Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Environmental Statement Volume 2

Chapter 5: Benthic Subtidal and Intertidal Ecology

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Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Volume 2

Chapter 5: Benthic Subtidal and Intertidal Ecology

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Table of Contents

5 BENTHIC SUBTIDAL AND INTERTIDAL ECOLOGY

5.1 Introduction

5.1.1 This chapter of the Environmental Statement (ES) has been prepared by GoBe Consultants Ltd and assesses the potential effect on benthic subtidal and intertidal ecology of the Offshore works (including construction of the offshore components and the landfall of the Offshore Export Cable Corridor (OECC)) associated with Thanet Extension Offshore Wind Farm (Thanet Extension). This chapter should be read in conjunction with the project description in Volume 2, Chapter 1: Project Description – Offshore (Document Ref: 6.2.1).

5.1.2 The following sections of this chapter include:

- A summary of relevant legislation and planning policy;
- A description of the methodology for the assessment, including details of the study area and the approach to the assessment of effects;
- A summary of consultation with stakeholders;
- A review of baseline (existing) conditions;
- Details of the measures proposed as part of the project to avoid or reduce environmental effects, including mitigation and design measures that form part of the project (embedded mitigation);
- As assessment of the likely effects for the construction, operation and decommissioning phases of the project, taking into account the measures proposed;
- Identification of any further mitigation measures or monitoring required in relation to likely significant effects; and
- Assessment of any cumulative effects with other proposed developments.

5.1.3 This chapter presents the results of an assessment of the impacts on the benthic and intertidal ecology arising from the construction, Operations and Maintenance (O&M) and decommissioning of the relevant offshore components (namely the array area, OECC and the export cable landfall site) of the proposed Thanet Extension Offshore Wind Farm (Thanet Extension) development.

5.1.4 The assessment of the impacts is based on the understanding of the proposed development in terms of the likely impacts and effects, and on a characterisation of the receiving environment as defined in detail within the Benthic Subtidal, and Intertidal Ecology Technical Reports (Document Ref: 6.4.5.1 and 6.4.5.2 respectively). The respective technical reports include a detailed characterisation of the benthic and intertidal study area, based on the existing literature, including for the Thanet Offshore Wind Farm (TOWF), and the site specific surveys undertaken for Thanet Extension.

5.2 Statutory and policy context

5.2.1 This section identifies legislation and national and local policy of particular relevance to benthic subtidal and intertidal ecology. The Planning Act 2008, Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 and Environment Act 1995 are considered along with the legislation relevant to benthic subtidal and intertidal ecology.

5.2.2 In undertaking the assessment, the following legislation has been considered:

- The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017;
- The Convention on the Conservation of European Wildlife and Natural Habitats (the Bern Convention; 1979);
- EU Council Directive 92/ 43/ EEC on the conservation of natural habitats and of wild flora and fauna (the 'Habitats Directive');
- The Conservation of Habitats and Species Regulations 2017;
- Natural Environment and Rural Communities (NERC) Act 2006;
- Marine and Coastal Access Act 2009; and
- The Wildlife and Countryside Act 1981 (as amended).

5.2.3 Guidance on the issues to be assessed for offshore renewable energy developments has been obtained through reference to the Overarching National Policy Statement (NPS) for Energy (NPS EN-1; Department for Energy and Climate Change (DECC), 2011a), the National Policy Statement for Renewable Energy Infrastructure (NPS EN-3, DECC, 2011b), the NPS for Electricity Networks Infrastructure (NPS EN-5; DECC, 2011c),the UK Marine Policy Statement (MPS; HM Government, 2011), and the relevant Marine Plans.

5.2.4 Specifically, the guidance within NPS EN-3 was considered, which identifies that applicants should have regard to both subtidal and intertidal seabed habitats (paragraph 2.6.59). NPS EN-3 (paragraph 2.6.63) specifically notes the following potential issues:

- Effects of Offshore Wind Farms (OWFs) can include temporary disturbance during the construction phase (including underwater noise) and ongoing disturbance during the O&M phase and direct loss of habitat; and
- The presence of the Wind Turbine Generators (WTGs) can also have positive benefits to ecology and biodiversity.

5.2.5 NPS EN-3 (paragraphs 2.6.64 to 2.6.67, 2.6.81 to 2.6.83, and 2.6.113 to 2.6.114) includes guidance on what matters are to be included in an applicant's assessment and these are summarised in Table 5.1.

Table 5.1: Summary of NPS EN-3 policy relevant to benthic subtidal and intertidal ecology and consideration of Thanet Extension

Policy/ legislation	Key provisions	Section where provision addressed
NPS EN-3	Applicants should assess the effects on the offshore ecology and biodiversity for all stages of the lifespan of the proposed OWF (paragraph 2.6.64).	The potential effects associated with the construction, operation and decommissioning of Thanet Extension have been assessed (section 5.10 - 5.12).
	Consultation on the assessment methodologies should be undertaken at an early stage with the statutory consultees as appropriate (paragraph 2.6.65).	Consultation has been undertaken through the scoping process and is ongoing with the relevant consultees through the Evidence Plan process (Table 5.5).
	Any relevant data that has been collected as part of post-construction ecological monitoring from existing, operational OWFs should be referred to where appropriate (paragraph 2.6.66).	Relevant data collected as part of post-construction monitoring from other OWFs (primarily TOWF) has informed the assessment of Thanet Extension (section 5.7 and within sections 5.10 - 5.12). The Marine Management Organisation (MMO) have produced a review (MMO, 2012) on post-construction monitoring that has been undertaken for OWFs within which it is noted that there have been limited effects arising on benthic communities from certain impacts. Where appropriate this chapter cross refers to those studies either individually or through reference to the MMO review.
	Applicants should assess the potential for the scheme to have both positive and negative effects on marine ecology and biodiversity (paragraph 2.6.67).	Both the positive and negative effects of Thanet Extension have been assessed sections 5.10 - 5.12).
	Applicants should assess the effects on the subtidal environment from habitat loss due to foundations and seabed preparation, predicted scour, scour protection and altered sedimentary processes (paragraph 2.6.113) and effects on the intertidal zone (paragraph 2.6.81).	The assessment has considered effects from all development phases on benthic and intertidal habitats and species in the vicinity of Thanet Extension. These assessments included all likely effects from temporary and long-term habitat loss and the effects of changes in physical processes (sections 5.10 - 5.12).
	Applicants should assess the effects on the benthic environment from extendible legs and anchors of construction vessels (paragraph 2.6.113) and habitat disturbance in the intertidal zone during cable installation and removal (decommissioning) (paragraph 2.6.81).	The Thanet Extension assessment has considered the effects of benthic and intertidal disturbances throughout the whole of the development (sections 5.10 - 5.12), with specific reference to construction vessels and anchors in paragraph 5.10.1 *et seq.* and habitat disturbance within the intertidal zone in paragraph 5.10.15 *et seq*.
	Applicants should assess the effects of increased suspended sediment leads during construction on subtidal habitats (paragraph 2.6.113) and intertidal habitats (paragraph 2.6.81).	Specific effects of increased suspended sediment load and the associated sediment deposition on benthic and intertidal ecology have been assessed with regards to the construction phase (paragraphs 5.10.1 and 5.10.15 *et seq.* respectively).
	Applicants should assess the predicted rates for subtidal habitat recovery (paragraph 2.6.113) and intertidal habitats (paragraph 2.6.81).	The likely rates of recovery of benthic and intertidal habitats/ species have been presented for each impact discussed, based on the recorded recovery of the local area (and the same habitats and species) from the TOWF post-construction benthic and saltmarsh surveys (Marine Ecological Surveys Ltd (MESL) 2012) and have been used to inform the assessment of the significance of the effect (sections 5.10 - 5.12).
	If it is proposed to install offshore cables to a depth of at least 1.5 m below the seabed, the Applicant should not have to assess the effects of the cables on intertidal and subtidal	The target burial depth below the long-term stable seabed level of between 0 - 3 m, is anticipated for the majority of the OECC, as such, the effects of Electromagnetic Fields (EMF) on benthic or intertidal

Policy/ legislation	Key provisions	Section where provision addressed
	habitat during the operational phase of the OWF (paragraph 2.6.114).	receptors are assessed in paragraphs 5.11.31 *et seq*.

5.2.6 In addition to the above, NPS EN-3 includes guidance relating to potential secondary or indirect impacts arising from changes to the physical environment which should also be considered.

5.2.7 Further guidance on what matters should be included within an applicant's assessment regarding biodiversity and designated sites is provided within NPS EN-1 (paragraphs 5.3.1 to 5.3.30), which is summarised in Table 5.2.

Table 5.2: Summary of NPS EN-1 policy relevant to benthic subtidal and intertidal ecology and consideration of Thanet Extension

Policy/ legislation	Key provisions	Section where provision addressed
NPS EN-1	Sites of Special Scientific Interest (SSSIs) that are not incorporated within internationally designated sites should be provided with a high degree of protection (paragraph 5.3.10). Where a proposed development within or outside a SSSI is likely to have an adverse effect on an SSSI (alone or together with other developments) development consent should not normally be granted. If after mitigation an adverse effect is still likely then consent should only be given where the benefits (including need) for a development outweighs the impacts on the SSSI in question and also the wider SSSI network. The Secretary of State (SoS) should use requirements and/ or planning obligations to mitigate the harmful aspects of the development, and where possible, ensure the conservation of the site's biodiversity or geological interest (paragraph 5.3.11).	Sandwich Bay to Hacklinge Marshes SSSI is partially within Thanet Coast and Sandwich Bay Special Protection Area (SPA) and Sandwich Bay Special Area of Conservation (SAC) and Thanet Coast SAC. Where the features within the SSSI are a feature of the Natura 2000 sites (SAC, SPA or Ramsar), those features have been considered as part of that Natura 2000 site in this assessment. Where a SSSI or the features of a SSSI are not included within a Natura 2000 site, the SSSI (or features) have been considered individually within this chapter.
	The SoS is bound by the duties in relation to Marine Conservation Zones (MCZs) imposed by sections 125 and 126 of the Marine and Coastal Access Act 2009 (paragraph 5.3.12).	A MCZ assessment is being undertaken separately (Report to Inform Appropriate Assessment (Document Ref: 6.4.5.3) with a summary of the relevant habitats presented within this chapter for completeness.

5.2.8 The planning process for Nationally Significant Infrastructure Projects (NSIPs) is administered by the Planning Inspectorate (PINS), while the SoS makes the final decision on the Development Consent Order (DCO). A number of points relating to the determination of an application and in relation to mitigation are detailed in NPS EN-3 (paragraphs 2.6.68 to 2.6.71 and 2.6.75 to 2.6.77), which are summarised in Table 5.3.

5.2.9 Guidance has been provided within the Marine Strategy Framework Directive (MSFD), adopted in July 2008, which has been considered in this assessment. The relevance of the MSFD to Thanet Extension has been described in Volume 1, Chapter 2: Policy and Legislation (Documents Ref: 6.1.2).

5.2.10 The overarching aim of the MSFD is to achieve 'Good Environmental Status' (GES) by 2020, across Europe's marine environment. Annex I of the MSFD identifies 11 high level qualitative descriptors for determining GES, with those relevant to the benthic and intertidal ecology assessment for Thanet Extension outlined in Table 5.4, with a brief description of how and where these have been addressed in this assessment.

Table 5.3: Summary of NPS EN-3 policy on decision making with regard to benthic subtidal and intertidal ecology and consideration in the Thanet Extension assessment

Policy/ legislation	Key provisions	Section where provision addressed
NPS EN-3	The SoS should consider the effects of a proposal on marine ecology and biodiversity taking into account all relevant information made available to it (paragraph 2.6.68).	Where relevant to benthic ecology this has been described and considered within the assessment for Thanet Extension (sections 5.10 - 5.12).
	The designation of an area as Natura 2000 site does not necessarily restrict the construction or operation of OWFs in or near that area (paragraph 2.6.69).	Natura 2000 sites have been considered during the Thanet Extension assessment (Volume 2, Chapter 8: Offshore Designated Sites (Document Ref: 6.2.8) with potential effects on the relevant habitats described in sections 5.10 - 5.12.
	Mitigation may be possible in the form of a careful design of the development itself and the construction techniques employed (paragraph 2.6.70).	Where considered appropriate, and where effects associated with the project may be considered significant in the absence of mitigation, mitigation has been considered during the Thanet Extension assessment (Table 5.11).
	Ecological monitoring is likely to be appropriate during the construction and operational phases to identify the actual impact so that, where appropriate, adverse effects can then be mitigated and to ensure further useful information to be published	Where appropriate, and through reference to the MMO's review of post-construction monitoring (MMO, 2011) monitoring has been considered during assessment of potential effects associated with the Thanet Extension project (Table 5.11).
	relevant to future projects (paragraph 2.6.71).	
	The conservation status of intertidal habitat (paragraph 2.6.84) and benthic habitat (paragraph 2.6.115) is of relevance to the SoS.	The conservation status of intertidal and benthic receptors has been considered throughout this assessment (section 5.7).
	The SoS should be satisfied that activities have been designed taking into account sensitive benthic environmental aspects (paragraph 2.6.116) and intertidal habitats (paragraph 2.6.85).	The assessment has identified potential impacts on sensitive benthic and intertidal habitats and valued ecological receptors, including biogenic reefs (sections 5.10 - 5.12).
	Where adverse effects are predicted, in coming to a judgement, the SoS should consider the extent to which the effects are temporary or reversible (paragraph 2.6.117), this includes the installation and decommissioning of cables (paragraph 2.6.86).	The duration and reversibility of effects has been included in the assessment of effects (sections 5.10 - 5.12).
	Where is it proposed that the offshore export cables are armoured and buried at a sufficient depth to minimise heat effects, the effects of heat on sensitive species from cable infrastructure during operation are unlikely to a reason for the SoS to refuse to grant consent for a development (paragraph 2.6.118).	The nature, potential burial depth, and installation of export cables has been considered in the assessment (sections 5.10 - 5.12) and in accordance with the cable design as presented in Volume 2, Chapter 1: Offshore Project Description (Document Ref: 6.2.1).

Table 5.4: Summary of the MSFD high level descriptor of GES relevant to benthic subtidal and intertidal ecology and consideration in the Thanet Extension assessment

Policy/ legislation	Descriptor of GES summary	Section where provision addressed
MSFD	Descriptor 1 – Biological diversity: Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.	The effects on biological diversity has been described and considered within the assessment for Thanet Extension alone and the cumulative effects assessment (CEA) (sections 5.10 - 5.13).
	Descriptor 2 – Non-indigenous species: Non-indigenous species introduced by human activity are at levels that do not adversely alter the ecosystems.	The potential for effects associated with non-indigenous species on benthic species and habitats that may be attributable to the Thanet Extension project are assessed in sections 5.10 - 5.12.
	Descriptor 4 – Elements of marine food web: All elements of marine food webs, to the extent they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.	The effects on benthic and intertidal ecology, inclusive of the interlinkages with interdependent ecological receptors described in other chapters is integral within this chapter and the wider ES with inter relationships described where appropriate.
	Descriptor 6 – Sea floor integrity: Seafloor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected.	The effects on benthic and intertidal ecology, inclusive of any risk to ecological integrity, has been described and considered within the assessment for Thanet Extension alone and the CEA (sections 5.10 - 5.13).
	Descriptor 7 – Alteration of hydrographical conditions: Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems.	The potential for permanent alterations to hydrographical conditions that may be attributable to Thanet Extension to adversely affect marine ecosystems is assessed within sections 5.10 - 5.12.
	Descriptor 8 – Contaminants: Concentrations of contaminants are at levels not giving rise to pollution effects.	The effects of contaminants on benthic and intertidal habitats and species have been assessed in section 5.7.
	Descriptor 10 – Marine litter: Properties and quantities of marine litter do not cause harm to the coastal and marine environment.	A Project Environmental Management and Plan (PEMP) will be produced and followed to cover the O&M phase of Thanet Extension. The PEMP will include planning for accidental spills, address all potential contaminant releases and include key emergency contact details (e.g. EA, Natural England and Maritime and Coastguard Agency (MCA)). A Decommissioning Programme will be developed to cover the decommissioning phase (Table 5.11).

5.3 Consultation and scoping

5.3.1 The benthic ecology of the area within which the proposed development is located has been the subject of detailed discussion between regulators and Vattenfall Wind Power Ltd (VWPL).

5.3.2 As part of the Environmental Impact Assessment (EIA) for Thanet Extension, consultation has been undertaken with various statutory and non-statutory authorities, through the agreed Evidence Plan process (being used for the EIA process as well as for the Habitats Regulation Assessment (HRA)). A record of key areas of consultation is summarised within Table 5.5 and will be presented in full within the project consultation report, to be published with the final application. A formal Scoping Opinion was sought from the SoS following submission of the Scoping Report (VWPL, 2016). The Scoping Opinion (PINS, 2017) was issued in January 2017 by PINS.

5.3.3 A summary of the responses relevant to the benthic and intertidal ecology chapter in the Scoping Opinion are summarised in Table 5.5 below.

Table 5.5: Summary of consultation relating to benthic subtidal and intertidal ecology

Date and consultation phase/ type	Consultation and key issues raised	Section where provision addressed
Scoping Opinion	The SoS welcomes reference to the habitats of principal importance within the study area and expects the ES to give specific consideration of these as part of the assessment of the construction, O&M and decommissioning effects.	Potential effects on saltmarsh and intertidal habitats of principle importance are addressed along with subtidal habitats (where relevant) in section 5.10 to 5.12
Scoping Opinion	The SoS notes that at present Section 2.5 of the Scoping Report makes no reference to the Thanet Coast MCZ or the Goodwin Sands rMCZ, any effects to these sites will need to be assessed and presented in the Environmental Statement (ES).	Impacts on Marine Conservation Zones (MCZs) and recommended MCZs (rMCZs) are included with the Volume 2, Chapter 8: Designated Sites (Document Ref: 6.2.8). Potential effects on the habitats designated within the Thanet Coast MCZ are considered in sections 5.10 to 5.13, it is however important to note that whilst the habitats in the vicinity of Goodwin sands are considered where appropriate the Goodwin Sands rMCZ has not been brought forward for consultation and is not therefore considered within this assessment or the associated MCZ assessment Report to Inform Appropriate Assessment (Document Ref: 6.4.5.3)
Scoping Opinion	The SoS notes references to Marine Evidence-based Sensitivity Assessments (MarESA) available on the Marine Life Information Network (MarLIN) website and encourages agreement is reached on its use in the assessment as part of the Evidence Plan process.	MarESA sensitivity assessments are used within the assessments as described within section 5.5; this approach has been discussed and agreed under the auspices of the Evidence Plan as agreed at the meeting on 12th July 2017.
Scoping Opinion	The MMO cite potential changes in benthic communities up to 50 m from the WTG scour protection.	Assessment of the potential for effects from scour is presented in section 5.11 through reference to the existing wind farms and in line with the MMO's review on post-construction monitoring
Scoping Opinion	SoS does not agree that interrelationship between intertidal and benthic ecology and marine water and sediment quality can be scoped out.	The potential interrelationships between topic areas and receptors is an integral part of this assessment and the wider ES. Specifically, inter-relationships are considered in section 5.14 of this chapter and are presented in Volume 2, Chapter 14: Inter-relationships (Document Ref: 6.2.14).
Scoping Opinion	Having regard to the construction and decommissioning phases and comments made by MMO and Natural England at Appendix 3 of this Opinion, the SoS does not agree that underwater noise impacts on benthic habitats can be scoped out at this stage.	Changes to underwater noise during construction have been addressed in paragraphs 5.10.62 - 5.10.66.
Scoping Opinion	With regard to operational noise and on the basis that monitoring studies of operational WTGs (North Hoyle, Scroby Sands, Kentish Flats and Barrow wind farms) show noise levels to be only marginally above ambient noise levels the SoS agrees that this can be scoped out of the EIA.	Noted. Operational noise impacts have been scoped out and are not assessed in this chapter.

Date and consultation phase/ type	Consultation and key issues raised	Section where provision addressed
Scoping Opinion	The SoS reminds the Applicant of relevant policy in NPS EN-3 that states that offshore cables should be buried at depths of at least 1.5 m below the seabed in order to avoid the need to assess the effect of the cables on sub tidal or intertidal habitats.	EMF impact assessment is presented in paragraphs 5.11.31 - 5.11.36.
Scoping Opinion	The Scoping Report identifies the presence of 'large aggregates' of S. spinulosa reef (Annex I habitat) within the existing site. The ES should consider not only potential direct impacts from construction, but also the potential impacts from maintenance and decommissioning activities on reef that may colonise the cables during the operational phase.	The baseline surveys described in section 5.7 did not identify any areas of *S. spinulosa* reef within the study area however the potential for biogenic reefs to form within the proposed project area is considered in section 5.9. Consideration of colonisation and associated impacts during operation and decommissioning are addressed in paragraphs 5.11.13 - 5.11.17 and 5.12.10 - 5.12.19 respectively.
Scoping Opinion	The SoS also notes reference to micro-siting being required to avoid impacts to S. spinulosa (Paragraph 310 of the Scoping Report) and this approach will need to be clearly outlined with detail as to how it is to be assessed in the ES.	This is detailed within the Thanet Extension Mitigation Schedule (Document Ref: 8.3) and summarised in section 5.9.
Scoping Opinion	SoS does not agree that installation effects in terms of habitat loss during construction can be scoped out at this stage.	Temporary habitat loss as a result of the use of jack-up vessels during construction has been considered in paragraphs 5.10.1 to 5.10.13, while consideration of the long-term loss of habitat due to the presence of foundations and scour protection and cable protection is considered within the operational phase (as this is a long-term impact for the life of the wind farm) and detailed in paragraphs 5.11.3 to 5.11.11.
Scoping Opinion	SoS draws the Applicant's attention to the comments of the MMO in relation to further assessment of impacts on epifauna being required and also that faunal sediment samples gathered are unsuitable for the analyses and assessment of contaminants.	The baseline surveys undertook specific sediment samples for contaminant assessment, full detail is available in Volume 4, Annex 5-1: Subtidal Benthic Technical Report (Document Ref: 6.4.5.1). Impacts on epifauna comprising part of the identified biotopes has been considered within the assessment of impacts in sections 5.10 - 5.12.
Scoping Opinion	Natural England is of the opinion that maintenance and operation impacts need to be considered as an additional impact to those from construction. An assessment of the amount of potential maintenance work likely to be required across the lifetime of the project should be presented in the ES. This should also include likely maintenance requirements associated with all inter-array and export cable works. Such an assessment should be informed by experiences at other constructed wind farm developments. The assessment needs to be linked to the associated potential environmental impact as a result of a need for increased protection or stabilisation material.	An assessment of the impacts during the operational phase of Thanet Extension is presented in section 5.11. Burial method and route planning will be informed based on the experience of TOWF with appropriate lessons learnt in order to inform the O&M component of this assessment as described in section 5.11.
Scoping Opinion	NE advise that the footprint of any scour and cable protection needs to be included in the 'loss of habitat' assessment and acknowledge the difficulty of cable installation at TOWF and	An assessment of the impacts during the operational phase of Thanet Extension, inclusive of scour

Date and consultation phase/ type	Consultation and key issues raised	Section where provision addressed
	the associated remedial works that became necessary.	protection and secondary protection for cables is presented in section 5.11.
Scoping Opinion	Natural England wish to see 'loss of habitat' during the construction period scoped into the EIA. 'Colonisation of Foundations' should also be scoped into the assessment at both construction and decommissioning levels, including assessment of non-native species.	The long-term impacts of 'loss of habitat' and 'colonisation of hard substrate' (including foundations) has been considered as an O&M phase impact (section 5.11) due to the long-term impacts of these, rather than them being short-term impacts only relevant during the construction and/ or decommissioning phases. The loss of the colonised habitat has been considered as a separate impact during the decommissioning phase (section 5.12).
S42 Consultation MMO January 2018	Since establishment of the TOWF, turbid wakes have been observed. These have been investigated by Cefas and Hull University (Forster, 2017) to determine whether they are present due to scour, but have been shown to be due to resuspension of sediment near the seabed. The study did not however investigate the effects of these wakes on the benthic invertebrates and fish in terms of reproduction and food availability to the bed. Turbid wakes therefore should be considered as a potential impact on both benthic and fish communities during operation of the windfarm. They should also be included in the Non-technical summary. This impact also needs to be considered under cumulative effects and under the inter-related effects chapters. The effects of the wakes on the benthos and fish may need to be monitored during the lifetime of the project. Further consultation on this will be required. See also point 5.2.	Turbid wakes have been assessed as an O&M phase impact and are considered in section 5.11.
S42 Consultation MMO January 2018	The MMO considers the predicted impacts due to construction, O&M and decommissioning of the proposed Thanet Extension presented in the PEIR benthic chapter are in line with those presented on other PEIRs.	Noted
S42 Consultation MMO January 2018	Turbid wakes should be considered as a potential impact on benthic communities during the operation of the wind farm, and the effects of turbid wakes may need to be monitored. See also point 4.9.	Turbid wakes have been assessed as an O&M phase impact and is considered in section 5.11.
S42 Consultation MMO January 2018	Direct and indirect seabed disturbances leading to the release of sediment contaminants has been included in Table 5.10 (Volume 2, Chapter 5: Benthic Subtidal and Intertidal Ecology (Document Ref: 6.2.5)) but has not been assessed in further detail in section 5.10. This impact is also not mentioned in the Non-technical summary.	A section assessing the impact has been added (paragraph 5.10.58) to this chapter and the Non-Technical Summary (Document Ref: 6.7.1).
S42 Consultation MMO January 2018	The intertidal biotopes detailed in the PEIR chapter (Volume 2, Chapter 5: Benthic Subtidal and Intertidal Ecology (Document Ref: 6.2.5)) do not match those that were determined during the intertidal characterisation (Volume 4, Annex 5-1: Benthic Intertidal (Document Ref: 6.4.5.1)). Please review and revise as necessary (see also comments below points 5.9 and 5.10) on intertidal biotopes determined in the characterisation report. Biotypes are subjective and need to be supplemented with the actual information gathered during the survey.	The biotopes within the intertidal have been updated to those identified in the intertidal characterisation surveys, alongside a brief description of the most common species recorded.

Date and consultation phase/ type	Consultation and key issues raised	Section where provision addressed
S42 Consultation MMO January 2018	Volume 2, Chapter 5 Benthic Subtidal and Intertidal Ecology of the PEIR stated states that Pegwell Bay is characterised by rocky platforms with *Lanice conchilega* and *Mytilus edulis* at the top of the shore. This does not correspond with the information provided in the intertidal characterisation report (Volume 4, Annex 5-1: Benthic Intertidal (Document Red: 6.4.5.1)). The MMO notes neither species were documented in the characterisation survey undertaken in 2017.	The dominant species identified within the intertidal have been updated to those recorded in the intertidal characterisation surveys.
S42 Consultation MMO January 2018	Embedded mitigation for Annex I habitats has been included in the project design. Further details are required regarding the assessment of 'core reef' areas, as these appear to be the only areas where the Project is proposing to avoid.	A proposed methodology to the core reef assessment along with proposed mitigation zones around core reef features has been produced and submitted for review to the Evidence Pland (EP) participants and is also presented in the Biogenic Reef Mitigation Scheme (Document Ref: 8.15).
S42 Consultation MMO January 2018	The description of the biotopes identified are misleading as they are based on the species most likely to be encountered in the biotopes (taken from the Marine Nature Conservation Review (MNCR) description) rather than the species actually encountered in the samples. For example, stations mainly located in the north east of the array have been assigned as *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand (SS.SSa.IMuSa.FfabMag) along with *Nephtys cirrosa* and *Bathyporeia spp*. in infralittoral sand (SS.SSa.IFiSa.NcirBat) and suggest these stations have a high prevalence of the bivalve *Fabulina fabula*, the polychaete *Magelona*, amphipod *Bathyporeia*, and polychaete *Nephtys cirrosa*. However, the data presented in the characterisation report suggests otherwise. Whilst the majority of these stations do indeed contain low numbers of the polychaete *N. cirrosa*, only 2 stations have one or two *Bathyporeia*, no *F. fabula* are present within any sample and *M. johnstoni* is only present in two samples. The species are therefore only loosely associated with these biotopes and may also be characteristic of other biotopes. The MMO suggests that biotopes are reviewed and the description of the characterising species is revised detailing the species that were actually found in the samples. If the data do not fit into a particular biotope then the samples should be assessed at a higher sedimentary level with additional detail on the species actually recorded.	The report refers to mosaics of biotopes (SS.SSa.IMuSa.FfabMag and SS.SSa.IFiSa.NcirBat), not single biotopes specific to individual stations, and the stations containing the mosaic of biotopes were identified by the multivariate analysis (section 5.5.2 and 6.2.4). The report clearly presents these results in relation to the taxa actually recorded within the survey area, and discuss them, highlighting how changes in sediment composition, however small, reflect on changes in associated faunal communities. Assigning a biotope to single stations would not provide any meaningful information (and would however results in a mosaic, just as referred to in the report); this is exactly why the multivariate analysis is used; to identify patterns. In addition, several stations hosted fauna which are characteristic of more than one biotope, and are typical of transitional areas from one biotope to another, in line with the description outlined in the Marine Habitat Classification for Britain and Ireland (NcirBat may grade into FfabMag, as the mud content increases making the sediment more compact). And this is why assigning a single biotope to a single station would not be possible in this case, because even a single station may have elements of multiple biotopes. The degree of fit to the biotopes assigned was considered in relation to biological (species composition) and physical characteristics (sediment type, depth), which were taken into

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		account and presented in Table 5.14.
S42 Consultation MMO January 2018	The samples in the north east of the site have been assigned to the same biotope code as those in the south, whereas the data (sediment and fauna) suggest these areas contain different habitats. The analysis undertaken for the characterisation actually suggests these are two different habitats (A1 and A2 – based on sediment and faunal analysis) but then ignores this evidence and considers them all as one habitat. The samples from the north west of the Array were classified as muddy sands according to the sediment description but have later been assigned to a mixed sediment biotope. The data needs to be reviewed and reassigned into the appropriate biotopes based on both sediment and fauna information. It may be necessary to review each sample separately.	The report specifies that multivariate group A comprised a mosaic of SS.SMX.CMx.MysThyMx and subgroups SS.SBR.PoR.SspiMx , with elements of the former prevailing in subgroup A1 and elements of the latter prevailing in subgroups A2; prevalence of selected fauna does not imply absence of other fauna, hence the report refers to mosaic of biotope. Evidence from all the results (sediment analysis, macrofaunal and video footage) were taken into account when assigning biotopes (as outlined in Section 5.5), to ensure that habitat assessment was comprehensive of all data acquired during the survey. Considering single stations would provide information of a single point source, the extrapolation of which to a larger scale would carry uncertainty when compared to the assessment which considers data alone and in combination.
S42 Consultation MMO January 2018	Not all the samples assigned to the *Sabellaria spinulosa* on stable circalittoral mixed sediment (SS.SBR.PoR.SspiMx) biotope actually contain any *S. spinulosa*. The data should be reviewed and reassigned accordingly. The sediment data/analyses suggest some of the samples should be assigned to a coarse sediment biotope rather than a mixed sediment biotope. All samples should be checked and reassigned appropriately. The intertidal biotopes assigned in the characterisation report (Volume 4 Annex 5-1: Benthic Intertidal (Document Ref: 6.4.5.1)) are misleading as the (European Nature Information System (EUNIS) code A2.23 [Polychaete/amphipod-dominated fine sand shores] has been assigned to the muddier samples near the Stour. However according to EUNIS/MNCR this biotope is characterised as fine sand with no mud content. These should be revised accordingly. The MMO notes that characterisation surveys use EUNIS codes whereas the PEIR uses the MNCR codes, however they are interchangeable in most cases. (See also point 5.4)"	As per reply to previous comment: the report refers to a mosaic of biotopes, with prevalence of selected fauna at some stations. Sediment data of all stations were taken into consideration when assessing biotopes, as reported in Table 5.14; when looking at the percentage of main sediment fractions in each of the multivariate groups, group A fits the description of mixed sediment, whereas group B that of sandy (as detailed in section 5.4.4 and changes in the median sediment particle size presented in Figure 5.31). All samples were assessed individually and in combination (multivariate analysis) during the biotope classification, also considering data from the seabed video footage. Considering single stations would provide information of a single point source, the extrapolation of which to a larger scale would carry uncertainty when compared to the assessment which considers data alone and in combination.

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S42 Consultation MMO January 2018	The intertidal biotopes assigned in the characterisation report (Volume 4 Annex 5-1: Benthic Intertidal) are misleading as the (European Nature Information System (EUNIS) code A2.23 [Polychaete/amphipod-dominated fine sand shores] has been assigned to the muddier samples near the Stour. However according to EUNIS/MNCR this biotope is characterised as fine sand with no mud content. These should be revised accordingly. The MMO notes that characterisation surveys use EUNIS codes whereas the PEIR uses the MNCR codes, however they are interchangeable in most cases. (See also point 5.4)	While the EUNIS code A2.23 biotope does not contain mud elements, this biotopes fits the biological communities best, this why it was designated as this. However, based on the mud content of the survey locations, the stations have been re-designated as EUNIS code A2.24 [Polychaete/bivalve-dominated muddy sand shores], as this best fits the combination of the biological community and the sediment samples.
S42 Consultation MMO January 2018	The biotope A2.242 [*Cerastoderma edule* and polychaetes in littoral muddy sand] has been assigned to many of the stations within the intertidal at Pegwell Bay. This biotope is characterised both by fine and muddy sand and by abundant cockles (*Cerastoderma edule*), however *C. edule* was only present in very low abundances (1 or 2 individuals) at many of the stations. Note that the bivalve *Limecola balthica* (formerly *Macoma balthica*) was also found at these stations in low numbers, which is characteristic of A2.241 [*Macoma balthica* and *Arenicola marina* in muddy sand shores] (*Arenicola marina* is also a characteristic species of Pegwell Bay but is not characteristic of the biotope A2.242). The MMO suggests either reassigning these stations to a higher level e.g. A2.24 [Polychaete/bivalve-dominates muddy sand shores], to account for all characteristic species observed, or assign both biotopes to the stations but state that *M. balthica* and *C. edule* were only found in low abundances. (See also point 5.4).	The biotope A2.242 [*Cerastoderma edule* and polychaetes in littoral muddy sand] was in part due to the high proportion of *Bathyporeia* although the point raised is acknowledged. Therefore, the stations have been re-assigned to both A2.242 [*Cerastoderma edule* and polychaetes in littoral muddy sand] and A2.241 [*Macoma balthica* and *Arenicola marina* in muddy sand shores].
S42 Consultation MMO January 2018	There is no information in the PEIR regarding benthic monitoring. The MMO expects that monitoring will be undertaken post construction to verify the predictions in the ES. It is likely that this will be secured through licensing conditions within the DML.	Confidence in the ES predictions are high based on the site specific knowledge gained from the post-construction monitoring undertaken for Thanet Offshore Wind Farm. Baseline surveys will be undertaken prior to the start of construction and it is proposed that post-construction monitoring only occurs if core reef is identified within the order limits.
S42 Consultation MMO January 2018	As has been noted by the MMO within Item 1.11, consideration must be given to all relevant in-combination effects on the marine environment including the proposed 132kV cable replacement project for the existing Thanet OWF.	The Thanet Cable Replacement project is no longer being pursued and as such a cumulative impact assessment is not required.
S42 Consultation MMO January 2018	Volume 2, Chapter 5: Benthic Subtidal and Intertidal Ecology, para 5.7.19 (Document Ref: 6.2.5). Actiniaria are not sea stars, they are sea anemones.	Corrected.
S42 Consultation MMO January 2018	Volume 2, Chapter 5: Benthic Subtidal and Intertidal Ecology para 5.7.22 states that no reef was observed in the grabs. The benthic characterisation report states that a Hamon grab was used to collect faunal samples. The grab type mixes the sample and will break up any reef encountered.	Noted. Text deleted.

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S42 Consultation MMO January 2018	The chalk reef assessment undertaken in the characterisation report (Volume 2, Chapter 14: Inter-relationships (Document Ref: 6.2.14)) is not appropriate for bedrock such as chalk reef. The classifications used by Irving and Limpenny relate to cobble/stony reef. None of the criteria used to assess 'reefiness' are appropriate for chalk reef. The video images indicate that chalk bedrock is present, therefore the MMO considers no further assessment is required.	Noted, the assessment of chalk reef based on Irving has been removed and the evidence from the video images used to confirm the presence of chalk bedrock, not reef.
S42 Consultation MMO January 2018	The MMO were formally consulted by Thanet Offshore Wind Limited regarding the Thanet 132kV Cable Replacement Project (ref. ENQ/2017/00240). The MMO has significant concerns that there does not currently appear to be any consideration of in-combination effects related to this proposed project. The MMO reiterates that consideration must be given to all relevant in-combination effects on the marine environment.	The Thanet Cable Replacement project is no longer being pursued and as such a cumulative impact assessment is not required.
S42 Consultation Natural England January 2018	The permanent loss or relocation of up to 4,811 m^2 of Saltmarsh in an area designated as an SPA and SSSI.	The chapter has been updated in line with the relevant reduction in the potential area of permanent saltmarsh loss as described in Volume 2, Chapter 1, Project Description (Offshore) (Document Ref: 6.2.1).
S42 Consultation Natural England January 2018	Natural England feel that more focus needs to be given to installation areas with more sensitive habitats, such as chalk and potential *Sabellaria* reef.	Further information on the impacts of sensitive habitats is now provided in section 5.10. Proposed mitigation plan for reefs has been developed and has been submitted to Natural England as part of the Evidence Plan process.
S42 Consultation Natural England January 2018	It needs to be made clearer whether the effects of sediment plumes have been sufficiently assessed.	The effects of sediment plumes were included within the assessment of the impacts from increases in SSC and sediment deposition. Clarification has been provided of the contribution from sediment plumes to these impacts.
S42 Consultation Natural England January 2018	Considering the problems with the installation and maintenance of the original Thanet Cables Natural England need further reassurances around installation techniques and potential O&M scenarios, and whether the actual worst-case scenario has been assessed.	O&M assumptions have been included and are provided within Volume 2, Chapter 1: Project Description (Offshore) (Document Ref: 6.2.1) and the Outline Offshore Operation and Maintenance Plan (Document Ref: 8.10)
S42 Consultation Natural England January 2018	We also welcome discussions around the core reef approach and are keen to discuss this further, however its use and determination of core reef value will depend on the available data for the area. In the absence of agreeing a core reef approach a pre-construction survey will be required to determine whether there are any habitats of conservation importance that require micro-siting.	Clarification sought in Evidence Plan meeting. Core reef approach has been sent to Natural England within the Biogenic Reef Mitigation Plan (Document Ref: 8.15).
S42 Consultation Natural England January 2018	Habitats of Conservation importance: Natural England notes that there is a large amount of detail regarding *Sabellaria* and Drillstone reefs which is missing from the benthic chapter. This would be better captured within the benthic	Chapter has been updated accordingly.

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	chapter or with improved signposting to ensure it is captured adequately.	
S42 Consultation Natural England January 2018	This drill stone reef represents a large, most likely, biogenic *Sabellaria* reef that is considered a habitat of conservation importance and every effort should be made to microsite around this structure. Furthermore, there seems to be much more detail within this chapter on Drillstone reef than within the benthic chapter, we would like to see this better translated across.	Noted. Where *S. spinulosa* is identified, mitigation measures will be applied. Further detail on Drillstone reef is provided in section 5.7.
S42 Consultation Natural England January 2018	Sensitive habitats: The habitats are generally referred to as widespread and common with a large amount of focus on the more ubiquitous sands and gravels and not enough focus on installation areas with more sensitive habitats – chalk, potential *Sabellaria* reef etc. It should also be recognised that gravels recover much more slowly than mobile sands which should be considered throughout the assessment.	No chalk reef was identified during the characterisation surveys and *S. spinulosa* reef was only recorded at one location which was classified as of low reefiness. Reef habitats will be subject to mitigation as habitats of conservation importance and as such any significant effects will be avoided and have not been assessed. Consideration of effects on chalk bedrock has been presented in the Physical Process chapter.
S42 Consultation Natural England January 2018	Sediment plumes: it is unclear whether impacts of sediment plumes have been assessed in benthic chapter. Improved signposting is required if it is covered elsewhere. In addition Natural England advise that impacts of elevated levels of suspended sediment on fish, birds and marine mammals is considered.	The effects of sediment plumes were included within the assessment of the impacts from increases in SSC and sediment deposition. Clarification has been provided of the contribution from sediment plumes to these impacts.
S42 Consultation Natural England January 2018	Sandwave clearance and cable maintenance: There is no full assessment of impacts of sandwave clearance or cable maintenance. It should therefore be noted that these would not currently be permitted in a DML.	An assessment of the impacts from sandwave clearance has now been provided in the ES. The full range of O&M activities have been assessed in the ES following a review of the activities presented in the PEIR.
S42 Consultation Natural England January 2018	There is insufficient discussion of the impacts of visible chalk plumes from export and inter-array cable installation that have been known to occur at this and other projects installing in chalk habitats. Potential for smothering from chalk particles that are not usually encountered in the water column should be assessed.	The impacts of chalk plumes have been included within the assessment of the increases in SSC and deposition with specific discussion of the impacts from the chalk plumes.
S42 Consultation Natural England January 2018	Confidence in installation techniques: Natural England highlight the issues experienced with inter-array cable burial at Thanet and the need for repeated export cable repairs. Further assurance is required that techniques have been selected that Vattenfall are confident will be successful and/or that a realistic number of reburial/ repairs have been adequately assessed. The various installation techniques and a realistic worst-case scenario of remedial works should be fully assessed as part of the application in order for it to be complete.	The installation methodologies have been selected based on lessons learnt from the Thanet Offshore Wind Farm experience and Vattenfall are confident that the methodologies selected will be sufficient.
S42 Consultation Natural England January 2018	Avoidance of Annex I terminology: Natural England wish to highlight that in order to avoid confusion we want to move away from generic use of the term “annex 1 habitat” as it has caused confusion and that instead any they should be referred to as “habitats of conservation importance.” Habitats and species should be listed as those of conservation importance along with the	Noted. The relevant sections of this report have been updated accordingly.

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	relevant legislation they are protected under e.g. Section 41 of the NERC Act, Annex 1 of the Habitats Directive, OSPAR etc.	
S42 Consultation Natural England January 2018	Given that Defra are now in the process of considering a third tranche of MCZs we would like to see further consideration of this site, as recent applications by other developers have done. Goodwin sands was identified during the Regional Project stages of the MCZ process as being nationally important due to the presence of: • Moderate energy infralittoral rock • Moderate energy circalittoral rock • Subtidal coarse sediment • Subtidal sand • Blue mussel beds • Rossworm reef (*Sabellaria spinulosa*) • Eastern English Channel outburst flood features The most sensitive habitats within this site are rock (likely to be subtidal chalk) and *Sabellaria*. It is noted that chalk and *Sabellaria* have already been flagged within the PEIR of being of importance, but they should be considered along with the other recommended features within the context of the MCZ. The site has large areas of subtidal sand and subtidal coarse sediment, and these are likely to be the features that directly interact the most with cabling activity. The impact to rMCZ features from cable laying, including sand wave clearance, dredging and any disposal should be assessed. Natural England advise that any sediment removed for cable laying should be kept within the system.	As discussed at the EP meeting on 29/01/18, the habitats and features of the Goodwin Sands rMCZ have been assessed as part of the ES. The impact assessment has demonstrated no likely significant adverse effects on the features of the rMCZ.
	Also, given the highly dynamic nature of the site, monitoring of the cable route after construction would be advisable to ensure that it remains buried. Proposals for dealing with any cable exposures should be covered in the application.	
S42 Consultation Natural England January 2018	A Phase 1 intertidal habitat survey is mentioned in paragraph 5.4.5 and states the scope was agreed in the evidence plan meetings. The only surveys we can see are in volume 4, Annex 5-1 (Document Ref: 6.4.5.1) and it doesn't seem to go into detail about saltmarsh quality?	The survey scope was agreed through the EP as discussed at the EP meeting on 29/01/18 and saltmarsh was not sampled.
S42 Consultation Natural England January 2018	Although monitoring studies have shown that operational noise is marginally above ambient noise levels for existing projects, this project has the potential to use much larger turbines. This has the potential to raise these sound levels. If these larger turbines are consented we would suggest this to be revisited, even if it is just to collect operational data on these sound levels and validate the statements made.	Noted.
S42 Consultation Natural England January 2018	Although NE don't disagree with "loss of habitat" and "colonisation of hard substrate" being considered as an O&M phase impact, we still consider it is also a result of the construction and/or decommissioning phases and should be mentioned in the relevant sections.	The long-term impacts of 'loss of habitat' and 'colonisation of hard substrate' (including foundations) has been considered as an O&M phase impact due to the long-term impacts of these, rather than them being short-term impacts only relevant during the construction and/ or decommissioning phases. The loss of the colonised habitat has been considered

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		as a separate impact during the decommissioning phase.
S42 Consultation Natural England January 2018	It would be good to see the data for the Thanet OWF included in these figures as well to see how similar the substrate is and thus how likely the same installation techniques are to work. As a variety of substrates have been identified within the offshore red line boundary, from past experience it may be likely that that there will be installation difficulties. For example, for the original Thanet OWF the developers experienced difficulties using a plough to bury the cables as they could not get them deep enough. As a result, more detail and consideration is needed regarding the techniques and tools that will be used to bury the cables in the differing substrates and across cable lengths. It would be also be good to fill in the substrate map for the original Thanet OWF to see how the whole site marries up.	The data for the original Thanet OWF is not available for inclusion within the ES, however, further detail on the sediments within the Thanet OWF array area has been provided in section 5.7. Full consideration of the challenges arising during the installation of Thanet OWF have been considered when identifying the installation methodologies for Thant Extension.
S42 Consultation Natural England January 2018	How do we know the *Sabellaria* reefs in this area have limited longevity compared to the Wash? Is there long-term data and evidence to support this assertion?	Additional information on the longevity of *Sabellaria* reefs in this area has been added to paragraph 5.7.9.
S42 Consultation Natural England January 2018	NE acknowledge that metals were below CEFAS AL1 and Canadian TEL, while hydrocarbons, organotins and PCBs were all at very low level and/or undetectable for the offshore array area.	Noted.

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S42 Consultation Natural England January 2018	Why is there sections of the OECC missing from the sediment classification map? Is it because data has not yet been collected?	The characterisation surveys were carried out on the OECC boundary presented at scoping which has now been revised. The survey data is available up to the point of the working depth for the survey vessel.
S42 Consultation Natural England January 2018	Despite the quality of the saltmarsh north of the river Stour being of a “lower quality” it still represents an important habitat to a range of species and should not be disregarded.	Noted. The quality of the saltmarsh has not been incorporated in the impact assessment however this point has been made to identify the differing quality of the saltmarsh throughout the region.
S42 Consultation Natural England January 2018	See NE’s comments on paragraph 4.10.10 regarding Option 1A and the quality of saltmarsh in areas around the proposed landfall compared to saltmarsh further north.	The statements with regards saltmarsh quality refer to information received from *inter alia* Natural England at an evidence plan meeting in 26th May 2017.
S42 Consultation Natural England January 2018	These NERC (BAP) habitats listed under Section 41 should be afforded protection from any damaging works, as they provide an important habitat for a range of species.	Mitigation measures for habitats of conservation importance will be agreed prior to construction.
S42 Consultation Natural England January 2018	It is important to be sure, as stated here, that any changes to the methodology post-consent will not represent a worse worst-case scenario.	Noted. The worst-case for each receptor has been presented so that any changes from that described here will be of a lesser impact.

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S42 Consultation Natural England January 2018	Direct disturbance to the intertidal area from cable installation operations, including in the saltmarsh - It would be good to provide an overall area figure here. Using a spider plough like the one utilised during TOWF would also be a good method to consider. Shouldn't the tracking of vehicles be also considered and added here?	Noted. The disturbance was presented in the impact assessment and has now been included in the table.
S42 Consultation Natural England January 2018	Permanent loss of saltmarsh habitat at landfall – Would this not sit in the construction phase as well? As stated in previous comments NE are concerned by the proposal of a permanent loss of saltmarsh and further alternative options should be considered and/or appropriate mitigation presented. The direct disturbance from cable installation is confusing as it gives total for 4 cable installation corridor widths then single figure for sand wave clearance, it would be helpful to see a proposed total for all 4 cables. The same for intertidal cable installation, what are the total figures? The direct disturbance to the seabed from maintenance operations – no figures are provided given for cable repairs. Given that most operational windfarms now have O&M licenses permitting a certain number of cable repairs, we would expect this to be reflected in this assessment for an average proposed number of repairs. Repairs have been required at Thanet OWF which have required additional marine licenses. Should the potential footprint of repair works not be assessed as part of the application we consider the application incomplete and additional marine licenses will have to be applied for any remedial cable repairs once operational.	As previously mentioned, the permanent loss of the saltmarsh is presented in the operational phase impacts due to the long-term duration of the impact. The table has been updated to provide more clarity and provide totals of all impacts.
S42 Consultation Natural England January 2018	A core reef approach has not been agreed. Natural England are keen to discuss this option, however its use and determination of core reef value will depend on the available data for the area. In the absence of agreeing a core reef approach a pre-construction survey will be required to determine whether there are any habitats of conservation importance that require micro-siting. Any potential use of a core reef approach is more applicable to areas where there will be long-term structure installed such as wind turbines or scour/ cable protection. For cable installation it is more appropriate to micro site around what is there at the time of installation due to the more immediate and short-term nature of the impact. Overall, more data needs to be provided to determine the area of these habitats of conservation importance/ reefs. For this core reef approach to be brought forward NE need to be in agreement beforehand.	Noted. A proposed methodology for the core reef approach has been submitted for discussion with the EP group and also is submitted as part of the ES (See Biogenic Reef Mitigation Plan, Document Ref: 8.15).
S42 Consultation Natural England January 2018	NE would like to see more consideration of sensitivity and recovery of all habitats across the array and cable area in the text, rather than just the dominant habitats that are more likely to display recovery. This is covered in Table 5.12.	The impact assessments have been updated to include additional information on the less common habitats. It is noted that significant adverse effects on habitats of conservation importance will be avoided through the development of a mitigation plan with Natural England.
S42 Consultation Natural England	There doesn't seem to be much discussion around the effects of the permanent loss of saltmarsh habitat and the magnitude of these effects. NE would not consider the effects to be minor in EIA terms considering the	The discussion of the impacts on the saltmarsh has been expanded with further justification of the assessment outcomes.

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January 2018	permanent loss of saltmarsh and other associated disturbance.	
S42 Consultation Natural England January 2018	NE feel it is wrong to state that there will be a single event in each location. Lessons learnt from the original Thanet OWF and other projects highlights that cable repairs often have to occur once they have been buried originally. Take the Thanet OWF cable replacement for example. A lot more information needs to be provided regarding the number, area and potential impact regarding O&M.	Further information on the O&M activities is provided in the chapter and included within the assessment.
S42 Consultation Natural England January 2018	Can this be carried out on a low tide to reduce the distance to the seabed so the distribution of sediment will likely to be lower? Does the sediment need to be released at the surface? Can it be released at the seabed?	The worst-case potential impact is a surface release on a high tide as this creates the largest plume, which has been assessed. Restrictions on timings would be excessively onerous and would severely restrict and extend the construction schedule.
S42 Consultation Natural England January 2018	Are all these species smothering tolerant?	As identified in paragraph 5.10.39 and through reference to the relevant literature the biotopes are highly resistant to changes in SSC and also to smothering from sediment deposition.
S42 Consultation Natural England	In order for sandwave clearance to be permitted in the DML the worst-case scenario needs to be assessed including volumes, location of deposition and potential impacts.	Further information on sandwave clearance has been provided and discussed within the assessment.
January 2018	NE need more detail on the volume and sediments to be removed.	
S42 Consultation Natural England January 2018	Has the potential of trenching through chalk and the associated SSC from this substrate been considered?	The impacts of chalk plumes have been included within the assessment of the increases in SSC and deposition with specific discussion of the impacts from the chalk plumes.
S42 Consultation Natural England January 2018	Until/ unless core reef areas are agreed with NE then any reef areas should be avoided.	Noted. A proposed methodology for the core reef approach has been submitted for discussion with the EP group and also is submitted as part of the ES.
S42 Consultation Natural England January 2018	NE understood it was difficult to monitor turbine colonisation at Thanet, therefore what evidence is there for no non-natives? We do not think there is enough evidence to support claims that Thanet would not act as a stepping stone. Studies under the INSITE program are demonstrating that there is a larval connectivity between structures in the North Sea. The extension will only extend area for any colonisation though as the existing windfarm is there.	Noted. This section has been clarified to note the limitations of the colonisation studies at Thanet Offshore Wind Farm and provide the clarification that the addition of Thanet Extension will not significantly increase the risk of spread of non-native species.
S42 Consultation Natural England January 2018	NE disagree that this permanent loss of saltmarsh is of minor significance. The magnitude seems to be based purely on the size of the impact, but what about considering the function and splitting the saltmarsh in half.	The design of the seawall extension has been refined and reduced to prevent any fragmentation of the saltmarsh.

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S42 Consultation Natural England January 2018	NE disagree with the conclusion that the permanent loss of saltmarsh in this area is assessed as minor in EIA terms – this related to Table 5.18 also.	The design of the seawall extension has been refined and reduced to prevent any fragmentation of the saltmarsh.
S42 Consultation Natural England January 2018	Does not assess area of impact from cable maintenance therefore cannot be permitted within the DML.	Further information on the O&M activities is provided in the chapter and included within the assessment.
S42 Consultation Natural England January 2018	NE appreciate that the timescales will not overlap, however what needs taking into account is the ability of species to withstand the repeated high SSC events even though they are not cumulative in time. Does this decrease or impact the resilience of the species?	The short life time and rapid reproduction rate of the characterising species, plus the likelihood of recolonisation from surrounding areas contributes to the overall resilience of both the species and the biotopes.
S42 Consultation Natural England January 2018	Will there be additional mitigation for saltmarsh loss? Furthermore, mitigation has also not been agreed for Sabellaria.	A saltmarsh monitoring plan has been produced and submitted as part of the ES and no further mitigation beyond the construction footprint restrictions is proposed. The core reef assessment methodology has been submitted as part of the EP process and submitted as part of the ES.
S42 Consultation Natural England January 2018	NE has no further comments regarding this report.	Noted
S42 Consultation Natural England January 2018	NE do not feel the references used are appropriate for chalk reef, as they were designed for stony reef in the first instance. At Navitus for example, the Wildlife Trust challenged the use of the Irving paper as they felt it was inappropriate to use for bed rock reef. It may be more appropriate to use the MCZ chalk reef definition.	Whilst it is noted that the material used within the benthic characterisation is for stony reef, it is felt that this is appropriate due to it taking account of the reef definition for both bedrock and/or stony reef "where the bedrock or stable boulders and cobbles arise from the surrounding seabed creating a habitat that is colonised by many different marine animals and plants".
S42 Consultation Natural England January 2018	The video images presented in Figure 5.1 are poor and the use of a sonar camera may be more appropriate for capturing images of *Sabellaria* here. Further/ better work needs to be carried under discussion with NE.	The use of a sonar camera will be considered for the post-consent surveys, the scope of which shall be agreed with the MMO and its advisors in advance.
S42 Consultation Natural England January 2018	*Sabellaria* is clearly an important species in this area as it was found in 33% of the samples.	Further surveys showed only one sample contained potentially low grade *S. spinulosa* reef (Paragraph 5.7.38). Other samples contained fragments of crust or individuals. Pre-construction surveys will assess the location of S. spinulosa reef and microsite any construction to avoid direct impact.
S42 Consultation Natural England	The heterogeneous nature of sediments across the site suggests to NE cable installation may not be straightforward and may involve a variety of techniques to successfully bury the cable.	Volume 2, Chapter 1: Project Description (Offshore) (Document Ref; 6.2.1) provides the range of installation measures

Date and consultation phase/ type	Consultation and key issues raised	Section where provision addressed
January 2018		considered for use. The lessons learnt on Thanet Offshore Wind Farm have been taken on board when considering the options for cable installation.
S42 Consultation Natural England January 2018	The cumulative effects of the Thanet Cable replacement need to be considered alongside this project, or preferably as one whole project. Both projects together will certainly cause large amounts of disturbance within Pegwell Bay, over a relatively large timeframe. Natural England would welcome further discussions around the cumulative impacts of both projects and how any potential environmental damage can be reduced. In addition to this, realistic predictions on the amount of remedial and O&M work required on the cables needs to be stated. Experience from the original Thanet wind farm and other OWF projects have highlighted that the disturbance will continue well after construction has been completed, and should be factored in, in order for the assessment to be complete.	The Thanet Cable Replacement project is no longer being pursued and as such a cumulative impact assessment is not required. Up-to-date predictions for O&M work on the cable can be found in ES, Volume 2, Chapter 1: Offshore Project Description (Document Ref: 6.2.1).
S42 Consultation Kent Wildlife Trust January 2018	While the impacts of developments on biodiversity and ecosystem function are not yet fully understood, it is imperative that sensitive sites are adequately protected, particularly in light of evidence of cumulative damage in the Wash SSSI. Some parts of the Wash SSSI are now classified as being in unfavourable status due to the deterioration of the saltmarsh as a result of multiple cables from the Lincs and Race Bank offshore wind farms having landfall through the saltmarshes. Lessons should be learned from this example of the Wash SSSI, and every effort should be taken to ensure that the features of this National Nature Reserve and internationally	Some parts of the Wash SSSI have been assessed as unfavourable, however, the reason for the status for many of these areas has not been identified and many units within the areas around the identified cables have not been assessed since 2009 prior to the construction of both wind farms. The majority of the units are also assessed as unfavourable recovering rather than unfavourable

Date and consultation phase/ type	Consultation and key issues raised	Section where provision addressed
	designated site are not jeopardised by being exposed to further damaging development of any kind.	declining. Furthermore, for those units where the unfavourable status had additional information, multiple reasons for the degradation of the site was given including grazing of the saltmarsh.
S42 Consultation Kent Wildlife Trust January 2018	We have concerns regarding the impact of the cabling route on Thanet Coast MCZ, particularly on the subtidal chalk feature. After reviewing Benthic Characterisation Report Volume 4, Annex 5-2 (Document Ref: 6.4.5.2), we do not believe enough sampling has been undertaken within the MCZ to give sufficient confidence on the presence or absence of subtidal chalk. Cabling within Thanet Coast MCZ could result in the loss of subtidal chalk. Once the removal of a subtidal chalk habitat has taken place, there is no option for the recovery of this habitat; it will be lost in perpetuity, and therefore the conservation objectives of the site would not be met. We suggest that the cabling route avoids Thanet Coast MCZ to reduce any risks to the conservation status of this site. This would also reduce any consenting risks to this development.	The geophysical surveys of the cable corridor and array area did not identify any areas of chalk reef habitat. Furthermore with the introduction of the cable exclusion area the cable route no longer passes through the MCZ, and as such it does not cross any areas of conservation concern and will not impact on the conservation objectives of the MCZ. Further detail of the impacts of Thanet Extension on the Thanet Coast MCZ and the Goodwin sands rMCZ are provided in Volume 4, Annex 5-3: MCZ Assessment.
S42 Consultation Kent Wildlife Trust January 2018	We do not agree with the decision of the SoS that the impacts of operational noise should be scoped out of the assessment for benthic subtidal and intertidal ecology at this stage on the basis that operational noise levels from other offshore wind farms (OWFs) are ”only marginally above ambient noise levels” (Table 5.5). If the decision stands to exclude the impacts of operational noise on benthic ecology, evidence should be made available regarding the noise levels recorded from the	Noted. Operational underwater noise levels have been recorded from a range of wind turbines (3MW to 6MW) and other noise sources such as shipping can be significantly louder than that of turbines.

Date and consultation phase/ type	Consultation and key issues raised	Section where provision addressed
	other OWFs (North Hoyle, Scroby Sands, Kentish Flats and Barrow wind farms), to justify this decision.	
S42 Consultation Kent Wildlife Trust January 2018	Relating to Section 5.7.19, the placement and piling of WTGs that would impact on the soft rock communities (identified using the biotope CM.MCR.SfR, equating to subtidal chalk) should be avoided as subtidal chalk is a UK BAP Priority Habitat. Given the lack of video footage recorded around the North West region of the survey area, we would recommend that further video surveys are carried out in this area to establish the presence or absence of subtidal chalk and the associated soft rock communities, so that this can be incorporated into the Environmental Statement.	Baseline surveys may be carried out prior to construction. Mitigation measures (including micrositing) for habitats of conservation importance will be discussed and agreed with the relevant parties prior to the construction of the wind farm as part of the post-consent process.
S42 Consultation Kent Wildlife Trust January 2018	We have concerns regarding the cumulative impacts of repeated cable installation. We suggest further work is required on the cumulative impacts from cable installation as part of Thanet Extension and cables from the existing Thanet Offshore Wind Farm, the replacement of the failed Thanet Offshore Wind Farm cables and the NEMO Link. We would like to discuss opportunities with Vattenfall to reducing cumulative impacts from cabling in the area by considering strategic cabling options for the Thanet and Extension wind farms.	The Thanet Cable Replacement project is no longer being pursued and as such a cumulative impact assessment of Thanet Cable Replacement is not required. Nemo interconnector forms parts of the baseline of the receiving environment and is considered as such.
S42 Consultation Environment Agency January 2018	A large extension of the existing sea front is proposed in the plans. This will cause direct and unacceptable loss of mudflat and saltmarsh at the landfall location.	The design of the seawall extension has been refined and reduced to prevent any fragmentation of the saltmarsh.
S42 Consultation Environment Agency January 2018	What will the long-term effects on fragmentation of the habitat be?	The change to the seawall extension design will prevent any fragmentation of the saltmarsh.
S42 Consultation Environment Agency January 2018	What effects on erosion, sediment transport and deposition will there be on the affected and surrounding area of mudflat?	The extension to the sea wall has been modified and therefore the relevant chapters have been updated. Any likely effects following the design change will be considered.
S42 Consultation Environment Agency January 2018	What thermal effects will the cable have on the mudflat, given that it is only going to be just below the surface (c 1m)? If the cables heat the ground, as seems to be the case from the information presented, then how will this change the habitat? Are these changes acceptable or will they cause degradation of the habitat?	Any thermal heating from the cables will be minimal and are not considered to result in heating beyond natural variation or to result in any impacts on the species present.
S42 Consultation Dover District Council January 2018	Does this include an impact assessment in respect of changes to the coastline and an increase of between 20 and 50m. The 50m shoreline change appears to have been given limited consideration.	Consideration of the change to the coastline is incorporated within the assessment of the potential permanent loss of the saltmarsh habitat.
S42 Consultation Dover District Council January 2018	Assumptions on the impact on the saltmarsh during construction can surely be more defined due to previous experience.	The previous experience of the project demonstrates that the saltmarsh was fully recovered within 3 years post-construction.

5.4 Scope and methodology

5.4.1 The boundary of the Thanet Extension array area fully encloses the existing TOWF, off the Kent Coast. The proposed OECC extends south-west from the array area to the landfall location in Pegwell Bay.

5.4.2 The benthic characterisation presented here provides a regional overview before focusing on the study area within 12 km of the offshore components of the development boundary (Figure 5.1). The study area encompasses the Thanet Extension array area as well as the OECC, up to and including the intertidal zone in Pegwell Bay, defined as ending at Mean High Water Springs (MHWS). The immediate Red Line Boundary, and 12 km buffer area effectively characterises the predicted zone of potential primary (direct) and secondary (indirect) impacts of the development on benthic receptors respectively (Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (Document Ref: 6.2.2)). The study area has been broken down into three sections, and these sections have been assessed individually in terms of their potential impacts on benthic subtidal and intertidal ecology. The sections considered within this chapter comprise the following:

- Array area (including WTGs, OSS and inter-array cables);
- OECC; and
- Landfall (including the intertidal).

370000 380000 390000 400000 410000 420000

5710000 5700000 5690000 5680000 5670000

N

THAMES ESTUARY
KNOCK
FALLS
GAP
SHINGLES
PRINCES CHANNEL
QUEENS CHANNEL
MARGATE ROAD
Thanet Wind Farm
North Foreland
Elbow
Broadstairs
Ramsgate
Knolls
Goodwin Knoll
North Sand Head
GOODWIN
SANDS
THE DOWNS
KELLETT GUT
TRINITY BAY
South Caliper
Tail of the Falls
South Falls Head
SOUTH FALLS
SANDETTIE BANK
Tongue DW (hazardous cargoes)
Tongue DW (non-hazardous cargoes)
Unexploded Ordnance
Cross-Channel Ferries (see Note)
Sandwaves (see Note)
DW (see Note)
1975
1828
1607
51°30
51°15'N
1°40'E

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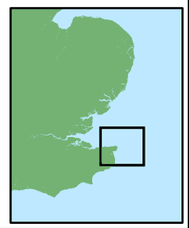
THANET EXTENSION OFFSHORE WIND FARM

Figure 5.1
Benthic Subtidal and Intertidal Study Area.

Legend

- Offshore Red Line Boundary
- Benthic Subtidal and Intertidal Study Area
- Cable Exclusion Area

Datum: ETRS 1989
Projection: UTM31N



1:200,000 0 2 4 km 0 1 2 nm

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Rev	0.1	Date	25/05/2018	
By	PN	Layout	N/A	

5.4.3 Where relevant, data from surveys undertaken for TOWF has been used in the characterisation of the Thanet Extension study area, complemented by the primary sources of information including site specific surveys undertaken for Thanet Extension. The scope of the subtidal benthic surveys having been agreed with the MMO and their advisers (March 2016), whilst the scope of the intertidal benthic survey having been agreed with the Evidence Plan marine ecology technical review panel (March 2017).

5.4.4 Site specific surveys for Thanet Extension have been undertaken to characterise the benthic ecology throughout the array and the OECC (Fugro, 2017a, b; Volume 4, Annex 5-1 (Document Ref: 6.4.5.1)). This survey comprised of a full geophysical survey of the array and OECC, supplemented with drop-down camera data and grab samples to determine the presence of sensitive habitats, including *Sabellaria spinulosa* reef, and to allow a characterisation of the species composition within the study area. The survey additionally included sediment Particle Size Analysis (PSA) and contaminant analysis using the grab samples.

5.4.5 A site specific extended Phase 1 intertidal survey (MESL, July, 2017; Volume 4, Annex 5-2 (Document Ref: 6.4.5.2)) was carried out at the proposed landfall location for the offshore export cables at Pegwell Bay in Kent. The scope was agreed under the EPand provides adequate coverage for the purposes of EIA inclusive of the sensitive saltmarsh habitats within the upper intertidal and the designated habitats of the lower intertidal; between MHWS and Mean Low Water Springs (MLWS). Standard Phase 1 survey methods were followed (Davies *et al*., 2001, Wyn & Brazier, 2001 and Wyn *et al*., 2000).

5.4.6 Under both the subtidal and intertidal benthic ecology surveys habitats and communities are classified according to the MNCR biotope classification (2004). Biotopes provide a simplified description of the variation in biological community across a region to make it easier to visualise patterns and see which areas are similar in character. In the UK there are two commonly used classification schemes; the Marine Habitat Classification for Britain and Ireland (Connor et al 2004) and the Europe-wide scheme EUNIS which is strongly based on the UK system (Davies & Moss 2004). This chapter and the associated annexes rely primarily on the biotope classification system.

5.5 Assessment criteria and assignment of significance

5.5.1 The sensitivities of different biotopes have been classified by the MarLIN [1] on the Marine Evidence based Sensitivity Assessment (MarESA) four-point scale (high – medium – low – not sensitive). The scale takes account of the resistance and recoverability (resilience) of a species or biotope in response to a stressor. Specific benchmarks (duration and intensity) are defined for the different impacts for which sensitivity has been assessed (e.g. smothering, abrasion, habitat alteration etc.). Detailed information on the benchmarks used and for further information on the definition of resistance and resilience can be found on the MarLIN website, while the benchmarks have been included in the assessments in section 5.10 - 5.12.

5.5.2 For the purposes of this assessment, four sensitivity categories have been defined, each drawing on the four MarLIN MarESA categories (Table 5.6).

5.5.3 The magnitude of potential impacts is defined by a series of factors, including the spatial extent of any interaction, the likelihood, frequency and duration of a potential impact. The definitions of magnitude used in the assessment are defined in Table 5.7.

5.5.4 The matrix used for the assessment of significance is shown in Table 5.8. The combination of the magnitude of the impact with the sensitivity of the receptor determines the assessment of significance of effect.

5.5.5 For the purposes of this assessment, any effect that is of major or moderate significance is considered to be significant in EIA terms, whether this be adverse (red and orange respectively) or beneficial (green and turquoise). Any effect that has a significance of minor or negligible is not significant.

[1] http://www.marlin.ac.uk/species/sensitivity_rationale

Table 5.6: Sensitivity/ importance of the environment

Receptor sensitivity/ importance	Description/ reason
High	Equivalent to MarLIN MarESA sensitivity category 'High'. The habitat or species is noted as exhibiting 'None' or 'Low' resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover only over very extended timescales i.e. > 25 years or not at all (resilience is 'Very Low'); or The habitat or species is noted as exhibiting 'None' or 'Low' resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover only over very extended timescales i.e. > 10 or up to 25 years (resilience is 'Low').
Medium	Equivalent to MarLIN MarESA sensitivity category 'Medium'. The habitat or species is noted as exhibiting 'None' or 'Low' resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover over medium timescales i.e. > 2 or up to ten years (resilience is 'Medium'); or The habitat or species is noted as exhibiting 'None' resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover over < 2 years (resilience is 'High'); or The habitat or species is noted as exhibiting 'Medium' resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover over medium to very long timescales, i.e. > 2 years or up to 25 years or not at all (resilience is 'Medium', 'Low' or 'Very Low').
Low	Equivalent to MarLIN MarESA sensitivity category 'Low'. The habitat or species is noted as exhibiting 'Low' or 'Medium' resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover over < 2 years (resilience is 'High'); or The habitat or species is noted as exhibiting 'High' resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover over medium to very long timescales, i.e. > 2 years or up to 25 years or not at all (resilience is 'Medium', 'Low' or 'Very Low').
Negligible	Equivalent to MarLIN MarESA sensitivity category 'Not Sensitive'. The habitat or species is noted as exhibiting 'High' resistance (tolerance) to an external factor, whether that arises from natural events or human activities, and is expected to recover over short timescales, i.e. < 2 years (resilience is 'High').

Table 5.7: Magnitude of Impact

Magnitude	Definition
High	The proposed development would result in a complete change to baseline conditions and status of conservation features/ ecological functionality; or The proposed development would result in a change from baseline conditions that would affect the conservation status of the site or feature.
Medium	The site feature's conservation status would not be affected, but the impact is likely to be significant in terms of ecological objectives or populations. If, in light of full information, it cannot be clearly demonstrated that the impact will not adversely affect the conservation objectives, then the impact should be assessed as high.
Low	Minor shift away from baseline but the impact is of limited temporal or physical extent.
Negligible	No change from baseline conditions/ observable impact predicted.

Table 5.8: Significance of potential effects

		Sensitivity			
		High	Medium	Low	Negligible
Negative Magnitude	High	*Major*	*Major*	*Moderate*	*Minor*
	Medium	*Major*	*Moderate*	*Minor*	*Negligible*
	Low	*Moderate*	*Minor*	*Minor*	*Negligible*
	Negligible	*Minor*	*Minor*	*Negligible*	*Negligible*
Beneficial Magnitude	Negligible	*Minor*	*Minor*	*Negligible*	*Negligible*
	Low	*Moderate*	*Minor*	*Minor*	*Negligible*
	Medium	*Major*	*Moderate*	*Minor*	*Negligible*
	High	*Major*	*Major*	*Moderate*	*Minor*

Note: shaded cells are defined as significant effects in respect of the EIA.

5.6 Uncertainty and technical difficulties encountered

5.6.1 Grab sampling and video surveys, while providing detailed information on the infauna and epifauna present, cannot cover wide swaths of the seabed and consequently represent point samples that must be interpreted in combination with the geophysical datasets to produce benthic maps that provide comprehensive cover.

5.6.2 Classification of survey data into benthic habitats and the production of benthic habitat maps from the survey data, while highly useful for assessment purposes, has two main limitations:

- Difficulties in defining the precise extents of each biotope, even when using site specific geophysical survey data to characterise the seabed; and
- There is generally a transition from one biotope to another, rather than fixed limits and therefore, the boundaries of where one biotope ends and another starts often cannot be precisely defined.

5.6.3 Consequently, the biotope maps presented in this chapter should not be considered as definitive, nor should the habitat boundaries be considered to be fixed, they do however represent a robust characterisation of the receiving environment.

5.6.4 There are additional limitations inherent within the MarESA sensitivity assessments. These include the assessments not being site specific and consequently there may be differences in sensitivity within a species in different habitats. These limitations are included within the confidence score assigned to the MarESA assessment, for which the full details and rationale are provided on the MarLIN website[2], and in the assessment summaries.

5.6.5 The overall confidence in the evidence used for the MarESA sensitivity assessments is assessed for three categories: the quality of the evidence/ information used; the degree to which the evidence is applicable to the assessment; and the degree of concordance (agreement) between the available evidence. A 'low' confidence score can be applied for the different categories if:

- For quality of the evidence – the assessment is based on expert judgement (i.e. insufficient scientific or grey literature);
- For applicability of the evidence – the assessment is based on proxies for the pressure (e.g. based on natural disturbance events rather than anthropogenic); and
- For the degree of concordance of the evidence – the available evidence does not agree on direction or magnitude of the impact or recoverability.

5.6.6 The confidence of the sensitivity assessment is based on the confidence of the assessments for the resilience and resistance of each habitat. If the confidence for the resilience or resistance assessment is 'low' or 'not relevant' then the corresponding confidence for the sensitivity assessment will also be low. This is of particular relevance to the quality of the evidence as evidence will only be available if studies have been undertaken.

[2] http://www.marlin.ac.uk/species/sensitivity_rationale

5.6.7 However, despite the above uncertainties, it should be noted that there is robust data available on the benthic communities present in the study area. The seabed in the area is well studied and surveyed, including for TOWF and also for the Nemo Interconnector Cable that has a landfall also within Pegwell Bay. Therefore, the sensitivities of the habitats present are understood and the post-construction surveys undertaken for TOWF can be used to validate the assessments of the likely impacts within this chapter. As such, the available evidence base is sufficiently robust to underpin the assessment presented here.

5.7 Existing environment

5.7.1 The benthic subtidal and intertidal study area (Figure 5.1) encompasses the Thanet Extension array area as well as the OECC, up to and including the intertidal zone in Pegwell Bay, defined as ending at mean high water springs (MHWS). The immediate Red Line Boundary, and 12 km buffer area effectively characterises the predicted zone of potential primary (direct) and secondary (indirect) impacts of the development on benthic receptors respectively (Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (Document Ref: 6.2.2)).

Methodology to Inform Baseline

5.7.2 The following information provides a summary of the desktop and site-specific methodologies used to inform the benthic and intertidal ecology characterisation. Full details of these, including detail on statistical analysis, are presented in Annex 5-1: Benthic Ecology Technical Report and Annex 5-2: Intertidal Ecology Technical Report (Document Ref: 6.4.5.1 and 6.4.5.2 respectively).

5.7.3 Information on the benthic and intertidal communities within the Thanet Extension ecology study area was collected through a detailed desktop review of existing benthic studies and datasets. These included the ES and pre-construction surveys for TOWF which provided detailed information from site specific surveys on the benthic habitats present historically and the EIA for the Nemo Interconnector which provided more up to date account of the ecology along the inshore section of the OECC. Further information was gained on the benthic communities and their recovery rate through reference to the post-construction surveys undertaken for the TOWF project. Where relevant historical data from the Thames Estuary Dredging Association (TEDA) Marine Aggregate Regional Environmental Assessment (MAREA) survey campaigns and the Outer Thames Regional Characterisation (REC), the Marine Macrofauna Sensitivity review which underpinned the assessment within these documents, and wider scale investigations that inform the broad scale habitats within the region were included. Site selection assessment documents for SACs, SPAs, Ramsar sites and MCZs were also drawn upon.

5.7.4 Site specific surveys for Thanet Extension have been undertaken to provide an up-to-date characterisation of the habitats and species occurring within the study area. The offshore benthic surveys were conducted by Fugro Ltd, with the intertidal surveys undertaken by Precision Marine Ltd (PML). All survey methodologies were in line with the relevant guidance documentation (Cefas, 2002; Cefas *et al*., 2004; Davis *et al*., 2001; Ware and Kenny, 2011). Within the southern section of the OECC (Figure 5.1), primary data collected as part of the Nemo interconnector project has been drawn on to characterise the receiving environment in this area. These surveys were undertaken as part of an EIA characterisation (2010), and for the purposes of a pre-construction baseline for the Nemo project (2017).

Characterisation of the Baseline Environment

The study area

5.7.5 Thanet Extension is situated at the boundary between the southern North Sea and the English Channel. This area is dominated by primarily coarse sediments, and is broadly lacking in hard substrate, except where the substratum is exposed (e.g. Brown *et al*., 1998; Thanet Offshore Wind Limited, 2005). Sandbanks are known to form in places, with some reaching 40 m above the seabed, the area is considered to support 5.8% of the submerged sandbank habitat in Europe (Jones *et al*., 2004a) however these are outwith the proposed development area.

5.7.6 The study area is typical of the southern North Sea, comprising of coarse heterogeneous sediments, primarily sands, interspersed with coarser sediments (gravels) and some small areas of sandy muds and muddy sands (Figure 5.2).

5.7.7 The study area includes areas of sandbanks (specifically within the Margate and Long Sands Site of Community Importance (SCI)) and incorporates areas of shallow and deeper waters. The shallow waters are found to the north-west and south-west of the Thanet Extension development area, closer to shore and extending to the outer Thames Estuary. The deeper areas are found to the east and south of the development area where the seabed deepens towards the Dover Straits (Figure 5.3).

5.7.8 The mobile sand dominated habitats found in the southern North Sea are typically species poor and characterised by robust species such as annelids and fast burrowing bivalves (Jones *et al*., 2004b). The coarser sediments (sandy gravels and gravelly sands) are more stable and consequently the benthic habitats can become richer and support species such as brittlestars and sessile fauna such as ascidians and anemones. Studies at other wind farms in the region (Gunfleet Sands, Kentish Flats, London Array and TOWF) all report species poor, polychaete dominated communities, with the richest communities being associated with deeper water.

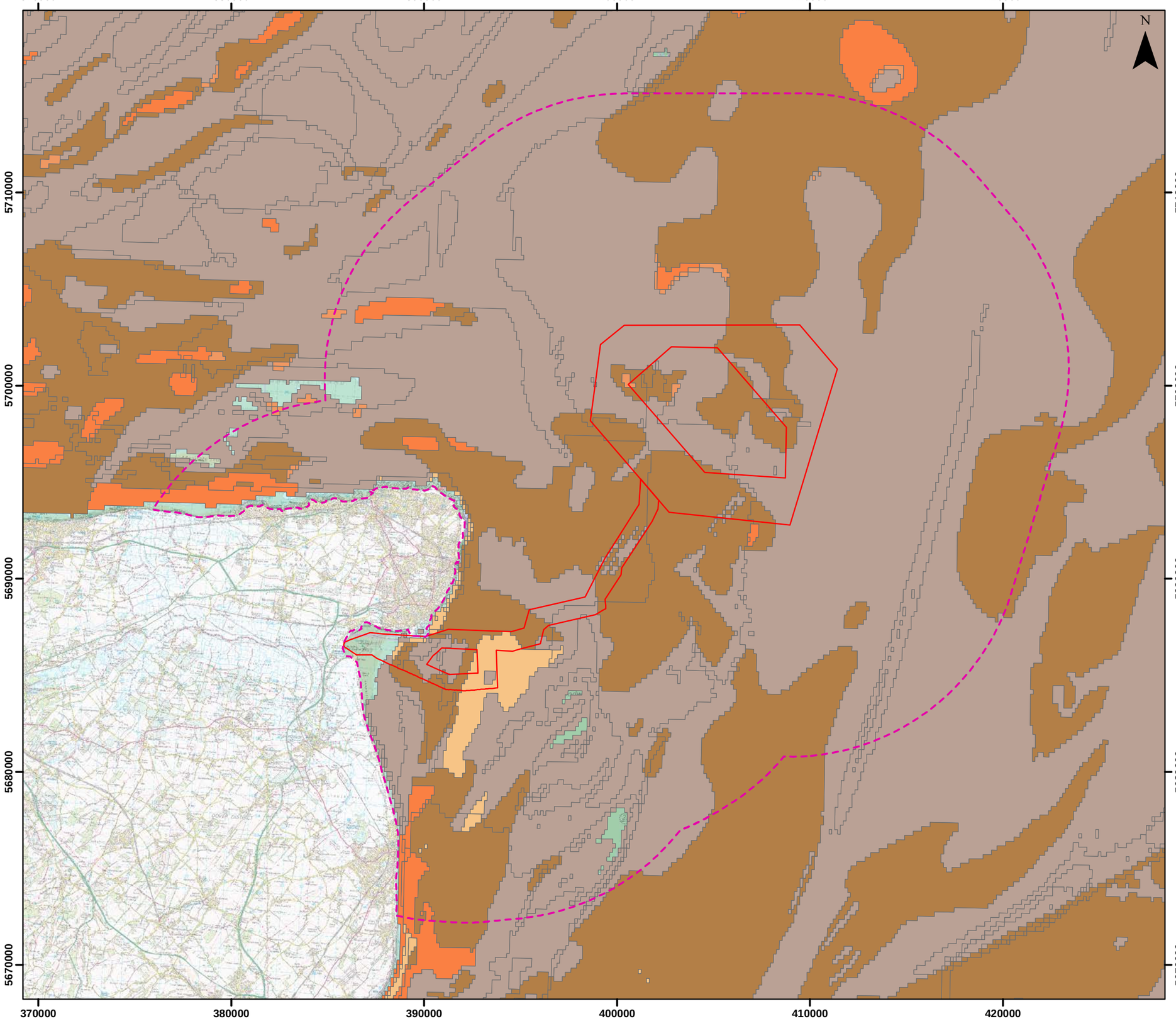
5.7.9 During the pre-construction surveys for TOWF, *Sabellaria spinulosa* reef features were recorded and are known to exist throughout the wider area (Thanet Offshore Wind Limited, 2005). The biogenic reef form of *S. spinulosa* is not however an obligate growth form and whilst *S. spinulosa* is present throughout the region it does not always take the biogenic reef form. Reef has been recorded to the north-east of Thanet Extension, within the Thames Estuary and recorded as being present within the TOWF and Thanet Extension development areas by fishermen working locally. Within the Thanet region *S. spinulosa* is recognised as forming ephemeral reef features that have limited longevity (Pearce *et al*., 2014), while regions such as The Wash are recognised to support longer lasting, more established reefs (Roberts *et al*., 2016). Within the TOWF array area however there appears to be a shift towards more established reef features, as identified by Pearce *et al.* (2014); the longevity of the reefs appearing to be associated with the TOWF project and therefore representing a potential beneficial effect, with these reefs also supporting an increased biodiversity compared to pre-construction reefs (Pearce *et al*., 2014).

The array

5.7.10 The sediments throughout the array site and wider study area are generally highly heterogeneous, although the site specific surveys showed that sediments in the south-west are relatively coarser, with finer, sandier sediments being found further offshore. Outcroppings of the underlying chalk bedrock occur in distinct locations to the north-west and south of the array area. A major reef structure (Drill Stone Reef) exists in the north-east of the site, with steep gradients at the edge of the reef of up to 30 degrees to the surrounding seabed (Figure 5.4). The reef stretches over approximately 3.5 km in west-north-west to east-south-east direction with a maximum width of approximately 1.3 km including a slightly detached part in the south-east. It has been suggested that Drill Stone Reef has been formed by *S. spinulosa* and surveys undertaken for TOWF identified *S. spinulosa* reef both inside and outside the TOWF array area on this structure. The characterisation surveys for Thanet Extension identified one area of 'low reefiness' on the far eastern edge of Drill Stone Reef only, with other areas of Drill Stone Reef considered to not contain reef. Further hummocky or rugged seabed areas were identified in the north-east sector of the survey area, generally coinciding with the chalk outcroppings, with only a thin veneer of mobile sediments. Large dunes were identified to the north-east, with gradients between 20 to 32 degrees.

5.7.11 The sediments within the array area of Thanet Extension follow the pattern of the sediments within TOWF, with finer sediments to the north and coarser sediments to the south, interspersed with rocky outcrops.

5.7.12 Bathymetry within the array area was determined from the geophysical surveys undertaken in 2016. Water depths throughout the survey area range between approximately 11.5 m below lowest astronomical tide (LAT) and 49 m LAT. Generally, the shallower areas are to the west and south-west, with deeper areas to the north-east and particularly the very east of the survey area, where the North Sea deepens as it approaches the English Channel (Figure 5.3 and Figure 5.4).



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THANET EXTENSION OFFSHORE WIND FARM

Figure 5.2
Broad Scale Seabed Sediment Distribution in the Study Area.

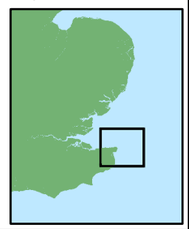
Legend

- Offshore Red Line Boundary
- Benthic Subtidal and Intertidal Study Area

Seabed Substrate

- Coarse sediment
- Fine mud
- Mixed sediment
- Mud to muddy sand
- Rock or other hard substrata
- Sand
- Sandy mud to muddy sand
- Seabed

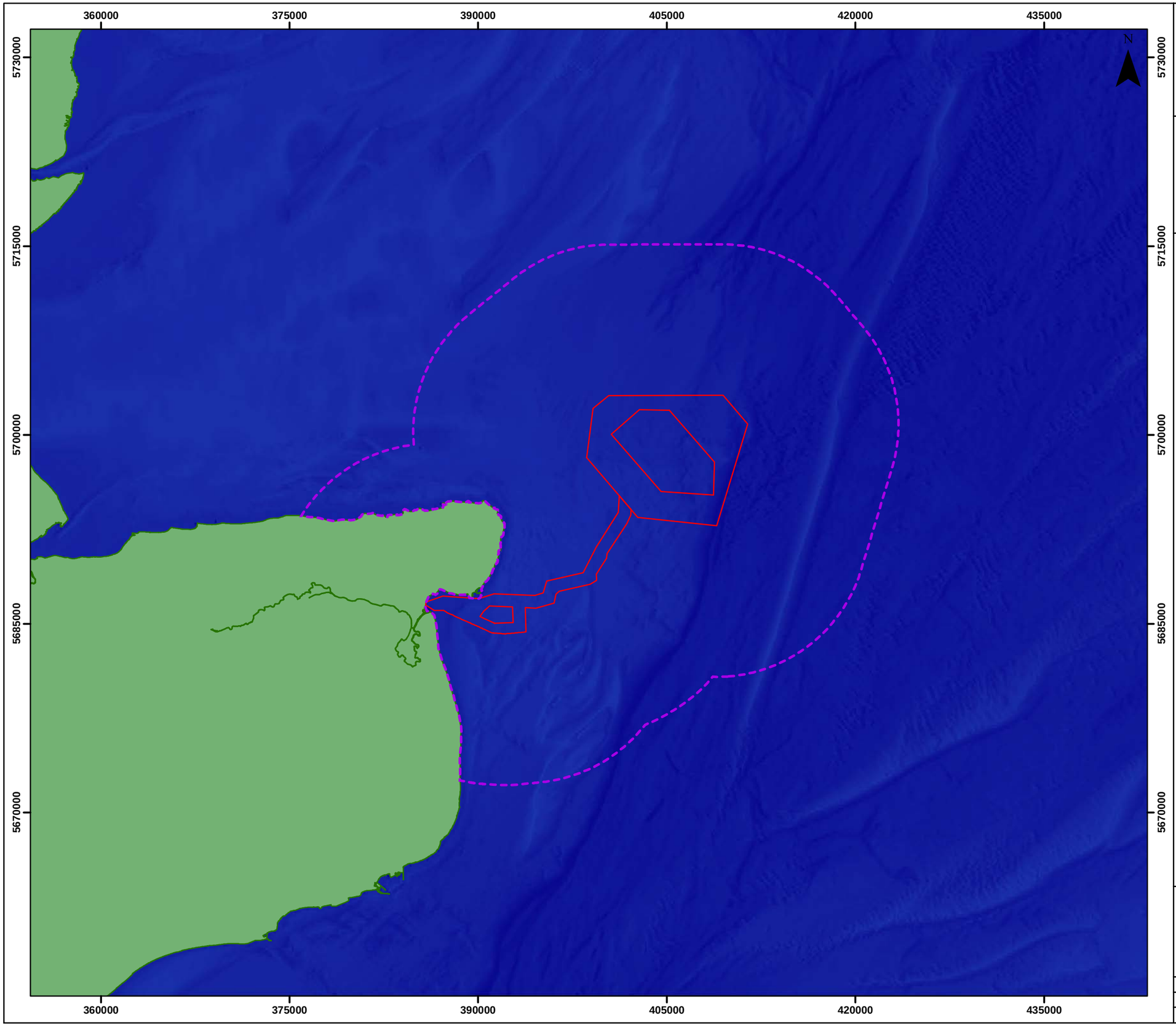
Datum: ETRS 1989
Projection: UTM31N



1:200,000 0 2 4 km 0 1 2 nm

Drg No	TEOW_Benthic_Fig.5.2		
Rev	0.1	Date	25/05/2018
By	PN	Layout	N/A

Figure 5.2



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THANET EXTENSION OFFSHORE WIND FARM

Figure 5.3
Broadscale Bathymetry in the Study Area and Wider Region.

Legend

- Offshore Red Line Boundary
- Benthic Subtidal and Intertidal Study Area

Datum: ETRS 1989
Projection: UTM31N

1:300,000 0 3 6 km 0 1.5 3 nm

Drg No	TEOW_Benthic_Fig.5.3		
Rev	0.1	Date	25/05/2018
By	PN	Layout	N/A

Figure 5.3

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THANET EXTENSION OFFSHORE WIND FARM

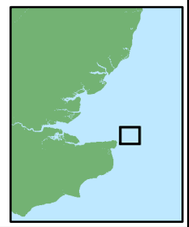
Figure 5.4
Pseudocolour Bathymetry of the Array Area.

Legend

Offshore Red Line Boundary

Pseudocolouring of this map has been used to increase the visbility of the bathymetry variations and identify those areas of harder substrate, rather than showing a true bathymetry scale[1].

Datum: ETRS 1989
Projection: UTM31N

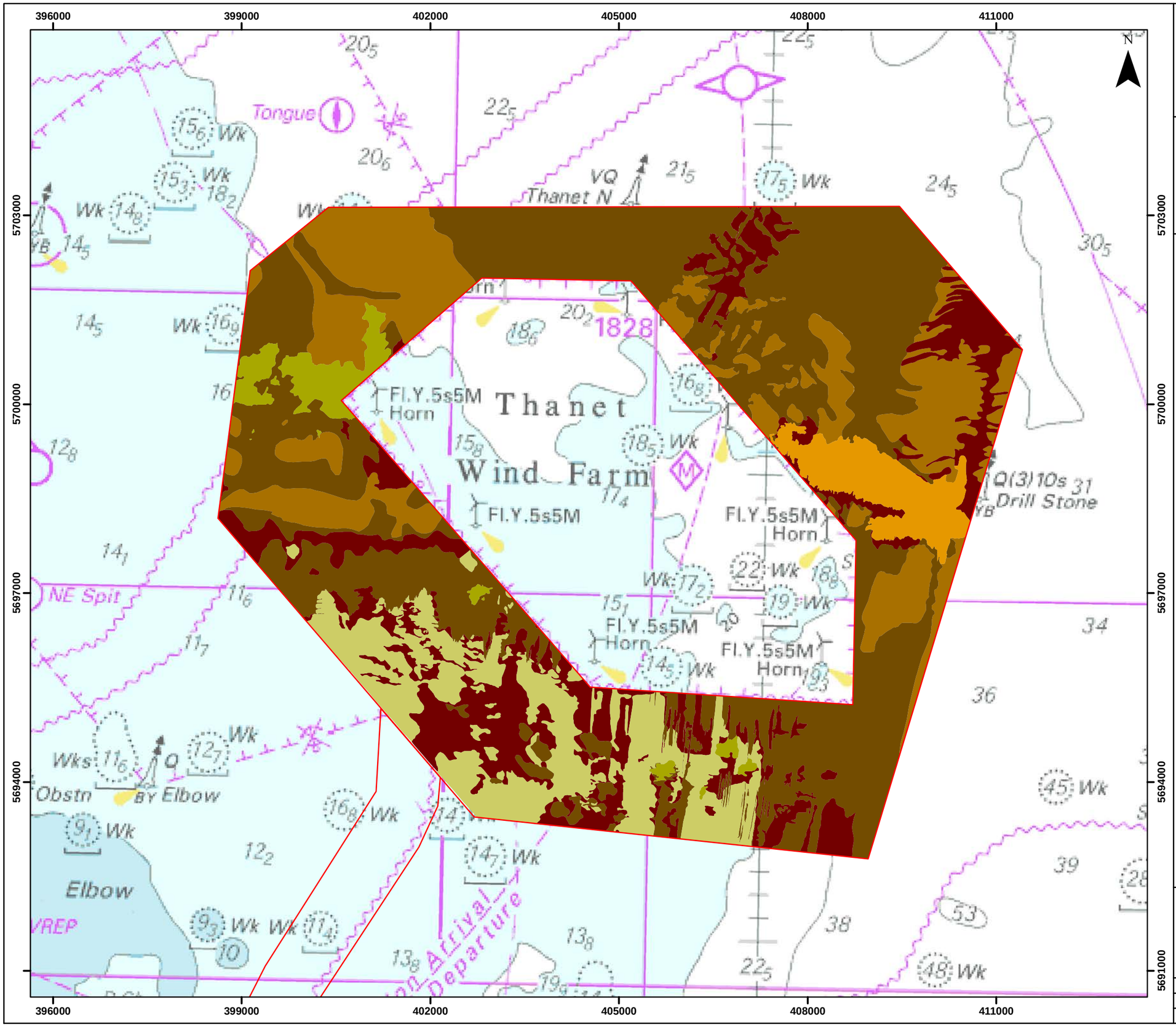


Note:
1. Data from the Thanet Extension Geophysical Survey conducted by Fugro Emu Ltd, July to September 2016.

1:60,000 0 0.65 1.3 km 0 0.35 0.7 nm

Drg No	TEOW_Benthic_Fig.5.4		
Rev	0.1	Date	25/05/2018
By	PN	Layout	N/A

Figure 5.4



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THANET EXTENSION OFFSHORE WIND FARM

Figure 5.5
Array Area Site Specific Sediment Distribution.

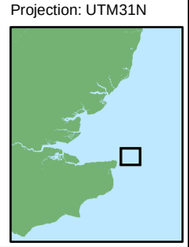
Legend

- Offshore Red Line Boundary

Sediment Classification[1]

- Outcrop
- 'Drill Stone' reef
- Clayey Sand
- Fine to Coarse Sand
- Gravelly Sand
- Sandy Gravel

Datum: ETRS 1989
Projection: UTM31N



Notes
[1] Data from the Thanet Extension Geophysical Survey conducted by Fugro Emu Ltd, July to September 2016

1:60,000 0 0.65 1.3 km 0 0.35 0.7 nm

Drg No	TEOW_Benthic_Fig.5.5		
Rev	0.1	Date	25/05/2018
By	PN	Layout	N/A

Figure 5.5

5.7.13 The sedimentary Principle Component Analysis (PCA), a statistical method of analysis which discerns patterns in the sediment samples to aid in the identification of the sediment type (detailed in Annex 5-1: Subtidal Benthic Technical Report (Document Ref: 6.4.5.1)) showed that there are three broad sediment types within the array area: sublittoral coarse sediment (SS.SCS), sublittoral sand (SS.SSa) and sublittoral mixed sediment (SS.SMx). The seabed was identified as having large areas of current-induced mobile bedforms and high sediment transfer between areas of the wind farm. This matches with the wider study area which predominantly comprises coarse heterogeneous sediments, dominated by sands (paragraph 5.7.6).

5.7.14 Metals analysis was carried out on samples collected at four locations within the array, with the sampling locations providing a broad coverage of the whole array area. The results of the metals analysis for the array samples showed that, with the exception of arsenic, concentrations of all metals within sediments were below both the Cefas alert level 1 (AL1) and the (more stringent) Canadian threshold effect level (TEL), and therefore below levels at which biological effects in benthic species could be expected. While arsenic levels within the array were above the Cefas AL1, Canadian TEL and the Clean Seas Environment Monitoring Programme[3] (CSEMP) effects range low (ERL) levels, it was below the Cefas Alert Level 2 (at which a more detailed assessment would be required prior to material of this nature being disposed of at sea i.e. may result in restrictions on sediment disposal), Canadian Probable Effect Level (PEL) and the CSEMP Effects Range Medium (ERM) levels.

5.7.15 Increased arsenic levels can be naturally occurring, resulting in some cases from remobilisation and erosion of arsenic rich rocks (Research Council of Norway, 2012), which vary naturally according to local geology. Anthropogenic sources of arsenic include mining and smelting (Research Council of Norway, 2012) and from burning of fossil fuels (ICES, 2004). Consequently, due to the high natural occurrences of arsenic it is often difficult to discern between natural and anthropogenic sources (OSPAR, 2005). Despite this difficulty, it is possible that the high levels of arsenic found in the outer Thames estuary, and the wider southern North Sea region, are associated with the historic dumping of arsenic waste in the Thames estuary (Whalley *et al*., 1999). However, the arsenic concentrations are within the range reported by Whalley *et al*. (1999) and as such are considered to represent background levels within the wider study area and region.

5.7.16 Hydrocarbon concentrations in the sediment were below the limit of detection at one of the four locations in the wind farm, with the concentrations at the other sites being below the Canadian marine sediment quality guidelines and are therefore unlikely to pose a threat to benthic ecology.

5.7.17 Levels of all organotins and polychlorinated biphenyls (PCBs) were below the limit of detection in all samples.

5.7.18 Characteristic of the region, turbidity levels were high during the video transects undertaken during the 2016 survey campaign and consequently habitat classifications from the video data is only possible to a high level. The video classification is however complemented by grab sample data which provides further detail on the sediment and infaunal community. Thirty video transects were undertaken within the array area, with 23 grab samples for biotope classification.

5.7.19 Three biotopes were identified in the array area from the video surveys: sublittoral sands and muddy sands (SS.SSa) was the dominant biotope, identified at 20 sites in the array survey area; circalittoral mixed sediment (SS.SMx.CMx) was the second most common biotope, with nine sites being observed as this biotope; and soft rock communities (CR.MCR. SfR) was identified at one site in the survey area (Figure 5.6). SS.SSa observed in this area was characterised by epibiota comprising of crustaceans, gastropods and echinoderms. SS.SMx.CMx is a naturally variable habitat and was reflected in the variety of communities identified, which included polychaetes, bivalves, echinoderms and burrowing anemones. CR.MCR.SfR featured chalk overlain with sediment and the epibiota included Actinaria (sea anemones).

5.7.20 The grab samples, while providing a more limited coverage of the array area than the video survey, enabled classification of the biotopes at each location, inclusive of the infaunal community (Figure 5.7). Grab samples were classified into biotope mosaics rather than individual biotopes due to the results showing characteristics of multiple biotopes. Four biotopes identified from the grab samples were: *Mysella bidentata* and *Thyasira* spp. in circalittoral muddy mixed sediment (SS.SMX.CMx.MysThyMx); *Sabellaria spinulosa* on stable circalittoral mixed sediment (SS.BSR.PoR.SspiMx); *Fabulina fabula* and *Magelona miribalis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand (SS.SSa.IMuSa.FfabMag); and *Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand (SS.SSa.IFiSa.NcirBat).

[3] https://www.bodc.ac.uk/projects/data_management/uk/merman/project_overview/

5.7.21 SS.SMX.CMx.MysThyMx was characterised as muddy sands and gravels in moderately exposed or sheltered, circalittoral habitats, containing bivalve species such as *Thyasira flexuosa* and *Mysella* (*Kurtiella*) *bidentata*. Infaunal species include (but is not limited to) the polychaetes *Lumbrineris gracillis*, *Chaetozone setosa* and *Scoloplops armiger* whilst amphipods of the genus *Ampelisca* may also be present. Epibiota identified included brittlestars and bryozoans.

THANET EXTENSION OFFSHORE WIND FARM

Figure 5.6
Broadscale Habitats Identified from the Seabed Video Footage.

Legend

- Offshore Red Line Boundary

Video Biotope[1]

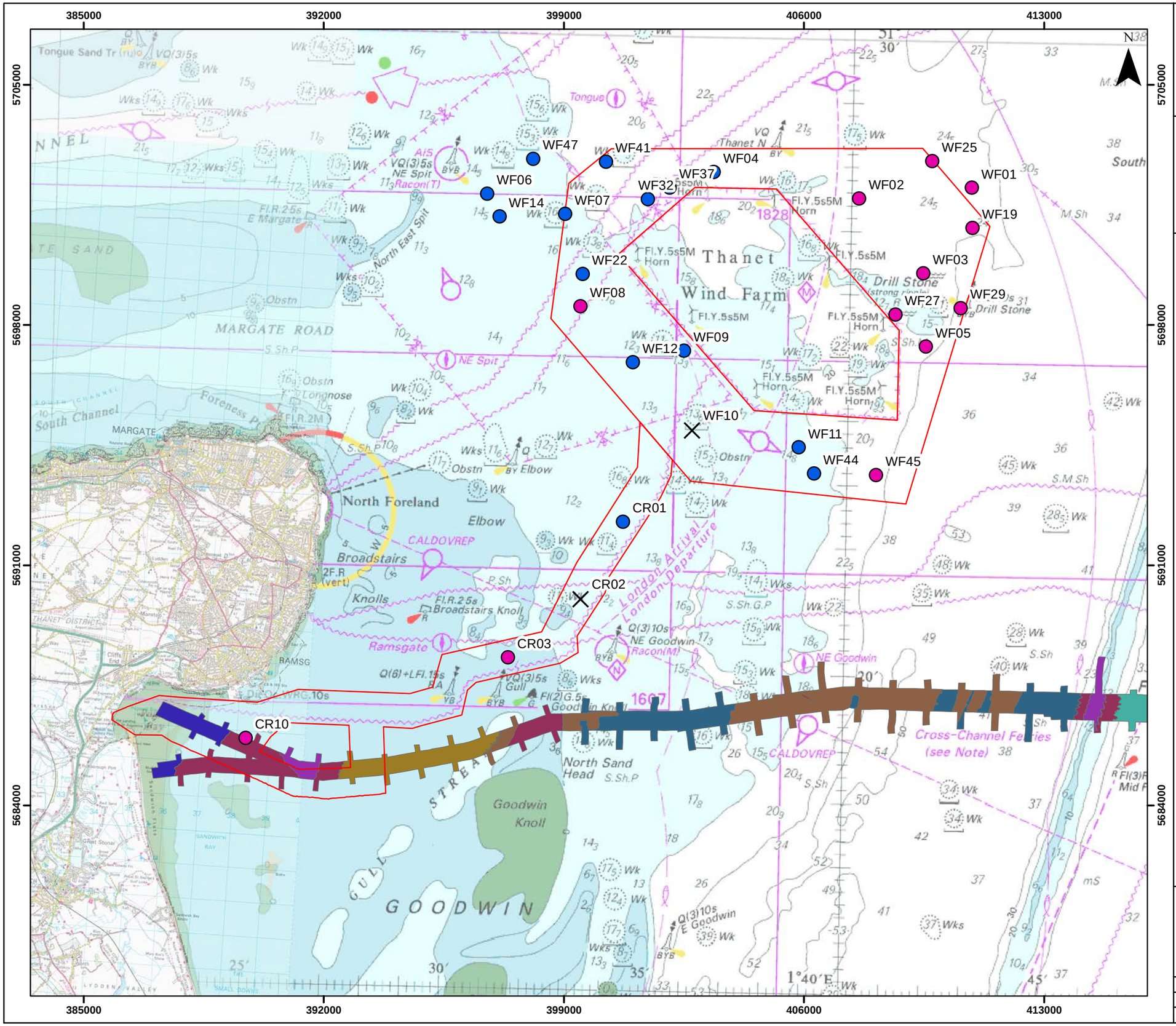
- CR.MCR.SfR
- No Data
- SS.SCS
- SS.SMx.CMx
- SS.SSa

Datum: ETRS 1989
Projection: UTM31N

Notes
[1] Data from the Thanet Extension Geophysical Survey conducted by Fugro Emu Ltd, July to September 2016

1:100,000 0 1 2 km 0 0.55 1.1 nm

Drg No	TEOW_Benthic_Fig.5.6			Figure 5.6
Rev	0.1	Date	25/05/2018	
By	PN	Layout	N/A	



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THANET EXTENSION OFFSHORE WIND FARM

Figure 5.7

Broadscale Habitats Identified from Grab Sample and Side-scan Sonar Data Analysis

Legend

- Offshore Red Line Boundary

Biotope[1]

- Combination of SS.SMx.CMx.MysThyMx and SS.SBR.PoR.SspiMx
- Combination of SS.Ssa.IMuSa.FfabMag and SS.Ssa.IFiSa.NcirBat
- No Data

Habitat Type (Nemo Interconnector, 2016)

- Circalittoral fine sand
- Infralittoral fine sand
- Infralittoral mixed sediments
- Infralittoral mobile clean sand with sparse fauna
- Infralittoral muddy sand
- [Branchiostoma lanceolatum] in circalittoral coarse sand with shell gravel
- Pomatoceros triqueter with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles
- [Sabellaria spinulosa] on stable circalittoral mixed sediment

Datum: WGS 1984
Projection: UTM31N

Notes
[1] Data from the Thanet Extension Geophysical Survey conducted by Fugro Emu Ltd, July to September 2016

1:110,000 0 1 2 km 0 0.6 1.2 nm

Drg No	TEOW_Benthic_Fig.5.7		
Rev	0.1	Date	08/06/2018
By	PN	Layout	N/A

Figure 5.7

5.7.22 SS.BSR.PoR.SspiMx was characterised as mixed sediment containing a high abundance of the tube-building polychaete *S. spinulosa* possibly forming a loose aggregation of tubes creating a low lying matrix of sand, gravel, mud and tubes on the seabed. The infauna comprised of: typical sublittoral polychaetes, including *Pholoe* spp., *Harmothoe* spp., and *Meddiomastus fragilis*; the bivalve *Abra alba*; tube building amphipods *Ampelisca* spp.; and calcareous tubeworms, hermit crabs and burrowing anemones.

5.7.23 SS.SSa.IMuSa.FfabMag was characterised by fine, compacted sands and slightly muddy sands, dominated by venerid bivalves and a high prevalence of *Fabulina fabula* and *Magelona* spp. Other commonly identified species were amphipods *Bathyporeia* spp. and polychaetes including *C. setosa*, *Spiophanes bombyx* and *Nephtys* spp.

5.7.24 SS.SSa.IFiSa.NcirBat was characterised by well-sorted medium to fine sand, containing *N. cirrosa* and amphipods such as *Bathyporeia* spp. in the shallow sublittoral to at least 30 m depth. The polychaete *M. mirabilis* may also be present in more sheltered, less tide-swept areas. Broadly, this biotope has a lower diversity than less disturbed biotopes and is generally dominated by free-swimming amphipods. Spionid polychaetes may also be present.

5.7.25 These four biotopes occurred in two groups, with SS.SMX.CMx.MysThyMx being found in combination with SS.BSR.PoR.SspiMx (Group A), while SS.SSa.IMuSa.FfabMag was found in combination with SS.SSa.IFiSa.NcirBat (Group B).

5.7.26 Group A was found predominantly to the west and south of the array area, while group B was found mainly in the north-east of the site, broadly following the sediment distribution patterns.

The offshore export cable corridor

5.7.27 The sediments throughout the OECC were generally heterogeneous, with a slight pattern in distribution of sediments being generally coarser offshore and finer closer to shore. Large sections of the seabed are broadly flat, with gradients of less than five degrees, with areas of dunes, outcrops and seabed ridges common throughout the OECC, with gradients of up to 35 degrees on some features. While these features are spread throughout the OECC, two distinct areas are particularly characterised by the presence of these features, one in the mid OECC region and the other in the nearshore section of the OECC (Figure 5.8).

5.7.28 Bathymetry within the area was determined from the geophysical surveys undertaken in 2016. Water depths along the OECC range from 18.0 m LAT to 0 m LAT at the landfall, with the deepest section at the meeting point of the OECC and the proposed array area and the seabed getting progressively shallower towards land.

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THANET EXTENSION OFFSHORE WIND FARM

Figure 5.8

Offshore Export Cable Corridor Site Specific Sediment Distribution.

Legend

- Offshore Red Line Boundary

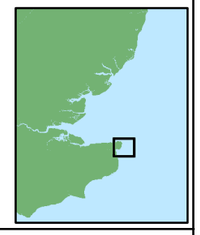
Sediment Classification (Fugro, 2016)

- Outcrop
- Clayey Sand
- Fine to Coarse Sand
- Gravelly Sand
- Sandy Gravel

Sediment Type (Nemo Interconnector, 2016)

- Clay Silt
- Gravel
- Sand
- Sand and Gravel

Datum: ETRS 1989
Projection: UTM31N



Notes
[1] Data from the Thanet Extension Geophysical Survey conducted by Fugro Emu Ltd, July to September 2016

1:63,360 0 0.65 1.3 km 0 0.35 0.7 nm

Drg No	TEOW_Benthic_Fig.5.8			**Figure 5.8**
Rev	0.1	Date	08/06/2018	
By	PN	Layout	N/A	

5.7.29 The PCA of the samples along the OECC identified two broad sediment types: SS.SCS and SS.SSa. The coarser sediments (SS.SCS) were found further offshore along the OECC, with the sandier sediments being found within the middle and near-shore sections of the OECC. Ripples and sand waves (i.e. dunes) were identified throughout the survey area, with the region closest to shore (where the survey swaths split) containing dunes potentially up to 8 m in height (range 0.1 – 8 m). The size of the dunes varies throughout the area, as does the wave length, ranging from 1 to 250 m. There is no single definable current direction forming the dunes, however it is assumed that tidal currents have a major role in their formation. The size and composition of the dunes suggests a low to moderate current within the region (0.5 - 1.0 ms^{-1}; Stow *et al*., 2009).

5.7.30 Metals analysis was undertaken of three samples within the OECC, spread evenly along the OECC. The results of the metals analysis for the OECC samples showed that, with the exception of arsenic, concentrations of all metals within sediments were below both the Cefas AL1 and the Canadian TEL, and therefore below levels at which biological effects in benthic species could be expected. While arsenic levels within the OECC were above the Cefas AL1, Canadian TEL and the CSEMP ERL levels, they were below the Cefas AL2, Canadian PEL and the CSEMP ERM levels.

5.7.31 Increased arsenic levels can be naturally occurring, resulting in some cases from remobilisation and erosion of arsenic rich rocks (Research Council of Norway, 2012), which vary naturally according to local geology. Anthropogenic sources of arsenic include mining and smelting (Research Council of Norway, 2012) and from burning of fossil fuels (ICES, 2004). Consequently, due to the high natural occurrences of arsenic it is often difficult to discern between natural and anthropogenic sources (OSPAR, 2005). Despite this difficulty, it is possible that the high levels of arsenic found in the outer Thames estuary, and the wider southern North Sea region, are associated with the historic dumping of arsenic waste in the Thames estuary (Whalley *et al*., 1999). However, the arsenic concentrations are within the range reported by Whalley *et al*. (1999) and as such are considered to represent background levels within the wider study area and region. Nine video transects were undertaken along the OECC, with visibility at eight sites being high enough to allow an assessment of the biotope to be determined. Seven of the assessed video transects fall within the revised proposed OECC (Figure 5.7). Five grab sample sites were targeted within the OECC, with a useable sample retrieved at four locations.

5.7.32 Three biotopes were identified along the OECC from the video surveys. Due to the low visibility at the time of the survey it was only possible to classify these to a relatively high level: SS.SMx.CMx was the most common biotope, identified at five locations; SS.SSA was the second most common biotope, identified at two locations; and SS.SCS identified at one location. SS.SMx.CMx is a naturally variable habitat and was reflected in the variety of communities identified, which included polychaetes, bivalves, echinoderms and burrowing anemones. SS.SSa observed in this area was characterised by epibiota comprising of crustaceans, gastropods and echinoderms. SS.SCS was characterised by robust fauna, which included in this case the sea star *Asteria rubens* and sea anemones (Actinaria).

5.7.33 The grab samples, while providing a more limited coverage of the area than the video survey, enabled classification of the biotopes at each location, inclusive of the infaunal community. The same four biotopes identified within the array area were identified in the OECC and were found in the same biotope matrix groupings as the array (SS.SMX.CMx.MysThyMx being found in combination with SS.BSR.PoR.SspiMx (Group A), while SS.SSa.IMuSa.FfabMag was found in combination with SS.SSa.IFiSa.NcirBat (Group B)). Group A was identified at one location in the OECC, closest to the array area, while Group B was found in the middle and near-shore sections of the OECC.

The intertidal export cable corridor

5.7.34 A total of four biotope complexes were identified at the landall location within Pegwell Bay: saltmarsh; polychaete/ amphipod-dominated fine sand shores (JNCC classification LS.LSa.FiSa); polychaete/ bivalve-dominated muddy sand shores (JNCC classification LS.LSa.MuSa); and *Cerastoserma edule* and polychaetes in littoral muddy sand (JNCC classification LS.LSa.MuSa.CerPo).

5.7.35 Rocky platforms comprised of wave-cut chalk outcroppings are found along the base of the chalk cliffs to the very north of the OECC (Pegwell Bay landfall option) and along the sea wall from Pegwell round to Ramsgate Harbour. Boulders are a common feature throughout this area and *M. edulis* is known to form reef structures on the chalk; while the *M. edulis* reef is not a component of the Sandwich Bay SAC, it is a protected habitat under the Natural Environment and Rural Communities 2006 (NERC) Act.

5.7.36 *C. edule* and polychaetes in littoral muddy sand was the biotope with the largest extent and was found across the mid and lower shore. Polychaete/ bivalve-dominated muddy sand shores was found across the upper shore, showing a clear zonation up the intertidal across the survey area and was the second most common biotope. Polychaete/ amphipod-dominated fine sand shores was present to the south of Pegwell Bay, adjacent to the River Stour in the mid and upper shore region. Saltmarsh was recorded across Pegwell Bay fringing the upper shore to the north east and south west of the hoverport. It was identified during the TOWF ES intertidal surveys that the saltmarsh to the north of the Stour was of lower quality.

5.7.37 It is also of note that recent monitoring surveys indicate that following the TOWF installation the saltmarsh feature reverted to its pre-construction status with no significant change being found after two years. Through discussion within the Evidence Plan (12th July 2017) it has also been confirmed that the saltmarsh is, in areas around the proposed landfall well established and as such less diverse than the patchier *Salicornia* saltmarsh to the north, in proximity to the hoverport.

Benthic features of conservation importance

5.7.38 During the benthic video surveys of the array and OECC (Figure 5.6), two locations within the array area were identified as potentially representing *S. spinulosa* reef and consequently were assessed for being biogenic reef as per the Gubbay (2007) guidelines. One station was assessed as being low potential for being *S. spinulosa* reef, while the second station was identified as not reef.

5.7.39 One station was assessed for potential geogenic reef, however, this site was identified to be not reef and was composed of exposed flat chalk outcrops, overlain by sand.

5.7.40 Pegwell Bay is known to support an unusual reef assemblage of *M. edulis* and *S. spinulosa* within the intertidal area and while the assemblage is not part of the designated features of the conservation sites in the region, reef features are protected as a NERC (BAP) habitat.

5.7.41 The Sandwich Bay SAC is designated for embryonic shifting dunes, 'white dunes', 'grey dunes' and dunes with *Salix repens* spp. *argentea*, which are found to the south of the Stour Estuary and outwith the northern landfall area.

5.7.42 Saltmarsh is not a feature of the SAC, however it is mentioned as a supporting habitat within the Thanet Coast and Sandwich Bay SPA/ Ramsar and is also a feature of the Sandwich Bay to Hacklinge Marshes SSSI.

5.7.43 Mudflats are not designated within the Natura 2000 sites, however are a feature of the SSSI. The impacts on the mudflats are assessed within the main assessment through knowledge of the intertidal biotopes present within the area and the assessment of the effects on the biotope(s).

5.7.44 The OECC no longer passes through the Thanet Coast MCZ but does pass through the Goodwin Sands rMCZ. The characterisation surveys of the area inclusive of the Thanet Coast MCZ did not identify any of these features within the cable corridor, with areas of subtidal chalk being identified but lacking the necessary elevation to be clearly exposed and the epifaunal community to qualify as reef, and areas of *S. spinulosa* having low 'reefiness'. A full assessment of the impacts of this site is provided in Volume 4, Annex 8-1: Marine Conservation Zones Assessment (Document Ref: 6.4.8.1). The Goodwin Sands rMCZ has been recommended to protect: moderate energy infralittoral rock; moderate energy circalittoral rock; subtidal coarse sediment; subtidal sand; blue mussel beds; rossworm reef (*S. spinulosa*); and Eastern English Channel outburst flood features. The characterisation surveys identified that the only features of the rMCZ that are present within the OECC where it passes through the rMCZ are subtidal coarse sediment and subtidal sands.

Table 5.9: Valued Ecological Receptors (VERs) within the Thanet Extension benthic ecology study area, their conservation status and importance

Habitat summary	Representative biotope	Protection status	Conservation status	Justification and regional importance
Sandy sediments with low infaunal diversity and sparse epibenthic communities	NcirBat, FfabMag	None	UK BAP priority habitat,	Regional – UK BAP with regional distribution from outer Humber to Thames region.
Coarse and mixed sediments with moderate to high infaunal diversity and scour tolerant epibenthic communities	MysThyMx	None	UK BAP priority habitat.	Regional – although this habitat is representative of a nationally important marine habitat, the southern North Sea is not a key geographic area.
Mixed sediments with high infaunal and epifaunal diversity	SspiMx	None	N/A.	Regional - habitats or species that provide important prey items for other species of conservation or commercial value.
'Sandbanks' within an SAC/ SCI	N/ A	Annex I Habitats Directive	Annex I 'Sandbanks which are slightly covered by seawater all the time' within an SAC. UK BAP priority habitat.	International – part of European designated sites (Margate and Long Sands SCI).
Subtidal biogenic reefs	N/ A	MCZ	Protected feature within the Thanet Coast MCZ. UK BAP priority habitat.	National – included as a protected feature of the Thanet Coast MCZ.
Subtidal chalk reefs	N/ A	Annex I Habitats Directive MCZ	Annex I 'Reefs' within an SAC. UK BAP priority habitat. Protected feature within the Thanet Coast MCZ.	International – part of European designated sites (Thanet Coast SAC).
Intertidal mudflats	MacAre	SSSI	Protected feature within the Sandwich Bay to Hacklinge Marshes SSSI. UK BAP Priority Habitat.	National – included as a protected feature of the Sandwich Bay to Hacklinge Marshes SSSI.

5.8 Key parameters for assessment

5.8.1 The Thanet Extension application is for the construction, O&M and decommissioning of an OWF with a capacity of up to 340 megawatts (MW), comprising of up to 34 WTGs, with capacities ranging from 8 to 12 MW, as described in Volume 2, Chapter 1: Project Description – Offshore (Document Ref: 6.2.1). Subject to final design it is possible that an alternative, larger capacity, WTG (i.e. >12 MW) type may be selected. In this scenario the overall project capacity will remain at 340 MW and the physical parameters such as maximum blade tip height, rotor diameter, and height of nacelle will remain within the maximum envelope described in this chapter and subsequent technical assessment chapters. The maximum adverse scenarios assessed for each of the impacts on benthic and intertidal ecology during construction, O&M and decommissioning phases are presented in Table 5.10.

5.8.2 The assessment scenarios identified within Table 5.10 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. These scenarios have been selected from the details provided within the project description (Volume 2, Chapter 1: Project Description – Offshore (Document Ref: 6.2.1)) as representing the 'worst-case' scenario. Effects of greater adverse significance are not predicted to arise should any other development scenario (e.g. different foundation type, WTG layout or cable installation method), based on details within the project Design Envelope to that assessed here be taken forward in the final design scheme.

5.8.3 As a result of the evolving design process for the project, it has become apparent that in order to ensure mitigation against the potential release of leachate from the historic landfill at Pegwell Bay, a cofferdam may berequired during construction. The cofferdam will be required where the seawall is either opened or extended depending on the outcome of site investigations and the final design for the onshore infrastructure. The impacts of the temporary installation of the cofferdam have been assessed in section 5.10.

Impacts scoped out of the assessment

5.8.4 On the basis of the baseline environment and the project description outlined in Volume 2, Chapter 1: Project Description – Offshore (Document Ref: 6.2.1), the impacts of operational noise have been agreed to be scoped out of the assessment for benthic subtidal and intertidal ecology (Table 5.5).

Table 5.10: Maximum design scenario assessed

Potential effect	Maximum design scenario assessed	Justification
Construction		
Direct disturbance within the subtidal arising from jack-up vessel operations	For up to 34 WTGs, one Offshore Substation (OSS) and one meteorological mast (assuming six 'legs' per vessel and two jack up operations per WTG/ OSS/ met mast foundataion installation; disturbance of 471.24 m^2 per operation x 36 x 2 = 33,929 m^2). For up to 34 WTGs, one Offshore Substation (OSS) and one meteorological mast (six anchors per foundation installation) operations per WTG/ OSS/ met mast foundataion installation; disturbance of 150 m^2 per operation x 36 = 5,400 m^2). Temporary direct habitat disturbance = 39,329 m^2.	The maximum adverse scenario is associated with HVAC transmission in the 34 WTG (8 MW or 10 MW) scenario as this provides up to 36 foundations (including the OSS and met mast), resulting in the highest number of jack-vessel operations.
Direct disturbance within the subtidal arising from cable installation	Temporary habitat disturbance of: • 64,000 m^2 from burial of 64 km of inter-array cables, by ploughing (10 m disturbance corridor); • 30,600 m^2 from cable barge anchor placement associated with cable laying for inter-array cables – six anchors (footprint per anchor of 10 m^2) with 15 anchoring operations per installation (6 x 10 m^2 x 15 x 34 inter-array cables = 30,600 m^2); • 1,440,000 m^2 from burial of 120 km of export cables (4 x 12 m width trenches of 30 km length) by ploughing • 48,000 m^2 from cable pre-sweeping (dredging) (24 km x 20 m); and • 34,560 m^2 from cable barge anchor placement associated with cable laying for export cables - six anchors (footprint of 10 m^2) (6 x 10 m^2 x 144 operations per installation x 4 export cables = 34,560 m^2).	The maximum adverse scenario is associated with HVAC transmission in the 34 WTG scenario as this includes the longest length of inter-array cables and the highest number of export cables, resulting in the greatest temporary habitat loss. The installation method with the largest area of disturbance is ploughing with a 12 m wide footprint.
Direct disturbance to subtidal potential habitats of conservation importance (HOCI) habitat during cable installation	*S. spinulosa* reef is known to be present within the region, including inside the existing TOWF array area and has the potential to form within the Thanet Extension proposed array area prior to construction.	The maximum adverse scenario is associated with the installation of up to four export cables and inter-array cables for up to 34 WTGs.
Direct disturbance to the intertidal from cable installation operations, including in the saltmarsh	Four cable trenches will be installed across the intertidal, between MLWS and the edge of the saltmarsh. Trench width will be up to 10 m wide (28 m including spoil, based on a 30 degree slope), with burial up to 3 m below the seabed. Each cable will be separated by 5 m. A temporary access track of 6 m will also be utilised.	The maximum adverse scenario for construction is associated with open-cut trenching through the intertidal and through the saltmarsh and the use of a cofferdam.

Potential effect	Maximum design scenario assessed	Justification
	Four trenches will be installed through the saltmarsh. Trenches will be 1 m wide, with 5 m either side to be used for vehicle movement and spoil. This will result in a maximum width of shoreline of 80 m. through the saltmarsh for a length of approximately 50 – 80 m. A cofferdam will be installed around the section of sea wall that is being extended or opened for cable installation. The cofferdam will be 165 m wide and 25 in length. The cofferdam and cable trench area will result in construction space in the saltmarsh totalling 7,376 m^2.	
Indirect disturbance from increased suspended sediment concentrations (SSC) and associated sediment deposition arising from foundation installation and seabed preparation and cable installation	Temporary increases in suspended sediment concentrations and sediment deposition as a result of: • The installation of 30 suction caissons and associated seabed preparation works (seabed preparation volume per foundation = 9,600m^3), resulting in 288,000 m^3 of sediment dredged and deposited at the surface; • Installation of 64 km of inter-array cable by jetting, to a depth of 3 m resulting in 96,000 m^3 of sediment being displaced (v- shaped trench, width of 1 m and 50% of sediment in the trench being liquidised; 64,000 m x 1 m x 3 m x 0.5 x 50%= 48,000 m^3); • Installation of 120 km of export cable by jetting, to a maximum depth of 3 m resulting in 1,740,000 m^3 of sediment displaced (v- shaped trench, width of 10 m and 50% of sediment being liquidised; 120,000 m x 10 m x 3 m x 0.5 x 50% = 900,000 m^3); and • Pre-sweeping, using a dredger, of 6 km of each export cable route for the purposes of sandwave clearance with all sediment disposed of in the water column along the cable route (1,440,000 m^3).	The maximum adverse scenario for foundation installation is the suction caisson jacket foundations for the 12 MW WTGs which would comprise 20 m diameter buckets (compared to 15 m buckets for the 8 or 10 MW WTGs). The increased diameter of the suction cassions results in the largest spoil volume for seabed preparation works. Drill arisings would not be produced for suction cassions, however, the volume of sediment produced from the use of suction caissions is higher than any other scenario. Of the methods proposed for inter-array and export cable installation, jetting results in the greatest volume of sediment dispersed as it is assumed that 100% of the sediment is liquidised, whereas for any other method less sediment would be suspended. Predicted increases in suspended sediment and sediment deposition assumes the greatest number and length of cables and the greatest burial depth.
Indirect disturbance from increased noise and vibration from construction activities	Installation of 36 monopiles (34 WTGs, one OSS and one met mast) using percussive piling at the maximum hammer energy of 5,000 kJ.	The maximum adverse scenario for foundation installation is the monopile foundations for the 8 MW or 10 MW WTGs as the monopile installation may require a hammer energy up to 5,000 kJ, and while the pin-pile jacket foundation would involve more piles and consequently a longer piling time, but a lower maximum hammer energy. Therefore, the largest noise and vibration impacts arises from the installation of the monopiles.
Indirect disturbance from increased SSC and sediment deposition in the intertidal	Installation of up to four export cables within the intertidal of 2 km per cable. Assumes a 10 m trench per cable with a maximum of 80,000 m^2 of sediment positioned to the side of the trench.	This scenario represents the maximum footprint as it represents the maximum footprint from four cables.

Potential effect	Maximum design scenario assessed	Justification
Direct and indirect seabed disturbances leading to the release of sediment contaminants	Seabed disturbance arising from installation of foundations and cables as described above for temporary increases in suspended sediments.	This scenario presents the maximum total seabed disturbance and therefore the maximum amount of contaminated sediment that may be released into the water column during construction activities.
Indirect disturbance arising from the accidental release of pollutants	Synthetic compound, heavy metal and hydrocarbon contamination resulting from offshore infrastructure installation and a maximum of 1,160 round trips to port by construction vessels over the construction period. Water-based drilling muds associated with drilling to install foundations, should this be required. Potential contamination of intertidal habitats resulting from machinery use and vehicle movement.	These parameters are considered to represent the maximum adverse scenario with regards to vessel movement during construction.
O&M		
Habitat loss of seabed habitat through presence of foundations, scour protection and cable protection	The maximum adverse scenario for long-term habitat loss also includes the use of cable protection (i.e. rock placement or concrete mattresses) along 25% of the export cable (30,000 m x 7 m = 210,000 m^2). Up to 80,000 m^2 export cable crossings. Up to 1,256 m^2 per foundation footprint for the 12 MW WTGs (area of 20 m diameter buckets x four legs), one OSS and one met mast on quadropod suction bucket foundations (30 x 1,256m^2 = 37,680 m^2). A further 7,854 m^2 area is predicted to be lost per foundation to prevent scour protection for the 28 WTGs (12 MW), one OSS and one met mast (7,854 m^2 x 30 foundations = 235,620 m^2). 80,000 m^2 inter-array cable protection for unburied cable (25% of the maximum 64 km), 12,000 m^2 array cable crossings, and 17,500 m^2 for inter-array cable protection approaching turbine foundations (50 m x 5 m x 70 (2 x 35 (foundation number (excluding the met mast))). Long-term total habitat loss of: 0.68 km^2.	The maximum adverse scenario is associated with the use of piled quadropod jackets for the 12 MW WTGs (each pile has a 4 m diameter and consequently, the area of seabed affected is greater even though this only includes 28 WTGs) and HVAC transmission as this includes the construction of an OSS. This also considers that scour protection is required for all foundations (including the met mast).
Direct introduction and subsequent colonisation of hard substrate (scour protection/ cable protection) may affect benthic ecology and biodiversity	Total area of introduced hard substrate: 0.68 km^2.	Maximum scenario for introduced hard substrate is as for the maximum scenario for loss of habitat.
Permanent loss of saltmarsh habitat at landfall	Permanent loss of saltmarsh from an extension of the seawall seawards of a curved structure (155 x 18.5 m) for worst-case this will result in loss of 0.0014 km^2 loss of saltmarsh habitat (which	Maximum scenario for loss of saltmarsh is for onshore infrastructure in Pegwell Country Park to be above ground and this requires the change to the shape of the seawall.

Potential effect	Maximum design scenario assessed	Justification
	represents 0.13% of the saltmarsh present within the SAC – noting that this is the smallest designated site at Pegwell Bay and therefore representing the worst-case in terms of percentage habitat lost).	
Direct and indirect disturbance to the seabed arising from maintenance operations (use of jack-up vessels, inspection of cables and foundations, repair of subtidal cables)	Temporary habitat loss/ disturbance from up to 342 jack-up visits over the 30[4] year lifetime of the project. Preventative maintenance of subsea cables including routine inspections to ensure the cable is buried to an adequate depth and not exposed. The integrity of the cable and cable protection system (i.e. bending restrictors and bend stiffeners where used) will also be inspected. Maintenance works to rebury/ replace and carry out repair works on subsea cables should this be required and the associated increase in SSC and sediment deposition arising from these repair and replacement works. No substantive maintenance work is expected to be required to the intertidal cables. Temporary disturbance in the intertidal from periodic preventative maintenance work, including geophysical investigations. The most likely scenario is that there would be planned yearly inspections of all cables within the intertidal, combined with 'unscheduled' inspections following extreme events (e.g. large storm events). The inspections are likely to comprise two or three persons accessing the intertidal on foot or small 4WD vehicle (use of low pressure vehicles such as an ARGO Cat or the use of hovercraft will also be considered) for a duration of approximately two to three weeks.	The described parameters are considered to represent the likely maximum adverse scenario for the requirement for jack-up barge operations per WTGs over the lifetime of the wind farm. No substantive maintenance works on the export cables at the cable route landfall site is anticipated, with access only required for the detailed surveys and inspections. While the burial depth of the cables will be designed so that they remain buried for the lifetime of the project, erosion or natural process may cause the cables to be exposed. If any cables are required to be re-buried, the most appropriate method will be determined at that stage, however will be no more intrusive than those used during construction.
Indirect disturbance arising from electromagnetic fields generated by the current flowing through the cables buried to less than 1.5 m below the surface.	Up to 64 km of inter-array cable connecting 34 WTGs operating at 66 kilovolts (kV) and up to 120 km of export cable (four cables of up to 30 km length each) operating at up to 220 kV buried less than 1.5 m below the surface.	The maximum adverse scenario is associated with the use of 34 WTGs as this results in the greatest length of inter-array cable and four export cables as this results in the longest total length of export cable.
Indirect disturbance leading to alterations of seabed habitats arising from scour effects and changes in the sediment and wave regime plus that of the turbid wakes arising from the presence of the WTGs	The greatest changes to the tidal and wave regimes and the sediment transport in the array arise from the use of the 12 MW suction bucket caisson foundations and the use of the maximum volume of cable protection and 80 cable crossings, using concrete mattresses.	The 12 MW WTGs on suction caisson foundations represents the greatest total in-water column blockage to currents, waves and sediment transport processes. Full justification of the worst-case scenarios can be found within the Marine Geology, Oceanography and Physical Processes Technical Annex (Document Ref: 6.4.2.1).

[4] The operational life is expected to be 30 years, although may be extended as the project nears decommissioning, as technology/ maintenance improves

Potential effect	Maximum design scenario assessed	Justification
	Scour effects are assessed within the Marine Geology, Oceanography and Physical Processes Technical Annex (Document Ref: 6.4.2.1).	
Indirect disturbance arising from the accidental release of pollutants	Synthetic compound, heavy metal and hydrocarbon contamination resulting from up to 34 WTGs, one OSS and one met mast. Accidental pollution may also result from up to 307 round-trips to port by operations and maintenance vessels (including crew supply vessels and jack-up vessels) per year over the 30-year design lifetime. A typical 12 MW WTG is expected to contain approximately 2,000 litres of grease, 2,000 litres of synthetic or hydraulic oil, 200 litres of liquid nitrogen, 2,000 kg of silicone oil and 100 kg SF6 gas. The OSS is expected to contain approximately 200,000 litres of diesel, 1,000 litres of grey water, 1,000 litres of black water, 600,000 litres of transformer coolant water, 20,000 litres of fire suppressant material, 1,500 kg of SF6, 5 m^3 of engine oil and 5 m^3 of HVAC coolant (glycol).	These parameters are considered to represent the maximum adverse scenario with regards to vessel movement during the operational period.
Decommissioning		
Direct disturbance due to operations to remove foundations, inter-array cables, export cables (including use of jack-up vessels)	Total subtidal temporary habitat loss = 556,071.6 m^2; and Total intertidal temporary habitat loss = 80,000 m^2. Assuming disturbance from cable removal results in 3 m wide disturbances and one jack-up vessel operation is required for the removal of each piece of wind farm infrastructure (i.e. each WTG or the OSS. Export cable disturbance: 120 km x 3 m = 360,000 m^2 (0.360 km^2). Inter-array cable disturbance: 64 km x 1 m = 64,000 m^2 (0.0.064 km^2). Jack-up vessel footprint: 113.1 m^2 per jack-up operation x 36 (34 WTGs, one OSS and one met mast) = 4,071.6 m^2.	Maximum adverse scenario as per the construction phase (34 WTGs and one OSS and up to 184 km of cable) and assumes the removal of all foundations and buried subtidal and intertidal cables. Piled foundations would be removed to two metres below the seabed. The removal of the cables is considered to be the worst-case, however, the necessity to remove cables will be reviewed at the time, after consideration of the environmental impact of the removal operation and the safety of the cables left *in situ*.
Indirect disturbance from increased SSC and associated sediment deposition from removal of foundations, inter-array cables and export cables	Increases in suspended sediment and associated sediment deposition from the removal of up to 36 foundations (i.e. 34 WTGs, one OSS and one met mast) and 184 km of inter-array and export cable.	Maximum adverse scenario as per the construction phase and assumes the removal of all foundations and buried subtidal and intertidal cables.
Direct and indirect seabed disturbances leading to the release of sediment contaminants	As above for construction impacts.	This scenario represents the maximum total seabed disturbance and therefore the maximum amount of contaminated sediment that may be released into the water column. Maximum adverse scenario as per the construction phase and assumes the removal of all foundations and buried subtidal and intertidal cables.

Potential effect	Maximum design scenario assessed	Justification
Direct loss of species and habitats from the removal of foundations	Maximum surface area of 1,257 m^2 per foundation provided by suction bucket foundations for 28 WTGs, one OSS and one met mast.	Maximum adverse scenario for introduction of hard substrate as per the O&M phase but assuming that foundations will be removed although scour and cable protection will be left *in situ*.
Direct permanent loss of habitat due to presence of scour and cable protection left *in situ* post-decommissioning	Permanent habitat loss of: 0.68 km^2.	Maximum adverse scenario for long-term habitat loss as per the O&M phase but assuming that foundations will be removed although scour and cable protection will be left *in situ*. 7,854 m^2 area is predicted to be lost per foundation to prevent scour protection for the 12 MW WTG with a total of 235,620 m^2 for the 28 WTGs, one OSS and one met mast with a further 17,500 m^2 for j-tube protection, 80,000 m^2 inter-array cable protection for unburied cable (25% of the maximum 64 km), 12,000 m^2 for array cable crossings, 80,000 m^2 for export cable crossings, and 210,000 m^2 for unburied export cable.
Indirect disturbance arising from the accidental release of pollutants	Synthetic compound, heavy metal and hydrocarbon contamination resulting from the installation of a maximum of 34 WTGs, one OSS and one met mast, and decommissioning over the decommissioning period. Potential contamination in the intertidal resulting from machinery use and vehicle movement.	Maximum adverse scenario as per construction phase.
Cumulative effects		
Addressed in Cumulative Effects, section 5.13.		

5.9 Embedded mitigation

5.9.1 Mitigation measures that were identified and adopted into the project design through the evolution of the project design (embedded) and that are relevant to the benthic and intertidal ecology are listed in Table 5.11. These measures are considered standard industry practice for this type of development. Mitigation measures that would apply to any benthic and intertidal ecology issues associated with the development specifically are described separately in section 5.15.

Table 5.11: Embedded mitigation relating to Benthic and Intertidal Ecology

Parameter	Mitigation measures embedded into the project design
General	
Definition of development boundaries	The development boundary selection was made following a series of constraints analyses, with the array area and OECC route selected to ensure the impacts on sensitive environmental receptors are minimised.
Construction	
Direct impacts on benthic habitats of conservation importance (HOCIs)	Although HOCIs have not been identified in the baseline surveys, they have been identified during the TOWF pre- and post-construction surveys and are known to be present in this area. Therefore, pre-construction surveys will be undertaken to identify any areas of core reef, which will then be microsited around to avoid impacts. An In Principle Biogenic Reef Mitigation Plan (Document Ref: 8.15) forms part of this DCO application and will be agreed with the relevant stakeholders prior to construction. An Ecological Clerk of Works (ECoW) will oversee the construction works in the intertidal area to ensure that impacts do not exceed those described within this assessment. A Phase 1 walkover survey will also be undertaken of the intertidal area prior to construction to provide an up-to-date assessment and delineation of sensitive habitats present and ensure that impacts to the intertidal area do not exceed those within this assessment. This will feed into the Saltmarsh Mitigation and Reinstatement Plan (Document Reference 8.13) that is being submitted as part of the DCO application.
Pollution prevention	A Project Environment Management Plan (PEMP) will be produced and followed to cover the construction and O&M phases of Thanet Extension. The PEMP will incorporate plans to cover accidental spills, potential contaminant release and include key emergency contact details (e.g. MMO, MCA and the project site coordinator). A Decommissioning Programme will be developed to cover the decommissioning phase. Typical measures will include: only using chemicals approved by Cefas under the Offshore Chemicals Regulations 2002; storage of all chemicals in secure designated areas with impermeable bunding (generally to 110% of the volume); and double skinning of pipes and tanks containing hazardous materials. The purpose of these measures ensure that potential for contaminant release is strictly controlled and therefore provides protection to marine life across all phases of the life of the wind farm.
O&M	
EMF	Inter-array and export cables will be buried to a maximum target depth of 3 m, subject to a cable burial risk assessment. Where it is not possible to bury the cables sufficiently, cable protection will be used. While cable protection or burial does not decrease the strength of EMF at source, it does increase the distance between the cables and benthic receptors, thereby reducing the received EMF (from attenuation of the EMF) and potentially reducing the effect on those receptors.

5.10 Environmental assessment: construction phase

5.10.1 The effects of construction of Thanet Extension have been assessed on benthic and intertidal ecology in the Thanet Extension benthic ecology study area. The environmental impacts arising from construction of Thanet Extension are listed in Table 5.10, along with the Design Envelope against which each construction phase impact has been assessed.

5.10.2 A description of the significance of effect upon benthic and intertidal receptors caused by each identified impact is provided below.

Temporary habitat disturbance from construction operations

5.10.3 Direct temporary loss/ disturbance of subtidal habitat within the Thanet Extension project area will occur as a result of jack-up barge operations to install foundations, the burial of inter-array, and export cables and the anchor placements associated with these operations.

5.10.4 The total maximum area of temporary subtidal habitat loss due to construction activities described in Table 5.10 is predicted to be approximately 1.62 km^2. This equates to 0.13% of the total seabed area within the wider Thanet Extension benthic ecology study area (1230.5 km^2). Activities resulting in the temporary habitat loss of both subtidal and intertidal habitats will occur intermittently throughout the construction period.

5.10.5 Of the total area of temporary habitat loss described in Table 5.10, a maximum of 133,929 m^2 (0.134 km^2) is predicted to be temporarily lost/ disturbed within the Thanet Extension array as a result of jack-up barge operations and burial of inter-array cables (including associated anchor placements). This equates to 0.01% of the total seabed area within the wider Thanet Extension benthic ecology study area. The maximum design scenario for each habitat/ valued ecological receptor affected by temporary habitat loss is estimated based on a scenario of all this loss occurring wholly within the dominant habitats (sandy and coarse sediments with low infaunal diversity and sparse epibenthic communities). This would equate to approximately 0.01% of the habitat within the Thanet Extension benthic ecology study area (sandy and coarse sediment habitats represent 98.45% of the Thanet Extension benthic study area).

5.10.6 Of the total temporary habitat loss/ disturbance described in Table 5.10, a maximum of 1,490,400 m^2 (1.49 km^2) will be temporarily disturbed within the subtidal areas of the Thanet Extension OECC as a result of cable burial, pre-sweeping (dredging) and associated anchor placements. This equates to 0.12% of the total seabed area within the wider Thanet Extension benthic study area. The maximum design scenario, for each habitat/ valued ecological receptor affected by temporary habitat loss along the Thanet Extension OECC, is estimated based on a scenario of all loss occurring wholly within the dominant habitats and would equate to approximately 0.12% of the habitat.

5.10.7 Given that the habitats are common and widespread throughout the region this represents a very small footprint compared to their overall extent. The impacts will be temporary and of short-term duration and only a single event in each location; therefore, the magnitude of the impact is assessed as low.

5.10.8 The species and habitats identified during the benthic characterisation surveys (SS.SMX.CMx.MysThyMx, SS.BSR.PoR.SspiMx, SS.SSa.IMuSa.FfabMag and SS.SSa.IFiSa.NcirBat) are typical of the wider region of the surrounding area. All biotopes have been assessed according to the MarESA criteria as having a high or medium recoverability to direct disturbance.

5.10.9 The subtidal habitats directly affected by temporary habitat loss and disturbance typically have low sensitivity to disturbance of this nature. Sandy biotopes such as SS.SSa.IFiSa.NcirBat, are typical of high energy environments and are therefore naturally subject to, and tolerant of, high levels of physical disturbance. The communities that characterise these biotopes are predominantly infaunal mobile species including polychaetes and venerid bivalves, which are capable of re-entering the substratum following disturbance.

5.10.10 The recoverability of such communities is likely to occur as a result of the combination of recruitment from surrounding unaffected areas and larval dispersal, and recovery is likely to occur within two to ten years (based on the MarESA assessments). This is supported by evidence relating to the recovery of benthic communities following aggregate extraction activities (MAREA) which have reported that following the cessation of dredging activities, the characteristic recovery time for sand communities may be two to three years. Data from marine aggregate sites off the south and south-east coasts of the UK indicate that following the initial suppression of species' diversity, abundance and biomass recovery of species' diversity to within 70 – 80% of that in non-dredged areas was achieved within 100 days (Newell et al., 2004). Species' abundance also recovered within 175 days (Newell et al., 2004). It is important to acknowledge however, that the activities associated with aggregate extraction are quite different to those associated with OWF construction activities. (i.e. they involve the complete removal of sediment). Data collated from more analogous activities such as the burial of telecommunications cables and OWF monitoring inclusive of that for TOWF indicate that recovery is rapid with limited, if any, significant effects being discernible.

5.10.11 With respect to abrasion/ physical disturbance resulting from jack-up operations and anchor placements, the majority of the infauna in NcirBat is likely to have intermediate intolerance to such disturbance at the surface, due to the depths in the sediment in which infauna live. Venerid bivalves including which have a fragile shell and are shallower burrowers, are more vulnerable. Polychaetes which expose their palps at the surface while feeding are similarly vulnerable. Overall, as discussed previously, the recoverability of the habitats within the Thanet Extension study area are likely to occur as a result of the combination of recruitment from surrounding unaffected areas and larval dispersal, and recovery is likely to occur within two to three years. Although the jack-up footprints will potentially remain on the seabed for a number of years, as demonstrated by monitoring studies of Round 1, and Round 2 wind farms, the communities within them are expected to recover within this time span.

5.10.12 Drawing on the detailed MarESA sensitivity assessments, the MarESA assessments for each benthic habitat identified for abrasion/ disturbance of the surface are presented in Table 5.12. The built in mitigation measures (Table 5.5) will ensure that any identified *S. spinulosa* reef identified during the pre-construction surveys will have sufficient buffers to prevent significant direct impacts to these features.

Table 5.12: MarESA assessment for the benthic habitats for abrasion/ disturbance

Biotope code	Biotope name	Sensitivity assessment	Assessment confidence
SS.SMX.CMx.MysThyMx [5]	*Mysella bidentata* and *Thyasira spp.* in circalittoral muddy mixed sediment	Low (based on medium resistance and high resilience)	Confidence is low as the assessment is based on expert judgement and therefore a baseline is not available.
SS.BSR.PoR.SspiMx[6]	*Sabellaria spinulosa* on stable circalittoral mixed sediment	Medium (based on low resistance and medium resilience)	Confidence is low as the assessment is based on expert judgement and therefore a baseline is not available.
SS.SSa.IMuSa.FfabMag[7]	*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand	Low (based on medium resistance and high resilience)	Confidence is low as the assessment is based on expert judgement and therefore a baseline is not available.
SS.SSa.IFiSa.NcirBat[8]	*Nephtys cirrosa* and *Bathyporeia spp*. in infralittoral sand	Low (based on low resistance and high resilience)	Confidence is high as the assessment is based on published literature, with the baseline assessment using tramping as the impact (however the applicability of this as a low confidence).

5.10.13 The magnitude of the impact has been assessed as Low, with the maximum sensitivity of the receptors being Medium. Therefore, the significance of effects from direct disturbance occurring as a result of jack-up vessel activities is **Minor** adverse, which is not significant in EIA terms.

5.10.14 The MarESA assessments identify that the confidence for the sensitivity of the specified habitats to abrasion/ disturbance of the surface is generally low for all habitats. For SS.SMX.CMx.MysThyMx, SS.BSR.PoR.SspiMx and SS.SSa.IMuSa.FfabMag, the low confidence is associated with the resistance measure, with high confidence associated with the recovery (resilience) of the habitats. For SS.SSa.IFiSa.NcirBat, the only measure which was assessed as having a low confidence score was the applicability of the sensitivity, which originates from a low confidence score for the applicability of the resilience assessment; however, since the evidence agrees in terms of direction and magnitude of the impact this is a conservative and robust assessment. SS.BSR.PoR.SspiMx is assessed as having a low resistance to this impact and therefore, while the confidence of the resistance of this habitat to this impact is low, this provides a conservative assessment of the impacts and therefore an appropriately robust assessment of the overall significance of effect on the other habitats. Furthermore, the post-construction surveys undertaken for TOWF identified that changes in faunal composition between pre- and post-construction were only as a result of natural variation, suggesting full recovery of the habitats disturbed during construction (MESL, 2013). As such, the assessment of effects as not significant remains valid.

Temporary habitat disturbance in the intertidal from cable installation

5.10.15 Direct loss/ disturbance of habitat will occur in the intertidal area from the installation of the export cables at the landfall and the placement of anchors associated with these operations.

5.10.16 The total maximum area of temporary habitat loss/ disturbance as part of the intertidal works is 80,000 m^2, including up to 7,376 m^2 within the saltmarsh (including trenching area and cofferdam extent). This equates to 0.67% of the saltmarsh habitat within the Thanet Coast and Sandwich Bay SAC.

[5] http://www.marlin.ac.uk/habitats/detail/374

[6] http://www.marlin.ac.uk/habitats/detail/377

[7] http://www.marlin.ac.uk/habitats/detail/142

[8] http://www.marlin.ac.uk/habitats/detail/154

5.10.17 Given that the intertidal habitats are common and widespread throughout the region this represents a very small footprint compared to their overall extent. The impacts will be temporary and of short-term duration and only a single event in each location; therefore, the magnitude of the impact is assessed as low for the intertidal sedimentary habitats.

5.10.18 Saltmarsh is common throughout Pegwell Bay and is present throughout the study area including further south towards Sandwich Bay. As part of the mitigation measures embedded into the Thanet Extension development, prior to construction, a Saltmarsh Mitigation and Reinstatement Plan will be produced which will detail how trenched material will be stored in order to facilitate reinstatement. The impacts to the saltmarsh will be localised and short-term and the Saltmarsh Mitigation and Reinstatement Plan will ensure that impacts are kept to an absolute minimum; therefore, the magnitude of the impact is assessed as low for saltmarsh within the intertidal.

5.10.19 The species and habitats identified during the intertidal characterisation surveys (LS.LSa.FiSa[9], LS.LSa.MuSa.CerPo[10] and LS.LSa.MuSa[11]) are typical of the wider region of the surrounding area. All three biotopes have been assessed according to the MarLIN or MarESA criteria as have a high or medium recoverability (resilience) to direct disturbance.

5.10.20 The habitats directly affected by the temporary habitat loss/ disturbance are considered to generally have low sensitivity to disturbance of this nature. The intertidal zone within Pegwell Bay consists of mobile sediments with some restricted sediment scour. The communities that characterise these biotopes are predominantly infaunal mobile species including polychaetes and bivalves, which are capable of re-entering the substratum following disturbance.

5.10.21 While it is likely that the characterising species (*Macoma balthica* and *Arenicola marina*) would be damaged by the physical impacts of the trench excavation in the intertidal, both species are highly mobile and able to recolonise disturbed habitat rapidly. Particularly in the case of *M. balthica*, following sediment removal (dredging) within the area, recovery of the population within the disturbed area had recovered to the same as the unaffected areas. Within one year, two generations could be identified, showing that recovery was both from adults migrating into the area and larval recruitment (Bonsdorff, 1984).

5.10.22 The built in mitigation measures (Table 5.5) will ensure that any identified biogenic reef identified during the pre-construction surveys will have sufficient buffers to prevent any direct impacts to these features. Drawing on the detailed MarESA assessments for each intertidal habitat identified for abrasion/ disturbance of the surface are presented in Table 5.13.

[9] https://www.marlin.ac.uk/habitats/detail/1125 - biotope Polychaetes in littoral fine sand (LS.LSa.FiSa.Po) has been used to provide the MarESA assessment for this biotope. LS.LSa.FiSa.Po is a sub-biotope of LS.LSa.FiSa, however the characterising species of the two biotopes are identical and the sensitivity assessment is therefore considered appropriate for use alongside expert judgement of the impacts on this biotope.

[10] http://www.marlin.ac.uk/habitats/detail/206

[11] https://www.marlin.ac.uk/habitats/detail/21 - a MarESA assessment has not been carried out for this species, so the evidence from the MarLIN assessment has been used.

Table 5.13: MarLIN and MarESA assessments for the intertidal habitats for abrasion/ disturbance

Biotope code	Biotope name	Sensitivity assessment	Assessment confidence
LS.LSa.FiSa.Po[9]	Polychaetes in littoral fine sand	Low (based on low resistance and high resilience)	Confidence is medium to high as the assessment is based on published literature (focusing on the impacts from trawling gear on this habitat) with general agreement on the direction and magnitude of the effect.
LS.LSa.MuSa.CerPo[10]	*Cerastoderma edule* and polychaetes in littoral muddy sand	Low (based on medium resistance and high resilience)	Confidence is medium as while the assessment is based on published literature, the assessment uses a proxy for disturbance.
LS.LSa.MuSa[11]	Polychaete/bivalve-dominated muddy sand shores	Low (based on medium resistance and high resilience)	Confidence is medium as while the assessment is based on published literature, the assessment uses a proxy for disturbance.

5.10.23 The magnitude of the impact has been assessed as Low on the basis that the impact is of temporary duration, reversible, and localised, with the maximum sensitivity of the intertidal receptors being Medium. Therefore, the significance of effects from direct disturbance occurring as a result of export cable installation activities in the intertidal area is **Minor** adverse, which is not significant in EIA terms.

5.10.24 Impacts to the saltmarsh in this region from the installation of cables is well known from TOWF and the recovery of the saltmarsh is known to be rapid (full recovery within two years) based on the post-construction monitoring undertaken for TOWF. While the tolerance (resistance) of the habitat to disturbance from the installation of the cables (and presence of vehicles) will be none, the recoverability (resilience) would be classed as high based on the MarESA assessments. This results in a sensitivity assessment of medium.

5.10.25 The magnitude of the impact (taking the embedded mitigation into consideration) has been assessed as Low, with the sensitivity of the saltmarsh being assessed as Medium. Therefore, the significance of effects from direct disturbance occurring as a result of the export cable installation activities is **Minor** adverse, which is not significant in EIA terms.

Temporary increases in suspended sediment and associated sediment deposition in the subtidal area

5.10.26 Temporary increases in SSC and associated sediment deposition are expected from the foundation and cable installation works and seabed preparation works (including sandwave clearance). Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Process (Document Ref: 6.2.2) and Volume 4, Annex 2-1: Marine Geology, Oceanography and Physical Processes Technical Report (Document Ref: 6.4.2.1) provides a full description of the physical assessment, with a summary of the maximum design scenarios associated with the impact, as detailed in Table 5.10, provided in this section.

5.10.27 SSC in the southern North Sea varies widely both spatially and temporally, with a general pattern of an inshore to offshore gradient in SSC. The highest SSCs are observed close to the mouths of large estuaries, such as the Thames. Within the array area of Thanet Extension, surface SSCs average more than 10 mg/l over the year, with levels in the winter generally between 30 – 80 mg/l though up to 100 mg/l has been recorded. Within the OECC, surface SSCs are between 10 – 20 mg/l during summer and above 40 mg/l during winter. Significantly higher levels may be seen during storm events (Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (Document Ref: 6.2.2)).

5.10.28 The Marine Geology, Oceanography and Physical Process assessment (Volume 2, Chapter 2) has determined that up to 288,000 m^3 of sediment would be released from the seabed preparation works for suction caisson foundations. All sediment would be released from the dredging vessel at the surface, with the preparation works producing 9,600 m^3 of sediment per foundation as a sediment plume.

5.10.29 When the sediment is released from the dredging vessel, approximately 90% of the material will fall directly to the seabed (the dynamic phase of the sediment plume), while the remaining 10% will become more displaced and stay in suspension for longer (the passive phase). The dynamic phase of the plume will remain in the water column in the order of seconds to minutes, with SSC levels reaching thousands of mg/l, far above natural levels, though this will only be very short-term while the plume is in the water column (seconds to minutes) and highly localised (tens of metres laterally and vertically). The passive phase of the plume may result in SSCs up to several 100's of mg/l, however, this will be for a maximum of two hours before returning to natural levels, although finer particles may remain in suspension for longer (hours to days), with the contribution of the plume to SSCs levels being less than 5 mg/l within 24 hours.

5.10.30 The shape and thickness of deposits from the dynamic phase of the plume cannot be predicted in advance and would likely vary at each location (based on sediment composition and tidal currents); a range of possible configurations are presented in Volume 4, Annex 2-1: Marine Geology, Oceanography and Physical Processes Technical Annex (Document Ref: 6.4.2.1). The release of the sediment from seabed preparation for one foundation (9,600 m^3) could result in an area of 192,000 m^2 (0.192 km^2; nominally 438 m x 438 m) being covered with an average of 0.05 m of sediment, although it is likely that the deposit may comprise several individual releases from multiple dredging cycles and so deposits are likely to be relatively thicker, with a smaller area of effect. For example, an average thickness of material of 0.10 m would lead to a smaller area of 96,000 m^2 (0.096 km^2) being covered. If the total volume of sediment that may be released from seabed preparation works was spread across the full array area, this would result in an average raising of the seabed by 0.004 m. If an average thickness of 0.05 m occurs for the sediment released for all foundations, this would result in 7.6% of the array area being covered to this depth. This equates to 0.42% of the wider benthic study area.

5.10.31 As the minimum spacing distance between WTGs is 480 m it is unlikely that the sands and gravels put into suspension (i.e. the components of the dynamic plume) will be dispersed far enough (i.e. between adjacent foundations) to cause any overlapping effects before being redeposited to the seabed. Only relatively fine sediment is likely to be advected far enough to potentially cause overlapping effects on SSC, however at these distances the SSC will not exceed natural variation.

5.10.32 The increase in SSC and deposition associated with foundation seabed preparation will be of temporary and of a short-term duration, with appropriate buffers for sediment disposal defined around any HOCIs; therefore, the magnitude of the impact is deemed to be negligible.

5.10.33 It may be necessary to undertake sandwave clearance (using either dredging or mass flow excavator) along sections of the cables prior to cable installation, with the impacts being similar to those described for seabed preparation dredging works, with the sediment plume structure being very similar. SSCs of between 5 to 10 mg/l are expected to extend to a distance of 10 km from the dredging/ mass flow excavator site. The impacts of sediment deposition are not known at this stage as the volume of material that may need to be removed is unknown. However, as described in Volume 2, Chapter 2: Physical Processes (Document Ref: 6.2.2), gravels will be spatially limited to approximately 20 m of the deposition site, with sands limited to a few hundreds of metres downstream. High initial SSC concentrations of finer sediments are expected but will be subject to rapid dispersal and reach near-background levels within hundreds to a few thousands of metres and given the prevailing sediments within the site, the contribution of fine material will be limited. Any local sediment accumulations would be subject to redistribution under the prevailing hydrodynamic conditions.

5.10.34 The increase in SSC and deposition associated with sandwave clearance will be of temporary and of a short-term duration, with appropriate buffers for sediment disposal defined around any HOCIs; therefore, the magnitude of the impact is deemed to be negligible.

5.10.35 The cable installation method that results in the greatest increase in SSC and sediment deposition is jetting (including mass flow excavation) (Table 5.10), with the assumption that 100% of sediment in the trench is suspended. Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Process assessment (Document Ref: 6.2.2) identifies that while the ejection height of the material is unknown, three heights have been modelled, with the greatest height resulting in the greatest area of effect but the smallest height resulting in the highest SSC and deposition levels. Therefore, the assessment presented here focuses on the lowest ejection height as this has the greatest impact on benthic organisms.

5.10.36 The cable installation will involve the formation of a 1 m wide and 3 m deep v-shaped trench for array cables and a 10 m wide and 3 m deep v-shaped trench for export cables. The maximum volume of sediment displaced during installation of the cable is 1.5 m^3 per metre of array cable and 25 m^3 per metre of export cable. Therefore, the maximum distance from each metre of cable over which the sediment can be spread to an average depth of 0.05 m is 50 m for array cables and 500 m for export cables; assuming this is achieved for the full cable routes (64 km of inter-array cables and 116 km of export cable), this will result in 4.9% of the wider benthic study area being affected. Gravels and sands will normally be deposited closer to the cable route, although this will result in sediment depths of tens of centimetres to metres, with finer sediment dispersed so that their contribution is unlikely to settle in measureable thicknesses. This would result in a much smaller footprint, though with an increased deposition within a more localised area.

5.10.37 Depending on the installation methods chosen, it is possible that chalk plumes could be generated during construction. This would result in the introduction of very fine sediments into the water column, which would normally not be present. However, the very fine nature of chalk sediment ensures that outside of the immediate vicinity of the cable route, the chalk SSC will rapidly disperse, with the fine nature of the particles ensuring that it is unlikely to settle in any measurable thickness

5.10.38 The impacts of cable installation will be temporary and of short-term duration, with appropriate buffers around any HOCIs; therefore, the magnitude of the impact is assessed as low.

5.10.39 The species and habitats identified during the benthic characterisation surveys (SS.SMX.CMx.MysThyMx, SS.BSR.PoR.SspiMx, SS.SSa.IMuSa.FfabMag and SS.SSa.IFiSa.NcirBat) are typical of the wider region of the surrounding area. All biotopes have been assessed according to the MarESA criteria as having a high recoverability to changes in SSC and associated sediment deposition. It is possible that *S. spinulosa* reefs may be present in this area, however, this species is deemed to have a low sensitivity to increases in SSC and a medium sensitivity to the levels of sediment deposition predicted to occur as part of these works.

5.10.40 The subtidal habitats in this region are accustomed to high levels of SSC that occur naturally within this region and consequently, are subject to and able to tolerate variations in SSC and also sediment deposition. The communities that characterise these biotopes are predominantly infaunal mobile species or sessile species including polychaetes and venerid bivalves, many of which are suspension or deposit feeders and capable of tolerating high levels of SSC and localised events of sediment deposition.

5.10.41 The recoverability of such communities is likely to occur as a result of the combination of recruitment from surrounding unaffected areas and larval dispersal, and recovery is likely to occur within two to ten years depending on the depth of burial (with areas that are affected by lighter levels of deposition recovering within two years; based on the MarESA assessments). This is supported for the identified habitats in this local area by the post-construction surveys for TOWF, which identified that differences between pre-construction and post-construction (two years after construction) faunal data were only due to natural variation and as such no significant effects were discernible. Additionally, the abundance of recorded higher quality *S. spinulosa* reef was higher in the post-construction surveys and this was attributed to the reduction in fishing pressure as a result of the presence of the WTGs.

5.10.42 With respect to increased SSC/ sediment deposition resulting from seabed preparation, sandwave clearance and cable installation activities, the majority of the fauna identified are likely to have low intolerance to increased SSC and intermediate intolerance to sediment deposition. Overall, as discussed previously, the recoverability of the species and habitats within the Thanet Extension study area is likely to occur as a result of the combination of local recruitment from unaffected areas and larval dispersal, and recovery is expected to occur within two years (based on the TOWF post-construction surveys). Although the cable installation scars will potentially remain on the seabed for a number of years, the communities within them are expected to recover within this timescale.

5.10.43 Drawing on the detailed MarESA sensitivity assessments, the MarESA assessments for each benthic habitat identified for increased SSC and sediment deposition are presented in Table 5.14.

5.10.44 Sandwave clearance and cable installation are likely to occur where the cable corridor passes through Goodwin Sands rMCZ. The features of the rMCZ that may be affected include subtidal coarse sediment and subtidal sand. It is likely that any impacts from the construction works for Thanet Extension would be limited to tens to hundreds of metres from the source and would not result in the introduction of non-native sediments to the rMCZ. Therefore, it is considered that there will be no significant impacts on the features of the rMCZ.

Table 5.14: MarESA assessment for the benthic habitats for increased SSC and associated sediment deposition (smothering)

Biotope code	Biotope name	Sensitivity assessment	Assessment confidence
SS.SMX.CMx.MysThyMx[12]	*Mysella bidentata* and *Thyasira spp.* in circalittoral muddy mixed sediment	Not sensitive to changes to SSC Not sensitive to light smothering (< 5 cm) Low sensitivity to heavy smothering (5 - 30 cm)	Confidence is low for the SSC assessment as assessment is based on expert judgement. Confidence in the quality of the evidence is high for the smothering assessments, although the applicability and agreement between the evidence is low.
SS.BSR.PoR.SspiMx[13]	*Sabellaria spinulosa* on stable circalittoral mixed sediment	Not sensitive to changes in SSC Not sensitive to light smothering (< 5 cm) Medium sensitivity to heavy smothering (5 – 30 cm)	Confidence in the quality of the evidence and the agreement between the evidence is high for SSC but the applicability confidence is low. The confidence in the quality of the evidence is high, in the applicability is medium and agreement of the evidence is low for light smothering. Confidence is low for heavy smothering as the assessment is based on expert judgement.
SS.SSa.IMuSa.FfabMag[14]	*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand	Low sensitivity to changes in SSC Low sensitivity to light smothering (< 5 cm) Low sensitivity to heavy smothering (5 – 30 cm)	Confidence is low for changes in SSC as the assessment is based on expert judgement. Confidence is high for the quality of evidence, low for the applicability and medium and low for the agreement between evidence for the light and heavy smothering respectively.
SS.SSa.IFiSa.NcirBat[15]	*Nephtys cirrosa* and *Bathyporeia spp*. in infralittoral sand	Low sensitivity to changes in SSC Not sensitive to light smothering (< 5 cm) Low sensitivity to heavy smothering (5 – 30 cm)	Confidence is low for changes in SSC. Confidence in the quality of the evidence and the agreement of the evidence is high and the applicability of the evidence is medium for smothering.

5.10.45 The magnitude of the impact has been assessed as Low for all contributing activities, with the maximum sensitivity of the receptors being Medium. Therefore, the significance of effect from changes in SSC and deposition occurring as a result of cable installation activities in the subtidal area is **Minor** adverse, which is not significant in EIA terms.

[12] https://www.marlin.ac.uk/habitats/detail/374

[13] http://www.marlin.ac.uk/habitats/detail/377

[14] https://www.marlin.ac.uk/habitats/detail/142

[15] http://www.marlin.ac.uk/habitats/detail/154

5.10.46 The MarESA assessments identify that some aspects of the confidence for the sensitivity of the specified habitats to changes in SSC and for sediment deposition (smothering) is low for all habitats. For all habitats, the low confidence score for the sensitivity assessment is associated with the resistance assessment rather than the resilience assessment, except for SS.SSa.IMuSa.FfabMag, which also has a low confidence score for the applicability of the resilience score. The significance of effect has been assessed based on the lowest resistance score of medium and resilience of high as part of the sensitivity assessments. Therefore, while the confidence score is low, the assessment is using the most conservative sensitivity. Furthermore, the post-construction surveys undertaken for TOWF identified that changes in faunal composition between pre- and post-construction were only as a result of natural variation, suggesting no long-term impacts from increased SSC or increased sediment deposition (MESL, 2013). As such, the assessment of the significance of effects as **not significant** remains valid.

Temporary increases in SSC and associated sediment deposition in the intertidal area

5.10.47 Temporary increases in SSC and associated sediment deposition in the intertidal area are expected from the cable installation works. Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Process (Document Ref: 6.2.2) and Volume 4, Annex 2-1: Marine Geology, Oceanography and Physical Processes Technical Report (Document Ref: 6.4.2.1) provides a full description of the physical assessment, with a summary of the maximum design scenarios associated with the impact, as detailed in Table 5.10, provided in this section.

5.10.48 Within the OECC, surface SSCs are between 10 to 20 mg/l during summer and above 40 mg/ l during winter, with the highest levels being found closer to shore. Significantly higher levels may be seen during storm events (Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (Document Ref: 6.2.2)).

5.10.49 The scenario that results in the greatest impact on intertidal habitats from cable installation is ploughing and the associated formation of berms. While these berms are present on the beach, they will be subject to tidal dispersion, although some of this will result in natural backfill of the trench. It is expected that the berms would be present for only a very short period of time and so the degree of redistribution that may occur is highly limited. SSCs will be increased locally but rapidly attenuate to natural levels.

5.10.50 After the trench has been backfilled, it is expected that re-working by waves and currents will quickly (in the order of days to weeks) redistribute and smooth any remaining local disturbances. As such all impacts will be short-term and highly localised.

5.10.51 Given that the impacts will be localised and of short-term duration, and that the habitats are common and widespread throughout the area, the magnitude of the impact is assessed as low to negligible.

5.10.52 The species and habitats identified during the intertidal characterisation surveys are typical of the wider region of the surrounding area. Both biotopes have been assessed according to the MarLIN and MarESA criteria as having a high recoverability to changes in SSC, high recoverability to ‘light’ sediment deposition (5 cm) and a high to medium recoverability to ‘heavy’ sediment deposition (> 5 cm).

5.10.53 The intertidal zone of Pegwell Bay within the landfall area is an accretion zone, with sediment received from natural supplies including updrift, offshore and fluvial sources. While sands and silts are transported into Pegwell Bay on tidal currents, the majority of sediment transport occurs during storm surge events, with shingle movement, flattening of areas and berm creation in others (Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (Document Ref: 6.2.2)). Therefore, the habitats identified within the landfall area will likely have a low intolerance to these impacts.

5.10.54 Recovery of these habitats is likely to occur through a combination of the local recruitment of individuals from unaffected areas and through larval dispersion, with recovery expected to be complete within two to ten years (based on the MarESA assessments).

5.10.55 Drawing on the detailed MarESA sensitivity assessments, the MarESA assessments for each intertidal habitat identified for increased SSC and sediment deposition are presented in Table 5.15.

Table 5.15: MarESA assessment for the intertidal habitats for increased SSC and associated sediment deposition (smothering)

Biotope code	Biotope name	Sensitivity assessment	Assessment confidence
LS.LSa.FiSa.Po[9]	Polychaetes in littoral fine sand	Not sensitive to changes in SSC Not sensitive to light smothering (< 5 cm) Low sensitivity to heavy smothering (5 – 30 cm)	Confidence is low for changes in SSC as the assessment is based on expert judgement. Confidence is low for light smothering as the assessment is based on expert judgement. Confidence is medium for heavy smothering as while the assessment is based on published literature, the assessment uses a proxy.
LS.LSa.MuSa.CerPo[10]	*Cerastoderma edule* and polychaetes in littoral muddy sand	Not sensitive to changes in SSC Low sensitivity to light smothering (< 5 cm) Medium sensitivity to heavy smothering (5 – 30 cm)	Confidence is high for changes to SSC as the assessment is based on published literature. Confidence is medium for light smothering as while the assessment is based on published literature, the assessment uses a proxy. Confidence is medium for heavy smothering as while the assessment is based on published literature, the assessment uses a proxy.
LS.LSa.MuSa[11]	Polychaete/bivalve-dominated muddy sand shores	Very low sensitivity to increases in SSC Low sensitivity to smothering	Confidence is medium for both increases in SSC and smothering as while the assessments are based on published literature, the assessments use proxies for either species or impact.

5.10.56 The magnitude of the impact has been assessed as Low, with the maximum sensitivity of the receptors being Medium. Therefore, the significance of effect from changes in SSC and associated sediment deposition occurring as a result of cable installation activities in the intertidal area is **Minor** adverse, which is not significant in EIA terms.

5.10.57 A low confidence score was attributed to LS.LSa.FiSa.Po for specific assessments within the MarESA assessments, with this predominately due to low confidence for the resistance assessment and also to the applicability for the resilience assessment. The significance of effect has been assessed based on the lowest resistance score of low and resilience of medium as part of the sensitivity assessments. Therefore, while the confidence score is low, the assessment is using the most conservative sensitivity. Furthermore, as discussed, the intertidal zone within Pegwell Bay is a naturally accreting site, with most sediment transported in during storm surges and consequently, the habitats will have to tolerate these events which are similar to the impacts of cable installation. As such, the assessment of the significance of effects as **not significant** remains valid.

Direct and indirect seabed disturbances leading to the release of sediment contaminants

5.10.58 There is the potential for sediment bound contaminants, such as metals, hydrocarbons and organic pollutants, to be released into the water column and lead to an effect on benthic receptors. Contaminant surveys in both the array and OECC reported no pollutants with concentrations above the Canadian threshold effect level (TEL), with the exception of arsenic. However, the arsenic levels recorded were within the southern North Sea range and may be due to remobilisation and erosion of arsenic -rich rock. More detail can be found in ES, Volume 2, Chapters 2: Marine Geology, Oceanography and Physical Processes (Document Ref: 6.2.2) and Volume 2, Chapter 3: Marine Water Quality (Document Ref: 6.2.3).

5.10.59 The total area that is likely to be disturbed by construction activities, and therefore the potential volume of material disturbed, resulting in the potential release of sediment bound contaminants is small and localised in extent. In addition, the nature of the subtidal sediments is predominantly coarse, typically with low levels of fines adhering to them, reducing the likelihood of these sediments containing high levels of pollutants.

5.10.60 Following disturbance as a result of construction activities, the majority of re-suspended sediments are expected to be deposited in the immediate vicinity of the works. The release of contaminants from the small proportion of fine sediments is likely to be rapidly dispersed with the tide and/ or currents and therefore increased bio-availability resulting in adverse eco-toxicological effects are not expected. The levels found are all comparable to the wider regional background and not considered to be of a low quality and will not result in a significant effect-receptor pathway if made bioavailable.

5.10.61 The impacts to benthic receptors as a result of the release of sediment-bound contaminants are therefore considered to be of negligible magnitude. The sensitivity of benthic species to the toxic pollutants that may be disturbed is is deemed to be high. The significance of the effect is therefore deemed to be of **Minor** adverse significance, which is not significant in EIA terms.

Impacts on benthic ecology from noise arising from foundation installation

5.10.62 The piling of the monopile or quadropod jacket foundations will result in the generation of underwater noise which will extend out from the source, travelling both through the water column and through the sediment.

5.10.63 It is acknowledged that marine invertebrates are likely to suffer injurious and possibly lethal effects from anthropogenic high intensity noise (i.e. piling). However, it is not possible to assess the impact of this in a meaningful way at this stage without any modelling currently available for these species or any studies focusing on polychaetes as the dominant taxa surrounding Thanet Extension. Furthermore, while it is possible that noise from piling may have similar effects on the eggs/ larvae of benthic invertebrates, the area of ensonification for which this happens is in the order of metres from the piling location and consequently, the magnitude of this impact would be negligible.

5.10.64 The available literature on the impact of noise and vibration on benthic species is increasing. However, the current available agreed metrics for noise modelling do not comprehensively incorporate the impacts of particle movement, which is of greater importance when considering the impacts on benthic species, rather than sound pressure which has been used so far (Hawkins and Popper, 2016). Additionally, the majority of studies have so far focused on crustaceans or molluscs (e.g. Edmonds *et al*., 2016, Roberts *et al*., 2016, Roberts & Elliott, 2017), and less is understood about the impacts on the polychaetes that dominate the benthic habitats identified at Thanet Extension.

5.10.65 Additionally, The MarESA sensitivity assessments for the habitats and species identified during the benthic characterisation surveys (SS.SMX.CMx.MysThyMx, SS.BSR.PoR.SspiMx, SS.SSa.IMuSa.FfabMag and SS.SSa.IFiSa.NcirBat) for changes in underwater noise detail that this impact is 'not relevant' due to a lack of evidence of any impact.

5.10.66 Consequently, the scarcity of available evidence for the impacts of noise on benthic invertebrates, in particular polychaetes, means it is not possible to carry out a detailed assessment of the impacts of noise. Consideration of the MarESA sensitivity assessment suggest that the potential effects associated with the construction and operation of the Thanet Extension project will be **Not significant**.

5.11 Environmental assessment: O&M phase

5.11.1 The effects of the operation of Thanet Extension have been assessed on benthic and intertidal ecology in the Thanet Extension benthic ecology study area. The environmental impacts arising from the operation of Thanet Extension are listed in Table 5.10, along with the Design Envelope against which each operation phase impact has been assessed.

5.11.2 A description of the significance of effect upon benthic and intertidal receptors caused by each identified impact is provided below.

Long-term habitat loss/ change from presence of foundations, scour protection and cable protection

5.11.3 The presence of the WTG and OSS foundations and the associated scour protection, along with the cable protection measures used at cable crossings and areas where burial is not possible, will lead to a change of habitat from sediment to hard substrate. This will be a permanent change and is therefore considered an impact of the operational phase of the development. It is assessed here as habitat loss and a potential adverse effect, although it is noted that this also comprises potential beneficial effects (providing new habitats for different faunal assemblages to colonise).

5.11.4 As described in Table 5.10, the greatest habitat loss will occur from the installation of the piled quadropods and associated scour protection for the 12 MW WTGs (plus OSS and met mast). This would result in a total habitat loss of 304,715.2 m^2 which equates to 0.02% of the wider Thanet Extension benthic study area. A total of 399,500 m^2 of cable protection will also be installed, which equates to 0.04% of the wider benthic study area.

5.11.5 The installation/ presence of the foundations, scour and cable protection has the potential to impact on existing *S. spinulosa* reefs that are known to be present in the area (although none are recorded within the Thanet Extension development area at the time of writing). The embedded mitigation described in Table 5.11 detailed that a Biogenic Reef Mitigation Plan will be developed and this will ensure that impacts to core reef are avoided throughout all stages of the development.

5.11.6 While the impact will be locally significant and comprise of a permanent change in seabed habitat within the footprint of the structures and scour and cable protection, the footprint of the area affected is highly localised and the affected habitats are common and widespread throughout the wider region and any areas of core *S. spinulosa* reef will be avoided through the embedded mitigation; therefore, the magnitude is assessed as negligible.

5.11.7 No long-term habitat loss will occur in the intertidal area of Thanet Extension as cable protection will not be used in this area.

5.11.8 While the soft sediment biotopes will be lost within these discrete areas, it is considered likely that some of the characterising species will remain as epifauna on the various hard substrates. In particular, *S. spinulosa* is known to form reefs on rock outcroppings in the vicinity of the proposed development and would be likely to do so here, although this would result in the habitat being classified as a new habitat.

5.11.9 All benthic biotopes have a high sensitivity to habitat loss/ change to a different seabed type as this counts as a complete loss of the old habitat and consequently there can be no recovery of the habitat, although the species may remain/ recolonise the area.

5.11.10 The MarESA assessments identified that all benthic habitats have a high sensitivity to the introduction of hard substrate, with the assessment having high or medium confidence, with the exception of the assessment for SS.BSR.PoR.SspiMx.

5.11.11 The magnitude of the impact has been assessed as Negligible and the maximum sensitivity of the habitats is High. Therefore, the significance of effects from the long-term habitat loss/ change is **Minor** adverse, which is not significant in EIA terms.

5.11.12 A low confidence score was attributed to SS.BSR.PoR.SspiMx, with this due to low confidence for the resistance assessment. It is noted that the species (*S. spinulosa*) is considered not sensitive to the introduction of hard substrate[16] as it is suitable for colonisation and the potential formation of reef structures, however this would result in a change of biotope. The assessment has been undertaken on the response of the biotope to this habitat change which is more conservative than the response of the species and therefore the assessment is still valid.

Colonisation of WTGs/ scour protection may affect benthic ecology and biodiversity

5.11.13 Hard substrate introduced into a predominately sedimentary environment will attract many marine organisms and colonisation of introduced habitat has been recorded at previous offshore wind developments and can be expected to occur at Thanet Extension. Species that typically colonise these structures include mussels, barnacles, tubeworms, sponges, hydroids and bryozoans.

5.11.14 This may result in an overall increased biodiversity; however, it represents a change from the baseline that occur in the area. Whether this is considered a positive or negative can be subjective and both are possible. Positive effects could include an increase in abundance of commercially important invertebrate species, which would benefit commercial fisheries. Negative effects could include providing habitat that may allow the establishment of non-native species.

5.11.15 Rock outcroppings are known to occur throughout the region, therefore the introduction of hard substrate will not fundamentally change the type of available habitats available within the wider study area. Therefore, while impacts will be long-term, the magnitude of the impact from the introduction of 0.64 km^2 (0.05% of the wider study area) of hard substrate will be negligible.

5.11.16 Additionally, there is a risk that the introduction of hard substrate into a sedimentary habitat can enable the colonisation of the introduced substrate by invasive/ non-indigenous species. While there is the potential that Thanet Extension would act as a 'stepping stone' for invasive species, they are known to exist already within the wider region. This is considered to be low risk for Thanet Extension as there is exposed hard substrate occurring naturally within the wider area. While colonisation of the hard substrate introduced at TOWF was not recorded in the post-construction, the surveys were not able to fully determine whether colonisation had occurred and therefore it is possible that non-native species are present. However, it is noted that the construction of Thanet Extension would only enlarge the available habitat in this location rather than create a separate 'stepping stone' and as such the contribution of Thanet Extension to the increase in risk of non-native species is minimal. Finally, the use of pleasure craft is common through the region (Volume 2, Chapter 10: Shipping and Navigation (Document Ref: 6.2.10)) and this provides a more likely method of transport for invasive species. Therefore, any contribution of Thanet Extension would be negligible in comparison to the impacts of other marine users.

[16] http://www.marlin.ac.uk/species/detail/1133

5.11.17 The species likely to colonise the hard substrate (e.g. *S. spinulosa*) have a high recoverability to disturbance and therefore the sensitivity to this impact is Low. Therefore, the significance of the effect from this impact is **Negligible** beneficial, which is not significant in EIA terms.

Permanent loss of saltmarsh habitat from alterations to the sea wall

5.11.18 The extension of the sea wall seawards to accommodate the TJB will result in the permanent loss of part of the saltmarsh habitat in this area.

5.11.19 The total maximum area of saltmarsh loss due to the sea wall works described in Table 5.10 is predicted to be 0.0014 km^2. This equates to 0.13% of the saltmarsh habitat within the Thanet Coast and Sandwich Bay SAC (it should be noted that the saltmarsh is not a feature of this SAC). Given that this habitat is widespread and common throughout the area, this represents a very small footprint compared to the overall extent. The area of permanent loss of saltmarsh has a maximum extent of 18.5 m from the existing sea wall. The saltmarsh in this area of Pegwell Bay extends between approximately 45 – 110 m from the existing sea wall out to a maximum width of 155 m; consequently, the extension to the sea wall will not give rise to any separation of areas of the saltmarsh habitat. While the impacts will be permanent, the impacts will be localised and will not split the habitat; therefore, the magnitude of the impact is assessed as low.

5.11.20 The saltmarsh habitat within Pegwell Bay varies in quality throughout the region (TOWF ES, 2004), with the saltmarsh habitat within the vicinity of the landfall location being considered of lower qualtiy and lesser importance than the habitat found further north around the hoverport (Evidence plan meeting 26/05/17). While the saltmarsh is mentioned within the citations for the Thanet Coast and Sandwich Bay SPA, it is not a feature of the Sandwich Bay SAC, although it is a feature of the Sandwich Bay to Hacklinge Marshes SSSI.

5.11.21 While the saltmarsh is a feature of the SSSI, it is not a feature of a Natura 2000 site. The proposed landfall area is an area that is considered to be generally lower value saltmarsh as a result of the areas of saltmarsh being elevated above the wider area such that it is not regularly inundated by tidal water and therefore being dominated by *Spartina* and grasses. It is therefore considered to be lower quality when compared to other areas of the saltmarsh within Pegwell Bay. The low quality and low potential to improve, combined with the status of the designation, means that the senstivity of the habitat to the permanent loss of this area of saltmarsh is assessed as medium.

5.11.22 The magnitude of the impact has been assessed as Low, with the sensitivity of the receptor assessed as Medium. Therefore, the significance of the effect from the permanent loss of saltmarsh is assessed as **Minor** adverse, which is not significant in EIA terms.

Direct and indirect disturbance to the seabed from jack-up vessel operations and cable maintenance activities

5.11.23 Direct temporary loss/ disturbance of subtidal habitat within the Thanet Extension project area will occur as a result of jack-up barge operations for maintenance to foundations and from cable maintenance and repair activities. Jack-up vessels are expected to be required for a range of maintenance activies both within the array area and the export cable corridor, including (but not limited to): major component repairs; inspection works; boat landings; ladder replacements; cable maintenance; cable inspections; and cable repairs.

5.11.24 The total maximum area of temporary subtidal habitat loss during the O&M phase arises from the use of jack-up vessels for operational and maintenance activities and from cable maintenance and cable repair (including de-burial and re-burial of export and array cables). Given that the habitats are common and widespread throughout the region impacts from the individual O&M activities will represent a very small footprint compared to their overall extent. The impacts will be temporary and of short-term duration and only a single event in each location; therefore, the magnitude of the impact is assessed as low.

5.11.25 The species and habitats identified during the benthic characterisation surveys (SS.SMX.CMx.MysThyMx, SS.BSR.PoR.SspiMx, SS.SSa.IMuSa.FfabMag and SS.SSa.IFiSa.NcirBat) are typical of the wider region of the surrounding area. All biotopes have been assessed according to the MarESA criteria as having a high or medium recoverability to direct disturbance.

5.11.26 Cable repair works will require de-burial and re-burial of a cable or cable section and along with cable preventative maintenance, including re-burial, will consequently result in increases in SSC and sediment deposition. However the impacts from these works would be spread over the 30 year period of O&M activities with only a limited number of acitivities occurring within any one year. As the impacts from these works will be temporary and of short-term duration, the magnitude of the impact is assessed as low.

5.11.27 The species and habitats identified during the benthic characterisation surveys (SS.SMX.CMx.MysThyMx, SS.BSR.PoR.SspiMx, SS.SSa.IMuSa.FfabMag and SS.SSa.IFiSa.NcirBat) are typical of the wider region of the surrounding area. All biotopes have been assessed according to the MarESA criteria as having a high or medium recoverability to direct increased SSC and deposition.

5.11.28 As detailed within paragraphs 5.10.9 *et seq.*, the habitats directly affected by temporary habitat loss/ disturbance have a low sensitivity to disturbance of this nature, with the MarESA assessment also presented in detail. Paragraphs 5.10.26 *et seq* detail that the habitats indirectly affected by increased SSC and deposition have a low to medium sensitivity to the expected levels of SSC and deposition, with the MarESA assessment also presented in detail.

5.11.29 The magnitude of the impacts has been assessed as Low, with the maximum sensitivity of the receptors being Medium (Table 5.12 and Table 5.14 for direct and indirect effects respectively). Therefore, the significance of effects from direct disturbance occurring as a result of jack-up vessel and cable repair and maintenance activities is **Minor** adverse, and the significance of effect from increased SSC and deposition occurring from array and export cable repair and replacement activities is **Minor** adverse, both of which are not significant in EIA terms.

5.11.30 The confidence of the MarESA assessments are as for the construction phase impacts (paragraph 5.10.14).

Indirect disturbance to benthic habitats from electromagnetic fields generated by the inter-array and export cables

5.11.31 EMF are generated by the current that passes through an electric cable. It is known that EMF can be detected by fish and elasmobranches and it is thought that any benthic invertebrates can also detect EMF. The MarESA sensitivity assessments do not consider there to be sufficient evidence to support assessments of impacts of EMF on benthic and intertidal habitats; therefore, a desktop study has been undertaken to describe the typical responses of benthic invertebrates.

5.11.32 Three types of fields are generated by underwater electric cables: electric fields (E-fields), magnetic fields (B-fields) and induced electric fields (iE-fields). Standard industry practice is for the cables used to have sufficient shielding to contain the E-fields generated and the cable system descriptions for the inter-array and export cables have abided by this (Volume 2, Chapter 1: Project Description – Offshore (Document Ref: 6.2.1)). Shielding and/ or burial does not reduce the B-fields and it is these fields that allow the formation of iE-fields. As such, further reference here to EMF is limited to B-fields and associated iE-fields.

5.11.33 Typically, the impacts of EMF on marine organisms has focused on electrically sensitive fish and elasmobranches, with little research focusing on benthic invertebrates, with the few studies using invertebrates focusing on crustaceans (e.g. Woodruff *et al*., 2012). Furthermore, many studies contradict each other or provide inconclusive results (Switzer & Meggitt, 2010), further reducing the available evidence.

5.11.34 However, one recent study examined the difference in invertebrate communities along an energised and nearby unenergised surface laid cables and this identified that there were no functional differences between the communities on and around the cables up to three years after installation (Love *et al*., 2016). This study also identified that the EMF levels reduce to background levels generally within one metre of the cable.

5.11.35 This supports evidence collected from Nysted Wind Farm at Rødsand, in Denmark, which while the study focused on fish the conclusions should be valid for mobile invertebrates, that determined that there was no change in the overall distribution that could be attributed to the presence of the cables (Hvidt *et al*., 2004).

5.11.36 These *in situ* studies, along with laboratory studies showing no significant changes in behaviour from EMF exposure (Woodruff *et al*., 2012), suggest that EMFs have no significant impact on mobile or sessile benthic invertebrates, including if the cable is surface laid. Furthermore, scour protection and cable protection is known to be colonised by benthic invertebrates (including *S. spinulosa*) and therefore, no significant impacts are expected on the benthic communities around Thanet Extension from EMFs.

Long-term changes to seabed habitats from scour effects and changes in sediment regime

5.11.37 The presence of foundations, scour protection and cable protection material may introduce changes to the local hydrodynamic and wave regime, resulting in changes to the sediment transport pathways and associated effects on benthic ecology. Scour and increases in flow rates can change the characteristics of the sediment potentially making the habitat less suitable for some species.

5.11.38 The use of correctly designed scour protection at foundations and insufficiently buried cables will prevent scour occurring (Volume 2, Chapter 2: Marine Geology, Oceanography and Physical Processes (Document Ref: 6.2.2)). The impacts of the use of this scour protection has been assessed within this chapter (paragraphs 5.11.3 to 5.11.12) and found to have no significant effects on the benthic environment.

5.11.39 The Marine Geology, Oceanography and Physical Processes assessment (Document Ref: 6.2.2) has determined that the impacts on hydrodynamic and wave regimes will be **Minor** adverse and would not result in significant changes to sediment transport and consequently will not have any impacts on benthic ecology.

Introduction of turbid wakes from presence of foundations

5.11.40 Offshore wind farms in the North Sea are known to produce turbid wakes downstream of the foundations, with this phenomenon recorded at wind farms in the UK, Germany and the Netherlands. Turbid wakes form as a result of the turbid layer at the bottom of the water column being entrained to the surface and it is accepted that these are not a result of scour around the foundations (Forster, 2017). As the turbid wakes are not from an increase in the total volume of sediment in the water column there will not be any additional sediment deposition arising from these, however, there will be a decrease in the SSC at the bottom of the water column. The primary impacts are expected to be either a decrease in the availability of food for filter feeders or a decrease in the availability of sediment particles for tube building as a result of the decrease in SSC concentrations at the seabed.

5.11.41 The turbid wakes form in the direction of the tide and as such will switch direction twice a day with the tides. Therefore, the benthic habitats and species in the area will only be subject to the effects for the duration of the tide, rather than this being a continuous impact. Additionally, the region around Thanet Extension is subject to high variation in the SSC in the water column due to the proximity to the Thames Estuary, with the change in the SSC as a result of the turbid wakes from the foundations expected to be within the natural variation for the region (Forster, 2017). It is expected that the contribution of the turbid wakes to the natural variation in SSC will be minimal and consequently, the magnitude of this impact is assessed as negligible.

5.11.42 The species and habitats identified during the benthic characterisation surveys (SS.SMX.CMx.MysThyMx, SS.BSR.PoR.SspiMx, SS.SSa.IMuSa.FfabMag and SS.SSa.IFiSa.NcirBat) are typical of the wider region of the surrounding area. All biotopes and *S. spinulosa* have been assessed according to the MarESA (MarLIN for *S. spinulosa*) criteria as having a high recoverability to decreases in SSC.

5.11.43 The tolerance of these biotopes and species to decreases in SSC vary from medium to high, with those biotopes dominanted by deposit feeders having the greatest tolerance and those with a higher proportion of filter feeders having a medium tolerance. *S. spinulosa* has a medium tolerance to decreases in SSC as this can reduce the availability of sediment for tube building. However, as described above, the change in SSC is only expected to last for one tidal cycle and the change remains within the natural variation of the local area. The post-construction surveys from TOWF have also identified an increase in the abundance and lovgevity of *S. spinulosa* reefs within the wind farm (Pearce *et al*., 2014), suggesting that the turbid wakes are not having an adverse effect on *S. spinulosa* reef formation. Based on the MarESA assessments, the biotopes within the array are considered to either be not sensitive or have a low sensitivity to changes in SSC and the data from TOWF suggests that *S. spinulosa* has a low sensitivity or is not sensitive to the changes in SSC resulting from turbid wakes.

5.11.44 The magnitude of the impact has been assessed as negligible, with the maximum sensitivity of the receptors deemed to be low. Therefore, the significance of the effects arising from turbid wakes from the foundations is **Negligible** adverse, which is not significant in EIA terms.

5.12 Environmental assessment: decommissioning phase

5.12.1 The effects of the decommissioning of Thanet Extension have been assessed on benthic and intertidal ecology in the Thanet Extension benthic ecology study area. The environmental impacts arising from the decommissioning of Thanet Extension are listed in Table 5.10, along with the Design Envelope against which each decommissioning phase impact has been assessed.

5.12.2 A description of the significance of effect upon benthic and intertidal receptors caused by each identified impact is provided below.

Temporary habitat disturbance from activities to remove foundations and cables

5.12.3 Temporary habitat loss/ disturbance of subtidal habitat within the Thanet Extension project area will occur as a result of the jack-up vessel operations to remove the foundations and superstructure of the wind farm infrastructure and the removal of the export and inter-array cables.

5.12.4 The total maximum area of temporary habitat disturbance due to jack-up vessels and cable removal during decommissioning is 428,071 m^2. This equates to 0.035% of the wider benthic study area.

5.12.5 Given that the habitats are common and widespread throughout the region, this represents a very small footprint compared to their overall extent. The impacts will be temporary and only a single event in each location; therefore, the magnitude of the impact is assessed as low.

5.12.6 The sensitivities of the species to disturbance are described in paragraph 5.10.9 *et seq*.

5.12.7 The magnitude of the impact has been assessed as Low, with the maximum sensitivity of the receptors being Medium (Table 5.12). Therefore, the significance of effects from direct disturbance occurring as a result of decommissioning activities is **Minor** adverse, which is not significant in EIA terms.

Increased SSC and associated sediment deposition from removal of foundations and cables

5.12.8 Increases in SSC and sediment deposition from the decommissioning works will be similar to that for construction and are of a similar magnitude. The magnitude of the impact and the sensitivities of the benthic habitats to SSC and sediment deposition are described in detail in paragraph 5.7.27 *et seq.* and for the intertidal habitats in paragraph 5.10.47 *et seq*.

5.12.9 The magnitude of the impact has been assessed as Low, with the maximum sensitivity of the receptors being Low. Therefore, the significance of effect from changes in SSC or sediment deposition occurring as a result of decommissioning activities in the subtidal and intertidal area is **Minor** adverse, which is not significant in EIA terms.

Loss of introduced habitat from removal of foundations

5.12.10 As detailed in paragraph 5.11.13, hard substrate introduced into Thanet Extension will become colonised by epifauna. The removal of the foundations during decommissioning would therefore remove these species and associated habitats they create.

5.12.11 Where it is identified that reef structures (e.g. *S. spinulosa* reef) have formed on the foundations, the appropriate approach to the decommissioning of these areas will be agreed with the MMO and Natural England.

5.12.12 The removal of the foundations will result in a permanent loss of 37,710 m^2 of hard substrate. The effects will be strictly localised. Therefore, based on the information available at the time of writing, the expected magnitude of impact is low.

5.12.13 While the removal of the substrate will result in localised declines in biodiversity, areas of bare habitat, lost during construction, will be exposed and will be open to recolonization by the original soft benthic species. It is expected that the baseline benthic communities will recover in these areas to their pre-construction state based on the recovery rates for disturbed sediment, which would equate to a maximum sensitivity for the baseline habitats of medium.

5.12.14 The magnitude of the impact has been assessed as Low, with the maximum sensitivity of the receptors being Medium. Therefore, the significance of effects from the removal of the hard substrate during decommissioning activities is **Minor** adverse, which is not significant in EIA terms.

Permanent habitat loss from scour protection and cable protection left *in situ*

5.12.15 As discussed in Table 5.10 the assessment of impacts during the decommissioning phase assumes that all infrastructure (WTGs, OSS, cables) will be removed, excluding the scour protection and cable protection that will be left *in situ*. WTG and OSS foundations will be removed to one metre below the seabed. It is noted that this is the worst-case scenario, with the final programme to be followed taking account of best available advice and guidance at the time and as per the decommissioning plan.

5.12.16 It is likely that the hard substrate will be colonised by different species and there is the chance that *S. spinulosa* reef will form on the scour protection and cable protection. Where it is necessary to disturb this habitat to complete decommissioning of Thanet Extension, the most appropriate approach will be agreed in advance with Natural England and the MMO.

5.12.17 The removal of all infrastructure, except the scour and cable protection will result in a continuation of some of the habitat loss assessed for the operational phase. In total, up to 0.68 km^2 (0.06% of the wider study area) of scour protection and cable protection will remain *in situ* and will result in permanent habitat loss in this highly localised area. While the impact is permanent and irreversible, the area affected is highly localised and small compared to the wider region where the benthic habitats are widespread; therefore, the magnitude of the impact is assessed as negligible.

5.12.18 The sensitivity of the baseline habitats to this impact is high, due to the permanent nature and change of substrate.

5.12.19 The magnitude of the impact has been assessed as Negligible, with the maximum sensitivity being High. Therefore, the significance of effect for the permanent loss of habitat from the scour protection and cable protection will be **Minor** adverse, which is not significant in EIA terms.

5.13 Environmental assessment: cumulative effects

5.13.1 Cumulative effects refer to effects upon receptors arising from Thanet Extension when considered alongside other proposed developments and activities and any other *reasonably foreseeable project(s)* proposals. In this context the term *projects* is considered to refer to any project with comparable effects and is not limited to offshore wind projects.

5.13.2 The approach to cumulative assessment for Thanet Extension takes into account the Cumulative Impact Assessment Guidelines issued by RenewableUK in June 2013, together with comments made in response to other renewable energy developments within the Southern North Sea, and the PINS 'Advice Note 9: Rochdale Approach'. The renewable energy developments that have informed this approach have been agreed within the Scoping Opinion (PINS, 2017), the suggested tiers, and the Cumulative Impact Assessment conducted for Thanet Extension.

5.13.3 In assessing the potential cumulative impact(s) for Thanet Extension, it is important to bear in mind that for some projects, predominantly those 'proposed' or identified in development plans etc. may or may not actually be taken forward. There is thus a need to build in some consideration of certainty (or uncertainty) with respect to the potential impacts which might arise from such proposals. For example, relevant projects/ plans that are already under construction are likely to contribute to cumulative impact with Thanet Extension (providing effect or spatial pathways exist), whereas projects/ plans not yet approved or not yet submitted are less certain to contribute to such an impact, as some may not achieve approval or may not ultimately be built due to other factors.

5.13.4 For this reason, all relevant projects/ plans considered cumulatively alongside Thanet Extension have been allocated into 'Tiers', reflecting their current stage within the planning and development process. This allows the cumulative impact assessment to present several future development scenarios, each with a differing potential for being ultimately built out. Appropriate weight may therefore be given to each scenario (Tier) in the decision making process when considering the potential cumulative impact associated with Thanet Extension (e.g., it may be considered that greater weight can be placed on the Tier 1 assessment relative to Tier 2).

5.13.5 The projects and plans selected as relevant to the assessment of impacts to subtidal benthic and intertidal ecology are based upon an initial screening exercise undertaken on a long list. Each project, plan or activity has been considered and scoped in or out on the basis of effect–receptor pathway, data confidence and the temporal and spatial scales involved. For the purposes of assessing the impact of Thanet Extension on subtidal benthic and intertidal ecology in the region, the cumulative impact technical note submitted with the Scoping Report (PINS, 2017) screens in the following projects and activities.

5.13.6 The proposed tier structure that is intended to ensure that there is a clear understanding of the level of confidence in the cumulative assessments provided in the Thanet Extension ES is as follows:

Tier 1

5.13.7 Thanet Extension considered alongside other projects/ plans currently under construction and/ or those consented but not yet implemented, and/ or those submitted but not yet determined where data confidence for the projects falling within this category is high.

5.13.8 Built and operational projects will be included within the cumulative assessment where they have not been included within the environmental characterisation survey, i.e. they were not operational when baseline surveys were undertaken, and/ or any residual impact may not have yet fed through to and been captured in estimates of 'baseline' conditions or there is an ongoing effect.

Tier 2

5.13.9 All projects included in Tier 1 plus other projects/ plans consented but not yet implemented and/ or submitted applications not yet determined where data confidence for the projects falling into this category is medium.

Tier 3

5.13.10 The above plus projects on relevant plans and programmes (the PINS Programme of Projects and MMO 'Marine Case Management System' being the source most relevant for this assessment). Specifically, all projects where the developer has advised PINS in writing that they intend to submit an application in the future were considered. This includes, for example, Norfolk Vanguard for which Scoping Reports have been submitted and data availability is limited and/ or data confidence is low.

5.13.11 The specific projects scoped into this cumulative impact assessment, and the tiers into which they have been allocated are presented in Table 5.16 below. The operational projects included within the table are included due to their completion/ commission subsequent to the data collection process for Thanet Extension and as such not included within the baseline characterisation.

Table 5.16: Projects for cumulative assessment

Development type	Project	Status	Data confidence assessment/ phase	Tier
Cable installation	Nemo Interconnector Cable	Consented	High - Third party project details published in the public domain and confirmed as being 'accurate'.	Tier 1
Disposal Area	Nemo Disposal Site B	Open	High - Third party project details published in the public domain and confirmed as being 'accurate'.	Tier 1
Disposal Area	Nemo Disposal Site C	Open	High - Third party project details published in the public domain and confirmed as being 'accurate'.	Tier 1
Disposal Area	Pegwell Bay	Open	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'.	Tier 2
Disposal Area	Pegwell Bay B	Open	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'.	Tier 2
Disposal Site	Ramsgate Harbour Site A	Open	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'.	Tier 2
Disposal Site	Ramsgate Harbour Site B	Open	Medium - Third party project details published in the public domain but not confirmed as being 'accurate'.	Tier 2

Table 5.17: Cumulative Rochdale Envelope

Impact	Scenario	Justification
Cumulative temporary habitat loss	Tier 1: *Construction phase* Nemo Interconnector Tier 2: No other developments to consider	The Nemo replacement export cable will result in temporary habitat loss of 340,000 m^2 in UK waters (within 12 km of Thanet Extension) from the installation of up to two cables in one trench.
Cumulative temporary increases in SSC and associated sediment deposition	Tier 1: *Construction phase* All projects within Tier 1 Tier 2: *Construction phase* All projects within Tier 2	The Nemo Interconnector cable has permission to use three disposal sites, with the two sites screened into this cumulative effects assessment having a total permitted disposal volume of 94,308 m^3. The use of the Pegwell Bay and Ramsgate Harbour disposal sites is primarily for the dumping of sediment removed during maintenance dredging. The use of these sites is intermittent and the volumes used are unknown in advance and therefore it is not possible to determine if the use of the sites will overlap with impacts from the construction of Thanet Extension. However, the while the volumes are likely to be greater, the impacts are likely to be similar to those for the deposition of the drilling arisings predicted for Thanet Extension.
Cumulative long-term habitat loss/ change from presence of foundations and scour protection and cable protection	Tier 1: *Construction phase* Nemo Interconnector Tier 2: No other developments to consider	If cable protection is used, the significance of the effect of long-term habitat loss from the Nemo interconnector cable has been assessed as minor in UK waters.
Cumulative permanent habitat loss/ change from presence of scour protection and cable protection	Tier 1: *Construction phase* Nemo Interconnector Tier 2: No other developments to consider	If cable protection is used, the significance of the effect of permanent habitat loss from the Nemo interconnector cable has been assessed as not significant.

Cumulative temporary habitat loss

5.13.12 The Nemo Cable is currently under construction and is expected is to complete in 2018 while construction of the proposed Thanet Extension development is not planned until 2019; therefore, there will be no temporal overlap of the projects. However, the baseline surveys for Thanet Extension have been undertaken and do not include the effects from this project and therefore the cumulative impacts arising from Nemo Cable and Thanet Extension need to be considered.

5.13.13 The Nemo Interconnector ES identified that the habitats along the route are the same as those identified for Thanet Extension with the addition of *Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles (SS.SCS.CCS.PomB[17]), which has a low sensitivity to abrasion/ disturbance of the surface.

5.13.14 The assessment of the impacts for temporary habitat loss during construction for Thanet Extension details that the maximum sensitivity for the identified habitats to abrasion/ disturbance is medium.

[17] http://www.marlin.ac.uk/habitats/detail/177

5.13.15 The maximum sensitivity of the habitats identified in the area is **medium** and the magnitude has been assessed as **low**. Therefore, the significance of effect from the temporary habitat loss from the installation of Thanet Extension cumulatively with the Nemo Interconnector is **Minor** adverse, which is not significant in EIA terms.

Cumulative increases in SSC and associated sediment deposition

5.13.16 The sediments identified along the Nemo Interconnector route are similar to those identified for Thanet Extension and therefore, sediment disturbed by the installation of all three developments will behave in the same manner, with the impacts being equivalent to those described for Thanet Extension.

5.13.17 The maximum sensitivity for the habitats identified during the surveys for the developments to increases in SSC and sediment deposition is Low (SS.SCS.CCS.PomB which is the only additional habitat identified during the Nemo Interconnector surveys to the Thanet Extension surveys is not sensitive to increases in SSC and 'light' sediment deposition).

5.13.18 The installation of the Nemo Interconnector will result in 94,308 m^3 of sediment displaced. Construction of the Nemo Interconnector is not expected to overlap and therefore, it is not expected that there will be any overlap between sediment plumes.

5.13.19 Separation distances between the projects will be at least 50 m, except at any cable crossings, and therefore there will be limited interaction between the sediment deposition from the different projects and it is unlikely that the cumulative sediment deposition will exceed 5 cm cumulatively from Thanet Extension and Nemo Interconnector.

5.13.20 It is not known what volumes of sediment, if any, will be deposited at the disposal sites identified in Table 5.16. However, as the disposal events are discrete and the disposal areas are wide, it is considered unlikely that the increases in SSC and sediment deposition resulting from the use of the disposal sites combined with the other identified projects will cumulatively exceed the natural variation or the 5 cm smothering baseline to be considered 'light' smothering for the sensitivity assessments.

5.13.21 The magnitude of the cumulative impact from the increased SSC and sediment deposition, in the subtidal and intertidal area, is considered to be low due to the limited interaction between the impacts of the different projects.

5.13.22 The maximum sensitivity to increases in SSC and sediment deposition for the habitats identified is Low and the magnitude of the impact has been assessed as Low. Therefore, the significance of effect is assessed as **Minor** adverse, which is not significant in EIA terms.

Cumulative long-term habitat loss/ change

5.13.23 The presence of introduced hard substrate results in long-term habitat loss in the localised area affected. However, while the habitat will be lost, it is expected that some of the common epifauna will recolonise the introduced substrate. This is particularly likely to occur in the case of SS.SCS.CCS.PomB along the Nemo Interconnector. For all the identified habitats the sensitivity to long-term habitat loss/ change is high.

5.13.24 While the sensitivity of the habitats is high, the area of each of the habitats compared to the extent of the habitats in the wider area is very small. The magnitude of the impact is therefore considered to be negligible.

5.13.25 The maximum sensitivity of the habitats to long-term habitat loss is High and the magnitude of the impact has been assessed as Low. Therefore, the significance of effect is **Minor** adverse, which is not significant in EIA terms.

Cumulative permanent habitat loss/ change

5.13.26 Scour protection and cable protection used on Thanet Extension and Nemo Interconnector may be left *in situ* following the decommissioning of the three projects. This will result in permanent loss of the underlying habitat, however, the likelihood is that this introduced hard substrate will have been colonised and have locally increased the biodiversity.

5.13.27 The sensitivity of the baseline habitats to this impact is high, due to the permanent nature and change of substrate.

5.13.28 The magnitude of the impact has been assessed as Negligible, with the maximum sensitivity being High. Therefore, the significance of effect for the permanent loss of habitat from the scour protection and cable protection will be **Minor** adverse, which is not significant in EIA terms.

5.14 Inter-relationships

5.14.1 Inter-relationships are considered to be the impacts and associated effects of different aspects of the proposal on the same receptor. These are considered to be:

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the project (construction, O&M, and decommissioning); to interact to potentially create a more significant effect on a receptor than if just assessed in isolation in these three key project stages (e.g. subsea noise effects from piling, operational WTGs, vessels and decommissioning); and
- Receptor led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor. As an example, all effects on benthic ecology such as direct habitat loss or disturbance, sediment plumes, scour, jack-

up vessel use etc., may interact to produce a different, or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects might be short-term, temporary or transient effects, or incorporate longer term effects.

5.14.2 A description of the likely inter-related effects arising from Thanet Extension on benthic ecology is provided in Volume 2, Chapter 14: Inter-relationships (Document Ref: 6.2.14), with a summary of assessed inter-relationships provided below.

5.14.3 Potential inter-relationships exist between benthic subtidal and intertidal ecology and:

- Fish and shellfish – impacts to benthic ecology may affect the food resource of fish;
- Water quality – impacts on water quality may result in impacts on benthic ecology; and
- Commercial fisheries – impacts on benthic ecology may impact on the catch of commercial fisheries.

5.15 Mitigation

5.15.1 No significant effects on the benthic and intertidal ecology have been identified as a result of the construction of Thanet Extension. Therefore, no additional mitigation to that already identified in Table 5.11 is considered necessary.

5.16 Transboundary statement

5.16.1 No transboundary impacts are predicted to result from the construction, O&M and decommissioning of Thanet Extension.

5.17 Summary of effects

5.17.1 This chapter has investigated the potential effects on intertidal and subtidal benthic ecology receptors arising from Thanet Extension. The range of potential impacts and associated effects has been informed by scoping responses and consultation responses from stakeholders, alongside reference to existing legislation and guidance.

5.17.2 The benthic habitat types present in the area of the Thanet Extension proposed boundary are widespread in the surrounding area and the impacts of the construction of OWFs and associated infrastructure are well studied. Additionally, the impacts on the local environment are well known from the post-construction monitoring undertaken for TOWF. The impacts considered include those brought about directly (e.g. by the presence of infrastructure on the seafloor) and indirectly (e.g. increased SSC from installation methods). Potential impacts considered in this chapter are listed below (Table 5.18).

5.17.3 Cumulative impacts were also considered and an assessment was carried out examining the potential for interaction of direct and indirect impacts (including the interaction of sediment plumes) as a result of the combined activities of Thanet Extension and other activities in the study area. This includes the installation of electricity cables and disposal sites.

5.17.4 These potential impacts have been investigated using a combination of methods including analytical techniques, the existing evidence base and numerical modelling. In accordance with the requirements of the Rochdale Envelope approach to EIA, the worst-case characteristics of the proposed development have been considered thereby providing a highly conservative assessment.

5.17.5 Even based on this conservative assessment approach, it has been found that all impacts arising from the construction, O&M and decommissioning of Thanet Extension (including cumulatively) on intertidal and subtidal benthic ecology receptors will result in a maximum level of effect significance of **minor** adverse (Table 5.18). The potential effects to intertidal and subtidal benthic ecology receptors are therefore Not Significant in terms of the EIA Regulations (Volume 1, Chapter 3: Environmental Impact Assessment Methodology (Document Ref: 6.1.3)).

5.17.6 A summary of the effects of the proposed development during construction, O&M and decommissioning phases on all intertidal and subtidal benthic ecology at the Thanet Extension site are presented in Table 5.18.

Table 5.18: Summary of predicted impacts of Thanet Extension

Description of impact	Impact	Possible mitigation measures	Residual impact
Construction			
Temporary habitat disturbance from construction activities	**Minor** adverse	N/ A	**Minor** adverse
Temporary habitat disturbance in the intertidal area from cable installation	**Minor** adverse	N/ A	**Minor** adverse
Temporary increase in SSC and sediment deposition	**Minor** adverse	N/ A	**Minor** adverse
Temporary increase in SSC and sediment deposition in the intertidal area	**Minor** adverse	N/ A	**Minor** adverse
Impacts on benthic ecology from noise arising from foundation installation	Not significant	N/ A	Not significant
Direct and indirect seabed disturbances leading to the release of sediment contaminants	**Minor** adverse	N/A	Not significant
O&M			
Long-term habitat loss/ change from the presence of foundations, scour protection and cable protection	**Minor** adverse	N/ A	**Minor** adverse
Colonisation of the WTGs and scour/ cable protection may affect benthic ecology and biodiversity	**Minor** adverse	N/ A	**Minor** adverse
Permanent loss of saltmarsh habitat from alterations to sea wall	**Minor** adverse	N/ A	**Minor** adverse
Direct disturbance to seabed from jack-up vessels and cable maintenance activities	**Minor** adverse	N/ A	**Minor** adverse
Indirect disturbance to benthic habitats from electromagnetic fields generated by inter-array and export cables	Not significant	N/ A	Not significant

Description of impact	Impact	Possible mitigation measures	Residual impact
Introduction of turbid wakes from presence of foundations	**Negligible**	N/A	Not significant
Long-term changes to the seabed habitats from scour effects and changes in the sediment regime	Not significant	N/ A	Not significant
Decommissioning			
Temporary habitat disturbance from removal of foundations and cables	**Minor** adverse	N/ A	**Minor** adverse
Increased SSC and sediment deposition from removal of foundations and cables	**Minor** adverse	N/ A	**Minor** adverse
Loss of introduced habitat from the removal of foundations	**Minor** adverse	N/ A	**Minor** adverse
Permanent habitat loss from scour protection and cable protection left *in situ*	**Minor** adverse	N/ A	**Minor** adverse
Cumulative effects			
Cumulative temporary habitat loss	**Minor** adverse	N/ A	**Minor** adverse
Cumulative increases in SSC and associated sediment deposition	**Minor** adverse	N/ A	**Minor** adverse
Cumulative long-term habitat loss/ change	**Minor** adverse	N/ A	**Minor** adverse
Cumulative permanent habitat loss/ change	**Minor** adverse	N/ A	**Minor** adverse

5.18 References

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