Hornsea Project Four

Fish Habitat Enhancement: Seagrass Restoration Implementation Study and Fish Monitoring Survey Summary

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Revision Summary

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Glossary

Term	Definition
Baited Remote Underwater Video	A video camera inside underwater housing that is mounted on an frame. Bait is placed in a wire cage mounted on a pole in the camera's field of view.
Compensation/ Compensatory Measures	If an Adverse Effect on the Integrity on a designated site is determined during the Secretary of State's Appropriate Assessment, compensatory measures for the impacted site (and relevant features) will be required. The term compensatory measures is not defined in the Habitats Regulations. Compensatory measures are however, considered to comprise those measures which are independent of the project, including any associated mitigation measures, and are intended to offset the negative effects of the plan or project so that the overall ecological coherence of the national site network is maintained.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIP).
Habitats Regulations Assessment (HRA)	A process which helps determine likely significant effects and (where appropriate) assesses adverse impacts on the integrity of European sites. The process consists of up to four stages: screening, appropriate assessment, assessment of alternative solutions and assessment of imperative reasons of over-riding public interest (IROPI) and compensatory measures.
Hornsea Project Four Offshore Wind Farm	The proposed Hornsea Project Four Offshore Wind Farm project. The term covers all elements of the project (i.e., both the offshore and onshore). Hornsea Four infrastructure will include offshore generating stations (wind turbines), electrical export cables to landfall, and connection to the electricity transmission network. Hereafter referred to as Hornsea Four.
Photosynthetically Active Radiation	The amount of light available for photosynthesis.
Planning Inspectorate (PINS)	The agency responsible for operating the planning process for NSIPs.
Report to Inform Appropriate Assessment (RIAA)	The information that the Competent Authority needs to inform an Appropriate Assessment at Stage 2 of the HRA process, and which has been provided by the Applicant in the RIAA (Volume 2, Annex 2: Report to Inform Appropriate Assessment Part 1 (submitted at Deadline 5), Part 2 (REP2-005), Part 3 (AS-016), Part 4 (REP1-012), Part 5-12 (APP-171-178)).
Special Area of Conservation (SAC)	Strictly protected sites designated pursuant to Article 3 of the Habitats Directive (via the Habitats Regulations) for habitats listed on Annex I and species listed on Annex II of the directive

Special Protection Area (SPA)	Strictly protected sites designated pursuant to Article 4 of the Birds Directive (via the Habitats Regulations) for species listed on Annex I of the Directive and for regularly occurring migratory species.

Acronyms

Term	Definition
AEoI	Adverse Effect on Integrity
BRUV	Baited Remote Underwater Video
DCO	Development Consent Order
EEA	Essex Environment Agency
FFC SPA	Flamborough and Filey Coast Special Protection Area
HSM	Habitat Suitability Modelling
IFCA	Inshore Fisheries and Conservation Authority
NEIFCA	North Eastern Inshore Fisheries and Conservation Authority
OEL	Ocean Ecology Limited
PAR	Photosynthetically Active Radiation
RIAA	Report to Inform Appropriate Assessment
SAC	Special Area of Conservation
SoS	Secretary of State
SU	Swansea University
UoH	University of Hull
WFD	Water Framework Directive
YWT	Yorkshire Wildlife Trust

1 Background

1.1 Introduction

1.1.1.1 Orsted Hornsea Project Four Limited (hereafter the 'Applicant') is proposing to develop Hornsea Project Four Offshore Wind Farm (hereafter 'Hornsea Four'). Hornsea Four's proposed array area will be located approximately 69 km offshore, to the east from of the East Riding of Yorkshire. Hornsea Four will include both offshore and onshore infrastructure including an offshore generating station (the offshore wind farm), export cables to landfall, an onshore substation and connection to the electricity transmission network. Detailed information on the project design can be found in **A1.4: Project Description (REP1-004)**, with detailed information on the site selection process and consideration of alternatives described in **A1.3: Site Selection and Consideration of Alternatives (APP-009)**.

1.1.1.2 Following the Applicant's submission, the Applicant has revisited its conclusion of no potential for an adverse effect on integrity (AEoI) in respect of the kittiwake feature of the Flamborough and Filey Coast Special Protection Area (FFC SPA) from Hornsea Four in-combination with other plans and projects. The Applicant maintains its position of no AEoI alone or in combination for all other qualifying species of the FFC SPA and for all other European sites.

1.1.1.3 The fish habitat enhancement measures will provide resilience to the compensation measures for the predicted impact of Hornsea Four as part of a suite of measures. The suite of compensation measures will increase the biogeographic population of each species as required to compensation for Hornsea Four's impact (see **Table 2** of Revision 2 of **B2.6 Compensation measures for FFC SPA Overview, B2.2: Report to Inform Appropriate Assessment Part 1** (submitted at Deadline 5), Revision 2 of **B2.7 FFC SPA: Kittiwake Compensation Plan** (submitted at Deadline 5) and Revision 2 of **B2.8 FFC SPA Guillemot and Razorbill Compensation Plan** (submitted at Deadline 5) for further details on the suite of compensation measures). The Fish Habitat Enhancement Roadmap (**B2.8.6 Compensation measures for FFC SPA: Fish Habitat Enhancement: Roadmap (REP5-032)** submitted at Deadline 5) provides an overview of the anticipated next steps for implementation of fish habitat enhancement as a resilience measure for Hornsea Four, if deemed necessary by the Secretary of State (SoS). This resilience measure is feasible and can be secured, and the Roadmap **(REP5-032)** sets out the approach that will be followed.

1.1.1.4 Fish habitat enhancement seeks to improve vital habitats for fish species, such as those that provide spawning or nursery grounds, to increase the productivity of key prey species for seabirds. Fish habitat enhancement is being pursued as a resilience measure for the compensation measures for:

- black-legged kittiwake (*Rissa tridactyla*);
- northern gannet (*Morus bassanus*);
- common guillemot (*Urea aalge*); and
- razorbill (*Alca torda*).

1.1.1.5 The implementation of the fish habitat enhancement measures will provide further resilience to the compensation measures proposed for kittiwake, gannet, guillemot and razorbill. The Applicant is confident that the measure of extensive large-scale seagrass restoration (up to

a total of 30 ha) will provide resilience to the compensation measures and compensate as part of a package for Hornsea Four.

1.1.1.6 Hornsea Four is expected to operate for 35 years following construction. If required, the accepted measure(s) will be implemented and monitored throughout the operational lifespan of the Hornsea Four.

1.2 Purpose of this document

1.2.1.1 This document presents an update on the ongoing monitoring work and research studies that have been commissioned as part of the Spurn Point trial seagrass restoration effort. Additionally, this document provides an update on the ongoing Seagrass Restoration Site Implementation Study being undertaken to assess the likely implementation success of the overall project and determine whether the defined restoration targets and goals can be achieved in consideration of all project constraints and challenges. This study is also being undertaken to identify other suitable sites for successful large-scale (30 ha) seagrass restoration to inform adaptive management if required.

1.2.1.2 This document also provides an overview of the anticipated next steps for the implementation of fish habitat enhancement as a resilience measure for Hornsea Four if deemed necessary by the Secretary of State (SoS) following the Appropriate Assessment.

2 Ongoing monitoring surveys

2.1.1.1 The following information presents a summary of the ongoing monitoring work and research studies that have been commissioned as part of the trial seagrass restoration effort to fill some of the evidence gaps highlighted in the **B2.8.5 Compensation measures for FFC SPA: Fish Habitat Enhancement: Ecological Evidence (APP-198)** and demonstrate the increased confidence in the contribution of seagrass restoration as a resilience measure for Hornsea Four.

2.2 Seagrass restoration works

2.2.1.1 Prior to obtaining consent of Hornsea Four, the Applicant has commenced seagrass restoration efforts with a trial scheme. In addition to a detailed site Seagrass Restoration Implementation Study (see **Section 3**), the trial seagrass restoration planting will be monitored to determine success at a small scale, prior to expanding the scheme to a wider area.

2.2.1.2 The restoration works are being carried out by the Yorkshire Wildlife Trust (YWT), on behalf of the Applicant, and as such the methodology has been devised by the YWT. The YWT planted 2 hectares (ha) in October 2021 and March 2022 at 1 m^2 planting density. A further 2 ha are proposed to commence planting in Q3 2022. See **Figure 1** below for the current and proposed seagrass restoration areas. The methodology of the seagrass restoration works is detailed in full in **Section 3** of **Revision 4 of B2.8.6 Compensation measures for FFC SPA: Fish Habitat Enhancement: Roadmap (REP5-033)**.

Figure 1: Seagrass survey areas, proposed and current restoration areas and protected areas at the Spurn Point seagrass restoration site. Courtesy of YWT.

2.2.1.3 In addition, a pilot seagrass nursery facility has been established at the Spurn National Nature Reserve, approximately 2 miles from the seagrass restoration area. The seagrass nursery is currently operational, with an aim to germinate collected seagrass seeds in advance of planting. The nursery facility has been constructed in a modular fashion to allow expansion to ensure capacity to provide seed germination for a large-scale restoration site.

2.3 Research Studies

2.3.1 Desktop Feasibility Study

2.3.1.1 The YWT and the University of Hull (UoH) undertook a desktop feasibility study, reviewing the historic extent of the seagrass bed, and building a knowledge base of the Outer Humber environmental conditions and parameters.

2.3.1.2 Furthermore, geomorphological mapping of the site is being undertaken to inform the assessment of the influence of seagrass restoration on sediment and current dynamics. Ongoing monitoring of the site will be undertaken using a combination of in situ and remote sensing techniques, with an aim to provide a better understanding of the seagrass role in fish habitat provision and carbon storage as well as any far-field impacts which seagrass reintroduction may have on the wider area of Spurn Point. Thus far, the baseline conditions of the geomorphological stability and specific water quality parameters of the *Zostera noltii* restoration site at Spurn Point have been established. To date, monitoring of the site since the 2021 seagrass restoration has revealed no detectable influence on sediment dynamics or water quality at the localised scale of assessment.

2.3.2 Fish Nursery Surveys

2.3.2.1 The YWT and the UoH commenced monthly intertidal fish surveys in January 2022 which consist of fyke net, fine mesh pot and water quality surveys; and quarterly nearshore Water Framework Directive (WFD) beam and Mamou trawl surveys. Baited remote underwater video (BRUV) surveys also commenced monthly in May 2022 (coordinated with improving water quality and visibility). The primary aim of these surveys is to identify fish species present across the restored seagrass meadow and potential benefits in providing important nursery habitats with a particular focus on forage fish species.

2.3.2.2 The monthly intertidal fyke netting surveys are undertaken using 3 x fyke nets (7 hoop large double D fyke nets (10mm & 14mm mesh) – 100cm x (2x5.3m) with a 10m leader specification). A 5 mm mesh was stitched to the reduced funnel inside of the Fyke net cod-end to retain sandeel (note a standard net has a 10 mm mesh within the cod-end).

2.3.2.3 Fine mesh pots (plastic prawn pots, with 5 mm mesh) are attached to the front nearshore post of the fykes nets. These pots draw in crabs, shrimp and prawns, reducing damage and entrapment in the fyke nets. The nets are deployed at high (H), medium (M) and low (L) tide points at six stations along the south-west coast of Spurn Head (See **Table 2.1**). Stations 1 to 3 are located over an oyster bed and serve as a control site for the survey. Stations 4 to 6 are located over the seagrass bed. The surveys alternate on a monthly basis between the control and the seagrass sites. The stations are shown in **Figure 2**. The Fyke netting operations take place over a period encompassing two low tides and one high tide to ensure that surveys sample across one full tidal cycle and align with Natural England permissions. Water quality surveys are also undertaken across 50 m belt transects at stations 3 to 6 (stations located at center points of each transect). Samples are taken every 10 m along the

transect using a bell flow system multi-parameter sonde with sensors for dissolved oxygen, turbidity, pH and temperature.

Table 2.1: Fyke netting stations

Station	Coordinates
Station 1 (H)	N53,34.515, E0,04.365
Station 2 (M)	N54,00.646, E0,13.924
Station 3 (L)	N53,47.638, E0,59.296
Station 4 (H)	N53,57.897, E1,17/113
Station 5 (M)	N53,27.918, E0,39.333
Station 6 (L)	N53,35.755, E1,59.962

2.3.2.4 Fyke netting surveys have so far been undertaken in March, May and June of 2022. **Table 2.2** below lists the species recorded within each survey. It should be noted, that previous fyke netting surveys undertaken at the site recorded sandeel in June 2018, November 2019, and April and November 2021. Herring were also recorded in March 2018, and April and November 2021. Both herring and sandeel are key prey for offshore bird species.

Table 2.2: Species recorded in Fyke netting surveys

Survey date	Species recorded
16 March 2022	Atlantic herring (*Clupea harengus*) Common shore crab (*Carcinus maenas*) European smelt (*Osmerus eperlanus*) Plaice (*Pleuronectes platessa*) Pollack (*Pollachius pollachius*) Sea bass (*Dicentrarchus labrax*)
16 May 2022	European smelt (*Osmerus eperlanus*) Flounder (*Platichthys flesus*) Plaice (*Pleuronectes platessa*) Sea bass (*Dicentrarchus labrax*) Sole (*Solea solea*) Turbot (*Scophthalmus maximus*) Unidentified flatfish (*Pleuronectiformes spp.*) Viviparous blenny (*Zoarces viviparus*)
23 June 2022	Sea bass (*Dicentrarchus labrax*) Flounder (*Platichthys flesus*)

Figure 2: Fyke netting survey stations.

2.3.2.5 BRUV (with light attractants) surveys consist of deployments at two stations, within wild seagrass and replanted areas. It is noted that this method is restricted by water visibility and the data obtained limited to species presence where identification is possible. The BRUV is deployed at the following stations:

Table 2.3: BRUV deployment stations

Station	Coordinates
Station 1	N53, 35,31.55, E0,8,13.35
Station 2	N53, 35,43.51, E0,8,28.48
Station 3	N53,35,56.67, E0,8,40.03

2.3.2.6 The BRUV deployment stations are shown in **Figure 3** below.

Figure 3: BRUV deployment stations.

2.3.2.7 To date, the BRUV deployments have not returned any imagery of suitable quality for analysis due to low visibility in the water column.

2.3.2.8 Quarterly WFD beam (1.5m beam trawl) and Mamou trawl surveys are undertaken in the nearshore, to assess finfish abundance. The Mamou Trawl (40' trawl mouth width, 15' trawl mouth depth, 48" floating trawl boards, 25mm knotted wings) is designed as a floating surface trawl which can be set to fish at a specific depth in the water column (See **Figure 5**). The trawl net consists of a 25mm K-dyneema knotless friction reduction belly mesh with a 5mm cod end and is towed at 2-3 knots into the tide. The sampling stations for WFD and mamou trawls are shown in **Figure 4** and a photo of the Mamou trawl in **Figure 5**.

2.3.2.9 These surveys will commence in Q3 2022 and are part of the fish nursery assessment and will aid in detailing the juvenile finfish composition, abundance, biodiversity, seasonality, and biometrics. Sampling will also be undertaken at a site away from the seagrass restoration site to act as a control for comparison.

2.3.2.10 Moreover, the desktop feasibility study detailed above in **Section 2.3.1** will also be used as a comparison for the restoration site.

Figure 4: Nearshore WFD beam and Mamou trawl survey stations.

Figure 5: Mamou trawl net.

2.3.3 Fish Connectivity Surveys

2.3.3.1 Fish connectivity surveys are due to commence in Q3 2022. The primary aim of these surveys is to identify if fish from the Humber Estuary and specifically from areas of seagrass habitat are being recruited into wider North Sea fish populations. The UoH Marine Laboratory will be undertaking a series of pelagic trawls (otter trawls), to capture fish species from various parts of the water column to ensure all species are being considered. The trawls are undertaken with an opening width of 1.5 m to ensure consistency across all trawls. The surveys will aim to capture fish samples (approximately 400), which will include cod, sandeel and whiting, at a variety of locations from the outer Humber Estuary to the locations that will be strategically placed within the outer Humber Estuary and then in a northeast direction following prevailing currents towards the Hornsea Four site, following the likely path of migration of juvenile fish. The trawls are deployed at the following locations:

Table 2.4: Fish connectivity survey stations

Station	Coordinates
Station 1	N53,34.515, E0,04.365
Station 2	N54,00.646, E0,13.924
Station 3	N53,47.638, E0,59.296
Station 4	N53,57.897, E1,17/113
Station 5	N53,27.918, E0,39.333
Station 6	N53,35.755, E1,59.962

2.3.3.2 The stations are shown in **Figure 6**.

2.3.3.3 The surveys will likely be split into two weather windows and will utilise Destructive Stable Isotope analysis to identify site-specific seagrass markers and determine when the fish may have been within the restoration site. The Destructive Stable Isotope will identify distinct chemical composition within fish otoliths that can be compared to chemical composition within nursery habitats to infer location. The aim of this work is to demonstrate connectivity between prey fish species that may travel to or use the Humber as a nursery ground before traveling out into the wider North Sea.

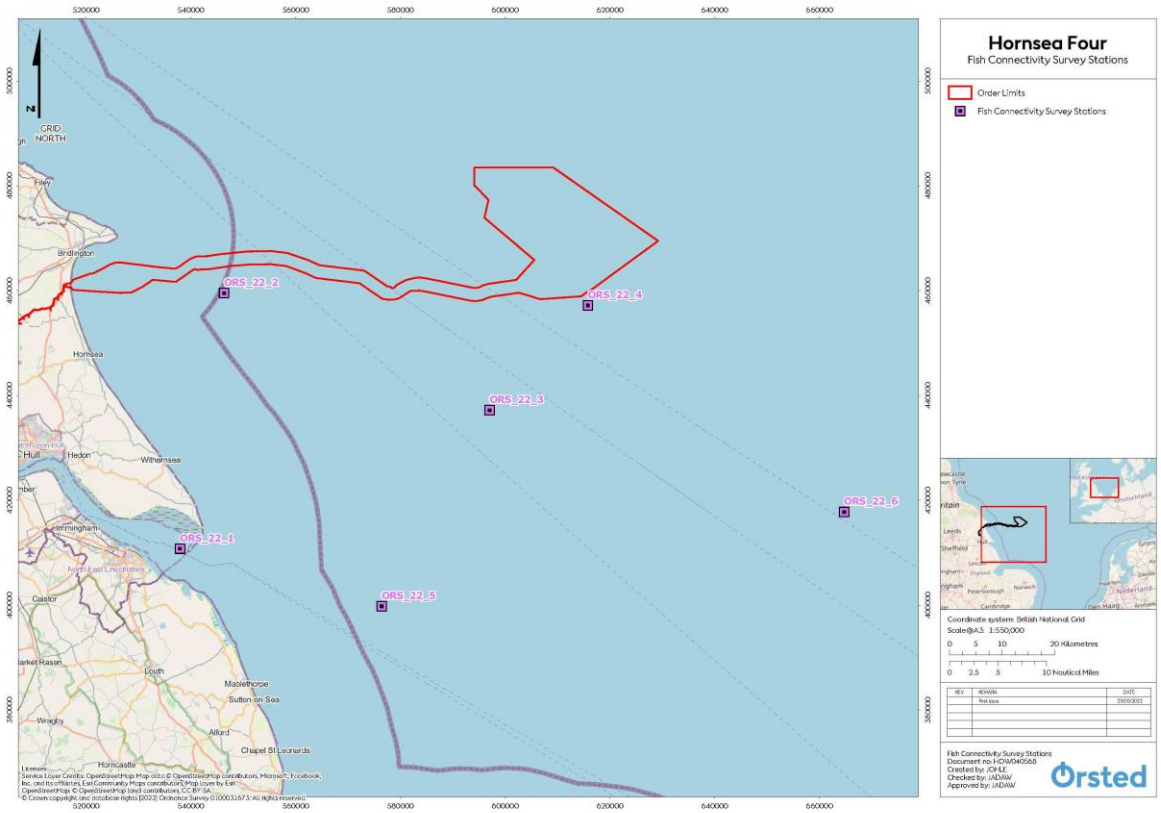

Figure 6: Fish connectivity survey stations.

2.4 Survey Programme

2.4.1.1 Table 2.5 details the proposed survey programme being undertaken by YWT and UoH.

Table 2.5: Indicative timescale of monitoring and research work.

Survey	Survey methods	Occurrence	Duration	2022											2023				
				F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M
Fish nursery surveys (intertidal)	Fyke net (with fine mesh pots) and water quality surveys	Monthly	2022		■		■	■											
Fish nursery surveys (nearshore)	WFD beam and Mamou trawl	Quarterly (ongoing for a minimum of 2 years)	2022 – 2023						■			■			■			■	
Fish connectivity surveys	Otter trawl	Discrete surveys.	2022						■	■	■								

3 Seagrass Restoration Site Implementation Study

3.1.1.1 In addition to the research being undertaken by the YWT and UoH, Ocean Ecology Limited (OEL) and Swansea University (SU) were commissioned to conduct a Seagrass Restoration Site Implementation Study. The study aims to appraise the suitability of sites, including the Spurn Point trial study area to support expansion to a large-scale 30 ha restoration and identify other suitable areas for seagrass restoration which will inform any required adaptive management measures. OEL and SU undertook a detailed site selection study and identified a selection of locations around the English coastline that represent the most suitable sites for successful large-scale (30 ha) seagrass restoration and provide suitable resilience to the wider package of compensation measures. Information used to short list these sites was gathered through expert knowledge, firsthand experience, published literature, and local contacts, as well as Habitat Suitability Modelling (HSM).

3.2 Desktop Review

3.2.1.1 The Seagrass Restoration Site Implementation Study consisted of a desktop review, compiling all existing understanding and knowledge of existing and planned seagrass restoration programmes, with a focus on the assimilation of results of various research studies conducted by Project Seagrass. Information was collated through interviews and questionnaires issued to seagrass restoration practitioners and took account of other project experience and lessons learnt. Any knowledge gaps were targeted through the assimilation

of wider knowledge, through liaison with seagrass restoration practitioners and internet queries.

3.3 Broadscale Screening

3.3.1.1 The desktop review informed broadscale screening of all potential UK restoration sites. HSM was also used to identify broadscale areas that may be favourable for seagrass growth. This was used to predict areas where seagrass restoration could potentially be a success based on factors such as shear bed stress, slope, depth, hydrodynamic connectivity data (e.g. identification of propagule sinks), photosynthetically active radiation (PAR), and sedimentation/erosion rates. Initially broadscale habitat modelling was undertaken, to screen all coastal areas in the UK, to identify and define key regions which present favourable environmental conditions for seagrass growth. The outputs of this screening are presented in Figure 7 below.

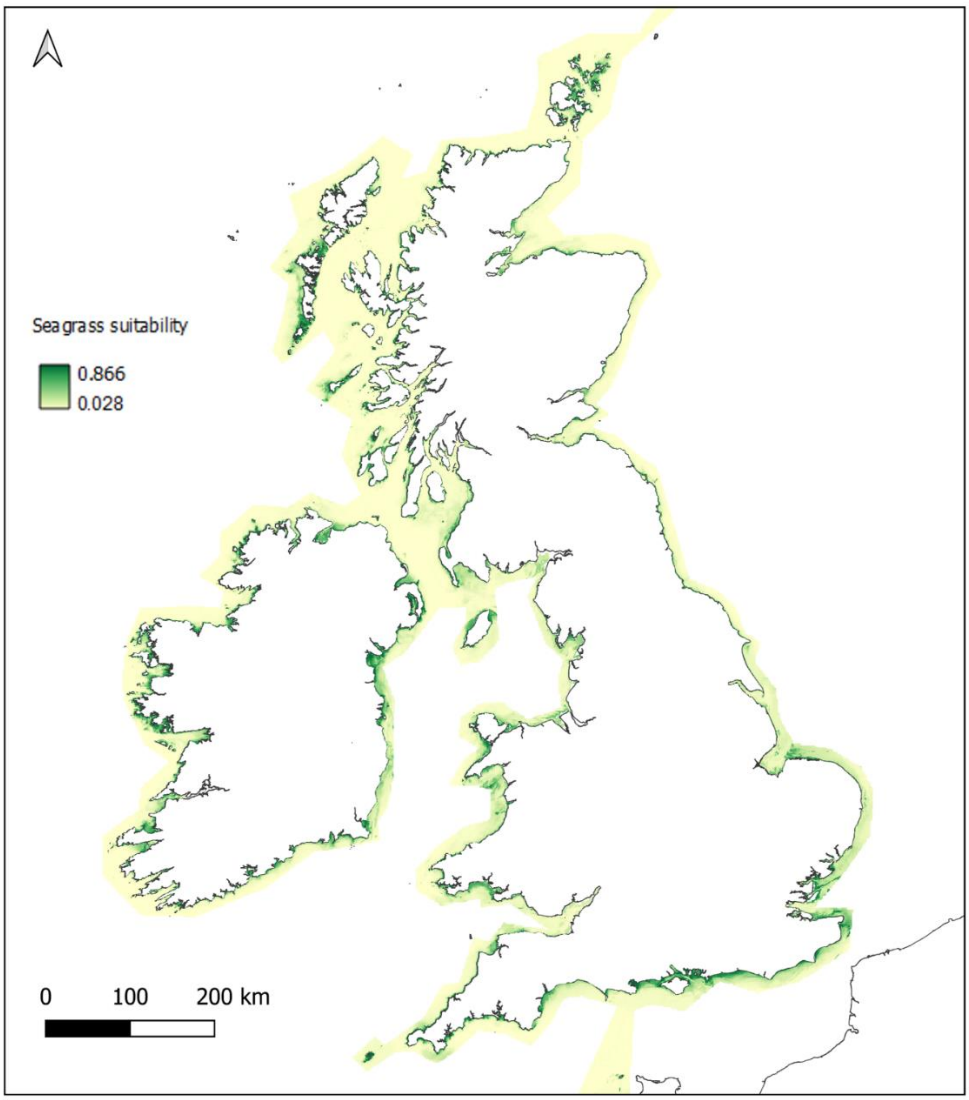

Figure 7: Broadscale Habitat Suitability Modelling (the higher the score the more suitable for seagrass).

3.3.1.2 Following this, the regions identified to be favourable for seagrass growth were screened based on their geography, with all broadscale regions located outside of England screened out. The broadscale regions were then screened based on their ecology, with regions divided based on their potential to restore both intertidal and subtidal seagrass, as connectivity between offshore bird prey stocks may differ between intertidal and subtidal seagrass meadows.

3.3.2 Process of Restoration Site Shortlisting

3.3.2.1 To achieve the desired output of a shortlist of favourable sites for seagrass restoration, seagrass restoration sites were shortlisted following a combined process of broadscale screening and finer scale site suitability assessments, as set out in Figure 8.

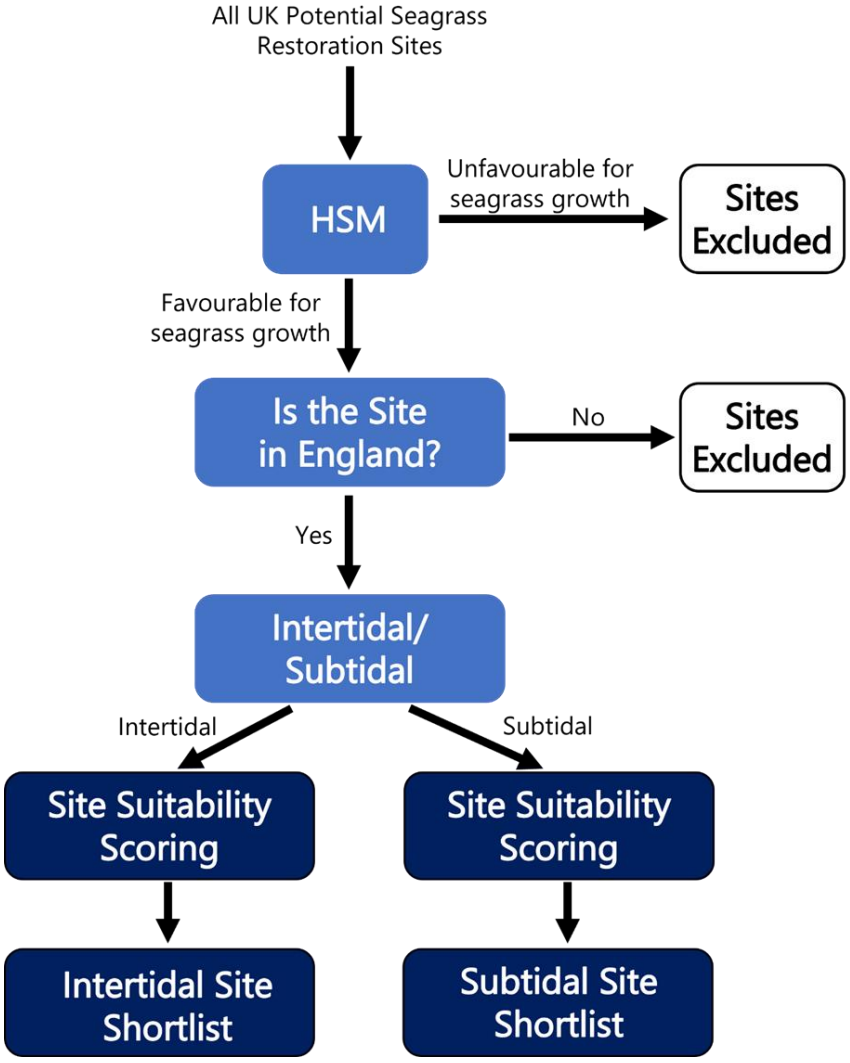

Figure 8: Process applied to shortlist seagrass restoration sites. Light blue: broadscale screening steps. Navy blue: Fine scale site suitability steps favourable/ unfavourable for seagrass growth determined at >/<0.8 probability threshold, respectively.

3.3.2.2 Within the identified broadscale regions, several specific restoration sites were identified by Project Seagrass. The sites identified from the broadscale screening are presented by tidal zone, region, broadscale area and location in Table 3.1.

Table 3.1: Potential locations for seagrass restoration based on Project Seagrass knowledge

Tidal Zone	Region	Broadscale area	Location
Subtidal	South Coast	The Solent and the Isle of Wight	Beaulieu Estuary
			Lymington River
			Medina and Yar Rivers
			Keyhaven Marshes
			Portsmouth Harbour
			Langstone Harbour
Subtidal and Intertidal	Essex and Suffolk	Rivers Stour & Orwell	Pinn Mill
			Jacques Bay
			Copperas Bay
			Wolverstone
			Maningtree to Wrabness
			Lower Holbrook
			Levringham Creek
			Nacton
		River Blackwater	Osea Island
			Goldhanger
			St Lawrence
		River Colne	Point Clear
			Mersea Island
Intertidal	Yorkshire	Humber	Spurn Head

3.4 Fine scale Screening

3.4.1.1 Using the HSM outputs from the broadscale screening (Figure 7), which identified several sites that were predicting the presence of seagrass suitability habitats, three broadscale areas were selected for further fine scale model re-runs (selected as they had a ≥ 0.8 predictability threshold). These sites were The Solent, the Essex Coast and The Humber. The outputs from the fine-scale HSM are shown in Figure 9.

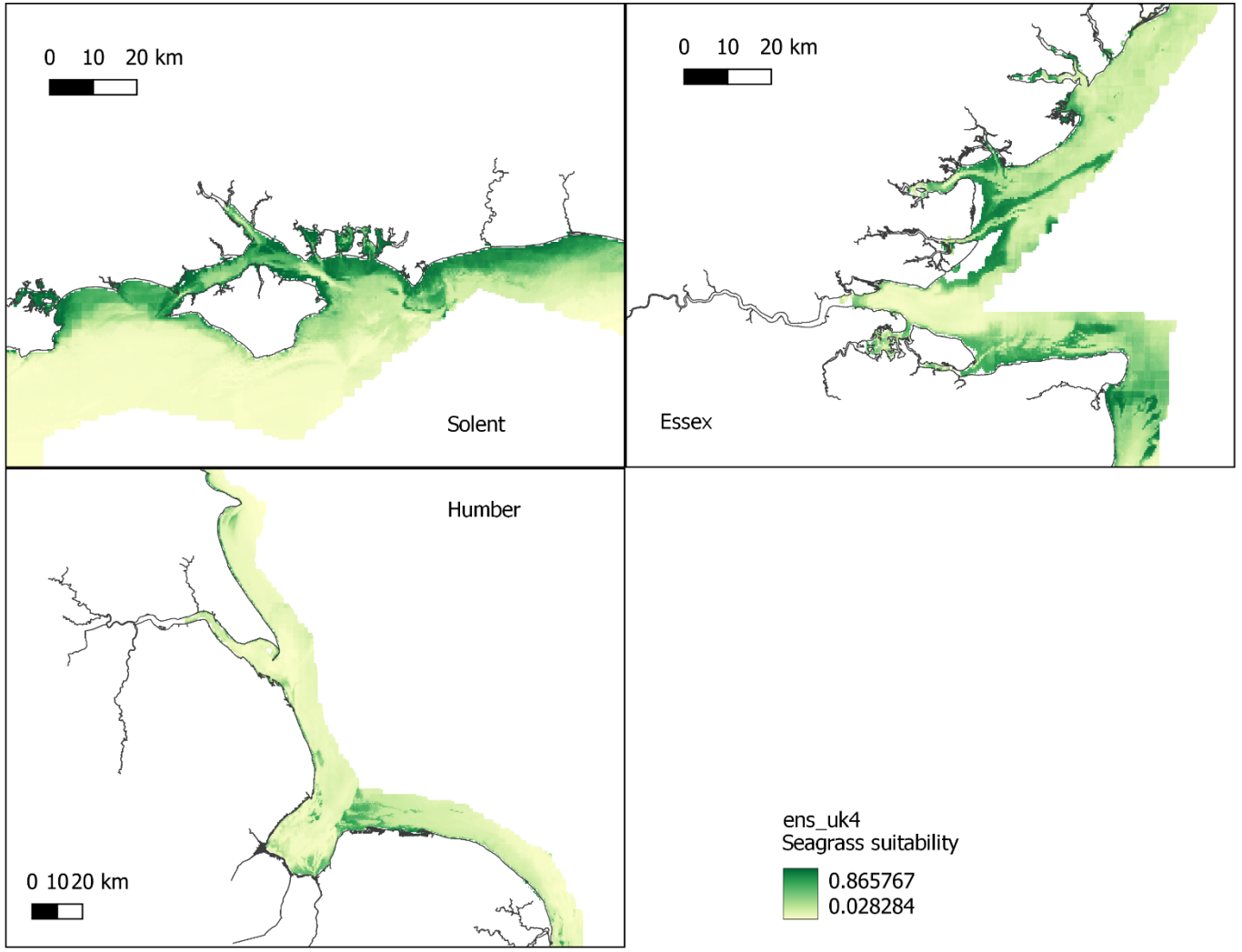

Figure 9: Finer scale HSM outputs for the Solent, Essex coast and Humber using a gradient colour ramp (the higher the score the more suitable for seagrass).

3.5 Site Suitability Scoring

3.5.1.1 The key sites identified in the broadscale screening, were then progressed into site suitability scoring. The scoring system was designed to consider a range of factors deemed pertinent to both successful seagrass restoration and the wider project goals. A total of 36 considerations were compiled and separated into 8 broad themes:

- Geography (includes consideration of likelihood of the site to support feeding offshore bird species, and accessibility of the site);
- Environmental and biological (includes consideration of presence of seagrass and monitoring schemes, sediment types, fish populations and nature of the site (sheltered or exposed));
- Existing restoration efforts (consideration of seagrass restoration project already in place, funding, seed harvesting);
- Historic data (consideration of historic presence of seagrass, reasons for decline/die off of seagrass);
- Land ownership (consideration of types of landowners, potential conflicts, incurred costs, and protected areas within the site);
- Local conflicts (consideration of contacts, response to initial outreach, support from local stakeholders);
- Conflicting interests (consideration of the potential for conflict with fishermen or local residents, potential for wider or regional push back, and popularity of the site with tourists); and
- Anthropogenic (presence of agricultural or sewage outfalls, coastal infrastructure, recent seabed disturbance, any known plans for development).

3.5.1.2 These themes were then scored for each of the restoration sites that passed the initial broadscale screening. A 1-3 scoring system was used, as this accommodates categorical (High/Medium/Low, Pass/Partial/Fail) as well as numerical scoring. The scores were totaled for each site, as well as for each theme for each site, and each site assigned a Red, Amber, Green categorisation to further rank sites in terms of potential for successful restoration.

3.5.1.3 A shortlist was produced of promising seagrass restoration sites, following the scoring of each potential restoration site. The higher the score the more suitable the site is for seagrass restoration. The sites were shortlisted independently for intertidal and subtidal restoration areas. The short-listed sites are listed in **Table 3.2** alongside their respective scores, and the top two sites for each tidal zone described below in **Sections 3.5.2 and 3.5.3**, detailing the influential factors behind their scoring.

Table 3.2: Shortlisted sites for seagrass restoration, nested under broadscale areas and regions.

Tidal Zone	Region	Broadscale area	Location	Rank	Site suitability score (out of 100)
Intertidal	Yorkshire	Humber	Spurn Head	1	90.48
	Essex and Suffolk	Rivers Stour & Orwell	Jacques Bay	2	75.24
			Nacton	3	74.9
Subtidal	Essex and Suffolk	Rivers Stour & Orwell	Jacques Bay	1	75.24
			Nacton	2	74.9
	South Coast	The Solent and the Isle of Wight	Portsmouth Harbour	3	72.38
	Essex and Suffolk	Rivers Stour and Orwell	Pinn Mill		
			Copperas Bay		
			Lower Holbrook		
			Levingham Creek		

3.5.2 Spurn Head (Intertidal site)

3.5.2.1 Over recent years the YWT have been involved in active restoration of *Z. noltii* at Spurn Point in the Humber Estuary. Dedicated efforts to protect seagrass within the Humber Estuary began in the early 2010s with the identification of seagrass as a Special Area of Conservation (SAC) feature and subsequent protection of these habitats under Inshore Fisheries and Conservation Authority (IFCA) bylaws, primarily targeting the cessation of bait digging in the area (EIFCA 2020). Initial work towards seagrass restoration in the Humber began with a feasibility review in 2017/18, looking at historic records, current seagrass extent and habitat suitability. Historic records revealed over 500 ha of seagrass in this area which is currently down to around 40 ha. An initial trial restoration of 0.5 ha was subsequently undertaken. More recently, funding has been secured from a number of sources, including Orsted, for the trialed restoration of four ha of *Z. noltii* at Spurn Point, two of which have already been planted. Initial results are positive and indicate a 70% uptake rate of seed planting.

3.5.2.2 Importantly, YWT own the restoration area outright and have been working closely with the UoH in the collection of environmental data as well as fish population data from this area. As part of this monitoring, the UoH have begun a dedicated study using stable isotope analysis to investigate the connectivity specifically between fish populations in the Humber (Spurn Point) and offshore fish populations in the vicinity of the proposed Hornsea Four site. There are also plans underway to increase the protected area under the EIFCA bylaws from around 30 ha to over 117 ha, prohibiting bait digging in this entire area. Areas of seagrass,

seagrass restoration, and protected areas at the Spurn Point restoration area are presented in **Figure 1**.

3.5.3 Jacques Bay and Nacton (subtidal and intertidal sites)

3.5.3.1 A series of historic reports document seagrass loss in the River Stour with indications that there is now very little if any left. Previous descriptions refer to extensive seagrass between Manningtree and Wrabness, as well as seagrass at Lower Holbrook. Locations of seagrass loss are less clearly defined within the Orwell.

3.5.3.2 Communications with Tim Gardiner of the Essex Environment Agency (EEA) were undertaken to develop further understanding of seagrass extent and the potential for restoration in the Stour and Orwell. Considerable work has been done since early 2020 to identify and describe seagrass beds within these two rivers (Gardiner 2021a b). Seagrass here is primarily *Z. noltii* with only several small patches of *Zostera marina* present. Seagrass extent is estimated at around 10 ha, which is up to 10 times that of previous estimations made by Project Seagrass. Through regular site visits along both the Stour and Orwell, Gardiner (2021a b) compiled a comprehensive review into the state *of Z. noltii* which covers localised sites of seagrass and habitat assessments for potential areas for restoration.

3.5.3.3 Seagrass extent has been correlated to several environmental variables including presence of *Sporobolus* sp. in the vicinity, distance to freshwater, distance to sewage outfalls, and macroalgae cover, among others (Gardiner 2021b). Notably, *Z. noltii* patches were positively correlated with the presence of *Sporobolus* sp. and significantly positively correlated to distance from fluvial and sewage outfalls, whereby seagrass extent was significantly greater with increased distance from sources of nutrient input. These observations are pertinent to the selection of restoration areas.

3.5.3.4 Opportunistic macroalgae has been identified as a potential concern for restoration efforts in the Stour and Orwell, however this is heavily correlated to fluvial and sewage inputs and could therefore be considered during site selection. There is considerable work underway in this area to better understand the overall current seagrass extent, environmental conditions and sediment types through the work of the University of Essex and an associated master's research project.

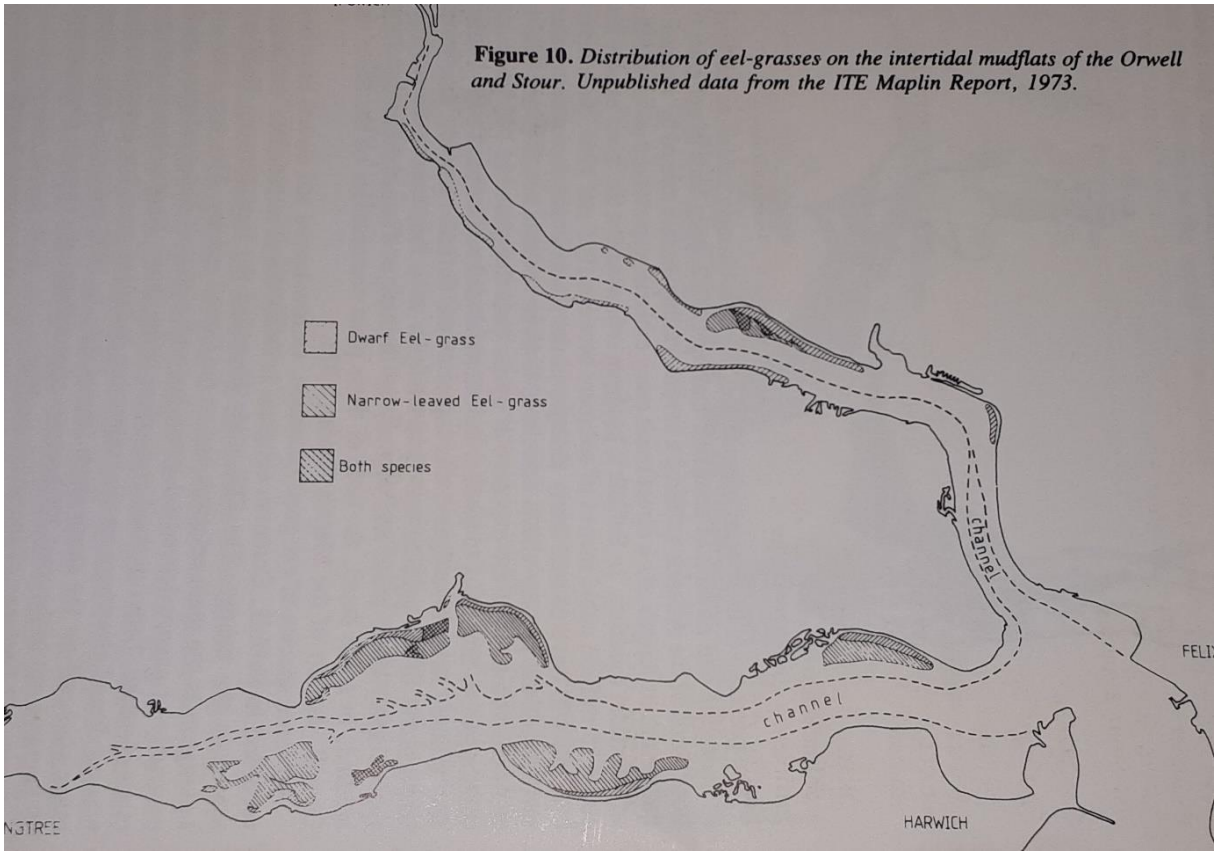

Figure 10: Distribution of seagrass in the rivers Stour and Orwell in 1973. These meadows have been reduced to approximately 10 ha with an estimated coverage of 343 ha in 1973.

4 Conclusions and Next Steps

4.1 Ongoing Monitoring Surveys

4.1.1.1 As part of ongoing monitoring and adaptive management, site-specific monitoring and environmental evaluation will be undertaken quarterly between the calendar years 2023 and 2029. This will include nearshore finfish surveys utilising WFD beam and Mamou trawl at seagrass and control sites, assessment of finfish abundance, and nearshore technical fish monitoring surveys and reporting, which will be undertaken by the UoH Marine Laboratory. The fish nursery surveys undertaken in 2022 at Spurn Point have recorded numerous fish species, including herring and other prey species.

4.2 Seagrass Restoration Site Implementation Study

4.2.1.1 The site suitability scoring undertaken as part of the Seagrass Restoration Site Implementation Study identified the following intertidal sites as suitable for seagrass restoration: Spurn Head, Jacques Bay and Nacton. The following subtidal sites were identified: Jacques Bay, Nacton, Portsmouth Harbour, Pinn Mill, Copperas Bay, Lower Holbrook and Levingham Creek (Table 3.2).

4.2.1.2 As presented in Table 3.2, the intertidal site Spurn Head in the Humber Estuary was allocated a score of 90.48 out of 100, significantly higher that all other assessed intertidal

and subtidal sites (scores ranging from 72.38 to 75.24). The score allocated to Spurn Head was primarily influenced by the following factors:

- YWT lease the site, and have been working closely with the UoH in the collection of environmental data as well as fish population data from this area;
- A bylaw (the Humber Fishing Bylaw) is already in place for the site for the protection of seagrass habitats, primarily targeting the cessation of bait digging in the area (approximately 30 ha) (EIFCA 2020);
- The YWT has engaged the North Eastern Inshore Fisheries and Conservation Authority (NEIFCA) to expand the protected area within which the bylaw is implemented, accounting for long-term stability results and spillover of seagrass from the original extent. A proposal was taken to the NEIFCA authority in December 2021 to review and define new boundaries which was approved and is currently in the informal consultation stages with sight to a formal submission in the latter stages of 2022; and
- Funding has been secured for the trialled restoration of 4 ha of *Z. noltii* at the site. Thus far 2 ha have already been planted, with initial results indicating a 70% uptake rate of seed planting.

4.2.1.3 It is on this basis, that the Humber Estuary is considered to the preferable site for seagrass restoration within the Seagrass Restoration Site Implementation Study.

4.2.1.4 As detailed in **Section 2.2** the Applicant has commenced seagrass restoration comprising an initial trial study for seed collection, storage, nursery and planting to be completed in advance of determination of the DCO application at a site within the Humber Estuary. The success of the pilot study shall inform a subsequent large-scale delivery of a larger seagrass restoration project, including the planting of 30 ha within the Humber Estuary. Full restoration efforts will begin following determination of the DCO Application by the SoS, subject to consent award, the SoS's decisions, and Financial Investment Decision, once consent is granted.

4.2.1.5 In the unlikely situation where adaptive management is required, then this research has identified the locations Jacques Bay and Nacton in Essex as suitable for seagrass restoration.

5 References

EIFCA (2020) Eastern Inshore Fisheries & Conservation Authority Bylaws.

Gardiner T (2021a) The Conservation Status of Dwarf Eelgrass (*Zostera noltei*). Ref Modul Earth Syst Environ Sci.

Gardiner T (2021b) The state of Dwarf Eelgrass *Zostera noltei* in the Stour and Orwell estuaries. Essex Nat 38.