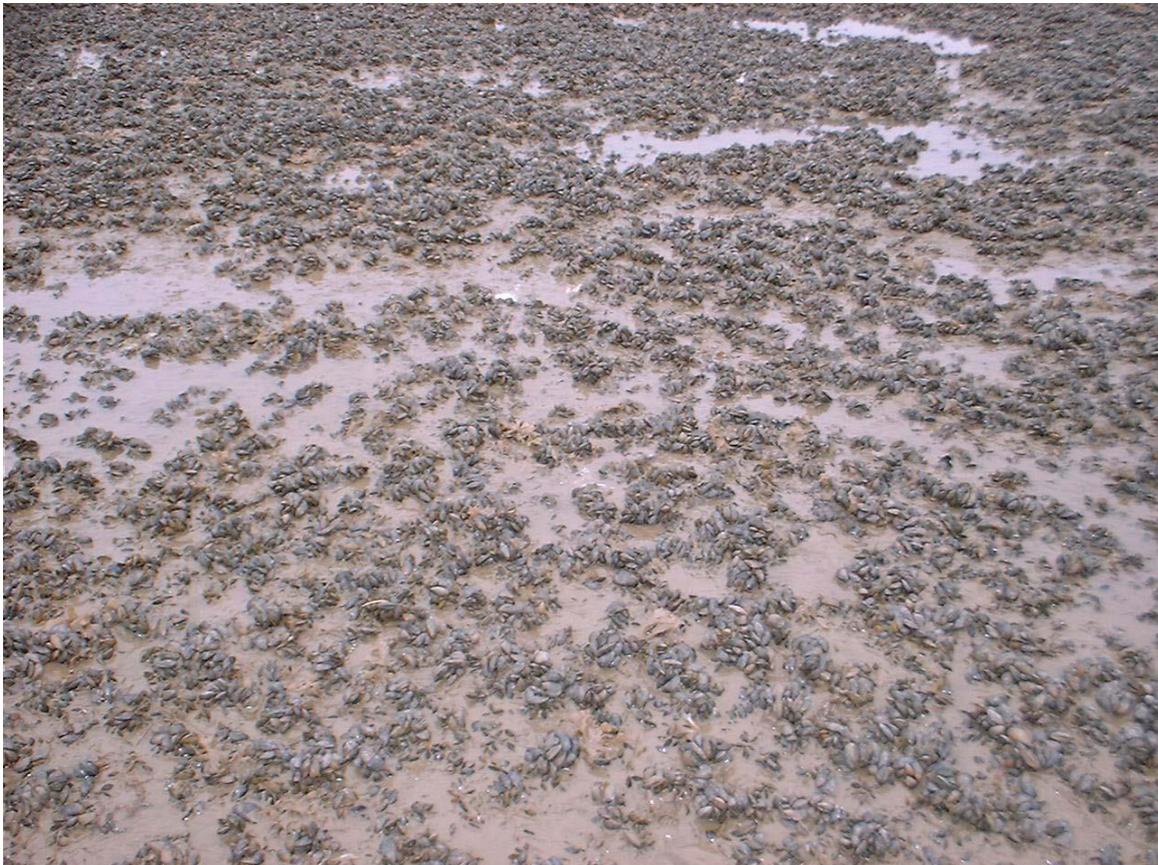




## **The Wash Several Fishery Order (2022) Management Plan**

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# The Wash Several Order (2022) Management Plan

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## 1.0 INTRODUCTION

### 1.1 Objective

Eastern IFCA is applying for a Several Order under the Sea Fisheries (Shellfish) Act 1967. This Order is intended to replace the several fishery aspects of the existing Wash Fishery Order 1992 (WFO) when it expires 3 January 2023. The WFO is a hybrid Several and Regulating Order, which is used to manage the wild and private bivalve mollusc fisheries in the Wash since it came into effect in 1993. Eastern IFCA, and its predecessor, Eastern Sea Fisheries Joint Committee (ESFJC), is the grantee of the WFO. The Regulated aspects of the Wash Fishery Order (1992) are planned to be replaced with a byelaw, so will not be detailed in this plan.

The Wash hosts several important conservation designations and fisheries supporting a fleet of circa 55 vessels. Fishing opportunity is however limited to cockles, brown shrimp and to a lesser extent whelks and mussels. The Wash has historically supported aquaculture and most recently this has involved use of small, inter-tidal areas leased to individuals who lay mussel seed and cultivate it to sell on as adult mussel. Aquaculture can, in of itself, benefit Wash fisheries particularly in relation to wild mussel fisheries, which have been in decline in The Wash, as a means of introducing additional spawning stock into The Wash which would in turn to contribute towards wild fisheries.

Aquaculture in The Wash has been underutilised under the Wash Fishery Order 1992. This reflects in part the lack of seed from within The Wash itself and the retention of Lays by persons who are no longer actively engaged in the Wash fisheries. Those more active in the aquaculture operations of The Wash have tended to rely on obtaining seed from outside of The Wash. Overall, aquaculture operations have been very informal and lack more detailed planning which would be expected where lease holders were the holders of the Order themselves.

The Wash Several Order 2022 is intended to provide the continuation of aquaculture within The Wash as a means of reducing the burden and reliance on the other Wash fisheries, to enhance environmental and fisheries sustainability. Eastern IFCA is applying to be the grantee to sub-lease lays to fishers to facilitate aquaculture operations by providing a robust management structure within which the industry can operate in accordance with our statutory responsibilities. More emphasis will be placed on operators to show how they intend to operate within this structure and to evidence this to continue to maintain lay allocation.

Allocation of lays will be limited to those who are active within the Wash molluscan shellfish fisheries and those who provide a credible business plan which evidences responsible fishing operations. Use of the lease will be conditional on operating under requirements which mitigate the potential impacts the environment and fisheries sustainability. Eastern IFCA will monitor and enforce these conditions to ensure compliance and to ensure that the most effective and productive use of lays.

## **Aim**

To enable and facilitate aquaculture within The Wash which furthers the conservation objectives of The Wash marine protected areas, enhances sustainability of other Wash fisheries and supports economic viability for associated industry.

## **Objectives**

- Restrict the allocation of lays to persons who are actively fishing within The Wash and who can evidence best practice through submitting a business plan;
- Allocate lays on a fair and equitable basis across those eligible on the strength of the application made, taking into account that there is a finite resource which may be oversubscribed;
- Allocate lays only in areas of The Wash which can support such without impacting on site integrity of the Wash marine protected areas or the sustainability of wild fisheries resources;
- Restrict the allocation of lays to a total area not exceeding the established maximum sustainable within The Wash;
- Restrict aquaculture operations using lease conditions to ensure that when returned to the public fishery, they can support natural habitats and species as would ordinarily occur within The Wash;
- Monitor operations to ensure that they are compliant with conditions of their issue and the statutory responsibilities of Eastern IFCA and have mechanisms to redress operations which are not.

As a grantee of an Order, the Authority is required to produce a management plan to accompany the application. The objective of this document is to outline the extent of the proposed Wash Several Order (2022) and the management of activity within this defined area.

The Wash Several Fishery Order (2022) is intended to come into force on the date of expiry of the Wash Fishery Order 1992. The proposed Order is granted for a period of 30 years. Eastern IFCA will comply with all of its requirements under the Order and will also endeavour to ensure that lease holders comply.

### **1.2 Extent of the Wash Several Order (2022)**

The Wash Several Order (2022) will enable Eastern IFCA to grant exclusive fishing rights to individuals for the purpose of aquaculture within leased areas called “lays”. The Several Order shall include the entire Wash embayment except that area of the embayment covered by the le Strange Estate. This Order replaces the area formally managed under the Wash Fishery Order 1992 and an area of The Wash which was formally considered to be part of the le Strange Estate but which, as a result of a

Supreme Court judgement<sup>1</sup>, become part of the public fishery. Figure 1 highlights the extent of the new Order. The approximate area of the Several Order is 62,430 ha.

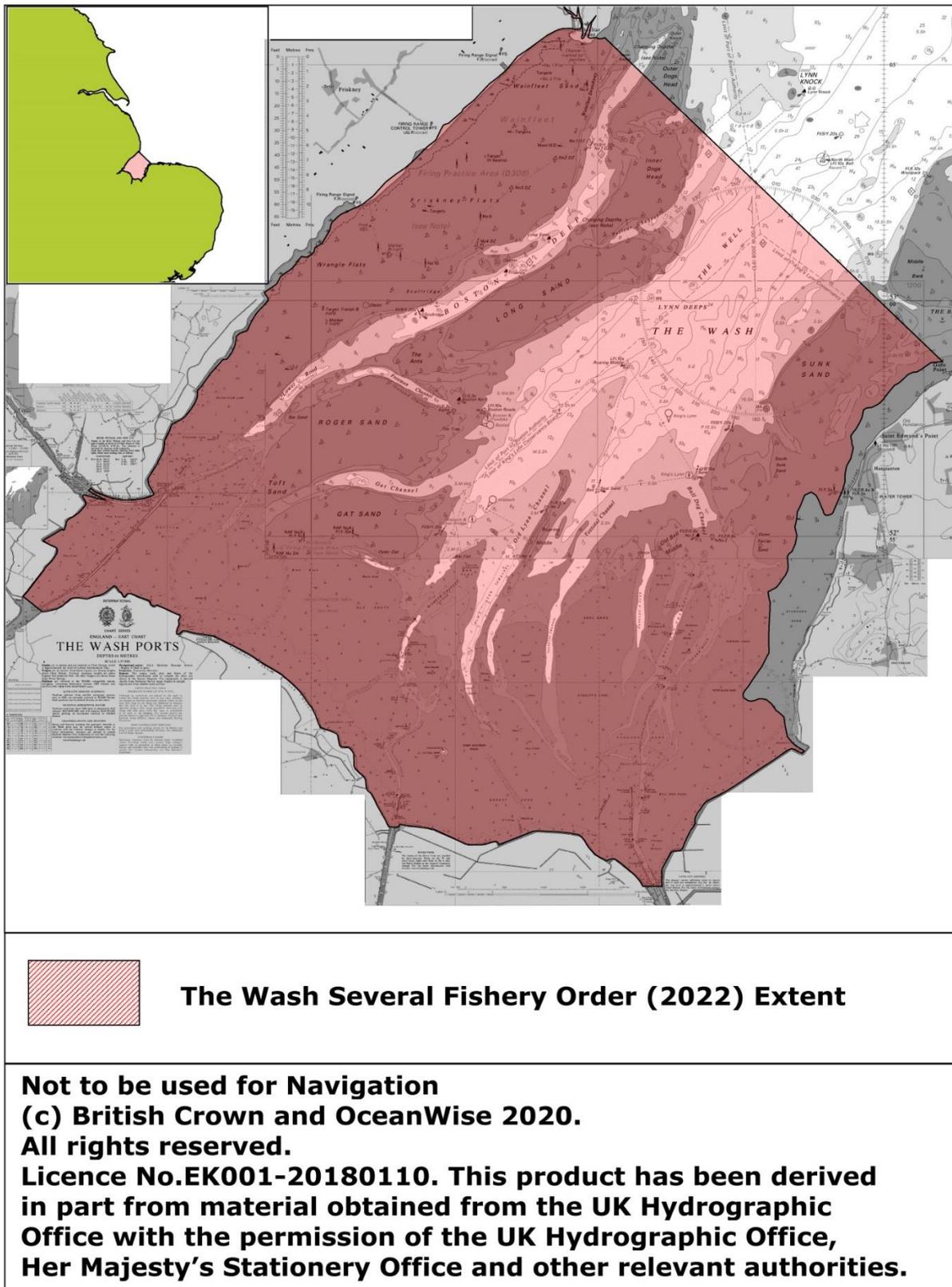


Figure 1 – Chart showing the extent of the Wash Several Fishery Order (2022)

### 1.3 Species covered by the Order

The “prescribed species” included by the Order are:

- Blue mussel, *Mytilus edulis*
- Common Cockle, *Cerastoderma edule*
- Native Oyster, *Ostrea edulis*
- King Scallop, *Pecten maximus*
- Queen Scallop, *Aequipecten opercularis*
- Carpet shell clams, *Tapes rhomboides*, *Venerupis* spp, *Ruditapes* spp,

Due to concerns associated with the spread of Invasive Non-Native Species, Pacific oyster, *Magallana gigas*, will not be included as a prescribed species of the Wash Several Fishery Order (2022).

Whilst the list above is relatively broad, application for a lay would include consideration of the appropriateness of the species to cultivated including its potential to become established in the area as an invasive, non-native species.

## 2.0 BACKGROUND

### 2.1 The Wash

The Wash is situated on the east coast of England, where it separates Norfolk from Lincolnshire. It is the largest embayment in the UK, covering an area of approximately 667 km<sup>2</sup>, roughly 45% of which is intertidal sand and mudflats, interspersed by small creeks and navigable channels. The embayment is predominantly fringed by some of the most extensive salt marshes in the UK, plus stretches of sand dunes at Gibraltar Point and shingle banks at Heacham to Snettisham. In the deeper, central parts of The Wash, there are extensive subtidal sandbanks that serve as important fish nursery ground and biogenic reefs of *Sabellaria spinulosa*.

Four main rivers - the Witham, Welland, Nene and Great Ouse flow into The Wash, providing a hydrological catchment area of 15,920 km<sup>2</sup> (Cefas, 2013). While The Wash has a 19 km mouth connecting it to the North Sea, these four rivers provide it with estuarine characteristics and a rich supply of nutrients. These nutrients mean The Wash mudflats are highly productive and rich in invertebrate life, including abundant populations of polychaete worms, small crustacea and bivalve molluscs – most notably the cockle and mussel beds that support commercial fisheries. These invertebrate populations in turn provide a food source for internationally important populations of migratory and resident wildfowl and wading birds that frequent the site. The Wash is also an important site for common seals, *Phoca vitulina*; the edges of the sandbanks and mudflats providing key habitat for breeding and hauling-out.

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<sup>1</sup> judgement of Mr David Halpern QC sitting as a deputy High Court judge and handed down by the High Court on the 27th July 2018 with the reference John Henry Loose -v- Lynn Shellfish and others: Neutral Citation Number:{2018] EWHC 1959(Ch)

In addition to its ecological importance, The Wash provides access to commercial shipping using the ports of Boston, Wisbech and King's Lynn and supports some major fisheries. These include some of the most important cockle (*Cerastoderma edule*), mussel (*Mytilus edulis*) and brown shrimp (*Crangon* spp) fisheries in the UK and locally important stocks of brown crab (*Cancer pagurus*), lobster (*Homarus gammarus*) and whelks (*Buccinum undatum*).

## 2.2 The Wash Fisheries

Historically, shellfish have been harvested from The Wash since at least the 1100s. Until the railway network reached Boston and King's Lynn in the 1840's, however, these were mainly subsistence fisheries that only supplied local markets. Once transport systems opened up markets in other UK towns and cities the Wash fisheries rapidly expanded. By the 1890s, there were approximately 300 boats and over 800 fishermen targeting the Wash shellfish stocks. This rapid expansion proved unsustainable, however, resulting in several stock declines between 1850-1900. In 1894 Eastern IFCA's predecessor, Eastern Sea Fisheries Committee was formed by the Boston and King's Lynn councils to regulate the Wash fisheries. Manpower shortages caused by the two world wars caused these fisheries to decline in importance until they began to recover again in the 1960s. In the 1980s, during a period of modernisation, most of the old wooden boats from Boston and King's Lynn were replaced with larger steel vessels, resulting in a modern fleet of circa 55 boats, each capable of efficiently targeting all the local fisheries. Among them, some have been designed with aquaculture specifically in mind, having large holds and through-hull flushing systems to facilitate the bulk relaying of mussel seed.

During the past twenty years, the main fisheries targeted by the boats from King's Lynn and Boston have been for brown shrimp (*Crangon* spp), cockle (*C. edule*) and mussel (*M. edulis*), while in the past ten years the whelk (*B. undatum*) fishery has become increasingly important. The deeper parts of The Wash also support important brown crab (*C. pagurus*) and lobster (*H. gammarus*) fisheries, mainly targeted by boats from Wells-upon-Sea and Brancaster. Fisheries for pink shrimp (*Pandalus montagui*) and sprat (*Sprattus sprattus*) were both important until the 1990s, but have subsequently declined, mainly due to declining market values and/or quota restrictions.

Until its relatively recent decline over the past ten years, The Wash supported one of the largest mussel fisheries in the UK. Traditionally, mussels were fished from natural beds, but over-exploitation in the 1990s, led to a collapse in stocks that resulted in Eastern Sea Fisheries Joint Committee introducing stringent management measures. The increased protection of natural mussel stocks has led to a new emphasis on mussel cultivation, in place of direct harvesting from natural beds.

## 2.3 Historic importance of aquaculture in The Wash

Barring a few isolated initiatives to cultivate Pacific oysters (*Magallana gigas*) in The Wash, the majority of the aquaculture has focused on mussels. Mussel cultivation has been carried out in The Wash for at least 100 years, with partially-grown juvenile mussels being deposited directly on to rented areas of the seabed, known as "lays", for growing on to a harvestable size. These lays not only provide the fishermen with a

reserve of mussels that help reduce their reliance on the fluctuations of the wild stocks, but those situated on the sheltered edges of sandbanks, close to the river mouths, traditionally provided a source of mussels when the weather was too rough to venture as far as the wild beds. Although the introduction of larger, more sea-worthy vessels in the 1980s enabled boats to venture further afield in rougher weather than had previously been safe to do so, mussel cultivation on the lays grew in importance. This has been due to mussels grown on the lays being better quality than those from the wild beds. Being situated in the eulittoral zone, where they have longer feeding opportunities than those on the wild beds located higher up in the intertidal zone, the mussels deposited on them tend to grow more rapidly than those on the wild beds. This not only helps to produce higher meat-yields, but also cleaner shelled individuals that are free from barnacles. The fishermen's management of the lays also provides a monoculture of uniform size mussels that are easier to process when harvesting. Such is the importance of the lays, since the 1990s, landings of cultivated mussels have greatly exceeded those landed directly from the wild beds.

Traditionally, the lays were stocked with juvenile mussels that had been collected from the wild intertidal beds. Since the 1990's, however, the increasing demand for mussel seed, coupled with declining wild stocks on the intertidal beds and conservation measures limiting quota, mean the wild beds have not been able to satisfy the several fishery's requirement for seed. Occasionally seed is purchased from other mussel fisheries in the UK, but with the price of mussel seed exceeding £120/tonne, the cost is often prohibitive, or too much of a risk for many fishermen to invest in. Since 2000, fishermen have trialled relaying mussel seed collected from sublittoral beds found along the Lincolnshire and Norfolk coasts and from The Wash. Between 2000 and 2012 this proved a relatively cheap source of seed that didn't threaten the sustainability of the wild intertidal beds. At its peak, some years over 10,000 tonnes were relayed from sublittoral beds into the several fishery. However, since then, windfarm construction site exclusion zones and/or Marine Protected Area conservation measures have prevented access to most of these beds. In the past ten years, limited access to both sublittoral and intertidal beds have starved the several fishery of seed, causing landings from it, and the whole mussel fishery in general, to badly decline.

#### **2.4 Wash Fishery Order 1992 Several Fishery**

The Wash Fishery Order 1992 (WFO) is a hybrid Regulating and Several Order that grants Eastern IFCA the right of several fishery, and of regulating a fishery for certain (prescribed) molluscan shellfish species (oysters, mussels, cockles, clams, scallops and queens) in The Wash. This allows the IFCA to manage a public fishery on the natural shellfish stocks (the "Regulated Fishery") through a licensing scheme, and to allow the cultivation of shellfish within The Wash on private, leased areas, collectively referred to as the "Several Fishery".

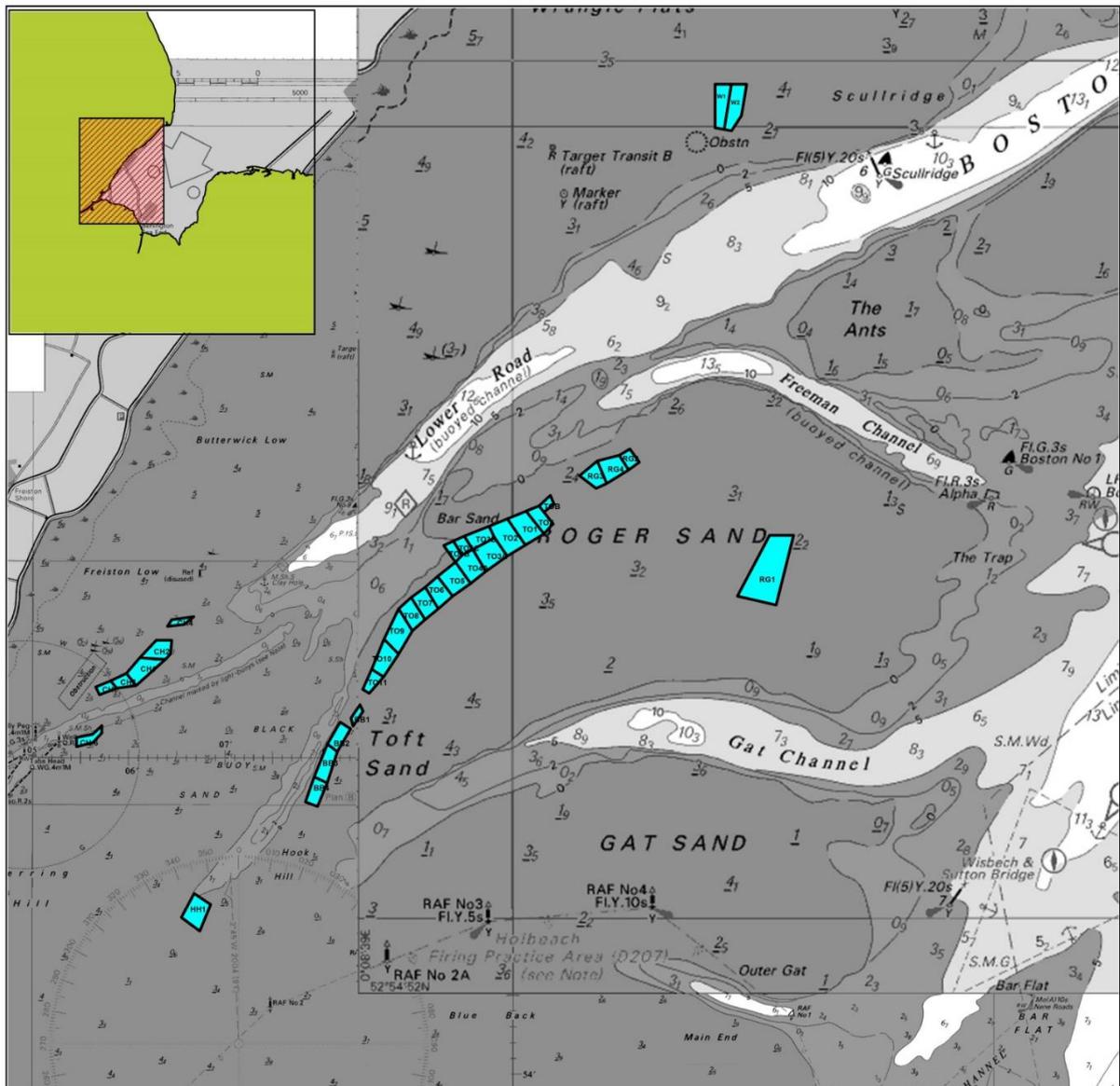
Through the WFO 1992, the Authority sets regulations (for example daily catch restrictions and minimum landing size), which apply only to the Regulated Fishery. The Several Fishery is managed using lease conditions – conditions on which a private lay is provided, and which must be adhered to in order to maintain the right to that lay.

Restrictions include technical gear requirements and as well as more administrative conditions.

Following a Review of WFO consents conducted in 2008, Eastern Sea Fisheries Joint Committee agreed to apply a set of additional measures to its management of WFO lays. These relate to the protection of particular biotopes on some of the sands; the risk of Pacific oyster invasion across the site; shellfish productivity in The Wash; and data sharing.

Without ministerial consent, the Order restricts the total area that individual lay holders can lease to 10 hectares. Currently there are 49 WFO leases within the Several Fishery, covering a total of 275 hectares. Figures 2 and 3 show the current extent of these lays. Since 2010 there has been a moratorium on new lays being issued, since which the only new lays that have been issued were those for which applications were already being processed at the time of the moratorium's introduction.

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**Lays leased under the WFO 1992**

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**Figure 2 – Chart showing the position of the lay ground leased through the WFO 1992 on the west side of The Wash**



**Lays leased under the WFO 1992**

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**Figure 3 – Chart showing the position of the lay ground leased through the WFO 1992 on the east side of The Wash**

## 2.5 Current methods of aquaculture in The Wash

The majority of aquaculture in The Wash has traditionally been the cultivation of mussels from part-grown seed to harvestable size. Seed mussels, whether sourced from the wild intertidal beds, sublittoral beds or purchased from other UK fisheries, are relayed directly onto the seabed within the leased lays. No structures such as poles, suspended ropes, tables or rafts have historically been used in The Wash for mussel cultivation. Relaying from the wild intertidal beds usually occurs during April and May but can be at any time of the year when sourced from elsewhere. The seed mussel is usually carried loose, or in 1 tonne bags, on the decks of the fishing boats from which it is washed or shovelled overboard while the boat is afloat. Several of the more modern boats now have a “through-hold flushing system” that enables mussels stored in the hold to be pumped directly from the hold into the sea. While discharging the mussel seed, the boat slowly circles so that the seed is scattered across the lay rather than being deposited in heaps. During low water periods following relaying, fishermen will often dry their boats out on their lay to inspect the coverage of seed that has been relayed, ensuring an even distribution by levelling out any heaps and identifying bare areas where further seed can be deposited.

Depending on the size of the seed that was relayed, it can take between one and two years for it to reach harvestable size. During this time fishermen will occasionally inspect their lays to determine how well the mussels are growing, to check the mussels are healthy and to ensure they aren't being poached by other fishermen.

Once the mussels have reached marketable size, harvesting usually takes place between September and April, although peak activity is usually between December and March. The majority of harvesting is conducted during high-water periods using up to two 1m wide Baird dredges. The mussels are usually cleaned, riddled and bagged in situ, so any under-sized mussels are returned immediately to the lay. While the number and size of dredges permitted for use on the lays is restricted, there is no restriction on how much mussel can be harvested during a trip or on the size of the mussels being landed. Towards the end of the fishing season when the stocks on the lays have become depleted, making dredging for them inefficient, some fishermen will handwork the remaining patches during low water periods. This tends to be a low-level activity, involving 2 or 3 fishermen on any particular lay.

Although the majority of aquaculture in The Wash has been mussel bottom-culture, there have been some occasions when cockles have been relayed onto the lays, or when Pacific Oysters have been grown. In the case of the latter, this has entailed growing the oysters in net bags supported above the seabed on steel-framed tables or trellises. Although Pacific oysters are a non-native species in the UK, it was originally believed that UK waters were too cold for them to breed so farming them was allowed. This proved not to be the case, however, and naturalised breeding populations have since invaded many areas, including small populations in The Wash. In most UK areas where Pacific oysters are now farmed, the oysters are grown from triploid gametes which have much lower fertility.

### 3.0 Statutory responsibilities relating to Aquaculture

When considering the management of a Several Fishery, the Authority has specific legal responsibilities issued through the Marine and Coastal Access Act (MaCAA) 2009 and the Sea Fisheries (Shellfish) Act 1967. As the Wash Several Fishery Order (2022) will overlap with several Marine Protected Areas, the Authority also has responsibilities under the Conservation of Habitats and Species Regulations 2017 (Habitat Regulations) and the Wildlife and Countryside Act (WCA) 1981 to ensure the Several Fishery is managed in a manner that does not have a significant adverse impact on the integrity of marine protected areas. In addition, the Aquatic Animal Health (England and Wales) Regulations 2009 and WCA include provisions relating to the spread of disease and invasive non-native species which are relevant to management of aquaculture operations.

#### 3.1 The Marine and Coastal Access Act, 2009

IFCAs' main duties and responsibilities are defined in sections (153) and (154) of the Marine and Coastal Access Act (MaCAA) 2009 being:

##### (153) Management of inshore fisheries

1. The authority for an IFC district must manage the exploitation of sea fisheries resources in that district.
2. In performing its duty under subsection (1), the authority for an IFC district must—
  - a. seek to ensure that the exploitation of sea fisheries resources is carried out in a sustainable way,
  - b. seek to balance the social and economic benefits of exploiting the sea fisheries resources of the district with the need to protect the marine environment from, or promote its recovery from, the effects of such exploitation,
  - c. take any other steps which in the authority's opinion are necessary or expedient for the purpose of making a contribution to the achievement of sustainable development, and
  - d. seek to balance the different needs of persons engaged in the exploitation of sea fisheries resources in the district.

By definition, in sub paragraph (10) of Section (153) “sea fisheries resources” means any animals or plants...that habitually live in the sea, including those that are cultivated in the sea. By definition in sub paragraph (12) of Section (153) any reference to the “exploitation” of sea fisheries resources is a reference to any activity relating to the exploitation of such resources, whether carried out for commercial purposes or otherwise, including...introducing such resources to the sea or cultivating such resources.

IFCAs can apply for the right of a Several Order under the Sea Fisheries (Shellfish) Act 1967 for the establishment, improvement and for the maintenance and regulation of a fishery for shellfish. The Wash Several Fishery Order 2022 is an example of this.

#### 3.2 Marine Protected Areas (MPAs)

Eastern IFCA is a Relevant Authority in the management of MPAs designated under the Habitats Directive and the Wild Birds Directive. These European regulations are in place to protect and support wildlife and/or habitats that are of European importance. Eastern IFCA has a statutory responsibility to ensure that fishing activity does not damage, disturb or have an adverse effect on the wildlife and habitats that EMS's are legally protecting. Any management introduced should contribute to furthering the conservation objectives of the site, so ensuring the integrity of the site is maintained and the site makes a full contribution to achieving the aims of the Directives. This includes the governance of the conservation interests of The Wash and North Norfolk Coast Special Area of Conservation (SAC) and The Wash Special Protection Area (SPA) when considering any aquaculture practices, current or future.

Section 28G of the Wildlife and Countryside Act (WCA) 1981 (as amended) defines 'section 28G authorities', including Eastern IFCA, who have a duty to take reasonable steps, consistent with the proper exercise of their functions, to ensure compatibility of activity with the conservation and enhancement of SSSI and to further the conservation and enhancement of the flora, fauna or geological or physical features by reason of which the site is of special scientific interest. Eastern IFCA therefore must consider the conservation and enhancement of The Wash SSSI when managing aquaculture within The Wash, to include any proposals for leased grounds under 'The Order'.

### **3.3 Spread of disease and invasive, non-native species**

Under the Aquatic Animal Health (England and Wales) Regulations 2009, Eastern IFCA, as the grantee of the Wash Several order, must apply for authorisation from the Fish Health Inspectorate (the competent authority) in order to operate an 'aquaculture production businesses.' In addition, such operations must meet any conditions imposed under that authorisation including keeping accurate records, following good hygiene practice and complying with any surveillance requirements.

The same regulations also require those undertaking aquaculture operation, in the case of the Wash Several Order 1992 being the lay holders, to take steps to report suspicion of a listed disease or increased mortality. Eastern IFCA has responsibility under s.23(3)(d) to ensure that any reports made to them are provided immediately to the Fish Health Inspectorate.

In addition, the WCA requires that persons must not release into the wild, any animals which are not 'ordinarily resident in and is not a regular visitor to Great Britain in a wild state' or any animal listed under Schedule 9 of the Act.

### **4.0 MARINE CONSERVATION DESIGNATIONS IN THE WASH**

The ecological importance of The Wash habitats has been recognised with the site being designated a Site of Special Scientific Interest (SSSI), a Special Area of Conservation (SAC), a Special Protection Area (SPA) and a Ramsar site. Within and surrounding The Wash there are also National Nature Reserves (NRR), Royal Society for the Protection of Birds (RSPB) reserves, and an Area of Outstanding Natural Beauty (AONB) designation.

#### 4.1 The Wash & North Norfolk Coast SAC

Covering a total area of 1,078 km<sup>2</sup>, the Wash and North Norfolk Coast Special Area of Conservation (SAC) encompasses The Wash embayment, extensive intertidal sand and mudflats, subtidal sandbanks, biogenic and geogenic reef, saltmarsh and a unique barrier beach system (Natura, 2000).

The following are Annex I habitats that are a primary reason for selection of this site under Article 4(4) of the Directive (92/43/EEC) (JNCC website)

- H1110. Sandbanks which are slightly covered by sea water all the time; Subtidal sandbanks
- H1140. Mudflats and sandflats not covered by seawater at low tide; Intertidal mudflats and sandflats
- H1160. Large shallow inlets and bays
- H1170. Reefs
- H1310. Salicornia and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand
- H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
- H1420. Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*); Mediterranean saltmarsh scrub

Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site are:

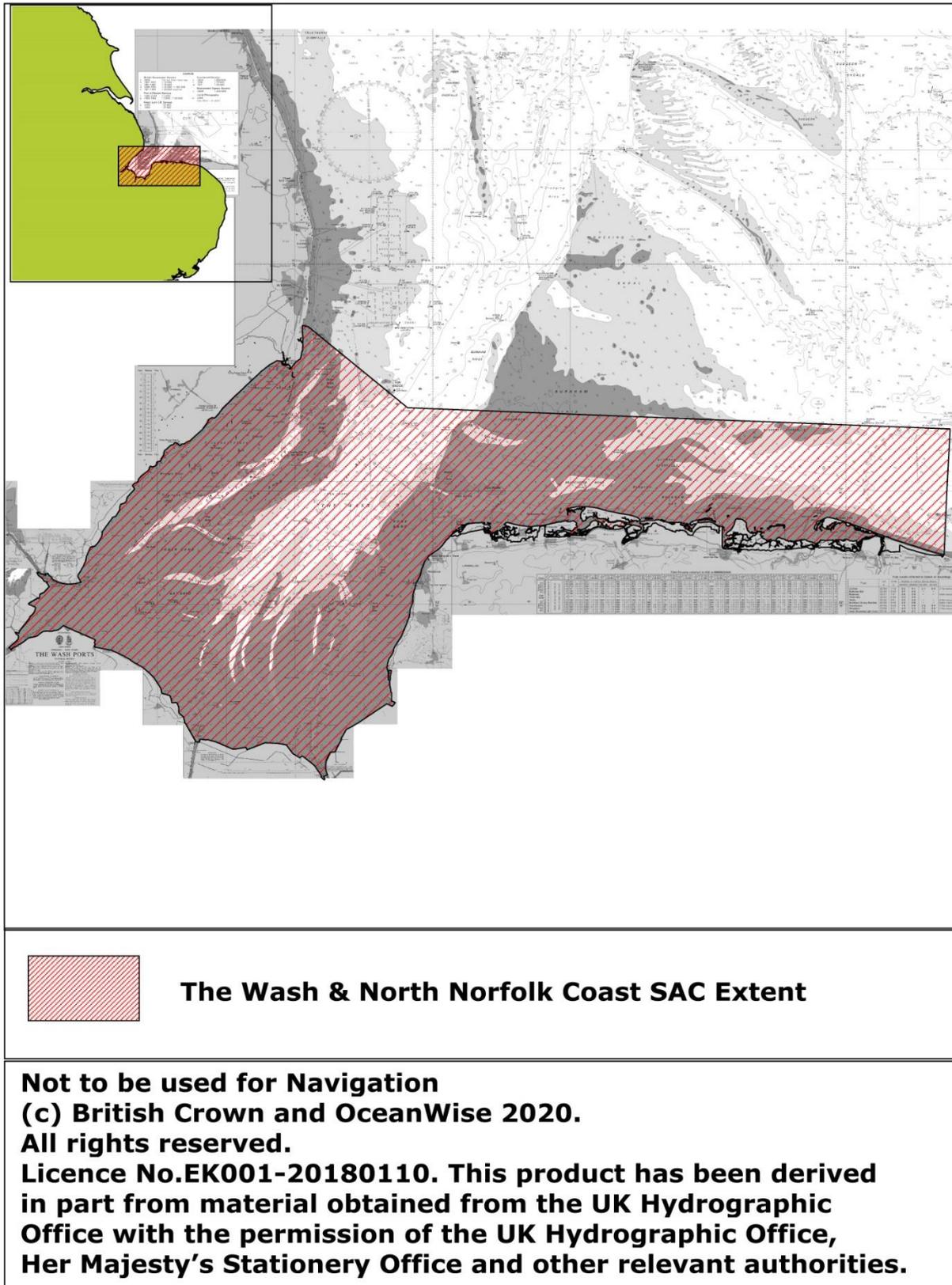
- H1150. Coastal lagoons

Annex II species that are a primary reason for selection of this site

- S1365 Harbour seal (*Phoca vitulina*)

Annex II species present as a qualifying feature, but not a primary reason for site selection

- 1355 Otter *Lutra lutra*



**Figure 4 – Chart showing the extent of the Wash & North Norfolk Coast SAC**

## 4.2 The Wash SSSI

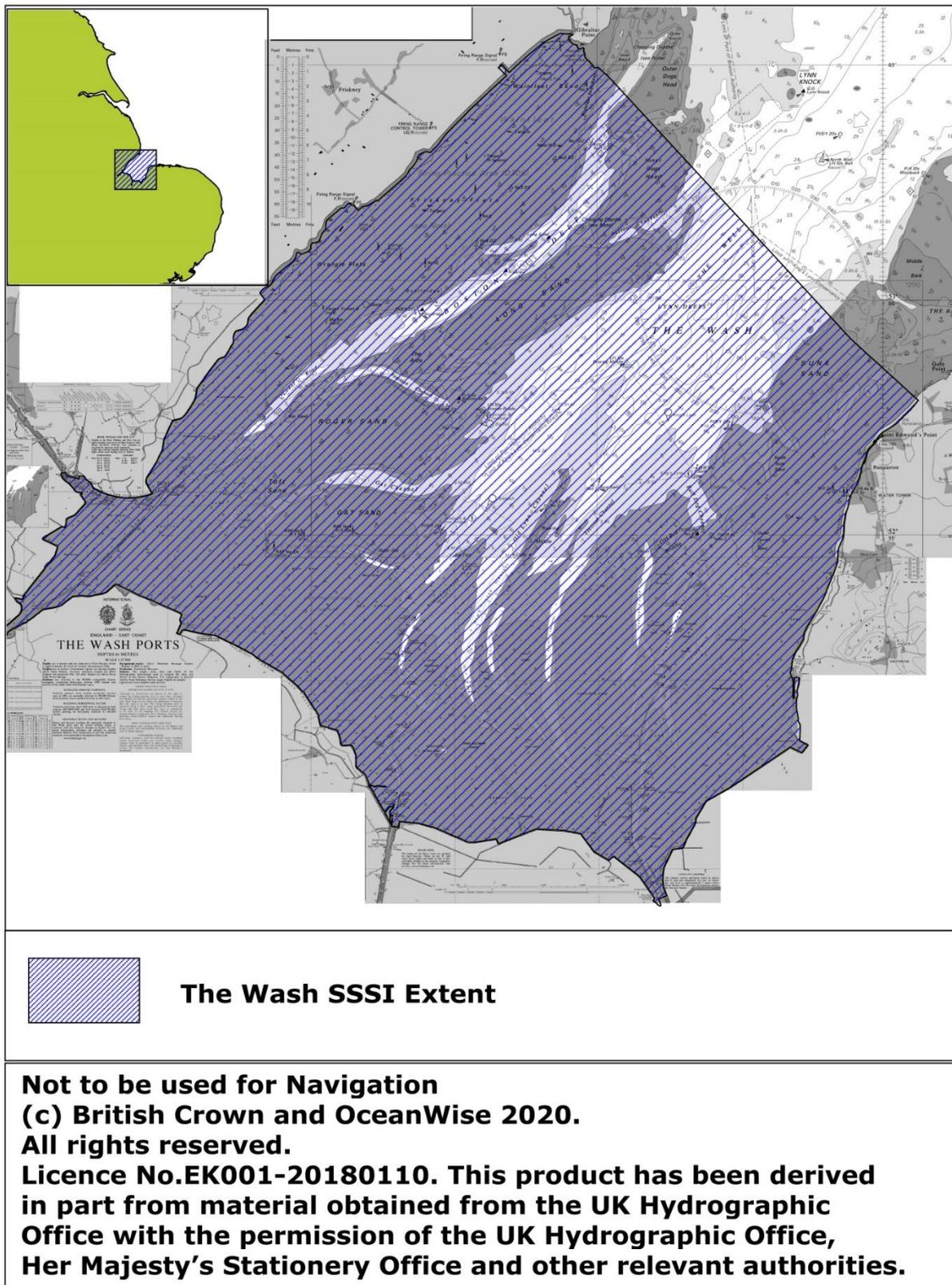


Figure 5 – Chart showing the extent of the Wash SSSI

The whole of The Wash is of exceptional biological interest, for which it has been designated a Special Site of Scientific Interest (SSSI). The SSSI is wholly coincidental with the boundary of The Wash SPA/Ramsar, overlaps in part with the Greater Wash SPA and is wholly contained within The Wash and North Norfolk Coast Special Area of Conservation (SAC) (English Nature, 2005).

The intertidal mudflats and saltmarshes within The Wash represent one of Britain's most important winter feeding areas for waders and wildfowl outside of the breeding season. Enormous numbers of migrant birds, of international significance, are dependent on the rich supply of invertebrate food found on the intertidal mudflats, while the saltmarshes are important breeding zones. In addition, The Wash is also very important as a breeding ground for Common Seals (Natural England. Reasons for designating the SSSI).

The Wash SSSI has 43 notified features, including:

- 3 species of breeding birds
- 15 species of non-breeding birds
- Common seal (*Phoca vitulina*)
- 4 broad habitats of the designated site
- 21 specific habitats of the designated site

All but one of the above (non-breeding whooper swan) are also designated under one or more of the other European designations (Natural England, 2020).

### 4.3 The Wash SPA

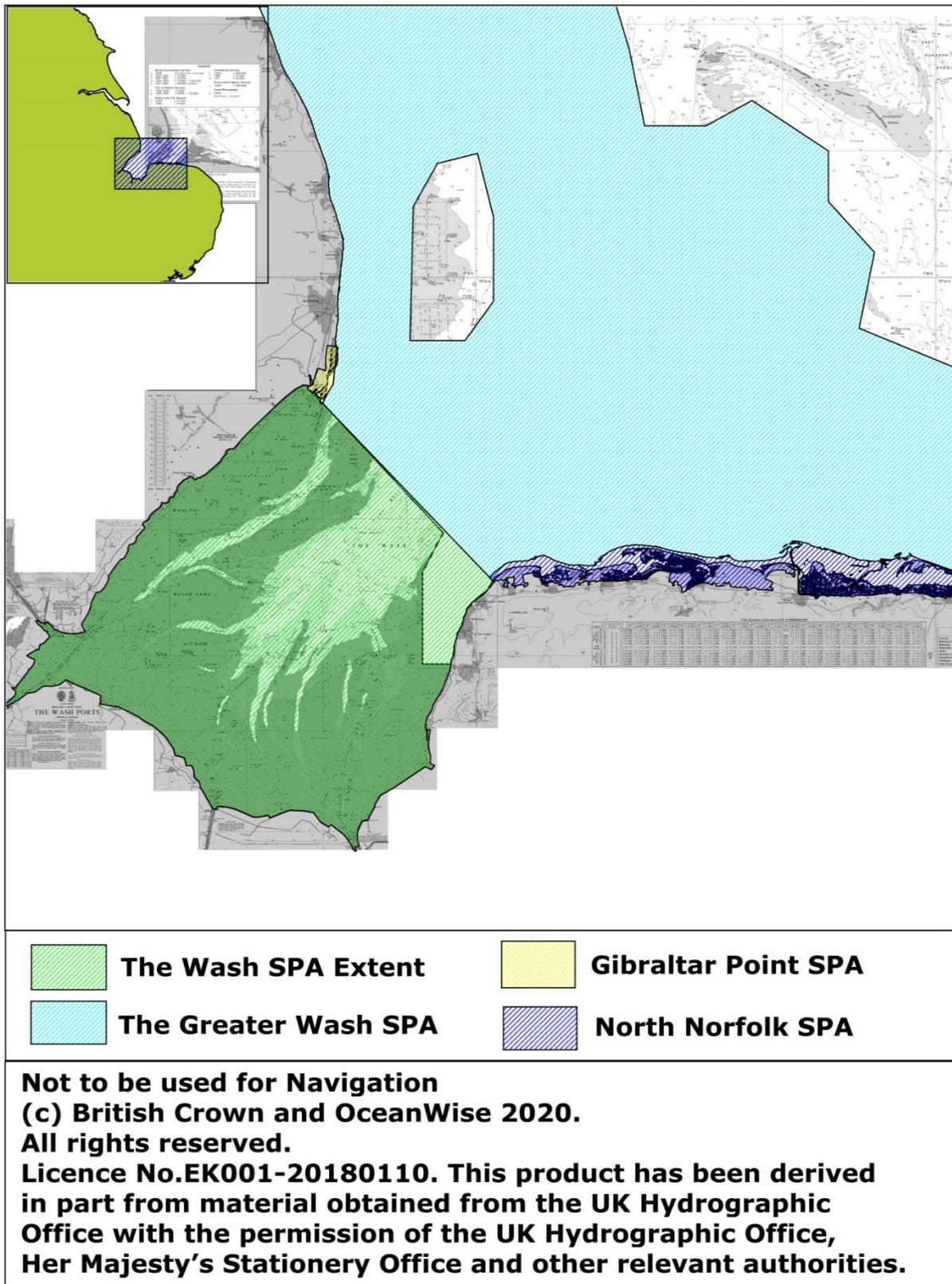


Figure 6 – Chart showing the extent of the SPAs in the proximity of The Wash

The 2014 Wash SPA Citation for EC Directive 79/409 on the conservation of wild birds: Special Protection Area, The Wash (Norfolk & Lincolnshire), describes The Wash as being numerically the most important area in Britain for wintering waterfowl, taking waders and wildfowl together. It is also the most important area in Britain in early autumn for moulting waders and also important to certain wintering passerines, to breeding waders and terns, and to certain seabirds.

The Wash qualifies under Article 4(1) of the Directive 2009/147/EC because it supports:

- 30 breeding pairs of little terns, *Sterna albifrons* (2% of the British population),
- 220 pairs of common terns, *Sterna hirundo* (2%),
- 130 Bewick's swans, *Cygnus cygnus* (3%), in winter.

The Wash qualifies under Article 4(2) as an internationally important wetland by supporting in winter an average of 163,000 waders and also 51,000 wildfowl; and because it supports on average the following internationally important numbers of individual species:

- 17,000 dark bellied brent geese, *Branta bernicla bernicla* (12% of the European wintering population),
- 7,300 pink-footed geese, *Anser brachyrhynchus* (7%),
- 16,000 shelducks, *Tadorna tadorna* (12%)
- 1,700 pintails, *Anas acuta* (2%),
- 24,000 oystercatchers, *Haematopus ostralegus* (3%),
- 5,500 grey plovers, *Pluvialis squatarola* (7%),
- 500 sanderlings, *Calidris alba* (3%),
- 7,500 knots, *Calidris canutus* (21%),
- 29,000 dunlins, *Calidris alpina* (1%),
- 8,200 bar-tailed godwits, *Limosa lapponica* (1%),
- 3,700 curlews, *Numenius arquata* (1%),
- 4,331 redshanks, *Tringa totanus* (5%),
- 980 turnstones, *Arenaria interpres* (2%),

In addition, the site qualifies because of its national importance to other migratory birds. Wintering birds include:

- 3,900 wigeon, *Anas penelope* (2% of the British wintering population),
- 220 goldeneye, *Bucephala clangula* (1%),
- 130 gadwall, *Anas strepera* (3%),
- 830 common scoters, *Melanitta nigra* (2%),
- 260 black-tailed godwits, *Limosa limosa* (6%),
- Several gull species (*Larus*).

The salt-marshes support a diverse breeding bird population, including over 4,000 pairs of black-headed gulls, *Larus ridibundus* (2%), shelducks and numerous wader species. Breeding redshanks occur at exceptionally high densities, and the breeding population of this species is of national importance (The Wash SPA Citation, 2014).

#### 4.4 The Greater Wash SPA

Covering an area of 3,536 km<sup>2</sup>, the Greater Wash SPA is located in the mid-southern North Sea between Bridlington Bay in the north and the Outer Thames Estuary SPA in the south. In the vicinity of The Wash, this SPA's boundary abuts that of The Wash SPA, except where they overlap on the north eastern side of The Wash to encompass the foraging area of Sandwich tern (The Greater Wash SPA Citation, 2018)

The site qualifies under Article 4.1 of the Directive 2009/147/EC by regularly supporting populations of national importance of the Annex I species:

- 1,407 Red-throated diver, *Gavia stellata* (8.3% GB nonbreeding population)
- 1,255 Little gull, *Hydrocoloeus minutus* (No current GB population estimate)
- 3,852 pairs Sandwich tern, *Sterna sandvicensis* (35.0% of GB breeding population)
- 510 breeding pairs Common tern, *Sterna hirundo* (5.1% of GB breeding population)
- 798 pairs Little tern, *Sternula albifrons* (42.0% of GB breeding population)
- 3,449 Common scoter, *Melanitta nigra* (0.6% biogeographic population)

#### 4.5 Gibraltar Point SPA

Covering an area of 422 hectares, the Gibraltar Point SPA is situated on the Lincolnshire coast, just outside of The Wash SPA.

The site qualifies under Article 4.1 of the Directive 2009/147/EC by regularly supporting a nationally important breeding population of:

- 40 pairs little terns, *Sternula albifrons*. (1.7% of the GB breeding population) (The Gibraltar Point SPA Citation, 1992)

It also qualifies under Article 4(2) by regularly supporting internationally or nationally important wintering populations of the following species of migratory wildfowl:

- 8,800 Bar-tailed godwit, *Limosa lapponica*
- 1,140 Sanderling, *Calidris alba*
- 3,980 Grey plover, *Pluvialis squatarola*

#### 4.6 North Norfolk Coast SPA

Extending 40km from Holme to Weybourne, the North Norfolk Coast SPA covers an area of 7,887 hectares and is the fourth most important wetland site for waterfowl in Britain. The site includes a variety of coastal habitats including intertidal mudflats and sandflats, coastal waters, saltmarshes, shingle, sand dunes, freshwater grazing marshes and reedbeds.

The intertidal mud and sand flats support high densities of invertebrates, important for breeding avocet and supporting high numbers of wading birds and wildfowl throughout the year. The shallow coastal waters support large populations of small fish, including sand eel and sprat, which provide vital food for the tern populations that breed in the vegetated and unvegetated shingle spits, bars and beaches. The site also provides

breeding sites for pink-footed geese (*Anser brachyrhynchus*) and dark-bellied brent geese (*Branta bernicula bernicula*). The saltmarsh supports breeding populations of skylark and meadow pipit, which in turn support internationally important breeding populations of marsh harrier (*Circus aeruginosus*). Large numbers of waterbirds use the site throughout the year. In summer the site is important for breeding populations of waders and terns, while in winter the site becomes important for large numbers of geese, sea-ducks, other ducks and waders using the site for roosting and feeding.

The site qualifies under Article 4.1 of the Directive 2009/147/EC by regularly supporting breeding populations of national importance of the Annex I species:

- Avocet, *Recurvirostra avosetta*, (30% GB Breeding population)
- Bittern, *Botaurus stellaris*, (5% GB Breeding population)
- Common tern, *Sterna hirundo*, (3.7% GB Breeding population)
- Little tern, *Sternula albifrons*, (13.8% GB Breeding population)
- Marsh harrier, *Circus aeruginosus*, (6.4% GB Breeding population)
- Montagu's harrier, *Circus pygargus*, (GB Breeding population)
- Sandwich tern, *Thalasseus sandvicensis*, (26.4% GB Breeding population)

The site also qualifies under Article 4.2 of the Directive 2009/147/EC by regularly supporting over-wintering populations of:

- Dark-bellied brent goose, *Branta bernicla bernicla*, (3.8% of GB Non-breeding population)
- Knot, *Calidris canutus*, (3.1% of GB Non-breeding population)
- Pink-footed goose, *Anser brachyrhynchus*, (10.6% of GB Non-breeding population)
- Wigeon, *Mareca penelope*, (1.1% of GB Non-breeding population)

The site also qualifies under Article 4.2 for supporting an internationally important over-wintering assemblage of birds. (NATURA, 2000)

For each of the Special Protection Areas listed above, the European Site Conservation Objectives for classified species are:

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

- The extent and distribution of the habitats of the qualifying features,
- The structure and function of the habitats of the qualifying features,
- The supporting processes on which the habitats of the qualifying features rely,
- The population of each of the qualifying features,
- The distribution of the qualifying features within the site.

#### 4.7 The Wash Ramsar Site

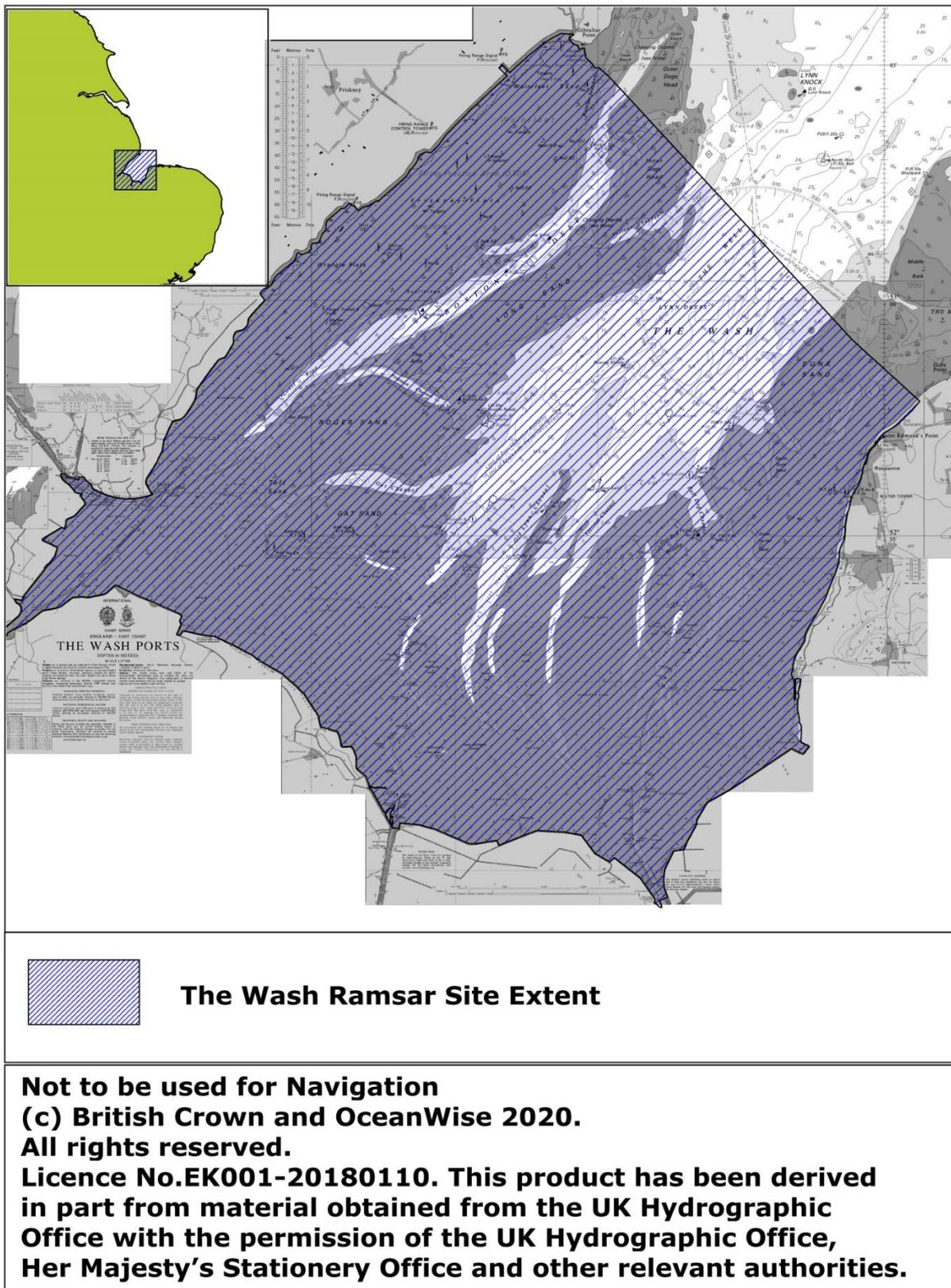


Figure 7 – Chart showing the extent of the Wash Ramsar Site

Ramsar sites are wetlands of international importance designated under the Ramsar Convention. Although they are not officially included in the Natura 2000 network, the UK government has advised they should be given the same level of protection. As the provisions on the Habitats Regulations relating to Habitat Regulations Assessments extend to Ramsar sites, Natural England considers the Conservation Advice packages for the overlapping European Marine Site designations to be, in most cases, sufficient to support the management of the Ramsar interests.

The Wash Ramsar site covers the same extent as The Wash SPA and is encompassed within The Wash and North Norfolk Coast SAC. However, it should be noted that the qualifying features of The Ramsar site include coastal vegetated shingle, coastal sand dunes, and an important assemblage of wetland invertebrates that are not qualifying features of either the SPA or the SAC (Natural England, 2020).

## **5.0 THE WASH SEVERAL FISHERY ORDER (2022) MANAGEMENT CONSIDERATIONS**

Eastern IFCA has been the grantee of the WFO since 1992 under which a management scheme has been established. The proposed management plan seeks to build on the existing measures to enhance the productivity of the Several Fishery whilst ensuring the statutory responsibilities are still met.

### **5.1 Ensuring compatibility between aquaculture and MPA designations**

Eastern-IFCA produced a Habitats Regulation Assessment (HRA), assessing the potential impacts of the proposed aquaculture activities and any mitigating measures, in order to demonstrate compatibility with the overlapping MPA's. The HRA for the Wash Several Fishery Order (2022) considered both the direct impacts that the aquaculture will have on the site's MPA features through such things as displacement, smothering and/or disturbance of protected habitats and species, and also indirect impacts such as potential impacts on the prey of the protected bird species and food availability for the wild shellfish stocks. Section 6.1 of this document provides a description of management measures which will be implemented under a Several Order to mitigate against impacts on site integrity from aquaculture operations. The broad interactions identified in the HRA are described below.

The Wash supports the second largest expanse of intertidal flats, and their associated populations of polychaetes, bivalves and crustaceans, in the UK. As the leased lays are predominantly situated along the sheltered eulittoral zones of intertidal sandbanks and mudflats, there is inevitable interaction between the aquaculture and the Wash and Norfolk Coast SAC Annex I habitat - Mudflats and sandflats not covered by seawater at low tide, in which the natural habitats and supported communities can be smothered by the cultured species. Mitigation is, therefore, in place to limit the total extent of the lays leased through the Order, and to ensure new lays are not situated on sensitive features.

Littoral sediments (mud and sand flats) are also protected under the Wash SSSI as a broad habitat feature, for the various aggregations of breeding and non-breeding bird

species that utilise the mud and sandflats for feeding and roosting. These birds are vulnerable to disturbance from human activities, including shellfish gathering, which can lead to reduced time spent feeding, or individuals being restricted to areas with a poor food supply. This is especially so at times when bird populations may be stressed, such as during severe winter weather. Mitigation is, therefore, in place to ensure the distribution, extent and species composition of marine invertebrate communities which they feed upon are maintained within Conservation Objective target thresholds. The key mitigation is ensuring that the extent and distribution of lays does not impact on the area available to designated bird species for feeding and restricting cultivation methods (primarily gear restrictions and prohibition on installing structures) such that, where lays are returned to the 'public fishery' they are in a state that can still support naturally occurring habitats.

Direct disturbance between the Several fishery and the listed bird species of the Wash SPA has been assessed. This concluded that because the majority of fishing activities on the lays occur over high water periods, those that did occur at low water (including fishermen occasionally inspecting their lays and/or conducting a small amount of hand worked harvesting) would not cause a significant disturbance.

The assessment also considered the impact of the fishery on the associated prey species for the birds listed for the Wash, Greater Wash, Gibraltar Point and North Norfolk SPA's, to ensure the *supporting processes on which the habitats of the qualifying features rely* (e.g. the wild shellfish stocks on the intertidal beds) are not adversely impacted. Mitigation includes ensuring leased ground does not encroach over the wild beds, thereby reducing their natural extent or cause them to be smothered with sediment. Mitigation is also in place to monitor potential issues of food availability for the wild shellfish stocks resulting from competition for resources with the Several fishery.

Harbour seals are an Annex II species of the Wash and Norfolk Coast SAC. The Several fishery is unlikely to have an impact on their prey species, but as the leased lays tend to be situated along the edges of intertidal sand and mudflats, the Several fishery activities could disturb their haul-out sites. Given that the majority of fishing activities on the lays occur over high water periods, those that did occur at low water (including fishermen occasionally inspecting their lays and/or conducting a small amount of hand worked harvesting) would not cause a significant disturbance.

Although the Several Fishery Order lays are situated on the edges of intertidal sand and mudflats rather than subtidal sites, possible interactions with their neighbouring Annex I habitat - Sandbanks which are slightly covered by sea water all the time, have also been assessed as suspended sediment from dredging the lays could cause smothering.

## **5.2 Ensuring compatibility between aquaculture and other fisheries**

The benefits of aquaculture, particularly regarding mussels, has long been recognised in The Wash, facilitating the cultivation of a better-quality product than can be harvested from the wild beds and providing the fishermen with a reserve of stock that can be used to satisfy orders without the dependency on the fluctuations of the public

fishery. While there are obvious benefits associated with aquaculture, lays leased through the Wash Several Fishery Order (2022) are essentially “severed” from the public fishery and are placed in private ownership for the duration of the lease. As the creation of these leased areas reduce the extent of the fishing grounds available to other fishermen and users of the site, Eastern IFCA must carefully balance the individual benefits provided by the Several fishery with the loss of public access to those areas. To minimise the loss of potential fishing opportunities within the public fishery, lays can only be leased in areas that do not support commercially viable wild stocks of cockles or mussels at the time of their issue. Further, historic survey data are used to ensure ground is not leased that has formally supported wild beds of these species which would indicate that they could do so again in the near future.

Before issuing new lays, Eastern-IFCA needs to consider whether there will be any impacts on general navigation for other fishermen and users of The Wash. In most cases, the aquacultural practice is to lay mussels directly on the seabed, which doesn't affect most traffic. However, the presence of relayed mussel beds on the edges of sheltered channels has the potential to interfere with fishermen trawling in those channels when targeting the brown shrimp fishery. Prior to issuing new lays, Eastern-IFCA consults with the local fishermen's associations who can raise any concerns they may have about the placement of a new lay.

Although the majority of the aquaculture in The Wash involves relaying mussels onto the seabed, there have been occasions when tables or trellises have been placed on lays for growing oysters and, elsewhere, mussels are frequently grown on suspended ropes, poles or rafts. Such structures, if used in the Several fishery, would have a much greater impact on navigation and trawl fisheries. Prior to consenting the use of such structures, Eastern IFCA would consult widely with all other users of the site to highlight any concerns. Additionally, the placement of such structures would also require a Marine Management Organisation (MMO) licence.

As the wild beds within the public fishery are frequently used as a source of mussel seed for the Several fishery, Eastern-IFCA needs to consider and minimise the impact that the removal of this seed has on those wishing to fish the public mussel fishery. In recent years, however, this has not presented a problem because the harvestable-sized (45mm) mussels on the wild beds are of insufficient quality for direct sale to the market. Instead, the general practice for most mussel fishermen in The Wash is to relay seed from the public fishery onto their lays, where a better-quality product can be grown. However, because both the cockle and mussel stocks in the public fishery contribute towards the bird-food requirements, the removal of mussel seed from the public fishery could impact on the size of the cockle fishery. Eastern-IFCA, therefore, only open the public beds for seed relaying when specific stock target thresholds have been achieved.

To ensure that areas granted as lays are capable of returning to a natural state, Eastern-IFCA applies three key management measures. These are:

- dictating the maximum dredge width,
- the maximum number of dredges, and
- the maximum vessel length that may be used.

These management measures are reflected in the management measures for the Regulated fishery within the same area and are assessed as not likely to impact the habitats or species (either designated or supporting) under The Wash MPAs.

### 5.2.1 Food availability

In 2008 high proportions of the adult cockle stocks throughout The Wash suffered high mortality rates in what was the start of a prolonged period of annual mortality events that has continued to present times. In 2007, prior to the first die-off, the biomass of shellfish in The Wash, including wild cockles and mussels on the intertidal beds, combined with the cultivated mussels on the lays were at an historic peak. When initial sampling found no pathogens in the cockles that could explain the die-offs, it was considered whether inter- and intra-specific competition for food could have exceeded the food availability carrying capacity. A review of the existing lay consents conducted in 2008 calculated that when at full capacity of 100t/ha, cultivated mussels could be responsible for up to 28% of filter feeding in The Wash. In 2009 ESFJC commenced a long-term programme to monitor phytoplankton levels in The Wash, deploying a data buoy in the Central Wash to collect continuous water temperature, salinity, turbidity and chlorophyll-a readings. The programme also included collecting additional monthly sonde readings from various sites around The Wash and mussel meat yield samples from four stations. Additionally, a number of specific projects also monitored phytoplankton levels on a finer scale around the Toft lays, where the highest volume of mussel cultivation occurred. These studies identified a localised depletion in chlorophyll levels directly over the lays, compared with the upstream measurements, but that the high levels of mixing throughout the waters in The Wash help to ensure that despite localised depletion of chlorophyll levels directly over the cultivated mussel beds, phytoplankton availability away from the lays is not restricted. The study recommended that further monitoring be undertaken of chlorophyll-a levels over natural shellfish beds, but cautiously concluded that mussel cultivation at current levels was unlikely to be impacting natural cockle and mussel populations by limiting their food supply. Further studies conducted by Cefas on phytoplankton assemblages in The Wash also cautiously concluded that at current levels the cultivated mussels in the Several fishery was not having an impact on phytoplankton assemblages.

Subsequent to the phytoplankton monitoring programme commencing, further moribund samples of cockles from The Wash were found to be infected with three species of *Haplosporidian* parasites. While these have not been conclusively proven to be the cause of the cockle die-offs, the samples provided strong circumstantial evidence that the *Haplosporidian* infections may be a major contributory factor in the observed mortalities. Since 2010 the mussel stocks in The Wash have also suffered unusually high mortalities. These were initially attributed to the presence of the intestinal copepod parasite, *Mytilicola intestinalis*, but subsequent studies have found no correlation between the incidence of this parasite and mortalities. Further studies are presently being conducted with Cefas to better understand both the cockle and mussel die-offs, but it is suspected there may be a number of factors that could be contributing towards the problem. As food availability could be among them, Eastern-IFCA continues to monitor phytoplankton and mussel meat yields in The Wash and maintains the moratorium introduced in 2010 of new lays being issued. Should

phytoplankton and mussel meat yields fall below target thresholds, mitigation described in Appendix 1 of this plan shall be implemented to reduce grazing pressure from mussels on the Several fishery lays.

### **5.3 Ensuring compatibility between aquaculture and biosecurity**

As the Several fishery lays can be stocked from other fisheries outside of The Wash, there is a significant risk of introducing disease and locally absent species into The Wash through this movement of live shellfish. Eastern IFCA has produced a Biosecurity Plan covering the full extent of the Wash Several Fishery Order (Eastern-IFCA Biosecurity Plan, 2020). This identifies the biosecurity risks associated with the Several fishery and describes the mitigation in place to prevent the spread of diseases and non-native invasive species into The Wash.

It is prohibited to relay shellfish from outside The Wash onto the lays without prior consent from Eastern IFCA. Applications to move shellfish into The Wash are considered on a case-by-case basis and consider the following:

- The disease status and history of the area the shellfish originate from;
- Monitoring mortality and what to do if shellfish disease is suspected;
- Known invasive non-native species in the area the shellfish originate from;
- Whether the supplier of the shellfish operates a biosecurity plan.

Under the lease agreements, all lay holders will be required to monitor shellfish mortality on their lays within six weeks of having relayed new mussel onto a lay (or at least once per year if no new seed has been added in that time). Any suspicion of mortality or shellfish disease within lays will be reported to the Fish Health Inspectorate (FHI). This includes reports of any sign of infection in shellfish, if shellfish are dying in larger numbers or more than normal and/or if shellfish are affected by unusual deaths. To encourage reporting of suspicions, Eastern IFCA has produced a standard form to monitor and report mortality incidents and provide some advice of signs and symptoms for lay holders to be aware of.

#### **5.3.1 Invasive, non-native species**

Although most of the aquaculture in The Wash has involved mussels, elsewhere Pacific oysters (*Magallana gigas*) are a commonly farmed species, which on a few occasions have also been grown in The Wash. The Pacific oyster, however, is defined as an invasive non-native species and is categorised as a 'medium risk' under the Water Framework Directive by the UK Technical Advisory Group and a 'moderate risk' by the GB Non-Native Species Secretariat. Pacific oyster, therefore, will not be included as a prescribed species of the Wash Several Fishery Order (2022).

As part of the application process, Eastern IFCA will assess the risks associated with the species to be cultivated. For species not native to the UK, consideration will be given as to whether cultivation can be done in such a way so as to mitigate risk of the species spreading to or invading from the lay. Ordinarily, a lay will not be granted where a risk exists.

## 5.4 Socio economic considerations

The Wash hosts a relatively stable fleet of around 55 vessels which rely primarily on the cockle and brown shrimp fisheries. Historically, the same fleet was also reliant on mussel fisheries which have since declined. Since 2015, a limited number of vessels have also participated in Wash whelk fisheries and a very limited number of vessels also participate in crab and lobster fisheries within The Wash. The interdependencies of these fisheries are crucial to maintaining sustainability, particularly in relation to the shrimp fishery which has the potential to be fished too early and with too much effort at times when the cockle fishery is less productive.

At the time of implementation, the WFO 1992 identified aquaculture within the Wash as a means of reducing the burden on the on these wild fisheries. At that time, there was still a productive mussel fishery which also supplied mussel seed for lays within The Wash. Since the decline of the Wash mussel fisheries, the availability of seed has also declined (although is typically more available than harvestable mussel) which has resulted in a decline in the use of lays. Whilst it is recognised that some business models will rely on lays only when seed is available within The Wash, the last two seed relaying fisheries were not prosecuted by any lay holders and none of the seed removed was used to stock lays in The Wash. This indicates that of the lays granted under the WFO, many are not being used as intended. It is noteworthy though that some are in more regular use, and these rely on seed from outside of The Wash.

Of those that are being used regularly, their operation includes use of partnerships between lay holders. Restrictions within the WFO preclude this from occurring except where Eastern IFCA has obtained the permission of the Minister as a means of minimising the risk of monopolisation of private fisheries and providing opportunity to the most possible Wash fishermen. Whilst it will be important to achieving the Aim and Objectives that as many Wash fishermen have access to lays as possible, enabling partnerships is also important to enable successful operations.

In recent years, widespread settlement of wild cockle spat has included settlement on otherwise dormant lays. The result being that the lay holders have benefited from some cockle spat which would have ordinarily benefited the public (regulated) fishery. There is some concern within industry that some lays are being maintained only on the chance that such wild settlements occur and become the 'absolute property' of the lay holder, as per the Sea Fisheries (Shellfish) Act 1967. Whilst this is contrary to the intention of the Several Fishery, there were no mechanisms within the WFO to mitigate against this or encourage better management of lays towards their intended purpose.

More modern Several Orders and their associated Fisheries Management plans require a greater investment in the planning and use of private fisheries. As with The Poole Harbour Fishery Order 2015, applicants for lays are required to submit business plans which set out how the applicant intends to undertake aquaculture operations. On considering whether to re-allocate private fisheries, the grantee (Southern IFCA) considers the extent to which lease holders achieved the intentions of these plans.

Table 1 below summarises the key measures within the lay allocation process and how this will contribute towards more productive private fisheries and fisheries sustainability throughout the Wash.

Measure	Rationale
Applicants must hold a Wash Cockle and Mussel Byelaw Permit	Permit holders will be active participants within the Wash cockle and mussel fisheries. This will ensure that lays are allocated to those who rely on other Wash-based fisheries, reducing the burden on these by providing an alternative means of income via aquaculture operations.
Submission of a business plan to include a method for operating the lay, the company and management structure, predicted aquaculture forecasts, safety planning and biosecurity plans.	This would represent significantly more than was required for apply for a lay under the WFO. The intention is to encourage better business practices and to ensure that the allocation finite area of lays available (which would be unlikely to support a lay for all Wash fishermen) is to those most likely to utilise it.
Restrict the allocation of lays to 10ha per person or business interest except where special case is made for larger lays	This is a continuation of an established measure within the WFO with the caveat that larger lays can be granted at the discretion of the Authority noting that the most successful lays have included larger sites involving multiple lay holders.
Use of lays will be restricted to 5 years and re-allocation will be considered taking into account how the operations met the business plan	Lease periods will be for no more than 5 years, after which the re-allocation will be considered by the Authority. In assessing the strength of an application for re-allocation, the Authority will consider if the applicant managed the lay in accordance with the plan submitted in their original application. This will include consideration of whether lay holders utilised seed mussel fisheries which were open within The Wash.

## 5.5 Lay allocation

Lay Allocation will be considered in two tranches.

**Tranche 1** (transition) will consider reallocation of lays issued under the Wash Fishery Order 1992. The intention is to allocate lays to business models which have relied on the opportunity to use lays, as a means of reducing reliance on the other Wash fisheries.

**Tranche 2** will consider new entrants to the several fishery and will prioritise those persons or business models which rely on other Wash fisheries, in accordance with the aims and objectives.

### 5.5.1 Tranche 1 (Transition)

Tranche 1 consider applications from lay holders under the Wash Fishery Order 1992. Only lay holder will have opportunity to apply for the same lay under the Wash Several Order 2022.

Application criteria and eligibility

The Authority, or an appropriately delegated sub-committee will consider the allocation of lays under tranche 1 subject to the production of documentation outlined in this section at the time of application.

#### Eligibility

To be eligible to apply for a lay in Tranche 1, a person must:

- Be the lease holder of a lay under the Wash Fishery Order 1992 at the time of application; and
- Must hold a permit to fish under the Wash Cockle and Mussel Byelaw 2021;
- Have submitted an application meeting the application criteria.

#### Application Criteria

Applications must be submitted by [date to be confirmed] and include a business plan setting out the following:

- **Executive summary** providing an overview of your proposed business and plans.
- **Methodology** to include:
  - Target species to be grown and harvested
  - Details of suppliers of seed for laying;
  - Details of buyers / target markets for harvested products
  - Specification of vessel / platform to be used; and
  - Details of equipment used in laying of seed and harvesting.
- **Company and management structure**
  - Details of the lease holder and any other personnel involved in aquaculture operations
  - Details of any partnerships between other lease holders (noting that additional consent is required where any partnership involves the use of more than 10ha of lays)
- **Forecasts**
  - Projected quantities of seed to each species to be broken down into annual forecasts for the lease period (up to 5 years)
    - Kg/year seeding forecast; and
    - Kg/year harvesting forecast
- **Safety**
  - A safety plan, including relevant risk assessments for operations at sea and the appropriate measures in place for the proposed activity
  - Evidence that persons taking the vessel to sea meet the requirements of the Merchant Shipping (Fishing Vessels) Regulations 1983

- **Biosecurity plan** to provide details of how the lease holder will ensure that operations are consistent with best practice and the legal requirements

#### Allocation of lays under Tranche 1

The allocation of lays under Tranche 1 will be under two stages:

- Stage 1 considers the business plan
- Stage 2 considers the suitability of the application area as a lay

**Stage 1** - The Authority, or an appropriately delegated sub-committee will assess each application on its own merits taking into account our statutory responsibilities under:

- The Marine and Coastal Access Act;
- The Wash Several Order 2022;
- The Sea Fisheries Shellfish Act 1967;
- The Conservation of Habitats and Species Regulations 2017;
- The Wildlife and Countryside Act 1981;
- The Aquatic Animal Health Act 2010; and
- The Eastern Inshore Marine Plan

Particular consideration will be given to:

- Credibility of the business plan;
- The potential impacts on:
  - the sustainability of the wild fisheries of The Wash;
  - the site integrity of Wash Marine Protected Areas;
  - the viability of fishing business models which operate within The Wash
- The size of the lay – ordinarily, the Authority will not grant lays to a person or business interest which is larger than 10ha however consideration will be given to such requests where a case is made for such in the application.

**Stage 2** – For lay applications approved at stage 1, Officers will assess the suitability of the area to host a lay using all available data and a using the results of a site visit and survey.

A site visit and survey must be undertaken in order to determine if the application area is suitable to host a lay, in accordance with the criteria in this section, associated Habitats Regulation Assessment and other statutory responsibilities.

Applicants are required to take an Officer of the Authority onto the application area to facilitate a site survey. In particular, the survey will:

- Identify if any wild shellfish stocks are present on the area
- Identify the habitats and species present within the site

The results of the survey will be considered by officers to determine its suitability against the following criteria:

- The Area does not presently host, and has not recently hosted, commercially viable bivalve mollusc stocks;

- The Area does not contain any protected species or habitats or species or habitats which support the conservation objectives of the Wash Marine Protected Areas.

### Maintenance of a lease

Leases will be issued for no more than 5 years and all fishing operations must be in accordance with the conditions set out below. Failure to adhere to these conditions may, at the absolute discretion of the Authority or an appropriately delegated sub-committee, result in the termination of the lease.

Reallocation of a lease after 5 years will be at the absolute discretion of the Authority or an appropriately delegated sub-committee and in accordance with the process set out below (re-allocation of Tranche 1 leases).

The Authority reserves the right to amend the conditions of this plan and the lease conditions as may be required to meet the Authority's statutory responsibilities.

### Conditions to maintain a lease

- The Authority receives annual fee within [time frame]
- Annual reporting against business plan
- No wild shellfish settlements
- Carried out activity in accordance with lease conditions and business plan

### Lease conditions

These will be developed to include the restrictions which act as mitigation against potential impacts on The Wash MPAs and fisheries sustainability in addition to meeting the aim and objectives of this FMP.

### Re-allocation of tranche 1 leases

Where a lease has expired, the lease holder may apply for re-allocation of the same for up to a further 5 years. The documentation required for application will be as per that required for Tranche 1 lease allocation and will also require a 'lease holder operations report' which will consider activity against the original business plan which will highlight where outputs from the lay have not met the expectations of that plan and what measures will be taken to address these.

The reallocation of lays will take into account the following:

- Wild shellfish settlements
- Success of operations against the business plan, taking into account appropriate variables
- Any additional environmental constraints including but not limited to the Marine protected Areas of The Wash and sustainability of wild fisheries within The Wash.
- The needs of all persons engaged in Wash based fisheries including viability of fisheries

- Any of the Authority's statutory requirements
- The reliance of some business models and plans on seed from The Wash and the availability during the lease period of such seed.

### **5.5.2 Tranche 2**

Tranche 2 allocation considers applications of lays up to the maximum total permitted within the Several Fishery which remains after Tranche 1. Application for Tranche 2 lays will open be accepted from 1 January 2027 to 28 February 2027.

The process and criteria for Tranche 2 lay allocation will be set out in the 2026 review of this Fisheries Management Plan.

## **5.6 Compliance and sanctions**

### 5.6.1 Compliance monitoring

Eastern IFCA will integrate the order within its risk-based, compliance framework.

Section 166(1) of MaCAA (2009) sets out that an IFCA officer has the powers to enforce any Order made under the Shellfish Act (1967) and whilst enforcing the Order an IFCA officer has common enforcement powers.

### 5.6.2 Sanctions

Any rights holder under the Order who contravenes any conditions set out in the lease issued by Eastern IFCA may, at the discretion of the Authority, have the lease revoked and any lays shall return to the possession of the Authority as detailed in the lease.

## 6.0 THE WASH SEVERAL FISHERY ORDER (2022) MITIGATION MEASURES

### 6.1 Aquaculture and MPA designations

Management requirement	Mitigation	Description
Ensure the Several fishery does not have a significant impact on the Annex I habitats of the W&NNC SAC	Proposed activities allowed under the new Several Order shall undergo a Habitats Regulations Assessment to ensure they will not have a significant adverse impact on the designated Annex I habitats of the site	The Several fishery lays are all situated in the lower eulittoral edges of sand banks and mudflats, which is predominantly of the SAC Annex I habitat - <i>Mudflats and sandflats not covered by seawater at low tide</i> . The interaction between the Several fishery activities and this habitat have been assessed for disturbance from abrasion, penetration and smothering which concluded were not significant at existing levels of lay extent. There is currently a moratorium on further lays being issued which will prevent the overall extent increasing beyond current level. Should new lays be issued in the future, they would need to be individually assessed with bespoke HRAs.
Ensure the Several fishery does not have a significant impact on the Annex II species of the W&NNC SAC	Proposed activities allowed under the new Several Order shall undergo a Habitats Regulations Assessment to ensure they will not have a significant adverse impact on the designated Annex II species of the site	The W&NNC SAC has two Annex II designated species, of which only the harbour seal is present in the vicinity of the Several fishery lays. The HRA concluded that the Several fishery wouldn't have an impact on their prey species, which is not mussels. While there is potential for low water activities on the lays to disturb seal haul-out sites, mitigation is in place to prevent lays being leased on known haul-out sites and the HRA concluded low water activities on the existing lays would not cause significant disturbance to harbour seals.
Ensure the Several fishery does not have a significant	Proposed activities allowed under the new Several Order shall undergo a	The intertidal shellfish stocks in The Wash are an important food source for many of the site's designated

<p>impact on the designated SPA and SSSI species</p>	<p>Habitats Regulations Assessment to ensure they will not have a significant impact to the prey species of the SPA and SSSI species.</p>	<p>SPA and SSSI bird species. Eastern-IFCA conduct annual surveys of the wild intertidal cockle and mussel stocks in The Wash to inform fisheries management decisions. Prior to fisheries opening on the public beds, assessments are undertaken to ensure sufficient shellfish will remain on the public beds to satisfy the bird food requirement. While the cultivated mussels on the lays are also preyed upon by birds, these stocks are not included in the assessments, so whatever shellfish stocks are present on the lays are superfluous to the bird food requirement. The HRA, therefore, concluded that the Several fishery would not have an adverse impact on bird prey species.</p>
	<p>Proposed activities allowed under the new Several Order shall undergo a Habitats Regulations Assessment to ensure they will not cause a significant disturbance to the designated SPA and SSSI species</p>	<p>Direct disturbance between the Several fishery and the listed bird species of the Wash SPA has been assessed. This concluded that because the majority of fishing activities on the lays occur over high water periods, those that did occur at low water (including fishermen occasionally inspecting their lays and/or conducting a small amount of handworked harvesting) would not cause a significant disturbance.</p> <p>Management policies developed for the public fisheries aim to ensure the distribution, extent and species composition of marine invertebrate communities which the birds prey upon are maintained within Conservation Objective target thresholds.</p>

## 6.2 Aquaculture and public fisheries interactions

Management requirement	Mitigation	Description
Seek to balance the different needs of persons engaged in the exploitation of sea fisheries resources in the district.	Restriction on the size and duration of lay leases	<p>Eastern-IFCA seeks to enable a successful Several fishery that balances the needs of those involved in the Several fishery and those involved in the public fishery. For this, there needs to be fair and equitable access to the Several fishery, on a scale that is not detrimental to the users of the public fishery or that allows a monopoly. Lays can be applied for and issued to any person, but without written consent from the minister, the total area and duration of leases is restricted:</p> <ul style="list-style-type: none"> <li>• Maximum total area of leases – 10 hectares</li> <li>• Maximum duration of any lease – 5 years</li> </ul>
Minimise loss of fishing opportunities to public fishery	Lays will not be leased on ground that supports wild beds of cockles or mussels	<p>New lays will not be issued (or existing lays re-issued) on ground that supports, or historically supported, wild beds of cockles or mussels. This is achieved by:</p> <ul style="list-style-type: none"> <li>• Conducting biotope surveys within and surrounding any proposed lays to confirm the absence of wild stocks prior to the new lay being issued.</li> <li>• Conducting an examination of historic survey GIS data to determine whether the area historically supported wild stocks that might currently be absent.</li> <li>• Consultation with all the local fishermen’s associations to highlight concerns they may have that the lay will encroach on wild beds.</li> </ul> <p>In addition, lease conditions will include a cause which triggers a review of the lease allocation where settlement of wild stocks occur within a lay. The Authority will</p>

		<p>assess the suitability of the lease to continue taking into account the level of demand for lays, the use of that lay in accordance with the business plan and the degree to which wild stocks are likely to continue to settle in that area. Ultimately, the Authority could exercise its discretion as whether to revise the lease with the lay holder which could result in revocation of the lay, or part thereof.</p>
	<p>Shellfish shall not be relayed from the public fishery in quantities that will have a detrimental impact on the public mussel fishery</p>	<p>Due to the poor quality of mussels on the wild beds, few are harvested direct for market, minimising the impact of mussels taken for relaying to the Several fishery. Further, a high proportion of the fishermen able to partake in the public mussel fishery are existing lay holders.</p> <p>To facilitate sustainability, mussel fisheries (either for direct harvesting or relaying seed) will not reduce mussel stocks on the wild intertidal beds below:</p> <ul style="list-style-type: none"> <li>• 12,000 tonnes total stock,</li> <li>• 7,000 tonnes adult stock (mussels <math>\geq 45</math>mm length)</li> </ul> <p>Survey data informs the permissible size of annual harvestable and relaying fisheries.</p>
	<p>Shellfish shall not be relayed from the public fishery in quantities that will have a detrimental impact on the public cockle fishery</p>	<p>As both the cockle and mussel stocks in the public fishery contribute towards the bird-food requirements, the removal of mussel seed from the public fishery could impact on the size of the cockle fishery when stocks are low. To minimise this risk, mussels shall not be relayed from the public fishery in quantities that would result in the wild stocks falling below the above thresholds.</p>
<p>Minimise the potential impacts the Several fishery</p>	<p>Application of similar vessel and gear restrictions in the Several fishery as the public fishery</p>	<p>Although lays are the private property of the lease holder, they are only leased for 10-year periods. It is important, therefore, that during the period of lease, the</p>

<p>could have on the private fishery</p>		<p>lay holder does not conduct activities that could cause damage that extends beyond the lease period. Fishing gear used on the lays must, therefore, be of an approved design, compatible with that used in the public fishery. Further, to minimise the risk of errant behaviour from lay holders causing damage to the public fishery, three public fishery technical measures are also applied to the Several fishery. These are:</p> <ul style="list-style-type: none"> <li>• Maximum dredge width of 1.0m</li> <li>• Maximum of 2 dredges</li> <li>• Maximum vessel length of 14.0m (oal)</li> </ul>
<p>Minimise any navigational impacts the activities in the Several fishery could cause</p>	<p>Several fishery lays must not cause a navigational hazard or significant navigational impact to other users of The Wash</p>	<p>Because the general aquacultural practice is to lay mussels directly on the seabed along the edges of inter-tidal sandbanks, the risk of causing a navigational hazard is considered to be minimal due to them being a low-elevation soft surface. The presence of the mussels could, however, have a navigational impact on other fishermen wishing to access a sandbank with limited water clearance, or for fishermen trawling for brown shrimps along the edge of sandbanks. Prior to issuing new lays, Eastern-IFCA consults with the local fishermen's associations, providing an opportunity for such concerns to be highlighted.</p>
	<p>Placement of structures such as poles, suspended ropes, tables, trellises and rafts within Several fishery lays will require formal consent</p>	<p>There have been occasions when tables or trellises have been placed on lays for growing oysters and, elsewhere, mussels are frequently grown on suspended ropes, poles or rafts. Such structures, if used in the Several fishery, would have a much greater impact on trawl fisheries and could be a navigational hazard. Prior to consenting the use of such structures, Eastern-IFCA would consult widely with all other users of the site to</p>

highlight any concerns. Additionally, the placement of such structures would also require a Marine Management Organisation (MMO) licence, the application for which would consider the navigational hazards caused to other users of the site.

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### 6.3 Aquaculture and species sustainability

Management requirement	Mitigation	Description
<p>Ensure the Several fishery does not have a significant impact on the sustainability of the wild shellfish beds</p>	<p>Lays will not be leased on ground that supports wild beds of cockles or mussels</p>	<p>Leasing lays on existing wild beds of shellfish would not only restrict the public access to those beds but could also reduce the sustainability of the wild fisheries if wild stocks were smothered or prevented from re-establishing within leased areas. New lays will not be issued (or existing lays re-issued) on ground that supports, or historically supported, wild beds of cockles or mussels. As described above, this will be achieved by conducting surveys in the vicinity of proposed lays, examining historic survey GIS data and consultation with the local fishermen’s associations to ensure new lays are not leased on wild beds.</p>
	<p>Mussel seed shall not be relayed from the public fishery in quantities that will have a detrimental impact on the sustainability of the wild intertidal mussel stocks.</p>	<p>Eastern-IFCA conducts annual stock assessment surveys on the wild intertidal mussel beds to inform the annual management measures for the mussel fisheries (harvestable and relaying). The following management measures are applied to the public mussel fisheries to facilitate sustainability:</p> <ul style="list-style-type: none"> <li>• Mussel fisheries (either for direct harvesting or relaying seed) will not reduce mussel stocks on the wild intertidal beds below the following thresholds:               <ul style="list-style-type: none"> <li>○ 12,000 tonnes total stock,</li> <li>○ 7,000 tonnes adult stock (mussels ≥45mm length)</li> <li>○ 5,000 tonnes juvenile stock (mussels &lt;45mm length)</li> </ul> </li> <li>• Mussel seed fisheries from the public intertidal beds will be limited to a Total Allowable Catch of 20% of the overall juvenile biomass and a daily vessel quota of 8 tonnes per day.</li> </ul>

		<ul style="list-style-type: none"> <li>• Mussel fisheries must not reduce the average biomass of mussels on individual beds below 25 tonnes/ha</li> <li>• When available, priority will be to open beds that are either sublittoral or are considered vulnerable to being lost/ephemeral rather than established intertidal beds.</li> </ul>
	<p>Cockles shall not be relayed from the public fishery in quantities that will have a detrimental impact on the sustainability of the wild intertidal cockle stocks.</p>	<p>Cockles have previously only been relayed onto Several fishery lays in small trials rather than commercial quantities. However, should relaying cockles become more prevalent in the future, the following measures would safeguard the sustainability of the wild cockle stocks.</p> <ul style="list-style-type: none"> <li>• Eastern-IFCA conducts annual stock assessment surveys on the wild intertidal cockle beds to inform the management measures for the cockle fishery.</li> <li>• Rather than having a separate TAC for a cockle relaying fishery, any cockles harvested for relaying would be taken from the harvestable fishery TAC and be part of the vessel's daily 2-tonne quota.</li> <li>• To facilitate sustainability, the cockle fishery is subject to the following management measures:</li> <li>• Cockle fisheries will not reduce stocks on the wild intertidal beds below the following thresholds: <ul style="list-style-type: none"> <li>○ 11,000 tonnes total stock,</li> <li>○ 3,000 tonnes adult stock (cockles <math>\geq 14</math>mm width)</li> </ul> </li> <li>• Cockle fisheries from the public intertidal beds are limited to a Total Allowable Catch of 33% of the overall adult cockle biomass and a daily vessel quota of 2 tonnes per day.</li> </ul>

		<ul style="list-style-type: none"> <li>• Areas supporting densities of Year-0 juvenile cockles exceeding 1,000/m<sup>2</sup> are subject to spatial closures</li> </ul>
	<p>Shellfish stocks within the Several fishery lays should not impact on the food available for the wild shellfish stocks</p>	<p>Eastern-IFCA undertakes regular monitoring of phytoplankton levels and mussel meat yields in The Wash. Trigger thresholds for these are in place, which if not achieved would indicate a decline in food availability below critical levels. Failure to meet these thresholds would result in action to reduce grazing pressure from the lays, including the removal of mussel where stocking densities are already too high (see Appendix 1).</p>

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## 6.4 Aquaculture and biosecurity

Management requirement	Mitigation	Description
Introduction of disease and/or invasive non-native species with shellfish acquired from fisheries outside of The Wash	The Wash Fishery Order and The Wash Restricted Area Biosecurity Plan (2020 – 2025)	The Biosecurity Plan identifies the risks of introducing disease or non-native species associated with the movement of shellfish from outside of The Wash and details measures aimed at preventing these from occurring.
	Prohibition on relaying shellfish from outside The Wash onto the Several Fishery Order lays without prior consent from Eastern-IFCA.	When determining whether consent shall be granted, Eastern-IFCA consider the following: <ul style="list-style-type: none"> <li>• The disease status and history of the area the shellfish originate from;</li> <li>• Known invasive non-native species in the area the shellfish originate from;</li> <li>• Whether the supplier of the shellfish operates a biosecurity plan.</li> </ul>
	Shellfish mortality monitoring	Under the lease agreements, all lay holders are required to monitor shellfish mortality on their lays within six weeks of having relayed new mussel onto a lay (or at least once per year if no new seed has been added in that time). Any suspicion of mortality or shellfish disease within lays will be reported to the Fish Health Inspectorate Eastern-IFCA has produced a standard form to monitor and report mortality incidents and provide some advice of signs and symptoms for lay holders to be aware of.
	Prohibition on culturing Pacific Oysters ( <i>Magallana gigas</i> )	Pacific Oysters ( <i>Magallana gigas</i> ) will not be a listed species of the Wash Several Fishery Order (2022), so their culture will be prohibited

## 7.0 REFERENCES

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## 8.0 Appendices

### 8.1 Appendix 1 – Food availability mitigation measures

At an Eastern-IFCA Full Authority meeting in January 2015, the members were asked to agree to adopt mitigation measures relating to food availability associated with the Several fishery lays. The following report, describing those measures, was appended to the meeting papers.

#### Annex 3 - Mitigation measures

Eastern IFCA will use its monitoring program SWEEP<sup>2</sup> to detect changes in two indicators of grazing pressure – chlorophyll and meat yields (see box 1). It is proposed that if these metrics reach a certain level over a certain time period it will trigger management action in the form of a reduction in stocking density of lays.

The rationale is that, should natural variability of primary production reach certain low levels whereby it is unlikely to be able to sustain the biomass of shellfish in The Wash; a reduction of the biomass of cultivated shellfish would be enforced proportional to the amount required to make up the shortfall in primary production.

There is considerable potential cost of removing mussels from lays prior to them having reached marketable size and a large degree of uncertainty regarding the potential for cultivated mussels to have an impact on wild shellfish through competition of food resource. As such, trigger levels will reflect only a significant decrease in food availability.

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<sup>2</sup> Study of the Wash Embayment Environment Productivity

### **Box 1. Indicators**

**Chlorophyll** – measured as Relative Florescence Units. RFU can infer chlorophyll concentrations with additional analysis. Most of the literature regarding carrying capacity refers to Chlorophyll concentration in the unit Chla ug L<sup>-1</sup> however accurate estimates of chlorophyll concentrations are not obtainable in the field using a sonde. Cefas process water samples taken from sites where sonde data is collected. Chlorophyll concentrations can be inferred from RFU if regression provides a significant correlation. It is suggested that initially, RFU will be used as an indicator of chlorophyll concentration as sonde data is available immediately after the deployment in the field, allowing a more immediate reaction to changes in chlorophyll levels. The potential use of laboratory derived chlorophyll concentrations will be assessed.

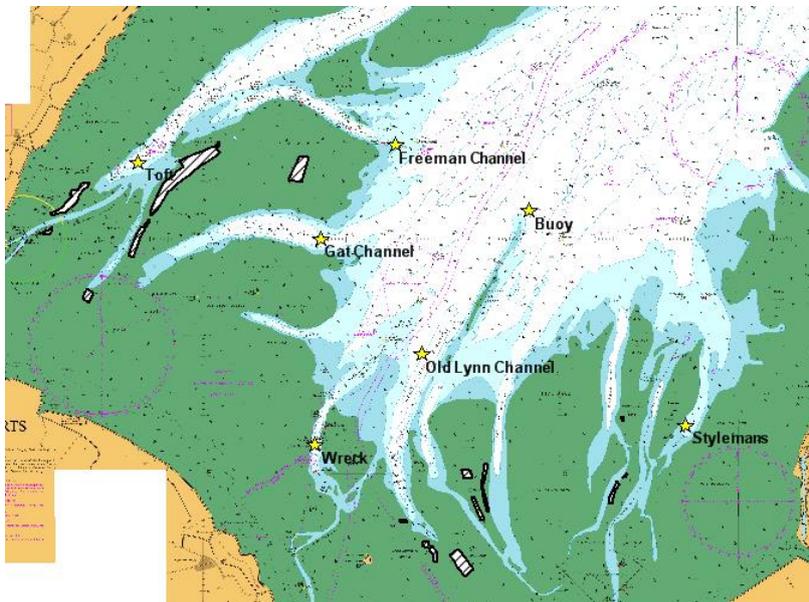
**Meat yield** – mussel samples are processed (by boiling and removing meats) and an estimate of the proportion of meat to total weight is recorded. This is used as a proxy for condition – higher meat yields infer a greater condition. Methods used in the available literature involve drying meats to obtain a dry weight however Eastern IFCA does not have the capacity to process mussels in this way.

For both of these metrics there is little comparable literature primarily as different methods are used.

There are three elements to this process;

1. Monitoring of chlorophyll and mussel condition at three sites in The Wash (fig.1);
2. Assessment of grazing pressure taking into account current stocking density of mussel lays; and
3. Reduction in permitted stocking density of lays based on an assessment of grazing pressure, including the removal of mussel where stocking densities are already too high.

## 1 - Monitoring



**Figure 1.** Distribution of water sampling sites across The Wash as per the SWEEP. Mussel samples are also taken at three of the sites to assess mussel condition; the Wreck, Toft and Thief sample sites.

Chlorophyll and mussel condition data are collected monthly. Data is input into a database

which assesses if thresholds have been reached according to the following rules.

### Phase 1 – Thresholds

The data collected through SWEEP thus far (from 2010 to 2013) has been assessed. Meat yields vary across the three sites – generally the mussels collected from the Wreck site have a greater meat yield than the Toft and Thief site. Growth rates and condition of mussels will vary across The Wash due to natural variability and factors such as immersion time and temperature (which are also likely to vary across sites). With regard to mussel condition, it is proposed that sample site specific trigger levels should be imposed to reflect this variability.

There is no available literature applicable to the method used to indicate condition as per SWEEP. As such, the trigger levels are solely based on the SWEEP data which has been collected by Eastern IFCA. Minimum recorded values of meat yield at each site are the current trigger level.

With regards to chlorophyll related trigger levels, there is no available literature which relates carrying capacity or food availability with Relative Fluorescence Units. Inglis *et al* (2000) suggests chlorophyll concentrations in the range of  $<0.5 \mu\text{g L}^{-1}$  represents very poor growing conditions which can result in a loss of condition. RFU values of 0.2 equate to chlorophyll concentrations of circa 0.5 to 0.9 chl  $\mu\text{g L}^{-1}$  (according to 2014 hand sonde data).

The suggested trigger levels are as follows:

Site	RFU	Meat yield
Wreck	<0.2	<11.5%
Toft	<0.2	<9.0%
Thief	<0.2	<8.7

**Table 1.** monthly trigger levels for the three monitored sites

Should RFU and meat yield reach these levels at two or more sites in the same month of monitoring an assessment of the grazing pressure (see below) will be carried out. If this assessment concludes grazing pressure is greater than primary production, lay holders will be informed that initial trigger levels have been reached.

If the trigger levels are reached again in the following month, another grazing pressure assessment will be undertaken and the proportion reduction required to balance estimated primary production and grazing pressure will be estimated. Lay holders will be informed that, they may need to reduce stocking density in a maximum of two months' time.

If trigger levels are reached for a third consecutive month lay holders will be given a final notice to reduce stocking density to reflect the findings of the grazing pressure assessment.

## Justification

### Mussel condition

Mussels are known to feed on a range of seston including both algal and non-algal organic matter. Non-algal organic matter has been shown to make up a significant part of the diet of mussel (ref) and the significance of non-algal organic matter in the diet of mussels is thought to show a strong relationship with the 'quality' of that matter (ref). To fully understand food availability in The Wash, measurements of non-algal organic matter would need to be factored in. However, there is no scope for the inclusion of this type of assessment as part of existing monitoring.

As such, including mussel condition (meat yield) as one of the two indicators of food availability provides for a more robust method for describing the risk to the wider shellfish stocks. Where both chlorophyll and mussel condition are below agreed thresholds, there is a greater risk that food is at least in part having an impact on shellfish within The Wash.

Shellfish condition, usually inferred from the relationship between the weight of the 'meat' and total weight, is known to vary spatially and temporally and particularly in relation to environmental factors – for example in relation to changes in current velocity (Strohmeier *et al* 2008), temperature and food availability.

In the field, mussel condition has been shown to exhibit seasonal trends in condition (Orban et al 2002, Okumus & Stirling 1998 and Dare & Edwards 1975). Temperature and food availability are thought to have strong influences on condition (Dare & Edwards 1975).

Mussels have been shown to lose condition after spawning (Okumus and Stirling 1998). However this is more pronounced in larger individuals. Mussels in the size range 45-50 mm do not show such a pronounced reduction in condition – this is reflected in the data from sampling in The Wash where no trends have been observed<sup>3</sup> (size range for samples is 45-50mm). In addition, mussel condition is thought to reduce in relation to both temperature and food availability between October and March – mussels losing 30-50% of their flesh weight (Dare & Edwards 1975).

From the data collected through SWEEP, no distinct seasonal trends can be seen. In addition, mussel condition has not shown any statistical relationship with chlorophyll levels (Jessop *et al* 2012). This is most likely a reflection of the limited sampling effort and high degree of variability in condition. As such there is no predictable condition (meat yield) against which a trigger level can be benchmarked. Instead, the minimum recorded meat yield for each site is initially being used as the threshold for each sample site.

Mussels will lose 30-50% of flesh weight through the seasonal variations and as a result of spawning (Dare & Edwards 1975) and can survive a loss of flesh weight (through starvation) of up to 78% (Kautsky 1982). Therefore, trigger levels for each site reflect a reduction in meat yield in the range of 78-50%. Currently, the minimum recorded meat yield at each site represent values within this range (Wreck = -50.9%, Toft = -66.8%, Theif = -63.6%) when compared to the highest recorded meat yield – thus producing a precautionary threshold. For all of the sites, reductions in meat yields represent a loss of condition greater than that which is considered 'normal' but can be recovered from if these conditions are not prolonged.

#### Phytoplankton concentration

There is a wide range of literature which explains the relationship between bivalve mollusc populations and phytoplankton – particularly with regard to bivalve controlled systems (i.e. primary production is limited by grazing pressure). Food depletion through grazing pressure can have wider ecosystem level effects if removal (grazing pressure) is greater than tidal exchange or primary production. Chlorophyll concentration in The Wash shows a 'normal' double peak trend i.e. a spring and autumn bloom indicative of a healthy system. Light attenuation (lower in higher turbidity), temperature and nutrient levels are likely to have a limiting effect on primary production to greater or lesser extents over the year showing seasonal trends.

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<sup>3</sup> Ref research report

Monitoring phytoplankton within The Wash has taken place since 2009 using a combination of a stationary sonde (the buoy sonde) and spot samples using a hand sonde deployed at various locations once per month. Sonde data records phytoplankton in terms of Relative Fluorescence Units which are not easily comparable to chlorophyll concentration in terms of Chl a  $\mu\text{g L}^{-1}$  which is the standard used in all available literature.

The sonde itself has a built in algorithm which estimates Chl a  $\mu\text{g L}^{-1}$  which can provide more instantaneous data than using laboratory based estimates (using water samples) but with less accuracy. According to data collected by the hand sonde in 2014, an RFU of 0.2 relates to an approximate chlorophyll concentration (chl a  $\mu\text{g L}^{-1}$ ) of 0.5 – 0.9, the relationship between RFU and chl a  $\mu\text{g L}^{-1}$  is not linear. Hand sonde data for 2010 and 2011 for (the two most complete data sets) show RFU values dropping below 0.2 only during December.

Growth rates of bivalve molluscs are dependent on several environmental factors; immersion time, water temperature and turbidity in addition to food availability. That said, generic guidelines produced by Inglis *et al* (2000) indicate that, chlorophyll in the range of 1-2  $\mu\text{g L}^{-1}$  (i.e. greater than an RFU of 0.2) represent moderate growing conditions if spring blooms are present during the year. Concentrations between 0.5 and 1  $\mu\text{g L}^{-1}$  are unlikely to result in a loss of condition but represent poor growing conditions, concentrations  $<0.5 \mu\text{g L}^{-1}$  can result in a loss of condition if prolonged.

A trigger level of 0.2 RFU is proposed as this represents the threshold below which growing conditions are poor but crucially, if not prolonged, mussels will recover condition.

### Summary

Reaching either of the trigger levels at a single site is unlikely to be a reflection of a genuine issue relating to food availability as a result of food depletion. In both cases, reaching the above explained trigger levels is within the realms of natural variation and, given the limited sampling effort could also be a reflection of sampling errors.

If a combination of trigger levels for RFU and meat yield is reached at two sites then there is the potential that food is limiting growth and condition of mussels - prolonged exposure to these conditions could have wider ecosystem level impacts on the shellfish populations in The Wash.

The extent to which reductions in the stocking density of shellfish lays is required is determined through an assessment of grazing pressure in The Wash.

## **2. Grazing pressure assessment**

A simple model is used to determine the extent to which stocking density is reduced.

The model considers how long it would take (in days) for the quantifiable biomass of filter feeders in The Wash (i.e. mussels, lay mussels and cockles) to remove the standing stock of phytoplankton. This is quantified as follows:

Feeding rates in terms of chlorophyll per individual per hour have been estimated in the field by Kotta and Molhenberg (2002) – a range is presented which is likely to reflect other environmental conditions such as temperature and seston concentration including a proportion intake of non-algal organic matter. Feeding rates are adjusted to take into account the mean length of mussel and cockle in The Wash using the following formula:

$$GL = G_{20} \times l^2 / 20^2$$

Where  $GL$  = Grazing rate at length and  $G_{20}$  = grazing rate at a length of 20mm. Grazing rate estimates as per Kotta and Molhenberg were also used for estimates of cockle grazing.

The standing stock of phytoplankton is estimated by scaling up the concentration of chlorophyll (using a mean from field samples) by the estimated volume of water within 2 meters depth.

Taking into account feeding rates an estimate of the time taken to remove the standing stock of phytoplankton is then estimated. This number (days) is then compared to an estimated cell doubling time (3-14 days) depending on the season (see table 2).

The quantified biomass of cockles and mussels in The Wash will make up only a portion of grazing pressure – other bivalves (*Maccoma* etc), polychaetes and zooplankton will also graze on phytoplankton (although zooplankton will likely graze on phytoplankton within a smaller size range than other filter feeders). The contribution of the quantified shellfish within The Wash to the total grazing pressure is unknown – it is currently set at a cautious 50%.

Where the grazing pressure (represented in days) is less than 50% of the estimated cell doubling time for the season (table 2), reductions in the stocking density of mussels on private lays will be adjusted. The change in biomass which results in the grazing pressure aligning with 50% cell doubling time will represent the proportion reduction in stocking density across all lays in The Wash.

Mechanics of this model is presented below.

**Table 2** – indicative parameters for grazing pressure model

Season	Chlorophyll concentration* (Chla ug L <sup>-1</sup> )	Grazing rate (ug chl ind <sup>-1</sup> h <sup>-1</sup> )	Cell doubling time (days)
Winter	0.5 (low)	Low	14 (low)
Spring	5 (high)	High	3 (high)
Summer	0.5 (low)	Med	14 (low)

Autumn	2 (medium)	Med	9 (med)
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\* Chlorophyll concentrations from field samples will be used – the concentrations presented above are indicative of what is found in The Wash and aligned with Inglis et al (2000) thresholds for mussel growth.

**Table 3** – Indicative outputs using the proposed model for estimating grazing pressure

All quantified shellfish within The Wash (43,640 tonnes of mussel and 19,319 tonnes of cockle)			
Concentration of chlorophyll (Chl ug L <sup>-1</sup> )	Estimated standing stock of phytoplankton (ug)	Time (hrs) to reduce standing stock of phytoplankton to zero	
		Grazing rate of shellfish* chl ug ind <sup>-1</sup> hour <sup>-1</sup>	
		Low	High
0.5	6.25E+11	2372.954	196.6707872
2	2.5E+12	9491.817	786.6831487
5	6.25E+12	23729.54	1966.707872

\* Grazing rate ranges vary for species; mussel = 0.10125 (low) to 2.025 (high) chl ug ind<sup>-1</sup> hr<sup>-1</sup>, cockle = 0.0008 (low) to 0.0156 (high) chl ug ind<sup>-1</sup> hr<sup>-1</sup>. Estimates on the number of individuals within The Wash were calculated using an average weight for the 2014 cockle survey (cockles) and the average weight of mussels (perris comms R. Jessop).

Using the above outputs from the grazing pressure model a comparison can be made between the grazing pressure and doubling time of phytoplankton in The Wash.

Assuming constant grazing rates and an immersion time of 16 hours, the scenario highlighted in table 3 would result in depletion of the standing stock of phytoplankton in 593 (low grazing rate) to 49 (high grazing rate) days. Grazing rates will vary by season, estimates will be used as per table 2.

Compared to even the slowest cell doubling time (14 days), grazing pressure in this scenario would not be considered limiting.

### Limitations

The approach outlined above is a very simplistic model. The key limitations to this approach are outlined below. Overall, this approach could be considered cautious.

*Nutrient recycling* – Bivalve beds are thought to have a nutrient recycling role which is likely to stimulate primary production. Asmus and Asmus (1991) found that potentially significant increases in primary production were the result of nutrient recycling by filter feeding molluscs. In addition, Cugier et al (2010) suggests that understanding the feedback due to the mineralisation of biodeposits is crucial to fully evaluate the role of filter feeders on primary production. By not including this in the model presented above, the estimated impact on the standing stock of phytoplankton is likely overestimated.

*Spatial variations in phytoplankton and seston quality* – the model above assumes uniform phytoplankton concentrations based on a relatively small sample size of sonde readings. Cranford et al (date) indicate that, in determining standing stocks of phytoplankton in large areas, many spot samples are required – it was concluded that satellite data would actually only provide the required spatial coverage. Satellite derived data would not allow for a reactive enough system in this case – with data taking several months to become available and process.

The quality of non-algal organic matter will likely vary across The Wash also, affecting both feeding rates and mussel condition. Tidal and riverine inputs will affect this in addition to rainfall and changes in anthropogenic inputs of nutrients. Phytoplankton concentrations, turbidity and seston quality will also vary within mussel beds, particularly dense aggregations such as those found in cultivation beds (Strohmeir et al 2008 and Kamermas 1993).

The Wash is thought to be well mixed horizontally and vertically with high current velocities conducive of a productive system. Despite this, not being able to reflect the spatial variability in plankton and seston is potentially a significant limitation in this simple model.

*Grazing pressure in The Wash* – Eastern IFCA has a limited understanding of the current grazing pressure of organisms in The Wash outside of those which are quantified during surveys (i.e. cockle and mussel surveys). Of potential significance are the razor clams (*Ensis* sp), slipper limpets and polychaetes. Determining the contribution of the quantifiable bivalve stocks to grazing pressure is an important element to determining the overall grazing pressure. At present, a cautious estimate of 50% is used when comparing to cell doubling time. This is potentially an overestimate.

Given the above noted limitations, outputs from the model – particularly when being used to determine the proportion decrease in stocking density of the lays - should provide only a starting point for discussions to determine a figure. A final proportion decrease will be agreed with Natural England. The model as presented above represents the use of the current best available evidence.

### **3. Limiting stocking density of lays**

Where trigger levels have been met consecutively for three months and grazing pressure calculations have determined a shortfall in primary production against the grazing pressure assessment, stocking density will be reduced in accordance with the shortfall.

The procedure for this is presented in figure 2. The process is explained below.

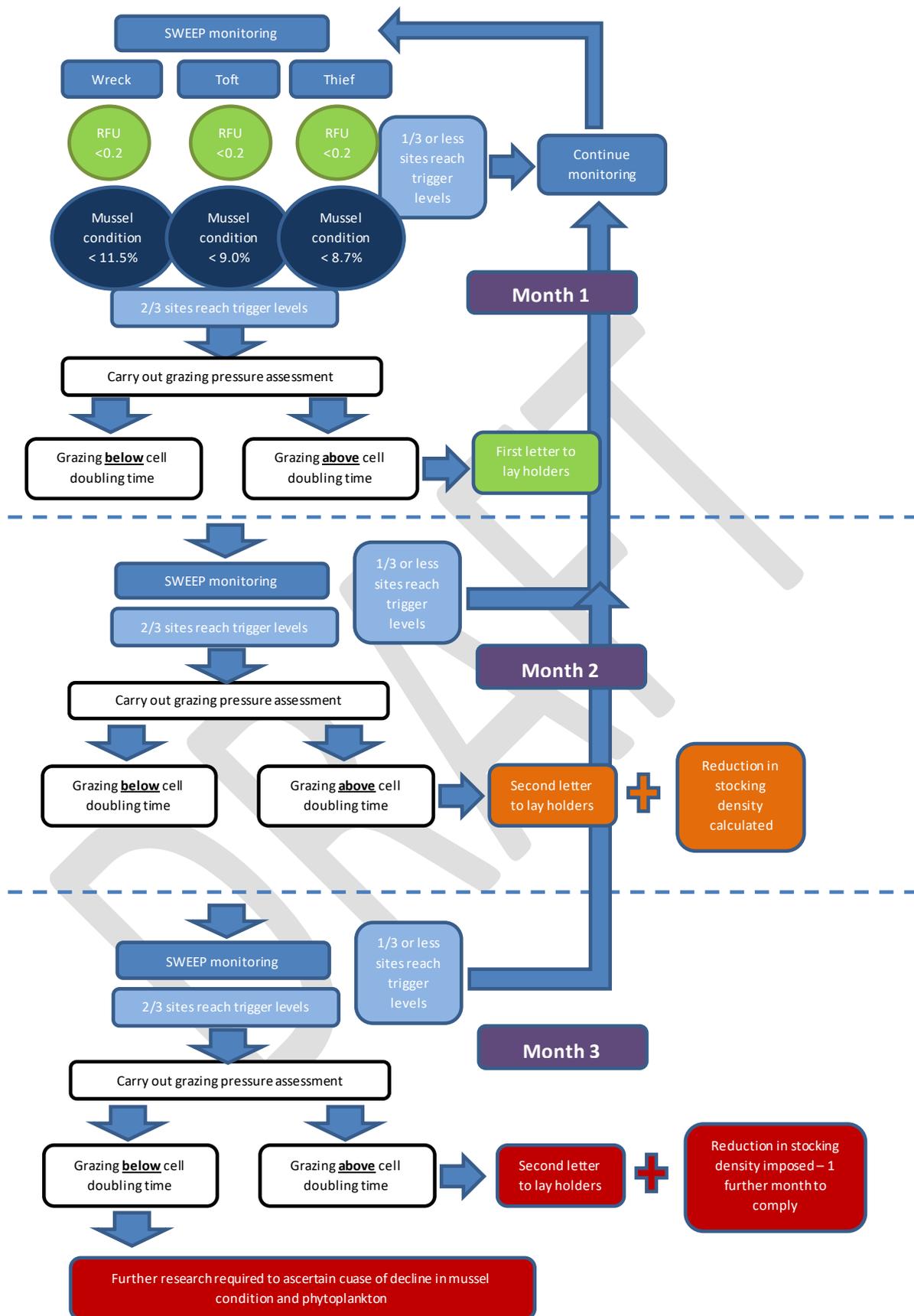
When trigger levels are met at two or more sites (as detected by monthly SWEEP monitoring), a grazing assessment is carried out. Where there is a shortfall in chlorophyll standing stock relative to grazing pressure a letter is sent to lay holders

indicating that trigger levels have been met and stocking densities may need to be limited. Reaching trigger levels for a single month will not result in actual reductions. If the grazing pressure assessment finds that there is not a shortfall in phytoplankton biomass, reductions in stocking densities will not have an effect and will not be suggested.

If trigger levels are reached at two sites for a second month, a further grazing assessment is carried out. Where the grazing assessment finds a shortfall in phytoplankton biomass (regardless of it this was true the previous month) a letter will be sent out to lay holders indicating that a reduction in stocking density will commence in two months' time if trigger levels are met for a third consecutive month. If the grazing assessment finds no shortfall, reducing stocking density will have no effect and no reductions in stocking density will be required.

If trigger levels are met for a third month, a grazing pressure assessment will be carried out. Findings will be used to impose a stocking density limit for lay holders who will be given a further month to comply.

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