Document Control

Title	**Chichester and Langstone Harbours SPA – Light otter trawl (sandeels)**
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Revision History

Date	Author	Version	Status	Reason	Approver(s)
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06/04/2016	V Gravestock	1.3	Draft	In-combination effects	
21/04/2016	V Gravestock	1.4	Draft	QA by SP	
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11/08/2016	V Gravestock	1.8	Final Draft	Inclusion of new shellfish management measures	
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This document has been distributed for information and comment to:

Title	Name	Date sent	Comments received
HRA – Chichester and Langstone Harbours SPA – Light otter trawl (sandeels) (v1.0)	Natural England	08/02/2016	30/03/2016
HRA – Chichester and Langstone Harbours SPA – Light otter trawl (sandeels) (v1.5)	Natural England	21/04/2016	12/05/2016

Southern Inshore Fisheries and Conservation Authority (IFCA)

Fisheries in EMS Habitats Regulations Assessment for amber and green risk categories

European Marine Site: Chichester and Langstone Harbours SPA (UK9011011)

Feature(s): Internationally important populations of regularly occurring Annex 1 species (Sandwich tern; Common tern, Little tern); Internationally important populations of regularly occurring migratory species (Grey plover; Sanderling, Dunlin, Redshank, Dark-bellied brent goose; Shelduck; Teal); Nationally important populations of regularly occurring migratory species (Ringed plover; Curlew, Bar-tailed godwit; Turnstone; Wigeon; Pintail; Shoveler; Red-breasted merganser; Little Egret); Internationally important assemblage of waterfowl (Waterfowl Assemblage)

Generic Feature(s): Surface feeding birds; Estuarine birds

Site Specific Sub-feature(s)/Supporting Habitat(s): Intertidal mudflats and sandflats; Mixed sediment shores; Shingle; Sand and shingle; Shallow coastal waters

Generic Sub-feature(s)/Supporting Habitat(s): Intertidal mud and sand; Intertidal mixed sediments; Estuarine fish community

Gear type(s) Assessed: Light otter trawl (sandeels)

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1. Introduction

1.1 Need for an HRA assessment

Southern IFCA has duties under Regulation 9(3) of the Conservation of Habitats and Species Regulations 2010 as a competent authority, with functions relevant to marine conservation to exercise those functions so as to secure compliance with the Habitats Directive. Article 6.2 of the Habitats Directive requires appropriate steps to be taken to avoid, in Natura 2000 sites, the deterioration of natural habitats and habitats of species as well as significant disturbance of the species for which the area has been classified.

Management of European Marine Sites is the responsibility of all competent authorities which have powers or functions which have, or could have, an impact on the marine area within or adjacent to a European Marine Site (EMS). Under section 36 of the Species and Habitats Regulations (2010):

“The relevant authorities, or any of them, may establish for a European marine site a management scheme under which their functions (including any power to make byelaws) are to be exercised so as to secure in relation to that site compliance with the requirements of the Habitats Directive.”

Within the Solent EMS such a management scheme has been developed in the form of the SEMS management scheme which was established in 2004. This resulted in the establishment of a framework for the effective management of the Solent EMS so that the conservation objectives are met. The key principles of the management scheme are included in Annex 2.

In the SEMs Management Group 2015 Monitoring Report, fishing activities have been flagged to be a high risk or (Tier 1) activity. High risk activities are considered as potentially representing a high risk and/or not having sufficient “systems in place to ensure they are managed in line with the Habitats Regulations” and, therefore, requiring further management consideration. During the 2015 consultation a request was made to reduce the risk of fishing activity from high to medium risk. The response from the group was that in order to do this a clear audit and evidence trail would be required to reduce the risk. This assessment, in line with Article 6.2 of the Habitats Directives, will form part of that audit trail, as will other assessments regarding the fishing activities within the Solent EMS. It is considered that some level of management will be required for high risk activities within the EMS.

This audit trail will be achieved through Southern IFCA’s responsibilities under the revised approach to the management of commercial fisheries in European Marine sites announced by the Department for Environment, Food and Rural Affairs (DEFRA).

The objective of this revised approach is to ensure that all existing and potential commercial fishing activities in European Marine Sites are managed in accordance with Article 6 of the Habitats Directive. Articles 4.1 and 4.2 of the Birds Directive also require that the Member States ensure the species mentioned in Annex I and regularly occurring migratory bird species are subject to special conservation measures concerning their habitat in order to ensure survival and reproduction in their area of distribution. This affords Special Protection Areas (SPAs) a similar protection regime to that of Special Areas of Conservation (SACs).

This approach is being implemented using an evidence-based, risk-prioritised, and phased approach. Risk prioritisation is informed by using a matrix of the generic sensitivities of the sub-features of the EMS to a suite of fishing activities as a decision making tool. These sub-feature-

activity combinations have been categorised according to specific definitions, as red[1], amber[2], green[3] or blue[4].

Activity/feature interactions identified within the matrix as red risk have the highest priority for implementation of management measures by the end of 2013 in order to avoid the deterioration of Annex I features in line with obligations under Article 6(2) of the Habitats Directive.

Activity/feature interactions identified within the matrix as amber risk require a site-level assessment to determine whether management of an activity is required to conserve site features. Activity/feature interactions identified within the matrix as green also require a site level assessment if there are "in-combination effects" with other plans or projects.

Site level assessments are being carried out in a manner that is consistent with the provisions of Article 6(3) of the Habitats Directive, but are required to meet the 6(2) responsibilities of Southern IFCA as a competent authority. The aim of the assessment will be to consider if the activity could significantly disturb the species or deteriorate natural habitats or the habitats of the protected species and from this, a judgement can be made as to whether or not the conservation measures in place are appropriate to maintain and restore the habitats and species for which the site has been designated to a favourable conservation status (Article 6(2)). If measures are required, the revised approach requires these to be implemented by 2016.

The purpose of this site specific assessment document is to assess whether or not in the view of Southern IFCA the fishing activity 'Light otter trawling for sandeels' has a likely significant effect on internationally important populations of regularly occurring Annex 1 species, the internationally and nationally important populations of the regularly occurring migratory species and internationally important assemblage of waterfowl and their supporting habitats of the Chichester and Langstone Harbours SPA; and on the basis of this assessment whether or not it can be concluded that light otter trawling will not have an adverse effect on the integrity of this EMS. Please note this assessment only includes the Langstone Harbour portion of the Chichester and Langstone Harbours SPA as light otter trawling for sandeels is only known to occur within this harbour.

1.2 Documents reviewed to inform this assessment

- SEMs Annual Monitoring Report 2015
- SEMs Delivery Plan 2014
- Natural England's risk assessment Matrix of fishing activities and European habitat features and protected species[5]
- Reference list[6] (Annex 1)

[1] Where it is clear that the conservation objectives for a feature (or sub-feature) will not be achieved because of its sensitivity to a type of fishing, - irrespective of feature condition, level of pressure, or background environmental conditions in all EMSs where that feature occurs – suitable management measures will be identified and introduced as a priority to protect those features from that fishing activity or activities.

[2] Where there is doubt as to whether the conservation objectives for a feature (or sub-feature) will be achieved because of its sensitivity to a type of fishing, in all EMSs where that feature occurs, the effect of that activity or activities on such features will need to be assessed in detail at a site specific level. Appropriate management action should then be taken based on that assessment.

[3] Where it is clear that the achievement of the conservation objectives for a feature is highly unlikely to be affected by a type of fishing activity or activities, in all EMSs where that feature occurs, further action is not likely to be required, unless there is the potential for in combination effects.

[4] For gear types where there can be no feasible interaction between the gear types and habitat features, a fourth categorisation of blue is used, and no management action should be necessary.

[5] See Fisheries in EMS matrix: http://www.marinemanagement.org.uk/protecting/conservation/documents/ems_fisheries/populated_matrix3.xls

- Natural England's Regulation 33 advice[7]/Natural England's interim conservative advice
- Site map(s) – supporting habitat(s) location and extent (Annex 3)
- Fishing activity data (map(s), etc) (Annex 4)
- Fisheries Impact Evidence Database (FIED)/SPA Toolkit

2. Information about the EMS

- Chichester and Langstone Harbours SPA (UK9011011)

2.1 Overview and qualifying features

- **Internationally important populations of the regularly occurring Annex 1 species** (A191 Sterna sandvicensis; Sandwich tern (Breeding); A193 Sterna hirundo; Common tern (Breeding); A195 Sterna albifrons; Little tern (Breeding))
    - Sand and shingle
    - Shallow coastal waters
- **Internationally important populations of the regularly occurring migratory species** (A141 *Pluvialis squatarola*; Grey plover (Non-breeding); A144 *Calidris alba*; Sanderling (Non-breeding); A149 *Calidris alpina alpina*; Dunlin (Non-breeding); A162 *Tringa totanus*; Common redshank (Non-breeding); A046a *Branta bernicla bernicla*; Dark-bellied brent goose (Non-breeding); A048 *Tadorna tadorna*; Common shelduck (Non-breeding); A052 *Anas crecca*; Eurasian teal (Non-breeding))
    - Saltmarsh
    - Intertidal mudflats and sandflats
    - Boulder and cobble shores
    - Mixed sediment shores
- **Nationally important populations of regularly occurring migratory species** (A137 *Charadrius hiaticula*; Ringed plover (Non-breeding); A160 *Numenius arquata*; Eurasian curlew (Non-breeding); A157 *Limosa lapponica*; Bar-tailed godwit (Non-breeding); A169 *Arenaria interpres*; Ruddy turnstone (Non-breeding); A050 *Anas penelope*; Eurasian wigeon (Non-breeding); A054 *Anas acuta*; Northern pintail (Non-breeding); A056 *Anas clypeata*; Northern shoveler (Non-breeding); A069 *Mergus serrator*; Red-breasted merganser (Non-breeding); *Egretta garzetta*: Little Egret).
- **Internationally important assemblage of waterfowl (Waterbird assemblage)**
    - Shingle
    - Saltmarsh
    - Intertidal mudflats and sandflats
    - Mixed sediment shores
    - Shallow coastal waters

Please refer to Annex 3 for a map of supporting habitats.

Chichester and Langstone Harbours are located on the south coast of England in Hampshire and West Sussex. They are large, sheltered estuarine basins comprising extensive sand- and mud-flats exposed at low tide. The two harbours are joined by a stretch of water that separates Hayling Island from the mainland. Tidal channels drain the basin and penetrate far inland. The mud-flats are rich in invertebrates and also support extensive beds of algae, especially *Enteromorpha* species, and eelgrasses *Zostera* spp. The basin contains a wide range of coastal habitats

[6] Reference list will include literature cited in the assessment (peer, grey and site specific evidence e.g. research, data on natural disturbance/energy levels etc)
[7] Solent EMS Regulation 33 Conservation Advice: http://publications.naturalengland.org.uk/publication/3194402

supporting important plant and animal communities. The site is of particular significance for waterbirds, especially in migration periods and in winter. It also supports important colonies of breeding terns.[8]

2.2 Conservation Objectives

The conservation objective for the Chichester and Langstone Harbours SPA features:

- Internationally important populations of regularly occurring Annex 1 species
- Internationally important populations of the regularly occurring migratory species
- Nationally important populations of regularly occurring migratory species
- Internationally important assemblage of waterfowl

Are to "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, and,
- The distribution of the qualifying features within the site**."**

The high level conservation objectives for the Chichester and Langstone Harbours SPA are available online at: http://publications.naturalengland.org.uk/publication/5789102905491456

3. Interest feature(s) of the EMS categorised as 'Red' risk and overview of management measure(s) (if applicable)

- Subtidal eelgrass *Zostera marina* beds

A red risk interaction between bottom towed gears and eelgrass/seagrass beds was identified and subsequently addressed through the creation of the 'Bottom Towed Fishing Gear' byelaw[9] and 'Prohibition of Gathering (Sea Fisheries Resources) in Seagrass Beds' byelaw[10]. The 'Bottom Towed Fishing Gear' prohibits the use any bottom towed fishing gear within sensitive areas (characterised by reef features or eelgrass/seagrass beds) in European Marine Sites throughout the district. The byelaw also states that if transiting through a prohibited area carrying bottom towed fishing gear, all parts of the gear are inboard and above the sea. Within the Solent EMS, which includes waters to the north of the Isle of Wight, all eastern harbours and Southampton Water, there are 20 prohibited areas. The 'Prohibition of Gathering (Sea Fisheries Resources) in Seagrass Beds' byelaw prevents digging, fishing for or taking any sea fisheries resource in or from prohibited areas containing eelgrass/seagrass beds in European Marine Sites throughout the District. Exceptions to the prohibition include if a net, rod and line or hook and line are used, in addition to the use of a vessel as long as the vessel's hull is not in contact with the seabed. It is also prohibited to carry a rake, spade, fork or any similar tool within specified areas. Within the Solent EMS, which includes north of the Isle of Wight, all eastern harbours and Southampton Water, there are 25 prohibited areas.

[8] Taken from http://jncc.defra.gov.uk/default.aspx?page=2034
[9] Bottom Towed Fishing Gear Byelaw: https://secure.toolkitfiles.co.uk/clients/25364/sitedata/files/PDFbyelaw_bottomtowedfishi.pdf
[10] Prohibition of Gathering (Sea Fisheries Resources) in Seagrass Beds Byelaw: https://secure.toolkitfiles.co.uk/clients/25364/sitedata/files/PDFbyelaw_prohibitionofgat.pdf

4. Information about the fishing activities within the site

4.1 Activities under Consideration/Summary of Fishery

Light otter trawling in Langstone Harbour is used to target sandeels (*Ammodytes tobianus*) and is focused during the summer months from May to October (Southern IFCA Committee Member Pers. Comm)[11]. The species is collected and used for the purposes of bait and not human consumption.

4.2 Technical Gear Specifications

An otter trawl comprises of following design (see Figure 1). Two shaped panels of netting are laced together at each side to form an elongated funnel-shaped bag (Seafish, 2015). The funnel tapers down to a cod-end where fish are collected (Seafish, 2015). The remaining cut edges of the net and net mouth are strengthened by lacing them to ropes to form 'wings' that are used to drive fish into the net (Seafish, 2015). The upper edge of the rope is referred to as the head line, the lower edge is referred to as the foot rope of fishing line and side ropes are known as wing lines (Seafish, 2015). Floats are attached to the headline to hold the net open and the foot rope is weighted to maintain contact with the seabed and prevent damage to the net (Seafish, 2015). The wings of the net are held open by a pair of trawl doors, also known as otter boards, and are attached to the wings by wires, ropes or chains known as bridles and sweeps (Seafish, 2015). The sweep connects the trawl door to top and bottom bridles which are attached to the headline and footrope of the net, respectively (Seafish, 2015). The choice of material used for the sweeps and bridles depends on the size of gear and nature of the seabed, with smaller inshore boats using thin wire and combination rope (Seafish, 2015). The trawl doors, which are made of wood or steel are towed through the water at an angle which causes them to spread apart and open the net in a horizontal direction (Seafish, 2015). The trawl doors are attached to the fishing vessel using wires referred to as trawl warps (Seafish, 2015). The trawl doors must be heavy enough to keep the net on the seabed as it is towed (Seafish, 2015). As the trawl doors are towed along the seabed they generate a sediment cloud which helps to herd fish towards the mouth of the trawl (Seafish, 2015). The bridles and sweeps continue the herding action of the trawl doors as they trail on the seabed and disturb the sediment, creating a sediment cloud (Seafish, 2015). The length of the sweeps and bridles and distance between the two trawl doors is tuned to the target species (Seafish, 2015). Species such as lemon sole and plaice can be herded into the trawl over long distances and so the length of the sweeps is longer (Seafish, 2015).

[11] Information was provided by a Southern IFCA Committee Member who has valuable knowledge and experience of the fishery.

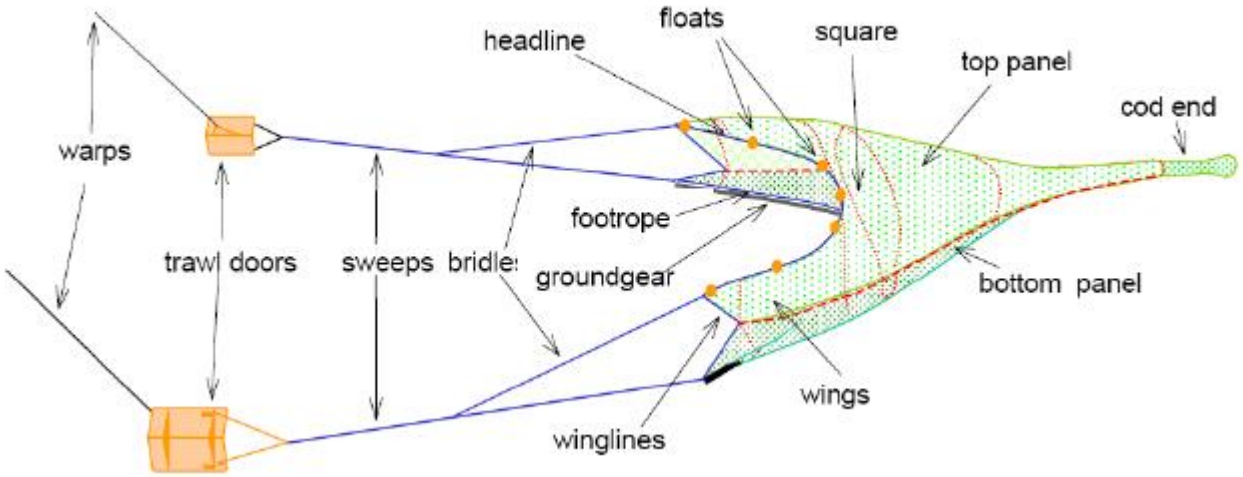

Figure 1. Key components of an otter trawl.
Source: www.seafish.org/upload/b2b/file/r_d/BOTTOM%20TRAWL_5a.pdf

The mesh size of the net used varies depending on the type of trawl (Seafish, 2015). In the UK, there has been a move towards an increase in mesh size, particularly in the top panel and wings, in order to improve gear selectivity (Seafish, 2015). When fishing for sandeels, a mesh size of less than 16 mm is used.

The ground rope will have some form of ground gear attached to protect the netting from damage on the seabed (Seafish, 2015). The ground gear can vary largely. The most basic is where bare fishing line and the netting is laced directly to the rope of combination rope (Seafish, 2015). Chains may also be used and the style of attachment can vary (Seafish, 2015). Ground gear may also include bobbins and rock hoppers which commonly use small and large rubber discs (up to 600 mm) (Seafish, 2015).

The drag of the gear, combined with the floats on the headline, mean the weight of the trawl on the seabed is in the region of 10 to 20% of what it would be in air (Seafish, 2015).

A light otter trawl is one that uses anything less than the definition given for a heavy otter trawl, which include any of the following (MMO, 2014):

- Sheet netting of greater than 4 mm twine thickness
- Rockhoppers or discs of 200 mm or above in diameter
- A chain for the foot/ground line (instead of wire)

Generally, vessels will shoot and haul their gear over the stern of the boat (Seafish, 2015).

Restrictions on vessels over 12 metres in length in the Southern IFCA district limits the size of gear that can be used within the district. The sizes of boats engaged in light otter trawling for sandeels range between 6 and 10 metres and are largely powered by outboard motors (Southern IFCA Committee Member Pers. Comm). The gear used to fish for sandeels is relatively small and considered to be very light, as it commonly hauled by hand (Southern IFCA Committee Member Pers. Comm). The area fished is relatively confined and limits the size of the gear that can be used (Southern IFCA Committee Member Pers. Comm). The weight of a trawl used by a 10 m boat is approximately 65 kg and 40 kg for smaller boats (6 to 8 m). Trawl doors are made of wood and there is no standard weight or size (Southern IFCA Committee Member Pers. Comm). A light otter trawl with a ground rope of 20 ft has doors of 18 by 12 inches and a ground rope of 24 ft has doors of 24 by 16 inches (Southern IFCA Committee Member Pers. Comm). The ground rope

used is referred to as a 'foot rope' and is comprised of a piece of light wire with rope wrapped around it. (Southern IFCA Committee Member Pers. Comm). The set up used is designed to have minimal contact with the seabed and remain above the seabed (Southern IFCA Committee Member Pers. Comm). The length of the sweeps and bridles is approximately 20 ft (6 m) and length of the warps is approximately 114 ft (35 m) (Southern IFCA Committee Member Pers. Comm). The maximum width across the entrance is approximately 3 m. Trawls are towed at between 1.5 and 2 knots and the length of a tow can be up to approximately 200 metres (Southern IFCA Committee Member Pers. Comm).

4.3 Location, Effort and Scale of Fishing Activities

Trawling takes place at high tide and is generally focused subtidally, however it can occur on the fringes of the intertidal. The activity is concentrated within the main channels in the southern and central parts of the harbour, particularly in an area known as Sword Sands (Annex 4).

Sightings data in Annex 4, (split between 2005 to 2010 and 2011 to 2015) illustrates that trawling is focused subtidally in the main channels, within the central and southern of the harbour. Sightings data is only available between 2005 and 2010. The majority of these sightings are concentrated within a small area where the main channel splits into the Broom Channel and Langstone Channel, south of Sword Sands. A limited number of sightings show the activity occurring in Mallard Sands, slightly northwest of Sword Sands and in the north eastern quarter of the harbour near Penner. The north eastern quarter is an area known for clam dredging and it is likely these sightings may have been mistaken for trawling. Please note that Southern IFCA's sightings data may reflect home ports of patrol vessels, high risk areas and typical patrol routes and therefore is only indicative of fishing activity. Over the ten year period covered by sightings data (2005-2015), it is likely that the geographical extent of the fishery is well reflected, however intensity may be skewed by aforementioned factors.

The total number of vessels operating within the fishery is approximately 5, with up to 1 or 2 vessels operating every day during the summer months (May to October). The confined area in which fishing takes place means the number of boats is limited to 3 to 4 at any one time (Southern IFCA Committee Member Pers. Comm).

Table 1 shows data collected by Langstone Harbour Board on the number of vessels sighted to be towing fishing gear within Langstone Harbour. This can include clam dredging, oyster dredging and trawling. Only vessels known to engage in trawling were included within Table 1 and whilst this is likely to exclude other forms of fishing activity (clam dredging and oyster dredging), vessels often engage in more than one type of fishing activity and therefore the sightings data presented in table 1 is likely to be an overestimate. Two of the vessels included within the analysis are also known to undertake trawling and shellfish dredging as part of scientific surveys and can be eliminated from the analysis from referring to the number of fishing sighted twice or more. The sightings data show a decline in the average number of vessels sighted from 2.1 in 2013 to 1 in 2015. The maximum number of vessels sighted was in July 2013 at 5. Over the three year period, there were only three instances where vessels were sighted 10 times or more in one month and nine instances where vessels were sighted over 5 times or more in one month. In 2014, the number of vessels sighted per month shows a clear increase from May until September. In other years this trend is not as clear, although in both 2013 and 2015, the highest numbers of vessels sighted per month is highest in July. Overall, the sightings reflect a relatively low level of fishing activity within Langstone Harbour.

The location of these fishing vessels was not recorded up until March 2015, when the location of a vessel engaged in fishing was recorded within a sector of the harbour (North Langstone Channel, Broom Channel, Russells Lake, South Salterns, Langstone Channel, Sinah Lake and Eastney

Lake). From March to December 2015, sectors where filtered sightings data have been recorded include once in Russels Lake and Broom Channel, twice in Langstone Channel and South Salterns and three times in North Langstone Channel. Two vessels sighted in these areas undertake trawling and shellfish dredging as part of scientific surveys. Excluding these vectors, sectors where sightings data have been recorded include once in North Langstone Channel, Langstone Channel, South Salterns and Russells Lake.

Table 1. Sightings of fishing vessels towing gear in Langstone Harbour between November 2012 and December 2015. Only vessels known to trawl were included. Data was provided by Langstone Harbour Board.

Year	Month	No. of fishing vessels sighted	No. of fishing vessels sighted twice or more	No. of fishing vessels sighted 5 times or more	No. of fishing vessels sighted 10 times or more
2012	Jan				
	Feb				
	Mar				
	Apr				
	May				
	Jun				
	Jul				
	Aug				
	Sep				
	Oct				
	Nov	3	2	2	0
	Dec	3	1	0	0
	Average	**3**	**1.5**	**1**	**0**
2013	Jan	1	1	0	0
	Feb	2	1	0	0
	Mar	2	1	0	0
	Apr	3	1	0	0
	May	2	0	0	0
	Jun	2	1	0	0
	Jul	5	2	0	0
	Aug	1	0	0	0
	Sep	1	0	0	0
	Oct	3	1	0	0
	Nov	3	1	0	0
	Dec	0	0	0	0
	Total	**2.1**	**0.8**	**0**	**0**
2014	Jan	1	0	0	0
	Feb	1	0	0	0
	Mar	1	0	0	0
	Apr	0	0	0	0
	May	4	4	0	0
	Jun	3	3	2	1
	Jul	3	2	2	2
	Aug	2	1	0	0
	Sep	4	1	0	0
	Oct	1	0	0	0

	Nov	0	0	0	0
	Dec	0	0	0	0
	Average	**1.7**	**0.9**	**0.3**	**0.3**
2015	Jan	2	1	1	0
	Feb	2	0	0	0
	Mar	0	0	0	0
	Apr	0	0	0	0
	May	0	0	0	0
	Jun	0	0	0	0
	Jul	3	1	0	0
	Aug	1	1	0	0
	Sep	2	0	0	0
	Oct	1	0	0	0
	Nov	1	1	0	0
	Dec	0	0	0	0
	Average	**1**	**0.3**	**0.1**	**0**

The sandeels caught are used for the purposes of bait and not human consumption. This means the catch levels are very low with a commercially licensed vessel catching approximately 1 kg of sandeels a day (Southern IFCA Committee Member Pers. Comm).

5. Test of Likely Significant Effect (TLSE)

The Habitats Regulations assessment (HRA) is a step-wise process and is first subject to a coarse test of whether a plan or project will cause a likely significant effect on an EMS[12]. Each feature/supporting habitat was subject to a TLSE, the results of which are summarised in tables 4 and 5.

5.1 Table 2: Summary of LSE Assessment(s) – Surface feeding birds

1. Is the activity/activities directly connected with or necessary to the management of the site for nature conservation?	**No**

[12] Managing Natura 2000 sites: http://ec.europa.eu/environment/nature/natura2000/management/guidance_en.htm

<table>
<tr><td>2. What potential pressures, exerted by the gear type(s), are likely to affect the feature(s)/supporting habitat(s)?</td><td colspan="2">Regulation 33 Advice/SPA Toolkit:
1. Physical loss (of non-breeding habitat) – removal
2. Physical loss (of non-breeding habitat) – smothering
3. Physical damage (of non-breeding habitat) – abrasion
4. Non-physical disturbance (and displacement) – noise
5. Non-physical disturbance (and displacement) – visual presence
6. Toxic contamination – introduction of synthetic and non-synthetic compounds
7. Non-toxic contamination – changes in nutrient loading and organic loading
8. Non-toxic contamination – changes in turbidity/Increased turbidity
9. Competition for prey
10. Changes in food availability

Additional pressures identified from Interim Conservation Advice:
11. Collision above/below water with static or moving objects
12. Introduction of light
13. Introduction or spread of non-indigenous species
14. Litter</td></tr>
<tr><td rowspan="2">3. Is the feature(s)/supporting habitats(s) likely to be exposed to the pressure(s) identified?</td><td>Pressure</td><td>Screening - Justification</td></tr>
<tr><td>4.</td><td>IN – Due to the depth of the draft of the vessels used in the fishery, they are unable to fish in close proximity to nesting surface feeding birds as a result of shallow water depth. Disturbance however may occur when birds are feeding as there may be an overlap in feeding and fishing grounds. Noise disturbance can result from the presence/movement of fishing vessels and operation of the fishing gear. The magnitude of disturbance and potential displacement is influenced by the intensity of fishing (no. of vessels, frequency and duration) and the activities relative proximity to sensitive bird species (wildfowl & waders). Further investigation is therefore necessary into the location and scale of the activity and location of sensitive bird species.</td></tr>
</table>

	5.	IN – Due to the depth of the draft of the vessels used in the fishery, they are unable to fish in close proximity to nesting surface feeding birds as a result of shallow water depth. Disturbance however may occur when birds are feeding as there may be an overlap in feeding and fishing grounds. Visual disturbance can results from the presence/movement of fishing vessels and operation of the fishing gear. The magnitude of disturbance and potential displacement is influenced by the intensity of fishing (no. of vessels, frequency and duration) and the activities relative proximity to sensitive bird species (wildfowl & waders). Further investigation is therefore necessary into the location and scale of the activity and location of sensitive bird species.
	9.	IN – The target prey species (i.e. sandeel and sprat) of the surface feeding birds is likely to overlap with the target species of the fishery (sandeel). Further investigation into the level of activity which may cause as adverse effect on the surface feeding birds considered is therefore needed to determine if the level of activity is likely to have a significant adverse effect, in addition to sensitive times of year and the location at which feeding and fishing take place.
	10.	IN – Due to the foraging strategies of the surface feeding birds considered (i.e. diet of sandeel and sprat), changes in food availability, other than through competition for prey, may result from the bycatch of other species. Further investigation into potential bycatch species and the diet of the surface feeding birds considered is therefore necessary to determine if there is an overlap between the two.
4. What key attributes of the site are likely to be affected by the identified pressure(s)?	Regulation 33 Advice: - Disturbance - Supporting habitat(s): Food availability Interim Conservation Advice: - Supporting habitat: food availability within supporting habitat - Supporting habitat: disturbance caused by human activity	
5. Potential scale of pressures and mechanisms of effect/impact (if known)	Refer to full LSE.	

6. Is the potential scale or magnitude of any effect likely to be significant?	**Alone** Yes	**OR In-combination**[13] N/A
6. Have NE been consulted on this LSE test? If yes, what was NE's advice?	Please refer to letters from Natural England dated 12/01/2016 & 01/03/16.	

5.2 Table 3: Summary of LSE Assessment(s) – Estuarine birds

1. Is the activity/activities directly connected with or necessary to the management of the site for nature conservation?	**No**	
2. What potential pressures, exerted by the gear type(s), are likely to affect the feature(s)/supporting habitat(s)?	Regulation 33 Advice/SPA Toolkit: 1. Physical loss (of non-breeding habitat) – removal 2. Physical loss (of non-breeding habitat) – smothering 3. Physical damage (of non-breeding habitat) – abrasion 4. Non-physical disturbance (and displacement) – noise 5. Non-physical disturbance (and displacement) – visual presence 6. Toxic contamination – introduction of synthetic and non-synthetic compounds 7. Non-toxic contamination – changes in nutrient loading and organic loading 8. Non-toxic contamination – changes in turbidity/Increased turbidity 9. Competition for prey 10. Changes in food availability Additional pressures identified from Interim Conservation Advice: 11. Collision above/below water with static or moving objects 12. Introduction of light 13. Introduction or spread of non-indigenous species 14. Litter	
3. Is the feature(s)/supporting	Pressure	Screening - Justification

[13] If conclusion of LSE alone an in-combination assessment is not required.

habitat(s) likely to be exposed to the pressure(s) identified?	3.	IN –Trawling is known to cause abrasion and disturbance to the seabed surface. Supporting habitats including intertidal mudflats and sandflats, shingle and mixed sediment shores are all considered vulnerable to physical damage by abrasion. The exposure to activities and one-off developments that may cause abrasion is higher for intertidal mudflats, sandflats and mixed sediment communities. Repeated or permanent damage can adversely affect the ability of the habitats to recover and may ultimately lead to loss. Further assessment on the local of vessel sightings, supporting habitats and species distribution is necessary to confirm this.
	4.	IN – Vessels can operate relatively close inshore and noise disturbance can result from the presence/ movement of fishing vessels and operation of fishing gear. The magnitude of disturbance and displacement is influenced by the intensity of fishing (no. of vessels, frequency and duration) and the activities relative proximity to sensitive bird species (wildfowl & waders). Any disturbance and subsequent displacement likely to occur will be at low tide during periods of feeding. Further investigation is therefore necessary into the scale activity and location of sensitive bird species.
	5.	IN – Vessels can operate relatively close inshore and visual disturbance is possible from the presence/ movement of fishing vessels and operation of fishing gear. The magnitude of disturbance and displacement is influenced by the intensity of fishing (no. of vessels, frequency and duration) and the activities relative proximity to sensitive bird species (wildfowl & waders). Any disturbance and subsequent displacement likely to occur will be at low tide during periods of feeding. Further investigation is therefore necessary into the scale activity and location of sensitive bird species.

	10.	IN – Trawling can have an indirect impact on designated bird species by affecting the availability of prey through bycatch of other species, community structure changes as a result of physical disturbance, removal/mortality of non-target organisms, smothering of prey species and physical damage to supporting habitats. Further assessment of trawling impacts on non-target species is needed, with consideration given to the sensitivity of different prey types and the key prey groups of different bird features.
4. What key attributes of the site are likely to be affected by the identified pressure(s)?	Regulation 33 Advice: - Disturbance - Supporting habitat(s): Food availability - Supporting habitat(s): Extent and distribution Interim Conservation Advice: - Supporting habitat: food availability within supporting habitat - Supporting habitat: disturbance caused by human activity - Supporting habitat: extent and distribution of supporting non-breeding habitat	
5. Potential scale of pressures and mechanisms of effect/impact (if known)	Refer to full LSE.	
6. Is the potential scale or magnitude of any effect likely to be significant?	**Alone** Yes	**OR In-combination**[14] N/A
6. Have NE been consulted on this LSE test? If yes, what was NE's advice?	Please refer to letters from Natural England dated 12/01/2016 & 01/03/16.	

5.3 Table 4: Summary of LSE Assessment(s) – Intertidal mud and sand; Intertidal mixed sediments

1. Is the activity/activities directly connected with or necessary to the management of the site for nature conservation?	**No**

[14] If conclusion of LSE alone an in-combination assessment is not required.

<table>
<tr><td>2. What potential pressures, exerted by the gear type(s), are likely to affect the feature(s)/supporting habitat(s)?</td><td colspan="2">Regulation 33 Advice/Interim Conservation Advice for Chichester and Langstone Harbours SPA:
1. Physical loss (of non-breeding habitat) – removal
2. Physical loss (of non-breeding habitat) – smothering/ Siltation rate changes (low), including smothering
3. Physical damage (of non-breeding habitat) – abrasion/Abrasion/disturbance of the substrate on the seabed surface/ Penetration and/or disturbance of the substrate below the seabed surface including abrasion
4. Toxic contamination – introduction of synthetic and non-synthetic compounds/ Introduction of other substances
5. Non-toxic contamination – changes in nutrient loading and organic loading/Organic enrichment
6. Non-toxic contamination – changes in turbidity/Changes in suspended solids (water clarity)
7. Introduction of non-native species and translocation/ Introduction or spread of non-indigenous species
8. Selective extraction of species
9. Interim Conservation Advice only: Litter
10. Interim Conservation Advice only: Physical change (to another seabed type))</td></tr>
<tr><td rowspan="2">3. Is the feature(s)/supporting habitat(s) likely to be exposed to the pressure(s) identified?</td><td>Pressure</td><td>Screening - Justification</td></tr>
<tr><td>3.</td><td>IN – This gear type is known to cause abrasion and disturbance to the seabed surface. Intertidal mudflats are naturally dynamic and many of the organisms inhabiting them have adaptations to morphological change. Intensive and persistent damage can be detrimental to the favourable condition of an interests feature structure and function. Further investigation is needed on the magnitude of the pressure, including the effect of the gear and the spatial scale/intensity of the activity.</td></tr>
<tr><td>4. What key attributes of the site are likely to be affected by the identified pressure(s)?</td><td colspan="2">No relevant attribute which relates to the physical damage of the supporting habitat.</td></tr>
<tr><td>5. Potential scale of pressures and mechanisms of effect/impact (if known)</td><td colspan="2">Refer to full LSE.</td></tr>
<tr><td>6. Is the potential scale or magnitude of any effect likely to be significant?</td><td>Alone

Yes</td><td>OR In-combination[15]

N/A</td></tr>
</table>

[15] If conclusion of LSE alone an in-combination assessment is not required.

6. Have NE been consulted on this LSE test? If yes, what was NE's advice?	Please refer to letters from Natural England dated 12/01/2016 & 01/03/16.

5.4 Table 5: Summary of LSE Assessment(s) – Estuarine fish community

1. Is the activity/activities directly connected with or necessary to the management of the site for nature conservation?	**No**	
2. What potential pressures, exerted by the gear type(s), are likely to affect the feature(s)/supporting habitat(s)?	Regulation 33 Advice/Interim Conservation Advice (for supporting habitat as water column): 1. Non-physical disturbance – noise/ Underwater noise changes 2. Non-physical disturbance – visual/ Visual disturbance 3. Toxic contamination – introduction of synthetic and non-synthetic compounds/ Hydrocarbon & PAH contamination/ Introduction of other substances/ Synthetic compound contamination/ Transition elements & organo-metal contamination 4. Non-toxic contamination – changes in nutrient and organic loading/ Nutrient enrichment/ Organic enrichment 5. Non-toxic contamination – changes in turbidity/ Changes in suspended solids (water clarity) 6. Biological disturbance – Selective extraction of species/ Removal of non-target species 7. Interim Conservation Advice only: Deoxygenation 8. Interim Conservation Advice only: Genetic modification and translocation of indigenous species 9. Interim Conservation Advice only: Introduction of light 10. Interim Conservation Advice only: Introduction or spread of non-indigenous species 11. Interim Conservation Advice only: Litter 12. Interim Conservation Advice only: Physical change (to another seabed type)	
3. Is the feature(s)/supporting	Pressure	Screening - Justification

habitat(s) likely to be exposed to the pressure(s) identified?	6.	IN – The selective extraction of species of target and the bycatch of non-target species are likely to overlap with prey items of designated species, particularly surface feeding birds. Trawling for sandeels is for bait purposes only and therefore it is likely only small quantities of the small target species will be taken. EU regulations on catch composition largely limit the bycatch that can be retained and so the majority will be returned to the sea. Further investigation into the level of activity that may cause an adverse effect on the estuarine fish community is necessary to determine if there is likely to be a significant adverse effect.
4. What key attributes of the site are likely to be affected by the identified pressure(s)?	Regulation 33 Advice: - Supporting habitat(s): Food availability Interim Conservation Advice: - Supporting habitat: food availability within supporting habitat.	
5. Potential scale of pressures and mechanisms of effect/impact (if known)	Refer to full LSE.	
6. Is the potential scale or magnitude of any effect likely to be significant?	**Alone** Yes	**OR In-combination**[16] N/A
6. Have NE been consulted on this LSE test? If yes, what was NE's advice?	Please refer to letters from Natural England dated 12/01/2016 & 01/03/16.	

[16] If conclusion of LSE alone an in-combination assessment is not required.

6. Appropriate Assessment

6.1 Co-location of Fishing Activity and Site Features/Supporting habitat(s)

Key areas favoured by designated bird species in the Chichester and Langstone Harbours SPA are summarised in table 6.

Table 6. Key areas for designated bird species in the Chichester and Langstone Harbours SPA. Source: Natural England (In Press), Natural England (2015), Stillman *et al*., (2009) and EA Alerts (2004).

Common Name	Latin Name	Favoured Area(s)
Sandwich tern	*Sterna sandvicensis*	This species feeds intensively at the confluence of the Langstone Channel and mouth of the estuary. Foraging also occurs immediately around all breeding sites. Breeding colonies occur at the Langstone Islands (Bakers Island, South Binness & Round Nap) and Hayling Oyster Beds. Foraging occurs throughout the entire harbour, harbour mouth and approaches dependent on size tide and current, with large feeding groups forming at high tide to the east and south of South Binness as the currents bring small fish into the harbour. Please refer to Annex 6 for a map of tern feeding areas within Langstone Harbour. Data provided in the Solent Overwintering Birds Workshop is presented in Annex 10.
Common tern	*Sterna hirundo*	This species feeds intensively at the confluence of the Langstone Channel and mouth of the estuary, with a strong tendency towards the harbour mouth. Foraging also occurs immediately around all breeding sites. Breeding colonies occur at the Langstone Islands (Bakers Island, South Binness & Round Nap) and Hayling Oyster Beds. Foraging occurs throughout the entire harbour, harbour mouth and approaches dependent on size tide and current, with large feeding groups forming at high tide to the east and south of South Binness as the currents bring small fish into the harbour. Please refer to Annex 6 for a map of tern feeding areas within Langstone Harbour. Data provided in the Solent Overwintering Birds Workshop is presented in Annex 10.
Little tern	*Sterna albifrons*	This species feeds immediately around all breeding sites, including Bakers Island and South Binness Island. Breeding colonies occur at the Langstone Islands (Bakers Island, South Binness & Round Nap) and Hayling Oyster Beds. The species are commonly seen feeding within the enclosed seascape and channels surrounded by North Binness, Long Island, Round Nap, South Binness and Bakers Island, as well as in areas adjacent to Farlington Marshes, particularly on the eastern site. Other feeding areas include along channels and mudflats reaching south of Farlington

		Marshes, Bakers Island and South Binness, especially at low tide and the sea directly west of West Hayling Local Nature Reserve. Please refer to Annex 6 for a map of tern feeding areas within Langstone Harbour. Data provided in the Solent Overwintering Birds Workshop is presented in Annex 10.
Grey plover	*Pluvialis squatarola*	**At low tide**, the majority of birds occur around Chichester Channel and western shores of Hayling Island. See also low tide WeBS data distribution maps presented in Annex 7, 8 and 9. Data provided in the Solent Overwintering Birds Workshop is presented in Annex 10.
Sanderling	*Calidris alba*	Distribution is related to sediment. **At low tide**, the population is confined to Pilsey Sands and sands at the mouth of Langstone Harbour. Eastney and Hayling. **At high tide**, the main roost is at Pilsey Island with smaller numbers at East Head. Some birds utilise Eastney and Hayling for roosting. Data provided in the Solent Overwintering Birds Workshop is presented in Annex 10.
Dunlin	*Calidris alpina*	Thorney Channel. **At low tide**, the population is found in high densities in Langstone off Budd's Wall, off Portsea Island and at the Kench and in Chichester in Thorney and Fishbourne Channels and South Hayling. **At high tide**, roosts at North Hayling Oyster Beds, Langstone RSPB Reserve and Pilsey Island. Roosts on both sides of Hayling. See also low tide WeBS data distribution maps presented in Annex 7, 8 and 9. Data provided in the Solent Overwintering Birds Workshop is presented in Annex 10.
Redshank	*Tringa totanus*	Low tide WeBS data distribution maps (presented in Annex 7, 8 and 9) reveal relatively high densities of the species throughout the intertidal area in Langstone Harbour, with the highest densities occurring in the upper reaches of the north eastern quarter near to Budd's Wall, on the upper western side of Hayling Island near to North Hayling oyster beds and in the upper reaches of the north western corner west of Farlington Marshes. Data provided in the Solent Overwintering Birds Workshop is presented in Annex 10.
Dark-bellied brent goose	*Branta bernicla bernicla*	**At low tide**, the greatest concentrations occur on Farlington Marshes in Langstone and around Chichester, Thorney and Bosham Channels in Chichester Harbour. Important concentrations of birds exist on Hayling and Portsea Islands. See also low tide WeBS data distribution maps presented in Annex 7, 8 and 9. Data provided in the Solent Overwintering Birds Workshop is presented in Annex 10.
Shelduck	*Tadorna tadorna*	**At low tide**, the greatest concentrations occur around Farlington Marshes and the western shore of Hayling Island in Langstone Harbour, plus Thorney Channel in Chichester Harbour. **At low tide**, concentrations are found at Birdham and East

		Chidham at low tide. **High tide** roosts occur in Langstone RSPB Reserve and at Farlington Marsh. See also low tide WeBS data distribution maps presented in Annex 7, 8 and 9. Data provided in the Solent Overwintering Birds Workshop is presented in Annex 10.
Teal	*Anas crecca*	Farlington Marshes in Langstone and Thorney Island in Chichester. See also low tide WeBS data distribution maps presented in Annex 7, 8 and 9. Data provided in the Solent Overwintering Birds Workshop is presented in Annex 10.
Ringed plover	*Charadrius hiaticula*	Widespread with small numbers around most of Chichester and Langstone Harbours SPA. **High tide** roosts occur at Pilsey Island, North Hayling Oyster Beds and Portsea Island. See also low tide WeBS data distribution maps presented in Annex 7, 8 and 9. Data provided in the Solent Overwintering Birds Workshop is presented in Annex 10.
Curlew	*Numenius arquata*	Chichester Channel. See also low tide WeBS data distribution maps presented in Annex 7, 8 and 9. Data provided in the Solent Overwintering Birds Workshop is presented in Annex 10.
Bar-tailed godwit	*Limosa lapponica*	**At low tide**, mouths of Chichester and Langstone Harbour on sandy sediments. Roost on the Kench (Langstone Harbour) and top of Hayling Island (Langstone Harbour). Pilsey and East Hayling. Largest **high tide** roosts found at Pilsey and Mid Hayling and small numbers at Langstone RSPB Reserve, Portsea Island and The Kench. See also low tide WeBS data distribution maps presented in Annex 8 and 9. Data provided in the Solent Overwintering Birds Workshop is presented in Annex 10.
Turnstone	*Arenaria interpres*	Low tide WeBS data distribution maps (presented in Annex 7, 8 and 9) reveal moderate to high densities of this species along on the western side of Hayling Island, a small area close to Henson aggregates at Bedhampton Wharf and a number of localised areas in the north eastern quarter which include Baker's Island, South Binness Island and Round Nap Island. Data provided in the Solent Overwintering Birds Workshop is presented in Annex 10.
Wigeon	*Anas penelope*	Heads of channels in Chichester Harbour, Thorney Island and Farlington Marshes in Langstone. See also low tide WeBS data distribution maps presented in Annex 7, 8 and 9. Data provided in the Solent Overwintering Birds Workshop is presented in Annex 10.
Pintail	*Anas acuta*	Localised flocks in Farlington Marshes in Langstone Harbour and Thorney Island in Chichester Harbour. See also low tide WeBS data distribution maps presented in Annex 7, 8 and 9. Data

		provided in the Solent Overwintering Birds Workshop is presented in Annex 10.
Shoveler	*Anas clypeata*	Farlington Marshes in Langstone Harbour. See also low tide WeBS data distribution maps presented in Annex 7. Data provided in the Solent Overwintering Birds Workshop is presented in Annex 10.
Red-breasted merganser	*Mergus serrator*	This species uses the whole harbour depending on the state of the tide.
Little egret	*Egretta garzetta*	No information available.

The SSSI units identified as being important areas of intertidal bird feeding habitat include Langstone Harbour West, Langstone Harbour East, Langstone Oyster Beds, Sinah Lake and North Binness Island. The SSSI units identified as important foraging and high tide roosting grounds for wintering bird species include Farlington Marshes and South Moor. Bird roosting sites from the Solent Waders and Brent Goose Strategy are presented in Annex 11.

A map of trawl sightings and supporting habitats can be found in Annex 5. The majority of trawl sightings, within the centre of the harbour, occur in areas of subtidal mixed sediment and subtidal sand. Where trawling occurs on the fringes of the intertidal, these are areas of intertidal sand and muddy sand. The limited number of sightings outside of this central area, in Mallard Sands and the north eastern quarter, are areas of intertidal mud and intertidal sand and muddy sand.

Using knowledge presented in table 6, tern feeding areas illustrated in annex 6; data provided in the Solent Overwintering Birds Workshop in Annex 10; and low tide WeBS data distribution maps (presented in Annex 7, 8 and 9), trawling may have some effect on sites used by the Common tern, Sandwich tern, Little tern, Grey plover, Dunlin, Curlew, Sanderling and Bar-tailed godwit. It is important to note that low tide WeBS data, illustrated in Annex 7, 8 and 9, will be indicative of when birds are feeding at low tide and trawling occurs at high tide, so it is likely that trawling will have very little direct impact on the disturbance of designated bird species feeding on the intertidal mudflats.

Please note that the low tide count WeBS data distribution map displayed in Annex 8 and 9 represent counts made in 2013/14 and 2009/10, respectively. These maps represent dot density and not the location of individual counts. Both maps were included in order to provide the most up to date information and greatest coverage of bird populations within Langstone Harbour. It is important to note that the low tide count WeBS data collection is undertaken in the Solent during the winter period on neap tides, two hours either side of low water. This means a number of areas will be missed as they will be covered by water. On a spring tide a larger area of the intertidal is exposed and this can lead to a greater number of birds. The maps can therefore only provide a snap shot in time.

6.2 Potential Impacts on Birds and Supporting Habitats

The potential impacts pathways of light otter trawling for sandeels on Chichester and Langstone Harbours SPA designated bird species and supporting habitats were identified through the tLSE assessment process and include direct impacts through disturbance and displacement caused by human activity and competition for prey and indirect impacts through changes in prey availability.

6.2.1 Changes in prey availability

Direct competition

Light otter trawling for sandeels is likely result in a degree of direct competition with surface feeding birds, in addition to potential changes in prey availability as a result of bycatch. The level of bycatch of other species however should be limited as a result of EU regulations which relate to catch composition (see section 6.5). The common tern, little tern and sandwich tern are all known to feed on fish, with the common tern and little tern known to feed on crustaceans and little tern also known to feed on molluscs. The proportion of sandeels in the diet of tern species can vary depending on both species and location (Furness & Tasker, 2000). In the North Sea, the proportion of sandeel in diets of the common tern ranged between 0.8 to 0.4, 0.6 for the sandwich tern and 0.2 for little tern. Another study, also based in the North Sea, reported the proportion of sandeel in the diets of tern spp. (common tern, arctic tern, roseate tern and sandwich tern) as 0.34 (Daunt *et al* ., 2008). The diet portion is one variable used to calculate sensitivity index of breeding success in relation to sandeel abundance. A study by Furness and Tasker (2000) highlighted tern species as having highly vulnerable breeding success in relation to reduced food abundance and high to moderate sensitivity to sandeel abundance in different areas of the North Sea (Table 7 and 8). The high vulnerability of breeding success to reductions in food availability is related to their small size, expensive and time limited foraging strategy and relative inflexibility in diet (Table 7) (Monaghan *et al*., 1992; Furness & Tasker, 2000). Another study, using the vulnerability score by Furness and Tasker (2000) and a different diet proportion, revealed an intermediate sensitivity to sandeel abundance (Table 9) (Daunt *et al*., 2008).

Table 7. Seabird vulnerability of breeding success in relation to reduced food abundance in the vicinity of breeding colonies. Source: Furness and Tasker (2000).

Species	Small size	High cost of foraging per unit of time	Constrained to short foraging range	Little ability to dive	Lack of spare time in daily budget	Low ability to switch diet	Score
Arctic tern	4	4	4	3	4	3	22
Roseate tern	4	4	4	3	4	3	22
Little tern	4	4	4	3	4	2	21
Common tern	3	4	4	3	4	2	20
Sandwich tern	3	4	3	3	3	3	19
Black-legged kittiwake	2	2	1	4	4	3	16
Arctic skua	2	2	3	4	1	3	15
Black-headed gull	3	3	3	4	2	0	15
Common gull	2	3	3	4	2	0	14

Black guillemot	2	3	3	1	3	2	14
Great skua	0	3	3	4	1	2	13
Atlantic puffin	2	3	1	2	3	2	13
Razorbill	1	3	2	1	2	3	12
Red-throated diver	0	3	4	0	2	3	12
Lesser black-backed gull	1	2	2	4	1	1	11
Herring gull	1	2	3	4	1	0	11
Greater black-backed gull	0	2	3	4	1	0	10
British storm petrel	4	2	1	3	0	0	10
Leach's petrel	4	2	1	3	0	0	10
Common guillemot	1	3	1	0	2	2	9
Shag	0	3	3	0	0	2	8
Great cormorant	0	3	4	0	0	0	7
Manx shearwater	2	1	0	2	0	2	7
Northern fulmar	1	0	0	4	2	0	7
Northern gannet	0	2	0	2	1	0	5

Table 8. Seabird sensitivity of breeding success in relation to sandeel abundance calculated by Furness and Tasker (2000). The vulnerability score for each species is derived from size, foraging cost per unit time, foraging range, diving ability, amount of spare time in daily budget, ability to switch diet (presented in Table 6). The sensitivity score for each species is derived from the vulnerability score and proportion of sandeels within its diet. Source: Furness and Tasker (2000).

Species	Vulnerability score	Shetland, Orkney, Thurso to Peterhead	Peterhead to Farnes	Southern and south-eastern North Sea	North-eastern North Sea
Arctic tern	22	22	18	13	13
Roseate tern	22	-	11	7	-
Little tern	21	-	4	4	-

Common tern	20	16	12	8	12
Sandwich tern	19	-	11	11	-
Black-legged kittiwake	16	14	13	10	13
Arctic skua	15	15	-	-	12
Black-headed gull	15	1	1	1	1
Common gull	14	1	1	1	1
Black guillemot	14	8	-	-	8
Great skua	13	8	-	-	8
Atlantic puffin	13	12	10	8	8
Razorbill	12	11	10	7	7
Red-throated diver	12	10	-	-	8
Lesser black-backed gull	11	7	7	4	4
Herring gull	11	4	1	1	1
Greater black-backed gull	10	6	4	4	4
British storm petrel	10	1	-	-	1
Leach’s petrel	10	1	-	-	-
Common guillemot	9	9	7	5	4
Shag	8	8	8	8	6
Great cormorant	7	1	1	1	1
Manx shearwater	7	1	-	-	-
Northern fulmar	7	3	1	1	1
Northern gannet	5	2	2	1	1

Table 9. Seabird sensitivity of breeding success in relation to sandeel abundance calculated by Daunt *et al*. (2008). Seabird sensitivity was based on the methodology used by Furness and Tasker (2000). The proportion of sandeels in the diet of each species varied to that used by Furness and Tasker (2000). Source: Daunt *et al*. (2008).

Species	Vulnerability score	Proportion of sandeels in diet	Sensitivity sandeel abundance
Kittiwake	16	0.87	13.9
Puffin	13	0.81	10.5
Razorbill	12	0.77	9.2
Shag	8	0.96	7.7
Guillemot	9	0.84	7.6
Tern spp.	21.8	0.34	7.4
Gannet	5	0.42	2.1

Poor breeding success in certain seabirds has been linked to low availability of sandeels and there is concern that sandeel fisheries can adversely affect seabirds, particularly in the North Sea (Monaghan *et al*., 1989; Rindolf *et al*., 2000; Furness, 2002). The reason for this is because the fishery coincides with the breeding season when energetic demands are high and can overlap spatially with seabird foraging areas (Wright & Begg, 1997). Between 1969 and 1987, when the North Sea sandeel fishery grew rapidly, the number of breeding common terns decreased by 40%, although breeding populations of sandwich tern and little tern increased by 90% and 20% respectively. Tern species target young-of-the-year (0 group) and sandeels aged 1 and older (1+ group), the latter of which is also targeted by the fishery (Daunt *et al*., 2008). 1+ group sandeels enter the water column between March and June and 0 group sandeels are available from mid-May onwards (Furness & Tasker, 2000; Lewis *et al*., 2001). At other times of year they are inaccessible to surface feeding birds as they remain buried in the sand (Furness, 2002).

An investigation into the relationship between sandeel abundance and breeding success and sandeel consumption, revealed no relationship between tern species (Common tern, Arctic tern, Roseate tern and Sandwich tern) sandeel consumption and sandeel abundance (Daunt *et al*., 2008). For the seabird population as a whole however, there was an effect of 0 group sandeel abundance on 0 group consumption rates, but no effect was detected for 1+ group sandeels (Daunt *et al* ., 2008). There was also no effect of 0 group or 1+ group sandeel abundance on the proportion of the total seabird population utilising the study area (Daunt *et al*., 2008). Breeding success of tern species was unrelated to the abundance of both sandeel age classes (Daunt *et al*., 2008). Daunt *et al*. (2008) concluded that the foraging ecology of tern species may explain the lack of effect, with terns thought to use the study area comparatively little, in addition to sandeels only representing approximately only a third of tern diets (in this particular study).

Furness (2002) concluded that predatory fish take much higher quantities of sandeel than that taken by the industrial fishery or wildlife in the North Sea and therefore changes in sandeel stocks are much more likely to be caused by changes in predatory fish abundances than changes in the industrial fishery (Furness, 2002). It is important to point out that the impacts of sandeel availability reported here are from studies based in the North Sea where there is an industrial fishery for sandeel (catches reached approximately 1000 tonnes in 1998, excluding Shetland) (Furness, 2002). Whilst these studies are helpful in highlighting the potential for adverse effect on tern species, it is must be remembered the

sandeel fishery in Langstone Harbour is very small scale with catches being used for bait and not human consumption. In addition, it is important to note the applicability of these studies based in the North Sea may be limited as a result of regional differences in sandeel growth rates (Boulcott *et al*., 2007) and how different habitat types can influence productivity (Freeman *et al*., 2004), both of which may differ between the North Sea and Langstone Harbour. Within the North Sea alone, there is evidence to suggest that the stock consists of several reproductively isolated components (Boulcott *et al*., 2007). Surveys conducted in 1999 revealed regional differences in length- and weight-at-age, both of which imply a disparity in growth rate across the North Sea. For example, fish off the UK's northeast coast showed a tendency mature later and smaller than elsewhere (Boulcott *et al*., 2007). This study demonstrates it is likely that regional differences in growth rates are likely to exist between Langstone Harbour and areas of the North Sea.

Foraging ranges

Protecting foraging areas during breeding periods is recognised as being important for breeding success (Thaxter *et al*., 2012). Foraging ranges provide evidence on the typical or likely distance travelled by different species from an area of breeding to one of foraging and therefore can be used to help identify potential foraging areas associated with breeding colonies (Thaxter *et al*., 2012). This information helps to assess potential impacts of plans or projects on specific breeding colonies through identifying and informing the likelihood and scale of potential interactions (Thaxter *et al*., 2012). Thaxter *et al*. (2012) investigated existing literature to estimate foraging ranges for 25 species of UK breeding seabirds in the context of being used as a helpful tool when scoping and defining potential or candidate marine protected areas. Representative foraging ranges for each species were estimated using sources of data which were grouped into four categories; direct, indirect, survey methods and speculative, in order to distinguish between sources of information which are likely to be more precise rather than approximate. Representative information on breeding season foraging ranges is provided in Table 10.

Table 10. Breeding season foraging ranges (kilometres) using representative information. Category represents the best available evidence. Error is presented as ±1 SD. Source: Thaxter *et al*., 2012.

Species	Max.	Mean max.	Mean	Category used	Confidence of assessment
Sandwich tern	54	49.0±7.1	11.5±4.7	Direct	Moderate
Common tern	30	15.2±11.2	4.5±3.2	Direct	Moderate
Little tern	11	6.3±2.4	2.1	Survey	Low

Indirect effects

Fishing activity can have indirect impacts upon birds by affecting the availability of prey through pathways that do not include targeted removal or direct competition (Natural England, 2014). Bottom towed fishing gear can cause the mortality of non-target species through direct physical damage inflicted by the passage of the trawl or indirectly through damage, exposure and subsequent predation (Roberts *et al*. 2010). This can lead to long-term changes in the benthic community structure (Jones, 1992), including decreases in biomass, species richness, production,

diversity, evenness (as a result of increased dominance) and alterations to species composition and community structure (Tuck *et al*., 1998; Roberts *et al*. 2010). Disturbance from repeated trawling selects for more tolerant species, with communities becoming dominated by smaller-bodied infaunal species with fast life histories, juvenile stages, mobile species and rapid colonists (Engel & Kvitek, 1998; Gubbay & Knapman, 1999; Kaiser *et al*. 2000; Jennings *et al*. 2001; Kaiser *et al*. 2002). In addition, larger individuals may become depleted more than smaller individuals (Jennings *et al*. 2002).

The impacts of fishing activities on benthic communities varies with gear type, habitat and between taxa (Collie *et al*. 2000; Thrush & Dayton, 2002; Kaiser *et al*. 2006). Reported effects are habitat-specific (Roberts *et al*. 2010). A meta-analysis conducted by Kaiser *et al*. (2006) revealed that soft-sediment, especially muddy sands were vulnerable to fishing impacts, with otter trawling producing a significant immediate impact on this habitat. The initial impact on benthic communities from otter trawl disturbance on mud was estimated to be -29%, -15% on sand and +3% on gravel (Kaiser *et al*., 2006; Hinz *et al*., 2009). In mud communities, otter trawling was reported to have a significant negative short-term impact, but positive long-term effect with respect to the mean abundance of benthic taxa (Kaiser *et al*. 2006). A number of studies found no detectable impacts, specifically in relation to different forms of trawling in sand habitats (Van Dolah *et al*., 1991; Kaiser & Spencer, 1996; Kenchington *et al*., 2001; Roberts *et al*., 2010), although this is not true in all cases. Such habitats are likely to be pre-adapted to higher levels of natural disturbance and are characterised by relatively resistant fauna (Kaiser *et al*. 2006).

Direct mortality of different megafaunal taxa groups varied after a single sweep with a commercial otter trawl (dimensions unknown) over shallow (30-40 m) sandy areas and deeper (40-50 m) silty sand areas in the southern North Sea (Bergman & van Santbrink, 2000). In areas of silty sand, direct mortality ranged from 0-52% for bivalves, 7% for gastropods, 0-26% for echinoderms, and 3-23% for crustaceans. In areas of sand, direct mortality ranged from 0-21% for bivalves, 12-16% for echinoderms and 19-30% for crustaceans. Experimental otter trawling (dimensions unknown) on the continental shelf of northwest Australia, in an area presumed to be sand, led to an exponential decline in the mean density of macrobenthos with increasing tow numbers (Moran & Stephenson, 2000; Johnson *et al*. 2002). Density was reduced by approximately 50% after four tows and 15% after a single tow (Moran & Stephenson, 2000; Johnson *et al*. 2002). A trawl with 20 cm disks, separated by 30 to 60 cm spacers was used (Johnson *et al*. 2002). No further information on the trawl used is known. The impacts of otter trawling on benthic communities on a sandy bottom in Grand Banks, Newfoundland were studied over a three year period (Kenchington *et al*., 2001). Three experimental corridors with adjacent reference corridors were established and experimental corridors were trawled 12 times within 5 days for three years using an Engel 145 otter trawl with 1250 kg otter doors, 60 m door spread and 46 cm rockhopper foot gear. Changes in the benthic community were sampled using an epibenthic sledge. The sled is largely used to sample epifauna and some infauna as the sled penetrates to a depth of 2 to 3 cm. Samples collected using the benthic sled revealed a 24% reduction in average biomass in trawled corridors compared to reference corridors. This decrease was caused by reductions in biomass of sand dollars, brittle stars, soft corals, sea urchins and snow crabs. No significant effects were observed for mollusc species. The mean total abundance per grab sample was 25% lower immediately post trawling in one of the three years and declines were demonstrated for 13 taxa primarily made up of polychaetes, which also declined in biomass (Løkkeborg, 2005).

Experimental fishing manipulations investigating the impacts of otter trawling on muddy sediments report relatively modest changes in benthic communities in the short-term (Hinz *et al*., 2009). Tuck *et al*. (1998) investigated the biological effects of trawling disturbance on a sheltered

sealoch in Scotland at 35-40 m depth in an area characterised by 95% silt and clay using modified rockhopper ground gear without a net. Unfortunately further details on the gear are not available. Trawling was conducted one day per month for 16 months and biological surveys were completed after 5, 10 and 16 months of disturbance and then for a further 6, 12 and 18 months after trawling disturbance in trawled and untrawled control areas (Tuck *et al*., 1998; Johnson *et al*. 2002). The response of different community parameters (i.e. species diversity, abundance) to trawling disturbance varied. Infaunal community structure became significantly altered after 5 months of fishing and remained so throughout the duration of the experimental. No significant differences in infaunal species richness however were detected during the first 10 months of trawling. After 16 months of trawling disturbance, and throughout the recovery period, species richness was significantly higher in the trawled site. Infaunal abundance was greater in the trawled site prior to fishing and after 12 months of recovery, although not after 18 months of recovery. The abundance of certain species (predominantly polychaetes), increased within the trawled site and others (i.e. bivalves) declined. Species diversity was lower in the fished site throughout the whole period, including prior to fishing commencing and no effects on total biomass were reported. Infaunal community structure became significantly altered after 5 months of fishing and remained so throughout the duration of the experimental. Experimental trawling, with a commercial otter trawl (dimensions unknown), over a muddy substrate at a depth of 30 to 40 m off the Catalan coast in Spain reported a similar percentage abundance of most major taxa between fished (polychaetes, 51.5%; crustaceans, 10.9%; molluscs, 34.7%; other taxa, 2.9%) and unfished (polychaetes, 48.9%; crustaceans, 11.3%; molluscs, 36.1%; other taxa, 3.7%) sites (Sanchez *et al*., 2000). Analysis of species richness and diversity indicated that the infaunal community did not alter during the first 102 hours following a single sweep. The number of individuals and taxa were significantly greater after 150 hours in an area subject to a single sweep, although no effect was detected after 72 hours in an area subject to a double sweep. For some taxa, significant differences in abundance were between fished and unfished areas including Chaetopteridae, a family of polychaete worms, and *Amphiura chiajes* whose abundances were greater in fished areas after a single sweep and Cirratulidae, another family of polychaete worms, whose abundance were greater in unfished areas after a double sweep. Significant differences in abundance between fished and unfished areas varied depending on treatment and species, with a number of species being more abundant in the unfished area compared with the fished area 150 hours after fishing. The authors speculated a decrease in the abundance of certain species in the unfished area may indicate the effects of natural variability at the site exceed that of fishing disturbance.

The initial impacts of otter-trawl gear on muddy habitats are relatively modest; however cumulative long-term disturbance can lead to significant changes in benthic communities (Hinz *et al*., 2009). Hinz *et al*. (2009) investigated the biological consequences of long-term chronic disturbance caused by the otter trawl *Nephrops norvegicus* (Norway lobster) fishery along a gradient of fishing intensity over a muddy fishing ground in the northeastern Irish Sea. Trawling intensity and its spatial distribution was estimated using overflight data and log book records of hours spent fishing. The study reported reductions in infaunal abundance of 72% from the lowest trawling effort recorded (1.3 times trawled/year) to the highest (18.2 times trawled/year). Over the same range of trawl intensities, infaunal biomass was reduced by 77% and species richness decreased by 40%, whilst epifaunal abundance was reduced by 81% and epifaunal species richness was decreased by 18%. It is worth noting that community descriptors were log transformed and therefore the reported reductions in abundance, biomass and species richness are greatest at low trawling intensities and less severe at higher trawling intensities. Hiddink *et al*. (2006a) conducted an assessment of large-scale impacts of a bottom trawl fishery on benthic production, biomass and species richness in the North Sea, using a size-based approach for assessing trawling impacts on benthic communities. Model development allowed for the effects of habitat parameters on the dynamics of benthic

communities and to predict the effects of trawling on species richness. Data used to validate the model was collected from 33 sampling stations in four areas of soft sediment in the North Sea subject to different levels of trawling intensity. The model predicted that benthic community biomass was reduced by 56% and production by 21%. Queirós *et al*. (2006) analysed the biomass, production and size structure of two communities from a muddy sand and a sandy habitat with respect to quantified gradients of trawling disturbance on real fishing grounds in the Dogger Bank (sandy) and Irish Sea (muddy sand). The Dogger Bank is mostly fished by beam trawlers targeting plaice and the Irish Sea is fished by otter trawls targeting Norway lobster. In the muddy sand habitat, chronic trawling was found to have a negative impact on biomass and production of benthic communities, whilst no impact was identified on benthic communities within the sandy habitat. The differences in result for each habitat type are caused by differences in size structure between the two communities that occur in response to an increase in trawling disturbance. Lindholm *et al*. (2013) reported similar results in an area of coarse silt/fine sand at 160-170 m depth with experimental trawling using a small footrope otter trawl (61 ft head rope, 60 ft ground rope, 8 inch and 4 inch discs, 3.5 ft x 4.5 700 lbs ft trawl doors) (Lindholm *et al*., 2013). The study reported no measurable effects of trawling on densities of invertebrates, including sessile and mobile epifauna and infauna. The study area was characterised by a high level of patchiness in both space and time with regards to invertebrate assemblage, particularly with respect to opportunistic species (polychaete worms and brittle stars). Densities of sessile and mobile invertebrates were low in the study and varied considerably between plots and study periods, suggesting that the effects on trawling should be considered with background environmental variation in mind.

Faunal groups and species responses

The relative impact of bottom towed fishing gear on benthic organisms, which form potential prey items for estuarine birds, is species-specific and largely related to their biological characteristics and physical habitat. The vulnerability of an organism is ultimately related to whether or not it is infaunal or epifaunal, mobile or sessile and soft-bodied or hard-shelled (Mercaldo-Allen & Goldberg, 2011). Fragile fauna (i.e. bivalves and sea cucumbers) have been shown to be particularly vulnerable to trawling damage and disturbance and sedentary and slowing moving species can be significantly lowered (Kaiser & Spencer, 1996; Gubbay & Knapman, 1999). Motile groups and infaunal bivalves have shown mixed responses to trawling disturbance, with life history considerations such as habitats requirements and feeding modes likely to play a key role in determining a species response (McConnaughey *et al*., 2000; Johnson *et al*., 2002). In a meta-analysis of experimental fishing impact studies, conducted by Kaiser *et al*. (2006), otter trawling was found to have the greatest impact on suspension feeders in mud habitats, perhaps reflecting the depth of penetration from the otter doors,. The most negative effect on deposit feeders was found in gravel habitats and the most negative effect on suspension feeders was found in sand habitats (Kaiser *et al*., 2006). Suspension feeding bivalves, such as *Corbula gibba*, are largely unable to escape burial of more than 5 cm (Maurer *et al*., 1981) and are also sensitive to high sedimentation rates that may occur following intensive trawling (Howell & Shelton, 1970; Tuck *et al*., 1998). Having said this, larger-sized individuals have been shown to be more resistant to trawling disturbance as they are relatively robust (Bergman & van Santbrink, 2000).

Studies have revealed mixed effects on epifauna (organisms that inhabit the seabed surface). Jennings *et al*., (2001) found that chronic trawling disturbance had no significant effect on epifauna in the North Sea. Similarly, no long term effects on the number of epifaunal species or individuals were detected by Tuck *et al*. (1998), although a number of species-specific changes in density did occur (increase in *Ophiura* sp. and

decreases in *Hippoglossoides platessoides*, *Metridium senile* and *Buccinum undatum*). The lack of long term effects detected by Tuck *et al*. (1998) is likely to be compounded by the fact that beam trawl gear used was not equipped with a net, as greater effects on epifauna may be expected. The removal of 7 tonnes of epifaunal was reported by Pitcher *et al*. (2000) during experimental trawling, however no significant changes in the density of epifauna were reported (Thrush & Dayton, 2002). Kenchington *et al*. (2001) investigated the impacts of otter trawling on benthic communities on a sandy bottom in Grand Banks, Newfoundland over a three year period. Changes in the benthic community were sampled using an epibenthic sledge. The sled is largely used to sample epifauna and some infauna as the sled penetrates to a depth of 2 to 3 cm. Samples collected using the benthic sled revealed a 24% reduction in average biomass in trawled corridors compared to reference corridors. Hinz *et al*. (2009) investigated the biological consequences of long-term chronic disturbance caused by the otter trawl *Nephrops norvegicus* (Norway lobster) fishery along a gradient of fishing intensity over a muddy fishing ground in the northeastern Irish Sea. The study reported reductions in epifaunal abundance of 81% from the lowest trawling effort recorded (1.3 times trawled/year) to the highest (18.2 times trawled/year). Over the same range of trawl intensities, epifaunal species richness decreased by 18%, while no effect was evident for epibenthic biomass.

Epifaunal biomass at high trawling intensity sites was reported to be dominated by *Asterias rubens*, a possible response to elevated food availability in the form of biota killed or damaged by trawling (Hinz *et al*., 2009). Starfish species can respond rapidly to prey availability (Freeman *et al*., 2001) and are known to be resilient from the damaging impacts of trawls (Hinz *et al*., 2009). Similarly, despite a lower species diversity, a greater dominance of the sea star, *Asterias amurensis*, was reported in heavily fished areas of the eastern Bering Sea (McConnaughey *et al*., 2000). The overall mean abundance of *A. amurensis* was 58.5 kg/ha in the heavily fished, compared with 53.1 kg/ha in the unfished area. In contrast, Bergman and Hup (1992) reported a 43% reduction in the mean density of *A. rubens* after a single beam trawling. Generally speaking, a number of studies have shown to have adverse impacts on echinoderms, including a 0-26% mortality in silty sand and 12-16% mortality in sand as a result of otter trawling in the North Sea (Bergman & van Santbrink, 2000) and a 24% reduction in total biomass of mega-epibenthic species as a result of otter trawling on a sandy bottom in Grand Banks, owing primarily to reductions in sand dollars, brittle stars, soft corals, sea urchins and snow crabs (Kenchington *et al*., 2001). Trawling caused significant damage only to echinoderms, with the highest probability of damage occurring to the sea urchin (10 percent damage) (Kenchington *et al*., 2001). Large and fragile echinoderms particularly susceptible to trawling, include the sea urchins *Brissopsis lyrifera* and *Echinocardium cordatum* (Ball *et al*., 2000), the latter of which has been reported to have a mortality of 10-40% after the single passage of a 4 m and 12 m beam trawl (higher in silty areas than in sandy areas) (Bergman & van Santbrink, 2000). Jennings *et al*. (2001) reported highly significant reductions in the biomass of burrowing sea urchins in response to a chronic beam trawling in the North Sea.

A meta-analysis by Kaiser *et al*. (2006) showed beam trawling in sand to have a greater individual impact on crustaceans, echinoderms and molluscs when compared with annelids, whilst otter trawling in muddy sand appeared to have a greater impact on crustaceans than annelids and molluscs. The single passage of a 4m and 12 m beam trawl in sand and silty sand led to direct mortalities of up to 22% in small-sized bivalves and crustaceans and in megafaunal species up to 68% for bivalves and 49% for crustaceans (Bergman & van Santbrink, 2000). Bivalves such as *Mya truncata*, *Lutraria lutraria* and *Nucula nitidosa* showed greater densities in samples taken after trawling compared to those taken prior to trawling. By contrast, Tuck *et al*. (1998) reported a decline in *Nucula nitidosa* and *Corbula gibba* in abundance in the trawled area relative to

reference area, with the former species being identified as sensitive. Other mollusc species reported to be sensitive to trawling disturbance includes the tellin shells, *Tellina fabula* (Bergman & Hup, 1992). Jennings *et al*. (2001) reported highly significant reductions in the biomass of bivalves in response to a chronic beam trawling in the North Sea. The physical interaction with trawl doors with the sea bed was simulated in a test tank in order to examine physical disturbance and biological damage (Gilkinson *et al*., 1998). During the simulation, bivalves which were buried in the scour path were displaced to the berm and 58-70% of displaced individuals were completely or partially exposed on the surface. Despite this, of the 42 specimens in the scour path, only two showed major damage, despite being displaced. A number of studies have reported limited impacts of molluscs in general as a result of trawling disturbance (Bergman & Hup, 1992; Prena *et al*., 1999).

Experimental fishing manipulations have shown that the impacts of trawling disturbance on annelids are limited, and in some instances may be positive, particularly with respect to polychaetes. Experimental flounder trawling on an intertidal silty habitat in the Bay of Fundy revealed no impact on either the composition or abundance of polychaetes, the majority of which are tube dwelling (Brylinsky *et al*., 1994). Whilst the single passage of a 4 m and 12 m beam trawl on sandy and silty sediment led to direct mortalities of 31% for annelids, principally the tubedwelling polychaete *Pectinaria koreni*, the mortality of many other small annelids observed was negligible (Bergman & van Santbrink, 2000). Ball *et al*. (2000) reported a decrease in abundance in most species following experimental trawling with a Nephrops otter trawl, except for most polychaete species which increased in abundance following trawling. These species included small opportunistic species such as such as *Chaetozone setosa* (52%), *Prionospio fallax* (149%) and *Scolelepis tridentate* (457%) or large scavenges such as *Nephtys incisa* (16%). Tuck *et al*. (1998) reported a consistently higher proportion of polychaetes in the treatment areas, with an increase in the abundance of opportunistic polychaete species belonging to the cirratulid family, *Cheatozone setosa* and *Caullenella zeflandica*, in response to trawling disturbance. The polychaete, *Pseudopolydora paucibranchiata*, also increased in density, immediately following trawling disturbance (Tuck *et al*., 1998). Other polychaete species however did decline in response to fishing disturbance, including *Scolopolos armiger*, *Nephtys cirrosa* and *Terebellides stroemi* (Tuck *et al*., 1998). *Scolopolos armiger* is thought to be sensitive to burial, whilst *N. cirrosa* and *T. stroemi* are larger bodied and therefore more likely to be adversely affected by trawling disturbance (Tuck *et al*., 1998). Bergman and Hup (1992) found that three-fold trawling had minimal effect on the densities of worm species, except for *Magelona*, *Lanice* and *Spiophanes*, although densities of the former species significantly increased after experimental trawling for larger individuals. Jennings *et al*. (2001; 2002) reported no significant changes in polychaetes in response to a chronic beam trawling in the North Sea. In contrast to the aforementioned studies, Kaiser *et al*., (1998) studied the effect of beam trawling of megafauna in an area of stable sediments in the north eastern and found a reduction the abundance in the polychaetes *Aphtodita aculeata* and *Nephtys* spp., although these differences were no longer apparent 6 months after trawling.

A number of studies have identified common trends for certain species in response to trawling disturbance. The gastropod *Buccinum undatum* is shown to decline in areas of trawling disturbance (Tuck *et al*., 1998; Kaiser *et al*., 2000), with one study stating the effects of trawling persisted for 6 months into the recovery period (Tuck *et al*., 1998). Similarly, *Echinocarodium cordatum* has been identified as a fragile and highly vulnerable to trawling disturbance (Bergman & Hup, 1992; Bergman & van Santbrink, 2000), showing declines of 40 to 60% in density in one study (Bergman & Hup, 1992). Similar reductions were shown by the polychaete *Lanice conchilega* (Bergman & Hup, 1992), a species of polychaete which is highly incapable of movement in response to disturbance and therefore take a significant period of time to recolonise disturbed habitats (Goss-Custard, 1977). Other species that have been reported to exhibit adverse effects of trawling include the polychaete

species *Nephtys* (Kaiser *et al*., 1998; Tuck *et al*., 1998) and *Magelona* (Bergman & Hup, 1992; Kaiser *et al*., 2000) and the emergent soft coral *Alcyonium digitatum* (Kaiser *et al*., 1998; 2000; Depestele *et al*., 2012). By contrast, the brittle star, Ophiura sp., has been reported to increase or remain constant in response to trawling disturbance (Tuck *et al*., 1998; Gubbay & Knapman, 1999; Kaiser *et al*., 2000; Callaway *et al*., 2007).

Natural disturbance

Communities that exist in areas of high natural disturbance rates are likely to have characteristics that provide resilience to additional disturbance (Hiddink *et al*., 2006a). Any vulnerable species would be unable to exist within conditions of frequent disturbance (Hiddink *et al*., 2006a). The impact of trawling is therefore expected to be higher in areas that experience low levels of natural disturbance and lower at locations of high levels of natural disturbance (Hiddink *et al*., 2006a). Despite the significance between benthic community responses to trawling disturbance and levels of natural disturbance, the relationship remains unquantified (Hiddink *et al*., 2006a). There can often be a failure to detect the effect of experimental fishing disturbance in areas exposed to high levels of natural disturbance (Thrush & Dayton, 2002). Whilst it may be appropriate to equate effects of natural disturbance to some effects of trawling disturbance, it is not always the case. Fishing can involve a higher intensity of disturbance, although this is dependent on frequency and extent (Thrush & Dayton, 2002). A trawl affects small-sized organisms through sediment perturbations, which is comparable to that of natural disturbance, whereas its impacts on larger-bodied organisms will be through physical contact with fishing gear (Bergman & van Santbrink, 2000). The relatively low impact on benthic communities inhabiting mobile sediments might therefore only apply to small-bodied animals (Bergman & van Santbrink, 2000).

The entrance to Langstone Harbour has very strong tidal streams and on a mean spring tide can reach up to 6.4 knots (Hampshire County Council, 2010; www.visitmyharbour.com). In addition, there is evidence of continually poor visibility within the centre of the harbour, south of Sword Sands, as a result of strong water currents. This indicates, in addition to strong tidal streams known to occur at the entrance, that this area which is subject to sandeel trawling is highly dynamic and likely to be subject to relatively high levels of natural disturbance.

In the context of MPA management, it is important to qualify which changes occur to naturally dynamic communities as a result of natural variability within the environment, as opposed to that resulting from anthropogenic pressures (Goodchild *et al*., 2015). The reason being that the conservation objectives of a site are ‘subject to natural change (Goodchild *et al*., 2015). It can therefore prove difficult in ascertaining if the conservation objective of a site is being compromised by anthropogenic pressures if the MPA feature is also subject to natural variability (Goodchild *et al*., 2015). Potential changes caused by towed fishing gear could be masked by the impacts of natural sediment movements which maintain the benthic community in a state of successional flux (Løkkeborg ., 2005; Goodchild *et al*., 2015). A recent study attempted to analyse existing data to study effects of towed fishing gears on mobile sediments against a background of natural variability, however, it concluded the results of the study were of little direct value in terms of MPA management (Goodchild *et al*., 2015)

Biological recovery

The timescale of recovery for benthic communities and potential prey species largely depends on sediment type, associated fauna and the rate of natural disturbance (Roberts *et al*., 2010). Experimental studies have reported a variety of responses to trawling disturbance (Dernie *et al*., 2003). Such variation arises from characteristics specific to the site, i.e. location, gear fishing, season and habitat (Dernie *et al*., 2003). This hinders the formation of general conclusions and recovery rates of communities that would of use for ecosystem management (Dernie *et al*., 2003).

Generally speaking, in locations where natural disturbance levels are high, the associated fauna are characterised by species adapted to withstand and recover from disturbance (Collie *et al*., 2000; Dernie *et al*., 2003; Roberts *et al*., 2010). More stable habitats, which are often distinguished by high diversity epifauna, are likely to take a greater time to recover (Roberts *et al*., 2010). In a recent meta-analysis on the biological impacts of different fishing activities, recovery of muddy sands was predicted to take months to years and sand was predicted to take days to months (Kaiser *et al*., 2006). Similarly, Dernie *et al*. (2003) reported clean sand communities to have the most rapid rate of recovery following disturbance, with muds having an 'intermediate' recovery rate and muddy sand habitats having the longest recovery rates. More specifically, Kaiser *et al*. (2006) reported recovery times in the abundance of biota of less than 50 days from beam trawling in highly energetic, shallow, soft-sediment habitats of sand and muddy sand. In more stable gravel sediments, biota were reduced by 40% after 50 days (Kaiser *et al*., 2006). Collie *et al*. (2000) reported recovery times of 100 days in sandy sediment communities from trawling disturbance. Kaiser *et al*. (1998) investigated the impacts of beam trawling on megafaunal communities in two areas characterised by mobile megaripple structures and stable uniform sediments. Effects of trawling in mobile sediments were not detectable and in uniform sediments were no longer evident after 6 months (Kaiser *et al*., 1998). The impacts of otter trawling on benthic communities on a sandy bottom in Grand Banks, Newfoundland a 120-146 m depth was studied over a three year period (Kenchington *et al*., 2001). The sampling programme was not designed to determine the long-term effects and recovery, although available data indicated a recovery of the habitat and biological community within a year or less (Løkkeborg, 2005). Tuck *et al*. (1998) studied the biological effects of otter trawling in a sheltered sealoch in Scotland at 35-40 m depth in an area characterised by 95% silt and clay. A similar condition to the reference site was reached after 18 months, with the abundance of individuals shown to return to similar levels recorded prior to trawling (Tuck *et al*., 1998). Partial recovery of infaunal species occurred after 12 months and effects on epifauna were largely indistinguishable from the reference site 6 months after fishing ceased (Tuck *et al*., 1998; Johnson *et al*., 2002). Brylinsky *et al*. (1994) reported the a rapid recovery of nematode abundance within 4 to 6 weeks following experimental flounder trawling on intertidal silty sediments in the Bay of Fundy.

Foden *et al*. (2010) investigated recovery of different sediment types based on the spatial and temporal distribution of benthic fishing. Vessel monitoring system data (2006 to 2007) was used to estimate the distribution and intensity of scallop dredging, beam trawling and otter trawling in UK marine waters. This data was then linked to habitat in a geographic information system. Recovery periods for different habitats were estimated based on existing scientific literature for gear types and fishing intensity (Table 11), with recovery rates generally increasing with sediment hardness. It was estimated that based on mean annual trawl frequencies that 80% of bottom-fished areas were able to recover completely before repeat trawling. In 19% percentage bottom-fished areas however, the frequency of scallop dredging in sand and gravel and otter trawling in muddy sand and reef habitats occurred at frequencies that prevented full habitat recovery. At average fishing intensities (for each

gear type), sand and mud habitats were able to recover fully, whilst gravel, muddy sand and reef habitats were fished at frequencies in excess of the estimated recovery period (shown in Figure 2 where the mean index of recovery exceeds 1).

Table 11. Recovery rates (days) of different habitats for different fishing gear types. ND: No Data. Source: Foden *et al*., 2010.

	Habitat Type				
Gear Type	Sand	Gravel	Muddy sand	Reef	Mud
Beam trawl	182[a]	ND	236[b]	ND	ND
Otter trawl	0[b]	365[d]	213[c]	2922[b]	8[b]
Scallop dredge	2922[b,e]	2922[b]	589[b]	1175[b]	ND

[a] Kaiser *et al*. (1998); [b] Kaiser *et al*. (2006); [c] Ragnarsson & Lindegarth (2009); [d] Kenchington *et al*. (2006); [e] Gilkinson *et al*. (2005)

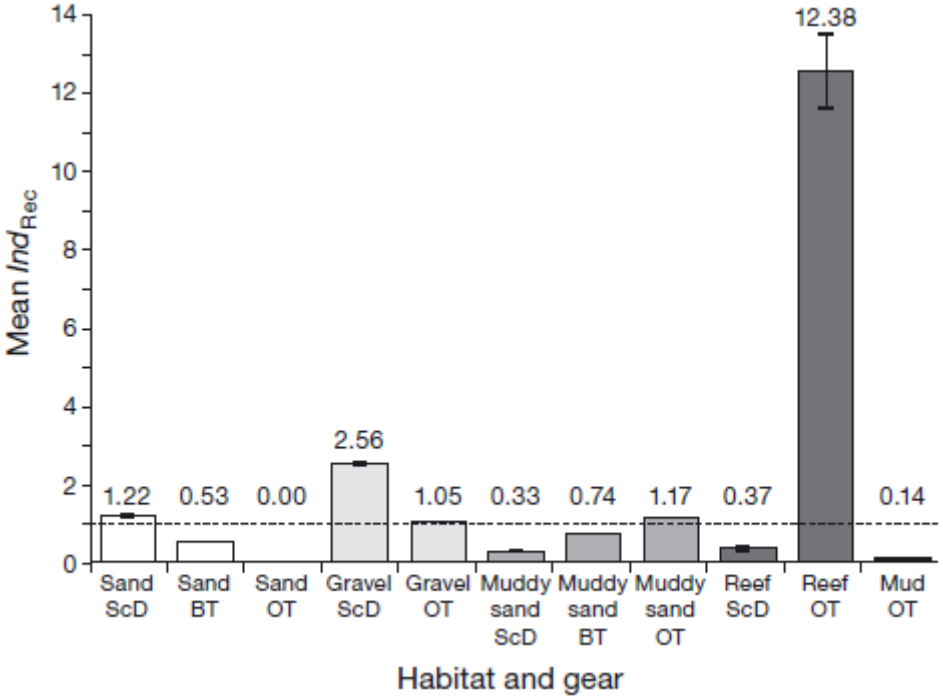

Figure 2. Mean index of recovery (Ind_{Rec}) for gear-habitat combinations using fishing intensity data derived from Vessel Monitoring Systems in 2007. At Ind_{Rec} Rec = 1, the recovery period is equal to fishing frequency (horizontal dashed line), at Ind_{Rec} <1 fishing frequency is less than the predicted recovery period and at Ind_{Rec} fishing frequency exceeds the recoveyr period. BT: Beam Trawl, OT: Otter Trawl and ScD: Scallop Dredge. Source: Foden *et al*., 2010.

Physical disturbance from chronic trawling occurs over large spatial scales and it may be expected that recovery rates will be slower than those assumed from experimental studies (Hinz *et al*., 2009). Recovery at small experimental scales is likely to simply be immigration, which is a form of recovery that is unlikely in large and repeatedly trawled areas (Jennings *et al*., 2001). The recovery of chronically disturbed benthic communities on fishing grounds will be largely dependent on recruitment and population growth, rather than on immigration from adjacent untrawled areas (Hiddink *et al*., 2006b). The importance of larval recruitment for the recolonization of a disturbed area increases with the size of the disturbed area (Smith & Brumsickle, 1989; Foden *et al*., 2010). The time of year when disturbance takes place may also influence the mode of recovery and recovery rate of the affected community (Foden *et al*., 2010). The recruitment supply of larvae and adult infauna will vary at different times of year and in relation to the physical characteristics at a specific location (Foden *et al*., 2010). The hydrodynamic regime will influence the rate of recolonization by influencing the deposition of infaunal adults and larval stages (Foden *et al*., 2010).

Population recovery rates are known to be species specific (Roberts *et al*., 2010). Long-lived bivalves will undoubtedly take longer to recovery from disturbance than other species (Roberts *et al*., 2010). Megafaunal species such as molluscs and shrimp over 10 mm in size, especially sessile species, are more vulnerable to impacts of fishing gear than macrofaunal species as a result of their slower growth and therefore are likely to have long recovery periods (Roberts *et al*., 2010). Short-lived and small benthic organisms on the other hand have rapid generation times, high fecundities and therefore excellent recolonization capacities (Coen, 1995). For example, slow-growing large biomass biota such as sponges and soft corals are estimated to take up to 8 years, whilst biota with short life-spans such as polychaetes are estimated to take less than a year (Kaiser *et al*., 2006).

Species-specific diets

While shorebirds will typically eat a range of different prey species such as molluscs and annelids, the type of preferred prey species will vary between bird species (Natural England, 2014). It is important to knowledge these variations in prey preference as the direct and indirect impacts of trawling on bird species are likely to be reflective of the target species and the vulnerability of prey species to impacts of dredging. The plasticity of a bird's diet will also vary depending on the species and it is important to consider alternate prey species as birds will not be restricted to one source of food. Table 12 provides details of prey items taken by designated bird species within the Chichester and Langstone Harbours SPA. For example, Oystercatchers will prey upon small cockles, Baltic tellins, soft-shell clams, lug-worms and ragworms (Wheeler *et al*., 2014). Some prey items may be of low value to the birds and not a major component of their diet (Zwarts *et al*. 1996ab; Atkinson *et al*. 2003). Alternative prey sources may also be less available as organisms may bury deeper into the sediment and thus require the birds to expend a greater amount of energy (Zwarts *et al*. 1996ab). Birds may directly compete with the fishery if both target the same species and in this case prey species of the common tern, sandwich tern and little tern are likely to overlap with the target species of the fishery. Furthermore, the key bird species at risk from changes in prey availability, caused indirectly by trawling, are non-breeding overwintering species as food requirements are considerably greater during winter due to thermoregulatory needs and metabolic costs (Wheeler *et al*., 2014).

Table 12. Typical prey items known to be taken by designated bird species in the Chichester and Langstone Harbours SPA. Information on general prey preference was obtained from the SPA Tool Kit. Specific information on prey species was taken from the Solent EMS Regulation 33 Advice and from Portsmouth Harbour SPA Draft Regulation 35 Advice for non-breeding birds (i.e. all species except terns).

Common Name	Latin Name	General Prey Preference	Prey Species
Sandwich tern	*Sterna sandvicensis*	Fish	Diet primarily consists of surface-dwelling marine fish[1] 9-15 cm long as well as small shrimps, marine worms and shorebird nestlings.[2]
Common tern	*Sterna hirundo*	Fish	The species is opportunistic and their diet consists primarily of

			small fish (5-15 cm long)[3,4] and occasionally planktonic crustaceans and insects.[2] Sandeels, sprat, juvenile fish.[5]
Little tern	*Sterna albifrons*	Fish, Molluscs, Crustaceans	Diet primarily consists of small fish (i.e. sandlance/sandeels Ammodytes spp., roach Rutilus rutlis, rudd Scardinius erythrophthalmus, carp Cyprinus carpio and perch Perca fluviatilis) and crustaceans 3-6 cm long, as well as annelid worms, and molluscs.[2] In Scotland, prey items include herring, sandeel and shrimp (Crangon vulgaris).[6] In Portugal, prey items include sand-smelts (Atherina spp.) and gobies (Pomatoschistus spp.).[7]
Grey plover	*Pluvialis squatarola*	Molluscs, crustaceans, worms	*Cerastoderma edule, Nereis diversolor, Macoma balthica, Hydrobia ulvae, Arenicola marina, Retusa obtusa, Corophium volutator*[8]
Sanderling	*Calidris alba*	Molluscs, crustaceans, worms	*Scolelepis squamata, Bathyporeia, Eurydice pulchra, Cerastoderma edule, Hediste diversicolor, Hydrobia* spp.[9]
Dunlin	*Calidris alpina*	Molluscs, insects, worms	*Macoma, Hydrobia* spp., *Nereis, Crangon, Carcinus*
Redshank	*Tringa totanus*	Molluscs, crustaceans, insects, worms	*Corophium, Hydrobia, Nereis*[10]
Dark-bellied brent goose	*Branta bernicla bernicla*	Plants/grasses/seeds	*Zostera* spp., *Enteromorpha, Ulva lactuca*

Shelduck	*Tadorna tadorna*	Molluscs, crustaceans, insects	*Hydrobia ulvae, Enteromorpha*
Teal	*Anas crecca*	Plants/grasses/seeds	*Enteromorpha* spp., *Ulvae* spp.
Ringed plover	*Charadrius hiaticula*	Molluscs, crustaceans, insects, worms	*Gammarus* spp. *Tubifex*
Curlew	*Numenius arquata*	Molluscs, crustaceans, insects, worms	Lack of information regarding prey species.
Bar-tailed godwit	*Limosa lapponica*	Insects, worms	*Nereis, Arenicola* spp., *Macoma, Cardium*
Turnstone	*Arenaria interpres*	Insects, worms	*Cerastoderma edule, Corophium, Nerine*[11]
Wigeon	*Anas penelope*	Plants/grasses/seeds	*Enteromorpha* spp., *Ulva* spp.
Pintail	*Anas acuta*	Insects, plants/grasses/seeds	Lack of information regarding prey species.
Shoveler	*Anas clypeata*	Insects	Lack of information regarding prey species.
Red-breasted merganser	*Mergus serrator*	Fish	Gobies, flatfish, herring fry (<11cm), shrimp, sticklebacks, *Nereis* spp.
Little egret	*Egretta garzetta*	Fish, amphibians, insects	Lack of information regarding prey species.

[1] Information obtained from Snow & Perrins (1998); [2] Information obtained from del Hoyo *et al*. (1996); [3] Information obtained from Hume (1993); [4] Information obtained from Sandilands (2005); [5] Information obtained from Robertson *et al*. (2014); [6] Information obtained from BirdLife International (2000); [7] Information obtained from Catry *et al*. (2006); [8] Information obtained from Durrell & Kelly (1990); [9] Information obtained from Cox *et al*. (2014); [10] Information obtained from European Commission (2009); [11]Information obtained from Brearey (1982)

6.2.2 Disturbance and displacement

Generic impacts

Human disturbance to shorebirds can be defined as ‘any situation in which human activities cause bird to behave differently from the behaviour it would exhibit without presence of that activity’ (Wheeler *et al*., 2014). The response of birds to disturbance is influenced by a number of factors, including distance from the disturbance source, scale of disturbance and time of year (Stillman *et al*., 2009). Disturbance from many small-scale sources is thought to be more detrimental than fewer, large-scale sources (West *et al*., 2002).

Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the disturbance present (Natural England, 2014). Under certain circumstances the impacts of disturbance may be equivalent to habitat loss, although such effects are reversible (Madsen, 1995; Hill *et al*., 1997; Stillman *et al*., 2007; Natural England *et al*., 2012). The effects of habitat loss through disturbance can include a reduction in the survival of displaced individuals and effects on the population size (Goss-Custard *et al*., 1995; Burton *et al*., 2006). Sites with high levels of human activity are often characterised by lower densities of birds when compared with sites that have low levels (Burger, 1981; Klein *et al*., 1995). The movement of birds to alternate feeding areas as a result of disturbance, which may be less suitable, can lead to increased shorebird density and thus interspecific competition; with alternate sites becoming depleted in food resources if used for prolonged periods of time (Goss-Custard, 2006; Wheeler *et al*., 2014). Disturbance can affect wintering bird populations in a number of ways including reduced intake a result of enhanced vigilance (Riddington 1996; Goss-Custard *et al*. 2006; Klaassen *et al*. 2006) and physiological impacts such as stress (Thiel *et al*., 2011). Such impacts can affect the fitness of individuals and have knock-on effects at a population scale (Natural England, 2011). Furthermore, disturbance can cause birds to take flight which increase energy demands and reduce food intake with potential consequences for survival and reproduction.

Birds can modify their behaviour in order to compensate for disturbance (Stillman *et al*., 2009). Some bird species may become habituated to particular disturbance events or types of disturbance (Walker *et al*., 2006, Nisbet, 2000, Baudains & Lloyd, 2007; Blumstein *et al*., 2003) and can do so over short periods of time (Rees *et al*., 2005; Stillman *et al*., 2009). The frequency of the disturbance will help to determine the extent to which birds can become habituated and thus the distance at which they response (Stillman *et al*., 2009). The behavioural response of a bird to disturbance is also dependent on the time of year (Stillman *et al*., 2009). Towards the end of winter, when migratory birds need to increase feeding rates to provide energy for migration, behavioural response to disturbance is less (Stillman *et al*., 2009). Birds will approach a disturbance source more closely and return more quickly after a disturbance has taken place (Stillman *et al*., 2009).

In the context of fishing activity from a vessel, limited research has taken place to investigate its potential effects on bird populations through disturbance. It is thought that shellfish dredging has very little direct impact on disturbance of waders since it occurs at high tide (Sewell *et al*., 2007). Sewell *et al*. (2007, p. 51) stated that 'We know of no evidence that dredging will have a direct impact in terms of disturbance on seabirds since most dredging occurs subtidally or at high-tide'. Wheeler *et al*. (2014) however stated, like other forms of disturbance, it could cause relocation and increased energy expenditure of birds. Similarly, trawling occurs at high tide and therefore disturbance pressures (or lack of) are likely to be the same.

Examples of disturbance impacts

In the mid-1980s, localised and sustained disturbance from bait diggers at Lindisfarne National Nature Reserve were considered responsible for significant declines in the numbers of Wigeon, Bar-tailed Godwit and Redshank at the site (Townshend & O'Connor, 1993).

In 1996/97, Gill *et al*. (2001a) investigated the effect of human-induced disturbance on black-tailed godwits across 20 sites on the east coast of England. The study revealed no significant relationship between numbers of godwits and human activity at a range of spatial scales (Gill *et al*.,

2001a). There was also no effect of the presence of marinas or footpaths on the number of godwits supported on the adjacent mudflats (Gill *et al*., 2001a).

Using a behaviour-based model, Durell *et al*. (2005) explored the effect if an extension to the port at Le Havre and proposed mitigation measures on the mortality and body condition of three overwintering bird species; curlew, dunlin and oystercatcher. Body condition was expressed as the percentage of birds failing to achieve at least 75% of their target weight for the time of year. Disturbance to feeding birds, day and night, had a significant effect on the mortality and body condition of all three species. The same was found for roosting birds. Roost disturbance was simulated by increased energy costs due to extra flying time of 10 minutes or more each day. Disturbance limited to the daytime only removed the effect of disturbance in curlew and oyster catcher, and although reduced the disturbance effect it still had a significant effect on the body condition and mortality of feeding dunlin. The introduction of a buffer zone, which would prevent disturbance within 150 m of the seawall, reduced the effects of disturbance on mortality and body condition to pre-disturbance levels.

Studies in the Solent which have focused on disturbance to birds, have reported disturbance levels of 30% during the winter of 1993/94 using disturbance events observed during low tide counts. Sources of disturbance from human activity on the shore included dog walkers, walkers, bait diggers and kite flyers (Thompson, 1994). A more recent study conducted from December 2009 to February 2010, which formed phase II of the Solent Disturbance & Mitigation Project, found for water-based recreational activities that 25% of observations resulted in disturbance and on the intertidal 41% of observation result in disturbance (Liley *et al*., 2010). Surfing, rowing and horse riding were activities found to most likely result in disturbance to birds. Over half of incidences where major flight was observed involved activities on the intertidal, with dog walking accounting for 47% of major flight events (Liley *et al*., 2010). The most responsive bird species to different activities were oyster catcher and wigeon (Liley *et al*., 2010). These two species had the highest proportion of observations involving a disturbance response. Primary data collected by Liley *et al*. (2010) was used to predict if disturbance could reduce the survival of birds using computer models (Stillman *et al*., 2012). Dunlin, ringed plover, oystercatcher and curlew were predicted to be the species most vulnerable to disturbance due to a combination of disturbance distances (see species-specific response), night-time feeding efficiency and vulnerability to food competition at high competitor densities (Stillman *et al*., 2012). Redshank, grey plover and black-tailed godwit typically had the shortest disturbance distances and were able to feed relatively effectively at night, meaning that these species were less affected by visitors (Stillman *et al*., 2012). Disturbance was predicted to result in increases in the level of time spent feeding intertidally by dunlin, ringed plover, redshank and grey plover, with no effect on black-trailed godwit and reductions in oystercatcher and curlew (Stillman *et al*., 2012). This was related to the ability of modelled birds to feed in terrestrial habitats, as those unable to do so spent longer feeding in intertidal habitats (Stillman *et al*., 2012).

Species-specific response

Responsiveness to disturbance is thought to be a species-specific trait (Yasué, 2005). Garthe and Hüppop (2004) developed a wind farm sensitivity index (WSI) for seabirds. The index was based on nine factors, derived from specie' attributes, and include; flight manoeuvrability, flight altitude, percentage of time flying, nocturnal flight activity, sensitivity towards disturbance by ship and helicopter traffic, flexibility in habitat use, biogeographical population size, adult survival rate and European threat and conservation status (Gatthe & Hüppop, 2004). Each factor was

scored on a 5-point scale from 1 (low vulnerability of seabirds) to 5 (high vulnerability of seabirds). The WSI was used by King *et al*. (2009) to develop sensitivity scores for species likely to be susceptible to cumulative impacts of offshore wind farms development. Table 13 provides available sensitivity scores of species within Chichester and Langstone Harbours SPA, with details of scores given for the species vulnerability to disturbance by ship and helicopter traffic.

Table 13. Sensitivity scores for designated bird species in the Chichester and Langstone Harbours SPA to offshore wind farm developments. Higher scores are indicative of a greater sensitivity. Information on species vulnerability to disturbance by ship or helicopter traffic is also provided. Scores were taken from King *et al*. 2009 who calculated scores using methods by Garthe & Hüppop (2004).

Species	Total sensitivity score	Disturbance by ship and helicopter traffic (1 – very flexible in habitat use, 5 – reliant on specific habitat characteristics)
Sandwich Tern	25.0	3
Little Tern	24.4	3
Dark-bellied Brent Goose	21.7	2
Red-breasted Merganser	21.0	3
Shoveler	6.7	1
Redshank	6.7	1
Pintail	6.3	1
Bar-tailed Godwit	5.7	1
Curlew	5.7	1
Ringed plover	5.3	1
Sanderling	5.3	1
Shelduck	5.3	1
Grey plover	4.7	1
Teal	3.8	1
Dunlin	3.3	1
Wigeon	2.7	1

There is great variation in the escape flight distances between species (Kirby *et al*., 2000) and the distance at which birds fly away from a disturbance can be viewed as a specie-specific trait (Blumstein *et al*., 2003). Response distances can depend on a number of different factors, including the time of year, tide, frequency, regularity and severity of disturbance, flock size and age of bird (WWT Consulting, 2012). Body mass has also been shown to be positively related to response distance (Liley *et al*., 2010). Table 14 and 15 provides details of response distances of

species within Chichester and Langstone Harbours SPA, with Table 9 providing details of response distances in relation to different types of activities.

Table 14. Distances from disturbance stimuli (in metres) at which study waterbird species took flight. Taken from Kirby *et al*., 2004 in WWT Consulting 2012.

	Study								
	Tydeman 1978	Cooke 1980	Tensen and van Zoest 1983	Watmough 1983a,b	Smit and Visser 1993	Smit and Visser 1993	Smit and Visser 1993	Burger 1998	Everaert and Stienen 2007
Activity	Boats	Researcher	People	Researcher	People	Kayaks	Surfers	Pleasure Watercraft	Wind turbines
Distance measure	Min	Mean	Mean	Mean	Mean	Mean	Mean	Minimum buffer distance	Nearest distance
Common tern								100	30/100 (<10-50)[1]
Sandwich tern									100 (<10-50)
Little tern									100 (<10-50)
Brent goose					105				
Shelduck		126			148/250	220	400		100
Wigeon		115		230					100/250
Teal	400	86							
Shoveler	200	126							100/250
Ringed plover					121				<10
Grey plover					124				
Dunlin		30			71/163				150/250
Bar-tailed Godwit			75		107/219	200	230		200
Curlew			95		211/339	220	400		100
Redshank		92	95			175	260		
Turnstone					47				

Red breasted merganser									100
Little egret									50/100

[1]Nearest distance to wind turbines for Terns *Sterna* spp. combined.

Table 15. Comparison, by species, of distances (in metres) at which no response or disturbance events (i.e. alert, short walk/swim, short flight or major flight) occurred to recreational activities in the Solent. Significance column indicates results from Mann-Whitney statistical tests. Source: Liley *et al*., 2010.

Species	No response		Disturbance occurred		Significance
	Median	Range	Median	Range	
Brent goose	97	17-215	51.5	5-178	P<0.01
Redshank	90	20-200	75-150	98	P<0.01
Curlew	100	40-200	75	25-200	P<0.01
Turnstone	80	16-200	50	5-100	P<0.01
Grey plover	80.5	22.5-200	75	30-125	
Little egret	150	40-200	75	30-200	P<0.01
Wigeon	125	45-200	75.5	20-125	P<0.01
Dunlin	115	29-200	75	25-300	P<0.01
Shelduck	100	80-200	77.5	50-140	P<0.01
Teal	137	20-175	60	35-200	P<0.05

In a study by Liley *et al*. (2010), which formed phase II of the Solent Disturbance & Mitigation Project, there was no clear set-back distance that would result in no response. There were instances where no response occurred within a few metres and there were instances were major flight occurred when birds when over 200 m from the disturbance source (Liley *et al*., 2010). Having said this, the proportion of events resulting in the displacement of birds declined beyond 100 m (Liley *et al*., 2010).

Mitigation

The effects of disturbance on the quality of an area for birds are reversible (Natural England *et al*., 2012). Studies have shown that bird numbers increase when either the source of disturbance is removed or mitigated (Natural England *et al*., 2012). Modelling of wintering oystercatchers on the Exe estuary revealed that preventing disturbance during late winter, when feeding conditions are harder and a migratory bird's energetic demands are higher, has been shown to largely eliminate any predicted population consequences (West *et al*., 2002). Following this modelling, it was recommended that to eliminate predicted population consequences of disturbances, competent authorities responsible for management should prevent disturbance to birds during late winter (West *et al*., 2002).

Establishing flight-initiation distances may be considered a starting point for competent authorities responsible for management in order to minimise adverse effects of disturbance (Wheeler *et al*., 2014). The establishment of such buffer areas are dependent on a number of factors including population densities, food availability, time of year and behaviour of individuals (Wheeler *et al*., 2014). As aforementioned, a buffer zone of 150 m from the seawall was found to reduce the effects of disturbance from an extension to the port at Le Havre on the mortality and body condition to pre-disturbance levels for three bird species (dunlin, curlew and oystercatcher) (Durell *et al*. 2005). Investigation into disturbance caused by recreational activities in the Solent however suggested that there was no clear set-back distance, for all species on all sites due to the large variability observed in response distances, which would result in no disturbance (Liley *et al*., 2010). The largely variability in flight-initiation distances suggests that competent authorities should be conservative when developing buffer zones, although previously published flight-initiation distances for a given species may be used as a guideline for setting buffer zones (Blumstein *et al*., 2003).

Whilst many authors may try and define a distance beyond which disturbance is assumed to have no effect, which is then used in turn to determine set-back distances, it may be inappropriate to set such distances (Stillman *et al*., 2009). The reason for this is because of the variation between species (Blumstein *et al*., 2005), as well as variation between individuals of the same species (Beale & Monaghan, 2004). This is further compounded by particular circumstances such as habitat, flock size, cold weather, variations in food availability, all of which will influence a birds' ability to response to disturbance and hence the scale of the impact (Rees *et al*., 2005; Stillman *et al*., 2001). In addition, there is no guarantee that the behavioural response i.e. response distance, will be related to population consequence (Gill *et al*., 1996; 2001b).

6.3 Site-Specific Seasonality Table

Table 16 below indicates (highlighted in grey) when significant numbers of each mobile designated feature are most likely to be present at the site during a typical calendar year. Periods highlighted in grey are likely to require consideration of mitigation to minimise impacts to qualifying bird features during these principal periods of site usage by those features. The months which are not highlighted in grey do not necessarily indicate when features are absent, rather that features may be present in less significant numbers than in typical years.

Table 16. Presence by month of mobile designated features at the Chichester and Langstone Harbours SPA. Grey indicates periods of presence in significant numbers whereas blank (white) indicates either periods of absence or of presence but only in numbers of less significance.

Common Name	Latin Name	Designated Season	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Reference
Common tern	*Sterna hirundo*	Breeding													FURNESS, R.W. 2015
Little tern	*Sternula albifrons*	Breeding													FURNESS, R.W. 2015
Sandwich	*Sterna*	Breeding													FURNESS, R.W.

tern	*sandvicensis*														2015
Bar-tailed godwit	*Limosa lapponica*	Non-breeding													BTO data (analysed 13th August 2015)
Curlew	*Numenius arquata*	Non-breeding													BTO data (analysed 13th August 2015)
Dark-bellied Brent goose	*Branta bernicla bernicla*	Non-breeding													BTO data (analysed 13th August 2015)
Dunlin	*Calidris alpine*	Non-breeding													BTO data (analysed 13th August 2015)
Grey plover	*Pluvialis squatarola*	Non-breeding													BTO data (analysed 13th August 2015)
Pintail	*Anas acuta*	Non-breeding													BTO data (analysed 13th August 2015)
Red-breasted merganser	*Mergus serrator*	Non-breeding													BTO data (analysed 13th August 2015)
Redshank	*Tringa tetanus*	Non-breeding													BTO data (analysed 13th August 2015)
Ringed plover	*Charadrius hiaticula*	Non-breeding													BTO data (analysed 13th August 2015)
Sanderling	*Calidris alba*	Non-breeding													BTO data (analysed 13th August 2015)
Shelduck	*Tadorna tadorna*	Non-breeding													BTO data (analysed 13th August 2015)
Shoveler	*Anas clypeata*	Non-breeding													BTO data (analysed 13th August 2015)
Teal	*Anas crecca*	Non-breeding													BTO data (analysed 13th August 2015)
Turnstone	*Arenaria interpres*	Non-breeding													BTO data (analysed 13th August 2015)
Wigeon	*Anas penelope*	Non-breeding													BTO data (analysed 13th August 2015)

6.4 Site Condition

6.4.1 Condition Assessments

Natural England provides information on the condition of designated sites and describes the status of interest features. This is derived from the application of 'Common Standards Monitoring Guidance' which is applied to a subset of 'attributes' of site features as set out in the sites' Regulation 33/35 Conservation Advice document. Feature condition influences the Conservation Objectives in that it is used to determine whether a 'maintain' or 'recover' objective is needed to achieve the target level for each attribute. Natural England's current process for conducting condition assessments for marine features was developed due to requirements to report on condition of Annex 1 features at the national level in 2012/13 under Article 17 of the Habitats Directive. Since then, the methods have been reviewed and Natural England are actively working to revise this process further so that it better fulfils obligations to inform management actions within MPAs and allows them to report on condition. In light of this revision to the assessment methods, the condition assessments for the features of European Marine Sites have not been made available in the timeframe required under the revised approach.

An indication of the condition of site interest features can be inferred, if available, from assessments of SSSIs[17] that underpin the SPA. There are a number of SSSIs which exist within the area covered by Chichester and Langstone Harbours SPA and these, along with relevant feature condition assessments are summarised in Table 17. Note that only SSSI sites where trawling is known to occur have been chosen.

Table 17. Condition assessments of SSSI units within the Chichester and Langstone Harbours SPA

SSSI Site Name	Habitat	Unit Name	Condition	Condition Threat Risk	Comments
Langstone Harbour	Littoral Sediment	Langstone Hbr West; Sinah Lake;	Unfavourable – recovering	High	Habitats are affected significantly by sea level rise and 'coastal squeeze. The extent of the habitat exposed at low tide is declining. Changes in water level are also likely to have adverse impacts on the distribution and extent of intertidal sediment biotopes.
Langstone Harbour	Littoral Sediment	South Binness Island	Unfavourable – recovering	Medium	No information available.

Overall, the SSSI condition assessments appear to suggest that littoral sediments within selected SSSI sites are unfavourable, but recovering. When examining reasons for this, it appears from the condition assessment comments that the reasons for this are largely down to sea level rise and subsequent 'coastal squeeze' which are affecting the extent of the habitat and the biotopes that exist there. This would suggest that whilst the condition of many of the sites is unfavourable, the reasons for this do not appear to be related to fishing activities.

[17] SSSI Condition assessments: http://designatedsites.naturalengland.org.uk/.

6.4.2 Population Trends

Population trend data, where available, can be used to identify site-specific pressures. Information on population trends comes from Wetland Bird Survey (WeBS) Alerts and JNCC's Seabird Monitoring Programme (SMP) population data. JNCC's Seabird Monitoring Programme (SMP) collates sample data on breeding numbers and breeding success of seabirds in Britain and Ireland. This data has been analysed by ABPmer on behalf of Natural England (ABPmer, 2014). Assessment data is available for two of the three designated Annex 1 bird species (no data available for the Little tern) and reveals a site-specific decline in one species (table 18). WeBS Alert data is available for fifteen out of the sixteen regularly occurring migratory species (no data is available for Turnstones) and provides information on population sizes, from which trends in numbers and distribution can be detected. The most recent WeBS report is based upon Alerts status as of 2009/10 and analysis of these results by ABPmer (2014) identifies five species which exhibit a site-specific decline, the details of which are given in table 18. WeBS Alert data also suggests that Teal may also be affected by site-specific pressures. A number of additional species (Little grebe, Cormorant, Lapwing and Black-tailed godwit), which form part of the waterbird assemblage, also exhibit site-specific declines and have also been included in table 18.

Table 18. Bird species in Chichester and Langstone Harbours that exhibit site-specific declines. Please note all information presented in this table has been taken from the Wetland Bird Survey (WeBS) Alerts database and reports and ABPmer (2014).

Species	Alert	Explanation
Sandwich tern	Medium – Short-term	Numbers of breeding Sandwich tern at the Chichester and Langstone Harbours SPA site have decreased over a short-term timescale. Numbers of this species breeding within the site and southern region has dramatically declined in recent years (late 2000s), having earlier peaked. The regional and site trends do not appear to be tracking that of the national trend, which shows an overall decline since records began in 1986.
Shelduck	High[1] – Long-term[3]	The numbers of Shelduck at this site have been stable in the medium term having previously declined. This trend appears to be tracking that of the region but not the British trend. The declining proportion of the regional numbers supported by this site suggest site-specific pressures may be affecting this species.
Pintail	Medium[2] – Short-term	The numbers of over-wintering Pintail have fluctuated making interpretation difficult. The short-term alerts should be viewed with caution. The trend does however appear to be tracking that of regional and British trends. The declining proportion of the regional numbers supported by this site suggest site-specific pressures may be affecting this species.
Ringed Plover	High – Long-term Medium – Med-term[3] Medium – Short-term[3]	The numbers of Ringed Plover have been decreasing in the medium-term having previous peaked. The trend appears to be tracking that of regional and British trends. The declining proportion of the regional numbers supported by this site suggest site-specific pressures may be affecting this species
Sanderling	High –	Numbers of over-wintering Sanderling have been stable in the medium-term having previously declined. The trend

	Long-term	on the site appears to be tracking that of the region although not the British trend. The declining proportion of the regional numbers supported by this site suggest that site-specific pressures may be affecting this species.
Bar-tailed Godwit	Medium – Long-term	Numbers of over-wintering Bar-tailed have been decreasing in the medium-term having previously been relatively stable. The trend on the site does not appear to be tracking that of the either the region or the British trend, which has been relatively stable long-term. The proportion of the regional population supported by this site is decreasing, suggesting the site is becoming less attractive relative to others in the region. In conclusion, the contrast between the declining site trend and the regional trend suggests that declining numbers are most likely due to site-specific pressures
Teal	Medium – Long-term	Numbers of Teal over-wintering have been stable in the medium-term having previously declined. Numbers of this species over-wintering within Southern Region have been stable in the medium-term having previously increased. Numbers of this species over-wintering in Great Britain have been stable in the medium-term having previously increased. The trend on the site does not appear to be tracking that of the either the region or the British trend. The declining proportion of the regional numbers supported by this site suggest that site-specific pressures may be affecting this species.
Little Grebe*	Medium – Short-term	Numbers of Little Grebe over-wintering have been decreasing in the short-term having previously peaked. Numbers of this species over-wintering within Southern Region have been stable in the medium-term having previously increased. Numbers of this species over-wintering in Great Britain have been increasing long term. The trend on the site does not appear to be tracking that of the either the region or the British trend. The declining proportion of the regional numbers supported by this site suggest that site-specific pressures may be affecting this species.
Cormorant*	Medium – Long-term	Numbers of Cormorant over-wintering have been stable in the medium-term having previously declined. Numbers of this species over-wintering within Southern Region have been increasing long term. Numbers of this species over-wintering in Great Britain having remained relatively stable long term. The trend on the site does not appear to be tracking that of the either the region or the British trend. The declining site trend and both the regional and British trends suggests that declining numbers underpinning these Alerts are most likely due to site-specific pressures.
Lapwing*	High – Long-term High – Long-term High – Long-term	Numbers of Lapwing over-wintering have been decreasing in the short-term having previously been relatively stable. Numbers of this species over-wintering within Southern Region have been decreasing in the short-term having previously been relatively stable. Numbers of this species over-wintering in Great Britain have been decreasing in the medium-term having previously peaked. The trend on the site does not appear to be tracking that of the either the region or the British trend. The declining proportion of the regional numbers supported by this site suggest that site-specific pressures may be affecting this species.
Black-tailed Godwit*	Medium – Long-term	Numbers of Black-tailed Godwit over-wintering have been stable in the medium-term having previously declined. Numbers of this species over-wintering within Southern Region have been increasing long term. Numbers of this species over-wintering in Great Britain have been increasing long term. The trend on the site does not appear to be tracking that of the either the region or the British trend. The declining proportion of regional and country-wide numbers supported by this site suggest that site-specific pressures may be affecting numbers on this site.

[1]High Alerts are triggered if declines exceed 50%
[2]Medium Alerts are triggered if bird numbers have declined by between 25 to 50%
[3]Short-term – 5 years, Med-term – 10 years & Long-term – up to 25 years
* These species form part of the waterbird assemblage

It is important to note that the data used to inform WeBS Alerts was collected in 2009/10 and therefore this data may not have captured the effects of fishing activities that have since commenced or increased since publication. The effects of fishing activities may not necessarily be captured in the next WeBS Alerts report (due in 2015) due to the time lag between cause and effect.

6.5 Existing Management Measures

- **Bottom Towed Fishing Gear** byelaw – prohibits bottom towed fishing gear over sensitive features including reef features and seagrass within the Solent Maritime SAC closing most of the site to these activities.
- **Vessel Used in Fishing** byelaw – prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear and restricted to carry less static gear.
- **Bass Nursery Areas** – fishing for bass or fishing for any fish using sand-eels as bait by any fishing boat within designated areas is prohibited between 30 April and 1 November. Designated areas include Southampton Water (Cadland foreshore to the Warsash foreshore, but excluding those waters above the Redbridge Causeway on the River Test) and Langstone Harbour (Gunnery Range Light at Eastney Point to Langstone Fairway Buoy, then to the foreshore east of Gunner Point) and all year round in a 556 m radius around the Fawley Power Station outfall.
- **Prohibition of Gathering (Sea Fisheries Resources) in Seagrass Beds** byelaw. This prohibits any person from digging for, fishing for or taking any sea fisheries resource in or from the prohibited areas and does not apply to fishing/taking fisheries resources by means of net, rod and line and hook and line. It also does not apply to fishing for/taking sea fisheries resources using a vessel, provided that no part of the vessels hull in contact with the seabed. No person shall carry a rake, spade, fork or any similar tool in prohibited areas
- The **Scallop Fishing (England) Order 2012** states that no more than 8 dredges per side to be towed at any one time and provides details for dredge configuration (i.e. the frame cannot exceed 85 cm in width). The **Scallop Fishing** Southern Sea Fisheries District Committee legacy byelaw states the maximum number of dredges which can be towed at any time is twelve, provides details of dredge configuration and that no person shall fish for or take any scallop from any fishery on any day before 0700 and after 1900 local time
- EU regulations state that specific required catch percentages apply to different mesh size ranges and target species (refer to 850/98 Annex I). When fishing for sandeels, a mesh size of less than 16 mm is used. When using a mesh of this size to target sandeels, the minimum percentage of the catch made up of the target species must be 95%. This means any other species, which makes up more than 5% of the catch, must be returned.

6.6 Table 19: Summary of Impacts

The potential pressures, associated impacts, level of exposure and mitigation measures are summarised in table 14. Only relevant attributes identified through the TLSE process have been considered here.

Feature	Supporting habitat(s)	Attribute	Target	Potential Pressure(s) and Associated Impacts	Nature and Likelihood of Impacts	Mitigation measures[18]
Internationally important populations of regularly occurring Annex 1 species	Shallow coastal waters	Food availability	Presence and abundance of suitable prey species should not deviate significant from an established baseline, subject to natural change	Competition for prey and changes in food availability were identified as potential pressures, the former being a direct impact and the latter being an indirect impact of trawling for sandeels. Light otter trawling targets sandeels and this species also forms a prey item of the surface feeding birds considered (little tern, sandwich tern, common tern). This may result in a degree of direct competition. Potential changes in prey availability may also occur as a result of bycatch. Poor breeding success in certain seabirds has been linked to low availability of sandeels and there is concern that sandeel fisheries can adversely affect seabirds, particularly in the North Sea (Monaghan *et al*., 1989;	Despite having a theoretically high vulnerability and sensitivity to changes in food availability/sandeel abundance in relation to breeding success, studies investigating the link between sandeel consumption, abundance and seabird breeding success revealed no relationship for tern species (Daunt *et al*., 2008). These studies have been based in the North Sea where an industrial fishery for sandeels exists. In Langstone Harbour, sandeels are caught for the purposes of bait. This limits both the amount of sandeel caught and the amount of time spent fishing, with one boat catching approximately 1 kg per day. Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00.

[18] Detail how this reduces/removes the potential pressure/impact(s) on the feature e.g. spatial/temporal/effort restrictions that would be introduced.

				Rindolf *et al*., 2000; Furness, 2002). The reason for this is because the fishery coincides with the breeding season when energetic demands are high and can overlap spatially with seabird foraging areas (Wright & Begg, 1997). A study by Furness and Tasker (2000) highlighted tern species as having high vulnerability to poor breeding success in relation to reduced food abundance and high to moderate sensitivity to sandeel abundance in different areas of the North Sea (Table 7 and 8). The high vulnerability of breeding success to reductions in food availability is related to their small size, expensive and time limited foraging strategy and relative inflexibility in diet (Table 7) (Monaghan *et al*., 1992; Furness & Tasker, 2000). Another study, using the vulnerability score by Furness and Tasker (2000) and a different diet proportion, revealed an intermediate sensitivity to sandeel abundance (Table 9) (Daunt *et al*., 2008). Another study, using the vulnerability score by Furness and Tasker (2000) and a different diet proportion, revealed an intermediate sensitivity to sandeel abundance (Table 9) (Daunt *et al*., 2008).	vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). Population trends may be used to infer site-specific pressures, such as sandeel trawling. The only designated surface feeding bird species to exhibit a site specific decline is the sandwich tern (no data exists for the little tern). The numbers of breeding sandwich tern have decreased in the short-term. The site trend for Chichester and Langstone Harbours SPA appear to be tracking that of the southern region, but not that of the national trend which shows an overall decline since records started in 1985. There is no evidence to suggest a link between declining tern populations in Chichester and Langstone Harbours SPA and the sandeel trawling which takes place in Langstone Harbour and has not been previously identified as a concern. The spatial and temporal extent of the activity and tern feeding overlaps and this occurs in the centre of the harbour and during summer months. The area used for the activity however only forms a small area of the tern feeding areas. Whilst it is known that the sandwich tern and common tern feed intensively at the confluence of the Langstone Channel, where the activity also occurs, feeding also occurs intensively occurs at the mouth of the estuary, where the activity rarely occurs (only one sighting in this area over 10 years). The little tern generally	Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.

				An investigation into the relationship between sandeel abundance and breeding success and sandeel consumption, revealed no relationship between tern species (common tern, arctic tern, roseate tern and sandwich tern) sandeel consumption and sandeel abundance (Daunt *et al*., 2008). Breeding success of tern species was unrelated to the abundance of both sandeel age classes (Daunt *et al*., 2008).	feed outside of the area where trawling occurs. The species are commonly seen feeding within the enclosed seascape and channels surrounded by North Binness, Long Island, Round Nap, South Binness and Bakers Island, as well as in areas adjacent to Farlington Marshes, particularly on the eastern site. Based on the limited amount of sandeels taken, the amount of time spent trawling, provision for alternate key feeding areas and lack of evidence to suggest a link between the activity and tern population trends, it is unlikely that light otter trawling for sandeels will have an adverse effect on the food availability for surface feeding birds. The level of bycatch of other species however should be limited as a result of EU regulations which relate to catch composition (see section 6.5).	
Internationally important waterfowl assemblage, including the internationally important regularly occurring migratory species	Intertidal mudflats and sandflats	Food availability	Presence and abundance of suitable prey species should not deviate significantly from an established baseline, subject to natural change	Changes in food availability were identified as a potential pressure through indirect impacts of trawling for sandeels. Bottom towed fishing gear can cause the mortality of non-target species through direct physical damage inflicted by the passage of the trawl or indirectly through damage, exposure and subsequent predation (Roberts *et al*. 2010). This can lead to long-term changes in the benthic community structure (Jones, 1992), including decreases in	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). Trawling predominantly occurs subtidally, occasionally fringing on the	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining

				biomass, species richness, production, diversity, evenness (as a result of increased dominance) and alterations to species composition and community structure (Tuck *et al*., 1998; Roberts *et al*. 2010). The impact of otter trawls on benthic communities varies between studies, notably between sediment types. The initial impact on benthic communities from otter trawl disturbance on mud was estimated to be -29%, -15% on sand and +3% on gravel (Kaiser *et al*., 2006; Hinz *et al*., 2009). Brylinsky *et al*. (1994) reported reductions in the abundance of nematodes and no effect on either the composition or abundance of polychaetes after experimental flounder trawling on intertidal silty sediment in the Bay of Fundy, although the rate of nematode recovery was rapid following trawling disturbance. The relative impact of trawling on benthic organisms, which form potential prey items, is species-specific and largely related to their biological characteristics and physical habitat (Mercaldo-Allen & Goldberg, 2011). Generally speaking, in locations where natural disturbance levels are high, the associated fauna are characterised by species	intertidal and is focused in the centre of the Langstone Harbour. Co-location maps of trawl sightings and site feature/supporting habitats reveals that trawling occurs primarily in areas of subtidal sand and subtidal mixed sediments. All sightings were taken between 2005 and 2010 and no sightings were made between 2011 and 2015. Sightings which fringe on the intertidal generally occur in areas of intertidal muddy sand and sand and are located within the known area of fishing. Only three sightings occur outside of this area and are within the north eastern quarter of the harbour and in an area known as Mallard Sands, one of which occur in areas of intertidal sand and muddy sand. Using available information on the diet of designated bird species, WeBS low tide count data distribution maps (Annex 7, 8 and 9) and data provided in the Solent Overwintering Birds Workshop (Annex 10), designated bird species sensitive to changes in food availability within intertidal mudflats and sandflats subject to trawling for sandeels include Grey plover, Dunlin, Curlew, Sanderling and Bar-tailed godwit. The sites used by these species, which occur in relative close proximity to trawling, are concentrated within the centre of the harbour. Key prey species outlined in Table 12 have not been identified as being sensitive to trawling disturbance in the studies examined. *Scolelepis squamata* is fed on by sanderling and Ball *et al*., (1998) reported a 457%	the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.

				adapted to withstand and recover from disturbance (Collie *et al*., 2000; Dernie *et al*., 2003; Roberts *et al*., 2010). In a recent meta-analysis on the biological impacts of different fishing activities, recovery of muddy sands was predicted to take months to years and sand was predicted to take days to months (Kaiser *et al*., 2006). Kaiser *et al*. (2006) reported recovery times in the abundance of biota of less than 50 days from beam trawling in highly energetic, shallow, soft-sediment habitats of sand and muddy sand. Collie *et al*. (2000) reported recovery times of 100 days in sandy sediment communities from trawling disturbance. Brylinsky *et al*. (1994) reported the rapid recovery of nematode abundance within 4 to 6 weeks following experimental flounder trawling on intertidal silty sediments in the Bay of Fundy. Population recovery rates are species specific (Roberts *et al*., 2010). Long-lived bivalves will undoubtedly take longer to recovery from disturbance than other species such as short-lived and small benthic organisms on the other hand have rapid generation times, high fecundities and therefore excellent recolonization capacities (Coen, 1995; Roberts *et al*., 2010).	increase in *Scolelepis tridentate* following experimental trawling with a *Nephrops* otter trawl. Deep burrowing molluscs, such as *Macoma balthica*, which is fed on by grey plover, dunlin and bar-tailed godwit, are known to have limited capability to escape (Wheeler *et al*., 2014). Generally speaking, experimental fishing manipulations have shown that impacts of trawling disturbance on annelids are limited and in some instances may be positive. Generally speaking, there is a limited temporal overlap in the presence of the overwintering bird species which occurs during the winter months and light otter trawling for sandeels which occurs during the summer monks. Bar-tailed godwit and Dunlin occur in Langstone Harbour from September to April, Curlew occur from June to April, Grey plover occur from August to March and Sanderling occur from August to April (excluding September). The activity is known to infrequently fringe on intertidal, with only five sightings of trawling on intertidal muddy sand and sand over 10 years (2005-2015). The activity is undertaken by a relatively low number of vessels and takes place during only 6 months of the year. The time spent fishing each day is also limited as trawling is undertaken for the purposes of bait (approximately 1 kg per day) and not human consumption. The gear used in this fishery is extremely light, with otter boards made of wood and the weight of the gear weighing up to 65 kg for	

					larger vessels (10 m in length). The lightness of the gear limits the damage caused to benthic communities. Based on the low fishing effort (small number of boats, summer months only, limited time spent fishing), the weight of the gear, infrequent occurrence over intertidal muddy sand and sand, a limited temporal overlap between the activity and overwintering birds, provision for alternate feeding sites and lack of prey species sensitive to trawling disturbance, the activity is unlikely to cause an adverse effect on the food availability for overwintering bird species. Furthermore, the infrequent nature of the activity is likely to allow sufficient time for recovery if the activity were to occur. The recovery periods for sand are known to be relatively rapid (100 days) and therefore the infrequent nature of the activity over intertidal muddy sand and sand will allow sufficient time for such recovery if the activity were to occur. The area in which trawling takes place is likely to be subject to strong tidal flows and communities within this area are likely to be naturally disturbed and adapted to such conditions.	
Internationally important waterfowl assemblage, including the internationally important regularly	Mixed sediment shores	Food availability	Presence and abundance of prey species and algae should not deviate significantly from an established	Changes in food availability were identified as a potential pressure through indirect impacts of trawling for sandeels. Bottom towed fishing gear can cause the mortality of non-target species through direct physical damage inflicted by the passage of the trawl or	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These

occurring migratory species			baseline, subject to natural change.	indirectly through damage, exposure and subsequent predation (Roberts *et al*. 2010). This can lead to long-term changes in the benthic community structure (Jones, 1992), including decreases in biomass, species richness, production, diversity, evenness (as a result of increased dominance) and alterations to species composition and community structure (Tuck *et al*., 1998; Roberts *et al*. 2010). The impact of otter trawls on benthic communities varies between studies, notably between sediment types. The initial impact on benthic communities from otter trawl disturbance on mud was estimated to be -29%, -15% on sand and +3% on gravel (Kaiser *et al*., 2006; Hinz *et al*., 2009). Brylinsky *et al*. (1994) reported reductions in the abundance of nematodes and no effect on either the composition or abundance of polychaetes after experimental flounder trawling on intertidal silty sediment in the Bay of Fundy, although the rate of nematode recovery was rapid following trawling disturbance. The relative impact of trawling on benthic organisms, which form potential prey items, is species-specific and largely related to their biological	more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). Trawling predominantly occurs subtidally, occasionally fringing on the intertidal and is focused in the centre of the Langstone Harbour. Co-location maps of trawl sightings and site feature/supporting habitats reveals that trawling occurs primarily in areas of subtidal sand and subtidal mixed sediments. All sightings were taken between 2005 and 2010 and no sightings were made between 2011 and 2015. Sightings which fringe on the intertidal generally occur in areas of intertidal muddy sand and sand and are located within the known area of fishing. Only three sightings occur outside of this area and are within the north eastern quarter of the harbour and in an area known as Mallard Sands. Existing sightings data do not show the activity to occur over areas of intertidal mixed sediments. The infrequent nature of this activity over the intertidal and highly patchy nature of intertidal mixed sediments largely eliminates any interaction with the activity and the possibility of any adverse effect on the food availability for overwintering birds.	amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.

				characteristics and physical habitat (Mercaldo-Allen & Goldberg, 2011). Generally speaking, in locations where natural disturbance levels are high, the associated fauna are characterised by species adapted to withstand and recover from disturbance (Collie *et al*., 2000; Dernie *et al*., 2003; Roberts *et al*., 2010). In a recent meta-analysis on the biological impacts of different fishing activities, recovery of muddy sands was predicted to take months to years and sand was predicted to take days to months (Kaiser *et al*., 2006). Kaiser *et al*. (2006) reported recovery times in the abundance of biota of less than 50 days from beam trawling in highly energetic, shallow, soft-sediment habitats of sand and muddy sand. Collie *et al*. (2000) reported recovery times of 100 days in sandy sediment communities from trawling disturbance. Brylinsky *et al*. (1994) reported the rapid recovery of nematode abundance within 4 to 6 weeks following experimental flounder trawling on intertidal silty sediments in the Bay of Fundy. Population recovery rates are species specific (Roberts *et al*., 2010). Long-lived bivalves will undoubtedly take longer to recovery from disturbance than other species such as short-		

				lived and small benthic organisms on the other hand have rapid generation times, high fecundities and therefore excellent recolonization capacities (Coen, 1995; Roberts *et al*., 2010).		
Internationally important waterfowl assemblage	Shallow coastal waters	Food availability	Presence and abundance of suitable prey species should not deviate significantly from an established baseline, subject to natural change	Competition for prey and changes in food availability were identified as potential pressures, the former being a direct impact and the latter being an indirect impact of trawling for sandeels. Light otter trawling targets sandeels and this species may also form a prey species of the red-breasted merganser which is known to feed on small fish. Potential changes in prey availability may also occur as a result of bycatch. Poor breeding success in certain seabirds has been linked to low availability of sandeels and there is concern that sandeel fisheries can adversely affect seabirds, particularly in the North Sea (Monaghan *et al*., 1989; Rindolf *et al*., 2000; Furness, 2002). The reason for this is because the fishery coincides with the breeding season when energetic demands are high and can overlap spatially with seabird foraging areas (Wright & Begg, 1997). An investigation into the	Daunt *et al*. (2008) investigated the link between sandeel consumption, abundance and seabird breeding success revealed no relationship between 1+ group sandeel abundance (which is commonly targeted by the fishery) on consumption rates and no effect of 0 group or 1+ group sandeel abundance on the proportion of the total seabird population utilising the study area (Daunt *et al*., 2008). This study was based in the North Sea where an industrial fishery for sandeels exists. In Langstone Harbour, sandeels are caught for the purposes of bait. This limits both the amount of sandeel caught and the amount of time spent fishing, with one boat catching approximately 1 kg per day. The level of bycatch of other species however should be limited as a result of EU regulations which relate to catch composition (see section 6.5). Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw

				relationship between sandeel abundance and breeding success and sandeel consumption, revealed no relationship between tern species (common tern, arctic tern, roseate tern and sandwich tern) sandeel consumption and sandeel abundance (Daunt *et al*., 2008). Breeding success of tern species was unrelated to the abundance of both sandeel age classes (Daunt *et al*., 2008). An investigation into the relationship between sandeel abundance and breeding success and sandeel consumption, revealed that for the seabird population as a whole, there was an effect of 0 group sandeel abundance on 0 group consumption rates, but no effect was detected for 1+ group sandeels (Daunt *et al* ., 2008). There was also no effect of 0 group or 1+ group sandeel abundance on the proportion of the total seabird population utilising the study area (Daunt *et al*., 2008).	more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). The red-breasted merganser uses the whole harbour and there is potential for spatial overlap with the activity. The red-breasted merganser occurs in Chichester and Langstone Harbour SPA from October to March and the activity occurs from May to October, thus largely eliminating any interaction between the presence of the red-breasted merganser and the activity. Based on the limited amount of sandeels taken, the amount of time spent trawling, provision for alternate other feeding areas and lack of temporal overlap between the activity and red-breasted merganser presence, it is unlikely that light otter trawling for sandeels will have an adverse effect on the food availability for the red-breasted merganser.	prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.
Common tern	All	Disturbance	No significant reduction in numbers or displacement of wintering birds from an	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling. Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of

			established baseline, subject to natural change.	disturbance. The effects of disturbance can include a reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to take flight which increase energy demands and reduce food intake with potential consequences for survival and reproduction. The significance of disturbance is likely to depend on the availability of alternative undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish dredging takes place. Responsiveness to disturbance is largely thought to be a species-specific trait.	Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). The common tern is a surface feeding and is known to utilise a number of areas within the harbour, particularly the confluence of Langstone Channel and the mouth of the harbour. The areas used for feeding by the species are likely to overlap with those used by the Common tern at the confluence of the Langstone Channel. The area used for the activity however only forms a small area of the tern feeding areas. The Common tern is present between April and September and therefore overlaps temporally with when trawling for sandeels is carried out (from May to October). In Langstone Harbour, sandeels are caught for the purposes of bait. This limits both the amount of sandeel caught (1-2 hours in the morning) and the amount of time spent fishing, with one boat catching approximately 1 kg per day. The wind-farm sensitivity index indicates tern species have a high sensitivity to wind farm developments. The escape flight distance exhibited by the species has been reported at 10 to 100 m in response to the presence of wind turbines. Minimum buffer distances of 100 m were suggested to avoid disturbance for pleasure watercraft.	permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.

					Langstone Harbour is an area subject to moderate levels of vessel traffic and some bird species can become habituated to particular disturbance events or types of disturbance. In addition, Langstone Harbour is subject to periodic maintenance dredging that is likely to lead to greater disturbance than that caused by trawling. Based on the limited amount of time spent trawling, provision for alternate key feeding areas (mouth of the harbour) and levels of vessel traffic within the harbour, it is unlikely that trawling will have an adverse effect on the Common tern through disturbance and displacement.	
Sandwich tern	All	Disturbance	No significant reduction in numbers or displacement of wintering birds from an established baseline, subject to natural change.	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling. Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the disturbance. The effects of disturbance can include a reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to take flight which increase energy demands and reduce food intake with potential consequences for survival and	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). The Sandwich tern is a surface feeding and is known to utilise a number of areas within the harbour, particularly the confluence of Langstone Channel and the mouth of the harbour. The areas used for feeding by the species are likely to overlap with those used by	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal

				reproduction. The significance of disturbance is likely to depend on the availability of alternative undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish dredging takes place. Responsiveness to disturbance is largely thought to be a species-specific trait.	the Sandwich tern at the confluence of the Langstone Channel. The area used for the activity however only forms a small area of the tern feeding areas. The sandwich tern is present between April and August and therefore overlaps temporally with when trawling for sandeels is carried out (from May to October). In Langstone Harbour, sandeels are caught for the purposes of bait. This limits both the amount of sandeel caught (1-2 hours in the morning) and the amount of time spent fishing, with one boat catching approximately 1 kg per day. The wind-farm sensitivity index indicates the Sandwich tern has high sensitivity to wind farm developments. The escape flight distance exhibited by the species has been reported at 10 to 100 m in response to the presence of wind turbines. Langstone Harbour is an area subject to moderate levels of vessel traffic and some bird species can become habituated to particular disturbance events or types of disturbance. In addition, Langstone Harbour is subject to periodic maintenance dredging that is likely to lead to greater disturbance than that caused by trawling. Based on the limited amount of time spent trawling, provision for alternate key feeding areas (mouth of the harbour) and levels of vessel traffic within the harbour, it is unlikely that trawling will have an adverse effect on	restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.

					the Sandwich tern through disturbance and displacement.	
Little tern	All	Disturbance	No significant reduction in numbers or displacement of wintering birds from an established baseline, subject to natural change.	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling. Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the disturbance. The effects of disturbance can include a reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to take flight which increase energy demands and reduce food intake with potential consequences for survival and reproduction. The significance of disturbance is likely to depend on the availability of alternative undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish dredging takes place. Responsiveness to disturbance is largely thought to be a species-specific trait.	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). The Little tern is a surface feeding bird, however the areas in which it feeds are generally outside of the area where trawling occurs. The species are commonly seen feeding within the enclosed seascape and channels surrounded by North Binness, Long Island, Round Nap, South Binness and Bakers Island, as well as in areas adjacent to Farlington Marshes, particularly on the eastern site. The Little tern is present between April and August and therefore overlaps temporally with when trawling for sandeels is carried out (from May to October). In Langstone Harbour, sandeels are caught for the purposes of bait. This limits both the amount of sandeel caught (1-2 hours in the morning) and the amount of time spent fishing, with one boat catching approximately 1 kg per day.	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can

					The wind-farm sensitivity index indicates that Little tern has high sensitivity to wind farm developments. The escape flight distance exhibited by the species has been reported at 10 to 100 m in response to the presence of wind turbines. Langstone Harbour is an area subject to moderate levels of vessel traffic and some bird species can become habituated to particular disturbance events or types of disturbance. In addition, Langstone Harbour is subject to periodic maintenance dredging that is likely to lead to greater disturbance than that caused by trawling. Based on the limited amount of time spent trawling, the use of feeding areas outside of those used for trawling, and levels of vessel traffic within the harbour, it is unlikely that trawling will have an adverse effect on the Little tern through disturbance and displacement.	be used, with vessels often using lighter towed gear.
Internationally important waterfowl assemblage	All	Disturbance	No significant reduction in numbers or displacement of wintering birds from an established baseline, subject to natural change.	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling. Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the disturbance. The effects of disturbance can include a reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more).	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of

				suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to take flight which increase energy demands and reduce food intake with potential consequences for survival and reproduction. The significance of disturbance is likely to depend on the availability of alternative undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish dredging takes place. Responsiveness to disturbance is largely thought to be a species-specific trait.	Trawling occurs at high tide and therefore will be likely to have very little direct impact on disturbance of waders since feeding takes place at low tide, thus eliminating the possibly of any adverse significant effect. Many areas utilised by the feeding waterfowl assemblage largely fall outside of that used for trawling. In addition, overwintering birds generally occur throughout the winter months and trawling for sandeels is carried out in the summer months, thus limiting disturbance. Langstone Harbour is an area subject to moderate levels of vessel traffic and some bird species can become habituated to particular disturbance events or types of disturbance. In addition, Langstone Harbour is subject to periodic maintenance dredging that is likely to lead to greater disturbance than that caused by trawling. Based on the levels of vessel traffic within the harbour, the occurrence of fishing at high tide and lack of temporal overlap, it is unlikely that trawling will have an adverse effect on the waterfowl assemblage through disturbance and displacement.	new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.
Grey plover	All	Disturbance	No significant reduction in numbers or displacement of wintering birds from an	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling. Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of

			established baseline, subject to natural change.	disturbance. The effects of disturbance can include a reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to take flight which increase energy demands and reduce food intake with potential consequences for survival and reproduction. The significance of disturbance is likely to depend on the availability of alternative undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish dredging takes place. Responsiveness to disturbance is largely thought to be a species-specific trait.	Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). Grey plover are known to feed at low tide and areas used by the species have the potential to overlap with trawling. Trawling however occurs at high tide and therefore will be likely to have very little direct impact on disturbance of Grey plover since feeding takes place at low tide, thus eliminating the possibly of any adverse significant effect. In addition, Grey plover occur from August to March and trawling for sandeels is carried out in from May to October, thus largely limiting any chances of disturbance. The wind-farm sensitivity index indicates the Grey plover has very low sensitivity to wind farm developments. The escape flight distance exhibited by the species has been reported at 124 m in response to disturbance of people. In the Solent, the median response distance to disturbance was 75 m. Studies of bird disturbance in the Solent revealed that grey plover typically had the shortest disturbance distances and were able to feed relatively effectively at night, meaning that these species were less affected by visitors. It is worth noting however that the study looked at disturbance in response to land-based and water-based recreational activities, with half of all incidences where major flight was observed involving activities on the	permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.

					intertidal. Langstone Harbour is an area subject to moderate levels of vessel traffic and some bird species can become habituated to particular disturbance events or types of disturbance. In addition, Langstone Harbour is subject to periodic maintenance dredging that is likely to lead to greater disturbance than that caused by trawling. Based on the levels of vessel traffic within the harbour, the occurrence of fishing at high tide, low sensitivity to disturbance and lack of temporal overlap, it is unlikely that trawling will have an adverse effect on Grey plover through disturbance and displacement.	
Sanderling	All	Disturbance	No significant reduction in numbers or displacement of wintering birds from an established baseline, subject to natural change.	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling. Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the disturbance. The effects of disturbance can include a reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to take flight which increase energy demands and reduce food intake with potential consequences for survival and	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). Sanderling are known to feed at low tide and areas used by the species have the potential to overlap with trawling. Trawling however occurs at high tide and therefore will be likely to have very little direct impact on disturbance of Sanderling since	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal

				reproduction. The significance of disturbance is likely to depend on the availability of alternative undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish dredging takes place. Responsiveness to disturbance is largely thought to be a species-specific trait.	feeding takes place at low tide, thus eliminating the possibly of any adverse significant effect. In addition, Sanderling occur from October to May and trawling for sandeels is carried out in from May to October, thus largely limiting any chances of disturbance. The wind-farm sensitivity index indicates that Sanderling have a very low sensitivity to wind farm developments. Langstone Harbour is an area subject to moderate levels of vessel traffic and some bird species can become habituated to particular disturbance events or types of disturbance. In addition, Langstone Harbour is subject to periodic maintenance dredging that is likely to lead to greater disturbance than that caused by trawling. Based on the levels of vessel traffic within the harbour, the occurrence of fishing at high tide, low sensitivity to wind farm disturbance and lack of temporal overlap; it is unlikely that trawling will have an adverse effect on Sanderling through disturbance and displacement.	restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.
Dunlin	All	Disturbance	No significant reduction in numbers or displacement of wintering birds from an established baseline,	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling. Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the disturbance. The effects of disturbance can include a	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These

			subject to natural change.	reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to take flight which increase energy demands and reduce food intake with potential consequences for survival and reproduction. The significance of disturbance is likely to depend on the availability of alternative undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish dredging takes place. Responsiveness to disturbance is largely thought to be a species-specific trait.	more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). Dunlin are known to feed at low tide and areas used by the species have the potential to overlap with trawling. Trawling however occurs at high tide and therefore will be likely to have very little direct impact on disturbance of dunlin since feeding takes place at low tide, thus eliminating the possibly of any adverse significant effect. In addition, Dunlin occur from September to April and trawling for sandeels is carried out in from May to October, thus largely limiting any chances of disturbance. The wind-farm sensitivity index indicates the Dunlin have a very has low sensitivity to wind farm developments. The escape flight distance exhibited by the species ranges, in one study the distance from the disturbance stimuli was 30 m when stimuli was a researcher, to 71 to 163 m when people caused the disturbance. The median distance at which a response occurred was reported at 75 metres in the Solent. Studies in the Solent revealed that Dunlin were predicted to be one of the most vulnerable species to disturbance and disturbance was predicted to increase time spent feeding intertidally (Stillman *et al.*, 2012). It is worth noting however that the study looked at disturbance in response to land-based and water-based recreational activities, with half of all incidences	amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.

					where major flight was observed involving activities on the intertidal. Langstone Harbour is an area subject to moderate levels of vessel traffic and some bird species can become habituated to particular disturbance events or types of disturbance. In addition, Langstone Harbour is subject to periodic maintenance dredging that is likely to lead to greater disturbance than that caused by trawling. Despite being predicted to be most of the most vulnerable species to disturbance, based on the levels of vessel traffic within the harbour, the occurrence of fishing at high tide, low sensitivity to wind farm disturbance and lack of temporal overlap, it is unlikely that trawling will have an adverse effect on Dunlin through disturbance and displacement.	
Redshank	All	Disturbance	No significant reduction in numbers or displacement of wintering birds from an established baseline, subject to natural change.	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling. Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the disturbance. The effects of disturbance can include a reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). Redshank are known to feed at low tide but the areas used by the species are unlikely to overlap with trawling. In	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also

				take flight which increase energy demands and reduce food intake with potential consequences for survival and reproduction. The significance of disturbance is likely to depend on the availability of alternative undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish dredging takes place. Responsiveness to disturbance is largely thought to be a species-specific trait.	addition, trawling occurs at high tide and feeding takes place at low tide. Furthermore, Redshank are known to occur from July to April and trawling for sandeels is carried out in from May to October, thus providing a small period of time for disturbance to potentially take place. The wind-farm sensitivity index indicates the Redshank has low sensitivity to wind farm developments. The escape flight distance exhibited by the species has been reported at 92 m in response to researchers, 95 m in response to people 175 m in response to kayaks and 260 m in response to surfers. In another study, the median distance at which a response occurred was reported at ranged between 75-150 metres in the Solent. Studies of bird disturbance in the Solent revealed that redshank had the shortest disturbance distances and were able to feed relatively effectively at night, meaning that this species is less affected by disturbance from visitors (Stillman *et al*., 2012). It is worth noting however that the study looked at disturbance in response to land-based and water-based recreational activities, with half of all incidences where major flight was observed involving activities on the intertidal. Langstone Harbour is an area subject to moderate levels of vessel traffic and some bird species can become habituated to particular disturbance events or types of disturbance. In addition, Langstone Harbour is subject to periodic maintenance dredging that	offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.

					is likely to lead to greater disturbance than that caused by trawling. Based on the levels of vessel traffic within the harbour, the lack of spatial overlap and low sensitivity to disturbance, it is unlikely that trawling will have an adverse effect on Redshank through disturbance and displacement.	
Dark-bellied brent goose	All	Disturbance	No significant reduction in numbers or displacement of wintering birds from an established baseline, subject to natural change.	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling. Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the disturbance. The effects of disturbance can include a reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to take flight which increase energy demands and reduce food intake with potential consequences for survival and reproduction. The significance of disturbance is likely to depend on the availability of alternative undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish dredging takes place.	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). Dark-bellied brent geese are known to feed at low tide but the areas used by the species are unlikely to overlap with trawling. In addition, trawling occurs at high tide and feeding takes place at low tide. Furthermore, Dark-bellied Brent geese are known to occur from October to March and trawling for sandeels is carried out in from May to October, thus largely eliminating any potential for disturbance. The wind-farm sensitivity index indicates the Dark-bellied brent goose has moderate sensitivity to wind farm developments. The escape flight	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring,

				Responsiveness to disturbance is largely thought to be a species-specific trait.	distance exhibited by the species ranges. The median distance at which a response occurred was reported at 51.5 metres in the Solent. Langstone Harbour is an area subject to moderate levels of vessel traffic and some bird species can become habituated to particular disturbance events or types of disturbance. In addition, Langstone Harbour is subject to periodic maintenance dredging that is likely to lead to greater disturbance than that caused by trawling. Based on the levels of vessel traffic within the harbour, the lack of spatial and temporal overlap and moderate sensitivity to wind farm development, it is unlikely that trawling will have an adverse effect on Dark-bellied brent geese through disturbance and displacement.	summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.
Shelduck	All	Disturbance	No significant reduction in numbers or displacement of wintering birds from an established baseline, subject to natural change.	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling. Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the disturbance. The effects of disturbance can include a reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). Shelduck are known to feed at low tide but the areas used by the species are unlikely to overlap with trawling. In	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also

				take flight which increase energy demands and reduce food intake with potential consequences for survival and reproduction. The significance of disturbance is likely to depend on the availability of alternative undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish dredging takes place. Responsiveness to disturbance is largely thought to be a species-specific trait.	addition, trawling occurs at high tide and feeding takes place at low tide. Furthermore, Shelduck are known to occur from November to June and trawling for sandeels is carried out in from May to October, thus only providing a short period of time for disturbance to potentially occur. The wind-farm sensitivity index indicates the Shelduck has very low sensitivity to wind farm developments. The escape flight distance exhibited by the species has been reported at 148-250 m in response to disturbance of people. In another study, the median distance at which a response occurred was reported at 77.5 metres in the Solent. Langstone Harbour is an area subject to moderate levels of vessel traffic and some bird species can become habituated to particular disturbance events or types of disturbance. In addition, Langstone Harbour is subject to periodic maintenance dredging that is likely to lead to greater disturbance than that caused by trawling. Based on the levels of vessel traffic within the harbour, the lack of spatial overlap and very low sensitivity to wind farm development, it is unlikely that trawling will have an adverse effect on Shelduck through disturbance and displacement.	offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.
Teal	All	Disturbance	No significant reduction in numbers or displaceme	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling.	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of

			nt of wintering birds from an established baseline, subject to natural change.	Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the disturbance. The effects of disturbance can include a reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to take flight which increase energy demands and reduce food intake with potential consequences for survival and reproduction. The significance of disturbance is likely to depend on the availability of alternative undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish dredging takes place. Responsiveness to disturbance is largely thought to be a species-specific trait.	during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). Teal are known to feed at low tide but the areas used by the species are unlikely to overlap with trawling. In addition, trawling occurs at high tide and feeding takes place at low tide. Furthermore, Teal are known to occur from September to March and trawling for sandeels is carried out in from May to October, thus largely eliminating the potential for disturbance. The wind-farm sensitivity index indicates the Teal has a very low sensitivity to wind farm developments. The escape flight distance exhibited by the species widely ranges. In response to boats, the distance from the disturbance stimuli was 400 m, however in response to researchers was 86 m. In another study, the median distance at which a response occurred was reported at 60 metres in the Solent. Langstone Harbour is an area subject to moderate levels of vessel traffic and some bird species can become habituated to particular disturbance events or types of disturbance. In addition, Langstone Harbour is subject to periodic maintenance dredging that	the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.

					is likely to lead to greater disturbance than that caused by trawling. Based on the levels of vessel traffic within the harbour, the lack of spatial and temporal overlap and very low sensitivity to wind farm development, it is unlikely that trawling will have an adverse effect on Teal through disturbance and displacement.	
Ringed plover	All	Disturbance	No significant reduction in numbers or displacement of wintering birds from an established baseline, subject to natural change.	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling. Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the disturbance. The effects of disturbance can include a reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to take flight which increase energy demands and reduce food intake with potential consequences for survival and reproduction. The significance of disturbance is likely to depend on the availability of alternative undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish dredging takes place.	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). Ringed plover are known to feed at low tide but the areas used by the species are unlikely to overlap with trawling. In addition, trawling occurs at high tide and feeding takes place at low tide. Furthermore, Ringed plover are known to occur from August to May and trawling for sandeels is carried out in from May to October, thus allowing a short period of time for disturbance to potentially occur. The wind-farm sensitivity index indicates the Ringed plover has very low sensitivity to wind farm developments. The escape flight	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring,

				Responsiveness to disturbance is largely thought to be a species-specific trait.	distance exhibited by the species has been reported at 121 m in response to disturbance of people. Studies of bird disturbance in the Solent revealed that ringed plover was one of the most vulnerable to disturbance and it was reported that disturbance increased the level of time spent feeding (Stillman *et al*., 2012). It is worth noting however that the study looked at disturbance in response to land-based and water-based recreational activities, with half of all incidences where major flight was observed involving activities on the intertidal. Langstone Harbour is an area subject to moderate levels of vessel traffic and some bird species can become habituated to particular disturbance events or types of disturbance. In addition, Langstone Harbour is subject to periodic maintenance dredging that is likely to lead to greater disturbance than that caused by trawling. Despite being predicted to be most of the most vulnerable species to disturbance, based on the levels of vessel traffic within the harbour, the occurrence of fishing at high tide, low sensitivity to wind farm disturbance and relative lack of temporal and spatial overlap, it is unlikely that trawling will have an adverse effect on Ringed plover through disturbance and displacement.	summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.
Curlew	All	Disturbance	No significant reduction in numbers or displaceme	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling.	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of

			nt of wintering birds from an established baseline, subject to natural change.	Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the disturbance. The effects of disturbance can include a reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to take flight which increase energy demands and reduce food intake with potential consequences for survival and reproduction. The significance of disturbance is likely to depend on the availability of alternative undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish dredging takes place. Responsiveness to disturbance is largely thought to be a species-specific trait.	during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). Curlew are known to feed at low tide and areas used by the species have the potential to overlap with trawling. Trawling however occurs at high tide and therefore will be likely to have very little direct impact on disturbance of curlew since feeding takes place at low tide, thus eliminating the possibly of any adverse significant effect. In addition, Curlew occur from June to April and trawling for sandeels is carried out in from May to October, thus providing a relatively large period of time for disturbance to occur. The wind-farm sensitivity index indicates the Curlew has low sensitivity to wind farm developments. The escape flight distance exhibited by the species has been reported at 95 - 339 m in response to people, 220 m in response to kayaks and 400 m In response to surfers. In another study, the median distance at which a response occurred was reported at 75 metres in the Solent. Studies of bird disturbance in the Solent revealed that curlew were the most vulnerable to disturbance and it was reported that disturbance decreased the level of time spent feeding (Stillman *et al*.,	the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.

					2012). It is worth noting however that the study looked at disturbance in response to land-based and water-based recreational activities, with half of all incidences where major flight was observed involving activities on the intertidal. Langstone Harbour is an area subject to moderate levels of vessel traffic and some bird species can become habituated to particular disturbance events or types of disturbance. In addition, Langstone Harbour is subject to periodic maintenance dredging that is likely to lead to greater disturbance than that caused by trawling. Despite being predicted to be most of the most vulnerable species to disturbance, based on the levels of vessel traffic within the harbour, the occurrence of fishing at high tide and low sensitivity to wind farm disturbance, it is unlikely that trawling will have an adverse effect on Curlew through disturbance and displacement.	
Bar-tailed godwits	All	Disturbance	No significant reduction in numbers or displacement of wintering birds from an established baseline, subject to natural change.	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling. Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the disturbance. The effects of disturbance can include a reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more).	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of

				suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to take flight which increase energy demands and reduce food intake with potential consequences for survival and reproduction. The significance of disturbance is likely to depend on the availability of alternative undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish dredging takes place. Responsiveness to disturbance is largely thought to be a species-specific trait.	Bar-tailed godwits are known to feed at low tide and areas used by the species have the potential to overlap with trawling. Trawling however occurs at high tide and therefore will be likely to have very little direct impact on disturbance of Bar-tailed godwits since feeding takes place at low tide, thus eliminating the possibly of any adverse significant effect. In addition, Curlew occur from September to April and trawling for sandeels is carried out in from May to October, thus limiting the potential for disturbance. The wind-farm sensitivity index indicates the Bar-tailed godwit has low sensitivity to wind farm developments. The escape flight distance exhibited by the species has been reported at 107-219 m in response to people, 200 m in response to kayaks and 230 m in response to surfers. Langstone Harbour is an area subject to moderate levels of vessel traffic and some bird species can become habituated to particular disturbance events or types of disturbance. In addition, Langstone Harbour is subject to periodic maintenance dredging that is likely to lead to greater disturbance than that caused by trawling. Based on the levels of vessel traffic within the harbour, the occurrence of fishing at high tide, low sensitivity to wind farm disturbance and lack of temporal overlap, it is unlikely that trawling will have an adverse effect on Bar-tailed godwits through disturbance	new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.

					and displacement.	
Turnstone	All	Disturbance	No significant reduction in numbers or displacement of wintering birds from an established baseline, subject to natural change.	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling. Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the disturbance. The effects of disturbance can include a reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to take flight which increase energy demands and reduce food intake with potential consequences for survival and reproduction. The significance of disturbance is likely to depend on the availability of alternative undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish dredging takes place. Responsiveness to disturbance is largely thought to be a species-specific trait.	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). Turnstone are known to feed at low tide but the areas used by the species are unlikely to overlap with trawling. In addition, trawling occurs at high tide and feeding takes place at low tide. Furthermore, Turnstone are known to occur from August to April and trawling for sandeels is carried out in from May to October, thus allowing a short period of time for disturbance to potentially occur. The escape flight distance exhibited by the species has been reported at 47 m in response to people. In another study, the median distance at which a response occurred was reported at 50 metres in the Solent. Langstone Harbour is an area subject to moderate levels of vessel traffic and some bird species can become habituated to particular disturbance events or types of disturbance. In addition, Langstone Harbour is subject	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using

					to periodic maintenance dredging that is likely to lead to greater disturbance than that caused by trawling. Based on the levels of vessel traffic within the harbour, the occurrence of fishing at high tide, short escape flight distances and lack of spatial overlap, it is unlikely that trawling will have an adverse effect on Turnstone through disturbance and displacement.	lighter towed gear.
Wigeon	All	Disturbance	No significant reduction in numbers or displacement of wintering birds from an established baseline, subject to natural change.	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling. Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the disturbance. The effects of disturbance can include a reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to take flight which increase energy demands and reduce food intake with potential consequences for survival and reproduction. The significance of disturbance is likely to depend on the availability of alternative undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). Wigeon are known to feed at low tide but the areas used by the species are unlikely to overlap with trawling. In addition, trawling occurs at high tide and feeding takes place at low tide. Furthermore, Wigeon are known to occur from September to March and trawling for sandeels is carried out in from May to October, thus allowing a limited time for disturbance to occur. The wind-farm sensitivity index indicates the Wigeon has extremely low sensitivity to wind farm developments. The escape flight	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of

				dredging takes place. Responsiveness to disturbance is largely thought to be a species-specific trait.	distance exhibited by the species has been reported at 115-230 m in response to a researcher. In another study, the median distance at which a response occurred was reported at 75.5 metres in the Solent. Studies of bird disturbance in the Solent revealed that wigeon were most responsive to different activities, with this species having one of the highest proportion of observations involving a disturbance response (Liley *et al*., 2010). It is worth noting however that the study looked at disturbance in response to land-based and water-based recreational activities, with half of all incidences where major flight was observed involving activities on the intertidal. Langstone Harbour is an area subject to moderate levels of vessel traffic and some bird species can become habituated to particular disturbance events or types of disturbance. In addition, Langstone Harbour is subject to periodic maintenance dredging that is likely to lead to greater disturbance than that caused by trawling. Despite showing relatively high sensitivity to disturbance, based on the levels of vessel traffic within the harbour, the occurrence of fishing at high tide and lack of spatial and temporal overlap, it is unlikely that trawling will have an adverse effect on Wigeon through disturbance and displacement.	the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.
Pintail	All	Disturbance	No significant reduction in numbers or	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling.	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5,	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within

			displacement of wintering birds from an established baseline, subject to natural change.	Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the disturbance. The effects of disturbance can include a reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to take flight which increase energy demands and reduce food intake with potential consequences for survival and reproduction. The significance of disturbance is likely to depend on the availability of alternative undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish dredging takes place. Responsiveness to disturbance is largely thought to be a species-specific trait.	with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). Pintail are known to feed at low tide but the areas used by the species are unlikely to overlap with trawling. In addition, trawling occurs at high tide and feeding takes place at low tide. Furthermore, Pintail are known to occur from September to March and trawling for sandeels is carried out in from May to October, thus allowing a limited time for disturbance to occur. The wind-farm sensitivity index indicates the Pintail has low sensitivity to wind farm developments. Langstone Harbour is an area subject to moderate levels of vessel traffic and some bird species can become habituated to particular disturbance events or types of disturbance. In addition, Langstone Harbour is subject to periodic maintenance dredging that is likely to lead to greater disturbance than that caused by trawling. Based on the levels of vessel traffic within the harbour, the occurrence of fishing at high tide low sensitivity to wind farm development and lack of spatial and temporal overlap, it is	the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.

					unlikely that trawling will have an adverse effect on Pintail through disturbance and displacement.	
Shoveler	All	Disturbance	No significant reduction in numbers or displacement of wintering birds from an established baseline, subject to natural change.	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling. Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the disturbance. The effects of disturbance can include a reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to take flight which increase energy demands and reduce food intake with potential consequences for survival and reproduction. The significance of disturbance is likely to depend on the availability of alternative undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish dredging takes place. Responsiveness to disturbance is largely thought to be a species-specific trait.	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). Shoveler are known to feed at low tide but the areas used by the species are unlikely to overlap with trawling. In addition, trawling occurs at high tide and feeding takes place at low tide. Furthermore, Shoveler are known to occur from September to March and trawling for sandeels is carried out in from May to October, thus allowing a limited time for disturbance to occur. The wind-farm sensitivity index indicates the Shoveler has low sensitivity to wind farm developments. The escape flight distance exhibited by the species has been reported at 200 m in response to boats and 126 m in response to researchers. Langstone Harbour is an area subject to moderate levels of vessel traffic and some bird species can become habituated to particular disturbance	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also

					events or types of disturbance. In addition, Langstone Harbour is subject to periodic maintenance dredging that is likely to lead to greater disturbance than that caused by trawling. Based on the levels of vessel traffic within the harbour, the occurrence of fishing at high tide low sensitivity to wind farm development and lack of spatial and temporal overlap, it is unlikely that trawling will have an adverse effect on Shoveler through disturbance and displacement.	restricts the type of gear that can be used, with vessels often using lighter towed gear.
Red-breasted merganser	All	Disturbance	No significant reduction in numbers or displacement of wintering birds from an established baseline, subject to natural change.	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling. Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the disturbance. The effects of disturbance can include a reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to take flight which increase energy demands and reduce food intake with potential consequences for survival and reproduction. The significance of disturbance is likely to depend on the availability of alternative	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). Red-breasted mergansers are a type of diving duck known to feed on small fish. The species is known to utilise the whole harbour and therefore there is a potential for the activity and the area utilised by the red breasted merganser to overlap. The Red-breasted merganser occurs in Chichester and Langstone Harbour SPA from October to March and the activity occurs from May to October, thus largely eliminating any interaction between the	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a daily closure from 17:00 to 07:00.

				undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish dredging takes place. Responsiveness to disturbance is largely thought to be a species-specific trait.	presence of the Red-breasted merganser and the activity. Based on the provision for alternate other feeding areas in the harbour and lack of temporal overlap between the activity and Red-breasted merganser presence, it is unlikely that light otter trawling for sandeels will have an adverse effect on the Red-breasted merganser through disturbance and displacement.	Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.
Little egret	All	Disturbance	No significant reduction in numbers or displacement of wintering birds from an established baseline, subject to natural change.	Disturbance and displacement through visual presence and noise were identified as potential pressures of trawling. Disturbance can result in displacement when birds are unable to use an area due to the magnitude of the disturbance. The effects of disturbance can include a reduction in the survival of displaced individuals and effects on the population size. The movement of birds to less suitable feeding areas can lead to increased densities and interspecific competition. Disturbance can cause birds to take flight which increase energy demands and reduce food intake with potential consequences for survival and reproduction. The significance of disturbance is likely to depend on the	Reports of trawling with the Langstone Harbour from local IFCOs reveal the total number of vessels operating within the fishery is approximately 5, with 1 or 2 vessels operating daily during the summer (May to October). Sightings data, provided by Langstone Harbour, reveal a relatively low level of fishing effort within Langstone Harbour, with an average of 0.9 vessels sighted more than twice or more in a month in 2014. This was the highest average between 2012 and 2015, except for 2012 (1.5 fishing vessels sighted twice or more). Little egret are known to feed on small fish, amphibians and insects. Trawling therefore may cause disturbance to the species when feeding. Unfortunately there is a lack of information of where the species is known to feed and at what time of year the species is present. The species is known to overwinter in the harbour and therefore interaction with the activity is likely to be limited.	Bottom Towed Fishing Gear byelaw prohibits bottom towed fishing gear over sensitive features including seagrass within the Solent EMS closing areas of the site to these activities. Southern IFCA is currently amending this byelaw to include an additional network of permanent closures areas to bottom towed fishing gear. These amendments are being made as part of a suite of new measures to manage shellfish dredging within the Solent EMS. The network of new closure areas is designed to protect good examples of low-energy SAC habitats, maintaining the integrity of the site, whilst also offering long-term stability to guard against the effects of fishing effort displacement. Additional spatial and temporal restrictions of shellfish dredging within the Solent EMS include a network of three dredge management fishing areas and a

				availability of alternative undisturbed areas for birds and the frequency, seasonality and intensity at which shellfish dredging takes place. Responsiveness to disturbance is largely thought to be a species-specific trait.	The median escape flight distance exhibited by this species has been reported at 75 m in the Solent. Langstone Harbour is an area subject to moderate levels of vessel traffic and some bird species can become habituated to particular disturbance events or types of disturbance. Based on the moderate vessel levels that occur within Langstone Harbour and likely time of year when the species is present, trawling is unlikely to have an adverse effect on the Little egret through disturbance and displacement. In addition, Langstone Harbour is subject to periodic maintenance dredging that is likely to lead to greater disturbance than that caused by shellfish dredging.	daily closure from 17:00 to 07:00. Within each dredge fishing management area, clam dredging will be prohibited for 35 weeks of the year during the spring, summer and autumn months. Vessels Used in Fishing byelaw prohibits commercial fishing vessels over 12 metres from the Southern IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear.

7. Conclusion[19]

Light otter trawling for sandeels has been identified as having the potential to directly compete with surface feeding birds for the same target species. Tern species are considered to be relatively vulnerable and sensitive to changes in food availability in relation to breeding success. However, there is limited evidence to suggest that the removal of sandeels by a fishery, which also form a prey item of tern species, has an adverse effect. In the North Sea, where a commercial fishery for sandeels exists, no relationship could be found between sandeel abundance and breeding success of tern species. Whilst studies based in the North Sea are helpful for highlighting any potential for adverse effects on tern species, it should be noted that the sandeel fishery in Langstone Harbour is very small scale with catches (of up to 1 kg) being used for bait and not human consumption or for industrial use.

Research into the impacts of trawling reveals the activity has the potential to cause biological disturbance to the supporting habitats of designated bird species and cause potential changes in food availability. The extent of the impact however largely depends on sediment type and physical regime within the area considered. In areas subject to dynamic physical regimes with coarser sediments the evidence of impacts from trawling are either undetectable or negligible and short-lived.

Impacts associated with bird disturbance and subsequent displacement were also considered, as the area in which light otter trawling for sandeels takes place overlaps with one key feeding area using by tern species as well as areas using by birds which feed intertidally.

Using Southern IFCA sightings data and feature mapping data (provided by Natural England), light otter trawling for sandeels is shown to occur within Langstone Harbour which forms part of the Chichester and Langstone Harbours SPA. The sightings show the activity is concentrated subtidally within a small area in the centre of the harbour where the main channel splits into the Broom Channel and Langstone Channel, south of Sword Sands. Within this area, the sediment type consists of subtidal mixed sediment and subtidal sand. Sightings highlighted the activity to also fringe the intertidal in areas predominantly made up of intertidal muddy sand and sand.

Having reviewed a wide range of evidence, including expert opinion, scientific literature, sightings data and feature mapping, it has been concluded that light otter trawling for sandeels, which occurs within areas of Langstone Harbour, is unlikely to have a significant adverse effect on the regularly occurring Annex 1 bird species and migratory bird species and their supporting habitats. The level of light otter trawling for sandeels is relatively low and the amount of sandeels caught is limited as it is used for the purposes of bait. The scale of the fishery is therefore very limited and any knock-on effects in relation to prey availability for surface feeding birds are likely to be negligible. There is currently no evidence to suggest any link between the population trends of tern species within the SPA and the activity. The limited amount of sandeels required for bait purposes also means that the amount of time spent fishing is short (1 to 2 hours per day) and seasonal. This limits the opportunity for disturbance of surface feeding birds during feeding. The area which is fished is also subject to moderate levels of vessel traffic and therefore it is likely that birds within the harbour are habituated to similar types of disturbance. Any disturbance to birds feeding intertidally will be limited as fishing occurs at high tide and birds feed at low tide. The gear used is extremely light and is hand hauled, with gear weighing between 40 kg for smaller boats (approximately 8 m) and up to 65 kg for larger boats (up to 10 m). The limits the level of potential damage to the benthic community and any changes in prey availability caused by the gear. The activity is concentrated subtidally and therefore any impact on the intertidal zone is likely to be limited due to the infrequent nature of the activity within this zone. The area in which the activity

[19] If conclusion of adverse effect alone an in-combination assessment is not required.

does occur within the site is a relatively physically dynamic area, characterised by strong tidal flows; and is therefore likely to support faunal communities which are adapted to highly disturbed conditions. Experimental fishing manipulations suggest that recovery from any trawling impacts within these areas is likely to be rapid, with physical recovery taking up to 4 days in sandy habitats and biological recovery estimated to take up to 100 days, although it is likely to be less. The nature of the fishery, which only takes place during the summer months, would therefore allow for any recovery if necessary.

Based on the small scale and nature of the fishery (number of boats involved; relative low levels of sandeels caught; limited duration spent fishing; seasonal nature of the fishery; weight of the gear used); lack of evidence to suggest any link between the activity and tern population trends; the existing level of vessel traffic within Langstone Harbour; infrequent occurrence on the intertidal; and limited potential to cause adverse effect on the sediment types over which it occurs, it is deemed that trawling using a light otter trawl for sandeels within Langstone Harbour in the Chichester and Langstone Harbours SPA is unlikely to have an adverse effect on the designated bird features and the supporting habitats considered and will not hinder the site from achieving its conservation objectives. It is Southern IFCA's duty as the competent and relevant authority to manage damaging activities that may affect site integrity and lead to deterioration of the site. The levels and location of the activity considered is such that it is not believed to lead to the deterioration of the site and that it is compatible with the site's conservation objectives.

In order to ensure that the management of trawling remains consistent with the conservation objectives of the site, Southern IFCA will continue to monitor fishing effort through sightings data and information from IFCOs. In the short term a change in the status of the fishery is unforeseen, however it is recognised that the status of a fishery may change. On this basis, the management of trawling will be reviewed as appropriate should new evidence on activity levels and/or gear-habitat interaction become available.

8. In-combination assessment

No adverse effect on bird features and their supporting habitats of the Chichester and Langstone Harbours SPA was concluded for the effect of light otter trawling for sandeels alone within the SPA. Light otter trawling for sandeels occurs in the Chichester and Langstone Harbours SPA alongside other fishing activities and commercials plans and projects and therefore requires an in-combination assessment.

Commercial plans and projects that occur within or may affect the Chichester and Langstone Harbours SPA are considered in section 8.1. The impacts of these plans or projects require a Habitats Regulations Assessment in their own right, accounting for any in-combination effects, alongside existing fisheries activities.

There is the potential for light otter trawling for sandeels to have a likely significant effect when considered in-combination with other fishing activities that occur within the site. These are outlined in section 8.2. Any fishing activities that were screened out as part of the revised approach assessment process will not be considered (see Chichester and Langstone Harbours SPA screening summary for details of these activities). In the Chichester and Langstone Harbours SPA, commercially licensed fishing vessels are known to utilise a number of different gear types and can be engaged in multiple fishing activities and this, whilst dividing effort between gear types, may lead to cumulative impacts different to those of a single fishing activity.

8.1 Other plans and project

Project details	Status	Potential for in-combination effect
Kendalls Wharf extension	In planning	Relevant pathways identified in relation to this project include loss of intertidal habitat, increase in suspended sediment and bird disturbance (construction and operation). Loss of intertidal habitat – As part of this project, the total area subject to capital dredging is expected to be 0.33 ha. Following dredging, 0.073 ha of intertidal mudflat would be removed. The total intertidal area lost or altered is 0.148 ha which equates to 0.01% of the total intertidal habitat in Langstone Harbour. The combined total loss and change to intertidal mudflat to result in a maximum loss of 0.120 ha of potential foraging ground to waders and wildfowl. Despite a relatively small area of habitat loss, when compared to the total available habitat within the Chichester and Langstone Harbours SPA, the proposed works could not be concluded to not have a likely significant effect on waterfowl and waders (except for dark-bellied Brent goose). The impact significance of intertidal habitat loss was concluded to be minor[20] with regards to potential reduction in functional habitat and moderate[21] for potential loss of feeding habitat for waders and wildfowl. Increase in suspended sediment concentrations – It is estimated that during capital dredge operations suspended sediment concentrations could reach a maximum of 196 mg/l. Naturally occurring suspended sediment concentrations reach up to 200 mg/l within Langstone Harbour. The temporary and spatially limited sediment plumes were not anticipated to have a significant effect on the feeding success of terns within the harbour as a whole and any such effect will be limited to the Broom Channel for a short duration. The impact significance of increases in suspended sediment concentration was concluded to be not significant[22]. In addition, a back-hoe dredger will be used to minimise sediments suspended. Bird disturbance – dredging and construction (installation of sheet piling and piles) are likely to generate both noise and visual disturbance. The wharf extension is located in relative close proximity to redshank roosts. Up to 10% of the redshank

[20] When an effect will be experienced but the effect magnitude is sufficiently small and well within accepted standards and/or receptor is of low sensitivity.
[21] Moderate significance impacts may cover a broad range, although the emphasis remains on demonstrating that the impact has been reduced to a level that is as low as reasonably practical. This does not mean reducing to minor‘ but managing moderate‘ ones effectively and efficiently.
[22] An impact that, after assessment, was found not to be significant in the context of the environmental statement objectives.

		population in Langstone Harbour may be disturbed or displaced by proposed wharf extension works. The effect of displacement of prey fish species is not anticipated to overlap with key tern feeding areas and the limited spatial and temporal nature of this effect it is not considered likely to have a significant effect on available food resources for terns within the wider harbour. The impact of disturbance to this roost was assessed to be of moderate significance, despite not being the preferred roost within the SPA. Disturbance to roosting, feeding and nesting grounds in the wider area was initially assessed to be of moderate significance, but was later reduced to minor significance as timing of the works are proposed to take place outside of bird sensitive periods. Construction is expected to take 3 to 4 months between 1st April and 30th September. Such measures are expected to sufficiently mitigate disturbance to overwintering birds. At a tLSE level for light otter trawling for sandeels, visual disturbance and noise disturbance were screened in. On further investigation (contained within this HRA), both impact pathways have been screened out. For tern species, the reason for this is due to limited amount of time spent trawling and provision for alternate feeding areas. For other wildfowl and wader species, the reason for this is largely down to the limited potential for direct impact since the activity occurs at high tide and feeding/foraging takes place at low tide, thus largely eliminating the possibility of disturbance. At a tLSE level for light otter trawling for sandeels, physical damage and abrasion were also screened in. It was recognised that light otter trawling may cause disturbance to the seabed but does not result in the physical loss of the extent of the feature. Physical damage from siltation was not identified by the Regulation 33 Conservation Advice for the Chichester and Langstone Harbour SPA. Loss of intertidal and increase in suspended sediment concentrations do not overlap with impact pathways related to light otter trawling. There are unlikely to be in-combination effects in relation to noise and visual disturbance due to the limited potential for this to occur in relation to light otter trawling for sandeels (for reasons described above) and mitigation measures for the proposed works (construction occurring outside of sensitive bird periods). In addition, disturbance caused by the proposed works will be localised, temporary and small in scale.

Queen Elizabeth aircraft carrier capital dredge	Consented and underway	Relevant impact pathways identified in relation to the project include loss of intertidal (as identified by the appropriate assessment). A likely significant effect on the interest features of the Chichester and Langstone Harbours SPA was concluded for the loss of intertidal as a result of the approach channel dredge. The approach channel dredge is expected to lead to an average increase of 2 to 4 mm in water levels at low water within the harbour. This permanent rise in water level translates to a loss of approximately 1 hectare of low intertidal mudflat distributed throughout the harbour, representing a loss of 0.12% of intertidal resources. This corresponds to a reduction in mudflat exposure around low water for approximately three hours per month (0.001 percent of mudflat hectare exposure per month). Designated interest features from Chichester and Langstone Harbours SPA move freely between adjacent SPAs (including Portsmouth Harbour) and so may be affected by the loss of intertidal as a result of the proposed dredging activity, potentially leading to increased pressure on available food sources in other SPAs. When considering the available range of intertidal resource across the Solent, in-combination with the short reduction in exposure, it was deemed in the appropriate assessment that the loss of 1 hectare of intertidal mudflat will not have an adverse effect on integrity of the site. At a tLSE level for light otter trawling for sandeels, physical damage and abrasion were screened in. It was recognised that light otter trawling for sandeels may cause disturbance to the seabed but does not result in the physical loss of the extent of the feature. It has been concluded that impacts surrounding the approach capital dredge will not have an effect on the integrity of the site. The lack of overlapping impact pathways and lack of spatial interaction means there will be no in-combination effect between the project and activity.
Portchester to Emsworth Coastal Defence Strategy	In planning	Relevant impact pathways identified in relation to the project include the loss of intertidal habitat and bird disturbance (construction). Loss of intertidal - The Portsea Island Coastal Strategy Study [PICSS] was approved in 2011 and covers the whole of Portsea Island. The strategy confirms the North Solent Shoreline Management Plan [SMP] policy (2010) for Portsea Island of ‘Hold the Line’ and splits Portsea Island into 7 discrete

		flood cells. Under the North Portsea Island scheme, covering 8.4 km of coastline from Tipner through to Milton, works have been identified including raising of seawalls and improving seawalls structural integrity. These proposed works are planned over the first ten years and these follow a phased approach, including Phase 1, Ports Creek Railways Bridge to Kendall's Wharf Northern Boundary, and Phase 2, Milton Common and Great Salterns Quay. Coastal squeeze loss of 11.69 ha of intertidal will be caused by sea level rise and the delivery of the delivery of the strategic policy option of 'Hold the Line'. An appropriate assessment concluded that because of the calculated coastal squeeze losses, that implementation of the strategy would have an adverse effect on designated sites. The AA however also concluded there is justification for these adverse effects as there is no alterative policy and there is an over-riding public need to protect life and property and so an Imperative Reasons of Overriding Public Interest statement was made. Environmental compensation will be achieved through the Regional Habitat Creation Programme which promotes the realignment of defences elsewhere in the Solent to create new intertidal habitats. This was signed off by Defra in April 2011. The phases that are currently underway or in planning have a small working footprint during their construction which is strictly controlled by a Construction and Environment Management Plan. Direct disturbance to the sediment is minimal and in discrete locations at any one time. For phase 1 there was an access footprint of 15m and in phase 2 a maximum access footprint of 10 m along the Milton Common Frontage and 20 m around Great Salterns Quay. No LSE is expected as any disturbance to discrete working areas is minimal, temporary and must follow good working practices as outlined in the Construction and Environment Management Plan. This is expected to lead to no longer term impacts in these areas which are considered less sensitive bird feeding areas as areas are highly disturbed and so is not well utilised by birds. In addition, works are undertaken outside of bird sensitive periods and so the impact of the works on food availability is further reduced. Phase 2 works will lead to the gain of 2,460m^2 mudflat habitat within Langstone Harbour from the removal of Great Salterns Quay. Bird disturbance – construction works, particularly to seawalls, are expected to generate some level of noise and visual disturbance. The sensitivity of the

		Phase 1 area is considered to be of low sensitivity due to existing activities which occur in and around the Harbour. Works will run outside of the most sensitive overwintering period. The installation of noise absorbing screens will also be adopted if levels reach 69 dB or higher at the location of overwintering birds (Phase 1). The use hand operation machinery has also been used to reduce noise levels. The working footprint of the intertidal area will be strictly controlled, keeping direct disturbance to sediments to a minimum and in one discrete location at any one time (phased approach). This means that disturbance will be both localised and temporary and there will be vast 'free from disturbance' areas available at any one time. Access will remain similar to existing access and therefore no additional disturbance is expected above existing levels, with some areas (in Phase 2 works) seeing large reductions in access. No LSE is expected on interest features present. At a tLSE level for light otter trawling for sandeels, visual disturbance and noise disturbance were screened in. On further investigation (contained within this HRA), both impact pathways have been screened out. For tern species, the reason for this is due to limited amount of time spent trawling and provision for alternate feeding areas. For other wildfowl and wader species, the reason for this is largely down to the limited potential for direct impact since the activity occurs at high tide and feeding/foraging takes place at low tide, thus largely eliminating the possibility of disturbance. At a tLSE level, physical damage and abrasion were also screened in. It was recognised that light trawling may cause disturbance to the seabed but does not result in the physical loss of the extent of the feature. The combined impacts of phased small scale coastal defence works and light otter trawling for sandeels will not lead to in-combination effects, with respect to noise and visual disturbance. Disturbance caused by the project are localised, temporary and very small in scale, as well as being concentrated during the least sensitive periods, whilst light otter trawling for sandeels have limited potential to cause disturbance due to the nature of the activity. The general loss of intertidal from the overall strategy has been signed off by Defra under an Imperative Reasons of Overriding Public Interest statement.

8.2 Other fishing activities

Fishing activity	Potential for in-combination effect
Clam dredging	Common impact pathways identified at a tLSE level and these include, physical damage – abrasion, disturbance (noise and visual) and changes in food availability. Clam dredging is often focused in areas on softer sediment in distinct, small spatial areas where shellfish beds exist. These largely include the north eastern quarter of Langstone Harbour. These sites occur intertidally (fished at high tide) and subtidally, with vessels often operating in very shallow waters. Sightings data presented in Annex 12 (indicative of recent fishing activity) reveal there is no spatial overlap between the two activities and therefore there are likely to be no in-combination effects for any of the impact pathways identified.
Oyster dredging	Common impact pathways identified at a tLSE level and these include, physical damage – abrasion, disturbance (noise and visual) and changes in food availability. Oyster dredging is concentrated takes place in distinct, small spatial areas where shellfish beds exist. In Langstone Harbour activity is concentrated in the north eastern quarter and centrally in an area known as Sword Sands. Sightings data, indicative of recent fishing activity and presented in Annex 12, does not show this latter area. This is however likely to overlap with the area used for light otter trawling for sandeels as this is concentrated in the centre of the harbour. Activities are however separate temporally, with oyster dredging taking place in November (since the 2013/14 season) and light otter trawling takes place during the summer months (May to October). Subtidal sediment communities do not form a supporting habitat of the SPA and the lack of temporal overlap would not lead to increased levels of disturbance through a higher number of vessels. The area in which the activities may potentially overlap is an area characterised by coarse sediment and subject to dynamic physical regimes. In these types of environments there is a high rate of natural disturbance and evidence of impacts from trawling are either undetectable or negligible and short-lived. The WeBs Low Tide Count data does also not show this area as being particularly valuable to estuarine bird species. Fishing effort for both activities in this area is also known to be relatively low, with up to 5 vessels light otter trawling for sandeels for 1 to 2 hours a day and a lack of sightings for oyster dredging in this area in recent years. Based on the level of fishing effort and nature of the area fished (highly disturbed with rapid recovery rates), it is unlikely that the two activities will lead to in-combination effects.
Demersal netting	No impact pathways were identified at a tLSE level for demersal netting. The activity is low impact and unlikely to lead to any in-combination effects. In addition, static gear types such as netting and mobile gear types such as oyster dredging are not compatible and often occur in different areas, thus largely eliminating any spatial overlap between the two activities.
Demersal longlining	No impact pathways were identified at a tLSE level for demersal longlining. The activity is low impact and unlikely to lead to any in-combination effects. In addition, static gear types such as longlining and mobile gear types such as

	oyster dredging are not compatible and often occur in different areas, thus largely eliminating any spatial overlap between the two activities.
Handlines & Jigging/Trolling	No impact pathways were identified at a tLSE level for handlines and jigging/trolling. The activity is very low impact and unlikely to lead to any in-combination effects.

9. Summary of consultation with Natural England

Consultation	Date submitted	Response from NE	Date received
First draft (v1.0)	08/02/2016	Recommended amendments	30/03/2016
Revised draft in response to NE recommendations (v1.5)	21/04/2016	Accepted amendments	12/05/2016

10. Integrity test

It can be concluded that the activity in this Habitats Regulations Assessment (light otter trawling for sandeels), alone or in-combination, does not adversely affect the designated interest features and their supporting habitat features of the Chichester and Langstone Harbours SPA; and that future activity, if it remains similar to current levels, will not foreseeably have an adverse effect on the interest features and their supporting habitats of the SPA. The mitigation measures detailed in table 19 are therefore considered sufficient.

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Zwarts, L., Ens, B.J., Goss-Custard, J.D., Hulscher, J.B., Durell. S.E.A. le V.dit. 1996b. Causes of variation in prey profitability and its consequences for the intake rate of the oystercatcher *Haematopus ostralegus*. *Ardea*, **84a**, 229-268.

Annex 2: The Key Principles of the SEMS Management Scheme (http://www.solentems.org.uk/sems/management_scheme/)

Principle 1 - Favourable Condition

The SEMS has qualified for designation against the background of current use and there is a working assumption that the features for which the site is designated are in favourable condition from the time of designation. The Management Scheme and the monitoring to be carried out by 2006 will test this assumption.

Principle 2 - Sustainable Development

The aim of the Management Scheme is not to exclude human activities from SEMS, but rather to ensure that they are undertaken in ways which do not threaten the nature conservation interest, and wherever possible, in ways that support it. The Management Scheme should ensure a balance of social, economic and environmental objectives when considering the management of activities within the Solent.

Principle 3 - Regulatory Use of Bye-laws

New bye-laws may be used as a regulatory mechanism for the SEMS. These should only be introduced into the Management Scheme when all other options have been considered and it is the only effective solution.

Principle 4 - Links to Existing Management and Other Plans/Initiative

Where appropriate the SEMS Management Scheme will directly utilise management actions from other existing management plans. The actions identified in the Management Scheme will therefore serve to inform and support existing management effects rather than duplicate them. The management measures identified in other plans will remain the mechanism through which these are to be implemented.

Principle 5 - Onus of Proof

The wording for principle 5 is based on the following three-stage process:

- Stage 1 - Evidence must be established that a site feature is in deterioration. This evidence must be scientific, credible and unambiguous but it need not originate from English Nature itself. It is acknowledged that other Relevant Authorities will be undertaking monitoring regimes and if their programmes flag up something of interest, it would be expected that they would present it to English Nature for further comment and verification.
- Stage 2 - English Nature, as the Government's body with responsibility for nature conservation, must believe that a site feature is in deterioration. If the evidence to support this view has come from their own monitoring - or if it has come from an external, authoritative source - EN should act as a conduit to demonstrate this fact to the Relevant Authority with responsibility for the management of the activity suspected of having detrimental effect.
- Stage 3 - English Nature and the Relevant Authority (ies) involved should work together to establish any cause and effect relationship. From this, changes to management actions may be made.

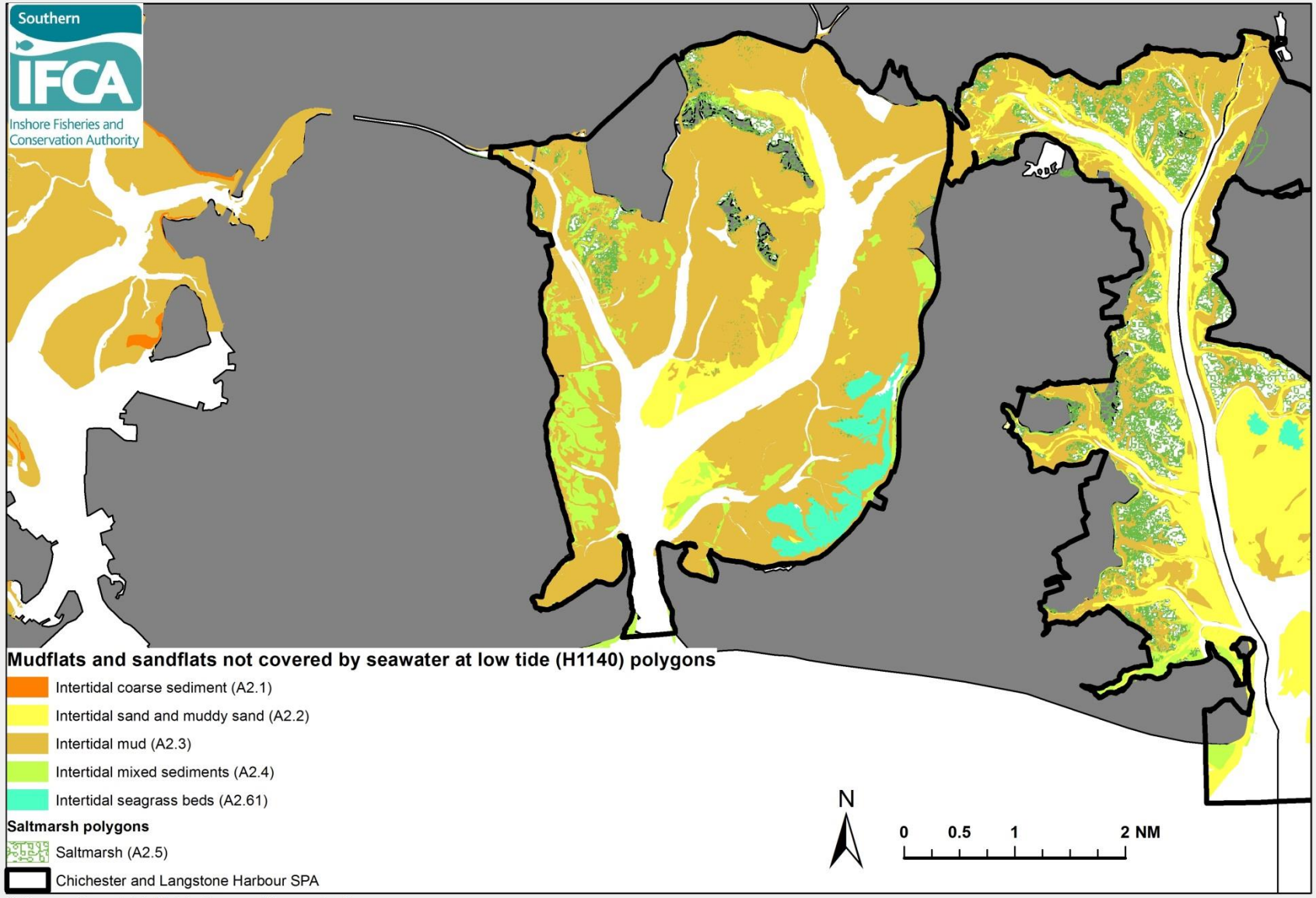
Consideration of this process had led to the following definition of onus of proof: If through their own site condition monitoring programme or that of another Relevant Authority, English Nature can demonstrate that they have reasonable evidence to indicate that a deterioration in the condition of a SEMS feature or species exists, then English Nature and the Relevant Authorities concerned will work together to identify any cause and effect relationship.

Principle 6 - Management Actions

Where reasonable evidence is found to clearly demonstrate the cause and effect relationship the Relevant Authorities involved will instigate changes to the management of the activity, which will be within a RAs statutory obligations and will provide a solution that is in accordance with the Regulations and be fair, balanced, proportionate and appropriate to the site and the activity. Where the cause and effect relationship is uncertain but deterioration in the condition is still significant the Relevant Authorities should consider any potential changes in management practices in light of the precautionary principle* and the cost effectiveness of proposed measures in preventing damage. However, the precautionary principle should not be used to prevent existing management actions continuing where there is no evidence of real risk of deterioration or significant disturbance to site features.

All forms of environmental risk should be tested against the precautionary principle which means that where there are real risks to the site, lack of full scientific certainty should not be used as a reason for postponing measures that are likely to be cost effective in preventing such damage. It does not however imply that the suggested cause of such damage must be eradicated unless proved to be harmless and it cannot be used as a licence to invent hypothetical consequences. Moreover, it is important, when considering whether information available is sufficient, to take account of the associated balance of likely costs, including environmental costs, and benefits." (DETR & the Welsh Office, 1998).

Annex 3: Supporting Habitat(s) Site Feature Map for Chichester and Langstone Harbours SPA (Langstone Harbour only)


Southern
IFCA
Inshore Fisheries and Conservation Authority
Mudflats and sandflats not covered by seawater at low tide (H1140) polygons
Intertidal coarse sediment (A2.1)
Intertidal sand and muddy sand (A2.2)
Intertidal mud (A2.3)
Intertidal mixed sediments (A2.4)
Intertidal seagrass beds (A2.61)
Saltmarsh polygons
Saltmarsh (A2.5)
Chichester and Langstone Harbour SPA
N
0 0.5 1 2 NM
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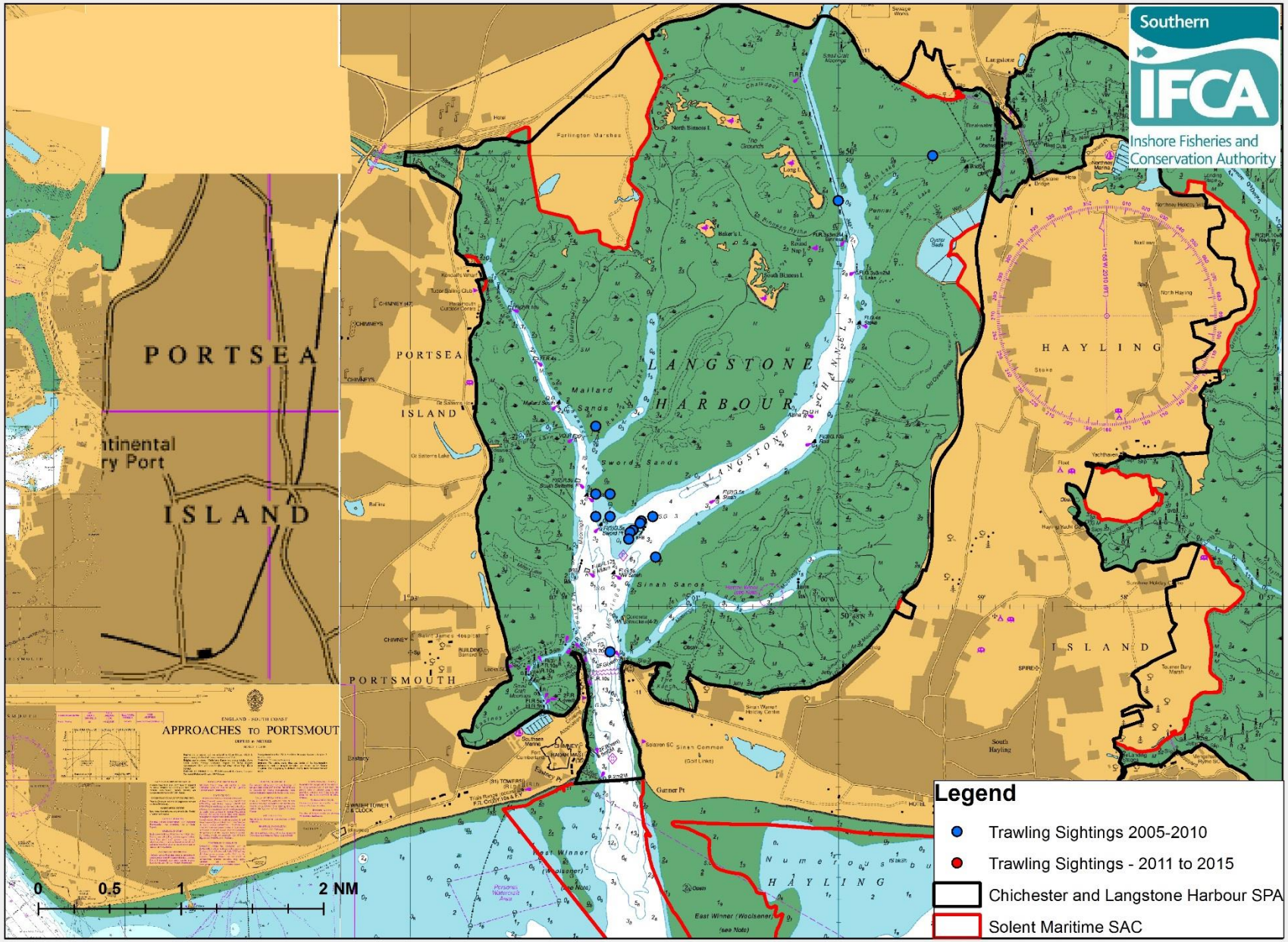
Annex 4: Fishing Activity Map(s) using Trawl Sightings Data from 2005-2015 (2005-2010 & 2011-2015) in Langstone Harbour.



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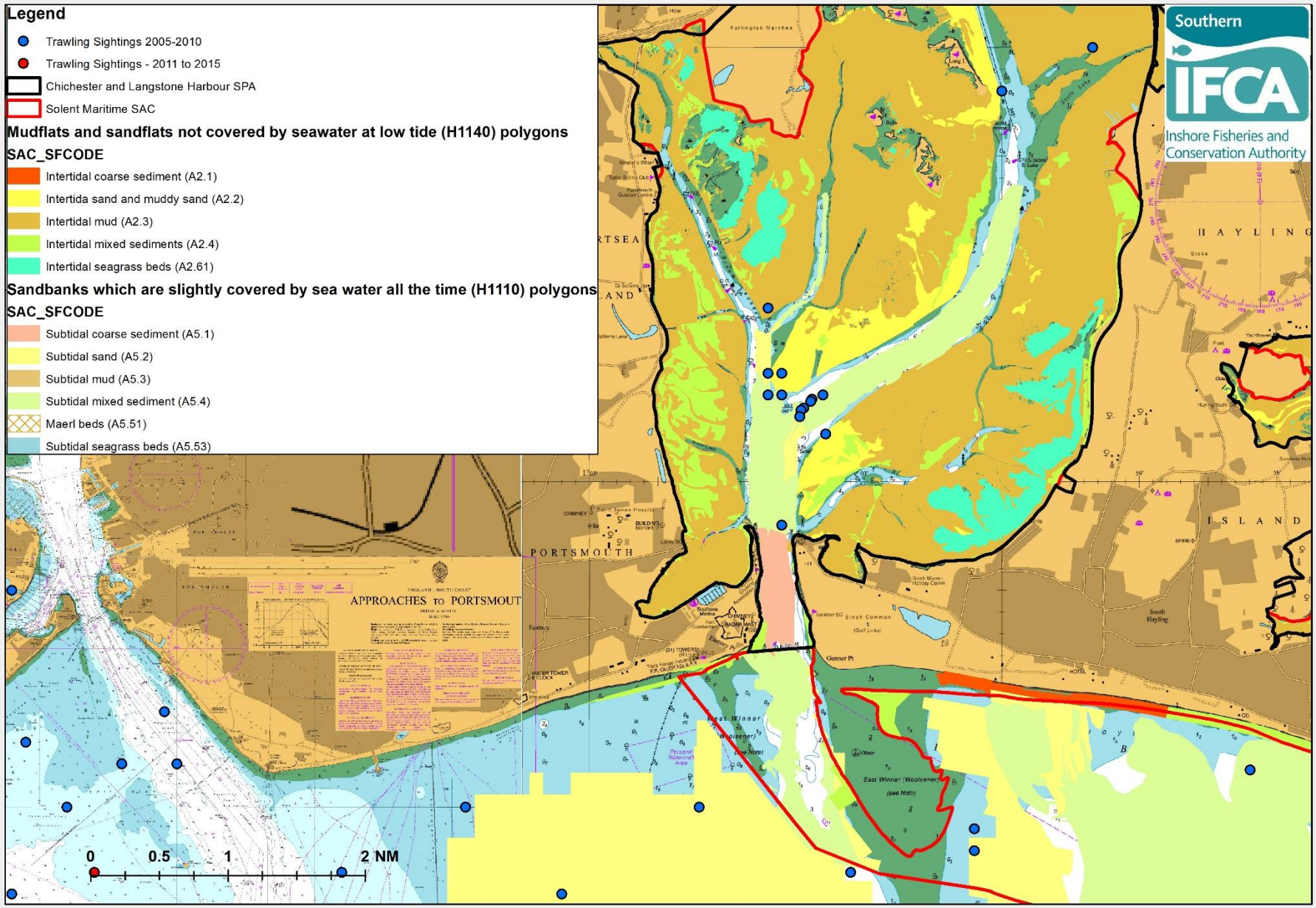
Annex 5: Co-Location of Fishing Activity using Trawl Sightings (2005 to 2015, broken down by 2005-2010 & 2011-2015) and Site Feature(s)/Supporting habitat(s) (Langstone Harbour)



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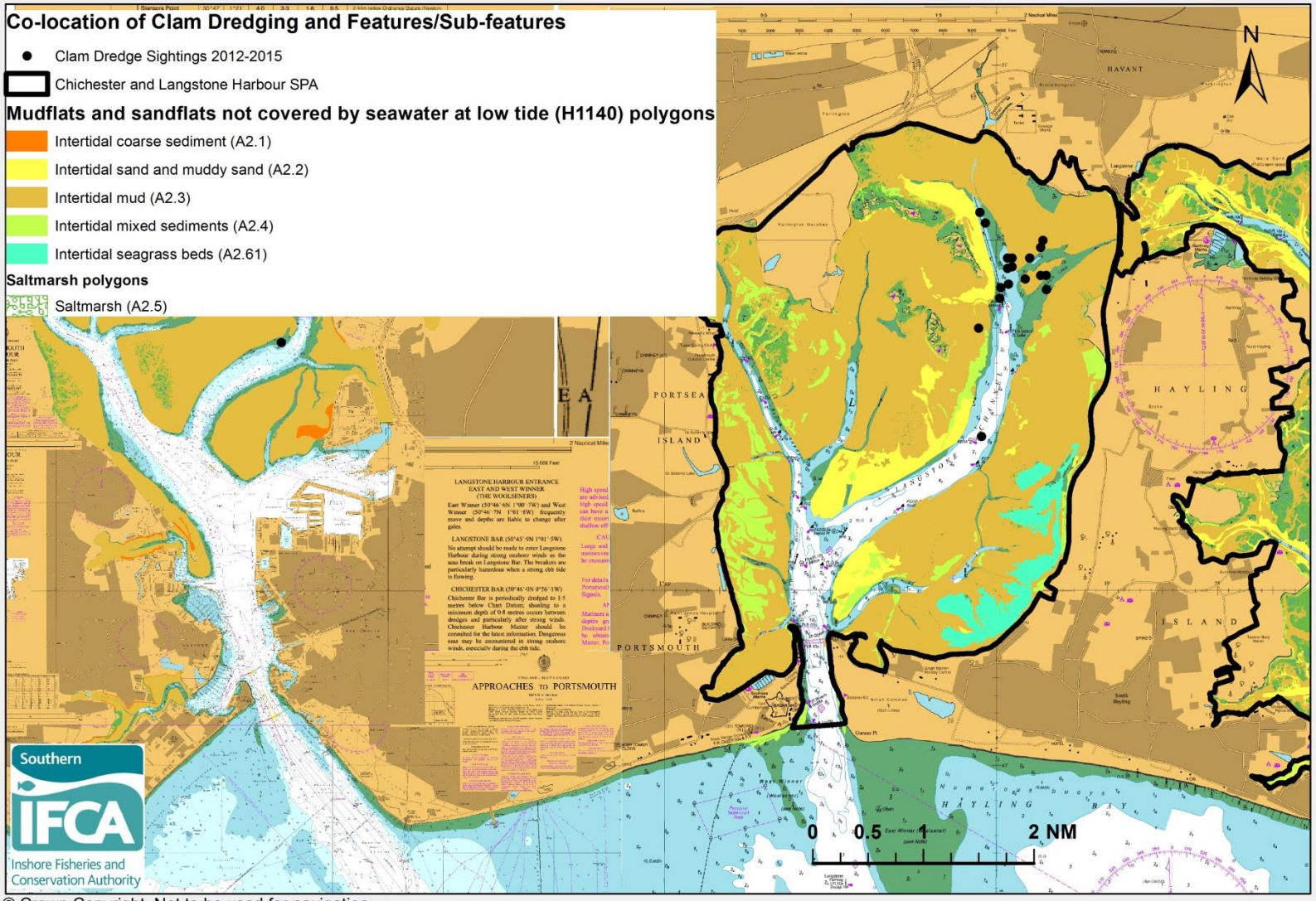
Annex 6: Map of Tern Feeding Areas with Langstone Harbour. Source: Natural England, 2015

SIFCA Reference: SIFCA/HRA/09/003



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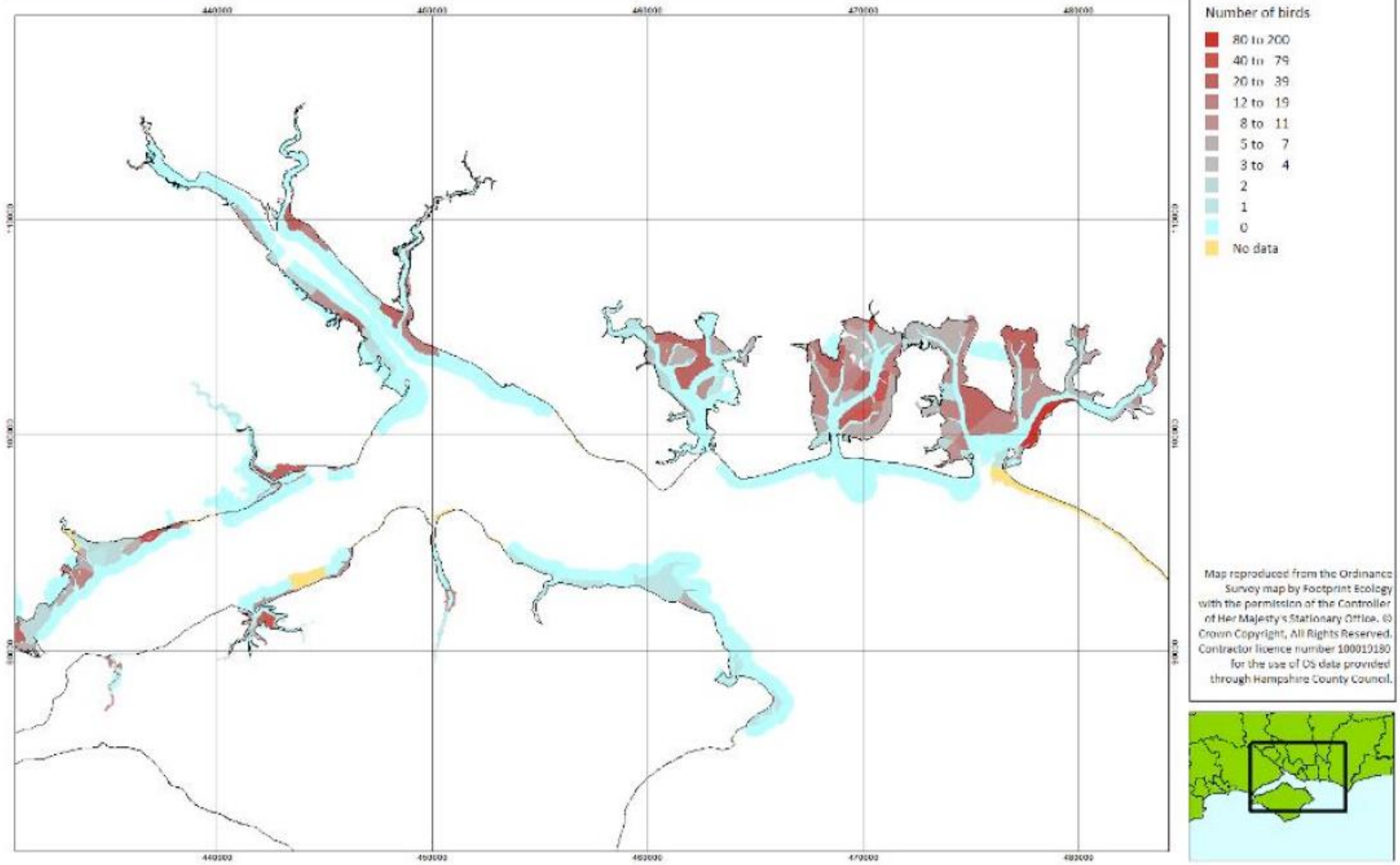
Annex 7: Low tide WeBS data distribution maps for Grey plover, Dunlin, Redshank, Dark-bellied brent goose, Shelduck, Teal, Ringed plover, Curlew, Turnstone, Wigeon, Pintail and Shoveler in the Solent taken from Stillman *et al*., (2009).

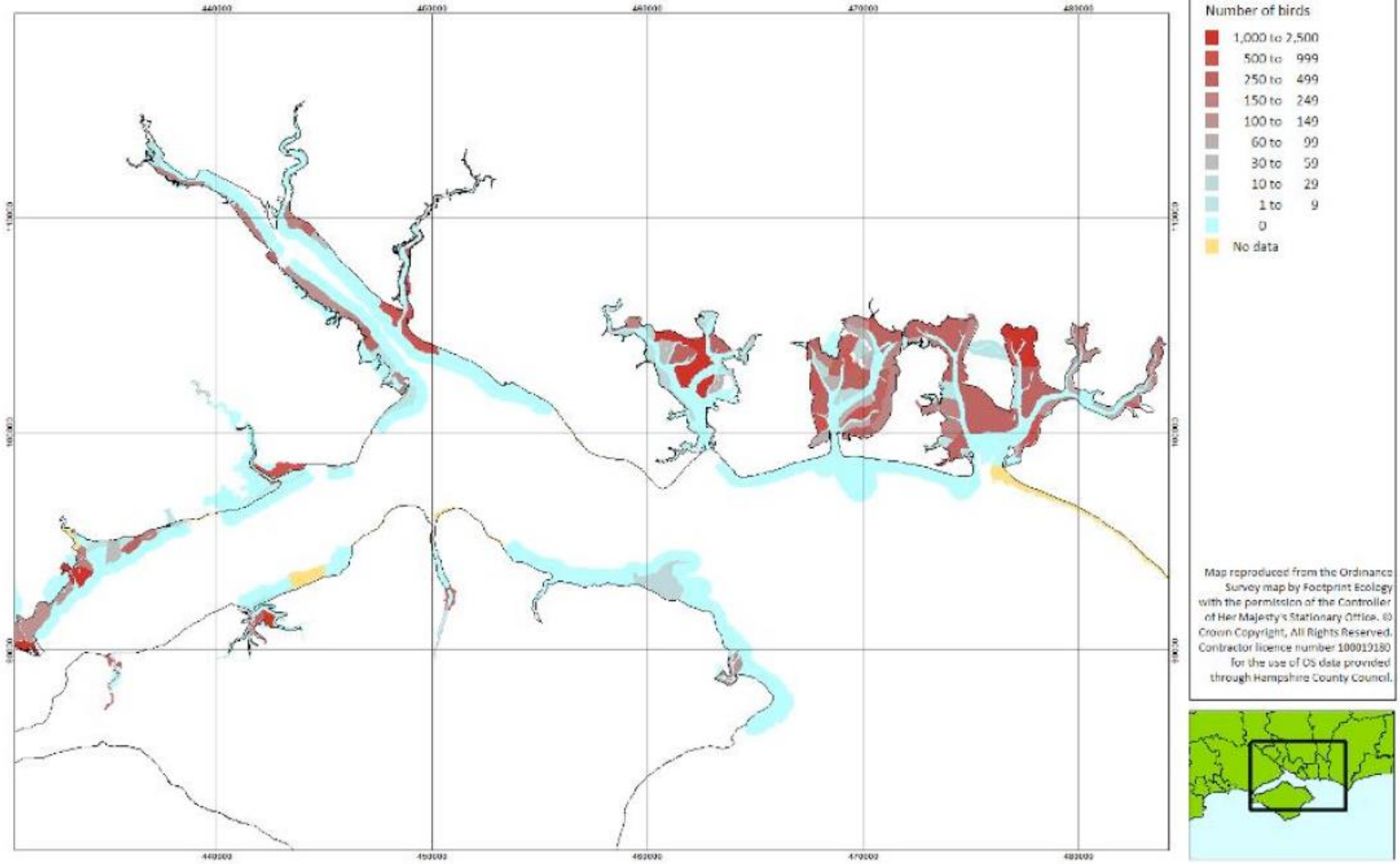
Map 20: Low tide WeBS data for grey plover

Solent disturbance and mitigation project: Phase I



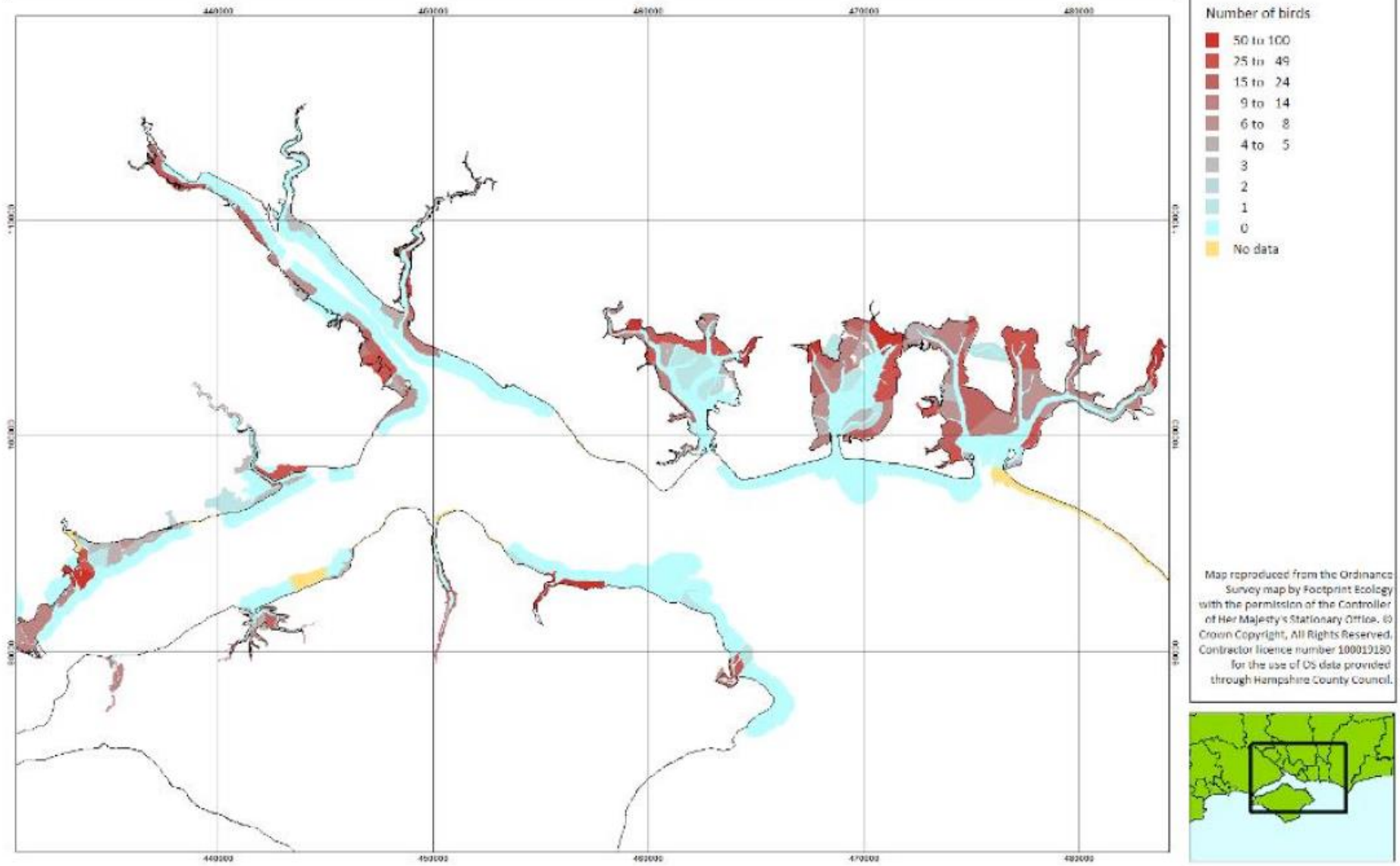
Map 22: Low tide WeBS data for dunlin

Solent disturbance and mitigation project: Phase I



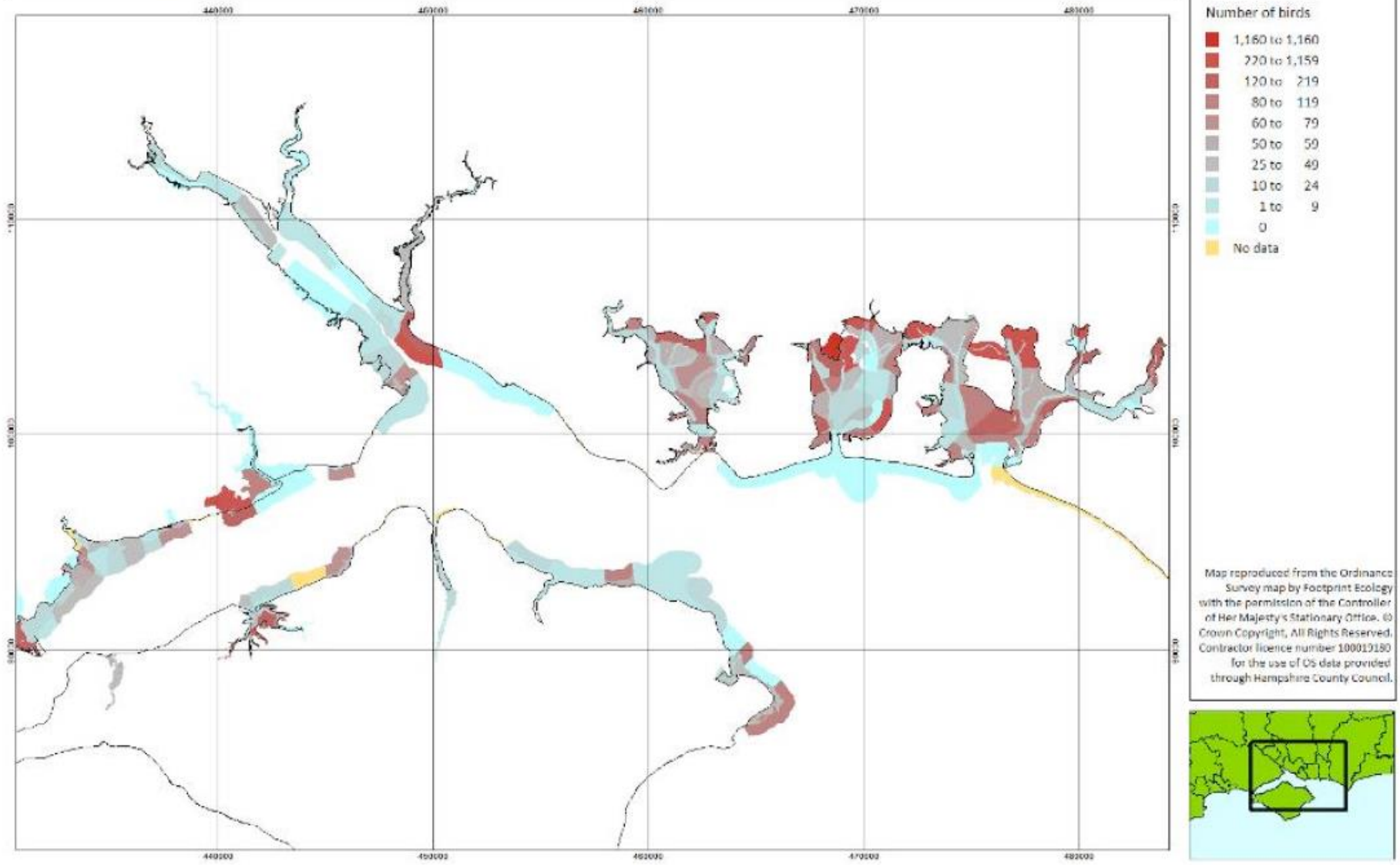
Map 25: Low tide WeBS data for redshank

Solent disturbance and mitigation project: Phase I



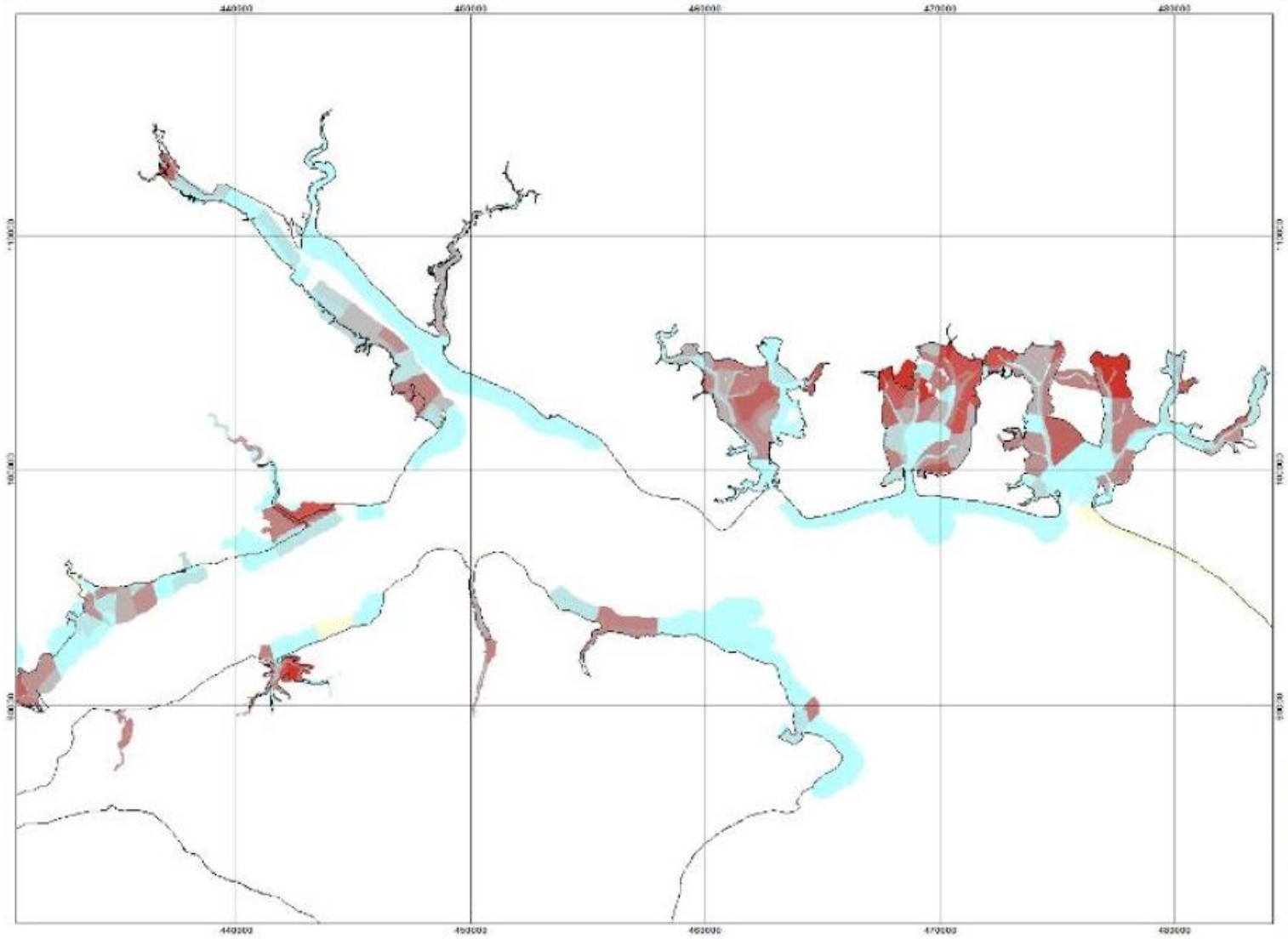
Map 13: Low tide WeBS data for dark-bellied brent goose

Solent disturbance and mitigation project: Phase I



Map 14: Low tide WeBS data for shelduck

Solent disturbance and mitigation project: Phase I



25 November 2008

Scale 1:228500

Number of birds

- 45 to 120
- 25 to 44
- 15 to 24
- 8 to 14
- 5 to 7
- 4
- 3
- 2
- 1
- 0
- No data

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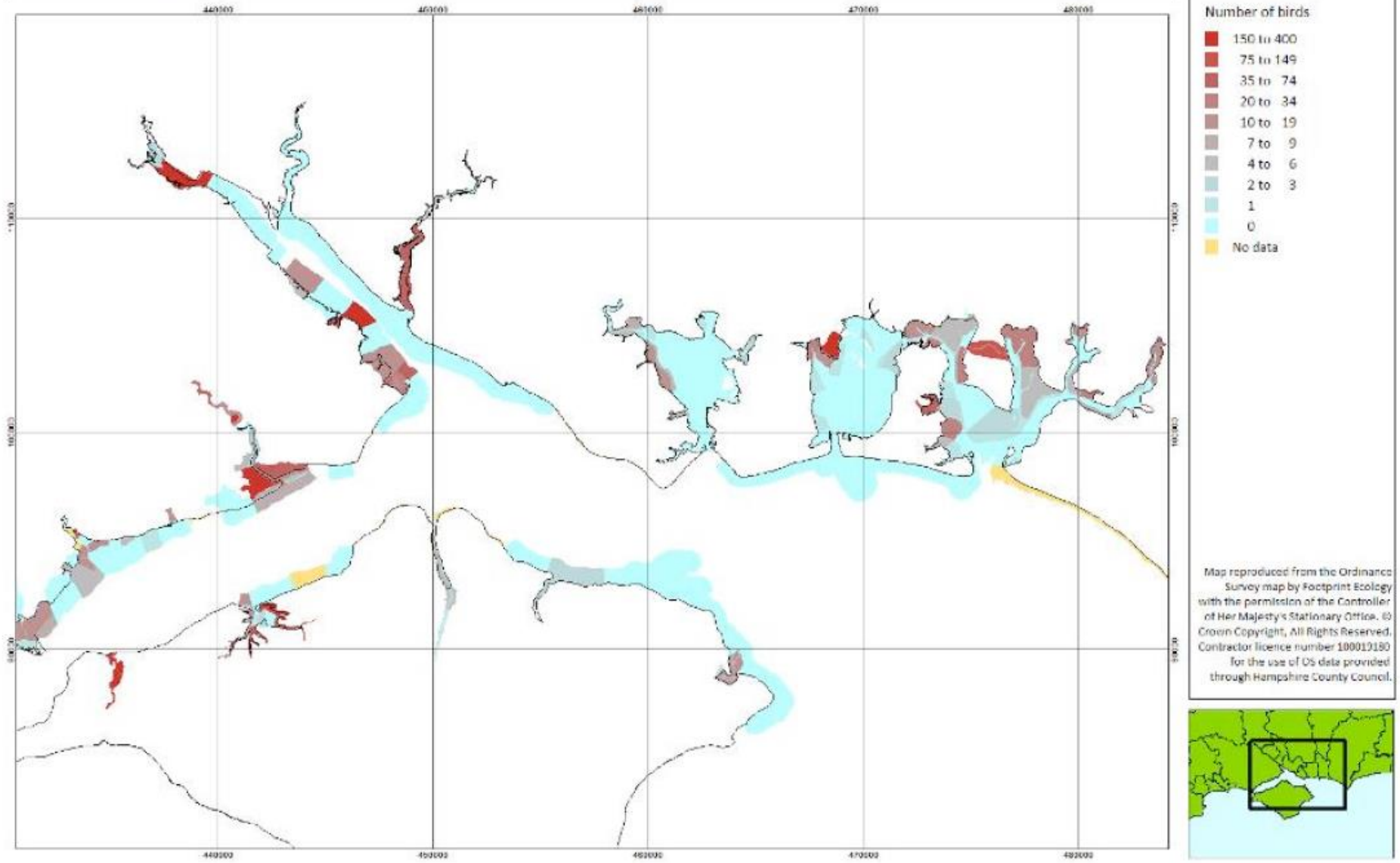
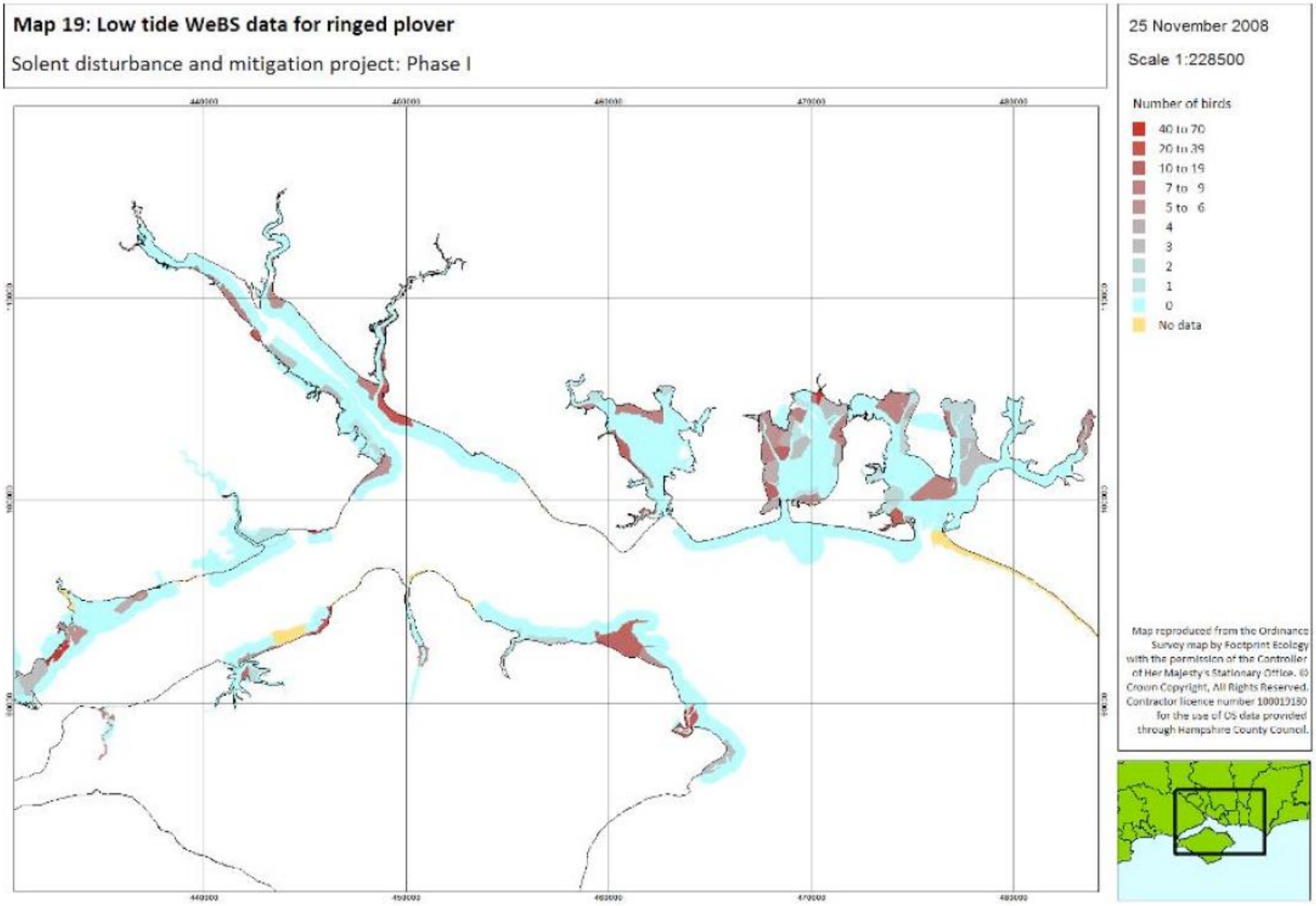
Map 16: Low tide WeBS data for teal

Solent disturbance and mitigation project: Phase I




Map 19: Low tide WeBS data for ringed plover
Solent disturbance and mitigation project: Phase I
25 November 2008
Scale 1:228500
Number of birds
40 to 70
20 to 39
10 to 19
7 to 9
5 to 6
4
3
2
1
0
No data
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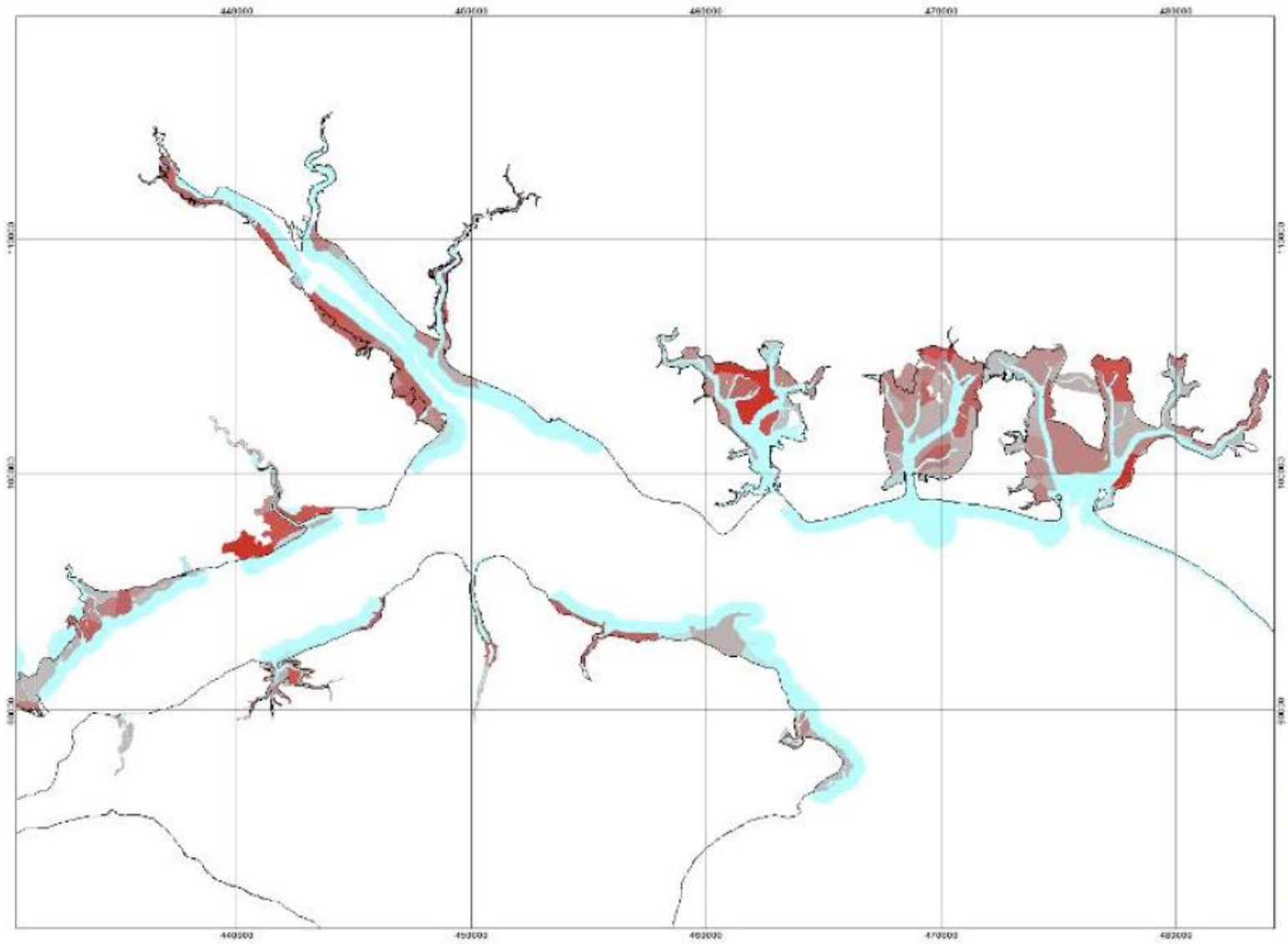
Map 24: Low tide WeBS data for curlew

Solent disturbance and mitigation project: Phase I



25 November 2008

Scale 1:228500

Number of birds

- 60 to 110
- 40 to 59
- 20 to 39
- 12 to 19
- 8 to 11
- 5 to 7
- 3 to 4
- 2
- 1
- 0

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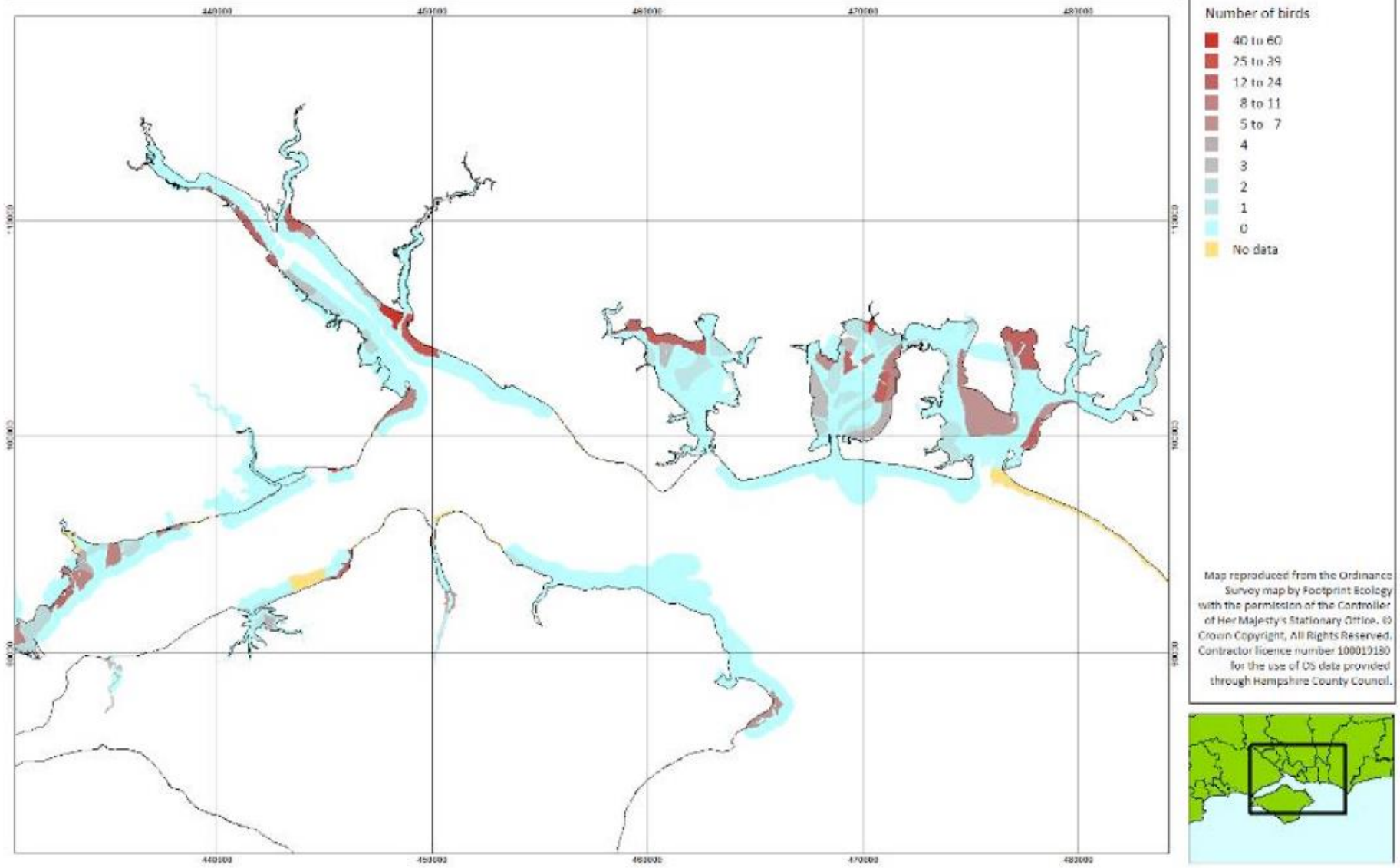
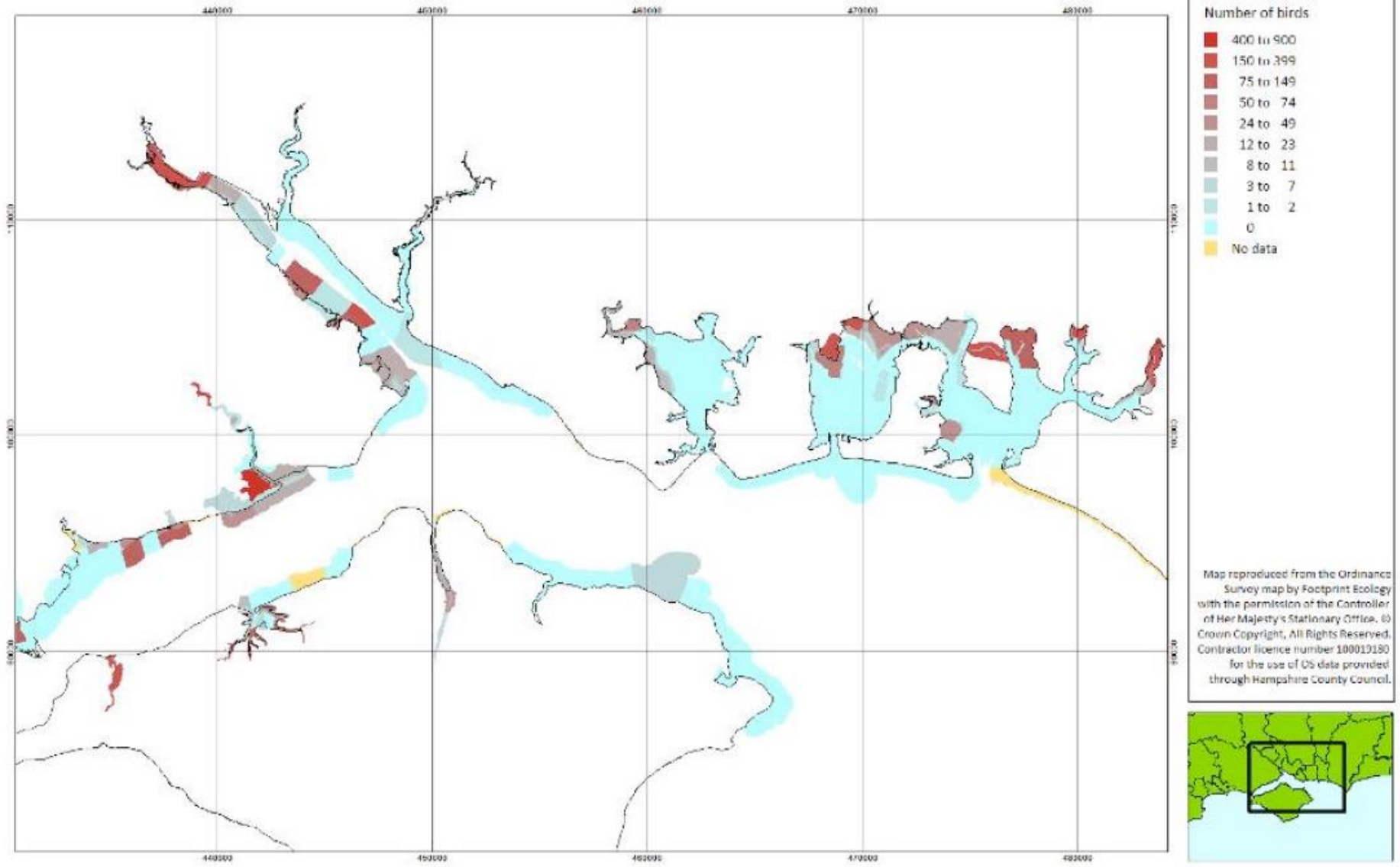
Map 26: Low tide WeBS data for turnstone

Solent disturbance and mitigation project: Phase I



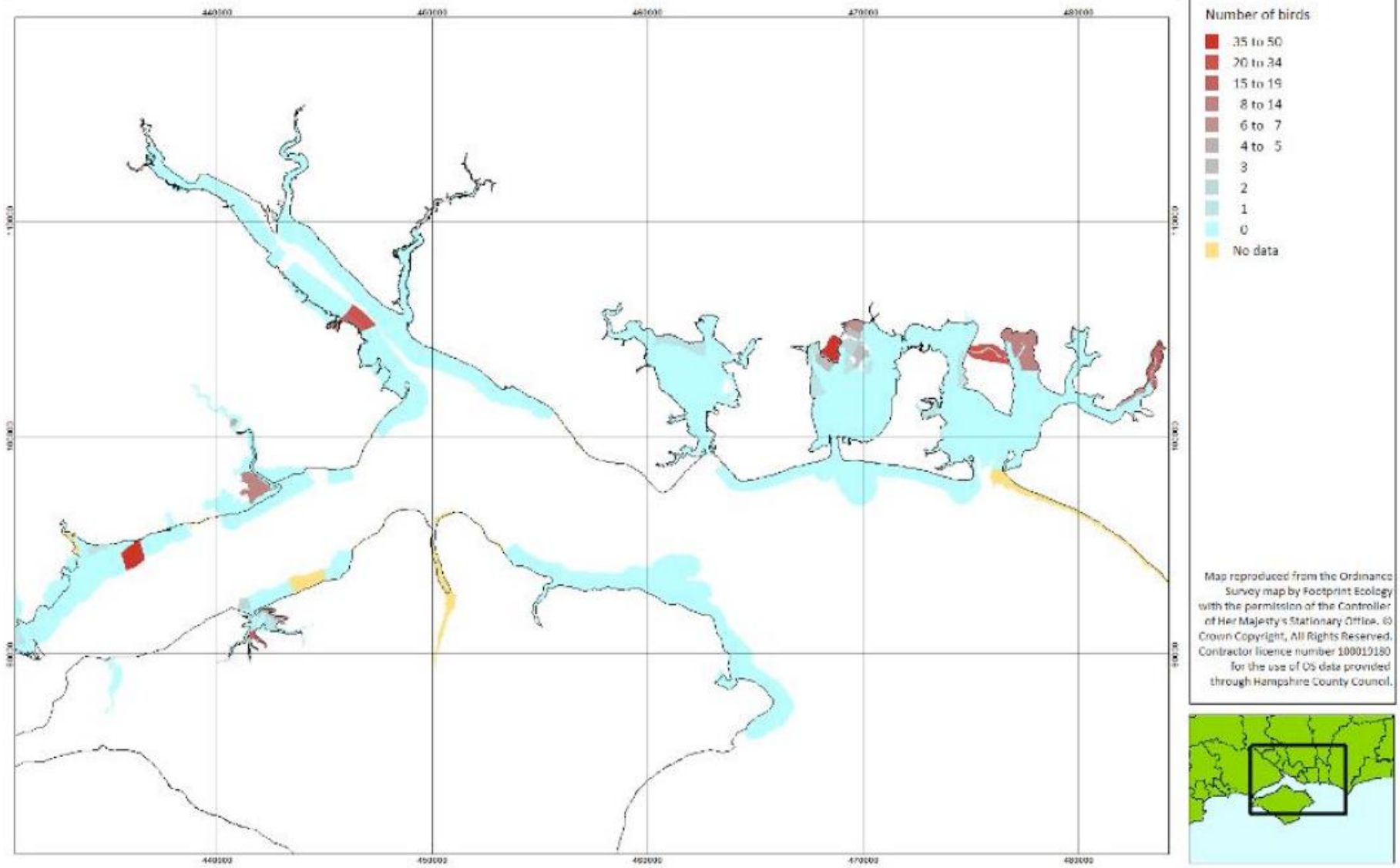
Map 15: Low tide WeBS data for wigeon

Solent disturbance and mitigation project: Phase I



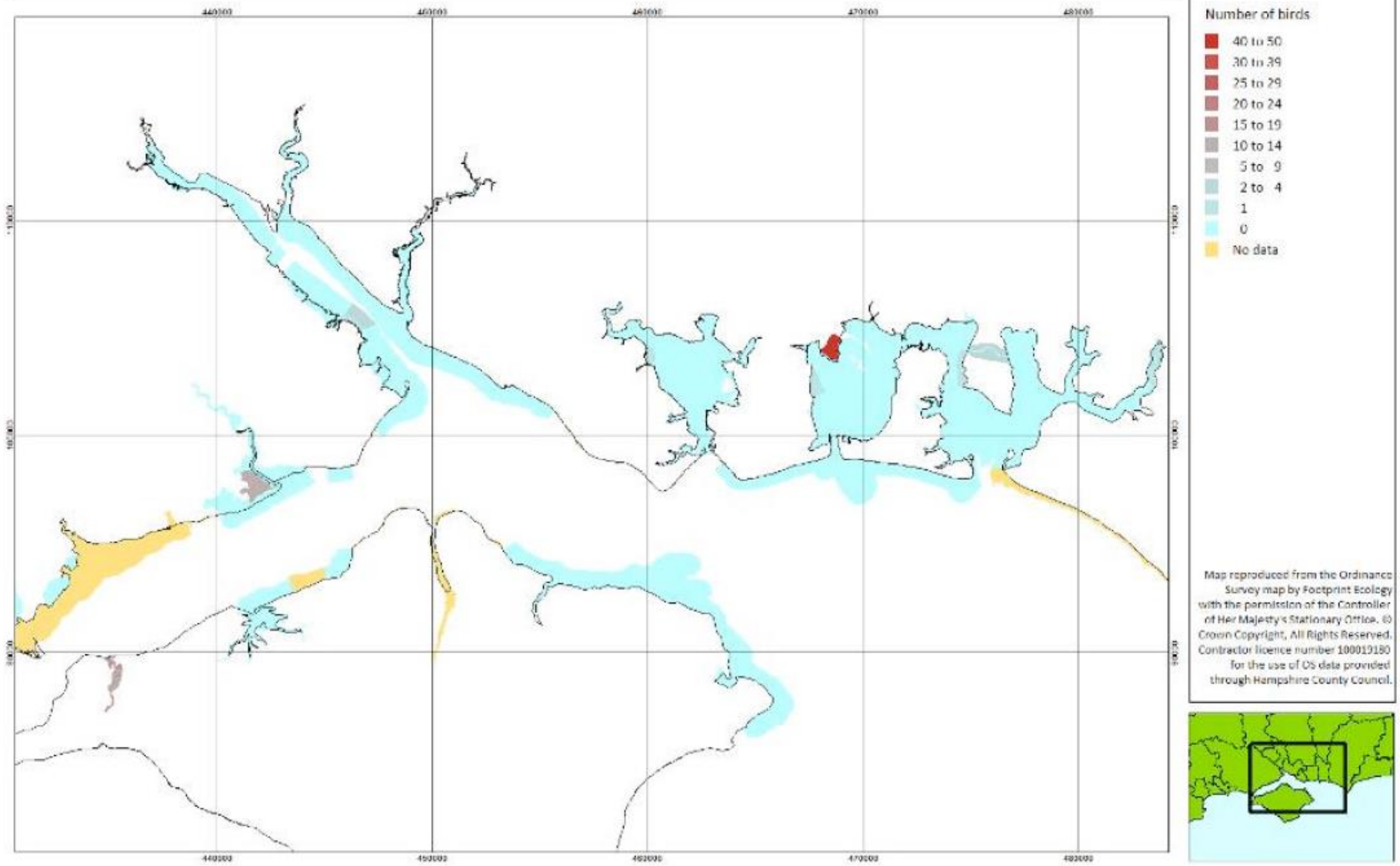
Map 17: Low tide WeBS data for pintail

Solent disturbance and mitigation project: Phase I

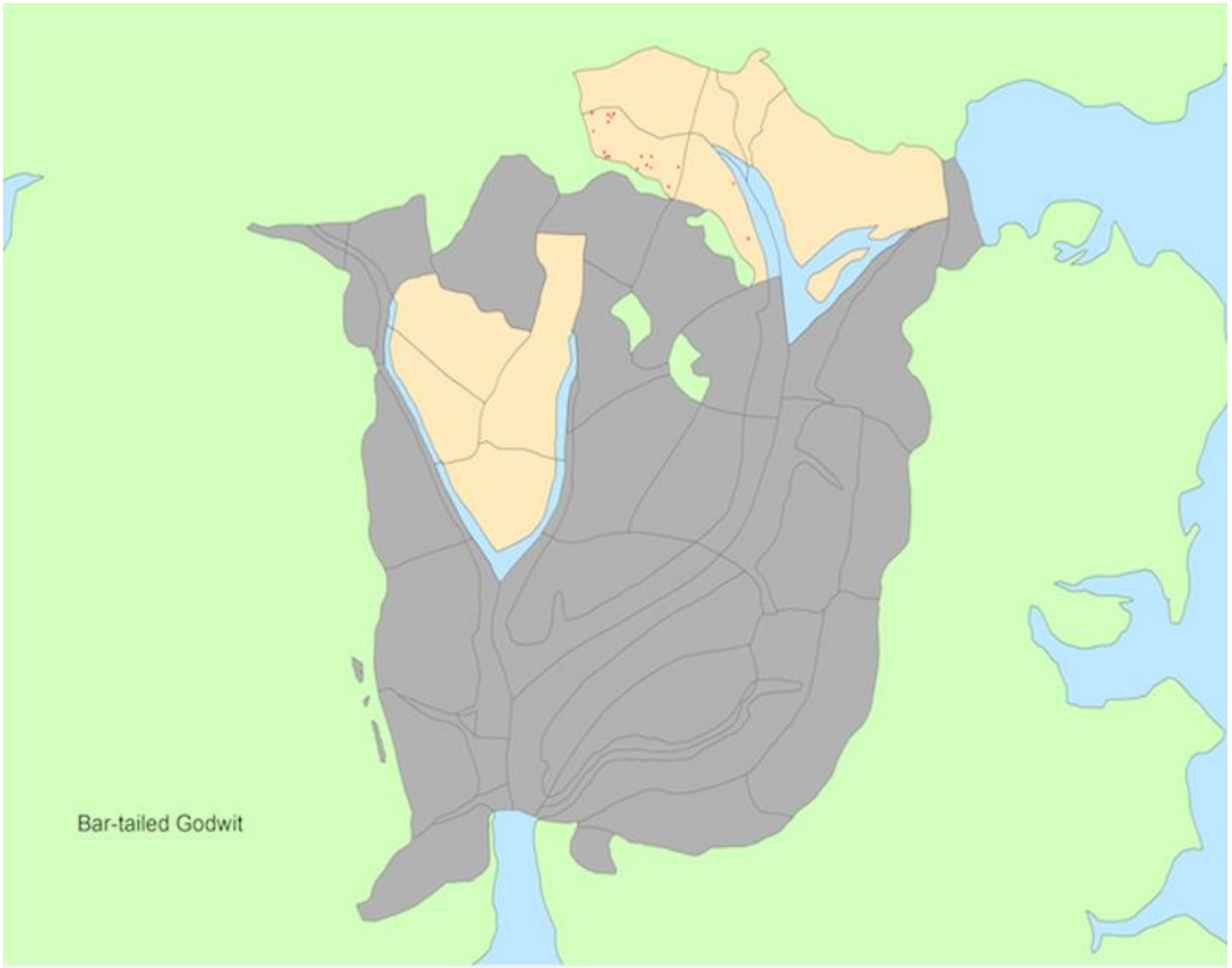


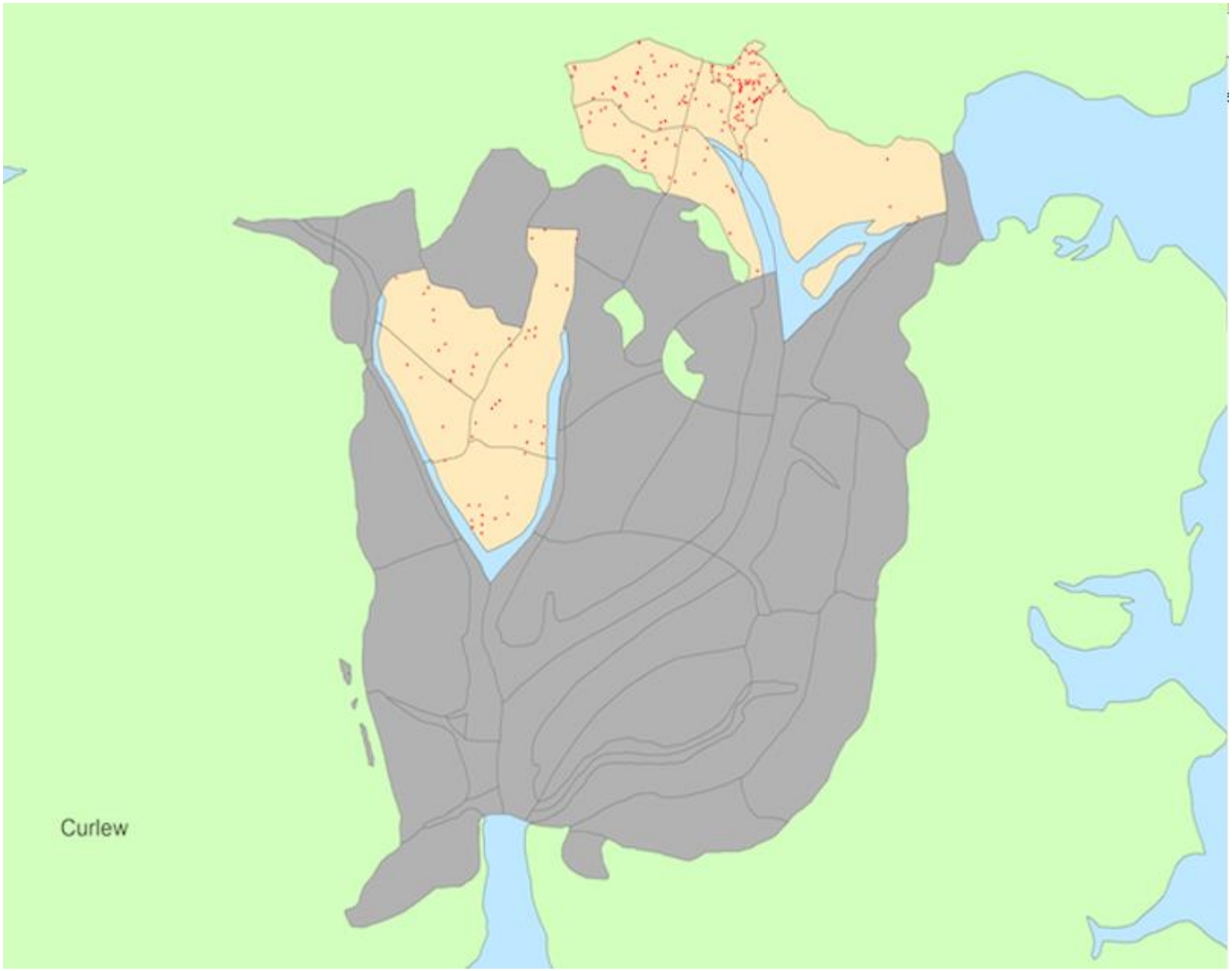
Map 18: Low tide WeBS data for shoveler

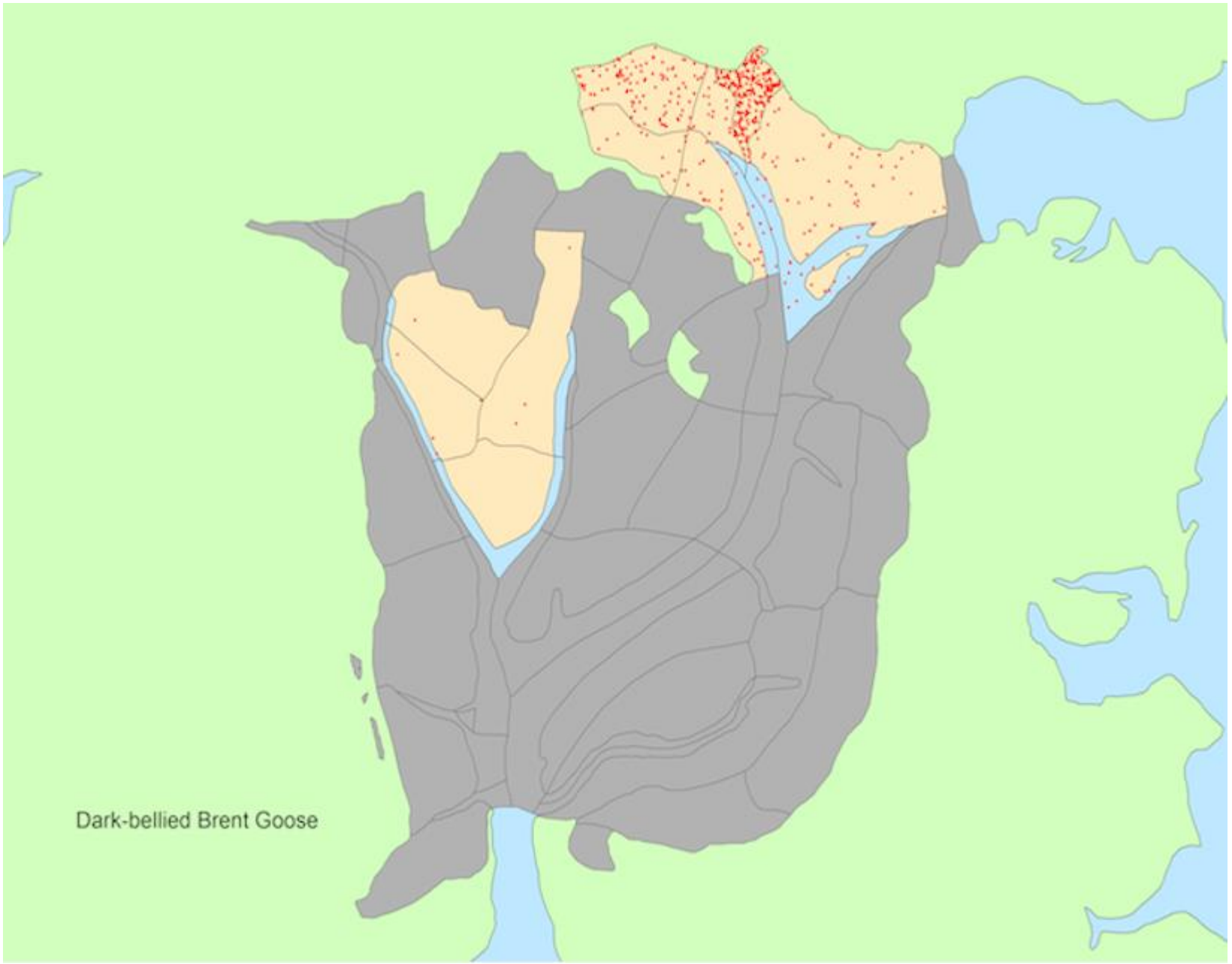
Solent disturbance and mitigation project: Phase I

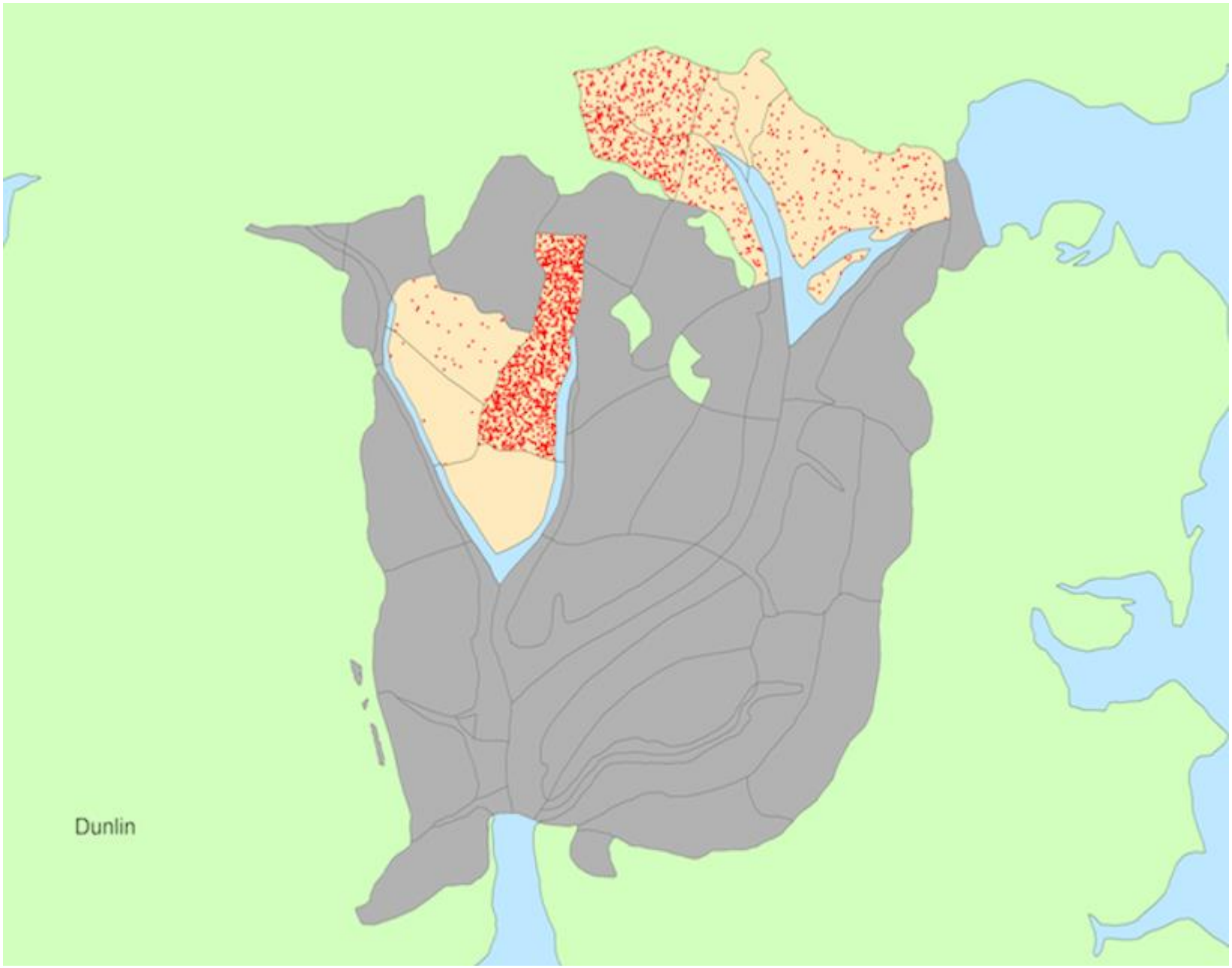


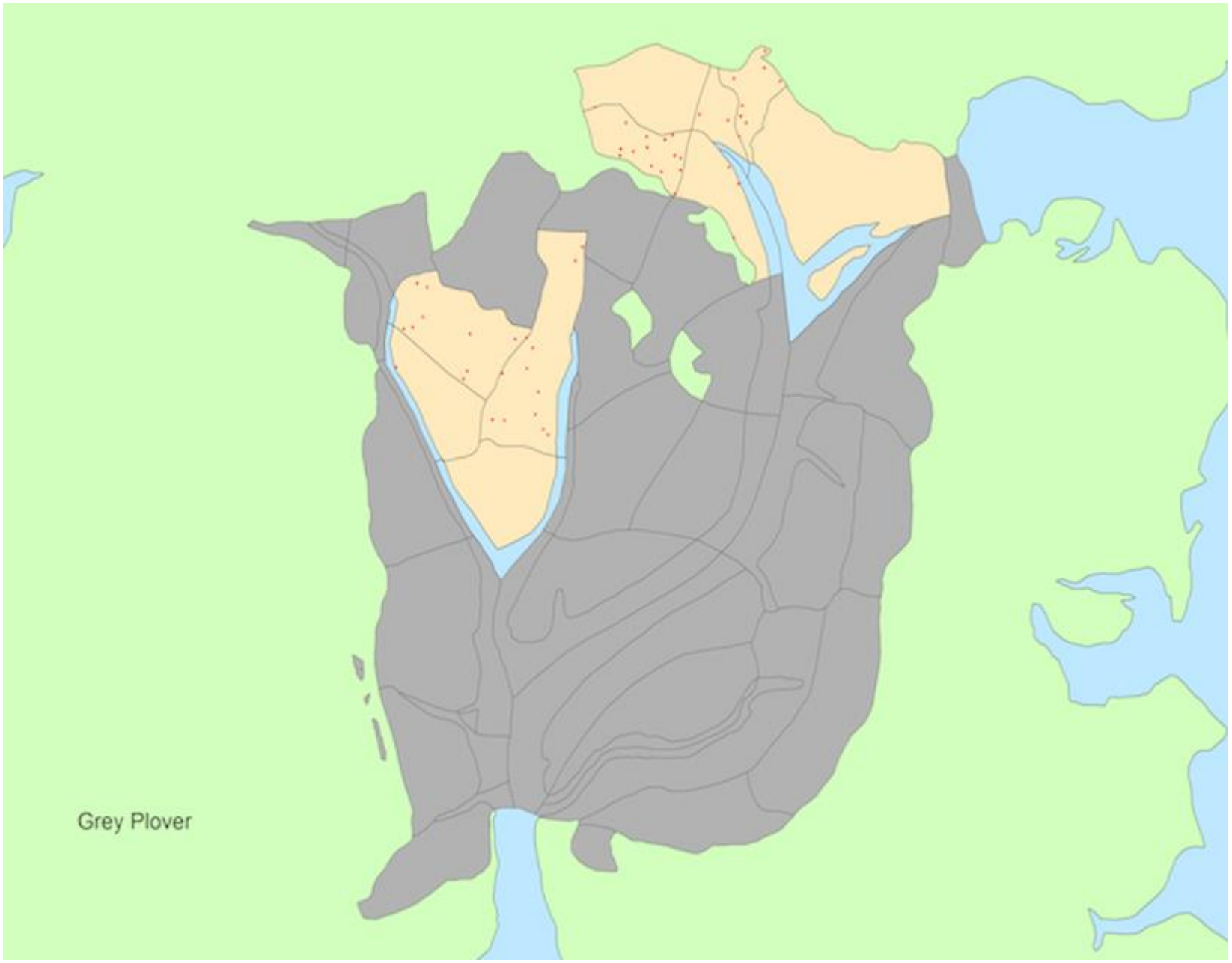
Annex 8: WeBS Low Tide Count (LTC) scheme point data distribution maps from 2013/14 for Grey plover, Bar-tailed godwit, Dunlin, Redshank, Dark-bellied Brent goose, Shelduck, Teal, Ringed plover, Curlew, Turnstone, Wigeon, and Pintail in key areas within Langstone Harbour. Taken from http://blx1.bto.org/webs-reporting/?tab=lowtide.


Bar-tailed Godwit

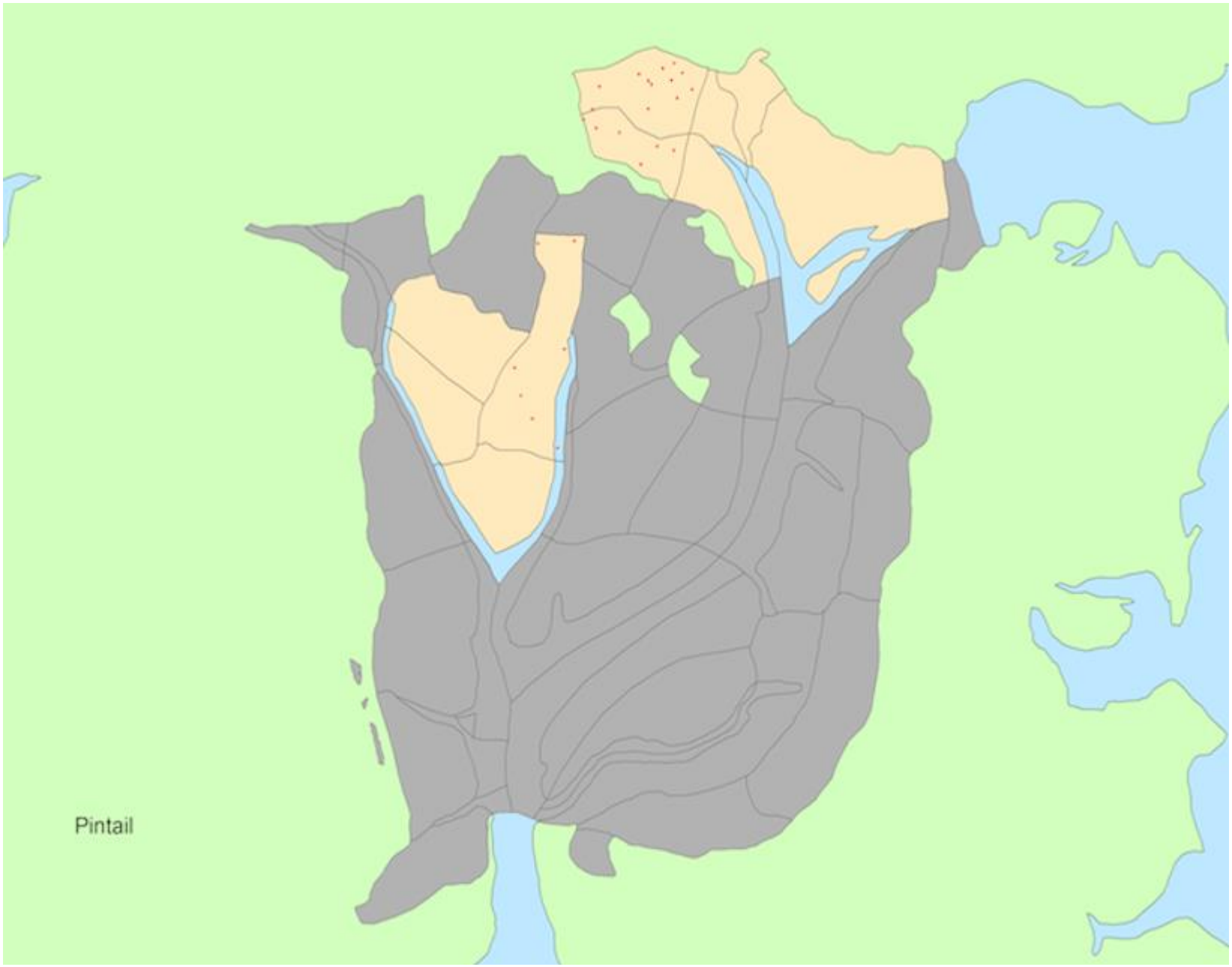

Curlew

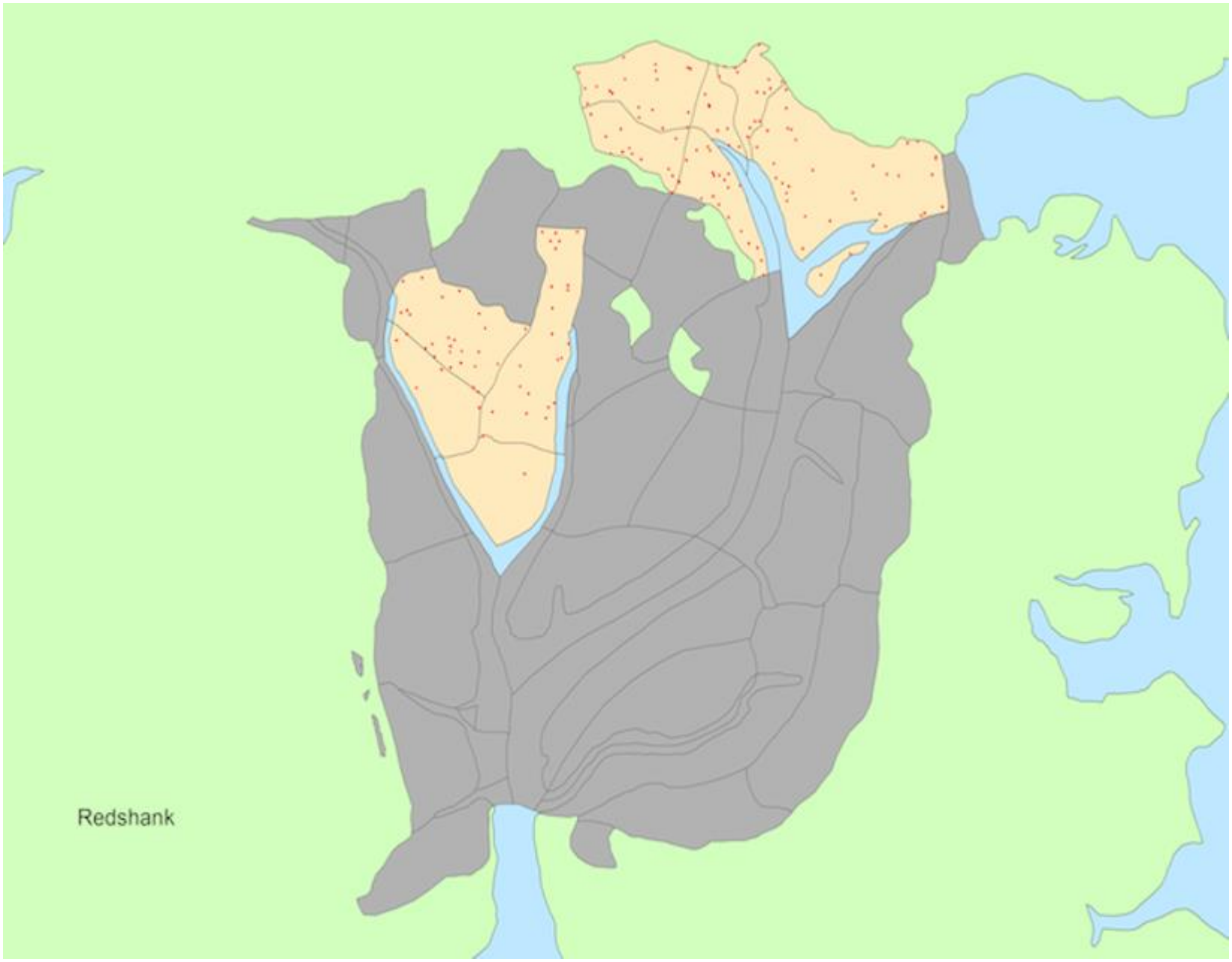

Dark-bellied Brent Goose

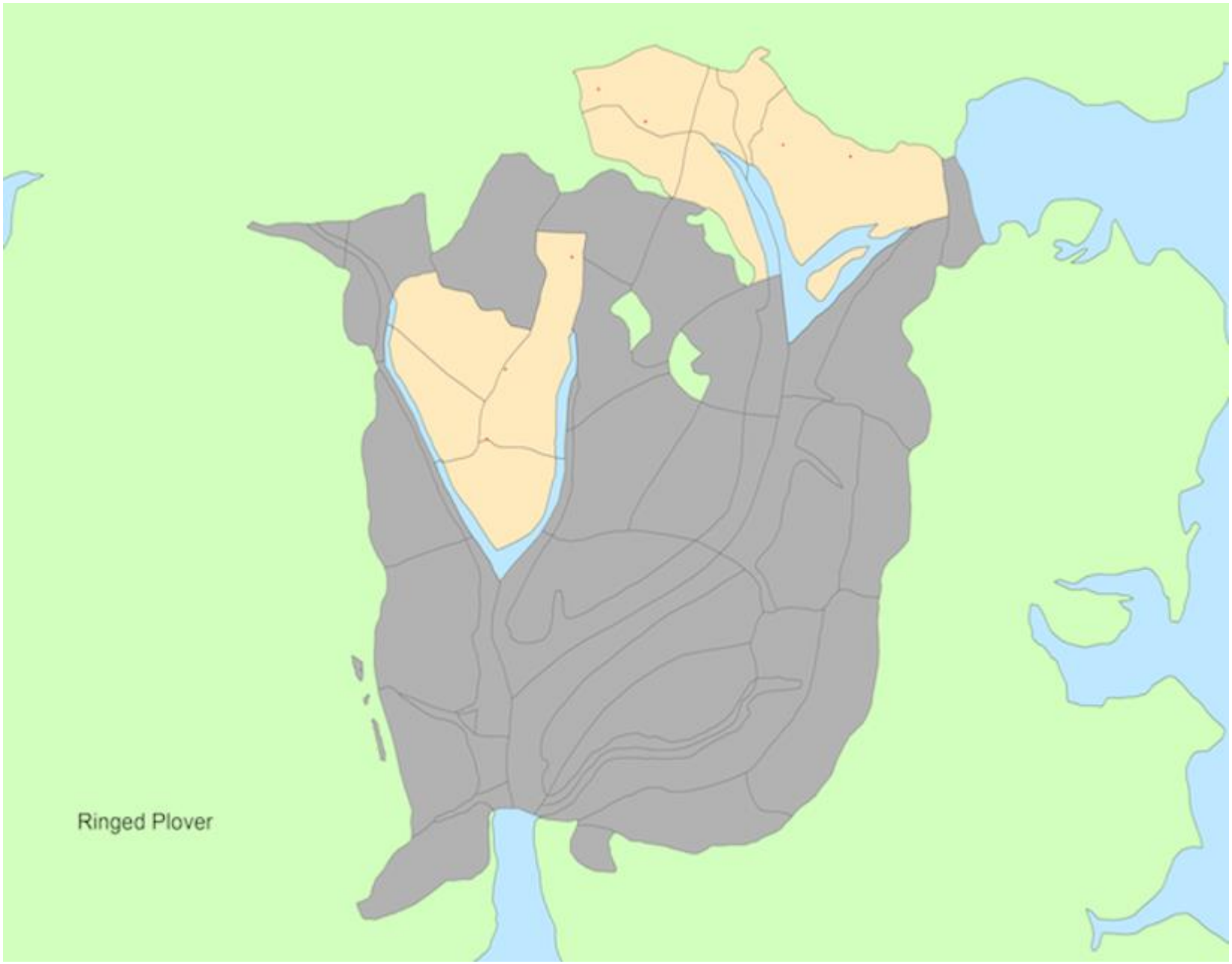

Dunlin

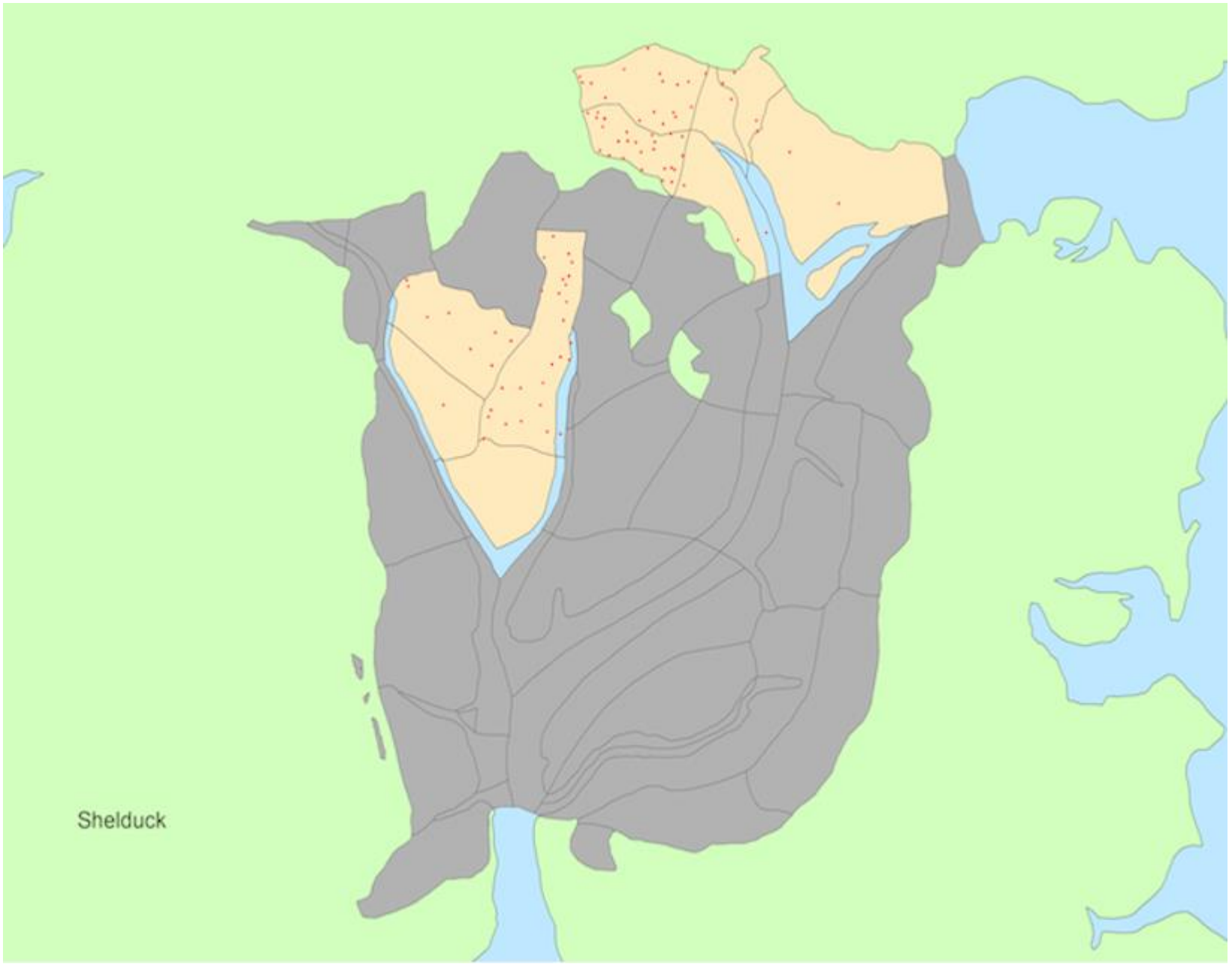


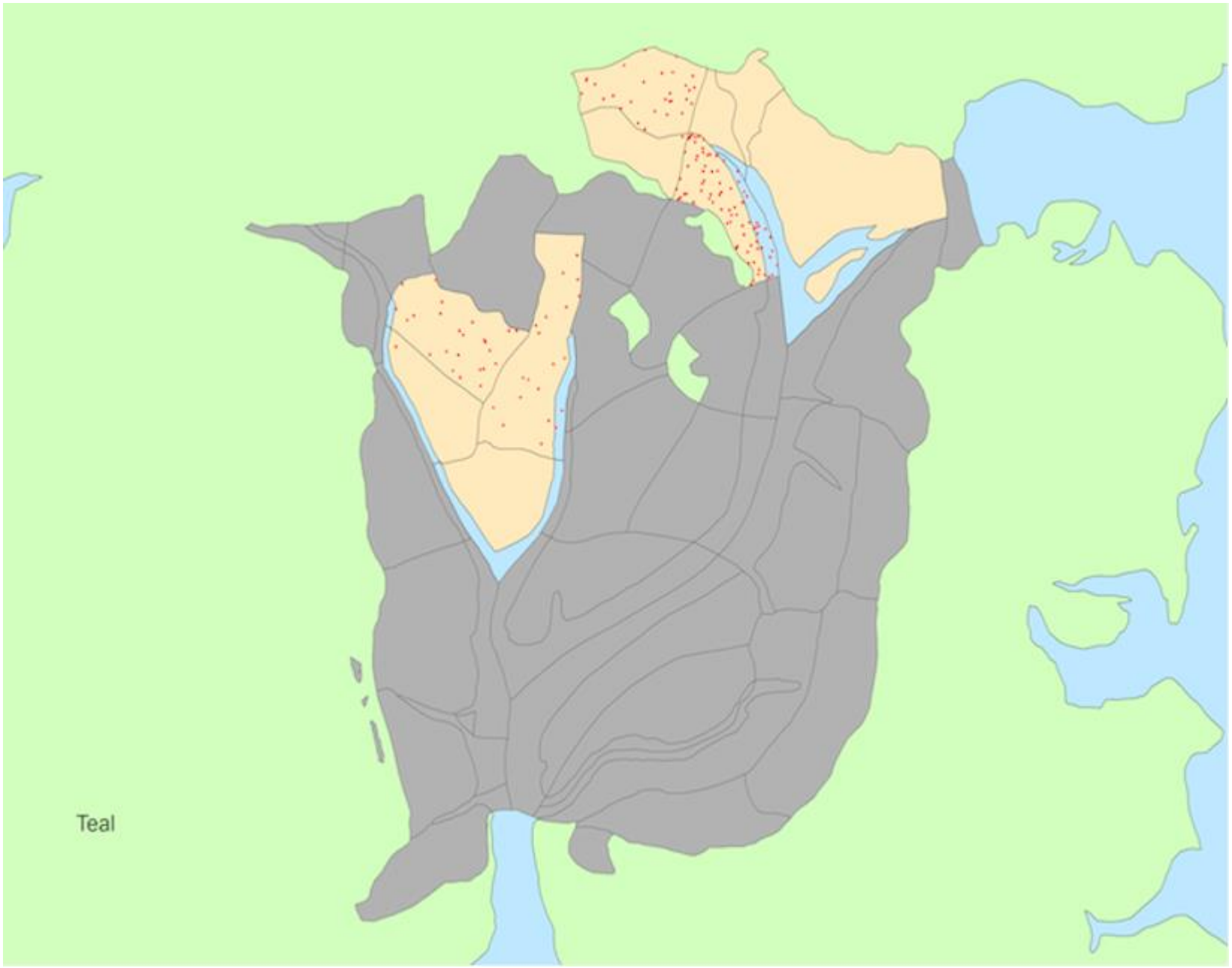
SIFCA Reference: SIFCA/HRA/09/003


Pintail


Redshank


Ringed Plover


Shelduck



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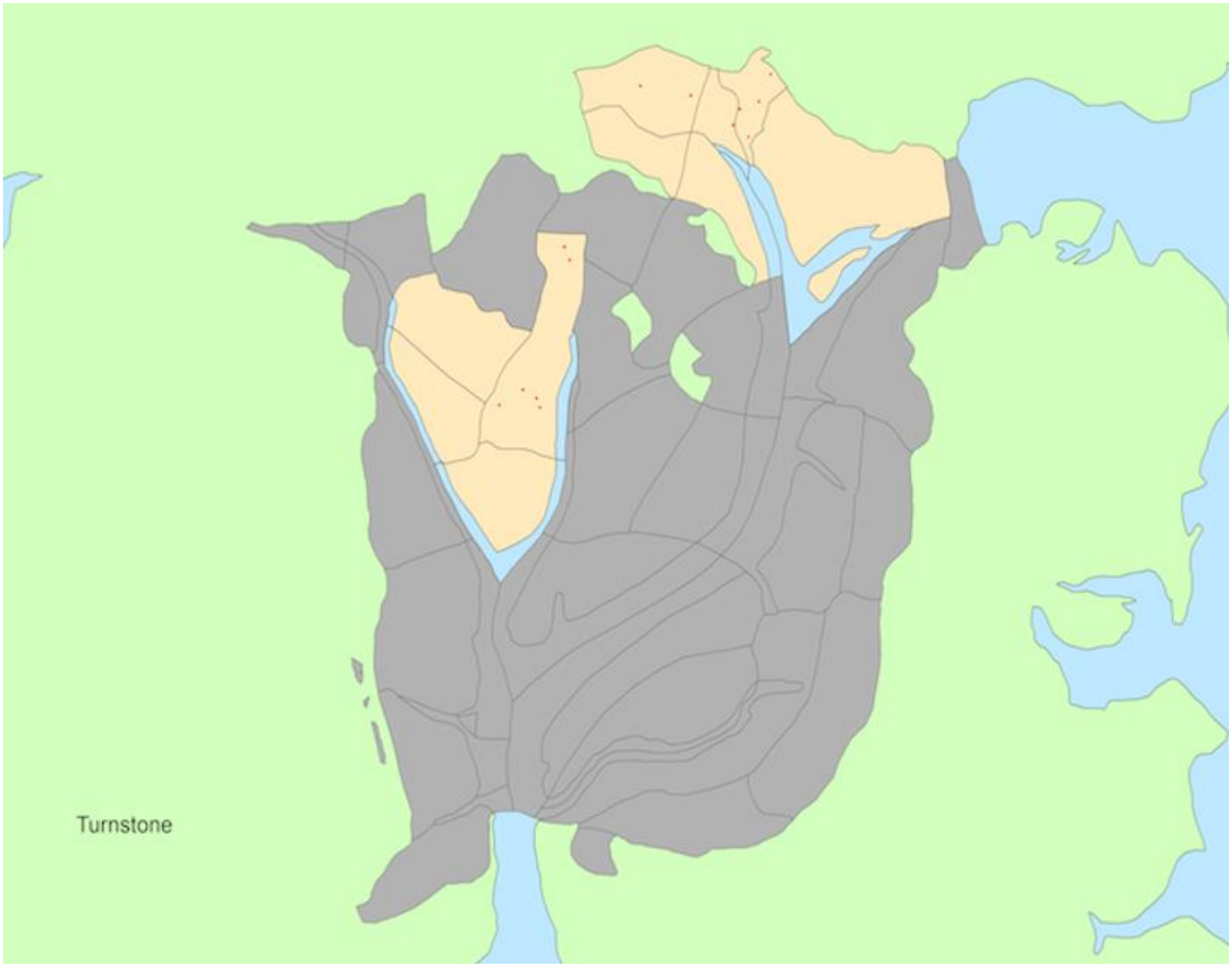

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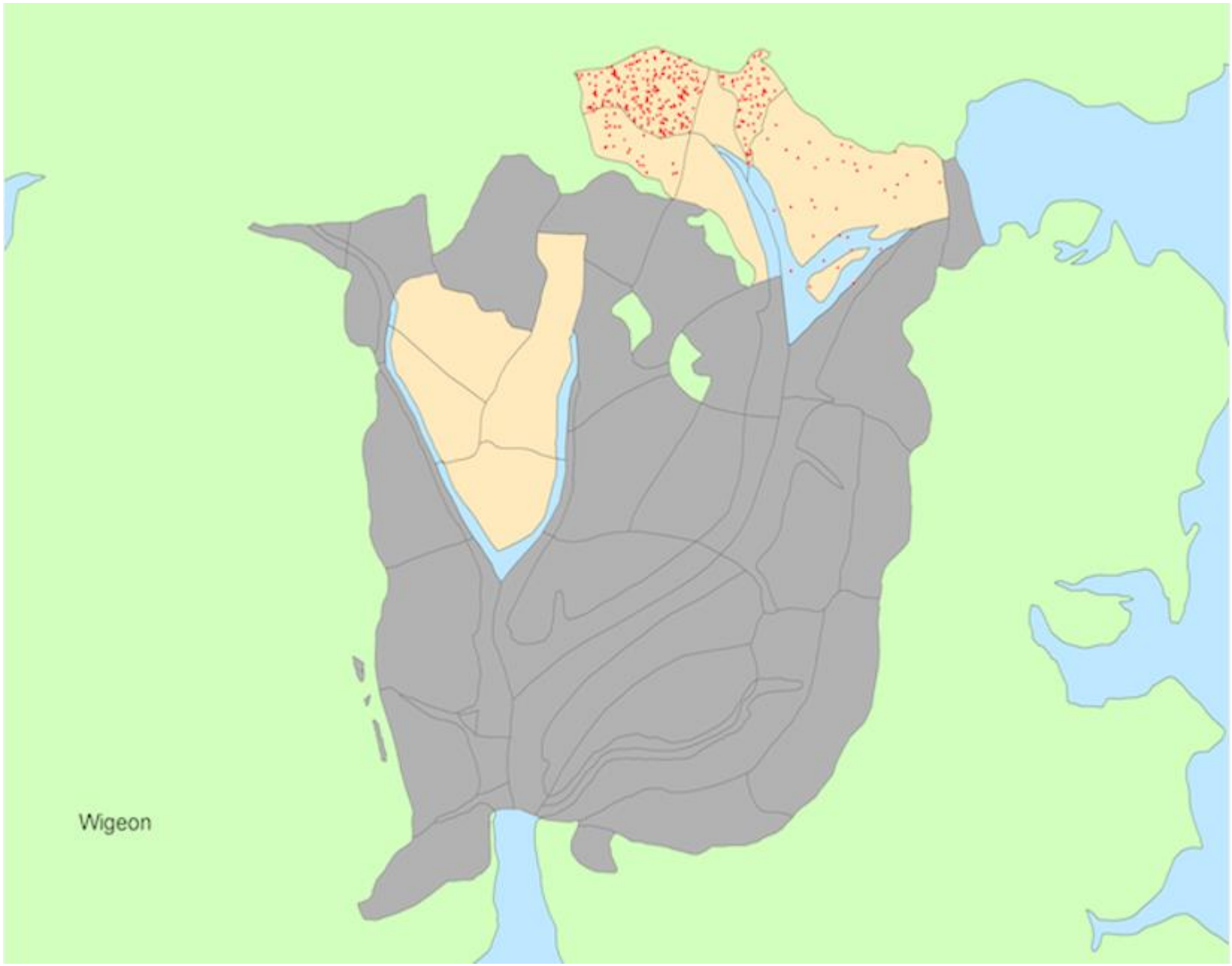
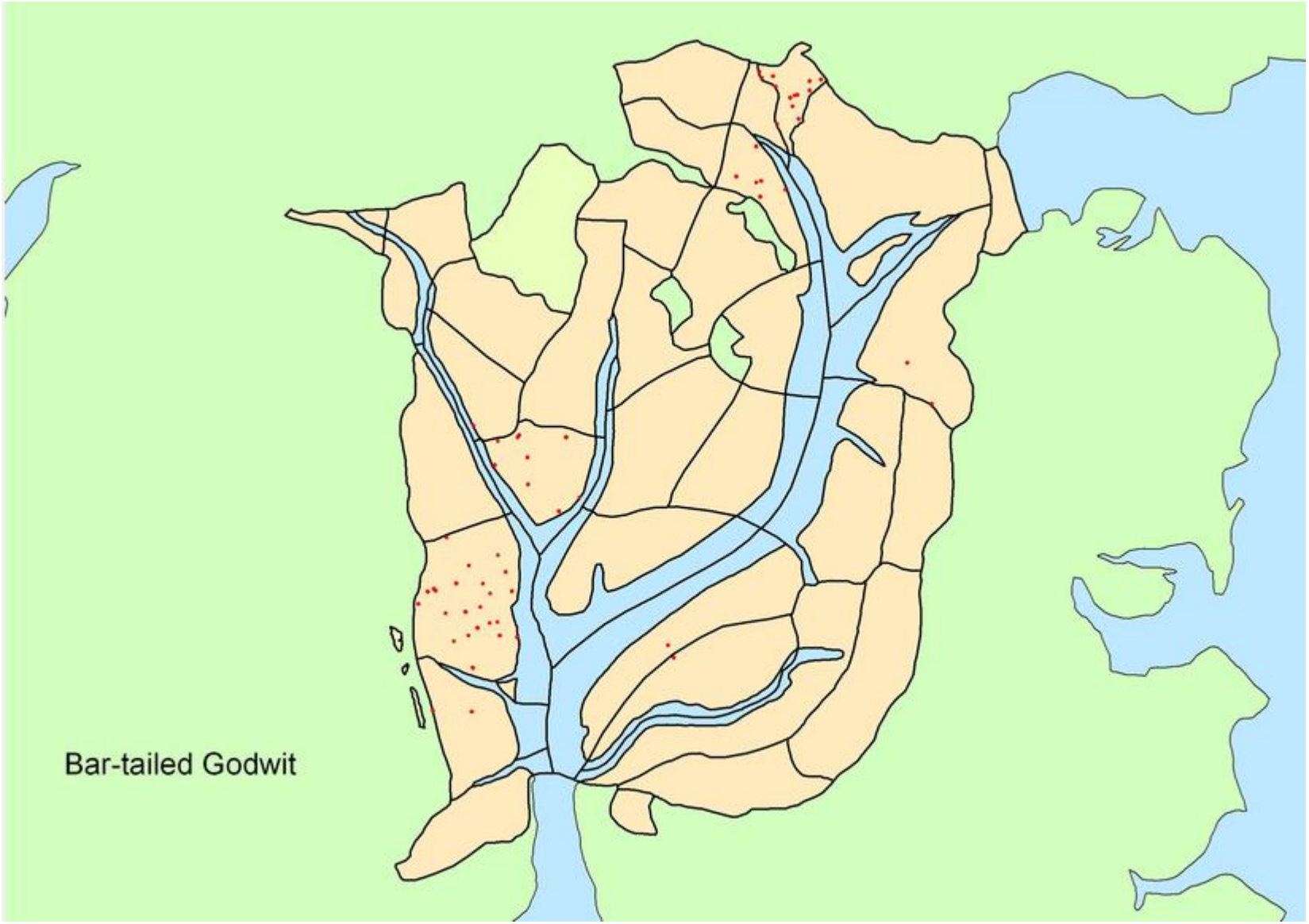
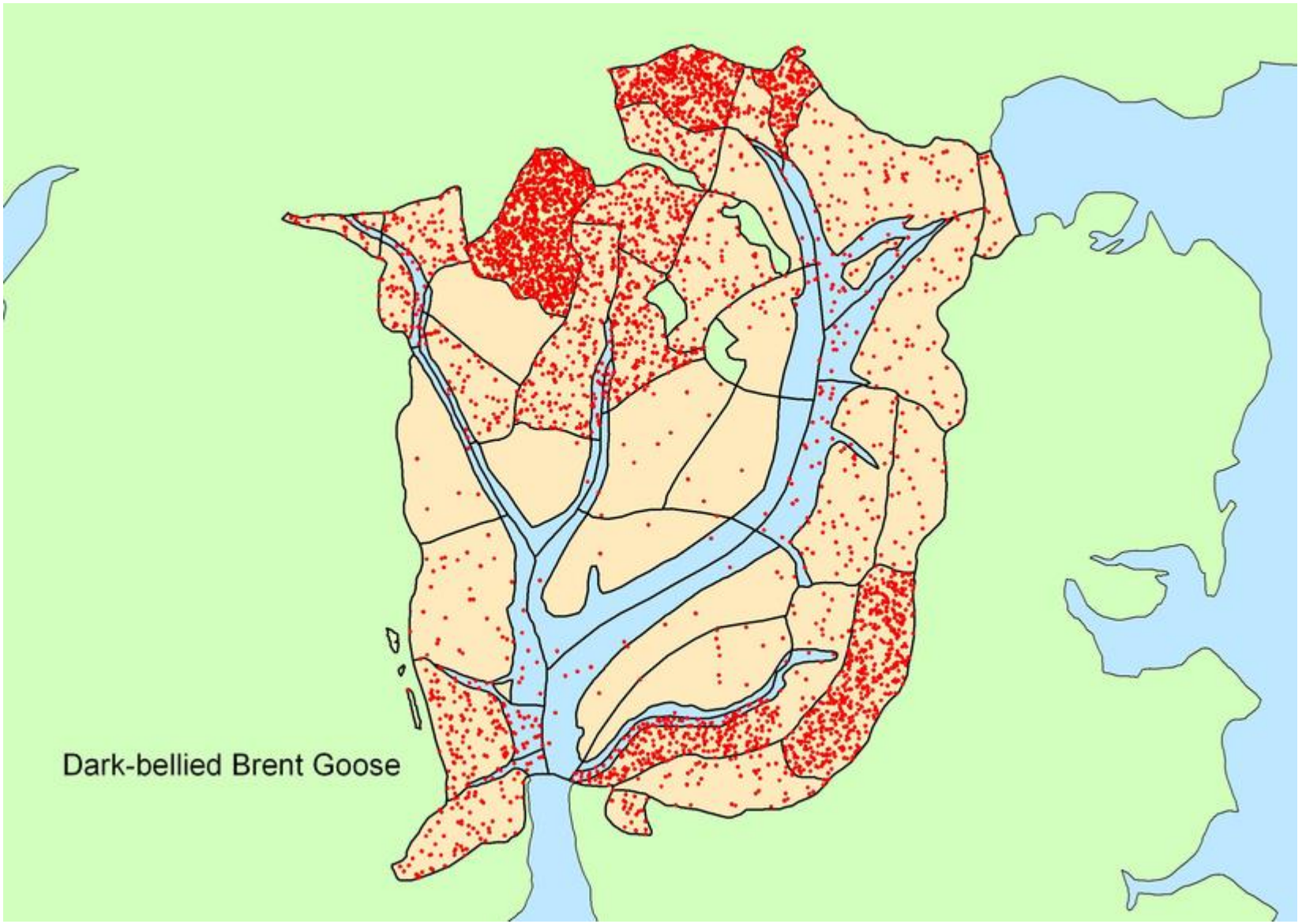
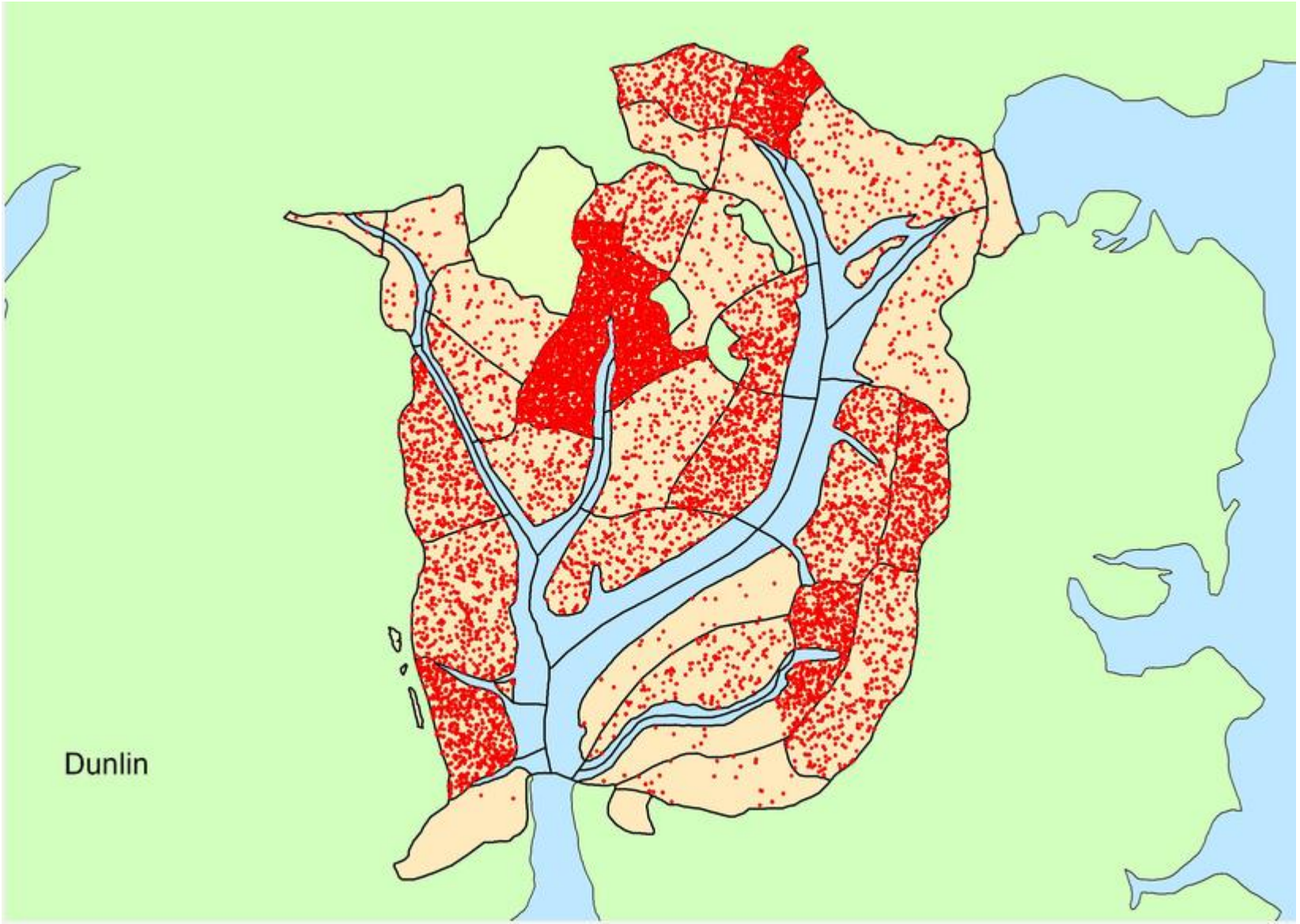

Wigeon

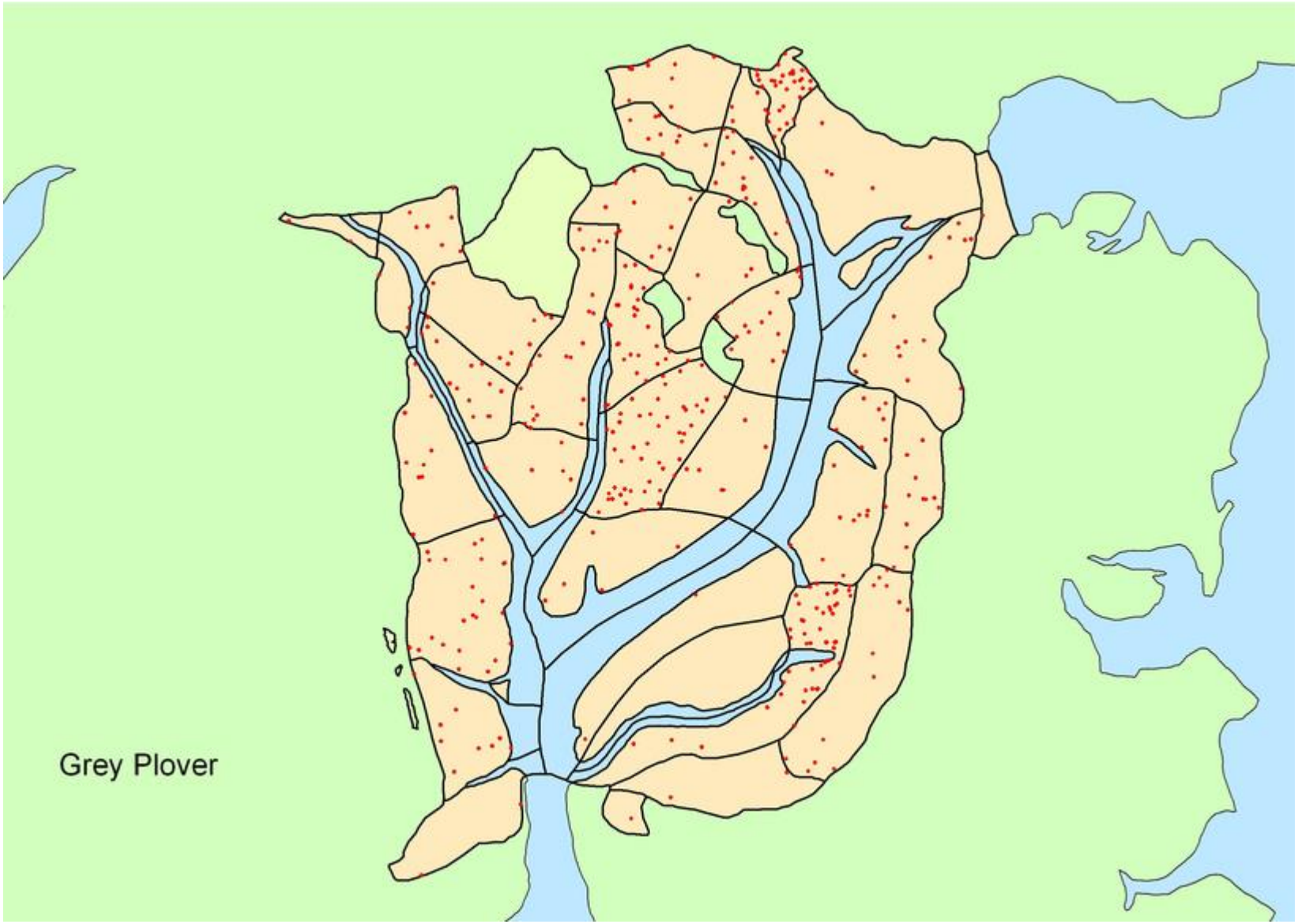
Annex 9: WeBS Low Tide Count (LTC) scheme point data distribution maps from 2009/10 for Grey plover, Bar-tailed godwit, Dunlin, Redshank, Dark-bellied Brent goose, Shelduck, Teal, Ringed plover, Curlew, Turnstone, Wigeon, and Pintail in the whole of Langstone Harbour. Taken from http://blx1.bto.org/webs-reporting/?tab=lowtide.

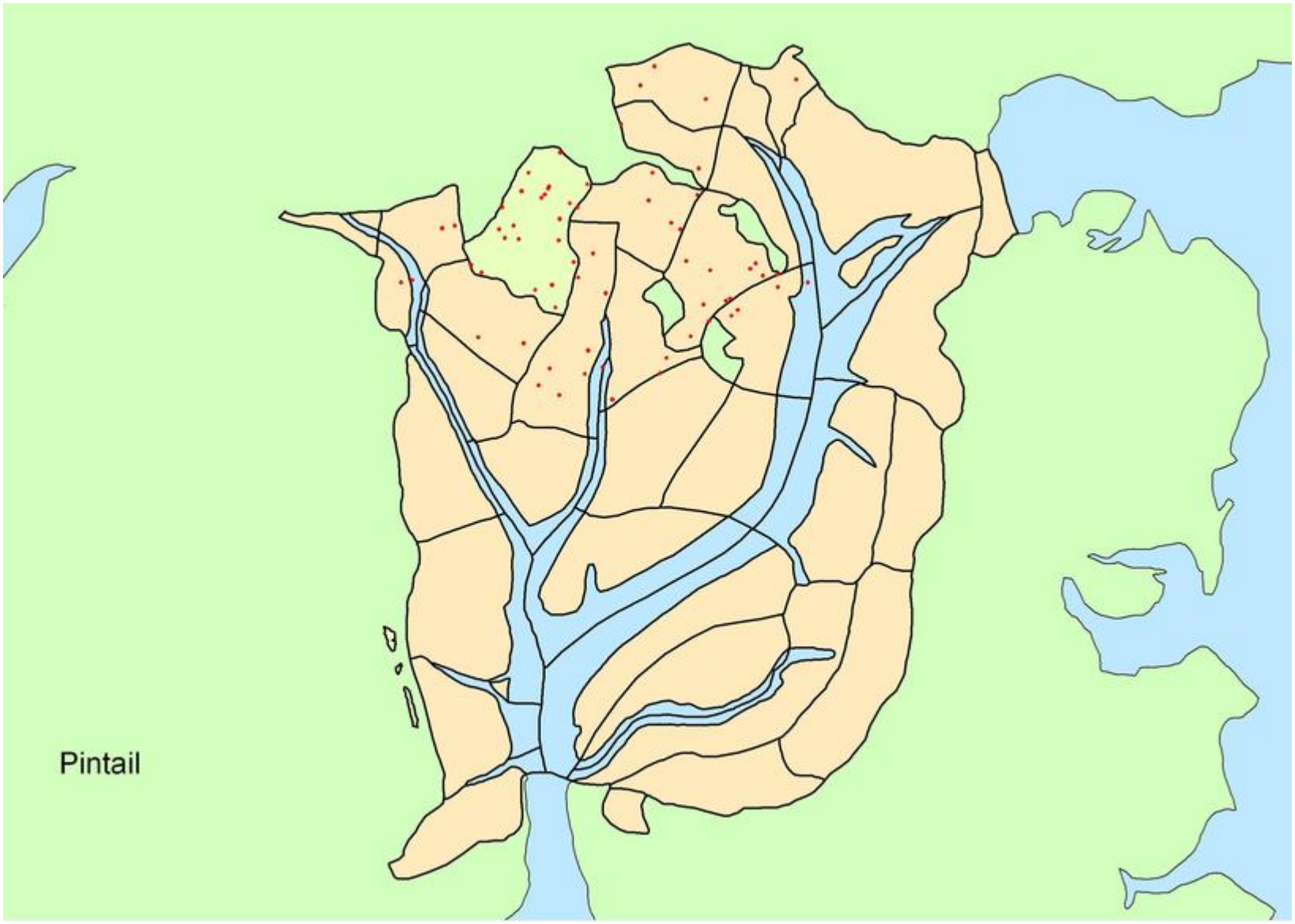

Bar-tailed Godwit

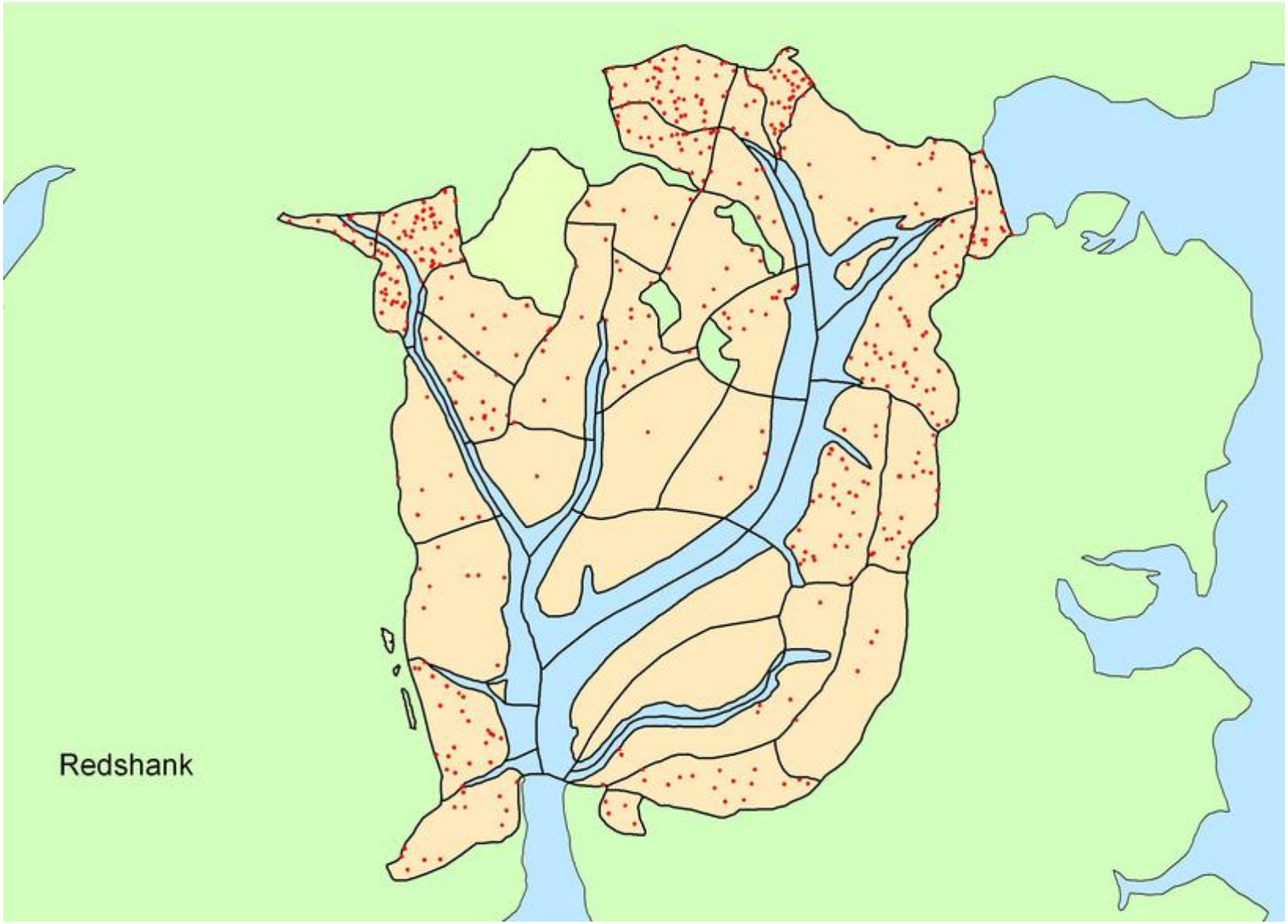

Curlew

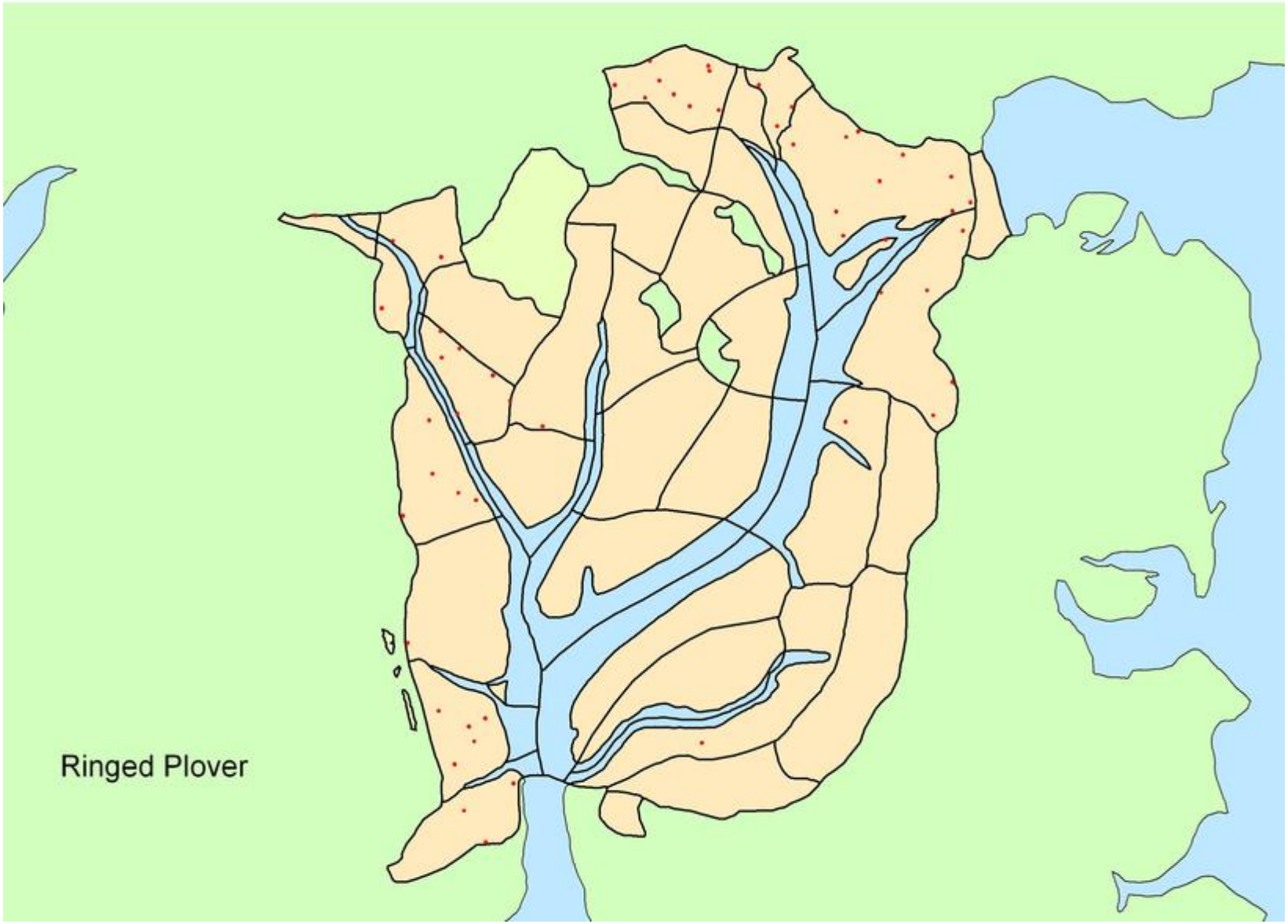

Dark-bellied Brent Goose

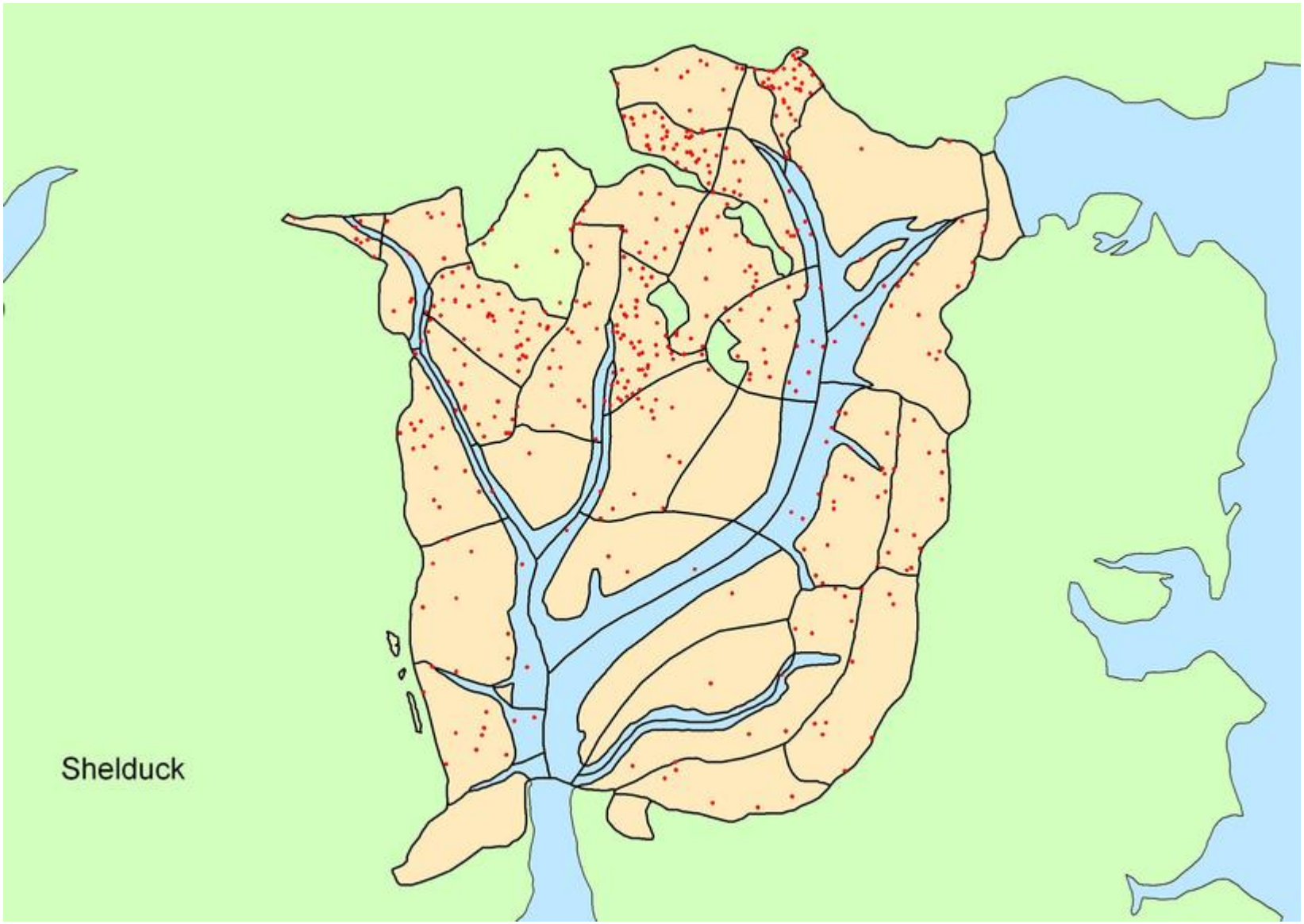

Dunlin

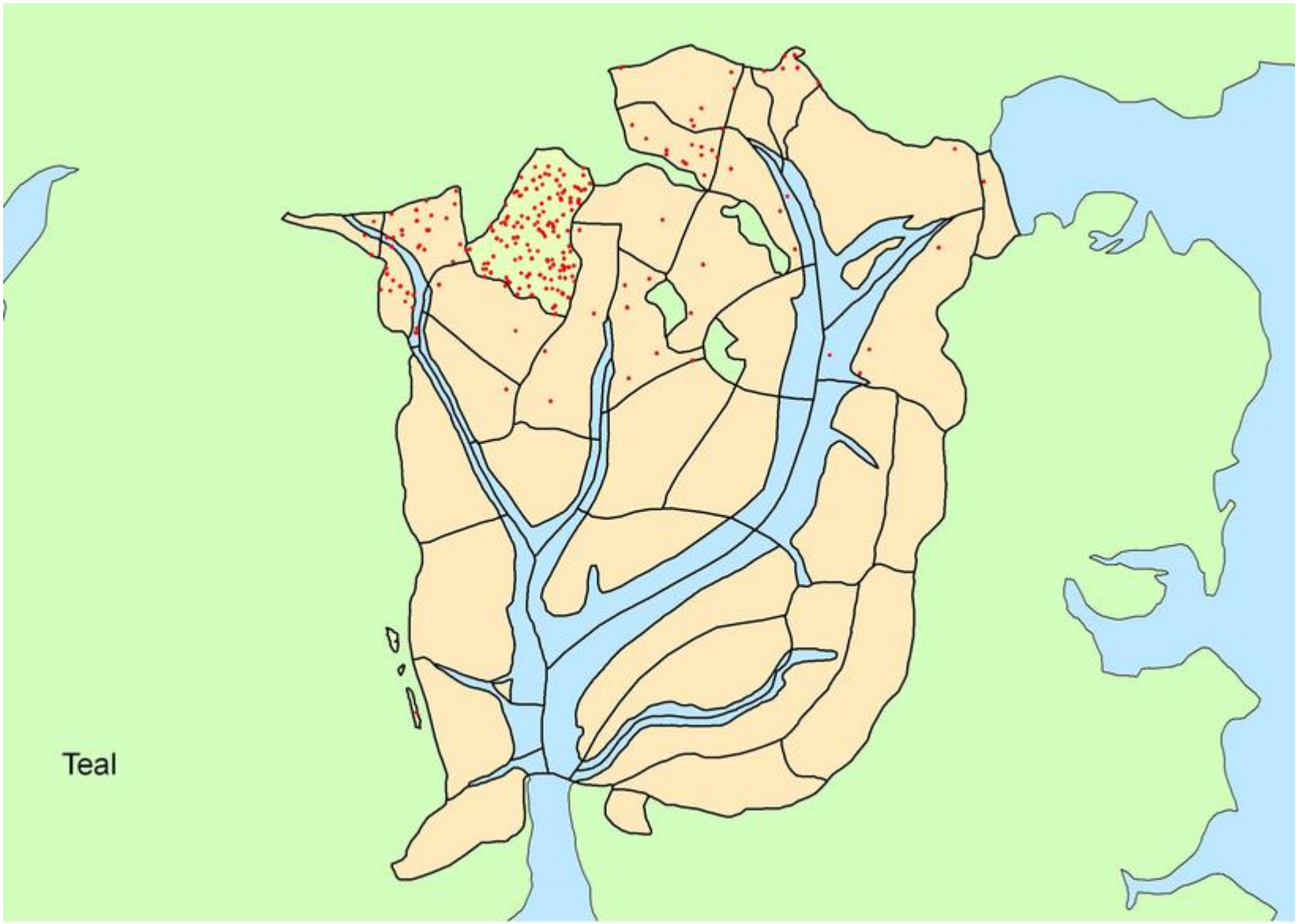

Grey Plover

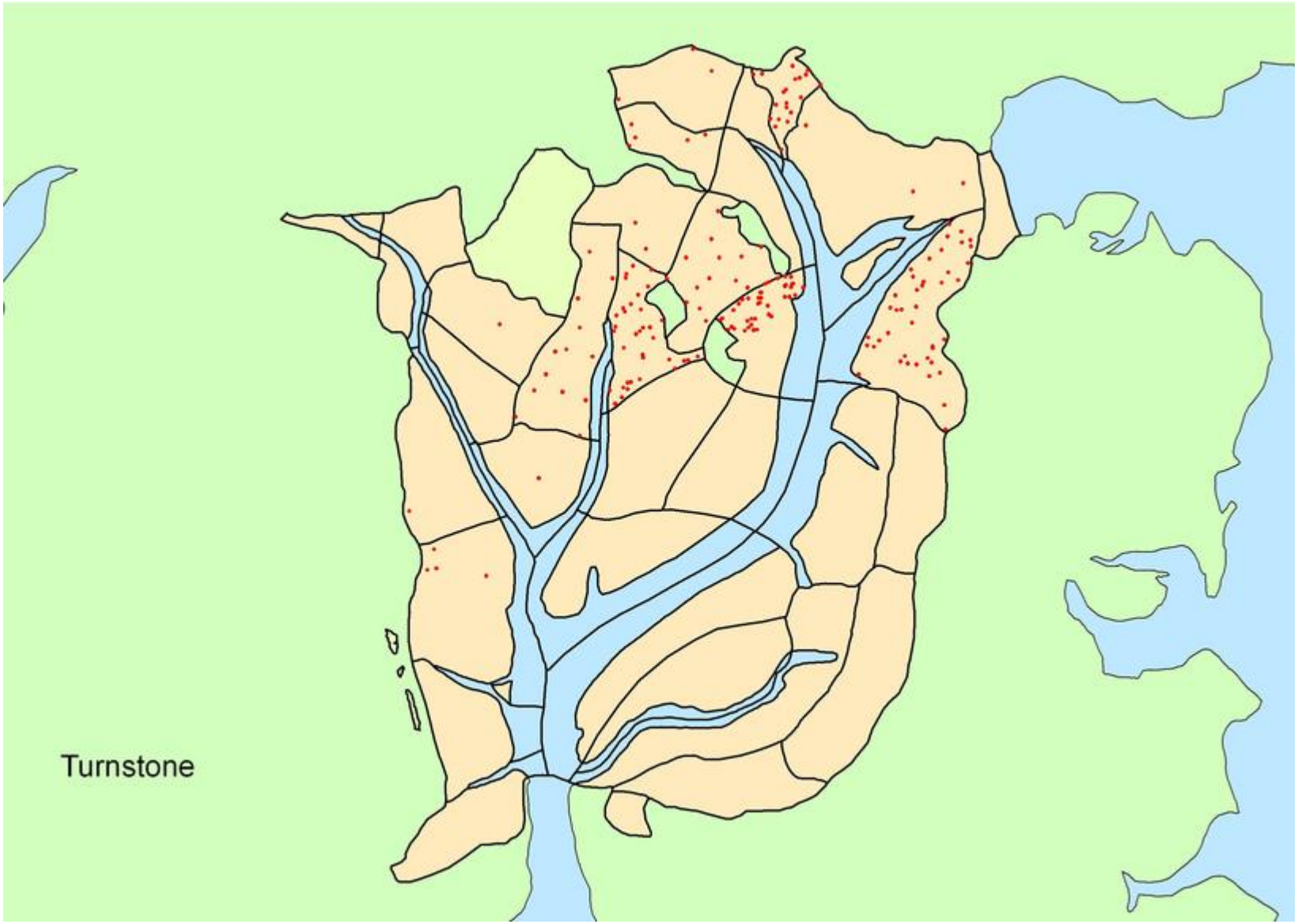

Pintail

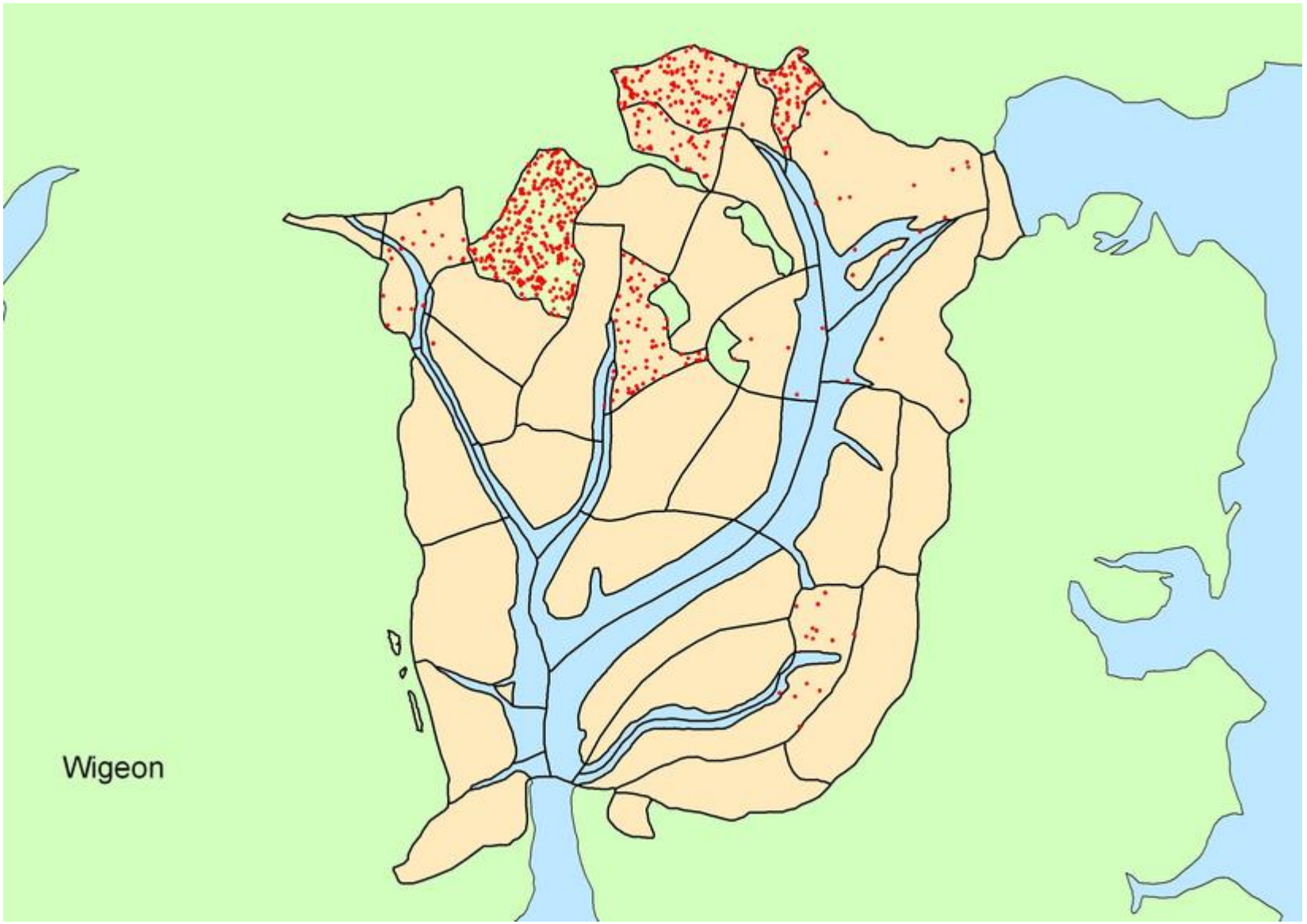

Redshank


Ringed Plover

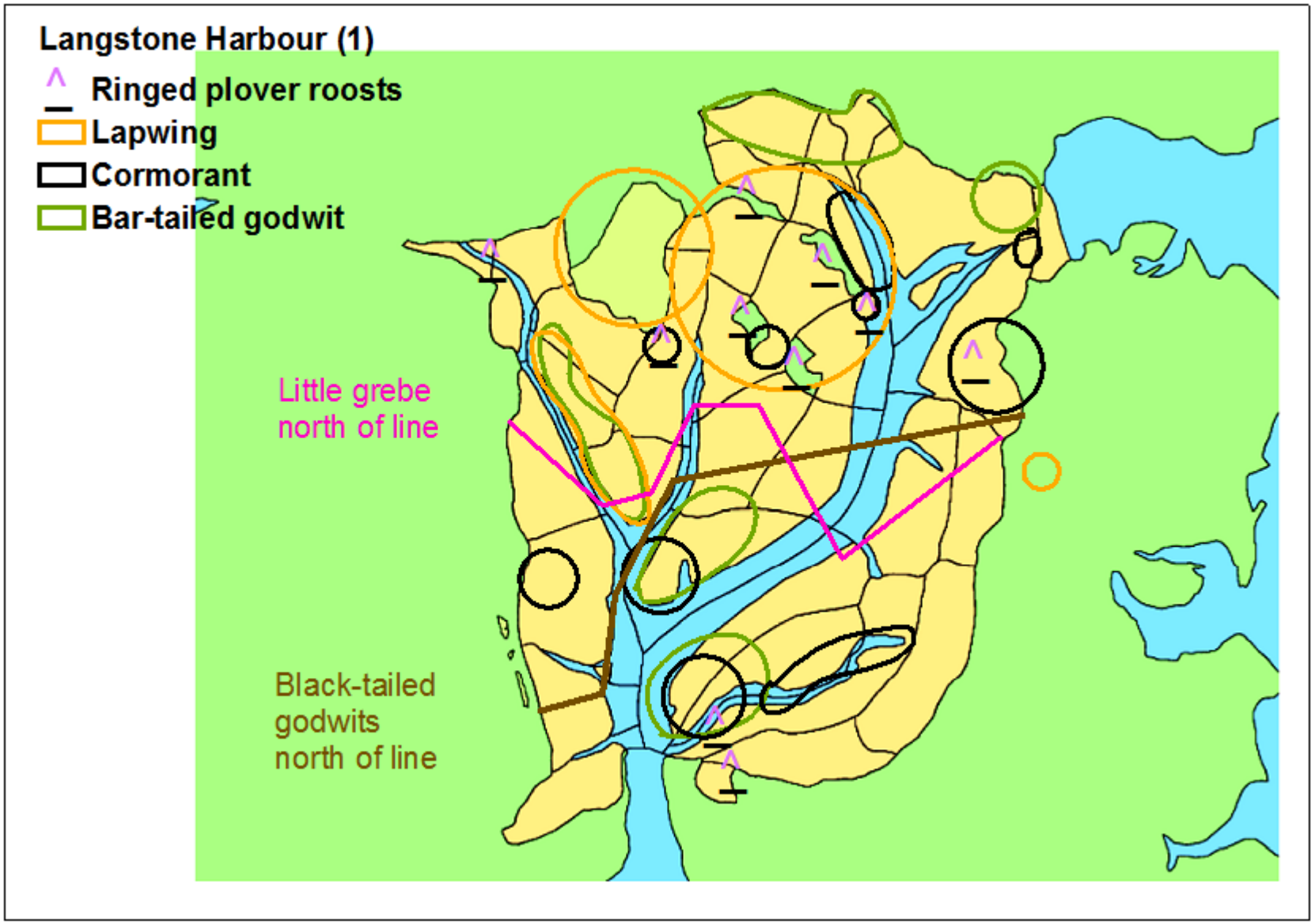

Shelduck

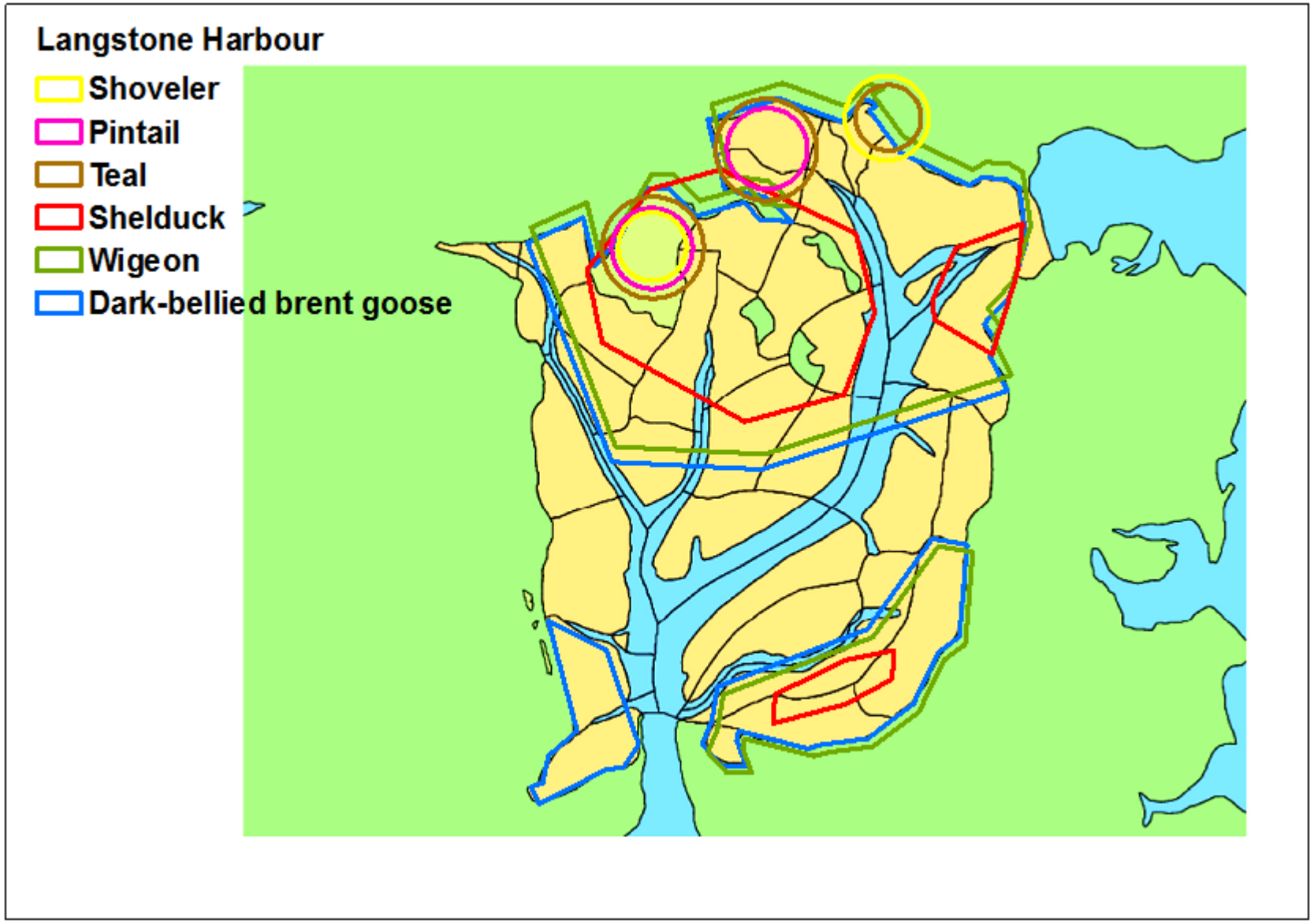

Teal

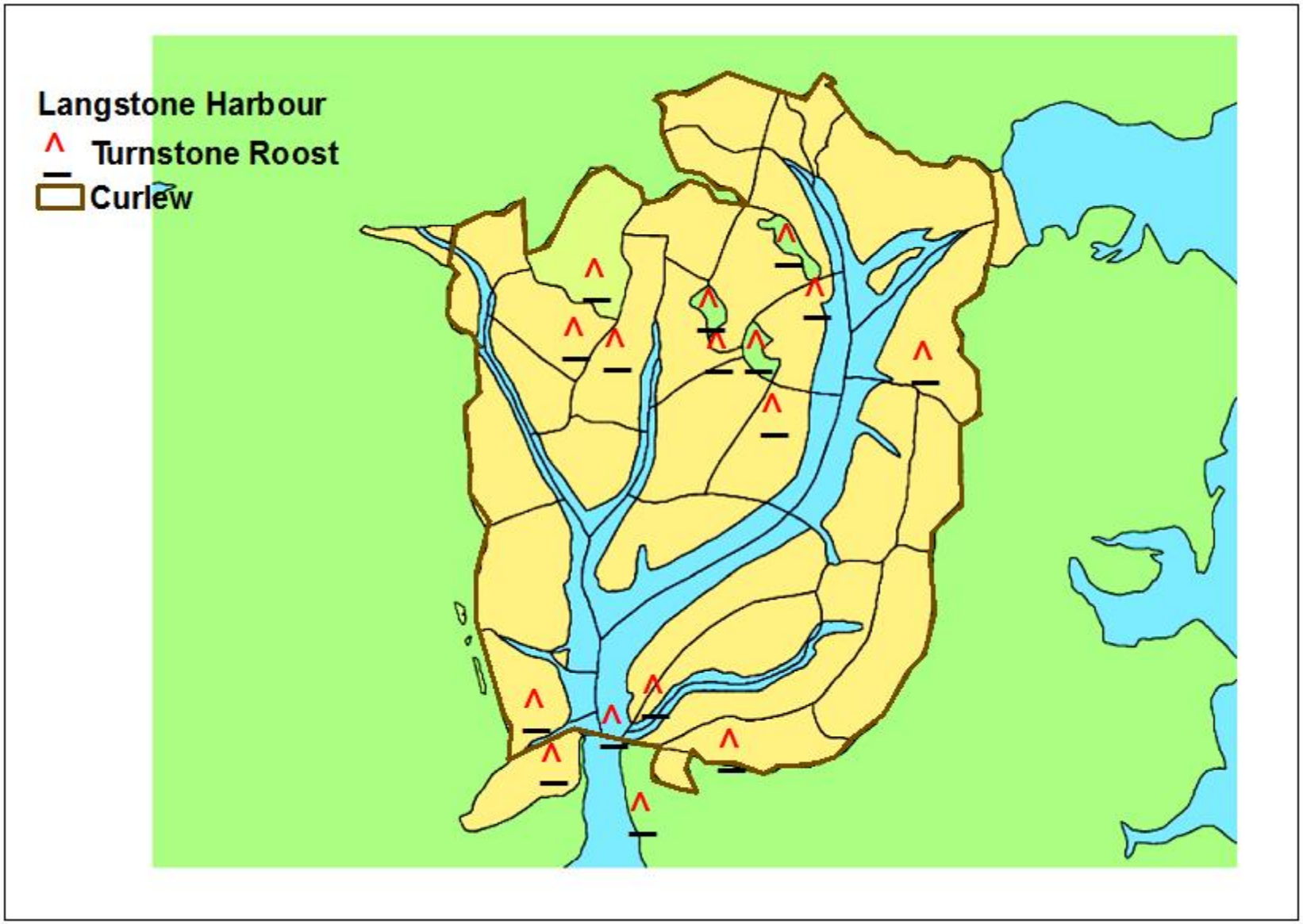

Turnstone

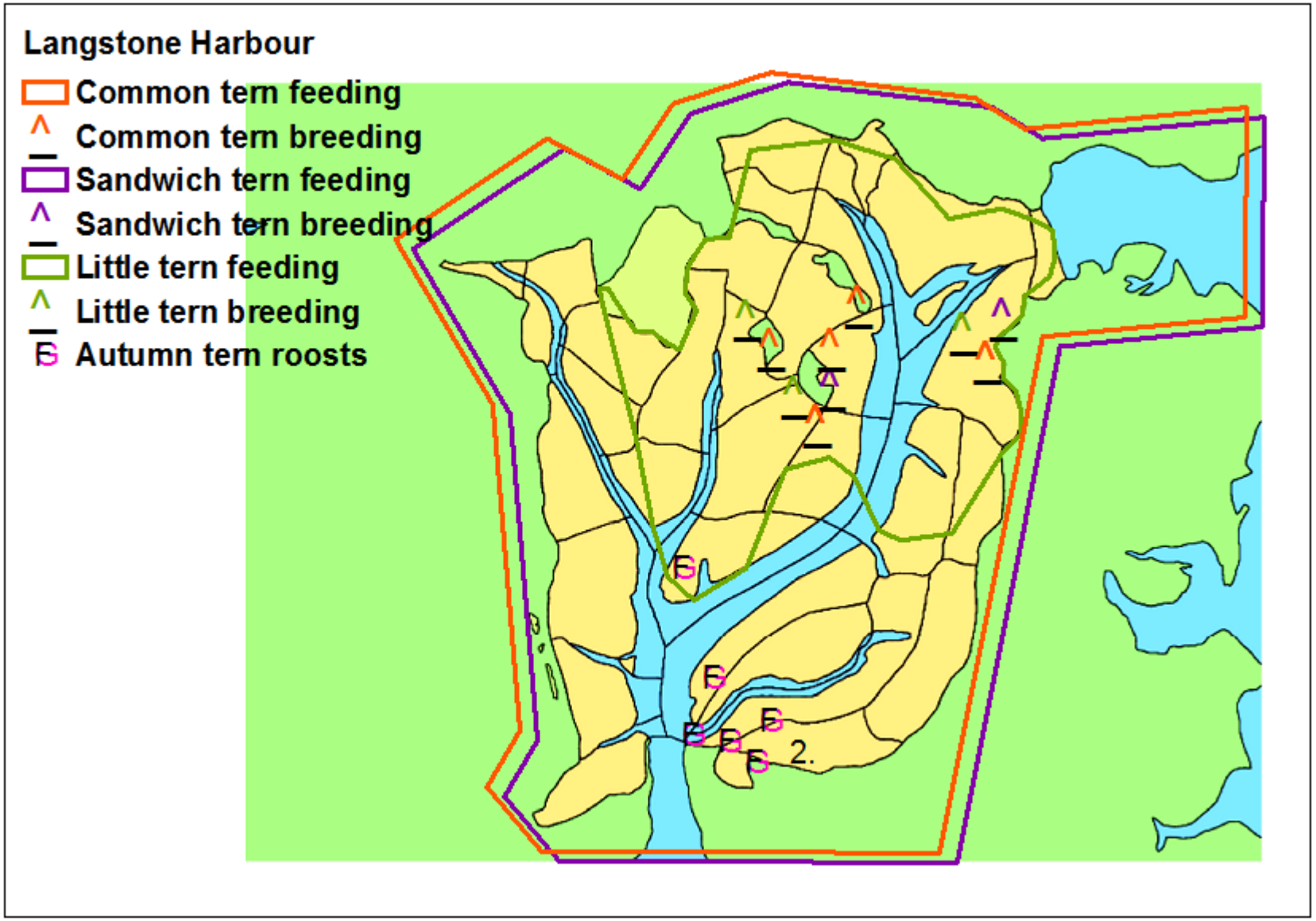

Wigeon

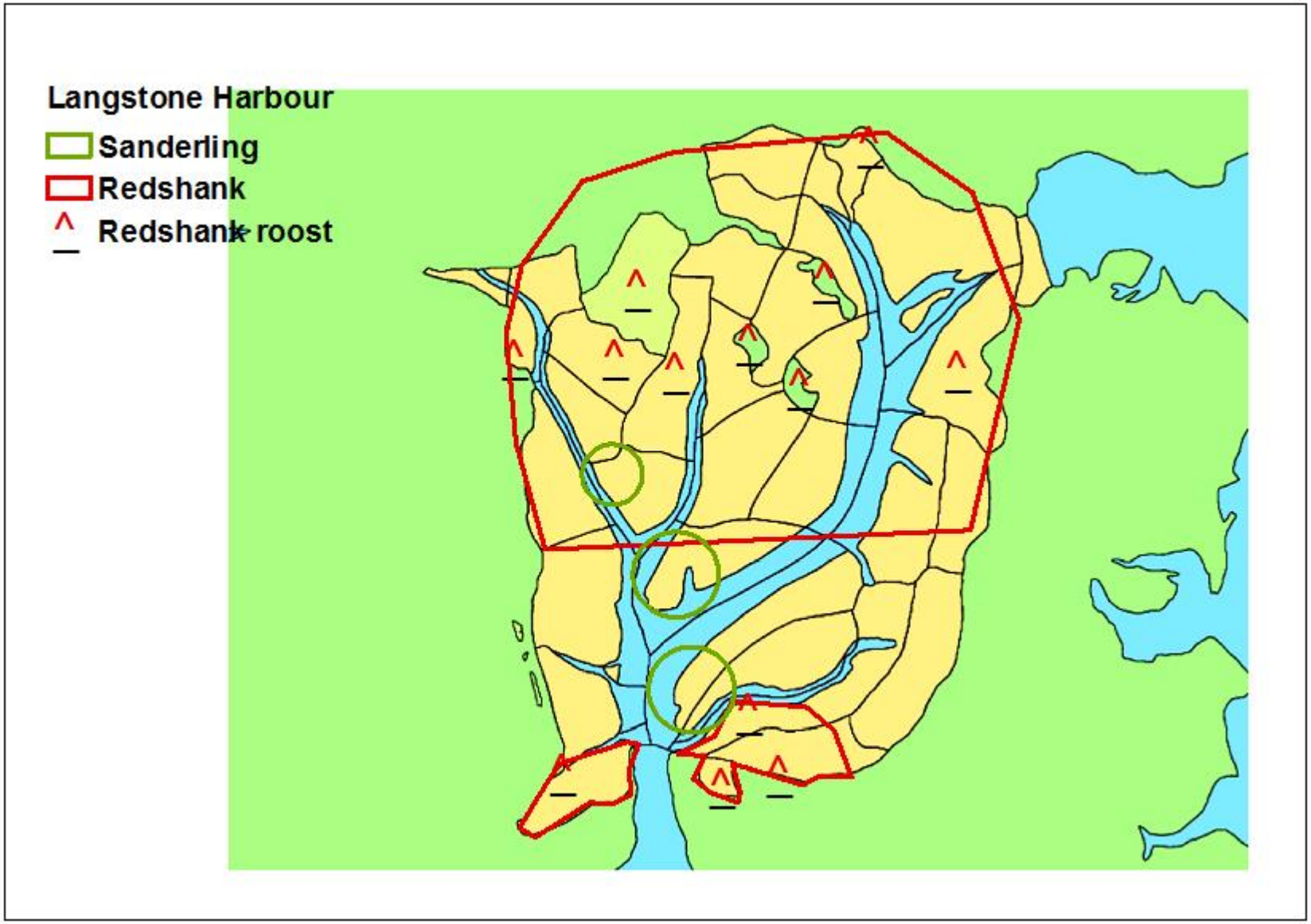
Annex 10: Important Feeding and Roosting Sites for Overwintering and Breeding Bird Species within Langstone Harbour. Taken from the Solent Overwintering Birds Workshop Report (Draft) (Natural England, In Press)

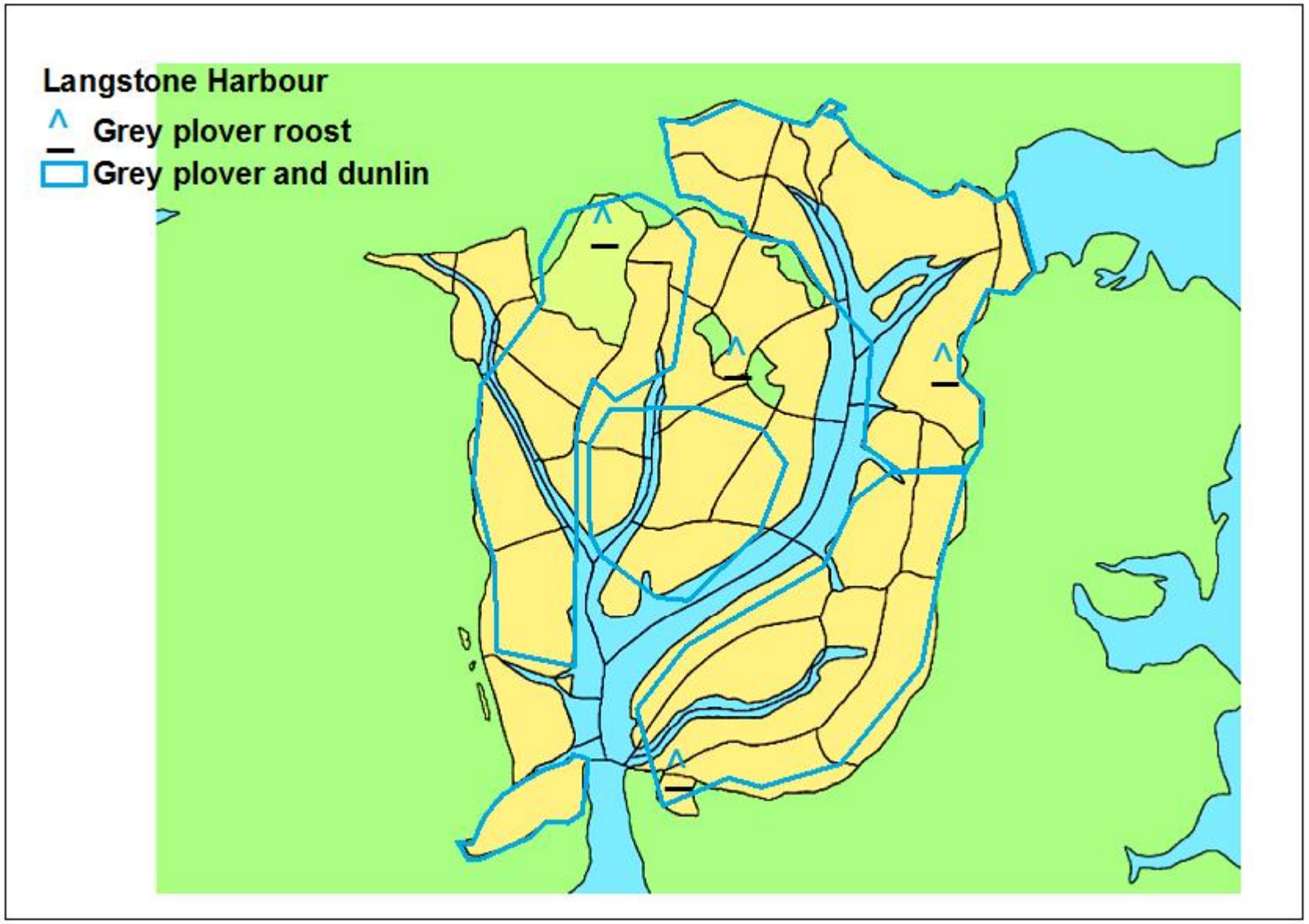

Langstone Harbour (1)
Ringed plover roosts
Lapwing
Cormorant
Bar-tailed godwit
Little grebe north of line
Black-tailed godwits north of line


Langstone Harbour
Shoveler
Pintail
Teal
Shelduck
Wigeon
Dark-bellied brent goose

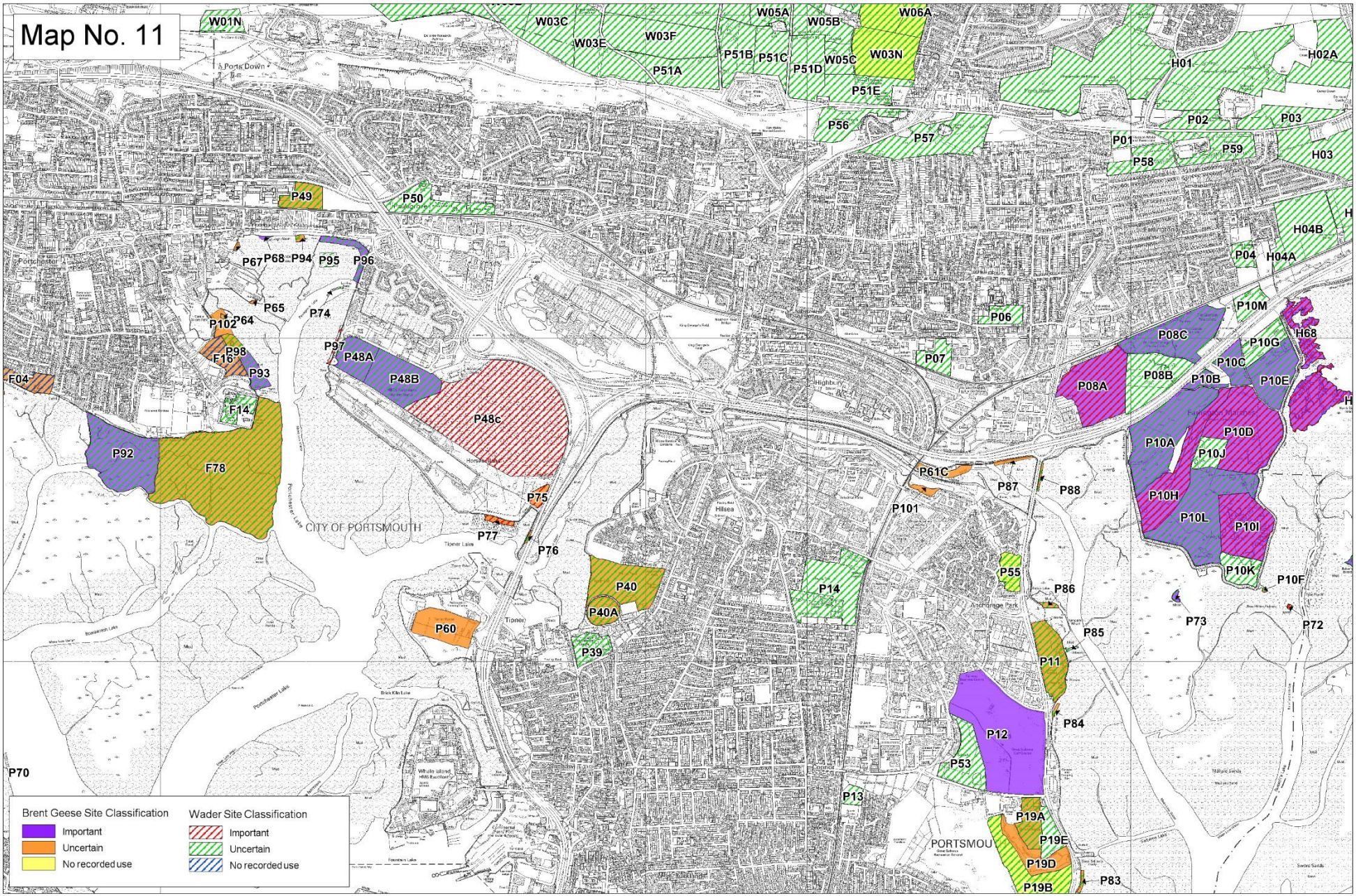

Langstone Harbour
Turnstone Roost
Curlew


Langstone Harbour
Common tern feeding
Common tern breeding
Sandwich tern feeding
Sandwich tern breeding
Little tern feeding
Little tern breeding
Autumn tern roosts
2.


Langstone Harbour
Sanderling
Redshank
Redshank roost

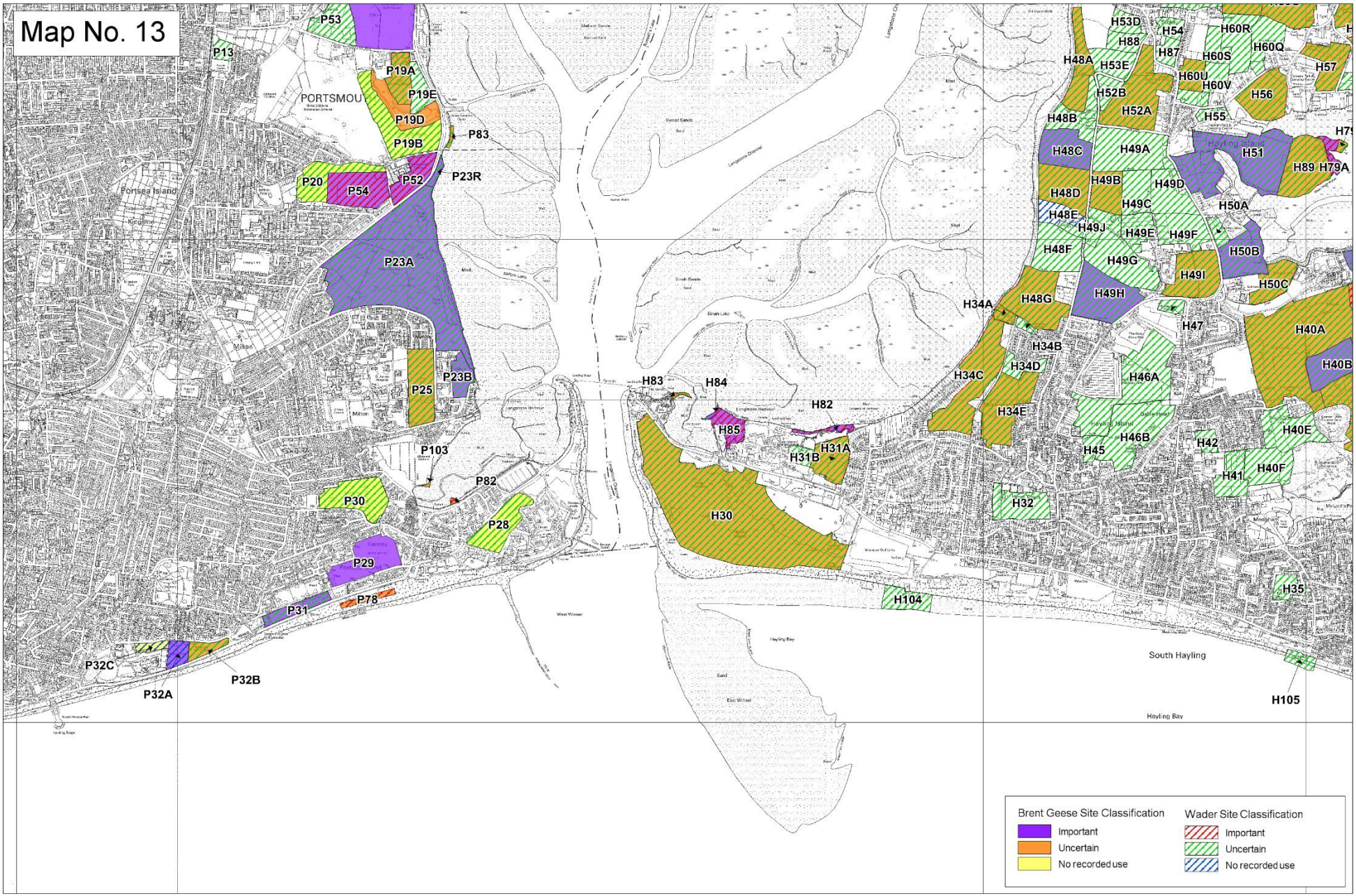

Langstone Harbour
Grey plover roost
Grey plover and dunlin

Annex 11: Bird roosting sites from the Solent Waders and Brent Goose Strategy. Taken from http://www.solentforum.org/forum/sub_groups/Natural_Environment_Group/Waders%20and%20Brent%20Goose%20Strategy/.



Current Use Analysis: Important Sites for Waders and Brent Geese

Maps produced by Hampshire and Isle of Wight Wildlife Trust on behalf of the Waders and Brent Goose Strategy Group, (Ordnance Survey licence no. 100015632) with permission of Her Majesty's Stationery Office, Crown Copyright 2010.



Current Use Analysis: Important Sites for Waders and Brent Geese

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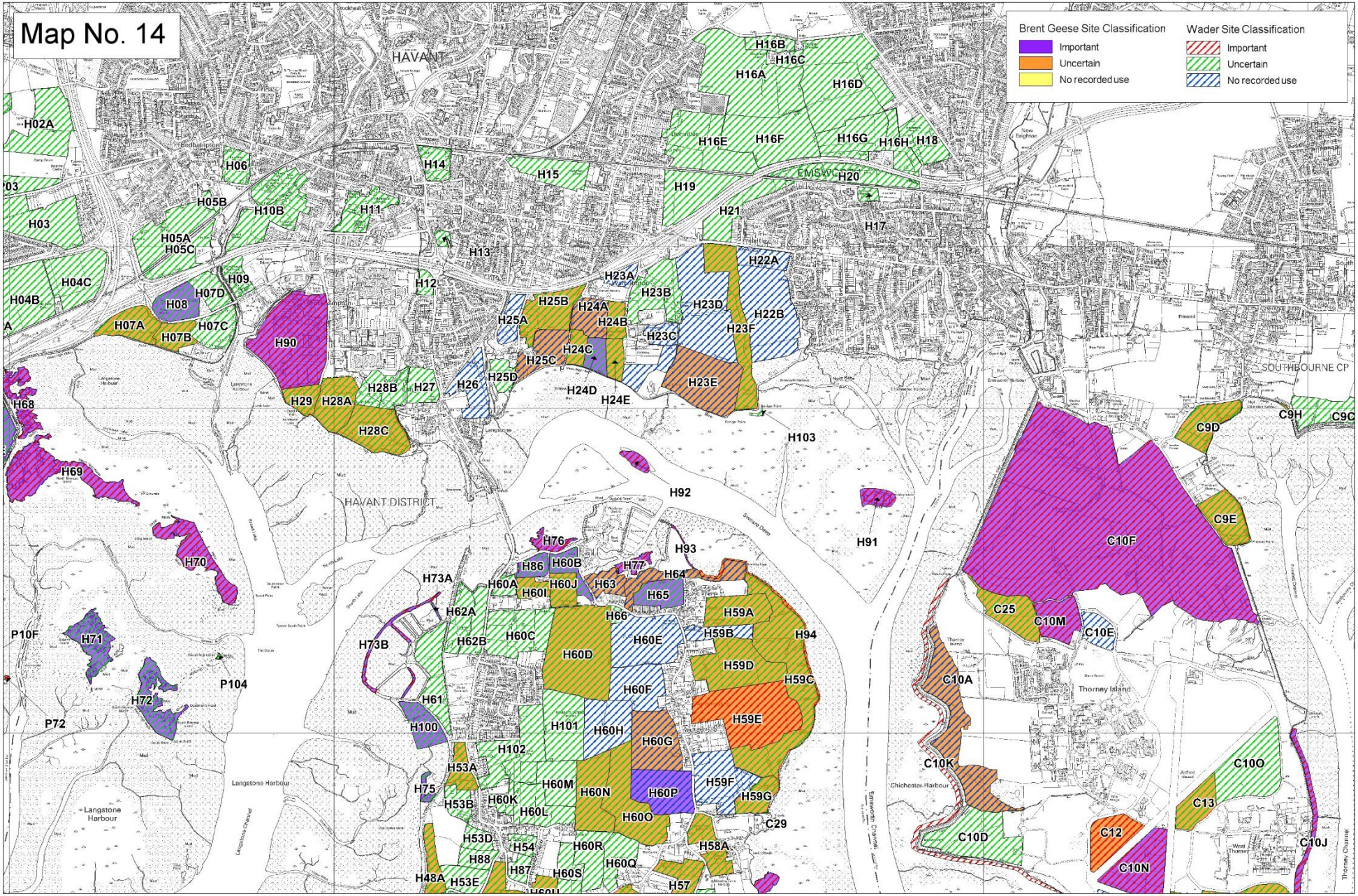

Current Use Analysis: Important Sites for Waders and Brent Geese

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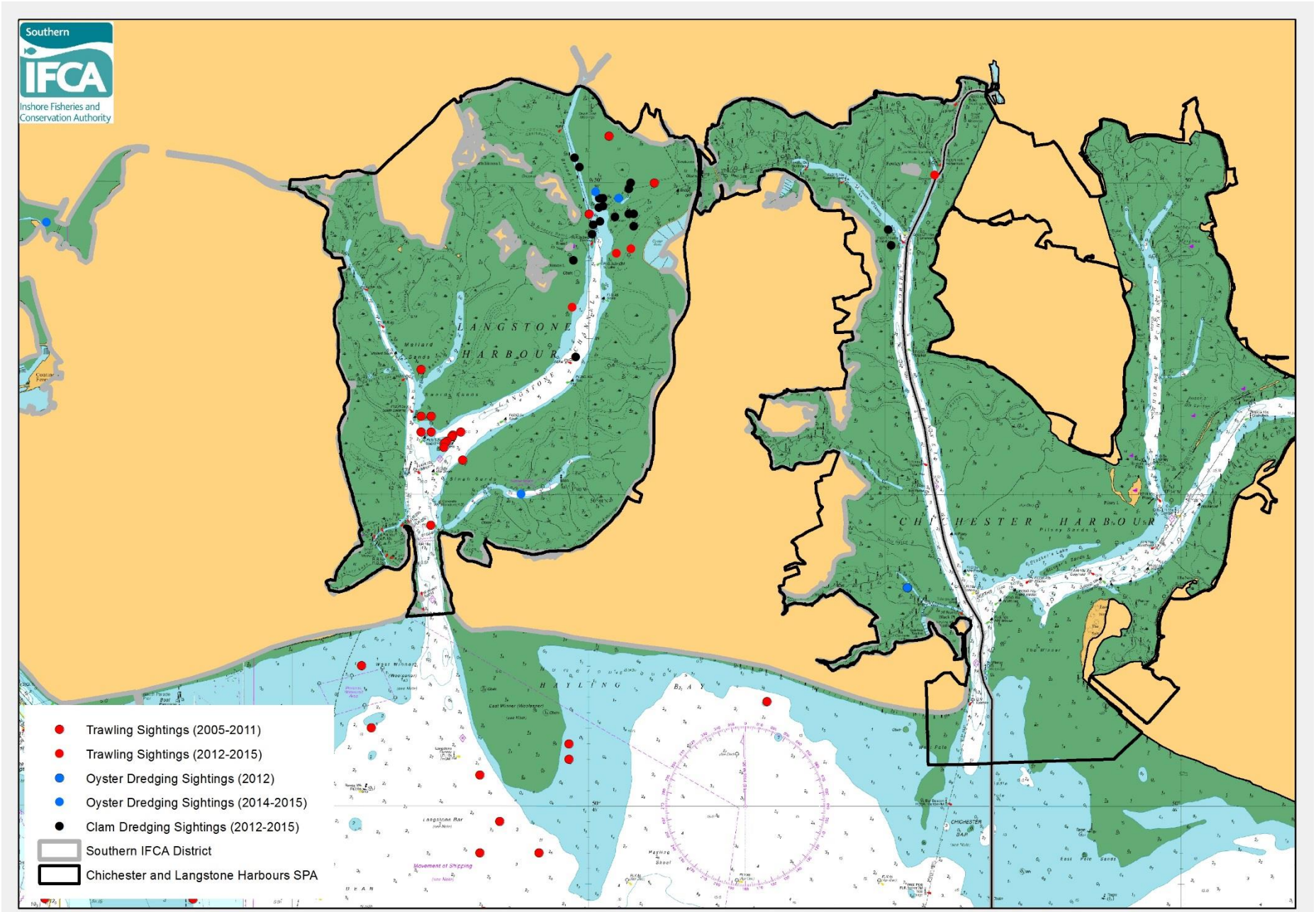
N

Annex 12: Co-location of Historic Trawling (2005-2011, 2012-2015), Recent Clam Dredging (2012-2015) and Oyster Dredging (2012, 2014-2015) Sightings in the Chichester and Langstone Harbours SPA



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