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AGRI-FOOD & BIOSCIENCES INSTITUTE

Mill Bay aquaculture

Cumulative Impact Assessment

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1 Introduction

European Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, and Directive 2009/147/EC (originally Directive 79/409/EEC, amended in 2009) on the Conservation of wild birds (often referred to as the Habitats and Birds Directives respectively) were developed with the aims of protecting habitats and species considered to be of European interest. This is achieved through member states designating sites as Special Areas of Conservation (SAC) for the protection of habitats and species (as listed in Annex I and Annex II of the Habitats Directive respectively) and Special Protection Areas (SPA) for the protection of wild birds and the habitats of listed species.

The Habitats and Birds Directives were brought into effect in Northern Ireland law by the Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995, also known as the Habitats Regulations. SAC and SPA designated sites form the Natura 2000 network of sites (sometimes referred to as N2K).

Following the UK exit from the EU, the Birds and Habitats Directives remain relevant legislation in relation to the marine environment within the UK. These have been transposed into NI law through the Conservation (Natural Habitats, etc.) (Amendment) (Northern Ireland) (EU Exit) Regulations 2019.

The Marine and Fisheries Division of the Department of Agriculture, Environment and Rural Affairs (DAERA) commissioned AFBI to prepare a Cumulative Impact Assessment report for current and proposed aquaculture activities within the Mill Bay area of the Carlingford Lough Special Protection Area (SPA) in Northern Ireland. This document therefore assesses the potential impacts of aquaculture activities at the proposed location on the designated features and conservation objectives of the Natura 2000 designated site outlined above. This assessment is based on information supplied by the DAERA, the Royal Society for the Protection of Birds (RSPB), the Wetlands Bird survey (WeBS), the Northern Ireland Environment Agency (NIEA), through site visits, and through information provided by the operators of current and potential aquaculture sites within the Mill Bay area. For the purpose of this report the Mill Bay area is considered to be the area as outlined in Figure 1.1. In order to ensure alignment with the EcoWin.net model boxes utilised within the Carrying Capacity assessments undertaken as part of this report (see section 4) some subtidal habitat is also included within the area considered as Mill Bay.

Carlingford Lough is a sea lough at the mouth of the Newry (or Clanrye) River on the east coast of Ireland, bordering both the Republic of Ireland (county Louth) and Northern Ireland (counties Down and Armagh). The upper reaches of the lough are dominated by fine muddy sand beds and intertidal mud-flats, whilst the seaward entrance to the lough is a mixture of boulder, cobble and bedrock forming numerous small islands and reefs. The areas of Carlingford Lough within Northern Irish jurisdiction have been designated as a SPA (the boundary of which is currently under review and an extension to the site boundary has been proposed), an Area of Special Scientific Interest (ASSI), an Area of Outstanding Natural Beauty (AONB), a Marine Conservation Zone (MCZ), and a RAMSAR site (as designated under the Convention on Wetlands of International Importance (also known as the Ramsar Convention)). The areas of Carlingford Lough within Southern Irish jurisdiction have been designated as a Special Area of Conservation (SAC), a SPA and a proposed Natural Heritage Area. Natura 2000 data forms list designated features as being classified either A, B, C, D, E etc. Only those features classified as either A, B, or C are considered as Natura 2000 features and need to be taken into consideration within impact assessments (Northern Ireland Environment Agency (NIEA) Competent Authority Habitat Regulations Assessment template).

1.1 Carlingford Lough SPA (site code UK9020161 - Northern Ireland)

Carlingford Lough SPA was classified in March 1998 and covers an area of approximately 830.51 hectares. In 2015 DAERA issued a notification highlighting their intention to extend the existing boundary of the Carlingford Lough SPA to include the marine area adjoining the existing SPA and a further area off the south-east County Down coast (see Figure 1.2 for a map of the site boundary). The proposed new SPA boundary covers an area of approximately 11,143.10 hectares.

The Carlingford Lough SPA qualifies under Article 4.1 of EC Directive 79/409 on the Conservation of Wild Birds by regularly supporting important numbers of the following species;

<u>Breeding</u>

- Common Tern (*Sterna hirundo*). For the period 1993-1997 the five year peak mean for Common Tern at this site constituted 10.9% of the all-Ireland breeding population.

- Sandwich Tern (*Sterna paradisaea*). For the period 1993-1997 the five year peak mean for Sandwich Tern at this site constituted 13.1% of the all-Ireland breeding population.

Up to date information regarding bird numbers and distribution for the above species were obtained from the Royal Society for the Protection of Birds (RSPB) and used within the GIS project accompanying this report to examine the potential impacts of aquaculture activities on these species.

This site was designated before the UK SPA review which was undertaken in 2001 (Stroud *et al* 2001). During this review an additional qualifying species (Light Bellied Brent Geese) was identified for this site.

As a result of the review described above this site now also qualifies under Article 4.2 of EC Directive 79/409 on the Conservation of Wild Birds by supporting populations of European importance of the following migratory species;

Over Winter (non breeding)

- Light-bellied Brent Goose (*Branta bernicla hrota*). For the period 1990-1995 the five year peak mean for Light-bellied Brent Geese at this site was 319 individuals which represented 1.6% of the wintering Canada/Ireland population.

Light-bellied Brent Goose is a Carlingford Lough SPA feature from the time of designation in 1998 (www.daera-ni.gov.uk/publications/special-protection-area-carlingford-lough). The SDF for the SPA (previously sent to the EC) also lists Light-bellied Brent Goose as a SPA feature in the most recent update of 2015 (https://jncc.gov.uk/our-work/list-of-spas/#northern-ireland). As a result of the 3rd UK SPA Review additional nationally important wintering waterbird species may be added as features to the SPA citation.

Site Conservation Objectives

The conservation objectives for this site are “To maintain each feature in favourable condition” (NIEA 2015). A number of Selection Feature Objectives for each feature have also been identified. These are;

“To maintain or enhance the population of the qualifying species.

Fledgling success sufficient to maintain or enhance population,

To maintain or enhance the range of habitats utilised by the qualifying species,

To ensure that the integrity of the site is maintained,

To ensure there is no significant disturbance of the species and

To ensure that the following are maintained in the long term:

- Population of the species as a viable component of the site
- Distribution of the species within the site
- Distribution and extent of habitats supporting the species
- Structure, function and supporting processes of habitats supporting the species" (NIEA 2015)

The most recent condition assessment undertaken by NIEA in 2014 (NIEA 2015) states that the Light-bellied Brent Goose feature of this site is in favourable condition, whilst both the Common Tern and Sandwich Tern features are in unfavourable condition.

In order to undertake a systematic assessment of the impacts of current aquaculture activities and proposed new aquaculture sites within the Mill Bay areas on the features of the Carlingford Lough SPA the GIS programme ArcGIS v10.6 has been utilised.

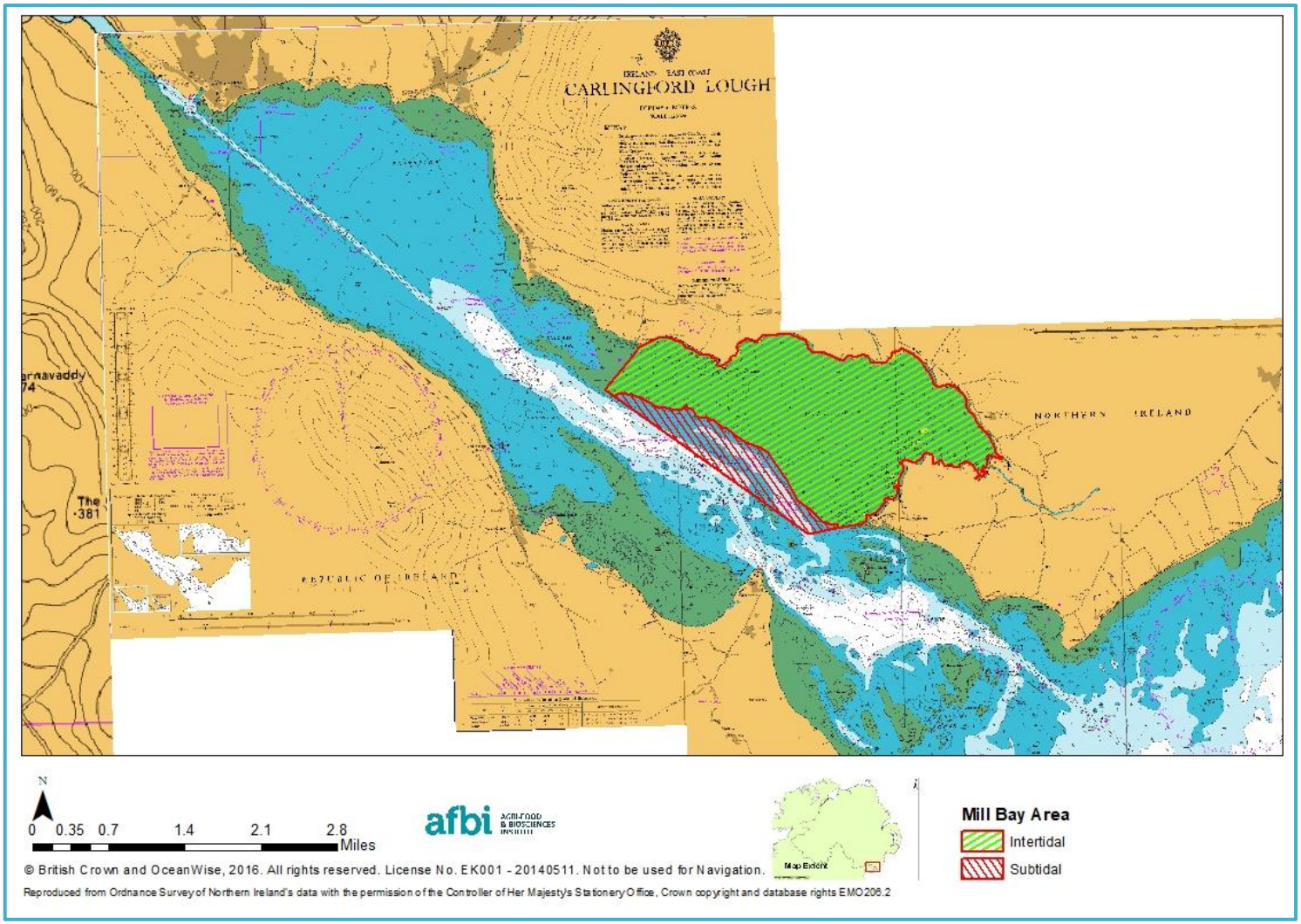

Figure 1.1: Map showing the area within Carlingford Lough identified as Mill Bay for the purpose of this report.

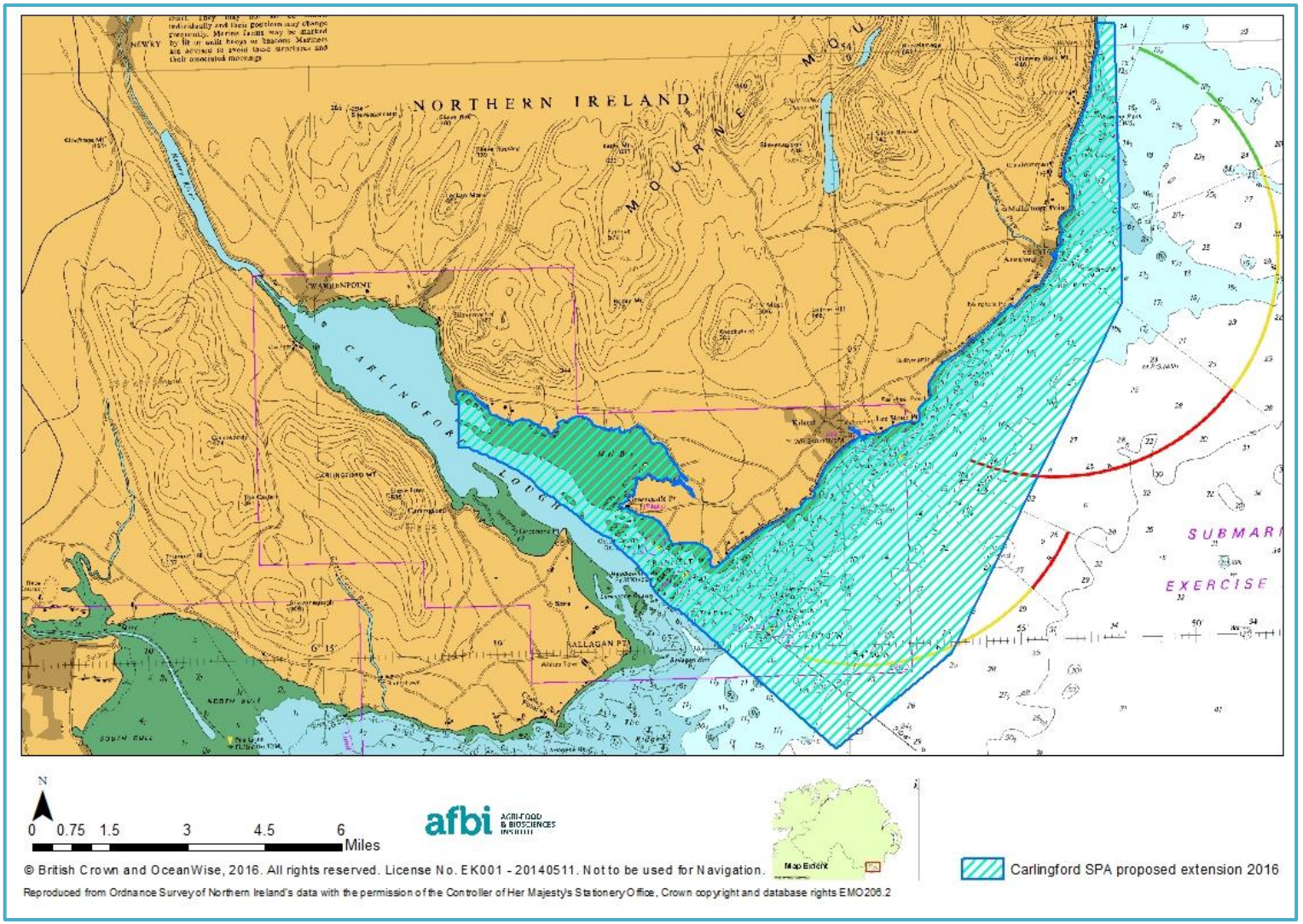

Figure 1.2: Map showing the boundary of the Carlingford Lough SPA – site code UK9020160

2 Impact Assessment

2.1 Current aquaculture activities within Carlingford Lough

Aquaculture within Carlingford Lough occurs on licensed sites within both the intertidal and subtidal areas of the Lough. Subtidal aquaculture involves the bottom culture of the blue mussel *Mytilus edulis*, whilst intertidal aquaculture occurs predominantly in the form of off-bottom (trestle) culture of the Pacific oyster *Magallana gigas,* (previously known as *Crassostrea gigas*). *M. edulis* seed is dredged from naturally settled wild seed mussel beds (outside Carlingford Lough) then relaid onto licensed aquaculture beds within Carlingford Lough for on growing to harvestable size.

At the time of writing, aquaculture sites licensed for bottom culture of shellfish cover approximately 943 hectares of the subtidal area of Carlingford Lough and approximately 218 hectares of the intertidal area of the Lough is licensed for the off bottom (trestle) culture of oysters. The total area of Carlingford Lough (both intertidal and subtidal) is estimated to be approximately 4,890 hectares (as calculated in ArcGIS). Therefore approximately 23.7% of the total area of the Lough is licensed for aquaculture. The location of all currently licensed aquaculture sites within Carlingford Lough are shown in Figure 2.1. However not all of these licensed sites are currently active and of those sites that are active, not all of the licensed area is utilised for shellfish cultivation.

2.1.1 Current Aquaculture activities within the Mill Bay area

In Northern Ireland the Marine and Fisheries Division of DAERA is responsible for the granting of fish culture licences, shellfish fishery licences or marine fish fishery licences under the Fisheries Act (Northern Ireland) 1966. Some of the conditions contained within these licences include the definition of the boundary of the licensed area, an outline the species to be cultured, and they also cover site decommissioning through the stipulation that all equipment “not in use for the cultivation of shellfish is removed from the Licensed area”. Additionally, Regulation (EU) 2016/429 of the European Parliament and of the Council of 9 March 2016 on transmissible diseases (The Animal Health Law (AHL)), which came into operation on 21 April 2021, requires aquaculture establishments of this nature to be approved by DAERA.

GIS shapefiles outlining the locations of licensed aquaculture sites within the Mill Bay area of Carlingford Lough have been supplied by DAERA. There are currently five

licensed intertidal aquaculture sites and two subtidal sites within the Mill Bay area of Carlingford Lough (Figure 2.2). Table 2.1 below outlines the information available for each of these sites. For ease of reference throughout this report the sites have been numbered as per the ID number assigned by DAERA (Figure 2.2). Of these sites one is licensed for the intertidal trestle culture of Pacific oysters (*Magallana gigas*), four are licensed for the intertidal trestle culture of Pacific oysters (*Magallana gigas*) and native oysters (*Ostrea edulis*), and two are licensed for the bottom culture of mussels (*Mytilus edulis*) (see Figure 2.2). Although several sites are licensed for the bottom culture of native oysters (*Ostrea edulis*) records of exports of shellfish from Carlingford Lough aquaculture beds and imports of shellfish onto licensed aquaculture sites in Carlingford Lough for the period 2010 to present show only *M. edulis* and *M. gigas* being produced within the Lough. These records also indicate that not all of the sites licensed for aquaculture within the Mill Bay area are at present actively producing shellfish.

From ArcGIS it is possible to ascertain the total area occupied by licensed aquaculture sites within the Mill Bay area that are within the boundary of the Carlingford Lough SPA. If the proposed extension to the Carlingford Lough SPA boundary is adopted then all aquaculture activities within the Mill Bay area will be within the SPA boundary.

The total area of Mill Bay (as outlined in Figure 1.1) was measured in ArcGIS and was estimated to be approximately 991 hectares, of which approximately 155 ha is subtidal. Current licensed intertidal aquaculture sites occupy approximately 109 ha, which equates to **13%** of the total intertidal area of Mill Bay.

Table 2.1: Current licensed aquaculture sites within the Mill Bay area of Carlingford Lough. DAERA have given the sites specific codes which are also used within this document. The location of each of these sites is shown in Figure 2.1.

Site No.*	Species	Culture method	Approx area** (Ha)	Equipment***	Additional info****
C7	*Magallana gigas* and *Ostrea edulis*	Trestle culture	47.13	Approximately 1,000 trestles onsite	**Access to this site is from the end of Ballyedmund lane or across Mill Bay as outlined in AFBI 2013 Annex III. The operators at this site estimate that approximately 60-70 hours per month are spent by staff onsite.**
C8	*Mytilus edulis*	Bottom culture	20.43	N/A	**The operators of this site estimate that on average 30 hours per month are spent working on this site. The operators do not currently have any system of predator control in place at this site but have reported issues with green crabs. The operators have stated that this site is only suitable for larger seed mussels.**
C9/ C16	*Magallana gigas/ Magallana gigas* and *Ostrea edulis*	Trestle culture	11.93/2.5	There are approximately 1,000 trestles deployed onsite.	**Access to this site across Mill Bay as outlined in AFBI 2013 Annex IV. The operators at this site estimate that approximately 10 hours per month are spent by one part-time member of staff onsite.**
C10	*Mytilus edulis*	Bottom culture	71.07	N/A	**The operators do not currently have any system of predator control in place at this site.** **This site is not currently stocked.**
C15	*Magallana gigas* and *Ostrea edulis*	Trestle culture	29	There are approximately 2,000 trestles onsite.	**The operator estimates that approximately 30 hours per month are spent by 2 individuals onsite. Access to the site is at low tide via an existing pathway currently used to access other aquaculture sites in the area (AFBI 2013 Annex III).**
C17	*Magallana gigas* and *Ostrea edulis*	Trestle culture	18.25	There are approximately 6,000 trestles onsite.	Activities on the site (husbandry, maintenance etc) are undertaken on approximately ten days per month and usually involve seven to ten workers on site.

= Site no. refers to the numbers shown in Figure 2.1 as provided by DAERA. *= Approximate site area in hectares as determined from the GIS shapefiles supplied by DAERA. *****= Equipment refers to the equipment on site as of August 2018, as supplied by DAERA. ******= Additional Information supplied by DAERA.

2.1.2 Proposed new aquaculture sites within the Mill Bay area

At the time of writing three applications for fish culture and shellfish fishery licenses have been submitted to DAERA for new aquaculture sites within the Mill Bay area of Carlingford Lough. Within this report these shall be referred to as Applications A, B and C. The Marine and Fisheries Division of the DAERA commissioned AFBI to prepare a Habitat Regulations Assessment (HRA) report for Applications A and B. These were submitted in 2018 and should be read in conjunction with this report. A HRA has not been prepared for Application C, however a Test of Likely Significance: Screening Matrix has been undertaken for this application and this is included within Annex C of this report. Details of these applications are outlined below, a summary of which is presented within Table 2.2.

Application A

This application is for the culture of Pacific oysters (*Magallana gigas*) on trestles within the intertidal zone at two sites within the Mill Bay area (Figures 2.3). The applicant states that two distinct year classes will be deployed within each area. The more northern site (site A1 in Figure 2.3) will be used for finishing off/fattening the oysters before harvest whilst the more southern site (site A2 in Figure 2.3) will be used for seed and juvenile oysters.

The area of the proposed applications are approximately 11.5 hectares (site A1) and 5.2 hectares (site A2). The applicant wishes to install a total of 8,320 trestles (5 m x 1 m x 1 m) within these areas and has stated that the estimated annual production from these sites will be 80 tonnes of Pacific oysters.

The applicant has stated that 6,240 trestles, 5 m x 1 m x 1 m in dimension will be deployed at the northern site (Site A1). This amounts to an area of approximately 31,200 m^2. The northern area applied for is 11.5 hectares or 115,000 m^2 therefore the proposed number of trestles will occupy approximately **27.13%** of the proposed site. This will therefore provide ample space to ensure adequate water flow between trestles within this area.

The applicant has stated that 2,080 trestles, 5 m x 1 m x 1 m in dimension will be deployed at the southern site (Site A2). This amounts to an area of approximately 10,400 m^2. The southern area applied for is 5.2 hectares or 52,000 m^2 therefore the proposed number of trestles will occupy approximately **20.0%** of the proposed site.

This will therefore provide ample space to ensure adequate water flow between trestles within this area.

If the proposed SPA extension is adopted this will result in the entirety of both proposed aquaculture areas being within the Carlingford Lough SPA boundary.

Application B

This application is for the culture of Pacific oysters (*Magallana gigas*) and mussels (*Mytilus edulis*) on trestles within the intertidal zone of Mill Bay (Figures 2.4). The area of the proposed application is approximately 49 hectares. The applicant wishes to install 10,000 trestles (5 m x 1 m x 1 m) within this area and has stated that the estimated annual production from this site will be 190 tonnes of Pacific oysters and 10 tonnes of mussels.

The area applied for is 49 hectares or 490,000 m^2. The proposed number of trestles will occupy 50,000 m^2 which is approximately **10.20%** of the proposed site. This will therefore provide ample space to ensure adequate water flow between trestles.

If the proposed SPA extension is adopted this will result in the entire proposed aquaculture site being within the Carlingford Lough SPA boundary.

Application C

This application is for the culture of Pacific oysters (*Magallana gigas*) on trestles within the intertidal zone of Mill Bay (Figures 2.5). The area of the proposed application is approximately 168 hectares. The applicant wishes to install 60,000 trestles (5 m x 1 m x 1 m) within this area and has stated that the estimated annual production from this site will be 500 tonnes of Pacific oysters.

The area applied for is 168 hectares or 1,680,000 m^2. The proposed number of trestles will occupy 300,000 m^2 which is approximately **17.86%** of the proposed site. This will therefore provide ample space to ensure adequate water flow between trestles.

If the proposed SPA extension is adopted this will result in the entire proposed aquaculture site being within the Carlingford Lough SPA boundary.

Table 2.2: Proposed new aquaculture sites within the Mill Bay area of Carlingford Lough. The location of each of these sites is shown in Figure 2.6.

Site ID.*	Species	Culture method	Approx area** (Ha)	Proposed Equipment***	Proposed production****
A1 + A2	*Magallana gigas*	Trestle culture	A1 = 11.5 A2 = 5.2	A1 = 6,240 A2 = 2,080	**80 tonnes over both sites**
B	*Magallana gigas* and *Mytilus edulis*	Trestle culture	49	10,000	**190 tonnes Pacific oysters 10 tonnes mussels**
C	*Magallana gigas*	Trestle culture	168	60,000	**500 tonnes of Pacific oysters**

*Site ID. refers to the ID given to each application by AFBI to be able to differentiate between them for the purpose of this report.
**Approximate site area in hectares as determined from the GIS shapefiles generated from the coordinates as listed within the applications.
***Equipment refers to the proposed equipment as listed within the applications.
**** Proposed production refers to that listed by the applicant on the application.

If all three of these applications are granted then the total area of the Intertidal zone of Mill Bay occupied by aquaculture would be 342.7 hectares, which equates to approximately **41%** of the total intertidal area. However, it should be noted that, (as can be seen in Figure 2.6), there is spatial overlap between the proposed licence areas outlined within application B and application C. As two licenses cannot be granted for the same area, the total area of Mill Bay occupied by aquaculture will be less than that stated above should these licences be granted. If Applications A and B are granted and Application C is granted minus the area that overlaps with the area of Application B then the total area of the Intertidal zone of Mill Bay occupied by aquaculture would be 295.7 hectares, which equates to approximately **35.4%** of the total intertidal area.

2.2 GIS Assessment

All available information relating to the designated features of the Carlingford Lough SPA (Northern Ireland) were converted into a format that was transferable to the GIS programme ArcGIS. This data was mapped alongside information relating to aquaculture activities within the Mill Bay area of Carlingford Lough. Section 2.2.1 below outlines the potential impacts of aquaculture activities in the Mill Bay area of Carlingford Lough on the designated features of the Carlingford Lough SPA.

2.2.1 Impacts of aquaculture activities on SPA designated features

Breeding Birds

Current and proposed aquaculture activities within Mill Bay have the potential to negatively impact the breeding bird populations for which the Carlingford Lough SPA is designated (namely Common Tern and Sandwich Tern) through;

- Disturbance at nesting sites
- Damage to/disturbance within feeding areas
- Impacts on prey availability

Each of these potential impacts will be discussed in turn within the following paragraphs.

Tern species breed on three islands near the mouth of Carlingford Lough which are monitored annually by the Royal Society for the Protection of Birds (RSPB) (Figure 2.7). The most recent figures for breeding Tern species within Carlingford Lough has been extracted from the Seabird Monitoring Programme (SMP) online database and is represented graphically in Figures 2.8-2.10. Although three sites are monitored for Tern numbers the data is presented as an annual figure for the Lough. Figure 2.8 shows a gradual increase in Common Tern numbers within Carlingford Lough between the years 2009 to 2015 after which numbers begin to fall. From Figure 2.9 it can be seen that numbers of Sandwich Tern within Carlingford Lough between the years 2009 to 2019 still remained low. This is similar to the trend observed between the years 1988 to 1992 when Sandwich Tern numbers within the Lough were greatly reduced (Figure 2.9). These figures show that both Sandwich Tern and Common Tern numbers within Carlingford Lough have remained generally low in recent years.

- Disturbance at nesting sites

Terns are colonial breeding waterbirds (Gonzalez-Solis *et al* 2001). Their high density nesting habits make them particularly sensitive to human disturbance (Rodgers and Smith, 1995).

Using Flushing Distance ("the distance from the observer to the bird at the moment it actually began movement away from approaching disturbance" (Rodgers and Smith, 1997)) to determine protective buffer zones for bird species, Rodgers and Smith (1997) recommend a buffer of 100m to minimise human disturbance to foraging and loafing waterbirds (which included Terns). Rodgers and Smith (1995) recommended a setback distance of 180m for mixed Tern/Skimmer colonies and Erwin (1989) recommended a buffer zone of 200m for Common Terns. Erwin (1989) also states that

"to protect colony sites early in the season before birds are established probably requires an additional 100m".

The protective buffer distances that exist for Common Terns were based on experiments undertaken on colonies in Florida (Erwin 1989 and, Rodgers and Smith 1995, 1997). Several factors can influence Flushing Distances of individuals within nesting colonies, these include; species sensitivity to disturbance, timing of disturbance, and habituation to the disturbance (Erwin, 1989).

In the absence of empirical data on the recommended protective buffer distance for Tern species in Carlingford Lough, a highly precautionary figure of 500 m has been used within this report to highlight the proximity of licensed aquaculture sites within Mill Bay to the islands utilised by breeding Tern species (Figure 2.11). This distance is not intended as a definitive protective buffer zone for conservation purposes as it is not based on field investigations, **it is for illustrative purposes only**.

As can be seen within Figure 2.11 none of the licensed aquaculture sites in Mill Bay are within 500 m of the islands on which Terns are monitored in Carlingford Lough. Site C10, which is licensed for bottom culture of mussels, is within approximately 650 m of the RSPB monitoring sites. Figure 2.12 shows the position of the proposed new aquaculture sites within the Mill Bay are of Carlingford Lough in relation to the islands on which Terns are monitored. As can be seen in Figure 2.12 none of the proposed new sites are within 500m of these islands.

Previous studies in America have listed Flushing Distances of Tern species to human disturbance which range from 100m (Rodgers and Smith, 1997), 180m (Rodgers and Smith, 1995) and 200m (Erwin 1989). Using these as a guide in the absence of any site specific field data we can surmise that activities at intertidal aquaculture sites over 500 m from Tern nest sites will not result in significant negative impacts on this feature of the SPA.

- <u>Damage to/disturbance within feeding areas</u>

The proposed marine extension to the Carlingford Lough SPA is based on analysis and reports undertaken by the Joint Nature Conservation Committee (JNCC) (NIEA, 2015). The proposed marine extension aims to protect the foraging areas of the Tern colonies within Carlingford Lough.

Terns are surface feeding seabirds (Furness and Tasker, 2000; Einoder, 2009) who feed primarily on fish species (Comeau *et al* 2009; Burger and Gochfeld 2003 and Cramp and Simmons, 2004 (cited in Christel *et al* 2013); and Comeau *et al* 2009), such as juvenile herring (Greenstreet *et al* 1999) and sandeels which are an important component in the diets of tern species (Dunn, 1972 and Tasker and Furness 1996).

As the proposed marine extension to the Carlingford Lough SPA aims to protect tern foraging areas it is important to establish if the benthic habitats within the Mill Bay area are suitable for sandeels. Sandeels have been shown to prefer sediments classified as medium and coarse sand (Holland *et al* 2005). Greenstreet *et al* (2010) defined four sandeel sediment preference categories based on the combination of "silt and fine sand" (particles <0.25 mm in diameter) and "coarse sand" (particles ranging from 0.25 to < 2.0 mm in diameter) particle size classes within the sediments (Figure 2.13). During surveys within Carlingford Lough undertaken by AFBI in 2016, 2018 and 2019, a total of 54 sediment samples were collected for Particle Size Analysis (PSA) within the area of Mill Bay (Figure 2.14). The results from these samples were grouped as per the two particle size classes described by Greenstreet *et al* (2010). When the results from the analysis of the samples collected within the Mill Bay area of Carlingford Lough were overlaid with the four sandeel preference categories described by Greenstreet *et al* (2010) we can see that 1 of these samples falls within the "Sub-prime" category, 6 fall within the "Suitable" category and the remaining 47 sites within the area of Mill Bay are within the "Unsuitable" category based solely on sediment particle size characteristics (Figure 2.15).

Sandeels prefer depths ranging between 30 to 70 m (Holland *et al*, 2005, Wright *et al* 2000) but have been found to occur as shallow as 15 m and up to depths of 120 m (Wright *et al* 1998 cited in Holland *et al*. 2005). The six sites within the "Sub-prime" category as per Greenstreet *et al.* (2010) are within the Intertidal area of Mill Bay therefore not within the depth range preferred by sandeels.

Becker and Ludwigs, (2004) (cited in Dänhardt and Becker, 2011) state the maximum diving depth for Common Tern as 0.5 m. Current and proposed intertidal aquaculture activities within Mill Bay therefore do not impact upon the feeding and foraging areas of the Tern species for which the Carlingford Lough SPA is designated.

The sample site that fell within the "Sub-prime" category falls within the subtidal area of Mill Bay on a licensed aquaculture site. The water depth at this sample site is

approximately 11m (as recorded during the sampling survey). The sediments at this site also contained cobbles and shell gravel.

Mussel beds are not the preferred habitat for herring therefore it can be inferred that Tern species within Carlingford Lough are not feeding within the areas where bottom culture of mussels is undertaken. Therefore vessel activity within bottom mussel cultivation areas will not disturb feeding terns. Wolsey (2011) has observed Common and Arctic Terns successfully foraging within the area of Carlingford Lough.

The main food source for Common Tern populations in the Wadden Sea has been identified as juvenile herring (Greenstreet *et al* 1999). Common Tern breeding success in the Wadden Sea has been strongly linked to the annual stocks of juvenile herring (Greenstreet *et al* 1999). An area within the Irish Sea just outside the mouth of Carlingford Lough has been identified as potential herring spawning grounds (Figure 2.16 AFBI unpublished data). Breeding Common Terns have a foraging range of approximately 4.5 ± 6.4km (Woodward et al. 2019). They could therefore potentially be feeding on juvenile herring within this area. The main prey species of Tern populations within Carlingford Lough is not presently known.

- Impacts on prey availability

The breeding Tern species for which Carlingford Lough is designated a SPA feed primarily on fish species (Greenstreet *et al*, 1999; Burger and Gochfeld 2003; Cramp and Simmons, 2004 (cited in Christel *et al* 2013); and Comeau *et al* 2009). Shellfish aquaculture within the area of Mill Bay will therefore not impact on the availability of prey species for these birds.

As can be seen from Figures 2.8 to 2.10 numbers of Terns have been very low in Carlingford Lough in recent years. The populations of Sandwich Tern and Common Tern within Carlingford Lough at time of designation are stated as being 575 and 339 respectively. In 2021 RSPB recorded the population of Sandwich Tern as being 52 and the population of Common Tern as being 84. This decline had been attributed to; wet weather, high tides, predation by Black backed gulls (Wolsey 2011 and 2012), disturbance, food availability, winter mortality and shifts in breeding populations outside of the site (Cook *et al*. 2013). The count of 52 Sandwich Tern recorded in 2021 is considered by the British Trust for Ornithology (BTO) as a small recovery (Booth Jones 2022). Breeding Sandwich Terns have a foraging range of 9 ± 9.2 (Woodward et al. 2019). An intensive programme of conservation and monitoring of Sandwich

Terns within Carlingford Lough resulted in improved breeding success from 2011 to 2015, however overall productivity has been consistently low due to the suspected predation of eggs and young by Otter (Matthew Tickner, RSPB pers. comm, cited in Booth Jones 2022). The current status of both the Common Tern and Sandwich Tern populations within Carlingford Lough is Unfavourable (NIEA 2015).

Overwintering (non breeding) Birds

Current and proposed aquaculture activities within the Mill Bay area of Carlingford Lough have the potential to negatively impact the overwintering (non breeding) bird populations for which the Carlingford Lough SPA is designated (namely Light-Bellied Brent Geese) through;

- Human presence within their preferred habitats
- Damage/disturbance to feeding areas/species

Light Bellied Brent Geese numbers within Carlingford Lough are counted annually through the Wetland Bird Survey (WeBS) Wildfowl and Wader Counts. Figure 2.17 shows the WeBS count data for the Light Bellied Brent Goose population within Carlingford for the winters of 1989/90 to 2019/20. These counts are undertaken at high tide and may not be representative of the populations utilising the site at low tide (when intertidal aquaculture operators are onsite).

- Human presence within their preferred habitats

Gittings and O'Donoghue (2012) investigated the effects of intertidal oyster aquaculture on the distribution of waterbirds within six sites in the Republic of Ireland. In their investigations Gittings and O'Donoghue (2012) found that Light Bellied Brent Geese showed a variable response to oyster trestles. During their investigations Gittings and O'Donoghue (2012) state that "detectable disturbance impacts to birds were only observed occasionally and were usually minor (birds which flushed but resettled nearby)" and at some sites Light bellied Brent Geese were observed feeding on top of the oyster trestles.

The Light Bellied Brent Geese populations that feed within Carlingford Lough have been observed travelling approximately 23.4km along the coast to roost in Dundalk Bay (Martin 2013 unpublished data).

- Damage/disturbance to feeding areas/species

The preferred food of Brent Geese is intertidal eelgrass (Owen and Black 1990, Hassall and Lane 2005, Inger *et al.* 2006). The distribution of intertidal eelgrass within Carlingford Lough (as provided by DAERA) is shown in Figure 2.18. From Figure 2.18 it can be seen that on the Northern shores of Carlingford Lough the intertidal eelgrass beds are confined to a small portion of the Mill Bay area. Figure 2.19 shows an overlay of the current licensed aquaculture sites within Mill Bay and the three new applications (as submitted) and the most recent eelgrass distribution maps for the whole of Carlingford Lough. From Figure 2.19 it can be seen that neither the existing nor proposed licensed aquaculture sites are within areas identified as intertidal eelgrass beds.

Current and proposed intertidal oyster culture sites within the Mill Bay area of Carlingford Lough have the potential to cause disturbance to Light Bellied Brent Geese populations through human presence in intertidal areas within which they feed on eelgrass. As can be seen in Figure 2.19 neither the existing nor proposed licensed aquaculture sites overlap with identified eelgrass beds. Surveys of the access routes utilised by the operators of the licensed intertidal aquaculture sites within Mill Bay were undertaken as part of the Cumulative Impact Assessment of Carlingford Lough aquaculture (AFBI 2013, Annex IV to Annex VIII). Surveys were also undertaken of the benthic habitats within the area of proposed application A and B (see individual HRA reports, available from DAERA, for these applications). Eelgrass was not observed during any of these surveys. Small patches of green algae (*Ulva* and *Enteromorpha* sp) were noted at the top of the shore beside and along the access routes during some of the surveys (AFBI 2013, Annex IV to Annex VIII). Inger *et al.* (2006) investigated prey choice in the Light Bellied Brent Goose population within Strangford Lough and stated that the “further depletion of *Zostera* leads an increasing proportion of the population to seek alternative food sources”. These alternative food sources are cited as being green algae, saltmarsh plants and terrestrial grassland (Owen and Black 1990, Inger *et al.* 2006).

Owen and Black (1990) and Hughes and Green (2005) observed that the feeding patterns of Brent Geese are related to tidal cycles. Brent Geese can therefore be both diurnal and nocturnal feeders. As a result of this during the darker winter months these birds will be able to feed on intertidal eelgrass during night time low tides undisturbed by aquaculture operators who cannot access their sites at this time. When looking at

feeding preferences in dark-bellied Brent geese (*Branta bernicla bernicla*) feeding on salt marshes at high tide, Hassall and Lane (2005) found that 22% of the time the birds were observed feeding occurred at night.

Preliminary studies on the effects of oyster trestles on bird feeding behaviour found that the percentage of birds observed feeding did not differ between the reference areas (free of aquaculture) and the trestle areas (Hilgerloh *et al* 2001).

2.3 Aquatic Animal Health

Northern Ireland has a high fish health status which must be safeguarded to support trade, with Carlingford Lough declared free for a number of listed aquatic diseases, namely *Marteilia refringens* and *Bonamia ostrea*, diseases which affect Native oysters (*Ostrea edulis*). The aquatic health regime is underpinned by Regulation (EU) 2016/429, the Animal Health Law (AHL), which lays down rules for the prevention and control of diseases which are transmissible to animals or humans, including rules for aquaculture establishments and transporters of aquatic animals. The AHL requires aquaculture establishments where aquaculture animals are kept with a view to their being moved, either alive or as products of aquaculture animal origin, to be approved by the Competent Authority, DAERA. Aquaculture establishments must take measures to prevent and control the spread of disease, including presenting a biosecurity plan as part of the approval process and, following approval, demonstrating its implementation. Most approved aquaculture establishments must also participate in a risk-based surveillance scheme put in place by DAERA. The AHL also sets out movement and health certification requirements for importing or exporting aquaculture animals into or out of Northern Ireland, facilitated by the European Commission's TRACES NT digital certification and management system. In addition to operator's having to notify DAERA in advance of a proposed movement of aquaculture animals, imports, exports and internal movements of shellfish are routinely monitored and inspected by the DAERA Fish Health Inspectorate to ensure compliance with relevant legislative requirements.

2.4 Non-Native Species

The Molluscan Shellfish (Control of Deposit) Order (Northern Ireland) 1972 prohibits the introduction into Northern Ireland waters of molluscan shellfish taken from outside Northern Ireland waters except under the authority of a permit granted by DAERA.

Only imports of shellfish originating from areas known to be free from non native species are permitted.

Seed mussel used for bottom culture in the Mill Bay area of Carlingford Lough are sourced from naturally occurring seed bed. Other bivalves for aquaculture, such as Pacific oysters (*Magallana gigas*) can be produced in purpose built authorised premises remote from the natural environment to remove exposure to aliens and disease. Consignments are packed dry before transport and are inspected by the local competent veterinary authority before despatch (CEFAS in England and Wales) and are accompanied by certification. All movements are recorded on TRACES by the competent authority.

The movement of Pacific oysters, which is a non native species, is also regulated under the Alien and Locally Absent Species in Aquaculture Regulations (Northern Ireland) 2012, which implement Council Regulation (EC) No 708/2007 on the use of alien and locally absent species in aquaculture.

Pacific oysters were introduced primarily to substitute declining native oyster stocks (Herbert *et al* 2012). It was previously believed that the Pacific oyster *M. gigas* was unable to breed in the colder UK waters, but the presence of established feral populations at several sites have shown that this is not the case.

To date there are no reported feral populations of *M. gigas* present within Carlingford Lough.

2.5 Benthic Impacts of Aquaculture

Intertidal oyster culture in the Mill Bay area of Carlingford Lough is undertaken within the boundaries of the Carlingford Lough SPA. It has the potential therefore to impact the benthic habitats within this designated site.

Filter-feeding bivalves remove suspended matter from the water column. A portion of what is captured is excreted as faeces whilst another part is sorted and rejected without being ingested and is referred to as pseudofaeces (ICES 2020). The bioaccumulation of faeces and pseudofaeces beneath intertidal oyster trestles has the potential to impact benthic community structures. These impacts are generally considered to the small scale and localised (Nuges *et al*, 1996; Forrest and Creese 2006; Forrest *et al,*

2009 and the literature reviewed within). Nuges *et al* (1996) studied the environmental impacts of Pacific oyster trestle culture in the River Exe estuary in Devon. They noted small but detectable changes in benthic communities and sedimentation levels beneath trestles that were twice those in the control areas, although the changes in sedimentation were not found to be statistically significant. De Grave *et al* (1998) investigated the impacts of large scale oyster culture in Dungarvan Bay and did not observe any evidence of organic enrichment underneath the trestles. Increased sedimentation beneath Pacific oyster trestles was observed by Forrest and Creese (2006) in a New Zealand estuary however, impacts from oyster culture was not noted 35m from the sites. Forrest and Creese (2006) also noted that "effects on macrofauna were not severe enough to produce a marked trend in species richness".

Oyster trestles within the Mill Bay area of Carlingford Lough are generally around 50 cm above the ground. This ensures adequate circulation and reduces sedimentation (Nuges *et al* 1996). In order to ensure that any changes in benthic sediments and communities remain small and localised, a programme of monitoring has been established (in agreement with the DAERA) for all new intertidal aquaculture sites within Carlingford Lough granted in recent years. Baseline core samples and samples for Particle Size Analysis (PSA) are collected before the installation of trestles onsite (to be used as a baseline for future comparisons). PSA samples are collected monthly for analysis. If changes in sediments are detected then further Infaunal samples are collected for baseline comparison and management options explored.

AFBI are currently monitoring sediment particle size within three licensed oyster aquaculture sites within the Mill Bay area of Carlingford Lough. Sediment samples for Particle Size Analysis (PSA) are collected regularly at 10 locations across these three sites. These PSA samples were collected as per AFBI Standard Operating Procedure (SOP) MARSIM056. Where possible all sites are sampled monthly, however during 2020 and 2021 due to the restrictions imposed as a result of the ongoing COVID-19 Pandemic this was not always possible. Samples are logged and frozen immediately on return to the laboratory in line with AFBI SOP MARSIM038. These samples are then sent to a subcontractor for analysis.

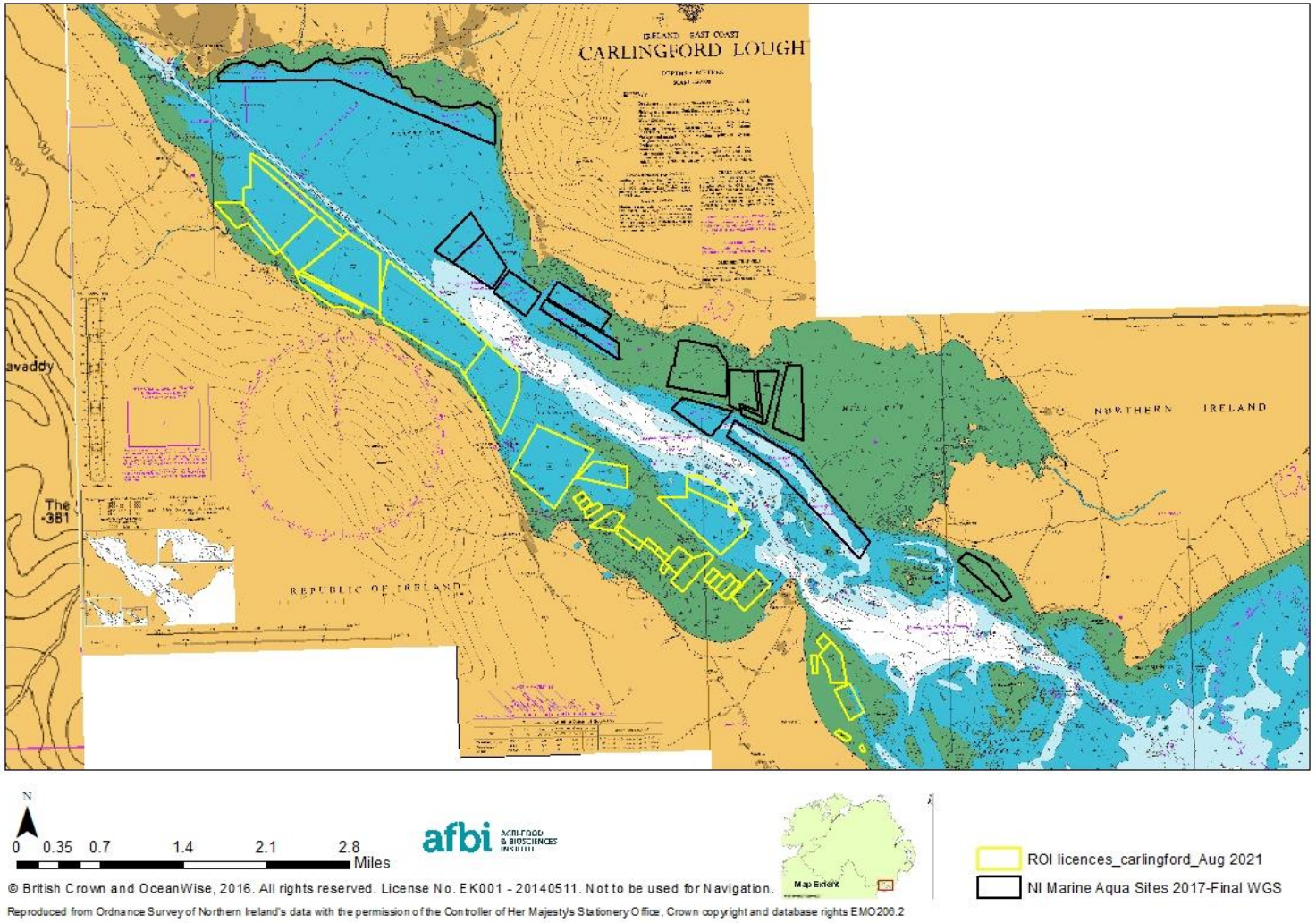

Figure 2.1: Map showing the location of all currently licensed aquaculture sites within Carlingford Lough.

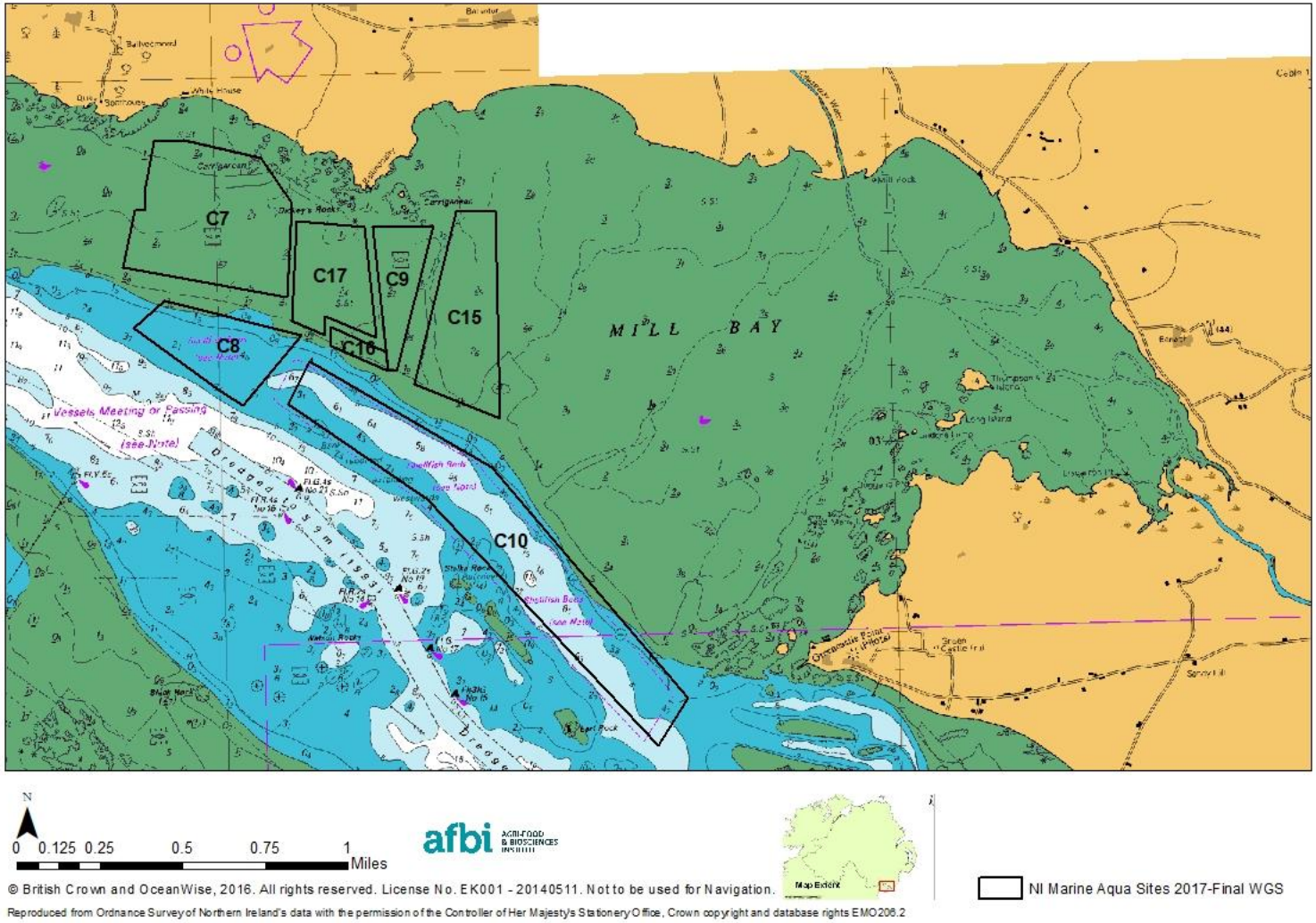

Figure 2.2: Map showing the location of all currently licensed aquaculture sites within the Mill Bay area of Carlingford Lough.

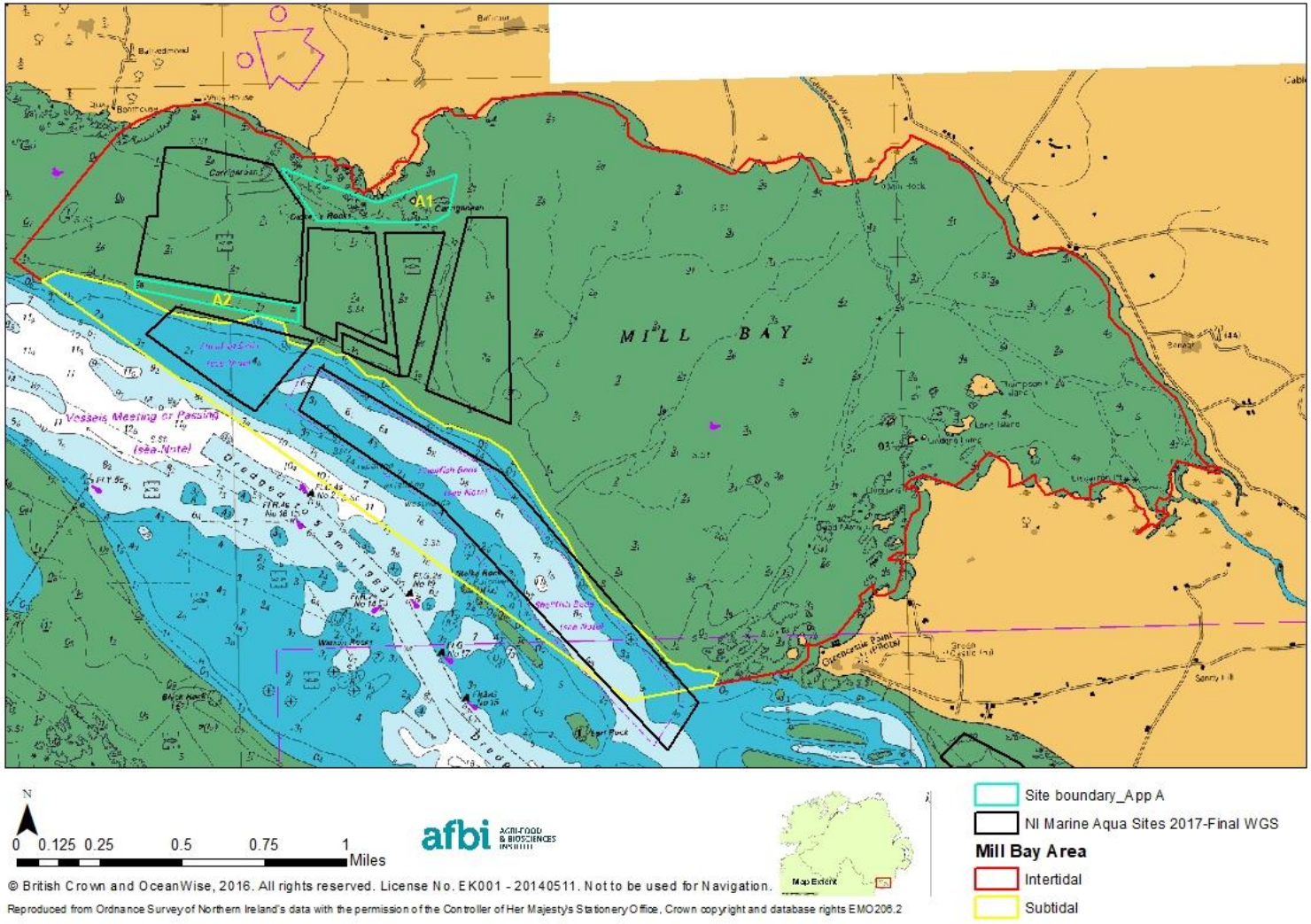

Figure 2.3: Map showing the location of the proposed new aquaculture sites within Mill Bay as per Application A.

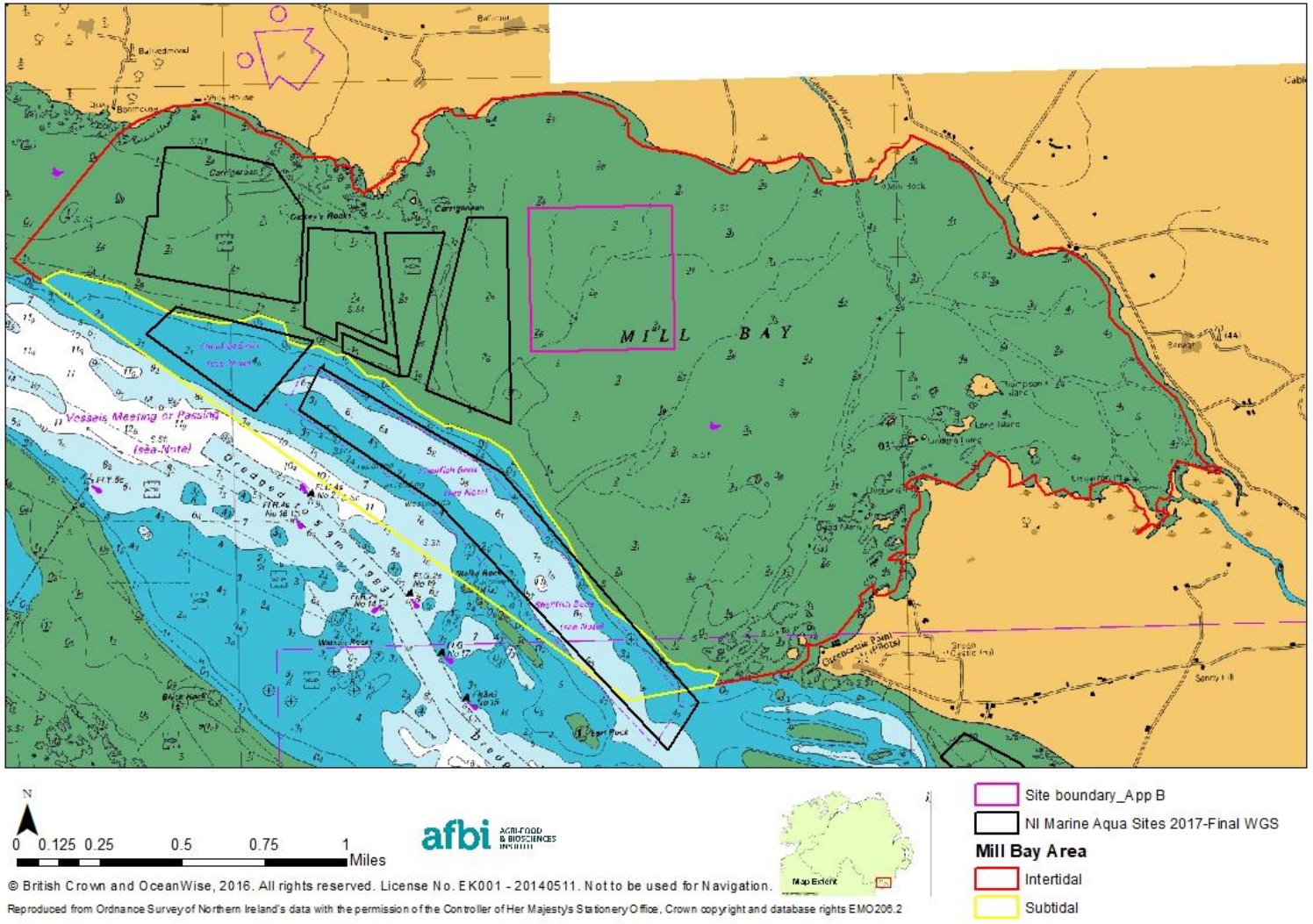

Figure 2.4: Map showing the location of the proposed new aquaculture site within Mill Bay as per Application B.

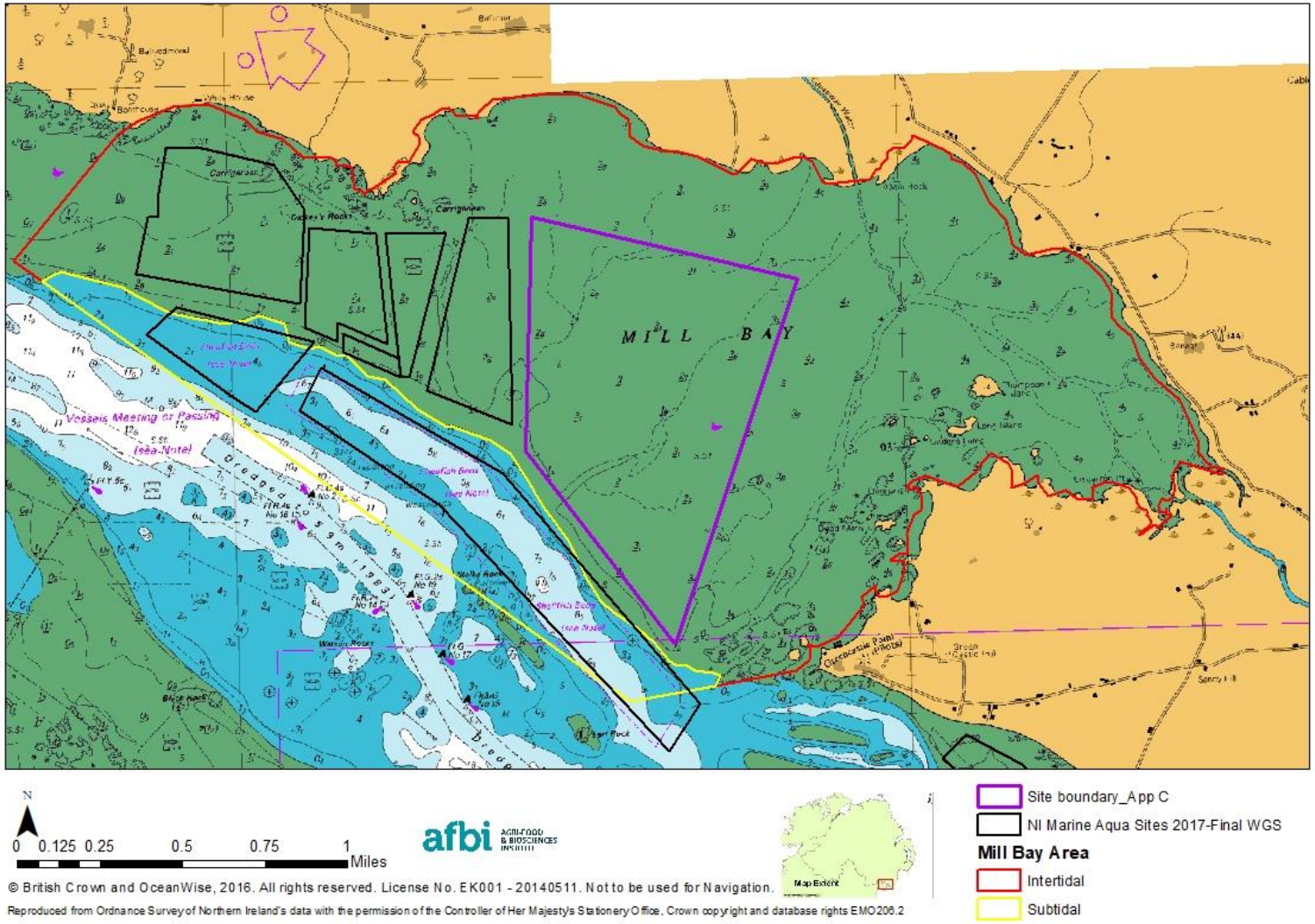

Figure 2.5: Map showing the location of the proposed new aquaculture site within Mill Bay as per Application C.

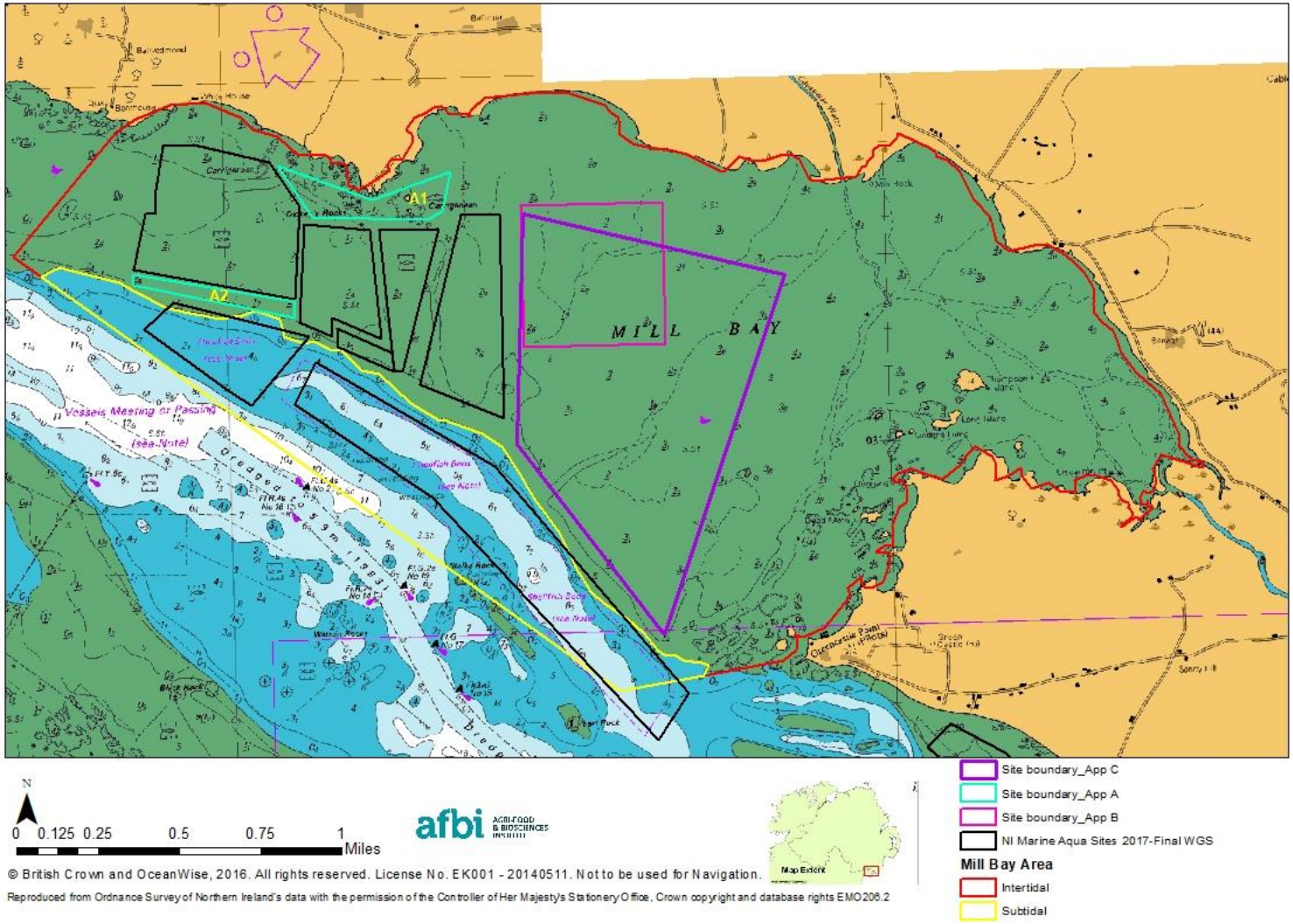

Figure 2.6: Map showing the location of all proposed new aquaculture sites within Mill Bay as per Applications A, B and C.

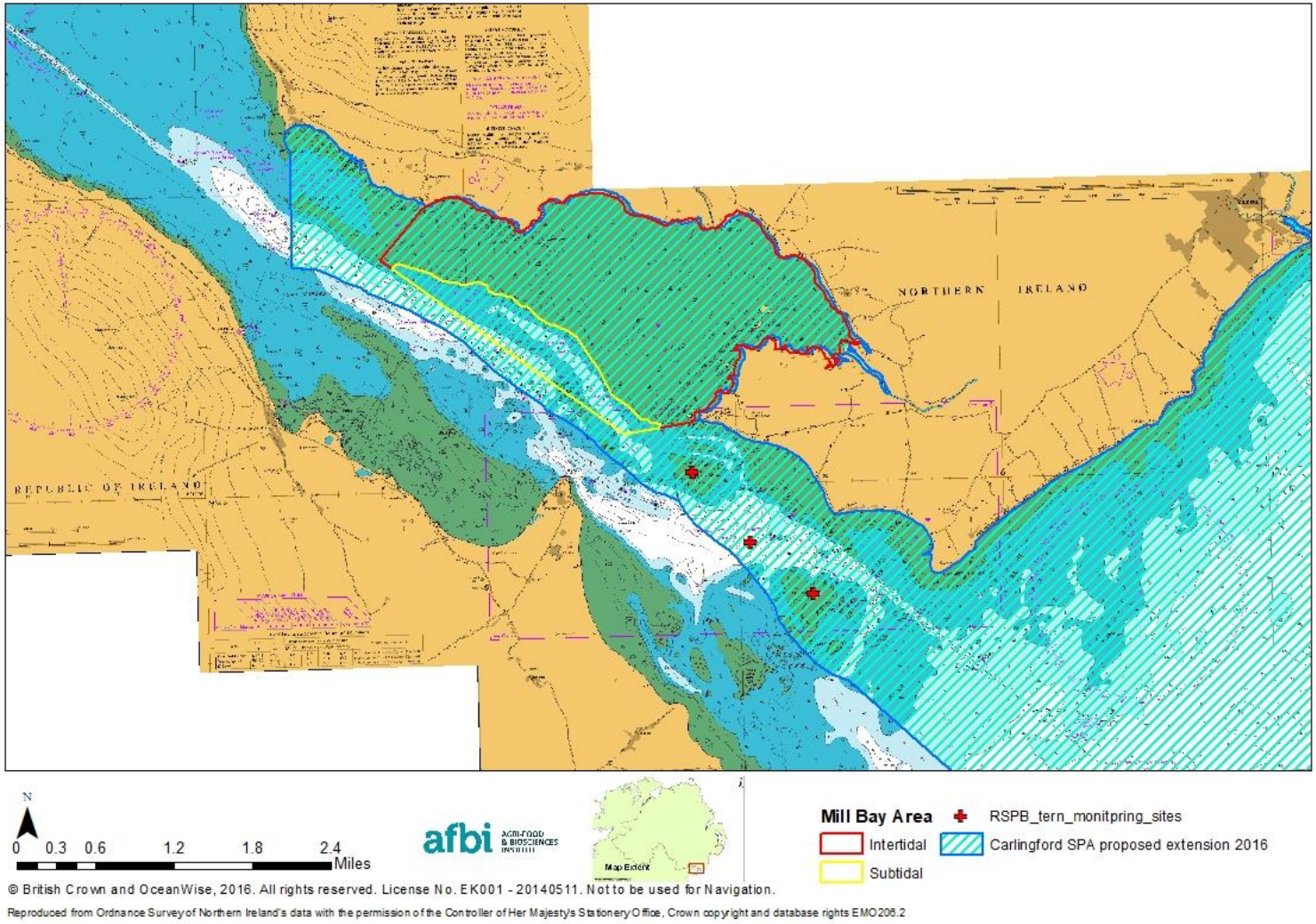

Figure 2.7: Map showing the islands monitored by RSPB for Breeding Tern species within Carlingford Lough.

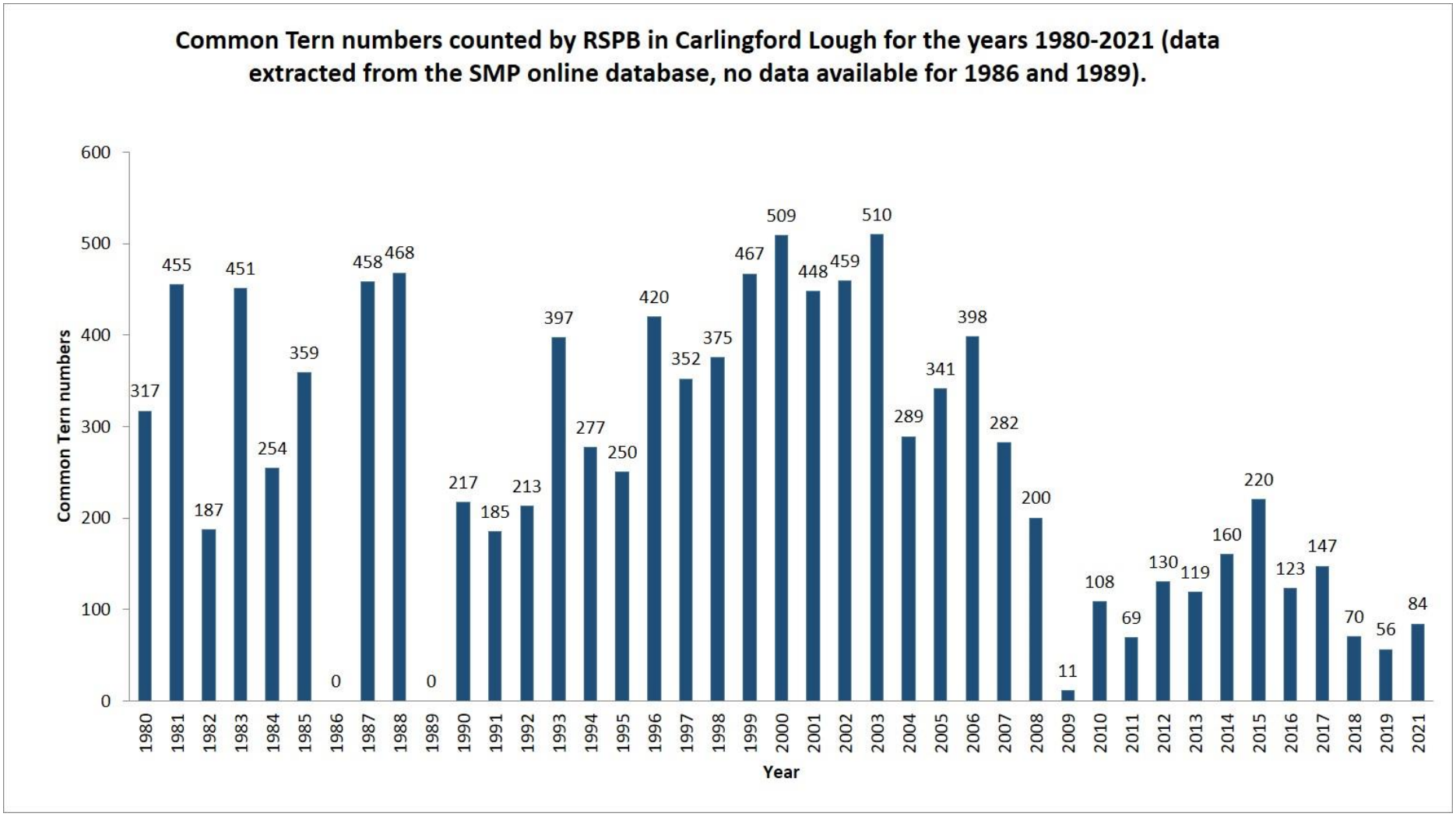

Figure 2.8: RSPB count numbers for Common Tern populations within Carlingford Lough.

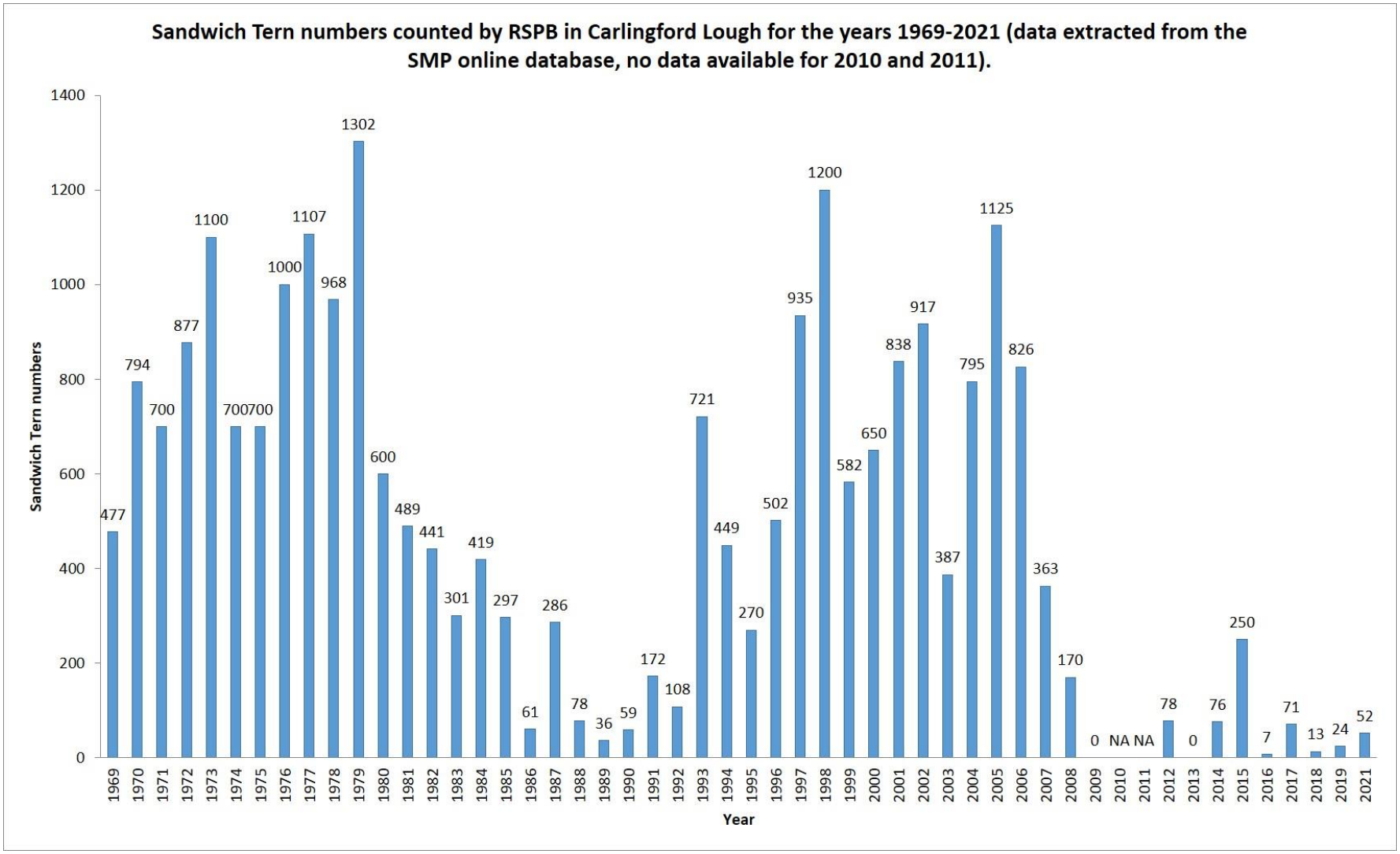

Figure 2.9: RSPB count numbers for Sandwich Tern populations within Carlingford Lough.

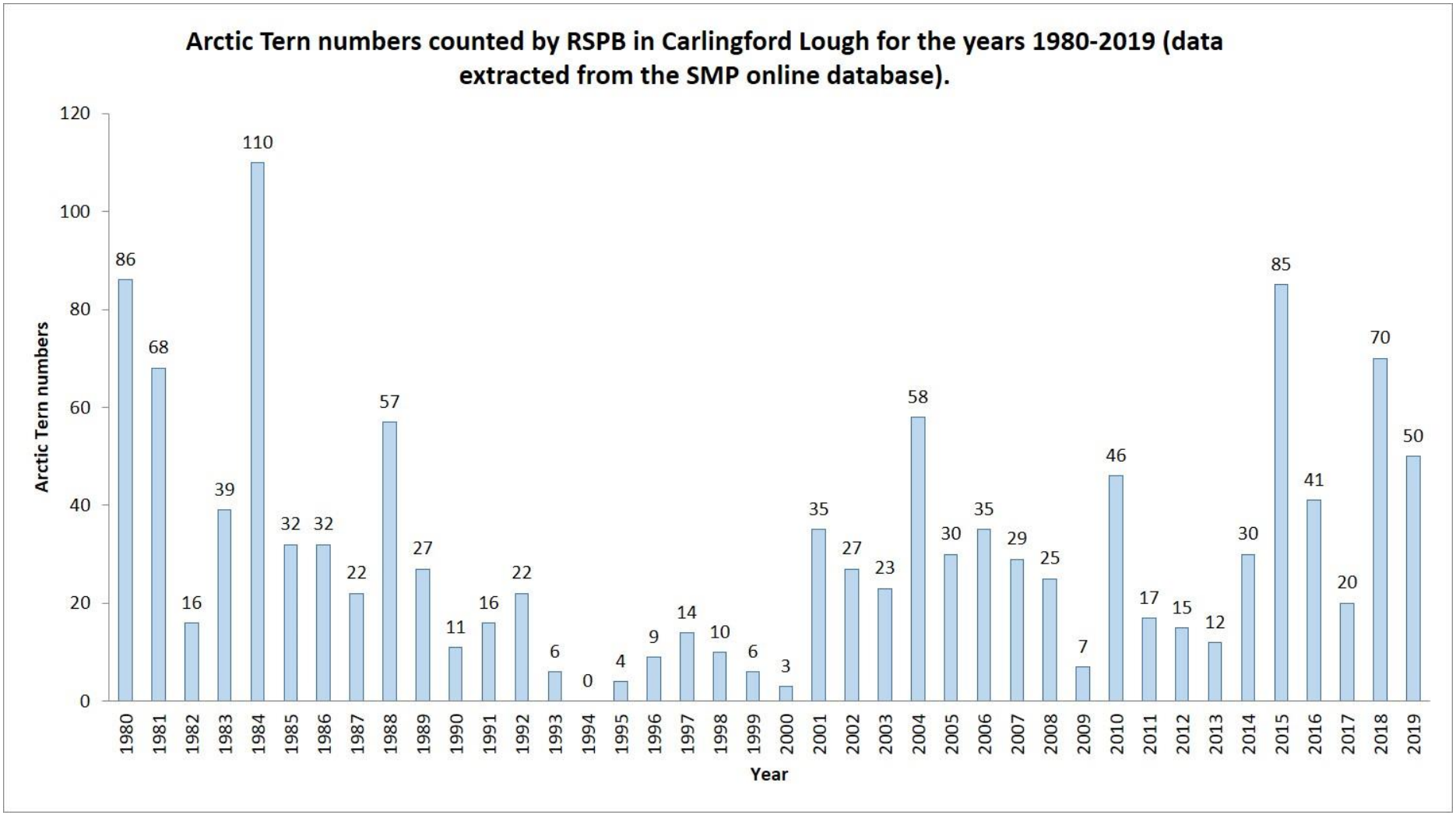

Figure 2.10: RSPB count numbers for Arctic Tern populations within Carlingford Lough.

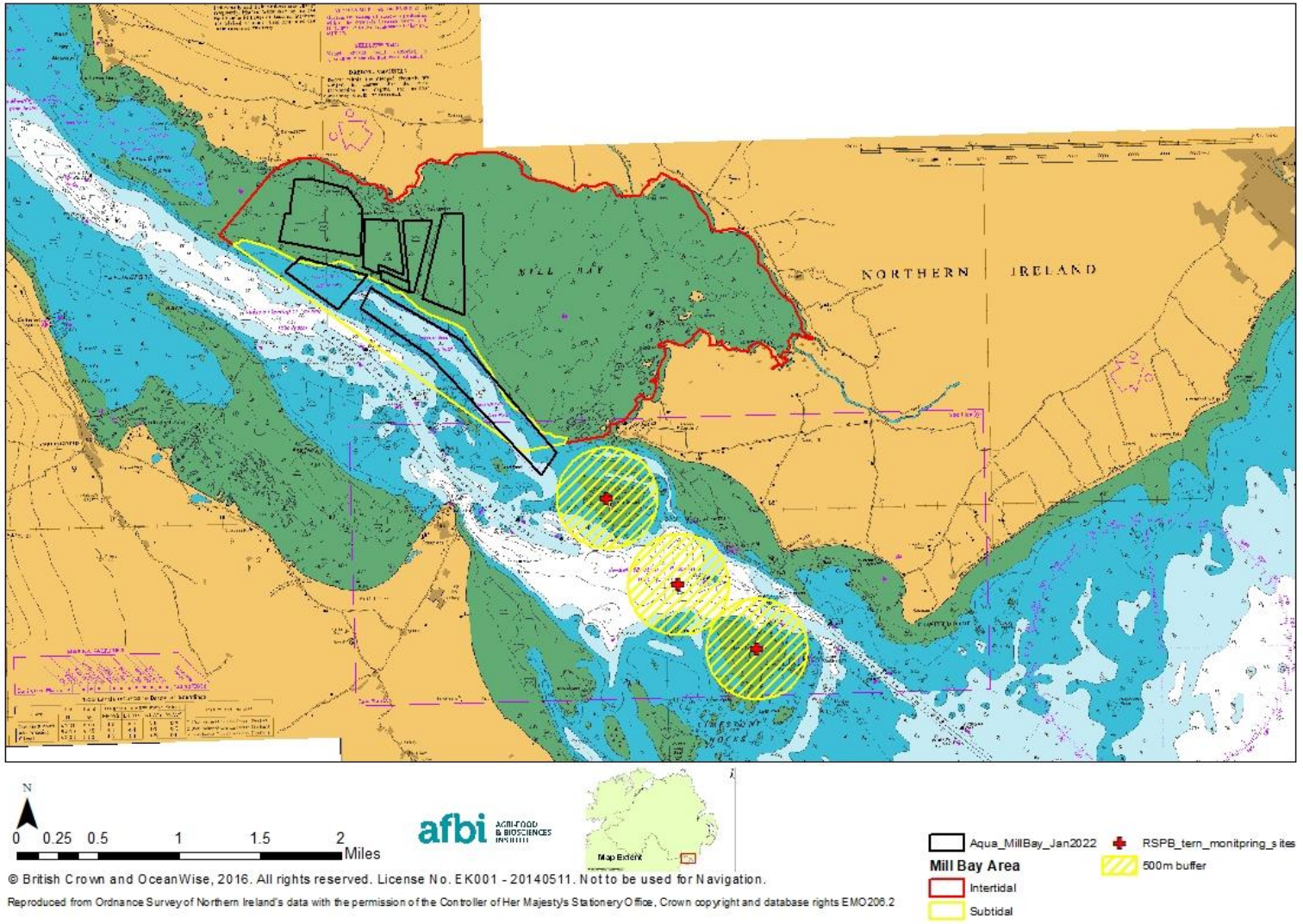

Figure 2.11: Map showing the licensed aquaculture sites within Mill Bay and the Islands within Carlingford Lough on which Tern species breed to which a 500 m buffer has been applied (yellow hashed area).

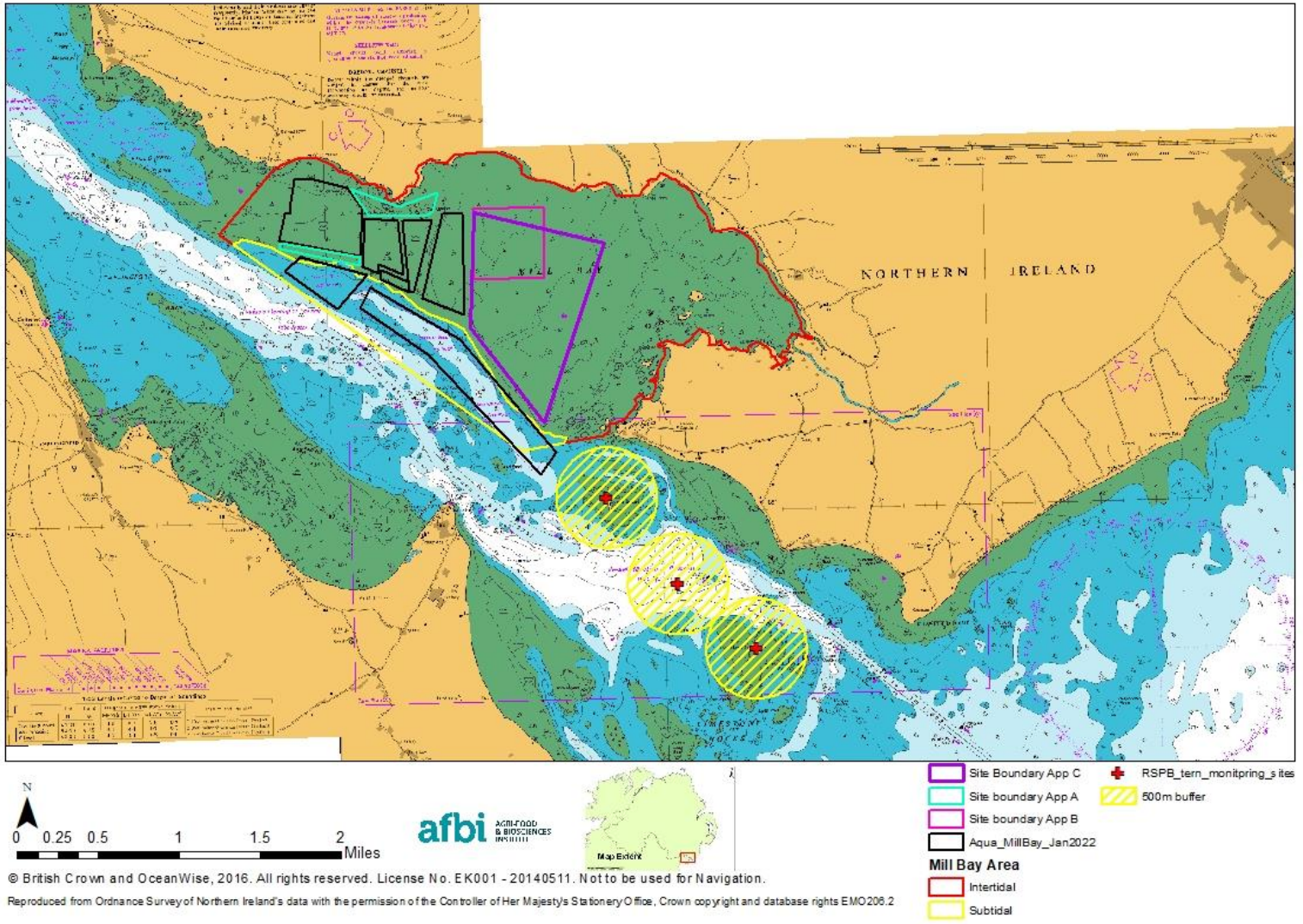

Figure 2.12: Map showing the proposed new aquaculture sites within Mill Bay and the Islands within Carlingford Lough on which Tern species breed to which a 500 m buffer has been applied (yellow hashed area).

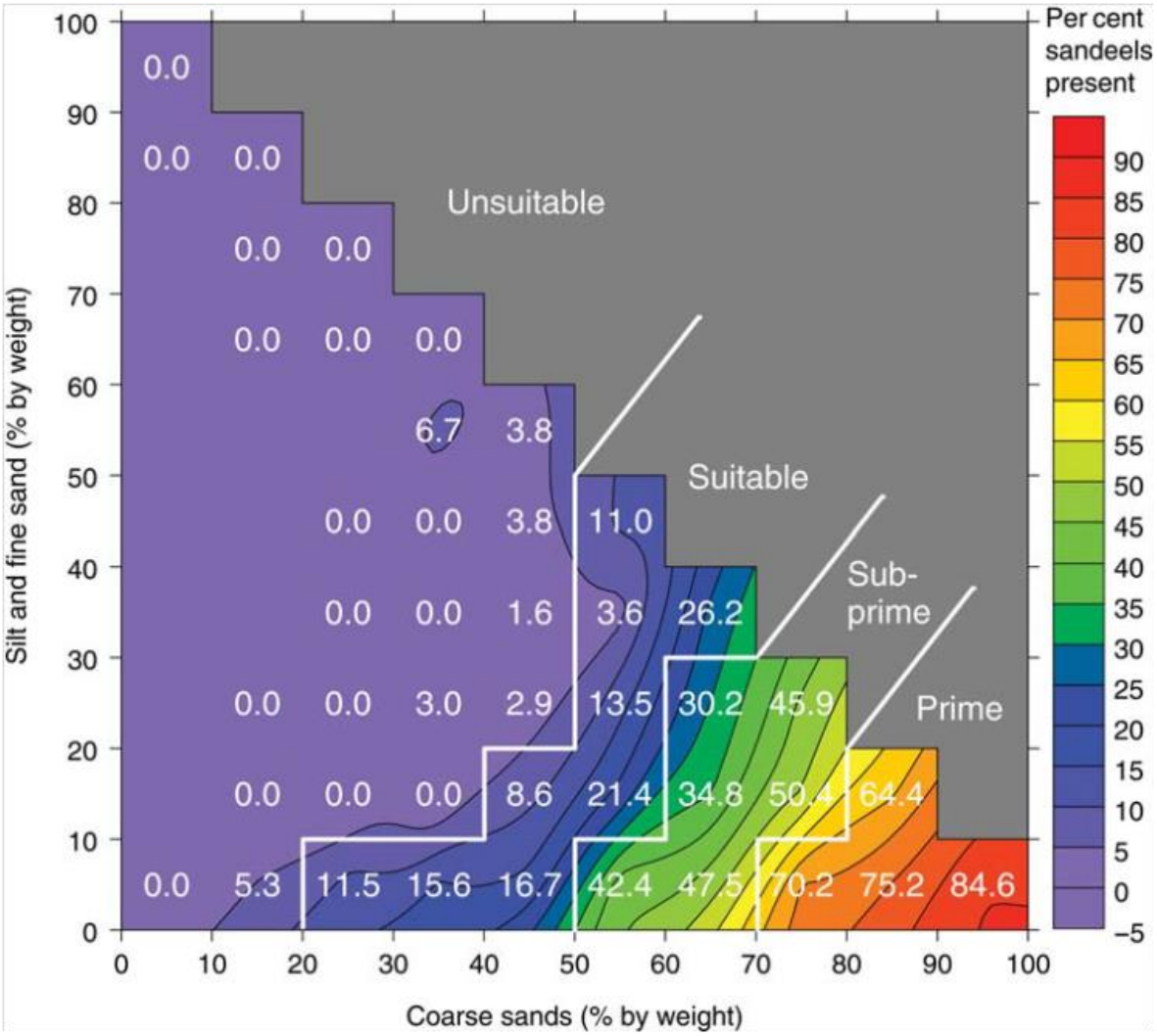

Figure 2.13: Four sandeel sediment preference categories as determined by Greenstreet *et al* 2010. Taken directly from Greenstreet *et al* 2010.

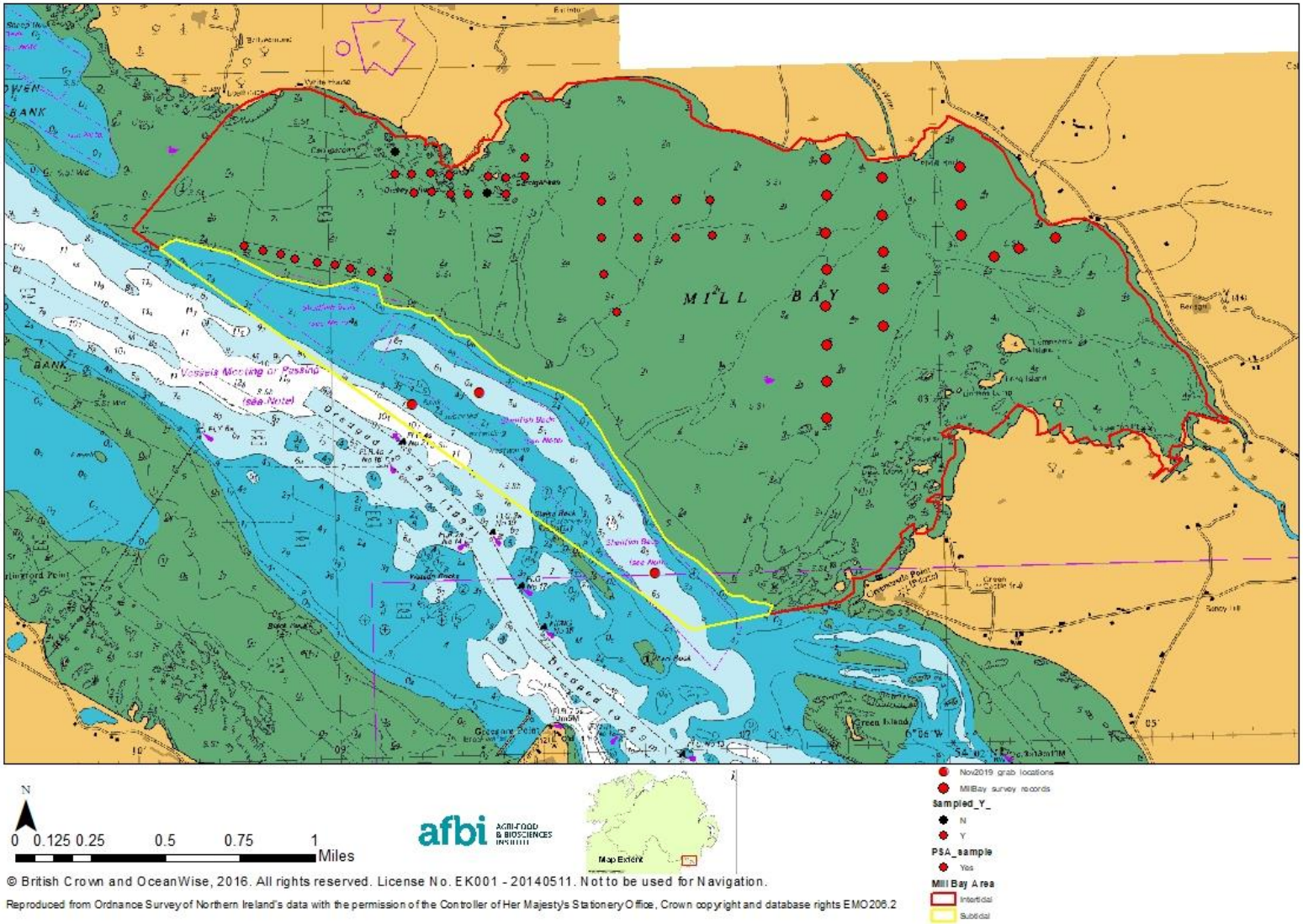

Figure 2.14: Map showing the locations of the Particle Size Analysis sample sites within the Mill Bay area of Carlingford Lough.

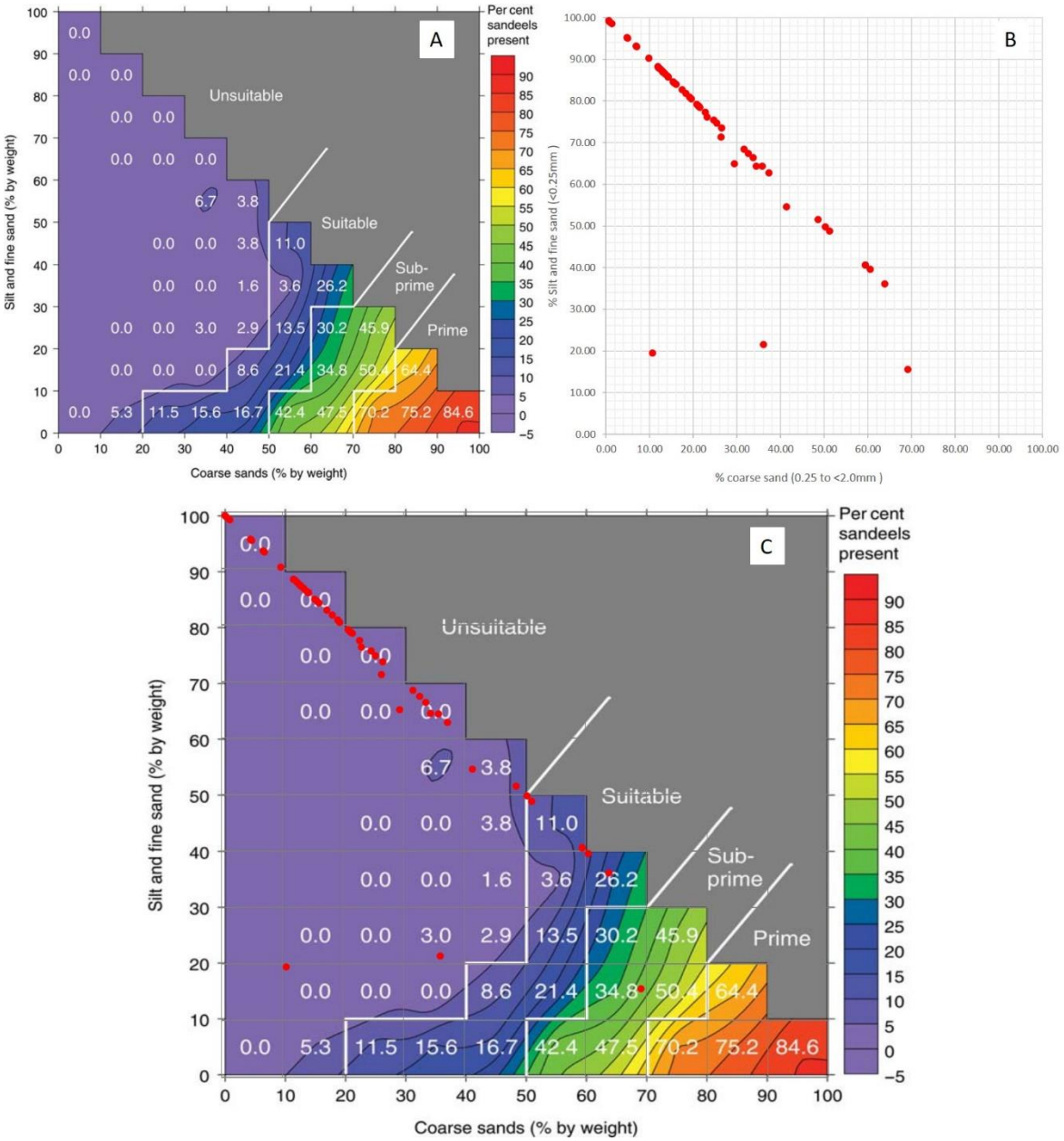

Figure 2.15: A) Four sandeel sediment preference categories as determined by Greenstreet *et al* 2010. B) Particle Size Analysis results for sediments collected within the Mill Bay area of Carlingford Lough. C) Results for sediments collected within the Mill Bay area (red dots) overlaid on the graph produced by Greenstreet *et al* 2010.

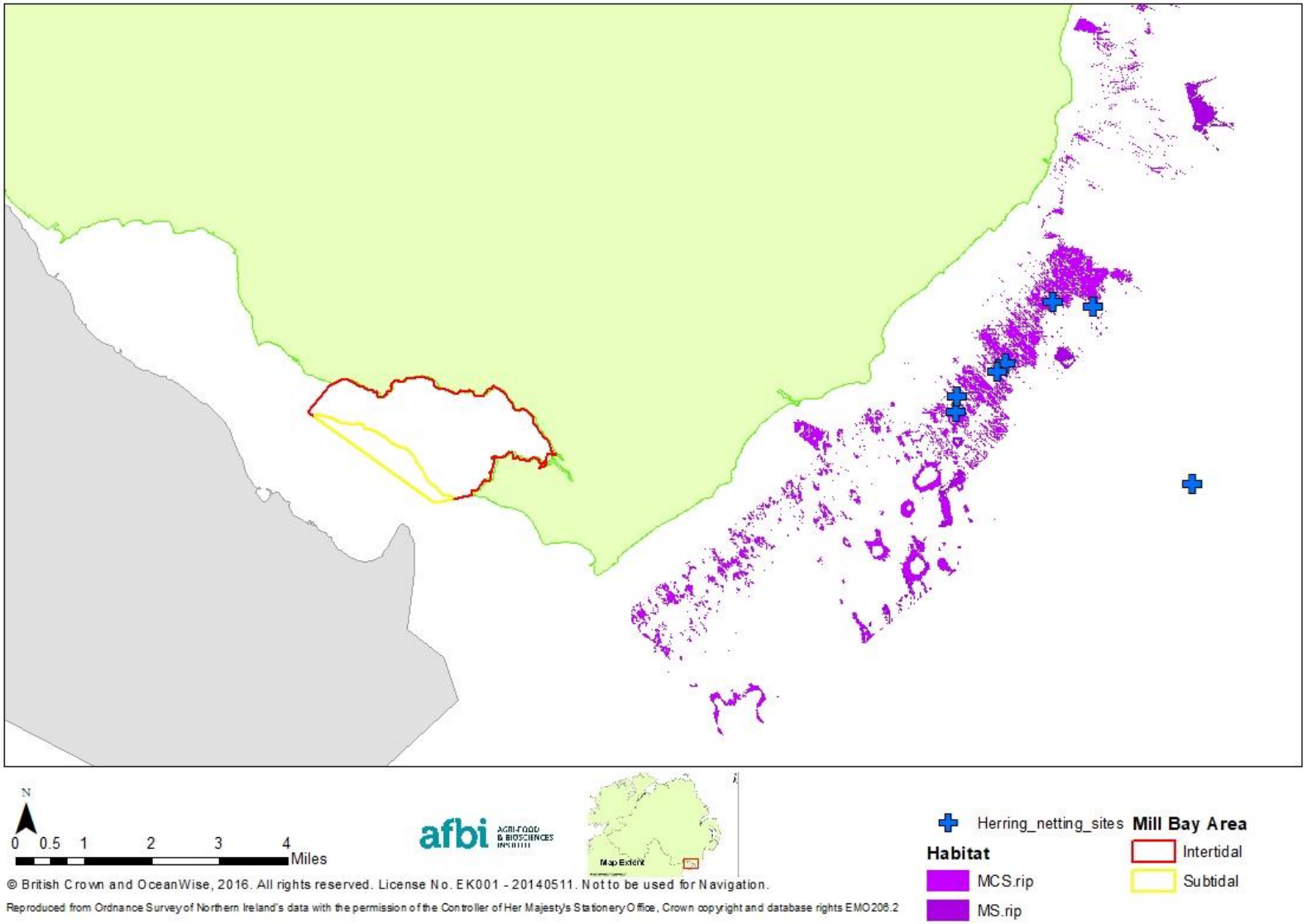

Figure 2.16: Map showing areas outside Carlingford Lough identified as potential herring spawning grounds.

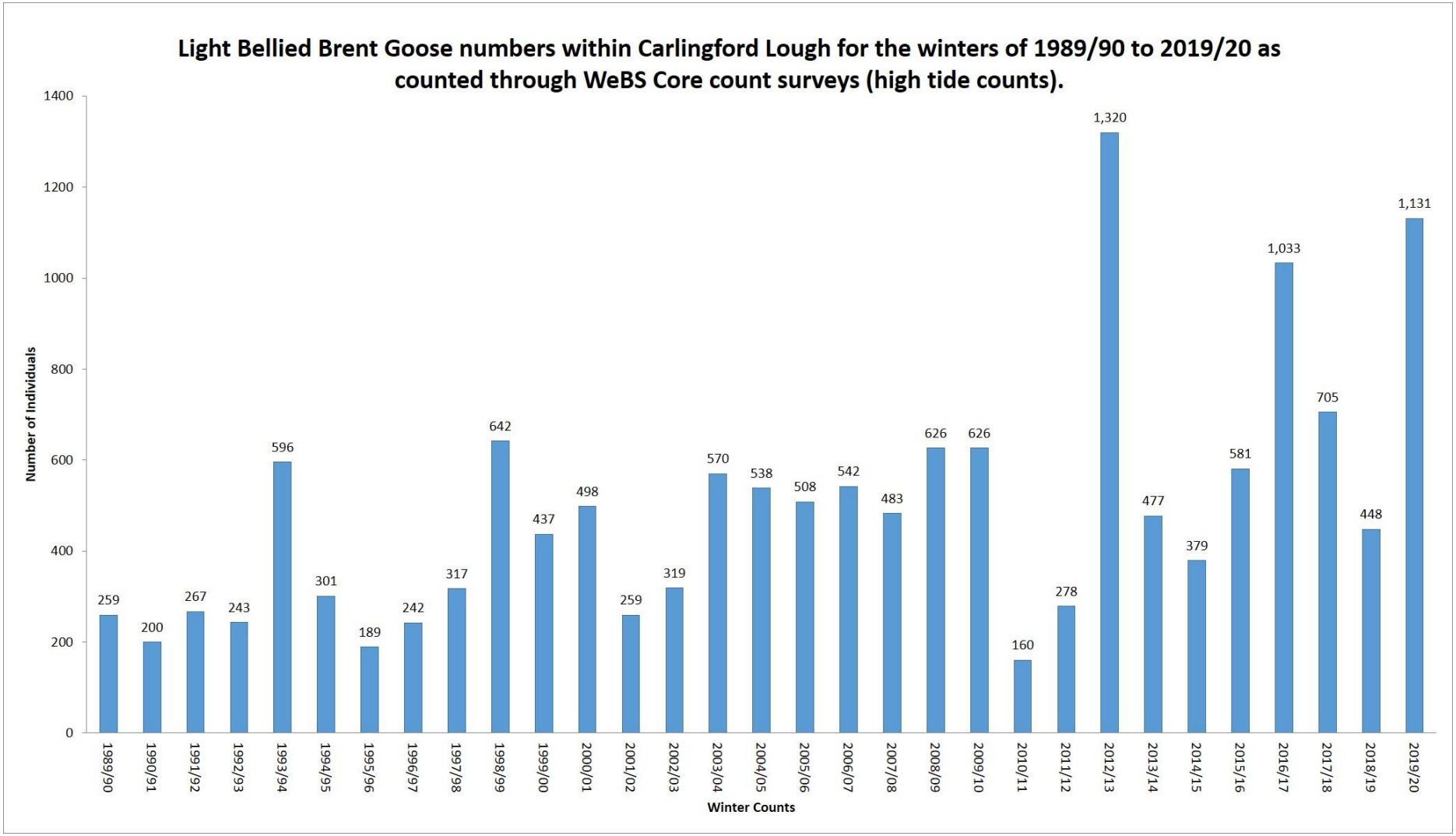

Figure 2.17: Graph showing the maximum numbers of Light bellied Brent Goose counted (per count season) within WeBS Core counts (high tide counts) within Carlingford Lough (for the winters of 1993/94 to 2019/20 (data supplied by DAERA).

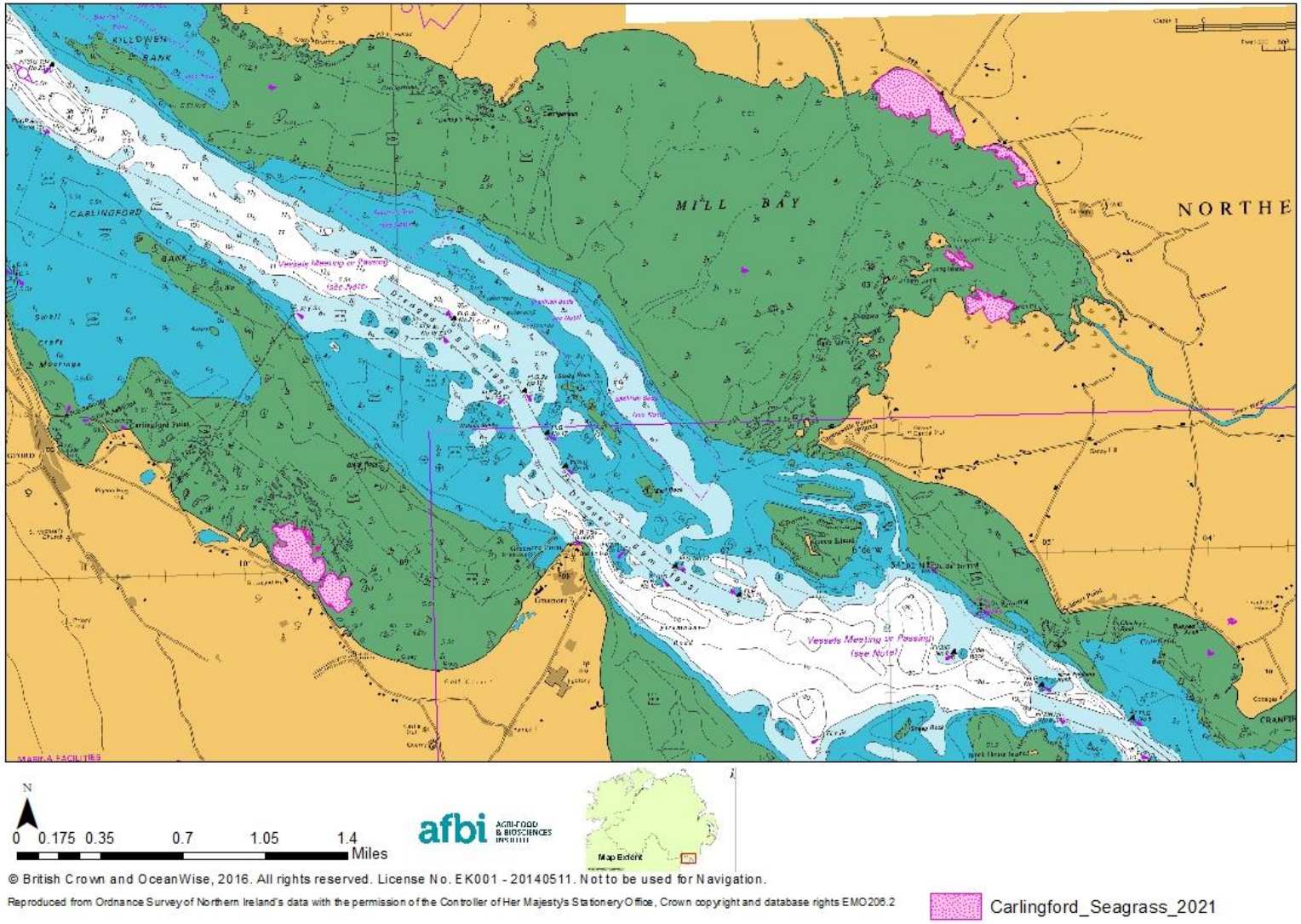

Figure 2.18: Map showing the distribution of intertidal eelgrass within Carlingford Lough as provided by DAERA.

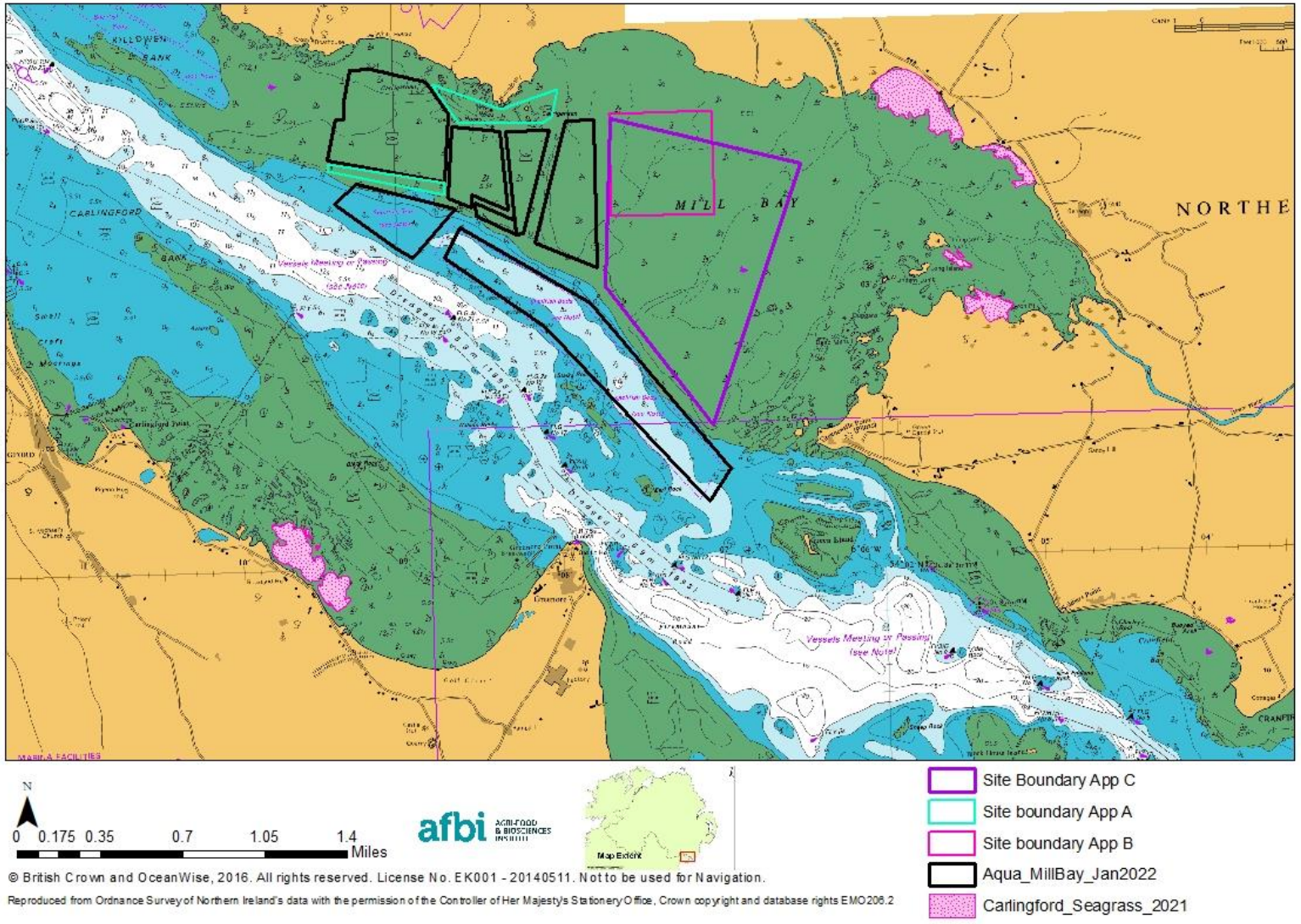

Figure 2.19: Map showing the location of the proposed new aquaculture sites in relation to the distribution of intertidal eelgrass within Carlingford Lough as provided by DAERA

3 Amended application areas

As discussed in Section 2.1 above, and as can be seen in Figure 2.6, there is spatial overlap between the proposed licence areas outlined within application B and application C. As two licenses cannot be granted for the same area DAERA requested that AFBI assess all three applications and produce an options paper for reducing the sites areas and proposed production. The full report submitted to DAERA is shown in Annex A.

The location of the proposed new site boundaries are shown in Figure 3.1 and the new areas and proposed production are outlined in Tables 3.1 and 3.2 below.

Table 3.1: Original size of sites as outlined within the applications (in hectares) and the proposed new sizes (in hectares).

Application	original area (Ha)	proposed new area (Ha)	% reduction (area)
A (1+2)	16.7	5.2	68.9
B	49	33	32.7
C	168	41	75.6

Table 3.2: Original annual production of the proposed new sites as outlined within the applications (in tonnes) and the proposed new annual production (in tonnes). The proposed new annual production figures for each application, as stated below, were agreed with all applicants at a meeting in Rathkeltair House on the 28th of November 2022.The Percentage reduction relates to the AFBI proposed reduction of the area of the sites as outlined within Table 3.1.

Application	original annual production	% reduction	proposed new annual production
A (1+2)	80	68.9	78
B	190	32.7	99
C	500	75.6	99

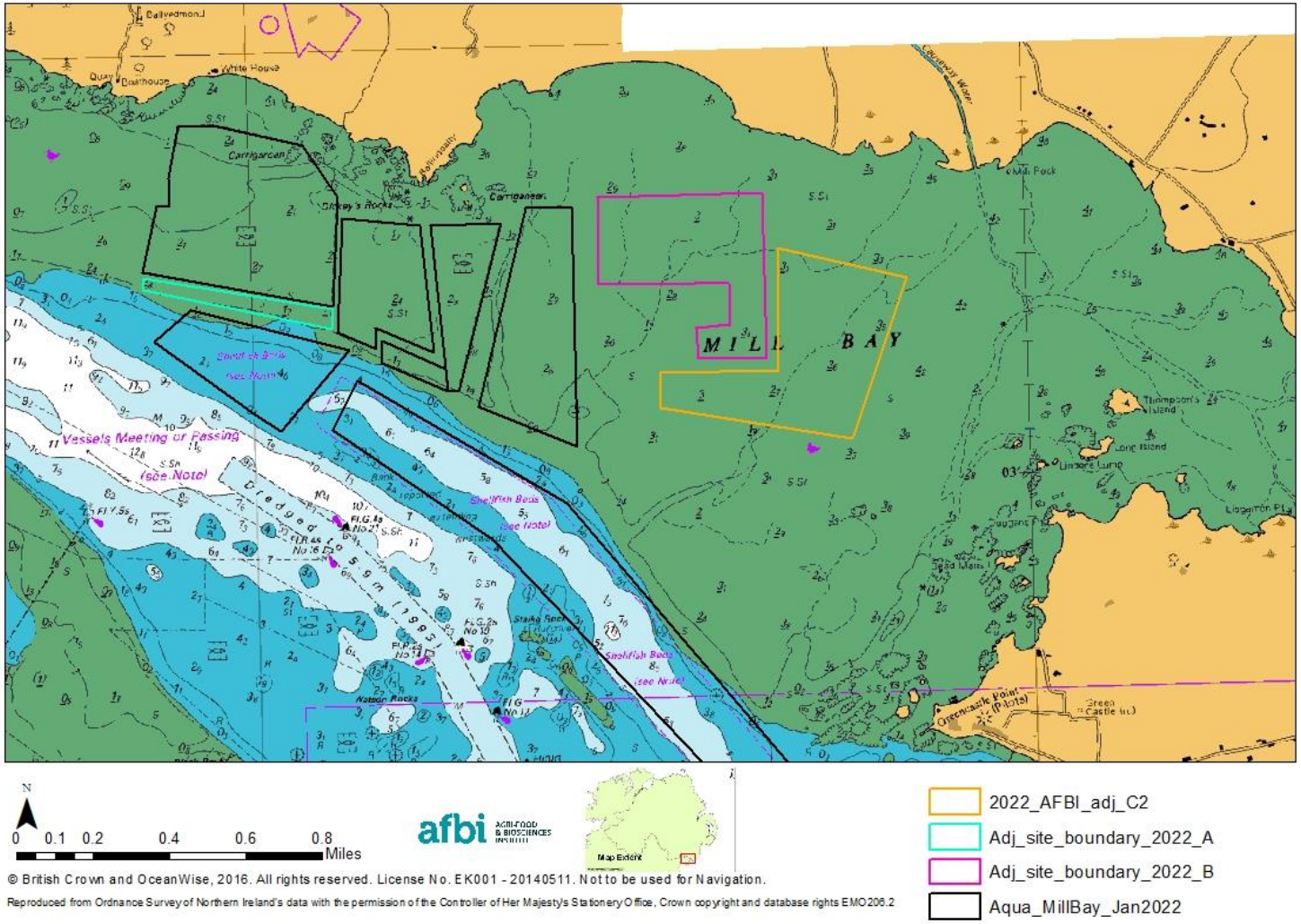

Figure 3.1: Map showing the proposed new boundaries for Applications A, B and C within the Mill Bay area of Carlingford Lough.

4 Ecological Carrying Capacity Assessment

In order to assess the ecological carrying capacity of aquaculture activities within the Mill Bay area of Carlingford Lough the Sustainable Mariculture in northern Irish Lough ecosystems (SMILE) model has been utilised. The SMILE model is used for the collation and processing of scientific information. The SMILE model was developed in 2007 and it enables the application of an integrated framework for the determination of sustainable carrying capacity within the shellfish production areas for which it was developed (namely, Carlingford Lough, Strangford Lough, Belfast Lough, Larne Lough and Lough Foyle). For further information on the SMILE model please refer to Ferreira *et al* (2007).

The original SMILE model developed for Carlingford Lough was updated in 2016 to incorporate new bathymetric data that had been collected since the completion of the original models in 2007. This resulted in an update to the Hydrodynamic model component of the SMILE model within Carlingford Lough enabling a finer scale hydrodynamic model grid to be produced. At this time the boundaries of some of the Ecowin.net model (also referred to as the Ecological model) boxes (one of the components of the SMILE model) were also updated to better fit the new Hydrodynamic model components.

For the purpose of this assessment the SMILE model was applied to enable thirteen scenarios, which simulated the impact on the ecosystem of increasing the abundance of filter-feeding organisms in Carlingford Lough. Chlorophyll a (Chl a) was used as a proxy for phytoplankton biomass within Carlingford Lough. The thirteen scenarios represented the levels of Chl a present within the Lough if;

a) Run 1 – There was no aquaculture within the Lough (only wild species present). This run is used as a baseline as wild species will always be present.

b) Run 2 – **All** current **licensed** aquaculture sites within the Northern area of Carlingford Lough were activated using the five year average production for the year 2017 to 2021 (as per data supplied by DAERA). Those sites for which there was no production data within the last five years, were activated using a default tonnage per hectares as determined from data for active sites. Current licensed aquaculture sites within the Southern area of Carlingford Lough were activated using a default value as determine from data supplied by Bord

Iascaigh Mhara (BIM) and the Marine Institute (MI). (As wild species is to be used as a baseline this component was also activated for this run).

c) Run 3 – **All** currently **active** aquaculture sites within the Northern area of Carlingford Lough were activated using the five year average production for the year 2017 to 2021 (as per data supplied by DAERA). Current licensed aquaculture sites within the Southern area of Carlingford Lough were activated using a default value as determine from data supplied by BIM and the MI. (As wild species is to be used as a baseline this component was also activated for this run).

d) Run 4 – Aquaculture activities (as per Run 2) were increased to include application A currently in progress within Mill Bay. As wild species is to be used as a baseline this component was also activated for this run.

e) Run 5 – Aquaculture activities (as per Run 2) were increased to include application B currently in progress within Mill Bay. As wild species is to be used as a baseline this component was also activated for this run.

f) Run 6 – Aquaculture activities (as per Run 2) were increased to include application C currently in progress within Mill Bay. As wild species is to be used as a baseline this component was also activated for this run.

g) Run 7 – Aquaculture activities (as per Run 2) were increased to include applications A and B currently in progress within Mill Bay. As wild species is to be used as a baseline this component was also activated for this run.

h) Run 8 – Aquaculture activities (as per Run 2) were increased to include applications, A, B and C currently in progress within Mill Bay. As wild species is to be used as a baseline this component was also activated for this run.

i) Run 9 – Aquaculture activities (as per Run 2) were increased to include the reduced area of application A within Mill Bay as determined by AFBI (Figure 3.1, Annex A). As wild species is to be used as a baseline this component was also activated for this run.

j) Run 10 - Aquaculture activities (as per Run 2) were increased to include the reduced area of application B within Mill Bay as determined by AFBI (Figure 3.1, Annex A). As wild species is to be used as a baseline this component was also activated for this run.

k) Run 11 - Aquaculture activities (as per Run 2) were increased to include the reduced area of application C within Mill Bay as determined by AFBI (Figure 3.1, Annex A). As wild species is to be used as a baseline this component was also activated for this run.

l) Run 12 - Aquaculture activities (as per Run 2) were increased to include the reduced area of applications A and B within Mill Bay as determined by AFBI (Figure 3.1, Annex A). As wild species is to be used as a baseline this component was also activated for this run.

m) Run 13 - Aquaculture activities (as per Run 2) were increased to include the reduced area of applications A, B and C within Mill Bay as determined by AFBI (Figure 3.1, Annex A). As wild species is to be used as a baseline this component was also activated for this run.

Analysis of measured data (taken from Taylor *et al* 1999) shows up to -62% annual variation within chlorophyll a values (using 90th percentile figures) recorded between sampling years. From this we would recommend that a minimum of 70%, of baseline values, of Chl a remains within the system available for wild species. This therefore implies that aquaculture activities should not reduce Chlorophyll a concentrations by greater than 30% of baseline values (Run 1). This Chl a standard has been reviewed and accepted by independent experts (Grant pers. comm.). Similar techniques have also been adopted by Filgueria *et al.* (2021), who utilised a threshold for reduction of organic seston by bivalve aquaculture species as a measure of ecological carrying capacity in three coastal embayments in Nova Scotia.

All model boxes with Chl a reduction greater than -30% are highlighted in Tables 4.1 to 4.4. The location of licensed existing aquaculture sites in relation to SMILE model Boxes are shown within Figure 4.1. The location of the proposed new aquaculture applications within the Mill Bay area in relation of SMILE model Boxes is shown in Figure 4.2.

Outputs from all model runs are shown in Appendix B. Only the outputs from Runs 2, 3, 8 and 13 will be discussed within this section of the report.

As can be seen from Tables 4.1 to 4.4 and Figures 4.3 to 4.6, impact (in terms of reduction in Chl a values) was observed in model boxes within which no aquaculture was undertaken. This is attributed to the knock-on effect of aquaculture activities within adjacent boxes resulting from the movement of phytoplankton by water currents and shifts of water between boxes.

The results of model Runs 2 and 3 (Tables 4.1 and 4.2 and Figures 4.3 and 4.4) highlight the impact on Chl a availability within the Lough of running the SMILE model

using inputs from only those licensed aquaculture sites that have been actively producing shellfish within the last five years. The number of model boxes exceeding the 30% Chl a reduction threshold decreased from 12 in Run 2 to 7 in Run 3.

Utilising the precautionary principle, for the purpose of this report we must assume that all sites licenced for aquaculture production within Carlingford Lough are actively producing shellfish and thus these sites were activated for all subsequent model runs.

Increasing the amount of shellfish aquaculture in model Box 30 by the addition of the three proposed new aquaculture sites in Mill Bay, as per the details on the original applications, had an impact on Chl a availability within all adjacent boxes and brought the percentage reduction of Chl a within **box 30 above the 30% threshold** (Table 4.3 and Figure 4.5). This impact was reduced when the production at the three proposed new sites was decreased as per AFBI recommendations (Section 3 and Appendix A).

As can be seen from Tables 4.1 and 4.4 changing the production levels within Carlingford Lough through the addition of the three proposed new aquaculture sites, at the reduced size and production levels proposed by AFBI, had a minor impact (**0.5%** increase in Chl a reduction values from those resulting from the current levels of aquaculture activity) on Chl a reduction values within SMILE model Box 30 (Mill Bay). The addition of these three new sites (at reduced production levels) **did not** result in the 30% Chl a threshold being breached within Box 30 (Table 4.4 and Figure 4.6).

It should also be noted that work is currently ongoing through the INTERREG VA funded Shared Waters Enhancement and Loughs Legacy (SWELL) project to extend the SMILE model components for Carlingford Lough to include a catchment model, (the Soil and Water Assessment Tool (SWAT) model), and link this and the Hydrodynamic model, with Northern Ireland Water and Irish Waters Sewerage Networks Models (DAPs) at all key points. This project is due to complete in April 2023.

Table 4.1: Simulated Chl a values (90th percentile calculated over index period, April to October). Results from Run 1 were used as a baseline and the % change in Chl a is shown to illustrate the impact when filtration by aquaculture species within all current licensed sites is taken into account (Run 2). The turquoise shaded area represents the model boxes with a Chl a reduction >30%. The proposed new aquaculture sites are within model box 30.

Box	Species	Run 1	Run 2	%reduction
Box 36	mussels	11.68	4.16	64.38
Box 35	mussels	11.19	4.69	58.05
Box 34	mussels	10.94	5.19	52.56
Box 24	mussels	9.36	4.45	52.45
Box 32	mussels	10.14	5.46	46.12
Box 22	mussels	8.77	4.80	45.24
Box 31	mussels	9.78	5.38	44.98
Box 33	mussels	10.10	5.94	41.14
Box 27	mussels	9.04	5.75	36.39
Box 29	None	9.71	6.50	33.07
Box 26	mussels	8.47	5.74	32.20
Box 28	mussels	9.18	6.24	32.03
Box 30	mussels +oysters	9.39	6.59	29.74
Box 21	mussels +oysters	7.08	5.19	26.69
Box 23	oysters	6.20	4.93	20.54
Box 25	mussels	7.32	5.90	19.40
Average				**39.69**

Table 4.2: Simulated Chl a values (90th percentile calculated over index period, April to October). Results from Run 1 were used as a baseline and the % change in Chl a is shown to illustrate the impact when filtration by aquaculture species within only those licensed sites which have been actively producing shellfish within the last five years taken into account (Run 3). The turquoise shaded area represents the model boxes with a Chl a reduction >30%. The proposed new aquaculture sites are within model box 30.

Box	Species	Run 1	Run 3	%reduction
Box 36	mussels	11.68	4.43	62.05
Box 35	mussels	11.19	5.12	54.24
Box 24	mussels	9.36	4.85	48.21
Box 34	mussels	10.94	5.87	46.32
Box 22	mussels	8.77	5.36	38.94
Box 33	mussels	10.10	6.48	35.86
Box 32	mussels	10.14	6.61	34.83
Box 29	None	9.71	6.90	28.92
Box 31	mussels	9.78	7.06	27.81
Box 27	mussels	9.04	6.59	27.07
Box 28	mussels	9.18	6.70	27.04
Box 26	mussels	8.47	6.32	25.40
Box 21	mussels +oysters	7.08	5.75	18.78
Box 30	mussels +oysters	9.39	7.91	15.69
Box 25	mussels	7.32	6.25	14.57
Box 23	oysters	6.20	5.47	11.88
Average				**32.35**

Table 4.3: Simulated Chl a values (90th percentile calculated over index period, April to October). Results from Run 1 were used as a baseline and the % change in Chl a is shown to illustrate the impact filtration by aquaculture species within all current licensed sites, plus the change in production resulting from the addition of the new aquaculture sites proposed within Applications A, B and C are taken into account (Run 8). The turquoise shaded area represents the model boxes with a Chl a reduction >30%. The proposed new aquaculture sites are within model box 30.

Box	Species	Run 1	Run 8	%reduction
Box 36	mussels	11.68	4.16	64.38
Box 35	mussels	11.19	4.69	58.06
Box 34	mussels	10.94	5.19	52.58
Box 24	mussels	9.36	4.45	52.47
Box 32	mussels	10.14	5.46	46.14
Box 22	mussels	8.77	4.80	45.29
Box 31	mussels	9.78	5.38	45.03
Box 33	mussels	10.10	5.94	41.15
Box 27	mussels	9.04	5.74	36.45
Box 29	None	9.71	6.50	33.07
Box 26	mussels	8.47	5.74	32.23
Box 28	mussels	9.18	6.23	32.07
Box 30	mussels +oysters	9.39	6.57	30.05
Box 21	mussels +oysters	7.08	5.19	26.77
Box 23	oysters	6.20	4.92	20.69
Box 25	mussels	7.32	5.90	19.44
Average				**39.74**

Table 4.4: Simulated Chl a values (90th percentile calculated over index period, April to October). Results from Run 1 were used as a baseline and the % change in Chl a is shown to illustrate filtration by aquaculture species within all current licensed sites, plus the change in production resulting from the addition of the new aquaculture sites proposed within Applications A, B and C, as amended by AFBI (see Appendix A), are taken into account (Run 13). The turquoise shaded area represents the model boxes with a Chl a reduction >30%. The proposed new aquaculture sites are within model box 30.

Box	Species	Run 1	Run 13	%reduction
Box 36	mussels	11.68	4.16	64.38
Box 35	mussels	11.19	4.69	58.05
Box 34	mussels	10.94	5.19	52.57
Box 24	mussels	9.36	4.45	52.46
Box 32	mussels	10.14	5.46	46.13
Box 22	mussels	8.77	4.80	45.26
Box 31	mussels	9.78	5.38	45.00
Box 33	mussels	10.10	5.94	41.14
Box 27	mussels	9.04	5.75	36.41
Box 29	None	9.71	6.50	33.07
Box 26	mussels	8.47	5.74	32.21
Box 28	mussels	9.18	6.24	32.04
Box 30	mussels +oysters	9.39	6.58	29.85
Box 21	mussels +oysters	7.08	5.19	26.72
Box 23	oysters	6.20	4.92	20.59
Box 25	mussels	7.32	5.90	19.42
Average				**39.71**

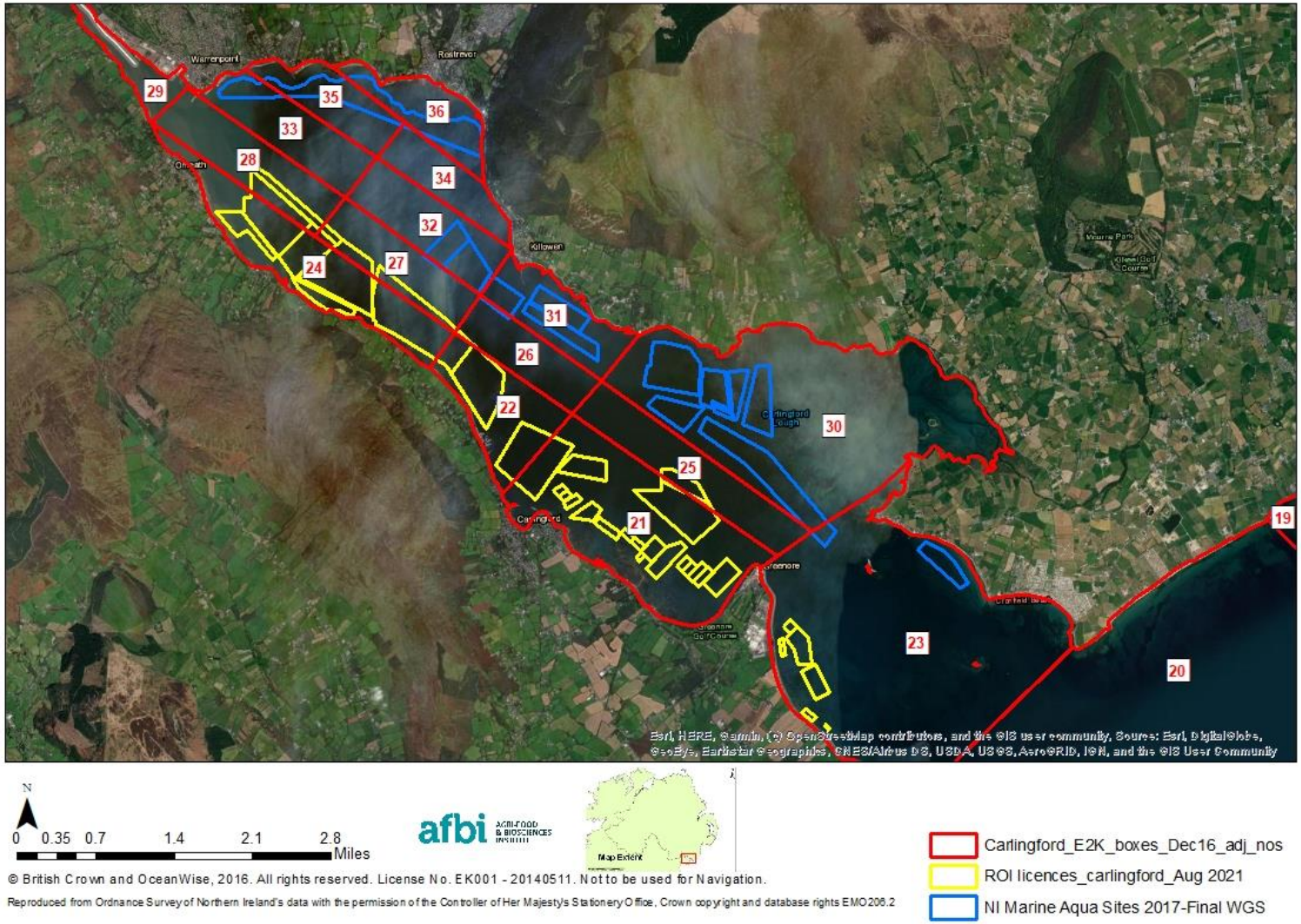

Figure 4.1: Map showing the location of the currently licensed aquaculture sites within Carlingford Lough in relation to the SMILE model boxes.

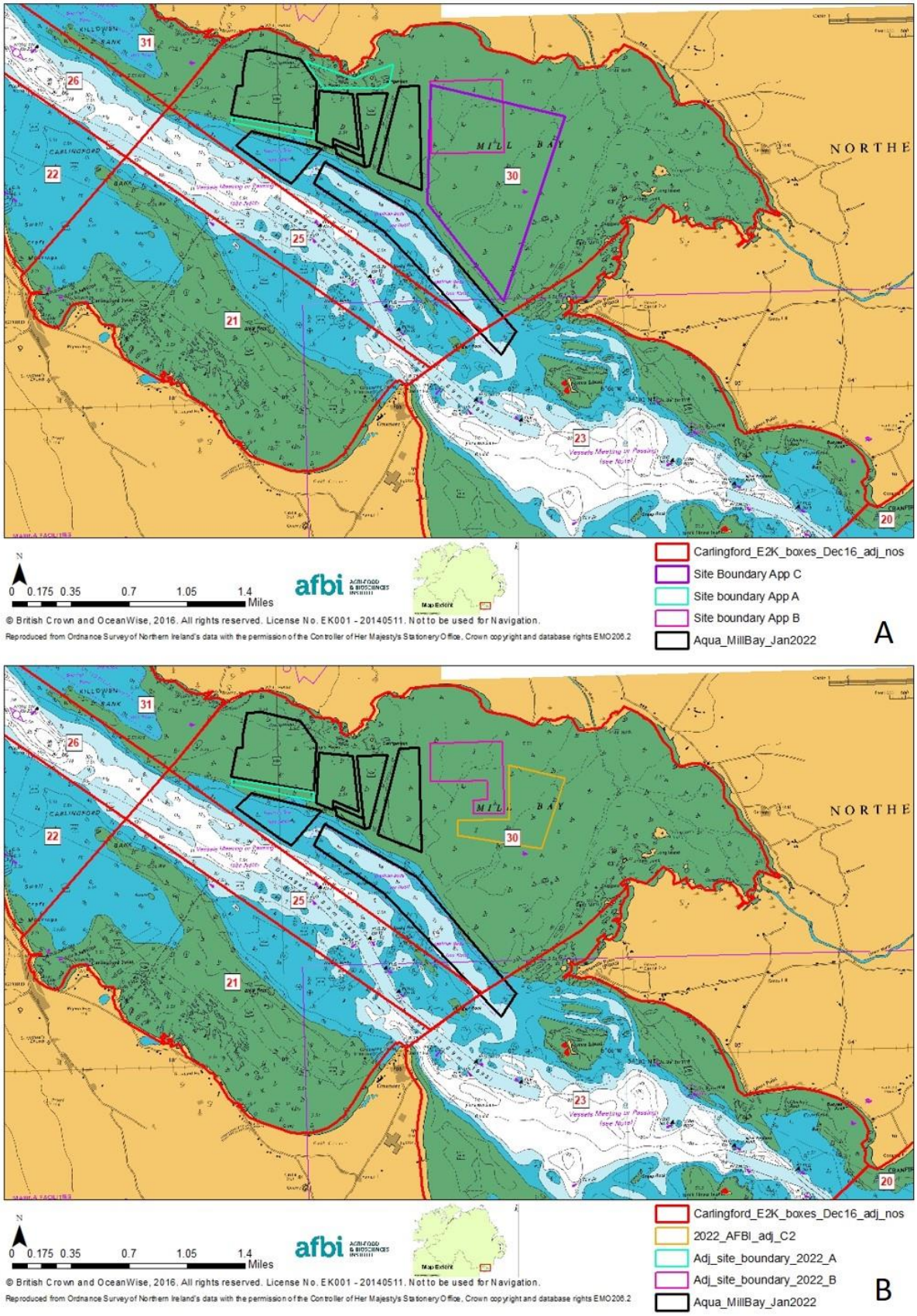

Figure 4.2: Map showing the location of the proposed new aquaculture sites within Mill Bay in relation to the SMILE model boxes. A: Site boundaries as per original applications, B: Site boundaries as per AFBI amendments (appendix A).

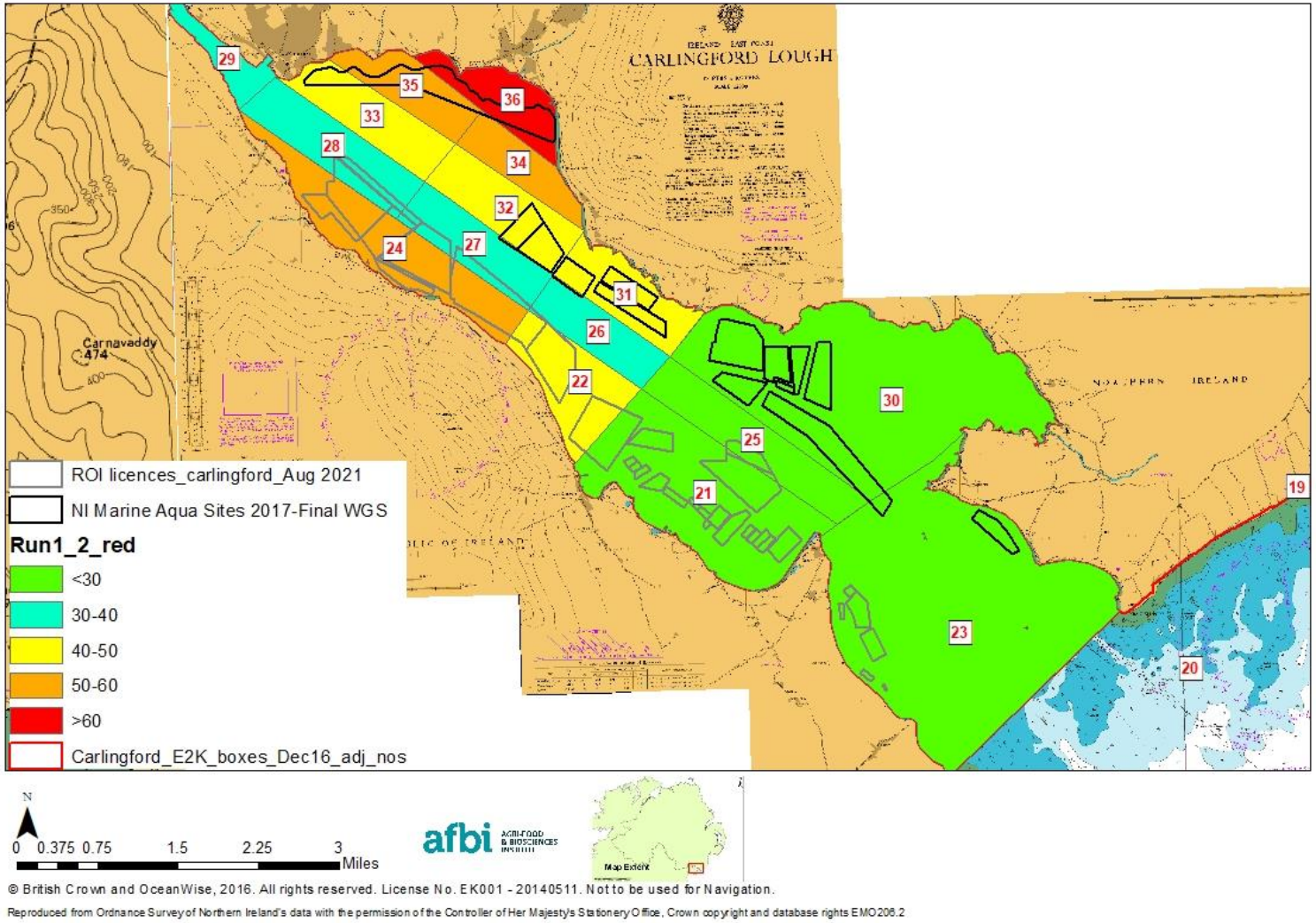

Figure 4.3: Map showing the location of SMILE mode boxes in Carlingford Lough alongside the outputs from Run 2 of the model.

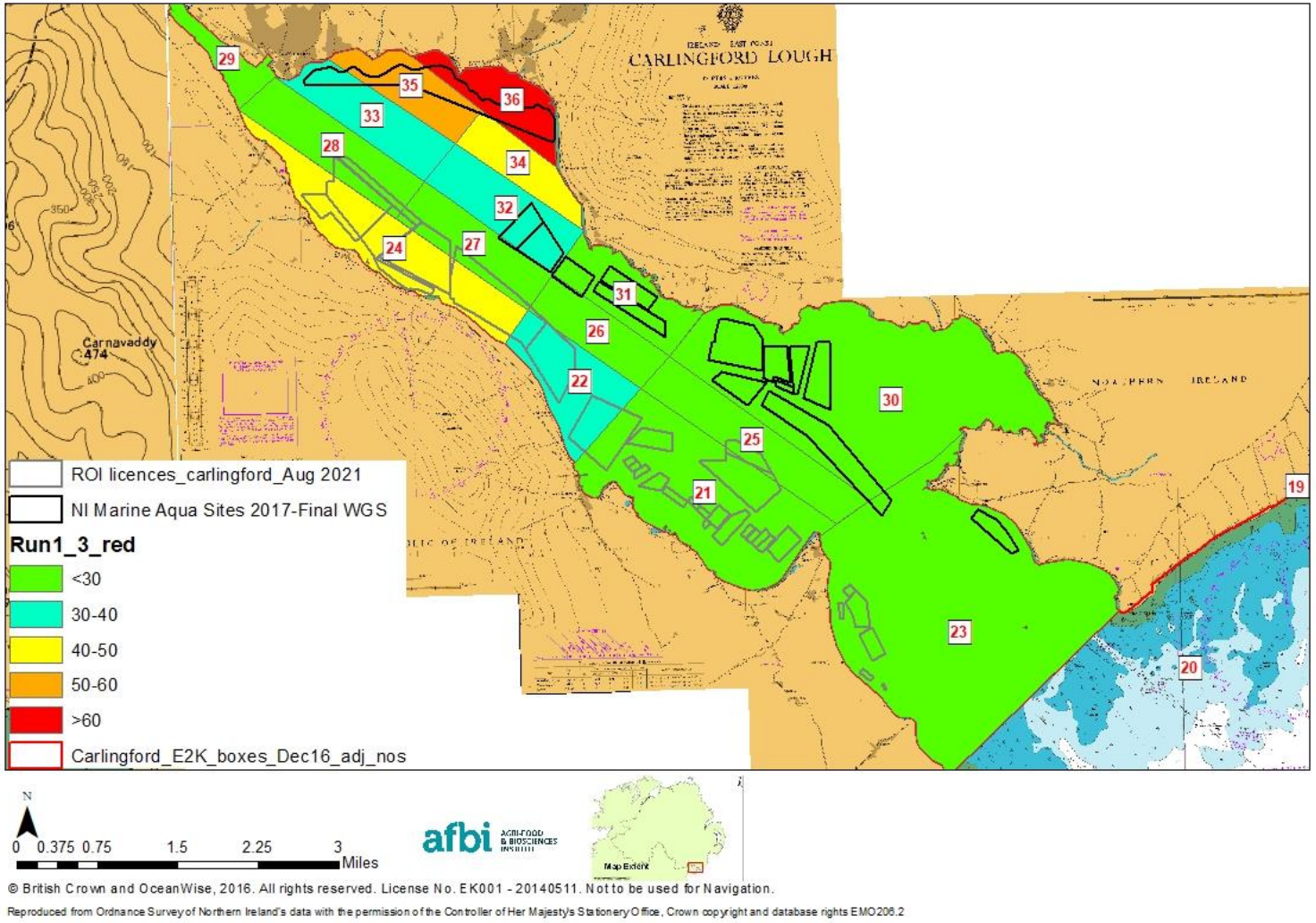

Figure 4.4: Map showing the location of SMILE mode boxes in Carlingford Lough alongside the outputs from Run 3 of the model.

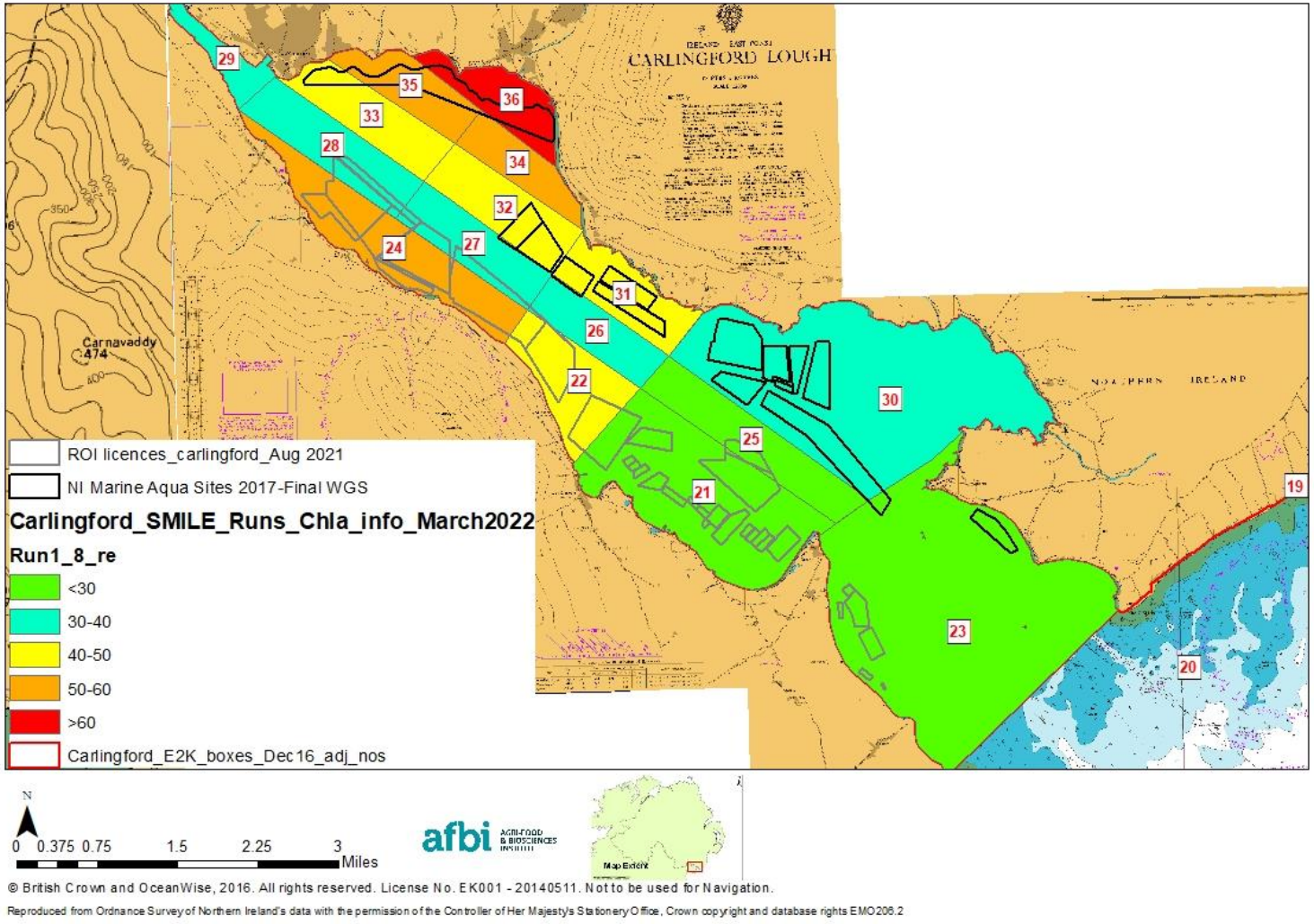

Figure 4.5: Map showing the location of SMILE mode boxes in Carlingford Lough alongside the outputs from Run 8 of the model.

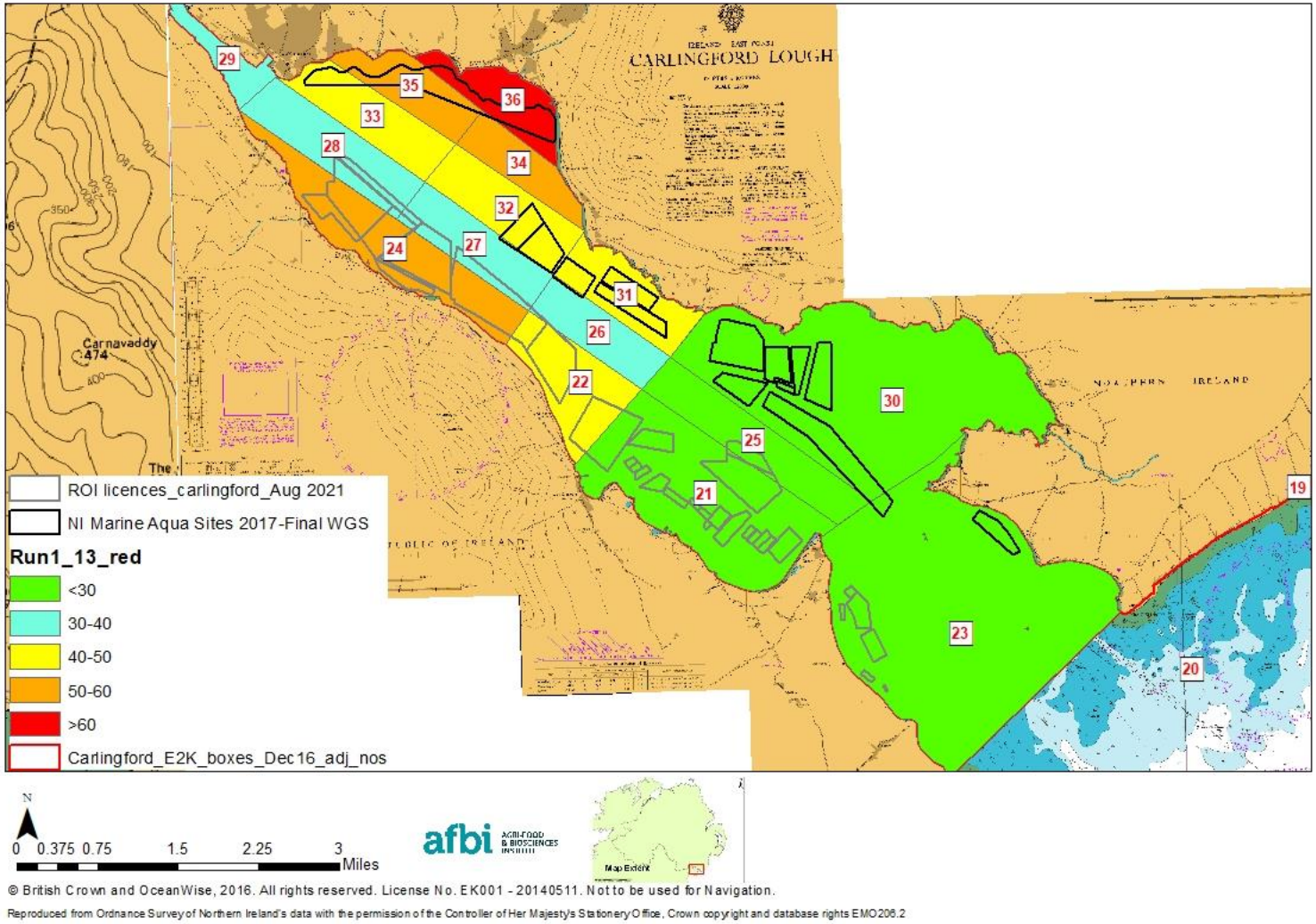

Figure 4.6: Map showing the location of SMILE mode boxes in Carlingford Lough alongside the outputs from Run 13 of the model.

5 Archaeological Heritage

DAERA Environment, Marine and Fisheries Division undertook a drone survey of the area of Mill Bay to map and determine the condition of historic wrack stones within this area. Utilising this survey and historic ortho imagery and LiDAR surveys undertaken within the last 20 years DAERA have produced a map showing the location and condition of the wrack stones within Mill Bay. The results of this have been provided to AFBI and are shown within Figure 5.1. As can be seen on Figure 5.1, areas of well-preserved wrack stones were identified within the boundaries of proposed applications B and C. DAERA intend to schedule some of the areas identified as well-preserved wrack stones within Mill Bay, outside of the boundaries of proposed applications B and C, for protection under the Historic Monuments and Archaeological Objects (Northern Ireland) Order 1995 (DAERA pers. comm).

DAERA will continue to monitor the condition and position of the historic wrack stones within this area going forward to ensure that aquaculture activities within this area are not negatively impacting these historic features.

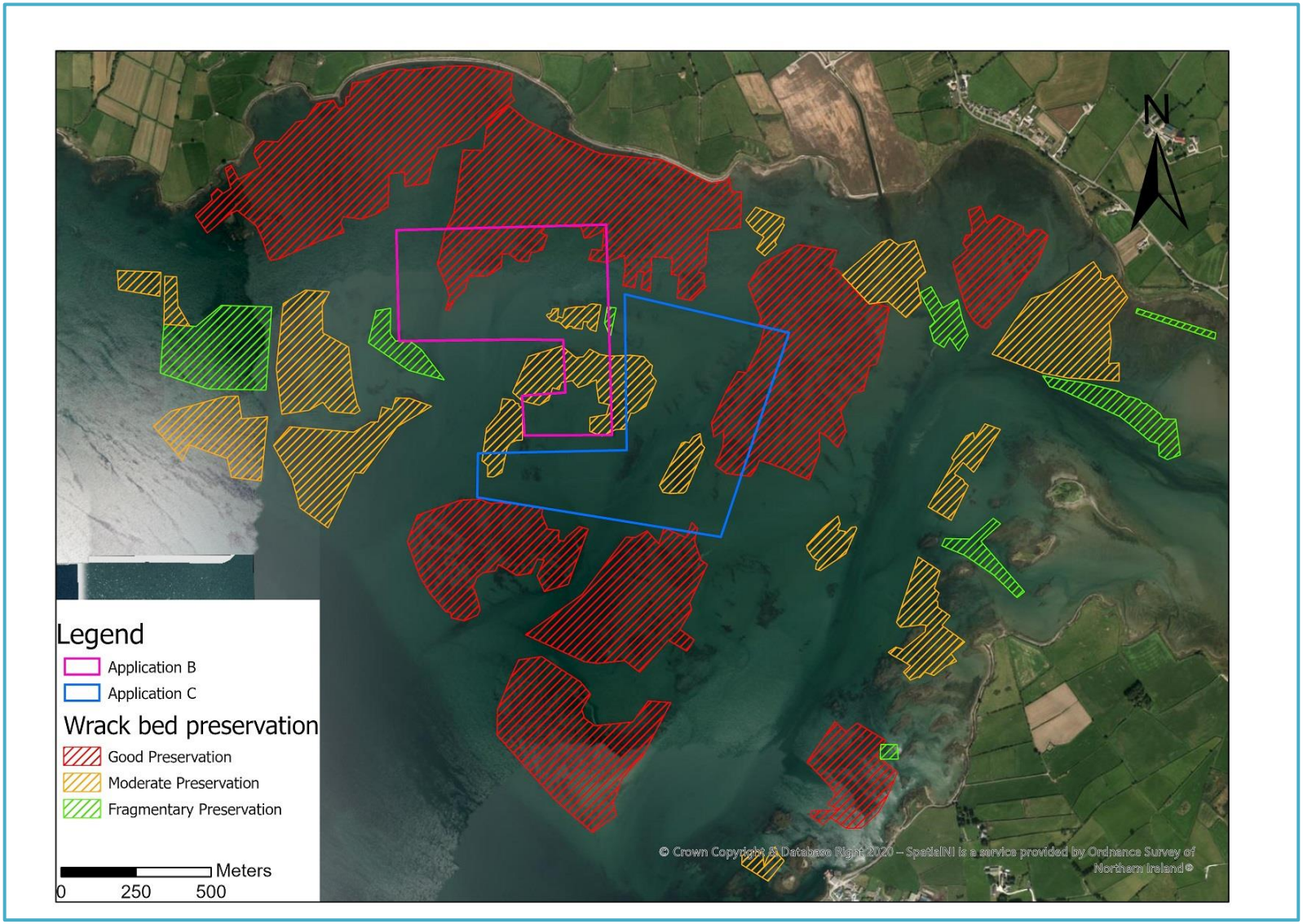

Figure 5.1: Map showing the location and preservation condition of wrack stones within the Mill Bay area of Carlingford Lough, as provided by DAERA Historical Environment Division.

6 Conclusions

The proposed marine extension to the Carlingford Lough SPA aims to protect the foraging areas of the Tern colonies within Carlingford Lough.

The Conservation Objectives for the Carlingford Lough SPA are “To maintain each feature in favourable condition” (DoE 2015). The Condition Assessment for each site is based on a series of attributes and measures.

For breeding Tern populations (both Common and Sandwich Terns) within the Carlingford Lough SPA the Condition Assessment targets are that there should be no significant decrease in the breeding population against national trends (DoE 2015).

Booth Jones *et al*. (2019) undertook a review of the potential impacts of aquaculture activities on waterbird population trends within Northern Ireland’s sea Loughs. The findings of this review suggest that aquaculture activity within Mill Bay is not impacting the short-term population trends of any of the waterbird species analysed within the area.

The proposed new aquaculture sites within the Mill Bay area of Carlingford Lough will not result in a significant decrease in breeding Tern population numbers as;

- The proposed new aquaculture sites are not within 500m of the Islands within Carlingford Lough on which Tern populations breed.

- Terns feed primarily on fish species such as Sandeels which are an important component in their diet. The sediments within the Mill Bay area of Carlingford Lough are not suitable sandeel habitat therefore intertidal oyster and mussel aquaculture within this area will not impact on the availability of prey species for these birds.

For the Light Bellied Brent Goose population within the Carlingford Lough SPA the Condition Assessment targets are that there should be no significant decrease in the population against national trends (DoE 2015).

The proposed new aquaculture sites within the Mill Bay area of Carlingford Lough will not result in a significant decrease in the Light Bellied Brent Goose population numbers as;

- The preferred food of Light Bellied Brent Geese is eelgrass of the species *Zostera*. Once eelgrass becomes depleted Light Bellied Brent Geese can feed on green algal species such as *Enteromorpha* spp and *Ulva lactuca* (Mathers and Montgomery 1997). During surveys of the area within the boundary of the proposed sites no eelgrass or green algal species were observed.

- At low tide when the sites are exposed Light Bellied Brent Geese will be able to forage under, on and around the trestles.

- Gittings and O'Donoghue (2012) found that Light Bellied Brent Goose showed a variable response to oyster trestles and at some sites investigated they were observed feeding on top of the oyster trestles.

The most recent Condition Assessment for the Light Bellied Brent Goose population within the Carlingford Lough SPA states that this feature is currently in favourable condition (DoE 2015).

- From the SMILE model results it can be seen that changing the shellfish production levels within Carlingford Lough through the addition of the proposed new aquaculture sites in Mill Bay, at the reduced level of production as proposed by AFBI (Appendix A), resulted in a change in Chl a values of 0.5% within Box 30.

- From the SMILE model results it can be seen that changing the shellfish production levels within Carlingford Lough through the addition of the proposed new aquacultures sites in Mill Bay, at the reduced level of production as proposed by AFBI (Appendix A), did not result in the reduction in Chl a within Box 30 exceeding the 30% threshold.

- From the SMILE model results it can be seen that changing the shellfish production levels within Carlingford Lough through the addition of the proposed new aquacultures sites in Mill Bay, at the reduced level of production as proposed by AFBI (Appendix A), did not result in an increase in the number of model boxes within which the reduction in Chl a exceeds the 30% threshold.

7 Recommendations

It should be noted that this report has been prepared to enable DAERA to assess licence applications submitted for aquaculture sites within the area of Mill Bay on the Northern Shore of Carlingford Lough. In order to manage aquaculture activities within the entirety of the Carlingford Lough ecosystem, the licensing authorities within Northern Ireland and the Republic of Ireland will be required to have a cross jurisdictional approach to carrying capacity.

In order to adequately minimise potential disturbance to the designated sites, and reduce the potential for far field impacts, it is recommended that the proposed applications within Carlingford Lough be allowed to proceed only under the following conditions;

- The licenced areas and the annual production within the three new applications should be reduced as outlined by AFBI in Appendix A.

- At a meeting between AFBI, DAERA and the 3 applicants to review the main outputs from this report, the applicants agreed to the new tonnage estimates for each of the amended sites (as outlined in Table 3.2).

- Rows of trestles should be spaced at least 2 m apart so as to allow adequate water circulation.

- In order to ensure that any changes in benthic sediments and communities remain small and localised a programme of benthic monitoring (Particle Size Analysis (PSA), sediment carbon, and infaunal samples) at designated stations should be established. AFBI have a protocol for monitoring at aquaculture site which has been agreed and accepted by the DAERA.

- If monitoring reveals that the licensed activity is having a significant impact on a designated feature the Competent Authority shall adapt the consent to eliminate this impact.

- In order to inhibit the spread of feral populations of Pacific oysters the site should only be stocked with sterile Pacific oysters and all hatchery reared spat should be sourced from hatcheries containing the appropriate health certifications.

- All spat and juveniles must be sourced from areas free from known invasive non native species.

- It should be a condition of any licences granted that the operators of the aquaculture site must not move or interfere with any areas within the licenced site identified by DAERA as historic wrack stones. These stones must be preserved in their current position which will be monitored by DAERA.

Failure to comply with proposed licence conditions as outlined above should result in the revocation of the fish culture licence.

8 References

Beer, C., and McQuaid, N., 2011. Intertidal seagrass (Eelgrass) Survey, Northern Ireland 2009-2010. *Report by the Marine Assessment and Licensing Team, Water Management Unit, Northern Ireland Environment Agency*.

Booth Jones, K. Calbrade,N., Woodward, I., Austin, G. (2019) Analysis of waterbird population trends for Northern Ireland's sea loughs: assessing the potential impacts of aquaculture and disturbance. Part 1 – Strangford Lough and Carlingford Lough. *BTO Research report.*

Booth Jones, K. (ed), 2022. The Northern Ireland Seabird Report 2021. *British Trust for Ornithology, Thetford.* https://www.bto.org/sites/default/files/publications/ni_seabird_report_2021_final_web_reduced.pdf

Burger, J. And Gochfield, M. 2003. Spatial and temporal patterns in metal levels in eggs of common terns (*Sterna hirundo*) in New Jersey. *The Science of the Total Environment* **311:** 91-100

Christel, I., Certain, G., Cama, A., Vieites, D. R., Ferrer, X. 2013. Seabird aggregative patterns: A new tool for offshore wind energy risk assessment. *Marine Pollution Bulletin* **66:** 84-91

Comeau, L.A., St-Onge, P., Pernet, F., Lanteigne, L. 2009. Deterring coastal birds from roosting on oyster culture gear in eastern New Brunswick Canada. *Aquaqcultural Engineering* **40:** 87-94

Cook, A.S.C.P., Barimore, C., Holt, C.A., Read, W.J., and Austin, G.E. 2013. Wetland Bird Survey Alerts 2009/2010:Changes in numbers of wintering waterbirds in the Constituent Countries of the United Kingdom, Special Protection Areas (SPAs) and Sites of Special Scientific Interest (SSSIs). BTO Research Report 641. BTO, Thetford. http://www.bto.org/volunteer-surveys/webs/publications/webs-annual-report

Department of Environment (DoE), 2015. Carlingford Lough Special Protection Area (SPA) UK9020160: Conservation Objectives. pp19

Dunn, E. K., 1972. Studies on terns with particular reference to feeding ecology. PhD Thesis. Durham University. 231pp Available at Durham E-Theses Online: http://etheses.dur.ac.uk/8621/

Einoder, L.D., 2009. A review of the use of seabirds as indicators in fisheries and ecosystem management. *Fisheries Research* **95** 6-13.

Erwin, M.R. 1989. Responses to Human Intruders by Birds Nesting in Colonies: Experimental Results and Management Guidelines. *Colonial waterbirds* **12**(1): 104-108

Ferreira, J.G., Hawkins, A.J.S., Monteiro, P., Service, M., Moore, H., Edwards, A., Gowen, R.,Lourenco, P., Mellor, A., Nunes, J.P., Pascoe, P.L., Ramos, L., Sequeira, A., Simas, T., Strong, J. 2007. SMILE – Sustainable Mariculture in northern Irish Lough Ecosystems – Assessing Carrying Capacity for Environmentally sustainable Shellfish Culture in Carlingford Lough, Strangford Lough, Belfast Lough, Larne Lough and Lough Foyle. *Ed. IMAR – Institute of Marine* Research. 100pp.

Filgueira, R., Guyondet, T., Thupaki, P., Sakamaki, T., and Grant, J. 2021. The effect of embayment complexity on ecological carrying capacity estimations in bivalve aquaculture sites. *Journal of Cleaner Production*. **288**: 125739

Forrest, B.M., and Creese, R.G. 2006. Benthic impacts of intertidal oyster culture, with consideration of taxonomic sufficiency. *Environmental Monitoring and Assessment*. **122:** 159-176

Forrest, B.M., Keeley, N.B., Hopkins, G.A., Webb, S.C., Clement, D.M. 2009 Bivalve aquaculture in estuaries: Review and synthesis of oyster cultivation effects. *Aquaculture*. **298:** 1-15

Frost, T.M., Austin, G.E., Calbrade, N.A., Holt, C.A., Mellan, H.J., Hearn, R.D., Stroud, D.A., Wotton, S.R. and Balmer, D.E. 2016. Waterbirds in the UK 2014/15: The Wetland Bird Survey. BTO/RSPB/JNCC. Thetford. http://www.bto.org/volunteer-surveys/webs/publications/webs-annual-report

Furness, R.W., and Tasker, M.L. 2000. Seabird-Fishery interactions: quantifying the sensitivity of seabirds to reductions in sandeel abundance, and identification of key areas for sensitive seabirds in the North Sea. *Marine Ecology Progress Series*. **202**: 253-264

Gittings, T. And O'Donoghue, P.D. 2012. The effects of intertidal oyster culture on the spatial distribution of waterbirds. Report prepared for the Marine Institute. Atkins, Cork. Pp 170

Gonzalez-Solis, J., Sokolov, E., and Becker, P. 2001. Courtship feedings, copulations and paternity in common terns, *Sterna hirundo*. *Animal Behaviour* **61**: 1125-1132

Greenstreet, S.P.R., Becker, P.H., Barrett, R.T., Fossum, P., and Leopold, M.F. 1999 Consumption of pre-recruit fish by seabirds and the possible use of this as an indicator of fish stock recruitment. *ICES Coop. Res. Rep.* **232:** 6-17

Greenstreet, S.P.R., Holland, G.J., Guirey, E.J., Armstrong, E., Fraser, H.M., and Gibb, I.M. 2010. Combining hydroacoustic seabed survey and grab sampling techniques to assess "local" sandeel population abundance. *ICES Journal of Marine Science* **67**: 971-984

Hassall, M. and Lane, S.J. 2005. Partial feeding preferences and the profitability of winter-feeding sites for Brent Geese. *Basic and Applied Ecology* **6**: 559-570

Hilgerloh, G., O'Halloran, J., Kelly, T. C., and Burnell, G. M. 2001. A preliminary study on the effects of oyster culturing structures on birds in a sheltered Irish estuary. *Hydrobiologia* **465**: 175-180

Holland, G. J., Greenstreet, S. P. R., Gibb, I. M., Fraser, H. M., and Robertson, M. R. 2005. Identifying sandeel *Ammodytes marinus* sediment habitat preferences in the marine environment. *Marine Ecology Progress Series* **303**: 269-282.

Hughes, B., and Green, A.J. 2005. Feeding Ecology. pp. 27-56 in Kear, J. (ed.), *Ducks, Geese and Swans. Volume 1: General chapters and Species accounts (Anhima to Salvadorina)*. Oxford university Press.

ICES. 2020. Working Group on Environmental Interactions of Aquaculture (WGEIA). ICES Scientific Reports. 2:112. 187 pp. http://doi.org/10.17895/ices.pub.7619

Inger, R., Bearhop, S., Robinson, J.A., and Ruxton, G. 2006. Prey choice affects the trade-off balance between predation and starvation in an avian herbivore. *Animal Behaviour* **71**: 1335-1341

Mathers, R.G., and Montgomery, W.I. 1997. Quality of Food Consumed by over Wintering Pale-Bellied Brent Geese *Branta bernicla hrota* and Wigeon *Anas penelope*. *Biology and Environment: Proceedings of the Royal Irish Academy.* **97B** (1): 81-89

Nuges, M.m, Kaiser, M.J., Spencer, B.E and Edwards, D.B., 1996. Benthic community changes associated with intertidal oyster cultivation. *Aquaculture Research*. **27:** 913-924

Owen, M., and Black, J.M. 1990. Waterfowl Ecology. Blackie and Son Ltd, Glasgow and London pp194

Rodgers, J.A., and Smith H.T.1995. Set-Back Distances to Protect Nesting Bird Colonies from Human Disturbance in Florida. *Conservation Biology* **9**(1): 89-99

Rodgers, J.A., and Smith H.T. 1997. Buffer zone distances to protect foraging and loafing waterbirds from human disturbance in Florida. *Wildlife Society Bulletin* **25**(1): 139-145

Stroud, D.A., Chambers, D., Cook, S., Buxton, N., Fraser, B., Clement, P., Lewis, P., McLean, I., Baker, H., and Whitehead, S., (Eds). 2001. The UK SPA network: its scope and Content. JNCC, Peterborough.

Taylor, J., Service, M., Charlesworth, M., and Kelso, B. 1999. Nutrient Inputs and Trophic Status of Carlingford Lough.

Tasker, M. L., and Furness, R. W. 1996. Estimation of food consumption by seabirds in the North Sea. *In* Seabird/fish interactions, with particular reference to seabirds in the North Sea, pp. 6-42. Ed. by G. L. Hunt and R. W. Furness. ICES Cooperative Research Report No. 216.

Wilson, S., O'Malley, D., Cassidy, D., and Clarke, D. 2012. Surveying the seals of Carlingford lough, A preliminary study 2008-11. 17pp

Wolsey, S. 2011. Green Island Tern Report 2011. Report prepared for RSPB pp76

Wolsey, S. 2012. Green Island Tern Report 2012. Report prepared for RSPB pp16

Woodward, I., Thaxter, C.B., Owen, E., Aonghais, S., Cook, C.P. (2019) Desk- based study revision of seabird foraging ranges used for HRA screening. Report of work carried out by the British Trust for Ornithology on behalf of NIRAS and The Crown Estate**. BTO Research Report No. 724**

Wright, P.J., Jensen, H., and Tuck, T. 2000. The influence of sediment type on the distribution of the lesser sandeel, *Ammodytes marinus*. *Journal of Sea Research* **44**: 243-256

Appendix A: Mill Bay aquaculture applications: proposed amendments

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Further information

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Introduction

The Marine and Fisheries Division of the Department of Agriculture, Environment and Rural Affairs (DAERA) commissioned AFBI to prepare a Cumulative Impact Assessment report for current and proposed aquaculture activities within the Mill Bay area of the Carlingford Lough Special Protection Area (SPA) in Northern Ireland. Part of the Cumulative Impact assessment report involves assessing options for reducing the area and proposed production at the three current aquaculture licence applications currently in progress within the Mill Bay area. This document therefore outlines the suggested amendments and the reasoning behind these proposals.

This assessment is based on information obtained through AFBI site visits, and through analysis of aerial photographs within ArcGIS.

Methods

AFBI site visits were undertaken within the area of Applications A and B in February and March 2016 as part of the Habitats Regulations Assessments for these applications.

For Application A a survey grid with sample stations placed every 100 m was superimposed over the boundary of the proposed new aquaculture sites. For Application B a survey grid with sample stations placed every 200 m was superimposed over the boundary of the proposed new aquaculture site. At each sample station a quadrat was randomly placed on the seabed and photographs and notes on benthic habitats and conspicuous epifauna recorded.

These photos were then utilised in conjunction with aerial photographs to delineate the proposed new boundaries for each application. In the case of Application C in the absence of a field survey being undertaken the aerial photography was used in isolation to propose the potential new site boundary.

Results

Figure 1 shows the locations of all three of the proposed new licenced aquaculture areas within the Mill Bay area of Carlingford Lough, whilst Figure 2 shows the AFBI proposed new boundaries for these sites.

Figures 3 to 5 show the site boundaries overlaid with aerial photographs and AFBI site photographs, where available, to highlight the reasoning behind the amendments made in figures 7 to 9.

The proposed new site areas are outlined within table 1 below.

Table 1: Original size of sites as outlined within the applications (in hectares) and the proposed new sizes (in hectares).

Application	original area (Ha)	proposed new area (Ha)	% reduction (area)
A (1+2)	16.7	5.2	68.9
B	49	33	32.7
C	168	41	75.6

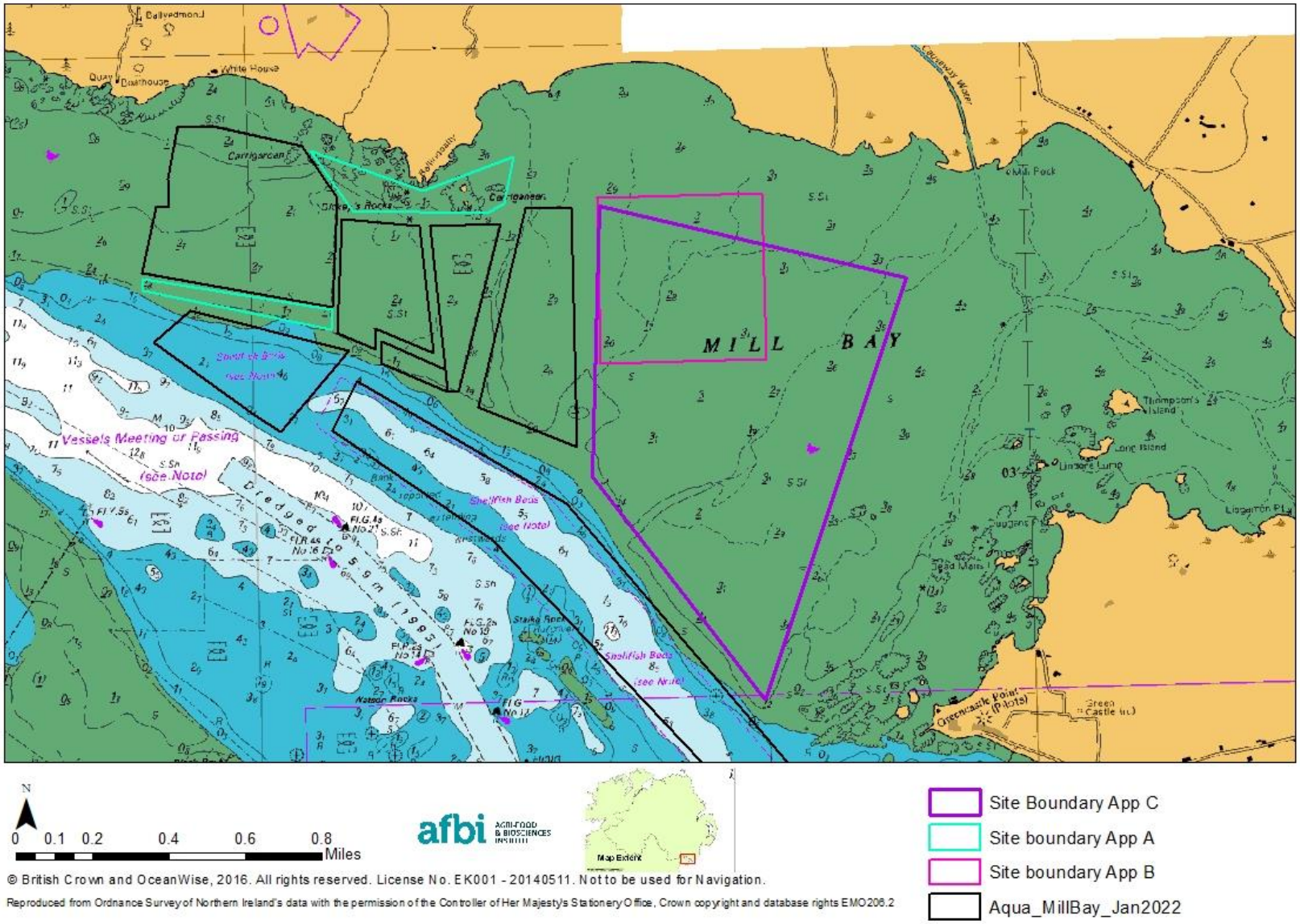

Figure 0: Map showing the location of the proposed new aquaculture sites the Mill Bay area of Carlingford.

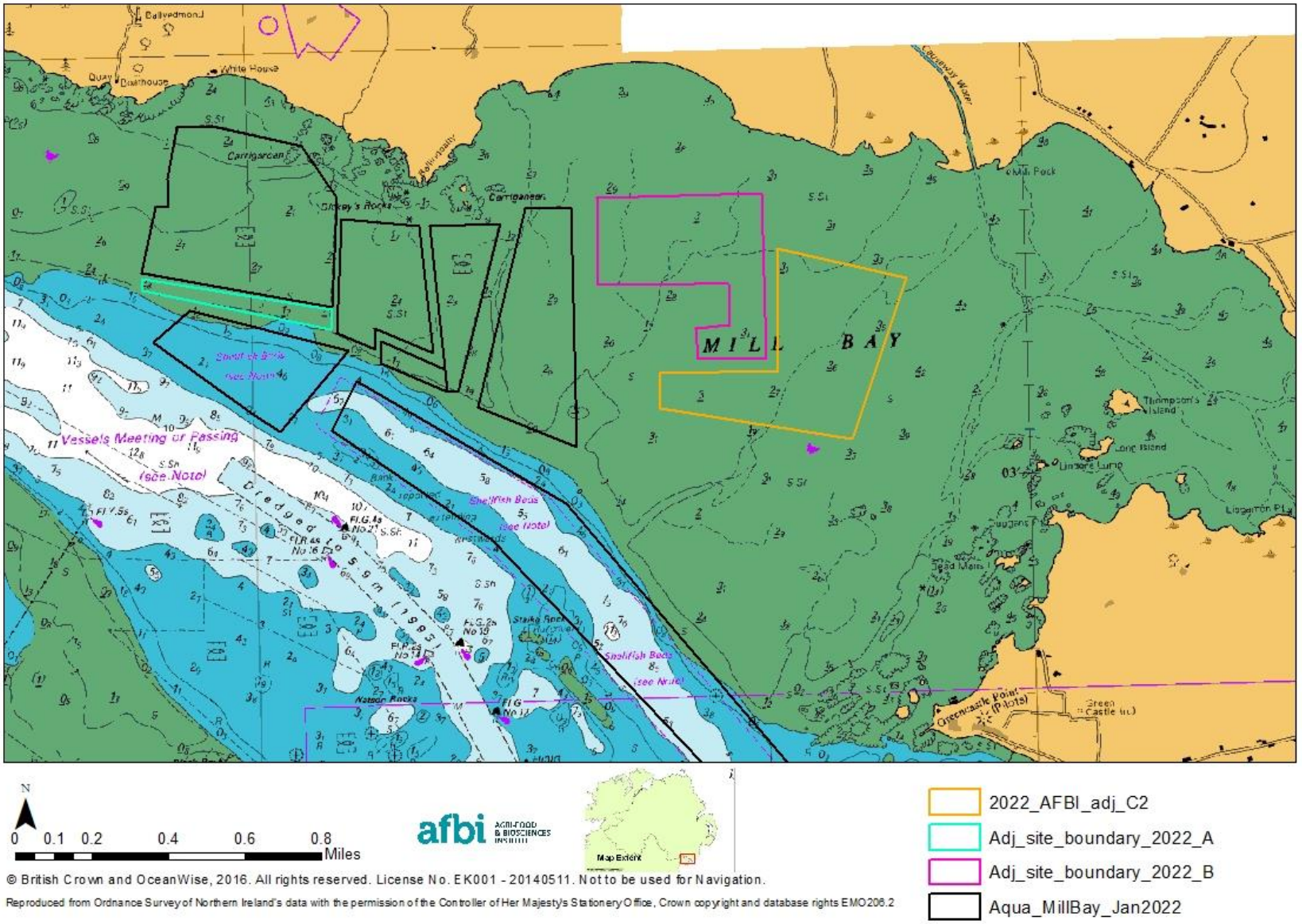

Figure 2: Map showing the AFBI proposed amendments to the boundaries of the proposed new aquaculture sites within the Mill Bay area of Carlingford Lough.

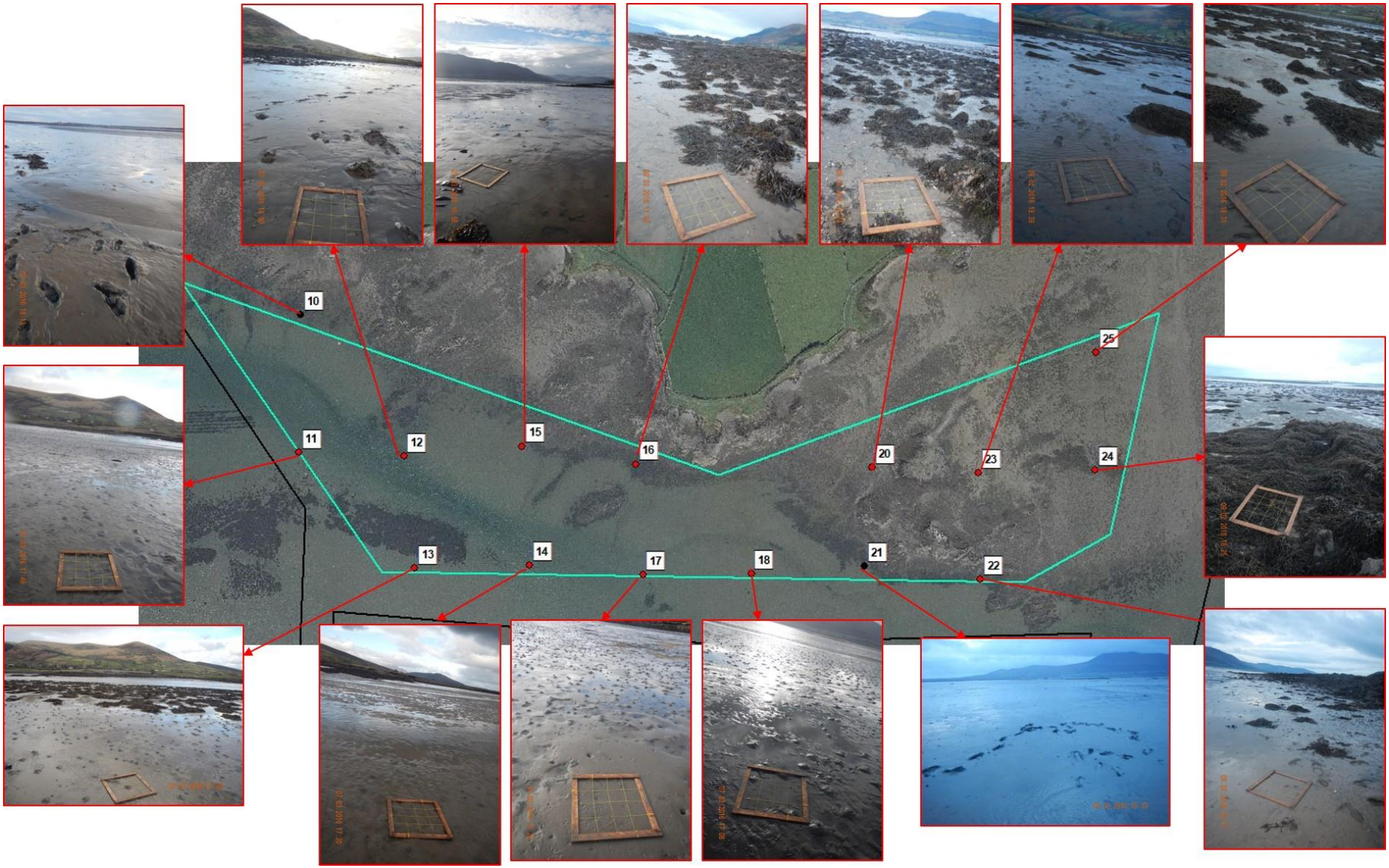

Figure 3: Aerial photo showing the boundary of Application A1 overlaid with the sample station photographs taken during the AFBI site survey in 2016.

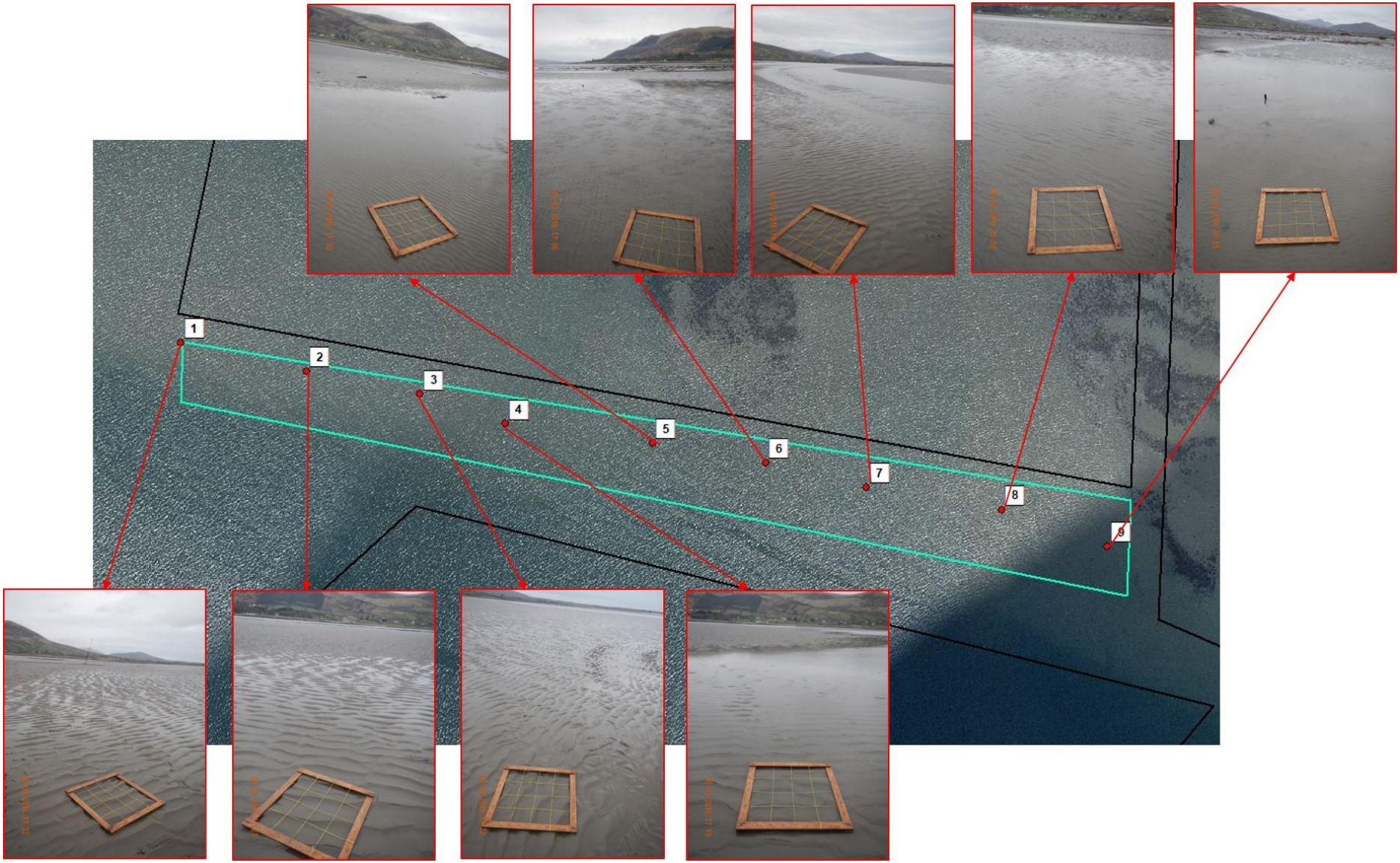

Figure 4: Aerial photo showing the boundary of Application A2 overlaid with the sample station photographs taken during the AFBI site survey in 2016.

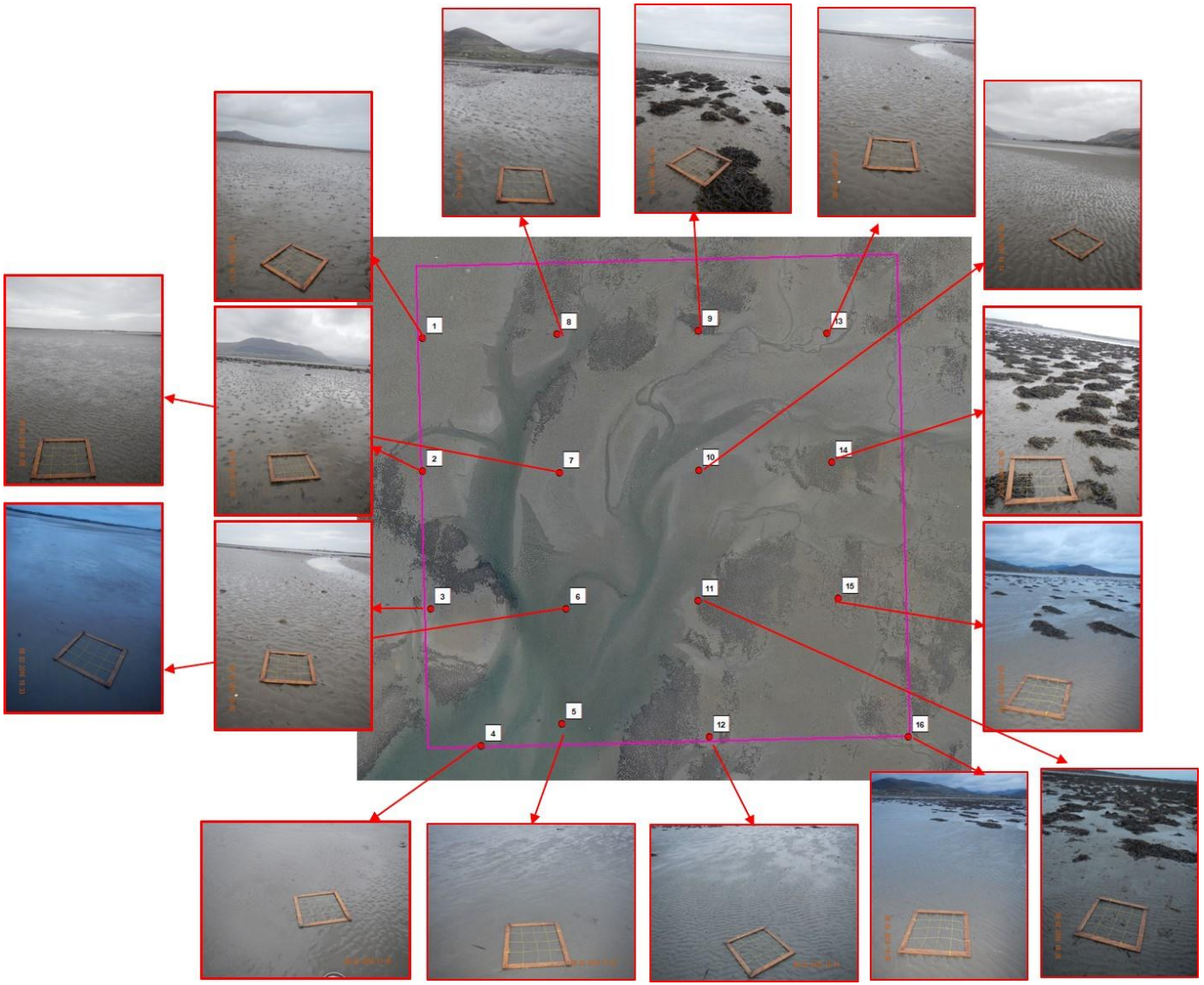

Figure 5: Aerial photo showing the boundary of Application B overlaid with the sample station photographs taken during the AFBI site survey in 2016.

Figure 6: Aerial photo showing the boundary of Application C.

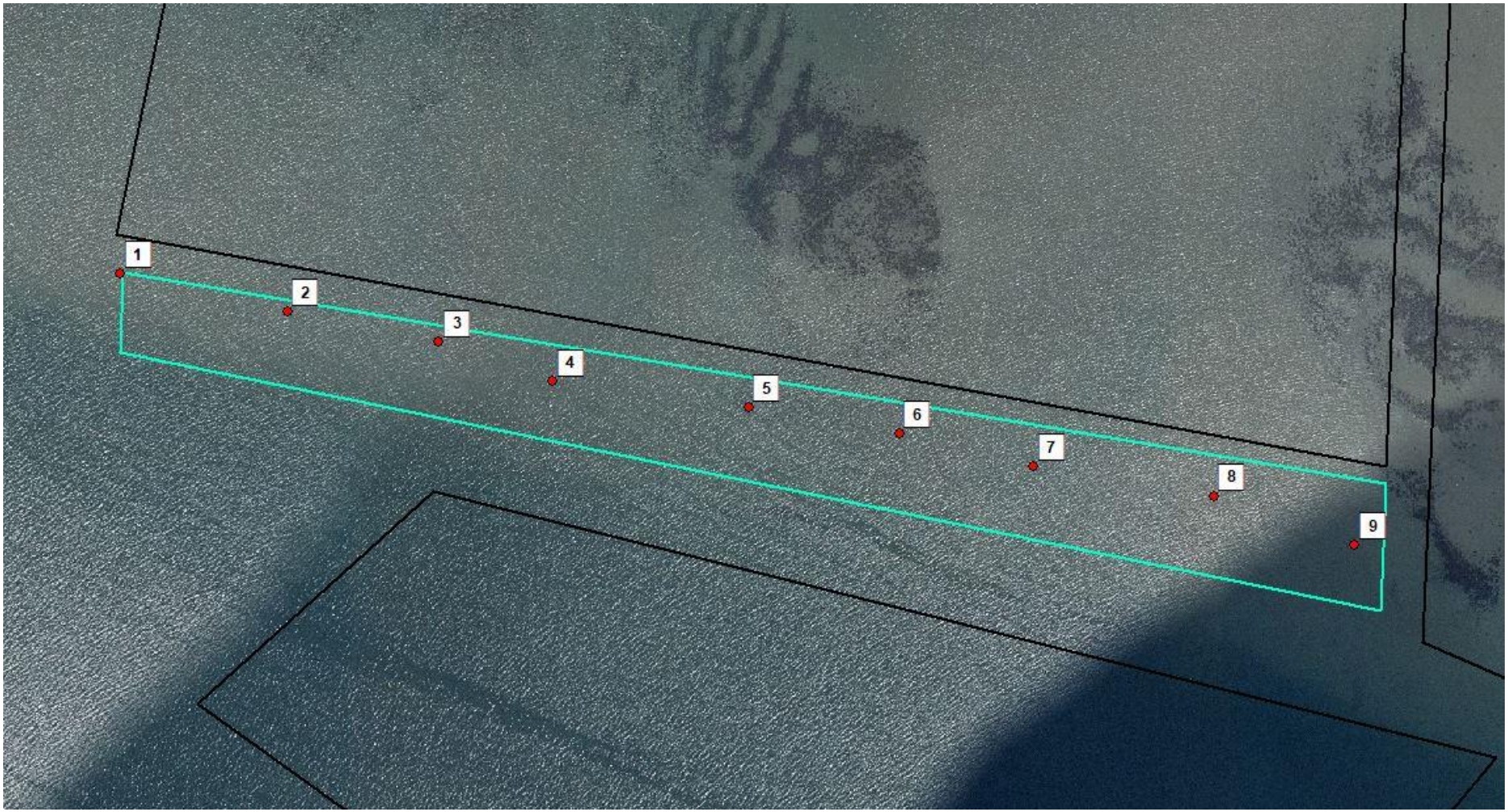

Figure 7: Aerial photo showing the proposed boundary of Application A.

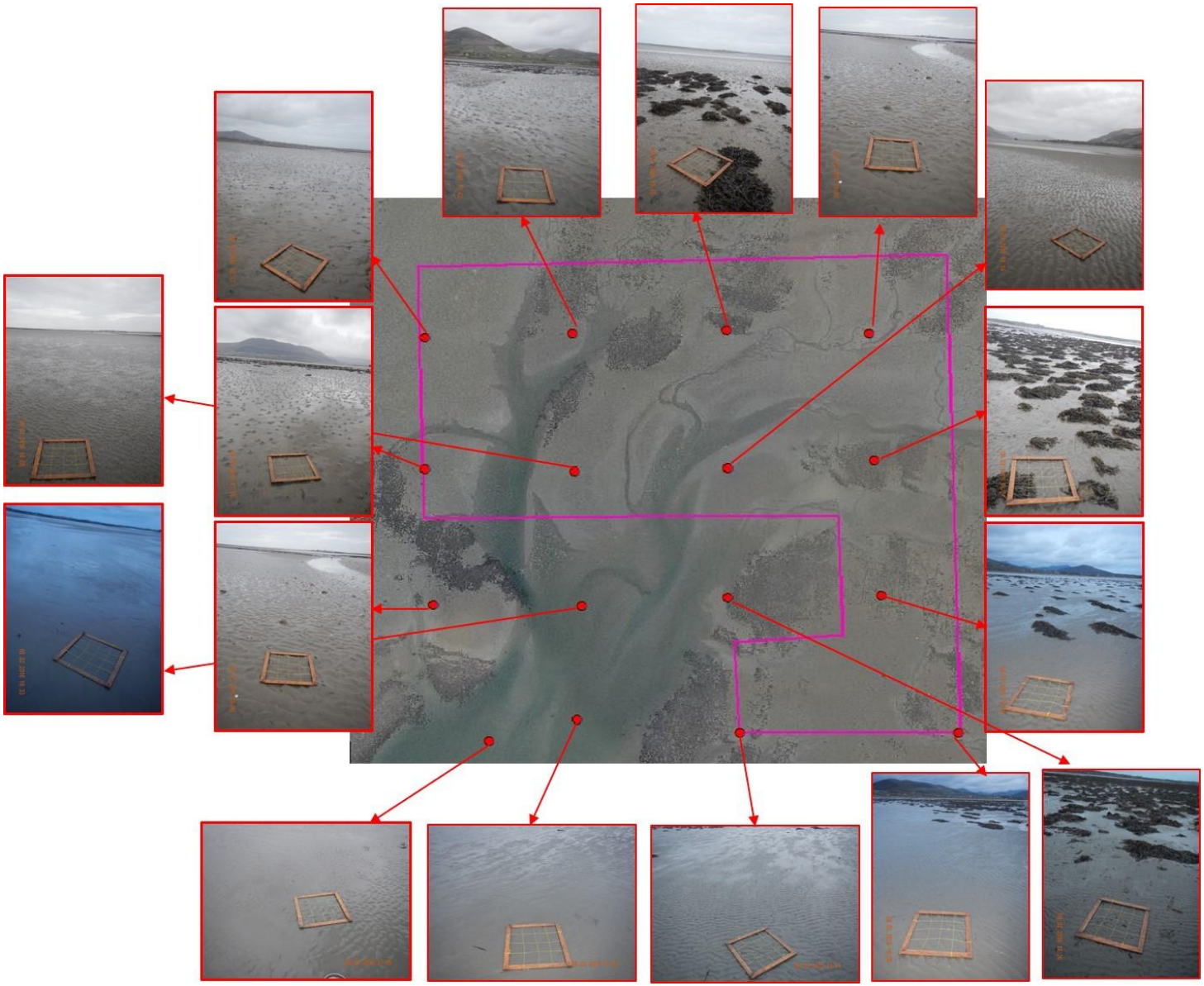

Figure 8: Aerial photo showing the proposed adjusted boundary of Application B overlaid with the sample station photographs taken during the AFBI site survey in 2016.

Figure 9: Aerial photo showing the proposed new boundary of Application C.

Discussion

Application A

As is shown in Figure 3 large areas of proposed site A1 consists of boulders covered in Fucoids. These areas are therefore not suitable for trestle culture. During the AFBI 2016 site survey of proposed site A1 two of the stations were unable to be sampled as the sediments were too soft to walk (stations 10 and 21 in Figure 3). These areas were also deemed unsuitable for trestle culture.

A can be seen in Figure 4 the area of proposed site A2 consists of firm sand. There were no boulders or other obstructions within this area, it was safe to walk on and no species of conservation interest were observed during the site survey. In terms of habitat suitability, this area was therefore deemed suitable for trestle culture.

It is for the reasons outlined above that we are proposing to reduce the area of Application A to only include proposed site A2, as shown in Figure 7. This results in a 69% reduction from the area originally proposed by the applicant (see Table 1). As the area of the proposed new site is being reduced by approximately 68.9% we are also proposing a 68.9% reduction in the estimated annual production at this site. The new production figures can be used to estimate the trestle numbers for which the site should be licensed.

Additional Runs of the SMILE ecosystem model are therefore required to be undertaken utilising the new proposed production for this site. The proposed figures to be converted to input figures which will be implemented within the new model runs are shown in Table 2.

Application B

As is shown within Figure 5 this large site consists of firm sand and areas of boulders with Fucoids. The area within the south western corner of proposed site B has been deemed unsuitable for trestle culture as during the AFBI 2016 site survey of this area the vehicle being utilised by the applicant, who accompanied us during the survey, got stuck within this area.

It is for the reasons outlined above that we are proposing to reduce the area of Application B to the area shown in Figure 8. This results in a 32.7% reduction from the area originally proposed by the applicant (see Table 1). As the area of the proposed

new site is being reduced by approximately 32.7% we are also proposing a 32.7% reduction in the estimated annual production at this site. The new production figures can be used to estimate the trestle numbers for which the site should be licensed.

Additional Runs of the SMILE ecosystem model are therefore required to be undertaken utilising the new proposed production for this site. The proposed figures to be converted to input figures which will be implemented within the new model runs are shown in Table 2.

As is shown in Figure 8, it was not possible to eliminate all areas containing boulders with Fucoids from the proposed new boundary. If a licence is granted for this site these areas of Fucoids should be mapped and the licence should stipulate that these areas must be not be disturbed.

Application C

As is shown within Figure 6 this large site appears to consist of sand and areas of boulders with Fucoids. At the time of writing AFBI have not been asked to undertake a Habitat Regulations Assessment for this application. As a result of this AFBI have not undertaken a site survey within this area. Therefore, the proposed new site boundary is based solely on aerial photographs.

From Figure 1 we can see that there is some overlap between the areas of Application B and C. This area of overlap has therefore been removed from Application C. From the aerial photograph shown within Figure 6 it can be seen that a large portion of the Southern area of the proposed site appears to be occupied by boulders with Fucoids (as identified through site visits within the areas of Application A and B).

It is for the reasons outlined above that we are proposing to reduce the area of Application C to the area shown in Figure 9. This results in a 75.6% reduction from the area originally proposed by the applicant (see Table 1). As the area of the proposed new site is being reduced by approximately 75.6% we are also proposing a 75.6% reduction in the estimated annual production at this site. The new production figures can be used to estimate the trestle numbers for which the site should be licensed.

Additional Runs of the SMILE ecosystem model are therefore required to be undertaken utilising the new proposed production for this site. The proposed figures

to be converted to input figures which will be implemented within the new model runs are shown in Table 2.

As is shown in Figure 9, it was not possible to eliminate all areas that potentially contain boulders with Fucoids from the proposed new boundary. If a licence is granted for this site these areas of Fucoids should be mapped and the licence should stipulate that these areas must be not be disturbed.

Table 2: Original annual production of the proposed new sites as outlined within the applications (in tonnes) and the proposed new annual production (in tonnes). The Percentage reduction relates to the AFBI proposed reduction of the area of the sites as outlined within Table 1.

Application	original annual production	% reduction	proposed new annual production
A (1+2)	80	68.9	25
B	190	32.7	128
C	500	75.6	122

Appendix B: SMILE Model Runs

Document version control:

Version	Issue date	Modifier	Note	Issued to and date
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Approved by:	M. Service
Date/initials:	M S 15-04-22……....

Further information

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Introduction

The Marine and Fisheries Division of the Department of Agriculture, Environment and Rural Affairs (DAERA) commissioned AFBI to prepare a Cumulative Impact Assessment report for current and proposed aquaculture activities within the Mill Bay area of the Carlingford Lough Special Protection Area (SPA) in Northern Ireland. Part of the Cumulative Impact assessment report involves assessing the ecological carrying capacity of existing and proposed new, aquaculture activities within the Mill Bay area. In order to assess the ecological carrying capacity of aquaculture activities within the Mill Bay area of Carlingford Lough the Sustainable Mariculture in northern Irish Lough ecosystems (SMILE) model has been utilised. Full details of this are outlined within the main body of the Mill Bay Carrying capacity report. This document contains the output tables and maps from all of the model runs undertaken as part of this assessment.

Model Runs

Run	Description	Run date
1	Baseline (no aquaculture sites active - wild species draw down only)	02.02.22
2	Run 1 inputs plus all licenced aquaculture sites activated	02.02.22
3	Run 1 inputs plus, only those aquaculture sites which have had activity within the last 5 years activated (All RoI sites assumed to be active)	02.02.22
4	Run 2 inputs plus App A	02.02.22
5	Run 2 inputs plus App B	02.02.22
6	Run 2 inputs plus App C	02.02.22
7	Run 2 inputs plus App A + B	02.02.22
8	Run 2 inputs plus App A + B + C	02.02.22
9	Run 2 inputs plus Amended App A	14.03.22
10	Run 2 inputs plus Amended App B	14.03.22
11	Run 2 inputs plus Amended App C	14.03.22
12	Run 2 inputs plus Amended App A + B	14.03.22
13	Run 2 inputs plus Amended App A + B + C	14.03.22

Run 2

Simulated Chl a values (90th percentile calculated over index period, April to October). Results from Run 1 were used as a baseline and the % reduction of Chl a is shown to illustrate the impact when filtration by aquaculture species within all current licensed sites is taken into account. The shaded area represents the model boxes with a Chl a reduction >30%. The Mill Bay area in Carlingford Lough is within model box 30.

These results and the location of licensed aquaculture sites in relation to SMILE model boxes are shown in Figure 1.1.

Box	Species	Run 1	Run 2	%reduction
Box 36	mussels	11.68	4.16	64.38
Box 35	mussels	11.19	4.69	58.05
Box 34	mussels	10.94	5.19	52.56
Box 24	mussels	9.36	4.45	52.45
Box 32	mussels	10.14	5.46	46.12
Box 22	mussels	8.77	4.80	45.24
Box 31	mussels	9.78	5.38	44.98
Box 33	mussels	10.10	5.94	41.14
Box 27	mussels	9.04	5.75	36.39
Box 29	None	9.71	6.50	33.07
Box 26	mussels	8.47	5.74	32.20
Box 28	mussels	9.18	6.24	32.03
Box 30	mussels +oysters	9.39	6.59	29.74
Box 21	mussels +oysters	7.08	5.19	26.69
Box 23	oysters	6.20	4.93	20.54
Box 25	mussels	7.32	5.90	19.40
Average				**39.69**

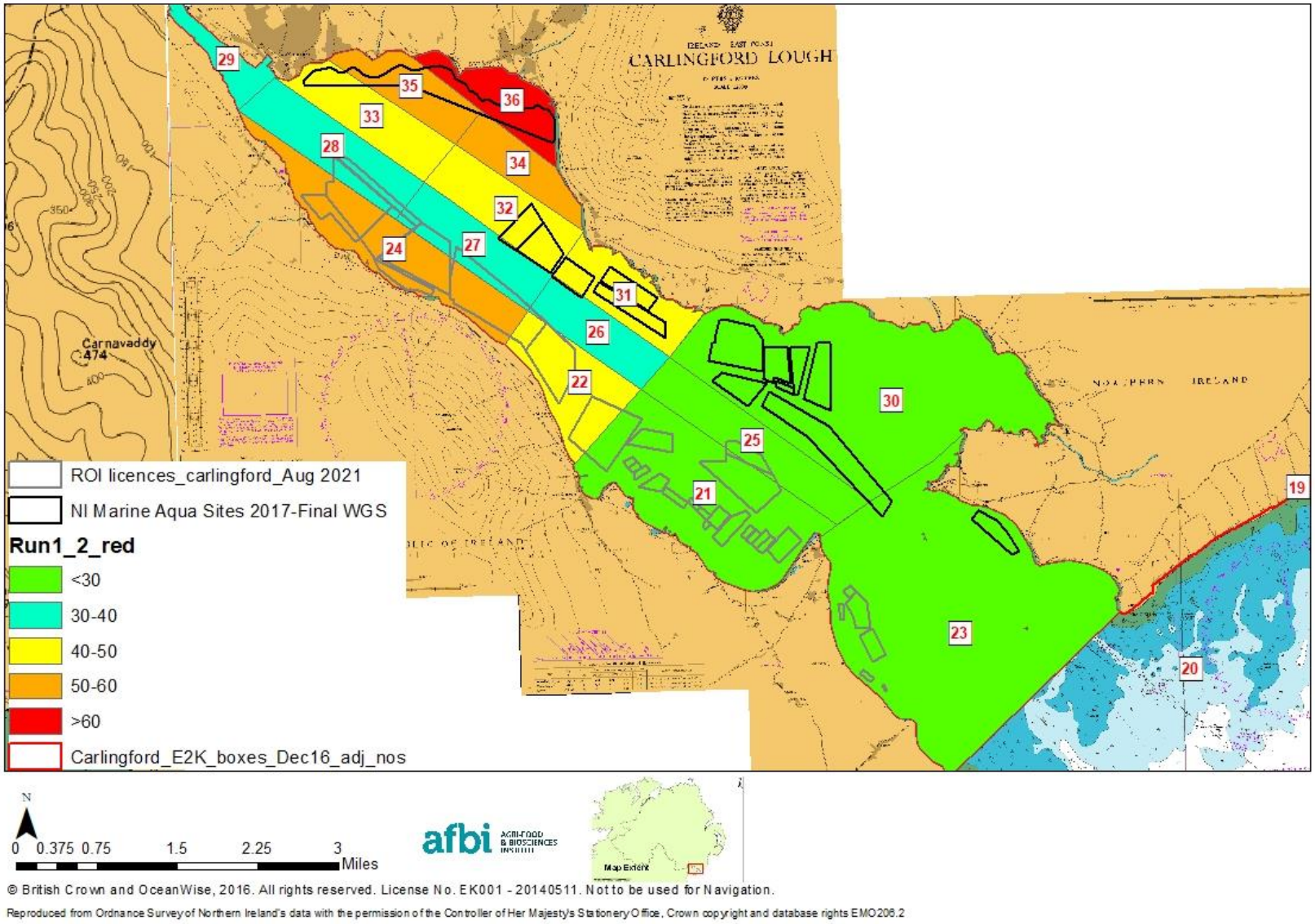

Figure 1.1: Map showing the location of SMILE mode boxes in Carlingford Lough alongside the outputs from Run 2 of the model.

Run 3

Simulated Chl a values (90th percentile calculated over index period, April to October). Results from Run 1 were used as a baseline and the % reduction of Chl a is shown to illustrate the impact when filtration by aquaculture species within only those licensed sites which have been actively producing shellfish within the last five years, is considered. The shaded area represents the model boxes with a Chl a reduction >30%. The Mill Bay area in Carlingford Lough is within model box 30.

These results and the location of licensed aquaculture sites in relation to SMILE model boxes are shown in Figure 1.2.

Box	Species	Run 1	Run 3	%reduction
Box 36	mussels	11.68	4.43	62.05
Box 35	mussels	11.19	5.12	54.24
Box 24	mussels	9.36	4.85	48.21
Box 34	mussels	10.94	5.87	46.32
Box 22	mussels	8.77	5.36	38.94
Box 33	mussels	10.10	6.48	35.86
Box 32	mussels	10.14	6.61	34.83
Box 29	None	9.71	6.90	28.92
Box 31	mussels	9.78	7.06	27.81
Box 27	mussels	9.04	6.59	27.07
Box 28	mussels	9.18	6.70	27.04
Box 26	mussels	8.47	6.32	25.40
Box 21	mussels +oysters	7.08	5.75	18.78
Box 30	mussels +oysters	9.39	7.91	15.69
Box 25	mussels	7.32	6.25	14.57
Box 23	oysters	6.20	5.47	11.88
Average				**32.35**

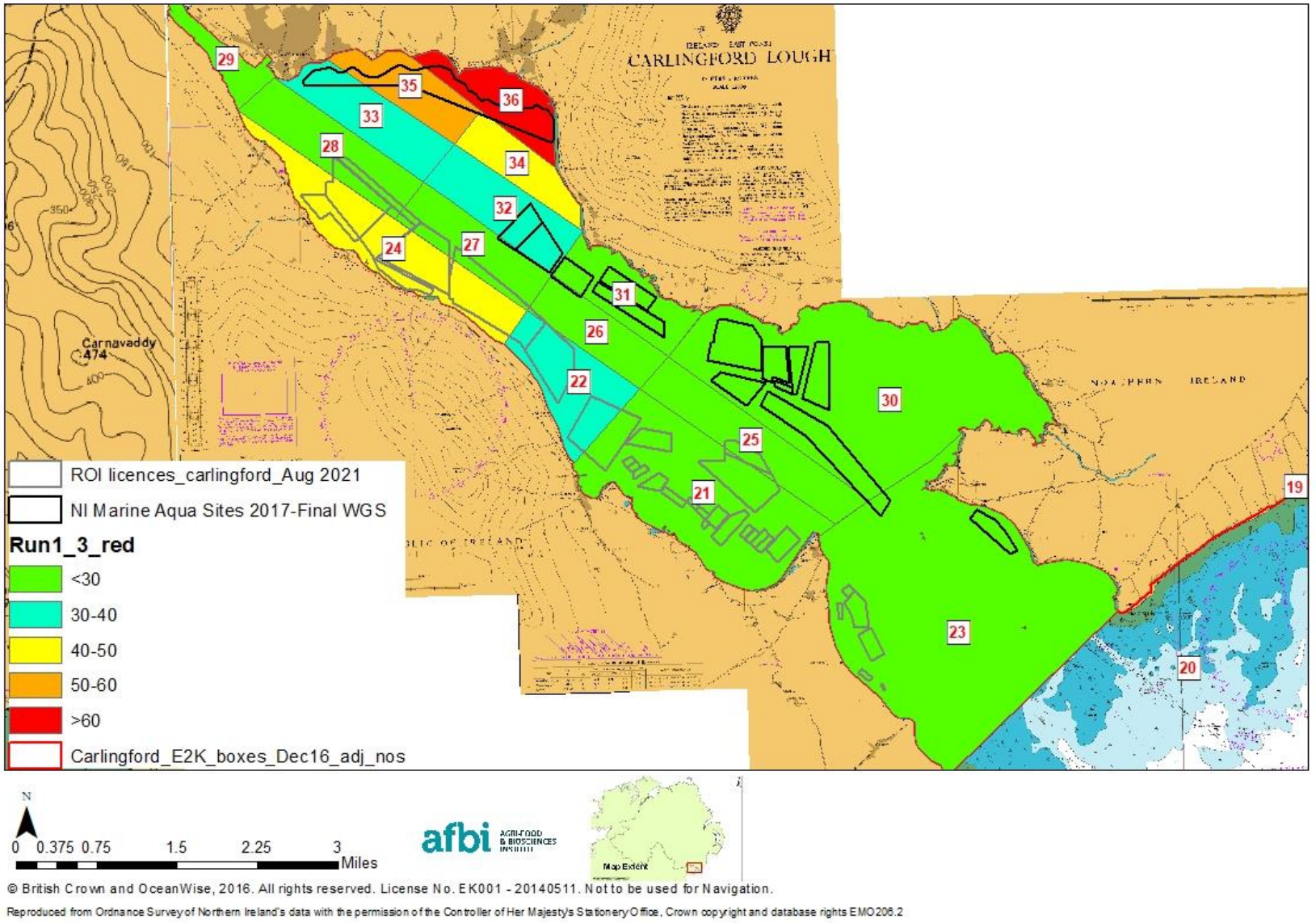

Figure 1.2: Map showing the location of SMILE mode boxes in Carlingford Lough alongside the outputs from Run 3 of the model.

Run 4

Simulated Chl a values (90th percentile calculated over index period, April to October). Results from Run 1 were used as a baseline and the % reduction of Chl a is shown to illustrate the impact when filtration by aquaculture species within all current licensed sites, plus the change in production resulting from the addition of the new aquaculture site proposed within Application A is taken into account. The shaded area represents the model boxes with a Chl a reduction >30%. The Mill Bay area in Carlingford Lough is within model box 30.

These results and the location of licensed aquaculture sites in relation to SMILE model boxes are shown in Figure 1.3.

Box	Species	Run 1	Run 4	%reduction
Box 36	mussels	11.68	4.17	64.30
Box 35	mussels	11.19	4.69	58.09
Box 34	mussels	10.94	5.19	52.54
Box 24	mussels	9.36	4.49	52.05
Box 32	mussels	10.14	5.49	45.84
Box 22	mussels	8.77	4.79	45.40
Box 31	mussels	9.78	5.36	45.20
Box 33	mussels	10.10	5.96	40.97
Box 27	mussels	9.04	5.78	36.04
Box 29	None	9.71	6.50	33.04
Box 26	mussels	8.47	5.70	32.67
Box 28	mussels	9.18	6.25	31.89
Box 30	mussels +oysters	9.39	6.59	29.79
Box 21	mussels +oysters	7.08	5.19	26.74
Box 23	oysters	6.20	4.89	21.15
Box 25	mussels	7.32	5.88	19.67
Average				**39.71**

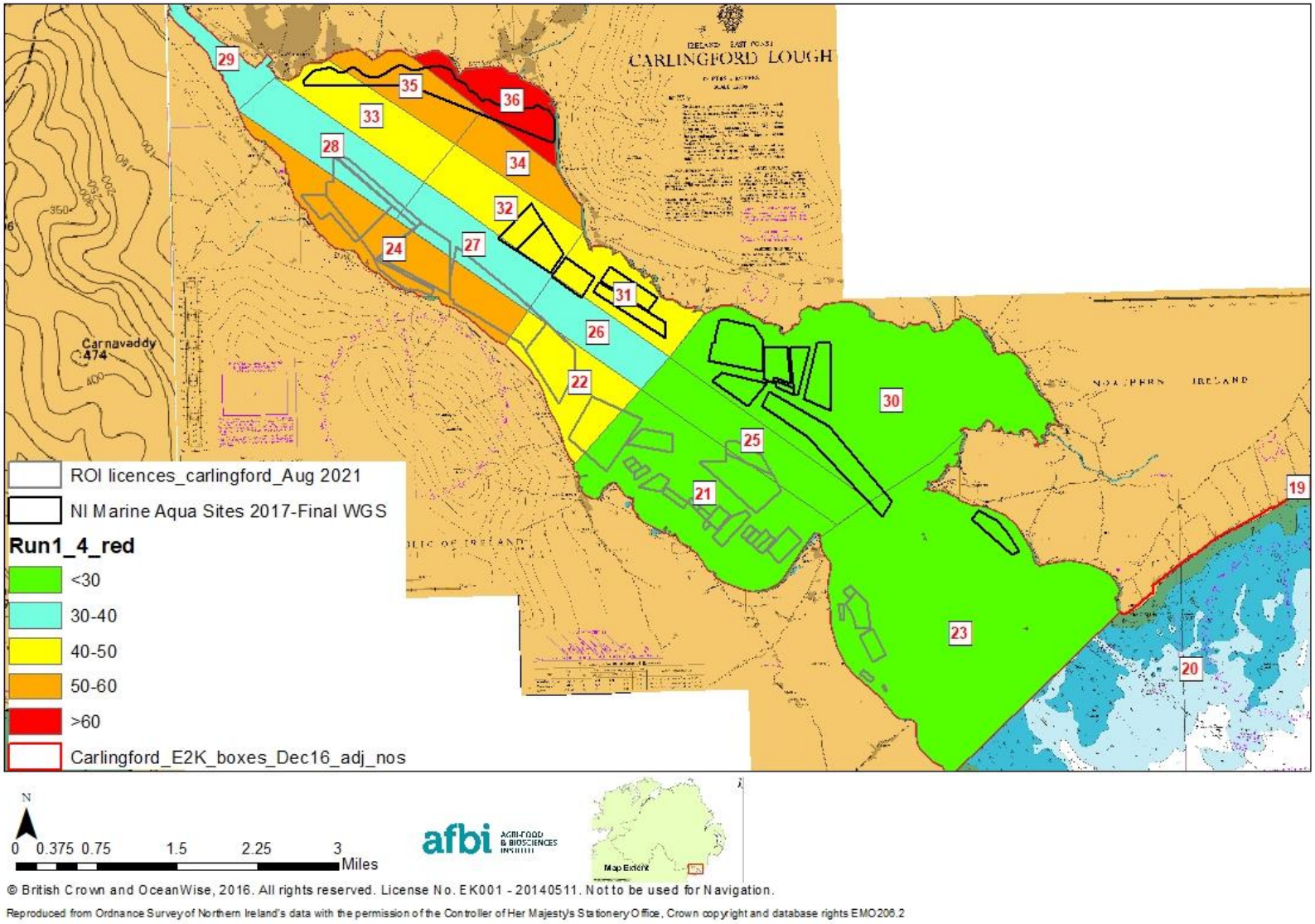

Figure 1.3: Map showing the location of SMILE mode boxes in Carlingford Lough alongside the outputs from Run 4 of the model.

Run 5

Simulated Chl a values (90th percentile calculated over index period, April to October). Results from Run 1 were used as a baseline and the % reduction of Chl a is shown to illustrate the impact when filtration by aquaculture species within all current licensed sites, plus the change in production resulting from the addition of the new aquaculture site proposed within Application B is taken into account. The shaded area represents the model boxes with a Chl a reduction >30%. The Mill Bay area in Carlingford Lough is within model box 30.

These results and the location of licensed aquaculture sites in relation to SMILE model boxes are shown in Figure 1.4.

Box	Species	Run 1	Run 5	%reduction
Box 36	mussels	11.68	4.17	64.30
Box 35	mussels	11.19	4.69	58.09
Box 34	mussels	10.94	5.19	52.54
Box 24	mussels	9.36	4.49	52.05
Box 32	mussels	10.14	5.49	45.84
Box 22	mussels	8.77	4.79	45.40
Box 31	mussels	9.78	5.36	45.20
Box 33	mussels	10.10	5.96	40.97
Box 27	mussels	9.04	5.78	36.04
Box 29	None	9.71	6.50	33.04
Box 26	mussels	8.47	5.70	32.67
Box 28	mussels	9.18	6.25	31.89
Box 30	mussels +oysters	9.39	6.59	29.79
Box 21	mussels +oysters	7.08	5.19	26.74
Box 23	oysters	6.20	4.89	21.15
Box 25	mussels	7.32	5.88	19.67
Average				**39.71**

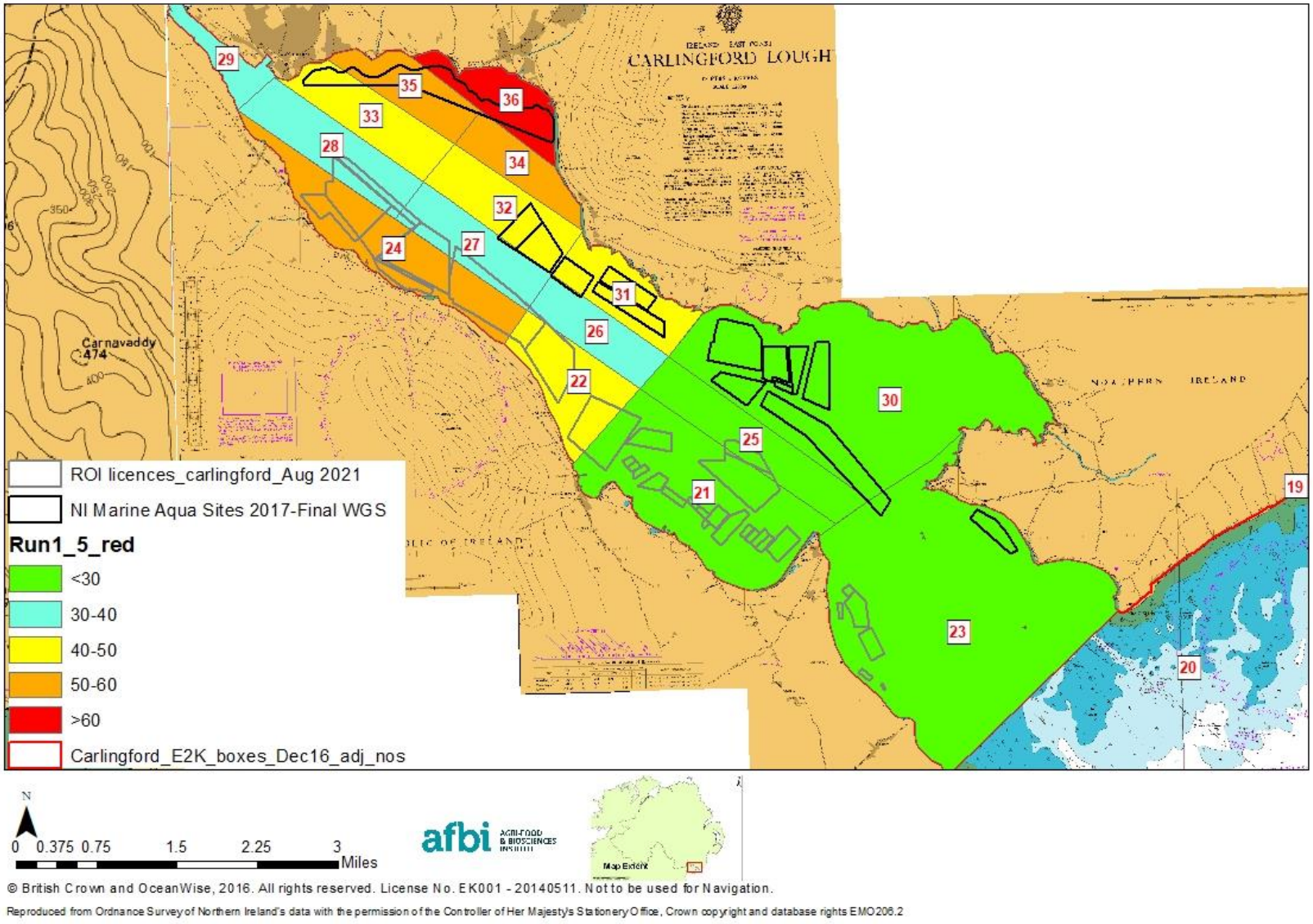

Figure 1.4: Map showing the location of SMILE mode boxes in Carlingford Lough alongside the outputs from Run 5 of the model.

Run 6

Simulated Chl a values (90th percentile calculated over index period, April to October). Results from Run 1 were used as a baseline and the % reduction of Chl a is shown to illustrate the impact when filtration by aquaculture species within all current licensed sites, plus the change in production resulting from the addition of the new aquaculture site proposed within Application C is taken into account. The shaded area represents the model boxes with a Chl a reduction >30%. The Mill Bay area in Carlingford Lough is within model box 30.

These results and the location of licensed aquaculture sites in relation to SMILE model boxes are shown in Figure 1.5.

Box	Species	Run 1	Run 6	%reduction
Box 36	mussels	11.68	4.16	64.38
Box 35	mussels	11.19	4.69	58.06
Box 34	mussels	10.94	5.19	52.58
Box 24	mussels	9.36	4.45	52.46
Box 32	mussels	10.14	5.46	46.14
Box 22	mussels	8.77	4.80	45.27
Box 31	mussels	9.78	5.38	45.01
Box 33	mussels	10.10	5.94	41.15
Box 27	mussels	9.04	5.74	36.43
Box 29	None	9.71	6.50	33.07
Box 26	mussels	8.47	5.74	32.22
Box 28	mussels	9.18	6.24	32.05
Box 30	mussels +oysters	9.39	6.58	29.94
Box 21	mussels +oysters	7.08	5.19	26.74
Box 23	oysters	6.20	4.92	20.64
Box 25	mussels	7.32	5.90	19.43
Average				**39.72**

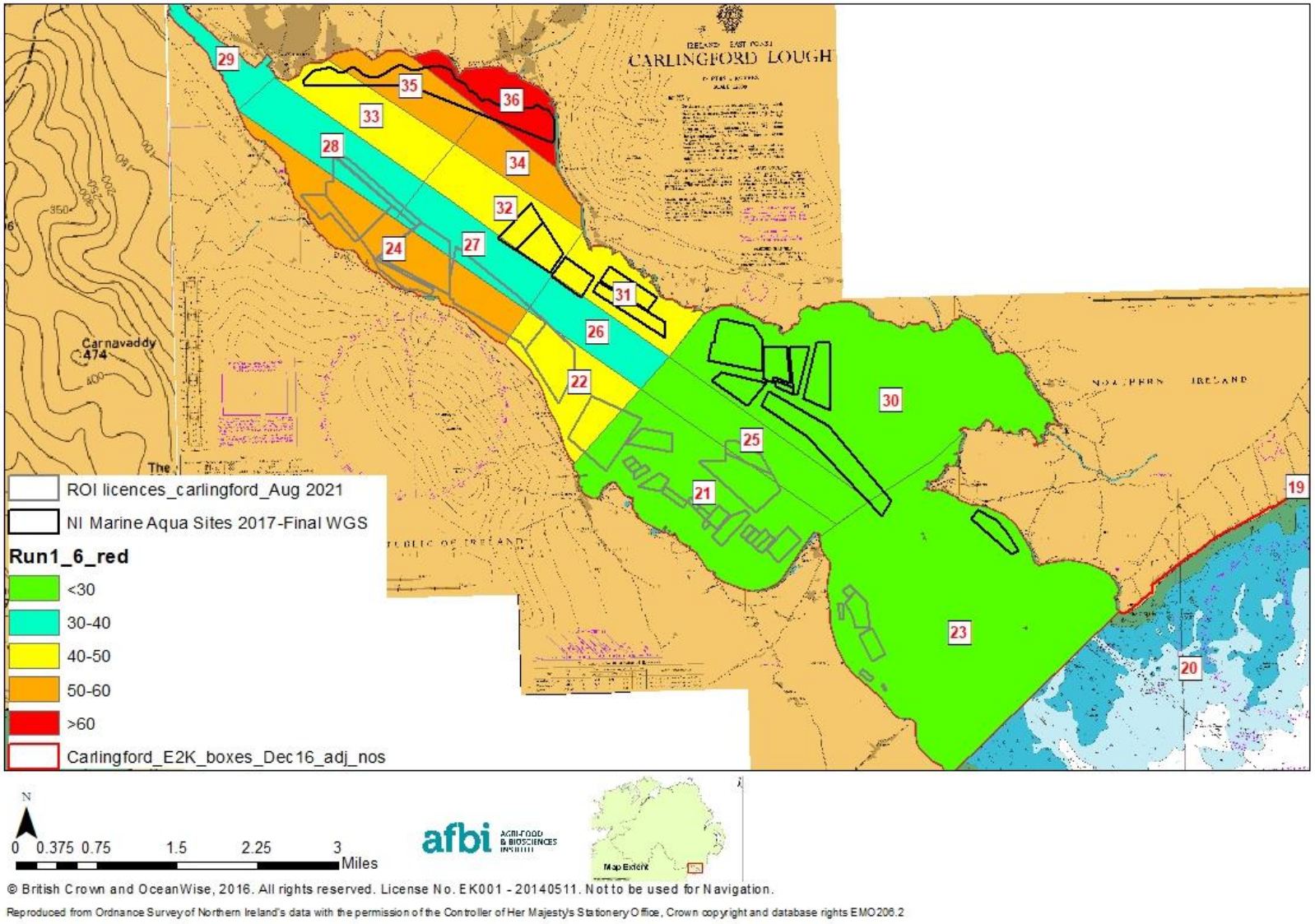

Figure 1.5: Map showing the location of SMILE mode boxes in Carlingford Lough alongside the outputs from Run 6 of the model.

Run 7

Simulated Chl a values (90th percentile calculated over index period, April to October). Results from Run 1 were used as a baseline and the % reduction of Chl a is shown to illustrate the impact when filtration by aquaculture species within all current licensed sites, plus the change in production resulting from the addition of the new aquaculture site proposed within Applications A and B are taken into account. The shaded area represents the model boxes with a Chl a reduction >30%. The Mill Bay area in Carlingford Lough is within model box 30.

These results and the location of licensed aquaculture sites in relation to SMILE model boxes are shown in Figure 1.6.

Box	Species	Run 1	Run 7	%reduction
Box 36	mussels	11.68	4.16	64.38
Box 35	mussels	11.19	4.69	58.05
Box 34	mussels	10.94	5.19	52.57
Box 24	mussels	9.36	4.45	52.46
Box 32	mussels	10.14	5.46	46.13
Box 22	mussels	8.77	4.80	45.26
Box 31	mussels	9.78	5.38	45.00
Box 33	mussels	10.10	5.94	41.14
Box 27	mussels	9.04	5.75	36.41
Box 29	None	9.71	6.50	33.07
Box 26	mussels	8.47	5.74	32.21
Box 28	mussels	9.18	6.24	32.04
Box 30	mussels +oysters	9.39	6.58	29.84
Box 21	mussels +oysters	7.08	5.19	26.72
Box 23	oysters	6.20	4.92	20.59
Box 25	mussels	7.32	5.90	19.42
Average				**39.71**

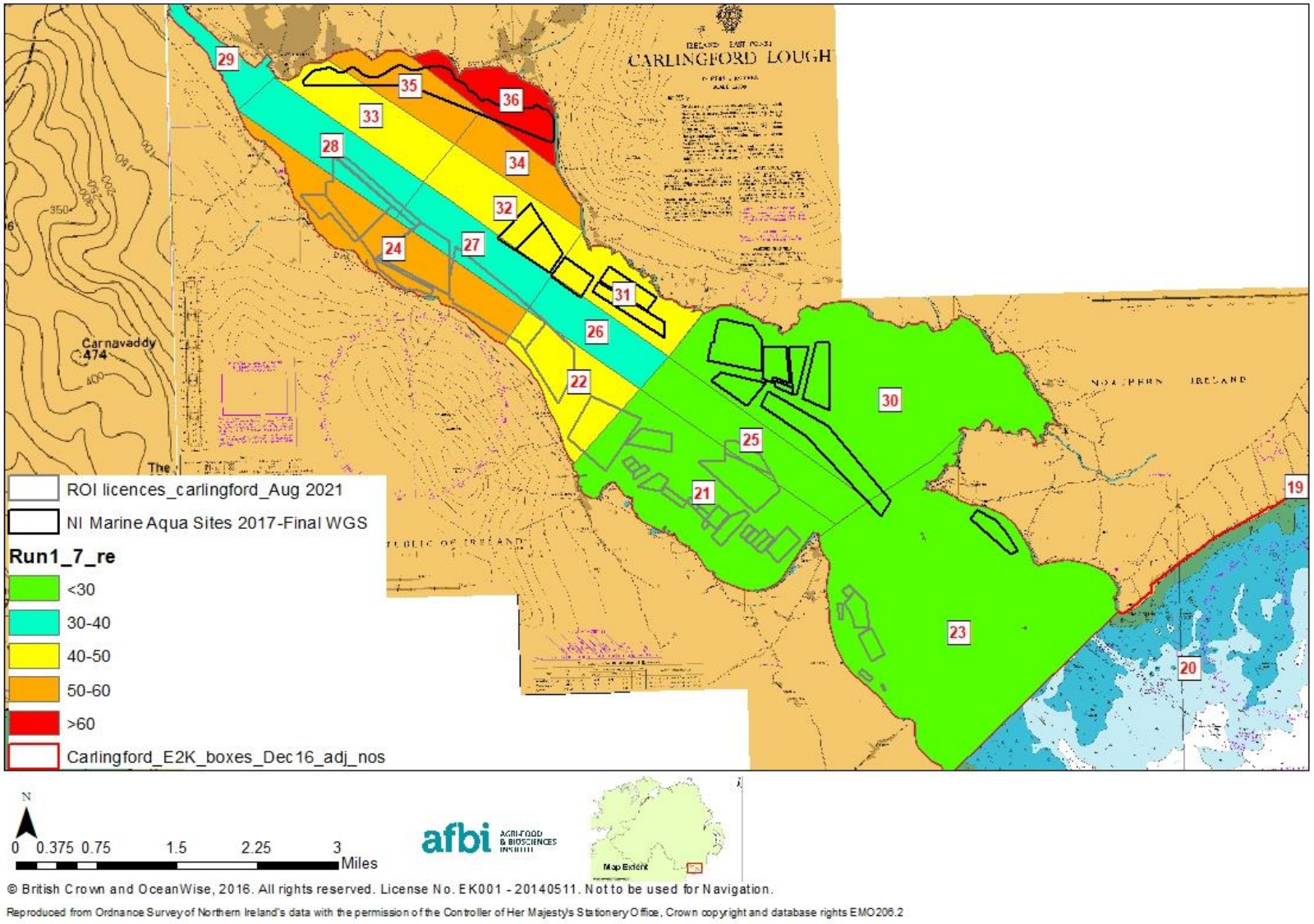

Figure 1.6: Map showing the location of SMILE mode boxes in Carlingford Lough alongside the outputs from Run 7 of the model.

Run 8

Simulated Chl a values (90th percentile calculated over index period, April to October). Results from Run 1 were used as a baseline and the % reduction of Chl a is shown to illustrate the impact when filtration by aquaculture species within all current licensed sites, plus the change in production resulting from the addition of the new aquaculture sites proposed within Applications A, B and C are taken into account. The shaded area represents the model boxes with a Chl a reduction >30%. The Mill Bay area in Carlingford Lough is within model box 30.

These results and the location of licensed aquaculture sites in relation to SMILE model boxes are shown in Figure 1.7.

Box	Species	Run 1	Run 8	%reduction
Box 36	mussels	11.68	4.16	64.38
Box 35	mussels	11.19	4.69	58.06
Box 34	mussels	10.94	5.19	52.58
Box 24	mussels	9.36	4.45	52.47
Box 32	mussels	10.14	5.46	46.14
Box 22	mussels	8.77	4.80	45.29
Box 31	mussels	9.78	5.38	45.03
Box 33	mussels	10.10	5.94	41.15
Box 27	mussels	9.04	5.74	36.45
Box 29	None	9.71	6.50	33.07
Box 26	mussels	8.47	5.74	32.23
Box 28	mussels	9.18	6.23	32.07
Box 30	mussels +oysters	9.39	6.57	30.05
Box 21	mussels +oysters	7.08	5.19	26.77
Box 23	oysters	6.20	4.92	20.69
Box 25	mussels	7.32	5.90	19.44
Average				**39.74**

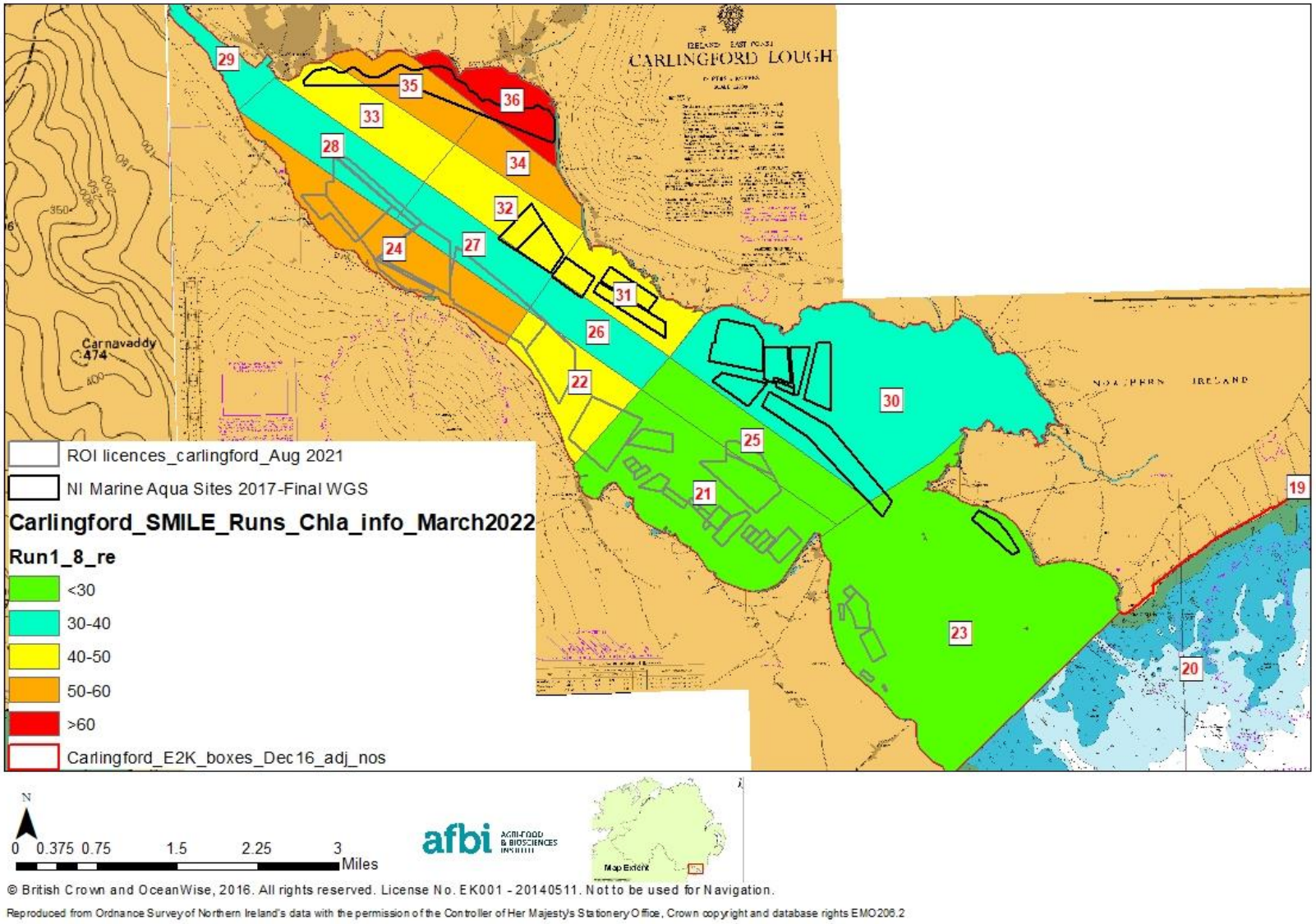

Figure 1.7: Map showing the location of SMILE mode boxes in Carlingford Lough alongside the outputs from Run 8 of the model.

Run 9

Simulated Chl a values (90th percentile calculated over index period, April to October). Results from Run 1 were used as a baseline and the % reduction of Chl a is shown to illustrate the impact when filtration by aquaculture species within all current licensed sites, plus the change in production resulting from the addition of the new aquaculture site proposed within Application A, as amended by AFBI (see Appendix A), is taken into account. The shaded area represents the model boxes with a Chl a reduction >30%. The Mill Bay area in Carlingford Lough is within model box 30.

These results and the location of licensed aquaculture sites in relation to SMILE model boxes are shown in Figure 1.8.

Box	Species	Run 1	Run 9	%reduction
Box 36	mussels	11.682	4.16	64.38
Box 35	mussels	11.190	4.69	58.05
Box 34	mussels	10.935	5.19	52.56
Box 24	mussels	9.363	4.45	52.45
Box 32	mussels	10.136	5.46	46.12
Box 22	mussels	8.773	4.80	45.24
Box 31	mussels	9.780	5.38	44.98
Box 33	mussels	10.096	5.94	41.14
Box 27	mussels	9.036	5.75	36.39
Box 29	None	9.707	6.50	33.07
Box 26	mussels	8.466	5.74	32.20
Box 28	mussels	9.177	6.24	32.03
Box 30	mussels +oysters	9.386	6.59	29.75
Box 21	mussels +oysters	7.084	5.19	26.70
Box 23	oysters	6.202	4.93	20.55
Box 25	mussels	7.320	5.90	19.40
Average				**39.69**

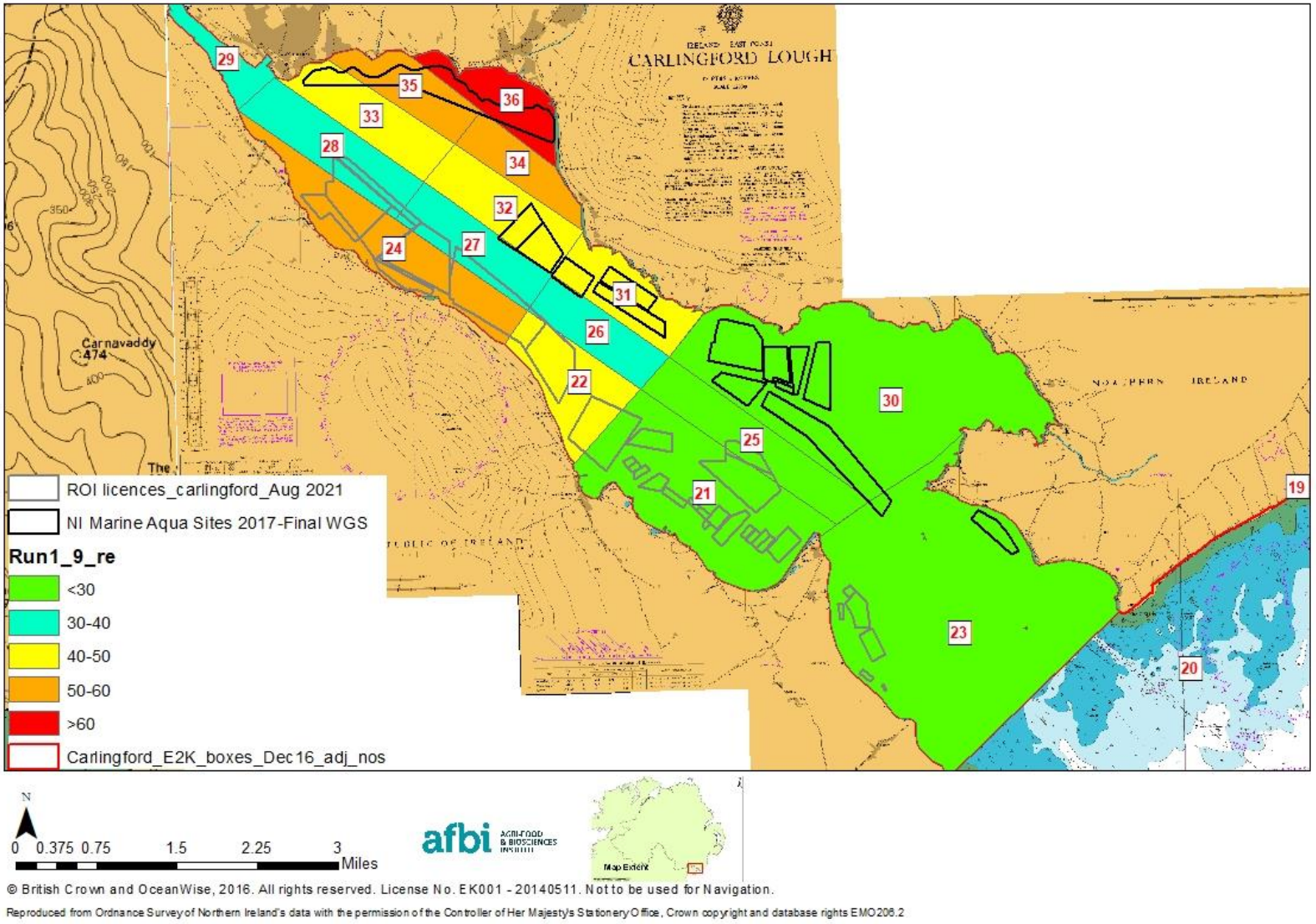

Figure 1.8: Map showing the location of SMILE mode boxes in Carlingford Lough alongside the outputs from Run 9 of the model.

Run 10

Simulated Chl a values (90th percentile calculated over index period, April to October). Results from Run 1 were used as a baseline and the % reduction of Chl a is shown to illustrate the impact when filtration by aquaculture species within all current licensed sites, plus the change in production resulting from the addition of the new aquaculture site proposed within Application B, as amended by AFBI (see Appendix A), is taken into account. The shaded area represents the model boxes with a Chl a reduction >30%. The Mill Bay area in Carlingford Lough is within model box 30.

These results and the location of licensed aquaculture sites in relation to SMILE model boxes are shown in Figure 1.9.

Box	Species	Run 1	Run 10	%reduction
Box 36	mussels	11.68	4.16	64.38
Box 35	mussels	11.19	4.69	58.05
Box 34	mussels	10.94	5.19	52.57
Box 24	mussels	9.36	4.45	52.45
Box 32	mussels	10.14	5.46	46.12
Box 22	mussels	8.77	4.80	45.25
Box 31	mussels	9.78	5.38	44.99
Box 33	mussels	10.10	5.94	41.14
Box 27	mussels	9.04	5.75	36.40
Box 29	None	9.71	6.50	33.07
Box 26	mussels	8.47	5.74	32.21
Box 28	mussels	9.18	6.24	32.04
Box 30	mussels +oysters	9.39	6.59	29.79
Box 21	mussels +oysters	7.08	5.19	26.71
Box 23	oysters	6.20	4.93	20.57
Box 25	mussels	7.32	5.90	19.41
Average				**39.70**

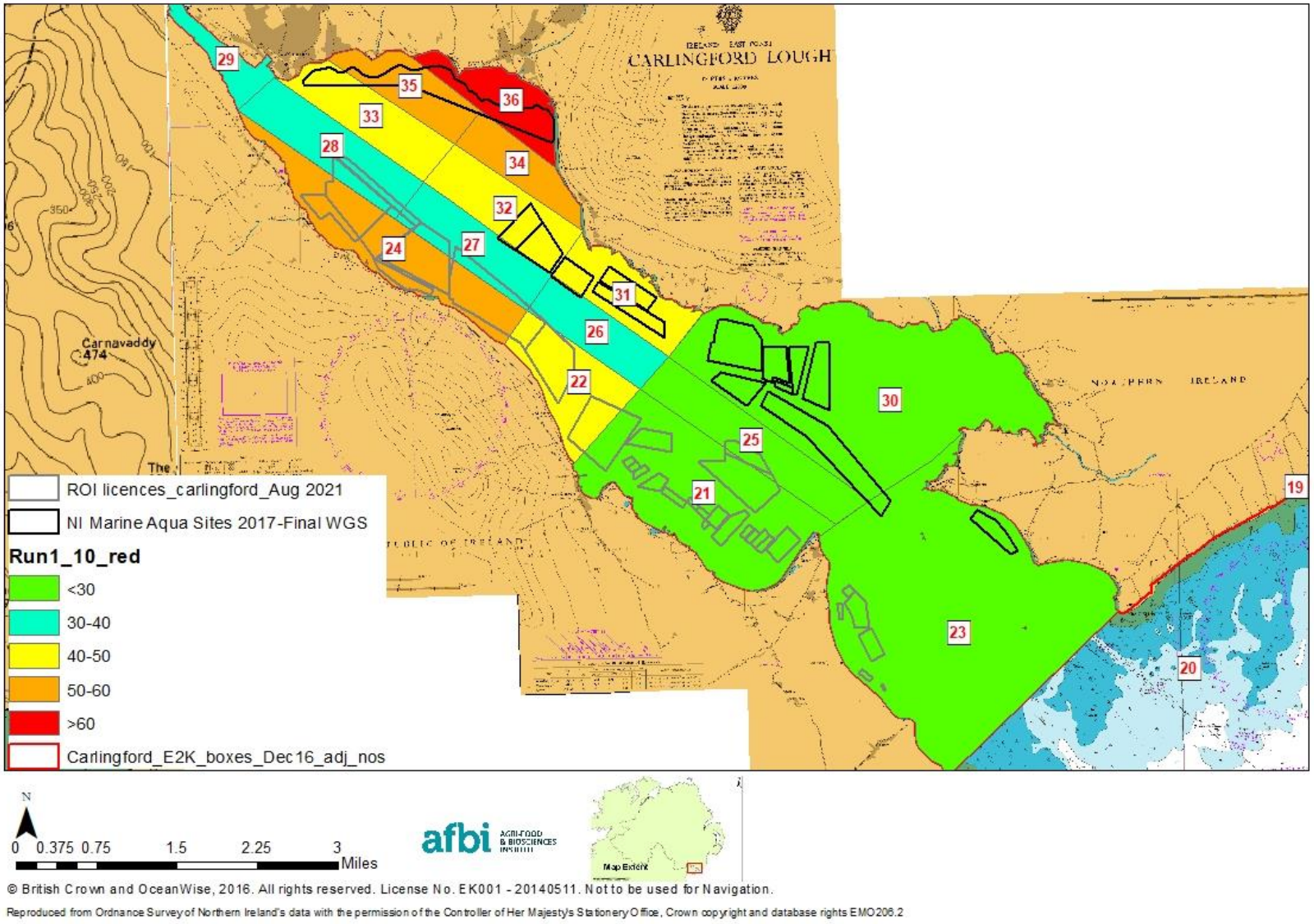

Figure 1.9: Map showing the location of SMILE mode boxes in Carlingford Lough alongside the outputs from Run 10 of the model.

Run 11

Simulated Chl a values (90th percentile calculated over index period, April to October). Results from Run 1 were used as a baseline and the % reduction of Chl a is shown to illustrate the impact when filtration by aquaculture species within all current licensed sites, plus the change in production resulting from the addition of the new aquaculture site proposed within Application C, as amended by AFBI (see Appendix A), is taken into account. The shaded area represents the model boxes with a Chl a reduction >30%. The Mill Bay area in Carlingford Lough is within model box 30.

These results and the location of licensed aquaculture sites in relation to SMILE model boxes are shown in Figure 1.10.

Box	Species	Run 1	Run 11	%reduction
Box 36	mussels	11.68	4.16	64.38
Box 35	mussels	11.19	4.69	58.05
Box 34	mussels	10.94	5.19	52.57
Box 24	mussels	9.36	4.45	52.45
Box 32	mussels	10.14	5.46	46.12
Box 22	mussels	8.77	4.80	45.25
Box 31	mussels	9.78	5.38	44.99
Box 33	mussels	10.10	5.94	41.14
Box 27	mussels	9.04	5.75	36.40
Box 29	None	9.71	6.50	33.07
Box 26	mussels	8.47	5.74	32.21
Box 28	mussels	9.18	6.24	32.04
Box 30	mussels +oysters	9.39	6.59	29.79
Box 21	mussels +oysters	7.08	5.19	26.71
Box 23	oysters	6.20	4.93	20.57
Box 25	mussels	7.32	5.90	19.41
Average				**39.70**

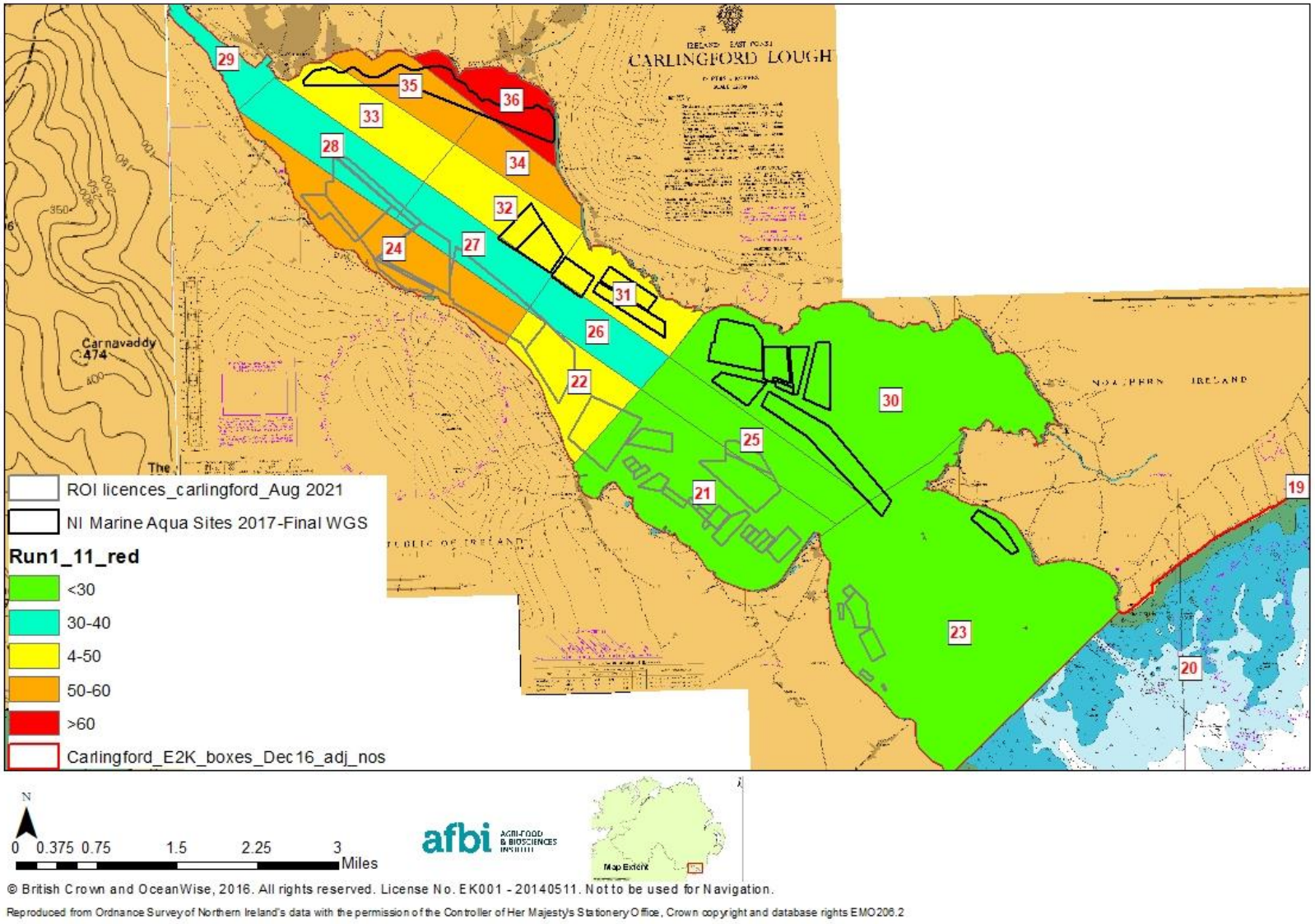

Figure 1.10: Map showing the location of SMILE mode boxes in Carlingford Lough alongside the outputs from Run 11 of the model.

Run 12

Simulated Chl a values (90th percentile calculated over index period, April to October). Results from Run 1 were used as a baseline and the % reduction of Chl a is shown to illustrate the impact when filtration by aquaculture species within all current licensed sites, plus the change in production resulting from the addition of the new aquaculture sites proposed within Applications A and B, as amended by AFBI (see Appendix A), is taken into account. The shaded area represents the model boxes with a Chl a reduction >30%. The Mill Bay area in Carlingford Lough is within model box 30.

These results and the location of licensed aquaculture sites in relation to SMILE model boxes are shown in Figure 1.11.

Box	Species	Run 1	Run 12	%reduction
Box 36	mussels	11.68	4.16	64.38
Box 35	mussels	11.19	4.69	58.05
Box 34	mussels	10.94	5.19	52.57
Box 24	mussels	9.36	4.45	52.46
Box 32	mussels	10.14	5.46	46.13
Box 22	mussels	8.77	4.80	45.26
Box 31	mussels	9.78	5.38	44.99
Box 33	mussels	10.10	5.94	41.14
Box 27	mussels	9.04	5.75	36.40
Box 29	None	9.71	6.50	33.07
Box 26	mussels	8.47	5.74	32.21
Box 28	mussels	9.18	6.24	32.04
Box 30	mussels +oysters	9.39	6.59	29.83
Box 21	mussels +oysters	7.08	5.19	26.72
Box 23	oysters	6.20	4.93	20.58
Box 25	mussels	7.32	5.90	19.41
Average				**39.70**

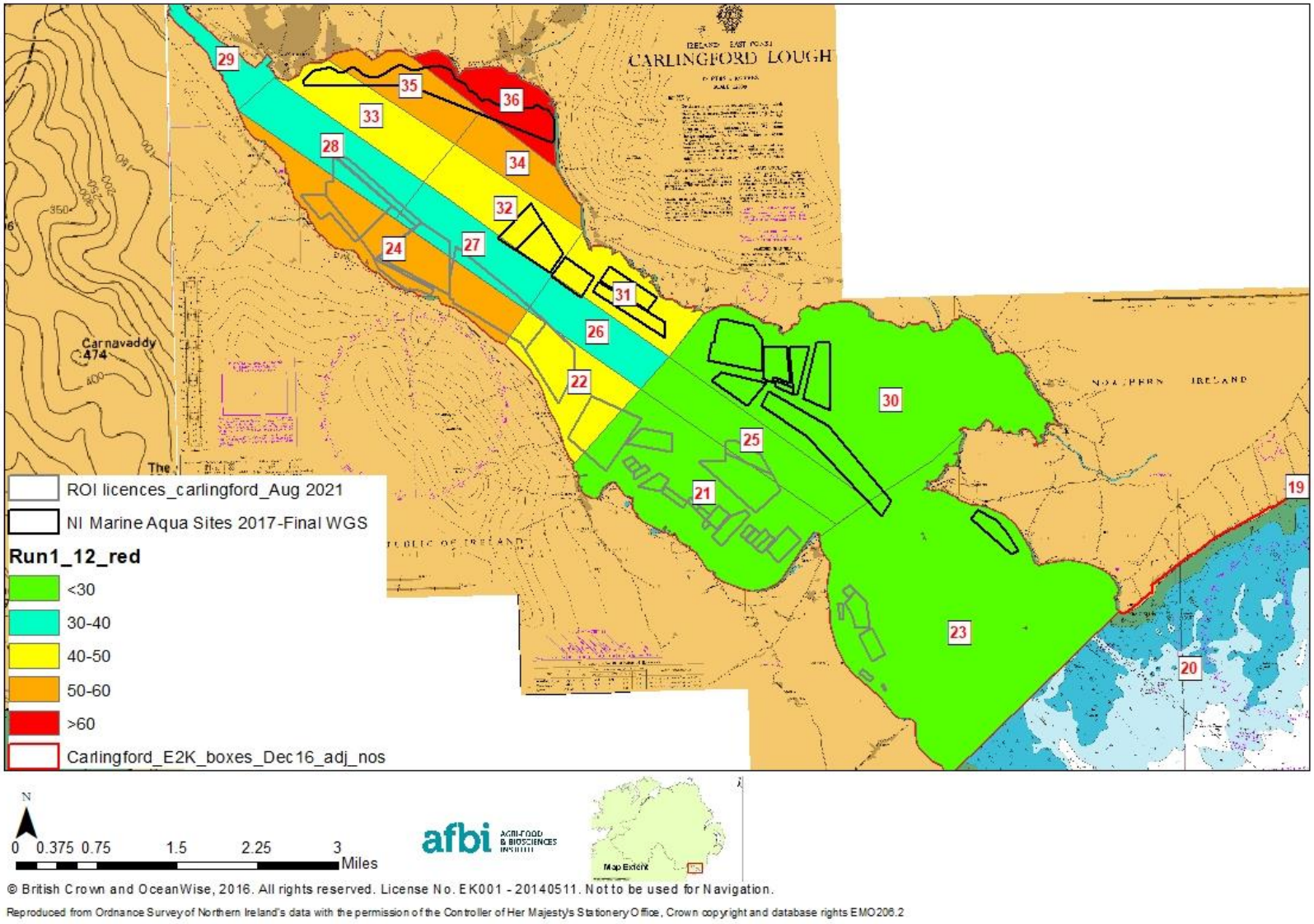

Figure 1.11: Map showing the location of SMILE mode boxes in Carlingford Lough alongside the outputs from Run 12 of the model.

Run 13

Simulated Chl a values (90th percentile calculated over index period, April to October). Results from Run 1 were used as a baseline and the % reduction of Chl a is shown to illustrate the impact when filtration by aquaculture species within all current licensed sites, plus the change in production resulting from the addition of the new aquaculture sites proposed within Applications A, B and C, as amended by AFBI (see Appendix A), is taken into account. The shaded area represents the model boxes with a Chl a reduction >30%. The Mill Bay area in Carlingford Lough is within model box 30.

These results and the location of licensed aquaculture sites in relation to SMILE model boxes are shown in Figure 1.12.

Box	Species	Run 1	Run 13	%reduction
Box 36	mussels	11.68	4.16	64.38
Box 35	mussels	11.19	4.69	58.05
Box 34	mussels	10.94	5.19	52.57
Box 24	mussels	9.36	4.45	52.46
Box 32	mussels	10.14	5.46	46.13
Box 22	mussels	8.77	4.80	45.26
Box 31	mussels	9.78	5.38	45.00
Box 33	mussels	10.10	5.94	41.14
Box 27	mussels	9.04	5.75	36.41
Box 29	None	9.71	6.50	33.07
Box 26	mussels	8.47	5.74	32.21
Box 28	mussels	9.18	6.24	32.04
Box 30	mussels +oysters	9.39	6.58	29.85
Box 21	mussels +oysters	7.08	5.19	26.72
Box 23	oysters	6.20	4.92	20.59
Box 25	mussels	7.32	5.90	19.42
Average				**39.71**

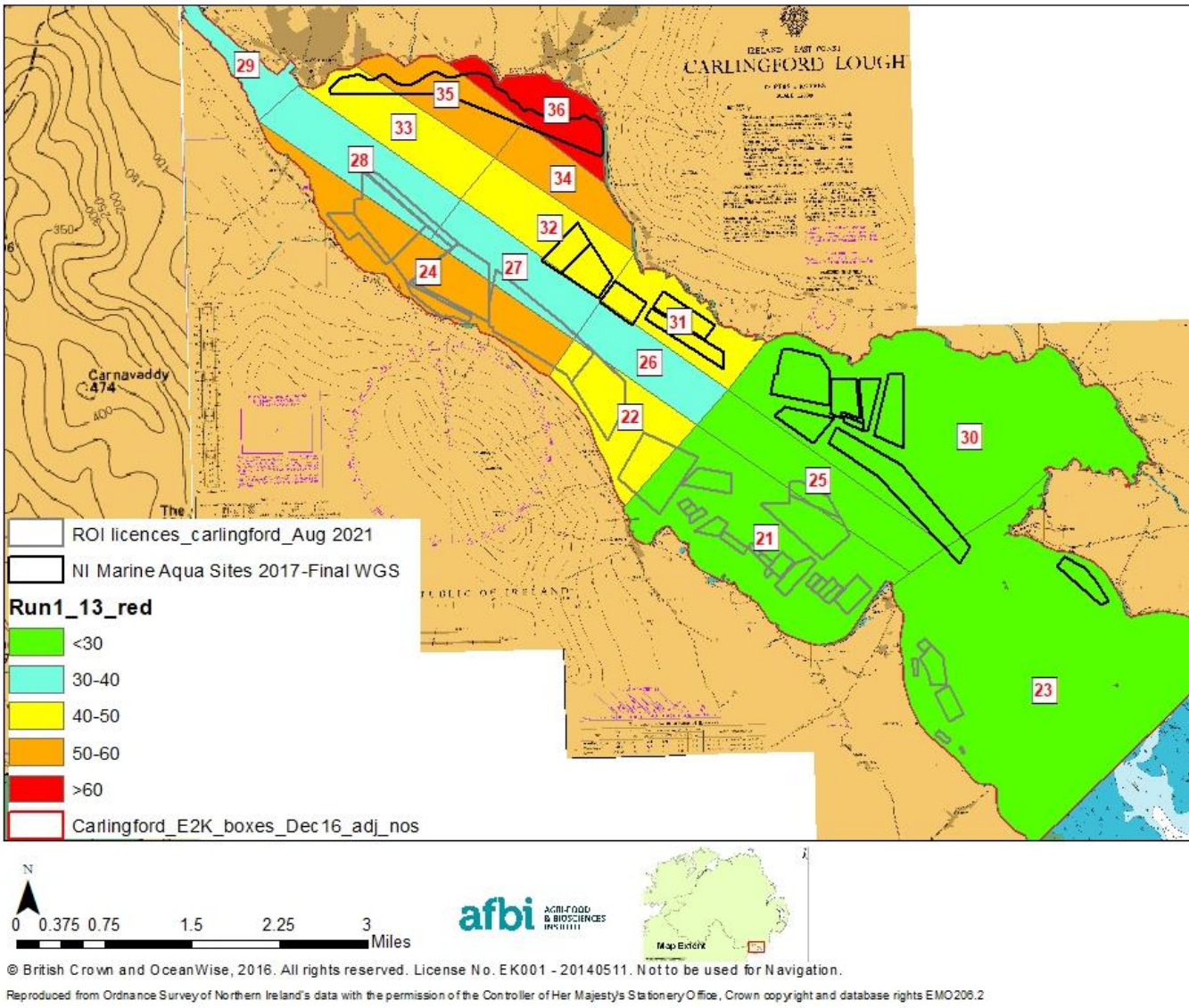

Figure 1.12: Map showing the location of SMILE mode boxes in Carlingford Lough alongside the outputs from Run 13 of the model.

Application C: Screening Matrix

Assessment under Article six of the Habitats Directive

In accordance with Council Directive 92/43/EEC, the DAERA has considered whether the project, plan or proposal either alone or in combination (neither being directly connected with or necessary to the management of the site) is likely to have a significant effect on the Natura 2000 site.

Screening Matrix: Application for a new aquaculture site within Carlingford Lough.

Name of Project or Plan.	**Application for a new site for the culture of Pacific oysters (*Magallana gigas*) within Carlingford Lough.**
Name and location of Natura 2000 site (s)	**Carlingford Lough Special Protection Area** Area: 830.51hectares Grid Reference: J230129 Date Classified: 09/03/98 Carlingford Lough is a sea lough at the mouth of the Newry (or Clanrye) River on the east coast of Ireland bordering both Ireland (county Louth) and Northern Ireland (counties Down and Armagh). The upper reaches of the lough are shallow and dominated by fine muddy sand beds and intertidal mud-flats, whilst the seaward entrance to the lough is a mixture of boulder, cobble and bedrock forming numerous small islands and reefs. The SPA lies between Killowen Point and Soldiers Point on the northern shores of the lough and the landward boundary is entirely coincident with that of the Carlingford Lough Area of Special Scientific Interest (ASSI). The SPA boundary includes all lands and intertidal areas seawards to the limits of territorial waters. Marine areas below mean low water are not included. On the 14th of January 2016 the then Department of the Environment opened a public consultation on a proposed extension to the existing SPA boundary. The proposal extends the site boundary to include marine areas within Carlingford Lough and the Irish Sea. No additional species were proposed at this time.

Natura 2000 site features:	This site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting populations of European importance of the following species listed on Annex I of the Directive: **During the breeding season;** Common Tern *Sterna hirundo*, 339 pairs representing 10.9% of the all-Ireland breeding population (5 year peak mean, 1993-1997). Sandwich Tern *Sterna sandvicensis*, 575 pairs representing 13.1% of the all-Ireland breeding population (5 year peak mean, 1993-1997). This site was designated before the UK SPA review which was undertaken in 2001 (Stroud *et al* 2001). During this review an additional qualifying species was identified for this site. As a result of the review described above this site now also qualifies under Article 4.2 of EC Directive 79/409 on the Conservation of Wild Birds by supporting populations of European importance of the following migratory species; **Over Winter (non breeding);** Light-bellied Brent Goose (*Branta bernicla hrota*). For the period 1990-1995 the five year peak mean for Light-bellied Brent Goose at this site was 319 individuals which represented 1.6% of the wintering Canada/Ireland population. This site forms part of an extended cross-border site which supports internationally important numbers of overwintering Light-bellied Brent Geese *Branta bernicla hrota*. The extended site also supports nationally important numbers of the following wader species: Oystercatcher *Haematopus ostralegus* 850 birds (five year mean for 1991/92 to 1995/96) representing 1.7 % of the Irish population. Ringed Plover *Charadrius hiaticula* 168 individuals (mean period not specified) representing 1.3% of the Irish population. Grey Plover *Pluvialis squatarola* 58 individuals (mean period not specified) representing 1.5% of the Irish population.

	Dunlin *Calidris alpina* 1494 individuals (mean period not specified) representing 1.2% of the Irish population. Redshank *Tringa totanus* 640 individuals (mean period not specified) representing 2.6% of the Irish population. Although the site supports nationally important numbers of the above species they are not included within the Carlingford Lough SPA designation.
Description of the Project or Plan	An application for a fish culture and shellfish fishery licence has been submitted to the DAERA for the culture of Pacific oysters (*Magallana gigas*) on trestles within the intertidal zone at a site on the Northern shore of Carlingford Lough. **Size and scale** The area of the proposed application is approximately 168 hectares. The applicant wishes to install 60,000 trestles (5 m x 1 m x 1 m) within this area for the culture of Pacific oysters. The applicant has stated that the estimated annual production from this site will be 500 tonnes of Pacific oysters. **Land-take** The applicant is proposing install 60,000 trestles, 5 m x 1 m x 1 m in dimension which amounts to an area of approximately 300,000 m^2. The area applied for is 168 hectares or 1,680,000 m^2 therefore the proposed number of trestles will occupy approximately **17.86%** of the proposed site. This will therefore provide ample space to ensure adequate water flow between trestles. **Distance to key features of the site** When the proposed SPA extension is adopted this will result in the entire proposed aquaculture site being within the Carlingford Lough SPA boundary. When the proposed extension is accepted then the total area of the Carlingford Lough SPA will increase to 11,143.10 hectares. The total area of proposed aquaculture site is approximately 168 hectares, therefore this site will occupy approximately **1.5 %** of the total area of the extended SPA site.
……Is the Project or Plan directly connected with or necessary to the management of the site (provide details)?	No

Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the Natura 2000 site.	The proposal is for an aquaculture site within Carlingford Lough for the rearing of Pacific oysters (*Magallana gigas*) in mesh bags placed on trestles in the intertidal zone. The applicant states that they wish to install a total of 60,000 trestles (5 m x 1 m x 1 m). The applicant has indicated that, if granted, activity on the site will be restricted to times when the tides are at their extremes. The applicant states that this will typically mean that workers can only access the proposed site for 10 days out of every month. Access to the site will be at low tide via an existing pathway currently used to access other aquaculture sites in the area. Servicing and maintenance at the proposed site will be undertaken via tractor and trailer/ATV. This will include general site maintenance/ husbandry, turning of bags and removal of biofouling. There will be periods of increased activity on site, coincident with harvesting, from October to December. **Impacts that may occur to the designated features of the Carlingford Lough SPA as a result of the proposed application are:** - **Disturbance to bird colonies** **<u>Breeding bird species</u>** Carlingford Lough SPA is designated for breeding populations of two tern species, Sandwich Terns and Common Terns. These birds breed on three islands near the mouth of the Lough which are monitored annually by the Royal Society for the Protection of Birds (RSPB). Data for breeding Tern species within Carlingford Lough was extracted from the Seabird Monitoring Programme (SMP) online database (http://jncc.defra.gov.uk/smp/). These data show that Tern numbers within Carlingford Lough have fallen in recent years. The most recent site condition assessment for the Carlingford Lough SPA lists both Common Tern and Sandwich Tern as being in Unfavourable condition (NIEA 2015). This decline in numbers has been attributed to wet weather, high tides and predation by great black-backed gulls (Wolsey 2011, 2012).

	The islands on which the Tern species breed within Carlingford Lough are approximately **0.97 km** from the proposed aquaculture site at the closest point. Terns are colonial breeding waterbirds (Gonzalez-Solis *et a.* 2001) and their high density nesting habits make them particularly sensitive to human disturbance (Rodgers and Smith, 1995). Several studies investigating the distance at which terns flush in response to human disturbance have been undertaken in America. Within these investigations flushing distances ranged from 100 m (Rodgers and Smith, 1997), to 180 m (Rodgers and Smith, 1995) and 200 m (Erwin 1989). Using these values as a guide in the absence of any site specific field data we can surmise that human activities at an intertidal aquaculture site **approximately 0.97 km** from Tern nest sites will not cause significant negative impacts on this feature of the SPA. **<u>Overwintering bird species</u>** The Carlingford Lough SPA is also designated due to the presence of overwintering populations of light bellied Brent Geese. Light Bellied Brent Goose numbers within Carlingford Lough are counted annually through the Wetland Bird Survey (WeBS) Wildfowl and Wader Core Counts. These surveys divide the Lough into sections which are counted at high tide throughout the year. The WeBS count data for the Light Bellied Brent Goose population within Carlingford for the winters of 1989/90 to 2019/2020 (Frost *et al* 2016; data supplied by DAERA) indicate that Light Bellied Brent Goose numbers appear to be relatively stable within Carlingford Lough. The most recent Site Condition Assessment for the Carlingford Lough SPA (NIEA 2015) lists this species as being in “Favourable” condition. The preferred food of Brent Geese is intertidal eelgrass (Owen and Black 1990, Hassall and Lane 2005, Inger *et al.* 2006). DAERA map the distribution of intertidal eelgrass on the Northern shores of Carlingford Lough and have observed that eelgrass beds are confined to a small portion of the Mill Bay area of the Lough. The proposed aquaculture site is outwith the areas identified as intertidal eelgrass beds. When investigating prey choice in the Brent goose populations within Strangford Lough (Northern Ireland) Inger *et al.* (2006) state that the “further depletion of *Zostera* leads an increasing proportion of the population to seek alternative

	food sources". These alternative food sources are cited as being green algae, saltmarsh plants and terrestrial grassland (Owen and Black 1990, Mathers and Montgomery 1997, Hughes and Green 2005, and Inger *et al.* 2006). Access to the proposed aquaculture site will be via an existing laneway. No eelgrass or green algal species were observed during site visits to this area undertaken by AFBI in 2016. - **Removal of a feeding area for birds.** **<u>Breeding bird species</u>** The proposed marine extension to the Carlingford Lough SPA is based on analysis and reports undertaken by the Joint Nature Conservation Committee (JNCC) (NIEA, 2015). The proposed marine extension aims to protect the foraging areas of the Tern colonies within Carlingford Lough. Terns are surface feeding seabirds (Furness and Tasker, 2000; Einoder, 2009) who feed primarily on fish species (Greenstreet *et al*, 1999; Burger and Gochfeld 2003; Cramp and Simmons, 2004 (cited in Christel *et al* 2013); and Comeau *et al* 2009), such as Sandeels which are an important component in the diets of tern species (Dunn, 1972 and Tasker and Furness 1996). As the proposed marine extension to the Carlingford Lough SPA aims to protect tern foraging areas it is important to establish if the benthic habitats within the boundary of the proposed new aquaculture site are suitable for sandeels. Sandeels have a preference for depths ranging between 30 to 70 m (Holland *et al*, 2005, Wright *et al* 2000) but have been found to occur as shallow as 15 m and up to depths of 120 m (Wright *et al* 1998 cited in Holland *et al*. 2005). The proposed aquaculture site is intertidal and therefore not within the depth range preferred by sandeels. The proposed new aquaculture site within the Mill Bay area of Carlingford Lough will therefore not impact on the feeding and foraging areas of Tern species within the current boundary of, and proposed marine extension to, the Carlingford Lough SPA. **<u>Overwintering bird species</u>** As mentioned within the previous section the preferred food of Light Bellied Brent Geese is eelgrass. Intertidal oyster culture within the proposed site has the potential to cause

	disturbance to Light Bellied Brent Goose populations through human presence in the intertidal areas within which they are grazing on eelgrass. DAERA routinely map the distribution of eelgrass within the Northern shores of Carlingford Lough. These surveys show that intertidal eelgrass beds are confined to a small portion of the Mill Bay area of the Lough. Preliminary studies on the effects of oyster trestles on bird feeding behaviour found that the percentage of birds observed feeding did not differ between the reference areas (areas free of aquaculture) and the trestle areas (Hilgerloh *et al* 2001). For some species of bird the trestles provided an additional food source. Gittings and O'Donoghue (2012) investigated the effects of intertidal oyster aquaculture on the distribution of waterbirds within six sites in Ireland. Gittings and O'Donoghue (2012) state that "detectable disturbance impacts to birds were only observed occasionally and were usually minor (birds which flushed but resettled nearby)" and at some sites Light bellied Brent Geese were observed feeding on top of the oyster trestles. Within these investigations Gittings and O'Donoghue (2012) found that Light Bellied Brent Geese showed a variable response to oyster trestles.

N2K Feature: Mention all features	**Describe any likely direct, indirect effects to the N2K features arising as a result of: Loss, reduction of habitat area; disturbance; habitat or species fragmentation; reduction in species density; changes in key indicators of conservation value (e.g. water quality, climate change).**	***Effect Significant/Not Significant? Why?**
Common Tern	Aquaculture activities have the potential to cause disturbance through human presence within nesting areas and damage/disturbance to feeding areas/species.	The proposed site is approximately 0.97 km from the islands within Carlingford Lough on which Common Tern breed. Aquaculture activities at the proposed site will therefore not cause disturbance to nesting Terns. Intertidal shellfish aquaculture at the proposed site will also not impact on prey

		availability for fish eating Tern species. Therefore this application will not negatively impact breeding Common Tern populations within Carlingford Lough.
Sandwich Tern	Aquaculture activities have the potential to cause disturbance through human presence within nesting areas and damage/disturbance to feeding areas/species.	The proposed site is approximately 0.97 km from the islands within Carlingford Lough on which Sandwich Tern breed. Aquaculture activities at the proposed site will therefore not cause disturbance to nesting Terns. Intertidal shellfish aquaculture at the proposed site will also not impact on prey availability for fish eating Tern species. Therefore this application will not negatively impact breeding Sandwich Tern populations within Carlingford Lough.
Light bellied Brent goose	Aquaculture activities have the potential to cause disturbance through human presence within preferred habitats and damage/disturbance to feeding areas/species.	Studies on the impacts of oyster culture on waterbirds found that Light Bellied Brent Goose showed a variable response to oyster trestles and were observed feeding on top of the trestles at some sites. DAERA did not identify the area of the proposed site as being an eelgrass bed during their most recent eelgrass survey of Carlingford Lough.

Describe any potential effects on the Natura 2000 site as a whole in terms of: interference with the key relationships that define the structure or function of the site	Proper management of aquaculture activities within the proposed new site will ensure that interference to the key relationships that define the structure of the Carlingford Lough SPA will be unlikely.

	The proposed marine extension to the Carlingford Lough SPA aims to protect the foraging areas of the Tern colonies within Carlingford Lough. Terns feed primarily on fish species such as sandeels which are an important component in their diet. The proposed aquaculture site is intertidal and therefore not within the depth range preferred by sandeels. The tern species within Carlingford Lough breed on islands approximately 0.97 km from the proposed aquaculture site and will therefore not be disturbed by human presence within the proposed area. The third species for which the site is designated feeds predominantly on eelgrass, which is absent within the boundary of the proposed new aquaculture site and the surrounding vicinity. Activities at the proposed site will not negatively impact the conservation objectives of the designated features of the Carlingford Lough SPA.

Provide details of any other projects or plans that together with the project or plan being assessed could (directly or indirectly) affect the site.	Fast Ferry activity, yachting, pleasure boating, dog walkers, agriculture, bait collectors, seaweed collectors, recreational walkers, sewage discharges, scientific research, other fisheries and other leisure activities.

Is the potential scale or magnitude of any effect likely to be significant? :	
Alone?	**Yes**☐ **No**☒
In-combination with other projects of plans?	**Yes**☐ **No**☐

List of Agencies / Organisations Consulted: Provide contact name and telephone or email address.	DAERA Marine and Fisheries Division
Habitats Regulations Assessment Summary	Activities at the proposed site will not negatively impact the conservation objectives of the designated features of the Carlingford Lough SPA. Please refer to the information contained in the paragraphs above for further details.

Conclusion: Is the proposal likely to have a significant effect on an N2K site?	**Yes**☐ **No**☒

Screening Matrix: Application for a new aquaculture site within Carlingford Lough.

Name of Project or Plan.	**Application for a new site for the culture of Pacific oysters (*Crassostrea gigas*) within Carlingford Lough.**
Name and location of Natura 2000 site (s)	**Murlough Special Area of Conservation** Area: 11,903.9 hectares Date Classified: May 2005
Natura 2000 site features:	This site has been designated due to the presence of the following Annex I Habitats: **Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)** This feature is classified as A for Representativity on the Natura 2000 data form for this site and occupies approximately 93 hectares. **Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)** This feature is classified as C for Representativity on the Natura 2000 data form for this site and occupies approximately 8.5 hectares. **Dunes with *Salix repens ssp. Argentea* (*Salicion arenariae*)** This feature is classified as C for Representativity on the Natura 2000 data form for this site and occupies approximately 0.2 hectares. **Embryonic shifting dunes** This feature is classified as C for Representativity on the Natura 2000 data form for this site and occupies approximately 2 hectares. **Fixed dunes with herbaceous vegetation (grey dunes)** This feature is classified as B for Representativity on the Natura 2000 data form for this site and occupies approximately 127 hectares. **Mudflats and sandflats not covered by seawater at low tide** This feature is classified as C for Representativity on the Natura 2000 data form for this site and occupies approximately 785 hectares.

	Sandbanks which are slightly covered by seawater all the time This feature is classified as C for Representativity on the Natura 2000 data form for this site and occupies approximately 10,000 hectares. **Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)** This feature is classified as C for Representativity on the Natura 2000 data form for this site and occupies approximately 4.5 hectares. This site has been designated due to the presence of the following Annex II Species: **March Fritillary *Euphydryas aurinia*** This site is considered to be one of the best areas in the United Kingdom for this species. **Common seal *Phoca vitulina*** A resident population of 84 individuals is stated within the Conservation Objectives for this site.
Description of the Project or Plan	An application for a fish culture and shellfish fishery licence has been submitted to the DAERA for the culture of Pacific oysters (*Crassostrea gigas*) on trestles within the intertidal zone at a site on the Northern shore of Carlingford Lough. **Size and scale** The area of the proposed application is approximately 168 hectares. The applicant wishes to install 60,000 trestles (5 m x 1 m x 1 m) within this area for the culture of Pacific oysters. The applicant has stated that the estimated annual production from this site will be 500 tonnes of Pacific oysters. **Land-take** The applicant is proposing install 60,000 trestles, 5m x 1m x 1m in dimension which amounts to an area of approximately 300,000 m^2. The area applied for is 168 hectares or 1,680,000 m^2 therefore the proposed number of trestles will occupy approximately **17.86%** of the proposed site. This will therefore provide ample space to ensure adequate water flow between trestles. **Distance to key features of the site** The proposed new aquaculture site is over **20 km** (by sea) from the boundary of the Murlough SAC).

Is the Project or Plan directly connected with or necessary to the management of the site (provide details)?	No
Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the Natura 2000 site.	The proposal is for an aquaculture site within Carlingford Lough for the rearing of Pacific oysters (*Crassostrea gigas*) in mesh bags placed on trestles in the intertidal zone. The applicant states that they wish to install a total of 60,000 trestles (5 m x 1 m x 1 m) The applicant has indicated that, if granted, the site would be serviced during times when the tides are at their extremes. This will typically mean workers will be accessing the site for 10 days out of every month, with increased activity during harvesting typically from October to December. Access to the site will be at low tide via an existing pathway currently used to access other aquaculture sites in the area. Servicing and maintenance at the proposed site will be undertaken by staff on foot and will also via tractor. **Impacts that may occur to the designated features of the Murlough SAC as a result of the proposed application are:** - **Disturbance to harbour seal (*Phoca vitulina*) populations** The proposed new aquaculture site is over 20 km (by sea) from the boundary of the Murlough SAC. AFBI obtained seal haulout data from DAERA from surveys conducted in 2019. During these surveys 10 seal haulout sites were identified. These seal haulout sites have been plotted in ArcGIS and a 200m buffer has been applied to indicate the potential locations of seal haulouts within a 200m distance to the proposed aquaculture site. The proposed aquaculture site is not within 200m of any identified seal haulout sites within Carlingford Lough. In order to ensure that there is no potential for disturbance to seals through activities on the proposed new aquaculture site

	it is recommended that the site operators undergo WiSe training.

N2K Feature: Mention all features	**Describe any likely direct, indirect effects to the N2K features arising as a result of: Loss, reduction of habitat area; disturbance; habitat or species fragmentation; reduction in species density; changes in key indicators of conservation value (e.g. water quality, climate change).**	***Effect Significant/Not Significant? Why?**
Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)	There is no spatial overlap between the proposed new aquaculture site and this feature of the SAC.	Not Significant.
Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	There is no spatial overlap between the proposed new aquaculture site and this feature of the SAC.	Not Significant.
Dunes with *Salix repens ssp. Argentea* (*Salicion arenariae*)	There is no spatial overlap between the proposed new aquaculture site and this feature of the SAC.	Not Significant.
Embryonic shifting dunes	There is no spatial overlap between the proposed new aquaculture site and this feature of the SAC.	Not Significant.
Fixed dunes with herbaceous vegetation (grey dunes)	There is no spatial overlap between the proposed new aquaculture site and this feature of the SAC.	Not Significant.
Mudflats and sandflats not covered by seawater at low tide	There is no spatial overlap between the proposed new aquaculture site and this feature of the SAC.	Not Significant.
Sandbanks which are slightly covered by seawater all the time	There is no spatial overlap between the proposed new aquaculture site and this feature of the SAC.	Not Significant.
Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)	There is no spatial overlap between the proposed new aquaculture site and this feature of the SAC.	Not Significant.

March Fritillary *Euphydryas aurinia*	There is no spatial overlap between the proposed new aquaculture site and this feature of the SAC.	Not Significant.
Common seal *Phoca vitulina*	Potential disturbance at haulout sites in Carlingford Lough if utilised by the Murlough harbour seal population.	Potential impacts not considered significant.

Describe any potential effects on the Natura 2000 site as a whole in terms of: interference with the key relationships that define the structure or function of the site	There is no spatial overlap between the designated features of the Murlough SAC and the proposed new aquaculture site within the Mill Bay area of Carlingford Lough. There is potential for disturbance at seal haulout sites in Carlingford Lough if utilised by the Murlough harbour seal population. The proposed new aquaculture site is greater than 200 m away from the closest seal haulout site within Carlingford Lough (as measured in ArcGIS v10.3). Therefore this proposal will not negatively impact the Harbour seal populations within the Murlough SAC.

Provide details of any other projects or plans that together with the project or plan being assessed could (directly or indirectly) affect the site.	Fast Ferry activity, yachting, pleasure boating, dog walkers, agriculture, bait collectors, seaweed collectors, recreational walkers, sewage discharges, scientific research, other fisheries and other leisure activities.

Is the potential scale or magnitude of any effect likely to be significant? :	
Alone?	**Yes**☐ **No**☒
In-combination with other projects of plans?	**Yes**☐ **No**☐

List of Agencies / Organisations Consulted: Provide contact name and telephone or email address.	DAERA Marine and Fisheries Division
Habitats Regulations Assessment Summary	Activities at the proposed site will not negatively impact the conservation objectives of the designated features of the Murlough SAC. Please refer to the information contained in the paragraphs above for further details.

Conclusion: Is the proposal likely to have a significant effect on an N2K site?	**Yes**☐ **No**☒

Data collected to carry out the assessment

Who carried out the assessment?	The Agri-food and Bioscience Institute (AFBI) acting on behalf of the Department of Agriculture Environment and Rural Affairs.
Sources of data	**WeBS** – Core count data for Light bellied Brent Geese in Carlingford Lough **Seabird monitoring programme online database** – Tern data **DAERA** – Northern Ireland aquaculture shapefiles, Eelgrass shapefiles, seal haulout shapefiles **AFBI data holdings** **Applicant**
Level of assessment completed	Stage one: Screening
Where can the full results of the assessment be accessed and viewed?	DAERA Marine and Fisheries Division Downpatrick

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- **Finding of No Significant Effects Report Matrix**

Name of Project or Plan	Proposed new aquaculture site within the Mill Bay area of Carlingford Lough.
Name and location of Natura 2000 site	Carlingford Lough SPA
Description of the Project or Plan	This application is for a new aquaculture site for the culture of Pacific oysters (*Magallana gigas*) in bags on trestles. The area applied for covers approximately 168 hectares (as measured in ArcGIS v10.3). The applicant has stated that they wish to deploy a maximum of 60,000 trestles, each of which is approximately 5 m x 1 m x 1 m in dimension, with 5 oyster cultivation bags per trestle. The applicant has stated that the estimated annual production from this site will be 500 tonnes of Pacific oysters.
Is the Project or Plan directly connected with or necessary to the management of the site (provide details)?	No

Are there other projects or plans that together with the project of plan being assessed could affect the site (provide details)?	No

The Assessment of Significance of Effects	
Describe how the project or plan (alone or in combination) is likely to affect the Natura 2000 site	Intertidal aquaculture activities within the proposed new aquaculture site have the potential to cause disturbance to breeding tern populations through an increase in human presence within nesting areas and damage/disturbance to feeding areas/species. Intertidal aquaculture activities within the proposed new aquaculture site have the potential to cause disturbance to Light Bellied Brent Goose populations through increased human presence within preferred habitats and damage to feeding areas and species (e.g. trampling of eelgrass beds).
Explain why these effects are not considered significant	The proposed new aquaculture site is approximately 1 km (at its closest point) from the islands on which Tern species breed within Carlingford Lough (as measured in ArcGIS). The proposed marine extension to the Carlingford Lough SPA aims to protect the foraging areas of the Tern colonies within Carlingford Lough. Terns feed primarily on fish species such as sandeels which are an important component in their diet. The proposed aquaculture site is intertidal and therefore not within the depth range preferred by sandeels. Intertidal shellfish aquaculture within this region will not impact on prey availability for Tern species. Therefore this application for a new intertidal aquaculture site within the Mill Bay area of Carlingford Lough will not negatively impact breeding Tern populations within the Carlingford Lough SPA. Studies on the impacts of oyster culture on waterbirds found that Light Bellied Brent Geese show a variable response to oyster trestles and at some sites have been observed feeding on top of the trestles. No eelgrass (the primary food source of Brent Geese) has been observed within the boundary of the proposed new aquaculture site.

	Therefore this application for a new aquaculture site within the Mill Bay area of Carlingford Lough not negatively impact overwintering Light Bellied Brent Geese populations within the Carlingford Lough SPA.		
List of Agencies Consulted: Provide contact name and telephone or email address.	DAERA		
Response to consultation			
Data Collected to Carry out the Assessment			
Who carried out the assessment	**Sources of Data**	**Level of assessment completed**	**Where can the full results of the assessment be accessed and viewed?**
AFBI	**NIEA** **WeBS** **SMP online database** **DAERA** **AFBI** **Applicant**	Stage one screening	AFBI Newforge Lane Belfast

- **Finding of No Significant Effects Report Matrix**

Name of Project or Plan	Proposed new aquaculture site within the Mill Bay area of Carlingford Lough.
Name and location of Natura 2000 site	**Murlough SAC**
Description of the Project or Plan	This application is for a new aquaculture site for the culture of Pacific oysters (*Magallana gigas*) and *Ostrea edulis* in bags on trestles. The area applied for covers approximately 168 hectares (as measured in ArcGIS v10.3). The applicant has stated that they wish to deploy a maximum of 60,000 trestles, each of which is approximately 5 m x 1 m x 1 m in dimension, with 5 oyster cultivation bags per trestle. The applicant has stated that the estimated annual production from this site will be 500 tonnes of Pacific oysters.
Is the Project or Plan directly connected with or necessary to the management of the site (provide details)?	**No**
Are there other projects or plans that together with the project of plan being assessed could affect the site (provide details)?	**No**

The Assessment of Significance of Effects	
Describe how the project or plan (alone or in combination) is likely to affect the Natura 2000 site	Intertidal aquaculture activities within the proposed new aquaculture site have the potential to cause disturbance to Harbour seal populations through an increase in human presence within haulout areas.
Explain why these effects are not considered significant	The proposed new aquaculture site is greater than 20 km (by sea) from the boundary of the Murlough SAC. The proposed new aquaculture site is greater than 200 m from the closest seal haulout sites within Carlingford Lough (as identified by DAERA 2019). In order to ensure that there is no potential for disturbance to seals through activities on the proposed new aquaculture site it is recommended that the site operators undergo WiSe training.

List of Agencies Consulted: Provide contact name and telephone or email address.	DAERA Marine and Fisheries Division NIEA		
Response to consultation			
Data Collected to Carry out the Assessment			
Who carried out the assessment	**Sources of Data**	**Level of assessment completed**	**Where can the full results of the assessment be accessed and viewed?**
AFBI	**NIEA** **WeBS** **Loughs Agency** **SMP online database** **DARD** **AFBI** **Site Operator**	Stage one screening	AFBI Newforge Lane Belfast

References

Burger, J. And Gochfield, M. 2003. Spatial and temporal patterns in metal levels in eggs of common terns (*Sterna hirundo*) in New Jersey. *The Science of the Total Environment* **311:** 91-100

Christel, I., Certain, G., Cama, A., Vieites, D. R., Ferrer, X. 2013. Seabird aggregative patterns: A new tool for offshore wind energy risk assessment. *Marine Pollution Bulletin* **66:** 84-91

Comeau, L.A., St-Onge, P., Pernet, F., Lanteigne, L. 2009. Deterring coastal birds from roosting on oyster culture gear in eastern New Brunswick Canada. *Aquaqcultural Engineering* **40:** 87-94

Cook, A.S.C.P., Barimore, C., Holt, C.A., Read, W.J., and Austin, G.E. 2013. Wetland Bird Survey Alerts 2009/2010:Changes in numbers of wintering waterbirds in the Constituent Countries of the United Kingdom, Special Protection Areas (SPAs) and Sites of Special Scientific Interest (SSSIs). BTO Research Report 641. BTO, Thetford. http://www.bto.org/volunteer-surveys/webs/publications/webs-annual-report

Department of Agriculture, Environment and Rural Affairs (DAERA) 2017. Murlough SAC UK0016612: Conservation Objectives. pp56

Dunn, E. K., 1972. Studies on terns with particular reference to feeding ecology. PhD Thesis. Durham University. 231pp Available at Durham E-Theses Online: http://etheses.dur.ac.uk/8621/

Einoder, L.D., 2009. A review of the use of seabirds as indicators in fisheries and ecosystem management. *Fisheries Research* **95** 6-13.

Erwin, M.R. 1989. Responses to Human Intruders by Birds Nesting in Colonies: Experimental Results and Management Guidelines. *Colonial waterbirds* **12**(1): 104-108

Frost, T.M., Austin, G.E., Calbrade, N.A., Holt, C.A., Mellan, H.J., Hearn, R.D., Stroud, D.A., Wotton, S.R. and Balmer, D.E. 2016. Waterbirds in the UK 2014/15: The Wetland Bird Survey. BTO/RSPB/JNCC. Thetford. http://www.bto.org/volunteer-surveys/webs/publications/webs-annual-report

Furness, R.W., and Tasker, M.L. 2000. Seabird-Fishery interactions: quantifying the sensitivity of seabirds to reductions in sandeel abundance, and identification of key areas for sensitive seabirds in the North Sea. *Marine Ecology Progress Series*. **202**: 253-264

Gittings, T. And O'Donoghue, P.D. 2012. The effects of intertidal oyster culture on the spatial distribution of waterbirds. Report prepared for the Marine Institute. Atkins, Cork. Pp 170

Gonzalez-Solis, J., Sokolov, E., and Becker, P. 2001. Courtship feedings, copulations and paternity in common terns, *Sterna hirundo*. *Animal Behaviour* **61**: 1125-1132

Greenstreet, S.P.R., Becker, P.H., Barrett, R.T., Fossum, P., and Leopold, M.F. 1999 Consumption of pre-recruit fish by seabirds and the possible use of this as an indicator of fish stock recruitment. *ICES Coop. Res. Rep.* **232:** 6-17

Greenstreet, S.P.R., Holland, G.J., Guirey, E.J., Armstrong, E., Fraser, H.M., and Gibb, I.M. 2010. Combining hydroacoustic seabed survey and grab sampling techniques to assess "local" sandeel population abundance. *ICES Journal of Marine Science* **67**: 971-984

Hassall, M. and Lane, S.J. 2005. Partial feeding preferences and the profitability of winter-feeding sites for Brent Geese. *Basic and Applied Ecology* **6**: 559-570

Hilgerloh, G., O'Halloran, J., Kelly, T. C., and Burnell, G. M. 2001. A preliminary study on the effects of oyster culturing structures on birds in a sheltered Irish estuary. *Hydrobiologia* **465**: 175-180

Holland, G. J., Greenstreet, S. P. R., Gibb, I. M., Fraser, H. M., and Robertson, M. R. 2005. Identifying sandeel *Ammodytes marinus* sediment habitat preferences in the marine environment. *Marine Ecology Progress Series* **303**: 269-282.

Hughes, B., and Green, A.J. 2005. Feeding Ecology. pp. 27-56 in Kear, J. (ed.), *Ducks, Geese and Swans. Volume 1: General chapters and Species accounts (Anhima to Salvadorina)*. Oxford university Press.

Inger, R., Bearhop, S., Robinson, J.A., and Ruxton, G. 2006. Prey choice affects the trade-off balance between predation and starvation in an avian herbivore. *Animal Behaviour* **71**: 1335-1341

Mathers, R.G., and Montgomery, W.I. 1997. Quality of Food Consumed by over Wintering Pale-Bellied Brent Geese *Branta bernicla hrota* and Wigeon *Anas penelope*. *Biology and Environment: Proceedings of the Royal Irish Academy.* **97B** (1): 81-89

Northern Ireland Environment Agency (NIEA), 2015. Carlingford Lough Special Protection Area (SPA) UK9020160: Conservation Objectives. pp19

Owen, M., and Black, J.M. 1990. Waterfowl Ecology. Blackie and Son Ltd, Glasgow and London pp194

Rodgers, J.A., and Smith H.T.1995. Set-Back Distances to Protect Nesting Bird Colonies from Human Disturbance in Florida. *Conservation Biology* **9**(1): 89-99

Rodgers, J.A., and Smith H.T. 1997. Buffer zone distances to protect foraging and loafing waterbirds from human disturbance in Florida. *Wildlife Society Bulletin* **25**(1): 139-145

Stroud, D.A., Chambers, D., Cook, S., Buxton, N., Fraser, B., Clement, P., Lewis, P., McLean, I., Baker, H., and Whitehead, S., (Eds). 2001. The UK SPA network: its scope and Content. JNCC, Peterborough.

Tasker, M. L., and Furness, R. W. 1996. Estimation of food consumption by seabirds in the North Sea. *In* Seabird/fish interactions, with particular reference to seabirds in the North Sea, pp. 6-42. Ed. by G. L. Hunt and R. W. Furness. ICES Cooperative Research Report No. 216.

Wolsey, S. 2011. Green Island Tern Report 2011. Report prepared for RSPB pp76

Wolsey, S. 2012. Green Island Tern Report 2012. Report prepared for RSPB pp16

Wright, P.J., Jensen, H., and Tuck, T. 2000. The influence of sediment type on the distribution of the lesser sandeel, *Ammodytes marinus*. *Journal of Sea Research* **44**: 243-256