is provided in Table 5.16.

Table 5.15 Habitats present at the proposed landfall site (see Figure 6.3)

EUNIS (2016)	Joint Nature Conservation Committee (JNCC) Equivalent Habitat (2015)
A2.22- Barren or amphipod dominated mobile sand shores	LS.LSa.MoSa- Barren or amphipod dominated mobile sand shores
A2.221- Barren littoral coarse sand	LS.LSa.MoSa.BarSa- Barren littoral coarse sand
A2.211- Talitrids on the upper shore and strandline	LS.LSa.St.Tal- Talitrids on the upper shore and strandline
A2.231- Polychaetes in littoral fine sand	LS.LSa.FiSa.Po- Polychaetes in littoral fine sand
A2.241- *Macoma balthica* and *Arenicola marina* in muddy sand shores	LS.LSa.MuSa.MacAre- *Macoma balthica* and *Arenicola marina* in littoral muddy sand
A2.245- *Lanice conchilega* in littoral sand	LS.LSa.MuSa.Lan- *Lanice conchilega* in littoral sand
A1.11- Mussels and/or barnacle communities	LH.HLR.MusB- Mussels and/or barnacle communities
A1.111- *Mytilus edulis* and barnacles on very exposed eulittoral rock	LH.HLR.MusB.MytB- *Mytilus edulis* and barnacles on very exposed eulittoral rock

Table 5.16 Littoral habitat type and description (adapted from Connor *et al* 2004 (Ref:6-11))			
Shore Position	**Habitat Code**	**Habitat Description**	**Habitat Image**
Upper shore	A2.221/LS.LSa.MoSa.BarSa Barren littoral coarse sand	This species poor biotope was observed just above the strandline at the proposed landfall. Barren littoral coarse sand is typically associated with well-drained upper beaches and lacks a macrofaunal community due to the local dynamic conditions.	
Upper shore	A2.211/LS.LSa.St.Tal Talitrids on the upper shore and strandline	A community of sandhoppers (including talitrid amphipods) was present just below the strandline, at the top of the compacted slope on the upper foreshore. Decaying vegetation typically provides cover and humidity for sandhoppers.	

Table 5.16 Littoral habitat type and description (adapted from Connor *et al* 2004 (Ref:6-11))			
Shore Position	**Habitat Code**	**Habitat Description**	**Habitat Image**
Upper to mid shore	A2.22/LS.LSa.MoSa Barren or amphipod dominated mobile sand shores	This biotope consisted of clean mobile sands (fine to medium and sometimes coarse) with a series of compact ripples in the mid shore. Due to the low water retention a limited range of species is typical, though none were recorded in the current survey.	No photographic still acquired
Mid to lower shore	A2.231/LS.LSa.FiSa.Po Polychaetes in littoral fine sand	This biotope was observed in the lower shore, close to mean low water, and consisted of clean rippled sand that remains damp throughout the tidal cycle. The infaunal community was characterised by one polychaete in particular, the cat worm, *Nephtys* sp. (probably *N. cirrosa*). Spionid worms were also recorded in a small number of samples. The polychaete tubeworms *Lanice conchilega* was present at the lowest part of the shore and lugworm *Arenicola marina* casts were often present within this biotope.	

Table 5.16 Littoral habitat type and description (adapted from Connor *et al* 2004 (Ref:6-11))			
Shore Position	**Habitat Code**	**Habitat Description**	**Habitat Image**
Lower shore	A2.241/LS.LSa.MuSa.MacAre *Macoma balthica* and *Arenicola marina* in muddy sand shores	Features of this biotope were present in the low shore, consisting of fine to medium sand often with a rippled surface, generally remaining water-saturated during low water. The species assemblage is characterised by the lugworm *Arenicola marina* and the Baltic tellin *Macoma balthica*, however the latter was not recorded during the survey.	No photographic still acquired
Lower shore	A2.245/LS.LSa.MuSa.Lan *Lanice conchilega* in littoral sand	Features of this biotope were present in the low shore close to the MLWS. These tubeworms typically inhabit fine to medium muddy sand. However in this case densities were very low and the sediment comprised clean fine to medium sands cohabited by lugworms (*A. marina*).	No photographic still acquired

Table 5.16 Littoral habitat type and description (adapted from Connor *et al* 2004 (Ref:6-11))			
Shore Position	**Habitat Code**	**Habitat Description**	**Habitat Image**
Mid to lower shore	A1.11/LH.HLR.MusB Mussels and/or barnacle communities	This biotope was observed on the outfall at the proposed landfall site, particularly the distal section of the structure located on the lower shore where drying periods would be shorter between tidal cycles. Communities were dominated by barnacles *Chthamalus* spp. and/or *Semibalanus balanoides*. Some edible mussels (*Mytilus edulis*) were also present.	
Lower shore	A1.111/LH.HLR.MusB.MytB *Mytilus edulis* and barnacles on very exposed eulittoral rock	This biotope is typically found on very exposed to exposed rocky shores in the eulittoral zone, particularly the mid and lower shore. This community is characterised by patches of small individuals of the mussel *Mytilus edulis* interspersed with patches of the barnacle *Semibalanus balanoides*. Only minor patches of *M. edulis* were present on the outfall within the A1.11/LH.HLR.MusB biotope at the proposed landfall site and so this biotope was not extensively represented.	

5.2.12 The upper shore habitats comprised barren, gravelly medium to coarse dry, loose sand; no macrofauna were recorded in association with these sediments during the survey. The 'barren littoral coarse sand' biotope was assigned to the upper shore sediments. This biotope graded into flat, compact, drying fine to medium sands characterised by the 'barren or amphipod-dominated mobile sand shores' biotope. The strandline debris was associated with a typical community of sand hoppers (talitrid amphipods), characteristic of the 'talitirids on the upper shore and strandline' biotope.

5.2.13 From the very upper shore, the beach elevation dropped several metres to a runnel along its base. The sediments along the slope comprised barren, flat, compact, drying fine to medium sands which were assigned the 'barren or amphipod dominated mobile sand shores' biotope. The lower 2 m of the slope consisted of gravelly medium to coarse sand before forming a runnel parallel to the beach, maintained by water draining from the upper shore.

5.2.14 The beach beyond the runnel comprised of a mosaic of rippled compact fine to medium drying sand and wet rippled sand influenced by run off from the runnel, with the barren infaunal communities corresponding with the 'barren or amphipod dominated mobile sand shores biotope'.

5.2.15 The biotope 'polychaetes in littoral fine sand' was recorded from the mid shore down to MLWS, across the width of the survey area. The polychaete *Nephtys* sp. was recorded throughout this biotope. Within areas assigned to this biotope, lugworm *Arenicola marina* were observed in moderate densities (approximately 2.4 per m^2) and sand mason worms *Lanice conchilega* in much lower densities (approximately 0.3 per m^2). The communities in these areas were therefore considered to represent a variant of the 'polychaetes in littoral fine sand' biotope, with some features of the '*Macoma balthica* and *Arenicola marina* in littoral muddy sand' biotope and the '*Lanice conchilega* in littoral sand' biotope. With the exception of cat worms (*Nephtys* sp.), fauna was sparse in areas of the 'polychaetes in littoral fine sand' biotope where lug and sand mason worms were absent.

5.2.16 The lower foreshore across the entire survey area was influenced by the freshwater discharge from the Boygrift Drain fluvial outfall. The brown foamy deposits likely originated from terrestrial soil run-off.

5.2.17 The intertidal communities and sediments recorded at the proposed landfall were found to be consistent with those recorded during the 2014 survey of the Triton Knoll export cable landfall at Anderby Creek, approximately 3 km south of the proposed landfall at Boygrift in East Lindsey (Ref:6-4).

5.2.18 It is acknowledged that the intertidal survey at the proposed landfall site was undertaken in the period following one of the Lincshore scheme beach renourishment events. Therefore, to provide context to the survey results, the results of long-term monitoring surveys undertaken by the EA have also been considered which have confirmed that the intertidal communities in this area are naturally impoverished and mostly composed of species typical of highly dynamic intertidal environments (Ref:6-3).

Intertidal Archaeology

5.2.19 The marine historic environment was assessed in relation to three distinct themes: seabed prehistory; maritime and aviation archaeology; and historic seascape character. The baseline summary includes reference to all known receptors (including both designated and non-designated assets where relevant) and potential receptors.

5.2.20 The baseline intertidal archaeology is detailed in the intertidal archaeology desk based assessment; see Phase 1 Intertidal Archaeology Report (Volume 4: Chapter 6, Appendix 6.2; note the figures in the appendix present an outline of the general landfall study area and do not represent the specific red line boundaries of the Proposed Landfall Site). The prehistoric archaeological record of the British Isles covers the period from the earliest hominin occupation more than 780,000 Before Present (BP) to the Roman invasion of Britain 1973 BP. During this period sea level fluctuations caused by three major phases of glaciations (the Anglian, Saalian and Devensian) have shaped the prehistoric landscape within the study area. The changes in sea level have at times exposed the floor of the Southern North Sea (SNS), including the study area, as a terrestrial land surface beyond the limits of the glacial ice sheets, creating an inhabitable environment suitable for hominin occupation and exploitation.

5.2.21 At the beginning of the Upper Palaeolithic period the area remained covered in glacial ice. By around 13,000 BP the area was ice free. By around 6,000 BP the majority of the North Sea Basin had been inundated. The Humber Regional Environmental Characterisation (REC) notes that *it is apparent that small but significant areas remain emergent……at the mouth of the Humber Estuary which were probably salt marshes* (Ref:6-12). It seems likely that the proposed landfall would have been dry land relatively late in the prehistoric period.

5.2.22 Areas of peat are marked on the British Geological Survey BGS) maps to the south of the proposed landfall, but not within it. Results from the geophysical survey (Ref:6-13) do not confirm the presence of such material but do indicate localised areas of weaker, less consolidated sedimentary material.

5.2.23 A geotechnical survey has been undertaken at the landfall (Ref:6-14). Two boreholes were undertaken within and near the proposed landfall to a depth of between 25 m and 30 m. In addition, Cone Penetration Tests (CPTs) were undertaken. The works revealed a sequence of made ground (only in one borehole, located to the west of Roman Bank and outside the landfall) overlying blown sand/storm beach deposits, in turn overlying saltmarsh and tidal creek deposits; these coastal-estuarine sediments may have some palaeoenvironmental interest. Under this was boulder clay overlying chalk. No peat deposits or other indications of early environment or activity were revealed.

5.2.24 The results of geophysical and geotechnical surveys undertaken in connection with the Offshore Scheme have been analysed by Wessex Archaeology (Ref:6-15). This has indicated that while a number of high amplitude reflectors were identified in the nearshore section of the Offshore Scheme, only one feature is located within the outline design of the subsea Direct Current (DC)

cables. These high amplitude features are interpreted as being within the Bolders Bank formation and are largely identified at some 4 m below the seabed, the depth of the seabed multiple. It is possible that these represent coarser sediments within the Bolders Bank formation or they may be indicative of shallow gas and of archaeological interest.

5.2.25 There are several recorded undesignated assets around the proposed landfall site. An Iron Age long necked beaker was found on the beach at Sutton on Sea opposite the golf course (HER number MLI41443, see Phase 1 Intertidal Archaeology Report (Volume 4: Chapter 6, Appendix 6.2)). A salt works of unknown date was destroyed during the construction of the golf course (RCZAS number HT1, see Phase 1 Intertidal Archaeology Report (Volume 4: Chapter 6, Appendix 6.2)).

5.2.26 The HER records two areas of ridge and furrow, probably representing medieval ploughing in the wider area (HER numbers MLI115845 and MLI115846, see Phase 1 Intertidal Archaeology Report (Volume 4: Chapter 6, Appendix 6.2)). Both areas are currently under arable and any earthworks appear to have been removed.

5.2.27 The OS Surveyors Plan of 1819 shows a drain, the 'Boy Grift Drain' running from Well, some 10 km south west of the proposed landfall site, to an outfall at the proposed landfall, where it is marked as 'Bilsby Out End'. A small group of buildings are marked in approximately the location of what are now the buildings of Sandilands Golf Club.

5.2.28 The first edition OS 6-inch to the mile scale map of 1888 shows Roman Bank (HER number MLI88784) as an earthwork with a narrow trackway on or adjacent to parts of it. The track way now forms the modern road. White House Farm is shown located immediately behind the sand dunes. Boy Grift Drain is shown running from inland, crossing the railway and discharging into the sea to the north of the proposed landfall site. The beach in the wider area is shown as being sandy with large patches of exposed clay.

5.2.29 The second edition OS map of 1907 shows White House Farm renamed as Sea Bank Farm. Boy Grift Drain is shown as having been culverted where it crosses the intertidal zone.

5.2.30 The third edition OS of 1948 shows a series of breakwaters, which take the form of groynes within the intertidal zone, on both the north and south sides of the Boy Grift Drain. Golf links are shown on the landward side of the high water mark.

5.2.31 The nearest designated asset is Stain Glebe Farm, located approximately 1 km west of the proposed landfall and listed at Grade II (List entry number 1063007). The building is a late 18th century cottage. The Huttoft enclosure map of 1780 shows the area as new enclosures while the first edition six inch to the mile OS map of 1888 shows the cottage with a group of adjacent farm buildings in fields. The structure seems to represent a post enclosure farm. The setting of the listed building comprises the adjacent structures with which it is associated and the surrounding fields. The proposed landfall does not form a significant part of the setting of the listed building.

5.2.32 The named locations of the recorded losses of some 18 vessels and two military aircraft are known in the area, though not within the ZoI or LoD. The results of geophysical and geotechnical surveys undertaken in connection with the subsea DC cables have been analysed by Wessex

Archaeology (Ref:6-15). Three geophysical anomalies have been recorded on the foreshore, at the edge of the landfall area, as follows:

- Wessex Archaeology – A medium sized anomaly, indicative of possible buried ferrous debris.
- Wessex Archaeology – A small anomaly, indicative of possible buried ferrous debris.
- Wessex Archaeology – A very large anomaly, indicative of possible substantial buried ferrous debris.

5.2.33 The above anomalies are recorded in the magnetic dataset only, indicating buried ferrous material or material without surface expression. There is no indication of these features in either the side scan sonar data or the multibeam data. One anomaly is particularly large and indicates a substantial piece of ferrous material. They are classified by Wessex Archaeology as 'A2 anomalies - uncertain origin of possible archaeological interest' (Ref:6-15).

6 Potential Impacts

6.1 Overview of Potential Temporary Impacts

6.1.1 For the purposes of this EIA construction effects are typically temporary or short-term occurring during the construction phase only. The following temporary impacts for each discipline, where relevant, have been identified as potentially resulting from the construction of the Project:

Coastal Processes

- Changes to beach morphology;
- Damage to coastal defences;
- Change in SSC and subsequent deposition; and
- Changes to water quality.

Benthic Intertidal Ecology

- Temporary loss/disturbance of habitat;
- Suspended sediment dispersion, deposition and smothering; and
- Accidental pollution.

6.2 Overview of Potential Operational, Longer Term and Permanent Impacts

6.2.1 The following operational, longer term and permanent impacts for each discipline, where relevant, have been identified as potentially resulting from the Project:

Coastal Processes

- Potential changes to beach morphology and implications for cable burial and the risk of exposure;
- Damage to coastal defences;
- Change in SSC and subsequent deposition; and
- Changes to water quality.

Benthic Intertidal Ecology

- Electromagnetic Field Effects (EMF);
- Heating effects; and
- Accidental pollution.

Intertidal Archaeology

- Impacts to known and potential seabed features; and
- Impacts to known and potential seabed prehistory.

6.3 Overview of Potential Decommissioning Impacts

6.3.1 The following decommissioning impacts for each discipline, where relevant, have been identified as potentially resulting from the Project:

Coastal Processes

- Changes to beach morphology;
- Damage to coastal defences;
- Change in SSC and subsequent deposition; and
- Changes to water quality.

Benthic Intertidal Ecology

- Temporary loss/disturbance of habitat;
- Suspended sediment dispersion, deposition and smothering; and
- Accidental pollution.

Intertidal Archaeology

- Impacts to known and potential seabed features; and
- Impacts to known and potential seabed prehistory.

Temporary Impacts - Coastal Processes

Changes to beach morphology

6.3.2 Ducts (up to four) are proposed to be installed beneath the sea defence (located at, or immediately above high water) from the location of the transition joint pit (TJP) landward of the sea defence to a point between MHWS and MLWS (worse case assumption at MHWS). Installation of the ducts will be via a trenchless technique such as HDD. The seaward end of the ducts (within the intertidal zone) would be located beneath beach level, and located via an exit pit.

6.3.3 On arrival of the submarine cable at the landfall from offshore, there may be a requirement to excavate an exit pit to locate the previously installed cable ducts within a temporary coffer dam structure. The exit pit will typically comprise a 5 m x 5 m footprint pit. The submarine cable would then be ‘pulled through’ the cable ducts, using a pre-installed messenger wire, to the TJP and jointed to the onshore cable.

6.3.4 In terms of changes to beach morphology, the relevant aspects of the installation activity are the excavation of coffer dammed exit pits to locate the ducts within the intertidal zone and the creation of trenches for cable burial (see paragraph 7.6.1), from the exit pits to low water.

6.3.5 In the case of both activities (excavation for the coffer dammed exit pits and trenches for the cables), material excavated during trenching will be used to backfill the trenches/pits. As such, any changes to beach morphology will be only temporary. Any changes in the local hydrodynamic regime, such as transport of sediment by longshore drift, which occur as a result of the presence of the coffer dam is expected to be limited, on the basis that the coffer dam will be installed around the exit pits for short periods of time for cable pull operations. Each cable pull is expected to take 1 – 2 days to one week. The offshore installation sequence has not been decided; therefore the temporary works on the beach may be removed between cable pull-in operations.

6.3.6 As this impact is considered to be short term and only a minor shift from baseline conditions, the magnitude is assessed as **low**. Given the location of the proposed landfall within the Lincshore renourishment scheme, the beach is considered to be tolerant to changes in morphology. As such the sensitivity is assessed at **negligible**. Overall, the significance of effect of a change to beach morphology has been assessed as **negligible**.

Damage to coastal defences

6.3.7 As discussed in paragraph 6.3.2, installation of up to four the ducts will be via a trenchless technique such as HDD. This approach is intended to avoid compromising the integrity of the coastal defences, as the cable ducts will be installed beneath the coastal defence and no direct interaction will occur with the defence structure itself. The seaward end of the ducts (within the intertidal zone) would be located beneath beach level, and located via an exit pit which would be excavated to facilitate installation of the cables in the ducts when the cable vessel arrives with the submarine cables.

6.3.8 Any unlikely damage to the sea defences as a result of the HDD works would be localised, small in nature and so should not affect the overall integrity of the defence, but may require minor remedial works to the defences. The sensitivity has been assessed as **low** because the use of a trenchless installation technique means that the sea defence will be avoided and in the unlikely event that damage did occur, it is likely that only minor works would be required to address the situation. The magnitude has been assessed as **medium** as, given the importance the function the sea defences fulfils, any change to the baseline condition is considered to be a material change. However as noted any damage would not be expected to effect the overall integrity of the defence, meaning this does not constitute a total loss of the function or a fundamental change to the baseline condition. Overall, the significance of effect of damage to coastal defences has been assessed as **minor** adverse.

Change in SSC and subsequent deposition

6.3.9 As discussed in paragraph 5.2.2, sediments at the proposed landfall are characterised as fine, medium and coarse sands. Should any installation activities be undertaken 'in the wet', any sediment suspended by the excavation and/or burial process will be dispersed by the local wave regime and tidal currents. The majority of the medium sand and coarser material is likely to settle within a few metres of the activity, whilst finer material may be transported further. Given the nature of the sediments, the localised nature of the disturbance of the bed and the short duration of the activity, it is considered that any plume of suspended sediments that arises will be highly localised and temporary in nature.

6.3.10 The EA currently undertake regular renourishment activity (Lincshore scheme) (dating back to 1994) from Mablethorpe to Skegness, including at the proposed landfall site. This activity involves the pumping of large volumes of sediment and water onto the intertidal zone. A sediment dispersion study was undertaken to investigate the dispersion of sediments from beach renourishment utilising numerical modelling techniques and drawing on particle size data from along the frontage (including data from Boygrift, East Lindsey) (Ref:6-16). The study concluded that there is little change to SSC due to the renourishment and it was stated that this agrees with previous monitoring undertaken by the EA (Ref:6-16).

6.3.11 Relative to the renourishment activity, any sediment disturbance due to the proposed cable burial assessed here is smaller in scale both spatially and temporally. Elevations to SSC in the nearshore area due to cable installation are expected to be localised, of short duration, with most disturbed sediments deposited in close proximity to the point of release.

6.3.12 In conclusion, the installation activities will temporarily increase the levels of suspended sediments in the water column adjacent to the proposed landfall. The coastal process regime is considered to be an impact pathway and is not considered to be a receptor for changes to suspended sediments and deposition. The potential impacts of the changes predicted here are considered in the relevant receptors sections, most notably in the benthic intertidal ecology (see paragraphs 6.3.19 to 6.3.27) and intertidal archaeological sections (paragraphs 6.3.49 to 6.3.57).

Changes to water quality

6.3.13 Cable installation activities have the potential to impact bathing water quality through two mechanisms:

- Re-mobilisation of faecal bacteria associated with contaminated sediments, directly impacting water quality with a consequent risk to public health; and
- Presence of project vessels (routine vessel/ballast water discharge) and land-based vehicles

6.3.14 Trenching will increase SSC over a localised area (<700 m) for a short period (<1 hour) (Ref:6-18). This transient effect is within the natural variability expected for the SNS and as described in paragraphs 6.3.9 to 6.3.12 will have negligible effect on the amenity value of the bathing water.

6.3.15 Faecal bacteria are predominantly associated with terrestrial sources (human and animal waste); however they may be deposited in sediments, as a component of fines, and subsequently remobilised with the potential for transport to shore. High faecal bacteria concentrations are only recorded at the adjacent bathing water beaches after storm events, related to the use of the emergency overflow drains.

6.3.16 One concern is that faecal bacteria may become deposited in local sediments, potentially surviving; trenching would then have the potential to disturb the sediments leading to an impact on the local bathing water quality. Bathing waters impacts assessments across the UK have found compelling evidence of faecal survival in only one case (pers com R Dannatt 2016). This case was characterised by muddy sediments, exposed to warming in summer (in the intertidal zone) and subject to a regular source of bacterial contamination from a stream receiving combined storm overflow discharges. There is no significant evidence of sand sized sediments as reservoirs of bacteria in other UK studies (pers com R Dannatt 2016). The beach at Boygrift, East Lindsey, comprises sandy sediments. There are no combined storm overflows in close proximity to the subsea DC cables. Combined, this suggests that there is unlikely to be significant risk from trenching to the adjacent bathing waters. The assessment concluded that the effect on bathing waters is **negligible**.

6.3.17 Quantities of any discharges of dissolved contaminants from Project vessels engaged in installation activities will be small, particularly relative to the other direct inputs to the water column (e.g. rivers, airborne contaminants). No discharges from vessels are permitted within 12 nm of the coast, therefore no impacts to bathing waters (through sewage discharges) are anticipated. Impacts of discharges offshore will be temporary and localised. Moreover, vessels engaged in cable laying operations will be equipped with waste disposal facilities (sewage treatment or waste storage) to International Maritime Organisation (IMO) International Convention for the Prevention of Pollution from Ships (MARPOL) standard. The magnitude of any associated changes in water quality is assessed as **negligible**.

6.3.18 Since the introduction of steel hulled vessels around 120 years ago, water has been used to stabilise vessels at sea. Ballast water is pumped in to a vessel to maintain safe operating conditions throughout a voyage (Ref:6-19). The main concern with the discharge of ballast water is that it can contain a multitude of marine species carried from foreign destinations, which on release into the waters of the Project area may pose ecological problems. Species that survive may establish a reproductive population in the host environment, becoming invasive and out-competing native species. This is considered further in the NGVL ES for the Offshore Scheme. The significance of effect has been assessed as **negligible**.

Temporary Impacts - Benthic Intertidal Ecology

Temporary loss/disturbance of habitat

6.3.19 Intertidal works to install the cable may result in temporary habitat loss/disturbance as a result of the installation of up to four cable ducts by trenchless methods (e.g. HDD) under the sea

defence, and specifically as a result of the associated excavation of an exit pit for the ducts at a location between MHWS and MLWS (to be determined) over a period of up to two months. The exit pit is likely to require the temporary excavation of sediment over a footprint of approximately 5m x 5m. The cables will not be laid at the same time; therefore the exit pit will be opened and closed on up to four occasions over the installation period, with one of the ducts being a spare and nothing being installed within it. Each cable pull will take a maximum of one week.

6.3.20 Temporary intertidal habitat loss and disturbance will also arise as a result of the subsequent installation of each of the submarine and fibre optic cables. This process will require the exit pit to be temporarily re-excavated and the submarine cables either floated to the exit point of the duct, or lowered onto the beach and pulled along the beach using an excavator and/or rollers. It is possible that a temporary coffer dam may be required. Alternatively, the cable barge may be required to purposefully ground on the beach at low tide. The cables may be installed throughout the intertidal zone via ploughing, trenching or excavator. All works will be confined to the outline design at the proposed landfall and may therefore result in temporary habitat loss/disturbance of up to 0.05 km^2 of intertidal sandy habitat. However, direct temporary habitat loss from the cable installation (i.e. trenching, ploughing, and excavation) is likely to be restricted to a width of approximately 1 m wide for each cable. As close as practical to the ends of the ducts the cables will be bundled together and run in a common trench reducing the footprint on the beach. Assuming, as a worst case, that the exit pit is located at the MHWS mark, the total temporary habitat loss/disturbance associated with the four cable trenches within the intertidal zone (i.e. down to MLWS) would be 1000 m^2. The installation of each submarine cable in the intertidal zone is anticipated to take up to one week. The excavated material will be replaced after cable installation and the beach profile will be restored to facilitate the recovery of intertidal habitats. As the offshore installation sequence has not been determined, the temporary works on the beach may be removed between cable pull-in operations and therefore temporary habitat loss/disturbance may occur up to three weeks phased over two to three years. Access to the beach will be via an existing private access point through the Sandilands Golf Course from Sea Bank/Roman Bank. Emergency access will be via an existing beach replenishment access point further south, also off Sea Bank/Roman Bank.

6.3.21 Due to the localised, temporary and reversible nature of the impact, the magnitude is assessed as **low**.

6.3.22 As discussed in paragraph 5.2.18, the intertidal sandy habitats present within the proposed landfall site are neither unique nor of significance in terms of economic or ecological value. The intertidal habitats are predicted to have high resistance and high recoverability to temporary habitat loss/disturbance (Ref:6-20). The predominant intertidal biotopes at the proposed landfall site (LS.LSa.MoSa.BarSa and LS.LSa.FiSa.Po) are subject to high levels of abrasion resulting from natural sediment mobility and are also subject to continued habitat disturbance as a result of the Lincshore scheme. The species that are present (if any) are robust and can withstand some physical disturbance and/or recover rapidly, or migrate as adults into the biotope (Ref:6-20). The sensitivity of this receptor is therefore considered to be **low**.

6.3.23 Due to the localised, temporary and reversible nature of the impact, along with the recovery potential of the affected habitats, the significance of effect of temporary habitat loss/disturbance has been assessed as **negligible**.

Suspended sediment dispersion, deposition and smothering

6.3.24 The surrounding area is likely to be impacted from the suspension and subsequent deposition of sediments as a result of ploughing, jetting and trenching operations. Jetting and trenching techniques will cause a greater level of sediment suspension compared to the use of ploughing equipment. Suspended sediment could potentially smother organisms within the deposition area.

6.3.25 During the drilling operations for the cable ducts beneath the coastal defences, drilling fluids and additives such as bentonite, may be used to assist in maintaining the integrity of the drilled hole and to transport the cutting materials out of the hole as drilling progresses. There is the potential for a small amount of cutting fluids to be discharged at the point where the bore punches out into the exit pit in the intertidal zone. The volume of potential fluids will however be low and will be contained to the exit pit, so the potential for drilling fluids to contribute to increased suspended sediment levels and smothering by deposition is extremely low.

6.3.26 Due to the short term nature of the installation activities in the intertidal zone (installation of each submarine cable is expected to take one week), any increases in SSCs are considered to be localised and minimal. Relative to the beach renourishment activity by the EA (paragraphs 5.2.1 to 5.2.9), any sediment disturbance would be much smaller, both spatially and temporally. All predictions for increases in SSCs should be considered in the context of the historic beach renourishment works that have been undertaken in this area since 1994. Relatively low increased levels of sediment deposition are considered unlikely to negatively impact intertidal sandy habitats receptors for the reasons described above. The magnitude of the impact is therefore assessed as **low**.

6.3.27 It is expected that inhabitants of the sandy habitats in this area are predisposed to have a high tolerance to temporarily increased SSCs. The intertidal sandy habitats are of low vulnerability and high recoverability; the LS.LSa.MoSa.BarSa biotope occurs in scoured habitats and it is likely to be exposed to chronic or intermittent episodes of high-levels of suspended solids as local sediments are re-mobilised and transported (Ref:6-20). Also, biotopes such as LS.LSa.MoSa.BarSa are characterised by the absence of species through sediment mobility, rather than the presence of typical species, the deposition of sediment which will be subsequently removed by wave action will therefore not alter the biotope (Ref:6-20). As such, intertidal sandy habitats are considered to have low vulnerability and high recoverability to smothering. The sensitivity of the intertidal species receptor is therefore assessed as **low**. The significance of effect of suspended sediment dispersion and deposition has been assessed as **negligible** for the intertidal communities.

Accidental pollution

6.3.28 Throughout the construction phase, there is a risk that pollution may be accidentally released from construction vessels (e.g., diesel oil, sewage discharge) and from vehicles/machinery operating in the intertidal zone. The majority of these potential sources of pollution, in the intertidal in particular, would be relatively small in size so the potential magnitude of any spill and subsequent dispersal into the marine environment would be limited. It would be expected that effects on intertidal ecology receptors would be limited, as any oil-based spills would be dispersed on the surface and would not greatly affect pelagic, demersal or benthic species. In addition, measures would be implemented to protect habitats from the potential for accidental spillage of diesel or chemicals. All transport and mobile plant would have protection/internal drip trays and spill kits would be provided and used for any minor oil/fuel spills. These will be outlined within the Construction Environmental Management Plan (CEMP) and Emergency Spill Response Plan. These measures would also reduce the likelihood of a spill occurring, minimising the risk to intertidal ecology. The magnitude of the impact is therefore assessed as **low**.

6.3.29 The intertidal habitats and species which would potentially be affected by accidental pollution are not considered to be sensitive to any of the potential contamination sources (Tillin and Budd, 2016; Ashley, 2016), particularly since the infaunal communities are typically very sparse (if present at all). The sensitivity of the receptor is therefore assessed as **low**. Due to the low likelihood of a pollution event occurring and the implementation of management measures to reduce the magnitude of such an event should this occur, together with the negligible sensitivity of the intertidal receptors, the significance of effect of accidental pollution is assessed as **negligible**.

Operational, Longer Term and Permanent Impacts - Coastal Processes

Potential changes to beach morphology and implications for cable burial and the risk of exposure

6.3.30 Beach levels at the Boygrift landfall, and along the wider frontage more generally, vary over a number of timescales and in response to both natural processes and human management intervention. In terms of natural variability, beach levels vary seasonally due to wave conditions, with sediments transported offshore during the winter and sediments returning to the beach during the summer months. Over longer timescales (and as described in paragraphs 5.2.3 and 5.2.4) there is known to be an erosional tendency along the frontage.

6.3.31 In addition to this natural variability in levels, the Lincshore renourishment scheme, as previously described, raises beach levels for the purpose of maintaining a standard of defence. The existence and timing of renourishment campaigns fundamentally affect beach levels. The Lincshore most recently completed a renourishment campaign in the summer of 2016.

6.3.32 It is understood that there is no guarantee that the Lincshore will continue into the future. It is also understood that the future of coastal erosion risk management along this frontage will be outlined in the ES's Saltfleet to Gibraltar Point Strategy. However, the current Shoreline Management

Plan (SMP; Scott Wilson, 2010) recommends a policy of 'Hold the Line' for this frontage, with the intent of maintaining the current standard of defence.

6.3.33 It is therefore highly likely that a form of defence will be in operation over the long term to implement this policy and maintain the standard of defence. Different defence options would have potentially different effects on beach morphology and levels. There is therefore some uncertainty over future beach levels, given the influence of human intervention and the natural tendency of the shoreline.

6.3.34 To address this, the final design depths across the intertidal zone will be developed with the most up to date understanding of the flood and coastal erosion risk management intervention being used along the frontage to implement the SMP policy. These final design decisions will also be informed with the most up to date understanding of recorded fluctuations in beach levels. The most up to date information on these two topics will be available in the period prior to commencement of cable installation. This will enable the selection of an appropriate burial depth to ensure sufficient coverage to manage the risk of future exposure. These pre-commencement design decisions and the discharging of any related pre-commencement conditions will be undertaken in consultation with the EA.

6.3.35 Given the measures outlined above whereby the final design burial depth will consider both the current coastal erosion and flood risk management strategy and an up to date understanding of changes to beach levels, both the sensitivity and magnitude of cable exposure are considered to be **low**. Overall, based on this assessment, the significance of effect of changes to beach morphology on cable exposure is predicted to be **negligible**.

Damage to coastal defences

6.3.36 Impacts during any unforeseen cable remedial works will be of a smaller magnitude when compared to cable installation as it will be contained to a defined area' and the significance of effect of the damage to the coastal defence remains **low** adverse.

Change in SSC and subsequent deposition

6.3.37 Impacts during any unforeseen repair works will be of a smaller magnitude when compared to cable installation as the work will be in a relatively small area' and therefore the significance of effect has been assessed as **negligible**.

Changes to water quality

6.3.38 Impacts during any unforeseen repair works will be of a smaller magnitude when compared to cable installation, and therefore the significance of effect has been assessed as **negligible**.

Operational, Longer Term and Permanent Impacts - Benthic Intertidal Ecology

Electromagnetic field (EMF) effects

6.3.39 As described in The Proposed Underground DC Cable (Chapter 05), during operation the DC cables emit electromagnetic fields which will cause a change in the detectable level of these fields in the immediate vicinity of the cable. The effect will be present along the entire proposed DC cable route.

6.3.40 Modelling has been conducted to estimate the EMF field strength produced by the Project. The modelling assumes that the submarine cables will be buried to a minimum target depth of 0.5 m within UK waters and that the cables will be laid individually. Given the approach to cable burial induced EMF are anticipated to be above background geomagnetic fields up to 50 m from the cable in UK waters (Ref:6-22); representing a zone of influence of 130 m. Potential effects will largely be negated by cable burial; burial to a depth of at least 0.5 m will prevent most invertebrates encountering the strongest fields present on the cable surfaces (Ref:6-22). As such, any effect is predicted to be of **low** magnitude.

6.3.41 The impact of EMFs on benthic species is largely unknown. There is little and contradicting evidence of interactions with anthropogenic sources of magnetic fields. As benthic communities are typified by sessile or low-mobility species, which are unlikely to navigate using magnetic fields and anomalies, these species are less likely to be impacted than more mobile species such as teleost fish or elasmobranchs. The exception could be crustaceans. The brown shrimp (*Crangon crangon*) has been recorded as being attracted to Alternating Current (AC) magnetic fields of the magnitude expected from submarine power cabling (Ref:6-23). However, Bochert and Zettler (Ref:6-24) found no effects of exposure to static B fields upon the same species, nor upon the round crab (*Rhithropanopeus harrisii*), an isopod (*Saduria entomon*) or the mussel (*Mytilus edulis*). Overall the sensitivity to EMF of intertidal fauna at the landfall area is predicted to be **low**. Therefore the significance of effect of EMF on invertebrates has been assessed as **negligible**.

Emission of heat

6.3.42 In relatively shallow and well mixed water bodies such as the SNS the temperature of the water can vary significantly with the seasons. For example, at Cleethorpes to the north of the proposed landfall site, average water temperature varies by nearly 10°C annually, being coldest in February and March (6.5°C) and warmest in August (15.6°C) (World Sea Temperatures 2017). Minimum and maximum temperatures can be well in excess of these figures and typically vary between 3°C and 17°C in the North Sea (Rei 2012, cited in Ref:6-25).

6.3.43 Relatively extreme temperature fluctuations can be expected for intertidal organisms both seasonally and diurnally. In such an environment it would not be expected that organisms which are highly sensitive to small scale temperature fluctuations would thrive.

6.3.44 Examples of shallow burrowing fauna present in the Fugro (2016) survey data (Ref:6-13) include the sand mason worm (*Lanice conchilega*). The thermal tolerance of this species has been reviewed by MarLIN (website accessed 2017) and it was assessed to be of low sensitivity to temperature increases. Comprehensive data on the thermal sensitivity of many species are lacking but given the proximity to overlying waters it is likely, as stated above, that such species do not have high sensitivity to temperature fluctuations.

6.3.45 Invertebrates which burrow beyond the upper few centimetres of sediment could potentially be exposed to temperature increases due to cable heating effects. Modelling of cable heating (Brakelmann and Stammen 2016; Ref:6-25) suggests that any increases in temperature will be limited to a very narrow band above the cables with negligible heating laterally. The footprint of any effect will therefore be extremely small, less than a 1 m wide strip above the cable although it is not possible to define the area precisely and it will also vary in response to current load (though not beyond 1 m; Ref:6-26).

6.3.46 None of the species at the proposed landfall site are understood to be present near the southern limit of their ranges and it is suggested that any heating effect of the cable would have to be marked, (in excess of around 5 °C according to the MarLIN definition for acute temperature rises) to represent a potential impact to individual fauna. In light of the dynamic nature of the SNS in terms of temperature fluctuations, and the inherent tolerance of marine fauna to fluctuations in temperature, the overall effect is considered likely to be of not more than low magnitude for deep burrowing fauna directly over the cable. At the scale of local populations any effect would likely be of **negligible** magnitude.

6.3.47 The sensitivity to temperature increases of burrowing fauna reported or likely to occur at the landfall area is **low**. Heating effects in the shallow sediments inhabited by most burrowing infauna are expected to be trivial. The significance of effect of heating has therefore been assessed as **negligible**.

Accidental pollution

6.3.48 Impacts during any unforeseen repair works will be of a smaller magnitude when compared to cable installation and therefore the significance of effect has been assessed as **negligible**.

Operational, Longer Term and Permanent Impacts - Intertidal Archaeology

Impacts to known and potential seabed prehistory

6.3.49 The potential impacts that could have an effect on known and potential seabed prehistory are:

- Direct damage/destruction to assets, and/or their physical setting, buried within the seabed sediments; and
- Increased protection to, or deterioration of, assets resulting in a beneficial or adverse effect on assets in the vicinity.

6.3.50 Although there are no records of any known prehistoric sites from offshore contexts within the proposed landfall site, there is significant potential for the presence of as yet undiscovered in situ

prehistoric sites and finds, and a high potential for isolated derived finds in a secondary context. All archaeological receptors have the potential to be damaged or destroyed if they are directly impacted during implementation of the development proposals. Furthermore, all damage to archaeological sites or material is permanent and recovery is limited to stabilisation or re-burial, limiting further impact. There is no potential for the recoverability of any seabed receptors if these are affected following a direct impact. Any adverse effects upon known and potential seabed prehistory receptors would be permanent and irreversible. As such, the magnitude of direct effects to such receptors would be high. While the direct impacts upon the known and potential seabed prehistory receptors would be permanent and irreversible, the physical process study indicates that the predicted SSC levels arising from cable installation are generally within the range of natural variability expected for this area. Elevated SSCs occur within a limited spatial range of the installation activity over a short duration, before falling to ambient conditions (Ref 6-14).

6.3.51 Given the relatively small area of the proposed landfall site and on the basis that there are no recorded coherent archaeological remains within the outline design of the proposed landfall, the magnitude of the impact of the cable installation activities is, therefore, assessed as **negligible** as no change from the baseline is anticipated. The sensitivity of the receptor is assessed as **low**, as there are no known archaeological receptors within the outline design at the proposed landfall site. Effects on as yet unknown remains (including remains represented by the magnetic anomalies from the geophysical survey) may be significant and would be considered high value assets in accordance with the precautionary approach, unless proven otherwise, but there is no evidence for remains of high or the highest significance to survive within the proposed landfall.

6.3.52 Unknown prehistoric material may be impacted and therefore the same impact presented for impacts during installation can be used for the assessment of impacts during operation and maintenance. Given the relatively small area of the proposed landfall and on the basis that there are no recorded coherent archaeological remains within the proposed landfall site, impacts during any unforeseen repair works will be of a smaller magnitude when compared to cable installation, and therefore will have a significance of effect of **negligible**..

Impacts to known and potential seabed features

6.3.53 The potential impacts that could have an effect on known and potential seabed features are:

- Direct damage/destruction to assets, and/or their physical setting, buried within the seabed sediments.
- Localised damage/destruction to assets, and/or their physical setting, buried within the seabed sediments.

6.3.54 There are no wrecks with statutory designations within the landfall area. There are three wreck sites and the potential for further wrecks or maritime-related debris to exist within the subsea DC cable corridor. Of these one is a known wreck of medium value (7059) and the two unknown wrecks are of high value (7003 and 7004). For all unknown wrecks, there is insufficient data to assess the value of each individual wreck. As such, all wreck sites must be considered to have

archaeological value, to a greater or lesser degree and, in accordance with the precautionary approach, must be considered as high value assets. Similarly, as the value of potential wrecks cannot be evaluated until they are discovered, potential wrecks of all periods should be expected to be of high value.

6.3.55 There are no known aircraft crash sites within the landfall area. Nonetheless, there is the potential for aircraft or aircraft-related debris to exist within the subsea DC cable corridor. Potential aircrafts and all A2 anomalies (uncertain origin of possible archaeological interest, ref 6-11) are of a high value, while potential derived aviation finds are considered of medium value.

6.3.56 All archaeological receptors have the potential to be damaged or destroyed if they are directly impacted during implementation of the development proposals. Furthermore, all damage to archaeological sites or material is permanent and recovery is limited to stabilisation or re-burial, limiting further impact. There is no potential for the recoverability of any seabed receptors if they are affected following a direct impact. Any adverse effects upon known and potential seabed receptors would be permanent and irreversible. As such, the magnitude of direct effects to such receptors would be high. While the direct impacts upon the known and potential seabed receptors would be permanent and irreversible, the physical process study indicates that 'the predicted SSC levels arising from cable installation are generally within the range of natural variability expected for this area. Elevated SSCs occur within a limited spatial range of the installation activity over a short duration, before falling to ambient conditions (Ref:6-18).

6.3.57 Given the relatively small area of the landfall and on the basis, that there are no recorded coherent archaeological remains within the proposed landfall site the magnitude of the impact of the cable installation activities is, therefore, assessed as **negligible** as no change from the baseline is anticipated. The sensitivity of the receptor is assessed as **low**, as there are no known archaeological receptors within the proposed landfall site. The significance of effect is assessed as being **negligible**. Effects on, as yet, unknown remains (including remains represented by the magnetic anomalies from the geophysical survey) may be significant and would be considered high value assets in accordance with the precautionary approach, unless proven otherwise, but there is no evidence for remains of high or the highest significance to survive within the proposed landfall.

Decommissioning Impacts

6.3.58 The anticipated operational life of the base Scheme design is approximately 40 years, although it is likely that its life will be extended beyond this as a result of refurbishment and plant replacement. In the event that Viking Link ceases operation the base Scheme design would be decommissioned. It is currently assumed that the DC cables and associated infrastructure would be removed; the cables could be left in-situ but removal is the likely worst case scenario.

6.3.59 Decommissioning impacts in the intertidal zone are not considered separately as they are predicted to be identical to or of a smaller magnitude than those predicted for cable installation, being of a similar scale, nature and duration. Therefore the effects of all impacts on receptors

relating to the coastal processes, benthic intertidal ecology and intertidal archaeology are assessed as **not significant**.

7 Mitigation

7.1 Construction Measures

Overview

7.1.1 These are measures incorporated into how the Project will be constructed. Mitigation will be secured/delivered via the Outline Construction Environmental Management Plan (CEMP). Note the measures described below are not exhaustive, see the Register of Mitigation (Chapter 17) for a full list of measures to be adopted during the Project.

7.1.2 Table 7.17, Table 7.18 and Table 7.19 present mitigation measures and best practice measures for each discipline that NGVL is committed to adopting.

Coastal Processes

Table 7.17 Construction measures - coastal processes
Mitigation and Best Practice Measures
Final depths of ducts installed via trenchless techniques within the intertidal zone will be determined following detailed site investigation and in close liaison with the EA.
Deployment of anchors/anchor chains on the seabed will be kept to a minimum in order to reduce disturbance to seabed.
Material removed during the excavation of the exit pits and cable trenches in the intertidal zone will be backfilled.
The Project will liaise closely with the EA prior to commencement of installation activities at the landfall to communicate the timing of works.
Project vessels will be equipped with waste disposal facilities (sewage treatment or waste storage) to IMO MARPOL, Annex IV, Prevention of Pollution from Ships standards.
Ballast water discharges from Project vessels will be managed under the International Convention for the Control and Management of Ships' Ballast Water and Sediments standard.

Benthic Intertidal Ecology

Table 7.18 Construction measures - benthic intertidal ecology
Mitigation and Best Practice Measures
Deployment of anchors/anchor chains on the seabed will be kept to a minimum in order to reduce disturbance to seabed.
During trenchless works in the intertidal zone, the following measures will be taken: · Drilling fluid use will be monitored at the surface to ensure that there is no significant release into the marine and intertidal environment. · The drilling fluid and cuttings will be transported to an appropriate licensed waste

Table 7.18 Construction measures - benthic intertidal ecology
Mitigation and Best Practice Measures
disposal site. Only licensed waste carriers will be used for transportation of any drilling fluids. · Drilling fluid breakouts that may occur in the intertidal zone will be contained within a small bunded pit. The mud will then be pumped back to the holding tank or collected by vacuum tanker and transported to an appropriate terrestrial licensed waste disposal site. · Filled sandbags will be on site to help contain breakouts/spills.
Construction vehicle movement on beaches will be kept to a minimum.
CEMP and an Emergency Spill Response Plan will be developed and implemented for the installation phase.

Intertidal Archaeology

Table 7.19 Construction measures - intertidal archaeology
Mitigation and Best Practice Measures
The Project will adopt an avoidance strategy for the anomalies interpreted as A2s; uncertain origin of possible archaeological interest. Although no Archaeological Exclusion Zones (AEZs) are recommended at this time. Further work may be necessary to ascertain the precise nature and archaeological potential of individual features should avoidance prove unfeasible.
A formal programme of archaeological monitoring in the form of a 'watching brief' will be conducted in the inter-tidal zone during intrusive ground works with attendance by a suitably qualified archaeologist or geoarchaeologist. The purpose of a watching brief is to safeguard, to as great a degree as possible, any potential archaeological sites that may exist in this area. Watching brief activities will be conducted in accordance with the standards outlined in the CIfA's *Standard Guidance for an archaeological watching brief* (Ref:6-27) and the Model Clauses for Archaeological Written s of Investigation (Ref:6-28). The watching brief programme requirements will be set out in a -specific WSI and method statement.
A -specific WSI will be prepared in consultation with Historic England. This will set out when, how and why archaeological mitigation measures recommended in this Chapter for the Project are to be implemented and will be prepared in line with the Model Clauses for Archaeological Written s of Investigation (Ref:6-28).
A Protocol for Archaeological Discoveries will be implemented for the Project. Reporting and recording protocols provide a system of monitoring unexpected or incidental finds relating to the historic environment and thus serve to reduce the potential impact of a development upon the historic environment by means of receiving prompt archaeological advice in the event of a discovery and by recording and conserving any objects that have been disturbed. Such a protocol is designed to enable Project staff to report any finds made in a manner that is convenient and effective. Should such finds be considered to indicate the presence of a site of archaeological interest, a temporary AEZ may be implemented until more data is available.

8 Residual Effects

8.1 Temporary Effects – Coastal Processes

8.1.1 The assessment presented in paragraphs 6.3.7 to 6.3.8 identified one potential impact that could have a residual effect. The significance of this impact was therefore, re-assessed taking into consideration the mitigation measures outlined in section 7.1.2.

Damage to coastal defences

8.1.2 The assessment identified that there is the potential that if coastal defences were damaged by the Project there is the potential for a minor effect on both the physical structure of the sea defences and to the environment that the defences protect. As previously mentioned, installation of the ducts will be via a trenchless technique such as HDD. This approach is intended to avoid compromising the integrity of the coastal defences. The depth of the ducts will be determined taking into account a more detailed understanding of ground conditions based on further site investigation.

8.1.3 The final design depths will consider the depths of any defence foundations, where known and/or determined through site investigation. NGVL will maintain close liaison with the EA during this design process to ensure the integrity of the defences and their foundation are not compromised.

8.1.4 The currently implemented management approach on this frontage is beach renourishment. NGVL will remain in close liaison with the EA regarding interaction with the DC Cable Route. This is likely to be most relevant during HDD works and submarine cable installation. This approach remains equally valid should the flood and coastal erosion risk management approach along the frontage change prior to cable installation.

8.1.5 Any potential damage to the sea defences as a result of the HDD works will be mitigated through the careful design of the trenchless technique. In the very unlikely event that damage occurs it would be localised, although it is acknowledged that it could affect overall integrity of the defence and require works to reinstate the integrity of the defences. However, with appropriate Best Practice and design being undertaken to cross beneath the flood defences, as per the measures outlined above, the likelihood of damage to the flood defences is considered to be low. It is also considered that the risk of a detrimental effect on any flood defence related activities (such as renourishment activities) would be low given the outlined liaison with the EA prior to installation. The sensitivity has been assessed as **low**, as discussed in paragraph 6.3.8, the construction measures will reduce the magnitude to **low** and consequently the overall residual effect has been assessed as **negligible**. As such, the effects of the impact ‘damage to coastal defences’ are concluded to be **not significant**.

8.2 Temporary Effects - Benthic Intertidal Ecology

8.2.1 The significance of effect was determined to be negligible for all potential temporary impacts (see paragraphs 6.3.19 to 6.3.27). Significance of residual effect remained **negligible** for all potential impacts with construction mitigation (Table 7.18) applied to these potential impacts. As such, effects of all impacts are assessed as **not significant**.

8.3 Temporary Effects - Intertidal Archaeology

8.3.1 No temporary impacts on intertidal archaeology receptors were identified.

8.4 Operational, Longer Term and Permanent Effects – Coastal Processes

8.4.1 As described in paragraphs 8.1.2 to 8.1.5, the assessment presented in paragraphs 6.3.7 to 6.3.8 identified one potential impact (damage to coastal defences) that could have a residual effect. Significance of this impact was therefore, re-assessed taking into consideration the construction mitigation measures outlined in Table 7.17. The overall residual effect has been assessed as **negligible**. As such, effects of all impacts are assessed as **not significant**.

8.5 Operational, Longer Term and Permanent Effects - Benthic Intertidal Ecology

8.5.1 The significance of effect was determined to be negligible for all potential operational impacts (see paragraphs 6.3.39 to 6.3.47). Significance of residual effect remained **negligible** for all potential impacts with construction mitigation (Table 7.18) applied to these potential impacts. As such, effects of all impacts are assessed as **not significant**.

8.6 Operational, Longer Term and Permanent Effects - Intertidal Archaeology

8.6.1 The significance of effect was determined to be negligible for all potential impacts (see paragraphs 6.3.49 to 6.3.57). Significance of residual effect remained **negligible** for all potential impacts with construction mitigation (Table 7.19) applied to these potential impacts. As such, effects of all impacts are assessed as **not significant**.

8.7 Decommissioning Effects

8.7.1 As described in paragraphs 6.3.58, decommissioning impacts in the intertidal zone are not considered separately as they are predicted to be identical to or of a smaller magnitude than those predicted for cable installation, being of a similar scale, nature and duration. Therefore the residual effects of all impacts on receptors relating to the coastal processes, benthic intertidal ecology and intertidal archaeology are assessed as **not significant**.

9 Cumulative Effects

9.1 Intra-project Effects

UK Onshore

Intra-project effects may occur in the vicinity of the UK Onshore Scheme where a common receptor is being affected by two or more effects reported in different specialist assessments e.g. the two separate impacts may interact or combine to result in an intra-project effect. An overview of where potential intra-project effects may interact or combine between specialist assessment topics indicated that potential intra-project effects could occur between the intertidal zone and impacts identified in Water Resources and Hydrology (Chapter 08), Ecology (Chapter 10) and Socio-economics and Tourism (Chapter 13). However these topics do not consider the potential impacts on the coastal processes, benthic intertidal ecology and intertidal archaeology receptors therefore there is no interaction with other specialist assessments which would result in an intra-project effect.

Offshore

Within this Chapter the intertidal zone has been fully assessed for potential impacts from both the Offshore Scheme and the UK Onshore Scheme, as both s overlap the Proposed Landfall Site between MLWS and MHWS. As such, no intra-project cumulative effects have been identified that have not been assessed within the current Chapter.

9.2 Inter-project Effects

9.2.1 No cumulative effects, specific to the intertidal zone, have been identified that temporally and spatially overlap with other projects (see chapter 28 Cumulative Effects (ES-2-D.01)) for the long list of projects considered). The closest known project with effects on intertidal receptors, i.e. coastal processes, benthic intertidal ecology and intertidal archaeology is the Triton Knoll Electrical System Export Power Cable Corridor, which makes landfall approximately 1.5 km to the south of the proposed landfall. There is potential temporal overlap between construction of the Triton Knoll Electrical System and the Viking Link project and the activities associated with the two projects are likely to lead to similar impacts on the relevant receptors. However, there is no spatial overlap due to the distance of 1.5 km between the projects, which is considerably larger than the ZoI of the impacts considered in section **Error! Reference source not found.** (i.e. greatest ZoI was for increases in suspended sediments extending up to 700 m from the project boundary). As such, there is no receptor – impact pathway for cumulative impacts on intertidal receptors. All cumulative impacts relating to the Project have been considered in Cumulative Effects (Chapter 16).

10 Summary of Assessment

10.1 Overview of Baseline Conditions

10.1.1 The proposed landfall site consists of a long strip of sandy beach backed by a large concrete sea wall with a narrow strip of vegetated dunes forming an embankment behind, which together form the main sea defence. The Boygrift Drain outfall is located in the north of the submarine cable corridor, emerging from the intertidal slope in the mid shore and extending out into the lower shore, close to the MLWS.

10.1.2 The intertidal substrates at the proposed landfall site comprised sands of varying coarseness, limited areas of muddy sand and minor areas of gravelly sand. The intertidal habitats primarily comprised sandy sediments with naturally species-poor infaunal communities which are typical of dynamic sandy shore environments. The biotopes and associated infaunal communities were comparable to other surveys undertaken in the area

10.1.3 The proposed landfall site lies within a section of shoreline that is subject to a long term recorded trend of erosion. Erosion of the thin veneer of sands along this shoreline has occurred historically, exposing (and leading to the erosion of) the underlying tills. To counter this process, the EA has undertaken a major beach renourishment scheme since 1994 (known as 'Lincshore'). The morphology at the proposed landfall is therefore significantly influenced by the beach renourishment undertaken by the EA and the subsequent erosion of the sediment placed on the beach.

10.1.4 The current Lincshore scheme runs from 2016 to 2020. The intention of the current scheme is to maintain beach levels and manage tidal flood risk in the interim period while the Saltfleet to Gibraltar Point Flood Risk Management Strategy is developed. This strategy, when completed, will inform tidal flood and erosion risk management along this shoreline for the next 100 years. The EA carried out a renourishment campaign in 2015 and this has been followed by a further campaign during the summer of 2016.

10.1.5 With regards to archaeology, there are no designated assets within the proposed landfall site. There are no World Heritage Sites, Scheduled Monuments, Protected Wrecks, listed buildings, registered battlefields, registered parks and gardens or conservation areas located within 1 km of the proposed Boygrift landfall. The recorded losses of some 18 vessels are known in the area, along with two recorded losses of a military aircraft. There are several geophysical anomalies of uncertain origin which may be of archaeological interest within the landfall area; these will be sought to be avoided in the first instance.

10.1.6 There is minor potential for the discovery of shipwrecks from all periods. In addition, there is some potential for the discovery of aircraft wrecks. Surveys undertaken in connection with the proposed landfall have identified three anomalies at the edge of the proposed landfall area which

will be sought to be avoided in the first instance, thus reducing the risk of damage to heritage assets. Up until the inception of the Lincshore beach nourishment scheme in 1994, the underlying tills were regularly exposed during heavy weather events. Any wrecks lying on the till in the intertidal zone are likely to have been discovered before the Lincshore scheme began. As such, the likelihood for the discovery of currently unknown shipwrecks and aircraft in the proposed Boygrift landfall is considered low.

10.2 Overview of Residual Effects

10.2.1 All residual effects on the coastal processes, benthic intertidal ecology and intertidal archaeology receptors in the intertidal zone are **not significant**; see Table 10.20, Table 10.21 and Table 10.22.

10.3 Residual Effects in East Lindsey District Council

10.3.1 All residual effects on the coastal processes, benthic intertidal ecology and intertidal archaeology receptors at the proposed landfall site at Boygrift, East Lindsey, are **not significant**.

Table 10.20 Impact assessment summary – coastal processes									
Determination of Potential impact				Impact Assessment			Residual Impact Assessment		
Project Phase	Aspect	Potential Impact	Receptor	Magnitude	Sensitivity	Significance	Magnitude	Sensitivity	Significance of Residual Effect
Installation Decommissioning	Excavation in intertidal area. Excavation of 5m x 5m exit pit. Coffer dam. Cable removal	Change to beach morphology	Beach morphology	Low	Negligible	Negligible	-	-	-
Operation (Maintenance & Repair)	Cable burial depth	Potential changes to beach morphology and implications for cable burial and the risk of exposure	Intertidal area	Low	Low	Negligible	-	-	-

Table 10.20 Impact assessment summary – coastal processes

Determination of Potential impact				Impact Assessment			Residual Impact Assessment		
Project Phase	Aspect	Potential Impact	Receptor	Magnitude	Sensitivity	Significance	Magnitude	Sensitivity	Significance of Residual Effect
Installation Operation (Maintenance & Repair) Decommissioning	HDD under seawall/cable removal	Damage to coastal defences	Coastal defences	Medium	Low	Minor	Low	Low	Negligible
Installation Operation (Maintenance & Repair) Decommissioning	Pre-sweeping, trenching, jetting, repair and maintenance operations, cable removal	Change in suspended sediment concentration and subsequent deposition	Sediment quality	N/A	N/A	N/A	-	-	-
Installation Operation (Maintenance & Repair) Decommissioning	Trenching, jetting, repair and maintenance operations, cable removal	Change to water quality	Bathing water	Negligible	Negligible	Negligible			

Table 10.20 Impact assessment summary – coastal processes									
Determination of Potential impact				Impact Assessment			Residual Impact Assessment		
Project Phase	Aspect	Potential Impact	Receptor	Magnitude	Sensitivity	Significance	Magnitude	Sensitivity	Significance of Residual Effect
Installation Operation (Maintenance & Repair) Decommissioning	Routine vessel /ballast water discharge	Change to water quality	Water quality	Negligible	Negligible	Negligible	-	-	-

Table 10.21 Impact assessment summary – benthic intertidal ecology									
Determination of potential impact				Impact assessment			Residual Impact assessment		
Project Phase	Aspect	Potential Impact	Receptor	Magnitude	Sensitivity	Significance	Magnitude	Sensitivity	Significance of Residual Effect
Installation Operation (Repair & Maintenance)	Excavation of 5m x 5m exit pit. Coffer dam. Works on intertidal zone. Excavation of four 250m long cable trenches. Cable repair	Temporary loss/disturbance of habitat	All intertidal species	Low	Low	Negligible	-	-	-
Installation Operation (Repair & Maintenance)	Excavation of cable trench between exit pit and MLWS. Cable trenching (ploughing and jet trenching).	Suspended sediment dispersion, deposition and smothering	All intertidal species	Low	Low	Negligible	-	-	-

Table 10.21 Impact assessment summary – benthic intertidal ecology									
Determination of potential impact				Impact assessment			Residual Impact assessment		
Project Phase	Aspect	Potential Impact	Receptor	Magnitude	Sensitivity	Significance	Magnitude	Sensitivity	Significance of Residual Effect
Installation, Operation (Repair &Maintenance) & Decommissioning	Release of hydrocarbons, sewage discharge or chemical spill	Accidental pollution	Intertidal sandy habitats	Low	Low	Negligible			
Operation	Emission of EMF	Electromagnetic Field effects	All intertidal species	Low	Low	Negligible	-	-	-
Operation	Emission of heat	Heating effects	All intertidal species	Low	Negligible	Negligible	-	-	-

Table 10.22 Impact assessment summary – intertidal archaeology									
Determination of Potential Impact				Impact Assessment			Residual Impact Assessment		
Project Phase	Aspect	Potential Impact	Receptor	Magnitude	Sensitivity	Significance	Magnitude	Sensitivity	Significance of Residual Effect
Installation	Cable burial	Direct disturbance to intertidal receptors	Potential seabed prehistory receptors	Negligible	Low	Negligible	-	-	-
			Geophysical anomalies of possible anthropogenic origin (A2s)	Negligible	Low	Negligible	-	-	-
			Currently unknown archaeological sites and artefacts	Negligible	High	Negligible	-	-	-

Table 10.22 Impact assessment summary – intertidal archaeology									
Determination of Potential Impact				Impact Assessment			Residual Impact Assessment		
Project Phase	Aspect	Potential Impact	Receptor	Magnitude	Sensitivity	Significance	Magnitude	Sensitivity	Significance of Residual Effect
Installation	Cable burial	Indirect disturbance to receptors - cable burial methods and works on intertidal zone causing changes to the hydrodynamic and sedimentary regimes due to spoil removal and distribution	Known and potential seabed prehistory receptors; maritime receptors; and aviation receptors	Negligible	High	Negligible	-	-	-
			Currently unknown archaeological sites and artefacts	Negligible	High	Negligible	-	-	-
			Currently unknown archaeological sites and artefacts	Negligible	High	Negligible	-	-	-

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